IBI GROUP
8133 Warden Avenue, Unit 300
Markham ON L6G 1B3 Canada
tel 905 754 8060 fax 905 940 2064
ibigroup.com

Draft Report

Ayr Stormwater Management Master Plan

Community of Ayr

Prepared for The Township of North Dumfries
by IBI Group
IBI Project Number 131788 | 2019-0506
January 2022

Document Control Page

CLIENT:	The Township of North Dumfries
PROJECT NAME:	Ayr Stormwater Management Master Plan
REPORT TITLE:	Ayr Stormwater Management Master Plan
IBI REFERENCE:	131788 | 2019-0506
VERSION:	Issued for 1st Submission
DIGITAL MASTER:	\\caneast.ibigroup.com\J\TO\2019-0506\400_Tchncl\70_Rprts\WTR_swmmp_draft_2022-01-28.docx
ORIGINATOR:	Chris Zhang, EIT, Designer Roy Johnson, P.Eng., Project Manager
REVIEWER:	Will Heywood, P.Eng., Associate Manager, Stormwater Management
AUTHORIZATION:	Philip Gray, Associate Director - Practice Lead, Infrastructure Planning
CIRCULATION LIST:	Lee Robinson, Director of Public Works
HISTORY:	Draft Report for Client Review – January 28, 2022

Table of Contents

Table of Contents (continued)

List of Tables

Table of Contents (continued)

List of Figures

Table of Contents (continued)

Appendices

Executive Summary

The Community of Ayr requires completion of a Stormwater Management Master Plan [SWMMP] following a Master Planning approach in accordance with the Environmental Assessment Act as outlined by the Municipal Engineer's Association Municipal Class Environmental Assessment (MEA), October 2000, as amended.

The Study is to focus on the Urban Area of the Community of Ayr (existing and emerging), as illustrated in the Township's Official Plan [AOP]. The Township also requires an analysis through this Study on the potential urbanization of lands framing the Northumberland Street corridor, extending from Greenfield Road to Highway No. 401.

The SWMMP will serve as a decision support tool, a methodology for the prioritization of works, a means to estimate future SWM requirements and costs and a transparent community process by which the Township can establish stormwater management guidelines and policies for the next ten to fifteen years.

The SWM Master Plan shall be an integrated approach that considers flood and erosion control, groundwater and surface water quality management, natural heritage environment management and infrastructure. In addition, the plan shall integrate existing policies, regulations, acts and guidelines and where appropriate develop new policies and design guidelines to aid in implementation and shall do so within a water sustainability context. In addition, the SWMMP should provide sufficient information for the Township to develop a framework for the provision of a stormwater user fee, if desired.

IBI Group will work closely with the Township to ensure that the goals of the SWMMP can be accomplished in an effective and efficient manner. Based on Addendum #4, there may be challenges working within the budget set out to Council, and IBI Group will work with the Township to deal with these issues.

1 Introduction

The Community of Ayr requires completion of a Stormwater Management [SWM] Master Plan [SWMMP] following a Master Planning approach in accordance with the Environmental Assessment Act as outlined by the Municipal Engineer's Association Municipal Class Environmental Assessment (MEA), October 2000, as amended.

The Study is to focus on the Urban Area of the Community of Ayr (existing and emerging), as illustrated in the Township of Ayr's Official Plan [AOP]. The Township also requires an analysis through this Study on the potential urbanization of lands framing the Northumberland Street corridor, extending from Greenfield Road to Highway No. 401. Refer to **Figure 1-1**.

The SWMMP will serve as a decision support tool, a methodology for the prioritization of works, a means to estimate future SWM requirements and costs and a transparent community process by which the Township can establish stormwater management guidelines and policies for the next ten to fifteen years.

The SWM Master Plan shall be an integrated approach that considers flood and erosion control, groundwater and surface water quality management, natural heritage environment management and infrastructure. In addition, the plan shall integrate existing policies, regulations, acts and guidelines and where appropriate develop new policies and design guidelines to aid in implementation and shall do so within a water sustainability context. In addition, the SWMMP should provide sufficient information for the Township to develop a framework for the provision of a stormwater user fee if desired.

IBI Group will work closely with the Township to ensure that the goals of the SWMMP can be accomplished in an effective and efficient manner. Based on Addendum #4, there may be challenges working within the budget set out to Council, and IBI Group will work with the Township to deal with these issues.

1.1 Background

The Community of Ayr has a population of approximately 5,000 persons and is anticipated to increase to a population of 10,000 to 11,000 persons by 2031. Increases in population require residential and employment lands, which increase the impervious cover of existing lands, and the stormwater which runs off during events requires mitigation. The SWMMP will provide specific recommendations for SWM measures to mitigate urban growth in the Study Area.

The Ayr Urban Area is designated on Maps 2 and 2.1 of the AOP. This designation is intended to serve as the primary focus for growth and development in the Township to the year 2031. Development within this designation will provide for a range of residential, commercial, employment, recreational and institutional uses. Future development within the Ayr Urban Area will be directed predominantly to the Urban Growth Centre and Designated Greenfield Area.

A goal of the AOP is to concentrate most of the growth in the Township within the Ayr Urban Area, with limited growth in designated Rural Settlement Areas and Rural Employment Area where municipal services can be provided in a cost effective and environmentally responsible manner.

The Township encourages the provision of new dwelling units in built-up areas in the Ayr Urban Area and existing Rural Settlement Areas, through infill, conversion, intensification or redevelopment compatible with surrounding uses, except where infrastructure is inadequate or there are significant physical constraints.

The SWMMP provides guidance for future development in these areas, including an overview of opportunities and constraints for SWM measures.

Nith River: The Nith River drains the western part of the Grand River watershed in Waterloo Region as well as Brant and Oxford counties. In the northern part of the river, water runs off the land quickly so flows can rise and fall quickly. Demand for water is high in the southern part of the river where farm irrigation is common. Typical summer flow in the Nith River at Ayr is 2.6m^3/s, with low lying areas flooded when flows exceed 110m^3/s. Per Ayr Flooding, the Regional event flow is approximately 600-800m^3/s.

Cedar Creek: The Upper Cedar Creek Scoped Subwatershed Study (UCCSSS) is intended to guide and coordinate decision making by the Region, area municipalities, the Grand River Conservation Authority (GRCA) and others involved in development planning, subwatershed stewardship and restoration. Cedar Creek supports a coldwater brook trout fishery and drains primarily agricultural lands, remnant natural woodlands, and low-lying wetlands south and west of the Cities of Kitchener and Cambridge, respectively. The northern part of the subwatershed is bisected by the Highway 401 corridor. The main Urban Area is the community of Ayr, in the Township of North Dumfries, located at the confluence of Cedar Creek and a meandering section of the Nith River.

Per the Grand River Watershed Management Plan (GRWWMP) and Ayr Flooding, Ayr is located within an Existing Flood Damage Centre (a community that has several structures located within the floodplain). Ayr experiences frequent nuisance flooding.

An initial review of flooding in Ayr suggests that there are few practical options to reduce riverine flooding to the most frequently flooded properties along Tanner Street. Next steps will focus on flood preparedness, implementing flood inundation mapping and increasing awareness of those residents located in the floodplain. Damages to property and a risk to life can occur during significant flood events. Therefore, the GRWWMP Team recommended that additional ways to reduce the flood damage potential in the community of Ayr be investigated.

1.2 Location

Ayr lies at the confluence of the Nith River and Cedar Creek, which generally flow north to south. There is a stream flow monitoring station in Ayr upstream of the confluence. Approximately 74.51ha drains to the Cedar Creek at Ayr Gauge. Regional flows at that gauge are 90.35 m^3/s, per UCCSSS.

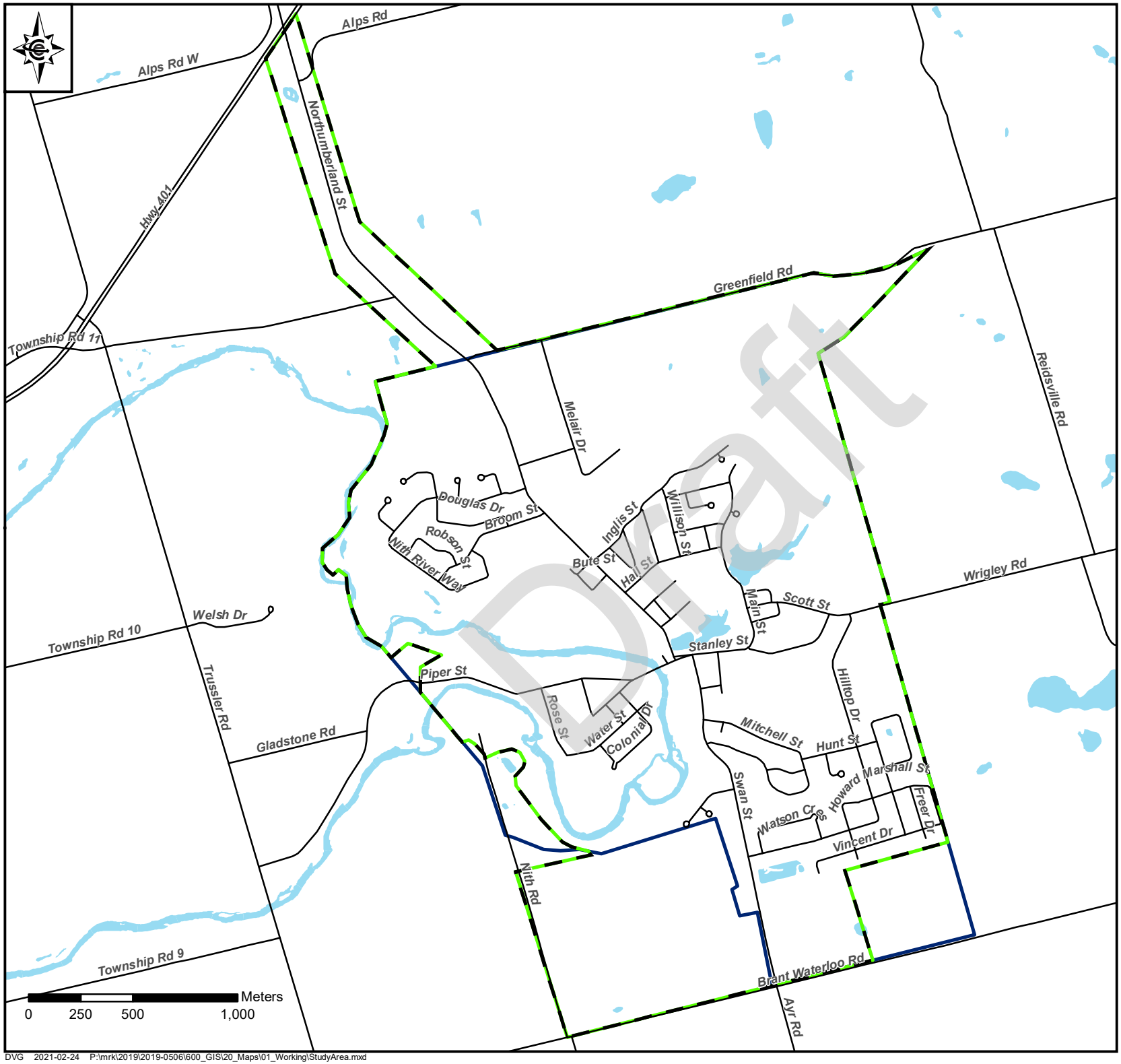
The following **Figure 1-1**, shows the Ayr site boundary as well as the boundary of this study.

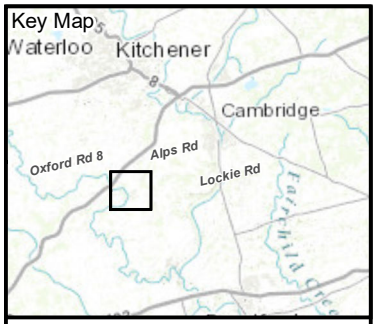
1.3 Study Overview

A Kickoff Meeting with the Township was held February 28, 2020 (Minutes attached in **Appendix A**).

It was assumed that the Township would provide, according to the RFP documents:

- GIS Mapping layers, including watercourses, property boundaries, existing and/or future Official Plan land use; natural features mapping; natural hazard areas or zones including regulatory floodplain zones; and any other relevant GIS layers that the Township can supply.
- LIDAR and/or existing digital elevation models for the Study Area
- Stormwater Management Reports for any developed areas with the Study Areas
- List of stakeholders
- Available record drawings, base plans, reports, digital ortho photography, and other relevant existing information
- Existing SWM pond assessments with their respective design reports, as available





Legend

- Approximate Study Boundary
- Municipal Boundary
- Watercourse

Figure 1 1

Ayr Township Location and Study Boundary

Township of North Dumfries Storm Water Management Master Plan

IBI

Project No.:	Date:
2019-0506	January 2022

DVG 2021-02-24 P:\mrk\2019\2019-0506\600_GIS\20_Maps\01_Working\StudyArea.mxd

As noted by Township staff, however, the Township did not routinely keep such records, therefore staff noted that alternative sources of that information will need to be developed. Such sources include GRCA, Region of Waterloo, and the Town's technical reviewer, K. Smart Associates Consulting Engineers & Planners located in Kitchener.

The information supplied by the Township was reviewed and any significant gaps in the available information that could affect the project was identified. Discussions were then had with Township staff to address these gaps in the most practical way. Examples of data gaps were:

- Existing storm sewer information
- Drainage area information outside of settlement areas
- Drainage areas to oil grit separators
- Drainage areas to uncontrolled outlets
- Existing SWM Pond IDs and reports

The Township does not have GIS information on existing storm sewers. As a result, no analysis of the system can be completed without a survey or other information on how the existing system was designed or built. This is critical to meeting the timelines outlined herein. Regional storm sewers, if any, are not included in this Study.

The Ministry of the Environment, Conservation and Parks [MECP] Access Environment website was used to search for Environmental Compliance Approval (ECAs) in the Study Area. We located two Oil-Grit Separator (OGS) ECAs, and three SWM Facility ECAs.

The most significant water quality issue in the Grand River Watershed is the eutrophication of the river from both anthropogenic and natural sources. Eutrophication results from excessive loadings of nutrients, specifically nitrogen, phosphorus and/or carbon to freshwaters, resulting in increased growth of aquatic plants and algae. It is our understanding that in the case of the Grand River, the nutrient of most concern in phosphorus.[1]

The available information was reviewed and the estimates of existing phosphorus loadings to the Nith River attributable to existing stormwater discharges were developed, and the potential change in loadings that might result from the foreseeable land development. This will help put future development in context and help to define what mitigation measures may be required as part of the overall SWM strategy.

1.3.1 Meeting Class EA Requirements

IBI Group's approach to completing a Class EA, is one of open involvement of all affected stakeholders early in the process. It is therefore proposed to inform the public through multiple points of contact, exceeding the requirements under the Class EA process.

1.3.2 Stakeholder List

A first step in the project was to prepare a comprehensive list of stakeholders to consult as a fulfillment of the Class EA Master Plan process. This list was based on parties identified by the Township as being interested in this or similar projects, as well as approval agencies and First Nations. During the full course of the project, the project stakeholder list will be maintained, and interested parties will be added for future mailings. IBI Group assumed that the cost of publishing all notices in local newspapers and the cost of facilities for public meetings will be paid directly by the Township. Refer to **Section 9.2** for the Stakeholders List.

1.3.3 Township of North Dumfries Official Plan

On December 16, 2013, Township Council passed By-law No. 2605-13 to adopt Official Plan Amendment No. 26 to the Official Plan for the Township of North Dumfries. This amendment

[1] *Water Management Plan: Technical Memorandum, Report No. WMPSC-2011-06-01, Conceptual Understanding of Phosphorus Delivery in the Grand River Watershed*, prepared by Water Quality Working Group, dated June 7, 2011

updated the Township's existing Official Plan to bring it into conformity with changes in Ontario planning policy and the Official Plan for the Region of Waterloo.

The Township has prepared a 2018 Official Plan Consolidation. This copy has been published for reference only. In the case of a discrepancy between this consolidation and any amendments, the amendment will be used. For Official Plan policies that were appealed or deferred in the 2018 Consolidation, the policies in the May 2008 Consolidation are applicable.

1.3.4 Ayr Urban Area

The Ayr Urban Area is designated on Maps 2 and 2.1 of the Official Plan. This designation is intended to serve as the primary focus for growth and development in the Township to the year 2031. Development within this designation will provide for a range of residential, commercial, employment, recreational and institutional uses. Future development within the Ayr Urban Area will be directed predominantly to the Urban Growth Centre and Designated Greenfield Area. Specific land use designation policies relating to the Ayr Urban Area are contained in **Section 2.7** of the Official Plan. The Ayr Urban Area is designated as illustrated on Maps 2 and 2.1 of the Official Plan.

The following summarizes the relevant sections of the Official Plan (numbering refers to related section of OP).

"2.7.2 In preparing or reviewing planning studies, or in reviewing development applications or site plans, the Township will ensure that development occurring within the Ayr Urban Area is planned and developed to:

a) Support the Planned Township Structure described in this Plan.

b) Contribute to the creation of complete communities that take into account the availability and location of existing and planned community infrastructure and human services with efficient and effective development patterns, densities and an appropriate mix of land uses that optimize the use of land, resources and public investment in infrastructure and public service facilities while supporting walkability, cycling and the use of transit.

c) Protect the natural environment, and surface water and groundwater resources.

2.7.3 The Township will within one year of the approval of this Plan commence a community planning process for the Ayr Urban Area to address:

a) The potential for implementation of a two-zone flood plain policy framework

b) The distribution of densities and land uses, including the appropriate integration of future development with the existing community

c) A review of the function of the Urban Growth Centre as designated on Map 2.1 with the intent being to identify means to promote the vitality of the Ayr Urban Core Area as the focus of the community

d) The future development of stormwater management facilities … including where feasible, the completion of associated environmental assessments required under the Environmental Assessment Act

g) The determination of the appropriate designation for the vacant lands north of the railway tracks identified as Special Policy Area 2.7.7 on Map 2.1

h) The determination of the appropriate designation for the vacant lands located adjacent to the Regional Road No. 50 and Township Road No. 3 Rural Employment Area identified as Special Policy Area 2.9.3.5.3 on Map 2.30

k) Appropriate integration of environmental areas into the urban environment

2.7.6 Prior to the approval of the Community Plan provided for in Policy 2.7.5, the re-designation of lands identified as Special Policy Area 2.7.6 on Map 2.1 of this Plan will not be permitted.

2.7.7 Notwithstanding the designation of General Industrial on the lands identified as Special Policy Area 2.7.7, no development of these lands will be permitted until such time as the Community Plan as provided for in Policy 2.7.5 has been approved.

2.7.8 Infill residential development, including new development on brownfield and greyfield sites, will be encouraged within the Urban Residential and Ancillary designation by way of consent where:

a) The proposed development conforms to the policies of this Plan and the ROP.

b) The severed and retained parcels conform to the requirements of the Township Zoning By-law or that a minor variance has been approved by the Committee of Adjustment.

c) The severed and retained parcels have frontage on an existing open road of a standard satisfactory to the Township, and that no new road (other than road widening) will be required.

d) That the proposed development conforms to the provisions of Subsection 53(1) of the Planning Act.

e) The proposed development will be compatible with the uses in the immediate neighbourhood in form and function with respect to lot size and configuration, so as to minimize the impact of the proposed development on existing uses.

2.7.9 Notwithstanding the designation of Urban Residential and Ancillary, this Plan recognizes the existing privately serviced residential development on lands identified as Special Policy Area 2.7.9 on Map 2.1. This Plan supports development proposing residential infill on private services on these lands, subject to the provisions of Policy 2.7.8.

2.7.10 Lands identified on Map 2.1 as Special Policy Area 2.7.10 will be identified with an ‘f’ suffix in the Township Zoning By-law. These lands are located below the regulatory flood plain as identified by the Grand River Conservation Authority. Prior to the establishment of a Two-Zone Flood Plain policy framework for the Ayr Township Urban Area, new development will not be permitted on these lands, however, additions to the existing structures may be permitted by amendment to the Township Zoning By-law and are subject to the approval of the Grand River Conservation Authority.

2.7.11 Freure Homes – Designated as Part 1 on Registered Plan 58R-9383 Part of Lots 35 and 36, Concession 8, Ayr Southeast corner of Greenfield Road and Northumberland Street. In recognition of the strategic location of the property and its prominence at the northerly entrance into the Community of Ayr via

Northumberland Street, the development of the subject lands warrants special considerations.

Through the site plan process, an integrated architectural control manual and landscaping plan shall be undertaken by the Owner and submitted to the Township for review and approval, in addition to the standard menu of technical studies outlined elsewhere in this Plan.

Residential development may be in the form of townhouse, stacked townhouse and/or low-rise apartment buildings.

The development of this property shall require the incorporation of the triangular shaped parcel to be brought into the ownership and title of this larger landholding through the approval and finalization of Consent Application B-01/14.

2.7.12 Lands illustrated on Map 2.1 as Special Policy Area 2.7.12 and designated as Urban Residential and Ancillary Area may allow for commercial land use activities such as an office building.

2.8 AYR URBAN AREA EXPANSIONS/RATIONALIZATIONS

2.8.1 Future expansions to the boundaries of the Ayr Urban Area are only permitted onto lands within the Countryside Line as shown on Map 7 of this Plan, and will be subject to the following:

a) The expansion is justified through the preparation of a Regional Land Budget completed by the Region as part of a municipal comprehensive review of the ROP, or the completion of a municipal comprehensive review as otherwise initiated by Regional Council.

e) The existing or planned infrastructure required to accommodate the proposed expansion is financially viable over its life-cycle, can be provided in an environmentally sustainable manner and is consistent with any applicable Township and/or Regional infrastructure master plan.

g) Any applicable watershed studies have been completed prior to the approval of the expansion.

j) The expansion is accompanied by detailed environmental and servicing studies as required by the policies of this Plan.

2.8.2 Prior to any future expansions of the Ayr Urban Area in accordance with Policy 2.8.1, the Township will initiate a community planning process to establish the detailed land, transportation and infrastructure policies to guide the development of the lands to be brought into the Urban Area. The results of the community planning process will be implemented through a future amendment to this Plan. Until such time as appropriate land use designation and planning policies are determined, land uses in this area will be in conformity with the underlying prime agricultural areas designation.

2.8.3 The Township may propose a rationalization of the boundaries of the Ayr Urban Area and/or the Countryside Line applicable to the Ayr Urban Area, to be implemented through a further amendment to this Plan, provided that the rationalization:

a) Only occurs at the time of the next municipal comprehensive review of this Plan.

b) Takes into consideration existing property configurations, patterns of existing land use, natural and constructed features, and will not extend or promote strip development.

c) Does not result in a net increase in the amount of land designated as Designated Greenfield Area and/or located within the Countryside Line, except as provided for in accordance with Policy 2.8.4.

d) Does not exchange provincially constrained environmental areas for unconstrained developable areas."

1.4 References

- *A Place to Grow – Growth Plan for the Greater Golden Horseshoe*, prepared by the Government of Ontario, dated May 2019 [Places to Grow]
- Best Practices Guide for Reducing Urban Non-Point Source Pollution in the Grand River Watershed, prepared by AECOM, dated March 27, 2014
- *Grand River Watershed Water Management Plan*. 2014. Prepared by the Project Team, Water Management Plan. Grand River Conservation Authority [GRCA], Cambridge, ON [GRWWMP] [2]
- Hilltop Estates Subdivision, Stage 4, Ayr, Stormwater Management Plan, prepared by Stantec Consulting Ltd., dated September 22, 2017
- Hilltop Stage 3, (Phase 4) and Broos Property (Phase 1), Ayr, Ontario, Stormwater Management Report, prepared by Stantec Consulting Ltd., dated July 13, 2015
- Hilltop Subdivision, Ayr, Final Stormwater Management Report, prepared by Stantec Consulting Ltd., dated August 2006
- Identification of the Effect of Climate Change on Future Design Standards of Drainage Infrastructure Ontario, prepared by McMaster University, dated June 2005 [Final MTO Report]
- *Managing New Urban Development in Phosphorus Sensitive Watersheds*, prepared by Hutchinson Environmental Sciences Ltd., dated October 31, 2014 [NVCA P Tool]
- *Nith River Flows*, Grand River Conservation Authority Website
- *Phosphorus Budget Tool in Support of Sustainable Development for the Lake Simcoe Watershed*, prepared by Hutchinson Environmental Sciences Ltd., dated October 31, 2014 [MOE P Tool]
- Policies for the Administration of the Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation, Ontario Regulation 150/06, prepared by GRCA, approved October 23, 2015 [O. Reg. 150/06]
- Preparing for Flooding, A Guide for Residents of Ayr, prepared by GRCA [Ayr Flooding]
- Region of Waterloo and Area Municipalities, Design Guidelines and Supplemental Specifications for Municipal Services, prepared by Region of Waterloo, dated January 2018 [Region Guidelines][3]
- *Regional Official Plan 2031*, prepared by the Region of Waterloo, dated June 18, 2015 [ROP][4]

[2] https://www.grandriver.ca/en/our-watershed/resources/Documents/WMP/Water_WMP_Plan_Complete.pdf
[3] https://www.regionofwaterloo.ca/en/living-here/resources/Design-Standards/2018_DGSSMS.pdf
[4] https://www.regionofwaterloo.ca/en/regional-government/land-use-planning.aspx

- *Strategic Plan*, Grand River Conservation Authority, 2019/2021 [GSP]
- *Township of North Dumfries Official Plan*, Consolidation Date: November 2018 [AOP]
- *Upper Cedar Creek Scoped Subwatershed Study*, prepared by Matrix Solutions Inc. et al, dated October 2019 [UCCSSS]
- *Water Management Plan: Technical Memorandum, Report No. WMPSC-2011-06-01, Conceptual Understanding of Phosphorus Delivery in the Grand River Watershed*, prepared by Water Quality Working Group, dated June 7, 2011 [P Delivery]

1.5 Previous Studies Additional Details

1.5.1 Grand River Watershed Management Plan (GRWWMP)

Per GRCA's website: [5]

> Water is a shared resource and therefore collaboration is essential to carefully manage it. The Grand River Conservation Authority supports and facilitates a collaborative Water Management Plan with municipalities, provincial and federal government agencies, and Six Nations of the Grand River to discuss water management challenges and to develop best-value solutions.

The Plan is like a municipal master plan - it is a system-wide, or watershed-wide approach to address overall needs and to achieve common goals. It provides a framework for collective and collaborative action on water management that goes beyond municipal boundaries.

The goals for water management planning support communities, economies and ecosystems, and are to:

- Ensure water supplies
- Improve water quality to improve river health and reduce the river's impact on Lake Erie
- Reduce flood damage potential
- Build resilience to deal with climate change

The Grand River has a long history of integrated water management planning. See the historic water management documents dating back to 1932.

As identified in the GRWWMP and Ayr Flooding, Ayr is located within an Existing Flood Damage Centre (a community that has several structures located within the floodplain). Ayr experiences frequent nuisance flooding.

An initial review of flooding in Ayr suggests that there are few practical options to reduce flooding to the most frequently flooded properties along Tannery Street. Next steps will focus on flood preparedness, implementing flood inundation mapping and increasing awareness of those residents located in the floodplain. Damages to property and a risk to life can occur during significant flood events. Therefore, the GRWWMP Team recommends that additional ways to reduce the flood damage potential in the community of Ayr be investigated.

1.5.1.1 Urban Nonpoint Source Pollution Strategy

Urban stormwater contributes significantly to the phosphorus and sediment levels in the central Grand River. To reduce sediment and phosphorus loads and associated pathogens from urban stormwater in the middle Grand River, the Project Team recommends that the central Grand River watershed municipalities implement best practices as listed in the 'Best Practice Guide for Reducing Urban Non-point Source Pollution of the Grand and Speed Rivers'. Best practices focus on:

[5] https://www.grandriver.ca/en/our-watershed/Water-management-plan.aspx

- Sustainable funding to support an appropriate stormwater management program
- Development and implementation of stormwater management master plans
- Improvements to sediment and erosion control implementation and enforcement for developing sites
- Enhanced communication and education programs
- Opportunities to retrofit existing uncontrolled areas
- Maintenance and operations of facilities.

Action:

- GRCA will continue to facilitate a watershed Stormwater Management Working Group (Cities of Waterloo, Kitchener, Cambridge, Guelph, Brantford, Centre Wellington and County of Brant) and host biannual meetings to share information and identify roles and responsibilities among watershed urban municipalities.
- The Cities of Waterloo, Kitchener, Cambridge, Guelph, Brantford, Centre Wellington (Fergus, Elora) and County of Brant (Paris) plan to pursue stormwater management best practices as listed in the 'Best Practice Guide for Reducing Urban Non-point Source Pollution of the Grand and Speed Rivers'.
- GRCA, municipalities (Cities of Waterloo, Kitchener, Cambridge, Guelph, Region of Waterloo, Central Wellington, County of Brant, and Brantford) will work together to optimize current stormwater monitoring programs to characterize the effects of stormwater on the central Grand River.

1.5.2 Strategic Plan (GSP)

Through four strategic priorities, GRCA's Strategic Plan 2019-2021 serves as GRCA's guide to enhance and build on their programs and services. GRCA operates a wide range of programs in engineering, planning, land management, recreation and education in order to:

1. Protect life and minimize property damage from flooding and erosion.
2. Improve the health of the Grand River watershed.
3. Connect people to the environment through outdoor experiences.
4. Manage landholdings in a responsible and sustainable way.

1.5.3 Upper Cedar Creek Scoped Subwatershed Study (UCCSSS)

The Regional Municipality of Waterloo, partnered with the Grand River Conservation Authority (GRCA), has retained the consulting teams of Matrix Solutions Inc. (Matrix), Wood Environment and Infrastructure (Wood), Natural Resource Solutions Inc. (NRSI), and SGL Planning & Design (SGL Planning) to undertake the Upper Cedar Creek Scoped Subwatershed Study.

The Project Study Area (PSA) lies almost entirely within the Township of North Dumfries, with a small section of the northwest headwaters of Cedar Creek extending to the outskirts of the City of Kitchener, within the Regional Municipality of Waterloo. The Project includes two levels of study – a subwatershed-scale analysis for the entirety of the 7,463ha Cedar Creek Subwatershed (i.e., the PSA), and a detailed local-scale analysis for those lands within the Detailed Study Area (DSA). The DSA consists of Cedar Creek Subwatershed lands north of Cedar Creek Road and west of Dumfries Road within the City of Kitchener and the Township of North Dumfries.

The objective of the Scoped Subwatershed Study is to maintain, restore, or enhance the health of the Cedar Creek Subwatershed, with a focus on lands north of Cedar Creek Road and west of Dumfries Road. Over the course of this Scoped Subwatershed Study Process, a set of Objectives has been developed based upon the findings of the study area characterization, as well as the insights gained from the impact assessment. A series of targets have been established which

represent functional criteria and requirements to mitigate anticipated impacts from potential future development and thereby achieve the management objectives. Furthermore, the targets guided the evaluation and development of recommendations to manage and mitigate the impacts of potential future development within the Subwatershed as evaluated as part of this Study. The Study Objectives and targets are summarized in Table 2 in Appendix B of the UCCSSS, along with the associated management strategies to mitigate impacts. These objectives have further served to develop a broad policy framework to direct future potential growth in the DSA.

1.5.3.1 Hydrology Modeling

The study completed a continuous simulation using a calibrated GAWSER hydrologic model which applied the precipitation and temperature data from the Roseville Gauge.

The report makes various recommendations for SWM mitigation, including:

- Any potential development should be required, at a minimum, to maintain existing groundwater recharge rates.
- Potential urban developments shall only discharge stormwater offsite at an approximately similar frequency, rate, and volume as is occurring under baseline conditions. Stormwater that is not discharged offsite should be infiltrated.
- Potential urban developments shall only discharge stormwater offsite at an approximately similar frequency, rate, and volume as is occurring under baseline conditions.
- Infiltration of potentially contaminated water shall only be performed in areas where there is a lessor chance of the contaminated water reaching the municipal supply aquifer. Runoff from areas that are more likely to be contaminated (e.g., roads, sidewalks, parking spaces) should be directed toward end-of-pipe recharge facilities that are sited outside those lands that contribute recharge to AFD1. Water entering these facilities should undergo appropriate quality treatment prior to infiltration. This quality treatment may include capturing spring freshet flows to capture salt-laden water for subsequent pumping to the sanitary system or evaporate during the following summer months.

1.5.3.2 Recommended Strategy

Based upon the results of the impact assessment, the water management strategy for the potential development within the Cedar Creek Subwatershed is required to satisfy the following criteria:

1. Control post-development flows to pre-development levels at the outlets from potential development areas, to provide flood protection for downstream properties.
2. Reduce surface runoff volume from potential development areas to maintain pre-development water budget and mitigate erosion impacts to downstream watercourses, including areas with no defined drainage features.
3. Provide stormwater quality control to an enhanced standard of treatment per current Provincial criteria.
4. Manage chloride loadings to runoff, particularly from snowpack during spring freshet.

The Cedar Creek Subwatershed is a unique environment, and as such, the management strategy developed for the potential land use scenarios needs to be specifically tailored to that environment.

The DSA, as well as the remaining portions of Cedar Creek, has a very low density of perennial watercourses, particularly so in the extreme headwaters of the watershed.

Perennial watercourses emerge in groundwater discharge areas, typically found in wetland areas associated with the Roseville Swamp. The perennial watercourses that are present have a strong baseflow component, and infrequently receive overland runoff. This is due to large proportion of both surficial, and subsurface, sand deposits within the watershed, which promotes infiltration (and subsequently groundwater recharge) rather than overland flow. As a result of the strong baseflow component, Cedar Creek watercourses are typically characterized as cold or cool water and are host to cold water species such as brook trout. Groundwater recharge generated within the DSA, and the resultant groundwater flow system, also supports other natural features such as Roseville Swamp, watercourses in adjacent watersheds (i.e. Blair Creek), with only a minor portion of municipal withdrawals reliant on DSA-derived recharge.

Protecting the quantity and quality of the groundwater system is critical to maintaining the ecologic and human function of those features.

1.6 Data Gaps

Based on the Kickoff Meeting with the Township, historically little data has been kept on catchbasin locations or stormwater assets. IBI Group has reached out the K. Smart, GRCA, Region of Waterloo and other sources to attempt to fill the gaps.

Stantec provided the following reports:

- *Hilltop Subdivision, Ayr, Final Stormwater Management Report*, prepared by Stantec Consulting Ltd., dated August 2006 [SWMF3/4]
- Hilltop Stage 3, (Phase 4) and Broos Property (Phase 1), Ayr, Ontario, Stormwater Management Report, prepared by Stantec Consulting Ltd., dated July 13, 2015 [SWMF4]
- *Hilltop Estates Subdivision, Stage 4, Ayr, Stormwater Management Plan*, prepared by Stantec Consulting Ltd., dated September 22, 2017 [SWMF5]

1.7 Problem and Opportunity Statements

The Township has retained IBI Group to develop a SWMMP to define all anticipated works necessary to maintain, expand and improve the existing storm drainage system (including SWM ponds) while protecting the valued natural resources both within and beyond Township limits.

The SWMMP has been prepared in accordance with the Class EA process and is available for public review.

This project presents an opportunity to improve the management of stormwater for both existing and planned development, which is based on changes in land use as outlined in the *Township of North Dumfries Official Plan*, Consolidation Date: November 2018 [AOP] and *Waterloo Regional Official Plan*, Chapter 8 Consolidated New ROP, 2015 [WROP].

An opportunity exists to implement a drainage strategy within the Township to be consistent with the GSP and GRWWMP. While implementing drainage improvements, there will be opportunities to minimize ongoing erosion and sedimentation, phosphorus loadings and changes in water balance which may cause a negative impact on the Grand River watershed. GRCA recommends that potential net change on hydrologic water balance and pollutant loadings to natural watercourses and wetlands be assessed.

1.8 Study Objectives

The primary objective of the study is to lay out a strategy of stormwater management for future development areas and provide guidance on how to best achieve SWM objectives.

Given the high permeability of the underlying soils, one important aspect of that strategy is infiltration. Consequently, it is recommended that future development employ a treatment train approach to stormwater management consistent with the MOE 2003 Stormwater Planning and Design Guide as well as the following documents:

a) Low Impact Development Stormwater Management Planning and Design Guide (TRCA/CVC, 2010 V1.0)

b) Stormwater Management Criteria (CVC, August 2012 V1.0)

c) Stormwater Management Criteria (TRCA, August 2012, V1.0)

d) Drainage Management Manual (MTO, 1997)

The study follows the above documents while maintaining consistency with the current stormwater direction of the Township which promotes infiltration and further establishes parameters for the creation of a Stormwater User fee if desired. This could include incentive programs for the implementation of on-site controls as well as the use of Low Impact Development (LID) stormwater management practices.

The SWM Master Plan includes a detailed assessment of the stormwater sewer (600mm or greater) for capacity for both existing conditions and future conditions resulting from areas of new development, infill and re-development. Further, this includes an overland flow route analysis to determine the areas at risk during a major storm event and make recommendations on how the overland flow route system can be improved. This task will use LIDAR data to develop a surface and identifying areas at risk for severe ponding during design storm events.

The SWM Master Plan reflects and integrates the ongoing Asset Management Plan which includes long-range forecast and planning direction for many of the specific policy items and recommendations (i.e. ponds, OGS and stream rehabilitation).

The SWM Master Plan will consider and create the SWM design standards to be incorporated into a Development Manual as well as considering the cost of maintenance and life cycles costs for SWM approaches. It will also provide direction with respect to existing easements, corridors and access agreements that may require renewals.

Future development requirements: Laying out the SWM criteria applicable to future development, along with design approaches to meet these criteria.

Long term maintenance plans: For SWM assets to be assumed and subsequently maintained by the Town, to lay out in general terms expectations for inspection, operation, and maintenance, along with estimated costs.

Funding: Provide guidance on potential funding sources of said maintenance plans, sufficient for the Township to develop a stormwater user fee if desired.

Flooding: Provide suggestions on mitigating local flooding caused by insufficient stormwater system capacities.

1.9 Purpose of Project File

The Master Plan document will be the key deliverable for the project for the implementation of future works. The document will provide the planning rationale and EA documentation required to proceed with detailed design of the recommended works. The Master Plan is expected to contain, at a minimum:

- Problem/Opportunity statement
- Documentation of all public, agency, and First Nations comments and responses
- Review of best practices and minimum design guidelines

- Rationale for evaluation criteria
- Summary evaluation of alternatives
- Summary of preferred solution prioritization
- Implementation, feasibility and staging recommendations
- Supporting technical memoranda (in appendices), including:
  - Results of field data investigation of stormwater management infrastructure
  - Maintenance program for individual stormwater assets
  - Recommendations for stormwater management policies to be developed by others
- Cost estimates
- SWM Pond Long-Term Maintenance Program
- Recommendations for Township Design Guidelines
- Mitigation measures and commitments
- Enough information to formulate a framework for stormwater user fee, if desired
- Operations and maintenance costs
- Prioritization of works
- Provide a basis for future investigations for the specific Schedule C projects identified within it, i.e. identify everything the Township needs for the first five years after study completion and complete all the site specific work required, including public consultation to meet Municipal Class EA requirements for Schedule A and B projects
- SWM Policy for integration into Development Manual
- Water Resources Monitoring Program.

This draft Master Plan is presented to the Township's staff for review and comment. After receipt of the Township's comments on the Master Plan, the draft will be finalized and delivered to the Township. The Master Plan will be made available for public review at selected Township facilities.

The Master Plan document includes an Executive Summary that provides a clear picture of the recommendations, and a description of how those recommendations were arrived at.

As needed, the final document will be formatted to meet the Township's AODA requirements or policies.

2 Planning Context and the EA Planning Process

The following section lays out the planning context and EA planning process for the SWM-MP Municipal Class EA.

2.1 Public Consultation

Public Information Sessions are provided to allow the public to learn about the project and provide feedback.

2.2 Policy Review

The following summarizes the policy review for the SWM-MP.

2.2.1 A Place to Grow

The Growth Plan for the Greater Golden Horseshoe (GGH) 2019 was prepared and approved under the Places to Grow Act, 2005 to take effect on May 16, 2019.

A Place to Grow Plan, together with the Greenbelt Plan, Oak Ridges Moraine Conservation Plan, and the Niagara Escarpment Plan, builds on the Provincial Policy Statement (PPS) to establish a unique land use planning framework for the GGH that supports the achievement of complete communities, a thriving economy, a clean and healthy environment, and social equity.

The plan provides guidance on the preparation of stormwater management plans. The following summarizes those requirements.

1. Municipalities will develop stormwater master plans or equivalent for serviced settlement areas that:

   a) are informed by watershed planning or equivalent
   b) protect the quality and quantity of water by assessing existing stormwater facilities and systems
   c) characterize existing environmental conditions
   d) examine the cumulative environmental impacts of stormwater from existing and planned development, including an assessment of how extreme weather events will exacerbate these impacts and the identification of appropriate adaptation strategies
   e) incorporate appropriate low impact development and green infrastructure
   f) identify the need for stormwater retrofits, where appropriate
   g) identify the full life cycle costs of the stormwater infrastructure, including maintenance costs, and develop options to pay for these costs over the long-term
   h) include an implementation and maintenance plan.

2. Proposals for large-scale development proceeding by way of a secondary plan, plan of subdivision, vacant land plan of condominium or site plan will be supported by a stormwater management plan or equivalent, that:

   a) is informed by a sub-watershed plan or equivalent
   b) incorporates an integrated treatment approach to minimize stormwater flows and reliance on stormwater ponds, which includes appropriate low impact development and green infrastructure
   c) establishes planning, design, and construction practices to minimize vegetation removal, grading and soil compaction, sediment erosion, and impervious surfaces

d) aligns with the stormwater master plan or equivalent for the settlement area, where applicable

2.2.2 Grand River Conservation Authority O. Reg. 150/06

The Conservation Authorities Act first empowered conservation authorities to make regulations to prohibit filling in floodplains below the highwater mark in 1956. These powers were broadened in 1960 to prohibit or regulate the placing or dumping of fill in defined areas where, in the opinion of the conservation authority, the control of flooding, pollution or the conservation of land may be affected (R.S.O. 1960, c. 62, s. 20 (1)). In 1968, an amendment to the Conservation Authorities Act (Statutes of Ontario, 1968, c. 15) further extended the power of Conservation Authorities to prohibit or control construction and alteration to waterways, in addition to filling.

In 1998, the Conservation Authorities Act was changed as part of the Red Tape Reduction Act (Bill 25), to ensure that regulations under the Act were consistent across the province and complementary with contemporary provincial policies. To better reflect provincial direction and to strengthen protection of public safety and the environment, the Conservation Authorities Act was modified to enable conservation authorities to enact the Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation (Ontario Regulation 97/04) to replace the Fill, Construction and Alteration to Waterways Regulation (R.R.O. 1990, Regulation 149 as amended by Ontario Regulation 142/98). All applications for permission received after May 4, 2006, are processed subject to the provisions of the *Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation*.

Ontario Regulation 97/04 allows conservation authorities to prevent or restrict development in areas where the control of flooding, erosion, dynamic beaches, pollution or the conservation of land may be affected by development, in order to prevent the creation of new hazards or the aggravation of existing ones.

The Minister of Natural Resources approved Ontario Regulation 150/06, for the GRCA, consistent with Ontario Regulation 97/04, on May 4, 2006. This regulation is entitled the Development, Interference with Wetlands and Alteration to Shorelines and Waterways Regulation (hereafter referred to as the Regulation).

Permission from the GRCA is required to develop in river or stream valleys, wetlands, shorelines or hazardous lands; alter a river, creek, stream or watercourse; or interfere with a wetland.

2.2.2.1 Stormwater Management

Section 8.1.14 of the O. Reg. states Stormwater Management Facilities may be permitted within the Riverine Flooding Hazard but outside of the riparian zone or effective flow area, whichever is greater, in accordance with the policies in Sections 7.1.2-7.1.3 - General Policies, provided that there is no feasible alternative site outside the Riverine Flooding Hazard and where it can be demonstrated that:

8.1.1.4

a) there is no loss of flood storage,

b) natural erosion and sedimentation processes within the receiving watercourse are not impacted,

c) where unavoidable, intrusions on significant natural features or hydrologic or ecological functions are minimized and it can be demonstrated that best management practices including site and infrastructure design and appropriate remedial measures will adequately restore and enhance features and functions,

d) facilities are excavated with minimal berming, special policy areas and floodplain flow regimes for a range of rainfall events including the

Regional Storm are maintained, and all excavated material is removed from the Riverine Flooding Hazard,

e) design and maintenance performance requirements as determined by the GRCA for the receiving watercourse are met and the effect of the floodplain flow regime on the intended function of the facility is incorporated into the siting and design.

8.4.15 Stormwater Management Facilities for water quality control will not be permitted within a wetland, but may be permitted in the area of interference where it can be demonstrated that:

a) all structural components and actively managed components of the stormwater management facility including constructed wetlands, are located outside of the wetland,

b) a detailed study demonstrates how the hydrologic and ecological functions of the wetland will be protected, restored and/or enhanced,

c) pollution and sedimentation during construction and post construction are minimized using best management practices including site and facility design, construction controls, and appropriate remedial measures,

d) design and maintenance requirements as determined by the GRCA are met, and

e) works are constructed, repaired or maintained according to accepted engineering principles and approved engineering standards or to the satisfaction of the GRCA, whichever is applicable based on the scale and scope of the project.

2.2.2.2 Special Policy Areas

Various future development areas are in or partially in Special Policy Areas. Based on a review of O. Reg. 150/06 *Special Policy Area* means an area within a community that has historically existed in the floodplain and where site-specific policies, approved by the Ministers of Natural Resources and Forestry, Municipal Affairs and Housing, GRCA and the municipality are intended to provide for the continued viability of existing uses (which are generally on a small scale) and address the significant social and hardships to the community that would result from strict adherence to the provincial policies concerning development. The Province establishes the criteria and procedures for approval.

A Special Policy Area is not intended to allow for new or intensified development if a community has feasible opportunities for development outside the floodplain.

Application of a Special Policy Area permits new development or redevelopment in the flood fringe and floodway where strict adherence to the One-Zone or Two-Zone approach would not provide enough development capability to maintain community viability. Where a Special Policy Area is applied, the municipality, GRCA and the Province of Ontario agree to relax provincial flood proofing and technical standards and accept a higher level of risk.

Special Policy Area application is limited to areas of historic development that qualify based on community and technical criteria. Application of a Special Policy Area requires the approval of the Province of Ontario (Ministry of Municipal Affairs and Housing and Ministry of Natural Resources and Forestry) and suitable policies and standards must be incorporated into the municipality's official plan and zoning regulations. Procedures for approval as specified by the Province must be adhered to.

Policies for Special Policy Areas (excluding allowances) are listed below:

8.1.33 A Special Policy Area (SPA) may be allowed in urban areas where:

a) it can be demonstrated by the municipality through detailed studies and appropriate documentation that the application of a One-Zone Policy or a Two-Zone Policy is not adequate to maintain a community's social and economic viability,

b) the application of a Special Policy Area is supported by the GRCA, the municipality and the Ministry of Natural Resources and Forestry after due consideration of several community-related and technical factors,

c) a higher level of risk is accepted by the municipality, the Province of Ontario (Ministry of Municipal Affairs and Housing and Ministry of Natural Resources and Forestry) and the GRCA,

d) a hydraulic study is undertaken to determine the extent of the floodway and flood fringe, and

e) the municipality incorporates appropriate policies and standards into its official plan and zoning by-laws.

8.1.34 Development within a Special Policy Area may be permitted in accordance with the policies and standards approved by the municipality, Province of Ontario and the GRCA.

Prohibited Uses within the Riverine Flooding Hazard

8.1.35 Notwithstanding Sections 8.1.2-8.1.35, development will not be permitted within the Riverine Flooding Hazard as specified in Section 7.2 - General Policies, or where the use is:

a) a new campground or the expansion of an existing campground,

b) a new parking lot associated with residential uses in a One-Zone Policy Area or the floodway of a Two-Zone or Special Policy Area,

c) underground parking associated with any use in a One-Zone or the floodway of a Two-Zone Policy Area

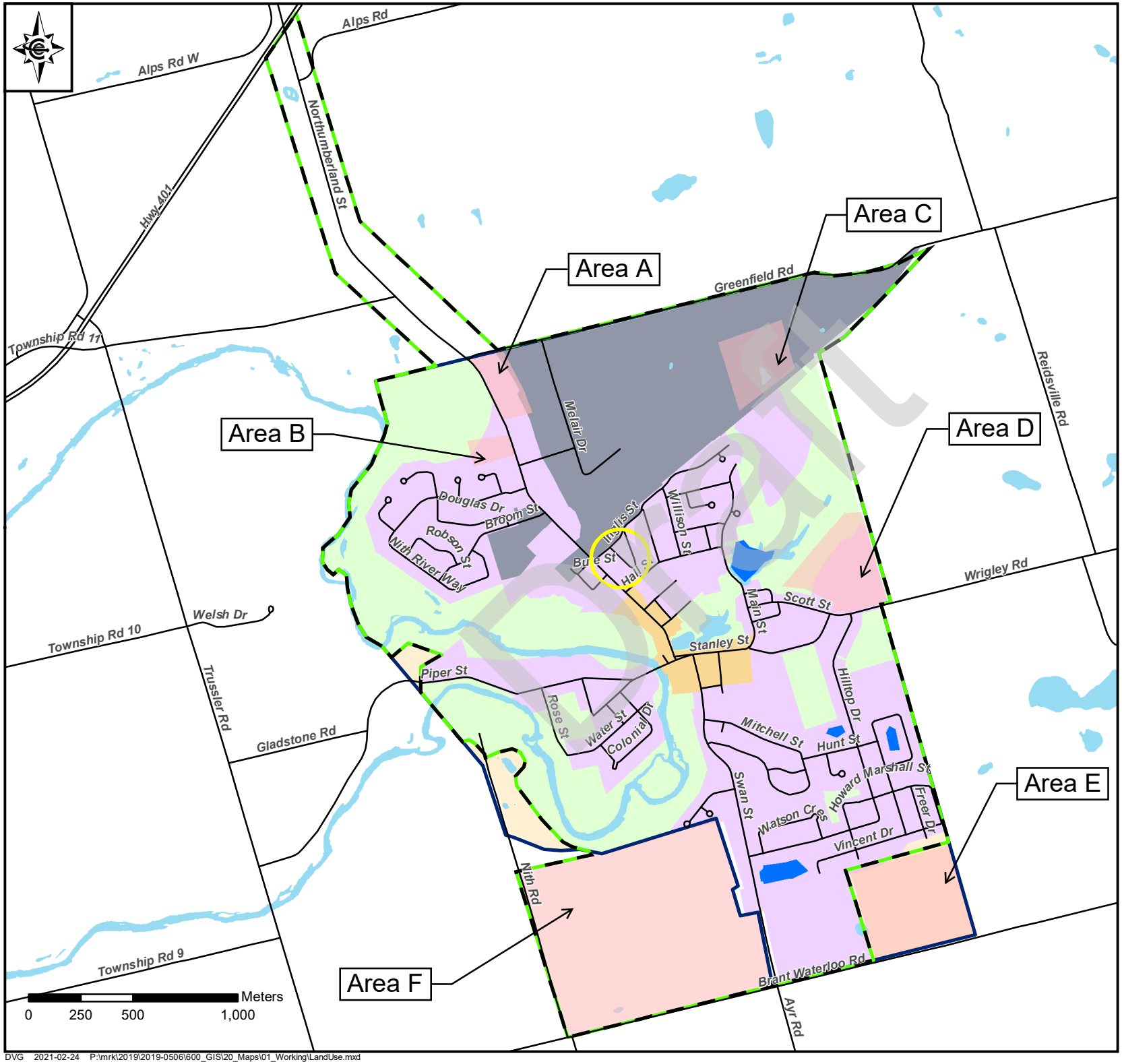
d) a driveway or access way to lands outside of Riverine Flooding Hazard where safe access is not achievable and no alternative access way providing safe access is available, or

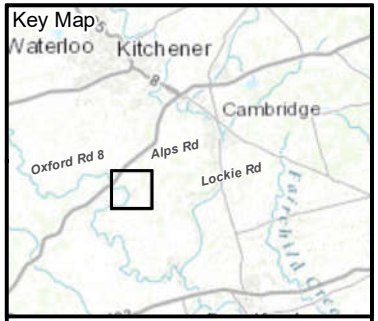
e) flood protection works and bank stabilization works to allow for future/proposed development.

8.1.36 Development, excluding non-habitable accessory buildings or structures associated with an existing use, will not be permitted within 15 metres (49.2 feet) of the either bank of the watercourse except for works permitted under the provisions of Section 9.

The existing areas identified for future development are shown in **Figure 2-1**, below.

The areas which appear to be in within SPAs are Area A, B, C, and E. These will have to adhere to the above policies.





Legend

- Approximate Study Boundary
- Municipal Boundary
- Approximate Future Development
- SWM Facilities
- Watercourse

Landuse Type

- Agricultural
- Urban Growth Centre
- General Industrial
- Open Space
- Urban Residential and Ancillary
- Urban Growth Centre

Figure 2 1

Ayr Township Land Use

Township of North Dumfries Storm Water Management Master Plan

IBI

Project No.:	Date:
2019-0506	January 2022

DVG 2021-02-24 P:\mrk\2019\2019-0506\600_GIS\20_Maps\01_Working\LandUse.mxd

2.2.3 Waterloo Regional Official Plan

The Regional Official Plan (Plan) (published in 2015) is the Regional Municipality of Waterloo's guiding document for directing growth and change for the next 20 years. This Plan represents a fundamental shift in shaping Waterloo Region towards a more balanced community structure, building from a strong, long standing planning policy framework that has supported substantial historical growth and change. The Regional Official Plan is a legal document that contains goals, objectives and policies to manage and direct physical (land use) change and its effects on the cultural, social, economic and natural environment within the regional community. Once approved, the Planning Act requires that all Regional and Area Municipal public works, Area Municipal official plans and land use related by-laws, and all future development must conform to the Regional Official Plan.

2.2.3.1 The Greenlands Network

The Greenlands Network is defined as environmental features and the linkages among them. The Greenlands Network, and the ecological functions it provides, contributes to maintaining the environmental health of Waterloo Region and the Grand River watershed. This Plan contains policies to maintain, enhance or, wherever feasible, restore the Greenlands Network. Such action is necessary to counteract the negative effects of fragmentation which can result in a loss of ecological integrity and the degradation of natural biodiversity. Such action is also necessary to maintain biological and geological diversity, viable populations of native species and ecosystems, and make possible adaptation in response to actual or expected effects of climate change.

This Plan recognizes the importance of wetlands, watercourses, lakes and groundwater to the strength of the Greenland Network. These hydrological features and their associated functions provide a variety of environmental benefits and are fundamental components of the overall ecosystem.

Responsibility for the environment is shared among Federal and Provincial governments, the Region, Area Municipalities, the Grand River Conservation Authority and private landowners. All have an important role in enhancing the natural environment within the region, and all have the responsibility to be good stewards. As a result, establishing a Greenlands Network requires co-operation among agencies, private landholders and the wider community.

This section establishes a policy framework for a co-operative approach to the identification of the environmental features that comprise the Greenlands Network. It also outlines how provincially, and regionally significant features (termed Core Environmental Features) will be maintained, enhanced or, wherever feasible, restored.

The policies in this section also provide direction on how other environmental features (termed Supporting Environmental Features) will be maintained, enhanced or, wherever feasible, restored and encourages the establishment of linkages among elements of the Greenlands Network

Objectives:

1. Maintain, enhance or wherever feasible restore environmental features and the ecological and hydrological functions of the Greenlands Network including the Grand River and its tributaries and the landscape level linkages among environmental features.
2. Use watershed studies, community plans and development applications as opportunities not merely to maintain, but also to enhance and restore the Greenlands Network.
3. Regulate development within hazardous lands and hazardous sites to prevent or minimize hazards to life and property.
4. Develop partnerships, programs and policies to maintain, enhance and restore the ecological functions of the Greenlands Network, including the Grand River and its tributaries.

Where development or site alteration is proposed on lands within or contiguous to an Environmentally Sensitive Landscape, the owner/applicant will be required to submit an Environmental Impact Statement which addresses landscape impacts in addition to any other requirements in accordance with the policies in Section 7.G.

2.2.3.2 Regional Recharge Areas (Environmental Protection)

Regional Recharge Areas designation, which includes portions of the Waterloo Moraine, identifies a large environmental feature where considerable deposits of sand and gravel allow for the infiltration of large quantities of rainfall and snowmelt deep into the ground. This important hydrologic function sustains some of the richest sources of groundwater in the Grand River watershed.

Regional Recharge Areas serve two important functions. From an environmental perspective, groundwater discharge from the shallow aquifers located within Regional Recharge Areas sustains a wide range of aquatic habitats and ecosystems within the Greenlands Network. This groundwater discharge also provides a high percentage of the baseflow to the Grand River, its tributary rivers and cold-water streams and therefore is critical to maintaining the health of the Grand River to the benefit of the region and downstream communities.

The second function of Regional Recharge Areas is to replenish deep underground aquifers that serve as a source for a significant share of the municipal drinking-water supply. Specific polices related to this source water supply function are outlined in the policies in Chapter 8.

Expansions of the Urban Area, Township Urban Areas, Rural Settlement Areas or Rural Employment Areas will not be permitted onto lands designated as Regional Recharge Areas, except as provided for in Policy 7.B.24.

7.B.24 Minor expansions of Rural Settlement Areas located within Regional Recharge Areas may be permitted to facilitate the enlargement of an existing employment, recreational or institutional use subject to the provisions of Policies 6.G.8 and 7.B.25. Such expansions will not be permitted where the lands subject to the expansion proposal are also designated as Environmentally Sensitive Landscape.

7.B.25 Development applications within Regional Recharge Areas on lands already designated for urban development in this Plan, will comply with the following:

(a) Category ‘A’ uses, or an employment land use restricted by Policy 8.A.5, will not be permitted

(b) The development maintains, improves or restores the hydrogeologic and hydrologic functions of Regional Recharge Areas as established through watershed studies, community plans or through further study in accordance with Policy 8.A.4

(c) The development incorporates best management practices, where appropriate, developed in accordance with the provisions of the Regional Implementation Guideline for Source Water Protection Studies

(d) The development is in conformity with all other applicable policies of this Plan.

2.2.3.3 Source Water Protection

Chapter 8 of the Plan contains policies for the protection and conservation of the Region’s drinking-water resources. These policies form an important component of the Region’s Water Resource Protection Strategy and play a critical role in the Region’s multi-barrier approach to providing safe drinking-water. By safeguarding drinking-water at the source, this Plan seeks to prevent unnecessary environmental, economic, social and health costs associated with the loss and/or cleanup of drinking-water resources due to contamination or overuse.

Overall Goal – Protect, maintain and, wherever feasible, enhance surface water and groundwater resources to ensure that a municipal drinking-water supply system continues to provide a sufficient quantity and quality of drinking-water.

Objectives:

1. Protect existing and future sources of drinking-water from incompatible land uses.
2. Maintain and, wherever feasible, enhance the quantity and quality of water infiltration and recharge to groundwater aquifers.
3. Minimize the potential for contamination, including potential contamination from de-icing salts, on sources of municipal drinking water.
4. Promote informed stewardship of Source Water Protection Areas in collaboration with the Province, Area Municipalities and Grand River Conservation Authority.

Source Water Protection Areas

Source Water Protection Areas are identified in this Plan to protect the current and future municipal drinking-water supply system. These protection areas are significant in that they contribute water, or are in close proximity, to municipal drinking-water supply wells and surface water intakes that are vulnerable to contamination and or depletion from incompatible land uses. Source Water Protection Areas consist of: Wellhead Protection Sensitivity Areas; High Microbial Risk Management Zones; Surface Water Intake Protection Zones; and Regional Recharge Areas.

Development applications within all Source Water Protection Area designations will comply with the following:

(a) employment uses that would direct infiltration of stormwater run-off without pre-treatment through the use of drywells or artificial/enhanced recharge will not be permitted; and

(b) employment uses that would require new water taking for industrial/commercial purposes and/or for irrigation purposes, except for water taking associated with mineral aggregate operations will not be permitted.

Source Water Protection Land Use Categories

The quantity and quality of drinking-water is affected by land uses found within Source Water Protection Areas. Not all land uses pose the same level of risk to drinking-water; therefore, this Plan identifies four categories of land uses based on their associated level of risk.

Land uses that may pose a risk to the quantity and/or quality of municipal drinking-water supplies are divided into the following four categories according to the level of risk:

(a) Category ‘A’ (Very High Risk Uses)

(b) Category ‘B’ (High Risk Uses)

(c) Category ‘C’ (Moderate Risk Uses)

(d) Category ‘D’ (represents preferential pathways, or other land uses that involve soil excavation and/or the creation of subsurface facilities, that contribute to the risk to municipal drinking-water supplies by increasing vulnerability).

8.A.9 Land uses typically associated with each of the land use categories identified in Policy 8.A include, but are not limited to, the uses listed in Schedule ‘B’ to this Plan.

Wellhead Protection Areas

This Plan designates Wellhead Protection Areas around each municipal drinking-water supply well. Wellhead Protection Areas are the total area of land which contributes water to a municipal drinking-water supply well. Within each Wellhead Protection Area, one or more Wellhead

Protection Sensitivity Areas (WPSA) may be delineated. The purpose of these designations is to prevent land uses involving hazardous chemicals and/or substances, disease causing organisms and land uses that increase the vulnerability of groundwater from becoming water quantity and/or quality risks to municipal drinking-water supply wells.

Wellhead Protection Sensitivity Areas (WPSA) are classified from 1 to 8. This classification allows for varying degrees of management relative to the vulnerability of the underlying groundwater to contamination, the importance of the well to the capacity of the municipal drinking-water supply systems, as well as the length of time groundwater within the WPSA will take to reach the municipal drinking-water supply well.

Based on Map 4 Source Water Protection Areas, AOP, there are three Municipal Wellheads in Ayr. Ayr is not located in a Regional Recharge Area. The downtown core, including the Urban Growth Centre is within WPSA-4, with the remainder of the northeast portions of Ayr located in WPSA-5. Refer to **Figure 2-2**.

Per the WROP, those areas are defined as:

- WSPA-4: delineates medium sensitivity areas found within the two-year time of travel to a municipal drinking-water supply well; and
- WSPA-5: delineates medium sensitivity areas found outside of the two year, but within the ten-year time of travel to a municipal drinking-water supply well.

Development applications within all Source Water Protection Area designations will comply with the following:

(a) Employment uses that would direct infiltration of stormwater run-off without pre-treatment using drywells or artificial/enhanced recharge will not be permitted

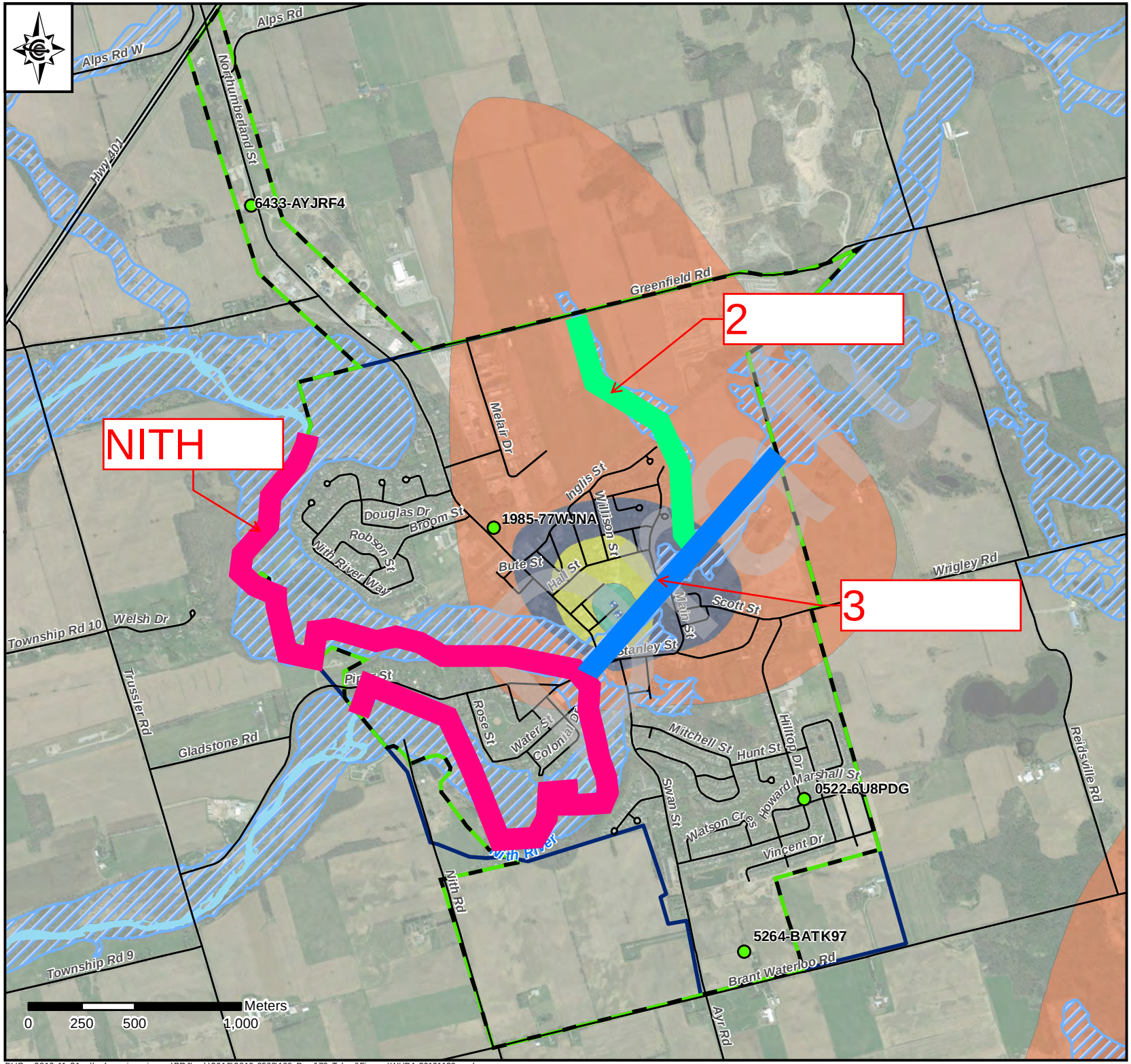
(b) Employment uses that would require new water taking for industrial/commercial purposes and/or for irrigation purposes, except for water taking associated with mineral aggregate operations will not be permitted.

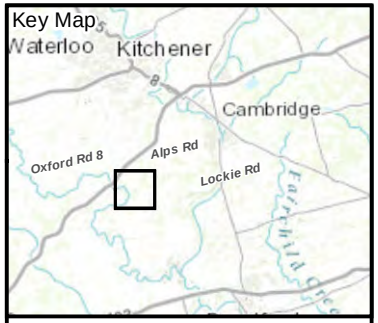
Development applications within the WPSA 4 designation will comply with the following: underground parking garages, individual wastewater treatment systems, private wells, pipelines, sewers, stormwater management ponds (or other ponds) and plans of subdivision or vacant land condominiums may be permitted subject to further study in accordance with Policy 8.A.4.

Development applications within the WPSA 5 designation will comply with the following: Category ‘D’ uses and plans of subdivision or vacant land condominiums may be permitted subject to further study in accordance with Policy 8.A.4.

Based on the foregoing, stormwater infiltration may not be allowed in some areas. SWM most comply with Policy 8.A.4. The studies requested will vary based on the location of the development application relative to the sensitivity of the Source Water Protection Area and its proximity to a municipal drinking-water supply well or surface water intake. Studies submitted by the owner/applicant will demonstrate that the proposed use will not negatively impact the quantity and/or quality of drinking-water resources in Source Water Protection Areas for the development application to receive approval.

Figure 2-2 below, shows the existing locations within the study area as described above.





Legend

- Monitoring Well
- Approximate Study Boundary
- Municipal Boundary
- Watercourse
- Regulatory Floodplain

Wellhead Protection Area

- A
- B
- C
- D
- E

SWM Facility ECA#

Figure 2 2

Wellhead Protection Areas

Township of North Dumfries Storm Water Management Master Plan

IBI

Project No.:	Date:
2019-0506	January 2022

DVG 2019-11-21 \\coleengineering.ca\PRJ\mrk\2019\2019-0506\100_Prpsl\70_Tchncl\Figures\WHPA 20191120.mxd

De-icing Salts

The use of de-icing salts is an important component of Regional and Area Municipal efforts to keep transportation corridors open and safe during icy and snowy conditions.

However, the impact of de-icing salts on the quality of municipal drinking-water supplies has become a concern. This Plan includes policies that encourage a more balanced approach to the use of de-icing salts through sound salt management practices and strategic urban design as methods to reduce the need for de-icing salt application to sidewalks, parking lots and roads.

8.B.1 Applications for a new plan of subdivision, or vacant land condominium, will only be approved where the owner/applicant has submitted a Salt Impact Assessment in accordance with the Regional Salt Impact Assessment Protocol Implementation Guideline to the satisfaction of the Region. This assessment is required to address the potential impacts of de-icing salts of the development on the Region's municipal drinking-water supply wells and to recommend ways to minimize such impacts.

8.B.2 Prior to the approval of any modifications to existing draft approved plans of subdivision, or vacant land condominiums, the Region may require the owner/applicant to submit a Salt Impact Assessment in accordance with Policy 8.B.1, where the scope of the modification would necessitate such an assessment.

8.B.3 The Region may require the owner/applicant to submit and implement Salt Management Plans in accordance with the Regional Salt Management Planning Implementation Guideline to the satisfaction of the Region for the following types of development applications:

(a) plans of subdivision and zoning by-laws proposing new employment land uses and multiple unit residential development

(b) plans of condominium for new development

(c) plans of condominium in previously constructed buildings or

(d) consent to create a lot for a multi-unit residential or employment land use.

2.2.3.4 Regional Guidelines

The primary purpose and benefit of creating a common set of design guidelines and contract specifications is to facilitate the design and construction of municipal services by consultants and contractors that work in more than one municipality.

Storm sewer design are covered in Section B.4 Storm (beginning on page B-24).

All storm sewers shall, as a minimum, be designed to a 5-year storm event, unless otherwise indicated. Rainfall intensity is to be determined using the following equation:

$$I\ (mm/hr) = 1593/(tc+11)^{0.8789}$$

Where tc = time of concentration

For a tc = 10 minutes, the intensity is

$$I\ (mm/hr) = 1593/(10+11)^{0.8789}$$

$$I = 109.7\ mm/hr$$

3 Study Area Characterization

3.1 Natural Environment

Desktop assessments of the natural environment will be completed by terrestrial and aquatic biologists. IBI Group's team includes the following sub-consultants who will be responsible for these reviews:

- **Myler Ecological Consulting**: Mr. Barry Myler is a fisheries specialist who will be primarily responsible for reviewing existing aquatic habitat conditions across the study area and commenting on how these conditions affect stormwater management planning.
- **LGL Limited**: LGL will review the existing terrestrial environment and ecology. LGL's effort will be led by Allison Featherstone. This review will help to identify existing natural areas and natural features that will affect siting opportunities for stormwater facilities, and which could affect requirements for maintaining local hydrologic water budgets.

3.1.1 Terrestrial Environment

A report containing LGL's findings can be found in **Appendix B**. A brief summary is presented below.

The study Area consists of several land use types, including agricultural, urban growth, industrial, residential and open space. Most notably, the Nith River and Cedar Creek, their tributaries and associated riparian habitat fall within the Study Area. There are also areas of wetlands, woodlands and aquatic features.

A site reconnaissance was conducted by LGL on April 24, 2020 to confirm the site conditions visible from public roads. A closer inspection may be required in advance of construction when the development areas are better known, but the description below provides an account of the current site conditions on that date.

Area A is a fallow field with mowed grass. It slopes from Northumberland Road towards the rail tracks. There is a fencerow of mature trees of mixed species between the mowed field and the houses.

Area B is currently under construction for a housing development. It is unclear whether any space will remain for stormwater management, or if this has already been incorporated into the development underway. West of the area, there are mature coniferous trees and then the landscape slopes steeply towards the Nith River.

Area C is not easily visible from the road but appears to be an agricultural field that was most recently used for corn. The area adjacent to the railroad appears to have been filled with some gravel and rock material.

Area D is an aggregate pit that appears to be in the process of reclamation. The entire area is barren soil, with some pooled water in the low points. There are some mature trees between Wrigley Road and the former pit.

Area E is mostly agricultural fields, but there are stockpiles of aggregate material and an old house with associated outbuildings. There is also a small-vegetated area just west of the house. The field to the west of the house was most recently in corn and the field to the east of the house was most recently in wheat, although the crop appears to be older and may not have been planted in 2019. The Charlie Creek is on the south side of Brant-Waterloo Road, flowing to the east.

Area F is a larger area which is made up of a few sections of agricultural land. Most of the fields were most recently in corn production. There is a fencerow of mature trees that splits the fields in a northerly direction and mature trees between the fields and the roads. There is a large house in the eastern field, surrounded by trees. Another old farmhouse is in the western field, where there is a small horse pasture, a small pond surrounded by wetland and a small wetland near Brant-Waterloo Road. Mature trees also line the drive up to the house and around the house and associated outbuildings.

The proposed future residential developments in the Study Area may intersect with several environmental constraints, including wetlands, woodlands, watercourses and habitat for SAR. However, the selection of Future Development Areas have focussed on locations that are mostly outside of these habitat types and where there is existing human disturbance and rotational crop fields. In advance of development of infrastructure, site-specific inventories of these habitats and the habitat of SAR should be conducted to determine if permits are required. A summary of the environmental permits which could be required is provided in Table 2 of the Terrestrial Report.

3.1.2 Aquatic Environment

A report containing Myler's findings can be found in **Appendix B**. The Summary and Conclusions are below:

Fish habitat within the Ayr SWMMP study area includes portions of the warmwater Nith River and the coldwater Cedar Creek. Eden Creek fish habitat is outside of the study area, which includes only a small portion of land that drains towards Eden Creek but no segments of the creek itself.

The GRFMP identifies rural and land use impacts on the Nith River and its tributaries of impaired water quality (nutrients, turbidity, temperature) and sedimentation within streambeds, altered flow conditions due to water-taking and impoundments, and reduced extent of vegetated riparian habitats. Stormwater management can address impaired water quality, sedimentation and flow conditions. Where stormwater facilities and/or their outlets are constructed near watercourses, there may be opportunities to restore naturally vegetated riparian habitat.

Work and activities to create, retrofit, modify or maintain SWM facilities near water within the study area may trigger mitigation measures to protect fish and fish habitat (e.g., seasonal construction timing restrictions combined with appropriate physical measures such as erosion and sedimentation controls) and measures to protect aquatic SAR (i.e., individuals and general habitat of Threatened Black Redhorse and Silver Shiner in compliance with the provincial ESA and the federal SARA).

DFO describes seasonal mitigation measures as follows: "Restricted activity timing windows are applied to protect fish from impacts of works or undertakings in and around water during spawning migrations and other critical life history stages." In Ontario, the timing "windows", or more intuitively "restrictions", are based on fish community life history characteristics and are timed to respect a distinction between fish species that spawn in the spring and those that spawn in the fall. Eggs of spring spawners mature quickly and hatch soon afterward in that same spring or early summer. Eggs of fall spawners, of which the coldwater Brook Trout and the stocked Brown Trout are the only representatives in Ayr, overwinter in the streambed substrates where they are deposited during spawning and do not hatch until the following spring. The specific timing restrictions are applied regionally, to Ontario's Northwest, Northeast and Southern Regions, respectively, and reflect regional climatic and fish community differences. The Southern Region timing restrictions that apply to the watercourses in the Ayr SWMMP study area are:

- Spring spawning timing restriction applies to Nith River (March 15 – July 15).
- All spawning timing restriction applies to Cedar Creek and Eden Creek (October Study Area Characterization.

For SWM works and activities near water and within the general habitat of Threatened SAR Black Redhorse and/or Silver Shiner, the "Aquatic Species" exemption in Section 23.4 of O. Reg.

242/08 may apply if the type and extent of disturbance meets criteria and, if so, will guide the application of appropriate mitigation, monitoring and restoration measures. Otherwise, work and activities near water could require both ESA and SARA permits issued by the provincial Ministry of Environment, Conservation and Parks (MECP) and DFO respectively.

In summary, stormwater management represents an opportunity for local improvements to fish habitat through improved water quality and water quantity and possibly also through localized habitat restoration. Constraints to construction and operation of specific stormwater management facilities will need to be assessed on a site-specific basis that takes into account the watercourse involved and the local characteristics and sensitivities of its fish community and fish habitat.

3.2 Geologic and Hydrogeologic Setting

Stormwater management measures and best practices can be limited by restricting factors such as a shallow groundwater table, soil conditions and natural topography. The geologic and hydrogeologic setting of Ayr is generally conducive to infiltration measures, however natural variations throughout the area warrant more detailed site-level studies to confirm the local applicability of chosen SWM measures.

3.2.1 Topography

Topography varies from between approximately 280m above sea level (masl), in low valleys associated with the Nith River along the western boundary of the Study Area, to topographic highs of approximately 310masl, associated with moraine features to the north and south.

Topography within this area reflects glacial processes that deposited landforms such as channels (spillways), topographic ridges (moraines), and high-relief hummocky topography with closed depressions. Recharge within the subwatershed is relatively high, due to extensive highly permeable sediments, and is amplified in areas with hummocky topography compared to areas covered by relatively flat till plains.

3.2.2 Physiography

The majority of the Ayr lies within the physiographic region known as the Horseshoe Moraines. The Horseshoe Moraines covers much of southern Ontario, west of the Niagara Escarpment and include the Paris-Galt Moraines, a physiographic feature well known for its significance as a groundwater recharge area. Precipitation falling on the Moraine is rapidly transmitted through the overburden to the underlying water table, where it recharges deeper groundwater aquifers and/or discharges to the many creeks and wetlands located on the flanks of the moraine.

Portions of the northern half of the Study Area are spanned by the Waterloo Hills physiographic region. The Waterloo Hills are characterized by sand till ridges or kame moraines, with outwash sand in intervening low lying areas (Chapman and Putnam, 1984).

Available mapping from the Ontario Geological Survey shows the physiography of Ayr are the result of a series of glacial spillway channels, with till moraines present covering portions of the southern half of the Town, and scattered pockets of kame moraines in the adjacent landscape.

3.2.3 Soils

Soils can be generalized to be coarse-grained across much of the Study Area. While varied, soils generally consist of loams, sandy loams and organic muck and marl. The soil types are classified based on their physical soil characteristics.

Gravelly loam and sandy loam soils characterize much of the yet undeveloped northern half of the Ayr. Towards the southern extent of the Study Area, soils progress increasing towards various loams, including large pockets of Dumfries Loam and Mannheim Loam. The soils around Ayr suggest that infiltration measures are applicable and can be successful for managing

stormwater in much of the area. However, detailed site-level studies in the southwest portion of the Study area should confirm the applicability of infiltration as a stormwater management measure.

Soils are presented visually in **Figure 3-1**.

3.2.4 Geology

Surficial Geology

Surficial geology underlying Ayr consists primarily of gravelly and sandy glaciofluvial deposits, overlain along the Nith River by modern alluvium. These underlying areas are of high permeability and should be carefully managed for groundwater recharge.

Till units that are present within the Study Area include the Port Stanley Till and Wentworth Till.

The Wentworth Till is described predominantly as a sandy silt to silty sand till and displays variable thickness, with its thickest portion found within the Paris Moraine of the Horseshoe Moraine physiographic element. The sandy silt till results typically results in modest infiltration rates; however, recharge rates are enhanced, due to the hummocky topography and closed depressions common in the Horseshoe Moraine physiographic region.

The Port Stanley Till is a stoney sandy silt till with low pasticity that is commonly considered the basal till unit. Recent work by the OGS (2017) suggest that the Port Stanley Till is prevalent along the southern portion of the Study Area. This till is texturally similar to the Wentworth Till although it may have a greater total carbonate content. Similar to the Wentworth Till, the sandy silt till of the Port Stanley Till results in lower infiltration rates than the surrounding spillway deposits and may act as a confining unit along the south portion of the Study Area.

The mapped surficial geology is included in **Figure 3-2**.

Bedrock Geology

Bedrock underlying Ayr consists of Upper Silurian sedimentary rocks, which dip to the southwest. Bedrock Geology of Southern Ontario mapping indicates the upper bedrock across the Study Area is the Salina Formation, a grey-brown coloured, argillaceous dolostone and dolomitic shale, with beds and nodules of gypsum. At depth, the Salina Formation is underlain by beds of salt.

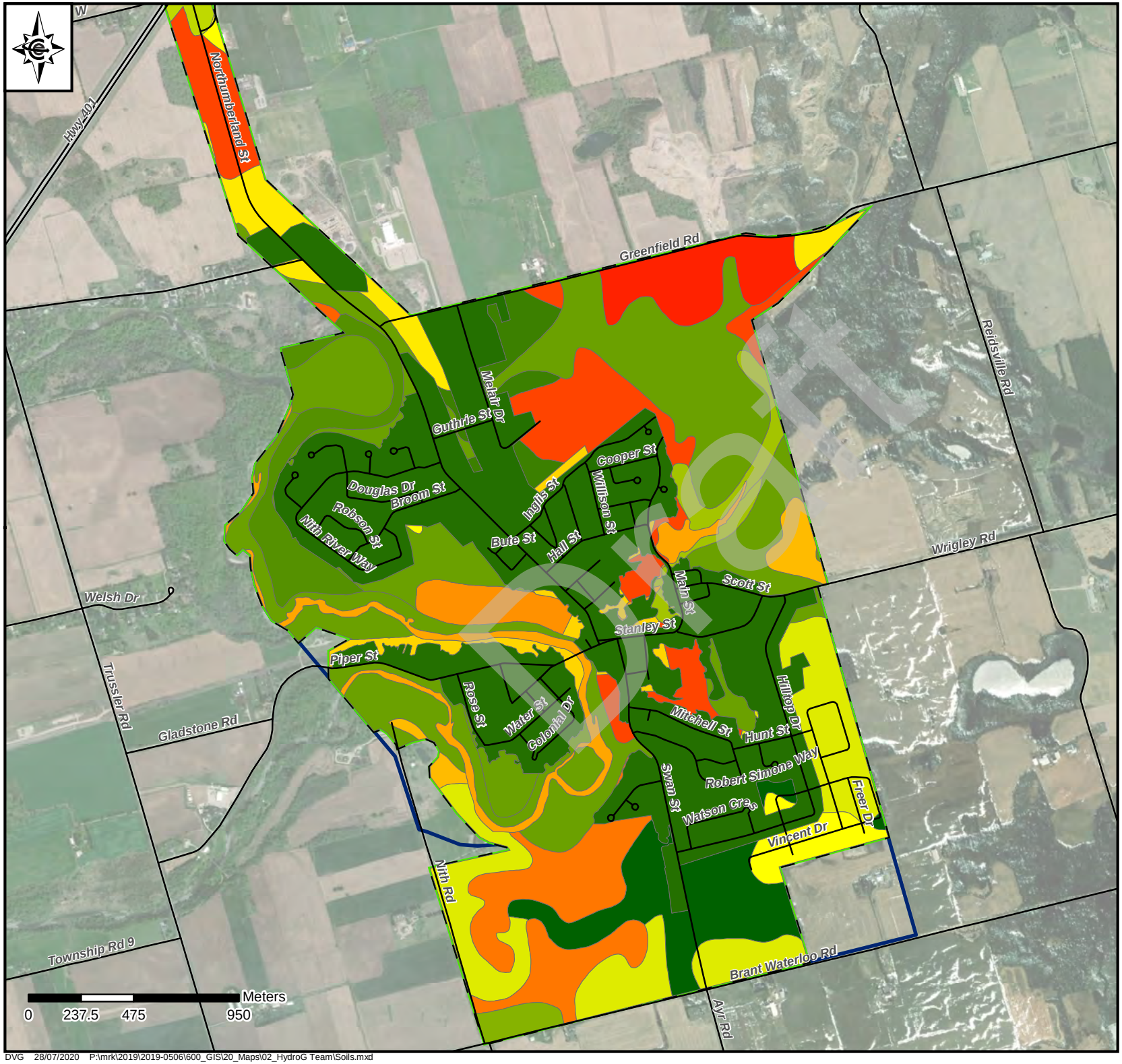
Karst features are formed from the dissolution of soluble rocks such as limestone, dolomite, and gypsum. It is characterized by underground drainage systems with sinkholes, caves, and disappearing streams and springs. Although Ayr is not recognized to lie in an area of mapped karstic bedrock features, Salina Formation dolostones are a candidate for possible dissolution over time. Areas of potential karst have been mapped by the OGS, associated with the neighboring Guelph Formation, approximately 4 km east of Ayr.

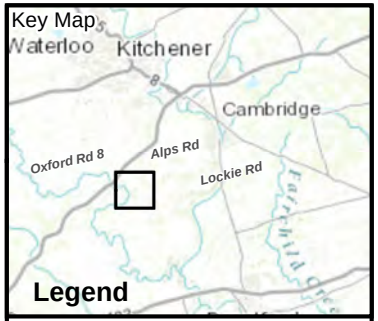
Depth to bedrock near the Study Area has been mapped to be between approximately 17 metres below ground surface (mbgs) to 75mbgs.

3.2.5 Hydrogeology

The Salina Formation has been identified as one of the highest water-yielding hydrogeologic units within the bedrock of southern Ontario. Though generally yielding hard to very hard fresh water, with higher natural concentrations total iron and sulphate, a consequence of the presence of gypsum and other evaporites, very low natural concentrations of sodium and chloride result in very good to excellent water quality throughout the Formation (Singer, Cheng and Scafe, 2003). Development and the subsequent increased application of road salts should be carefully managed within the Study Area, in accordance with municipal and Regional Official Plan policies, to ensure the long-term sustainability of the Formation’s groundwater quality.

FIGURE 3-1 Soils





Legend

SOIL_NAME1

- AYR SANDY LOAM
- BUILT UP
- BURFORD GRAVELLY LOAM
- CALEDON SANDY LOAM
- DISTURBED LAND
- DUMFRIES LOAM
- FOX SANDY LOAM
- GRAVEL PIT
- HAYSVILLE SANDY LOAM
- KIRKLAND SANDY LOAM
- LISBON SANDY LOAM
- MANNHEIM LOAM
- MARTIN SAND AND
- ORGANIC SOIL - >36" DEEP
- ST. JACOBS LOAM
- TUSCOLA LOAM
- URBAN
- WATER - RIVER
- WATERLOO FINE SANDY LOAM
- Approximate Study Boundary
- Municipal Boundary

Figure 3 1

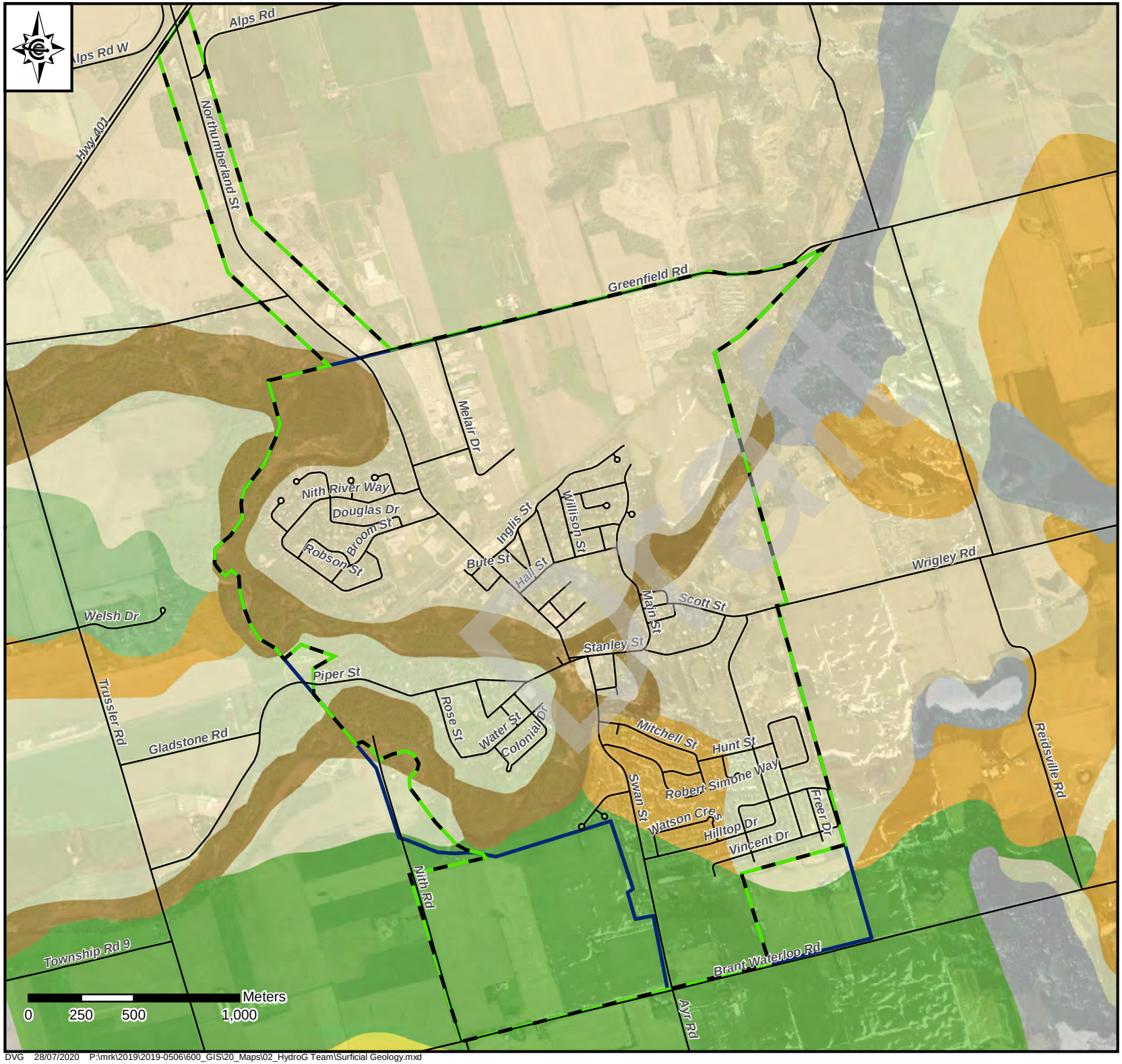
Ayr Township Soils Map

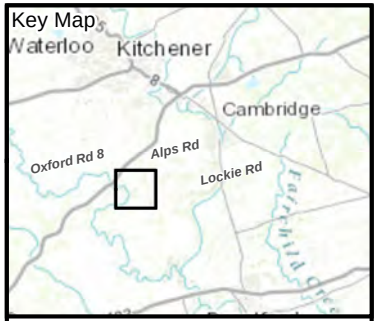
Township of North Dumfries
Storm Water Management
Master Plan

IBI

Project No.:	Date:
2019-0506	January 2022

DVG 28/07/2020 P:\mrk\2019\2019-0506\600_GIS\20_Maps\02_HydroG Team\Soils.mxd





Legend

- Approximate Study Boundary
- Municipal Boundary

Surficial Geology

- 5b: Till (sandy silt to sily sand)
- 5d Till (clay to silt)
- 6: Ice-contact stratified deposits
- 7a: Glaciofluvial deposits (sandy)
- 7b: Glaciofluvial deposits (gravelly)
- 9: Coarse-textured galciolacustrine deposits
- 19: Modern alluvial deposits
- 20: Organic deposits

Figure 3 2

Ayr Township Surficial Geology Map

Township of North Dumfries Storm Water Management Master Plan

IBI

Project No.:	Date:
2019-0506	January 2022

DVG 28/07/2020 P:\mrk\2019\2019-0506\600_GIS\20_Maps\02_HydroG Team\Surficial Geology.mxd

Groundwater in the area is used for a number of purposes including municipal and domestic water supply, agricultural and industrial use. Shallow groundwater typically flows from areas of topographic highs to topographic lows (the Nith River). Other common discharge areas include creeks, streams, ponds and wetlands. Throughout much of Ayr, shallow groundwater flow generally flows west or southwest.

Based on available well records, the majority of shallow groundwater levels through the Study Area range between 2.6 mbgs and 10 mbgs.

A depth to groundwater map is included as **Figure 3-3**.

3.3 Watercourses/Waterbodies

3.3.1 Watercourses

The following watercourses exist within the Study Area.

Nith River: The Nith River drains the western part of the Grand River watershed in Waterloo Region as well as Brant and Oxford counties. In the northern part of the river, water runs off the land quickly so flows can rise and fall quickly. Demand for water is high in the southern part of the river where farm irrigation is common.

Cedar Creek: The Region of Waterloo and Grand River Conservation Authority (GRCA) have completed a study of the Cedar Creek subwatershed - partially located in the City of Kitchener and the Township of North Dumfries. This study is intended to guide and coordinate decision making by the Region, area municipalities, the GRCA and others involved in development planning, subwatershed stewardship and restoration.

Eden Creek: The RFP notes “potential urbanization of lands framing the Northumberland Street corridor, extending from Greenfield Road to Highway No. 401”. Some of these lands drain to Eden Creek which has been mapped as cold water. A subwatershed study has not been completed for Eden Creek.

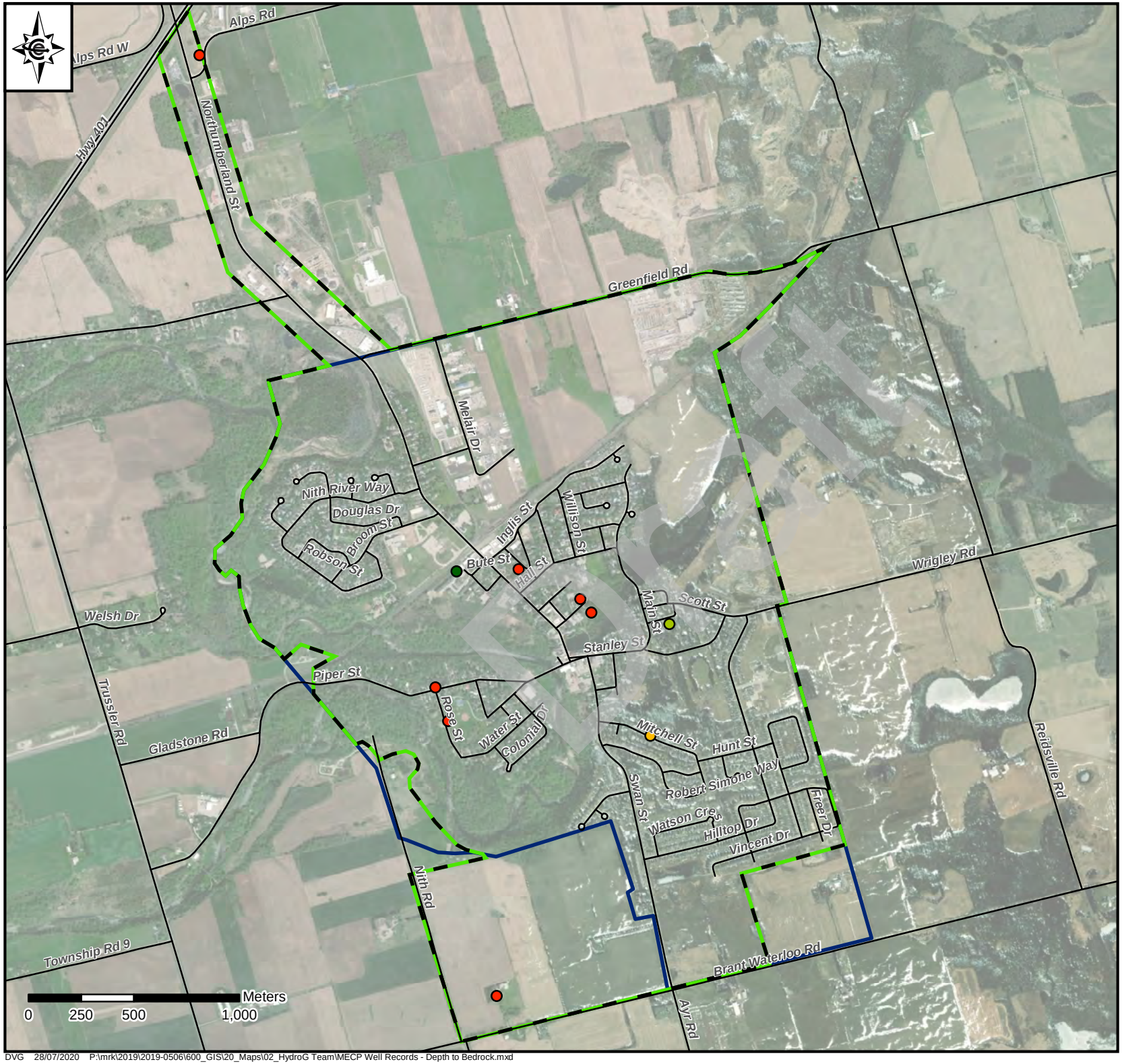
GRCA maintains a flow gauge on the Nith River at Ayr (see **Figure 3-4**).

The **Table 3.1** identifies the critical flows in the Nith River at Ayr.

Table 3.1 Critical Flows in Nith River at Ayr

FLOW (M^3/S)	SIGNIFICANCE
2.6	Normal summer flow
110	Water at banks; low-lying areas flooded
142	Water on parking lots behind Northumberland St.
Up to 200	Warning Zone 1
226	Water at rear doors behind Northumberland St.
200-300	Warning Zone 2
300-400	Warning Zone 3
400-600	Warning Zone 4
600-800	Warning Zone 5

Source: https://apps.grandriver.ca/waterdata/kiwischarts/rf_nithriver.aspx



Legend

- Approximate Study Boundary
- Municipal Boundary

MWs - Depth to Bedrock (mbg)

- < 3
- 16.8
- 31.4
- > 50

Figure 3 3

Ayr Township Depth to Groundwater Map

Township of North Dumfries Storm Water Management Master Plan

IBI

Project No.:	Date:
2019-0506	January 2022

DVG 28/07/2020 P:\mrk\2019\2019-0506\600_GIS\20_Maps\02_HydroG Team\MECP Well Records - Depth to Bedrock.mxd

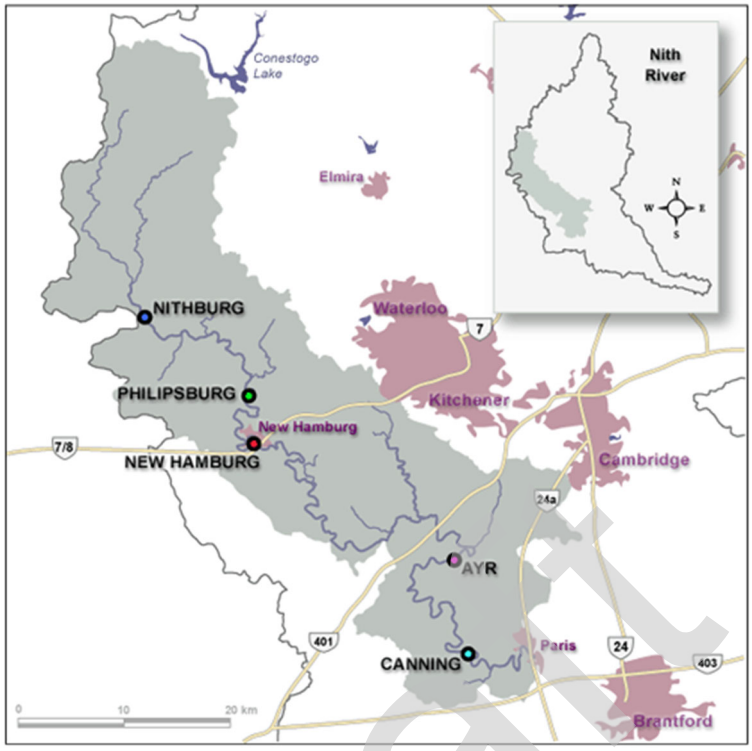


Figure 3-4 Location of Flow Gauges in the Nith River

3.3.2 Wetlands

The need for site visits with GRCA staff at detailed design will depend on the potential for direct impacts on regulated wetland features and the need to verify wetland boundaries. On-site delineation and verification of wetland boundaries at detailed design will be required.

The GRCA's wetland mapping layer should be reviewed in conjunction with the evaluated and unevaluated wetland layer maintained by the Province.

There is at least one minor wetland mapping discrepancy west of Northumberland Street and south of the RR Tracks. A site visit during the appropriate time of year may be needed to confirm the limits of this wetland. It also appears that a stormwater outlet/outfall has been constructed recently on the north edge of this wetland. It would be helpful to identify any wetlands that have been or could potentially be altered in any way for stormwater management purposes. Wetlands that are now considered to be part of the Township's stormwater management infrastructure should be identified as part of this EA.

The MNRF has mapped one unevaluated wetland, east of Swan Street and south of Hilltop Drive. This small wetland is not currently mapped by the GRCA but is considered a regulated wetland. Depending on the outcome of the EA, a site visit during the appropriate time of year may be needed to confirm the presence or absence of this wetland.

3.3.3 GRCA Context

In addition to the floodplains in the Village of Ayr, there are other areas within the study area that are regulated by the GRCA under Ontario Regulation 150/06. The study area is traversed by the Nith River and Cedar Creek and their associated floodplains and areas of steep valley/erosion hazard slopes. Other smaller tributaries of the Nith River are also located within the study area. Further, there are both Provincially Significant Wetlands and other wetlands and their regulated

allowances within the study area. Any future development/site alteration within these regulated areas would require the prior issuance of a GRCA permit pursuant to Ontario Regulation 150/06.

The GRCA owns several properties within the study area. The Reinhart, Rear, and Ayr Floodplain properties are 3 of the GRCA's larger landholdings within the study area. Jedburgh and Watson Ponds are part of the GRCA's Upper Mill Pond Property. The GRCA also owns and operates the dam structure on Jedburgh Pond. As such, GRCA property staff may have further comments as the study progresses.

3.4 Municipal Infrastructure

3.4.1 Inventory of Stormwater Management Facilities (SWMFs)

The existing SWMFs in the Township were inventoried by IBI Group as part of this study. The following **Table 3.2** provides information about each of the existing SWMFs, while **Figure 3-5** shows the locations.

There are two (2) oil and grit separator (OGS) systems located on Northumberland St, which are both privately owned. These were installed in 2007 and 2018, identified as SMWF #2 and SWMF #1, respectively. SWMF #2 discharges to the Nith River while SWMF #1 discharges to a low-lying area and ultimately a wetland. For the Porter OGS, the manufacturer recommended cleanout when the 3rd chamber starts to fill up. It is usually a minimum requirement that an OGS is cleaned every couple of years.

Of the six (6) ponds listed in **Table 3.2**, SWMF #3/4/5 have been built in the last 15 year and are currently privately owned. Based on their respective ECA (refer to **Appendix C**), the design criteria are as follows:

- SWMF #3 – Enhanced Level of quality and quantity control of 2mm to Regional Storm events (including 100-year) post development flows to predevelopment flows
- SWMF #4 – Enhanced Level of quality and quantity control of 2mm to Regional Storm events (including 100-year) post development flows to predevelopment flows
- SWMF #5 – Enhanced Level water quality protection and erosion control, and to attenuate port-development peak flows to pre-development peak flow for all storm events up to and including the 100-year storm event, discharging to Nith River

Only SWMF# 3 was inspected and appeared in good condition. These three (3) ponds will be assumed by the Township.

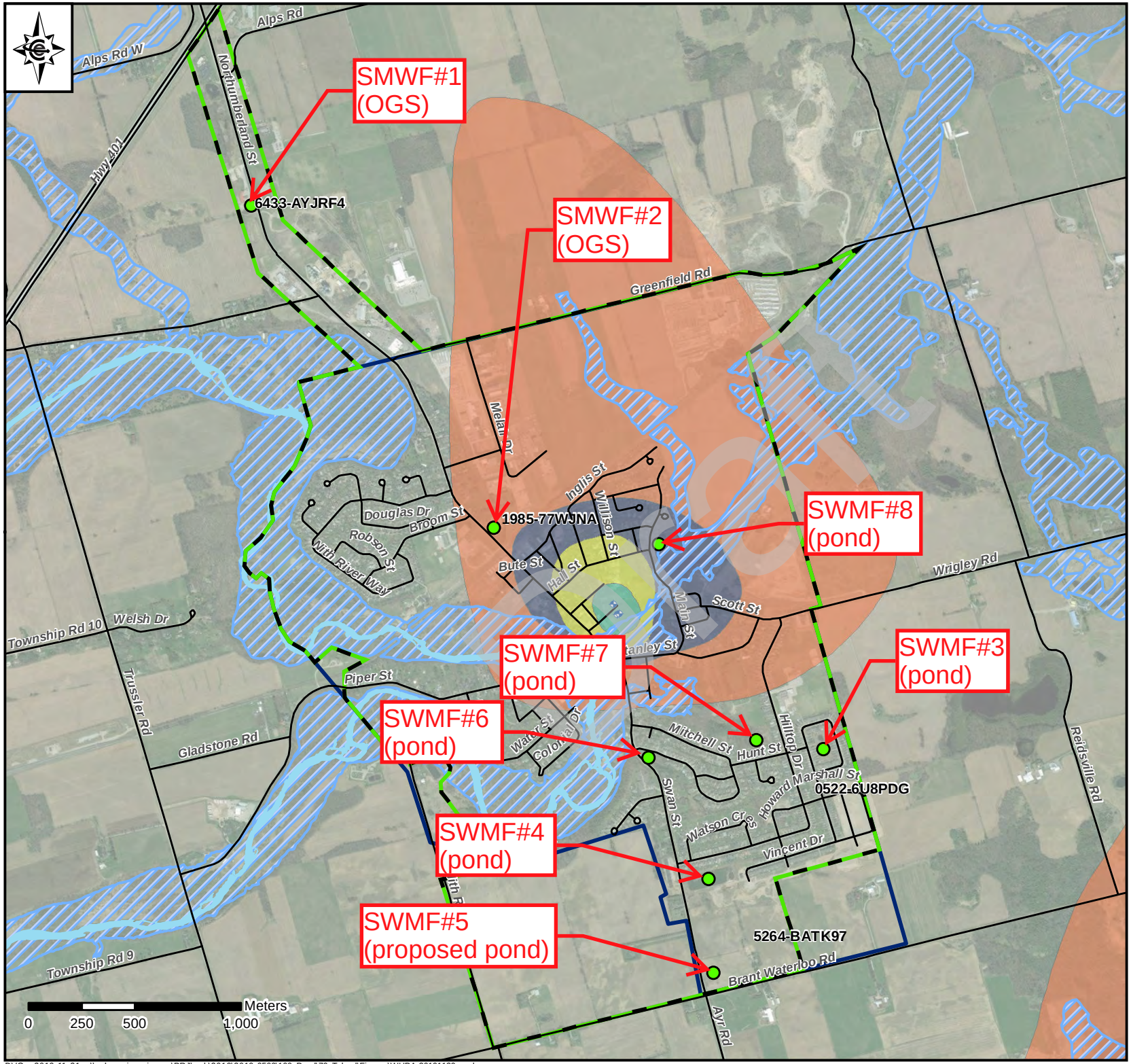
SWMF #6/7/8 are older ponds now assumed by the Township. There are similarities with these ponds as they do not appear to have been maintained much over their lifetime. All three (3) of these ponds have dense vegetation which appears to be growing wild.

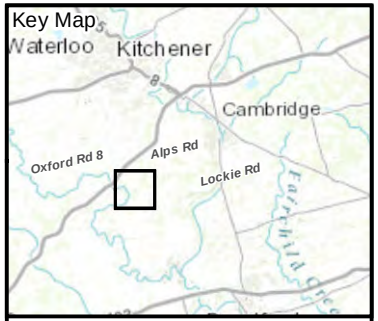
- SWMF #6 is an on-line pond which had a low flow channel running through it at the time of inspection. It appears to provide attenuation before being discharged through a long culvert and into the Nith River.
- SWMF #7 is a dry-pond which had no water in it at the time of inspection. There is mild sediment accumulation at outlet.
- SWMF #8 is a dry-pond which had no water in it at the time of inspection. There is mild sediment accumulation at outlet.
- Jedburgh and Watson Ponds are part of the GRCA's Upper Mill Pond Property.

Further details of the inspections along with inlet/outlet conditions of these ponds can be found in **Section 4.5.**

Table 3.2 Existing SWMF Information

SWM FACILITY ID	OGS OR POND	ECA, ISSUE DATE	LOCATION	OWNER/OPERATOR	TARGET VOLUMES / ID UNIT DESIGNATION
SWMF#1	OGS	6433-AYjRF4 June 6, 2018	1202 Northumberland Street	Grand Castle Corp. 18 Adelaide St Maxville PO Box 100 North Glengarry, ON K0C 1T0	Porter's 4090 Litres, three chamber, pre-cast concrete inceptor
SWMF#2	OGS	1985-77WJNA October 23, 2007	Northumberland Street Reconstruction, 173 to 1107 Northumberland Street, Waterloo City Owned by Region of Waterloo	The Regional Municipality of Waterloo 150Frederick St 6th Floor Kitchener, ON N2G 4J3	sediment capacity of 26945 litres; oil capacity of 3930 litres; a total holding capacity of 31285 litres and a maximum treatment flow rate of 70 litres per second
SWMF#3 Hilltop Community SWMF A	Pond	0522-6U8PDG November 15, 2006	Hilltop Subdivision, Stage 3 Lot 33/34, Concession 7 North Dumfries Township Inside Robert Simone Way (all four sides)	828543 Ontario Inc. 1919 Albian Rd Toronto, ON M9Q 6J9	- 8.6ha - a constructed wetland located on Block 106, east of Marten Crescent, complete with a forebay with approximately 1,042cu.m. in permanent, 447cu.m. of extended detention and a total storage volume of 9,324cu.m., complete with, - one (1) 110mm and one (1) 400mm diameter vertical orifices located in a 1500mm diameter perforated riser to discharge into a 600mm diameter outlet pipe to drain into Municipal storm drainage manhole MH61 on Hunt Street, - a 2.4m. wide by 2.0m deep, 300m long infiltration gallery around the periphery of the wetland complete with 300mm diameter perforated pipe and 20mm to 50mm diameter clear stone, - a 4m wide by 150mm deep overflow spillway, protected with rip-rap to discharge stormwater flow west onto the Hilltop Drive, in case of blockage of all outlets during severe storms, - 1.0m deep, varying width, approximately 465m long infiltration galleries located at the backyard of the residential area as shown on drawings, complete with 150mm diameter perforated pipe and 20mm to 50mm diameter clear stone,
SWMF#4 Hilltop Community SWMF B	Pond	0522-6U8PDG November 15, 2006	Hilltop Subdivision, Stage 3 Lot 33/34, Concession 7 North Dumfries Township	828543 Ontario Inc. 1919 Albian Rd Toronto, ON M9Q 6J9	- 38.72 ha - a constructed wetland located on Blocks 39 and 33, located at east of Swan Street, complete with two forebays with approximately 4,840cu.m. in permanent, 6,800cu.m. of extended detention and a total storage volume of 74,541cu.m., complete with, - one (1) 195mm and one (1) 250mm diameter vertical orifices located in a 1800mm diameter perforated riser to discharge into a 525mm diameter outlet pipe to drain into the existing Valleyview Stormwater Management Facility ultimately discharging to the Nith River, - one (1) 10m wide 750mm deep trapezoidal overflow spillway to discharge to Swan Street side ditch to Nith River,
SWMF#4 Hilltop Community SWMF B	Pond	4689-A8ZLNZ June 29, 2016 Amendment to ECA 0522-6U8PDG	Broos Property Phase 1 Lot 32 and 33, Concession 7 Township of North Dumpfries, County of Wellington	2081788 Ontario Corporation 2 Prince Edward Rd Woodstock, ON M4V 1G7	Expansion of Storm Water Management Works to service Hilltop Community Subdivision and Broos Property for enhanced level of quality and quantity control of 25 millimetres to Regional Storm events (including 100-year) post development flows to pre-development flow rates consisting of the following: Proposed Works Facility 'B' (catchment area of 29.8 hectares (interim) 30.3 hectares (ultimate) of development and 39.1 hectares (interim), 30.8 hectares (ultimate) external undeveloped area): a constructed wetland located on Blocks 39 and 77, located at east of Swan Street, complete with two (2) forebays with approximately 3055 cubic metres in permanent, 4926 cubic metres (interim) and 2763 cubic metres (ultimate) of extended detention and a total storage volume of 76118 cubic metres (interim) and 60216 cubic metres (ultimate), complete with: one (1) 195 millimetre, one (1) 250 millimetre, one (1) 450 millimetre diameter vertical orifices located in a 1800 millimetre diameter perforated riser to discharge into a 525 millimetre diameter outlet pipe to drain into the existing Valleyview Stormwater Management Facility ultimately discharging to the Nith River, one (1) 10 metre wide 500 millimetre deep trapezoidal overflow spillway to discharge to Swan Street side ditch to Nith River, 0.7 metre deep, 1.5 metre wide, approximately 445 metre long infiltration gallery located along the lots 1-28, complete with 150 millimetre diameter perforated pipe and 50 millimetre diameter clear stone, 0.7 metre deep, 1.5 metre wide, approximately 172.7 metre long infiltration gallery located along the rear yards of blocks 32-46, complete with 150 millimetre diameter perforated pipe and 50 millimetre diameter clear stone; 0.7 metre deep, 1.5 metre wide, approximately 172.7 metre long infiltration gallery located along the rear yards of blocks 47-58 and 78-85, complete with 150 millimetre diameter perforated pipe and 50 millimetre diameter clear stone;
SWMF#5 Legacy Estates Subdivision SWMF	Pond	5264-BATK97 May 2, 2019	Legacy Estates Subdivision (Previously Hilltop Estate Subdivision Stage 4) 895 Brant-Waterloo Rd Township of North Dumfries, Regional Municipality of Waterloo, Ontario N0B 1E0	839658 Ontario Inc. 1919 Albion Road Toronto, ON M9W 5S8	Establishment of stormwater management works to serve the proposed Legacy Estates Subdivision development, located at 895 Brant-Waterloo Rd, in the Township of North Dumfries, Regional Municipality of Waterloo, for the collection, transmission, treatment and disposal of stormwater runoff from a total catchment area of 25.4 hectares, to provide Enhanced Level water quality protection and erosion control, and to attenuate post-development peak flows to pre-development peak flows for all storm events up to and including the 100-year storm event, discharging to Nith River. Facility consisting of the following: stormwater management facility (catchment area 25.4 hectares): one (1) constructed wetland with a 1.5 metre deep sediment forebay, located immediately adjacent to the intersection of Swan Street and Brant-Waterloo Road, having a permanent storage volume of approximately 2,035 cubic metres, an extended detention volume of approximately 1,016 cubic metres, and a total active storage volume of approximately 19,775 cubic metres at an active storage depth of 2.0 metres (elevation 296.0 metres), complete with one (1) inlet structure at the northwest corner, consisting of a 1200 millimetre storm inlet pipe and a concrete headwall, one (1) 20.0 metre wide emergency overflow weir, one (1) 3.0 meter wide access road, and one (1) outlet structure at the southwest corner, consisting of a 1,200 millimetre diameter perforated CSP riser, a 150 millimetre diameter orifice and a 600 millimetre outlet pipe, discharging to the Mitchell Drain via the orifice and a cooling trench along the perimeter of the constructed wetland during low flows and the outlet pipe/orifice during higher flows, allowing a maximum discharge of 0.81 cubic metres per second under the 100-year storm event to the Mitchell Drain;
SWMF#6 Valley View SWMF	Pond	Unknown	Intersection of Swan Street and Mitchell Street	Ayr	Directly upstream of the Mitchell Drain.
SWMF#7 Hilltop Estates Phase 1 SWMF	Pond	Unknown	Northwest of Hunt Street and Hilltop Drive	Ayr	Large dry pond capturing water from surrounding rear lots. Outlet is corrugated vertical perforated pipe in the direction of Nith River. Vegetation is overgrown and very dense is some places. The concrete inlet with flow dispersion blocks presumable receives stormwater from Hunt Street. There is erosional scarring directly downstream of the invert.
SWMF#8	Pond	Unknown	Northeast of Main St and Hall St	Ayr	Dry pond provides some flood and erosion control with inputs from Main Street CBs. Likely outlets to Jedburgh Pond through hickenbottom device.





Legend

- Monitoring Well
- Approximate Study Boundary
- Municipal Boundary
- Watercourse
- Regulatory Floodplain

Wellhead Protection Area

- A
- B
- C
- D
- E

- SWM Facility

Figure 3 5

SWM Facilities Locations

Township of North Dumfries Storm Water Management Master Plan

IBI

Project No.:	Date:
2019-0506	January 2022

DVG 2019-11-21 \\coleengineering.ca\PRJ\mrk\2019\2019-0506\100_Prpsl\70_Tchncl\Figures\WHPA 20191120.mxd

3.4.2 Catch Basins/Roadside Ditches

Typically, to assess the existing capacity of a municipal storm drainage system, IBI Group would develop a hydrologic model using PCSWMM or Rational Method. Given that no storm sewer documentation is available, and, instead, local drainage is handled by pervious catchbasins, this approach is not feasible.

However, the following tasks could be completed:

- Overland flow pathways and conduits will be developed based on review and processing of the available LiDAR dataset obtained from Region of Waterloo.
- Inlet capture capacities will be based on available information sources such as MTO's Drainage Manual; supplemented by field reconnaissance by IBI Group staff to confirm the catchbasin grate types currently in place.
- Surface runoff catchment areas draining onto roadways or into specific inlets will be delineated within the available mapping and LiDAR information, with catchment imperviousness based on available land-use mapping supplemented by sampling of selected representative areas using the available aerial photography.

The critical limitation on outflow from the catchbasin is the percolation rate of the underlying soils. Sandy soils tend to have high percolation rates while clay soils have the lowest. The hydraulic properties of the soil determine how well it will drain, however as runoff carries particulates into the catchbasin, this can further impede the flow. Once the soil reaches saturation and the catchbasin exceeds capacity, local flooding can occur.

For comparison, for a Single OPSD 400.01, 400.03 CB, the inlet capacity at 0.30m depth is $0.2m^3/s$; for a double, $0.4m^3/s$. The typical interior dimensions of a single CB is 600mm x 600mm = $0.36m^2$. Utilizing an infiltration rate of 210mm/hr (0.21m/hr), which is typically associated with well-draining sand, yields a maximum infiltration rate of:

$$0.21m/hr \div 3600\ s/hr = 6x10^{-5}m/s.$$
$$6x10^{-5}m/s \times 0.36m^2 = 0.000021m^3/s = 0.021\ l/s.$$

Consequently, IBI Group would recommend that infiltration systems be explored to provide sufficient storage to allow for drawdown of the design storm over 24-48 hours.

Five (5) areas were identified by the Township as having issues with flooding. See **Appendix D** for maps showing these locations.

3.5 Summary of Future Development Areas and Constraints

The following **Table 3.3** summarizes the existing condition of the Future Development Areas.

Table 3.3 Summary of Future Development Areas

DEVELOPMENT AREA	TERRESTRIAL HABITAT	SWM POND/OUTLET FEASIBLE?	SPECIAL POLICY AREA?	OTHER CONSTRAINTS
A	fallow field with mowed grass. It slopes from Northumberland Road towards the rail tracks. There is a fencerow of mature trees of mixed species between the mowed field and the houses.	Could either be sent to Northumberland St. sewer system, if available. Also an option to discharge to oxbow lake of Nith River west of Northumberland St.	SPA 2.7.11	

Table 3.3 Summary of Future Development Areas

DEVELOPMENT AREA	TERRESTRIAL HABITAT	SWM POND/OUTLET FEASIBLE?	SPECIAL POLICY AREA?	OTHER CONSTRAINTS
B	currently under construction for a housing development. It is unclear whether any space will remain for stormwater management, or if this has already been incorporated into the development underway. West of the area, there are mature coniferous trees and then the landscape slopes steeply towards the Nith River	Potential to discharge at oxbow lake of Nith River directly north of development area.	SPA 2.7.9	
C	not easily visible from the road but appears to be an agricultural field that was most recently used for corn. The area adjacent to the railroad appears to have been filled with some gravel and rock material.	There could be space for a pond or other infiltration measures.	SPA 2.7.7	
D	an aggregate pit that appears to be in the process of reclamation. The entire area is barren soil, with some pooled water in the low points. There are some mature trees between Wrigley Road and the former pit.	Potential to discharge into Cedar Creek.		
E	mostly agricultural fields, but there are stockpiles of aggregate material and an old house with associated outbuildings. There is also a small vegetated area just west of the house. The field to the west of the house was most recently in corn and the field to the east of the house was most recently in wheat, although the crop appears to be older and may not have been planted in 2019. The Charlie Creek is on the south side of Brant-Waterloo Road, flowing to the east.	There could be space for a pond or other infiltration measures. Potential outlet to Charlie Creek to the east.	SPA 2.7.9	
F	larger area which is made up of a few sections of agricultural land. Most of the fields were most recently in corn production. There is a fencerow of mature trees that splits the fields in a northerly direction and mature trees between the fields and the roads. There is a large house in the eastern field, surrounded by trees. Another old farmhouse is in the western field, where there is a small horse pasture, a small pond surrounded by wetland and a small wetland near Brant-Waterloo Road. Mature trees also line the drive up to the house and around the house and associated outbuildings.	Nith River is directly north of the development area.		

4 Analysis and Assessment of SWM System

4.1 Land Use Changes

A description of existing land use can be found in **Section 3**. It is anticipated that low to medium density residential development will occur in the future development areas.

4.2 Phosphorus Loading

The GRCA doesn't have a tool for assessing pre and post development TP. GRCA recommends using well-established modeling tools in conjunction with a robust monitoring program to identify changes from pre-development conditions. A detailed assessment of future development is beyond the scope of this document, but IBI Group recommends that detailed assessments be carried out during the detailed design phase.

At present, GRCA does not have specific, approved phosphorus loading coefficients. In our sample analysis, we have utilized average values from the NVCA P Tool, Appendix A, Table 6 Phosphorus (P) Export for Nottawasaga River Subwatersheds Derived from CANWET Modeled Phosphorus Loads and Land Use Areas (refer to **Appendix E**). GRCA should be contacted to determine applicable targets, etc.

At detailed design, pre- and post-development P loadings should be calculated using a similar method, along with the required Best Management Practices (BMPs) to meet GRCA targets. In the example, a zero net increase in P loadings target has been assumed for illustrative purposes.

For example, for a 10ha hay/pasture redeveloped into a High Intensity Residential use, the existing P load is 1.15kg/year, while unmitigated post development P load is 13.2kg/year. Therefore, BMPs are required to removed 13.20 – 1.15 = 12.05kg/year of P.

In the sample calculations provided, three BMPs in series (bioretention system, infiltration system, and a wet pond) provide for 12.01kg/year, leaving 1.19kg/year total P loading. Additional measures, or potentially higher removal rates than assumed could achieve the balance.

4.3 Water Budget

4.3.1 Site Water Balance

A water balance provides for an accounting of water transfers across a defined system's boundaries over a defined time period. Any difference between the inflows to the system and the outflows from the system during this time period must be balanced by a change of storage within the system. In designing infiltration targets for a defined area, the approach is modified through the introduction of mitigation measures, best practices or Low Impact Development tools to maintain align inputs and outputs to pre-development levels.

4.3.1.1 General

Natural consequences of urban development include a reduction in groundwater infiltration, diversion of this infiltration towards surface water bodies as runoff, altered flow regimes and channel erosion. Infiltrating rainwater also plays an important role in the protection of surface water and groundwater quality, as the percolation through soil pores acts as a natural filter to contaminants. An increased volume of runoff impacts erosion potential of receiving streams and an increased contaminant load to surface water bodies are common hydrologic consequences in the urban water cycle.

Development within the identified settlement areas in Ayr will organically increase the impervious cover across the Community. Impervious cover consists of pavements in the form of roadways,

sidewalks, driveways and parking lots, as well as building rooftops. For the purposes of the SWMMP, impervious cover has been assumed to be 75% in a post-development scenario in all of the settlement areas.

4.3.1.2 Background

Ayr is a Community that is bisected by two (2) distinct physiological settings. Much of the southern half of the municipal and Study Area boundaries lie on finer-grained till moraines, while the northern half of the Community lies with coarse-grained sediments deposited by glacial spillways. Due to the distinct differences in the resulting surficial geology, stormwater management considerations should be adjusted to best suit the area.

An underlying soils map can be found in **Figure 3-1**.

4.3.1.3 Methodology

A site scale water balance analysis for each area was completed following the Thornthwaite and Mather water balance method outlined in *Chapter 3* of the Ministry of Environment's ("MOE"s) *Stormwater Management Planning and Design Manual* (MOE, 2003). The water balance method estimates evapotranspiration, infiltration, and runoff volumes based on soil type, vegetation cover, topography, and precipitation.

The Roseville station (ID# 6147188) is the closest meteorological station to the Site. Therefore, the climate normal data from this station in the most recent year with complete data, 2018, and the 30-year climate normal data between 1981 and 2010 were obtained from Environment Canada and used in the water balance analysis.

The 2018 data was compared with the climate normal data from this station between 1981 and 2010 and the differences were minor. An 8 degree average daily temperature and 904.9mm of total annual precipitation in 2018 compared with a 7.3 degree average daily temperature and 918.8mm of total annual precipitation using the 30-year climate normal. The 2018 data was selected to better represent the effects of climate change moving forward.

The monthly mean temperature and monthly precipitation data were used in the Thornthwaite and Mather Equation to estimate the monthly potential evapotranspiration. The estimated monthly potential evapotranspiration was adjusted using a daylight correction value to account for varying length of daylight throughout the year.

The precipitation surplus (amount of water available to infiltrate or runoff) was estimated by calculating the difference of the yearly precipitation and potential evapotranspiration. Infiltration was estimated by multiplying a set of infiltration factors (dependent on the topography, soil type and land cover) to the estimated precipitation surplus.

Impervious percentages for the pre-development and post-development scenarios were estimated by measuring the total impervious areas (including surface parking, concrete surfaces, walkways and road surfaces) across the Site. The estimations of pre-development pervious area are based on readily available aerial photographs and mapping, while the post-development pervious area has been assumed and held constant at 25%. The water balance will need to be refined at individual site-level when site plan designs are available. In the post-development scenario, evapotranspiration has been assumed to be 20% of precipitation.

The infiltration factor for each area was selected from Table 3.1 in the MOE's *Stormwater Management Planning and Design Manual* (MOE, 2003) based on the summation of various factors (topography, soil type and land cover).

4.3.1.4 Results Summary

A summary of the key water balance elements for each area is presented in **Table 4.1** through **Table 4.6** below.

A reduction in infiltration is observed in all scenarios in the post-development scenario, resulting in significant increased runoff to the Nith River and other surrounding surface water bodies. Based on the calculations, the largest impact is observed in Area C with the smallest anticipated impact occurring in Area B.

Area A

Table 4.1 Area A – Water Balance

ELEMENT (M^3/YEAR)	PRE-DEVELOPMENT (M^3/YEAR)	POST-DEVELOPMENT (M^3/YEAR)	CHANGE (M^3/YEAR)	CHANGE (%)
Precipitation	37,553	37,553	-	-
Evapotranspiration	20,801	11,548	-9,253	-44.5
Infiltration	11,383	2,779	-8,604	-75.6
Runoff	5,369	23,227	17,857	332.6

Area B

Table 4.2 Area B – Water Balance

ELEMENT (M^3/YEAR)	PRE-DEVELOPMENT (M^3/YEAR)	POST-DEVELOPMENT (M^3/YEAR)	CHANGE (M^3/YEAR)	CHANGE (%)
Precipitation	14,338	14,338	-	-
Evapotranspiration	6,986	4,113	-2,873	-41.1
Infiltration	3,550	1,314	-2,236	-63.0
Runoff	3,852	8,961	5,110	132.7

Area C

Table 4.3 Area C – Water Balance

ELEMENT (M^3/YEAR)	PRE-DEVELOPMENT (M^3/YEAR)	POST-DEVELOPMENT (M^3/YEAR)	CHANGE (M^3/YEAR)	CHANGE (%)
Precipitation	84,156	84,156	-	-
Evapotranspiration	46,065	25,879	-20,186	-43.8
Infiltration	26,891	6,227	-20,664	-76.8
Runoff	8,414	52,050	43,636	518.6

Area D

Table 4.4 Area D – Water Balance

ELEMENT (M^3/YEAR)	PRE-DEVELOPMENT (M^3/YEAR)	POST-DEVELOPMENT (M^3/YEAR)	CHANGE (M^3/YEAR)	CHANGE (%)
Precipitation	120,985	120,985	-	-
Evapotranspiration	68,778	36,437	-32,341	-47.0
Infiltration	36,433	8,229	-28,204	-77.4
Runoff	15,124	74,648	59,524	393.6

Area E

Table 4.5 Area E – Water Balance

ELEMENT (M^3/YEAR)	PRE-DEVELOPMENT (M^3/YEAR)	POST-DEVELOPMENT (M^3/YEAR)	CHANGE (M^3/YEAR)	CHANGE (%)
Precipitation	210,118	210,118	-	-
Evapotranspiration	127,053	63,281	-63,772	-50.2
Infiltration	35,302	9,760	-25,542	-72.4
Runoff	47,762	137,077	89,315	187.0

Area F

Table 4.6 Area F – Water Balance

ELEMENT (M^3/YEAR)	PRE-DEVELOPMENT (M^3/YEAR)	POST-DEVELOPMENT (M^3/YEAR)	CHANGE (M^3/YEAR)	CHANGE (%)
Precipitation	752,243	752,243	-	-
Evapotranspiration	454,864	226,552	-228,311	-50.2
Infiltration	89,214	33,455	-55,759	-62.5
Runoff	208,166	492,236	284,070	136.5

The detailed inputs and calculations for each area are included as part of **Appendix F**.

4.3.1.5 Infiltration Deficit Summary

Based on the results of the water balance exercises presented above, the following targets should be met at site-level with regards to future development within each area:

COMMUNITY	AREA (HA)	INFILTRATION DEFICIT (M^3/YEAR)
Area A	4.15	8,604
Area B	1.59	2,236
Area C	9.30	20,664
Area D	13.37	28,204
Area E	23.22	25,542
Area F	83.13	33,455

Based on the analysis, a general increase in runoff will occur during the post-development condition with a reduction in infiltration. These areas will require the implementation of BMPs in an integrated treatment approach to mitigate the loss of infiltration from the proposed changes in land use. It should be noted that specific mitigation measures are to be confirmed on a site-specific basis at the functional design stage.

4.3.2 Natural Features Water Balance

GRCA recommends that potential net change on hydrologic water balance and pollutant loadings to natural features such as watercourses and wetlands be assessed. Similar to the Community of Ayr itself, parts of the Grand River watershed require 100% infiltration and others are entirely underlain with clay soils with limited to negligible infiltration.

A priority for GRCA is to identify the hydrologic nature of its natural features and how each feature is supported by the hydrologic cycle, that is whether it is supported through infiltration and groundwater-fed or a runoff depression. A stormwater management solution that works backward from this is often the preferred approach for GRCA, with the goal to ultimately maintain the existing function of the natural feature in a post-development scenario.

A detailed water balance is outside of the scope of this SWM Master Plan, however detailed assessments should be made at site-level as part of the development process for all identified natural features that may be impacted by development, as determined through an Environmental Impact Study. At minimum, an existing conditions monitoring program should be completed at a monthly resolution to understand the natural hydrologic inputs and outputs for each feature.

In consultation with GRCA, individual watercourse and wetland goals and targets should be established, consistent with other targets and objectives determined through watershed studies, subwatershed studies and other relevant studies.

The effectiveness of a SWM Facilities is measured against the criteria that it was designed to achieve. Regular maintenance is also necessary to provide continued effectiveness throughout its lifetime. A SWMF which will have the greatest chance of maintaining successful levels of effectiveness when the design has accounted for climate change. This section discusses the effects of climate change and investigates areas of concern.

4.4 Climate Change

Climate change refers to the long-term trend in the change of the world's weather patterns, including changes in average temperature and rainfall distribution. Stormwater runoff is intrinsically a function of rainfall, therefore change in the intensity, duration, and frequency of rainfall events has an impact on runoff, and the response of stormwater systems. Aquatic habitat health is also linked to temperature. The impacts of unmitigated climate change on storm infrastructure will be assessed.

For this Study, Station G6140954 (in the Grand River Region) was used as a basis for comparison, then modified the existing Ayr IDF curves by applying the percent change in rainfall intensities used in Sta G6140954. These were used to develop updated IDF curves for the 5-year and 100-year return periods for future conditions. Then, the effects of climate change on conveyance systems were assessed by comparing future rainfall intensities to existing, specifically, comparing the 5-year intensities with an inlet time of 10 minutes, as these are representative of minor system conveyance structure requirements.

The potential effects of climate change on rainfall intensity-duration-frequency (IDF) statistics across southern Ontario have been explored by various researchers. The MECP has created the Ontario Climate Change Data Portal (http://ontarioccdp.ca/) that provides project changes in air temperature statistics and rainfall IDF curves for a set of 25km x 25km map grid squares that cover the Province. This provides a valuable resource of information that can be used to assess the potential impacts of increased frequency or intensity of heavy rainfall within and around Ayr. The future IDF curves were extracted from the OCCDP and applied using the Modified Rational Method. One issue is what change might be expected in the magnitude of the 100-year rain event and resulting impact on local flooding issues and stormwater system capacity.

Based on the Final MTO Report, Station G6140954 (Brantford) the IDF curves (Figure A9 and Figure A10 in **Appendix G**) are for the two periods 1961-1980 and 1981-2000 respectively. It appears from the results in Table A1 and Table A2 (in **Appendix G**) that for the same duration and return periods, the precipitation intensity has increased from the 1961-1980 to the 1981-2000 time period.

A comparison of the 24-hour duration precipitation at the station G6140954 is shown in **Table 4.7**, below, and Figure 5 (in **Appendix G**) for the two time periods 1961-1980 and 1981-2000. The

4.7% increase in the 2-year precipitation and the 20.1 % increase in the 100-year precipitation between the two periods show how the intensity of observed precipitation increased in the recent years.

Table 4.7 Observed 24-Hour Precipitation (mm) Comparison for 1961-1980 and 1981-2000 at Station G6140954

RETURN PERIOD (YEARS)	2	5	10	20	50	100
1961-1980	50.7	62.1	69.7	77.0	86.4	93.5
1981-2000	53.0	68.9	79.4	89.5	102.5	112.3
Change	4.7	10.9	13.9	16.2	18.6	20.1

Source: Final MTO Report

In this case, only the meteorological station G6140954 (Brantford) is used. By applying the rational method and the Manning equation, the changes in the estimated pipe diameter as compared with the current pipe diameter (see MTO report Figure 23 in **Appendix G**). Table 16 (in **Appendix G**) summarizes the changes (in percentage) in the pipe diameter by 2050s and 2080s as compared to current design standards. It appears that for the commonly used 10-year drainage system, the pipe diameter should be increased by about 9% and 14.5% by 2050s and 2080s respectively in order to maintain the present level of operational capability. In comparison to the Ayr analysis using the existing IDF curve, a similar increase in pipe diameter was found relative to future years of 2050 and 2080. This is an important consideration when replacing old, or installing new, conveyance systems.

Table 4.8 shows an example comparison of current pipe sizes with what is needed for future pipes to convey the anticipated flows of 2050 and 2080.

Table 4.8 Comparison of Pipe Size with Future Flows

EXAMPLE CURRENT PIPE DIAMETER (MM)	2050 PIPE DIAMETER (MM)	2080 PIPE DIAMETER (MM)
450	500	525

The anticipated increase in rainfall due to climate change also means a greater probability that flooding will occur in areas with outdated drainage systems. One example of an area that has already experienced flooding is at Newel St and Willison St. An analysis of the drainage area found it to be 8.4 acres. A general rule is that there should be 1 catch basin (CB) per acre of drainage. There are currently 4 CBs in the area which means there is less than half the CBs generally required for a drainage area of this size.

The photograph below in **Figure 4-1**, taken by a local resident, shows the intersection completely inundated after a storm in August of 2016.

4.5 Erosion Areas of Concern and Recommendations

The RFP set out clear requirements about identifying existing erosion sites (by creek reach). This will feed into evaluating level of risk to public health and safety and environment, and alternatives for restoration. Refer to **Appendix H** for Erosion Inventory and Assessment information.

4.5.1 By Creek Reach

As per the RFP, this task consists of identifying erosion sites (by creek reach), evaluate risk to public health and safety and environment, identify alternatives for restoration, and provide estimates of associated costs. Identify priority erosion sites along Township watercourses which may pose a risk to public health and safety and environment and develop a restoration plan to address the erosion sites.

Figure 4-1 Photograph of Flood Event from August 25, 2016

Figure 4-2 Photograph of Erosional Scour at Inlet of SWMF #7

4.5.2 By Pond Outlet

During IBI Group's site walks, a few areas of erosion concern were noted. One of the most significant was the inlet to SWMF #7 where scouring has dug out a plunge pool as water enters the pond. As time goes on, the erosional scarring is only expected to worsen.

The outlet at SWMF#6 also shows some signs of deteriorating, particularly at the invert. It also does not have a proper headwall as shown in the image below.

Figure 4-3 Photograph of Erosional Scour at Inlet of SWMF #6

4.5.3 Inlet Erosion

Another common issue is around CBs where sediment is being carried into the grate.

Figure 4-4 Photograph of Catch Basin Surrounded by Loose Sediment, at Thompson St and Inglis St.

The CB below is likely experiencing blockages as water can enter through an open hole in the size along with any debris.

Figure 4-5 Photograph of Drain Connection Near East Corner of Arena Parking Lot off Church St.

5 Examination of Stormwater Retrofit Opportunities

5.1 General

Through inspections by IBI Group, it was found that 2 ponds could be considered for retrofit opportunities. These are identified as SWMF #7 and #8 in **Figure 3-5, Section 3.4.1**. From their appearance, it is assumed that these ponds have had little to no maintenance since their construction. They appear to be quantity control only ponds and could, in theory, be retrofitted to provide quality control.

5.2 Examination of Existing Retrofit Strategy

At this time, the Township does not have an existing retrofit strategy. A retrofit strategy is recommended as more SWMF are assumed.

5.3 Retrofit Strategy Development

Further investigation is needed to improve retrofit strategy development. Potential strategies could include:

- Surveys and ‘reverse engineering’ of Ponds 7 and 8 to determine retrofit opportunities to provide quality control
- Replacement or repairs to pond features such as inlets and outlets
- Adding a permanent pool/forebay to increase effluent quality
- Changing capacity of existing pond to correspond to changes in drainage area

6 SWM Maintenance Program

6.1 Introduction

A main component of the Project included an assessment of the Township's current stormwater infrastructure. This assessment required a visual inspection of stormwater ponds. The objective of this stage was to produce all necessary field data to be used in subsequent stages of the project.

Using data gathered from the background review and field investigations, the needs of each stormwater management facility were assessed. Obvious maintenance requirements such as deteriorated structures, eroded slopes or outlets and adverse sediment accumulation were determined and reported below.

6.2 Background

The Township is currently responsible for the operation and management of the following assumed ponds: SWMF #6, SWMF #7, and SWMF #8. Several future ponds will also be assumed by the Township over the next 20 years.

6.3 Function and Maintenance of SWMFs

SWMFs have been introduced to mitigate the impacts of urban runoff from existing and new development areas.

Depending on their design, SWMFs can provide:

- Flood protection
- Water quality treatment
- Erosion control
- Base flow augmentation
- Infiltration
- Spill management
- Aesthetics
- Buffer between urbanized areas and/or natural areas

The following sections describe the basic functions, along with related maintenance activities, that can keep SWMFs operating as intended.

6.4 Results

6.4.1 Inventory

For an inventory of all SWMF, see **Section 3.4.1**.

6.4.2 Inspections

All field work was completed by IBI Group staff. Access requirements (keys, arranging field meetings with Township staff, etc.) were arranged Township staff. Once each pond was accessed, a visual inspection of the general condition of the pond, access roads, vegetation, overland flow routes, inlet/outlet headwalls was performed.

The facilities condition were documented using the field forms as well as dated digital photographs. Digital geo-referenced photos were also be taken of the periphery land use and general facility layout for inclusion into the SWM facility database. The initial conditions

assessment includes a condition rating of all assets as documented during the field inspection and confirmed by our Project Engineer and Project Manager.

Inspection information was stored after each inspection of the facility. This data includes the inspector, condition of the component, comments by the inspector, date of inspection, condition ranking and photo.

Components assessed include:

- General facility appearance
- Inlet and outlet structures
- Low flow channels
- Emergency overland spillway
- Vegetation
- Access road and walkways
- Perimeter fencing
- Any unusual situations within the facility such as the presence of erosion, unsafe conditions, nuisance issues, encroachments, poor water quality, etc.
- Sediment accumulation
- Public safety.

The condition ranking system is the basis for the maintenance assessment of the facilities and components. A condition ranking between 1 and 6 was given, where:

1 = Excellent (the component has no deterioration)

2 = Satisfactory (some wear is noticed, but does not affect the functionality of the component)

3 = Attention Required (the component is still functioning but has minor problems that may prevent the component from functioning properly during extreme events – some simple upkeep is required)

4 = Non-Functional (the component is no longer functioning as designed)

5 = Non-functional and deterioration, but not causing a safety hazard

6 = Safety Hazard (the component presents a safety hazard either because it allows access to restricted areas, e.g. a grate on a pipe is not secure, or the component is structurally unsound e.g. erosion of the access road).

6.4.2.1 Frequency of Inspection

A typical SWMF will require more attention in the first few years of operation, with inspections being more frequent. In general, visual inspections should take place, particularly after heavy rainfalls (>10mm) in the first 2 years and a minimum of 4 times per year (seasonally) thereafter. Long term observation should take place every 10 years as needed.

6.4.2.2 Checklist

A sample checklist is provided in **Appendix I**. This checklist can be filled out each visit with a copy provided to the Owner for ongoing record keeping.

6.4.2.3 Inspection of SWMF Features

Based on the checklist referenced above, general information about the pond are recorded. A visual inspection of water levels and quality, followed by a thorough inspection of inlet and outlets.

The condition of the structures noted in terms of severity, as well as if a grate is secure and if any seepage is evident. The inspection continues with a look at outlet swales or emergency overflow if applicable. A visual inspection of vegetation is reported followed by overall conditions of the pond including features such as access roads, fences, gates etc. Any presence of beaver dams, fish, and waterfowl are also noted. Pictures of all pond features should also be included with the inspection. This always maintenance practices/schedules to be updated and adjusted as needed. The following **Table 6.1** shows results of the inspections in a Pond Evaluation Matrix using the ranking system described in **Section 6.4.2**.

Table 6.1 SWMF Conditions Evaluation Matrix

CRITERIA	SWMF #3 RANKING	SWMF #4 RANKING	SWMF #5 RANKING	SWMF #6 RANKING	SWMF #7 RANKING	SWMF #8 RANKING
General facility appearance	2	N/A	N/A	1	2	2
Inlet and outlet structures	3	N/A	N/A	1	3	2
Low flow channels	1	N/A	N/A	1	N/A	N/A
Emergency overland spillway	N/A	N/A	N/A	1	N/A	2
Vegetation	2	N/A	N/A	2	2	2
Access road and walkway	N/A	N/A	N/A	3	N/A	N/A
Perimeter fencing	N/A	N/A	N/A	N/A	2	2
Unusual situations within the facility such as presence of erosion, unsafe conditions, nuisance issues, encroachments, poor water quality, etc.	3	N/A	N/A	1	2	2
Sediment accumulation	2	N/A	N/A	1	2	2
Public safety	2	N/A	N/A	3	2	2
Total	15	n/a	n/a	14	15	16

The scoring system evaluates each pond with the lower score indicative of fewer issues. For example, SWMF#6 had the lowest score, but still requires some maintenance around the access / walkway. The N/A (ie Not Applicable) signifies that the criteria was not observed in the inspection or does not exist. Inspections have yet to be made on SWMF #4 and #5.

6.5 Sediment Removal Process

Although SWMFs are designed for similar purposes, site specific constraints make each pond unique. As such, it is important to obtain and review background data for each pond, including design drawings, reports, and bathymetric surveys.

6.5.1 Background Review

A detailed condition survey for all ponds (including bathymetric surveys) will need to be completed and all available data, drawings, photographs, etc. will have to be analyzed to confirm the extent of the anticipated sediment cleanout operations. Sediment surveys, sediment volumetric analysis, design, erosion and sediment control planning, and preparing complete contract tender documents that are all encompassing to facilitate contract administration and inspection services, all are paramount to a successful project.

Pond cleanouts will also involve dealing with important aspects such as, access restrictions, tree protection, bank stabilization, construction adjacent to private property, and minimizing noise, air, traffic and other environmental disruptions and inconvenience to residents. Township staff will need to be kept aware of the project and it is imperative that the work be monitored continuously to ensure no complaints arise due to public inconveniences. The proposed SWM facility

maintenance plans and construction documents must be practical and efficient and identify and account for constraints that add risk to the project that may impact sediment removal methodology and pricing.

6.5.2 Applicable Legislation Regulations and Guidance Documents

Several key issues must be addressed to successfully manage the challenges of the sediment removal from SWMFs:

i. Understanding regulatory compliance with the various agency review/approval processes as it relates to sediment removal from SWM facilities and working in/around environmentally sensitive areas

ii. Sediment sampling in advance of tender to understand the types of materials and the appropriate means for disposal and potential costs

iii. Identifying all remedial work required in each pond to ensure its healthy function over the long term

iv. Developing a suitable restoration plan to ensure that any vegetation impacted by the cleanout operations will be restored to the satisfaction of the Township, GRCA, and general public

v. Ensuring effective communication with Township staff, regulatory agencies, residents, and other stakeholders.

Regulatory compliance requirements for SWMF cleanouts are generally outlined in the following:

Stormwater management ponds are considered 'Sewage Works' under the Ontario Water Resources Act. … stormwater management ponds are considered to be "Ontario" waters. Due to these connections, and accessibility by the public, stormwater management ponds may become inhabited by fish from adjacent natural sources or through unlawful introductions. Stormwater management ponds may also attract and become inhabited by wildlife such as turtles and frogs. While it may not be known if a stormwater management pond is inhabited by fish and/or wildlife prior to clean-out activities being carried out, it is best to anticipate the need to handle or remove these species prior to operations which may require a licence or authorization under the Fish and Wildlife Conservation Act, 1997 (FWCA).

- *Stormwater Management Pond Clean-out Best Management Practices*, Ministry of Natural Resources and Forestry [MNRF] Aurora District (May 2016).

Based on the foregoing document, the following **Table 6.2** outlines the potential work requirements, explanations, and associated timing windows related to SWMF sediment cleanout operations.

Table 6.2 SWMF Approvals Required for Cleanout

WORKS/APPROVAL	EXPLANATION	TIMING WINDOW
Bird Nest Surveys	Migratory Birds Convention Act regulates activities that disturb migratory birds and/or the nests of migratory birds. The Canadian Wildlife Service (CWS) has established guidelines for the timing of vegetation clearing activities that may affect migratory birds and these guidelines should be followed during the construction and operation of SWM facilities.	If the sediment cleanout operations occur during bird nesting periods (April 1st through July 31st), then nest surveys are recommended prior to starting cleanout operations. The recommended month for cleanout is **September** wherever possible, to avoid the breeding season of birds.

Table 6.2 SWMF Approvals Required for Cleanout

WORKS/APPROVAL	EXPLANATION	TIMING WINDOW
Endangered Species Act, 2007 (ESA)	If aquatic or terrestrial Species at Risk (SAR) are known to occur in the area of the SWMF or if surveys within and around the pond have confirmed the presence of SAR, additional information and/or an authorization may be required.	
Licence to Collect Fish for Scientific Purposes under O. Reg. 664/98 of the Fish and Wildlife Conservation Act (FWCA)	If fish are confirmed to exist within a SWMF, then a Fish Rescue plan and associated permit request may be required from the MNRF.	If Redside Dave are present in the receiving watercourse, work should occur within the MNRF's recommended construction timing window for Redside Dace (**July 1 – September 15**). Any proposals to work outside of this window must be discussed with the MNRF.
Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Water Courses Permit	If SWMF is within an area regulated by the Conservation Authority.	
Sediment Testing	To adequately characterize the sediment for proper disposal, the appropriate number of soil samples needs to be determined. This determination is based on the sampling frequency prescribed in the amended O. Reg. 153/04 of the Environmental Protection Act (EPA).	
Wildlife Scientific Collector's Authorization (WSCA) under the FWCA	May be required for SWMFs clean-outs where there will be intentional or anticipated incidental capture, handling and/or relocation of herpetofauna (e.g. frogs, turtles). It should be noted that most SWMFs support amphibians and reptiles. This is assessed by MNRF staff based on the likelihood of suitable habitat in the immediate area and the likelihood of the SWMF being used by herpetofauna. In some cases, a site visit and/or herpetofauna surveys will be required in support of an application.	Clean-out will likely need to be completed during the active season for these species, which is generally **April 15 to September 30**.
Recommended Timing Window July-September		

Sediment Testing and Disposal

To adequately characterize the sediment for proper disposal, the appropriate number of soil samples needs to be determined. This determination is based on the sampling frequency prescribed in the amended Ontario Regulation 153/04 of the Environmental Protection Act (EPA) that states in *Soil Excavated at or Brought to the Phase II Property*, Section 34 (2) "at least one soil sample shall be analyzed for each 160 cubic metres of soil for the first 5,000 cubic metres to be assessed at each source from which soil is being brought to the phase two property, following which at least one sample for each additional 300 cubic metres of soil which is to remain on, in or under the phase two property shall be analyzed."

Sediment sampling procedures should generally conform to the requirements of the amended O.Reg.153/04 and the MOECP Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario (December 1996).

Sediment sampling locations should include, as a minimum, the inlet and outflow areas of the SWM pond. The sediment should be analyzed for a variety of contaminants-of-concern including the parameters listed below:

- Sediment Characteristic samples should be analyzed for volatile organic compounds (VOCs), petroleum hydrocarbons in the F1-F4 fractions, selected metals, electrical conductivity, sodium adsorption ratio, and polycyclic aromatic hydrocarbons.
- One (1) representative sediment sample should also be analyzed using the toxicity characteristic leachate procedure (TCLP) for inorganics, VOCs, semi-VOCs, and ignitibility to ensure that any contaminated sediment would be classified as a non-hazardous waste suitable for offsite disposal at an MOECP approved facility, if required.

Tenders should be requested from several reputable waste management companies that operate landfill sites or treatment facilities approved by the MOECP to accept non-hazardous waste in Ontario. If the contract administrator, primary contractor, or excavation subcontractor is responsible for the selection of a waste disposal company, the Township should approve that company prior to finalization of the contract documents. The Township's involvement will ensure that contaminated soils are handled and disposed of in accordance with the requirements of O.Reg.558/00.

The contractor should provide the name, address, and acceptance criteria for a soil disposal site that will receive any non-contaminated surplus soils. The Township should require written acceptance from the receiver site stating they will accept the soils based on the chemical analysis provided. Again, the receiver site should be specified in the contract documents. An industrial/commercial fill receiver site is preferred over a residential fill receiver site.

If the sediment does not meet the most stringent O.Reg.153/04 Table 1 Site Condition Standards (SCS), then the sediment may stay on-site if it meets the applicable SCS for the property or it should be disposed of at an MOECP approved facility.

Although consultants are able to investigate methodology for sediment removal (and there are various methods such as excavate/mix with dry material and haul, excavate, store and mix with "drying agents", vacuum or suction and removal), we believe that the "open market" will often be the best at deciding on the best methodology which will be based on any one contractor's past experience, ability and equipment, environmental considerations for each pond, minimizing neighbourhood inconvenience, approvability, and price.

Based on previous work completed by IBI Group on similar projects, we believe that having a consultant work with the Township as they prepare a Bidder Prequalification Tender (public process) from which the available methods/technologies are brought to the Township by prospective bidders. The Township could pre-select bidders for each pond. In this manner, the best methodology for each specific pond can be identified, as each pond will have different opportunities and constraints.

Based on the success of this approach with other municipalities, we highly recommend this process to be followed on this project. This work will require detailed sequencing by the contractor with advance notifications to affected residents or Township Park/Works Department Staff.

6.5.3 Design and Tender

Once a SWMF requires cleanout it is important that it is performed by a qualified professional who can address several key issues. The following section provides details on some of the deliverables to be expected.

6.5.3.1 Deliverables

The Contractor or Consultant will prepare a report in support of obtaining agency approvals. The report may include additional background memorandums from various disciplines (e.g. terrestrial, soil quality, survey, etc.), as appropriate.

Approvals/Permits

The Contractor or Consultant will coordinate with approval agencies to obtain the required permits to support the proposed maintenance activities and remedial works is also required.

Drawings

The Contractor or Consultant will prepare drawings to illustrate the recommended plan and provided to the Township with details of the proposed maintenance/cleanout strategies for review, discussion and a decision on the preferred scheme. This will be discussed at meetings with the Township staff, as appropriate.

Engineering drawings and site restoration drawings will be prepared to illustrate the following information:

- 1:1000 General Location plan
- 1:500 Base plans with
  - Depiction of additional remedial works, as determined in the field, with appropriate details.
  - Construction access route(s) and identification of tree protection, removal and restoration plans as necessary.
  - Erosion and sediment control measures with details to describe temporary flow diversion methods and related monitoring requirements.
- Typical Sections and Details depicting sediment depths and areas, existing and proposed cross-section profile(s), as appropriate.
- General Notes related to construction sequences, practices, and general site considerations.

Tender Documents

Tender documents should include all forms of tender, contract price schedules and contractual schedules such as, “General and Supplementary Conditions”, “Special Provisions”. It should address project specific items such as:

- Location plan
- Site access routes
- Construction area restriction plans showing staging and storage areas
- Erosion and silt protection
- Excavation volumes
- Bathymetric surveys
- Existing and proposed typical cross-sections
- Sediment quality
- Dewatering techniques
- Disposal methodologies
- Material specifications and sundry construction
- Retrofit / repairs to the existing components of the pond structure
- Rehabilitation of eroded banks

Construction methodology plans and details:

- Erosion and sediment control plans and project schedule and sequencing details
- Site restoration plans (including seeding / sodding, erosion control matting, etc.)
- Landscaping (including bioengineering and habitat features) plans and details

- Restoration Plans, Details and Specifications for hard and soft site elements
- Detailed Cost Estimate, this includes for each pond site the accessibility of site, location of disposal, volume of sediment and quality of sediment
- Flow bypass measures for period with rainfall

Deliverables

- Short and long-term monitoring requirement
- Operations and Maintenance Manual
- Detailed Design Report (including all documentation of calculations and recommendations)

Tender documents will also be provided to the Township.

Public Consultation / Liaison

In order to effectively implement sediment removal of SWMF(s) the local community will need to be notified about the workplan. The following information are key aspects that should be provided to the affected property owners:

- When and where the construction activities would be taking place
- Any required easement and construction access through private property
- The method of sediment removal and dewatering
- Odour, dust and noise generation during operations
- The duration of dewatering and sediment removal

6.5.4 Construction Supervision and Contract Administration

Tender and Award

The Tender and award process may involve Pre-Tender bidders meetings, responding to questions, preparing addenda, and contractor selection. Evaluation of construction bids should consider the ability of the contractor to complete the work within the specified timeframe, the cost, and the contractor's experience with pond projects and innovative or value-added knowledge or technologies offered.

Pre-Construction

A Pre-Construction meeting should be held on-site to identify site specific constraints, work areas, staging areas and no disturbance areas. A detailed Pre-Construction survey, including digital pictures and videos, should be completed to document existing conditions. A Health and Safety audit should be conducted, with the results of the survey and audit should be included in the Pre-Construction Report.

Contract Administration and Construction Inspection Services

After a construction phasing and staging plan has been developed and a qualified contractor retained, it is important to develop and maintain a working construction scheduling document to track the progress of the construction and ensure that possible delays are minimized or avoided entirely. Environmental monitoring also plays an important role in managing risk to the Township during the construction period. Sediment removal projects are often high public profile projects and communication between the field staff, contract administrators, project manager and the Township is critical. Periodic formal environmental inspections will occur during landscaping and at other times throughout the construction stages. Various specialists including a site inspector, environmental inspector and ecological specialists need to work together during the different stages of the program. Contract administration and site inspections should include:

- Scheduling, co-ordinating and attending project review meetings including a pre-construction review meeting.
- Regular on-site inspections which include reporting.
- Liaising with the contractor and evaluating any out-of-scope requests.
- Ensuring that all environmental protection measures are acceptable and functioning as designed and identifying deficiencies to be corrected by the contractor.
- Maintaining a daily diary of construction events documenting the progress of the work and to substantiate the quality and quantity of the work performed.
- Providing comments to the contractor's proposed procedures, methods and construction phasing to ensure compliance with design and contract requirements.
- Managing claims, notices of intent to claim, disputes and questions relating to contractor performance, quality of the work and interpretation of the contract documents.
- Addressing inquires and request for information from external Agencies, adjacent landowners and members of the public.
- Reviewing and processing payment certification of Substantial and Total Performance for Construction Lien Act purposes.

Record Drawings and Project Completion

During the close-out period, close attention must be paid to the project documentation. In particular, any deficiencies must be identified, defined and the contractor notified. The deficiency must ultimately be rectified prior to the release of securities or other bonds supplied by the contractor. A final thorough review of the contract documents and the constructed works is required at this time. As-built conditions will be surveyed and design drawings updated to reflect the current conditions.

6.6 Maintenance

Prior to the Township assuming a SWMF, the Consultant should provide an Operation & Maintenance Report along with forecasted costs of maintenance and cleanout. For reference, a sample O&M Report is located in **Appendix J**.

6.7 Costs

Based on the foregoing, the following **Table 6.3** outlines the consultant costs per discipline, as well as cost of deliverables:

Table 6.3 Typical Consultant Costs Associated with Pond Cleanouts

CONSULTANT	RESPONSIBILITY/ DELIVERABLE	BASIS FOR FEES	FEE ($)
IBI Group	Water Resources	Fixed fee	XXX
IBI Group	Report	Fixed fee	XXX
IBI Group	Tender Drawings	Fixed fee	XXX
		TOTAL	**XXX**

Table 6.4 Typical Costs Associated with Pond Cleanouts

RESOURCE	DESCRIPTION	COST PER UNIT*	UNIT
General Inspector	City staff to perform seasonal inspections.	250	Use
Fencing	Black vinyl covered fence	16.4	m
Riprap	8 inch stone used around inlet / outlet	150	Cu. Metre
Weeping tile	Weeping tile with sock	15	Metre
General Contractor	Non-specific contractor to do simple repairs outside scope of city labourers	1	Dollar
General Consultant	Non-specific consultant to assess various problems outside of city expertise	1	Dollar
City Official	Non-specific city employee to consult with local residents	1	Dollar
2 Person Crew	2 Person City Work Crew (8 Hours)	800	Day
3 Person Contract Crew	3 Person Contract Work Crew (10 hours)	3000	Day
Site Inspector	Performs advanced inspections	600	Use
Water Sampling	Generic company for testing water samples	700	Use
Front-end Loader	Standard Front-end loader for use with 2 Person City Work Crew	800	Day
Miscellaneous	Undefined materials to be allocated to task	1	Dollar
Engineer	City Engineer	50	Hour
Lock	A padlock	25	Use
Paint	Paint	13.2	L
Soil	Soil to use as fill	353	Cu. m.
Erosion Fabric	Erosion fabric	10	Metre
Grass Seed	Grass seed	50	Kilogram
Fence Repair Contractor	A contractor to perform structural repairs on fences	250	Use
Buoy Rope	Rope to attach the buoy to the emergency station, as well as safety rope around the buoy	50	Use
Plastic Pipe Cap	A cap to cover plastic riser pipes	50	Use
Buoy	Red floating buoy	50	Use
Hazard Sign	A sign	100	Use
Pest Control [Beaver]	A pest control company	1000	Use
Plastic Pipe	Plastic piping	32.8	m
Hoop	Emergency equipment hoop	100	Use
Pest control	Removal of problem animals	1	Dollar
Grate	A grate to cover a large outlet pipe	1000	Use
Aeration Equipment	A sub-surface aerator powered by a windmill	2500	Use

* The unit costs listed are an estimated cost for the resources. It is recommended that the Township update the unit rates.

It should be noted that costs are determined by the size and condition of pond and amount of sediment being required for cleanout.

7 Evaluation of Alternatives

Several alternative solutions were generated for SWM measures for the existing and future land uses within the Township that consist mainly of urban areas. The approach for developing and evaluating alternatives is consistent with the requirements of the planning and design process for Master Planning projects described in the Municipal Class EA (Municipal Engineers Association, June 2000; amended 2007, 2011). It involves reviewing Phase 1 work (i.e. Identification of the Problem) and undertaking Phase 2 (i.e. Establishing Existing Conditions, Identification of Long List of Alternatives, Development and Assessment of Alternative Management Strategies and Selection of a Preferred Strategy). In addition, consultation with stakeholders is a necessary step in this process.

7.1 General

In order to identify the solution that best encompasses the study's principles, goals and objectives a long list of alternatives was generated. The alternatives consider both existing and future land uses within the Township that consists of rural and urban areas.

7.2 Overview of Alternatives

The MECP divides SWM measures into three broad categories:

1. Source/lot level controls
2. Conveyance controls
3. End of pipe controls

The preferred SWM strategy is to provide an integrated treatment train approach to water management based on providing control at the lot level and in conveyance (to the extent feasible) followed by end-of-pipe controls. This combination of controls is typically the only means of meeting the multiple criteria for water balance, water quality, erosion control, and water quantity.

The reasoning behind that approach is to maximize the benefits from the combination of those elements, including:

- More effective SWM.
- Reduction in land area required to implement end-of-pipe solutions.
- Enhanced opportunities to integrate SWMPs effectively as amenities.
- Decreased total cost when land value is factored in.
- Increased level of public awareness and involvement in the implementation and management of SWM initiatives.

7.2.1 Source Controls

Currently, the MECP has not released a document for Low Impact Development planning and design. The standard typically used in Ontario is the Credit Valley Conservation (CVC) and Toronto Region Conservation Authority (TRCA) Low Impact Development Stormwater Management Planning and Design Guide, created as "a tool to help developers, consultants, municipalities and landowners understand and implement sustainable stormwater planning and practices in the CVC and TRCA watersheds. 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."

"The guide is intended to provide engineers, ecologists and planners with up-to-date information and direction on landscape-based SWM planning and low impact development SWM practices

such as rainwater harvesting, green roofs, bioretention, permeable pavement, soakaways and swales. The information contained in the guide will help practitioners adopt landscape-based SWM approaches, and will help select, design, construct and monitor more sustainable SWM practices."

Although developed for use in the CVC and TRCA watersheds, the underlying principles have been adopted for use by engineers for applying LID in other jurisdictions. The GRCA has included this document in the *Water Sustainability Planning Key Resource List* and it is generally the case that effort should be made to follow the LID approach by incorporating lot level and conveyance controls as recommended in the MECP's "Stormwater Management Planning and Design Manual" (2003) or most current version.

The LID Manual notes that "Effective stormwater management strategies employ a treatment train approach that combines a suite of lot level, conveyance and end-of-pipe controls to treat runoff efficiently and effectively. At the present time, reliance on larger end-of-pipe detention pond facilities as the primary component of a stormwater management strategy is the norm. This compromises opportunities to implement low impact development practices that enhance the performance of stormwater management systems and provide ecological sustainability benefits."

For new development areas, potential opportunities to integrate SWMPs at the site level stage in the planning process include:

- Harvesting of rainwater from rooftops for non-potable uses (e.g., irrigation, toilet flushing) using rain barrels or cisterns.
- Installation of green roofs.
- Drainage of runoff from rooftops to pervious or depression storage areas.
- Integration of soakaways (e.g., infiltration trenches or chambers) below landscaped areas, parking areas, parks, sports fields, etc.
- Incorporation of bioretention areas, rain gardens, biofilters or constructed wetlands into the landscape design for the site.
- Use of permeable pavement in low and medium traffic areas.
- Incorporation of bioretention areas, vegetated filter strips, and swales to intercept and treat parking lot and road runoff.
- Incorporation of woodland restoration in upstream areas to reduce runoff rates.
- Integration of detention ponds and wetlands as large aesthetic and recreational features within the landscape.

For infill and redevelopment sites, application of LID SWM measures needs to consider context and the limits of both landscape and built form. SWM opportunities that should be explored for infill and retrofit developments include:

- Rooftop storage
- Green roofs
- Rainwater harvesting
- Bioretention areas
- Biofilters
- Grassed swales
- Permeable pavement
- Rain gardens
- Stormwater planters and fountains
- Depression storage
- Soakaways

- Constructed wetlands
- Enhanced urban tree canopy

Source controls are applied at the individual lot level, typically serving small drainage areas (approximately 2 hectares). Typically, they take the form of either storage or infiltration controls.

Source: Left – CWP; Right – Low Impact Development Center

Figure 7-1 Example of Inline and Offline Bioretention [6]

Storage controls are for the temporary detention of stormwater to attenuate peak flows to a desired level. They could include such mechanisms as:

- Roof storage – control flow roof drains and temporary detention storage on flat roofs.
- Parking lot storage – detention storage on top of parking lots, using an underground orifice control.
- Rear lot storage – using catchbasin restrictors to create temporary ponding in rear yards.
- Underground storage – consisting of either upsized pipes (used for detention instead of merely conveyance of flows) or specialized tank structures (like modified box culverts, or plastic storage units) in combination with an orifice control.

Given the high permeability of the underlying soils in the area, infiltration measures are an important option in achieving SWM criteria.

Infiltration controls are typically designed to provide for water balance opportunity; that is, offsetting the increase in impervious cover associated with urban development by providing a mechanism to infiltrate water back into the soil. Typical mechanisms include:

- Reduced grading to allow greater ponding of stormwater and natural infiltration.
- Directing roof leaders to rear yard ponding areas, soakaway pits, or to cisterns or rain barrels.
- Sump pumping foundation drains to rear yard ponding areas.
- Infiltration trenches
- Grassed swales
- Vegetated filter strips
- Stream and valley corridor buffer strips

[6] Source: Low Impact Development LID SWM Guide

The primary function of infiltration controls is to mitigate the impacts that urbanization normally has on the water balance (i.e., increased surface runoff, reduced soil moisture replenishment and groundwater recharge). Concentrated infiltration of stormwater collected from larger areas (e.g., infiltration basins, an end-of-pipe infiltration type control) will not match the characteristics of distributed infiltration which occurred under predevelopment conditions. The natural hydrologic cycle can be maintained to the greatest extent possible by lot level infiltration controls.

Infiltration technologies can achieve water quality enhancement; however, stormwater containing high concentrations of suspended solids will tend to clog these controls. Further, infiltration of contaminated water can impair groundwater quality. Therefore, these measures are ideally suited to the infiltration of relatively clear stormwater, such as stormwater from rooftops which contains only atmospheric contaminants (i.e., contaminants deposited on the rooftop by precipitation or dry fall) or foundation drainage.

7.2.1.1 Pervious Catchbasin

Pervious catchbasins are simply normal catchbasins with a larger sump which are physically connected to an exfiltration storage medium. In some designs, the storage medium is connected to the catchbasin located directly above via a hole or series of holes in the catchbasin floor. Although this design is convenient and conserves land, it is more susceptible to clogging and compaction as a result of the lack of pre-treatment and the weight of the water in the catchbasin. There are manufacturers which offer catchbasin filters for pre-treatment in this type of design. These filters are expensive, however, and need frequent replacement. A second design uses the catchbasin sump for pre-treatment of runoff and discharges low flows through the wall of the catchbasin to the adjacent exfiltration storage medium.

Pre-Treatment

Pervious catchbasins are intended to infiltrate road drainage which has high levels of suspended sediment. Exfiltration of stormwater without pre-treatment will result in poor longevity of the exfiltration system. Large catchbasins with deep sumps will help pre-treat the runoff before it is conveyed to the infiltration trench. However, the amount of pre-treatment will be small even for large manholes, and other pre-treatment measures should be incorporated, if possible, before the stormwater enters the sewer system. Pre-treatment is best achieved by the incorporation of grassed boulevards as discussed in the previous section on pervious pipes.

Technologies for treating runoff from small areas include CB Shield (**Figure 7-2)**. CB Shield is a catch basin insert. As the name suggests, it shields the sediment and grit found in the sump of the catchbasin from being washed out. CB Shield inserts are placed into catchbasins to prevent scour with the top slope of the shield deflecting the flow of water to the back wall of the catchbasin while the grates allow water to flow over the top and exit the outlet pipe. Sediment falls between the slots. CB Shield is easily installed in an existing catchbasin in less than two minutes, which results in saving on retrofitting established infrastructure. CB Shield can capture 50% TSS on an average site (ETV fine Particle Size Distribution, 0.2ha and 50% impervious).

CB shield can help pre-treat an LID system or a filter system. Adding a CB Shield to the treatment train can help to achieve 80% TSS removal.

CB Shield would not provide quality pre-treatment on open bottom catchbasins and would be more suitable on the type of pervious catch basin outlined in the figure below, which has a solid bottom and overflow pipe.

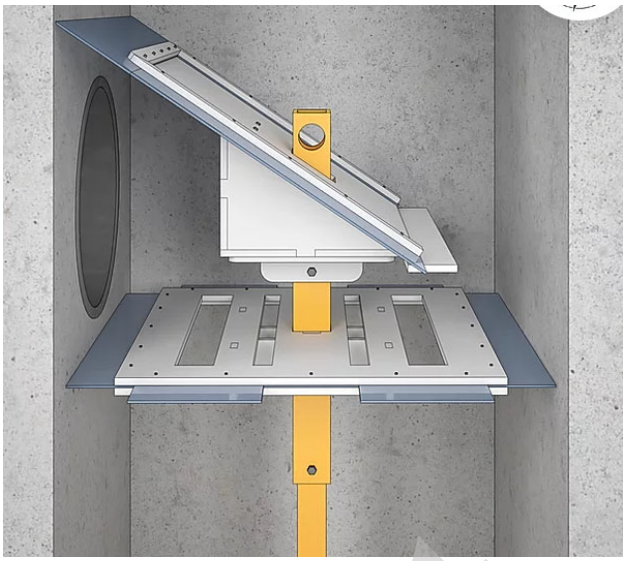


Figure 7-2 Example CB Shield[7]

Technical Effectiveness

Pervious catchbasins have been used in both the Cambridge and the Ottawa areas (**Figure 7-3**). As with the pervious pipe systems, varying results have been reported. The Regional Municipality of Ottawa-Carleton has reported success with pervious catchbasins. Where difficulties have been observed, it has usually been due to:

- Poor design (storage media, filter cloth, lack of pre-treatment)
- Poor construction practices
- Inadequate stabilization of development before construction (construction timing)
- Poor site physical conditions (soils, water table)

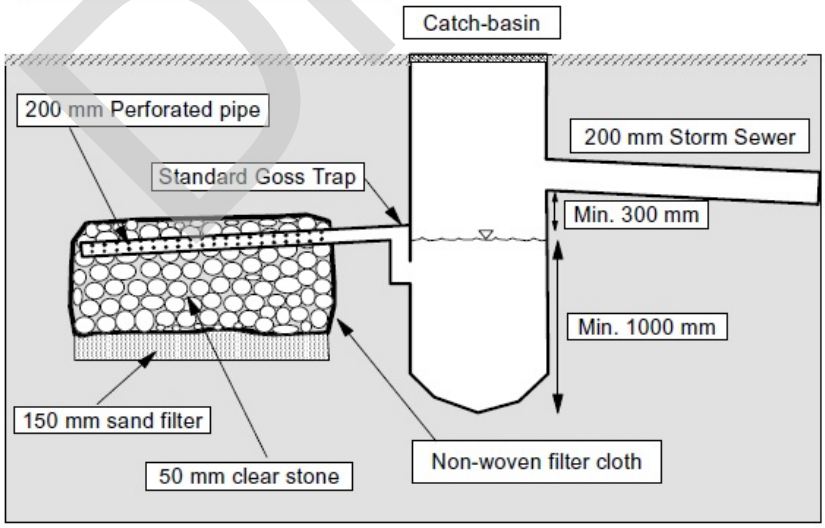


Figure 7-3 Cross-section of Typical Pervious Catch-basin[8]

As a retrofit solution, existing pervious CBs could be replaced with a standard CB, equipped with a CB Shield and goss trap (for oil capture), with overflow to a retention chamber system.

[7] Source: https://www.cbshield.com/about_us
[8] Source: MECP Stormwater Management Planning and Design Manual

7.2.1.2 Stormwater Retention Systems

Infiltration chambers are another design variation on soakaways (**Figure 7-4**). They include a range of proprietary manufactured modular structures installed underground, typically under parking or landscaped areas that create large void spaces for temporary storage of stormwater runoff and allow it to infiltrate into the underlying native soil.

Structures typically have open bottoms, perforated side walls and optional underlying granular stone reservoirs. They can be installed individually or in series in trench or bed configurations. They can infiltrate roof, walkway, parking lot and road runoff with adequate pretreatment. Due to the large volume of underground void space they create in comparison to a soakaway of the same dimensions, and the modular nature of their design, they are well suited to sites where available space for other types of BMPs is limited, or where it is desirable for the facility to have little or no surface footprint (e.g., high density development contexts). They can also be referred to as infiltration tanks.

Used in conjunction with quality pre-treatment devices, retention systems can provide sufficient volume for various levels of service as required.

Source: StormTech (left); Cultech (right)

Figure 7-4 Example Stormwater Retention Systems [9]

7.2.1.3 Bioretention Areas

Bioretention areas are shallow excavated surface depressions containing mulch and a prepared soil mix and planted with specially selected native vegetation that captures and treats runoff (see **Section 4.5** of the LID Manual for detailed design guidance). During storms, runoff ponds in the depression and gradually filters through the mulch, prepared soil mix and root zone. The filtered runoff can either infiltrate into the native soil or be collected in a perforated underdrain and discharged to the storm sewer system. They remove pollutants from runoff through filtration in the soil and uptake by plant roots and can help to reduce runoff volume through evapotranspiration and full or partial infiltration. They can also provide wildlife habitat and enhance local aesthetics.

Bioretention areas can be integrated into a range of landscape areas including medians and cul-de-sac islands, parking lot medians and boulevards. A variety of planting and landscape treatments can be employed to integrate them into the character of the landscape. Biofilters are a design variation that feature an impermeable liner and underdrain due to site constraints and are typically applied as pretreatment to another stormwater control although they can be effective as standalone filtration facilities.

[9] Source: Low Impact Development LID SWM Guide

7.2.1.4 *Rain Gardens*

A variation on depression storage and bioretention areas, the rain garden is a deliberately designed landscape, with specific plant species and soil media to receive and detain, infiltrate and filter runoff discharged from roof leaders (**Figure 7-5**). Rain gardens are effective in both new and retrofit situations and can be designed to complement the landscape of most properties. The successful design and application of lot level controls begins with the design of the subdivision and requires private owners to maintain such systems.

Left and Right - front yard rain gardens that takes runoff from the residential lot and street (Source: City of Maplewood, Minnesota)

Figure 7-5 Example Rain Gardens[10]

7.2.1.5 *Soakaways*

Soakaways, which can also be referred to as infiltration trenches, galleries or chambers, are constructed below grade and therefore take up little or no space at the surface (**Figure 7-6**). Such facilities can be installed below a broad range of land uses including residential yards, parking areas, walkways, pedestrian plazas, parks and sports fields.

Source: Lanark Consultants (left); Cahill Associates (centre); North Dakota State University (right)

Figure 7-6 Example Soakaways[11]

7.2.1.6 *Permeable Pavement*

Permeable pavement is a variation on traditional pavement design that utilizes pervious paving material underlain by a uniformly graded stone reservoir (**Figure 7-7**). The pavement surface may consist of permeable asphalt, permeable concrete, permeable interlocking concrete pavers, concrete grid pavers and plastic grid pavers. Openings in permeable interlocking concrete pavers, concrete grid pavers and plastic grid pavers are typically filled with pea gravel, sand or topsoil and grass. Permeable pavements prevent the generation of runoff by allowing precipitation falling on the surface to infiltrate into the stone reservoir and, where suitable

[10] Source: Low Impact Development LID SWM Guide
[11] Source: Low Impact Development LID SWM Guide

conditions exist, into the underlying soil. They are most appropriately applied in low to medium traffic areas (*e.g.,* residential roads, low traffic parking lots, driveways, walkways, plazas, playgrounds, boat ramps etc.) that typically receive low levels of contaminants. In addition to the stormwater management benefits, permeable pavements can be more aesthetically attractive than conventional, impermeable pavements.

Permeable interlocking concrete pavers (block pavers): Concrete pavers are designed with gaps between them that allow stormwater to infiltrate into the aggregate reservoir. The gaps are approximately 10% of the surface area and are filled with small stone.

Permeable paver parking lot in Mississauga, ON (Source: CVC)

Plastic or concrete grid systems are concrete or durable plastic grids filled with gravel or a pervious planting mix for grass or low ground cover. The grids provide support for vehicles or foot *traffic while preven*ting compaction and rutting of the fill material. Grid systems are appropriate for applications such as walkways, overflow parking, firelanes, maintenance and utility acccess lanes, or driveways.

Residential driveway (Source: R. Bannerman); Plastic grid filled with gravel (Source: Gravelpave©)

Pervious Concrete and Porous Asphalt have pavement mixes with reduced or no fines which creates stable void spaces. The void spaces allow stormwater to drain through to the underlying stone reservoir. They require different pouring and setting procedures than their impervious versions.

Pervious concrete(Source: Hunt and Collins, 2008); Porous asphalt parking lot (Source: University of New Hampshire Stormwater Center)

Figure 7-7 Example Permeable Pavement Types[12]

[12] Source: Low Impact Development LID SWM Guide

7.2.1.7 Vegetated Filter Strips

Gently sloping, densely vegetated areas that are designed to treat runoff as sheet flow from adjacent impervious surfaces (see LID Manual for detailed design guidance) (**Figure 7-8**). Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and by providing some infiltration into underlying soils. Filter strips may be comprised of a variety of trees, shrubs, and native vegetation to add aesthetic value as well as water quality benefits. They are best suited to treating runoff from roads and highways, roof downspouts and low traffic parking lots. They are also ideal as pretreatment to another lot level or conveyance practice. Filter strips also provide a convenient area for snow storage and treatment.

Source: Trinkaus Engineering (left), Seattle Public Utilities (right)

Figure 7-8 Example Filter Strips Along Residential Road and as Pretreatment for Dry Swale[13]

7.2.2 Conveyance Controls

Conveyance controls are mechanisms like pervious pipes, grassed swales, or vegetated filter strips designed to provide for water balance (infiltration) or water quality benefits to tradition conveyance measures. Above ground features like swales and strips are relatively easy to inspect and maintain, while pervious pipes require a greater investment of time and money, and may become clogged, resulting in reduced function.

7.2.2.1 Perforated Pipe Systems

A stormwater conveyance system that features pipe that is perforated along its length and installed in a granular bedding which allows infiltration of water into the native soil through the pipe wall as it is conveyed (**Figure 7-9**). They can also be referred to as pervious pipes, percolation drainage systems or exfiltration systems. Design variations can also include catch basins that are connected to granular stone reservoirs by pervious pipes or where the catch basin sumps are perforated, allowing runoff to gradually infiltrate into the native soil. They are best suited to treat drainage from low to medium traffic areas with relatively flat or gentle slope.

7.2.2.1 Grassed Swale

Grassed swales are vegetated open channels designed to convey, treat and attenuate stormwater runoff (also referred to as enhanced vegetated swales) (**Figure 7-10**). Check dams and vegetation in the swale slows the water to allow sedimentation, filtration through the root zone and soil matrix, evapotranspiration, and infiltration into the underlying native soil. Simple

[13] Source: Low Impact Development LID SWM Guide

grassed channels or ditches have long been used for stormwater conveyance, particularly for roadway drainage.

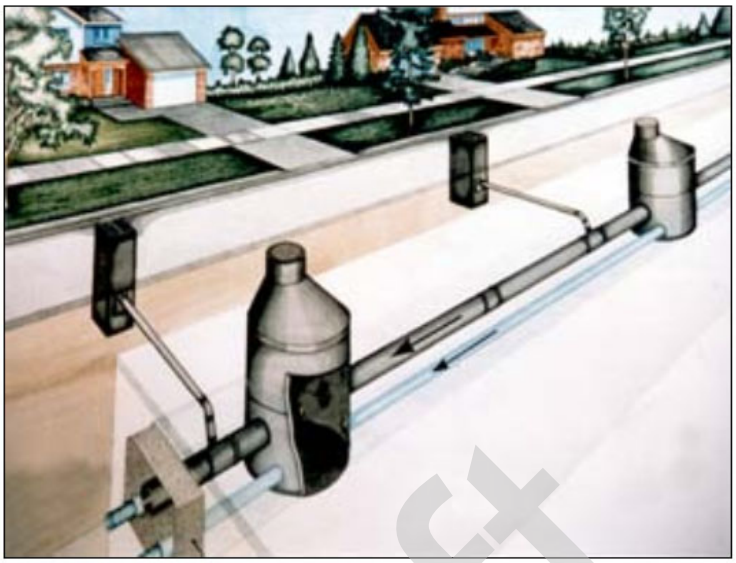


Figure 7-9 Example Perforated Pipe System[14]

Source: Delaware Department of Transportation (left); Center for Watershed Protection (right)

Figure 7-10 Example of Grassed Drainage Swale w/ Rock Check Dams[15]

Grassed swales incorporate design features such as modified geometry and check dams that improve the contaminant removal and runoff reduction functions of simple grassed channel and roadside ditch designs. A dry swale is a design variation that incorporates an engineered soil media bed and optional perforated pipe underdrain system. Grassed swales are not capable of providing the same water balance and water quality benefits as dry swales, as they lack the engineered soil media and storage capacity of that best management practice.

Lot level and conveyance controls are often lumped together as lot level/conveyance controls.

[14] Source: Low Impact Development LID SWM Guide
[15] Source: Low Impact Development LID SWM Guide

Due to the presence of lot level controls on private lands, landowner education is key to ensuring that systems remain effective over time. The successful application of lot level landscape solutions therefore requires the commitment of the municipality and the establishment of creative partnerships between the developer, municipality and landowner to realize consistent benefits over the long term.

7.2.3 End of Pipe Measures

Historically, end-of-pipe measures have been the predominant means of providing for water quality, water quantity, and erosion control. They typically take the form of SWM facilities which receive stormwater runoff from large areas via conveyance measures like sewers or ditches and discharge treated water to watercourses. Typical end of pipe measures include:

- Wet ponds
- Wetlands
- Dry ponds
- Infiltration basins

Except for infiltration basins, they may consist of any of the following components, alone or in combination:

- Permanent pool – a volume of stormwater that does not drain, designed to provide for settling and dilution of settlement (Quality Control).
- Extended detention – temporary (24-72 hour) storage of relatively small, frequent stormwater runoff volumes to reduce erosion in the receiving system (Erosion Control).
- Active storage – stormwater detention for larger, less frequent events to attenuate peak flows (Quantity Control).

Infiltration basins are designed without a traditional outlet, instead capturing, storing, and infiltrating stormwater into the ground, which replenishes the groundwater table, increases baseflow, decreases erosion, and eliminate peak flows (up to design storage volumes events) (**Figure 7-11**).

7.2.4 Restoration Measures

These would consist of direct restoration/enhancement of existing habitats in the Township as opposed to improvements to SWMFs. Examples include stream restoration, aquatic/terrestrial habitat enhancement.

7.3 Identification/Description of Alternative Solutions

As an initial step, the Project Team identified and described alternative solutions, or functionally different ways of addressing the problem / opportunity statement, as described in **Section 1.7**. Any “reasonable” alternative was included initially. All alternatives were considered equally for discussion purposes and evaluation as seen in **Section 7.**

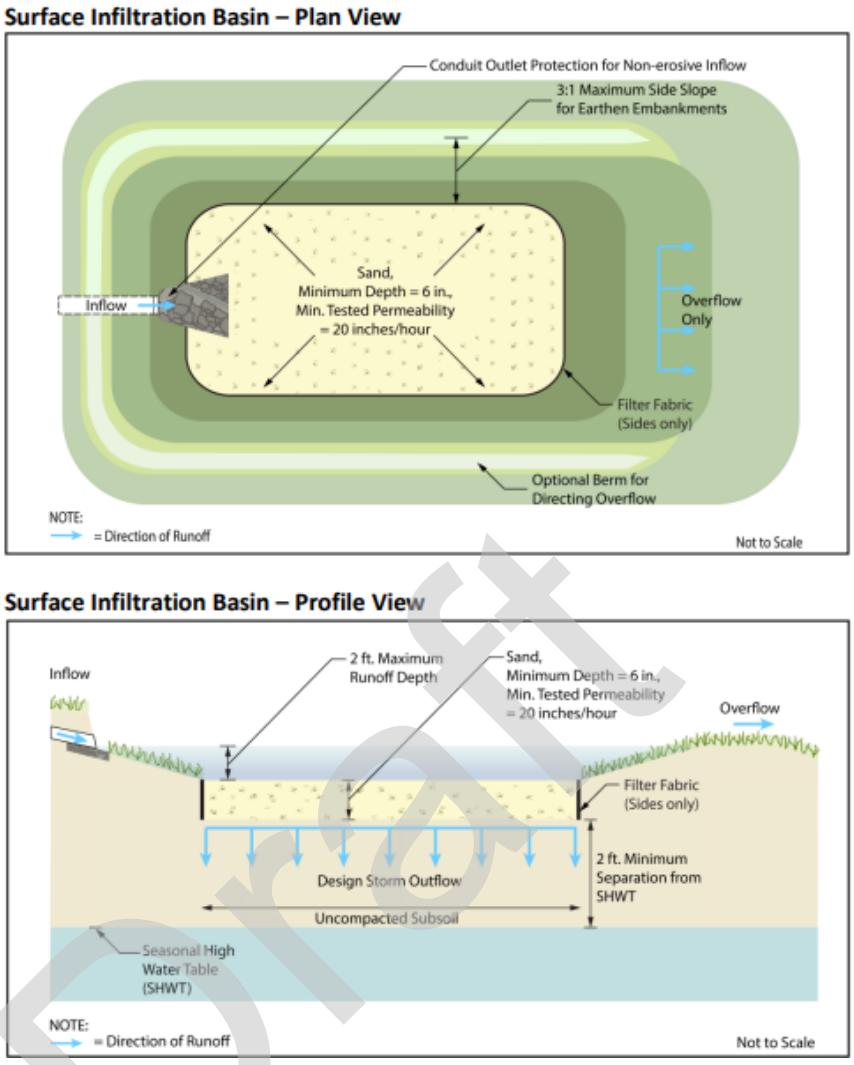


Figure 7-11 Infiltration Basin[16]

7.4 General

The development of Alternative SWM Strategies is necessary in order to determine the effectiveness of each strategy with respect to protecting, enhancing and restoring the natural resources of the watersheds located within the Township under existing and planned land use changes.

For the purposes of the SWMMP, a SWM Strategy was defined as a set of BMPs which, when implemented collectively, will attempt to address impacts associated with change in land uses within the watersheds. The land uses under consideration include existing urban and rural land uses and proposed development within the settlement areas.

The assessment was undertaken using results from the modelling as well as taking into account various factors such as social, economic and environmental criteria which are defined to further develop specific components of the Alternative Strategies. In addition, the assessment will look to find an alternative which minimizes, to the extent possible, the impact on the community, natural environment and the economy.

[16] Source: New Jersey Stormwater Best Management Practices Manual

The approach used for developing and evaluating alternatives is, where appropriate, consistent with the planning and design process for Master Planning projects as described in the Class EA document. The approach has been used for measures which are located outside proposed development areas (i.e. stream restoration works, stormwater pond retrofit works).

For other measures, such as the construction of SWM measures for proposed developments, or the implementation of a Township wide program (i.e. disconnection of roof downspouts) general direction as to the types of measure, or proposed programs will be provided in each alternative.

7.5 Development of Alternative SWM Strategies

The Township is comprised of agriculture, urban growth, industrial, residential and open space. Most notably, the Nith River and Cedar Creek, their tributaries and associated riparian habitat fall within the Study Area. There are also areas of wetlands, woodlands and aquatic features.

Results from the Existing Conditions as assessed in **Section 3** indicate the existing environmental conditions provide opportunity of the development and implication of alternative SWM strategies.

A total of five (5) Alternative Management Strategies have been brought forward for assessment. The five strategies are defined as:

1. Do Nothing
2. Traditional SWM Strategy
3. Traditional SWM with BMP Implementation Strategy
4. Traditional SWM with Urban Retrofits Strategy
5. Traditional SWM with Rural Retrofits Strategy

Table 7.1 below has been developed to summarize the potential effects of each alternative with respect to flow volume, phosphorus loadings, infiltration reduction and erosion potential. These impacts would occur within the Township as a result of the proposed land use change.

7.5.1 Do Nothing

The “Do Nothing” alternative would involve leaving the Township as is. No SWM works are carried out in any of the proposed development or redevelopment areas. An assessment to the impacts associated with the implementation of this strategy is required as part of undertaking a Municipal Class Environmental Assessment Study.

As seen in **Table 7.1**, this strategy would result in higher flow volumes, increased flooding, increased production of phosphorus, increased erosion potential, and infiltration reduction.

7.5.2 Traditional SWM Strategy

The Traditional SWM Strategy is the implementation of SWM in proposed development or redevelopment areas. The SWM works would consist of the construction of SWM ponds for quantity, quality and erosion control as per MECP guidelines demonstrate. Proposed developments would be serviced by conventional storm sewer systems and limited source control measures would be implemented such as downspout disconnection. This alternative would result in higher flow volumes, an increase in erosion potential, and an increase in production of phosphorus and infiltration reduction.

7.5.3 Traditional SWM with BMP Implementation Strategy

This Strategy is consistent with the Traditional SWM Strategy as it will apply to proposed development and redevelopment areas. A variety of BMP source controls, conveyance controls and end-of-pipe measures will be implemented for all proposed areas of development. Alternative

developments (i.e. LEED certified developments, Low Impact Developments) would also be considered.

A series of assumptions for the types of Best Management Practices to be implemented with this Strategy were made in order to include this Strategy as an Alternative. The types of BMP measures to be implemented are further explained in **Section 7.2**.

7.5.3.1 Quality Control

Oil-Grit Separators [OGS]

Traditional quality control BMPs include oil-grit separators for both oil retention and reduction in Total Suspended Solids [TSS]. As requested by the Township, IBI Group has reviewed available OGS units to determine their suitability for use in the Township and has reviewed the Canadian Environmental Testing Verification [CETV] program.

Environmental Technology Verification (ETV) provides an independent evaluation of new technologies with a view to validate environmental claims so that users, developers, regulators, and other parties can make informed decisions about purchasing, applying and regulating innovative technologies. ETV is not a certification scheme; instead, it ensures that a product's environmental claims are true and verified and presents a clear assessment of the technology's environmental potential and value.

With ETV, each technology is assessed against its own characteristics, based on performance claims, with tests defined on a case-by-case basis. This differentiates ETV from certification and labeling schemes, which are based on pre-defined criteria or specifications.

ETV offers a mechanism to develop references in a market where no standard currently exists, especially for new technologies; therefore, ETV is applicable in particular for technologies whose innovative features or performance are not fully reflected in existing product standards.

Based on input from the GRCA, ETV does not approve OGSs; it only verifies claims on the ability to remove TSS, and that so far none of the tested OGSs would meet the Enhanced (80% TSS Removal) criterion, with the exception of filter type units (i.e. Jellyfish).

ETV Canada maintains Technology Fact Sheets [TFS] on their website, until the verification is deemed no longer valid, at which point it is removed; therefore, IBI recommends that any guidelines reference the site as opposed to listing the current TFSs. Currently, the list of verified technologies can be found on their website at https://etvcanada.ca/home/verify-your-technology/current-verified-technologies.

7.5.4 Traditional SWM with Urban Retrofits Strategy

This strategy is consistent with the Traditional SWM Strategy in that conventional SWM strategies would be implemented within proposed development or redevelopment areas. In addition to traditional SWM, a variety of source, conveyance and end-of-pipe measures will be implemented in existing urban areas.

This strategy is highly based on the amount of participating landowners to implement the proposed retrofits at the source level. The types of urban retrofits to be implemented in this strategy are further explained in **Section 8.1**.

7.5.5 Traditional SWM with Rural Retrofits Strategy

This strategy is consistent with the Traditional SWM Strategy in that conventional SWM strategies would be implemented within proposed development or redevelopment areas. In addition to traditional SWM, a variety of source, conveyance and end-of-pipe measures will be implemented in existing rural areas. Like the Traditional SWM with Urban Retrofit Strategy, rural retrofit implementation is also based on the amount of participating rural landowners to implement the

proposed retrofits at the source level. The types of rural retrofits to be implemented in this strategy are further explained in **Section 8.1**.

Table 7.1 SWM Strategy Alternatives

PRELIMINARY CRITERIA	SWM STRATEGY ALTERNATIVES				
	DO NOTHING	TRADITIONAL	TRAD W/ BMPS	TRAD W/ URBAN RETROFITS	TRAD. W/ RURAL RETROFITS
Land Uses Where Strategy is to be Applied	None	Proposed Development and Redevelopment Areas	Proposed Development and Redevelopment Areas	Proposed Development and Redevelopment Areas and Existing Urban Areas	Proposed Development and Redevelopment Areas and Existing Rural Areas
Flows	Increase in Runoff Rates and Volumes	Increase in Flow Volume	Reduction in Flow Volume	Reduction in Urban Areas	Reduction in Rural Areas
Phosphorus Loading	Current Condition	Increase	Reduction	Reduction in Urban Areas	Current Condition in Urban Areas, Reduction in Rural Areas
Infiltration	Current Condition	Reduction	Increase	Increase in Urban Areas	Current Condition
Erosion Potential	Current Condition	Increase	Reduction	Reduction in Urban Areas	Current Condition

7.6 Development of Evaluation Categories and Criteria

A preferred SWM Strategy will be developed by the synthesis of the inter-disciplinary inputs to the project, including computer modeling, terrestrial and aquatic habitat assessments, water balance and hydrogeology, social, cultural, and economic considerations. The approach in developing and evaluating the alternative is generally consistent with the Class EA planning/design process for Master Planning project.

Using the initial set of developed evaluation criteria, and incorporating public comments as appropriate, a net effects analysis is applied to the preliminary list of alternative solutions which involves the following steps:

- Identification of potential effects.
- Develop and apply mitigation/compensation/enhancement measures.
- Determine net effects after mitigation measures have been applied.

The Township would like to explore the opportunities for innovative approaches such as Low Impact Development (LID) and green infrastructure for lot level controls, conveyance controls and end of pipe facilities. To assess the most applicable alternatives, IBI reviewed available information regarding Site setting that could influence the infiltration capacity of each area. This will include a review of the surficial geology, topography, depth to groundwater, depth to overburden, soil cover etc. In addition, available Source Water Protection (“SWP”) mapping and SWP plans will be reviewed to understand if there are any constraints regarding LIDs within Wellhead Protection Areas (WHPAs) or other SWP vulnerable areas.

In addition, a water balance will be completed using the Thornthwaite and Mather methodology to compare pre-development and post-development hydrologic recharge of groundwater. This information will aid in assessing the list of alternatives and assess the suitability of various LID measures that could be completed.

The comparative evaluation of the alternative solutions will be carried out using a systematic approach that fulfills the intent of the Class EA process. The evaluation process will be presented in the form of an evaluation matrix in which alternative is scored or ranked against the other alternatives, with respect to a number of criteria that fall into the following categories:

- Environmental criteria: These include potential impacts on natural terrestrial features and aquatic habitat and will include consideration of net change on hydrologic water balance and pollutant loadings to natural watercourses.
- Financial criteria: Includes initial capital cost including consideration of any need for property acquisition; expected life-cycle costs; and implications for future financing of centralized stormwater facilities that may serve more than one development property.
- Public safety and public acceptability: This category will address potential concerns regarding public safety and health; and how ell proposed facilities may fit into existing or future built-up areas.
- Implementation: Includes consideration of how easily implementation can occur as new land development occurs; and how well the SWM plan integrates with current land-use planning and the development approval process.

Evaluation of the alternatives will be undertaken in consultation with the Project Team and the Township's Project Manager. Our Project Ecologist will also contribute to the evaluation of alternatives, particularly about potential impacts to the environment both during and after construction. A list of possible criteria is presented in **Table 7.2**.

Table 7.2 Criteria for Evaluating Alternatives

TECHNICAL
Opportunity to reduce peak flows to Nith River
Opportunity to decrease erosion of watercourses
Opportunity to improve water quality
Opportunity to reduce phosphorus loading in Nith River
Opportunity to mitigate changes in water balance
NATURAL HERITAGE FEATURES
Provisions of direct and indirect fish habitat
Potential to improve terrestrial habitat
Impacts to natural hazard features
SOCIAL ENVIRONMENT
Ability to improve public health and safety
Impacts to private property
Impacts to public property
CULTURAL ENVIRONMENT
Impacts to built and cultural heritage landscape
Impacts to archeological resources
ECONOMIC ENVIRONMENT
Capital costs
Operation and Maintenance costs
Risk Management
Impact on agricultural land use

The evaluation criteria were applied on an individual development area basis where the key implementations of the alternative SWM strategies could be effectively applied. The preferred alternatives for each settlement area are based on existing site constraints and the feasibility of implementing SWM improvements to each area. The preferred alternative strategy is outlined in **Section 8**.

8 Preferred SWM Strategy

The preferred SWM strategy will be comprised of several elements. These may include replacement of existing storm pipes and culverts; erosion abatement projects; construction of new storm pond/wetland facilities or other types of centralized stormwater management such as infiltration facilities; and recommendations regarding stormwater design practices within new developments to minimize stormwater volume at the source and achieve objectives for preserving existing local hydrology.

We will clearly define each separate component of the preferred strategy and identify what the implementation sequence needs to be. We will identify all projects that are to be the responsibility of the Township, and identify what future Class EA requirements may apply, and what the regulatory approval requirements are, for each component project. As noted in the RFP, for those projects identified as Class EA “Schedule B” projects, the Master Plan document will demonstrate that the Schedule B requirements have been fulfilled, as we will have followed Approach 2 in completing the Master Plan.

The preferred strategy will include recommendations regarding existing municipal drainage infrastructure assets, to provide the Township with a prioritized list of needs.

Existing data incorporated into the database and each component will be categorized into one of the following groups:

1. Excellent: Component is in a "new" condition without any visible deficiencies
2. Satisfactory: Component is functioning within normal parameters but visible signs of wear are present
3. Attention Required: Component is no longer working as designed and requires maintenance however, maintenance actions are minor (e.g. cleaning or debris removal)
4. Non-Functional: Component is not functioning and requires more immediate maintenance (e.g. pond is full of sediment, inlet is blocked, spillway is eroded, etc.)
5. Safety Hazard: Component presents a safety hazard to the public and should be repaired immediately (e.g. grate on large inlet pipe is open or missing allowing ingress, manhole cover missing, etc.).

Once each component has been entered into the system, any components with a rating of three (3), ie “Attention Required” or higher will be given maintenance tasks as well as tasks added for inspection, as deemed appropriate. This will form the basis for the maintenance and budget needs for each facility, helping to evaluate and prioritize implementation requirements.

8.1 Site Specific Recommendations

Recommendations for the following future development areas are provided in the following sections. As mentioned in **Section 4.3.1.1**, the cover was assumed to be 75% imperviousness in post-development scenarios for all settlement areas. There appear to be no foreseen soil or geological constraints within the study area.

For each Area listed, the developer and consulting engineer are responsible for meeting the stormwater management objectives in their design submission.

8.1.1 Area A

A development of 4.15ha is proposed which would result in an infiltration deficit of 8,604m^3/year, which should be mitigated. This area will need to consider SPA 2.7.11. Stormwater could discharge to the oxbow lake of the Nith River, west of Northumberland St. BMP source/lot level

controls and conveyance controls outlined in **Section 7** could be applied. The largest challenge to be overcome appears to be getting the stormwater under the road and overcoming the mild slope towards the train tracks to the west.

8.1.2 Area B

A development of 1.59ha is proposed which would result in an infiltration deficit of 2,236m^3/year, which should be mitigated. This area will need to consider SPA 2.7.9. Stormwater could be discharged directly to the oxbow lake of the Nith River directly North. BMP source/lot level controls and conveyance controls outlined in **Section 7** could be applied. The largest challenge to be overcome will be ensuring quality measures are in place with the development located adjacent to the watercourse.

8.1.3 Area C

A development of 9.30ha is proposed which would result in an infiltration deficit of 20,664 m^3/year, which should be mitigated. This area will need to consider SPA 2.7.7. The area is not adjacent to a watercourse, but there is space for a pond and potential to convey water under the train tracks to the south and into the Jedburgh Pond. From there water moves to the Watson Pond eventually making its way into the Nith River. This area will need to focus on BMP end of pipe controls as outlined in **Section 7**. The largest challenge to be overcome will be ensuring quantity control measures are in place with the development not in close proximity to a watercourse.

8.1.4 Area D

A development of 13.37ha is proposed which would result in an infiltration deficit of 28,204m^3/year, which should be mitigated. There is space for a pond here and it is close enough to discharge into Cedar Creek. BMP source/lot level controls, conveyance controls and end of pipe controls outlined in **Section 7** could be applied. The largest challenge to be overcome will be incorporating these SWM controls during the apparent reclamation process from former aggregate pit.

8.1.5 Area E

A development of 23.22ha is proposed which would result in an infiltration deficit of 25,542m^3/year, which should be mitigated. This area will need to consider SPA 2.7.9. Due to the size of the area, there is potential for a SWM pond and outlet at Charlie Creek to the east. BMP source/lot level controls, conveyance controls and end of pipe controls outlined in **Section 7** could be applied. The largest challenge to be overcome will be providing quality and quantity measures required to outlet to natural watercourse.

8.1.6 Area F

A development of 83.13 ha is proposed which would result in an infiltration deficit of 33,455m^3/year, which should be mitigated. Due to the size of the area, there is potential for a SWM pond and potential to discharge to the Nith River to the north. BMP source/lot level controls, conveyance controls and end of pipe controls outlined in **Section 7** could be applied. The largest challenge to be overcome will be avoiding the wetlands and safely conveying any excess water to the Nith River.

8.1.7 Northumberland Road

The stretch of Northumberland Road between Greenfield Road and Highway 401 is currently a rural cross-section with some curb and catch basins implemented to the south. At the north there is a pond and a wetland on the west side of the road which begins across from Alps Road and

continues south for approximately 300m. The east side has a shallow ditch through this area. Continuing south, both the east and west sides are quite flat, but there appears to be room for a deepening of existing ditch or an infiltration trench. There is a high point south of the gas station, therefore depending on the capacity, all runoff to the north of this point could be directed to the pond and wetland. For the section of Northumberland Road to the south of the gas station, the distance to the closest waterbody is approximately 700m to the south with a natural slope of 0.3%. Conveying the water on the west side could be achieved through grass swale or infiltration trench with subdrain. There are areas with more defined ditches, but some areas face a steep slope at the edge of the ROW. Ultimately culverts would be required under driveways and ultimately the west intersection of Greenfield Road. The east side has sections that are flat while other sections slope away from the road. There is space to implement surface LIDs on this side.

9 Public Consultation

The following sections outlines the overall public consultation process.

9.1 Consultation Activities

9.1.1 Public Information Centre

Given the scope of the work (equivalent to a Schedule B Class EA) and the scheduling noted in Addendum #3, IBI Group recommends that only two PICs be held to provide the public with an opportunity to review the problem/opportunity statement, potential alternative solutions, our proposed evaluation criteria and, finally, our recommended preferred solution. It is anticipated that each of the PICs will be an “open house” come-and-go format, with a presentation at a scheduled time.

At the time of this writing, the COVID 19 Pandemic makes in-person meetings ill advised; therefore, IBI Group provided materials for the Township to host online in lieu of PICs.

PIC 1 was held virtually on March 16, 2021. The PIC boards and comments can be found in **Appendices K** and **L**.

9.1.2 Notice of Commencement

A Notice of Commencement was published on the Township’s website and in local newspapers. The notice will also be directly mailed to the stakeholders list. A draft notice will be developed immediately after contract award and will be provided to the Township for review at the project kick-off meeting. The notice will contain the problem/opportunity statement for the project and invite the public to comment and/or join the project mailing list. See **Appendix M**.

9.1.3 Notice of Public Information Centre

The RFP requires that three Public Information Centres (PICs) be held through the course of this project. Notices of PICs will be published approximately four (4) weeks in advance of the PIC. The notice will also be directly mailed to individuals and organizations on the stakeholder list. IBI Group will prepare draft notices for review by Township staff.

9.2 Stakeholders List

Table 9.1Stakeholders List

AGENCY	CONTACT NAME	CONTACT EMAIL ADDRESS	CONTACT TELEPHONE NUMBER
Township of North Dumfries	Andrew McNeely, Chief Administrative Officer	Amcneely@northdumfries.ca	519-632-8800 ext. 121
Grand River Conservation Authority	John Broom, Resource Planner	jbrum@grandriver.ca	519-621-2763 x 2233
Ministry of the Environment, Conservation and Parks	Amy Shaw – Guelph District Office; Aziz S. Ahmed, P. Eng. Manager, Municipal Water and Wastewater Permissions Section, Environmental Permissions Branch	Aziz.Ahmed@ontario.ca	416-314-4625 Cell: 416-712-7427
Ministry of Natural Resources and Forestry	Tammy Verhaeghe, District Manager Guelph District	'tammy.verhaeghe@ontario.ca'	
Six Nations of the Grand River	Lonny Bomberry/Dawn Laforme, Consultation Supervisor Lands and Resources Department	lonnybomberry@sixnations.ca dlaforme@sixnations.ca	519 445-2201 / 519-753-0665

Table 9.1 Stakeholders List

AGENCY	CONTACT NAME	CONTACT EMAIL ADDRESS	CONTACT TELEPHONE NUMBER
Mississaugas of the Credit First Nation	Fawn Sault, Consultation Manager Department of Consultation and Accommodation	Fawn.Sault@mncfn.ca	

9.3 First Nations Consultation

GRCA has provided a list of First Nations contacts below:

- Lonny Bomberry/Dawn Laforme
  519 445-2201 / 519-753-0665
  lonnybomberry@sixnations.ca
  dlaforme@sixnations.ca
  Consultation Supervisor
  Lands and Resources Department
  Six Nations of the Grand River
- Fawn Sault
  Fawn.Sault@mncfn.ca
  Consultation Manager
  Department of Consultation and Accommodation
  Mississaugas of the Credit First Nation
  These First Nations were notified of the study in an email-letter April 14th, 2020 (refer to **Appendix J**).

9.4 Consultation with GRCA

As per IBI Group's email request of March 25, 2020, the Grand River Conservation Authority (GRCA) reviewed IBI Group's request to provide background information and input into this study. Refer to **Appendix K** for details.

9.5 Consultation with the Ministry of the Environment, Conservation, and Parks

IBI Group sent a letter via email to the Guelph MECP District Office (Amy Shaw) April 22, 2020, with copy to Aziz Ahmed, MECP Manager, Municipal Water and Wastewater Permissions at the Main Branch. Refer to **Appendix K** for details.

10 Implementation Plan

10.1 Asset Monitoring, Management and Maintenance Program

A Town-wide stormwater asset database has been provided in **Table 10.1** and **Table 10.2** below, showing existing ponds and catch basins from IBI Group's field investigations, respectively. Both tables also identify any components that require maintenance.

As mentioned in **Section 7.6**, prior to a pond being assumed by the Township, the Consultant shall provide an Operation & Maintenance Report. This will provide a schedule of maintenance which can be used to update the asset database.

Upon analysis of the stormwater management facility assessment results, IBI Group will prepare a long-term stormwater asset maintenance program, which will help to guide Township Public Works staff in the overall operation of the stormwater infrastructure. The maintenance program will be incorporated into the Master Plan and will include cost estimates as well as relevant regulations and processes for operations and maintenance activities.

The deliverable for this stage of the project will include a complete database, along with an operation and maintenance standard operating procedure manual, which the Township may use to guide its Public Works staff.

10.2 Rain Gauge Network

There is one existing rain gauge within Ayr that is operated by the GRCA (**Figure 10-1**). It is located off of Main Street by the Cedar Creek outlet from Jedburgh Pond. It is currently installed on a permanent mount several meters above the ground. The location of this gauge is well situated within the center of the town, with the entirety of the township within a 2km radius of the gauge. Existing rain gauge locations in and around Ayr are shown on **Figure 10-2**.

Figure 10-1 Photograph Taken at the One-Way Bridge at Main Street

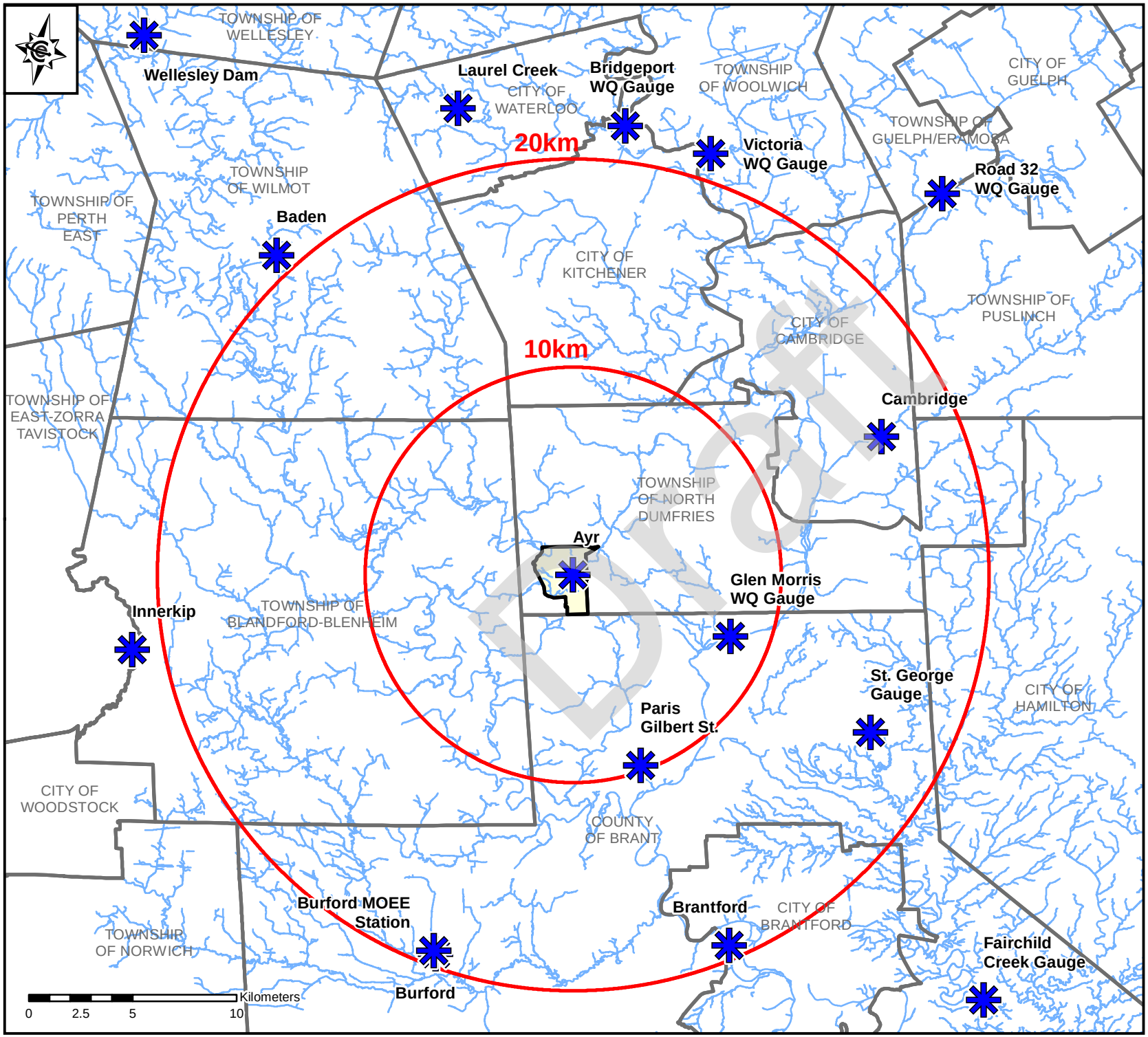
The data recorded by this station does not get posted to the GRCA's online data portal. Through coordination with the GRCA, they provided the following statement: "The rain gauge in Ayr is problematic and does not have a good enough period of record for IDF data. If you want still want this rain gauge data, please let us know and staff will provide this for you."

Table 10.1 Existing SWMF Database

SWM FACILITY ID	ECA, ISSUE DATE	LOCATION IN DECIMAL DEGREES		DRAINAGE AREA TO POND (HA)	OUTLET LOCATION	MAINTENANCE REQUIREMENTS
		LATITUDE	LONGITUDE			
SWMF#3 Hilltop Community SWMF A	0522-6U8PDG November 15, 2006	43.2826	-80.4385	8.6	- outlet pipe to drain into Municipal storm drainage manhole MH61 on Hunt Street, - overflow spillway, protected with rip-rap to discharge stormwater flow west onto the Hilltop Drive	- access road has trees and vegetation growing out of it which obstruct access - could be assumed by Township in 2021
SWMF#4 Hilltop Community SWMF B	0522-6U8PDG November 15, 2006; 4689-A8ZLNZ June 29, 2016 Amended ECA 0522-6U8PDG	43.27586	-80.4448	30.3	-outlet pipe to drain into the existing Valleyview Stormwater Management Facility ultimately discharging to the Nith River, - overflow spillway to discharge to Swan Street side ditch to Nith River,	- not yet inspected - could be assumed by Township in 2031
SWMF#5 Legacy Estates Subdivision SWMF	5264-BATK97 May 2, 2019	43.27278	-80.4446	25.4	- outlet structure at the southwest corner, discharging to the Mitchell Drain	- not yet inspected - could be assumed by Township in 2034
SWMF#6 Valley View SWMF	Unknown	43.28172	-80.447	Unknown	- discharges directly to Mitchell Drain	- there is currently no fence surrounding pond or signage, but overgrown vegetation likely keeps outsiders out - the outlet headwall is a large boulder and pipe is starting to rust
SWMF#7 Hilltop Estates Phase 1 SWMF	Unknown	43.28221	-80.4415	Unknown	-outlet presumably discharges to Nith River	- vegetation is overgrown and very dense is some places. -erosional scarring directly downstream of the invert.
SWMF#8	Unknown	43.29099	-80.4474	Unknown	-outlet likely discharges to Jedburgh Pond	- an access road is non-existent or overgrown - no signage

Table 10.2 Existing Catchbasin Database at Areas Experiencing Flooding

CATCH BASIN ID	LOCATION IN DECIMAL DEGREES		OPSD	TYPE DESCRIPTION	OBSERVATIONS	MAINTENANCE REQUIREMENTS
	LATITUDE	LONGITUDE				
1.1	44.22567	-80.6957	n/a	galvanized steel grate possibly stepcon	Stagnant water/apparent blockage	Clean out sediment
2.1	43.31133	-80.6623	400.02	herring bone square frame/cover	Stagnant water/apparent blockage	Clean out sediment
2.2	43.30233	-80.6665	400.02	herring bone square frame/cover	Stagnant water/apparent blockage	Clean out sediment
2.3	44.26017	-80.643	400.02	herring bone square frame/cover	No visible blockage	Monitor for sediment buildup
2.4	43.3085	-80.6405	400.02	herring bone square frame/cover	Stagnant water/apparent blockage	Clean out sediment
3.1	43.72619	-80.5047	n/a	Hopper Forest circular cover (straight grate no frame)	Visible blockage	Clean out sediment
3.2	43.7358	-80.4828	n/a	Circular cover (straight grate no frame)	Visible blockage	Clean out sediment
3.3	43.73466	-80.4974	n/a	Circular cover (straight grate no frame)	Visible blockage	Clean out sediment
3.4	43.73969	-80.5047	n/a	Circular cover (straight grate no frame)	Visible blockage	Clean out sediment
4.1	43.70422	-80.7263	400.02	herring bone square frame/cover	No visible blockage	Monitor for sediment buildup
4.2	43.70133	-80.7355	400.02	herring bone square frame/cover	No visible blockage	Monitor for sediment buildup
4.3	43.69598	-80.7441	400.02	herring bone square frame/cover	No visible blockage	Monitor for sediment buildup
4.4	43.7005	-80.7245	n/a	Circular cover (straight grate no frame)	No visible blockage	Monitor for sediment buildup
5.1	43.61518	-80.8279	n/a	Hopper Forest cover (straight grate no frame)	Stagnant water/apparent blockage	Pervious pipe running horizontal from CB should be flushed out.
5.2	43.61655	-80.8288	n/a	Hopper Forest cover (straight grate no frame)	Secondary pipe apparently clogged	Pervious pipe running horizontal from CB should be flushed out.



Legend

- Rain Gauge Stations
- Municipal Boundaries
- Watercourse
- Ayr Study Area

Figure 10-2

Locations of Rain Gauges

Township of North Dumfries
Storm Water Management Master Plan

IBI

Project No.: 2019-0506

Date: January 2022

LTS 4/8/2020 D:__Projects\x2019-0506\600_GIS\20_Maps\01_Working\RainGauge.mxd

While access to this data is possible, it is not recommended to rely on data collected by this station as per the GRCA's advice that the gauge is problematic.

It is recommended for the Township to have their own source of rainfall data being collected directly, or that GRCA reactivate the current disused gauge. Proposed locations for possible gauge installs have been identified. Based on the size of the municipality, only one (1) location is recommended. Some of the features of an ideal monitoring location include:

- A flat rooftop with plenty of space from the edge
- Easy access to the location. For rooftops, access via a short ladder or internal hatch access
- No tall objects nearby or overhanging trees
- Owned and/or operated by the Municipality. Schools and other buildings may require additional coordination for access
- No access to the location from members of the public

The preferred location for gauge installation is on the utility building on the north side of Gibson Street. The utility building has all the characteristics listed above and is situated at a central location within the municipality. The recommended location on Gibson Street, along with some alternative locations are shown on **Figure 10-3**.

If the gauge operated by the GRCA becomes operational with reliable data, an additional rain gauge operated by the municipality may not be required. If having a rain gauge with municipal control is preferred, then it is recommended to install the gauge in a location that would increase the spatial distribution of the monitored area. Some alternative proposed locations are the Ayr Water Pollution Control Plant, the North Dumfries Health and Community Centre, or St. Brigid Elementary School.

To ensure rain gauges are collecting accurate precipitation data throughout the monitoring period, regular maintenance is required. Regular maintenance tasks typically include the following:

- Calibration
- Cleaning (clearing any possible debris build up)
- Data download
- Assessment of site security

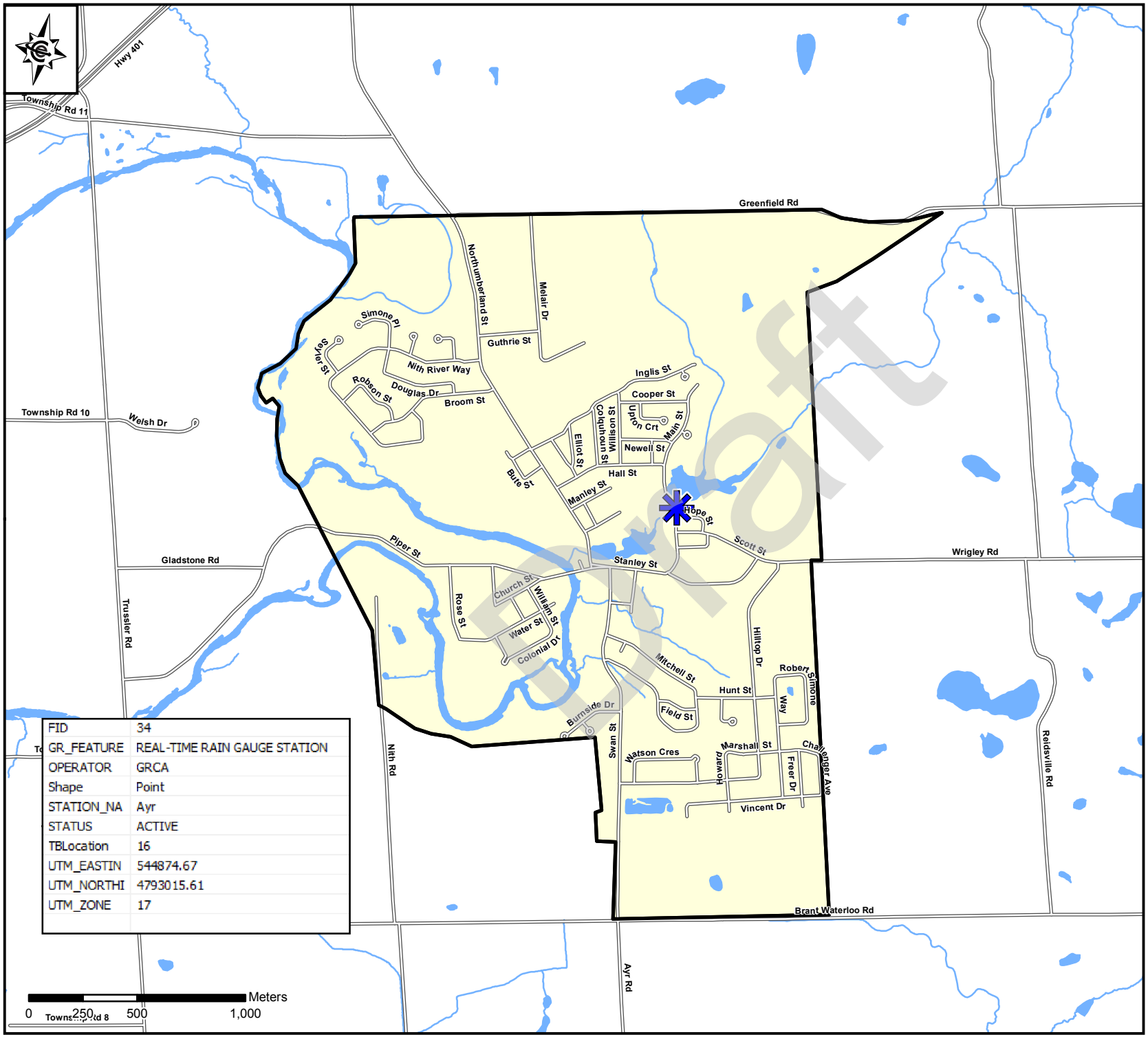
An effective rain gauge maintenance schedule will depend on the configuration and data logging and data transmission capabilities of the rain gauge installed.

A rain gauge that is equipped with remote data access or wireless data transmission capabilities would require fewer site visits to perform regular maintenance tasks and data downloads as the data quality and key indicators of equipment health could be tracked remotely on an hourly or daily basis (depending on the frequency of data transmission). In such a case, monthly or quarterly site visits for gauge calibration and site maintenance are likely sufficient to ensure high quality and reliable data is collected. Gauges should always be visited after the winter to re-calibrate the gauge, and to ensure that snow and ice buildup did not adjust or damage the gauge or sensors.

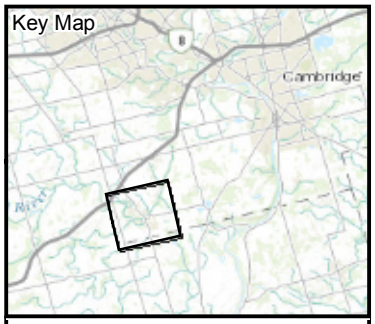
A rain gauge that is equipped with only a basic data logger without the ability to transmit data wirelessly will require more frequent site visits to retrieve data and ensure the equipment is maintained. In such a case, bi-weekly or monthly site visits for gauge calibration, site maintenance and data downloads are likely necessary to ensure high quality and reliable data is collected.

10.3 Operation and Maintenance Procedures

IBI Group has identified the operation and maintenance requirements of each SWM facility and its assets which will allow for forecasting future requirements in terms of capital costs, operation and maintenance costs, and resources required by the Township to maintain its SWM facilities. The life cycle costs of each SWM facility have been calculated based on the forecasted operations and maintenance requirements. This information is incorporated into the database, allowing Township staff to easily identify and plan yearly costs and resources required for each SWM facility and the overall program.



FID	34
GR_FEATURE	REAL-TIME RAIN GAUGE STATION
OPERATOR	GRCA
Shape	Point
STATION_NA	Ayr
STATUS	ACTIVE
TBLocation	16
UTM_EASTIN	544874.67
UTM_NORTHI	4793015.61
UTM_ZONE	17



Legend

- Rain Gauge Stations
- Road
- Watercourse
- Waterbody
- Ayr Study Area

Figure 10-3

Proposed and Alternative Locations for a New Rain Gauge

Township of North Dumfries
Storm Water Management Master Plan

IBI

Project No.: 2019-0506

Date: January 2022

LTS 4/8/2020 D:__Projects\x2019-0506\600_GIS\20_Maps\01_Working\RainGauge.mxd

After completing an inventory of the SWM facilities and their assets within the Township, we were able to develop an inspection and maintenance approach. The approach will be documented with an operation and maintenance standard operating procedure manual that will outline how to monitor, inspect, and maintain the SWM facilities and their assets. See **Appendix J** for an example operation and maintenance manual. The manual specifies in detail the procedures Township staff will need to undertake when monitoring and inspecting the SWM facility and will include the following:

- Timelines for monitoring, inspections, and maintenance activities
- Monitoring and inspection checklist based on the timelines
- Guidance to interpret the monitoring data
- Recommendations for the various maintenance activities that may be undertaken for each SWM facility based on the monitoring data
- A standardized rating system to assess the priority of the maintenance needs for the various SWM facilities
- Procedures for sediment sampling, removal, and disposal
- Procedures for obtaining required approvals for removal and disposal of sediments.

The above helps the Township ensure that it remains in compliance with the ECAs for its municipal stormwater facilities.

In prioritizing the proposed solutions, considerations will be made for future implementation of the solutions, which is outside of the scope of this project. This may include the consideration of staging plans, property acquisition, easements, utility relocation, or any other timing or physical constraints the City may encounter. The Project Team will strive to present solutions capable of achieving the highest water quality results, while simultaneously thinking of the practical aspects the City will face beyond the life of Phases I and II of this Class EA project

10.4 Stormwater Quality Management Strategy

The Master Plan will include a stormwater quality management strategy.

The focus will be on promoting measures that reduce stormwater pollution at source. Measures that may be included are as follows:

- Encouragement of lot level improvements on public and private property, such as:
    - Soakaway pits
    - Roof leader splashpads
    - Oil / grit separators
    - Pervious pavement
    - Green roof technology
- Implementation of conveyance enhancements on municipal rights-of-way, such as:
    - Pervious piping
    - Bioswales
    - Dryswales

10.5 Policy Considerations

In addition to providing physical solutions in the stormwater quality management strategy, the Project Team will also recommend policies based on review of other local municipal, provincial, or other agency documents. The recommendations for incorporation to Township policies will be detailed in the Master Plan document. Policy recommendations will include, but not be limited to:

- Municipal standards, operations, maintenance and design practices
- Infill development SWM practices
- Disposal of material removed from municipal stormwater treatment facilities

10.5.1 Municipal Standards, Operations, Maintenance and Design Practices

Comparable municipal guidelines, such as the City of Barrie's Storm Drainage and Stormwater Management Policies and Guidelines, 2009, or the City of Toronto's Wet Weather Flow Management Guidelines, 2007, will be reviewed to ensure the Township maintains current standards in stormwater maintenance and design. Review of various municipal perspectives will allow for optimization of the Township own practices.

10.5.2 Infill Development SWM Practices

Comparable infill development guidelines, such as the City of Ottawa's Urban Design Guidelines for Low-Medium Density Infill Housing Update, 2009, will be reviewed to ensure the Township maintains current standards in infill stormwater management maintenance and design. Review of various municipal and provincial perspectives will allow for optimization of the Township's own practices.

10.5.3 Disposal of Materials Removed from Municipal Stormwater Facilities

IBI Group will provide the Township with advice on to how to deal with material that is occasionally removed from stormwater facilities such as storm ponds. Clean-out of accumulated sediments from storm ponds is needed from time to time, to maintain ECA compliance. Disposal of that material is an important cost consideration for pond clean-outs. We will review and summarize current regulatory requirements in this regard and provide the Township with a step-by-step procedure for designing a pond clean-out.

11 Notice of Study Completion

A Notice of Completion will be developed to provide the public with a final opportunity to comment on the project. The Notice will indicate the conclusions of the Master Planning/EA process, and will indicate where copies of the Master Plan can be reviewed. The Master Plan must be completed to document the Class EA process and must be filed for a 30 calendar-day public review.