Town of Newmarket

Town of Newmarket Comprehensive Stormwater Management Master Plan

Prepared by:

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Project Number:

60330930

Date:

June, 2017

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June 12, 2017

Jen Slykhuis
Town of Newmarket
395 Mulock Drive
P.O. Box 328
Station Main
Newmarket, ON L3Y 4X7

Dear Ms. Slykhuis:

Project No: 60330930

Regarding: Town of Newmarket Stormwater Master Plan

We are providing you with our report for the above named project with all sections completed. Please contact the undersigned if you have any questions or comments.

Sincerely,
AECOM Canada Ltd.

Pippy Warburton, P.Eng.
Water Resources Manager, Water
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Encl.

Distribution List

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
0		Feb 2015	Draft Characterization complete
1	team	July 2015	Draft Report
2	team	January 2016	Final Report
3	team	July 2016	Revised Final Report to include requested water quantity input
4	team	January 2017	Revised Final Report to include LSRCA Review Comments
5	team	April 2017	Revised Final Report to include LSRCA Review Comments
6	team	June 2017	Revised Final Report to include LSRCA Review Comments

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List of Acronyms and Abbreviations

ANSI	Area of Natural and Scientific Interest
BMP	Best Management Practice
CAMC	Conservation Authorities Moraine Coalition
COA	Certificate of Approval
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
COSSARO	Committee on the Status of Species at Risk in Ontario
CSWMMP	Comprehensive Stormwater Master Plan
CVC	Credit Valley Conservation
EA	Environmental Assessment
ELC	Ecological Land Classification
ESA	Endangered Species Act
GIS	Geographic Information System
ha	Hectare
HVA	Highly Vulnerable Aquifer
IDF	Intensity-Duration-Frequency
LID	Low Impact Development
LSPP	Lake Simcoe Protection Plan
LSRCA	Lake Simcoe Region Conservation Authority
mAMSL	Metres Above Mean Sea Level
Mbgs	Metres Below Ground Surface
MCEA	Municipal Class Environmental Assessment
MNRF	Ministry of Natural Resources and Forestry
MOECC	Ministry of Environment and Climate Change
NHIC	Natural Heritage Information Centre
NRVIS	Natural Resource Values Information System
ORM	Oak Ridges Moraine
ORMCP	Oak Ridges Moraine Conservation Plan
OWES	Ontario Wetland Evaluation System
PIC	Public Information Centre
PSW	Provincially Significant Wetland
PTool	Lake Simcoe Phosphorus Loading Development Tool
QA/QC	Quality Assurance / Quality Control
RGA	Rapid Geomorphic Assessment
ROP	Regional Official Plan
SARA	Species at Risk Act
SGRA	Significant Groundwater Recharge Area
SMF	Stormwater Management Facility
SWH	Significant Wildlife Habitat
SWM	Stormwater Management
SWMF	Stormwater Management Facility
Town	Town of Newmarket
TRCA	Toronto Region Conservation Authority
TSS	Total Suspended Solids
UYSS	Upper York Sewage Solutions
WHPA	Wellhead Protection Area
YPDT	York, Peel Durham Region
YSA	Yonge Street Aquifer

1. Introduction

The Lake Simcoe Protection Plan (LSPP) has identified urban stormwater runoff as a significant source of phosphorus to Lake Simcoe and its tributaries, contributing to excessive algae and plant growth, oxygen depletion, and degraded water quality. The LSPP requires municipalities to prepare and implement Comprehensive Stormwater Management Master Plans (CSWMMPs) for each settlement area in the Lake Simcoe watershed. These plans are to be prepared in accordance with the Municipal Class Environmental Assessment (MCEA) study process and adhere to the local municipal and regulatory agency guidelines. This is to ensure that the management of stormwater for both existing and planned development meets the overall technical, environmental as well as social and cultural objectives for the study area, and ultimately the protection and/or enhancement of Lake Simcoe water quality.

The Town of Newmarket Comprehensive Stormwater Management Master Plan provides an integrated assessment of existing and proposed/future conditions with respect to stormwater management within the Town of Newmarket (Town). The report also details opportunities for improvement and recommendations for future actions with the ultimate goal of decreasing phosphorus loading to Lake Simcoe. Given the inter-relationship of stormwater management with natural systems (i.e. watercourses, wetlands, woodlots) as well as the overall hydrologic cycle (surface/groundwater) and existing infrastructure and land uses, staff from several technical disciplines contributed to the CSWMMP.

The CSWMMP complies with the 10 steps identified in the Lake Simcoe Region Conservation Authority's (LSRCA) Comprehensive Stormwater Management Master Plan Guidelines (LSRCA, 2011).

- Step 1: Scoping to identify settlement areas in the municipality
- Step 2: Determine the Study Area for the Settlement
- Step 3: Develop a Characterization of the Study Area
- Step 4: Divide the Area into Management Units where appropriate
- Step 5: Evaluate the Cumulative Environmental Impact of Stormwater from Existing and Planned Development
- Step 6: Determine the Effectiveness of Existing Stormwater Management Systems
- Step 7: Identify and Evaluate Stormwater Improvement and Retrofit Opportunities
- Step 8: Establish a Recommended Approach for Stormwater Management for the Study Area
- Step 9: Develop an Implementation Plan for the Recommended Approaches
- Step 10: Develop Programs for Inspection and Maintenance of Stormwater Management Facilities

These steps are discussed in subsequent sections of this report (not necessarily in order). The Town of Newmarket has completed relatively recent studies to evaluate the effectiveness of stormwater management in the study area completing a Stormwater Management Pond Inventory and Maintenance Plan in 2008-2009 and a Town-wide Drainage Study in 2008-2012. These two studies form the basis of the analysis completed in the current study with updates to reflect a more broad based approach required of an EA process and any changes in conditions or additional information available since the completion of those studies.

1.1 Study Area {Steps 1-2}

The Town of Newmarket is a municipality in the heart of the Region of York, midway between Toronto and Barrie. The Town covers 14.2 square miles (38.1 square kilometers) with a population of 84,000. The population is projected to grow to 98,000 by 2026 (Town of Newmarket, 2009). According to the Town's Official Plan (2014), the majority of existing land use within the Town's boundaries is categorized as residential. Industrial areas primarily lie adjacent to Highway 404. Parks and open space are scattered within the Town's boundaries and provide recreational, natural, and environmental value.

According to the LSRCA Comprehensive Stormwater Management Master Plan Guidelines (2011) the settlement area is defined as "urban areas and rural settlement areas (e.g., cities, towns, villages, and hamlets) where development is concentrated and lands are designated in municipal official plans for development over the long term." Within the Town of Newmarket this encompasses built up areas (designated in the approved official plan), and adjacent areas where overland stormwater drainage will flow into the settlement area. The Town of Newmarket GIS database of existing and planned land use was used to identify the settlement area.

1.1.1 Management Units {Step 4}

The Study Areas (i.e., settlement areas) were divided into discrete management units in order to identify specific stormwater management constraints, opportunities and recommendations. Each management unit represents a grouping of areas with shared characteristics based on the results of the existing conditions review. Stormwater management pond catchment areas provided by the Town of Newmarket were related to individual watercourses within the Study Area, including: East Holland River, Western Creek, Ansnorveldt Creek, Weslie Creek, Armitage Creek, Tannery Creek and Bogart Creek. Management units were further delineated and grouped based on the following factors:

- Surficial geology;
- Topography;
- Existing land use; and
- Aquatic and terrestrial ecological features.

A total of eleven management areas were identified and are mapped on **Figure 1-2**.

Environmental constraints, opportunities and recommendations have been identified in Section 5 of this report, both generally for the Study Area and also specifically for each management unit.

1.2 Class Environmental Assessment Master Plan Process

The CSWMMP is a long range plan that integrates the existing and future land use needs of the study area with environmental assessment planning principles. This plan examines the needs of the area in order to outline a framework for planning for subsequent projects. Similar to an EA in evaluating options, a broad-based process is used including functional performance, environmental, social and economic/cost considerations. The CSWMMP allows for an integrated planning approach that the Town of Newmarket can adopt as it continues to grow and a methodology for implementing new and upgrading existing stormwater management facilities.

The Study follows the approved master planning process as outlined in Section A.2.7 (Approach #2 in Appendix 4) of the Municipal Engineer's Association (MEA) Municipal Class Environmental Assessment (October 2000, amended in 2011). The work has been scoped to satisfy Phases 1 and 2 of the EA process and to fulfil requirements of projects identified as Schedule B. The Master Plan will become the basis for future investigations of any specific Schedule C projects that are proposed within.

Consultation occurred initially LSRCA to confirm the scope of the work and obtain background information related to the study area. Additional consultation that occurred during the study is documented in Section 7 and in **Appendix A**.

1.3 History of Stormwater Management in Ontario

The history of Stormwater Management (SWM) in Ontario shows an extensive evolution in objectives and scope. In the early to mid-1980s, objectives of master drainage plans focused on minimizing flooding impacts of development on downstream watercourses. In the following years, increased environmental awareness and public pressures shifted the objectives to include maintaining and enhancing natural systems within developing watersheds.

During this same time frame the scope of issues originally consisted of the management of the quantity of surface runoff to minimize impacts of development on downstream flooding and erosion. Typical issues included runoff quantity control, floodplain management, erosion control and flood control, culvert improvements, erosion and sediment control, and major/minor system designs within subdivisions.

The development of SWM and master drainage plans resulted in additional issues, including potential impacts on water quality, linkages and relationships of urban drainage to environmental features, groundwater protection issues, and the concepts of ecosystem planning. The range of issues continued to grow to include fisheries/aquatic habitat protection and enhancement, water temperature, baseflow maintenance, infiltration requirements, best management practices, monitoring, and the protection of some woodlots and wetlands.

Today, SWM strives to maintain water balance through infiltration to groundwater and maintaining runoff at low rates, prevent erosion through flow control and vegetative planting, pollution reduction through vegetation (nutrient uptake), SWM measures, and Low Impact Development (LID) measures. LID measures are a large component of today's SWM tools, as they aim to create a hydrologic landscape that replicates the predevelopment hydrologic regime. Additional SWM measures include source pollution prevention such as reduced fertilizer and pesticide use, road salt reduction programs, and community action programs such as alternate lawn practices, pet litter control, and sewer use By-law enforcement. Today's SWM incorporates source and lot-level controls, conveyance system controls, end-of-pipe facilities, and treatment train approaches. The table below summarizes the history of SWM in Ontario.

1.4 Existing Policies

The following section summarizes the objectives and background of the relevant policies reviewed in support of the CSWMMP.

1.4.1 Lake Simcoe Protection Plan

Lake Simcoe Protection Plan Polices 4.5-SA provides specific requirements on what needs to be in a CSWMMP. The remaining policies and actions listed {4.6-SA, 4.7- DP,4.10-DP & 4.11-DP) would be supported by the completion of a Stormwater Management Master Plans in accordance with the Municipal Class Environmental Assessment (EA), and includes the following:

a) A characterization of existing environmental conditions on a subwatershed basis, consistent with any relevant subwatershed evaluations, if available;
b) An evaluation of the cumulative environmental impact of stormwater from existing and planned development;
c) A determination of the effectiveness of existing stormwater management works at reducing the negative impacts of stormwater on the environment, including consideration of the potential impacts of climate change on the effectiveness of the works;
d) An examination of any stormwater retrofit opportunities that have already been identified by the municipality or the LSRCA for areas where stormwater is uncontrolled or inadequately controlled;
e) The identification of additional stormwater management retrofit opportunities or improvements to existing stormwater management works that could improve the level of treatment within a particular settlement area;
f) A description of existing or planned programs for regular maintenance of stormwater management works;
g) An identification of the recommended approaches for stormwater management in each settlement area; and
h) An implementation plan for the recommended approaches.

Additional approaches may be relevant to the current study and can be described generally as follows:

- Provide "Enhanced" stormwater quality treatment controls, as defined by the Ministry of the Environment for all new development;
- Evaluate an integrated treatment-train approach to minimize reliance on end-of-pipe stormwater management;
- Minimize post-development impacts on water balance, targeting zero impact on predevelopment annual infiltration;
- Minimize post-development impacts on phosphorus loads, targeting zero net impact post-development; and,
- Assess any stormwater retrofit opportunities where stormwater is uncontrolled or inadequately controlled.

1.4.2 Wellhead Protection Plan

A Wellhead Protection Area (WHPA) is the area known as capture zone which surrounds the wellhead. Land use activities in this area have the greatest potential to affect the quality of groundwater within the aquifer from which the well derives its source, and as such, WHPAs are vulnerable to contamination.

There are three (3) pieces of legislation that currently apply to the protection of drinking water supplies within study area:

- **Provincial Policy Statement (2005)** – provides broad policy direction on matters of provincial interest as it relates to land use planning and development.

- **Regional Official Plan (2010)** – provides land use and resource management direction for the land and water outside of the Oak Ridges Moraine as it applies to WHPA's.

- **Clean Water Act (2006)** – Ontario government's commitment to protect drinking water at the source as part of the overall commitment to human health and the environment.

The Regional Official Plan (ROP) provides a policy that restricts and/or prohibits certain land uses due to their potential impact to groundwater quality. To ensure that municipal well water quality and quantity is protected from contamination the policy states:

> *..."That the storage or use of pathogen threats by new land uses, including the siting and development of stormwater management ponds and rapid infiltration basins or columns, except for the storage of manure for personal or family use, is prohibited within the 100-metre pathogen zone around each municipal well shown on Map 6 and may be restricted within the 100-metre to 2-year time of travel."... (York Region, 2010)*

1.4.3 Ministry of Environment and Climate Change Stormwater Management Guidelines

The Stormwater Management Planning and Design Manual (MOE, 2003) provides planning and design guidelines for stormwater management. The Manual outlines design methods for water quality, erosion and flood control. The following policies apply specifically to the Town of Newmarket Stormwater Master Plan:

- Water quality control to be established to the standards outlined in the Stormwater Management Planning and Design Manual for the requisite level of control required by the receiving watercourse (Enhanced Level control as specified by the Lake Simcoe Protection Plan [LSPP]); and

- Provide the requisite erosion control for protection of downstream watercourses to ensure they remain stable (Ontario Water Resources Act as administered by the Ministry of the Environment).

MOECC released an Interpretation Bulletin (February 2015) clarifying their guidance and approvals approach for Stormwater Management. The main item this bulletin identifies is the need to maintain the natural hydrologic cycle to the greatest extent possible. It notes that the MOECC will be releasing a guidance document related to Low Impact Development in late 2016 and states that "Low impact development stormwater management is relevant to all forms of development, including urban intensification and retrofit." In addition, the MOECC provides guidance on the assessment of phosphorus loading and management through the Phosphorus Budget Tool (PTool) (Hutchinson Environmental Services Ltd, March 2012 for MOE).

1.4.4 Lake Simcoe Region Conservation Authority

The LSRCA provides environmental and planning expertise to developers and municipalities with respect to development and construction in the Lake Simcoe Watershed, to ensure provincial, federal and conservation authority policies and regulations are followed. LSRCA also manages regulated areas within the watershed and provides general guidelines for development, by way of their Comprehensive Stormwater Management Master Plan Guidelines (LSRCA, 2011). The LSRCA has provided guidance and data to support this CSWMMP.

1.4.5 Town of Newmarket Official Plan

The Town of Newmarket Official Plan was adopted in 2008 and consolidated in September 2014 and addresses stormwater management in the following sections:

> ***PART II – BUILDING A STRONG COMMUNITY***
>
> ***12.0 Urban Design and Compatibility***
>
> ***12.3 Sustainability in Design***
> *Innovative energy producing options, green industry and green building designs and construction practices will be supported and encouraged in building renovation and redevelopment through the site plan process. Specific sustainability features sought by the Town may include:*
> *a. innovative methods of reducing stormwater flows;*
>
> ***PART III – URBAN SYSTEMS***
>
> ***14.0 Servicing***
>
> ***14.4 Stormwater Management***
> *Proper stormwater management eliminates or reduces the risk flooding, erosion, pollution of streams, rivers and lakes and possible impairment of drinking water resources. By controlling the quantity and quality of stormwater runoff the Town's streams, rivers, lakes and groundwater can be improved. Proper stormwater management will involve the preparation of subwatershed planning studies and stormwater management studies. These studies assist in identifying measures for stormwater management for all development within individual subwatersheds.*
>
> ***Policies***
> *1. New developments will provide appropriate stormwater management facilities as approved by Council and, where necessary, the Lake Simcoe Region Conservation Authority.*
> *2. Stormwater drainage facilities will be designed and constructed so as to protect receiving watercourses and adjacent land uses from any potential adverse impacts of stormwater runoff.*

3. Stormwater management facilities shall maintain natural stream geometry wherever possible and control the quantity and protect and enhance the quality of stormwater runoff entering the receiving watercourses, including the control of erosion and sedimentation during the after construction.
4. Council may prepare comprehensive subwatershed planning studies for specific subwatersheds or development areas within the Town.
5. Council will require the preparation of stormwater management studies in support of any development proposal. Stormwater management studies will identify:
a. the facilities required, including their size, location, and capacity, for controlling the quantity and quality of stormwater runoff, including:
i. storm sewers and/or channels;
ii. culverts;
iii. detention or retention ponds;
iv. upstream stormwater diversions; and,
v. the use of rooftop, parking lot, or parks and open space as temporary detention areas;
b. the measures necessary to control erosion, sedimentation and stream bank stability during and after construction;
c. the storm sewer and outfalls to the receiving watercourses; and,
d. the environmental impacts of stormwater management facilities on fisheries, forest and wildlife resources.
6. Stormwater management studies shall be prepared in accordance with subwatershed planning studies. For areas where a subwatershed planning study has not been prepared, the stormwater management study shall be prepared using engineering and hydrologic models acceptable to the Town and those other authorities with jurisdiction.
7. The size of stormwater management facilities shall be based on the ultimate development pattern within the subwatershed or development area.
8. All stormwater management facilities shall be designed to the satisfaction of the Town and those other authorities with jurisdiction.

14.8 Environmentally Progressive Services
Environmentally progressive services will help reduce current resource inputs and outputs to and from homes and buildings. Such practices will help decrease impacts on the environment, water cycle, and climate. Environmentally progressive services are encourages to be incorporated into developments and may include:

- *reduced stormwater flows;*
- *reduced use of water;*
- *reduced waster production and increased recycling;*
- *use of renewable energy systems and energy efficient technologies; and,*
- *creation of innovative green spaces such as green roofs.*

Several components of the plan related to Natural Heritage Systems, Floodplains and Hazard Lands impact SWM Planning, as they restrict SWM facility locations, and recommend SWM measures reduce impacts on the natural environment.

1.4.6 The Newmarket Urban Centres Secondary Plan

The Newmarket Urban Centres Secondary Plan covers an area located along the Davis Drive and Yonge Street Corridors. The Secondary Plan updates the Official Plan Land Use categorization through these corridors and identifies planning requirements for redevelopment of these lands. Stormwater Management is specifically identified in several areas but in general identify that the increased density, impervious area and development provided for in the rezoning shall be mitigated by the implementation of low impact development stormwater management measures to improve conditions with respect to stormwater volumes and contaminant loadings and that maximize infiltration.

The Plan also specifies the enhancement and/or creation of Neighbourhood and Open Space Parks. Several of these parks have existing stormwater management facilities or are located along the stream corridor within the floodplain. The Plan also identifies 7 km of Green Streets slotted to have increased tree canopy and enhanced vegetation plantings.

1.4.7 Newmarket Engineering Design Standards

Section C of the Newmarket Engineering Design Standards (Town of Newmarket, 2009) identifies design requirements of stormwater management infrastructure for new development. This includes design standards for storm sewers, culverts, stormwater management ponds and overland flow routes. The 2012 Town-wide Drainage Study recommended changes to these guidelines to reflect recommendations from that study as well as updated IDF curves. These are currently being implemented.

The standards related to stormwater management generally defers to the 2003 MOE Guidelines and requirements related to on-site stormwater management are generally limited to parking lot and roof top storage to reduce peak flows.

1.4.8 York Region Official Plan

Adopted in 2010 the York Region Official Plan (subject to ongoing review to address site specific appeals), has several components that address stormwater management. Section 2.3 Water Systems generally outlines the policy requirements. The specific sections related to Stormwater Management are listed below. Other Sections (5.2 Sustainable Cities, Sustainable Communities and 5.4 Regional Centres and Corridors for example) reiterate these items.

> ***Stormwater Management***
> *Stormwater is the runoff that occurs in urbanized areas, increasing downstream watercourse erosion, pollution and increased water temperatures. Stormwater can intensify flooding during storm events. Stormwater should be managed as a resource. The use of sustainable stormwater planning and practices will help ensure the continued health of the streams, rivers, lakes, fisheries and terrestrial habitats in our watersheds.*
>
> ***Objective***
> *To ensure the careful management of stormwater through the use of innovative techniques.*
>
> *It is the policy of Council:*
> *36. To work in partnership with local municipalities, the Province, conservation authorities and other agencies in the implementation of stormwater management initiatives.*
> *37. To require the preparation of comprehensive master environmental servicing plans, or appropriate technical studies, as a component of secondary plans and major development or re-development to minimize stormwater volume and contaminant loads, and maximize infiltration through an integrated treatment approach, which may include techniques such as rainwater harvesting, phosphorus reduction, constructed wetlands, bioretention swales, green roofs, permeable surfaces, clean water collection systems, and the preservation and enhancement of native vegetation cover.*
> *38. That local municipalities require that stormwater management works be inspected and maintained to ensure that they function as designed.*
> *39. To work with local municipalities and the Lake Simcoe Region Conservation Authority in the preparation and implementation of comprehensive stormwater management master plans for each settlement area within the Lake Simcoe Watershed by June 2014.*

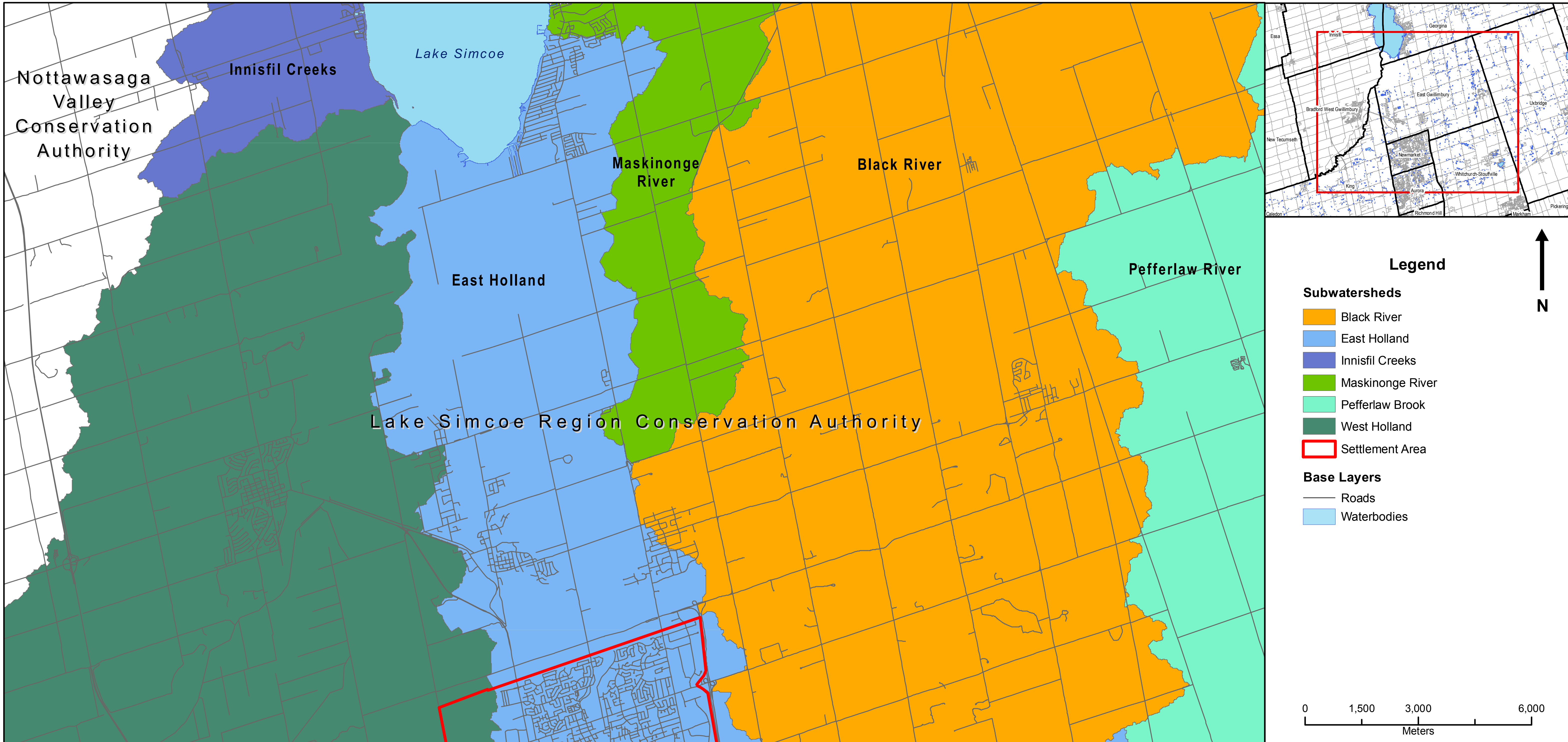
1.4.9 Oak Ridges Moraine Conservation Plan

A portion of the study area falls within the Oak Ridges Moraine, and must conform with the Oak Ridges Moraine Conservation Plan (2001). The plan outlines requirements for stormwater management for development within the Oak Ridges Moraine including construction related stormwater management, with development requiring a stormwater management plan meeting the following criteria:

> *(1) The objectives of a stormwater management plan are to;*
> > *(a) maintain groundwater quantity and flow and stream baseflow;*
> > *(b) protect water quality;*
> > *(c) protect aquatic species and their habitat;*
> > *(d) prevent increases in stream channel erosion; and*
> > *(e) prevent any increase in flood risk.*
>
> *(2) A stormwater management plan shall provide for an integrated treatment train approach that uses a planned sequence of methods of controlling stormwater and keeping its impact to a minimum by techniques including, without limitation;*
> > *(a) lot level controls such as devices and designs that direct roof discharge to rear yard ponding areas;*
> > *(b) conveyance controls such as grassed swales; and*
> > *(c) end-of-pipe controls such as wet ponds at the final discharge stage.*
> > *(3) A stormwater management plan shall be prepared in accordance with the applicable watershed plan under section 24, if one exists.*

1.4.10 Considerations for New Policies

The draft Lake Simcoe Watershed Model By-law and LID SWM Guidelines for Municipalities (April 16, 2015 draft) is intended to provide a model framework for LID SWM requirements to be defined within the Municipal legislative framework. It is still up to each Municipality to select some or all of the draft Model By-law and LID SWM Guidelines, as they so choose. The Town of Newmarket needs to consider the adoption of these new guidelines.



Town of Newmarket Stormwater Master Plan

Settlement Area

November 2016	1:100,000	Datum: NAD 83 Zone 17 Source: Town of Newmarket, York Region
P#: 60330930	V#: 01	

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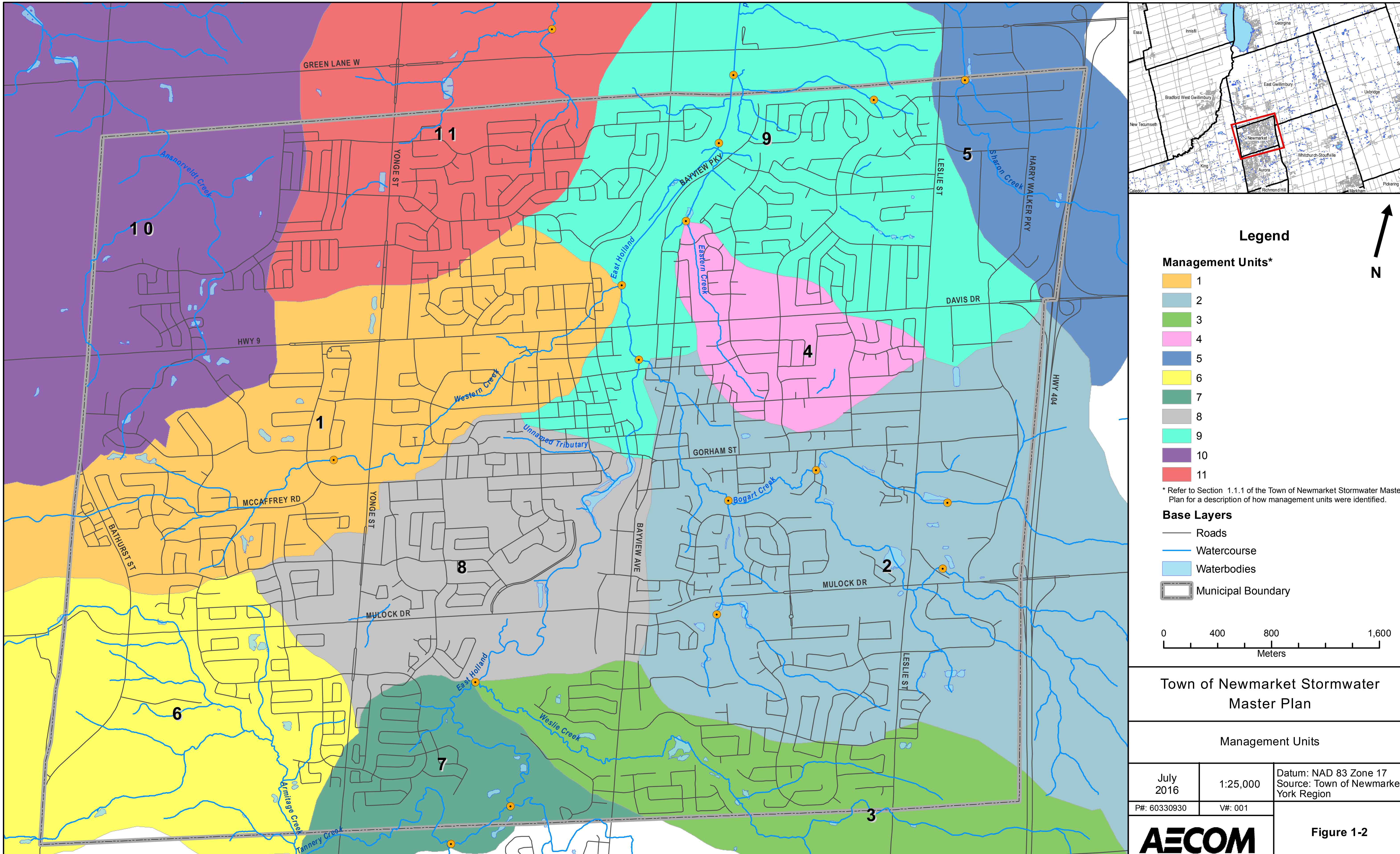
Figure 1-1



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2. Existing Conditions {Step 3, 5}

2.1 Existing Development

Existing land uses for the Study Area were provided by the Town of Newmarket and are shown in **Figure 2-1**. **Table 2-1** provides a detailed summary of the existing land uses. The four most dominant land uses in the Study Area include urban, natural heritage, industrial areas and transportation. Approximately 42 percent of the Study Area is dominated by urban land use, which consists of a broad range of commercial, office, institutional, and residential land uses that support jobs, housing and services (Town of Newmarket, 2014). Natural heritage features which are part of the Town's Natural Heritage System are the second dominant land use and represent 15 percent of the Study Area. Natural heritage features consist of locally significant meadows, woodlands and wetlands, as well hydrological networks of watercourse and floodplains associated with the East Holland River (Town of Newmarket, 2014). Industrial areas, which provide employment opportunities, are concentrated adjacent to Highway 404 and represent approximately 9 percent of the Study Area. The Town's transportation network, which is served by roads and railway systems and connects to the Greater Toronto Area and other parts of Ontario, also contributes 9 percent of the existing land use (Town of Newmarket, 2014).

The parks and open spaces land use type consists of major parks, golf courses, conservation areas, trail systems and river corridors, which comprise 7 percent of the Study Area (Town of Newmarket, 2014). These areas promote active and passive recreation and provide physical linkages between natural heritage features. Institutional and commercial land uses, each comprise 6 percent of the Study Area, respectively. Institutional areas primarily consist of post-secondary educational facilities, long-term care facilities and social, cultural and administrative facilities (Town of Newmarket, 2014). Commercial areas mainly promote retail and service orientated activities (Town of Newmarket, 2014). Only 4 percent of the study area is dominated by intensive and non-intensive agriculture and the remaining 2 percent consists of estate residential and rural developments.

Table 2-1. Existing Land Use in the Study Area

Land Use Type	Area (ha)	Percentage (%)
Urban	1589.27	41.61
Natural Heritage	554.10	14.51
Industrial	345.02	9.03
Transportation Network:		
Rail	11.77	0.31
Road	326.91	8.56
Subtotal:	***338.69***	***8.87***
Parks and Open Spaces:		
Manicured Open Space	182.18	4.77
Golf Course	103.10	2.70
Subtotal:	***285.27***	***7.47***
Institutional	238.65	6.25
Commercial	235.41	6.16
Agriculture:		
Intensive agriculture	129.60	3.39
Non-intensive agriculture	21.20	0.56
Subtotal:	***150.80***	***3.95***
Estate Residential	48.00	1.26
Rural Development	33.99	0.89
Total:	**3819.19**	**100.00**

2.2 Hydrology

The Study Area is located in the Lake Simcoe watershed, which is situated in Southern Ontario between Lake Ontario and Georgian Bay of Lake Huron. The watershed has an area of approximately 3,557 square kilometers. Lake Simcoe itself has a surface area of 722 square kilometers. The Lake drains into Lake Couchiching through the Atherley Narrows and into Georgian Bay through the Trent Severn Waterway (Scott et al, 2006). The Lake Simcoe watershed consists of 33 subwatersheds. The watershed boundary for the Town of Newmarket regional hydrology is presented on **Figure** 2-2.

The Study Area is located mainly in the East Holland River watershed, with a very small area in the north-west located in the West Holland River watershed. The Holland River watershed is composed of the East Holland River, the West Holland River (also called the Schomberg River) and the main branch of the Holland River. The East and West Holland Rivers join near 10th Line and flow into the main branch of the Holland River before draining into Lake Simcoe at Cook's Bay.

2.2.1 East Holland River Watershed

The East Holland River watershed is located in the southwest portion of the Lake Simcoe watershed. The watershed extends from the Oak Ridges Moraine in the south to Lake Simcoe in the north. The watershed neighbours with the West Holland River watershed to the west, the Black River watershed to the east, and the Maskinonge River watershed to the northeast. The East Holland River watershed covers an area of 268 km^2 (Beak Consultants, 1994). The watershed is located almost entirely within the York Region, with a small part within the regional municipalities of Durham and Simcoe.

The East Holland watershed has a maximum elevation of 403 mAMSL, a minimum elevation of 198 mAMSL, and an average elevation of 274 mAMSL. The watershed has mostly low topographic relief, steeper areas are found in the southern portion of the watershed. The majority of the watershed falls within the Simcoe Lowlands. The Oak Ridges Moraine extends into the watershed in the southeast, accounting for approximately 12 percent of the watershed area (The Louis Berger Group, 2006). Sandy-loam and clay-loam are dominant soils in the watershed.

The major streams in the East Holland River watershed include the East Holland River and its main tributaries, Tannery Creek, Marsh Creek, Weslie Creek, Armitage Creek, Bogart Creek, Western Creek, Sharon Creek, Holland Landing Creek, Queensville Drain, Holborne Drain, Ravenshoe/Boag Drain, and Youngs Point Creek. The East Holland River flows in a northerly direction and drains into Cook's Bay. The East Holland River flows through the centre of the Town of Newmarket, along with various tributaries. Bogart Creek meanders into the Town from the Oak Ridges Moraine, and empties into the main branch in north-central Newmarket. Western creek empties into the main branch in the Town's north end. Tannery creek is a stream that joins the main branch in south Newmarket. Other tributaries include Weslie Creek, Artmitage Creek, both in the south end of the Town. There are numerous waterbodies and storm water management ponds throughout the Town. There are two reservoirs in Newmarket; Fairy Lake is a former mill pond on the East Holland River, and is managed by the LSRCA. Bogart Pond is also a former mill pond, and is located on Bogart Creek. The water level in the reach of the East Holland north of Davis Drive is controlled from an unfinished Newmarket Canal lock, now used as a weir. There are a number of storm water management ponds in the Town of Newmarket. A portion of these ponds are private, some are under the control of developers, and some are under the control of the Town of Newmarket.

According to the LSRCA, the East Holland watershed is the most populated and environmentally degraded region of the Lake Simcoe watershed (LSRCA, 2010a). The watershed is one of the most urbanized watersheds in the Lake Simcoe watershed with over 27 percent urban areas. Other major land uses in the watershed include agricultural areas (35 percent) and forested lands (24 percent), (The Louis Berger Group, 2006).

2.2.2 West Holland River Watershed

The West Holland watershed is located in the southwestern portion of the Lake Simcoe watershed. Similarly to the East Holland River, the watershed extends from the Oak Ridges Moraine in the south to Lake Simcoe in the north. The West Holland River watershed has an area of 348 km^2 (Beak Consultants, 1994). The larger part of the watershed lies within the York Region, with the remaining part in Simcoe County, and in the Peel region.

The major streams in the West Holland River watershed include the West Holland River and its main tributaries, North Schomberg River, South Schomberg River, Pottageville Creek, Kettleby Creek, Keele Creek, Glenville Creek, Arnsnorvelt Creek, Frazer Creek, Scanlon Creek, Coulsons Creek, William Neeley Creek, and North and South Canal. The North and South Schomberg Rivers originate in the southern portion of the watershed, and flow into the West Holland River. The West Holland River then flows in a northeasterly direction and drains into Cook’s Bay. The Town of Newmarket encompasses only a very small portion of the West Holland River watershed in the northwest section of the Town.

The West Holland watershed has a maximum elevation of 370 mAMSL, a minimum elevation of 199 mAMSL, and an average elevation of 258 mAMSL. The majority of the watershed is flat, steeper areas are found in the southern and southeastern portions of the watershed. The majority of the watershed falls within the Simcoe Lowlands, the remaining area is part of Upland Till Plains. Many of the uplands are associated with the Oak Ridges Moraine, which extends into the West Holland Watershed in the south, comprising approximately 7 percent of the watershed area (The Louis Berger Group, 2006). Sandy-loam and clay-loam are dominant soils in the watershed.

The West Holland River watershed is characterized by intensive market gardening activity, with dominant agricultural (59 percent) land use. Forested areas occupy 22 percent of the areas. Urban areas make up approximately (8 percent) of the watershed (The Louis Berger Group, 2006). Also, the Holland Marsh is a significant land use feature in this watershed.

2.3 Stream Morphology

Geomorphological conditions and processes within East and West Holland subwatersheds were documented in the following reports:

- AECOM (2009). Townwide Drainage Study. Prepared for Town of Newmarket, June 2009.
- Conestoga-Rovers & Associates (2013). Upper York Sewage Solutions Environmental Assessment: Natural Environment Baseline Conditions Report. Prepared for The Regional Municipality of York.
- LSRCA (2010a). East Holland River Subwatershed Plan. Lake Simcoe Region Conservation Authority.
- LSRCA (2010b). West Holland River Subwatershed Plan. Lake Simcoe Region Conservation Authority.
- LSRCA (2010c). Lake Simcoe Basin Best Management Practices Inventory. Lake Simcoe Region Conservation Authority.
- PARISH Geomorphic Ltd. 2007. Basin Scale Fluvial Geomorphology Assessment for the York Region Watersheds. Prepared for the Lake Simcoe Conservation Authority. 20 pp plus appendices.

2.3.1 General Observations

The following are general observations regarding fluvial geomorphological form and processes with the Town of Newmarket:

- The majority of channels are intermittent or ephemeral in nature (Conestoga-Rovers & Associates 2013).

- Many channels have been historically straightened for agricultural and urban purposes. Historic straightening has increased erosion potential and has resulted in the removal of riparian vegetation, which is a key component of bank strength (Conestoga-Rovers & Associates 2013).
- Historic aerial analysis reveals that channel planform has been relatively stable over the past half century (LSRCA 2010a, 2010b).
- Meander belt widths are generally less than 60 m within the Town, except for the main branch of The East Holland River which has a meander belt of 61-100 m in the southern portion of the Town and it increases to 101-160 m downstream of its confluence with Western Creek near Davis Drive (PARISH Geomorphic Inc., 2007).

2.3.2 Rapid Geomorphological Assessment

The Rapid Geomorphic Assessment (RGA) was designed by the Ontario Ministry of Environment and Climate Change (1999) to assess reaches in urban channels. Reaches can be defined as lengths of channel that display similar physical characteristics and have a setting that remains nearly constant along their length. Thus, in a reach, the controlling and modifying influences on the channel are similar, and are reflected in similar geomorphological form, function and processes within the reach. RGA is a presence/absence methodology designed to document evidence of channel instability. The various indicators are grouped into four categories indicating a specific geomorphic process: aggradation, degradation, channel widening and planimetric form adjustment. Upon tallying the results, a given reach is determined to be either ‘In-Regime or Stable’ (least sensitive), ‘Transitional or Stressed’ (moderately sensitive), or ‘In-Adjustment’ (most sensitive).

In the East Holland Watershed all watercourses were determined to be either ‘In-Regime or Stable’ or ‘Transitional or Stressed’ (i.e. no ‘In-Adjustment’ channels were observed) and channel widening was found to be the dominant channel process (LSRCA, 2010a). Likewise, only one reach was determined to be ‘In-Adjustment’ in the West Holland River subwatershed and the dominant channel process was also widening (LSRCA, 2010b). Widening is common in urban watersheds as the channels enlarge their cross-section to accommodate large flow events.

2.3.3 Channel Classification

As part of the Upper York Sewage Solutions (UYSS) EA study (Conestoga-Rovers & Associates 2013), a reconnaissance-level fluvial geomorphic assessment was completed for all watercourses within the UYSS study area, which included the Town of Newmarket. Reaches within the study area were defined based on desktop assessment of characteristics including sinuosity, valley setting, geology, gradient, land use and tributary confluences, using aerial photography, drainage network, geology and topographic mapping. Each reach was assigned a category A through F. **Table 2-2** provides description of each of the categories. The distribution of reach categories can be observed in **Figure 2-3**. Note the UYSS study area did not include the western edge of the Town of Newmarket and thus those channels were not classified.

Representative reaches were walked in July 2011 to field-truth the desktop analyses and collect additional information including bankfull channel dimensions and channel boundary materials. As well, the extent of anthropogenic intervention, severity of bed and bank erosion, and dominant mode of channel adjustment was also noted during the field investigations. Based on these field indicators, the ability of each reach type to assimilate increased discharge was assessed. Channel dimensions, substrate, processes, and ability to assimilate higher discharges can be observed in **Table 2-2**.

Over half (52 percent) of the watercourses assessed were classified as small altered watercourses (Class E). As well, an additional 18.6 percent of channel length is classified as large altered watercourses (Class B). The high percentage of altered watercourses is attributed to urbanization and agriculture. The altered channels are generally found in the northern portion of the Town. These altered channels are more susceptible to erosion than natural channels due to decreased channel length (i.e. increased slope) and loss of natural hydraulic roughness.

Furthermore, total stream power is the rate of energy expenditure along a channel and can be used to identify segments of channel that are predisposed to bed and bank erosion. Stream power (Ω) was determined along all second-order channels and higher that have a drainage area larger than 100 hectares according to the following equation:

$$\Omega = \gamma Q S$$

where is γ specific weight of water (9810 N/m^3), Q is the two year return discharge (m^3/s), and S and is the bed gradient (m/m). Q was determined using ArcHYDRO module of ESRI's ArcGIS and S was estimated from a 5 m digital elevation model. The distribution of stream power within the Town of Newmarket can be observed in **Figure 2-4**. Stream power is highest along sections of Western Creek and the East Holland River where the channel has been historically straightened (i.e. reduction of channel length increases channel slope and thus stream power).

Table 2-2. Summary of Reach Characteristics within the Town of Newmarket (Conestoga-Rovers & Associates 2013)

Reach Class	Description	Approximate Channel Length (m)	Typical Bankfull Width (m)	Typical Bankfull Depth (m)	Typical Channel Pattern	Typical Bed/Bank Material	Relative Extent of Anthropogenic Influence	Relative Severity of Erosion	Dominant Mode of Channel Adjustment	Sensitivity to Flow Supplementation
A	Large Natural Watercourse	2114 (6.7%)	5 – 17	0.5 – 0.75	Irregular Meander	Sand, Silt, Gravel	Minor	Minor	Widening	Moderate
B	Large Altered Watercourse	5860 (18.6%)	6 – 17	0.2 – 0.8	Straight/Irregular Meander	Sand, Silt, Pebbles, Gravel	Major	Moderate	Widening	Moderate
C	Backwatered Watercourse	0 (0.0%)	4 – 54	8 – 10	Irregular Meander	Organic Material, Sand, Silt	Moderate	Negligible	Natural Meander Processes	Low
D	Small Natural Watercourse	2349 (7.5%)	1.5 – 3	0.3 – 0.6	Irregular Meander	Sand, Silt	Minor	Moderate	Natural Meander Processes	Moderate to High
E	Small Altered Watercourse	16367 (52.0%)	1.5 – 4	0.2 – 0.5	Irregular Meander	Sand, Silt, Gravel	Moderate	Major	Widening	Moderate to High
F	Swales and Drains	4099 (13.0%)	NA	NA	Poorly Defined to Sinuous	Silt, Sand, Pebbles, Organic Material (commonly vegetated)	Moderate	Minor	None to Degradation	High
G	Straight Drainage Ditch	666 (2.1%)	1 – 4	0.4 – 0.8	Straight	Silt, Sand	Moderate	Minor	Widening	Moderate to High

2.3.4 Stream Inventories

In 2009, AECOM field staff conducted stream inventories along Western, Eastern, and Boggart Creeks and an unnamed tributary of the East Holland River (refer to Figure 2.3 and 2.4 for channel locations). Below is a summary of documented morphological conditions for each reach:

- *Western Creek:* Development occurs up to the edges of the banks at many locations resulting in the use of hard engineering approaches (e.g. gabion baskets, armour stone). Western Creek has the most erosion issues of the four channels investigated. Channel straightening was noted throughout.
- *Eastern Creek:* The cross-sectional area was enlarging through widening and downcutting. More pronounced riparian buffer than the other three channels.
- *Bogart Creek:* Development occurs up to the edges of the banks at many locations resulting in the use of hard engineering approaches (e.g. gabion baskets, armourstone). Channel straightening was noted throughout.
- *Unnamed Tributary* of the East Holland River*:* Channelized, vegetation choked channel. Minor erosion issues.

2.4 Hydrogeology

2.4.1 Purpose

The purpose of the hydrogeological investigation is to provide an overview of groundwater conditions within the Newmarket Stormwater Management Plan study area. Through completion of a desktop study, areas of differing environmental sensitivity with respect to groundwater have been identified. Understanding groundwater resources within the study area allows for proper planning of the Town of Newmarket's stormwater management facilities and addresses both environmental and design aspects during the planning phases of development. Groundwater conditions at a stormwater management pond affects the pond's ability for surface water infiltration, as wells as its ability to mitigate adverse impacts from surrounding development on baseflow contribution to local surface water resources; including wetlands, creeks and streams.

2.4.2 Methods

A review of secondary source information was undertaken to confirm geological and hydrogeological conditions within the study area. Several key reports were reviewed to determine the hydrogeological setting of the study area and included the following:

- Upper York Sewage Solutions Environmental Assessment – Natural Environment Baseline Conditions Report (AECOM, 2013);
- South Georgian Bay Lake Simcoe Source Protection Plan (LSRCA, 2012)

A Geographic Information System exercise was performed to identify areas of high vulnerability to groundwater contamination. For example, surficial geology mapping was used to identify highly permeable soils at surface that may indicate potential groundwater recharge areas. Coincident high permeability sediments, wetlands and stream headwaters were mapped to identify potential groundwater discharge areas. In addition, Ministry of the Environment and Climate Change (MOECC) water well locations within the study area were mapped, and selected water well records were consulted to characterize the subsurface distribution of sediments and identify the location of high groundwater tables within the study area.

2.4.3 Results

2.4.3.1 Geology

Bedrock Geology

Locally, the upper bedrock contact is known to occur at depths ranging from 50 m near Lake Simcoe to greater than 200 m within bedrock valleys underlying the Oak Ridges Moraine (ORM; AECOM, 2013).

Geological mapping for the area indicates overburden deposits that overlie shale of the Blue Mountain Formation in the southern half of the study area and limestone of the Lindsay formation in the northern half of the study area. The Blue Mountain Formation is a dark blue-grey to black shale that is thinly interbedded with limestone or calcareous siltstone. This formation is Upper Ordovician in age and overlies the Lindsay Formation (Armstrong and Dodge, 2007). The Lindsay Formation is Middle Ordovician in age and is one of 5 units of the Simcoe Group. It can be described as a fine to coarse grained, fossiliferous limestone in which the uppermost part consists of black, organic-rich shaly limestone known as the Collingwood Member (Armstrong and Dodge, 2007).

Quaternary Geology

The Quaternary geology of the study area is illustrated on **Figure 2-5**. The study area is underlain by a complex sequence of glacial and postglacial overburden deposits. The Quaternary sediments within the study area were largely deposited during the Wisconsinan stage during the advance and retreat of glacial ice sheets. During the post-glacial period, regional rivers cut through the Pleistocene sediments depositing modern alluvial (river or flowing water) sediment deposits.

Recent Deposits

Modern alluvial deposits of clay, silt, sand and gravel were laid down in river floodplains during the post-glacial period. Within the study area, these deposits are primarily located within the floodplain of the Holland River and its associated tributary system.

Organic deposits are mapped in the south-central portion of the study area, located east of Bayview Avenue (**Figure 2-5**).

Glaciolacustrine Deposits (8a, 9b and 9c)

Surficial geology within the study area consists primarily of glaciolacustrine deposits. These deposits were formed during and after the final retreat of the Wisconsinan ice sheets making them the youngest glacial sediments within the study area. These deposits primarily are massive to well laminated clay and silt deposits that were deposited in deeper water (low energy) environments.

Coarse textured glaciolacustrine deposits of sand and gravel, deposited in shallow, near shore environments, also are also present along the outer parameter of the study area (**Figure 2-5**). Although these sediments generally form a thin veneer, locally they can be several metres thick. These units represent local ponding of water or higher water levels in major post-glacial lakes following retreat of the glaciers. While these deposits can serve as an aquifer and provide water to local private wells, they are not targeted as a source by any municipal wells in York Region.

Kettleby Till (5d)

The Halton Till sheet was deposited as glacial ice advanced out of the Lake Ontario basin approximately 13,000 years ago (Barnett, 1992). The Kettleby Till was deposited at about the same time to the north of ORM by southward flowing ice of the Lake Simcoe lobe. The Kettleby Till generally is comprised of clayey silt till interbedded with clay, sand and gravel. Within the study area, the Kettleby Till occurs predominantly as a local surface till on topographic highs, discontinuous, and generally is less than 20 m in thickness (AECOM, 2013). The fine-grained texture of the Kettleby Till tends to limit infiltration (recharge) to underlying units, but at the same time also serves to impede the vertical movement of contaminants into the ORM and other deeper formations.

Newmarket Till (5b)

The advance of the Laurentide Ice Sheet during the Late Wisconsinan period resulted in the deposition of a regionally extensive subglacial till sheet, referred to as the Newmarket till. The Newmarket till is a thick, widespread deposit that underlies the Oak Ridges Moraine and most of southcentral Ontario. It is described as a silty sand to sandy silt, dense diamicton that ranges in thickness from 5 to 30 m, but locally can be up to 100 m thick or more (AECOM, 2013). In certain areas, the till sheet has been eroded completely by glaciofluvial processes (channels) providing hydraulic gateways to the lower aquifer system.

Within the central portion of study area, Newmarket Till can be found surrounded by glaciolacustrine deposits, forming distinct ‘islands’ that are typically associated with drumlins (**Figure 2-5**). The Newmarket Till tends to be more continuous along the western perimeter of the study area where topography is higher.

Lower Deposits

Lower deposits are considered to be those sediments which underlie surficial deposits and do not outcrop within the study area. They are typically encountered at depths greater than 40 metres below ground surface (mbgs). These deposits include the Thorncliffe Formation, Sunnybrook Drift and Scarborough Formation. These deposits have been interpreted to extend under most of York Region from Lake Simcoe to Lake Ontario.

The Thorncliffe Formation is a glaciofluvial and glaciolacustrine sediment and is comprised of extensive stratified sands, silty sand and commonly sit and clay near the base of the deposit. The Thorncliffe Formation underlies the Newmarket Till in the study area and is an important source of drinking water for both private and municipal well supplies.

The Scarborough Formation is interpreted to be a fluvio-deltaic system deposited by an extensive braided melt water stream and river system draining from an advancing ice sheet. Similar to the Thorncliffe Formation, municipal water supply wells commonly source water from the Scarborough Formation.

2.4.3.2 Hydrogeology

Hydrostratigraphic Units and Local Aquifers

Aquifers are classically defined as a geological unit that is sufficiently permeable to permit the extraction of a useable supply of water. Aquifer units within the study area are typically comprised of coarse textured unconsolidated (overburden) sediments. However, weathered surficial till and extensive fractures within the till may also form secondary aquifer conditions. Unconfined aquifers are aquifers which are open to receive water from the surface directly and in which the water table surface is free to fluctuate depending on the recharge or discharge rate. Alternatively, confined aquifers are aquifers overlain by low permeability materials that form a confining layer and inhibit groundwater movement, also known as Aquitards. Aquitards within the study area are considered to be fine textured glaciolacustrine deposits of silts and clays and consolidated till deposits.

Hydrostratigraphy is the classification of the various major stratigraphic units into aquifers and aquitards, with some simplification or combination of units with similar properties. Previous studies of the hydrostratigraphy of the ORM included eight (8) simplified hydrostratigraphic layers. The study area and surrounding area has been extensively studied as part of the Oak Ridges Moraine Groundwater Management Strategy (CAMC-YPDT, 2006). The deeper overburden geology and hydrogeology were assessed using conceptualization developed by the Conservation Authorities Moraine Coalition (CAMC) and their study partners, as part of the CAMC – YPDT (York, Peel Durham, Region) project. This detailed hydrostratigraphic model for the Oak Ridges Moraine has particular emphasis on the 'core area', which includes the Toronto and Region Conservation Authority watersheds, Lake Simcoe Region Conservation Authority, York Region and parts of Durham and Peel regions. The groundwater flow model for the core area is comprised of all eight previously-identified hydrostratigraphic layers. This model has been used to provide a baseline understanding of hydrogeological conditions on a regional scale. As described in the UYSS EA (AECOM, 2013), the hydrostratigraphic framework of the study area consists of fine textured glaciolacustrine silt and clay deposits and consolidated tills, overlying glacial lacustrine and glacial fluvial sand. Thin and discontinuous surficial deposits overlying the till may be locally significant.

Regional hydrostratigraphic units include the following:

- Recent Deposits (gravel, sand, silt, clay, peat, muck, marl, fill) – ***Unconfined Aquifer or Aquitard****;*
- Glaciolacustrine Deposits (gravel, sand, silt and clay) – ***Unconfined Aquifer or Aquitard****;*
- Kettleby Till (clayey silt to silt till) – ***Aquitard****;*
- Oak Ridges Moraine (sand and gravel) – ***Unconfined Aquifer;***
- Interstadial Sand Deposits (fine to coarse sand, and gravel) – ***Confined Aquifer****;*
- Channel Deposits (silt) – ***Aquitard;***
- Newmarket Till (sandy silt to sand till) – ***Aquitard****;*
- Thorncliffe Formation (silty sand, sand) – ***Confined Aquifer****;*
- Sunnybrook drift (silty clay) – ***Aquitard****;*
- Scarborough Formation (fine to coarse sand) – ***Confined Aquifer****;* and
- Bedrock (shale, limestone) – ***Aquitard****.*

Regional aquifers in the study area are typically found in the Oak Ridges Moraine, Interstadial Sand Deposits, Thorncliffe Formation and Scarborough Formation (AECOM, 2013). Recent surficial river floodplain deposits, organic deposits and glaciolacustrine deposits are typically thin and discontinuous, and generally do not support domestic well supplies. These surficial coarse textured deposits may locally be significant however, functioning as a pathway for surface water runoff and shallow groundwater flow to wetlands and other areas.

Regional aquitard units include the Kettleby Till, Channel Deposits (silt), Newmarket Till, Sunnybrook Drift and bedrock. Glaciolacustrine silt and clay deposits overlying the till and channel deposits may locally combine with these deposits and restrict recharge.

The till deposits typically have a low hydraulic conductivity and limited ability to transmit groundwater, however, local features such as heterogeneities, secondary porosity, permeability features and fractures may locally permit a low yield, and/or provide groundwater recharge-discharge pathways (AECOM, 2013).

In general, the hydrogeology of the study area can be described as a regionally low permeability fine textured glaciolacustrine and till aquitard unit, overlying and confining a deeper regional aquifer system consisting of the Interstadial Sand Deposits, Thorncliffe Formation and Scarborough Formation.

Significant Groundwater Recharge Areas

Surface water received from precipitation will percolate or infiltrate into the ground until it reaches the water table. This occurs in surficial sediments that are permeable and allow for easy movement of water through its pore spaces. Areas such as these are known as recharge areas.

Significant Groundwater Recharge Areas (SGRA) are characterized by high permeably soils at surface, such as sand or gravel, which allows water to readily pass from the ground surface to an aquifer. These areas are considered significant when they aid in maintaining the water level in an aquifer that provides water for potable means or supplies groundwater to a cold water ecosystem.

Within the study area, SGRA is associated with coarse textured glaciolacustrine deposits and ice-contact stratified deposits of sand and gravel in the western portion of the study area (**Figure 2-5**). As indicated in Section 2.4.3.1, these deposits can be described as highly permeable sediments with capabilities of transmitting large quantities of groundwater. Since these soils are exposed at surface they also have the capability of allowing water to infiltrate from the surface to recharge the unconfined groundwater aquifer, allowing them to be classified as SGRA. The remaining surficial soils within the study area are considered fine grained (i.e., till, fine textured glaciolacustrine deposits, glaciofluvial deposits and modern alluvial deposits) and do not possess the soil characteristics necessary to allow for significant quantities of groundwater recharge.

Highly Vulnerable Aquifers

A highly vulnerable aquifer (HVA) is one that is susceptible to contamination due to its location near ground surface or the type of material found in the ground around the aquifer. Aquifers that are near the ground surface and have less of a barrier between the ground surface and water below the ground are considered to be HVA.

Within the study area, HVA consists of the land surrounding the East Holland River and major associated tributaries as well as areas with coarse textured glaciolacustrine deposits mapped at surface (**Figure 2-6**).

2.4.3.3 Groundwater Resources

Wellhead Protection Zones

A significant aquifer, known as the Yonge Street Aquifer (YSA), underlies a portion of the study area. This aquifer is used to supply the communities of Aurora, Newmarket, Holland Landing and Sharon-Queensville with municipal water. The YSA can be described as a channel aquifer complex within the Lake Simcoe Basin. The YSA is located along the trail of municipal water supply wells, generally extending along Yonge Street in York Region from Vandorf Sideroad north to Green Lane, then deflecting in a northeast direction to the Town of East Gwillimbury (AECOM, 2013) (**Figure 2-7**). The regional groundwater model (YPDT, 2006) correlates the YSA with the Thorncliffe Aquifer Complex. Four (4) municipal water supply wells are located within the study area, each of which targets YSA as its groundwater source.

As described in Section 1.3.2, areas that are vulnerable to contamination have been delineated for the municipal wells and are known as Wellhead Protection Areas (WHPA). A WHPA is the area or capture zone surrounding the wellhead where land use activities have the greatest potential to affect the quality of groundwater within the aquifer from which the well derives its source. The WHPA's for York Region YSA municipal wells are shown on **Figure 2-7**. A review of **Figure 2-7** indicates that the Yonge Street Aquifer WHPA covers the majority of the study area.

Groundwater Resources

Aquifers within the study area provide groundwater supplies for private domestic, large municipal and industrial/commercial purposes. MOECC water well records for the area include identification of the type of use, including agricultural (e.g., farms), commercial (e.g., garden centres, golf courses), institutional (e.g., churches, schools), municipal or communal well supplies, wells used for engineering purposes (e.g., test holes, monitoring wells), and domestic well supplies. MOECC water well records provide key information about the well, including type, depth, static water level, available drawdown, and formation into which the well is screened. **Figure 2-7** indicates the locations of MOECC water well records, primary use of the wells and highlights shallow wells that are screened at a depth of less than 10 mbgs.

A review of MOECC water well records within the study area indicates the occurrence of approximately fifty (50) agricultural well supplies, seventeen (17) commercial well supplies, three (3) cooling and air conditioning well supply uses, five (5) industrial well supplies, seventeen (17) municipal supply wells, twenty (20) public supply wells, two hundred and sixty five (265) monitoring wells and test holes, three hundred and sixty eight (368) domestic wells, and three hundred and seventy six (376) well records that are classified as either dewatering, not used, other and wells with unknown use. A total of three hundred and thirteen (313) water wells within the study area are shown to have a depth of 10 m or less. Only forty-three (43) of these are classified as domestic water wells, the remaining are monitoring and/or test holes or have unknown use information stated. These wells would be more susceptible to negative impacts due to land use surrounding the well than those wells completed at greater depth.

The actual number of shallow wells within the study area may be greater than that stated above, as dug, bored and drivepoint wells commonly are unregistered, and thus would not be reflected within the MOECC database.

Finally, it should not be assumed that all MOECC water wells within the study area are currently active. Some of the wells identified within the MOECC record database may be decommissioned or no longer in use.

2.5 Aquatic Ecology

2.5.1 Background Information Review

A background information review of aquatic and hydrological features and functions located within the Study Area was conducted using the following available secondary sources:

- Ontario Ministry of Natural Resources and Forestry (MNRF) Natural Resource Values Information System (NRVIS) mapping;
- MNRF Natural Heritage Information Centre (NHIC) Rare Species Records;
- Conservation Ontario 2014 Aquatic Species at Risk Distribution Mapping;
- MNRF Significant Wildlife Technical Guide (MNRF, 2000);
- East Holland River Subwatershed Plan (LSRCA, 2010a);
- West Holland River Subwatershed Plan (LSRCA, 2010b);
- UYSS Environmental Assessment, Natural Environment Baseline Conditions Report (CRA *et al.*., 2013); and
- Digital orthoimagery.

Relevant information about aquatic features was also requested from the LSRCA, the Town of Newmarket and Regional Municipality of York.

2.5.2 Results

Aquatic features identified in the Study Area through the background information review are summarized in the following sections.

2.5.2.1 East Holland River Subwatershed

The majority of the Study Area (92 percent) is located within the East Holland River Subwatershed (**Figure 2-8**). This subwatershed extends from the Oak Ridges Moraine in the south to the Lake Simcoe in the north and covers a drainage area of 268 km^2 (CRA *et al.*, 2013). A large proportion (52.9 percent) of the land use within this subwatershed is agriculture followed by urban land use (23.1 percent), while the remaining area (19.1 percent) consists of natural areas (LSRCA, 2010a). Within the Study Area, the main drainage features are the East Holland River and its tributaries, including Western Creek, Bogart Creek, Weslie Creek, Tannery Creek and Armitage Creek. The East Holland River Subwatershed contains cold to coolwater tributaries that originate on the Oak Ridges Moraine and become warmwater as they flow north through the Study Area towards Lake Simcoe. The majority of the tributaries within the Town of Newmarket are warmwater while the coldwater tributaries are prominent at the periphery of the Town and closer to the headwaters on the Oak Ridges Moraine (**Figure 2-8**).

The LSRCA has an extensive record of fish data collected for the East Holland River Subwatershed. A total of 35 species have been captured within the East Holland River from 1930 to 2007 (LSRCA, 2010a). These are summarized in **Table 2-3**. The fish communities found within the East Holland River Subwatershed represent a mixture of coldwater and warmwater species.

Table 2-3. Fish Species of the East Holland River

Common Name	Scientific Name	Thermal Regime	Provincial/ S Rank	COSEWIC	Tolerance
Black Crappie [a]	*Pomoxis nigromaculatus*	Warm	S4	-	Tolerant
Blackchin Shiner	*Notropis heterodon*	Cool	S4	NAR	Intolerant
Blacknose Dace	*Rhinichthys atratulus*	Cool	S5	-	Tolerant
Blacknose Shiner	*Notropis heterolepis*	Cool	S5	-	Intolerant
Bluegill	*Lepomis macrochirus*	Warm	S5	-	Intermediate
Bluntnose Minnow	*Pimephales notatus*	Warm	S5	-	Intermediate
Bowfin	*Amia calva*	Warm	S4	-	Intermediate
Brassy Minnow	*Hybognathus hankinsonii*	Cool	S5	-	Intermediate
Brook Stickleback	*Culaea inconstans*	Cool	S5	-	Intolerant
Brook Trout	*Salvelinus fontinalis*	Cold	S5	-	Intolerant
Brown Bullhead	*Ameiurus nebulosus*	Warm	S5	-	Intermediate
Central Mudminnow	*Umbra limi*	Cool	S5	-	Tolerant
Common Carp [b]	*Cyprinis carpio*	Warm	-	-	Tolerant
Common Shiner	*Luxilus cornutus*	Cool	S5	-	Intermediate
Creek Chub	*Semotilus atromaculatus*	Cool/Warm	S5	-	Tolerant
Emerald Shiner	*Notropis atherinoides*	Cool	S5	-	Intermediate
Fathead Minnow	*Pimephales promelas*	Warm	S5	-	Tolerant
Golden Shiner	*Notemigonus crysoleucas*	Cool	S5	-	Intermediate
Goldfish [b]	*Carassius auratus*	Warm	-	-	Tolerant
Greenside Darter	*Etheostoma blennioides*	Cool	S4	NAR	Intolerant
Iowa Darter	*Etheostoma exile*	Cool	S5	-	Intermediate
Largemouth Bass	*Micropterus salmoides*	Warm	S5	-	Tolerant
Longnose Dace	*Rhinichthys cataractae*	Cool	S5	-	Intermediate
Mottled Sculpin	*Cottus bairdii*	Cold	S5	-	Intermediate
Northern Pike	*Esox lucius*	Cool	S5	-	Intermediate
Northern Redbelly Dace	*Phoxinus eos*	Cool	S5	-	Intermediate
Pumpkinseed	*Lepomis gibbosus*	Warm	S5	-	Intermediate
Rainbow Darter	*Etheostoma caeruleum*	Cool	S4	-	Intolerant
Redside Dace [c]	*Clinostomus elongatus*	Cool	S2	END	Intolerant
Rock Bass	*Ambloplites rupestris*	Cool	S5	-	Intermediate
Sand Shiner	*Notropis stramineus*	Warm	S4	-	Intermediate
Slimy Sculpin	*Cottus cognatus*	Cold	S5	-	Intolerant
Spottail Shiner	*Notropis hudsonius*	Cool	S5	-	Intermediate

Common Name	Scientific Name	Thermal Regime	Provincial/ S Rank	COSEWIC	Tolerance
Yellow Perch	*Perca flavescens*	Cool	S5	-	Intermediate
White Sucker	*Catostomus commersonii*	Cool	S5	-	Tolerant

Notes:

a. non-native species

b. non-native invasive species

c. endangered species

1. S-rank: ***The Natural Heritage provincial ranking system (provincial S-rank) is used by the MNRF Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. Definitions are as follows:***
S1 ***- Extremely rare in Ontario; usually 5 or fewer occurrences in the province or very few remaining individuals;***
S2 ***- Very rare in Ontario; usually between 5 and 20 occurrences in the province or with many individuals in fewer occurrences;***
S3 ***- Rare to uncommon in Ontario; usually between 20 and 100 occurrences in the province;***
S4 ***- Common and apparently secure in Ontario; usually with more than 100 occurrences in the province.***
S5 ***- Very common and demonstrably secure in Ontario.***
SX ***– Extirpated from Ontario.***
Species at Risk **are those species designated as Threatened and Endangered by the Status of Species at Risk in Ontario (COSSARO) and are protected under the *Endangered Species Act 2007* (ESA).**

COSEWIC – Committee on the Status of Endangered Wildlife in Canada; NAR – not at risk; END - endangered

Reference – East Holland River Subwatershed Report (LSRCA, 2010a); Upper York Sewage Solutions Environmental Assessment, Natural Environment Baseline Conditions Report (CRA et al., 2013).

Redside Dace (*Clinostomus elongatus*), is the only species listed as Endangered or Threatened under the federal *Species at Risk Act* (SARA) and the provincial *Endangered Species Act 2007* (ESA) that has been recorded within the subwatershed. It has last been recorded in 1994 within the coldwater stream of Sharon Creek, which is located outside of the Study Area (CRA *et al.*, 2013). According to the LSRCA 2014 Aquatic Species at Risk mapping (Conservation Ontario, 2014), a section of a coldwater branch of the East Holland River located in the northeast corner of the Study Area is identified as having known distributions of fish species designated by COSEWIC as Extirpated, Endangered and/or Threatened that are under consideration for listing under Schedule 1 of the federal *SARA.* These species and their respective federal and provincial designations are identified in **Table 2-4**. Species listed in Schedule 1 as Extirpated, Endangered or Threatened receive protection under the SARA while species currently under consideration for listing on Schedule 1 do not. However, development within this reach should treat these species as if they are listed in Schedule 1 by the time that the proposed development is initiated (Fisheries and Oceans Canada, 2014).

Table 2-4. Fish Species Under Consideration for Listing on Schedule 1 of SARA

Common Name	Scientific Name	Federal Designation by COSEWIC[1]	Provincial Designation by COSSARO[2]
American Eel	*Anguilla rostrata*	Threatened	Endangered
Lake Sturgeon	*Acipenser fulvescens*	Special Concern	Threatened
Redside Dace	*Clinostomus elongatus*	Endangered	Endangered

Notes:

1. COSEWIC – Committee on the Status of Endangered Wildlife in Canada
2. COSSARO – Committee on the Status of Species at Risk in Ontario

2.5.2.2 West Holland River Subwatershed

The northwest corner of the Study Area is located in the West Holland River Subwatershed (**Figure 2-8**) and contains Ansnorveldt Creek. This subwatershed extends from the Oak Ridges Moraine in the south to Lake Simcoe in the north and covers a drainage area of 348 km^2 (CRA *et al*., 2013). Approximately 8.0 percent of the Study Area is within the West Holland River Subwatershed. Similar to the East Holland River Subwatershed, the headwaters of this subwatershed originate on the Oak Ridges Moraine in the south and flow north to Lake Simcoe. The section of Ansnorveldt Creek within the Study Area is characterized as warmwater and considered to have low to moderate sensitivity (CRA *et al*., 2013). A total of 34 fish species have been recorded by LSRCA within this subwatershed from 1930 to 2008 (LSRCA, 2010b). These are summarized in **Table 2-5** and consist of warm, cool and coldwater species. According to the LSRCA 2014 Aquatic Species at Risk mapping (Conservation Ontario, 2014), the section of Ansnorveldt Creek within the Study Area does not have known distributions of any fish or mussel Species at Risk.

Table 2-5. Fish Species of the West Holland River Watershed

Common Name	Scientific Name	Thermal Regime	Provincial/ S Rank	COSEWIC	Tolerance
Black Crappie [a]	*Pomoxis nigromaculatus*	Warm	S4	-	Tolerant
Blacknose Dace	*Rhinichthys atratulus*	Cool	S5	-	Tolerant
Bluntnose Minnow	*Pimephales notatus*	Warm	S5	-	Intermediate
Bowfin	*Amia calva*	Warm	S4	-	Intermediate
Brassy Minnow	*Hybognathus hankinsonii*	Cool	S5	-	Intermediate
Brook Stickleback	*Culaea inconstans*	Cool	S5	-	Intermediate
Brook Trout	*Salvelinus fontinalis*	Cold	S5	-	Intolerant
Brown Bullhead	*Ameiurus nebulosus*	Warm	S5	-	Intermediate
Central Mudminnow	*Umbra limi*	Cool	S5	-	Tolerant
Common Carp [b]	*Cyprinis carpio*	Warm	-	-	Tolerant
Common Shiner	*Luxilus cornutus*	Cool	S5	-	Intermediate
Creek Chub	*Semotilus atromaculatus*	Cool/Warm	S5	-	Tolerant
Emerald Shiner	*Notropias atherinoides*	Cool	S5	-	Intermediate
Fathead Minnow	*Pimephales promelas*	Warm	S5	-	Tolerant
Golden Shiner	*Notemigonus crysoleucas*	Cool	S5	-	Intermediate
Goldfish [b]	*Carassius auratus*	Warm	-	-	Tolerant
Greenside Darter	*Etheostoma blennioides*	Warm	S4	NAR	Intolerant
Iowa Darter	*Etheostoma exile*	Cool	S5	-	Intermediate
Johnny Darter	*Etheostoma nigrum*	Cool	S5	-	Tolerant
Largemouth Bass	*Micropterus salmoides*	Warm	S5	-	Tolerant
Longnose Dace	*Rhinichthys cataractae*	Cool	S5	-	Intermediate
Mottled Sculpin	*Cottus bairdii*	Cold	S5	-	Intermediate
Northern Pike	*Esox lucius*	Cool	S5	-	Intermediate
Northern Redbelly Dace	*Phoxinus eos*	Cool	S5	-	Intermediate
Pearl Dace	*Margariscus margarita*	Cool	S5	-	Intermediate
Pumpkinseed	*Lepomis gibbosus*	Warm	S5	-	Intermediate
Rainbow Darter	*Etheostoma caeruleum*	Cool	S4	-	Intolerant
Redside Dace [c]	*Clinostomus elongatus*	Cool	S2	END	Intolerant
Rock Bass	*Ambloplites rupestris*	Cool	S5	-	Intermediate
Slimy Sculpin	*Cottus cognatus*	Cold	S5	-	Intolerant
Spottail Shiner	*Notropis hudsonius*	Cool	S5	-	Intermediate
Yellow Bullhead	*Ameiurus natalis*	Warm	S4	-	Tolerant
Yellow Perch	*Perca flavescens*	Cool	S5	-	Intermediate
White Sucker	*Catostomus commersonii*	Cool	S5	-	Tolerant
Notes:					
a. non-native species					
b. non-native invasive species					
c. endangered species					

Common Name	Scientific Name	Thermal Regime	Provincial/ S Rank	COSEWIC	Tolerance
1. S-rank: ***The Natural Heritage provincial ranking system (provincial S-rank) is used by the MNRF Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. Definitions are as follows:*** *S1* ***- Extremely rare in Ontario; usually 5 or fewer occurrences in the province or very few remaining individuals;*** *S2* ***- Very rare in Ontario; usually between 5 and 20 occurrences in the province or with many individuals in fewer occurrences;*** *S3* ***- Rare to uncommon in Ontario; usually between 20 and 100 occurrences in the province;*** *S4* ***- Common and apparently secure in Ontario; usually with more than 100 occurrences in the province.*** *S5* ***- Very common and demonstrably secure in Ontario.*** *SX* ***– Extirpated from Ontario.*** *Species at Risk* **are those species designated as Threatened and Endangered by the Status of Species at Risk in Ontario (COSSARO) and are protected under the** ***Endangered Species Act 2007*** **(ESA).** **COSEWIC – Committee on the Status of Endangered Wildlife in Canada; NAR – not at risk; END - endangered** ***References – East Holland River Subwatershed Report (LSRCA, 2010a); Upper York Sewage Solutions Environmental Assessment, Natural Environment Baseline Conditions Report (CRA et al., 2013).***					

2.5.2.3 Seeps and Springs

Seeps and springs are areas where groundwater comes to the surface. They are often found within headwater areas and coldwater watercourses, which can support sensitive fish species. These features can also be important feeding and drinking areas for wildlife, especially in the winter, and will typically support a variety of plant and animal species (MNR, 2000). Information pertaining to seeps and springs was requested from the LSRCA, York Region and the Town of Newmarket. There are no known seeps and springs within the Study Area, although these are likely to be present in association with the intermittent and coldwater watercourses located in the southern portion of the Town of Newmarket (**Figure 2-8**).

2.5.2.4 LSRCA Regulated Areas

Portions of the Study Area are located within areas regulated by the LSRCA Regulation Limit under the *Conservation Authorities Act* (**Figure 2-8**). Section 2 of Ontario Regulation 179/06 states that development is prohibited in or on areas that are subject to flooding, erosion, unstable stream valleys, or where interference in or within 120 m of Provincially Significant Wetlands (PSWs) and 30 m of all other wetlands, and site alterations to shorelines and watercourses may result in negative impacts on the hydrologic functions of these sensitive features. Any proposed development or site alteration within these Regulated Limit areas would require a permit from the LSRCA.

2.5.3 Restoration Areas

It is LSRCA's objective to improve the aquatic ecosystems within the East Holland River and West Holland River Subwatersheds. Recommended actions to achieve this objective include but are not limited to the following (LSRCA, 2010a and 2010b):

- Work with partners to continue monitoring aquatic communities and habitats in the subwatersheds;
- Work with partner municipalities to improve and restore aquatic ecological functions within the subwatersheds such as fish migration barrier removal, wetland creation, natural channel design and restoring floodplain functions;
- Continue to implement and utilize buffer requirements and timing guidelines; and
- Assess the feasibility of increasing natural cover in the subwatersheds.

Information pertaining to opportunities for restoration areas was requested from the LSRCA, York Region and the Town of Newmarket.

Barriers to fish movement in the forms of perched culverts, dams, weirs and other type of barriers prevent fish from accessing part of their habitats that are critical for carrying out important life functions. According to data received from LSRCA, there are 72 identified opportunities for removal of fish migration barriers along surveyed watercourses in the Town of Newmarket (**Figure 2-8**).

Increases in water flow resulting from bank hardening and channelization of watercourses can degrade aquatic habitat through creation of unstable banks, increased flooding, bank erosion and sedimentation. LSRCA has identified 149 opportunities to improve bank hardening and channelization in the Town of Newmarket (**Figure 2-8**).

2.6 Terrestrial Ecology

2.6.1 Background Information Review

A background information review of terrestrial natural heritage features and functions located within the Study Area was conducted using the following available secondary sources:

- Ontario MNRF NRVIS mapping;
- MNRF NHIC Rare Species Records (2014a);
- York Region Official Plan (2010);
- Town of Newmarket Official Plan (2014);
- Ontario Breeding Bird Atlas (BSC *et al*., 2006);
- Ontario Butterfly Atlas Online (Jones *et al.,* 2012);
- Ontario Reptile and Amphibian Atlas (Ontario Nature, 2012);
- Atlas of Mammals in Ontario (Dobbyn, 1994);
- Significant Wildlife Technical Guide (MNRF, 2000);
- East Holland River Watershed Plan (LSRCA, 2010a); and
- Digital orthoimagery.

Relevant information about terrestrial natural heritage features was also requested from the LSRCA, the Town of Newmarket and Regional Municipality of York.

2.6.2 Results

Terrestrial natural heritage features identified in the Study Area through the background information review are summarized in the following sections.

2.6.2.1 Natural Cores - Key Natural Heritage Features

Vegetation Communities

Ecological Land Classification (ELC) vegetation community delineations for the Study Area were obtained from LSRCA. These ELC community delineations were categorized into the Community Series level (Lee *et al*., 1998). The Community Series are identified based on the type of vegetation cover or plant form present that represents the community (i.e., open, shrub or treed vegetation cover) and is the lowest level in ELC that can be identified without field investigations (Lee *et al*., 1998). The Community Series that occur within the Study Area are summarized in **Table 2-6** below and the locations are shown in **Figure 2-9**.

Table 2-6. Summary of ELC Community Series within the Study Area

ELC Community Series		ELC Code	Area (Hectares)	% of Study Area
Anthropological Areas	n/a	n/a	**3265.10**	**85.49**
Cultural Communities	Cultural Meadow	CUM	150.75	3.95
	Cultural Plantation	CUP	0.22	0.01
	Cultural Thicket	CUT	9.46	0.25
	Cultural Woodland	CUW	64.14	1.68
Total for Cultural Communities :			**224.57**	**5.88**
Forest Communities	Coniferous Forest	FOC	17.18	0.45
	Deciduous Forest	FOD	142.15	3.72
	Mixed Forest	FOM	90.00	2.36
Total for Forest Communities:			**249.33**	**6.53**
Aquatic and Wetland Communities	Meadow Marsh	MAM	15.38	0.40
	Shallow Marsh	MAS	4.14	0.11
	Open Aquatic	OAO	13.00	0.34
	Submerged Shallow Aquatic	SAS	1.75	0.05
	Coniferous Swamp	SWC	19.66	0.51
	Deciduous Swamp	SWD	12.47	0.33
	Mixed Swamp	SWM	6.22	0.16
	Thicket Swamp	SWT	7.59	0.20
Total for Aquatic and Wetland Communities:			**80.21**	**2.10**
Total:			**3819.21**	**100.00**

The majority (85 percent) of the Study Area is dominated by anthropological land use areas such as residential, commercial, institutional, agriculture and industrial areas that are of low ecological significance. A variety of different vegetation communities are present outside of the anthropological areas, with the majority concentrated along the stream corridors, including wetlands, cultural meadows and various forest types.
Forest communities comprise approximately 7 percent of the Study Area, of which deciduous forest is the most dominant. Interior forest habitat is an important wildlife habitat feature which may support woodland area-sensitive species that are less tolerant of anthropogenic disturbance and require large interior habitats (LSRCA, 2010a).

Cultural communities, which include cultural meadows, woodlands and plantations, represent approximately 6 percent of the Study Area. Most of the cultural meadows within the East Holland River Subwatershed are dominated by non-native cool season grasses as well as native and non-native forbs and shrubs (LSRCA, 2010a). Despite the high degree of non-native plants, these meadows may provide suitable habitat for a variety of native plants and wildlife, including rare species.

The remaining 2 percent consists of wetland communities and include portions of the Provincially Significant Aurora Marsh Wetland Complex and Ansnorveldt Wetland Complex, as well as the Locally Significant Newmarket Wetland. These wetlands are described in further detail below.

Significant Wetlands

Wetlands are described as lands that are seasonally or permanently flooded by shallow water as well as lands where the water table is close to the surface and an abundance of water that has caused the formation of hydric soil, which supports primarily hydrophytic or water tolerant plants (MNR, 2013). The MNRF evaluates the significance of wetlands through the Ontario Wetland Evaluation System (OWES). This evaluation system uses a scoring system to assign values to four principal components of the wetland, which are the biological, social, hydrological, and special features. Based on the resulting score of an evaluation, a wetland can fall into one of two classes: Provincially Significant or Locally Significant (MNRF, 2013).

Within the Study Area, there are two Provincially Significant Wetlands and one Locally Significant Wetland. These are summarized in **Table 2-7** below and mapped on **Figure 2-10**. Wetland descriptions were obtained from the *Upper York Sewage Solutions Environmental Assessment, Natural Environment Baseline Conditions Report* (CRA *et al*., 2013).

Table 2-7. Significant Wetlands within the Study Area

Wetland Name	Significance	Wetland Description
Ansnorveldt Wetland Complex	Provincial	This provincially significant Ansnorveldt Wetland Complex is located in King Township on the edge of the Holland Marsh, with some wetland units extending onto the lower slopes of the Oak Ridges Moraine within the Study Area. The wetland complex extends from Weston Road east to Dufferin Street and from Highway 9 north to South Canal Road. All surveyed wetland units are located along six tributary streams in the West Holland River Subwatershed and are hydrologically connected along a discharge zone at or near the base of the Oak Ridges Moraine.
Aurora (McKenzie) Marsh Wetland Complex	Provincial	A provincially significant wetland complex, consisting of two individual wetlands, composed of two wetland types including swamp, and marsh. This wetland complex is located along the southern boundary of the Study Area and is associated with tributaries of the East Holland River.
Newmarket Wetland	Local	This locally significant wetland is situated in downtown Newmarket, bordered by Prospect Street, Sprigley Street, Queen Street and Stickwood Court. This wetland is less than 2 ha in size, however it was evaluated due to it being one of the few wetlands within the Town of Newmarket and on the Schomberg Clay Plain. The wetland is 0.75 ha in size and is located on the floodplain of Bogart Creek, a tributary of the East Holland River. A smaller tributary enters the Newmarket Wetland from the south and the wetland is in turn connected to the adjacent Bogart Creek via two channels.

Areas of Natural and Scientific Interest

An Area of Natural and Scientific Interest (ANSI) is defined as an area of land and/or water containing natural landscapes or features that have been scientifically identified (by the MNRF) as having life science or earth science values related to protection, scientific study or education (MNRF, 2014b). ANSIs are designated as earth science (geological) or life science (biological) depending on the features present. There is one earth science and one life science ANSI identified within the Study Area (**Figure 2-10**). **Table 2-8** provides a summary of these ANSIs and descriptions of their significance. ANSI descriptions were obtained from the *Upper York Sewage Solutions Environmental Assessment, Natural Environment Baseline Conditions Report* (CRA *et al*., 2013).

Table 2-8. ANSIs within the Study Area

ANSI Name	Area Type	Significance	ANSI Description
Glenville Hills	*Earth Science*	Provincial Candidate	This feature is approximately 524.3 ha in size and contains Late Wisconsinan, Port Bruce Stadial Newmarket Till and Port Huron Stadial Kettleby Till, kames, kame slopes and some minor Schomberg Ponds sediments. The Lake Ontario ice lobe deposited most of the Oak Ridges Moraine sediments found in this area. This is an excellent site for kame development on the north flank of the Oak Ridges Moraine. The northern part of the site is covered by the Kettleby Till and marks the southernmost advance of Lake Simcoe sublobe during Port Bruce Stadial.
Glenville Hills Kames	*Life Science*	Provincial Candidate	This ANSI is 86.4 ha in size and is part of the Glenville Hills Earth Science ANSI (LSRCA, 2010a).

Environmentally Significant Areas

An Environmentally Sensitive Area is a natural area identified by a municipality or Conservation Authority as fulfilling certain criteria for ecological significance or sensitivity. There are no environmentally sensitive areas identified within the Study Area.

Significant Woodlands

Woodlands are an important key natural heritage feature in the Town of Newmarket and also in the Regional Municipality of York. Woodlands provide critical ecological services and benefits including habitat for a diversity of plants and wildlife (including provincially rare plants and Species at Risk), soil erosion prevention, water retention, purification of air and water, recreation and sustainable harvest of woodland products. According to Section 2.2.45 of the York Region Official Plan (2010), a woodland is considered significant if it meets at least one of the following criteria:

1. *It is at least 0.5 ha and supports any of the following:*
    a. *Any provincially significant species or vegetation community as designated by NHIC; or,*
    b. *Any Species at Risk designated as threatened or endangered by COSEWIC or COSSARO; or,*
2. *It is within 30 m of a provincially significant wetland, water body, permanent stream or intermittent stream.*
3. *It is at least 2 ha and:*
    a. *It is within 100 m of another significant feature (ANSI, Provincially Significant Wetland or locally significant wetland, significant valleyland, ESAs or fish habitat); or,*
    b. *Occurs within the Regional Greenlands System.*
4. *It is located south of the Oak Ridges Moraine (ORM) that is greater than or equal to 4 ha in size.*
5. *It is located north of the Oak Ridges moraine that is greater than or equal to 10 ha in size.*
6. *Any woodland that occurs on lands designated as part of the ORM, the Greenbelt Natural Heritage System and/or the Lake Simcoe Watershed that will be evaluated for significant based on the requirement of each respective Plan and its associated guidelines.*

Generally, the Town of Newmarket contains low forest cover (approximately 9 percent) as a result of its highly urbanized landscape (Town of Newmarket, 2014). According to the *York Regional Significant Woodland Study* (North-South Environmental Inc., 2005), the Town of Newmarket contains 8.7 percent of the woodlands considered as significant within the York Region. Significant forests within the Town of Newmarket are mapped in **Figure 2-10**. These forests are generally associated with watercourses and wetlands within the Study Area, and some fall within the Oak Ridges Moraine Boundary and the Greenbelt – Protected Countryside boundary.

Conservation Areas

Four conservation areas owned by the LSRCA occur within the Study Area (**Figure 2-10**). These include the following:

- **Mabel Davis Conservation Area –** This include a 7 ha strip of land in the middle of the Town of Newmarket which provides habitat for a variety of plants and animals (LSRCA, 2014).
- **Wesley Brooks Conservation Area** – This is a 13.4 ha area that includes a heavily wooded island and several marshy areas that are excellent nesting and feeding grounds for local waterfowl (LSRCA, 2014).
- **Queen Street Conservation Area –** There is no information currently available on this Conservation Area.
- **Bailey Ecological Park** – this is considered as a valuable bird and animal sanctuary (LSRCA, 2014).

Significant Valleylands

A valleyland is a natural landform depression that is typically associated with a river or stream. Generally, the East Holland River Subwatershed does not contain significant valleylands (LSRCA, 2010a).

Significant Wildlife Habitat

Significant Wildlife Habitat (SWH) is an area that is considered to be an important habitat for a particular species or concentration of species (LSRCA, 2010a). The MNRF identifies four principal types of SWH in the *Significant Wildlife Habitat Technical Guide* (MNR, 2000). These are habitats for seasonal concentration of animals, rare vegetation communities, habitats of species of conservation concern and wildlife movement corridors. Within the Study Area, there are no deer wintering yards, which is a type of a seasonal concentration habitat, and there are no known rare vegetation communities. According to the East Holland Subwatershed Plan (LSRCA, 2010a), there is only one rare vegetation community within the subwatershed and it includes a fen located within the Provincially Significant Holland Marsh Wetland, which is located north of the Study Area. There may be habitat of species of conservation concern where provincially significant species (i.e., those ranked as S1, S2 or S3) and species designated as Special Concern by COSSARO occur within the Study Area. There are also natural corridors that promote wildlife movement identified within the Study Area; these are further discussed in **Section 2.6.2.3**.

Although the majority of the Study Area is heavily developed and urbanized, remaining wetland, woodland and cultural meadow features still provide habitat for a diversity of wildlife species. A review of several wildlife atlases resulted in a total of 193 recorded wildlife species within the Study Area, including birds, amphibians, reptiles, mammals and butterflies. **Table 2-9** provides a summary of these results and identifies any provincially significant species and Specie at Risk. It is important to note that some of these records are more than 20 years old and are therefore considered to be historical. Some of these may no longer persist within the Study Area.

Table 2-9. Summary of Recorded Wildlife within the Study Area

Type of Wildlife	Number of Recorded Species	Provincially Significant (S1, S2, S3 & Special Concern)[1]	Species At Risk (Threatened and Endangered)[2]	Atlas Source
Birds	103 (of which 56 are confirmed breeders)	2 Special Concern Species: **Eastern Wood Pewee** (*Contopus virens*) **Wood Thrush** (*Hylocichla mustelina*)	4 Threatened Species: **Bank Swallow** (*Riparia riparia*) **Barn Swallow** (*Hirundo rustica*) **Bobolink** (*Dolichonyx oryzivorus*) **Chimney Swift** (*Chaetura pelagica*)	Atlas of the Breeding Birds of Ontario; 10 x10 km Square No. 17PJ27 (BSC *et al.*, 2006).
Amphibians	Toads and Frogs: 8 Salamanders: 6	None	1 Endangered Species: **Jefferson Salamander** (*Ambystoma jeffersonianum*)	Ontario Reptile and Amphibian Atlas (Ontario Nature, 2013).
Reptiles	Turtles: 3 Snakes: 5	2 Special Concern Species: **Eastern Milksnake** (*Lampropeltis triangulum*) **Snapping Turtle** (*Chelydra serpentine*)	1 Threatened Species: **Blanding's Turtle** (*Emydoidea blandingii*)	Ontario Reptile and Amphibian Atlas (Ontario Nature, 2013).
Mammals	31	None	1 Endangered Species: **Little Brown Bat** (*Myotis lucifugus*)	Atlas of the Mammals of Ontario (Dobbyn, 1994).
Butterflies	37	1 Special Concern Species: **Monarch** (*Danaus plexippus*)	None	Ontario Butterfly Atlas Online; 10 x10 km Square No. 17PJ27 (Jones et al., 2012).
Odonates	Unknown	Unknown	Unknown	Online Odonate Atlas unavailable at time of preparation of this report.

[1]**S-rank:** *The Natural Heritage provincial ranking system (provincial S-rank) is used by the MNRF Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. Definitions are as follows:*
S1 *- Extremely rare in Ontario; usually 5 or fewer occurrences in the province or very few remaining individuals;*
S2 *- Very rare in Ontario; usually between 5 and 20 occurrences in the province or with many individuals in fewer occurrences;*
S3 *- Rare to uncommon in Ontario; usually between 20 and 100 occurrences in the province;*

S4 *- Common and apparently secure in Ontario; usually with more than 100 occurrences in the province.*
S5 *- Very common and demonstrably secure in Ontario.*
SX *– Extirpated from Ontario.*
[2]***Species at Risk*** are those species designated as Threatened and Endangered by the Status of Species at Risk in Ontario (COSSARO) and are protected under the *Endangered Species Act 2007* (ESA).

Forest interior habitats can provide specialized habitat for wildlife that require deeper forests and are not tolerant to edge effects. Forest interior habitats are defined as the part of a wooded area that is greater than 100 m from the perimeter of the woodland. Forested areas within the first 100 m from the wooded edge are considered to be "edge" habitats which are more subject to predators, parasites, high winds, and have higher susceptibility to human interference and introduction of invasive species (LSRCA, 2010a). Within the Study Area, the majority of the fragmented woodland patches have little to no forest interior habitats and are primarily composed of edge habitats. Higher quality forest interior habitat is found at the edge of the Study Area within the Glenville Hills Kames Earth Science ANSI and also within the woodland adjacent to the Provincially Significant Ansnorveldt Wetland Complex (**Figure 2-11**).

Provincially Rare Species and Species at Risk

Species at Risk include species listed as Special Concern, Threatened or Endangered in Ontario by COSSARO. Provincially rare species include species with designations by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), as well as Provincially Ranked S1 (extremely rare in Ontario), S2 (very rare in Ontario), or S3 (rare to uncommon in Ontario) species.

The MNRF's NHIC rare species records (2014a) were searched for 1 km^2 squares that intersect with the Study Area. The search resulted in nine provincially rare species or Species at Risk, including three Threatened and two Special Concern species (**Table 2-10**). The majority of the records are greater than 20 years old and are considered to be historical. Some of these may no longer persist in the Study Area with the exception of Bobolink (*Dolichonyx oryzivorus*), Eastern Meadowlark (*Sturnella magna*) and Snapping Turtle (*Chelydra serpentina*).

Table 2-10. NHIC Rare Species Records for the Study Area

Taxon	Scientific Name	Common Name	S-Rank[1]	COSEWIC Status	COSSARO Status	Year Last Observed
Bird	Bobolink	*Dolichonyx oryzivorus*	S4B	Threatened	Threatened	2003
	Eastern Meadowlark	*Sturnella magna*	S4B	Threatened	Threatened	2004
Insect	Azure Bluet	*Enallagma aspersum*	S3	-	-	1954
Mollusk	Tapered Vertigo	*Vertigo elatior*	S2S3	-	-	1939
Plant	Schweinitz's Sedge	*Carex schweinitzii*	S3	-	-	1981
	Weak Blue Grass	*Poa languida*	S3	-	-	1980
Reptile	Blanding's Turtle	*Emydoidea blandingii*	S3	Threatened	Threatened	1983
	Milksnake	*Lampropeltis triangulum*	S3	Special Concern	Special Concern	1979
	Snapping Turtle	*Chelydra serpentina*	S3	Special Concern	Special Concern	2010

[1]***S-rank:*** *The Natural Heritage provincial ranking system (provincial S-rank) is used by the MNRF Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. Definitions are as follows:*
S1 *- Extremely rare in Ontario; usually 5 or fewer occurrences in the province or very few remaining individuals;*
S2 *- Very rare in Ontario; usually between 5 and 20 occurrences in the province or with many individuals in fewer occurrences;*
S3 *- Rare to uncommon in Ontario; usually between 20 and 100 occurrences in the province;*
S4 *- Common and apparently secure in Ontario; usually with more than 100 occurrences in the province.*
S5 *- Very common and demonstrably secure in Ontario.*
SX *– Extirpated from Ontario.*

Additionally, the LSRCA has records of the following three Endangered species within the East Holland River Subwatershed: Eastern Prairie Fringed Orchid (*Platanthera leucophaea*), King Rail (*Rallus elegans*) and Redside Dace (*Clinostomus elongatus*) (LSRCA, 2010a). However, the Eastern Prairie Fringed Orchid and the King Rail have been recorded well north of the Study Area.

2.6.2.2 Natural Corridors – Animal Movement Corridors

Natural corridors connect natural areas and habitats at a larger landscape scale and facilitate the movement of wildlife to find resources they need to survive from one habitat to another. These are important as they promote genetic diversity in species populations, and allow for seasonal migration and dispersal of animals (MNRF, 2000). Human development often fragments connecting habitats, which may obstruct species movement and change ecological processes.

There are relatively few natural corridors within the Study Area, and most are surrounded by residential, industrial and commercial areas. All of these are considered to be of lower habitat quality that follow riparian habitat but still provide some wildlife corridor functions. Natural corridors occur along sections of the East Holland River and its tributaries, Bogart Creek, Weslie Creek, Ansnorveldt Creek, Tannery Creek and Armitage Creek (**Figure 2-11**). The strongest connectivity occurs at the northwest and southwest corners of the study area with adjacent areas to the west.

2.6.2.3 Natural Vegetation Protection Zones

The entire Study Area falls within the boundaries of the 2009 LSPP Watershed Boundary. Additionally, portions of the Study Area fall within the boundaries of the *Greenbelt Plan 2005* and the *Oak Ridges Moraine Conservation Plan 2002* (*ORMCP*). These areas are mapped on **Figure 2-10** and include portions of the Provincially Significant Ansnorveldt Wetland Complex and the surrounding significant woodland, which are part of the Protected Countryside of the *Greenbelt Plan 2005*, and the significant woodlands located along Bathurst Street in the Town of Newmarket that fall within the boundary of the *ORMCP*.

Sections 2.2.15, 2.2.16 and 2.2.18 of the *York Region Official Plan* (2010), require that a minimum vegetation protection zone (i.e. buffer) of 30 m shall be applied to the key natural heritage and hydrological features that fall within the boundaries of each respective planning document as summarized in **Table 2-11** below.

Table 2-11. Key Natural Heritage and Hydrological Features that Receive Vegetation Protection Zones

Plan	ORMCP	LSPP	Greenbelt Plan 2005
Section of the York Region Official Plan (2010)	2.2.15	2.2.16	2.2.18
Features	• Wetlands; • Significant woodlands; • Significant valleylands; • Seepage areas and springs; • Fish habitat; • Permanent streams; • Intermittent streams; • Sand Barrens; • Savannahs; • Tallgrass prairies; and, • Kettle Lakes.	• Wetlands; • Significant woodlands; • Permanent streams; • Intermittent streams; • Lakes other than Lake Simcoe; and, • Natural areas abutting Lake Simcoe	• Wetlands; • Significant woodlands; • Seepage areas and springs; • Fish habitat; • Permanent streams; • Intermittent streams; and, • Lakes.

Development or site alteration is not permitted in these key natural heritage features and their associated vegetation protection zones on the Oak Ridges Moraine, in the Lake Simcoe Watershed, or in the Greenbelt.

Additionally, the following minimum natural vegetative buffers are required from any proposed development as specified under Sections 9.2 and 9.3 of the *Town of Newmarket Official Plan* (2014) from the following features:

- 15 m on either side of a warm water stream;
- 30 m on either side of a cold water stream;
- 10 m from all woodlands, including a 3 m wide vegetated strip measured from the tree dripline and 7 m setback to the nearest proposed development; and
- 15 m from all wetlands.

2.6.2.4 Restoration Areas

It is LSRCA's objective to improve the terrestrial natural heritage system within the East Holland River and West Holland River Subwatersheds. Recommended actions to achieve this objective include but are not limited to the following (LSRCA, 2010a and 2010b):

- Assessing the feasibility of increasing natural cover in the subwatershed;
- Identify opportunities for land securement of priority sites;
- Work with partner municipalities to enhance existing woodland areas; and
- Encourage partner municipalities to identify opportunities for restoration works on development sites.

Information pertaining to opportunities for restoration areas was requested from the LSRCA, York Region and the Town of Newmarket.
According to the LSRCA, there are 144 identified opportunities to restore insufficient riparian vegetative buffers along surveyed watercourses in the Town of Newmarket (**Figure 2-11**). Restoration of riparian vegetative buffers would increase vegetation cover and habitat connectivity within the West and East Holland Subwatersheds, provide habitat for wildlife species, increase erosion prevention, enhance water quality and improve aquatic habitat.

2.7 Water Quality

A background information review of water quality and hydrological features and functions located within the Study Area was conducted using the following available secondary sources:

- East Holland River Subwatershed Plan (LSRCA, 2010a);
- West Holland River Subwatershed Plan (LSRCA, 2010b);
- UYSS Environmental Assessment, Natural Environment Baseline Conditions Report (CRA *et al.*., 2013); and
- LSRCA Lake Simcoe Watershed Report Card, 2013 (LSRCA, 2013).

The East Holland River Subwatershed Plan presents a summary of water quality data based on the MOE Provincial Water Quality Objectives (PWQOs), which are numerical and narrative ambient surface water quality criteria that the MOE strives to maintain in surface waters. The PWQOs are intended to protect all forms of aquatic life and all aspects of the aquatic life cycle during indefinite exposure to surface water. For the East Holland River Subwatershed, the monitoring data collected between 2002 to 2008 shows that median concentrations of Phosphorus, Total Suspended Solids (TSS) iron, aluminum, and zinc are above the objectives at numerous locations. The Phosphorus data shows a decreasing trend through the period of record, however current concentrations are still impairing water quality.

The West Holland River Subwatershed Plan also presents a summary of water quality data based on the MOE PWQOs. It notes that based on the water quality data collected between 2002 and 2008 indicates that Phosphorus is the main parameter impacting water quality in the West Holland River, with median concentrations exceeding the PWQO guidelines. The monitoring data shows that despite the phosphorus levels exceeded the PWQO guidelines, historical data shows there is a general decreasing trend in phosphorus concentrations since levels were recorded in the 1970s. Chloride and nitrate were also identified as exceeding the PWQOs to a lesser extent along with TSS and iron.

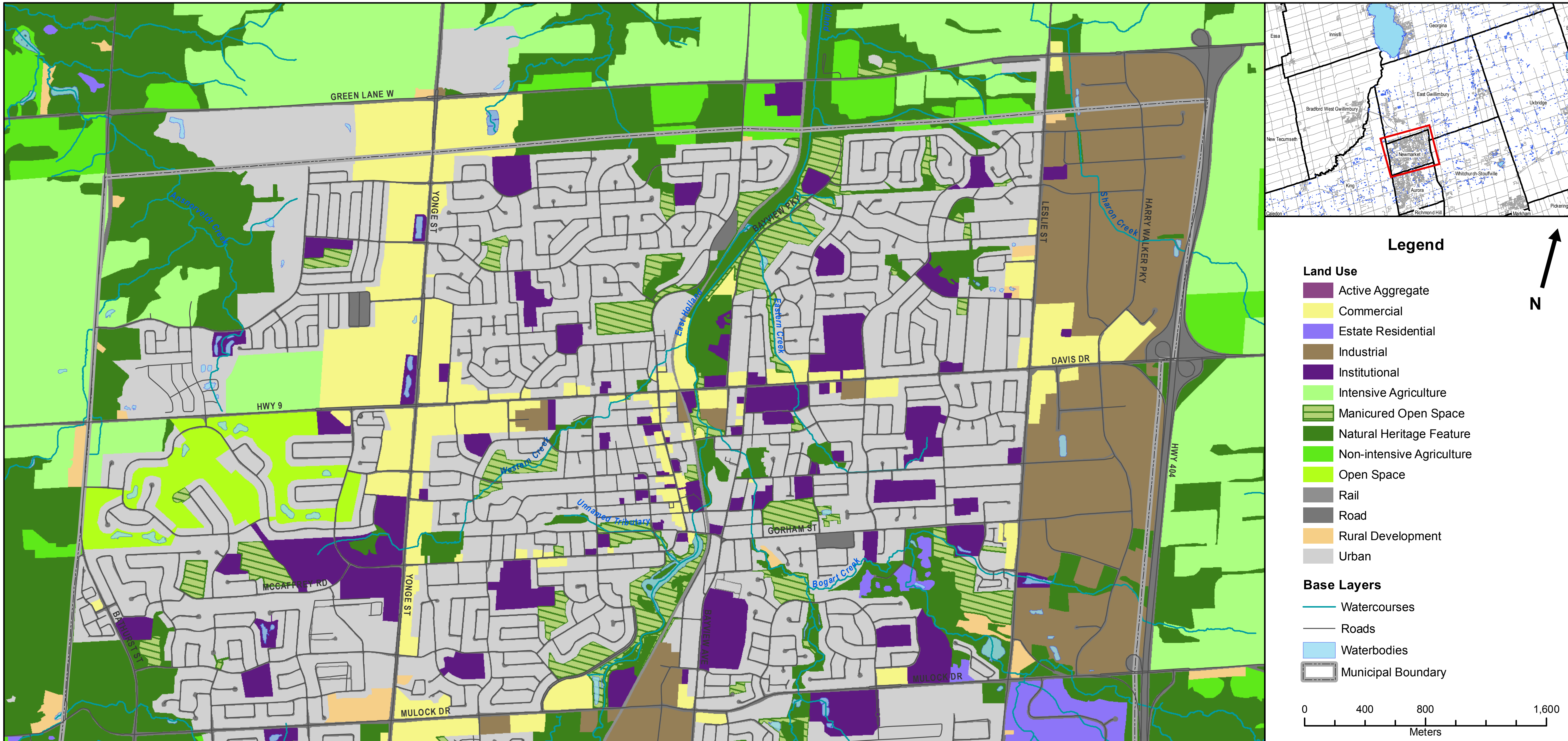
The UYSS report presents a summary of extensive water quality data obtained from the MOE's Provincial Water Quality monitoring Network, and LSRCA. Data from various monitoring stations were analyzed. Values were compared to the PWQOs:

- Water temperatures vary seasonally, with summer month averages ranging from 20.5 °C to 21.8 °C, and daily maximum temperatures ranging from 24.5 °C to 29.6 °C.
- Field pH data generally fell within the PWQO recommended range of 6.5 to 8.5, with only one single data point exceeding pH 8.5.
- The PWQO for Dissolved Oxygen (DO) concentration is based on the oxygen needed to sustain aquatic life relative to oxygen saturation concentrations. The long-term DO concentrations have exceeded 6 mg/L for all records with the exception of a single data point. The PWQO minimum DO concentration varies based on water temperature, but generally falls between 4 mg/L and 8 mg/L.
- The PWQOs state that current scientific evidence is insufficient to develop a firm TP objective at this time, however, TP concentrations in rivers and streams should not exceed 0.03 mg/L to prevent excessive plant growth. Total Phosphorus (TP) data ranged from approximately 0.1 mg/L to 0.2 mg/L. Maximum monthly average concentrations were observed in the summer months. The monthly average TP concentrations of 0.08 mg/L to 0.19 mg/L in the East Holland River consistently exceed the PWQO of 0.03 mg/L.
- There is no PWQO for nitrate/nitrite, however interim Canadian water quality guidelines have been developed at 13 mg/L for the nitrite ion in freshwater and marine system, and 16 mg/L as nitrate. Concentrations in the East Holland River ranged from 0.64 mg/L to 0.75 mg/L, and are well within the guidelines.
- There are no PWQOs for Total Dissolved Solids (TDS), although generally water is considered unfit for human consumption when TDS levels exceed 1,000 mg/L. The limited TDS data available from the monitoring stations indicate that TDS concentrations were generally in the range of 300 to 600 mg/L, with an average TDS concentration in the East Holland River of 460 mg/L.

The LSRCA 2013 Report Card gives an overall grade of D, or Poor, to the East Holland River and C, or Fair, to the West Holland River subwatersheds. The gradings are based on concentration of Phosphorus and benthic invertebrate communities. The grades indicate that these are more heavily impacted by human activity, such as the East Holland and Maskinonge Rivers. The land uses contribute phosphorus to watercourses and can cause changes to stream habitat that negatively affect the benthic invertebrate community.

2.8 Water Quantity

The *Hydrology Report for the West Holland River, East Holland River and Maskinonge River Watersheds (*Cumming Cockburn Ltd., 2005) included hydrologic modeling for each of the three watersheds. Key flow points were created throughout each watershed for pre and post development conditions. Current peak flow conditions for points found within and directly outside of the Town of Newmarket are listed in **Table 4-3**. Further information about the study and results can be found in **Section 4.2.2**.



Town of Newmarket Stormwater Master Plan

Existing Land Use in Study Area

October 2016	1:25,000	Datum: NAD 83 Zone 17 Source: Natural Environment Baseline Conditions Report - Upper York Sewage Solutions EA, Town of Newmarket, York Region
P#: 60330930	V#: 002	

AECOM

Figure 2-1

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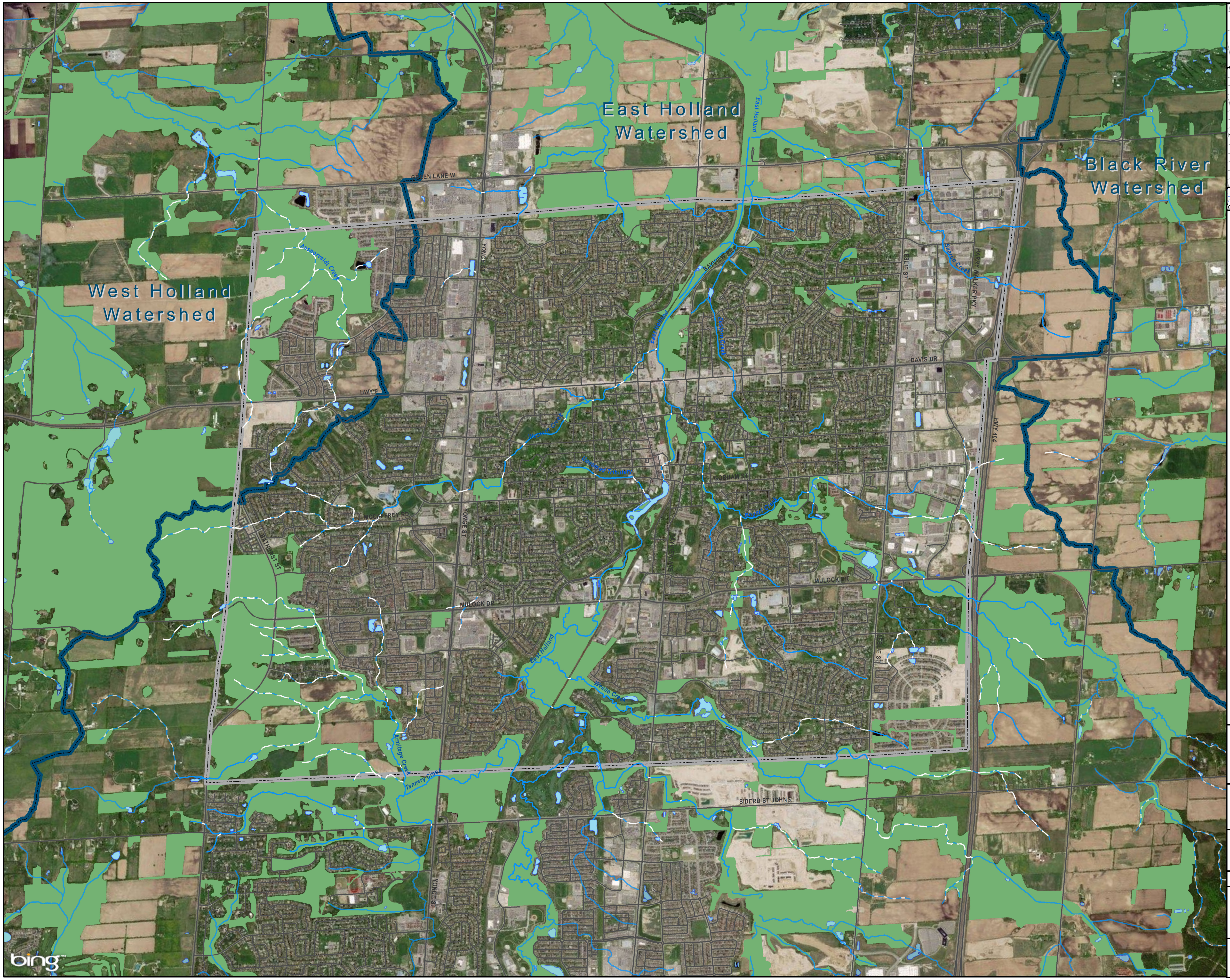

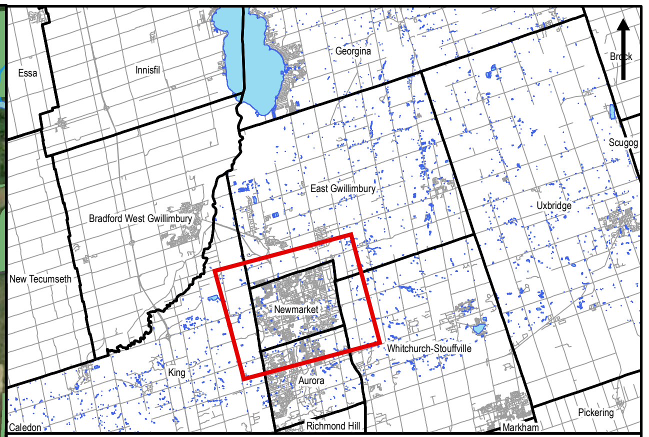

N

Legend

Watercourse Regime
- Permanent
- Intermittent
- Subwatersheds

Base Layers
- Roads
- Waterbodies
- Town of Newmarket Significant Forests
- Municipal Boundary

0 400 800 1,600
Meters

Town of Newmarket Stormwater Master Plan

Regional Hydrology

June 2017	1:35,000	Datum: NAD 83 Zone 17 Source: Town of Newmarket, York Region
P#: 60330930	V#: 002	
AECOM		**Figure 2-2**

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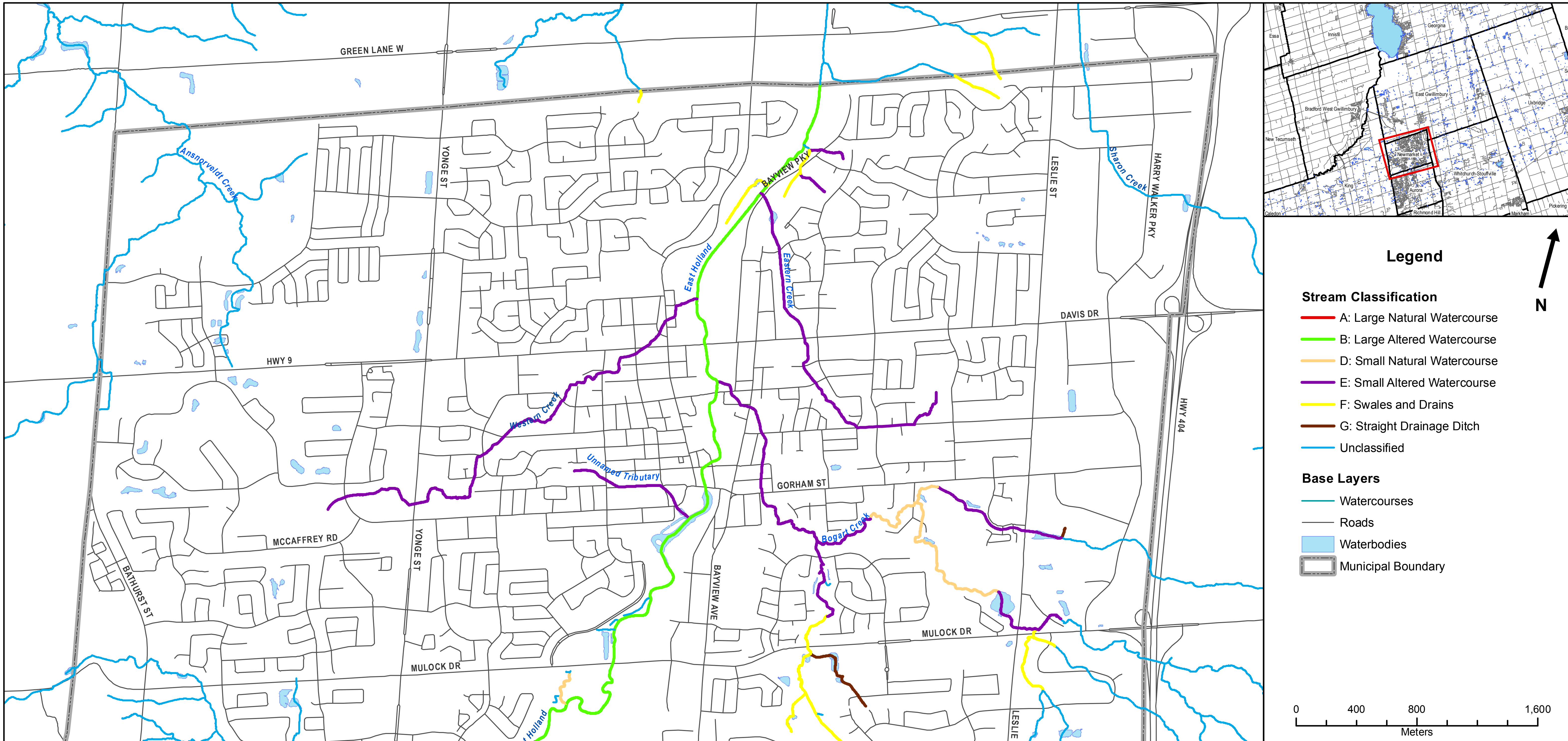

Comprehensive SWM Plan
Town of Newmarket

Stream Classification

July 2016	1:25,000	Datum: NAD 83 Zone 17 Source: Natural Environment Baseline Conditions Report - Upper York Sewage Solutions EA, York Region
P#: 60330930	V#: 001	

AECOM

Figure 2-3

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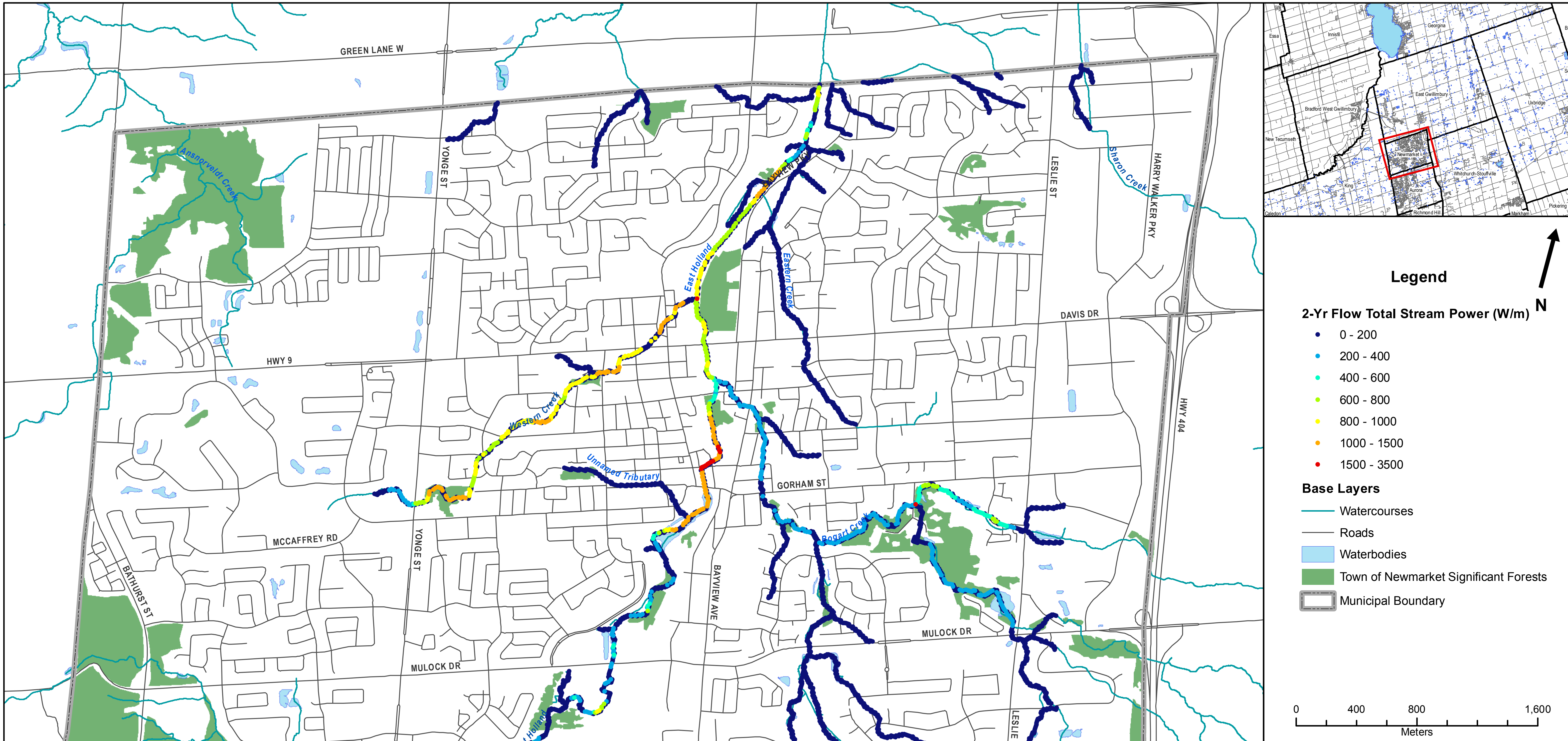


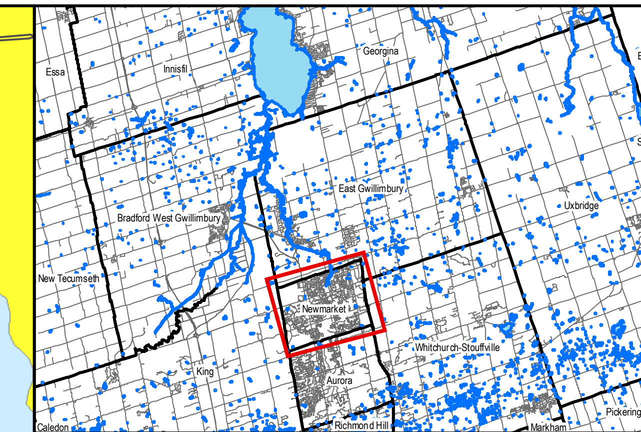
Comprehensive SWM Plan
Town of Newmarket

Total Stream Power (W/m)

July 2016	1:25,000	Datum: NAD 83 Zone 17 Source: Natural Environment Baseline Conditions Report - Upper York Sewage Solutions EA, York Region
P#: 60330930	V#: 001	

AECOM

Figure 2-4



N

Legend

Surficial Geology

- Fluvial Deposits (Sand & Gravel)
- Organic Deposits (Peat, Muck & Marl)
- Glacial Deposits (Stone-poor)
- Till (Clay to Silt-textured)
- Moraine Deposits (Sand & Gravel)
- Glaciofluvial Deposits (Sand & Grave)
- Glaciolacustrine Deposits (Silt and Clay)
- Glaciolacustrine Deposits (Sand, Minor Silt)
- Significant Groundwater Recharge Areas

Base Layers

- Watercourses
- Roads
- Waterbodies
- Municipal Boundary

0 400 800 1,600
Meters

Town of Newmarket Stormwater Master Plan

Surficial Geology

November 2016	1:25,000	Datum: NAD 83 Zone 17 Source: LIO, Ontario Geological Survey 2010. Surficial geology of Southern Ontario, Town of Newmarket, York Region
P#: 60330930	V#: 01	

AECOM

Figure 2-5

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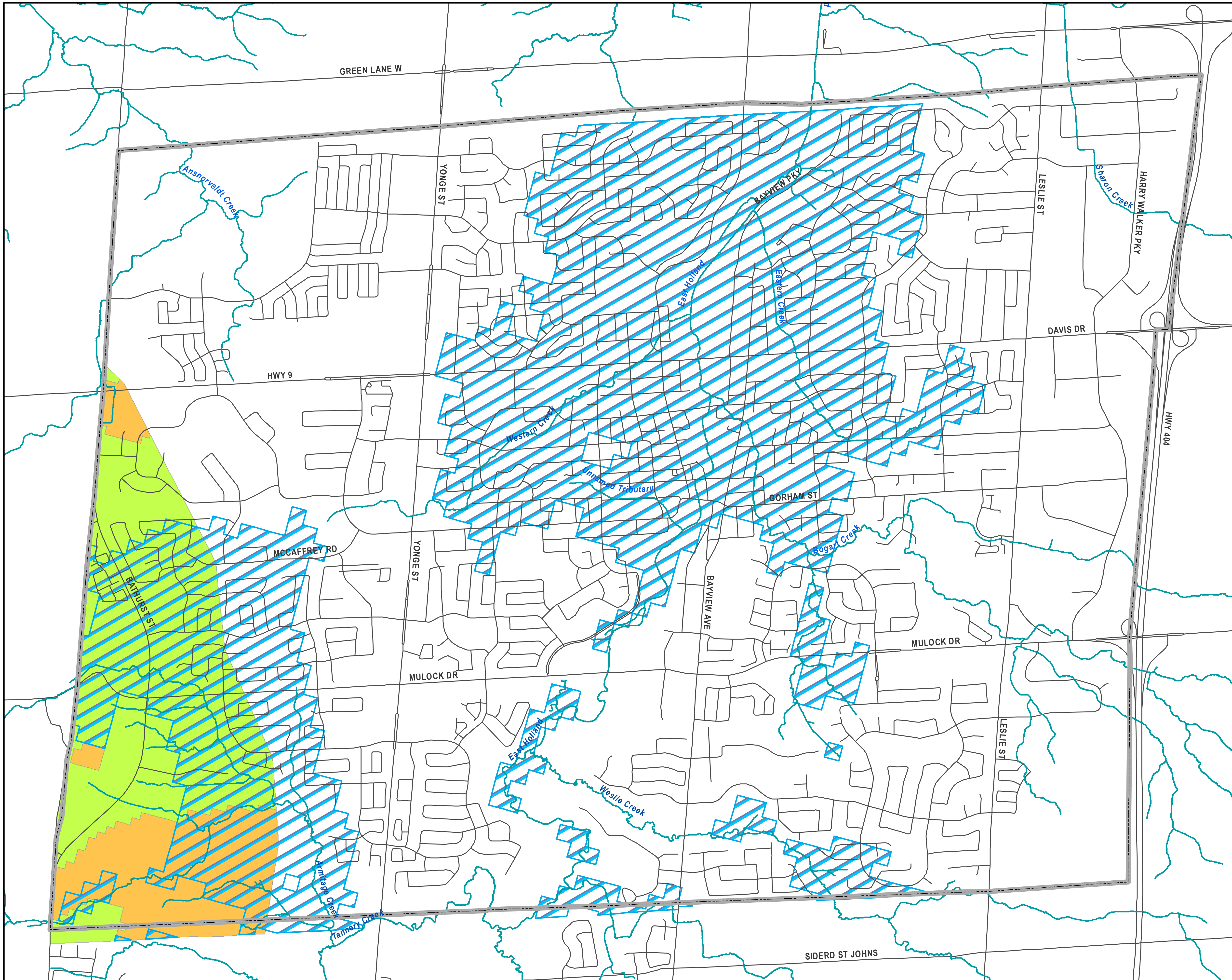

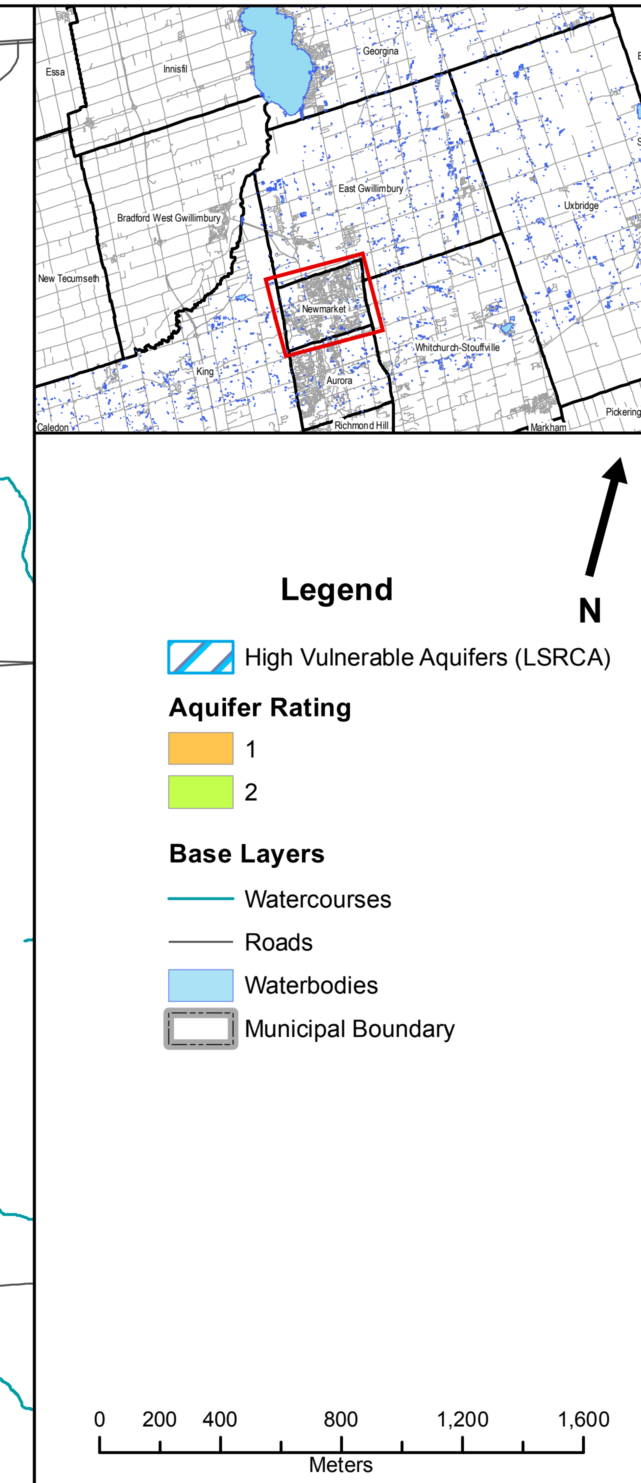

Town of Newmarket Stormwater Master Plan

High Vulnerable Aquifers

November 2016	1:25,000	Datum: NAD 83 Zone 17 Source: LSRCA, Town of Newmarket, York Region
P#: 60330930	V#: 01	

AECOM

Figure 2-6

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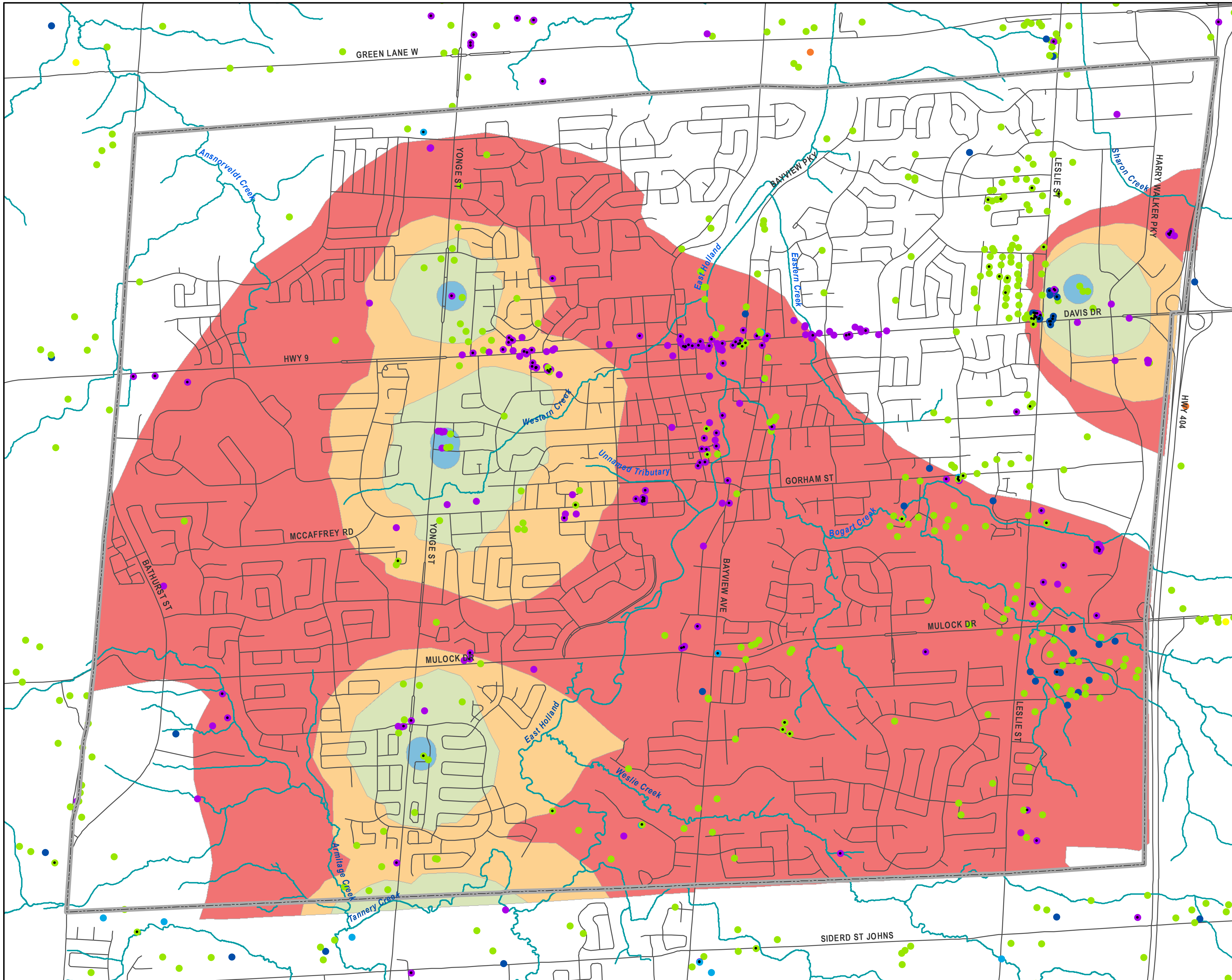

Town of Newmarket Stormwater Master Plan

MOE Water Wells

November 2016	1:25,000	Datum: NAD 83 Zone 17 Source: Town of Newmarket Official Plan 2006-2026, MOE, York Region
P#: 60330930	V#: 002	

AECOM

Figure 2-7

Map location: P:\60330930 Comp SWM Nwmkt\900-Work\920-929 (GIS-Graphics)\Design\Water_Wells_20160413.mxd
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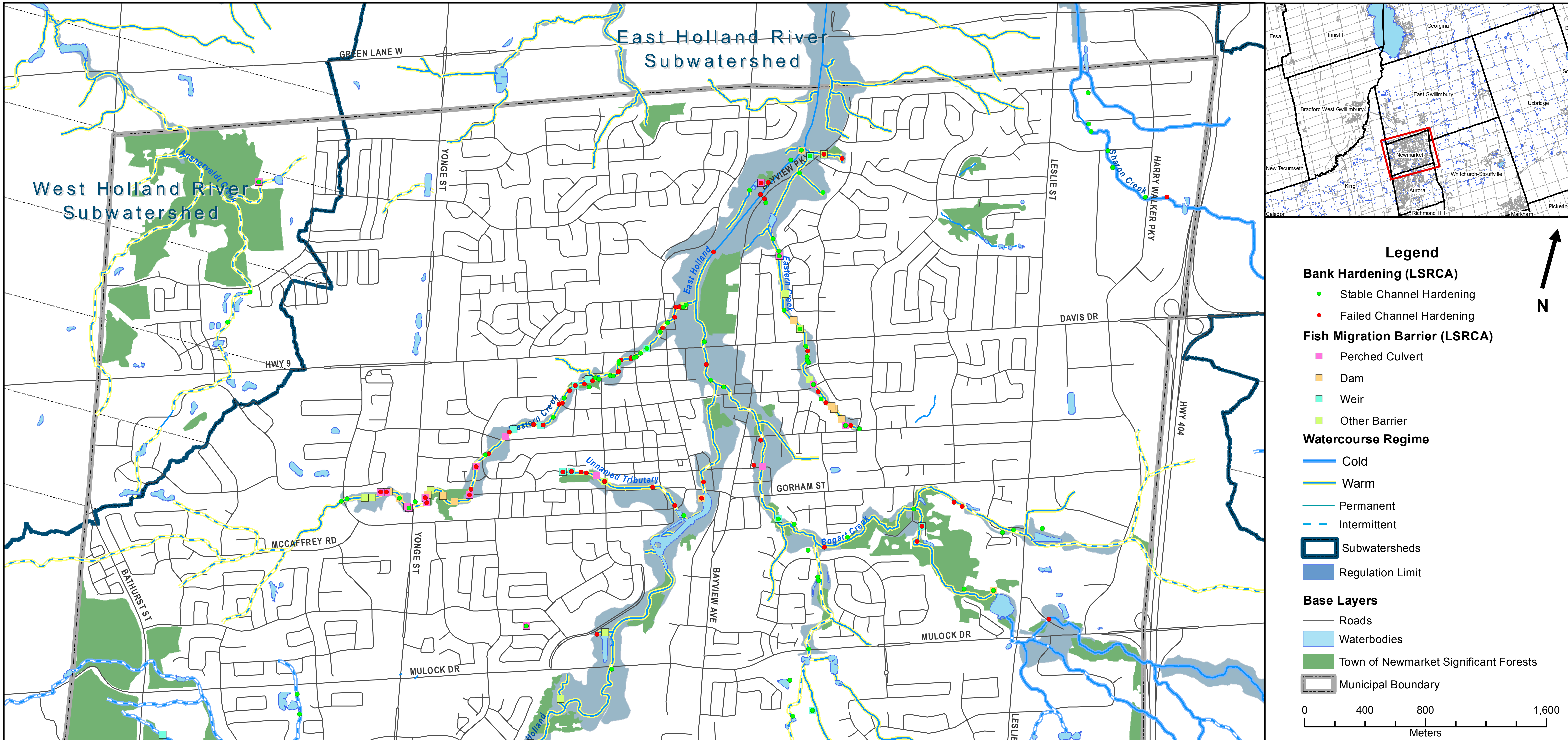

Town of Newmarket Stormwater Master Plan

Key Hydrological Features

November 2016	1:25,000	Datum: NAD 83 Zone 17 Source: LSRCA, Town of Newmarket, York Region
P#: 60330930	V#: 002	

AECOM

Figure 2-8

Map location: P:\60330930 Comp SWM Nwmkt\900-Work\920-929 (GIS-Graphics)\Design\Aquatic_20151214.mxd
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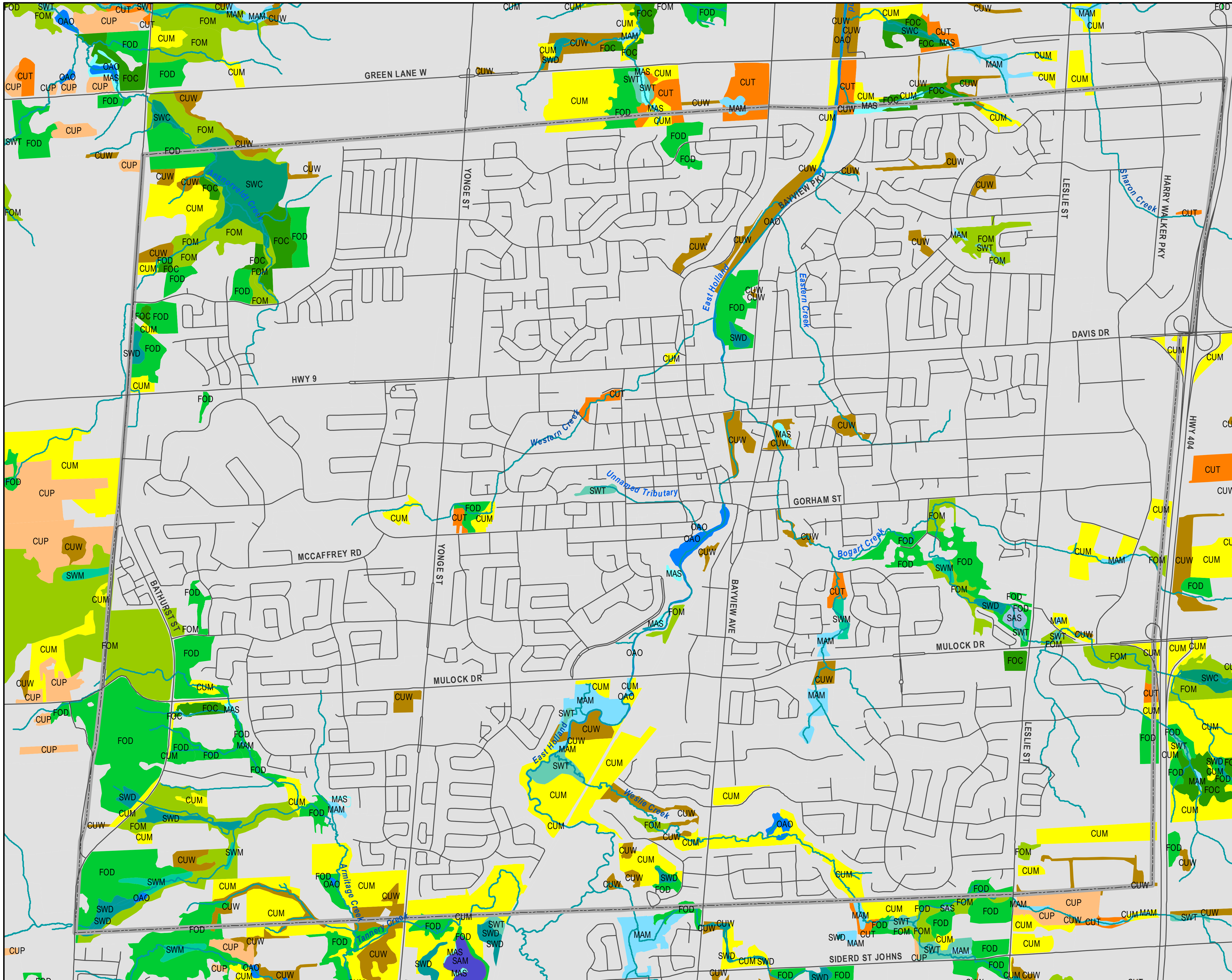

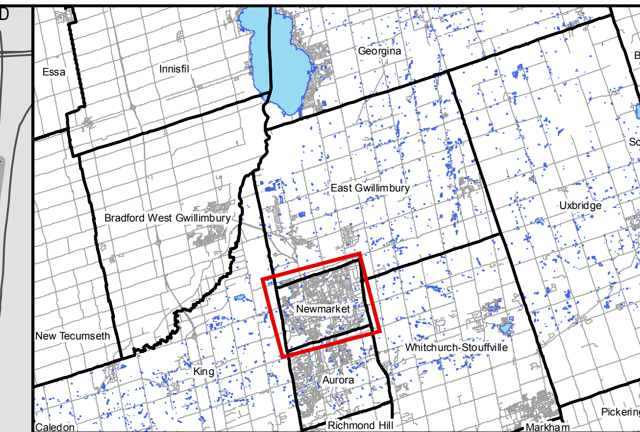

N

Legend

Ecological Communities*

- Anthropological Areas
- CUM
- CUP
- CUT
- CUW
- FOC
- FOD
- FOM
- MAM
- MAS
- OAO
- SAS
- SWC
- SWD
- SWM
- SWT
- SAM

* Refer to Table 2-6 in Section 2.6.2.1 of the Town of Newmarket Stormwater Master Plan for a description of the ecological communities

Base Layers

- Watercourses
- Roads
- Waterbodies
- Municipal Boundary

0 400 800 1,600
Meters

Town of Newmarket Stormwater Master Plan

Ecological Land Classification (ELC) Communities

October 2016	1:25,000	Datum: NAD 83 Zone 17 Source: Natural Environment Baseline Conditions Report - Upper York Sewage Solutions EA, Town of Newmarket, York Region
P#: 60330930	V#: 001	

AECOM

Figure 2-9

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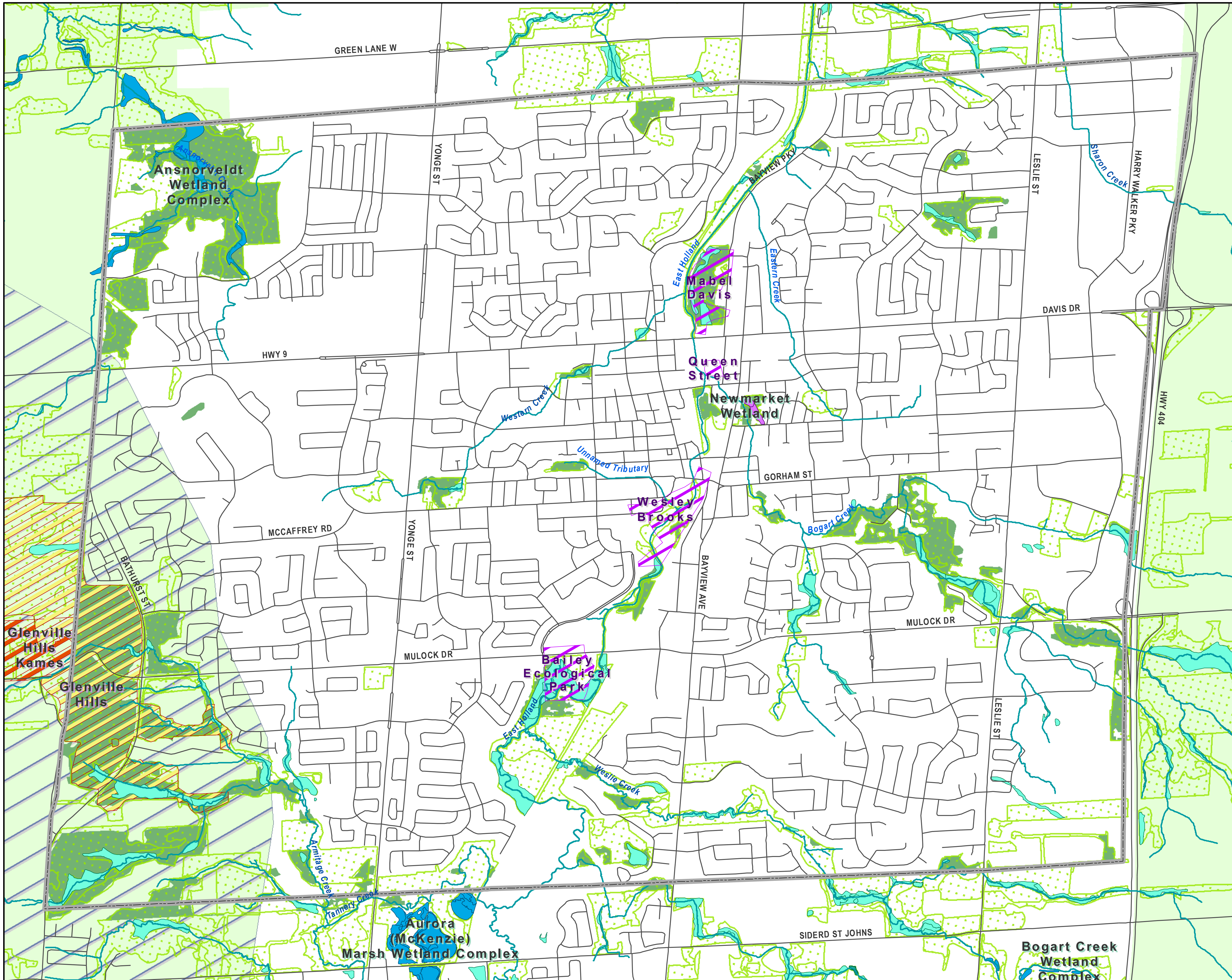

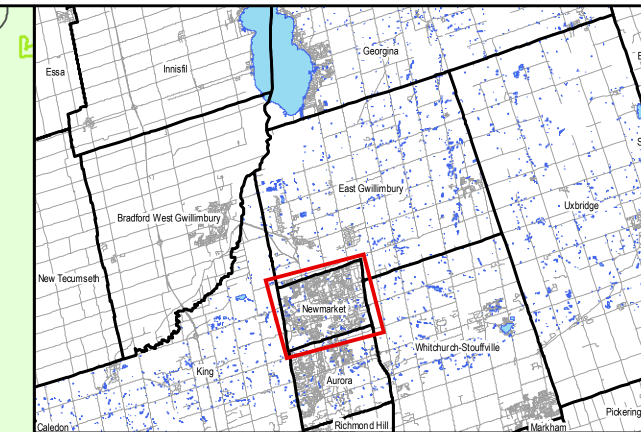

N

Legend

Environmental Layers

- Locally Significant Wetland
- Provincially Significant Wetland
- Unevaluated Wetlands
- Provincial Candidate ANSI, Earth Science
- Provincial Candidate ANSI, Life Science
- Town of Newmarket Significant Forests
- Oak Ridges Moraine
- Greenbelt
- Conservation Areas
- Natural Heritage Feature - Core Areas

Base Layers

- Watercourses
- Roads
- Waterbodies
- Municipal Boundary

0 200 400 800 1,200 1,600
Meters

Town of Newmarket Stormwater Master Plan

Natural Core - Key Natural Heritage Features

November 2016	1:25,000	Datum: NAD 83 Zone 17 Source: Natural Environment Baseline Conditions Report - Upper York Sewage Solutions EA, LIO, Town of Newmarket, York Region
P#: 60330930	V#: 01	
AECOM		Figure 2-10

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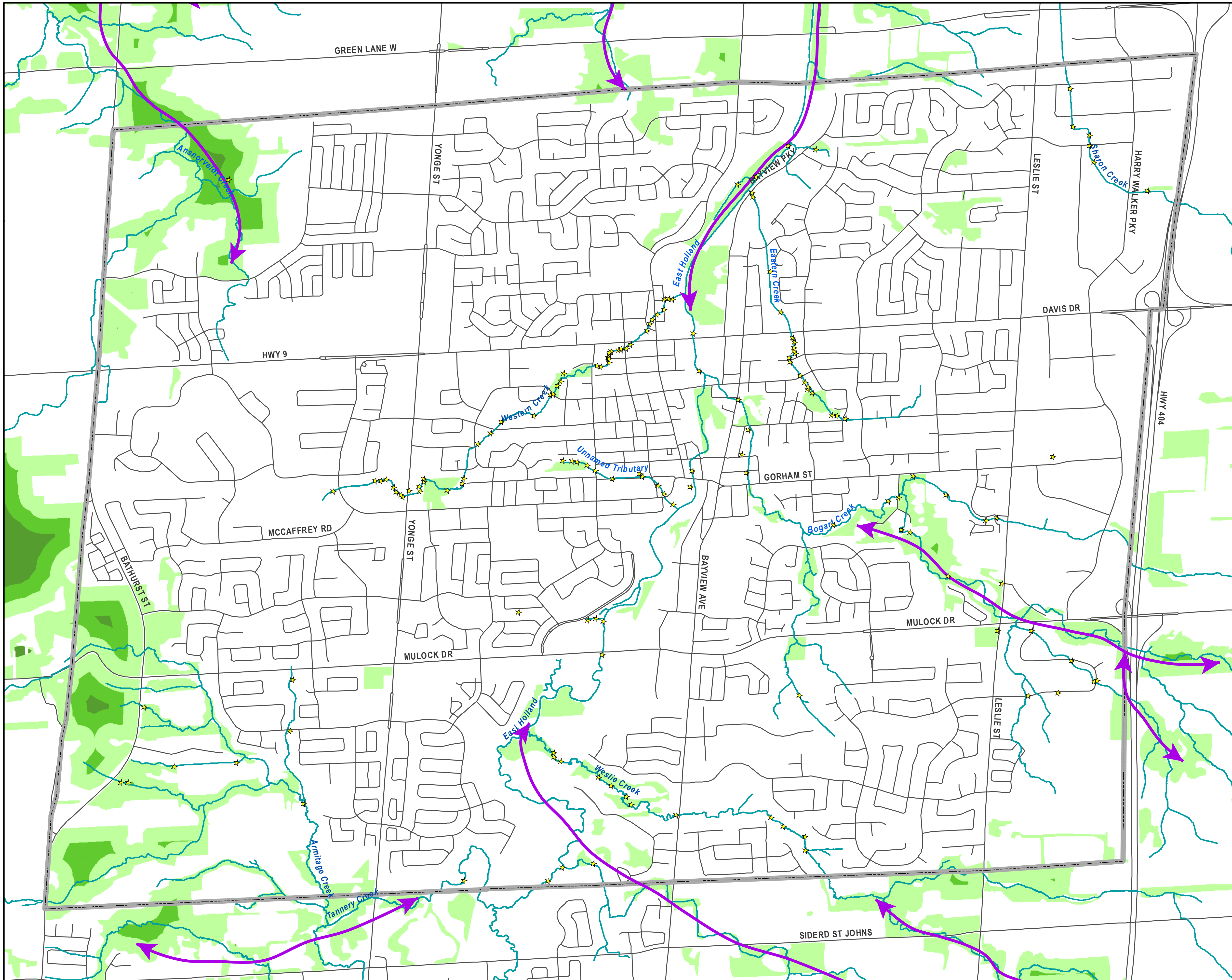

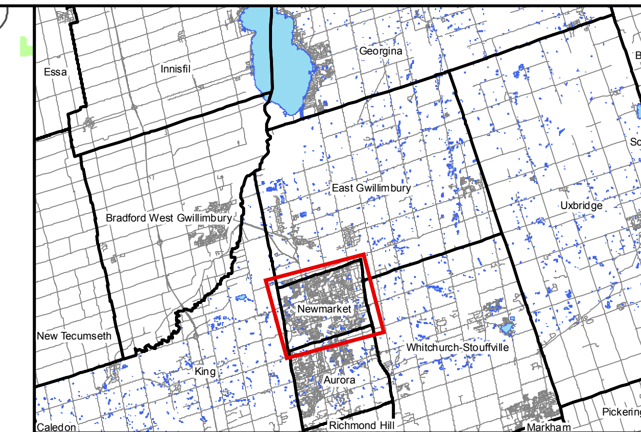

Town of Newmarket Stormwater Master Plan

Significant Wildlife Habitat and Natural Corridors

November 2016	1:25,000	Datum: NAD 83 Zone 17 Source: LSRCA, Town of Newmarket, York Region
P#: 60330930	V#: 001	

AECOM

Figure 2-11

Map location: P:\60330930 Comp SWM Nwmkt\900-Work\920-929 (GIS-Graphics)\Design\SigWildlifeHabitat_20160415.mxd
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3. Effectiveness of Existing Stormwater Systems {Step 6}

Records indicate that the SWM facilities were first constructed in the Town of Newmarket nearly 30 years ago. Stormwater management was first introduced to mitigate potential flooding problems. Stormwater management was later updated to provide for water quality protection to reduce the impact of urban development on receiving watercourses. This led to the first set of Ministry of the Environment (MOE) Stormwater Management Guidelines. The most recent MOE guidelines (2003) now include reference to groundwater protection and erosion control. There has also been a trend to move away from the use of SWM ponds, placed at the discharge point, where stormwater enters the watercourse, to a series of SWM measures that can be located further upstream within a development area. These are commonly put into one of three classifications:

- at source control measures to control stormwater as close to the source as possible;
- conveyance controls to treat stormwater as it is conveyed; and
- end-of-pipe controls to treat stormwater prior to it entering the receiving system.

These suites of controls are often referred to today as Best Management Practices or BMP's. There are approximately 100 SWM ponds within the Town of Newmarket, 58 of which are currently owned and operated by the Town. The main types of facilities found throughout the Town include:

- dry ponds, (designed to drain following a runoff event), provide water quantity control;
- wet ponds, (include a permanent pool), provide water quantity and quality control; and
- instream channels; control structures within a natural stream to provide water quantity control.

The SWM facilities are operated under the authorization of the MOE through the issuance of a Certificate of Approval (COA) or Environmental Compliance Approval (ECA), since they are deemed to be sewage works under the Ontario Water Resources Act. The Town is the owner and operator of the facilities and is required to ensure that the facilities provide the appropriate level of flood protection and water quality control, and ensure that they are maintained and fully operable at all times.

The SWM facility Level of Protection discussed in this report are taken from the Ministry of the Environment's 2003 Stormwater Management Planning and Design Manual. **Table 3-2** of this report identifies the Protection Level for ponds based on Storage volume per impervious levels for contributing drainage areas. The protection levels are as follows:

- Enhanced (formerly Level 1) based on an 80 percent long-term suspended sediment removal;
- Normal (formerly Level 2) based on a 70 percent long-term suspended sediment removal; and
- Basic (formerly Level 3) based on a 60 percent long-term suspended sediment removal.

The suspended sediment removal rates do not correlate directly to the phosphorus removal rates. For example, wet SWM facilities may be classified as a Level 1 (Enhanced) facility, however based on the PTool, the phosphorus removal efficiency of a wet pond is 63 percent. Similarly, a dry pond is categorized as a Level 3 (Basic) facility with a 60 percent suspended sediment removal efficiency, yet is expected to provide a 10 percent Phosphorus removal efficiency based on the PTool.

3.1 Summary of Previous Studies

3.1.1 Newmarket Stormwater Management Pond Inventory and Maintenance Plan

This report was prepared for the Town of Newmarket by AECOM in 2009. The main objective of this study was to perform an inventory and survey of these facilities, and to complete detailed overall stormwater management pond maintenance needs plan. Restoring the original design function of these facilities helps to safeguard public health, reduce flooding potential for public and/or private lands, demonstrate due diligence with respect to good asset management principles, and can help maximize the life expectancy of the facility by correcting problems at the most cost effective time. The report outlines the actions required for implementing the monitoring and maintenance program. The study also recommends construction of stormwater management facilities or other storage devices in vacant lots or park sites in older developed areas to address the drainage problems, downstream flooding and erosion problems.

Additionally, the study recommends improvements in stormwater management facility function. Retrofitting provides an opportunity to improve existing water quality Best Management Practices (BMPs) that may be inadequate or performing poorly. It recommended installing pre-treatment technologies such as sediment traps, filter strips and oil and grit separators upstream of the facilities to reduce sediment loads. It also recommends disconnecting roof leaders and encouraging grassed swales which helps infiltration of clean stormwater directly into the ground. The study provided a prioritized list of ponds identified as requiring sediment cleanout, together with associated sediment removal and disposal costs. These are summarized in **Table 3-1** below. It also identified facilities that had not yet been assumed by the Town, and noted that the facilities should have sediment removed before being assumed by the Town, shown in **Table 3-2** below. Pond locations are provided on **Figure 3-1**.

Table 3-1. Cleanout Priority as Identified in 2009 SWM Facility Inventory and Maintenance Needs Plan

Sediment Cleanout Priority	AECOM Pond ID	Meets MOE Design Guidelines?	Meets MOE Maintenance Guidelines?	% of Permanent Pool as Sediment	Estimated Volume of Sediment (m^3)
1	43	Yes	No	128	943
2	36	Yes	No	32	446
3	39	No	No	149	1327
4	84	No	No	114	49
5	86	No	No	82	9
6	74	No	No	67	330
7	44	No	No	58	1557
8	70	No	No	52	2300
9	89	No	No	37	479
10	41	No	No	33	298
11	90	Yes	Yes	70	2276
12	35	Yes	Yes	67	2546

Table 3-2. Sediment Summary of Privately Owned Ponds and Ponds Not Yet Assumed by the Town of Newmarket

AECOM Pond ID	% of Permanent Pool as Sediment	Estimated Volume of Sediment (m^3)
14	52	3,098
22	29	365
23	17	215
29	22	317
30	10	74
31	61	533
55	1	120
58	56	862
71	44	1,926
34	106	728
3	49	940
12	33	1,013

3.1.2 Town of Newmarket Town-Wide Drainage Study

This study was prepared by AECOM in 2009. The focus of the report was stormwater quantity and flooding issues, as well as erosion considerations and stormwater management quality controls. It reviewed the Town's stormwater management conveyance by item (storm sewers and channels) to identify causes of flooding, and areas where the system may be under capacity. It focused on the older areas of the Town that were developed prior to the adoption of modern stormwater management practices (core areas). The study examined the existing drainage system, looking at pipes greater than 600 mm diameter, and identified opportunities for improvements. On September 16, 2006, the Town of Newmarket experienced a 100-year storm that resulted in flooding in the Eastern, Western and Bogart Creek Drainage Basins that are tributary to the East Holland River. The Town received many surface and basement flooding reports which provided the impacts for this study and focused on areas of concern. The study identified storm sewers requiring upgrades to ameliorate flooding conditions. The report further recommended further exploration of the cost and benefit of a foundation drain disconnection program, to further reduce capacity impacts on the existing sanitary sewers and to promote infiltration of stormwater runoff to pervious surfaces.

This study also identified additional opportunities for water quantity and quality control, including rain barrels, decreased use of fertilizers and pesticides, increased street sweeping and catchbasin cleaning, roof gardens, vegetated swales, tree planting, nature-scaping, pervious pavers, and infiltration measures. A table showing the prioritization of improvement works and associated costs was provided in the report. The recommendations included catchbasin installations at various locations, remediation work including replacing and twinning sewers at multiple locations, and further investigating increasing channel capacity at one location. The summary is presented in **Table 3-3** below. AECOM's Management Units have been included in the table for reference purposes. The study also references the 16 SWM facilities identified for retrofitting in the LSRCA 2007 Lake Simcoe Basin Stormwater Retrofit Opportunities. These pond retrofits and the LSRCA report are discussed in further detail in the following section.

Table 3-3. Table 5 Prioritization of Improvement Works from 2009 Town-wide Drainage Study

Location	AECOM Management Unit	Recommendations for Improvement	Priority Group	Estimated Cost
Srigley St west of Carlson Drive	4	Remediation work would include replacing/twinning the sewer from east of Oris Drive to the edge of the creek to increase capacity and minimize the water levels in the sewers. Suggested remediation includes equivalent of pipe twinning or upsizing several segments of the storm sewer system as follows: 270 m upstream section upsized to 750 mm and 380 m downstream section upsized to 1350 mm diameter pipe.	1	$649,000
Intersection of Eagle St. and Scott Av	8	Install catchbasins (3 DCBs) Restoration considerations in Lions Park to address flooding issues.	1	$9,000
Davis Dr. east of Yonge St.	1	Install catchbasins (1 DCB)	1	$3,000
Walter Ave just west of Newbury Dr.	1	Recommend to add inlet structures (e.g. 2 DCBs) in this area to connect to minor system to relieve major system.	1	$6,000
Crusader Way South of Srigley St.	4	Remediation work would include twinning/upgrading the sewer on Srigley St. from east of Oris Drive to the edge of the creek to increase capacity and minimize the water levels in the sewers. Investigate increasing channel capacity.	2	$649,000
Gorham St. east of Maple Street	2	Install catchbasins (1DCB) and increase storm sewer capacity	2	$3,000
Eagle Street east of Lorne Av.	8	Install catchbasins (1DCB) and increase storm sewer capacity	2	$3,000
Penn Ave. just south of Gwillimbury Rd.	1	Install catchbasins (1DCB) and increase storm sewer capacity	3	$3,000
Eagle St. between Lorne Ave. and William St.	8	None	-	-
Main St. North of Davis Dr.	1	None	-	-
Gorham St. west of Carlson Dr.	2	None	-	-
Birchwood Park (tennis court area)	4	None	-	-

3.1.3 LSRCA Publications

3.1.3.1 Lake Simcoe Basin Stormwater Management Retrofit Opportunities 2007

The purpose of this study was to create a complete, consistent and contemporary data set of all urban catchments, outlets, existing SWM facilities and locations of potential SWM facilities, and to calculate the phosphorus load associated with urban stormwater runoff in the Lake Simcoe Watershed.

The report noted that the total phosphorus loading without existing stormwater treatment in Newmarket is approximately 4,713 kg/year, and phosphorus loading with existing stormwater treatment is 3,310 kg/year. It identified stormwater remediation opportunities including construction of ponds in uncontrolled catchments, or upgrading existing facilities. The report identified 16 SWM facilities within the town of Newmarket that require retrofitting. These ponds are identified in **Table 3-4** below.

Table 3-4. Cleanout Priority as Identified in 2007 LSRCA SWM Pond Retrofit Study

Cleanout Priority	LSRCA Pond Identifier	AECOM Pond Identifier	Design Pond Level	Current Pond Level
1	N-NW6	43	1	NA
2	N-SW4	19	1	NA
3	N-CE2	38	1	3
4	N-CW21	77	1	3
5	N-CW6	14	1	3
6	N-SW5	18	1	NA
7	N-NW3	1	1	4
8	N-NW4	3	3	4
9	N-CE20	?	1	2
10	N-SW11	22	1	3
11	N-SE11	28	3	4
12	N-SW18	?	1	3
13	N-SE9	34	1	2
14	N-SW12	58	1	NA
15	N-SW10	24	1	2
16	N-SE10	73	3	4

The study recommended small lot level remediation practices that could be effective at mitigating some of the impacts of stormwater if adopted at a large scale, including the initiation of a rain barrel program to educate the public about stormwater. Mitigation measures for temperature issues associated with stormwater runoff were also identified. Suggested alterations of stormwater pond design were identified to help to minimize temperature increase in receiving water courses, including construction of a bottom-draw outlets, planting of vegetative buffers along pond edges, and the implementation of night time or early morning stormwater pond release. The report also identified additional water quality issues, including salt loading and contaminant loading from pesticides. It identified remediation measures including; increased street cleaning in late winter to avoid accumulated sand and salt from being washed into water bodies, examining potential alternatives to road salt, and consideration of a ban on the cosmetic use of pesticides.

3.1.3.2 Stormwater Pond Maintenance and Anoxic Conditions Investigation 2011

If the percent of urban land-use in a watershed is high (e.g. Aurora-Newmarket) stormwater runoff may be the predominant source of nutrient loading to receiving waters. The objectives of this study were to assess current levels of select stormwater ponds and to examine the prevalence of low oxygen conditions in stormwater ponds. The ponds located in larger urban areas of Newmarket, Aurora, Barrie, Innisfil, Keswick and Uxbridge were selected.

Under normal conditions dissolved phosphorus has a strong affinity to iron resulting in the incorporation of iron bound phosphorus into sediments such as those captured in Stormwater facilities. However, under low (hypoxic) to no (anoxic) oxygen conditions iron is reduced and the bound phosphorus is released into the water column resulting in an internal source of phosphorus loading to the pond. The data also suggested that due to the low residence time of the stormwater pond, hypoxic conditions develop rapidly with storm events causing a mixing of waters and release of the unbound phosphorus to receiving waterbodies. As the vast majority of stormwater pond monitoring has focused on the efficiency of a pond during storm events the development and impact of low oxygen conditions have largely gone unnoticed. Therefore, a second objective of the above project was to examine the prevalence and extent of low oxygen conditions in Stormwater facilities and begin to quantify the significance of the issue.

The above report indicated that Phosphorus loads were calculated by catchment based on catchment size, level of imperviousness (residential area = 0.45, industrial / commercial = 0.85), and an average phosphorus load per hectare per year of 1.32 (residential) or 1.82 (industrial / commercial) based on monitoring data from Liang, 1999. phosphorus reductions specific to the above report were identified as 4 levels of control as follows:

• Level 1 = 80% phosphorus reduction
• Level 2 = 69% phosphorus reduction
• Level 3 = 54% phosphorus reduction
• Level 4 = 40% phosphorus reduction

The above levels differ from the standard Level of Protection for SWM facilities discussed elsewhere in this report. According to the study completed in 98 ponds, 56 ponds had dropped by 1 or more levels of efficiency, 12 of which had dropped below level 4 (the lowest level of efficiency). Interestingly, 37 of the ponds studied were found to have greater volumes than listed in the design information. While the reasons for the greater volumes is unknown, it may be that in some instances ponds were over excavated when first constructed to allow for collection of excess sediment during the servicing of the subdivision and the house building phase. Appendix D of the report specifies 16 SWM facilities within the Town of Newmarket, ranked in order of cleanout priority. This report used the SWM facilities identified in the 2007 LSRCA SWM Pond Retrofit Study, identified in **Table 3-1** above.

The study presents several maintenance recommendations. Municipalities should develop and implement maintenance programs to return stormwater management ponds to their design levels. The 12 ponds which had dropped below Level 4 should be given highest priority for clean out and maintenance. Step 10 of Comprehensive Stormwater Management Master Plan Guidelines indicates that municipalities will need to establish an ongoing program that assesses the effectiveness of individual stormwater ponds. These programs should include field inspections of ponds including volume/design levels. It should be noted that the Town of Newmarket has such a stormwater facility inspection and maintenance plan in place.

The study further recommends that enhanced street cleaning be conducted in spring to remove sand applied to roads during winter, specifically for the subwatersheds with ponds that have the highest sediment accumulation rates. Investigation is recommended into stormwater ponds that apparently have larger volumes than design criteria. This investigation will help uncover if this is a data management issue/deficiency, operational failing of the pond, or a construction/post construction issue. The information gathered would inform maintenance decisions along with operations/design considerations. The study also recommends that municipalities adopt the Yellow Fish program along with other initiatives aimed at educating the general public about limiting pollutants from entering storm drains and ponds.

Low oxygen conditions were fairly prevalent in the stormwater ponds, with 42 of the 98 ponds surveyed showing daytime hypoxic/anoxic conditions. Water quality sampling at a select number of ponds yielded strong evidence for nutrient release under these conditions. Furthermore, the hot and dry weather that was found to promote these low oxygen conditions are predicted to become more frequent under 2050 climate model scenario. The extent of low oxygen conditions in stormwater ponds was studied and recommendations were provided. Further investigation and implementation of alternative approaches to stormwater management should be considered that do not involve potential for standing water to become anoxic. Figure 5 of the report shows approximately three ponds within the Newmarket area as having a Dissolved Oxygen (DO) levels between 2.5 mg/L and 5 mg/L, and approximately four ponds having DO levels of less than 2.5 mg/L. Appendix D of the report provides data for DO values, however not all of the SWM facilities are identified, with privately owned and operated facilities in the Town of Newmarket missing identification labels. Based on the information provided, it was noted that SWM facility 1 (identified as N-NW3 in the Anoxic report) was sampled to have a DO level of 1.2 mg/L.

Low Impact Design and innovative stormwater management systems could be alternative approaches considered. Further monitoring of stormwater ponds (water and sediment) was suggested, to determine the frequency and duration of low oxygen conditions, quantity the nutrient release, and assess total nutrient loads exiting stormwater ponds. The report also suggests testing methods and technologies for preventing stormwater pond anoxia or controlling nutrient release from sediments. Incorporating methodologies for monitoring of low oxygen nutrient release into all stormwater ponds is also recommended.

3.2 Phosphorus Loading under Existing Conditions

The Phosphorus loading rates by land use as used by the PTool are provided in **Table 3-5**.

Table 3-5. Phosphorus Loading Rates by Land Use

Land Use	Phosphorus Loading Rate (kg/ha/yr)
High Intensity Commercial	1.82
High Intensity Residential	1.32
Low Intensity Development	0.13
Sod Farm/Golf Course	0.24
Forest	0.1
Transition	0.16
Quarry	0.18
Cropland	0.36
Hay – Pasture	0.12
Open Water	0.26
Unpaved Road	0.83
Wetland	0.1

3.2.1 Methods

The Ontario Ministry of the Environment and Climate Change has provided an online PTool for the Lake Simcoe subwatershed. The methodology used to determine phosphorus loading and removal efficiencies was to use the PTool. The PTool allows one to apply phosphorus loading to a development based on land usage, and then further determine the phosphorus removal efficiency achieved through the use of various best management practices (BMPs).

As the Ptool setup is limited to the number of BMPs that can be applied to each area, the PTool was also recreated in electronic spreadsheet form. This allowed for greater flexibility in calculating phosphorus loading and removal rates within the management units, specifically for calculating removal efficiencies for additional non-SWM facility BMPs. The same phosphorus loading rates and removal efficiencies were applied in the spreadsheet.

The PTool was used to determine the Phosphorus loading rates for all areas, and the Phosphorus removal rates for areas serviced by dry and wet SWM facilities. It should also be noted that the Phosphorus loading and removal calculations were only applied to the Management Unit areas that fall within the Town of Newmarket boundaries. GIS land use areas were not provided outside of the boundary and are outside the scope of this work.

The storm catchment areas were provided by the LSRCA, along with land use data in GIS format. This data was summarized for input into the PTool to determine the Phosphorus loading and removal rates. The total Phosphorus loading and removal rates were then summarized for each Management Unit.

3.3 Phosphorus Removal under Existing Conditions

The impacts of providing SWM BMPs for phosphorus removal were investigated as part of this study. The Phosphorus removal efficiencies by BMP as provided by the PTool are provided in **Table 3-6**.

Table 3-6. Phosphorus Removal Efficiency by BMP

BMP	Phosphorus Removal Efficiency (%)
Bioretention System	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems	77
Green Roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration Trench	60
Sorbtive Media Interceptors	79
Underground Storage	25
Vegetated Filter Strip	65
Wet Detention Pond	63

3.3.1 Existing Conditions Removal Efficiency of SWM Facilities

GIS data was provided by the Town of Newmarket which included stormwater management facility locations and stormwater catchment areas. In some instances catchment areas contained multiple SWM facilities; individual catchment areas were not provided for each SWM facility. The SWM facilities are shown on **Figure 3-1**.

Phosphorus loading rates were determined separately for SWM-serviced and non-SWM serviced areas based on existing land use, using the PTool. The PTool was then used to determine the Phosphorus removal rates for SWM-serviced areas. This was done for three scenarios; Existing Conditions (based on the existing removal capacity of the SWM facilities), Proposed Conditions (based on the design removal capacity of the SWM facilities as they would function post clean-out); and a Do Nothing scenario (assuming all SWM facilities will fill over time and at best function with a removal efficiency comparable to a dry SWM facility).

The MOE Stormwater Planning and Design Manual is used in SWM facility design to determine the required permanent pool and active storage volume required to meet the required protection level, based on the percent imperviousness and size of the contributing catchment area. As sediment accumulates within the SWM ponds, the available permanent pool volume is reduced, thereby reducing the sediment removal efficiency of the facility. Desktop and field data was gathered pertaining to the existing conditions of the SWM facilities within the Town of Newmarket. This data was amalgamated from several sources to determine the current functioning protection level, based on the existing available permanent pool volume. The current protection level used to determine if the pond currently functions as a wet pond (protection levels 1 or 2), or a dry pond (protection level 3). The PTool applies a Phosphorus removal efficiency of 63% to wet SWM facilities, and a removal efficiency of 10% for dry SWM facilities. **Table 3-7** provides a summary of the original design protection levels, as well as the current protection levels based on available permanent pool volume. Data was not provided for all of the ponds, and those with insufficient data are not included in the table.

Table 3-7. Original Design Protection Levels for SWM Facilities

Pond ID	Design Pond Type	Design Permanent Pool Volume (m^3)	Catchment Area (ha)	% Impervious	Design Storage Volume (m^3/ha)	Current Storage Volume (with sediment) (m^3/ha)	Management Unit	Design Protection Level
1	Wet	655	8.5	74	96	84	11	1
2	Wet	19,646	60	73	346	317	11	1
3	Wet	1,921	19.6	74	170	106	1	3
4	Wet	2,580	25.5	74	206	190	1	3
5	Wet	-	0.42	-	-	-	7	-
6	Wet	7,619	13	2	1,016	1,009	10	1
7	Wet	4,471	11.1	8	417	375	10	1
8	Wet	3,669	11.3	19	360	356	1	1
9	Wet	6,913	37.9	18	230	230	1	1
10	Wet	4,275	13.1	12	296	285	10	1
11	Wet	7,045	19.8	33	255	251	10	1
12	Wet	3,052	9.5	-	540	374	1	1
13	Wet	9,409	3.2	3	2,523	2,281	1	1
14	Wet	5,911	67.3	12	144	89	1	2
16	Wet	-	5.77	-	-	-	7	-
17	Wet	-	1.99	-	-	-	7	-
18	Dry	-	13.1	28	40	38	7	3
19	Wet	201	92.7	28	43	43	7	1
22	Wet	1,272	16.6	24	107	88	7	1
~~25~~	~~Wet~~	~~-~~	~~7.58~~	~~-~~	~~-~~	~~-~~	~~7~~	~~-~~
26	Wet	-	40.5	-	-	-	2	-
27	Wet?	-	-	-	-	-	6	-
28	Wet	-	24.2	-	-	-	3	-
29	Wet	1,428	47.4	25	70	63	3	-
30	Wet	755	18.6	27	81	77	3	-
31	Wet	867	2.1	1	455	200	3	-
32	Wet	-	-	-	-	-	6	-
33	Dry	-	-	-	-	-	6	-
34	Dry	690	35.4	47	67	39	2	3
35	Wet	3,785	19	28	235	104	2	1
36	wet	1,400	37.7	38	77	65	2	2
37	Dry	-	19	-	-	-	2	-
38	Wet	8,209	60.8	62	307	306	2	1
39	Wet	893	17	42	98	12	2	1
40	Dry	-	-	-	-	-	2	-
41	Wet	909	25.4	30	58	52	2	1

Pond ID	Design Pond Type	Design Permanent Pool Volume (m^3)	Catchment Area (ha)	% Impervious	Design Storage Volume (m^3/ha)	Current Storage Volume (with sediment)	Management Unit	Design Protection Level
42	Wet	-	80.7	37	-	-	8	1
43	Wet	739	97.2	25	123	17	9	1
44	Wet	2,701	53.6	42	90	61	9	1
45	Dry	-	-	-	-	-	10	-
46	Dry	-	-	-	-	-	9	-
47	Dry	-	-	-	-	-	9	-
48	Dry	-	-	-	-	-	9	-
49	Dry	-	-	-	-	-	9	-
50	Dry	-	-	-	-	-	9	-
~~51~~	~~Wet~~	-	-	-	-	-	~~6~~	-
52	Wet	2,951	21.1	29	163	158	1	1
53	Wet	563	4.8	66	170	170	2	1
54	Dry	-	2	-	-	-	2	-
55/56/62-one pond	Wet	10,308	86.9	58	1,340	1,325	6	1
~~57~~	~~Wet~~	-	-	-	-	-	~~2~~	-
58	Dry	1,533	20.7	45	109	70	3	1
59	Dry	-	-	-	-	-	9	-
60	Dry	-	-	-	-	-	9	-
61	Wet	-	28.7	-	-	-	2	-
63	Dry	-	8.04	-	-	-	4	-
64	Wet	-	10.44	-	-	-	2	-
65	Dry	-	13.85	-	-	-	2	-
66	online	-	-	-	-	-	1	-
67	Wet	-	20.57	-	-	-	10	1
68	Dry	-	24.48	-	-	-	10	-
70	Wet	4,452	31.6	67	107	72	5	-
71	Wet	4,382	24.2	67	233	148	6	1
73	Dry	-	14	26	40	40	3	3
74	Wet	491	53.2	35	50	43	2	1
75	Wet	120	6.3	9	59	59	2	1
76	Dry	41	55.3	43	41	41	4	3
77	Wet	8,498	101.5	47	219	196	8	1
79	Dry	-	22.3	33	40	40	1	3
80	Dry	15	15.4	29	41	40	1	3
81	Wet	200	76.6	44	43	43	1	1
83	online	-	7.4	-	-	-	1	-
84	Wet	43	80.3	33	41	40	11	1
85	Dry	-	8.1	27	40	40	9	3

Pond ID	Design Pond Type	Design Permanent Pool Volume (m^3)	Catchment Area (ha)	% Impervious	Design Storage Volume (m^3/ha)	Current Storage Volume (with sediment)	Management Unit	Design Protection Level
86	Wet	11	7.7	26	41	40	9	1
87	Dry	-	115.3	23	40	40	9	3
88	Dry	-	17.4	27	40	40	9	3
89	Wet	1,302	26.6	77	89	71	5	1
91	Dry	-	15.6	52	40	40	8	1
92	Dry	-	1.3	57	40	40	8	3
93	Wet	-	-	-	-	-	2	-
94	Wet	-	-	-	-	-	10	1
95	Dry	-	22.8	-	-	-	10	-
96	Wet	-	-	-	-	-	2	1
97	Wet	-	17.1	-	-	-	6	1
98	Wet	-	12.9	-	-	-	2	1
99	Wet	-	16.53	-	-	-	10	1
101	Wet	-	18.7	-	-	-	2	-
102	Wet	-	13.72	-	-	-	3	-
23&24	Wet	-	5.5	-	-	-	7	1

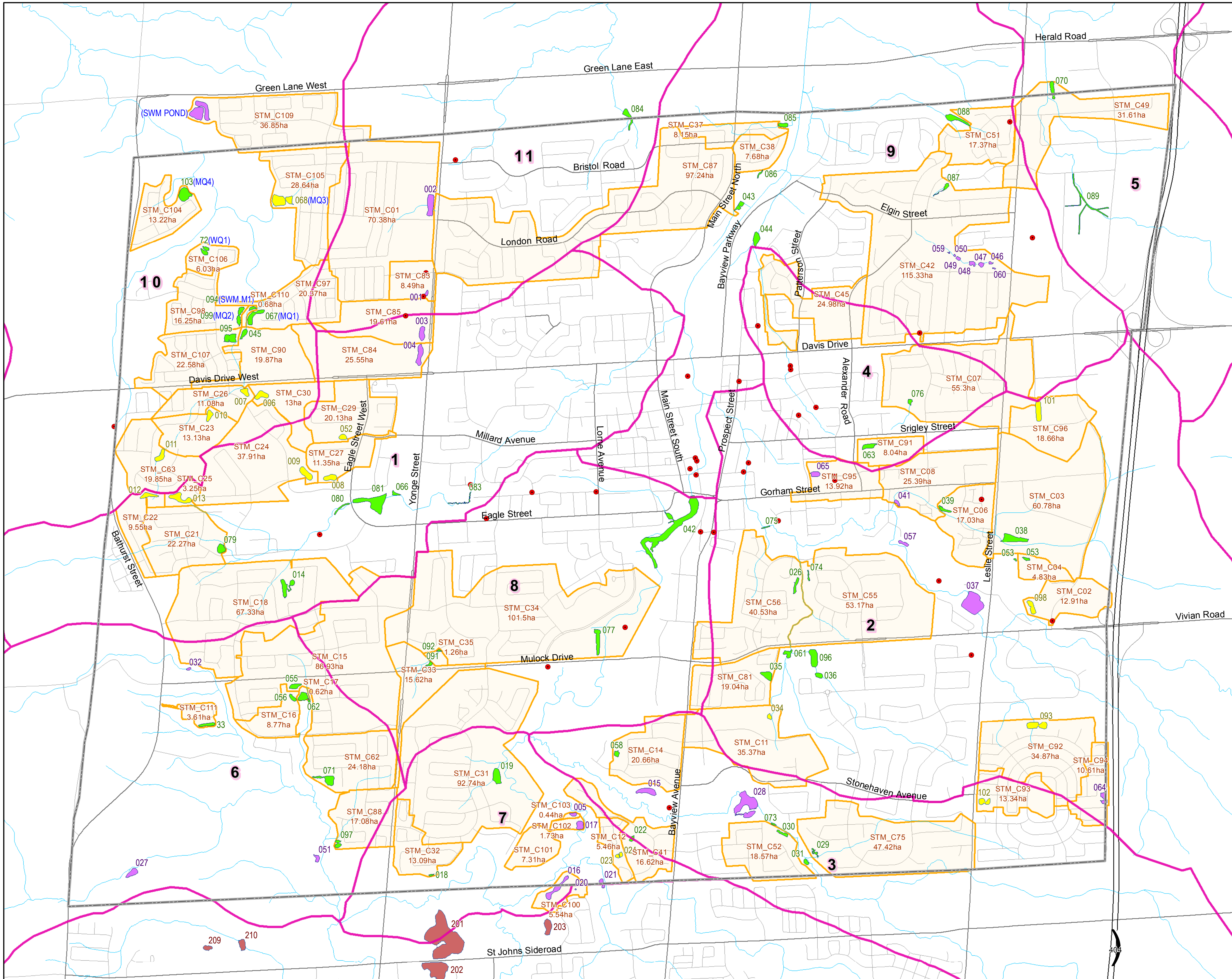
The PTool was used to determine the existing conditions Phosphorus loading rates based on land use, and the Phosphorus removal rates based on the existing SWM facility functional protection levels. A summary of the functional protection level for each pond under existing and proposed conditions is provided in **Appendix B**. Due to the high potential for resuspension of sediment, online SWM facilities were not included in the Phosphorus removal calculations. Phosphorus removal was calculated using the PTool (see output provided in **Appendix B**). Phosphorus removal is calculated in the PTool by subtracting the post-development Phosphorus loading from the pre-development Phosphorus loading rate.

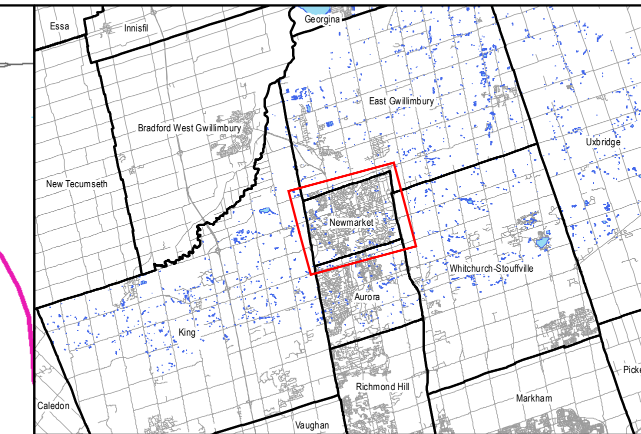
The Phosphorus loading and removal rates for existing conditions are summarized in **Table 3-8** for each of the management units. The SWM facilities are shown on **Figure 3-1**.

Table 3-8. Existing Conditions Phosphorus Loading and Removal Rates for SWM Facilities

			Existing Conditions		
Management Unit	**SWM Facilities[1]**	**Area[2] (ha)**	**Existing Development without SWM – Annual TP Loading (kg)**	**Existing Development & Existing SWM – Annual TP Loading (kg)**	**Effectiveness of Existing SWM (% of TP loading reduction &/or comments)**
1	3,4,8,9,12,13,14, 52,~~66~~,79,~~80,81,~~ ~~83~~	526.4	696.8	546.5	22
2	26,34,35,~~36,37~~, 38,39,~~40,~~41,53~~,~~ ~~54,57,61~~,64,65, 74,~~75~~,93,~~96~~, 98,101	731.1	978.6	760.3	22
3	~~28~~,29,30,~~31,~~ 58,~~73~~,102	248.4	238.6	204.7	14
4	63,76	152.7	224.0	215.2	4
5	70,~~89~~	124.3	223.6	193.6	13
6	~~27,32,~~33,~~51~~, 55,56,62, 71,97	369.4	260.5	210.5	19
7	5,16,17,18,19, 22,23/24,~~25~~	164.7	130.4	69.3	47
8	~~42~~,77,91,92	416.8	553.6	474.6	14
9	43,~~44,46,47,48,4~~ ~~9,50,59,60~~,85, 86,87,88	533.3	687.9	651.3	5
10	6,7,10,11,~~45~~,67, 68,~~94~~,95, 99 (MQ2), WQ1, MQ4	305.9	223.5	150.2	33
11	1,2,~~84~~	241.8	349.0	271.0	22

Notes:
1. All ponds shown, ponds not included in Phosphorus removal calculations (e.g. online) shown as crossed out.
2. Management Unit areas represent the portion of each management unit located **within the Town of Newmarket boundary**.
3. Phosphorus loading and removal calculations are provided in **Appendix B**.





N

Legend

- Municipal Boundary
- Existing STM Treatment MH
- Watercourse
- Storm Catchments
- Management Units

Existing SWM Pond Ownership

- Town of Newmarket
- Private
- Out of Town
- Unassumed

Newmarket Pond ID (where applicable)
LSRCA Pond ID (where applicable)

0 0.25 0.5 1 1.5
Kilometers

Comprehensive SWM Plan
Town of Newmarket

Storm Water Management Pond
Drainage Catchments

June 2017	1:26,000	Datum: NAD '83 UTM 17N Source: City of Newmarket
P#: 60330930	V#: 001	

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Figure 3-1

Map location: P:\60330930 Comp SWM Nwmkt\900-Work\920-929 (GIS-Graphics)\Design\Final Maps\Figure 3-1 SWMP Drainage Catchments 11x17 20170420.mxd
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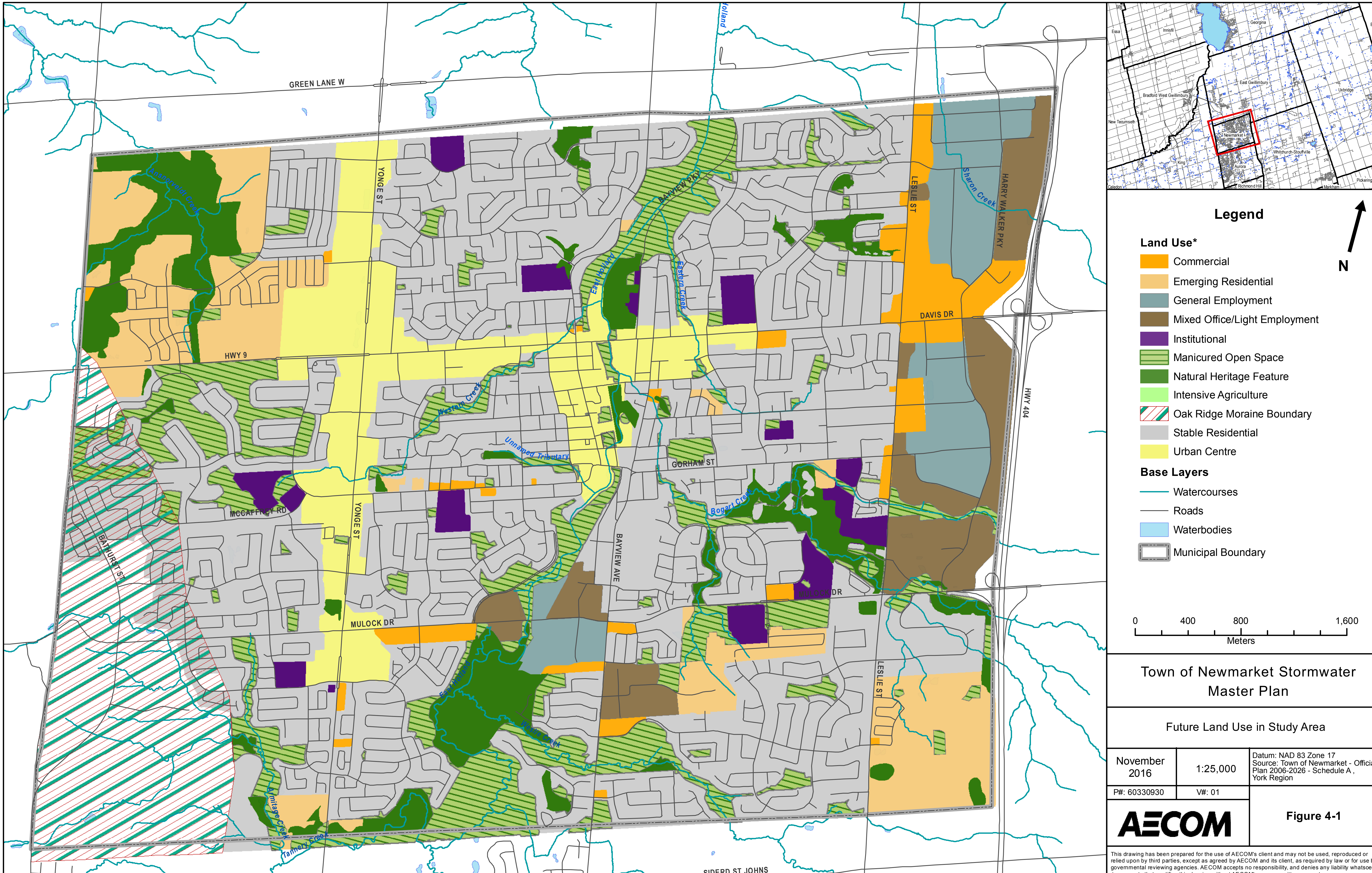
4. Future Conditions {Step 5}

4.1 Proposed Development

Proposed land uses for the Study Area were provided by the Town of Newmarket and are shown on **Figure 4-1** and are summarized in **Table 4-1**. Refer to **Table 2-1** for existing land use in the study area. The three most dominant land uses in the Study Area include urban centres, residential, and open space. Approximately 54 percent of the Study Area is dominated by residential, which consists of estate residential (Town of Newmarket, 2014). The parks and open spaces land use type consists of major parks, golf courses, conservation areas, trail systems and river corridors, which comprise 11 percent of the Study Area (Town of Newmarket, 2014). Urban land use (8 percent) consists of a broad range of office, and spaces that support jobs, housing and services (Town of Newmarket, 2014). Natural heritage features which are part of the Town's Natural Heritage System (6 percent) consist of locally significant meadows, woodlands and wetlands, as well hydrological networks of watercourse and floodplains associated with the East Holland River (Town of Newmarket, 2014). These areas promote active and passive recreation and provide physical linkages between natural heritage features. Institutional and commercial land uses, each comprise 2 percent and 3 percent of the Study Area, respectively. Institutional areas primarily consist of post-secondary educational facilities, long-term care facilities and social, cultural and administrative facilities (Town of Newmarket, 2014). Commercial areas mainly promote retail and service orientated activities (Town of Newmarket, 2014).

Table 4-1. Proposed Land Use Area

Land Use Type	Area (ha)	Percentage (%)
Urban Centre	312.24	8%
Natural Heritage	225.03	6%
General Employment	153.20	4%
Mixed Employment	167.80	5%
Subtotal:	***858.26***	
Open Spaces and Oak Ridge Moraine:		
Open Space	397.28	11%
Oak Ridge Moraine	272.52	7%
Subtotal:	***669.80***	
Institutional	78.75	2%
Commercial	107.53	3%
Residential	1999.33	54%
Subtotal:	***2185.62***	
Total:	**3713.68**	**100%**



Town of Newmarket Stormwater Master Plan

Future Land Use in Study Area

November 2016

1:25,000

Datum: NAD 83 Zone 17
Source: Town of Newmarket - Official Plan 2006-2026 - Schedule A , York Region

P#: 60330930

V#: 01

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Figure 4-1

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4.2 Hydrology

The development and the intensification under future conditions shows an increasing trend in impervious area. The increased imperviousness results in an increase in runoff if not mitigated. The increase in runoff comes with a secondary issue of increased sediment and contaminant loading to downstream water bodies. Low Impact Development (LID) and Best Management Practices (BMPs) can be implemented to mitigate the effects of increased runoff. Various methods of reducing runoff are discussed in subsequent sections of this report, some of which include downspout and roof leader disconnection programs, reconnecting floodplains where possible, and retrofitting existing SWM facilities.

4.2.1 Water Balance

Infiltration within a sub catchment joins the groundwater flow system, and under steady state conditions eventually discharges to the surface watercourses as base flow. This simplified version implies that no significant interflow occurs and that no long-term changes occur in the volume of water stored in the surface water and groundwater reservoirs. This suggests that the annual precipitation, P, is equal to the sum of the average annual stream flow, Q, and the average annual evapotranspiration, ET, such that $P = Q + ET$.

The water balance for the study areas was developed in accordance with Section 3.2 of the 2003 MOE Stormwater Management Planning and Design Manual (Manual). Based on the Management Unit catchment area and an average annual precipitation of 767 mm, the average annual precipitation was calculated as summarized in **Table 4-2**.

The average annual evapotranspiration rate was obtained from Table 3.1 of the Manual. The table takes into account topography, soils, and ground cover. Site specific values were estimated using this table for both existing and proposed conditions, with percent impervious values used to evaluate evapotranspiration and recharge values. The existing and proposed conditions annual precipitation values remain unchanged, with slight modifications applied to evapotranspiration and recharge values to reflect the minor changes between existing and proposed conditions identified in the land use analysis. Values for recharge were further revised for proposed conditions to account for the infiltration that will be provided by the proposed LID measures. Values for LID infiltration were based on an assumed 10 mm rainfall capture, distributed over the total LID treatment area for each measurement unit. MOE climate data was referenced to determine the total number of annual events exceeding 10 mm. This annual volume was applied to the proposed conditions recharge value in **Table 4-2** below. As the intent of the LID measures is mainly to reduce phosphorus loading, the increase in infiltration is secondary, and will have the added benefit of mitigating the effects of development. Detailed calculations are provided in **Appendix C**.

Table 4-2. Water Balance Summary

Parameter	Area (ha)	Imperviousness (%)	Precipitation [P] (m)	Evapo-transpiration [ET] (m)	Infiltration [I]	Runoff [(Q$_s$)]	Q$_s$ Difference Exs vs Prop
EXISTING CONDITIONS							
Management Unit 1	525.64	75.72	4,031,659	684,072	232,278	3,115,308	
Management Unit 2	747.9	75.68	5,736,393	974,927	331,038	4,430,428	
Management Unit 3	251.76	67.06	1,930,999	444,503	150,932	1,335,564	
Management Unit 4	152.72	84.85	1,171,362	124,015	42,109	1,005,238	
Management Unit 5	118.36	86.96	907,821	82,727	28,090	797,004	
Management Unit 6	378.57	45.13	2,903,632	1,113,386	378,053	1,412,193	
Management Unit 7	97.85	52.97	750,510	246,661	83,754	420,094	
Management Unit 8	416.82	76.36	3,197,009	528,154	179,336	2,489,519	
Management Unit 9	518.45	75.39	3,976,512	683,885	232,215	3,060,411	
Management Unit 10	303.33	56.33	2,326,541	710,008	241,085	1,375,448	
Management Unit 11	228.38	85.21	1,751,675	181,047	61,475	1,509,153	
PROPOSED CONDITIONS - WITH LID							
Management Unit 1	525.64	77.86	4,031,659	684,072	226,431	3,121,156	5,848
Management Unit 2	747.9	81.83	5,736,393	974,927	254,369	4,507,098	76,670
Management Unit 3	251.76	74.59	1,930,999	444,503	116,429	1,370,066	34,503
Management Unit 4	152.72	83.97	1,171,362	124,015	44,555	1,002,792	-2,446
Management Unit 5	118.36	88.96	907,821	82,727	40,229	784,865	-12,139
Management Unit 6	378.57	49.7	2,903,632	1,113,386	346,566	1,443,680	31,487
Management Unit 7	97.85	65.05	750,510	246,661	62,241	441,607	21,513
Management Unit 8	416.82	81.32	3,197,009	528,154	142,834	2,526,021	36,502
Management Unit 9	518.45	80.24	3,976,512	683,885	187,576	3,105,050	44,639
Management Unit 10	303.33	73.39	2,326,541	710,008	148,028	1,468,505	93,057
Management Unit 11	228.38	85.85	1,751,675	181,047	67,432	1,503,196	-5,957
PROPOSED CONDITIONS - NO LID							
Management Unit 1	525.64	77.86	4,031,659	623,779	211,806	3,196,074	74,918
Management Unit 2	747.9	81.83	5,736,393	728,389	247,326.04	4,760,678	253,580
Management Unit 3	251.76	74.59	1,930,999	342,891	116,429.43	1,471,679	101,612
Management Unit 4	152.72	83.97	1,171,362	131,218	44,555.45	995,589	-7,203
Management Unit 5	118.36	88.96	907,821	70,039	23,782	814,001	29,136
Management Unit 6	378.57	79.7	2,903,632	1,020,655	139,866.47	1,743,110	299,431
Management Unit 7	97.85	65.05	750,510	183,304	62,241.41	504,964	63,357
Management Unit 8	416.82	81.32	3,197,009	417,340	141,708.80	2,637,960	111,939
Management Unit 9	518.45	80.24	3,976,512	549,109	186,451.21	3,240,951	135,901
Management Unit 10	303.33	73.39	2,326,541	432,638	146,903.33	1,746,999	278,495
Management Unit 11	228.38	85.85	1,751,675	173,213	58,814.70	1,519,647	16,452

Note: Evapotranspiration and Recharge coefficients taken from Table 3.1 of the 2003 MOE SWM Planning and Design Manual.

4.2.2 Additional Peak Flow Studies for the Town of Newmarket

As stated in Section 2-8, hydrological modeling was conducted for the *Hydrology Report for the West Holland River, East Holland River and Maskinonge River Watersheds (*Cumming Cockburn Ltd., 2005). Hydrologic modeling for each watershed was conducted using updated land use information and development plans in order to better understand the impact of urban intensification. The report used an event-based flow model, generating results for a variety of storm events (2, 5, 10, 25, 100 and regional storm events) for key flow points within each watershed (shown in **Figure 4-2**). For the purposes of this report, the results from the key flow points located within and directly outside of the Town of Newmarket's boundary were extracted and can be viewed in **Table 4-3**. The table displays the difference between existing peak flows and modeled future peak flows for the storm events previously listed. Future peak flows under a no SWM control scenario are also included. It can be noted that an increase in peak flow rates occurs at the majority of flow points under the no SWM control scenario.

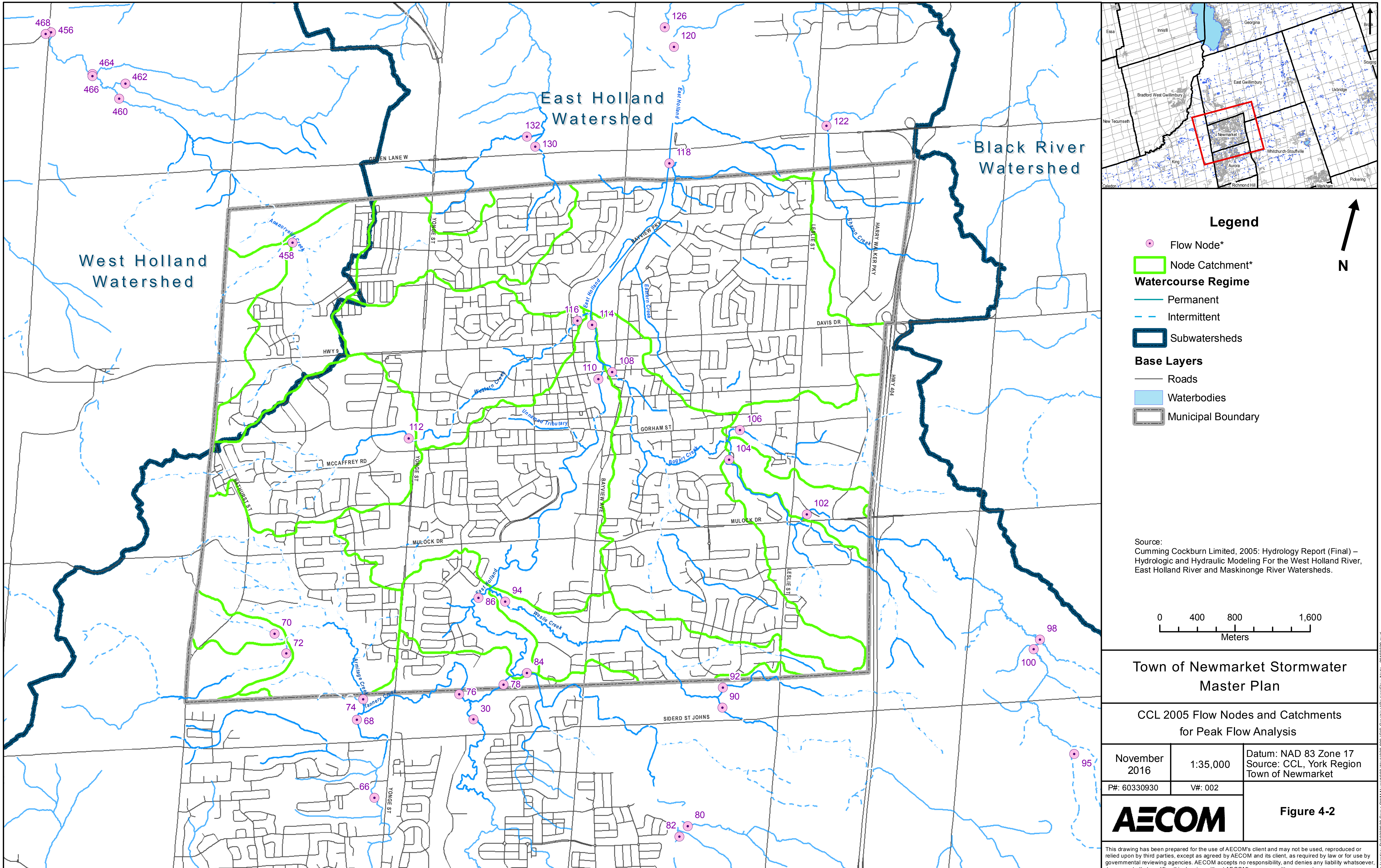
East Holland Watershed
West Holland Watershed
Black River Watershed
GREEN LANE W
HWY 9
DAVIS DR
GORHAM ST
MCCAFFREY RD
MULOCK DR
SIDERD ST JOHNS
YONGE ST
BAYVIEW AVE
BAYVIEW PKY
LESLIE ST
HARRY WALKER PKY
HWY 404
BATHURST ST
East Holland
Eastern Creek
Western Creek
Unnamed Tributary
Bogart Creek
Wesley Creek
Armitage Creek
Tannery Creek
Sharon Creek
Legend
Flow Node*
Node Catchment*
Watercourse Regime
Permanent
Intermittent
Subwatersheds
Base Layers
Roads
Waterbodies
Municipal Boundary
N
Source:
Cumming Cockburn Limited, 2005: Hydrology Report (Final) – Hydrologic and Hydraulic Modeling For the West Holland River, East Holland River and Maskinonge River Watersheds.
0 400 800 1,600
Meters
Town of Newmarket Stormwater Master Plan
CCL 2005 Flow Nodes and Catchments for Peak Flow Analysis
November 2016
1:35,000
Datum: NAD 83 Zone 17
Source: CCL, York Region
Town of Newmarket
P#: 60330930
V#: 002
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Figure 4-2
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Table 4-3. CCL 2005 Peak flow modeling results

Flow Point	Drainage Area (ha)	Type of Simulated Peak Flow	Peak Flows (m^3/s) under Design and Regional Storms						
			2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	Regional
70	41.5	Peak Flow - Existing (m^3/s)	0.5	0.8	1.1	1.5	1.7	2.0	4.4
		Peak Flow - Future (m^3/s)	0.5	0.8	1.1	1.5	1.7	2.0	4.4
		Peak Flow Difference (m^3/s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Peak Flow Difference (%)	0%	0%	0%	0%	0%	0%	0%
		Peak Flow - Future without SWMFs (m^3/s)	0.5	0.8	1.1	1.5	1.7	2.0	
72	256.1	Peak Flow - Existing (m^3/s)	1.4	2.4	3.1	4.1	4.9	5.8	21.5
		Peak Flow - Future (m^3/s)	1.4	2.4	3.2	4.2	5.0	5.9	21.6
		Peak Flow Difference (m^3/s)	0.0	0.1	0.1	0.1	0.1	0.1	0.1
		Peak Flow Difference (%)	1%	2%	2%	2%	2%	2%	0%
		Peak Flow - Future without SWMFs (m^3/s)	1.4	2.4	3.2	4.2	5.0	5.8	
74	688.2	Peak Flow - Existing (m^3/s)	3.0	5.8	8.3	11.4	13.9	16.6	57.8
		Peak Flow - Future (m^3/s)	3.9	7.1	10.5	16.2	19.9	23.2	66.5
		Peak Flow Difference (m^3/s)	0.9	1.3	2.1	4.8	6.1	6.5	8.6
		Peak Flow Difference (%)	30%	22%	26%	42%	44%	39%	15%
		Peak Flow - Future without SWMFs (m^3/s)	6.8	10.5	14.0	18.4	22.1	30.0	
76	3885.3	Peak Flow - Existing (m^3/s)	19.0	31.7	41.5	54.3	65.0	75.9	279.2
		Peak Flow - Future (m^3/s)	21.0	35.0	46.0	60.4	73.1	85.2	298.7
		Peak Flow Difference (m^3/s)	2.0	3.3	4.5	6.2	8.1	9.3	19.5
		Peak Flow Difference (%)	11%	10%	11%	11%	12%	12%	7%
		Peak Flow - Future without SWMFs (m^3/s)	26.1	41.0	51.9	66.3	79.9	92.6	
78	9106.1	Peak Flow - Existing (m^3/s)	23.6	39.3	52.9	70.7	84.7	99.0	400.1
		Peak Flow - Future (m^3/s)	27.1	46.4	61.7	82.6	100.7	117.8	441.4
		Peak Flow Difference (m^3/s)	3.5	7.1	8.8	11.9	16.0	18.7	41.2
		Peak Flow Difference (%)	15%	18%	17%	17%	19%	19%	10%
		Peak Flow - Future without SWMFs (m^3/s)	36.2	55.8	70.0	89.7	107.5	125.2	
84	959.2	Peak Flow - Existing (m^3/s)	5.9	10.5	14.9	20.6	24.6	31.5	84.0
		Peak Flow - Future (m^3/s)	7.2	11.8	16.5	24.5	31.0	36.3	99.6
		Peak Flow Difference (m^3/s)	1.3	1.2	1.6	3.9	6.5	4.8	15.6
		Peak Flow Difference (%)	22%	12%	11%	19%	26%	15%	19%
		Peak Flow - Future without SWMFs (m^3/s)	14.1	22.2	28.2	37.2	49.0	57.2	
86	10065.3	Peak Flow - Existing (m^3/s)	23.2	39.3	52.4	70.7	85.2	99.6	435.9
		Peak Flow - Future (m^3/s)	25.7	44.4	60.3	82.5	100.4	118.0	488.8
		Peak Flow Difference (m^3/s)	2.5	5.1	7.9	11.8	15.2	18.4	52.9
		Peak Flow Difference (%)	11%	13%	15%	17%	18%	18%	12%
		Peak Flow - Future without SWMFs (m^3/s)	37.6	58.2	72.5	95.2	113.6	133.0	
94	1301.1	Peak Flow - Existing (m^3/s)	4.1	7.8	10.1	13.6	16.3	18.9	70.0
		Peak Flow - Future (m^3/s)	4.1	7.8	10.0	13.2	16.1	19.3	86.6
		Peak Flow Difference (m^3/s)	0.0	0.0	0.0	-0.4	-0.1	0.4	16.6
		Peak Flow Difference (%)	-1%	0%	0%	-3%	-1%	2%	24%
		Peak Flow - Future without SWMFs (m^3/s)	7.3	11.3	15.5	20.2	24.1	28.2	
102	1429.4	Peak Flow - Existing (m^3/s)	2.2	3.8	5.0	6.9	8.5	10.2	63.4
		Peak Flow - Future (m^3/s)	2.4	4.1	5.5	7.5	9.4	11.5	68.4
		Peak Flow Difference (m^3/s)	0.2	0.3	0.5	0.6	0.9	1.3	5.0
		Peak Flow Difference (%)	10%	9%	9%	9%	11%	13%	8%
		Peak Flow - Future without SWMFs (m^3/s)	2.6	4.4	5.8	7.9	9.7	11.7	
104	1619.5	Peak Flow - Existing (m^3/s)	2.8	4.8	6.4	8.8	10.7	12.9	74.7
		Peak Flow - Future (m^3/s)	2.9	5.0	6.6	9.4	11.5	13.7	77.9
		Peak Flow Difference (m^3/s)	0.1	0.2	0.3	0.7	0.8	0.8	3.2
		Peak Flow Difference (%)	4%	4%	4%	8%	7%	7%	4%
		Peak Flow - Future without SWMFs (m^3/s)	5.8	8.4	10.5	13.1	15.1	18.8	
106	234.2	Peak Flow - Existing (m^3/s)	3.0	6.9	8.3	11.6	13.3	15.3	30.4
		Peak Flow - Future (m^3/s)	3.0	6.9	8.3	11.5	13.1	15.1	30.7
		Peak Flow Difference (m^3/s)	0.0	0.0	0.0	-0.1	-0.2	-0.2	0.3
		Peak Flow Difference (%)	2%	0%	0%	-1%	-2%	-1%	1%
		Peak Flow - Future without SWMFs (m^3/s)	10.2	14.9	18.0	23.5	27.0	30.6	

Flow Point	Drainage Area (ha)	Type of Simulated Peak Flow	Peak Flows (m^3/s) under Design and Regional Storms						
			2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	Regional
108	2288.4	Peak Flow - Existing (m^3/s)	7.6	13.0	17.8	24.5	30.0	35.4	127.7
		Peak Flow - Future (m^3/s)	9.6	14.9	20.2	28.5	35.0	42.2	140.3
		Peak Flow Difference (m^3/s)	2.0	1.9	2.4	4.1	5.0	6.8	12.5
		Peak Flow Difference (%)	26%	15%	13%	17%	17%	19%	10%
		Peak Flow - Future without SWMFs (m^3/s)	22.4	32.5	40.9	57.3	66.9	78.0	
110	11834.9	Peak Flow - Existing (m^3/s)	27.3	45.8	60.3	80.5	96.1	111.7	478.2
		Peak Flow - Future (m^3/s)	30.3	51.8	70.2	94.3	113.6	133.1	541.1
		Peak Flow Difference (m^3/s)	3.1	6.0	9.9	13.7	17.5	21.4	62.9
		Peak Flow Difference (%)	11%	13%	16%	17%	18%	19%	13%
		Peak Flow - Future without SWMFs (m^3/s)	45.4	68.8	85.1	108.3	127.6	146.3	
112	324.4	Peak Flow - Existing (m^3/s)	5.3	8.0	9.8	12.1	13.9	16.4	38.7
		Peak Flow - Future (m^3/s)	5.1	7.8	9.5	11.7	13.4	15.9	38.7
		Peak Flow Difference (m^3/s)	-0.1	-0.2	-0.3	-0.4	-0.5	-0.5	0.0
		Peak Flow Difference (%)	-2%	-3%	-3%	-3%	-4%	-3%	0%
		Peak Flow - Future without SWMFs (m^3/s)	10.2	15.1	18.3	24.4	28.2	32.2	
114	599.9	Peak Flow - Existing (m^3/s)	13.5	21.0	25.8	32.3	37.3	42.5	69.1
		Peak Flow - Future (m^3/s)	13.2	20.3	24.7	30.8	35.7	40.8	69.6
		Peak Flow Difference (m^3/s)	-0.3	-0.7	-1.1	-1.5	-1.6	-1.7	0.4
		Peak Flow Difference (%)	-2%	-4%	-4%	-5%	-4%	-4%	1%
		Peak Flow - Future without SWMFs (m^3/s)	19.0	28.7	34.8	43.5	50.0	56.5	
116	14123.3	Peak Flow - Existing (m^3/s)	32.2	54.1	70.9	94.2	112.3	131.1	573.7
		Peak Flow - Future (m^3/s)	35.8	60.8	81.8	109.6	131.8	154.4	648.9
		Peak Flow Difference (m^3/s)	3.6	6.8	10.9	15.4	19.5	23.3	75.2
		Peak Flow Difference (%)	11%	13%	15%	16%	17%	18%	13%
		Peak Flow - Future without SWMFs (m^3/s)	58.3	91.6	116.9	148.7	176.3	203.3	
118	15415.5	Peak Flow - Existing (m^3/s)	35.6	58.7	75.7	98.4	115.5	133.6	594.6
		Peak Flow - Future (m^3/s)	39.2	65.4	85.1	110.7	129.8	153.7	670.3
		Peak Flow Difference (m^3/s)	3.6	6.7	9.5	12.4	14.3	20.1	75.8
		Peak Flow Difference (%)	10%	11%	13%	13%	12%	15%	13%
		Peak Flow - Future without SWMFs (m^3/s)	69.0	102.1	123.9	148.9	172.4	195.4	
458	426.7	Peak Flow - Existing (m^3/s)	2.8	4.8	7.0	9.5	12.4	14.4	36.4
		Peak Flow - Future (m^3/s)	4.2	8.2	10.6	15.9	19.3	23.4	52.6
		Peak Flow Difference (m^3/s)	1.4	3.4	3.6	6.3	6.9	9.0	16.2
		Peak Flow Difference (%)	49%	70%	52%	67%	56%	62%	45%
		Peak Flow - Future without SWMFs (m^3/s)	10.9	17.3	21.3	28.3	33.0	37.8	

In addition to the CCL 2005 Study, two of the Town of Newmarket's Official Plan Amendments (OPA) made water quantity control recommendations for future development. The OPAs included peak flow analysis to determine the overall impact of future development on local watercourses. Both OPAs found that post development peak flows increased under an uncontrolled future scenario. The following recommendations were made in each OPA:

Armitage Valley Southwest Newmarket Master Servicing Update (Schaeffers, 2001)

- Recommended that a 2 year (36mm) 24 hour detention erosion control be implemented within the watershed
- Recommended that quantity control for post development conditions remain consistent with pre-development conditions through the use of SWM controls.
- Recommended four SWM ponds were to be used to service the proposed development; see **South West Newmarket Land Use Plan- Location of Official Plan Amendment 6, (**Figure 1 Armitage Valley Southwest Newmarket Land Use Plan), from the February 2009 Armitage Valley Southwest Newmarket Master Servicing Update prepared by Schaeffer & Associates Ltd)
    - Pond A is an existing pond. Pond retrofitting was recommended to allow the pond to handle the increased amount of stormwater runoff.
    - Pond B and C are existing ponds that were relocated to help better service the new community.

- Pond D was created to help further control the increased stormwater runoff from the new development.

- Recommended that ponds be designed with the ability to adequately control 100 year storm events.

Woodland Hills Subdivision – Phase 1 (Schaeffers, 2000)

- Recommended major and minor systems to be designed to convey flows up to and including 100 year storm events to end-of-pipe controls.
- Recommended retrofitting the existing pond (Pond E2) to accommodate the increased run-off associated with post-development conditions, (see **North West Newmarket - Location of Official Plan Amendment 55,** Figure 1.1 and Figure 1.2 of from the January 2000 Woodland Hills Subdivision – Phase 1 Northwest Newmarket OTTSWMM and H.G.L. Analysis, prepared by Schaeffer & Associates Ltd).

While both OPAs pertain more to localized development within the Town of Newmarket their methods and recommendations for water quantity control can act as guidelines for future development in Newmarket.

4.3 Stream Morphology

Watercourses are dynamic features that are constantly adjusting their boundaries to achieve equilibrium and erosion is a natural and necessary process that occurs along all watercourses. However, erosion processes may also be accelerated by anthropogenic impacts, notably urbanization. When urbanization occurs the catchment becomes more impervious than under natural vegetative conditions. As such, urbanization drastically alters the flow regime of receiving watercourses by increasing the intensity and frequency of channel altering flood events. Depending on the magnitude of land use and degree of stormwater management control, the impacts on the channel may include accelerated adjustment (e.g., bank and bed erosion, meander migration) that may result in risk to property or infrastructure. Channels throughout the Town of Newmarket are currently adjusting to historic land use changes. Further changes in land use could have the potential to exacerbate channel adjustments.

Aside from change in flow regime, the following are potential impacts/consequences of urban development on stream morphology that should be considered as the Town of Newmarket continues to evolve and grow:

- *Channelization of Watercourses:* In an effort to reduce the area of a watercourse, reaches are often straightened. Straightening a channel increase the energy gradient which causes the channel to become unstable and shift towards a new equilibrium.
- *Changes in Sediment Supply Regime:* Land use change alters the quantity and calibre of sediment supplied to the channel which can drastically change channel morphology.
- *Reduction in Riparian Vegetation:* Locally, loss of riparian vegetation can increase runoff and accelerate sediment supply. As well, a reduction in riparian vegetation drastically reduces bank strength which can lead to increased scouring and channel migration.
- *Loss of Channels:* Often ephemeral headwater channels are buried/removed to make way for development/infrastructure. Loss of headwater channels alters the natural flow and sediment supply regimes.

Future land use change was assessed in each management unit from a stream morphology perspective. Units #1 and #4 are considered high constraint as channels within these units have been historically straightened (i.e. reduction in channel length) leading to high stream power which has caused bank and bed scouring. Also, debris and sediment accumulations were noted throughout these management units. As well, several headwater tributaries have been removed during previous development. Future land use conditions in both units indicate an increase in Urban Centre land use. Further urbanization within these units can exacerbate channel instability and erosional issues through flow and sediment regime alteration and reduction in riparian vegetation. This increased channel instability degrades aquatic and riparian habitat and can put surrounding infrastructure at risk.

The other nine management units do not pose the potential risk that Units 1 and 4 do. However, as development occurs throughout the Town of Newmarket the potential impacts/consequences of urban development on stream morphology as noted above should be considered.

Furthermore, although urban development can often negatively impact stream morphology, future changes in land use can present opportunities to improve stream morphological conditions. The following are opportunities to improve stream morphological conditions throughout the Town of Newmarket, and especially within Management Units 1 and 4:

- *Re-establish Riparian Vegetation:* Rooting systems of riparian vegetation drastically increases bank strength which reduces bank erosion and channel migration.
- *Naturalize Previously Altered Reaches:* Applying the principles of natural channel design to previously altered/channelized reaches will improve reach stability and the quality and quantity of aquatic habitat.
- *Re-establish Floodplain:* Urban development often occurs within a channel's floodplain and well into the riparian zone. The floodplain can be re-established by removing anthropogenic fill, wetland creation, and reducing impervious surfaces. Re-naturalizing the floodplain provides water and sediment storage which reduces the magnitude of flood events and curtails fine sediment loading as well as improves aquatic and terrestrial habitat.

4.4 Hydrogeology

Changes in land use which results in a net increase in impervious surface area has the potential to reduce the quantity of aquifer recharge from infiltration. The magnitude of potential impact will be dependent on a combination of pre-existing soil properties and topography within the subject area. For example, highly permeable soils (i.e. sand and/or gravel) offer high infiltration rates and are typically designated as groundwater recharge areas. Increases in the amount of impervious surface arising from land use changes within these areas will pose a more significant impact on groundwater recharge rates as compared to those areas which are dominated by fine-textured soils (i.e., silt, clay and till) which offer a lower infiltration opportunity and are subject to proportionately high quantities of surface run off. As illustrated in **Figure 2-5**, the study area is dominated by fine-textured soils that generally offer minimal opportunities for groundwater recharge. The only component of the study area designated as a groundwater recharge area is located within the ORM, which encompasses a portion of Management Units 1, 6, and 10. Since future land use within the ORM is restricted, the only areas in which there could potentially be a net increase in impervious surface area due to future development will occur outside of the designated groundwater recharge area. Therefore, potential impacts related to groundwater recharge are considered minor within the study area.

Increases in groundwater demand (i.e., municipal pumping) will occur as a result of planned future development within the study area. Currently, there are four (4) municipal water supply wells located within the study area, as identified in **Figure 2-7**. These wells obtain their source water from deep aquifer systems (Thorncliffe Aquifer and the Yonge Street Aquifer) that generally are not considered to be hydraulically connected to local surface water features, such as wetlands and coldwater streams. Although increases in municipal pumping will pose a low likelihood of impacting the quantity and/or quality of groundwater discharge within the study area, municipal groundwater taking from the deep aquifers and subsequently discharged via sewage treatment would not be returned to the same subwatershed.

Increases in groundwater use for the purpose of private water supply (i.e., domestic, commercial and/or industrial purposes) may derive their source from shallow aquifers. Shallow aquifers have a high potential to be hydraulically connected to local surface water features, and therefore, an increase in private water supply demand may potentially impact groundwater discharge to local surface water features within the area of influence.

Reduction in groundwater quality due to the increased application of winter road maintenance products (i.e., salt, brines, etc.), hydrocarbon impacts from roadways, and nutrient loading from fertilizer use (primarily nitrogen, potassium and Phosphorus) within areas of surficial sand deposits applies to areas within the ORM. Outside the ORM, there is no significant pathway from the surface to the underlying aquifer due to thick low permeability aquitard materials at surface, with the exception of areas with coarse-textured alluvial deposits and glaciofluvial deposits. Therefore, the potential for impacts to groundwater due to increases in these contaminants is considered low.

4.5 Aquatic Ecology

Increases in surface water run-off as a result of increases in impervious surfaces associated with land use changes, such as reductions in natural vegetation cover to support urban land development, may negatively affect receiving watercourses and waterbodies identified in the study area. Increased volumes and velocities of surface water flowing into nearby watercourses may cause stream bank and bed erosion, increases in turbidity, increases in water temperatures and decreases in water quality, all of which can lead to degradation of aquatic habitats. Additionally, eutrophication of watercourses and waterbodies, in which algal blooms form in response to increased level of nutrients, may result from increases in phosphorus loading. Consequently, this may also lead to increased turbidity, decreased water quality, decreased aquatic species diversity, and may also lead to anoxic conditions of the affected watercourse and water body (Chislock *et al*., 2013). Aquatic features identified as being potentially affected by increased run-off and phosphorus loading due to changes in future land use are described below.

Management Units 2, 3, 5 and 6 contain tributaries of Bogart Creek, Weslie Creek, Sharon Creek and Armitage Creek that are identified as cold water reaches, respectively. These reaches may support cold water aquatic species that are sensitive to changes in water temperature and water quality. Reductions in open space and natural heritage lands for future development within Management Units 2 and 3 are anticipated to result in increased volumes of surface water entering Bogart Creek and Weslie Creek, respectively, due to increases in impervious surfaces. Both Management Units are anticipated to have a moderate increase in phosphorus loading. No significant changes in land use or surface water run-off are anticipated for Management Unit 5; however, there is anticipated to be a moderate to high increase in phosphorus loading. Most of Armitage Creek and its tributaries fall within the Oak Ridges Moraine Boundary within Management Unit 6. Increases in impervious areas as result of future development within this management unit are limited to outside of the Oak Ridges Moraine, and there are no anticipated changes in phosphorus loading. Potential impacts to Armitage Creek in Management Unit 6 are considered to be relatively minor.

The remaining tributaries of the East Holland River, Western Creek, and Tannery Creek in the other Management Units are identified as warm water reaches that may support aquatic species that are tolerant of some environmental disturbances and less sensitive to changes in water temperature. With the exception of Management Unit 11, all of these Management Units are anticipated to have an increase in surface water run-off resulting from increases in impervious surfaces. Management Units 4, 10 and 11 are anticipated to have reductions in phosphorus loading, while the remaining units show small to moderate increases.

4.6 Terrestrial Ecology

Wetlands, woodlands and other vegetation communities may be susceptible to land use changes that lead to large increases in run-off volume and increases in phosphorus loading. In particular, wetlands are key components of a terrestrial ecosystem and serve many ecological functions, including natural stormwater management. Wetlands can attenuate flooding, maintain and improve water quality, provide erosion protection, control and store surface water, recharge and discharge groundwater, support habitat for a diversity of plant and wildlife species and provide corridors for wildlife movement (LSRCA, 2014b). Woodlands also have important functions such as water and air quality improvement, floodwater attenuation, maintenance of groundwater quantity and quality, increase in infiltration and provision of habitat for wildlife species (Government of Canada, 2014). Hydrology is important to these features' ecological composition, structure and functions (TRCA, 2012). Increases in run-off may increase surface water inputs and decrease availability of groundwater, change soil moisture conditions and change species composition and community structure, which may reduce the ecological functions of wetlands, woodlands and other vegetation communities (TRCA, 2012). Aquatic features identified as being potentially affected by increased run-off and phosphorus loading due to changes in land use within the study area are described below.

All of the Management Units contain areas with either significant forests, unevaluated wetlands and/or other natural areas that provide wildlife habitat and are a part of the Town of Newmarket's Natural Heritage System. All of the Management Units are anticipated to have an increase in surface water run-off due to land use changes, with the exception of Management Units 5 and 11. Open space is proposed to be reduced in Management Units 2, 3, 8 and 10 for future residential, commercial, urban and/or employment area developments.

The Locally Significant Newmarket Wetland is located in Management Unit 2. A small parcel of residential area contributing surface run-off to this wetland is planned to be replaced by a commercial area, which will likely result in more impervious surfaces than residential areas (Town of Newmarket, 2009). It is also expected that use of road salts will increase from existing conditions, which will decrease the water quality directly flowing into this wetland.

The Provincially Significant Ansnorveldt Wetland Complex is located in Management Unit 10. Some adjacent areas of open space and the Natural Heritage System lands will be removed for residential development but not the wetland itself. An impact assessment will be required if any development is planned within 120 m of this Provincially Significant Wetland.

Riparian vegetation along tributaries of Bogart Creek, East Holland River and Arnosveldt Creek in Management Units 2, 7, 9 and 10 function as low quality natural corridors that may facilitate wildlife movement. If vegetation removal is planned in support of future development, this may further decrease the quality of these natural corridors.

Management Unit 8 contains two conservation areas, Wesley Brooks and Bailey Ecological Park. Management Unit 9 contains Mabel Davis and Queen Street Conservation Areas. There are no significant changes in the natural vegetation cover from existing conditions in these conservation areas.

Portions of Management Units 1, 6 and 10 fall within the Oak Ridges Moraine boundary. The Glenville Hills Kames Provincial Candidate Life Science ANSI is located within Management Units 1 and 6. Land use changes associated with increased impervious surfaces within Management Units 1, 6 and 10 are limited to outside of the Oak Ridges Moraine.

Management Units 1, 2, 3, 5, 7, 8 and 9 are expected to have small to moderate increase in phosphorus loading as result of future changes in land use. No change in phosphorus loading is expected in Management Unit 6, and phosphorus loading in the remaining Management Units 4, 10 and 11 is expected to decrease. Generally, increases in surface water run-off as result of increased impervious surfaces, and increases in phosphorus loading may potentially change the hydrology and negatively impact the features identified above. Impacts on significant forests, unevaluated wetlands and ANSIs located within the Oak Ridges Moraine are considered to be minimal given the lack of future land use change in these areas within Management Units 1, 6 and 10.

4.7 Water Quality

The proposed intensification of the Town of Newmarket as identified in the future land uses indicate that water quality control measures will be required to mitigate the negative effects on water quality that are associated with increased development. Low Impact Development methods for Proposed water quality control measures are discussed in further detail in subsequent sections of this report, along with suggested retrofits to existing SWM facilities.

4.8 Water Quantity

The Town has developed Master Drainage Plans to address potential peak flow increases as part of the NW and SW Newmarket Secondary Plans, and will continue to do so in the future. An increase in runoff quantity could be expected from the intensification of the Town of Newmarket, which should be managed on a site-specific basis as development is identified and proceeds through the design stages. On a broader level, water quantity control is addressed in this report as it is mitigated to some extent through the implementation of the proposed LID measures and the SWM facility retrofits. Quantifying the level of water quantity control as a direct result of these measures is difficult without running a hydrologic model to determine peak runoff values, however, the implementation of the LID measures and the retrofit of SWM facilities will provide water quantity and peak flow controls. The SWM facility retrofits will provide water quantity and peak flow controls in that under the post-retrofit scenario the SWM facilities will be functioning at their full design capacities. General volumetric quantities were determined based on the proposed LID retrofits. Volumes were calculated by applying an assumed rainfall capture depth across the area to beg treated by the LID methods. The rainfall capture depth was assumed to be 10 mm, and MOE climate data was used to determine the number of annual rainfall events that exceeds 10 mm (i.e. the number of events that would maximize the available LID infiltration volume). The areas to be treated can be found in **Appendix B** as part of the LID design calculations.

Table 4-4. Water Quantity Calculations

Parameter	Area treated by LID (infiltration) (ha)	Number of Annual Storm events > 10 mm*	Difference Δ (m^3)
PROPOSED CONDITIONS			
Management Unit 1	6.5	22.5	14,625
Management Unit 2	3.13	22.5	7,043
Management Unit 3	0	22.5	-
Management Unit 4	0	22.5	-
Management Unit 5	7.31	22.5	16,448
Management Unit 6	0	22.5	-
Management Unit 7	0	22.5	-
Management Unit 8	0.5	22.5	1,125
Management Unit 9	0.5	22.5	1,125
Management Unit 10	0.5	22.5	1,125
Management Unit 11	3.83	22.5	8,618

*Number of annual storm events exceeding 10 mm derived from MOE climate data.

5. Improvement and Retrofit Opportunities {Step 7}

In 1999 the LSRCA completed a study which recommended retrofits for six SWM facilities in the Town of Newmarket. To date five of the facilities have been retrofitted. **Table 5-1** below summarizes completed and LSRCA recommended retrofits. Retrofits of SWM ponds allow for the SWM quality component of the ponds to be restored or upgraded, thereby improving the Phosphorus removal efficiency in conjunction with the sediment removal efficiency. Further, Phosphorus removal for ponds was evaluated as part of the 2007 UYSS offset program. Four ponds were identified for retrofit to offset phosphorus loading increases due to the proposed Water Reclamation Centre.

The Lake Simcoe Basin Stormwater Management and Retrofit Opportunities (2007) report by the LSRCA has identified the need for a complete, consistent, and contemporary data set associated with stormwater runoff in the Lake Simcoe Watershed. This data set includes all urban catchments, outlets, existing SWMFs and locations, and phosphorus loads associated with stormwater runoff in the Town of Newmarket. This report also identifies retrofit opportunities including facilities that can be upgraded, or areas that can support a SWMF. A total of 16 of these opportunities in Newmarket have been identified, affecting a total of 959.95 hectares. The total estimated cost associated with the proposed retrofits is $11,836,184.00, with a potential phosphorus reduction of 776.48 kg/yr. The following **Table 5-1** shows the Newmarket pond retrofit opportunities as provided in the LSRCA 2007 report.

Table 5-1. Newmarket Retrofit Opportunities (LSRCA, 2007)

Pond ID	Size of SWMP (m^3)	Phosphorus Reduction (kg/yr)	Estimated Cost ($150/$m^3$ excavated)	Estimated Cost (per kg P removed)	Constraints	Retrofit Status	Retrofits Recommended by LSRCA in 1999 or 2007 UYSS	UYSS 2007 Phosphorus Removal Estimates (kg/yr)
3	4,709	19	$706,434	$35,481	None		Retrofit of existing level 3 wet pond to level 1 wet pond	-
19							Install flow splitter; construct 0.3m deep wetland with plunge pools and sediment forebay 3,946m^3.	-
22	n/a	n/a	$20,000	n/a	None		Major maintenance and repair of existing pond including new outfall and restoration	-
37						Silt was removed from this pond in August 2008		-
N-SE4, 35	16,552	123	$2,482,891	$20,159	Potential fisheries concerns		Combine level 2 wet pond and quantity pond to form level 1 wet pond to treat both catchments	-
38						In 2006, the town completed retrofit for quality control of the Leslie street SWM pond located on the east side of Leslie street approximately 350m south of Gorham Street.	Construct 2m deep wet pond parallel to watercourse 4,730m^3. Retrofit existing pond to provide a level 3 wet pond.	-
39	1,930	16	$289,627	$17,757	Fisheries concerns		Retrofit of existing quantity pond to level 1 wet pond	-
41							Remove internal access roads and over excavate west and east ponds 2m deep. West pond = 1,405m^3 East pond= 1,292m^3. Retrofit the existing east and west ponds to provide level 3 protection.	-
42						LSRCA completed the dredging of a section of Fairy Lake in 2008 (Water Street)		-
44	3,307	28	$496,140	$17,757	None	In 2008, LSRCA was successful in its application to Environment Canada to retrofit the pond in George Richardson Park (East side of Bayview Parkway	Retrofit of existing quantity pond to level 1 wet pond . Install forebay and excavate as required to provide 3,133m^3 of storage.	-

Pond ID	Size of SWMP (m^3)	Phosphorus Reduction (kg/yr)	Estimated Cost ($150/$m^3$ excavated)	Estimated Cost (per kg P removed)	Constraints	Retrofit Status	Retrofits Recommended by LSRCA in 1999 or 2007 UYSS	UYSS 2007 Phosphorus Removal Estimates (kg/yr)
						approx 500m south of Elgin Street) A red sand filter was installed to remove Phosphorus.		
74	2,821	42	$423,223	$9,881	None	Planned as part of the UYSS Water Reclamation Project.	Retrofit of existing quantity pond to level 2 wet pond. Remove internal access roads and over excavate west and east ponds 2m deep. West pond = 1,405m^3 East pond= 1,292m^3. Retrofit the existing east and west ponds to provide level 3 protection.	23
26/N-CE18	3,067	46	$460,090	$9,881	None	Planned as part of the UYSS Water Reclamation Project.	Retrofit of existing quantity pond to level 2 wet pond	25
N-CE4, 76	3,467	53	$520,108	$9,647	Pond footprint would be located in park		Retrofit of existing quantity pond to level 2 wet pond	-
76	13,139	126	$1,970,887	$15,624	Pond would be located in East Gwillimbury		Retrofit of existing quantity pond to level 1 wet pond	-
77						In 2001 the Town constructed the SWM/QUALITY pond beside 395 Mulock Drive (municipal offices).	Install flow spiller, maintain channel as overflow, and excavate 2m deep 11,713m^3 wet pond. Preserve existing trees. Construct a level 1 wet pond at an estimated cost of $150 000.	-
80							Construct 0.3m deep wetland with plunge pools and forebay – 1,546m^3	-
81, N-CW2, 8, 79, N-CW7	4,842	n/a	$726,340	n/a	None, phosphorus reduction could not be calculated for wetland, therefore estimated cost per kg P removed cannot be calculated	Planned as part of the UYSS Water Reclamation Project.	Retrofit of existing quantity pond to level 2 wetland pond. Install flow splitter; construct 0.3m deep wetland with plunge pools and sediment forebay 3,946m^3.	132
84	9,659	81	$1,448,956	$17,754	Pond located on	Planned as part of the UYSS Water	Retrofit of existing quantity pond to level 1	56

Pond ID	Size of SWMP (m^3)	Phosphorus Reduction (kg/yr)	Estimated Cost ($150/$m^3$ excavated)	Estimated Cost (per kg P removed)	Constraints	Retrofit Status	Retrofits Recommended by LSRCA in 1999 or 2007 UYSS	UYSS 2007 Phosphorus Removal Estimates (kg/yr)
					Town of East Gwilimbury property	Reclamation Project.	wet pond. Construct 0.3m deep wetland with plunge pools and forebay – 1,546m^3.	
87, N-NE7	3,650	94	$547,519	$5,787	Fisheries concerns		No existing pond, room for level 3 wet pond.	-
89	6,154	97	$923,221	$9,489	None	Planned as part of the UYSS Water Reclamation Project.	Retrofit of existing quantity pond to level 2 wet pond and LID in adjacent grass roadside ditches.	36
N-NE9	3,790	32	$568,618	$17,758	Some tree removal		No existing pond, room for level 1 wet pond.	-
N-NW7	1,263	10	$189,483	$17,758	Property ownership and tree removal		No existing pond, room for level 1 wet pond.	-
N-SW6	418	4	$62,641	$17,745	Some tree removal		No existing pond, room for level 1 wet pond.	-
	Total:	**776.48**	**$11,836,184**					

Stormwater Management Facility Inventory and Maintenance Needs Plan (AECOM, 2009) recommended retrofits for the SWMFs in Newmarket. It was determined that the design of 17 of the facilities do not provide adequate storage based upon MOE design guidelines. The ponds that did not meet MOE design guidelines as noted in the 2009 report are listed in **Table 5-2.**

Table 5-2. Ponds not meeting MOE Guidelines for Water Quality Control (AECOM, 2009)

Pond ID	Catchment Area (ha)	% Impervious of Contributing Area	MOE Guideline for Minimum Available Storage Required (m^3)	Permanent Pool Volume (m^3)	Additional Storage Required to meet MOE Guidelines for Minimum Available Storage (m^3)
39	15.4	42	1,151	893	878
84	80.3	33	4,763	43	3,401
34	25.5	47	2,117	690	1,427
86	8.4	26	392	11	258
74	47.6	35	2,964	491	1,772
44	53.6	42	4,026	2,701	1,325
58	22.3	45	1,795	1,533	262
70	66.8	67	7,974	4,452	3,522
89	26.6	77	3,627	1,302	603
41	49.3	30	2,681	909	2,473
1	11.8	74	1,533	655	521
19	70.6	28	3,602	201	5,781
80	15.4	29	720	199	4720
81	76.6	44	5,981	200	381
73	14.0	26	603	0	2,325
91	8.7	52	803	0	803
92	23.8	57	1,829	36	1,793
Notes: None of the listed ponds have been retrofitted to date					

The Upper York Sanitary Solutions EA evaluated the options for the required phosphorus offset to reduce phosphorus inputs to the East Holland Subwatershed due to increases in Phosphorus loading from the proposed Water Reclamation Centre. This review identified stormwater pond retrofits to water quality wet-ponds or using Low Impact Development Best Management Practices as the preferred alternative. Ponds 26, 70, 74, and 89 will be retrofitted by 2021 by York Region.

5.1 Opportunities for Additional Infiltration - Low Impact Development

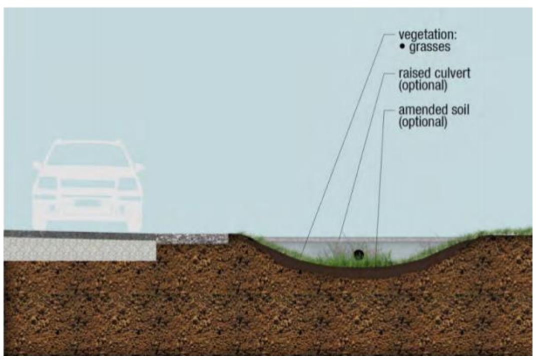
Low Impact Development (LID) provides opportunities for urban development to maintain the natural hydrologic cycle by collecting and filtering stormwater naturally, and directing the water back into the ground as under pre-development conditions. In addition to the SWM facilities, LID measures may also help to reduce phosphorus loading, by reducing runoff volumes and allowing filtration of stormwater through soil media.

LID measures may include infiltration trenches, rain gardens, and road right of way options including bioretention, roadside swales, perforated pipes, and pervious pavement. LID measures reduce runoff volume, help prevent soil erosion, filter pollutants, recharge groundwater, and enhance streetscapes. Design features such as curb cuts or urban road sections may be used in conjunction with LID methods to provide a surface water flow path to enhanced ditches or bioretention swales.

Enhanced grass swales are vegetated open channels designed to convey, treat and attenuate stormwater runoff. Check dams and vegetation slow the water to allow suspended particulates to settle out, and infiltration through the root zone also allows for uptake of nutrients by the vegetation. In addition to providing a water quality control component to stormwater runoff, enhanced grass swales also reduce impervious cover and accent the natural landscape, providing aesthetic benefits.

Rain gardens are shallow depressions designed with bioretention features that are suited to receive overland flows diverted from paved areas. Bioswales are similar to enhanced grass swales in terms of the design , however they also incorporate aspects of bioretention cells consisting of bioretention soil media, a gravel storage layer, and optional underdrain components. They can significantly enhance neighbourhood aesthetics when planted with vegetation that tolerates both dry and wet growing conditions. Infiltration methods such as perforated pipes (e.g. the Etobicoke System) provide water quality and quantity control. Perforated pipes are generally wrapped in filter fabric to prevent blockage of the perforations and encased in a granular stone trench. Water flowing within the pipe is able to exfiltrate into the surrounding soil as it is conveyed through the pipe. **Figure 5-1** shows various LID options.

Figure 5-1. LID Options

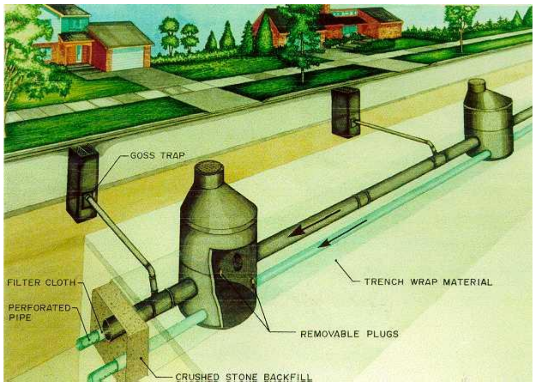


Enhanced Grass Swale – "Grey to Green Road Retrofits", Credit Valley Conservation

Enhanced Grass Swale – Prien & Newhof

Bioretention Swale – "Grey to Green Road Retrofits", Credit Valley Conservation

Rain Garden in Residential Neighbourhood, Credit Valley Conservation



Etobicoke Exfiltration System, Ryerson University

Residential Rain barrel, Credit Valley Conservation

Maplewood Mall, Minnesota Rainwater Tank, Credit Valley Conservation

Green Roof, Credit Valley Conservation

5.2 Low Impact Development Measures and Phosphorus Removal Methods

As discussed earlier in this report, the impacts of providing LID measures for phosphorus removal were investigated as part of this study. The removal efficiencies for proposed conditions are the same as those presented earlier in this report.

Infiltration via soakaway pits or infiltration trenches was generally recommended for captured rooftop runoff from appropriate sites. Rooftop runoff is generally considered ‘clean’ and requires no treatment prior to infiltration. For the purposes of the phosphorus loading calculations, a land use of Low Intensity Development was applied to the rooftop runoff to reflect the relatively clean nature of the roof runoff, even if the site location itself would be classified as High Intensity. For the remainder of the removal efficiencies, the applicable land use was attributed to the location for which the LID was proposed. Potential BMP locations are shown on **Figure 5-2**.

Additional measures to consider include an education and engagement campaign to invite residents to become part of the solution. Various LID measures could be proposed to the general public to implement, such as the use of rain barrels, rain gardens, providing additional tree canopy, downspout disconnection programs for older neighbourhoods, or the incorporation of LID measures into boulevards. These measures could be reviewed to determine how they could be translated into policies and guidelines.

5.3 Phosphorus Removal under Future Conditions

The impacts of providing SWM BMPs for phosphorus removal were investigated as part of this study. The Phosphorus removal efficiencies by BMP as provided by the PTool are provided in **Table 5-3**.

Table 5-3. Phosphorus Removal Efficiency by BMP

BMP	Phosphorus Removal Efficiency (%)
Bioretention System	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems	77
Green Roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration Trench	60
Sorbtive Media Interceptors	79
Underground Storage	25
Vegetated Filter Strip	65
Wet Detention Pond	63

The methodology used to determine phosphorus removal efficiencies by each non-SWM Facility BMP (LID) was to recreate PTool in an electronic spreadsheet. This allowed for greater flexibility in calculating phosphorus loading and removal rates within the management units. The same phosphorus loading rates and removal efficiencies were applied in the spreadsheet. The total annual phosphorus loading rate was calculated for each management unit for verification. The phosphorus removal rate was then calculated for each non-SWM Facility BMP (LID) treatment type and summarized for each management unit.

For Future Conditions, the PTool was used to determine the Phosphorus removal for the Future Conditions/As Designed scenario. The Future conditions "As Designed" scenario includes Phosphorus removal rates based on all SWM facilities functioning at original Design levels, and proposed LID measures implemented as recommended. **Table 5-4** summarizes the Phosphorus removal rates for the Management Units for all BMPs including SWM facilities and the individual proposed LIDs, for the Future Conditions/As Designed scenario. **Table 5-5** presents a summary of the overall Existing and Future Conditions Phosphorus loading and removal rates for all scenarios.

Table 5-4. Future Conditions "As Designed" Phosphorus Loading and Removal Summary

Management Unit	Area[1] (ha)	Overall P Loading (kg/yr)	Treatment Type	Treatment Method	P Removal Efficiency (%)	P Removal (kg/yr)
1	526.4	676	Potential rooftop infiltration at Upper Canada Mall	Soakaway/infiltration	60	3.48
			Potential rooftop infiltration at Region building (Yonge and Eagle)	Soakaway/infiltration	60	0.63
			Potential parking lot treatment at Ray Twinney complex	Soakaway/infiltration	60	1.42
			All SWM facilities functioning at original design level	SWM Facilities	10-65	151.7
					Total:	**157.2**
2	731.1	926	Potential infiltration by funded LID at Industrial or Commercial site	Soakaway/infiltration	60	0.55
			Potential rooftop infiltration at Magna Centre	Soakaway/infiltration	60	1.19
			Potential infiltration of parking lot runoff at Magna Centre	Soakaway/infiltration	60	1.23
			All SWM facilities functioning at original design level	SWM Facilities	10-65	295.1
					Total:	**298.1**
3	248.4	259	All SWM facilities functioning at original design level	SWM Facilities	65	**38.3**
4	152.7	207	All SWM facilities functioning at original design level	SWM Facilities	65	**8.54**
5	124.3	206	Potential infiltration by funded LID at Industrial or Commercial site	Soakaway/infiltration	60	0.55
			Potential rooftop infiltration – Pony Drive/Stellar Drive	Soakaway/infiltration	60	3.84
			Potential parking lot infiltration – Pony Drive/Stellar Drive	Soakaway/infiltration	60	2.14
			All SWM facilities functioning at original design level	SWM Facilities	10-65	33.5
					Total:	**40.0**
6	369.4	235	All SWM facilities functioning at original design level	SWM Facilities	10-65	**113.4**
7	164.7	152	All SWM facilities functioning at original design level	SWM Facilities	10-65	**86.0**
8	416.8	546	All SWM facilities functioning at original design level	SWM Facilities	10-65	80.4
			Lion's Park restoration - LID catchment wide retrofit program	Soakaway/infiltration	60	0.07
					Total:	**80.5**
9	533.3	644	Bioswale/filter consideration in the Wayne and Waratah intersection	Soakaway/infiltration	60	0.11
			All SWM facilities functioning at original design level	SWM Facilities	10-65	100
					Total:	**100.11**
10	305.9	277	Potential infiltration by funded LID at Industrial or Commercial site	Soakaway/infiltration	60	0.55
			All SWM facilities functioning at original design level	SWM Facilities	10-65	94.5
					Total:	**95.1**
11	241.8	325	Potential parking lot infiltration near Yonge and Bonshaw	Soakaway/infiltration	60	2.44
			Potential rooftop infiltration near Yonge and Bonshaw	Soakaway/infiltration	60	1.27
			All SWM facilities functioning at original design level	SWM Facilities	10-65	54.8
					Total:	**58.5**

Note: 1. Management Unit areas represent the portion of each management unit located within the Town of Newmarket boundary.
2. Phosphorus calculations can be found in Appendix B.

The PTool was also used to determine the results for the Do Nothing scenario, as summarized in **Table 5-5**. For the Do Nothing scenario, it was assumed that no LIDs will be constructed, and that with time all SWM facilities will become sediment laden. Under this scenario, it was assumed that SWM facilities designed as Wet facilities would function at best as dry SWM facilities, with a maximum Phosphorus removal efficiency of 10 percent. It was further assumed that all SWM facilities designed as Dry facilities would provide little to no Phosphorus removal benefits. As such, areas contributing to Dry SWM facilities were modelled as 'untreated' in the Do Nothing scenario.

Table 5-5 presents an overall summary of the Existing and Future conditions Phosphorus loading and removal scenarios. The Existing conditions total Phosphorus loading rate is presented for each of the Management Units. Phosphorus loading rates are then shown for all scenarios including the Existing conditions with SWM controls, Future conditions loading rates for the Do Nothing scenario, Future with retrofit SWM controls, and Future with retrofit SWM and LID controls. The percent improvement as compared to existing conditions loading rates is provided for each scenario.

As summarized in **Table 5-5**, the overall Phosphorus removal efficiency for the Future with retrofit SWM and LID scenario shows an increase in Phosphorus removal ranging from 8 percent to 55 percent. Although the additional Phosphorus removal benefits of the LID measures seem negligible, this is only due to the fact that the LID treatment areas are very small as compared to the SWM facility treatment areas. The LID measures also function to provide additional water quality and quantity benefits and contribute to the balancing of the water budget. The implementations of the proposed SWM facility retrofit and LID measures clearly have a beneficial effect on Phosphorus removal.

Table 5-5. Future Conditions Phosphorus Loading Rates and Removal Rates for SWM Facilities and LID

			Existing Conditions			Future	Uncontrolled (Do Nothing[3])		Future- SWM retrofits		Future- SWM retrofits & LID	
Management Unit	SWM Facilities[1]	Area[2] (ha)	Existing Development without SWM – Annual TP Loading (kg)	Existing Development & Existing SWM – Annual TP Loading (kg)	Effectiveness of Existing SWM (% of TP loading reduction &/or comments)	Total Annual TP Loading (kg)	- Annual TP Loading (kg)	Change from Existing (% TP reduction)	- Annual TP Loading (kg)	Change from Existing (% TP reduction)	- Annual TP Loading (kg)	Change from Existing (% TP reduction)
1	3,4,8,9,12,13,14, 52,~~66~~,79,~~80,81,~~ ~~83~~	526.4	696.8	546.5	22	676.0	652.4	6	524.3	25	518.8	26
2	26,34,35,~~36,37~~, 38,39,~~40,~~41,53~~,~~ ~~54,57,61~~,64,65, 74,~~75~~,93,~~96~~, 98,101	731.1	978.6	760.3	22	926.0	879.9	10	630.8	36	627.9	36
3	~~28~~,29,30,~~31,~~ 58,~~73~~,102	248.4	238.6	204.7	14	258.9	254.0	-6	220.5	8	220.6	8
4	63,76	152.7	224.0	215.2	4	207.1	207.1	8	198.6	11	198.6	11
5	70,~~89~~	124.3	223.6	193.6	13	202.7	197.4	12	169.2	24	162.7	27
6	~~27,32,~~33,~~51~~, 55,56,62, 71,97	369.4	260.5	210.5	19	234.8	216.8	17	121.4	48	121.4	48
7	5,16,17,18,19, 22,23/24,~~25~~	164.7	151.3	69.5	54	151.8	137.4	-9	69.8	54	69.8	54
8	~~42~~,77,91,92	416.8	553.6	474.6	14	546.1	533.8	4	465.7	16	465.6	16
9	43,~~44,46,47,48,4~~ ~~9,50,59,60~~,85, 86,87,88	533.3	687.9	651.3	5	644.2	562.0	18	544.3	21	544.1	21
10	6,7,10,11,~~45~~,67, 68,~~94~~,95, 99 (MQ2), WQ1, MQ4	305.9	223.5	150.2	33	256.4	242.3	-8	161.9	28	161.3	28
11	1,2,~~84~~	241.8	349.0	271.0	22	324.6	315.9	9	269.8	23	266.1	24

Notes:

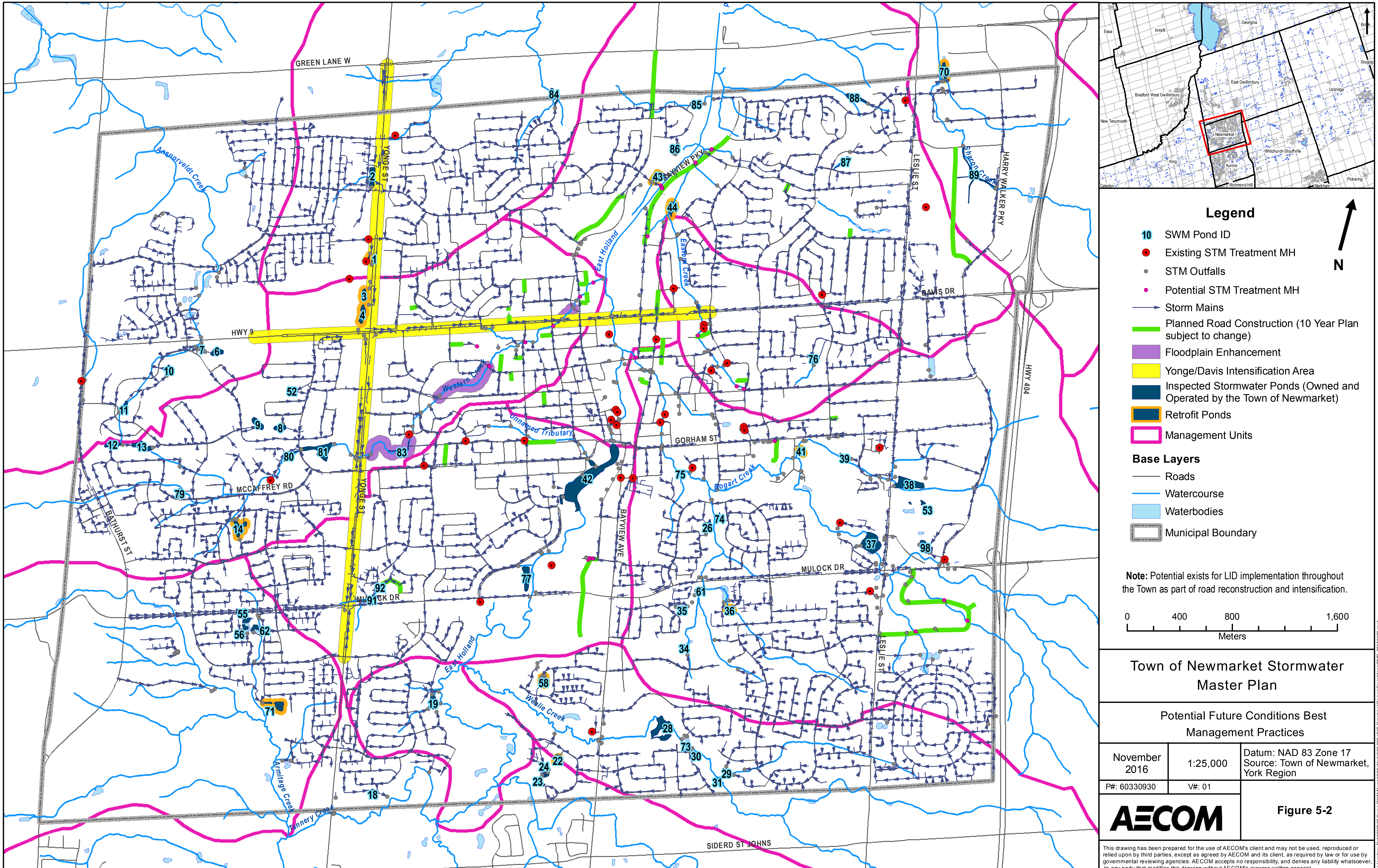
1. All ponds shown, ponds not included in sediment removal (e.g. online) shown as crossed out.
2. Management Unit areas represent the portion of each management unit located **within the Town of Newmarket boundary**.
3. Do Nothing scenario modelled with designed "Wet Ponds" modelled as "Dry Ponds", and designed "Dry Ponds" catchment areas modelled as "untreated" areas.
4. Phosphorus loading and removal calculations are provided in **Appendix B.**

5.4 Instream Best Management Practices

LSRCA conducted a Best Management Practices Inventory along watercourses within its jurisdiction in 2008 and 2009, which included the Town of Newmarket. The purpose of the inventory was to identify potential restoration projects along stream corridors in the Lake Simcoe watershed in order to improve fish habitat and reduce phosphorus input into Lake Simcoe. The inventory allowed LSRCA to prioritize future restoration works. Many of the opportunities identified by the field staff was directly or indirectly related to the fluvial geomorphological form and processes. **Figure 5-2** illustrates the opportunities identified within the Town of Newmarket.

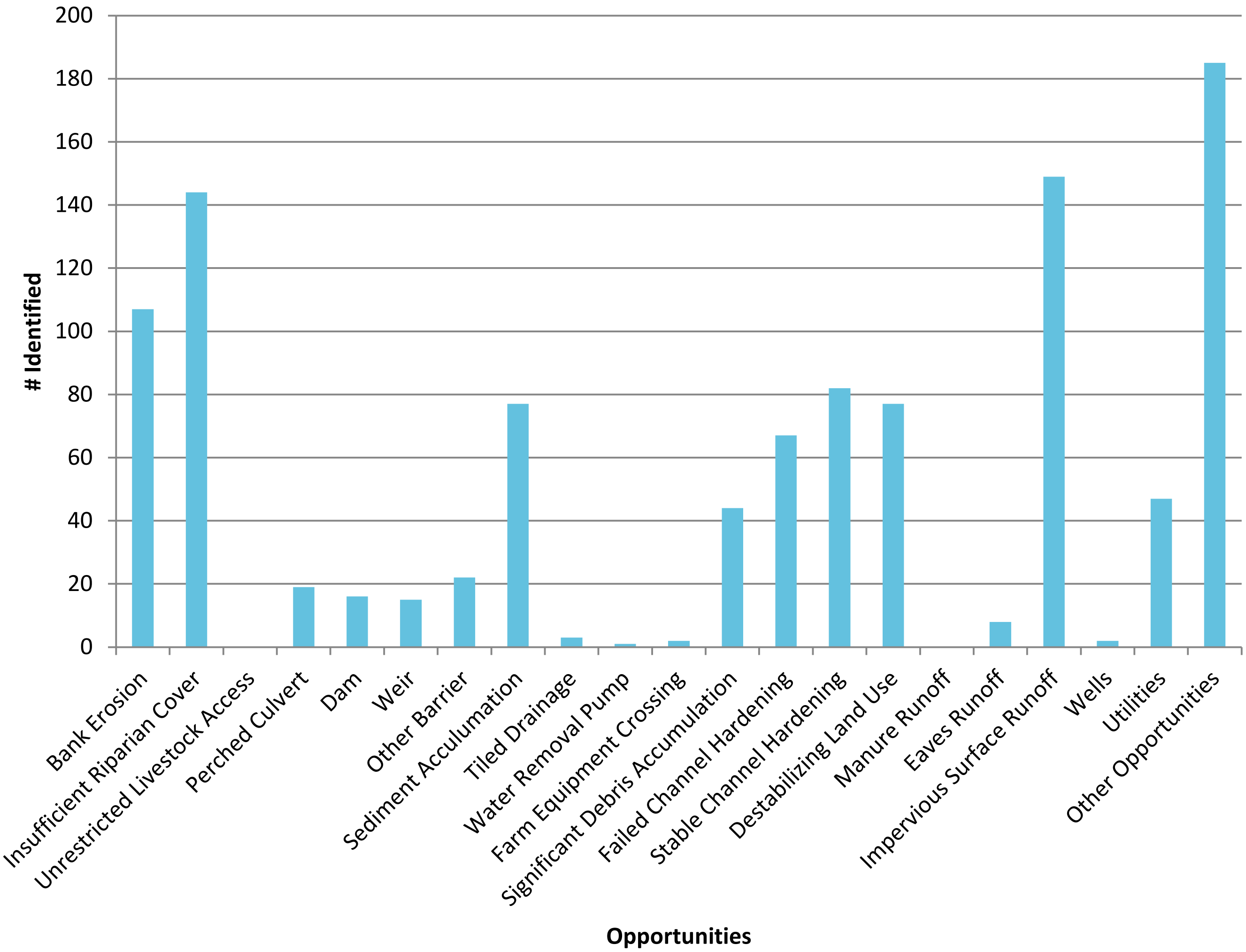
Furthermore, the location of bank erosion, sediment accumulations, and debris accumulations within the Town of Newmarket can be observed in **Figure 5-3**. These three categories are direct indicators of local geomorphological conditions. There is a high density of erosion sites along Western Creek, a small historically straightened watercourse that contains high stream power. As well, there are numerous erosion sites and sediment accumulations along Eastern Creek, which has also been historically straightened.

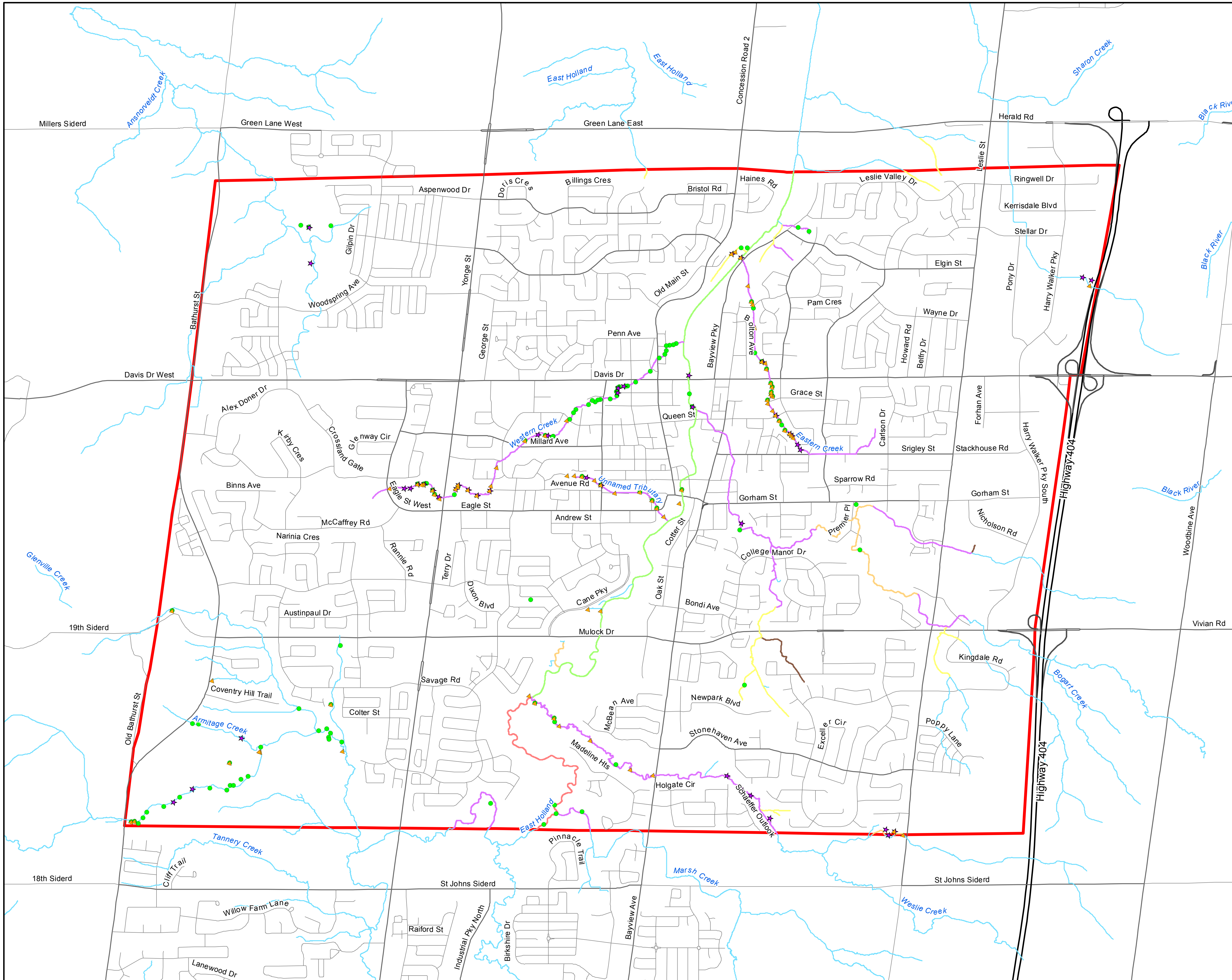
Although not represented in the above tables or in the removal calculations, additional measures are recommended in that they reduce runoff and thereby phosphorus loading to downstream water bodies. One method is to reconnect floodplain storage where feasible. This would allow for additional storage within the floodplain and also reduce instream erosion containing phosphorus.

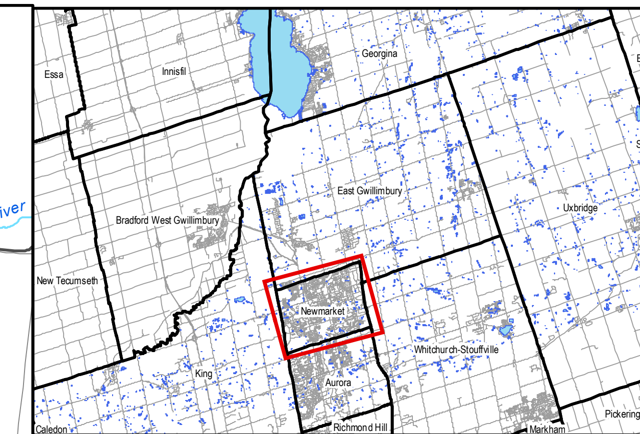


GREEN LANE W
HWY 9
YONGE ST
BAYVIEW PKY
BAYVIEW AVE
LESLIE ST
HARRY WALKER PKY
HWY 404
DAVIS DR
GORHAM ST
MCCAFFREY RD
BATHURST ST
MULOCK DR
SIDERD ST JOHNS
Ansnorveldt Creek
East Holland
Western Creek
Unnamed Tributary
Bogart Creek
Sharon Creek
Wesley Creek
Armitage Creek
Tannery Creek
Legend
SWM Pond ID
Existing STM Treatment MH
STM Outfalls
Potential STM Treatment MH
Storm Mains
Planned Road Construction (10 Year Plan subject to change)
Floodplain Enhancement
Yonge/Davis Intensification Area
Inspected Stormwater Ponds (Owned and Operated by the Town of Newmarket)
Retrofit Ponds
Management Units
Base Layers
Roads
Watercourse
Waterbodies
Municipal Boundary
N
Note: Potential exists for LID implementation throughout the Town as part of road reconstruction and intensification.
0 400 800 1,600
Meters
Town of Newmarket Stormwater Master Plan
Potential Future Conditions Best Management Practices
November 2016
1:25,000
Datum: NAD 83 Zone 17
Source: Town of Newmarket, York Region
P#: 60330930
V#: 01
AECOM
Figure 5-2
This drawing has been prepared for the use of AECOM's client and may not be used, reproduced or relied upon by third parties, except as agreed by AECOM and its client, as required by law or for use by governmental reviewing agencies. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without AECOM's express written consent.

Figure 5-3. BMP Inventory Opportunities – Town of Newmarket







N

Legend

- Sediment Accumulation
- Debris Accumulation
- Bank Erosion

Stream Classification

- A: Large Natural Watercourse
- B: Large Altered Watercourse
- D: Small Natural Watercourse
- E: Small Altered Watercourse
- F: Swales and Drains
- G: Straight Drainage Ditch
- Unclassified

Roads

- Freeway
- Expressway / Highway
- Ramp
- Major Road
- Local Road
- Study Area Boundary

0 400 800 1,600
Meters

Comprehensive SWM Plan
Town of Newmarket

BMP Inventory Opportunities - Bank Erosion

November 2016	1:30,000	Datum: NAD 83 Zone 17 Source: Lake Simcoe Basin Best Management Practices Inventory,LSRCA
P#: 60330930	V#: 001	

AECOM

Figure 5-4

Map location: P:\60330930 Comp SWM Nwmkt\900-Work\920-929 (GIS-Graphics)\Design\BMP Inventory Opportunities 20151214.mxd
Date Saved: 11/1/2016 3:40:17 PM

5.5 Hydrogeology

5.5.1 Opportunities

Opportunities to mitigate potential impacts from the reduction in groundwater recharge due to increases in impervious area from future development within all Management Units include the following:

- Maximize infiltration through integrated techniques such as; constructed wetlands, bioretention swales, infiltration galleries, green roofs, permeable surfaces, preservation and enhancement of native vegetation cover;
- Implement Best Management Practices (BMP) that promote groundwater infiltration/recharge, for the purpose of trying to establish post-development infiltration at pre-development levels; and
- Implement appropriate Low Impact Development (LID) techniques to encourage shallow groundwater recharge into surficial till and/or clay soils.

In addition to the opportunities listed above, rapid infiltration ponds or columns can be constructed in coarse-textured surficial soils to promote groundwater recharge. Potential areas for the new construction of rapid infiltration ponds, outside the ORM, include the area designated as 'Glaciofluvial Deposits' as illustrated on **Figure 2-5**, located within Management Unit 2.

Opportunities to mitigate potential groundwater quality impacts from increased application of winter road maintenance products (i.e., salt, brines, etc.), hydrocarbon impacts from roadways, and nutrient loading from fertilizer use (primarily nitrogen, potassium and Phosphorus) within areas with coarse-textured alluvial deposits and glaciofluvial deposits include the following:

- Implement best management practices for the reduction of application of winter road maintenance products within subject areas;
- Provide pre-treatment through filter strips, or sumps, to prevent the infiltration of contaminated water into the water table; and
- Reduce spill response time for incidents with the potential to release gasoline, oil or other contaminants into uncontrolled areas.

5.5.2 Constraints

Well Head Protection Areas

Three (3) individual pieces of legislation currently apply for the protection of drinking water supplies in York Region; including the study area:

- **Provincial Policy Statement (2014)** – provides broad policy direction on matters of provincial interest as it relates to land use planning and development.
- **Regional Official Plan (2010)** – provides land use and resource management direction for the land and water outside of the Oak Ridges Moraine as it applies to WHPAs.
- **Clean Water Act (2006)** – Ontario government's commitment to protect drinking water at the source as part of the overall commitment to human health and the environment.

The Regional Official Plan (ROP) provides a policy that restricts or even prohibits certain land uses due to their potential impact to groundwater quality. To ensure that municipal well water quality and quantity is protected from contamination the policy states:

> *..."That the storage or use of pathogen threats by new land uses, including the siting and development of stormwater management ponds and rapid infiltration basins or columns, except for the storage of manure for personal or family use, is prohibited within the 100-metre pathogen zone around each municipal well shown on Map 6 and may be restricted within the 100-metre to 2-year time of travel."... (York Region Official Plan, 2010)*

Figure 2-7 illustrates the extent of existing WHPA and the land designated as the 2-year time of travel to which the above restriction applies.

<u>*Oak Ridges Moraine*</u>

Management Units 1, 6 and 10 contain part of the Oak Ridges Moraine (ORM) boundary, and therefore are guided by policies of land use contained within the Oak Ridges Moraine Conservation Plan (ORMCP) (O.Reg 140/02). Through the Plan, the Ontario Government has set a policy framework for protecting the ORM by providing land use and resource management direction for land within the ORM. Among other land use restrictions, the Plan provides the following guidance pertaining to the management of stormwater:

> *"...New stormwater management ponds siting in the ORM are prohibited within the respect to land in key natural heritage features and hydrologically sensitive features (permanent and intermittent streams, wetlands, kettle lakes, seepage areas and springs)..." (O.Reg 140/02, s.45(8)).*
>
> *"...new rapid infiltration basins and new rapid infiltration columns are prohibited..." (O.Reg 140/02, s.47)*

The ORMCP defines 'hydrologically sensitive features' as permanent and intermittent streams, wetlands, kettle lakes and seepage areas and springs. As previously discussed in **Section 2.5.2**, cold water streams are mapped in the southwestern portion of the Study Area and are associated with a number of unevaluated wetlands. Through the interpretation of available surficial geology mapping and thermal regime mapping of watercourses it is interpreted that seeps and springs may exist within the east and southeastern portion of the study area, where the headwaters of numerous coldwater streams are mapped. The ORMCP provides minimum areas of influence and minimum vegetation protection zones for hydrologically sensitive features as 30 metres from any part of the feature.

5.6 Aquatic Ecology

5.6.1 Constraints

Constraints associated with aquatic features identified to be potentially affected by stormwater management include the following:

- Stormwater management facilities are known to have warming effects on water discharged into receiving watercourses by acting as heat sinks which can have significant effects on downstream coldwater aquatic habitats (LSRCA, 2007; TRCA, 2013). Stormwater management facilities in Management Units 2, 3, 5 and 6 placed upstream of cold water reaches should be designed to minimize thermal effects in addition to controlling water quantity and improving water quality. Examples of mitigating thermal effects can include construction of bottom-draw outlet, planting a vegetation buffer along the perimeter of the pond (particularly with trees that provide shade) and/or releasing the water at night or early morning (LSRCA, 2007).

- Management Units 1, 4, 7, 8, 9, 10 and 11 have warm water reaches which support aquatic species that are less sensitive but still susceptible to changes in water quality and quantity. Stormwater management facilities placed upstream of warm water reaches should also be designed to maintain or improve the water temperature and water quality of the watercourses downstream.

- According to the *Town of Newmarket Official Plan* (2014), 15 m and 30 m vegetative buffers are required for warm water and cold water streams, respectively, from any proposed development.

- Management Units 1, 6 and 10 have tributaries that are located within the Oak Ridges Moraine and therefore guided by policies of land use mandated in the ORCMP (O.Reg. 140/02). Section 45, Subsection 8 of the ORCMP states the following:

  "New stormwater management ponds siting in the ORM are prohibited within the respect to land in key natural heritage features and hydrologically sensitive features (permanent and intermittent streams, wetlands, kettle lakes, seepage areas and springs)..."

5.6.2 Opportunities

Stormwater management practices can provide opportunities to protect and enhance aquatic features and their functions (CVC and TRCA, 2010). Opportunities to mitigate potential impacts of increased run-off from future development within all of the Management Units are identified as follows:

- As identified in **Section 2.5.3** of this report, the LSRCA has identified opportunities along surveyed streams for removal of fish migration barriers and to improve bank hardening and channelization (refer to **Figure 2-8**). Consideration should be given to replacing hardened straight-edge shorelines with less hard or sloping shorelines that could include rip rap, gravel or native vegetation where feasible. These opportunities should be considered during implementation of retrofit opportunities for existing stormwater facilities as well as during the design of new stormwater management facilities.

- As identified in **Section 2.6.2.4** of this report, the LSRCA has identified opportunities along surveyed streams where the riparian buffer can be improved (refer to **Figure 2-11**). Increasing riparian vegetation cover along the cold water reaches is particularly important as this will help moderate water temperatures by providing shade, stabilize the banks, reduce soil erosion and sediment inputs into the reaches, increase infiltration of run-off, and filter sediments and contaminants out of the run-off prior to it reaching the watercourse.

5.7 Terrestrial Ecology

5.7.1 Constraints

Constraints associated with terrestrial features identified to be potentially affected by stormwater management include the following:

- According to the *Town of Newmarket Official Plan* (2014), stormwater management facilities should be located at least 10 m from all woodlands and 15 m from all wetlands, for all Management Units.

- Stormwater management facilities should be placed outside of the Locally Significant Newmarket Wetland and the Provincially Significant Arnosveldt Wetland Complex.

- Significant forests, unevaluated wetlands and the Glenville Hills Kames Provincial Candidate Life Science ANSI are located within the Oak Ridges Moraine and are protected by the policies mandated by the Ok Ridges Moraine Conservation Plan (O.Reg. 140/02). Section 45, subsection 8 of the ORCMP states the following:

  "New stormwater management ponds siting in the ORM are prohibited within the respect to land in key natural heritage features and hydrologically sensitive features (permanent and intermittent streams, wetlands, kettle lakes, seepage areas and springs)..." (O.Reg 140/02, s.Oak Ridges Moraine Conservation Plan, 2002)

- Removal of existing riparian vegetation along watercourses for any new stormwater management facilities or retrofitting opportunities should be avoided. Generally, vegetation removal should be kept to a minimum to the extent possible and outside of the bird breeding season (May 1 to July 31) to avoid contravention of the *Migratory Birds Convention Act, 1994* (MBCA).

5.7.2 Opportunities

Stormwater management practices can provide opportunities to protect and enhance terrestrial features and their functions (CVC and TRCA, 2010). Opportunities to mitigate potential impacts of increased run-off and phosphorus loading from future development within all of the Management Units are identified as follows:

- As identified in **Section 2.6.2.4** of this report, the LSRCA has identified opportunities along surveyed streams where the riparian buffer can be improved (refer to **Figure 2-11**). Enhancing riparian buffers with appropriate vegetation can improve land connectivity and quality of The Town's Natural Heritage System core areas. Particularly, enhancing natural corridors identified as poor quality land linkages that follow the tributaries of Bogart Creek, East Holland River and Arnosveldt Creek in Management Units 2, 7, 9 and 10 can improve habitat quality and facilitate wildlife movement to other parts of the Town.

- A future commercial area is planned to replace an existing residential area immediately upstream of the Locally Significant Newmarket Wetland located on Srigley Street just east of Bayview Avenue, as shown on **Figure 2-10**. A stormwater management facility should be placed upstream of this wetland and designed to control the quantity and quality of run-off discharging into the wetland in order to mitigate the potential effects associated with this land use change.

- Innovative landscaping designs for existing and new stormwater management facilities should make allowances for naturalization and integration with the surrounding natural areas. This can be achieved by increasing vegetation cover to the extent possible by planting native species appropriate to the surrounding vegetation communities along the perimeter of the stormwater management pond and also the outfall channel. Additional vegetation cover (e.g., shrubs, immature trees, etc.) can cool the water in the stormwater management pond by providing shade. It can also increase species diversity by providing habitat that supports a variety of plant and wildlife species. Grass surrounding stormwater management ponds should not be cut but allowed to grow as this will further enhance surface water quality and also deter nuisance species such as geese from congregating near the ponds (Gallagher, 2013).

6. Recommended Approach for Stormwater Management {Step 8, 9}

6.1 Class EA Process Alternatives

The Class EA Process requires the identification and analysis of alternatives, to ensure that all options are considered. Phase 1 of the Class EA process involves:

- identifying the problem or opportunity;
- discretionary public consultation to review the problem or opportunity; and
- determination of the applicability of the Master Plan Approach.

Phase 2 of the Class EA process includes:

- identifying alternative solutions to the problem or opportunity;
- selecting a schedule;
- creating an inventory of natural, social, and economic environment issues;
- identifying the impact of alternative solutions on the environment and identifying mitigating measures;
- evaluating alternative solutions and identifying the recommended solution;
- consultation with agencies and public;
- selection of the preferred solution;
- and review and confirmation of the schedule.

The Alternatives for this study included an analysis of the following scenarios:

- Do Nothing;
- Existing Conditions with Retrofitted SWM facilities; and
- Proposed Conditions/As Designed (Retrofitted) SWM facilities with proposed LID and BMP measures.

These scenarios are discussed in further detail in the following sections of this report.

6.2 Evaluation of Alternatives

The 2007 LSRCA report indicated that the cost for the pond retrofits (cleanout) for the prioritized 16 SWM facilities would be approximately $11.8 million. Additional costs would be associated with the proposed LID and BMP measures. This is the recommended alternative as it successfully mitigates the effects of Phosphorus loading, and is in keeping with the Town's policies. The results show that the SWM facilities provide a substantial benefit in Phosphorus reduction due to the fact that they treat the large areas. The additional LID measures provide localized benefits that contribute to the overall health of the stormwater and receiving water systems and are in keeping with the Town's policies.

Table 6-1 presents a summary matrix of the alternatives rating them against various categories. Overall, the Proposed Conditions/As Designed with additional LID and BMP Measures Alternatives scored the highest. Despite being the most cost prohibitive option, this negative aspect is outweighed by the overall benefits of the SWM facilities and additional LID and BMP measures, particularly when considering the water quality issues as discussed in the Water Quality section of this report.

Table 6-1. Evaluation of Alternatives

Restoration Alternative	Erosion Protection	Sediment Transport	Natural Environment	Construct-ability	Flooding	Life Cycle	Long Term Integration	Approv-ability	Cost	Total
1. Do Nothing	1	1	1	3	2	1	1	1	3	14
2. Existing Conditions with Retrofit	2	2	2	2	2	2	2	2	2	18
3. Proposed Conditions with Retrofit plus BMP/LID	3	3	3	2	3	2	3	3	1	23

1 = Poor

2 = Fair

3 = Good

6.3 Recommended Approach

An existing conditions analysis was carried out based on the assumption that all of the SWM facilities are functioning at existing conditions. No additional proposed LID or BMP measures were accounted for in this analysis. This analysis indicates that a total reduction in Phosphorus of 45 percent is achieved under existing conditions when assessing only the area serviced SWM Facilities.

The Do Nothing alternative is clearly not feasible. For this analysis it was assumed that no additional LID or BMP measures would be implemented, and that no further retrofits, maintenance or clean out of existing SWM facilities would occur. It was assumed that in the long term the permanent pools would eventually fill with sediment, and in effect operate as dry SWM facilities. A corresponding 10 percent Phosphorus removal efficiency was applied to all SWM facilities for this scenario. The analysis indicates that the overall Phosphorus reduction would amount to only 40 percent under this scenario (when assessing only the area serviced by SWM Facilities). Despite having no costs associated with it, this alternative is not recommended as the negative environmental impacts are too great and not in keeping with the Town's policies.

An analysis was also carried out for the Future Conditions/As Designed scenario. For this analysis it was assumed that all SWM facilities would be cleaned out and operating at full design capacity. The additional LID measures as proposed in this report were also accounted for in the calculations. This analysis indicated that an overall Phosphorus reduction of 78 percent could be achieved through the implementation of these measures (when assessing only the area serviced by BMPs including SWM Facilities and LID measures). The LID infiltration measures should be implemented such that 10 mm of rainfall is captured over the LID contributing area for storm events equal to or greater than 10 mm.

A summary of the recommended approach specific to each Management Unit is provided in **Table 6-2** below. Included in the recommendations are additional proposed areas that, if designed for a 10 mm runoff infiltration capacity, could balance the water budget as shown in **Table 4-2**.

Table 6-2. Summary of Recommended Approach

Management Unit	Area[1] (ha)	Treatment Type
1	526.4	Clean out and retrofit all SWM facilities to original design level Provide LID's as follows: - rooftop infiltration capacity of 10mm event at Upper Canada Mall - rooftop infiltration capacity of 10mm event at Region building (Yonge and Eagle) - parking lot treatment at Ray Twinney complex **-capture additional 2.6 ha area with 10 mm infiltration capacity to balance water budget**
2	731.1	Clean out and retrofit all SWM facilities to original design level Provide LID's as follows: - infiltration capacity of 10mm event by funded LID at Industrial or Commercial site - rooftop infiltration capacity of 10mm event at Magna Centre - infiltration capacity of 10mm event of parking lot runoff at Magna Centre **-capture additional 34 ha area with 10 mm infiltration capacity to balance water budget**
3	248.4	Clean out and retrofit all SWM facilities to original design level **-capture 15 ha area with 10 mm infiltration capacity to balance water budget**
4	152.7	Clean out and retrofit all SWM facilities to original design level
5	124.3	Clean out and retrofit all SWM facilities to original design level Provide LID's as follows: -Potential infiltration capacity of 10mm event by funded LID at Industrial or Commercial site -Potential rooftop infiltration capacity of 10mm event – Pony Drive/Stellar Drive -Potential parking lot infiltration capacity of 10mm event – Pony Drive/Stellar Drive
6	369.4	Clean out and retrofit all SWM facilities to original design level **-capture 14 ha area with 10 mm infiltration capacity to balance water budget**
7	164.7	Clean out and retrofit all SWM facilities to original design level **-capture 10 ha area with 10 mm infiltration capacity to balance water budget**
8	416.8	Clean out and retrofit all SWM facilities to original design level Provide LID's as follows: -Lion's Park restoration - LID catchment wide retrofit program –infiltration capacity of 10mm event **-capture additional 16 ha area with 10 mm infiltration capacity to balance water budget**
9	533.3	Clean out and retrofit all SWM facilities to original design level Provide LID's as follows: -Bioswale/filter consideration in the Wayne and Waratah intersection – infiltration capacity of 10mm event **-capture additional 20 ha area with 10 mm infiltration capacity to balance water budget**
10	305.9	Clean out and retrofit all SWM facilities to original design level Provide LID's as follows: -Potential infiltration capacity of 10mm event by funded LID at Industrial or Commercial site **-capture additional 41 ha area with 10 mm infiltration capacity to balance water budget**
11	241.8	Clean out and retrofit all SWM facilities to original design level Provide LID's as follows: -Potential parking lot infiltration capacity of 10mm event near Yonge and Bonshaw -Potential rooftop infiltration capacity of 10mm event near Yonge and Bonshaw

Note: Management Unit areas represent the portion of each management unit located within the Town of Newmarket boundary.

Additional methods to reduce Phosphorus loading may include reducing runoff and capturing flows. Reducing runoff could be accomplished by implementing various methods such as infiltration trenches or swales, or soakaway pits. Developing a downspout disconnection program and promoting the roof leader disconnection program will also contribute to reduced runoff. Retrofitting of SWM facilities may help to reduce downstream storm peaks and flow velocities, and thereby pollutant loadings. Capturing flows for treatment using bioswales, oil grit separators, and SWM facilities will reduce the TSS and phosphorus loading to receiving water bodies. The Wayne and Warratah Area Flooding and Erosion Remediation Study (AECOM, 2015 DRAFT) also recommends an increase in sewer size installation to the 10 year design storm going forward, particularly downstream of areas with flooding issues.

In addition to the above, best management practices should be implemented across the watershed to reduce phosphorus loading. Additional measures to consider include implementing best management practices for agricultural areas to minimize contribution of phosphorus loading to streams and waterways. Where possible, offline ponds should be maintained along with natural floodplain storage. Floodplain storage should be reconnected where possible to reduce flows, thereby decreasing sediment loads and the associated phosphorus loading.

6.4 Recommended Inspection and Maintenance Programs {Step 10}

The following sections are as outlined in the 2009 Newmarket SWM Facility Inventory and Maintenance Needs Plan as the actions required for implementing the required monitoring and maintenance program. If appropriated staff cannot be allocated as recommended, the Town may choose to retain a qualified consultant to perform some or all of the implementation activities.

6.4.1 Annual Facility Inspection

The Town should designate appropriate staff to perform inspections and ensure staffs have appropriate training in regards to SWM facilities inspections and safety. Specific safety training may include water safety training and confined spaces training entry training as underground facilities such as manholes and catchbasins are common in SWM faculties.

It is recommended that annual facility inspections be completed in the autumn to co-ordinate debris clearing from trash racks and pipes before the winter or in spring to co-ordinate with post melt litter removal prior to the wet season.

Equipment:

- GPS unit with inventory inspection form;
- Small boat (i.e. canoe, Zodiac boat);
- Chest waders;
- Stadia rod or other calibrated rod for measuring water and sediment depth;
- Camera; and
- Consider installing staff gauges to monitor water levels.

The goal of the inspection program is to establish standards to ensure that the facility inspections are consistent and reliable and to identify deficiencies requiring maintenance early so they can be addressed with minimal cost.

6.4.1.1 LID Operation and Maintenance Plans

Operation and maintenance plans for LID measures should be carried out as applicable to the LID method installed. For infiltration trenches this may include monitoring during periods of inundation as well as observing the wet/dry cycling of soils. Additional maintenance may include monitoring of water quality, groundwater elevation, long-term infiltration capacity, and plant tolerances. The most frequently cited maintenance concern for infiltration trenches is clogging caused by organic matter and fine silts. Maintaining appropriate surface vegetation may also become an issue and should be included in the operation and maintenance plan.

Rain gardens require regular inspection and maintenance, with inspections ideally carried out after heavy rainfall for blockage or damage. Full inspections should be carried out annually. Flow tests should be carried out to verify that the underdrain is working properly and that full drainage occurs within 24 hours. Should ponding occur for longer than 24 hours, maintenance tasks may include replacing the soil mix with new soils to reinstate percolation rates, loosening or tilling the existing soil, removing fine sediment layers prior to turning over the top layer of soil, clearing overflow and discharge pipes, and ensuring that the surface of the ponding area is approximately 200-300 mm below the surrounding hard surfaces and overflow.

Biorentention or roadside swales have a flood conveyance role that must be maintained, including the swale configuration and the cover. Weed removal and replanting may be required to prevent erosion and to maintain the hydraulic properties of the swale. Strong healthy growth of vegetation is critical to the performance of bioretention swales. Debris deposition will require clearing to maintain the hydraulic function. Maintenance items should include routine inspection of the swale profile, inspection of inlet and outlet points, removal of sediment if it impedes conveyance or smothers vegetation, repairing any damage due to erosion or scour, tilling of trench surface if there is evidence of clogging, mowing of vegetation to preserve the optimal design height for the vegetation, removal of invasive weeds, and regular irrigation as required to establish healthy vegetation growth.

Maintenance of perforated pipes consists of clearing out debris and accumulated sediment caught in pre-treatment devices. Inspections should be performed to confirm that the draining time is in accordance with the original design. If drain times exceed the design values the pump may require cleanout via pumping and flushing. If slow drainage persists, the system may need removal or replace of granular material and/or geotextile liner.

Pervious pavements must be cleaned periodically to maintain the permeable surface. Cleaning is performed by vacuuming to remove sediments that have accumulated. The frequency of vacuuming is dependent on the sediment accumulation. Routine maintenance should include visual inspection of the pervious pavement to ensure that it is clean of debris and sediments. Routine maintenance should be carried out approximately monthly, such as surface blowing (with a leaf blower or similar equipment), truck sweeping and/or dry vacuuming. These maintenance practices may help prevent stubborn clogging by keeping sediment from becoming ground deep into the pavement's void structure. In areas where freezing occurs, maintenance just prior to winter may ensure that the voids are free of non-compressible materials that may inhibit drainage, thereby contributing to freeze-thaw damage. Pressure washing may be required following winter to remove anti-skid materials that may have been used on the surface.

6.4.2 Sediment Quantity Monitoring

Sediment monitoring should be completed for 5 consecutive years after the Town has assumed the pond. This monitoring will establish a sediment loading rate, which will be used to predict timing of future sediment removal. Sediment quantity monitoring should be completed every five years afterwards to ensure sediment loading rates have not changed and sediment levels have not exceeded permissible volumes. Standard sediment quantity monitoring procedures should be established upon completion of sediment quantity assessments, the priority list of ponds requiring sediment removal should be updated with the new information.

6.4.3 Sediment Quality Testing

Sediment quality testing should be completed prior to initiating any sediment removal. The following steps should be undertaken as part of a sediment quality testing program.

- Develop standard operating procedures for testing sediment quality;
- Establish when sediment quality samples are required, research and identify accredited laboratories;
- Determine the required number of samples required to accurately characterize the sediment;

- Develop a standard sediment collection technique and consider purchasing or leasing the appropriate equipment (i.e. core sampler); and
- Develop appropriate forms for recording sample locations and analysis.

6.4.4 SWM Facility Database

The SWM Facility Database is to be updated annually upon completion of annual inspection. The updated database will provide a valuable tool in assessing future maintenance and retrofit opportunities. The following steps should be undertaken as part of the SWM facility database program:

- Develop procedures to ensure SWM facility inspection and the maintenance database is continuously updated;
- Ensure records of COA requirements that are in addition to standard conditions (e.g. for monitoring and reporting) are included;
- Teach staff to set-up, populate and maintain the database; and
- Incorporate user or public complaints into the database.

6.4.5 Additional Programs

The establishment of an annual inspection program, sediment quality testing and SWM facility database will provide a tracking system to determine how the SWM facilities are performing. Additional programs may be considered to help identify areas of improvement. These programs include:

- SWM facility water quality and quantity monitoring program; and
- SWM Retrofit study to identify design enhancements to achieve new legislative requirements or watershed targets implemented since the original design.

6.4.6 Sediment Removal & Disposal

Depending on whether the works are undertaken by the Town or by a licensed contractor, a sediment and erosion control plan will be required to prevent the release of sediment from entering the receiving drainage system and causing serious harm to fish or fish habitat. Sediment release is not only detrimental to the health of the receiving system but can result in costly maintenance for the downstream infrastructure. Sediment removal may require a permit from the LSRCA. Refer to **Section 3.6** for details on sediment removal and disposal options.

If a licensed contractor is hired by the Town, construction and maintenance plans will be required. These plans must identify any diversion methods that will be required to safely bypass flows during the maintenance work. As well, all drawdown pipes will need to be identified and protected prior to sediment removal in wet ponds.

6.4.7 Funding Opportunities for LID Implementation

LSRCA's Landowner Environmental Assistance Program (LEAP) is a program that provides landowners with funding and technical assistance for environmental projects. Funding is available through this program for lot level storm projects such as rain gardens.

LSRCA's Stewardship and Forestry team continues to adapt programming to support environmental improvements within the watershed, including efforts to reduce the negative impacts of stormwater caused by urbanization. While continuing to work collaboratively with municipalities across the watershed, new programming from LSRCA aimed at urban restoration will support funding and technical assistance to meet the stormwater challenges faced by the institutional, commercial, and industrial sectors.

The LSRCA has also developed the Lake Simcoe Phosphorus Offset Program to offset TP generation for stormwater retrofits, including conventional controls and LID measures. The program is predicated on a zero TP load via a partial “cash-in-lieu” type system, where new development pays an offset fee that would be applied to other areas which can be mitigated more effectively. This program is still awaiting final approval form the MOECC and is not yet operational as of the submission date of this report.

As with other cities and towns, the Town of Newmarket is considering provisions for SWM Financing through various sources such as Property Taxes, Utility Fee programs, Development charges, Stormwater Fee-in-Lieu, and Infrastructure Renewal Levies.

Additional environmental grants may be available for funding through granting agencies such as RBC, Blue-Water, Enbridge Savings by Design, TD Green Funds.

7. Consultation and Approvals

A Public Information Centre (PIC) was held March 31, 2015 to gather input from Newmarket residents, and other agencies and stakeholders related to the Comprehensive Stormwater Management Master Plan (CSWMMP). Presented materials and comments from this meeting are provided in **Appendix A**.

8. Conclusions and Recommendations

The following conclusions and recommendations include those carried forward from the Townwide Drainage Study and the Town of Newmarket Stormwater Management Facility Inventory and Maintenance Needs Plan (AECOM, 2009). The following recommendations are a result of the above and of this study:

- Carry out pond retrofits and clean outs as recommended;
- Implement roadway curb cuts and no curb systems where feasible to allow for roadway runoff to roadside planting and infiltration systems;
- Install Oil Grit Separators as identified for road reconstruction projects proposed within the next 10 years;
- Install LID retrofits at the Ray Twinney Complex, Magna complex, and at other Town facilities identified where feasible;
- Install LID retrofits as outlined in the report to provide water balance, water quality, and water quantity benefits as demonstrated in the report;
- Implement corridor restoration and reconnection of floodplain storage to streams where identified and feasible;
- Pursue future funding opportunities to support identified and additional LID and urban restoration opportunities within the Study Area; and
- Develop a Public Education and Engagement Campaign to promote sustainable practices and stormwater management throughout the community, together with the necessary review to translate the practices into policies and guidelines.

Recommended LID and retrofit measures as discussed in this report are summarized below.

Table 8-1. Treatment Recommendations

Man Unit	Treatment Proposed	Water Quality	Water Quantity	Water Budget	Treatment Method
1	Rooftop infiltration capacity of 10mm event at Upper Canada Mall	✔	✔	✔	Soakaway/infiltration
	Potential Parking lot treatment at Region building (Yonge and Eagle)	✔	✔	✔	Soakaway/infiltration
	Rooftop infiltration capacity of 10mm event at Region building (Yonge and Eagle)	✔	✔	✔	Soakaway/infiltration
	Potential parking lot treatment at Ray Twinney complex	✔	✔	✔	Soakaway/infiltration SWM Facilities
	Clean out and retrofit SWM facilities to original design level	✔	✔	□	SWM Facilities
	Further study may be feasible to evaluate over-control of future development to increase infiltration and reduce peak flows	□	□	□	
	Capture additional 3 ha area and provide LID with 10 mm infiltration capacity to balance water budget and reduce peak flows	✔	✔	✔	Soakaway/infiltration
2	Infiltration capacity of 10mm event by funded LID at Industrial or Commercial site	✔	✔	✔	Soakaway/infiltration
	Rooftop infiltration capacity of 10mm event at Magna Centre	✔	✔	✔	Soakaway/infiltration
	Infiltration capacity of 10mm event of parking lot runoff at Magna Centre	✔	✔	✔	Soakaway/infiltration
	Clean out and retrofit SWM facilities to original design level	✔	✔	□	SWM Facilities
	Further study may be feasible to evaluate over-control of future development to increase infiltration and reduce peak flows	□	□	□	
	Capture additional 34 ha area and provide LID with 10 mm infiltration capacity to balance water budget and reduce peak flows	✔	✔	✔	Soakaway/infiltration
3	Clean out and retrofit SWM facilities to original design level	✔	✔		SWM Facilities
	Further study may be feasible to evaluate over-control of future development to increase infiltration and reduce peak flows	□	□		
	Capture additional 15 ha area and provide LID with 10 mm infiltration capacity to balance water budget and reduce peak flows	✔	✔	✔	Soakaway/infiltration
4	Clean out and retrofit SWM facilities to original design level	✔	✔		SWM Facilities
5	Potential infiltration capacity of 10mm event by funded LID at Industrial or Commercial site	✔	✔	✔	Soakaway/infiltration
	Potential rooftop infiltration capacity of 10mm event – Pony Drive/Stellar Drive	✔	✔	✔	Soakaway/infiltration
	Potential parking lot infiltration capacity of 10mm event – Pony Drive/Stellar Drive	✔	✔	✔	Soakaway/infiltration
	Clean out and retrofit SWM facilities to original design level	✔	✔		SWM Facilities
6	Clean out and retrofit SWM facilities to original design level	✔	✔		SWM Facilities
	Further study may be feasible to evaluate over-control of future development to increase infiltration and reduce peak flows	□	□		
	Capture additional 14 ha area and provide LID with 10 mm infiltration capacity to balance water budget and reduce peak flows	✔	✔	✔	Soakaway/infiltration
7	Clean out and retrofit SWM facilities to original design level	✔	✔		SWM Facilities
	Further study may be feasible to evaluate over-control of future development to increase infiltration and reduce peak flows	□	□		

Man Unit	Treatment Proposed	Water Quality	Water Quantity	Water Budget	Treatment Method
	Capture additional 10 ha area and provide LID with 10 mm infiltration capacity to balance water budget and reduce peak flows	✔	✔	✔	Soakaway/infiltration
8	Clean out and retrofit SWM facilities to original design level	✔	✔	□	SWM Facilities
	Lion’s Park restoration - LID catchment wide retrofit program –infiltration capacity of 10mm event	✔	✔	✔	Soakaway/infiltration
	Further study may be feasible to evaluate over-control of future development to increase infiltration and reduce peak flows	□	□	□	
	Capture additional 16 ha area and provide LID with 10 mm infiltration capacity to balance water budget and reduce peak flows	✔	✔	✔	Soakaway/infiltration
9	Bioswale/filter consideration in the Wayne and Waratah intersection – infiltration capacity of 10mm event	✔	✔	✔	Soakaway/infiltration
	Clean out and retrofit SWM facilities to original design level	✔	✔	□	SWM Facilities
	Further study may be feasible to evaluate over-control of future development to increase infiltration and reduce peak flows	□	□	□	
	Capture additional 20 ha area and provide LID with 10 mm infiltration capacity to balance water budget and reduce peak flows	✔	✔	✔	Soakaway/infiltration
10	Potential infiltration capacity of 10mm event by funded LID at Industrial or Commercial site	✔	✔	✔	Soakaway/infiltration
	Clean out and retrofit SWM facilities to original design level	✔	✔	□	SWM Facilities
	Further study may be feasible to evaluate over-control of future development to increase infiltration and reduce peak flows	□	□	□	
	Capture additional 41 ha area and provide LID with 10 mm infiltration capacity to balance water budget and reduce peak flows	✔	✔	✔	Soakaway/infiltration
11	Potential parking lot infiltration capacity of 10mm event near Yonge and Bonshaw	✔	✔	✔	Soakaway/infiltration
	Potential rooftop infiltration capacity of 10mm event near Yonge and Bonshaw	✔	✔	✔	Soakaway/infiltration
	Clean out and retrofit SWM facilities to original design level	✔	✔		SWM Facilities

9. Next Steps

The next steps include obtaining Approval by Council and Implementation of the Recommended Approach.

10. References

Armstrong, D. and J.E.P. Dodge, 2007:
Paleozoic Geology of Southern Ontario. Miscellaneous Release – Data 219. Sedimentary Geoscience Section, Ontario Geological Survey.

Bird Studies Canada (BSC), Environment Canada's Canadian Wildlife Service (EC-CWS), Ontario Nature, Ontario Field Ornithologists (OFO) and Ontario Ministry of Natural Resources (MNR). 2006:
Ontario Breeding Bird Atlas Website. Accessed on December 2014. Available: http://www.birdsontario.org/atlas/index.jsp

Chislock, M. F., Doster, E., Zitomer, R. A. & A.E. Wilson, 2013:
Eutrophication: Causes, Consequences, and Controls in Aquatic Ecosystems. Nature Education Knowledge 4(4):10.

Jones, C., Layberry, R., and A. Macnaughton, 2012:
Ontario Butterfly Atlas Online. Toronto Entomologists' Association. Accessed November 2014. Available: http://www.ontarioinsects.org/atlas_online.htm

Conestoga-Rovers & Associates (CRA), AECOM and Black & Veatch, April 2013:
Upper York Sewage Solutions Environmental Assessment, Natural Environment Baseline Conditions Report. Prepared for The Regional Municipality of York.

Conservation Ontario, 2014:
Aquatic Species at Risk Distribution Maps. Accessed on December 2014. Available: http://www.conservation-ontario.on.ca/what-we-do/watershed-stewardship/aquatic-species-at-risk

Credit Valley Conservation (CVC) and Toronto and Region Conservation Authority (TRCA), 2010:
Low Impact Development Stormwater Management Planning and Design Guide.

Cumming Cockburn Limited, 2005:
Hydrology Report (Final) – Hydrologic and Hydraulic Modeling For the West Holland River, East Holland River and Maskinonge River Watersheds.

Fisheries and Oceans Canada, 2014:
A Guide for Interpreting Fish and Mussel Species at Risk Maps Version 8.

Dobbyn, J.S., 1994:
Atlas of the Mammals of Ontario. Ontario: Federation of Ontario Naturalists.

Government of Canada, 201:
Forest Ecosystem Products and Services. Acessed on March 3, 2015. Available: http://www.nrcan.gc.ca/forests/canada/ecosystem-products-services/13207.

Gallagher, T. 2013:
Stormwater Management Ponds Township of Uxbridge [PowerPoint Slides]. Assessed on March 2015.

Available:
http://www.town.uxbridge.on.ca/sites/default/files/documents/Stormwater%20Management%20Ponds%20-%20Township%20of%20Uxbridge%20-%20June%202013.pdf

Lake Simcoe Region Conservation Authority (LSRCA), 2007:
Lake Simcoe Basin Stormwater Management and Retrofit Opportunities.

Lake Simcoe Region Conservation Authority (LSRCA), 2010a:
East Holland River Subwatershed Plan.

Lake Simcoe Region Conservation Authority (LSRCA), 2010b:
West Holland River Subwatershed Plan.

Lake Simcoe Region Conservation Authority (LSRCA), 2011:
Comprehensive Stormwater Management Master Plan Guidelines – Guidelines for the Development and Implementation of Comprehensive Stormwater Management Master Plans in the Lake Simcoe Watershed. April 26, 2011. 43 pp.

Lake Simcoe Region Conservation Authority (LSRCA), 2014a:
Conservation Areas. Accessed on November 2014. Available: http://www.lsrca.on.ca/conservation_areas/..

Lake Simcoe Region Conservation Authority (LSRCA), 2014b:
Lake Simcoe Region Conservation Authority Watershed Development Policies. Accessed on March 2015. Available: http://www.lsrca.on.ca/pdf/watershed_development_policies.pdf.

Lake Simcoe Region Conservation Authority (LSRCA), 2009:
Lake Simcoe Basin Best Management Practices Inventory.

Lee, H.T., W.D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig and S. McMurry, 1998:
Ecological Land Classification for Southern Ontario: First Approximation and its Application. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

North-South Environmental Inc., 2005:
York Region Significant Woodland Study. Prepared for the Regional Municipality of York. November 2005.

Ontario Ministry of Natural Resources (MNR), 2000:
Significant Wildlife Habitat Technical Guide. October 2000. 139 pp.

Ontario Ministry of Natural Resources (MNR), 2013:
Ontario Wetland Evaluation System: Southern Manual (3rd Ed., Ver. 3.2).

Ontario Ministry of Natural Resources and Forestry (MNRF), 2014a:
Natural Heritage Information Centre (NHIC) Rare Species Records. Accessed November 24, 2014. Available:
http://www.giscoeapp.lrc.gov.on.ca/web/MNR/NHLUPS/NaturalHeritage/Viewer/Viewer.html

Ontario Ministry of Natural Resources and Forestry (MNRF), 2014b.
Ontario's parks and protected areas. Accessed on November 2014. Available:
https://www.ontario.ca/environment-and-energy/ontarios-parks-and-protected-areas..

Ontario Nature, 2013:
Ontario Reptile and Amphibian Atlas. Accessed November 2014. Available: http://www.ontarionature.org/protect/species/reptiles_and_amphibians/index.php

Regional Municipality of York, 2010:
Modified York Region Official Plan - 2010. Annotated Version showing Policy Status as per June 20, 2013 Office Consolidation.

Schaeffers & Associates Ltd., 2000:
OTTSWMM and H.G.L. Analysis. Woodland Hills Subdivision – Phase 1 Northwest Newmarket. Town of Newmarket

Schaeffer & Associates Ltd., Marshall Macklin Monaghan Valcoustics Canada Ltd. And ReDevco Management Inc., 2001:
Armitage Valley Southwest Newmarket Master Servicing Update.

Town of Newmarket, 2009:
Lifestyle - About Newmarket. Accessed December 2014. Available: http://www.town.newmarket.on.ca/en/aboutus.asp.

Town of Newmarket, 2009:
Section C Storm Drainage & Stormwater Management – Engineering Design Standards and Criteria.

Town of Newmarket, 2014:
Town of Newmarket Official Plan. September 2014 Consolidation.

Toronto and Region Conservation Authority (TRCA), 2012:
Stormwater Management Criteria. Version 1.0.

Toronto and Region Conservation Authority (TRCA), 2013:
Evaluation of an Innovative Techniques for Augmenting Stream Baseflows and Mitigating the Thernam Impacts of Stormwater Ponds.

Appendix A

Study Correspondence

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

Please complete the sign-in sheet and review display materials.

The project team is available to answer your questions and address any concerns.

Your input is valued! Please fill out a comment sheet.

Welcome!

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

This Comprehensive Stormwater Master Plan provides an integrated assessment of existing and proposed/future conditions with respect to stormwater management within the Town of Newmarket. The Plan details opportunities for improvement and recommendations for future actions, and complies with the 10 steps identified in the Lake Simcoe Region Conservation Authority's Comprehensive Stormwater Management Master Plan Guidelines.
The steps followed in this include :

1. **Scope and definition of settlement areas within the entire urban boundary of the Town;**
2. **Determination of Study Area;**
3. **Characterization of Study Area;**
4. **Division of the Study Area into Management Units;**
5. **Evaluation of Cumulative Environmental Impacts of Stormwater Management from Existing and Proposed/Future Development;**
6. **Determine Effectiveness of Existing SWM Systems;**
7. **Identification and evaluation of Stormwater improvement and retrofit opportunities;**
8. **Establishing a Recommended Approach for Stormwater Management for the Study Area;**
9. **Developing an Implementation Plan for Recommended Approaches; and**
10. **Developing Programs for Inspection and Maintenance of Stormwater Management Facilities.**

Introduction

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

Newmarket

The Purpose of the Comprehensive Stormwater Master Plan is to explore various alternatives to reduce the Phosphorus loading in runoff with in the Study Area.

The Plan is an integrated assessment of existing and proposed/future conditions with respect to stormwater management within the Town of Newmarket, and details opportunities for improvement and recommendations for future actions.

AECOM

Purpose of the Comprehensive Stormwater Master Plan

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

Newmarket

This study has been undertaken according to the Master Planning process, set out within the Municipal Class Environmental Assessment (Municipal Engineers Association, October 2000, as amended in 2007 and 2011), and is subject to the requirements of the Environmental Assessment Act.

The Comprehensive Stormwater Master Plan is a long range plan that integrates the existing and future land use needs of the Study Area with environmental assessment planning principles. This plan examines the needs of the area in order to outline a framework for planning for subsequent projects. Similar to an Environmental Assessment (EA) in evaluating options, a broad-based process is used including functional performance, environmental, social and economic/cost considerations. The Comprehensive Stormwater Master Plan allows for an integrated planning approach that the Town of Newmarket can adopt as it continues to grow, and a methodology for implementing new and upgrading existing stormwater management facilities.

As part of the projects AECOM will ensure that requirements of Phases 1 and 2 of the Municipal Class EA process are completed.

The Class Environmental Assessment Planning Process is depicted graphically on the following panel.

Municipal Class Environmental Assessment (EA) Process

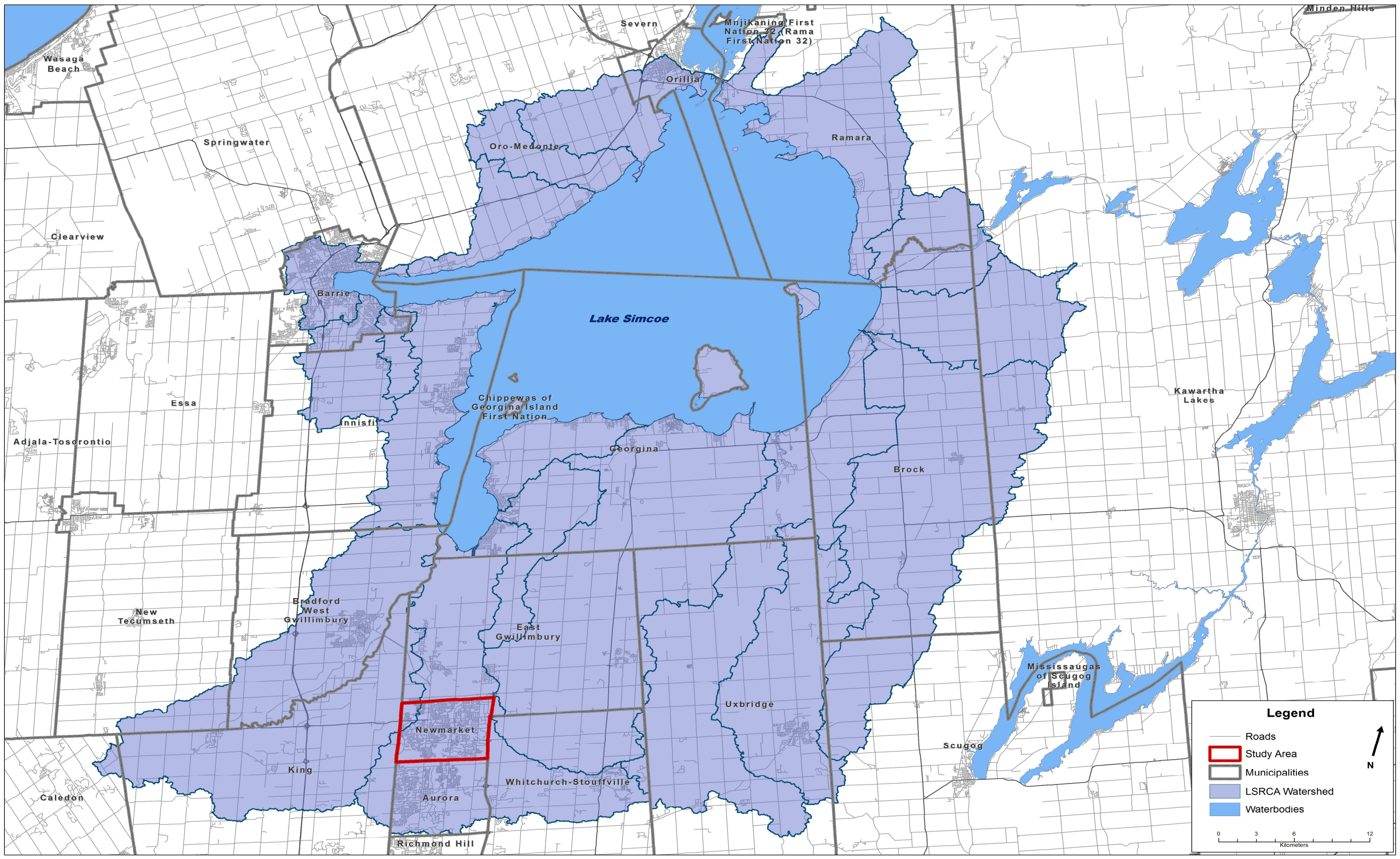
AECOM

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

REPLACE WITH EA PROCESS BOARD

Municipal Class EA Process Chart

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

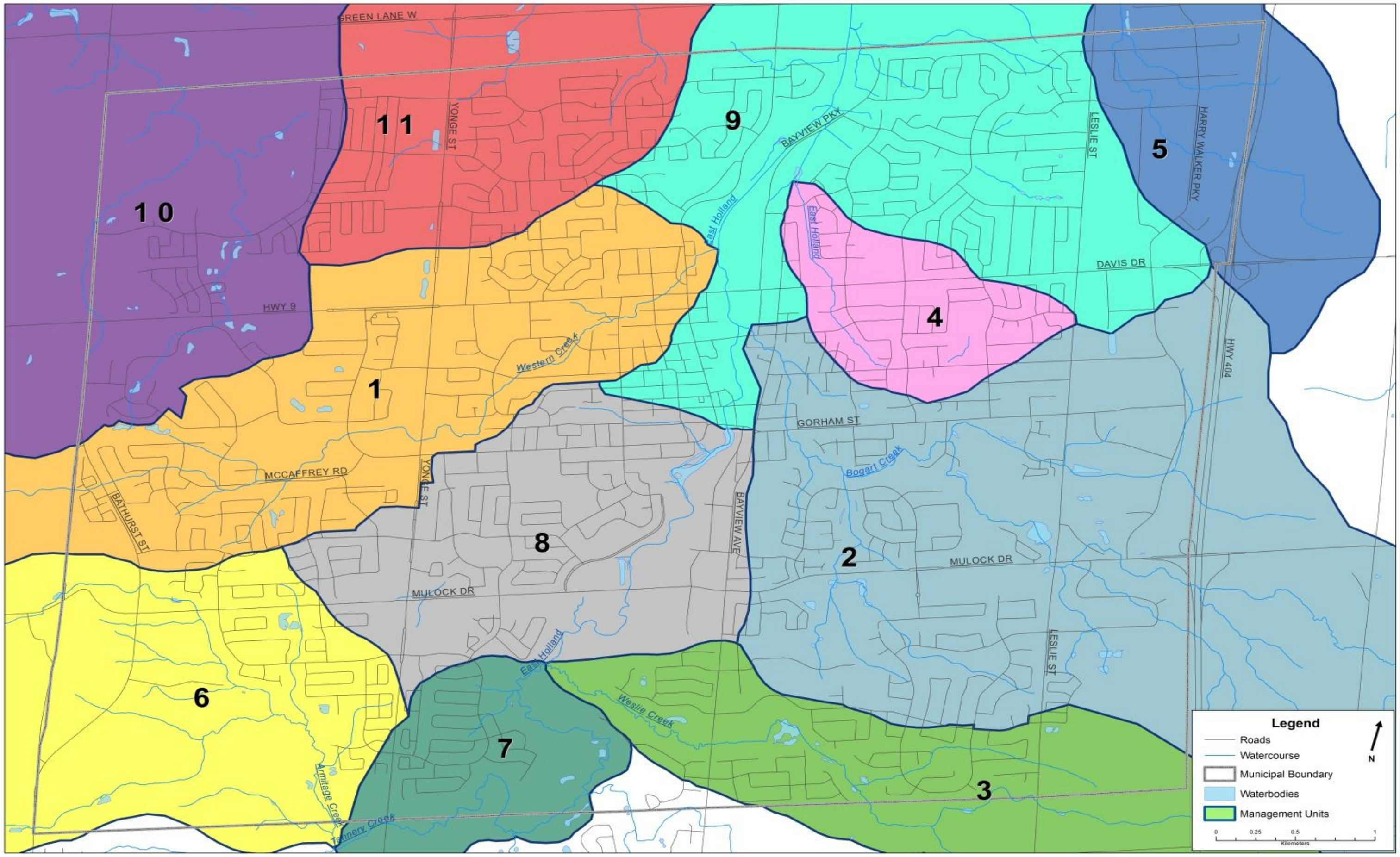


AECOM

Lake Simcoe Watershed and Study Area

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

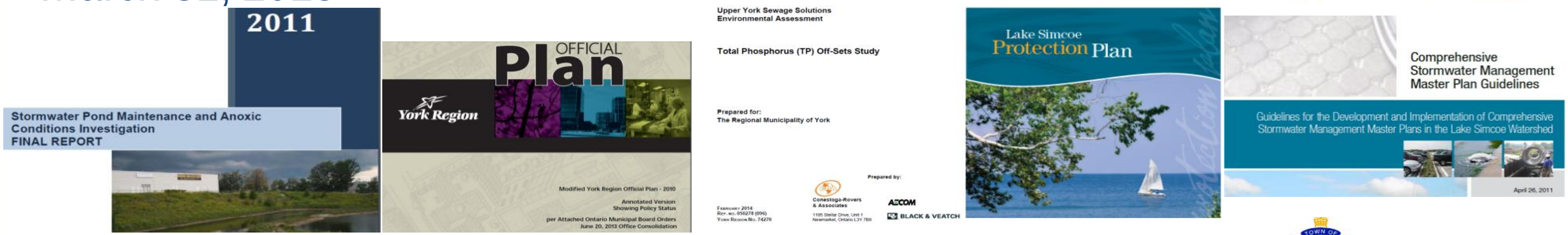
Newmarket



AECOM

Study Area and Management Units

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015



Numerous studies have been carried out previously for both Stormwater Management and Phosphorus loading. Those relevant to the Town of Newmarket Comprehensive Stormwater Master Plan were reviewed as part of this study.

Of specific interest to this study were the Town-Wide Drainage Study, the Upper York Sewage Solutions Individual EA, the Stormwater Facility Inventory and Maintenance Plan and Stormwater Pond Studies by LSRCA.

SECTION C
STORM DRAINAGE
&
STORMWATER MANAGEMENT

NEWMARKET URBAN CENTRES
SECONDARY PLAN
RECOMMENDED TO THE REGION OF YORK FOR APPROVAL

Lake Simcoe Basin Stormwater Management and Retrofit Opportunities
2007

Oak Ridges Moraine
Conservation Plan

AECOM

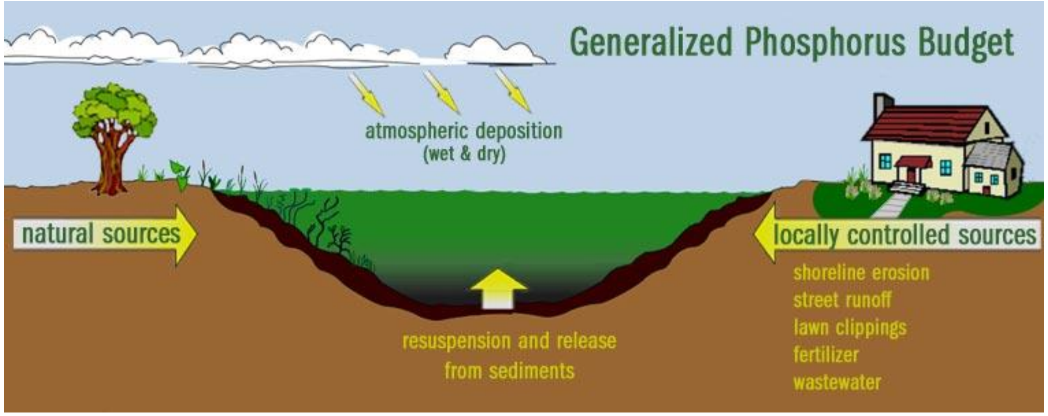
Background Information

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

Newmarket

What is Phosphorus?

Phosphorus is a naturally occurring nutrient in our environment and is also commonly found in commercial fertilizers and other household products. While Phosphorus is a valuable nutrient that helps plants to grow, such as our lawns and gardens, when there is an excessive amount of phosphorus, it can have a negative impact on our watershed environment, including the quality of water in Lake Simcoe and its river system.



Phosphorus sources, Lake Access

What is Phosphorus?

AECOM

Newmarket

Human activities lead to increased inputs of P in streams. The most obvious sources are from municipal wastewater (sewage) treatment plants and from industry and are called point sources that are regulated by monitoring loads at the ends of their discharge pipes and setting strict limits. Diffuse, or non point sources, are much more difficult to measure and to control.

The major sources of P to most urban lakes are non point, are all controllable to a large extent by homeowners and/or local community agencies and typically include:

- **soil-P from erosion (construction sites, road banks, shoreline and stream bank disturbance, lawns & gardens)**
- **road and roof runoff (sediment and organic matter that accumulates between rainfalls)**
- **lawn clippings, leaves and other organic matter**
- **excess lawn fertilizer**

All of these sources collect on the ground and are washed into sewers and streams when it rains.

AECOM

How is Phosphorus transported?

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

Newmarket

Why is it bad for Lake Simcoe?

Excessive phosphorus has been the most significant cause of water quality impairment in Lake Simcoe and its rivers, or tributaries. It leads to excessive aquatic plant and algal growth in the lake. When algae decay in the deeper areas of the lake, they create an oxygen shortage that affects coldwater fish such as lake trout and lake whitefish, which need sufficient levels of oxygen to survive and reproduce.

Lake Simcoe has seen a dramatic decline in some fish species, along with an increase in algae blooms and aquatic weed growth. Phosphorus emissions from both urban and rural sources have upset the lake's ecosystem and fostered excessive aquatic plant growth, raising water temperatures, and decreasing oxygen levels, thereby rendering limited breeding grounds inhospitable.

What is Phosphorus? Why is it bad for Lake Simcoe?

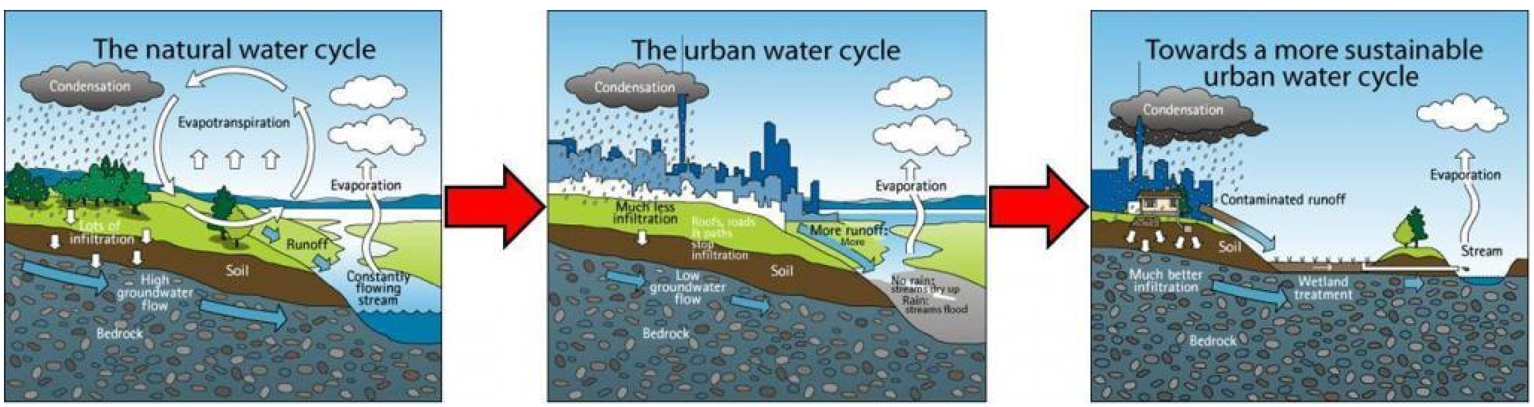
AECOM

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

Newmarket

Stormwater runoff is water that flows over surfaces and across the land when it rains. The water is routed into minor (sewers) and major (overland) drainage systems and ultimately into natural areas including creeks, wetlands, and lakes.

Urban development increases the area of hard (impervious) surfaces, increasing the stormwater runoff and decreasing the amount of water infiltrating into the ground.



Stormwater in Urban Areas, SSWM.info

What is Stormwater?

AECOM

Town of Newmarket
Comprehensive Stormwater Master Plan
Public Information Centre No. 1
March 31, 2015

Newmarket

What is Stormwater Management (SWM)?

Stormwater runoff is water that flows over surfaces and across the land when it rains. The water is routed into minor (sewers) and major (overland) drainage systems and ultimately into natural areas including creeks, wetlands, and lakes.

Stormwater Management is the process of controlling the runoff to mitigate erosion, flooding, and water quality to protect our water resources.

The implementation of stormwater management measures results reducing phosphorus loading:

- **By reducing runoff – less water to wash phosphorus off the surface**
- **By filtering the runoff – removing phosphorus attached to particles**
- **By settling – allowing phosphorus attached to particles to settle out of the runoff**

What is Stormwater Management (SWM)?

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Newmarket

Dry stormwater ponds are an end of pipe stormwater measure that capture runoff and provide a controlled release. Dry ponds have no permanent pool and act mainly as quantity control facility. They are effect for providing erosion control and reducing the risk of flooding. They provide only minimal water quality control. These ponds are generally depressional area with surrounding berm designed to store water to reduce peak outflows. Can be manicured grass for park, sports field or naturalized area.

Dry Stormwater Pond (Newmarket), AECOM

Dry Stormwater Pond (Kitchener), AECOM

Dry Stormwater Pond (Guelph), AECOM

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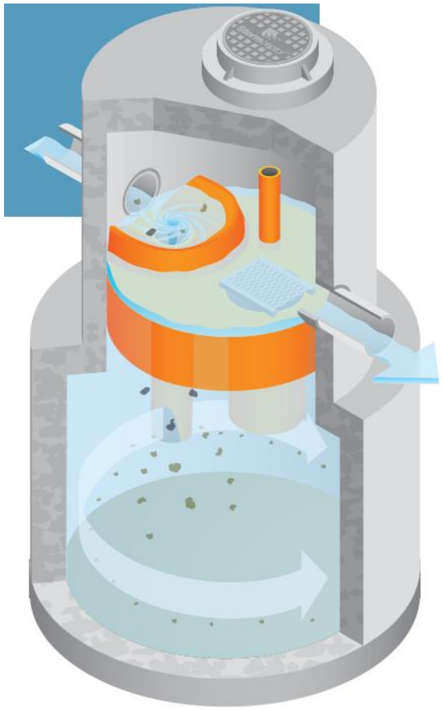
Types of SWM - Dry Ponds

Newmarket

A Treatment Manhole or Oil-Grit Separator (OGS) is a specially designed manhole structure on the storm sewer system that promotes sediment settling and removes oil and grease. These manholes need regular cleanouts to maintain their function.

Phosphorus is removed through settling of particulate matter.



Oil Grit Separator, Imbrium

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Types of SWM – Oil-Grit Separator

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Wet stormwater detention ponds are also an end of pipe stormwater measure, and work by capturing and detaining stormwater runoff and releasing it slowly at a designed rate. The permanent pool allows for the suspended particulates in the stormwater runoff to settle out in the pond. The water is then released at the designed rate to continue downstream in the system. Wet ponds can be designed to provide varying levels of water quality and quantity control. Maintenance is required in the form of pond cleanouts to preserve the permanent pool volume and the designed water quality control effectiveness.

Wet Stormwater Pond (Newmarket), AECOM

Wet Stormwater Pond (Brant), AECOM


Wet Stormwater Pond (Guelph), AECOM

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Types of SWM - Wet Ponds

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Low Impact Development (LID) provides opportunities for urban development to maintain the natural hydrologic cycle by collecting and filtering stormwater naturally, directing water back into the ground as under pre-development conditions. LID measures may also help to reduce phosphorus loading, mainly through infiltration reducing overall surface runoff. These may include infiltration trenches, rain gardens, and road right of way options including bioretention, roadside swales, perforated pipes, and pervious pavement. LID measures reduce runoff volume, help prevent soil erosion, filter pollutants, recharge groundwater, and enhance streetscapes.

Design features such as curb cuts or urban road sections may be used in conjunction with LID methods to provide a surface water flow path to enhanced ditches or bioretention swales.

Types of SWM – LID

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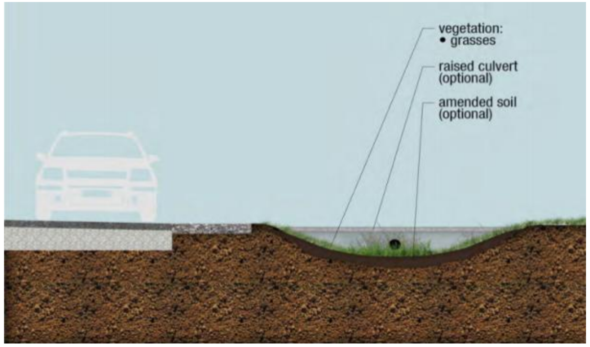
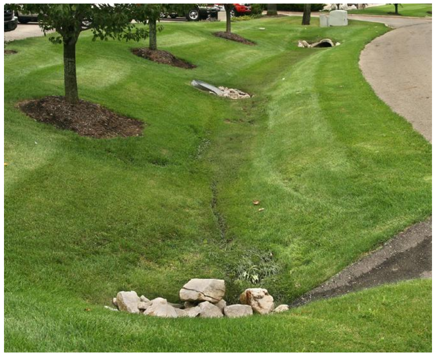
Enhanced grass swales are vegetated open channels designed to convey, treat and attenuate stormwater runoff. Check dams and vegetation slow the water to allow suspended particulates to settle out, and infiltration through the root zone also allows for uptake of nutrients by the vegetation. In addition to providing a water quality control to stormwater runoff, enhanced grass swales also reduce impervious cover and accent the natural landscape, providing aesthetic benefits.



Enhanced Grass Swale – "Grey to Green Road Retrofits", Credit Valley Conservation



Enhanced Grass Swale – Prien&Newhof

Low Impact Development (LID) options

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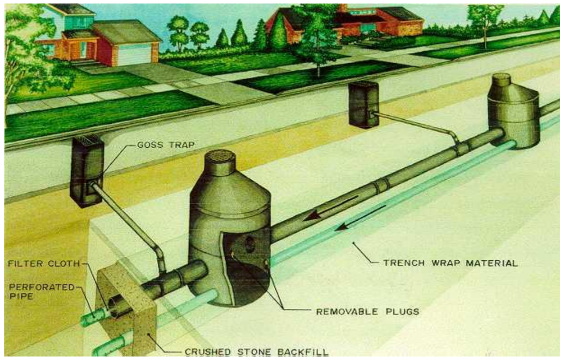
Rain gardens are shallow depressions designed with bioretention features that are suited to receive overland flows diverted from paved areas.

Bioswales are similar to enhanced grass swales in terms of the design , however they also incorporate aspects of bioretention cells consisting of bioretention soil media, a gravel storage layer, and optional underdrain components. They can significantly enhance neighbourhood aesthetics when planted with vegetation that tolerates both dry and wet growing conditions.

Infiltration methods such as perforated pipes (e.g. the Etobicoke System) provide water quality and quantity control.

Rain Garden in Residential Neighbourhood, Credit Valley Conservation

Bioretention Swale – “Grey to Green Road Retrofits”, Credit Valley Conservation



Etobicoke Exfiltration System, Ryerson University

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Low Impact Development (LID) options

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Rainwater harvesting reduces stormwater runoff by collecting rainwater (usually from rooftop downspouts) and using it between storm events for irrigation, car/truck washing, toilet flushing or other non-potable uses. Rainwater can be collected in above ground rainbarrels, tanks or cisterns or underground tanks fitted with pumps.

Green roofs consist of a thin layer of growing media installed on top of a conventional flat roof. Green roofs reduce the rate and volume of runoff by providing temporary storage on the surface of the vegetation, within the growing media and drainage layers, as well as allowing water to be lost to the atmosphere via evapotranspiration. Green roofs can help to lower your heating and cooling costs.

Residential Rainbarrel,
Credit Valley Conservation

Maplewood Mall, Minnesota Rainwater Tank, Credit Valley Conservation

Green Roof, Credit Valley Conservation

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Low Impact Development (LID) options

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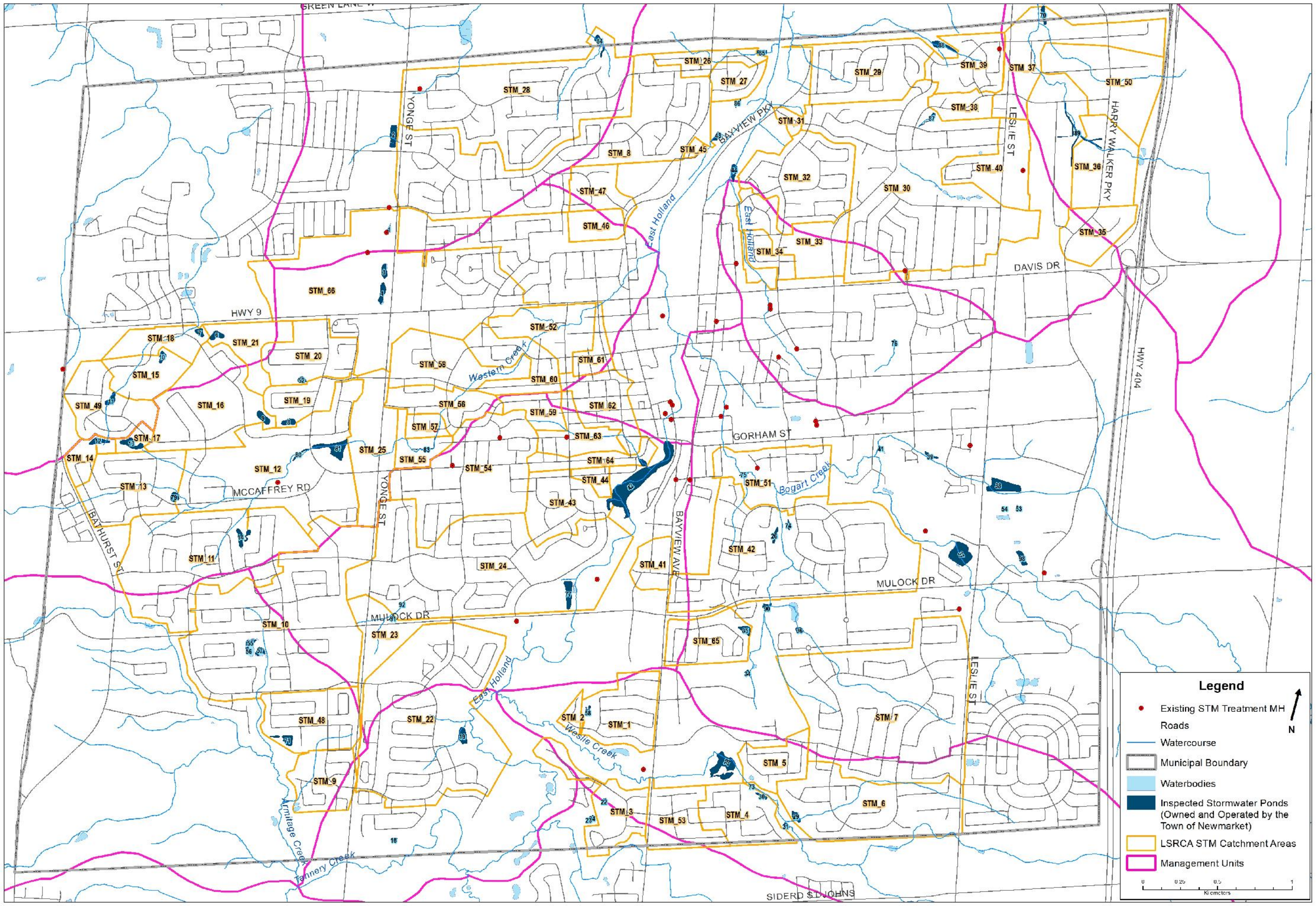

Study Components

Town of Newmarket
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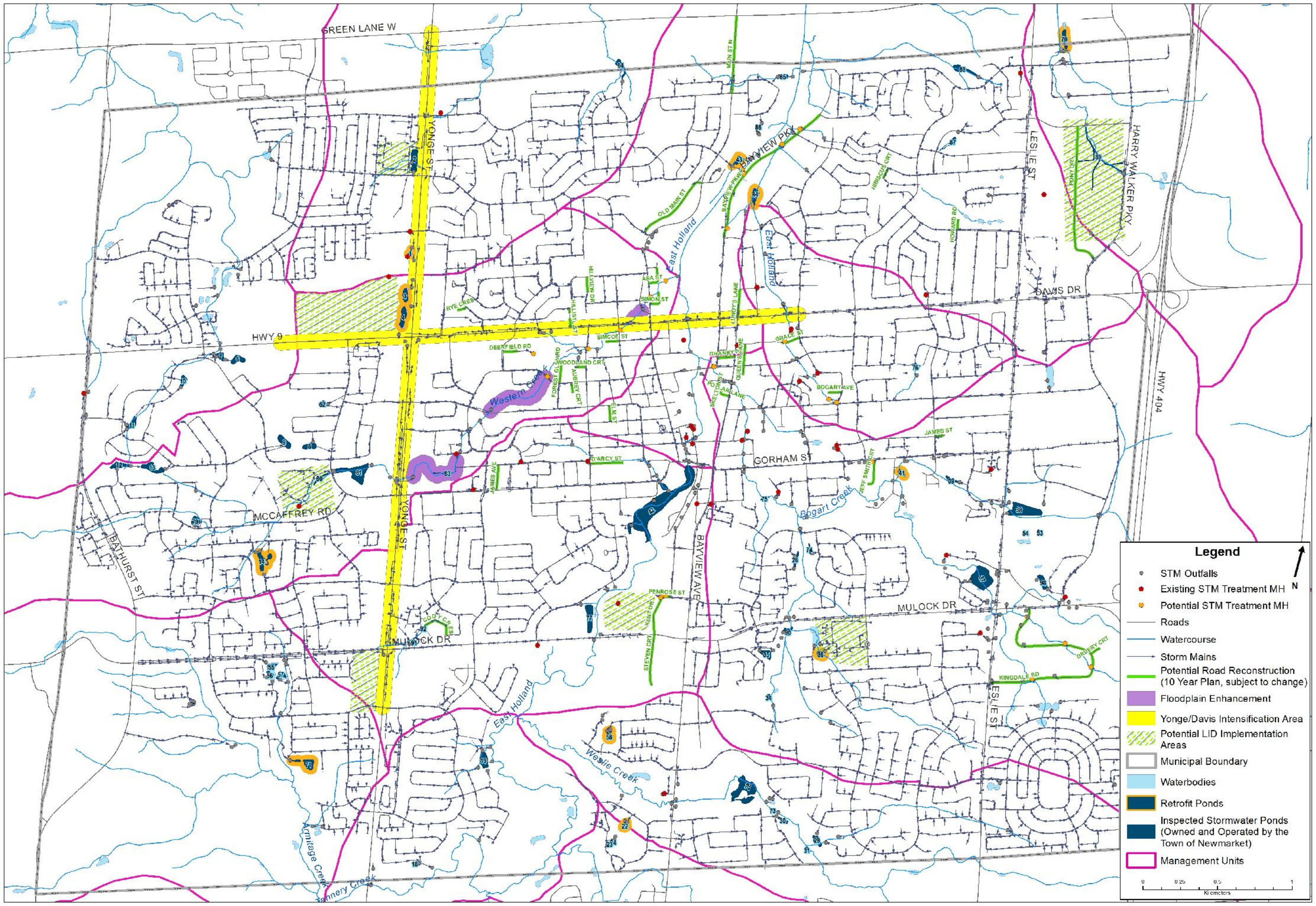

Existing and Future SWM Upgrades

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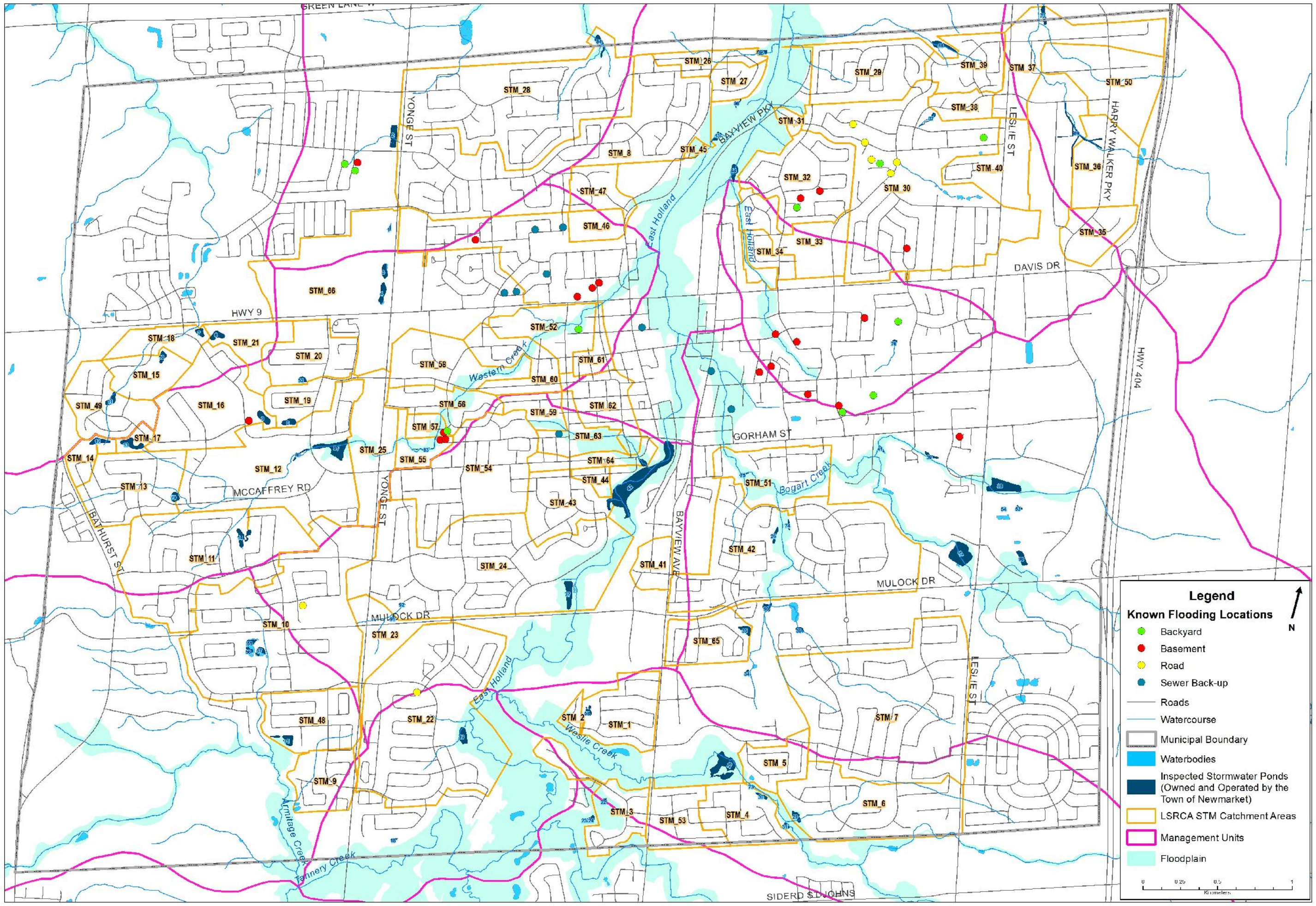

Known Flooding Areas

Town of Newmarket
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The following recommendations are a result of the analysis of the study:

- **Carry out pond retrofits and clean outs as outlined in the Plan;**
- **Implement roadway curb cuts and no curb systems where feasible to allow for roadway runoff to planting systems and infiltration systems;**
- **Install Oil Grit Separators where necessary and/or feasible for road reconstruction projects proposed within the next 10 years;**
- **Install LID measures at the Ray Twinney Complex and at other Town facilities where feasible;**
- **Implement corridor restoration and reconnection of floodplain storage to streams where feasible; and**
- **Public Education and Engagement Campaign to promote sustainable practices and stormwater management throughout the community.**

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Recommendations

Town of Newmarket
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The following steps will be completed next:

- **Finalizing the report and recommendations based on public input;**
- **Approval by Council;**
- **Implementation of Recommended Approach.**

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Next Steps

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March 31, 2015

Contact Information

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Capital Projects Coordinator, Town of Newmarket

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Senior Project Manager – Water Resources, AECOM

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Thank You!

Newmarket

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F: 905 953 5138

COMMENT SHEET

PUBLIC INFORMATION CENTRE – Drop In
Stormwater Master Plan

Date: **Tuesday March 31, 2015 - 6:30 p.m. to 8:00 p.m.**

Location: Council Chamber, Municipal Offices, 395 Mulock Drive

YOU ARE INVITED TO OFFER ANY COMMENTS:

- the emphasis is on Phosphoros; will mitigation of other pollutants be studied?
- how will this impact new developments or developments that have been approved but not yet started
- will maintenance (both ongoing and rebuilding) be properly budgeted for

(Please use back if there is not enough space)

Please provide name and address below (PLEASE PRINT):

Name:

Address:

Postal Code:

E-Mail:

Please place this Comment Sheet in the box provided or you may fax, mail or e-mail it by no later than Friday, April 10, 2015 to:

Meredith Goodwin
Capital Projects Mgr
Town of Newmarket
395 Mulock Drive
Newmarket, ON L3Y 4X7

or

mgoodwin@newmarket.ca
Fax Number: 905-953-5138

Newmarket

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Location: Council Chamber, Municipal Offices, 395 Mulock Drive

YOU ARE INVITED TO OFFER ANY COMMENTS:

Concillor Tom Hempen - Ward 4
- study in
2008 sewer backup complaints.
are they still relevent.?
has there been backups since?
- what were the recommedations from
those in the report
Slide - Known Flooding Areas

(Please use back if there is not enough space)

Please provide name and address below (PLEASE PRINT):

Name: ______

Address: ______

Postal Code: ______

E-Mail: ______

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Capital Projects Mgr
Town of Newmarket
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Appendix B

Phosphorus Loading and Removal Efficiency Calculations

Appendix B1

Pond Summary Table

Pond Number	Existing Ownership	Management Unit	Pond Type	Pond Design	Existing Function	Designed Level of Enhancement
3	Private	1	-	Wet	Wet	3
4	Private	1	-	Wet	Wet	3
8	Unassumed	1	-	Wet	Wet	1
9	Unassumed	1	-	Wet	Wet	1
12	Unassumed	1	-	Wet	Wet	1
13	Unassumed	1	-	Wet	Wet	1
14	Town of Newmarket	1	quality/quantity	Wet	Wet	2
52	Unassumed	1	-	Wet	Wet	1
66	Town of Newmarket	1	online	-	-	n/a
79	Town of Newmarket	1	quantity	Dry	Dry	3
80	Town of Newmarket	1	online	-	-	3
81	Town of Newmarket	1	quality/quantity-online	-	-	1
83	Town of Newmarket	1	online	-	-	n/a
26	Town of Newmarket	2	quantity	Dry	Dry	n/a
34	Unassumed	2	quality/quantity	Wet	Wet	3
35	Town of Newmarket	2	quality/quantity	Wet	Wet	1
36	Town of Newmarket	2	quantity-online	-	-	2
37	Private	2	quality/quantity-online	-	-	n/a
38	Town of Newmarket	2	quality/quantity	Wet	Wet	1
39	Town of Newmarket	2	quality/quantity	Wet	Dry	1
40	Town of Newmarket	2	removed from inventory	-	-	n/a
41	Private	2	quality/quantity	Wet	Wet	1
53	Town of Newmarket	2	quality/quantity	Wet	Wet	1
54	Town of Newmarket	2	Removed from Inventory	-	-	n/a
57	Private	2	online - not a SWM pond	-	-	n/a
61	Town of Newmarket	2	quantity-online	-	-	n/a
64	Private	2	-	Wet?	Wet?	n/a
65	Private	2	-	Wet	Wet	n/a
74	Town of Newmarket	2	quality/quantity	Wet	Dry	1
75	Town of Newmarket	2	quality/quantity-online	-	-	1
93	UNASSUMED	2	n/a	Wet	Wet	n/a
96	Town of Newmarket	2	quality/quantity-online	-	-	1
98	Unassumed	2	quality/quantity	Wet	Dry	1
101	Unassumed	2	-	Wet	Wet	n/a
28	Private	3	online	-	-	n/a
29	Town of Newmarket	3	quality/quantity	Dry	Dry	n/a
30	Town of Newmarket	3	quantity	Dry	Dry	n/a
31	Town - Removed from Inventory	3	Removed from Inventory	-	-	n/a
58	Town of Newmarket	3	quality/quantity	Wet	Wet	1
73	Town of Newmarket	3	quantity-online	-	-	3
102	UNASSUMED	3	-	Wet	Wet	n/a
63	Town of Newmarket	4	-	Dry	Dry	n/a
76	Town of Newmarket	4	quantity	Dry	Dry	3
70	Town of Newmarket	5	-	Wet	Wet	n/a
89	Town of Newmarket	5	online	-	-	1
27	Private	6	online	-	-	n/a
32	Private	6	online	-	-	n/a
33	Town of Newmarket	6	Dry pond/wetland	Dry	Dry	n/a
51	Private	6	online - not a SWM pond	-	-	n/a
55/56/62	Town of Newmarket	6	quality/quantity	Wet	Dry	1
71	Town of Newmarket	6	quality/quantity	Wet	Wet	1
97	Town of Newmarket	6	quality/quantity	Wet	Wet	1
5	Private - Golf Course	7	quality/quantity	Wet	Wet	n/a
16	Private - Golf Course	7	quality/quantity	Wet	Wet	n/a
17	Private - Golf Course	7	quality/quantity	Wet	Wet	n/a
18	Town of Newmarket	7	quality/quantity	Dry	Dry	3
19	Town of Newmarket	7	quality/quantity	Wet	Wet	1
22	Town of Newmarket	7	quality/quantity	Wet	Wet	1
23&24	Ponds23/24 same pond/connected	7	-	Wet	Wet	1
25	Private	7	online - not a SWM pond	-	-	n/a
42	Town of Newmarket	8	quality/quantity-online	-	-	1
77	Town of Newmarket	8	-	Wet	Wet	1
91	Town of Newmarket	8	-	Dry	Dry	1
92	Town of Newmarket	8	quantity	Dry	Dry	3
43	Town of Newmarket	9	quality/quantity	Wet	Dry	1
44	Town of Newmarket	9	quality/quantity-online	-	-	1
46	Private	9	online	-	-	n/a
47	Private	9	online	-	-	n/a
48	Private	9	online	-	-	n/a
49	Private	9	online	-	-	n/a
50	Private	9	online	-	-	n/a
59	Private	9	online	-	-	n/a
60	Private	9	online	-	-	n/a
85	Town of Newmarket	9	quantity	Dry	Dry	3
86	Town of Newmarket	9	quality/quantity	Wet	Wet	1
87	Town of Newmarket	9	quantity	Dry	Dry	3
88	Town of Newmarket	9	quantity	Dry	Dry	3
6	Unassumed	10	-	Wet	Wet	1
7	Unassumed	10	-	Wet	Wet	1
10	Unassumed	10	-	Wet	Wet	1
11	Unassumed	10	-	Wet	Wet	1
45	Town of Newmarket	10	online	-	-	n/a
67 (MQ1)	Town of Newmarket	10	quality/quantity	Wet	Dry	1
68 (MQ3)	Unassumed	10	-	Dry	Dry	n/a
94	Town of Newmarket	10	quality/quantity-online	-	-	1
95	Town of Newmarket	10	-	Wet	Wet	n/a
72 (WQ1)	Town of Newmarket	10	quality/quantity	Wet	Wet	n/a
99 (MQ2)	Town of Newmarket	10	quality/quantity	Dry	Dry	1
103 (MQ4)	Town of Newmarket	10	quality/quantity	Wet	Wet	n/a
1	Private	11	-	Wet	Wet	1
2	Private	11	quality/quantity	Wet	Wet	1
84	Town of Newmarket	11	online	-	-	1

Shaded Ponds are online ponds and were not included in the phosphorus removal calculations.

EXISTING CONDITIONS			
REAS NOT TREATED BY SWM PONDS	AREAS TREATED BY SWM PONDS		
	UNTREATED	WET	DRY
Mangement Unit 1			
Cropland	4.49		
High Intensity - Comm/Industrial	144.34	42.68	0.32
High Intensity - Residential	122.06	112.06	19.48
Sod farm/Golf course	42.42	36.05	2.46
Total Area:	313.32	190.78	22.27
Mangement Unit 2			
Cropland	0.27		
High Intensity - Comm/Industrial	130.51	104.76	31.26
High Intensity - Residential	183.06	95.20	75.44
Sod farm/Golf course	73.68	19.96	16.94
Total Area:	387.52	219.92	123.64
Mangement Unit 3			
Cropland	22.00		
High Intensity - Comm/Industrial	29.59	0.29	0
High Intensity - Residential	33.15	30.43	55.93
Sod farm/Golf course	63.32	3.66	10.04
Total Area:	148.06	34.38	65.97
Mangement Unit 4			
Cropland	0.00		
High Intensity - Comm/Industrial	35.42	0	19.58
High Intensity - Residential	54.27	0	38.76
Sod farm/Golf course	0.00	0	4.71
Total Area:	89.68	0.00	63.05
Mangement Unit 5			
Cropland	0.00		
High Intensity - Comm/Industrial	96.71	24.82	0
High Intensity - Residential	0.00	1.65	0
Sod farm/Golf course	0.00	1.13	0
Total Area:	96.71	27.60	0.00
Mangement Unit 6			
Cropland	62.69		
High Intensity - Comm/Industrial	8.54	5.08	25.34
High Intensity - Residential	4.48	36.50	54.16
Sod farm/Golf course	152.55	12.67	7.44
Total Area:	228.26	54.25	86.93
Mangement Unit 7			
Cropland	0.00		
High Intensity - Comm/Industrial	0.00	15.56	0
High Intensity - Residential	0.00	67.64	13.10
Sod farm/Golf course	28.98	39.45	0
Total Area:	28.98	122.65	13.10
Mangement Unit 8			
Cropland	0.00		
High Intensity - Comm/Industrial	115.03	18.11	14.79
High Intensity - Residential	140.15	62.91	0.50
Sod farm/Golf course	43.27	20.48	1.57
Total Area:	298.45	101.50	16.86
Mangement Unit 9			
Cropland	7.97		
High Intensity - Comm/Industrial	161.72	0.00	20.40
High Intensity - Residential	46.08	7.64	197.41
Sod farm/Golf course	71.78	0.03	20.23
Total Area:	287.56	7.68	238.04
Mangement Unit 10			
Cropland	52.15		
High Intensity - Comm/Industrial	9.96	3.15	6.87
High Intensity - Residential	11.32	68.07	24.55
Sod farm/Golf course	68.11	56.08	5.68
Total Area:	141.54	127.30	37.10
Mangement Unit 11			
Cropland	1.28		
High Intensity - Comm/Industrial	48.42	44.98	0
High Intensity - Residential	101.40	31.22	0
Sod farm/Golf course	11.55	2.91	0
Total Area:	162.65	79.11	0.00
Total Area:	2183	965	667
			3815

PROPOSED CONDITIONS			
AREAS NOT TREATED BY SWM PONDS		AREAS TREATED BY SWM PONDS	
	UNTREATED	WET	DRY
Mangement Unit 1			
High Intensity - Comm/Industrial	110.30	38.68	0.00
High Intensity - Residential	152.10	119.33	19.60
Sod farm/Golf course	47.47	36.51	2.40
Total Area:	309.86	194.51	22.00
Mangement Unit 2			
High Intensity - Comm/Industrial	21.93	165.42	0.00
High Intensity - Residential	268.05	116.37	36.39
Sod farm/Golf course	94.01	24.79	4.14
Total Area:	383.99	306.57	40.53
Mangement Unit 3			
High Intensity - Comm/Industrial	0.45	12.07	0
High Intensity - Residential	89.03	19.68	57.48
Sod farm/Golf course	59.14	2.25	8.33
Total Area:	148.62	34.00	65.80
Mangement Unit 4			
High Intensity - Comm/Industrial	17.89	0	12.55
High Intensity - Residential	66.67	0	46.64
Sod farm/Golf course	4.84	0	4.14
Total Area:	89.39	0.00	63.34
Mangement Unit 5			
High Intensity - Comm/Industrial	80.23	28.48	0
High Intensity - Residential	0.00	0.99	0
Sod farm/Golf course	14.61	0.00	0
Total Area:	94.84	29.47	0.00
Mangement Unit 6			
High Intensity - Comm/Industrial	0.00	18.44	0
High Intensity - Residential	0.00	108.33	0
Sod farm/Golf course	228.23	14.44	0
Total Area:	228.23	141.21	0.00
Mangement Unit 7			
High Intensity - Comm/Industrial	0.00	12.36	0
High Intensity - Residential	0.00	72.79	13.10
Sod farm/Golf course	29.47	37.01	0
Total Area:	29.47	122.16	13.10
Mangement Unit 8			
High Intensity - Comm/Industrial	87.79	16.97	14.58
High Intensity - Residential	170.78	66.60	1.04
Sod farm/Golf course	39.91	17.93	1.21
Total Area:	298.49	101.50	16.83
Mangement Unit 9			
High Intensity - Comm/Industrial	113.62	2.68	15.39
High Intensity - Residential	81.33	93.60	110.41
Sod farm/Golf course	92.57	8.62	15.05
Total Area:	287.52	104.90	140.85
Mangement Unit 10			
High Intensity - Comm/Industrial	0.63	16.73	0.00
High Intensity - Residential	26.88	76.27	40.90
Sod farm/Golf course	98.30	42.45	3.78
Total Area:	125.81	135.45	44.68
Mangement Unit 11			
High Intensity - Comm/Industrial	37.79	21.39	0
High Intensity - Residential	126.32	33.92	0
Sod farm/Golf course	8.70	13.65	0
Total Area:	172.81	68.96	0.00
Total Area:	2169	1,239	407

Appendix B2

SWM Pond Areas - Land Uses for Existing Conditions

MU	Pond	Existing Conditions Model Exs Pond As	Model Prop Pond As	STM Area	CatchName	Land Use	AREA (ha)	%
1	3	Wet	Wet	19.6	STM_C85	High Intensity - Comm/Industrial	19.61	100%
						High Intensity - Residential	0.00	0%
1	4	Wet	Wet	25.5	STM_C84	Sod farm/Golf course	0.33	1%
					STM_C84	High Intensity - Comm/Industrial	18.16	71%
					STM_C84	High Intensity - Residential	7.06	28%
1	8	Wet	Wet	11.3	STM_C27	Sod farm/Golf course	4.09	36%
					STM_C27	High Intensity - Comm/Industrial	0.11	1%
					STM_C27	High Intensity - Residential	7.14	63%
1	9	Wet	Wet	37.9	STM_C24	Sod farm/Golf course	15.73	41%
					STM_C24	High Intensity - Residential	22.18	59%
1	12	Wet	Wet	9.5	STM_C22	Sod farm/Golf course	3.04	32%
					STM_C22	High Intensity - Comm/Industrial	0.14	2%
					STM_C22	High Intensity - Residential	6.36	67%
1	13	Wet	Wet	3.2	STM_C25	Sod farm/Golf course	1.97	61%
					STM_C25	High Intensity - Residential	1.28	39%
1	14	Wet	Wet	67.3				
					STM_C18	Sod farm/Golf course	8.03	12%
					STM_C18	High Intensity - Comm/Industrial	1.35	2%
					STM_C18	High Intensity - Residential	54.07	80%
1	52	Wet	Wet	21.1	STM_C29	Sod farm/Golf course	2.85	14%
					STM_C29	High Intensity - Comm/Industrial	3.30	16%
					STM_C29	High Intensity - Residential	13.97	69%
1	79	Dry	Dry	22.3	STM_C21	Sod farm/Golf course	2.46	11%
					STM_C21	High Intensity - Comm/Industrial	0.32	1%
					STM_C21	High Intensity - Residential	19.48	87%
							213.06	
2	26	Dry	Dry	40.5	STM_C56	Sod farm/Golf course	4.36	11%
					STM_C56	High Intensity - Comm/Industrial	1.09	3%
					STM_C56	High Intensity - Residential	35.08	87%
2	34	Wet	Wet	35.4	STM_C11	Sod farm/Golf course	5.71	16%
					STM_C11	High Intensity - Comm/Industrial	18.74	53%
					STM_C11	High Intensity - Residential	10.92	31%
2	35	Wet	Wet	19	STM_C81	Sod farm/Golf course	2.38	13%
					STM_C81	High Intensity - Comm/Industrial	1.20	6%
					STM_C81	High Intensity - Residential	15.45	81%
2	38	Wet	Wet	60.8	STM_C03	Sod farm/Golf course	6.54	11%
					STM_C03	High Intensity - Comm/Industrial	53.60	88%
					STM_C03	High Intensity - Residential	0.64	1%
2	39	~~Wet~~/FULL-EXS DRY	Wet	17	STM_C06	Sod farm/Golf course	6.19	36%
					STM_C06	High Intensity - Comm/Industrial	3.78	22%
					STM_C06	High Intensity - Residential	7.07	42%
2	41	Wet	Wet	25.4				
					STM_C08	High Intensity - Comm/Industrial	4.21	17%
					STM_C08	High Intensity - Residential	18.01	71%
2	53	Wet	Wet	4.8	STM_C04	High Intensity - Comm/Industrial	4.83	100%
2	64	Wet	Wet	10.44		Sod farm/Golf course	3.92	38%
				STM_C94		High Intensity - Comm/Industrial	0.00	0%
				STM_C94		High Intensity - Residential	6.51	62%
								100%
2	65		Wet	13.85		Sod farm/Golf course	1.04	7%
		Wet		STM_C95		High Intensity - Comm/Industrial	3.29	24%
				STM_C95		High Intensity - Residential	9.52	69%
								100%
2	74	~~Wet~~/FULL-EXS DRY	Wet	53.2	STM_C55	Sod farm/Golf course	3.88	7%
					STM_C55	High Intensity - Comm/Industrial	16.00	30%
					STM_C55	High Intensity - Residential	33.28	63%
2	93	Wet	Wet	34.7		Sod farm/Golf course	0.35	1%
				STM_C92		High Intensity - Comm/Industrial	0.21	1%
				STM_C92		High Intensity - Residential	34.14	98%
								100%
2	98	~~Wet~~/FULL-EXS DRY	Dry	12.9	STM_C02	Sod farm/Golf course	2.52	19%
					STM_C02	High Intensity - Comm/Industrial	10.40	81%
2	101	Wet	Wet	18.7		Sod farm/Golf course	0.02	0%
				STM_C96		High Intensity - Comm/Industrial	18.68	100%
				STM_C96		High Intensity - Residential	0.00	0%
							343.57	100%
3	29	~~Wet~~/FULL-EXS DRY	Dry	47.4	STM_C75	Sod farm/Golf course	9.39	20%
					STM_C75	High Intensity - Residential	38.02	80%
3	30	Dry	Dry	18.6	STM_C52	Sod farm/Golf course	0.65	3%
					STM_C52	High Intensity - Residential	17.91	96%
3	102	Wet	Wet	13.72		Sod farm/Golf course	2.41	18%
				STM_C93		High Intensity - Comm/Industrial	0.29	2%
		UNASSUMED		STM_C93		High Intensity - Residential	11.02	80%
								100%
3	58	Wet	Wet	20.7	STM_C14	Sod farm/Golf course	1.25	6%
					STM_C14	High Intensity - Comm/Industrial	0.00	0%
					STM_C14	High Intensity - Residential	19.41	94%
							100.35	
4	63	DRY	Dry	8.04	STM_C91	Sod farm/Golf course	1.00	12%
	NEW				STM_C91	High Intensity - Comm/Industrial	4.43	55%
					STM_C91	High Intensity - Residential	2.61	32%
4	76	Dry	Dry	55.3	STM_C07	Sod farm/Golf course	4.00	7%
					STM_C07	High Intensity - Comm/Industrial	15.15	27%
					STM_C07	High Intensity - Residential	36.15	65%
							63.34	
5	70	Wet	Wet	31.6	STM_C49	Sod farm/Golf course	3.80	12%
					STM_C49	High Intensity - Comm/Industrial	24.82	79%
					STM_C49	High Intensity - Residential	2.98	9%
6	33	Enhanced Wetland	Wet	3.59	STM_C??	Sod farm/Golf course	0.00	0%
						High Intensity - Comm/Industrial	0.00	0%
						High Intensity - Residential	3.59	100%
6	55	~~Wet~~/FULL-EXS DRY	Wet	86.9	STM_C15	Sod farm/Golf course	7.44	9%
					STM_C15	High Intensity - Comm/Industrial	25.34	29%
	55/56/62 'same' pond				STM_C15	High Intensity - Residential	54.16	62%

6	56	~~Wet~~/FULL-EXS DRY	Wet	8.8	STM_C16	Sod farm/Golf course	2.75	31%
					STM_C16	High Intensity - Comm/Industrial	2.17	25%
	55/56/62 'same' pond				STM_C16	High Intensity - Residential	3.84	44%
6	62	~~Wet~~/FULL-EXS DRY	Wet	0.6	STM_C17	Sod farm/Golf course	0.62	100%
	55/56/62 'same' pond							
6	71	Wet	Wet	24.2	STM_C62	Sod farm/Golf course	2.14	9%
					STM_C62	High Intensity - Comm/Industrial	2.55	11%
					STM_C62	High Intensity - Residential	19.49	81%
6	97	Wet	Wet	17.1	STM_C88	Sod farm/Golf course	7.16	42%
					STM_C88	High Intensity - Comm/Industrial	0.36	2%
					STM_C88	High Intensity - Residential	9.58	56%
							137.59	
7	5		Wet	0.42		Sod farm/Golf course	0.42	100%
						High Intensity - Comm/Industrial	0.00	0%
						High Intensity Residential	0.00	0%
								100%
7	16		Wet	5.77	STM_C100	Sod farm/Golf course	5.13	89%
					STM_C101	High Intensity - Comm/Industrial	0.00	0%
					STM_C102	High Intensity Residential	0.64	11%
								100%
7	17		Wet	1.99	STM_C102	Sod farm/Golf course	1.99	100%
					STM_C102	High Intensity - Comm/Industrial	0.00	0%
					STM_C102	High Intensity Residential	0.00	0%
								100%
7	18	Dry	Dry	13.1	STM_C32	High Intensity - Residential	13.10	100%
7	19	Wet	Wet	92.7	STM_C31	Sod farm/Golf course	20.99	23%
					STM_C31	High Intensity - Comm/Industrial	15.56	17%
					STM_C31	High Intensity - Residential	56.15	61%
7	22	wet	Wet	16.6	STM_C41	Sod farm/Golf course	6.63	41%
					STM_C41	High Intensity - Residential	9.67	59%
7	23&24	wet	Wet	5.5	STM_C12	Sod farm/Golf course	4.28	78%
	Ponds23/24 same pond/connected				STM_C12	High Intensity - Residential	1.18	22%
~~7~~	~~25~~	~~REMOVE~~	~~Wet~~	~~7.58~~	~~STM_C101~~	~~Sod farm/Golf course~~	~~7.36~~	~~97%~~
	~~Golf cours~~	~~NOT A SWM POND~~			~~STM_C101~~	~~High Intensity - Comm/Industrial~~	~~0.21~~	~~3%~~
					~~STM_C101~~	~~High Intensity Residential~~	~~0.00~~	~~0%~~
							~~143.32~~	~~100%~~
8	77	Wet	Wet	101.5	STM_C34	Sod farm/Golf course	20.48	20%
					STM_C34	High Intensity - Comm/Industrial	18.11	18%
					STM_C34	High Intensity - Residential	62.91	62%
8	91	dry	Dry	15.6	STM_C33	Sod farm/Golf course	1.54	10%
					STM_C33	High Intensity - Comm/Industrial	13.56	87%
					STM_C33	High Intensity - Residential	0.50	3%
8	92	dry	Dry	1.3	STM_C35	High Intensity - Residential	0.03	2%
					STM_C35	High Intensity - Comm/Industrial	1.23	98%
							118.36	
9	43	~~Wet~~/FULL-EXS DRY	Wet	97.2	STM_C87	Sod farm/Golf course	7.73	8%
					STM_C87	High Intensity - Comm/Industrial	7.26	7%
					STM_C87	High Intensity - Residential	82.24	85%
9	85	Dry	Dry	8.1	STM_C37	Sod farm/Golf course	0.03	0%
					STM_C37	High Intensity - Residential	8.08	99%
9	86	Wet	Wet	7.7	STM_C38	Sod farm/Golf course	0.03	0%
					STM_C38	High Intensity - Residential	7.64	100%
9	87	Dry	Dry	115.3	STM_C42	Sod farm/Golf course	12.20	11%
					STM_C42	High Intensity - Comm/Industrial	11.11	10%
					STM_C42	High Intensity - Residential	92.02	80%
9	88	Dry	Dry	17.4	STM_C51	Sod farm/Golf course	0.27	2%
					STM_C51	High Intensity - Comm/Industrial	2.02	12%
					STM_C51	High Intensity - Residential	15.07	87%
							245.71	
10	6	wet	wet	13	STM_C30	Sod farm/Golf course	12.97	100%
					STM_C30	High Intensity - Residential	0.02	0%
10	7	wet	wet	11.1	STM_C26	Sod farm/Golf course	6.14	55%
					STM_C26	High Intensity - Residential	4.94	45%
10	10	wet	wet	13.1	STM_C23	Sod farm/Golf course	8.99	68%
					STM_C23	High Intensity - Residential	4.14	32%
10	11	wet	wet	19.8	STM_C63	Sod farm/Golf course	6.04	30%
					STM_C63	High Intensity - Residential	13.81	70%
10	67	(MQ1)		20.57		Sod farm/Golf course	0.81	4%
		~~Wet~~/FULL-EXS DRY	Dry	STM_C97		High Intensity - Comm/Industrial	4.44	22%
				STM_C97		High Intensity - Residential	15.32	74%
								100%
10	68	wet	Wet	28.48?	Sod farm/Golf course	Sod farm/Golf course	1.35	5%
	NEW	(~~M2~~/MQ3)		STM_C105	High Intensity - Comm/Industrial	High Intensity - Comm/Industrial	2.22	8%
				STM_C105	High Intensity - Residential	High Intensity - Residential	24.91	87%
								100%
10	95	("Future MQ2"-Toth)	Wet	22.8		Sod farm/Golf course	1.68	7%
				STM_C107		High Intensity - Comm/Industrial	0.86	4%
				STM_C107		High Intensity - Residential	20.26	89%
								100%
10	99	(MQ2)	Dry	16.53		Sod farm/Golf course	4.86	29%
		~~Wet~~/FULL-EXS DRY		STM_C98		High Intensity - Comm/Industrial	2.43	15%
				STM_C98		High Intensity - Residential	9.23	56%
								100%
10	72	(WQ1)	Wet	5.56		Sod farm/Golf course	5.56	100%
		Wet		STM_C106		High Intensity - Comm/Industrial	0.00	0%
	new subdivision			STM_C106		High Intensity - Residential	0.00	0%
								100%
10	103	wet	Wet	13.41?		Sod farm/Golf course	13.34	99%
		(MQ4)		STM_C104		High Intensity - Comm/Industrial	0.07	1%
				STM_C104		High Intensity - Residential	0.00	0%
								100%
							164.40	
11	1	Wet	Wet	8.5	STM_C83	High Intensity - Comm/Industrial	8.48	100%
					STM_C83	High Intensity - Residential	0.01	0%
11	2	Wet	Wet	60	STM_C01	Sod farm/Golf course	2.91	4%
					STM_C01	High Intensity - Comm/Industrial	36.50	52%
					STM_C01	High Intensity - Residential	31.21	44%
							79.11	100%

Appendix B3

SWM Pond Areas - Land Uses for Proposed Conditions

		Proposed Conditions						
MU	Pond	Model Exs Pond As	Model Prop Pond As	STM Area	CatchName	Land Use	AREA (ha)	%
					STM_C85			
1	3	Wet	Wet		STM_C85	High Intensity - Comm/Industrial	18.54	95%
					STM_C85	High Intensity - Residential	1.07	5%
								100%
1	4	Wet	Wet		STM_C84	Sod farm/Golf course	0.31	1%
					STM_C84	High Intensity - Comm/Industrial	16.42	64%
					STM_C84	High Intensity - Residential	8.78	34%
								100%
1	8	Wet	Wet		STM_C27	Sod farm/Golf course	3.86	34%
					STM_C27	High Intensity - Comm/Industrial	0.22	2%
					STM_C27	High Intensity - Residential	7.28	64%
								100%
1	9	Wet	Wet		STM_C24	Sod farm/Golf course	15.33	40%
					STM_C24	High Intensity - Residential	22.52	59%
								100%
1	12	Wet	Wet		STM_C22	Sod farm/Golf course	3.03	32%
					STM_C22	High Intensity - Comm/Industrial	0.00	0%
						High Intensity - Residential	6.38	67%
								99%
1	13	Wet	Wet		STM_C25	Sod farm/Golf course	2.02	62%
					STM_C25	High Intensity - Residential	1.27	39%
								101%
1	14	Wet	Wet					
					STM_C18	Sod farm/Golf course	9.33	14%
					STM_C18	High Intensity - Comm/Industrial	0.00	0%
					STM_C18	High Intensity - Residential	58.00	86%
								100%
1	52	Wet	Wet		STM_C29	Sod farm/Golf course	2.63	13%
					STM_C29	High Intensity - Comm/Industrial	3.49	17%
					STM_C29	High Intensity - Residential	14.03	70%
								100%
1	79	Dry	Dry		STM_C21	Sod farm/Golf course	2.40	11%
					STM_C21	High Intensity - Comm/Industrial	0.00	0%
						High Intensity - Residential	19.60	88%
							216.51	
2	26	Dry	Dry		STM_C56	Sod farm/Golf course	4.14	10%
					STM_C56	High Intensity - Comm/Industrial	0.00	0%
						High Intensity - Residential	36.39	90%
2	34	Wet	Wet		STM_C11	Sod farm/Golf course	3.10	9%
					STM_C11	High Intensity - Comm/Industrial	16.02	45%
					STM_C11	High Intensity - Residential	16.25	46%
2	35	Wet	Wet		STM_C81	Sod farm/Golf course	1.34	7%
					STM_C81	High Intensity - Comm/Industrial	1.59	8%
					STM_C81	High Intensity - Residential	16.10	85%
2	38	Wet	Wet		STM_C03	Sod farm/Golf course	6.24	10%
					STM_C03	High Intensity - Comm/Industrial	53.71	88%
					STM_C03	High Intensity - Residential	0.83	1%
2	39	~~Wet~~/FULL-EXS DRY	Wet		STM_C06	Sod farm/Golf course	1.39	8%
					STM_C06	High Intensity - Comm/Industrial	7.97	47%
					STM_C06	High Intensity - Residential	7.67	45%
2	41	Wet	Wet			Sod farm/Golf course	2.03	8%
					STM_C08	High Intensity - Comm/Industrial	2.00	8%
					STM_C08	High Intensity - Residential	21.36	84%
2	53	Wet	Wet		STM_C04	High Intensity - Comm/Industrial	4.83	100%
2	64	Wet?	Wet			Sod farm/Golf course	0.01	0%
					STM_C94	High Intensity - Comm/Industrial	10.60	100%
					STM_C94	High Intensity - Residential	0.00	0%
								100%
2	65		Wet			Sod farm/Golf course	0.05	0%
					STM_C95	High Intensity - Comm/Industrial	13.78	99%
					STM_C95	High Intensity - Residential	0.09	1%
								100%
2	74	~~Wet~~/FULL-EXS DRY	Wet		STM_C55	Sod farm/Golf course	5.94	11%
					STM_C55	High Intensity - Comm/Industrial	11.82	22%
					STM_C55	High Intensity - Residential	35.41	67%
2	93	Wet	Wet			Sod farm/Golf course	2.17	6%
					STM_C92	High Intensity - Comm/Industrial	32.70	94%
					STM_C92	High Intensity - Residential	0.00	0%
								100%
2	98	~~Wet~~/FULL-EXS DRY	Wet		STM_C02	Sod farm/Golf course	2.51	19%
					STM_C02	High Intensity - Comm/Industrial	10.40	81%
2	101	Wet	Wet			Sod farm/Golf course	0.00	0%
					STM_C96	High Intensity - Comm/Industrial	0.00	0%
					STM_C96	High Intensity - Residential	18.66	100%
							347.10	100%
3	29	Dry	Dry		STM_C75	Sod farm/Golf course	7.63	16%
					STM_C75	High Intensity - Residential	39.60	84%
3	30	Dry	Dry		STM_C52	Sod farm/Golf course	0.69	4%
					STM_C52	High Intensity - Residential	17.87	96%
3	102	Wet	Wet			Sod farm/Golf course	1.00	7%
					STM_C93	High Intensity - Comm/Industrial	12.07	90%
		UNASSUMED			STM_C93	High Intensity - Residential	0.28	2%
								100%
3	58	Wet	Wet		STM_C14	Sod farm/Golf course	1.26	6%
					STM_C14	High Intensity - Comm/Industrial	0.00	0%
					STM_C14	High Intensity - Residential	19.40	94%
							99.80	
4	63	DRY	Dry		STM_C91	Sod farm/Golf course	2.26	10%
	NEW				STM_C91	High Intensity - Comm/Industrial	0.78	28%
					STM_C91	High Intensity - Residential	5.00	62%
4	76	Dry	Dry		STM_C07	Sod farm/Golf course	1.88	3%
					STM_C07	High Intensity - Comm/Industrial	11.77	21%
					STM_C07	High Intensity - Residential	41.64	75%
							63.34	
5	70	Wet	Wet		STM_C49	Sod farm/Golf course	0.00	0%
					STM_C49	High Intensity - Comm/Industrial	28.48	90%
					STM_C49	High Intensity - Residential	3.12	10%
							31.60	

6	55	~~Wet~~/FULL-EXS DRY	Wet		STM_C15	Sod farm/Golf course	3.01	3%
					STM_C15	High Intensity - Comm/Industrial	18.12	21%
	55/56/62 'same' pond				STM_C15	High Intensity - Residential	65.80	76%
6	33	Enhanced Wetland	Wet	3.59	STM_C??	Sod farm/Golf course	0.00	0%
Town of Newmarket						High Intensity - Comm/Industrial	0.00	0%
						High Intensity - Residential	3.59	100%
6	56	Wet	Wet		STM_C16	Sod farm/Golf course	2.89	33%
					STM_C16	High Intensity - Comm/Industrial	0.00	0%
	55/56/62 'same' pond				STM_C16	High Intensity - Residential	5.87	67%
6	62	~~Dry~~ WET	Wet		STM_C17	Sod farm/Golf course	0.62	100%
	55/56/62 'same' pond							
6	71	Wet	Wet		STM_C62	Sod farm/Golf course	1.50	6%
					STM_C62	High Intensity - Comm/Industrial	0.30	1%
					STM_C62	High Intensity - Residential	22.41	93%
6	97	Wet	Wet		STM_C88	Sod farm/Golf course	6.43	38%
					STM_C88	High Intensity - Comm/Industrial	0.02	0%
					STM_C88	High Intensity - Residential	10.65	62%
							141.21	
7	5		Wet			Sod farm/Golf course	0.44	100%
						High Intensity - Comm/Industrial	0.00	0%
						High Intensity Residential	0.00	0%
								100%
7	16		Wet		STM_C100	Sod farm/Golf course	5.52	100%
					STM_C101	High Intensity - Comm/Industrial	0.02	0%
					STM_C102	High Intensity Residential	0.00	0%
								100%
7	17		Wet		STM_C102	Sod farm/Golf course	1.73	100%
					STM_C102	High Intensity - Comm/Industrial	0.00	0%
					STM_C102	High Intensity Residential	0.00	0%
								100%
7	18	Dry	Dry		STM_C32	High Intensity - Residential	13.10	100%
7	19	Wet	Wet		STM_C31	Sod farm/Golf course	18.87	20%
					STM_C31	High Intensity - Comm/Industrial	12.34	13%
					STM_C31	High Intensity - Residential	61.49	66%
7	22	wet	Wet		STM_C41	Sod farm/Golf course	6.17	38%
					STM_C41	High Intensity - Residential	10.13	62%
7	23&24	wet	Wet		STM_C12	Sod farm/Golf course	4.29	79%
	Ponds23/24 same pond/connected				STM_C12	High Intensity - Residential	1.17	21%
~~7~~	~~25~~	~~REMOVE~~	~~Wet~~		~~STM_C101~~	~~Sod farm/Golf course~~	~~7.03~~	~~96%~~
	~~Golf cours~~	~~NOT A SWM POND~~			~~STM_C101~~	~~High Intensity - Comm/Industrial~~	~~0.28~~	~~4%~~
					~~STM_C101~~	~~High Intensity Residential~~	~~0.00~~	~~0%~~
							~~142.57~~	~~100%~~
8	77	Wet	Wet		STM_C34	Sod farm/Golf course	17.93	18%
					STM_C34	High Intensity - Comm/Industrial	16.97	17%
					STM_C34	High Intensity - Residential	66.60	66%
8	91	dry	Dry		STM_C33	Sod farm/Golf course	1.21	8%
					STM_C33	High Intensity - Comm/Industrial	13.35	86%
					STM_C33	High Intensity - Residential	1.04	7%
8	92	dry	Dry		STM_C35	High Intensity - Residential	0.04	3%
					STM_C35	High Intensity - Comm/Industrial	1.23	97%
							118.36	
9	43	~~Wet~~/FULL-EXS DRY	Wet		STM_C87	Sod farm/Golf course	8.28	9%
					STM_C87	High Intensity - Comm/Industrial	2.68	3%
					STM_C87	High Intensity - Residential	86.23	89%
9	85	dry	Dry		STM_C37	Sod farm/Golf course	0.10	1%
					STM_C37	High Intensity - Residential	8.05	99%
9	86	Wet	Wet		STM_C38	Sod farm/Golf course	0.34	4%
					STM_C38	High Intensity - Residential	7.37	96%
9	87	Dry	Dry		STM_C42	Sod farm/Golf course	14.72	13%
					STM_C42	High Intensity - Comm/Industrial	7.34	6%
					STM_C42	High Intensity - Residential	93.27	81%
9	88	Dry	Dry		STM_C51	Sod farm/Golf course	0.23	1%
					STM_C51	High Intensity - Comm/Industrial	0.00	0%
					STM_C51	High Intensity - Residential	17.14	99%
							245.75	
					STM_C30	Sod farm/Golf course	12.74	98%
10	6	wet	wet		STM_C30	High Intensity - Comm/Industrial	0.02	0%
					STM_C30	High Intensity - Residential	0.19	1%
10	7	wet	wet		STM_C26	Sod farm/Golf course	6.52	59%
					STM_C26	High Intensity - Residential	4.48	40%
10	10	wet	wet		STM_C23	Sod farm/Golf course	9.37	71%
					STM_C23	High Intensity - Residential	3.76	29%
10	11	wet	wet		STM_C63	Sod farm/Golf course	11.55	58%
					STM_C63	High Intensity - Residential	8.30	42%
10	67	(MQ1)				Sod farm/Golf course	2.47	12%
		~~Wet~~/FULL-EXS DRY	Dry		STM_C97	High Intensity - Comm/Industrial	17.90	88%
					STM_C97	High Intensity - Residential	0.00	0%
								100%
10	68	wet	Wet			Sod farm/Golf course	0.85	3%
	NEW	(~~M2~~/MQ3)			STM_C105	High Intensity - Comm/Industrial	27.79	97%
					STM_C105	High Intensity - Residential	0.00	0%
								100%
10	95	("Future MQ2"-Toth)	Wet			Sod farm/Golf course	0.86	4%
					STM_C107	High Intensity - Comm/Industrial	21.72	96%
					STM_C107	High Intensity - Residential	0.00	0%
								100%
10	99	(MQ2)	Dry			Sod farm/Golf course	1.30	8%
		~~Wet~~/FULL-EXS DRY			STM_C98	High Intensity - Comm/Industrial	14.95	92%
					STM_C98	High Intensity - Residential	0.00	0%
								100%
10	72	(WQ1)	Wet			Sod farm/Golf course	0.47	8%
		Wet			STM_C106	High Intensity - Comm/Industrial	5.57	92%
new subdivision					STM_C106	High Intensity - Residential	0.00	0%
								100%
10	103	wet	Wet			Sod farm/Golf course	0.10	1%
		(MQ4)			STM_C104	High Intensity - Comm/Industrial	13.12	99%
					STM_C104	High Intensity - Residential	0.00	0%
							164.02	100%
11	1	Wet	Wet		STM_C83	High Intensity - Comm/Industrial	8.49	100%
					STM_C83	High Intensity - Residential	0.00	0%
11	2	Wet	Wet		STM_C01	Sod farm/Golf course	4.65	8%
					STM_C01	High Intensity - Comm/Industrial	21.39	36%
					STM_C01	High Intensity - Residential	33.91	57%
							68.45	

Appendix B4

PTool - P Loading and Removal for Existing Conditions

Ontario
MINISTRY OF THE ENVIRONMENT

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

Project DEVELOPMENT Summary

DEVELOPMENT: **MU 1**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**526.37**	Total Pre-Development Phosphorus Load (kg/yr):	**696.76**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	4.49	0.36	1.62
High Intensity - Comm/Industria	187.34	1.82	340.96
High Intensity - Residential	253.61	1.32	334.77
Sod Farm / Golf Course	80.93	0.24	19.42

DEVELOPMENT:	MU 1
Subwatershed:	East Holland

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	4.49	0.36	NONE	0%	1.62
High Intensity - Comm/Industrial	144.34	1.82	NONE	0%	262.70
High Intensity - Comm/Industrial	0.32	1.82	Dry Detention Ponds	10%	0.52
High Intensity - Comm/Industrial	42.68	1.82	Wet Detention Ponds	63%	28.74
High Intensity - Residential	122.06	1.32	NONE	0%	161.12
High Intensity - Residential	19.49	1.32	Dry Detention Ponds	10%	23.15
High Intensity - Residential	112.06	1.32	Wet Detention Ponds	63%	54.73
Sod Farm / Golf Course	42.42	0.24	NONE	0%	10.18
Sod Farm / Golf Course	2.46	0.24	Dry Detention Ponds	10%	0.53
Sod Farm / Golf Course	36.05	0.24	Wet Detention Ponds	63%	3.20

Post-Development Area Altered:	**526.37**
Total Pre-Development Area:	**526.37**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**696.76**
Post-Development:	**696.76**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**546.50**
Change (Pre - Post):	**150.27**
22% Net Reduction in Load	

DEVELOPMENT:	**MU 1**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	P Load (kg/yr)
Pre-Development:	**696.76**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**546.50**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**150.27**
Conclusion:	**22% 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:

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

Project DEVELOPMENT Summary

DEVELOPMENT: **MU 2**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**731.09**	Total Pre-Development Phosphorus Load (kg/yr):	**978.62**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	0.27	0.36	0.10
High Intensity - Comm/Industria	266.53	1.82	485.08
High Intensity - Residential	353.71	1.32	466.90
Sod Farm / Golf Course	110.58	0.24	26.54

DEVELOPMENT:	MU 2
Subwatershed:	East Holland

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	0.27	0.36	NONE	0%	0.10
High Intensity - Comm/Industrial	31.26	1.82	Dry Detention Ponds	10%	51.20
High Intensity - Comm/Industrial	104.76	1.82	Wet Detention Ponds	63%	70.55
High Intensity - Comm/Industrial	130.51	1.82	NONE	0%	237.53
High Intensity - Residential	75.44	1.32	Dry Detention Ponds	10%	89.62
High Intensity - Residential	95.2	1.32	Wet Detention Ponds	63%	46.50
High Intensity - Residential	183.06	1.32	NONE	0%	241.64
Sod Farm / Golf Course	16.94	0.24	Dry Detention Ponds	10%	3.66
Sod Farm / Golf Course	19.96	0.24	Wet Detention Ponds	63%	1.77
Sod Farm / Golf Course	73.69	0.24	NONE	0%	17.69

Post-Development Area Altered:	**731.09**
Total Pre-Development Area:	**731.09**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**978.62**
Post-Development:	**978.61**
Change (Pre - Post):	**0.01**
	0% Net Reduction in Load
Post-Development (with BMPs):	**760.25**
Change (Pre - Post):	**218.37**
	22% Net Reduction in Load

DEVELOPMENT:	**MU 2**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**978.62**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**760.25**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**218.37**
Conclusion:	**22% 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:	**MU 3**
Subwatershed:	**East Holland**

Total Pre-Development Area (ha):	**248.42**	Total Pre-Development Phosphorus Load (kg/yr):	**238.55**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	22	0.36	7.92
High Intensity - Comm/Industria	29.88	1.82	54.38
High Intensity - Residential	119.52	1.32	157.77
Sod Farm / Golf Course	77.02	0.24	18.48

DEVELOPMENT:	MU 3
Subwatershed:	East Holland

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	22	0.36	NONE	0%	7.92
High Intensity - Comm/Industrial	0.29	1.82	Wet Detention Ponds	63%	0.20
High Intensity - Comm/Industrial	29.59	1.82	NONE	0%	53.85
High Intensity - Residential	55.93	1.32	Dry Detention Ponds	10%	66.44
High Intensity - Residential	30.43	1.32	Wet Detention Ponds	63%	14.86
High Intensity - Residential	33.15	1.32	NONE	0%	43.76
Sod Farm / Golf Course	10.04	0.24	Dry Detention Ponds	10%	2.17
Sod Farm / Golf Course	3.67	0.24	Wet Detention Ponds	63%	0.33
Sod Farm / Golf Course	63.32	0.24	NONE	0%	15.20

Post-Development Area Altered:	**248.42**
Total Pre-Development Area:	**248.42**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**238.55**
Post-Development:	**238.54**
Change (Pre - Post):	**0.01**
	0% Net Reduction in Load
Post-Development (with BMPs):	**204.73**
Change (Pre - Post):	**33.83**
	14% Net Reduction in Load

DEVELOPMENT:	**MU 3**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**238.55**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**204.73**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**33.83**
Conclusion:	**14% 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:	**MU 4**
Subwatershed:	**East Holland**

Total Pre-Development Area (ha):	**152.73**	Total Pre-Development Phosphorus Load (kg/yr):	**224.01**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	54.99	1.82	100.08
High Intensity - Residential	93.03	1.32	122.80
Sod Farm / Golf Course	4.71	0.24	1.13

DEVELOPMENT:	MU 4
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	19.58	1.82	Dry Detention Ponds	10%	32.07
High Intensity - Comm/Industrial	35.42	1.82	NONE	0%	64.46
High Intensity - Residential	38.75	1.32	Dry Detention Ponds	10%	46.03
High Intensity - Residential	54.27	1.32	NONE	0%	71.64
Sod Farm / Golf Course	4.71	0.24	Dry Detention Ponds	10%	1.02

Post-Development Area Altered:	**152.73**
Total Pre-Development Area:	**152.73**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**224.01**
Post-Development:	**224.02**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**215.23**
Change (Pre - Post):	**8.79**
	4% Net Reduction in Load

DEVELOPMENT:	**MU 4**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**224.01**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**215.23**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**8.79**
Conclusion:	**4% 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
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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 5**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**124.31**	Total Pre-Development Phosphorus Load (kg/yr):	**223.63**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	121.53	1.82	221.18
High Intensity - Residential	1.65	1.32	2.18
Sod Farm / Golf Course	1.13	0.24	0.27

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)
High Intensity - Comm/Industrial	24.82	1.82	Wet Detention Ponds	63%	16.71
High Intensity - Comm/Industrial	96.71	1.82	NONE	0%	176.01
High Intensity - Residential	1.65	1.32	Wet Detention Ponds	63%	0.81
Sod Farm / Golf Course	1.13	0.24	Wet Detention Ponds	63%	0.10

Post-Development Area Altered: **124.31**
Total Pre-Development Area: **124.31**
Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**223.63**
Post-Development:	**223.63**
Change (Pre - Post):	**0.00**
	0% Net Reduction in Load
Post-Development (with BMPs):	**193.63**
Change (Pre - Post):	**30.00**
	13% Net Reduction in Load

DEVELOPMENT:	**MU 5**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**223.63**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**193.63**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**30.00**
Conclusion:	**13% 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:

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

Project DEVELOPMENT Summary

DEVELOPMENT: **MU 6**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**369.44**	Total Pre-Development Phosphorus Load (kg/yr):	**260.48**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	62.69	0.36	22.57
High Intensity - Comm/Industria	38.95	1.82	70.89
High Intensity - Residential	95.14	1.32	125.58
Sod Farm / Golf Course	172.66	0.24	41.44

DEVELOPMENT:	**MU 6**
Subwatershed:	**East Holland**

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	62.69	0.36	NONE	0%	22.57
High Intensity - Comm/Industrial	8.54	1.82	NONE	0%	15.54
High Intensity - Comm/Industrial	25.34	1.82	Dry Detention Ponds	10%	41.51
High Intensity - Comm/Industrial	5.08	1.82	Wet Detention Ponds	63%	3.42
High Intensity - Residential	4.48	1.32	NONE	0%	5.91
High Intensity - Residential	54.16	1.32	Dry Detention Ponds	10%	64.34
High Intensity - Residential	36.5	1.32	Wet Detention Ponds	63%	17.83
Sod Farm / Golf Course	152.54	0.24	NONE	0%	36.61
Sod Farm / Golf Course	7.44	0.24	Dry Detention Ponds	10%	1.61
Sod Farm / Golf Course	12.67	0.24	Wet Detention Ponds	63%	1.13

Post-Development Area Altered:	**369.44**
Total Pre-Development Area:	**369.44**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**260.48**
Post-Development:	**260.50**
Change (Pre - Post):	**-0.02**
	0% Net Increase in Load
Post-Development (with BMPs):	**210.46**
Change (Pre - Post):	**50.02**
	19% Net Reduction in Load

DEVELOPMENT:	**MU 6**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**260.48**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**210.46**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**50.02**
Conclusion:	**19% 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
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Project DEVELOPMENT Summary

DEVELOPMENT: MU 7
Subwatershed: East Holland

Total Pre-Development Area (ha):	**164.73**	Total Pre-Development Phosphorus Load (kg/yr):	**151.32**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	15.56	1.82	28.32
High Intensity - Residential	80.74	1.32	106.58
Sod Farm / Golf Course	68.43	0.24	16.42

DEVELOPMENT:	MU 7
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	15.56	1.82	Wet Detention Ponds	63%	10.48
High Intensity - Residential	13.1	1.32	Dry Detention Ponds	10%	15.56
High Intensity - Residential	67.64	1.32	Wet Detention Ponds	63%	33.04
Sod Farm / Golf Course	28.98	0.24	NONE	0%	6.96
Sod Farm / Golf Course	39.45	0.24	Wet Detention Ponds	63%	3.50

Post-Development Area Altered:	**164.73**
Total Pre-Development Area:	**164.73**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**151.32**
Post-Development:	**151.32**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**69.53**
Change (Pre - Post):	**81.78**
	54% Net Reduction in Load

DEVELOPMENT:	**MU 7**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**151.32**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**69.53**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**81.78**
Conclusion:	**54% 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: **MU 8**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**416.81**	Total Pre-Development Phosphorus Load (kg/yr):	**553.61**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	147.93	1.82	269.23
High Intensity - Residential	203.56	1.32	268.70
Sod Farm / Golf Course	65.32	0.24	15.68

DEVELOPMENT:	MU 8
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	14.79	1.82	Dry Detention Ponds	10%	24.23
High Intensity - Comm/Industrial	18.11	1.82	Wet Detention Ponds	63%	12.20
High Intensity - Comm/Industrial	115.03	1.82	NONE	0%	209.35
High Intensity - Residential	0.5	1.32	Dry Detention Ponds	10%	0.59
High Intensity - Residential	62.91	1.32	Wet Detention Ponds	63%	30.73
High Intensity - Residential	140.15	1.32	NONE	0%	185.00
Sod Farm / Golf Course	1.57	0.24	Dry Detention Ponds	10%	0.34
Sod Farm / Golf Course	20.48	0.24	Wet Detention Ponds	63%	1.82
Sod Farm / Golf Course	43.27	0.24	NONE	0%	10.38

Post-Development Area Altered:	**416.81**
Total Pre-Development Area:	**416.81**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**553.61**
Post-Development:	**553.61**
Change (Pre - Post):	**0.00**
0% Net Increase in Load	
Post-Development (with BMPs):	**474.64**
Change (Pre - Post):	**78.97**
14% Net Reduction in Load	

DEVELOPMENT:	**MU 8**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**553.61**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**474.64**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**78.97**
Conclusion:	**14% 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: **MU 9**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	533.27	Total Pre-Development Phosphorus Load (kg/yr):	687.92

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	7.97	0.36	2.87
High Intensity - Comm/Industria	182.12	1.82	331.46
High Intensity - Residential	251.14	1.32	331.50
Sod Farm / Golf Course	92.04	0.24	22.09

DEVELOPMENT:	MU 9
Subwatershed:	East Holland

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	7.97	0.36	NONE	0%	2.87
High Intensity - Comm/Industrial	20.4	1.82	Dry Detention Ponds	10%	33.42
High Intensity - Comm/Industrial	161.72	1.82	NONE	0%	294.33
High Intensity - Residential	197.42	1.32	Dry Detention Ponds	10%	234.53
High Intensity - Residential	7.64	1.32	Wet Detention Ponds	63%	3.73
High Intensity - Residential	46.08	1.32	NONE	0%	60.83
Sod Farm / Golf Course	20.23	0.24	Dry Detention Ponds	10%	4.37
Sod Farm / Golf Course	0.03	0.24	Wet Detention Ponds	63%	0.00
Sod Farm / Golf Course	71.78	0.24	NONE	0%	17.23

Post-Development Area Altered:	**533.27**
Total Pre-Development Area:	**533.27**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**687.92**
Post-Development:	**687.92**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**651.31**
Change (Pre - Post):	**36.62**
	5% Net Reduction in Load

DEVELOPMENT:	**MU 9**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**687.92**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**651.31**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**36.62**
Conclusion:	**5% 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
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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 10**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**305.94**	Total Pre-Development Phosphorus Load (kg/yr):	**223.51**

Pre-Development Land Use	**Area (ha)**	**P coeff. (kg/ha)**	**P Load (kg/yr)**
Cropland	52.15	0.36	18.77
High Intensity - Comm/Industria	19.98	1.82	36.36
High Intensity - Residential	103.94	1.32	137.20
Sod Farm / Golf Course	129.87	0.24	31.17

DEVELOPMENT:	MU 10
Subwatershed:	East Holland

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	52.15	0.36	NONE	0%	18.77
High Intensity - Comm/Industrial	9.96	1.82	NONE	0%	18.13
High Intensity - Comm/Industrial	6.87	1.82	Dry Detention Ponds	10%	11.25
High Intensity - Comm/Industrial	3.15	1.82	Wet Detention Ponds	63%	2.12
High Intensity - Residential	11.32	1.32	NONE	0%	14.94
High Intensity - Residential	24.55	1.32	Dry Detention Ponds	10%	29.17
High Intensity - Residential	68.07	1.32	Wet Detention Ponds	63%	33.25
Sod Farm / Golf Course	68.11	0.24	NONE	0%	16.35
Sod Farm / Golf Course	5.68	0.24	Dry Detention Ponds	10%	1.23
Sod Farm / Golf Course	56.08	0.24	Wet Detention Ponds	63%	4.98

Post-Development Area Altered:	**305.94**
Total Pre-Development Area:	**305.94**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**223.51**
Post-Development:	**223.51**
Change (Pre - Post):	**0.00**
	0% Net Reduction in Load
Post-Development (with BMPs):	**150.18**
Change (Pre - Post):	**73.33**
	33% Net Reduction in Load

DEVELOPMENT:	**MU 10**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**223.51**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**150.18**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**73.33**
Conclusion:	**33% 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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Project DEVELOPMENT Summary

DEVELOPMENT:	**MU 11**
Subwatershed:	**East Holland**

Total Pre-Development Area (ha):	**241.76**	Total Pre-Development Phosphorus Load (kg/yr):	**348.98**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	1.28	0.36	0.46
High Intensity - Comm/Industria	93.4	1.82	169.99
High Intensity - Residential	132.62	1.32	175.06
Sod Farm / Golf Course	14.46	0.24	3.47

DEVELOPMENT:	MU 11
Subwatershed:	East Holland

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	1.28	0.36	NONE	0%	0.46
High Intensity - Comm/Industrial	48.42	1.82	NONE	0%	88.12
High Intensity - Comm/Industrial	44.98	1.82	Wet Detention Ponds	63%	30.29
High Intensity - Residential	101.4	1.32	NONE	0%	133.85
High Intensity - Residential	31.22	1.32	Wet Detention Ponds	63%	15.25
Sod Farm / Golf Course	11.55	0.24	NONE	0%	2.77
Sod Farm / Golf Course	2.91	0.24	Wet Detention Ponds	63%	0.26

Post-Development Area Altered:	**241.76**
Total Pre-Development Area:	**241.76**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**348.98**
Post-Development:	**348.98**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**271.00**
Change (Pre - Post):	**77.98**
22% Net Reduction in Load	

DEVELOPMENT:	**MU 11**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**348.98**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**271.00**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**77.98**
Conclusion:	**22% 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:

Appendix B5

PTool - P Loading and Removal for Do Nothing Scenario

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Project DEVELOPMENT Summary

DEVELOPMENT: MU 1
Subwatershed: East Holland

Total Pre-Development Area (ha): **526.37**
Total Pre-Development Phosphorus Load (kg/yr): **676.02**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	148.98	1.82	271.14
High Intensity - Residential	291.02	1.32	384.15
Sod Farm / Golf Course	86.37	0.24	20.73

DEVELOPMENT:	MU 1
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	110.3	1.82	NONE	0%	200.75
High Intensity - Comm/Industrial	38.68	1.82	Dry Detention Ponds	10%	63.36
High Intensity - Residential	171.7	1.32	NONE	0%	226.64
High Intensity - Residential	119.32	1.32	Dry Detention Ponds	10%	141.75
Sod Farm / Golf Course	49.87	0.24	NONE	0%	11.97
Sod Farm / Golf Course	36.5	0.24	Dry Detention Ponds	10%	7.88

Post-Development Area Altered:	**526.37**
Total Pre-Development Area:	**526.37**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**676.02**
Post-Development:	**676.02**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**652.35**
Change (Pre - Post):	**23.67**
	4% Net Reduction in Load

DEVELOPMENT:	**MU 1**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**676.02**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**652.35**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**23.67**
Conclusion:	**4% 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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Ontario
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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 2**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**731.09**	Total Pre-Development Phosphorus Load (kg/yr):	**925.95**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	187.35	1.82	340.98
High Intensity - Residential	420.81	1.32	555.47
Sod Farm / Golf Course	122.93	0.24	29.50

DEVELOPMENT:	MU 2
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	21.93	1.82	NONE	0%	39.91
High Intensity - Comm/Industrial	165.42	1.82	Dry Detention Ponds	10%	270.96
High Intensity - Residential	304.44	1.32	NONE	0%	401.86
High Intensity - Residential	116.37	1.32	Dry Detention Ponds	10%	138.25
Sod Farm / Golf Course	98.14	0.24	NONE	0%	23.55
Sod Farm / Golf Course	24.79	0.24	Dry Detention Ponds	10%	5.35

Post-Development Area Altered:	**731.09**
Total Pre-Development Area:	**731.09**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**925.95**
Post-Development:	**925.95**
Change (Pre - Post):	**0.00**
0% Net Increase in Load	
Post-Development (with BMPs):	**879.89**
Change (Pre - Post):	**46.06**
5% Net Reduction in Load	

DEVELOPMENT:	**MU 2**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**925.95**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**879.89**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**46.06**
Conclusion:	**5% 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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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 3**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**248.42**	Total Pre-Development Phosphorus Load (kg/yr):	**258.88**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	12.52	1.82	22.79
High Intensity - Residential	166.18	1.32	219.36
Sod Farm / Golf Course	69.72	0.24	16.73

DEVELOPMENT:	MU 3
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	0.45	1.82	NONE	0%	0.82
High Intensity - Comm/Industrial	12.07	1.82	Dry Detention Ponds	10%	19.77
High Intensity - Residential	146.51	1.32	NONE	0%	193.39
High Intensity - Residential	19.68	1.32	Dry Detention Ponds	10%	23.38
Sod Farm / Golf Course	67.46	0.24	NONE	0%	16.19
Sod Farm / Golf Course	2.25	0.24	Dry Detention Ponds	10%	0.49

Post-Development Area Altered:	**248.42**
Total Pre-Development Area:	**248.42**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**258.88**
Post-Development:	**258.89**
Change (Pre - Post):	**-0.01**
	0% Net Increase in Load
Post-Development (with BMPs):	**254.04**
Change (Pre - Post):	**4.84**
	2% Net Reduction in Load

DEVELOPMENT:	**MU 3**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**258.88**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**254.04**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**4.84**
Conclusion:	**2% 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:

Project DEVELOPMENT Summary

DEVELOPMENT: **MU 4**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**152.73**	Total Pre-Development Phosphorus Load (kg/yr):	**207.13**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	30.44	1.82	55.40
High Intensity - Residential	113.31	1.32	149.57
Sod Farm / Golf Course	8.98	0.24	2.16

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)
High Intensity - Comm/Industrial	30.44	1.82	NONE	0%	55.40
High Intensity - Residential	113.31	1.32	NONE	0%	149.57
Sod Farm / Golf Course	8.98	0.24	NONE	0%	2.16

Post-Development Area Altered: **152.73**
Total Pre-Development Area: **152.73**
Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**207.13**
Post-Development:	**207.13**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**207.13**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	

DEVELOPMENT:	**MU 4**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**207.13**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**207.13**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**0.00**
Conclusion:	**0% Increase 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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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 5**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**124.31**	Total Pre-Development Phosphorus Load (kg/yr):	**202.67**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industrial	108.71	1.82	197.85
High Intensity - Residential	0.99	1.32	1.31
Sod Farm / Golf Course	14.61	0.24	3.51

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)
High Intensity - Comm/Industrial	80.23	1.82	NONE	0%	146.02
High Intensity - Comm/Industrial	28.48	1.82	Dry Detention Ponds	10%	46.65
High Intensity - Residential	0.99	1.32	Dry Detention Ponds	10%	1.18
Sod Farm / Golf Course	14.61	0.24	NONE	0%	3.51

Post-Development Area Altered:	**124.31**
Total Pre-Development Area:	**124.31**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**202.67**
Post-Development:	**202.67**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**197.35**
Change (Pre - Post):	**5.31**
	3% Net Reduction in Load

DEVELOPMENT:	**MU 5**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**202.67**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**197.35**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**5.31**
Conclusion:	**3% 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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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 6**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	369.44	Total Pre-Development Phosphorus Load (kg/yr):	234.80

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	18.44	1.82	33.56
High Intensity - Residential	108.33	1.32	143.00
Sod Farm / Golf Course	242.67	0.24	58.24

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)
High Intensity - Comm/Industrial	18.44	1.82	Dry Detention Ponds	10%	30.20
High Intensity - Residential	108.33	1.32	Dry Detention Ponds	10%	128.70
Sod Farm / Golf Course	228.23	0.24	NONE	0%	54.78
Sod Farm / Golf Course	14.44	0.24	Dry Detention Ponds	10%	3.12

Post-Development Area Altered: **369.44**
Total Pre-Development Area: **369.44**
Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**234.80**
Post-Development:	**234.80**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**216.80**
Change (Pre - Post):	**18.00**
8% Net Reduction in Load	

DEVELOPMENT:	**MU 6**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**234.80**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**216.80**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**18.00**
Conclusion:	**8% 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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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 7**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**164.73**	Total Pre-Development Phosphorus Load (kg/yr):	**151.83**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	12.36	1.82	22.50
High Intensity - Residential	85.89	1.32	113.37
Sod Farm / Golf Course	66.48	0.24	15.96

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)
High Intensity - Comm/Industrial	12.36	1.82	Dry Detention Ponds	10%	20.25
High Intensity - Residential	85.89	1.32	Dry Detention Ponds	10%	102.04
Sod Farm / Golf Course	29.47	0.24	NONE	0%	7.07
Sod Farm / Golf Course	37.01	0.24	Dry Detention Ponds	10%	7.99

Post-Development Area Altered:	**164.73**
Total Pre-Development Area:	**164.73**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**151.83**
Post-Development:	**151.83**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**137.35**
Change (Pre - Post):	**14.48**
10% Net Reduction in Load	

DEVELOPMENT:	**MU 7**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**151.83**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**137.35**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**14.48**
Conclusion:	**10% 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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Project DEVELOPMENT Summary

DEVELOPMENT: MU 8
Subwatershed: East Holland

Total Pre-Development Area (ha):	**416.81**	Total Pre-Development Phosphorus Load (kg/yr):	**546.09**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	119.34	1.82	217.20
High Intensity - Residential	238.42	1.32	314.71
Sod Farm / Golf Course	59.05	0.24	14.17

DEVELOPMENT:	**MU 8**
Subwatershed:	**East Holland**

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)
High Intensity - Comm/Industrial	102.37	1.82	NONE	0%	186.31
High Intensity - Comm/Industrial	16.97	1.82	Dry Detention Ponds	10%	27.80
High Intensity - Residential	171.82	1.32	NONE	0%	226.80
High Intensity - Residential	66.6	1.32	Dry Detention Ponds	10%	79.12
Sod Farm / Golf Course	41.12	0.24	NONE	0%	9.87
Sod Farm / Golf Course	17.93	0.24	Dry Detention Ponds	10%	3.87

Post-Development Area Altered:	**416.81**
Total Pre-Development Area:	**416.81**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**546.09**
Post-Development:	**546.09**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**533.78**
Change (Pre - Post):	**12.31**
	2% Net Reduction in Load

DEVELOPMENT:	**MU 8**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**546.09**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**533.78**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**12.31**
Conclusion:	**2% 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:

Database Version: V 2.0 Release Update
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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 9**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**533.27**	Total Pre-Development Phosphorus Load (kg/yr):	**644.22**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	131.69	1.82	239.68
High Intensity - Residential	285.34	1.32	376.65
Sod Farm / Golf Course	116.24	0.24	27.90

DEVELOPMENT:	MU 9
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	129	1.82	NONE	0%	234.78
High Intensity - Comm/Industrial	2.68	1.82	Wet Detention Ponds	63%	1.80
High Intensity - Residential	191.74	1.32	NONE	0%	253.10
High Intensity - Residential	93.6	1.32	Wet Detention Ponds	63%	45.71
Sod Farm / Golf Course	107.63	0.24	NONE	0%	25.83
Sod Farm / Golf Course	8.62	0.24	Wet Detention Ponds	63%	0.77

Post-Development Area Altered:	**533.27**
Total Pre-Development Area:	**533.27**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**644.22**
Post-Development:	**644.21**
Change (Pre - Post):	**0.02**
	0% Net Reduction in Load
Post-Development (with BMPs):	**561.99**
Change (Pre - Post):	**82.23**
	13% Net Reduction in Load

DEVELOPMENT:	**MU 9**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**644.22**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**561.99**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**82.23**
Conclusion:	**13% 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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Database Version: V 2.0 Release Update
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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 10**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**305.94**	Total Pre-Development Phosphorus Load (kg/yr):	**256.43**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	17.36	1.82	31.60
High Intensity - Residential	144.05	1.32	190.15
Sod Farm / Golf Course	144.53	0.24	34.69

DEVELOPMENT:	MU 10
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	0.63	1.82	NONE	0%	1.15
High Intensity - Comm/Industrial	16.73	1.82	Dry Detention Ponds	10%	27.40
High Intensity - Residential	67.78	1.32	NONE	0%	89.47
High Intensity - Residential	76.27	1.32	Dry Detention Ponds	10%	90.61
Sod Farm / Golf Course	102.08	0.24	NONE	0%	24.50
Sod Farm / Golf Course	42.45	0.24	Dry Detention Ponds	10%	9.17

Post-Development Area Altered: **305.94**

Total Pre-Development Area: **305.94**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**256.43**
Post-Development:	**256.43**
Change (Pre - Post):	**0.00**
	0% Net Reduction in Load
Post-Development (with BMPs):	**242.30**
Change (Pre - Post):	**14.13**
	6% Net Reduction in Load

DEVELOPMENT:	**MU 10**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**256.43**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**242.30**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**14.13**
Conclusion:	**6% 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:

Project DEVELOPMENT Summary

DEVELOPMENT: **MU 11**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**241.76**	Total Pre-Development Phosphorus Load (kg/yr):	**324.59**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	59.18	1.82	107.71
High Intensity - Residential	160.24	1.32	211.52
Sod Farm / Golf Course	22.34	0.24	5.36

DEVELOPMENT:	MU 11
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	37.78	1.82	NONE	0%	68.76
High Intensity - Comm/Industrial	21.39	1.82	Dry Detention Ponds	10%	35.04
High Intensity - Residential	126.32	1.32	NONE	0%	166.74
High Intensity - Residential	33.92	1.32	Dry Detention Ponds	10%	40.30
Sod Farm / Golf Course	8.7	0.24	NONE	0%	2.09
Sod Farm / Golf Course	13.65	0.24	Dry Detention Ponds	10%	2.95

Post-Development Area Altered:	**241.76**
Total Pre-Development Area:	**241.76**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**324.59**
Post-Development:	**324.57**
Change (Pre - Post):	**0.02**
	0% Net Reduction in Load
Post-Development (with BMPs):	**315.87**
Change (Pre - Post):	**8.71**
	3% Net Reduction in Load

DEVELOPMENT:	**MU 11**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**324.59**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**315.87**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**8.71**
Conclusion:	**3% 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:

Appendix B6

PTool - P Loading and Removal for Proposed Conditions

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Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: MU 1
Subwatershed: East Holland

Total Pre-Development Area (ha):	**526.37**	Total Pre-Development Phosphorus Load (kg/yr):	**676.02**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	148.98	1.82	271.14
High Intensity - Residential	291.02	1.32	384.15
Sod Farm / Golf Course	86.37	0.24	20.73

DEVELOPMENT:	MU 1
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	110.3	1.82	NONE	0%	200.75
High Intensity - Comm/Industrial	38.68	1.82	Wet Detention Ponds	63%	26.05
High Intensity - Residential	152.1	1.32	NONE	0%	200.77
High Intensity - Residential	19.6	1.32	Dry Detention Ponds	10%	23.28
High Intensity - Residential	119.32	1.32	Wet Detention Ponds	63%	58.28
Sod Farm / Golf Course	47.47	0.24	NONE	0%	11.39
Sod Farm / Golf Course	2.4	0.24	Dry Detention Ponds	10%	0.52
Sod Farm / Golf Course	36.5	0.24	Wet Detention Ponds	63%	3.24

Post-Development Area Altered:	**526.37**
Total Pre-Development Area:	**526.37**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**676.02**
Post-Development:	**676.02**
Change (Pre - Post):	**0.00**
0% Net Increase in Load	
Post-Development (with BMPs):	**524.28**
Change (Pre - Post):	**151.74**
22% Net Reduction in Load	

DEVELOPMENT:	MU 1
Subwatershed:	East Holland

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**676.02**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**524.28**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**151.74**
Conclusion:	**22% 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: **MU 2**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**731.09**	Total Pre-Development Phosphorus Load (kg/yr):	**925.95**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	187.35	1.82	340.98
High Intensity - Residential	420.81	1.32	555.47
Sod Farm / Golf Course	122.93	0.24	29.50

DEVELOPMENT:	MU 2
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	165.42	1.82	Wet Detention Ponds	63%	111.39
High Intensity - Comm/Industrial	21.93	1.82	NONE	0%	39.91
High Intensity - Residential	36.39	1.32	Dry Detention Ponds	10%	43.23
High Intensity - Residential	116.37	1.32	Wet Detention Ponds	63%	56.84
High Intensity - Residential	268.05	1.32	NONE	0%	353.83
Sod Farm / Golf Course	4.14	0.24	Dry Detention Ponds	10%	0.89
Sod Farm / Golf Course	24.78	0.24	Wet Detention Ponds	63%	2.20
Sod Farm / Golf Course	94.01	0.24	NONE	0%	22.56

Post-Development Area Altered: **731.09**

Total Pre-Development Area: **731.09**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**925.95**
Post-Development:	**925.95**
Change (Pre - Post):	**0.00**
0% Net Reduction in Load	
Post-Development (with BMPs):	**630.86**
Change (Pre - Post):	**295.09**
32% Net Reduction in Load	

DEVELOPMENT:	**MU 2**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**925.95**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**630.86**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**295.09**
Conclusion:	**32% 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: MU 3
Subwatershed: East Holland

Total Pre-Development Area (ha):	**248.42**	Total Pre-Development Phosphorus Load (kg/yr):	**258.88**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	12.52	1.82	22.79
High Intensity - Residential	166.18	1.32	219.36
Sod Farm / Golf Course	69.72	0.24	16.73

DEVELOPMENT:	MU 3
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	12.07	1.82	Wet Detention Ponds	63%	8.13
High Intensity - Comm/Industrial	0.45	1.82	NONE	0%	0.82
High Intensity - Residential	57.48	1.32	Dry Detention Ponds	10%	68.29
High Intensity - Residential	19.68	1.32	Wet Detention Ponds	63%	9.61
High Intensity - Residential	89.02	1.32	NONE	0%	117.51
Sod Farm / Golf Course	8.33	0.24	Dry Detention Ponds	10%	1.80
Sod Farm / Golf Course	2.25	0.24	Wet Detention Ponds	63%	0.20
Sod Farm / Golf Course	59.14	0.24	NONE	0%	14.19

Post-Development Area Altered:	**248.42**
Total Pre-Development Area:	**248.42**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**258.88**
Post-Development:	**258.88**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**220.54**
Change (Pre - Post):	**38.33**
	15% Net Reduction in Load

DEVELOPMENT:	**MU 3**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**258.88**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**220.54**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**38.33**
Conclusion:	**15% 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:

Project DEVELOPMENT Summary

DEVELOPMENT:	**MU 4**
Subwatershed:	**East Holland**

Total Pre-Development Area (ha):	**152.73**	Total Pre-Development Phosphorus Load (kg/yr):	**207.13**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	30.44	1.82	55.40
High Intensity - Residential	113.31	1.32	149.57
Sod Farm / Golf Course	8.98	0.24	2.16

DEVELOPMENT:	MU 4
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	12.55	1.82	Dry Detention Ponds	10%	20.56
High Intensity - Comm/Industrial	17.89	1.82	NONE	0%	32.56
High Intensity - Residential	46.64	1.32	Dry Detention Ponds	10%	55.41
High Intensity - Residential	66.67	1.32	NONE	0%	88.00
Sod Farm / Golf Course	4.14	0.24	Dry Detention Ponds	10%	0.89
Sod Farm / Golf Course	4.84	0.24	NONE	0%	1.16

Post-Development Area Altered:	**152.73**
Total Pre-Development Area:	**152.73**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**207.13**
Post-Development:	**207.13**
Change (Pre - Post):	**0.00**
	0% Net Reduction in Load
Post-Development (with BMPs):	**198.59**
Change (Pre - Post):	**8.54**
	4% Net Reduction in Load

DEVELOPMENT:	**MU 4**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**207.13**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**198.59**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**8.54**
Conclusion:	**4% 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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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 5**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**124.31**	Total Pre-Development Phosphorus Load (kg/yr):	**202.67**

Pre-Development Land Use	**Area (ha)**	**P coeff. (kg/ha)**	**P Load (kg/yr)**
High Intensity - Comm/Industria	108.71	1.82	197.85
High Intensity - Residential	0.99	1.32	1.31
Sod Farm / Golf Course	14.61	0.24	3.51

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)**
High Intensity - Comm/Industrial	28.48	1.82	Wet Detention Ponds	63%	19.18
High Intensity - Comm/Industrial	80.23	1.82	NONE	0%	146.02
High Intensity - Residential	0.99	1.32	Wet Detention Ponds	63%	0.48
Sod Farm / Golf Course	14.61	0.24	NONE	0%	3.51

Post-Development Area Altered:	**124.31**
Total Pre-Development Area:	**124.31**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**202.67**
Post-Development:	**202.67**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**169.19**
Change (Pre - Post):	**33.48**
	17% Net Reduction in Load

DEVELOPMENT:	**MU 5**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**202.67**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**169.19**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**33.48**
Conclusion:	**17% 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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Project DEVELOPMENT Summary

DEVELOPMENT: **MU 6**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**369.44**	Total Pre-Development Phosphorus Load (kg/yr):	**234.80**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	18.44	1.82	33.56
High Intensity - Residential	108.33	1.32	143.00
Sod Farm / Golf Course	242.67	0.24	58.24

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)
High Intensity - Comm/Industrial	18.44	1.82	Wet Detention Ponds	63%	12.42
High Intensity - Residential	108.33	1.32	Wet Detention Ponds	63%	52.91
Sod Farm / Golf Course	228.23	0.24	NONE	0%	54.78
Sod Farm / Golf Course	14.44	0.24	Wet Detention Ponds	63%	1.28

Post-Development Area Altered: **369.44**
Total Pre-Development Area: **369.44**
Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**234.80**
Post-Development:	**234.80**
Change (Pre - Post):	**0.00**
	0% Net Reduction in Load
Post-Development (with BMPs):	**121.38**
Change (Pre - Post):	**113.41**
	48% Net Reduction in Load

DEVELOPMENT:	**MU 6**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**234.80**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**121.38**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**113.41**
Conclusion:	**48% 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:

Project DEVELOPMENT Summary

DEVELOPMENT:	**MU 7**
Subwatershed:	**East Holland**

Total Pre-Development Area (ha):	**167.73**	Total Pre-Development Phosphorus Load (kg/yr):	**155.79**

Pre-Development Land Use	**Area (ha)**	**P coeff. (kg/ha)**	**P Load (kg/yr)**
High Intensity - Comm/Industria	12.36	1.82	22.50
High Intensity - Residential	88.89	1.32	117.33
Sod Farm / Golf Course	66.48	0.24	15.96

DEVELOPMENT:	MU 7
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	12.36	1.82	Wet Detention Ponds	63%	8.32
High Intensity - Residential	13.1	1.32	Dry Detention Ponds	10%	15.56
High Intensity - Residential	72.79	1.32	Wet Detention Ponds	63%	35.55
Sod Farm / Golf Course	29.47	0.24	NONE	0%	7.07
Sod Farm / Golf Course	37.01	0.24	Wet Detention Ponds	63%	3.29

Post-Development Area Altered:	**164.73**
Total Pre-Development Area:	**167.73**
Unaffected Area:	**3**

	P Load (kg/yr)
Pre-Development:	**155.79**
Post-Development:	**151.83**
Change (Pre - Post):	**3.96**
	3% Net Reduction in Load
Post-Development (with BMPs):	**69.80**
Change (Pre - Post):	**85.99**
	55% Net Reduction in Load

DEVELOPMENT:	**MU 7**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**155.79**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**69.80**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**85.99**
Conclusion:	**55% 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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Project DEVELOPMENT Summary

DEVELOPMENT: MU 8
Subwatershed: East Holland

Total Pre-Development Area (ha):	**416.81**	Total Pre-Development Phosphorus Load (kg/yr):	**546.09**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	119.34	1.82	217.20
High Intensity - Residential	238.42	1.32	314.71
Sod Farm / Golf Course	59.05	0.24	14.17

DEVELOPMENT:	MU 8
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	14.58	1.82	Dry Detention Ponds	10%	23.88
High Intensity - Comm/Industrial	16.97	1.82	Wet Detention Ponds	63%	11.43
High Intensity - Comm/Industrial	87.79	1.82	NONE	0%	159.78
High Intensity - Residential	1.04	1.32	Dry Detention Ponds	10%	1.24
High Intensity - Residential	66.6	1.32	Wet Detention Ponds	63%	32.53
High Intensity - Residential	170.78	1.32	NONE	0%	225.43
Sod Farm / Golf Course	1.21	0.24	Dry Detention Ponds	10%	0.26
Sod Farm / Golf Course	17.93	0.24	Wet Detention Ponds	63%	1.59
Sod Farm / Golf Course	39.91	0.24	NONE	0%	9.58

Post-Development Area Altered:	**416.81**
Total Pre-Development Area:	**416.81**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**546.09**
Post-Development:	**546.09**
Change (Pre - Post):	**0.00**
	0% Net Increase in Load
Post-Development (with BMPs):	**465.71**
Change (Pre - Post):	**80.37**
	15% Net Reduction in Load

DEVELOPMENT:	**MU 8**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**546.09**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**465.71**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**80.37**
Conclusion:	**15% 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: **MU 9**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**533.27**	Total Pre-Development Phosphorus Load (kg/yr):	**644.22**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	131.69	1.82	239.68
High Intensity - Residential	285.34	1.32	376.65
Sod Farm / Golf Course	116.24	0.24	27.90

DEVELOPMENT:	MU 9
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	15.39	1.82	Dry Detention Ponds	10%	25.21
High Intensity - Comm/Industrial	2.68	1.82	Wet Detention Ponds	63%	1.80
High Intensity - Comm/Industrial	113.62	1.82	NONE	0%	206.79
High Intensity - Residential	110.41	1.32	Dry Detention Ponds	10%	131.17
High Intensity - Residential	93.6	1.32	Wet Detention Ponds	63%	45.71
High Intensity - Residential	81.33	1.32	NONE	0%	107.36
Sod Farm / Golf Course	15.05	0.24	Dry Detention Ponds	10%	3.25
Sod Farm / Golf Course	8.62	0.24	Wet Detention Ponds	63%	0.77
Sod Farm / Golf Course	92.57	0.24	NONE	0%	22.22

Post-Development Area Altered:	**533.27**
Total Pre-Development Area:	**533.27**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**644.22**
Post-Development:	**644.22**
Change (Pre - Post):	**0.00**
	0% Net Reduction in Load
Post-Development (with BMPs):	**544.27**
Change (Pre - Post):	**99.95**
	16% Net Reduction in Load

DEVELOPMENT:	**MU 9**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**644.22**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**544.27**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**99.95**
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:

Project DEVELOPMENT Summary

DEVELOPMENT: **MU 10**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**305.94**	Total Pre-Development Phosphorus Load (kg/yr):	**256.43**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	17.36	1.82	31.60
High Intensity - Residential	144.05	1.32	190.15
Sod Farm / Golf Course	144.53	0.24	34.69

DEVELOPMENT:	MU 10
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	16.73	1.82	Wet Detention Ponds	63%	11.27
High Intensity - Comm/Industrial	0.63	1.82	NONE	0%	1.15
High Intensity - Residential	40.9	1.32	Dry Detention Ponds	10%	48.59
High Intensity - Residential	76.27	1.32	Wet Detention Ponds	63%	37.25
High Intensity - Residential	26.88	1.32	NONE	0%	35.48
Sod Farm / Golf Course	3.78	0.24	Dry Detention Ponds	10%	0.82
Sod Farm / Golf Course	42.45	0.24	Wet Detention Ponds	63%	3.77
Sod Farm / Golf Course	98.3	0.24	NONE	0%	23.59

Post-Development Area Altered: **305.94**

Total Pre-Development Area: **305.94**

Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**256.43**
Post-Development:	**256.43**
Change (Pre - Post):	**0.00**
	0% Net Reduction in Load
Post-Development (with BMPs):	**161.91**
Change (Pre - Post):	**94.52**
	37% Net Reduction in Load

DEVELOPMENT:	**MU 10**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**256.43**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**161.91**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**94.52**
Conclusion:	**37% 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:

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

Project DEVELOPMENT Summary

DEVELOPMENT: **MU 11**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**241.76**	Total Pre-Development Phosphorus Load (kg/yr):	**324.59**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industria	59.18	1.82	107.71
High Intensity - Residential	160.24	1.32	211.52
Sod Farm / Golf Course	22.34	0.24	5.36

DEVELOPMENT:	MU 11
Subwatershed:	East Holland

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)
High Intensity - Comm/Industrial	21.39	1.82	Wet Detention Ponds	63%	14.40
High Intensity - Comm/Industrial	37.78	1.82	NONE	0%	68.76
High Intensity - Residential	33.92	1.32	Wet Detention Ponds	63%	16.57
High Intensity - Residential	126.32	1.32	NONE	0%	166.74
Sod Farm / Golf Course	13.65	0.24	Wet Detention Ponds	63%	1.21
Sod Farm / Golf Course	8.7	0.24	NONE	0%	2.09

Post-Development Area Altered:	**241.76**
Total Pre-Development Area:	**241.76**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**324.59**
Post-Development:	**324.57**
Change (Pre - Post):	**0.02**
	0% Net Reduction in Load
Post-Development (with BMPs):	**269.77**
Change (Pre - Post):	**54.81**
	17% Net Reduction in Load

DEVELOPMENT:	**MU 11**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**324.59**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**269.77**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**54.81**
Conclusion:	**17% 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:

Appendix B7

P Removal for Recommended LID's -Excel Spreadsheets

MANAGEMENT UNIT 1

Potential P Load Reduction with BMPs = 5.54 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
Wet Detention Pond	63

Potential Rooftop Infiltration at Upper Canada Mall:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	4.40	1.32	5.81	Soakaway/Infiltration tr	60	3.48	3.48
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

*Used Low Intensity Develoment to represent 'clean' rooftop runoff in commercial area

3.48 kg/yr removed

Potential Rooftop Infiltration at Town Building at Yonge & Eagle:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	0.80	1.32	1.06	Soakaway/Infiltration tr	60	0.63	0.63
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

*Used Low Intensity Develoment to represent 'clean' rooftop runoff in commercial area

0.63 kg/yr removed

Potential Parking lot treatment at Ray Twinney Complex:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	1.30	1.82	2.37	Soakaway/Infiltration tr	60	1.42	1.42
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

*Used Low Intensity Develoment to represent 'clean' rooftop runoff in commercial area

1.42 kg/yr removed

MANAGEMENT UNIT 2

Potential P Load Reduction with BMPs = 2.96 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
Wet Detention Pond	63

0.5 ha High Intensity Commercial - provide LID as per LRSCA request in Comments received

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.50	1.82	0.91	soakaway/infiltration	60	0.55	0.55
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

0.55 kg/yr removed

Potential infiltration of parking lot runoff at Magna Centre:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	1.13	1.82	2.05	soakaway/infiltra	60	1.23	1.23
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

1.23 kg/yr removed

Potential Rooftop Infiltration at Magna Centre:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	1.50	1.32	1.98	soakaway/infiltration	60	1.19	1.19
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

*Used Low Intensity Develoment to represent 'clean' rooftop runoff in commercial area

1.19 kg/yr removed

Potential OGS units:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.25	1.82	0.45		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

0.00 kg/yr removed

Management Unit 3

Potential P Load Reduction with BMPs = 0 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
Wet Detention Pond	63

Existing OGS units:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.01	1.82	0.01		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

0.00 kg/yr removed

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

0.00 kg/yr removed

Management Unit 4

	Potential P Load Reduction with BMPs = 0.0 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
Wet Detention Pond	63

Existing OGS units:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.01	1.82	0.02		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

0.00 kg/yr removed

Potential OGS units:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.004		0	0.00	0.000
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

0.00 kg/yr removed

Management Unit 5

Potential P Load Reduction with BMPs = 6.53 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
Wet Detention Pond	63

0.5 ha High Intensity Commercial - provide LID as per LRSCA request in Comments received

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.50	1.82	0.91	soakaway/infiltration	60	0.55	0.55
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

0.55 kg/yr removed

Potential Roof areas for infiltration - Pony Drive/Stellar industrial area

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	4.85	1.32	6.40	soakaway/infiltration	60	3.84	3.84
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

3.84 kg/yr removed

Potential Parking lot treatment - Pond Drive/Stellar industrial area:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	1.96	1.82	3.57	soakaway/infiltration	60	2.14	2.14
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

2.14 kg/yr removed

Management Unit 6

Potential P Load Reduction with BMPs = 0 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
Wet Detention Pond	63

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

Management Unit 7

Potential P Load Reduction with BMPs = 0 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
Wet Detention Pond	63

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

Management Unit 8

Potential P Load Reduction with BMPs = 0.07 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Sakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
wet detention pond	63

Lion's Park restoration - LID catchment wide retrofit program

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.50	0.24	0.12	soakaway/infiltration	60	0.07	0.07
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00
							0.07 kg/yr removed

Potential OGS units:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.10	1.82	0.18		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00
							0.00 kg/yr removed

Existing OGS units:

Management Unit 9

Potential P Load Reduction with BMPs = 0.11 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
wet detention pond	63

LID as per LRSCA request in Comments received-bioswale/filter consideration in the Wayne and Waratah intersection

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.10	1.82	0.18	soakaway/infiltration	60	0.11	0.11
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00
							0.11 kg/yr removed

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.08	1.82	0.15		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00
							0.00 kg/yr removed

Management Unit 10

Potential P Load Reduction with BMPs = 0.55 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
Wet Detention Pond	63

0.5 ha High Intensity Commercial - provide LID as per LRSCA request in Comments received

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.50	1.82	0.91	soakaway/infiltration	60	0.55	0.55
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00
							0.55 kg/yr removed

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

Management Unit 11

Potential P Load Reduction with BMPs = 3.70 kg/yr

BMP:	TP Removal Efficiency (%)
Bioretention system	0
Constructed Wetland	77
Dry Detention Pond	10
Dry Swales	0
Enhanced Grass/WQ Swales	0
Flow Balancing Systems (?)	77
Green roofs	0
Perforated Pipe Infil/Exfil	87
Sand or Media Filters	45
Soakaway/Infiltration trench	60
Sorbtive media interceptors	79
Underground Storage	25
Veget. Filter Strip/buffer	65
Wet Detention Pond	63

Potential rooftop Infiltration near Yonge and Bonshaw:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	0.00	1.82	0.00		0	0.00	0.00
High Intensity Residential	1.60	1.32	2.11	soakaway/infiltration	60	1.27	1.27
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

*Used Low Intensity Develoment to represent 'clean' rooftop runoff in commercial area

1.27 kg/yr removed

Potential parking lot treatment near Yonge and Bonshaw:

	Area	P coeff (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency %	BMP P (kg/yr)	BMP P (kg/yr)
High Intensity Commercial	2.23	1.82	4.06	soakaway/infiltration	60	2.44	2.44
High Intensity Residential	0.00	1.32	0.00		0	0.00	0.00
Low Intensity Development	0.00	0.13	0.00		0	0.00	0.00
Sod Farm/Golf Course	0.00	0.24	0.00		0	0.00	0.00
Transition	0.00	0.16	0.00		0	0.00	0.00
Forest	0.00	0.10	0.00		0	0.00	0.00
Quarry	0.00	0.18	0.00		0	0.00	0.00

2.44 kg/yr removed

Appendix C

Water Balance Calculations

Water Balance

Newmarket Annual Precipitation (mm)=	767	
Existing Annual ET (mm)	536	
Existing Annual Recharge (mm)	182	0 mm recharge for impervious areas
Proposed Annual ET (mm)	536	
Proposed Annual Recharge (mm)	182	0 mm recharge for impervious areas

Parameter	Area (ha)	Imperviousness (%)	Precipitation [P] (m^3)	Evapo-transpiration [ET] (m^3)	Infiltration [I] (m^3)	Runoff [Q_s] (m^3)	Q_s Difference Exs vs Prop
EXISTING CONDITIONS							
Management Unit 1	525.64	75.72	4,031,659	684,072	232,278	3,115,308	
Management Unit 2	747.9	75.68	5,736,393	974,927	331,038	4,430,428	
Management Unit 3	251.76	67.06	1,930,999	444,503	150,932	1,335,564	
Management Unit 4	152.72	84.85	1,171,362	124,015	42,109	1,005,238	
Management Unit 5	118.36	86.96	907,821	82,727	28,090	797,004	
Management Unit 6	378.57	45.13	2,903,632	1,113,386	378,053	1,412,193	
Management Unit 7	97.85	52.97	750,510	246,661	83,754	420,094	
Management Unit 8	416.82	76.36	3,197,009	528,154	179,336	2,489,519	
Management Unit 9	518.45	75.39	3,976,512	683,885	232,215	3,060,411	
Management Unit 10	303.33	56.33	2,326,541	710,008	241,085	1,375,448	
Management Unit 11	228.38	85.21	1,751,675	181,047	61,475	1,509,153	
PROPOSED CONDITIONS - WITH PROPOSED LID							
Management Unit 1	525.64	77.86	4,031,659	684,072	226,431	3,121,156	5,848
Management Unit 2	747.9	81.83	5,736,393	974,927	254,369	4,507,098	76,670
Management Unit 3	251.76	74.59	1,930,999	444,503	116,429	1,370,066	34,503
Management Unit 4	152.72	83.97	1,171,362	124,015	44,555	1,002,792	-2,446
Management Unit 5	118.36	88.96	907,821	82,727	40,229	784,865	-12,139
Management Unit 6	378.57	49.7	2,903,632	1,113,386	346,566	1,443,680	31,487
Management Unit 7	97.85	65.05	750,510	246,661	62,241	441,607	21,513
Management Unit 8	416.82	81.32	3,197,009	528,154	142,834	2,526,021	36,502
Management Unit 9	518.45	80.24	3,976,512	683,885	187,576	3,105,050	44,639
Management Unit 10	303.33	73.39	2,326,541	710,008	148,028	1,468,505	93,057
Management Unit 11	228.38	85.85	1,751,675	181,047	67,432	1,503,196	-5,957
PROPOSED CONDITIONS - NO LID							
Management Unit 1	525.64	77.86	4,031,659	623,779	211,806	3,196,074	74,918
Management Unit 2	747.9	81.83	5,736,393	728,389	247,326.04	4,760,678	253,580
Management Unit 3	251.76	74.59	1,930,999	342,891	116,429.43	1,471,679	101,612
Management Unit 4	152.72	83.97	1,171,362	131,218	44,555.45	995,589	-7,203
Management Unit 5	118.36	88.96	907,821	70,039	23,782	814,001	29,136
Management Unit 6	378.57	79.7	2,903,632	1,020,655	139,866.47	1,743,110	299,431
Management Unit 7	97.85	65.05	750,510	183,304	62,241.41	504,964	63,357
Management Unit 8	416.82	81.32	3,197,009	417,340	141,708.80	2,637,960	111,939
Management Unit 9	518.45	80.24	3,976,512	549,109	186,451.21	3,240,951	135,901
Management Unit 10	303.33	73.39	2,326,541	432,638	146,903.33	1,746,999	278,495
Management Unit 11	228.38	85.85	1,751,675	173,213	58,814.70	1,519,647	16,452

Notes:

Evapotranspiration and Recharge coefficients taken from Table 3.1 of the 2003 MOE SWM Planning and Design Manual.

*LID Area represents total area within Management Unit that is serviced by LID infiltration

*Annual Volume based on number of events with >10mm infiltration