



**City of Hamilton  
Airport Employment Growth District**

**AEGD Subwatershed Study &  
Stormwater Master Plan (SWMP)**

**Implementation Document**



**Final Report**

**April 2017**

**Version 2.2**



55 Regal Rd, Unit 3

Guelph, ON

N1K 1B6

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## City of Hamilton Airport Employment Growth District

# AEGD Subwatershed Study & Stormwater Master Plan (SWMP) - Implementation Document

## Process Checklist

The following Process Checklist has been developed in support of the AEGD Subwatershed Study & Stormwater Master Plan (SWMP) - Implementation Document (December 2016).

The Process Checklist is intended to be utilized by City staff and development proponents. The following is not intended to be comprehensive, but rather guide the user through the implementation process and identify key points of coordination, consultation, studies and approvals.

In general, the scope of each element identified below and the applicability to individual sites shall be confirmed through consultation with the City of Hamilton, the relevant Conservation Authority and relevant Provincial agencies.

All development proponents within the AEGD study area are required to complete an Environmental Impact Statement (EIS) for the subject property.

Step	Description	Impl. Doc Section	Other Reference	Completed/ Required
1	Identify policies and plans applicable subject property	2.4	1,2,3,4	
<b>2</b>	<b>Environmental Impact Statement (EIS)</b> See Section 4.1.1.6, Table 4.3	4.1.1, 4.2.3	11	
2a	Identify known Core Natural Heritage Features	2.8.1 & 4.1.1.6	1,2,3,4	
2b	Refer to City of Hamilton's Natural Heritage (NH) System mapping and other NH information sources including from relevant Conservation Authority	4.1.1	1,2,3,4,5	
2c	Consult with the City of Hamilton Natural Heritage Planning Staff and the relevant Conservation Authority to develop an approved Terms of Reference (TOR) for the EIS.	4.1.1	6	
2d	Conduct the necessary studies to complete the EIS	4.1.1	6	
2e	Submit the complete EIS report to the City of Hamilton and other applicable review agencies	4.1.1	-	
2f	Present EIS findings to the Environmentally Significant Areas Impact Evaluation Group (ESAIEG).	4.1.1	-	
2g	Revise and resubmit the EIS report for approval as required	4.1.1	-	

<b>3</b>	<b>Stormwater Management Criteria</b>			
3a	Consult the Low Impact Development Stormwater Management Guidance Manual (Pending 2017) for Provincial minimum on-site volume control targets and water balance requirements which may supersede the AEGD SWM Criteria.	2.9	-	
3b	Consult the Source Protection Plans (SPP)	2.8.2 & 2.9	7,8,9	
3c	Identify SWM Criteria per 2011 Stormwater Master Plan (Part B) for Flood Protection, Water Quality, Erosion, Infiltration and Natural Features	2.9.6	-	
3d	Identify changes to SWM Criteria (Steps 1 and 2) from approved EIS	-	-	
<b>4</b>	<b>Planning Stage Submission</b>	<b>4.6.1</b>	<b>10</b>	
4a	Geotechnical Investigation	4.2.4	-	
4b	In-Situ Hydraulic Conductivity Testing	4.2.5	-	
4c	Select preferred Source Controls	3.4	10	
4d	Determine dry-pond location for flood control	3.5	-	
4e	On-site flood control facility	3.5, 4.3 & 5.1	10	
4f	Model Selection	4.2.7.1	-	
4g	Hydrologic and Hydraulic modelling including subwatershed discretization and demonstrate agreement with flow reference stations.	4.2.7	10	
<b>5</b>	<b>Detailed Design Stage Submission</b>	<b>4.6.2</b>		
5a	Design of source controls	4.4, Appendix C	10	
5b	Structural design rooftop storage or green roofs	4.6.2	10	
5c	Design Brief	4.6.2	-	
5d	Detailed operation and maintenance plan with cost estimates	4.6.2	-	
5e	Monitoring Plan	4.6.2 & 7.0	-	
5f	Policy Considerations and City requirements	5.1	-	
<b>6</b>	<b>Approvals</b>	<b>4.5</b>		
6a	Conservation Authority - Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation (Ontario Regulation 97/04)	4.5.1	-	
6b	MOECC - Ontario Water Resources Act (OWRA) O.Reg 525/98 - Environmental Compliance Approval (ECA)	4.5.2	-	
6c	MNR - Endangered Species Act	4.5.3	-	
6d	Other Approvals	4.5	-	

Other References

1. City of Hamilton Urban Official Plan (Adopted by Council: July 9, 2009, MMAH Approved: March 16, 2011, and Effective Date: August 16, 2013) and applicable schedules.

2. City of Hamilton Rural Official Plan (Adopted by Council: September 27, 2006, MMAH Approved: December 24, 2006, and Effective Date: March 7, 2012) and applicable schedules.
3. Greenbelt Plan (2005). Note: The Minister of Municipal Affairs and Housing is issuing the Proposed Greenbelt Plan (2016) pursuant to the Greenbelt Act, 2005 for consultation. Final release is activated in early 2017.
4. AEGD Secondary Plan (OPA 38)
5. Natural Heritage Information Centre online make-a-map database
6. City of Hamilton. March 2015. Environmental Impact Statement (EIS) Guidelines.
7. Sulphur Creek Subwatershed - Halton Region Source Protection Area and the Hamilton Region Source Protection Area Version 3.2 (July 24, 2015 – effective December 31, 2015)
8. Big Creek Subwatershed - Grand River Source Protection Area within the Lake Erie Source Protection Region (November 26, 2015 – effective July 1, 2016)
9. Welland and Twenty Mile Creek Subwatersheds - Source Protection Plan for the Niagara Peninsula Source Protection Area (December, 2013 – effective October 1, 2014).
10. City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014)
11. City of Hamilton Public Works Department Hamilton Water Division Guidelines for Hydrogeological Studies and Technical Standards for Private Services (November 2013)

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## 1.0 INTRODUCTION

In 2011 The City of Hamilton completed a series of coordinated studies relating to the Airport Employment Growth District (AEGD). The AEGD is guided by a Secondary Plan and has been designed to provide for a major business park development which:

- Effectively integrates with and complements the existing John C. Munro Hamilton International Airport (HIA) and the existing residential development,
- Recognizes and allows for certain existing land uses to continue until such time that they are redeveloped, and
- Respects and enhances the prominent natural areas throughout the Secondary Plan area.

The plan protects natural features and provides for a limited range of employment-related commercial uses that serves employees of the Secondary Plan area. The AEGD is intended to offer a range of employment and employment-related land uses in the context of an eco-industrial park. In general, the eco-industrial park concept provides for prestige industrial, light industrial, airside industrial and airport related business development which all incorporate an environmental footprint that is managed through a range of urban and sustainable design techniques.

As part of the 2011 coordinated studies (including a Transportation, Water and Wastewater Servicing Master Plans) undertaken as part of the AEGD project, a Subwatershed Study and Stormwater Master Plan were also completed to establish a preliminary Natural Heritage System and a stormwater/groundwater management framework. The Subwatershed and Stormwater Master Plan studies were completed in a fully integrated, yet iterative process, which allowed for the concept of an eco-industrial park concept to be more fully explored, while giving more consideration to subwatershed study components. This has also led to the development of a Stormwater Master Plan that is also more integrated in regards to the environmental components of the subwatershed plan and the planning and infrastructure elements of the land use plan.

The Stormwater Master Plan, as with all AEGD Master Plans was prepared in accordance with the Master Plan process outlined by the Municipal Engineer's Association Municipal Class Environmental Assessment (MCEA), October 2000, as amended in 2007 and 2011 and satisfies Phases 1 and 2 of the MCEA.

The 2011 AEGD Subwatershed Study and Stormwater Master Plan was undertaken in three (3) distinct study phases (see **Section 2.6**). Note: the study phases do not correspond to the MCEA phases.

**Phase 1:** Identification and characterization of the existing environmental conditions, including environmental constraints and opportunities;

**Phase 2:** Evaluation of future land use impacts and development of a coordinated Subwatershed Strategy and Stormwater Master Plan, comprised of recommended strategies to address stormwater management and natural heritage; and

**Phase 3:** Unique to the AEGD coordinated studies, the Subwatershed Study and Stormwater Master Plan include a Phase 3. Phase 3 included the development of an Implementation Document to guide future work by the City and development proponents. The following Implementation Document represents Phase 3.

### ***1.1 Implementation Document Update***

On February 17th, 2015, the Ontario Municipal Board (OMB) approved the Airport Employment Growth District (AEGD) Secondary Plan (Appendix 24 of the Urban Hamilton Official Plan) which was based on the Minutes of Settlement signed by the City of Hamilton, Silvestri Investments, Twenty Road West Landowners Group, and Craig Smith.

The approved Secondary Plan includes a revised Land Use Schedule (**Figure 2.4.1**) showing lands subject to the Secondary Plan and ultimately to be added to the Urban Boundary. Compared to the initial Secondary Plan approved by Council in 2010, there are four notable geographic differences:

- Addition of land west of Highway 6 and east of Fiddler's Green Road;

- Addition of lands south of Book Road East, and west of Smith Road;
- Removal of Silvestri lands (south of Garner Road East, north of the Utility Corridor, and west of Smith Road); and,
- Removal of Twenty Road West lands (east of Glancaster Road, South of Twenty Road West, and North of Dickenson Road West) while maintaining a Garth Street Corridor.

Resulting from the OMB decision in 2015, the Implementation Document as originally written in January 2011 required revision to align it with current and emerging policies, guidelines and regulations as well as changes to the Secondary plan and proposed phasing. As such the following Implementation Document has been revised and updated to reflect current conditions.

The Subwatershed Study and Stormwater Master Plan (January 2011) document should be regarded as technical resources for subwatershed and stormwater management approaches, however the user must be cognisant that information contained therein may not be representative of current conditions and was not developed in the current policy context of 2016. As such mapping and other resources within the Subwatershed Study and Stormwater Master Plan (January 2011) may be revised, amended and / or superseded by more recent or pending mapping, studies, policies and guidelines, including but not limited to the following:

- City of Hamilton Urban Official Plan (Adopted by Council: July 9, 2009, Ministry of Municipal Affairs and Housing (MMAH) Approved: March 16, 2011, and Effective Date: August 16, 2013)
- City of Hamilton Rural Official Plan (Adopted by Council: September 27, 2006, MMAH Approved: December 24, 2006, and Effective Date: March 7, 2012)
- Conservation Authority mapping, policies and site specific studies.
- Provincial Policy Statement (2014)
- Clean Water Act and Source Protection Plans (SPP)
- City of Hamilton Environmental Impact Statement (EIS) Guidelines (March 2015)

- Ministry of the Environment and Climate Change (MOECC) Low Impact Development Stormwater Management Guidance Document (Pending 2017)

Consultation with the City of Hamilton, the respective Conservation Authority (Niagara Peninsula Conservation Authority (NPCA), the Hamilton Region Conservation Authority (HCA) and the Grand River Conservation Authority (GRCA), the Ministry of Natural Resources and Forestry (MNRF) or other agencies is recommended.

### ***1.2 Purpose of this Document***

The purpose of this Implementation Document is to present an implementation plan which guides the future work required to successfully implement the components of the Subwatershed Strategies and the Stormwater Targets which were established as part of the 2011 Subwatershed (Natural Heritage and Groundwater Plans) and Stormwater Master Plan studies.

This Implementation Document also identifies the policy and / or regulation changes that have occurred since the finalization of 2011 Subwatershed and Stormwater Master Plan studies and provides relevant direction.

### ***1.3 Report Outline***

Provided below is a brief overview of the content of the following Implementation Document:

**Section 1** - Provides the document introduction, document purpose and the report outline.

**Section 2** – Summarizes the AEGD Subwatershed Study (Part A) and Stormwater Master (Part B) Plan including the Eco-Industrial vision and objectives for the AEGD, description of the HIA airport constraints, an overview of the study area, land-uses, study approach and study phases. Most important, Section 2 also describes the Natural Heritage Plan, the Groundwater Management Plan and the Stormwater Management Plans including relevant environmental targets and criteria.

**Section 3** – Provides additional guidance with respect to the recommended stormwater management approaches of the Stormwater Master Plan and updates the flood control (dry-pond) location, phasing and cost estimates.

**Section 4** – Provides a detailed description of the various implementation considerations, including a comprehensive summary of the Environmental Impact Statements (EIS) requirements.

**Section 5** – Outlines the various municipal implementation considerations specifically policy considerations, staff training requirements as well as assumption protocols for the various features of the stormwater management master plan.

**Section 6** – Describes municipal operation and maintenance, specifically municipal management options, funding sources, and operations and maintenance requirements.

**Section 7** – Describes potential monitoring requirements.

**Section 8** - Lists the relevant document references.

## **2.0 SUMMARY: SUBWATERSHED STUDY & SWM MASTER PLAN**

The following sections are intended to provide the reader with a summary of the AEGD Subwatershed Study and the Stormwater Master Plan (January 2011) including the relevant background information as it pertains to the Eco-Industrial vision for the AEGD, study constraints, a description of the study area and jurisdiction, an overview of the proposed land uses, and the overall study approach.

For additional detail refer to the 2011 AEGD Subwatershed Study and Stormwater Management Master Plan.

### ***2.1 Eco Industrial Vision and Objectives for the AEGD***

As part of the land use planning framework for the AEGD a vision for the future growth of the area was developed along the lines of the eco-industrial concept. The overall vision and the natural environment principles are as follows:

*The Airport Employment Growth District is vibrant and visually appealing and the natural and cultural heritage resources in the area have been preserved and used to establish a distinct character for the area. It is a working community that attracts a range of airport related and other businesses providing both conventional and knowledge-based services. The environmental footprint of the area has been managed through a range of sustainable design techniques and the character of the surrounding land uses have been protected through appropriate land use transitions and transportation planning.*

### **2.2 Airport Constraints**

The AEGD Subwatershed Study and Stormwater Master Plan identified a series of constraints associated with the study area which effectively shaped the 2011 study outcomes and are important to note when moving through the implementation process, specifically:

#### **Air travel safety**

The use of open water end-of pipe facilities such as wet ponds and constructed wetlands were identified early in the process as a potential constraint. In compliance with Transport Canada's Document TP 1247, traditional storm water management wet-ponds (which

may attract birds and wildlife) are discouraged in the vicinity of an airport as such features attract water fowl and increase the likelihood of bird strikes during aircraft takeoff and landing activities. Therefore, the proximity of the Hamilton International Airport (HIA) to potential development lands within the AEGD, inherently limited the use of traditional open water type end-of-pipe stormwater facilities, such as wet-pond and wetlands, due to safety concerns.

### **Existing Drainage Features**

The surface drainage features within the AEGD study area make up the extreme headwaters of four (4) watersheds (see **Section 2.3.1**):

1. Welland River
2. Twenty Mile Creek
3. Sulphur Creek
4. Big Creek

The vast majority of these features within the above noted watershed exist as altered or improved agricultural drainage, vegetated swales through agricultural fields, roadside ditch features and natural drainage features in varying states of preservation. These relatively low gradient features provide little to no opportunity to outlet conventional stormwater management systems (subsurface pipes at depth) to the existing drainage features without significant watercourse alteration or great expense.



## **2.3 Study Area**

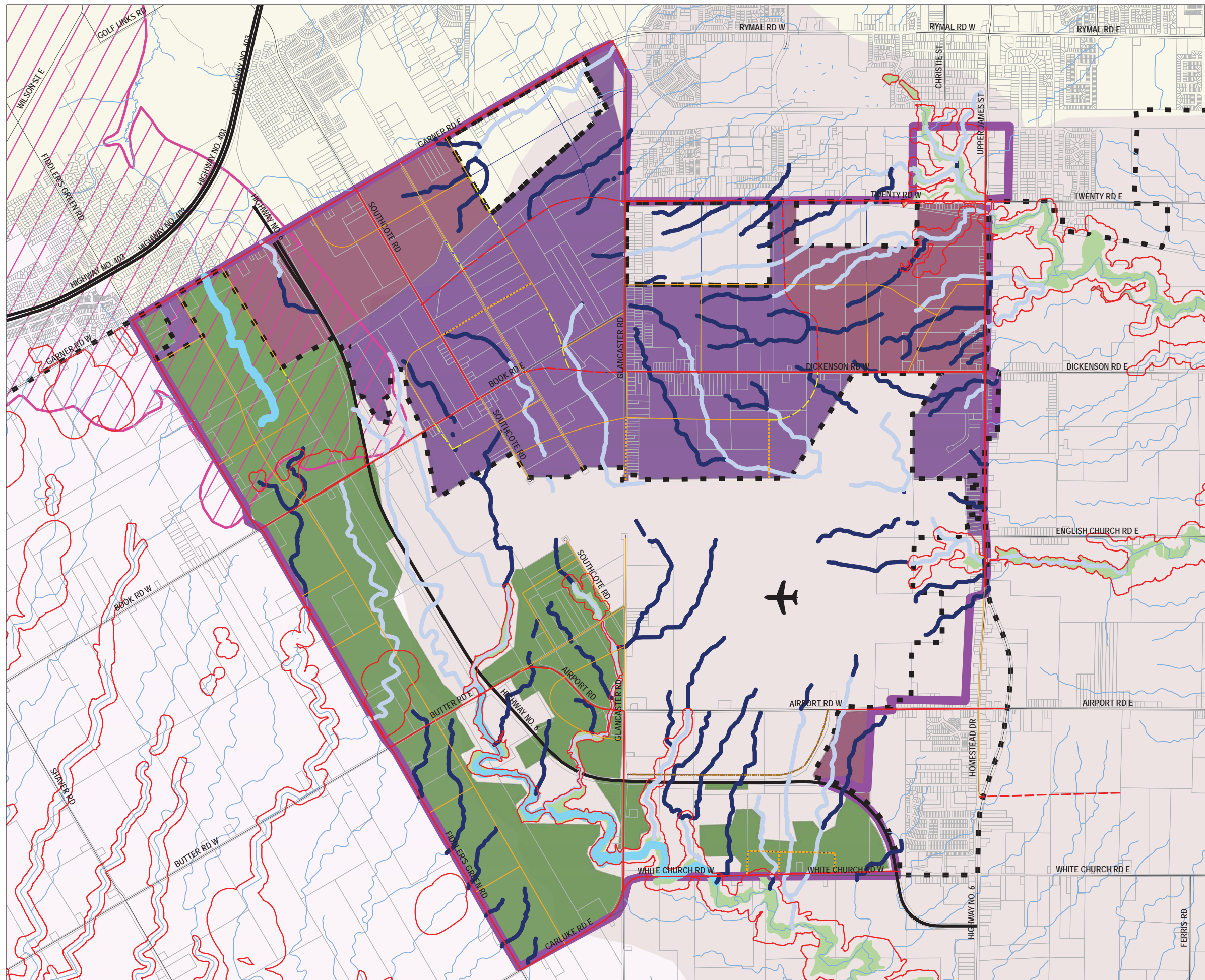
The entire AEGD study area encompasses approximately 2,800 hectares of land (excluding the Greenbelt). Located in the west end of Glanbrook, extending between Garner Road / Twenty Road West in the north and Carluke Road East / White Church Road in the south, Fiddler's Green Road in the west and Upper James Street in the east. The Secondary Plan Area (phase 1 and phase 2) comprises approximately 692 net hectares of land (**Figure 2.3**).

### **2.3.1 Study Area Jurisdiction and Policy Framework**

As discussed previously, the AEGD Study area is composed of four (4) watersheds (Welland River, Twenty Mile Creek, Sulphur Creek and Big Creek) within the jurisdiction of three (3) Conservation Authorities (**Figure 2.3.1**):

1. Niagara Peninsula Conservation Authority (NPCA) - Welland River, Twenty Mile Creek
2. Hamilton Region Conservation Authority (HCA) - Sulphur Creek
3. Grand River Conservation Authority (GRCA) - Big Creek

The majority of the lands which make up the AEGD are within the Twenty Mile Creek and the Welland River watershed under the jurisdiction of the NPCA. Relatively smaller portions of the study area are within the Sulphur Creek watershed to the north and the Big Creek watershed to the east under the jurisdiction of HCA and the GRCA respectively.



**Phasing**

- Phase 1 - Short Term
- Phase 2 - Medium Term
- Additional Study Area - Long Term

**Transportation Master Plan**

- Major Arterial Road
- Minor Collector Road
- Minor Collector Road (Potential Alignment)
- Major Collector Road (Potential Alignment)
- Major Arterial Road (Potential Alignment)
- Proposed Service Road (Potential Alignment)

**MNRF Fish Habitat Buffers**

- Support/Indirect Fish Habitat (30m)\*†
- Seasonal/Warmwater Habitat (30m)†
- Coldwater Habitat (60m)‡

**Conservation Authority Jurisdiction**

- Grand River Conservation Authority
- Hamilton Conservation Authority
- Niagara Peninsula Conservation Authority

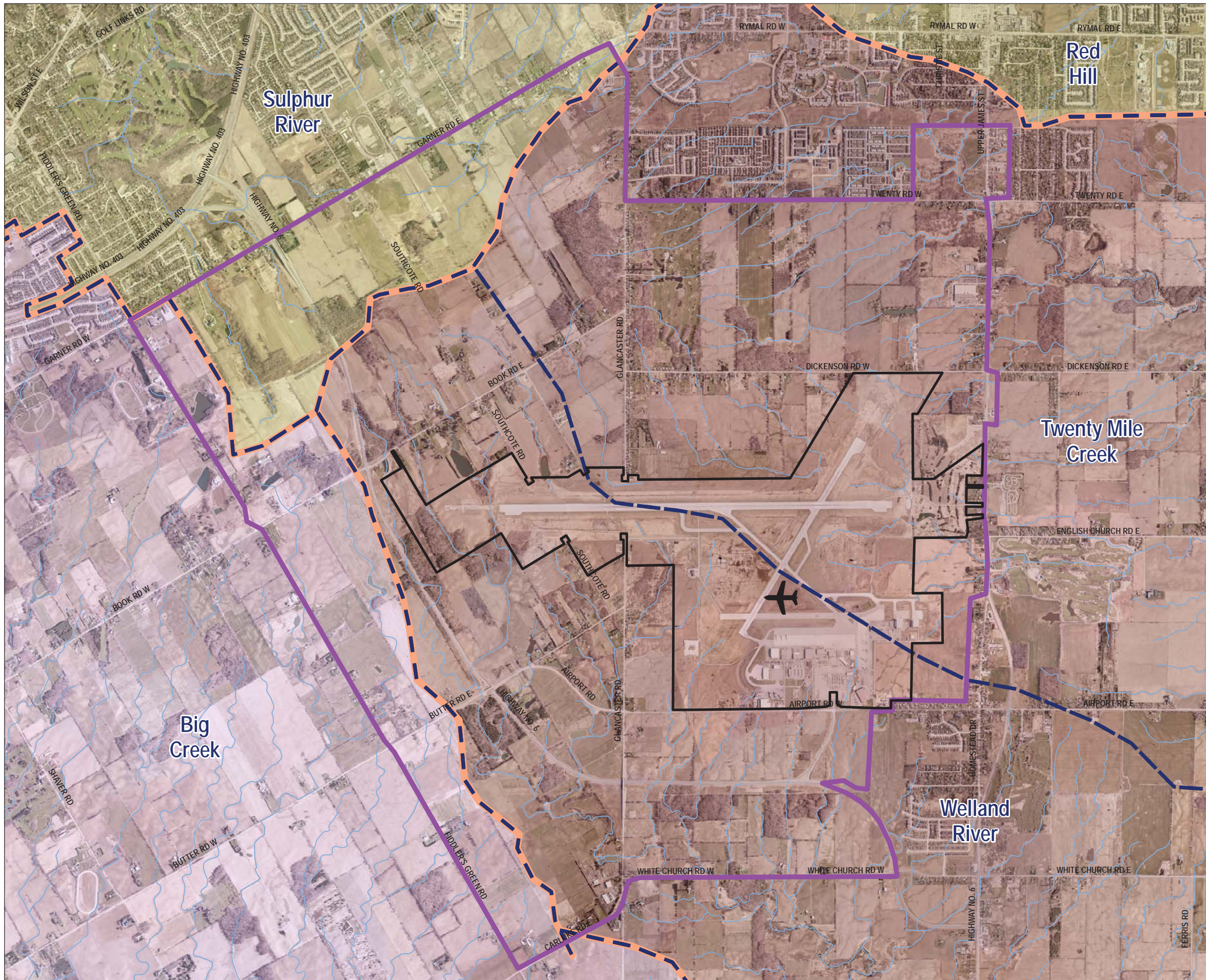
**Other Features**








- High Recharge potential
- Floodplain
- Generic Regulation Lines\*\*
- Airport Employment Growth District Study Boundary
- Urban Boundary

**Notes:**

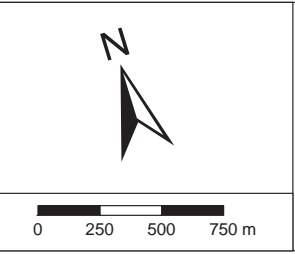
- \* If watercourse is retained as an enhanced feature.
- \*\* Generic regulations include a 30 m buffer on all watercourses. Not all features regulated by the relevant Conservation Authority are mapped.
- † Buffer based on 15m from each bank
- ‡ Buffer based on 30m from each bank

**Figure 2.3**  
**Airport Employment Growth District**  
**Phasing**



-  Airport Employment Growth District Study Boundary
  -  Watershed Boundary
  -  John C Munro Hamilton International Airport
  -  Conservation Authority Jurisdiction Boundary
- Conservation Authority Jurisdiction**
-  Grand River Conservation Authority
  -  Hamilton Conservation Authority
  -  Niagara Peninsula Conservation Authority

**Figure 2.3.1**  
**Airport Employment Growth District**  
**Conservation Authority Boundaries**




April 2017

Planning and Economic Development Department

## **2.4 City of Hamilton Official Plans**

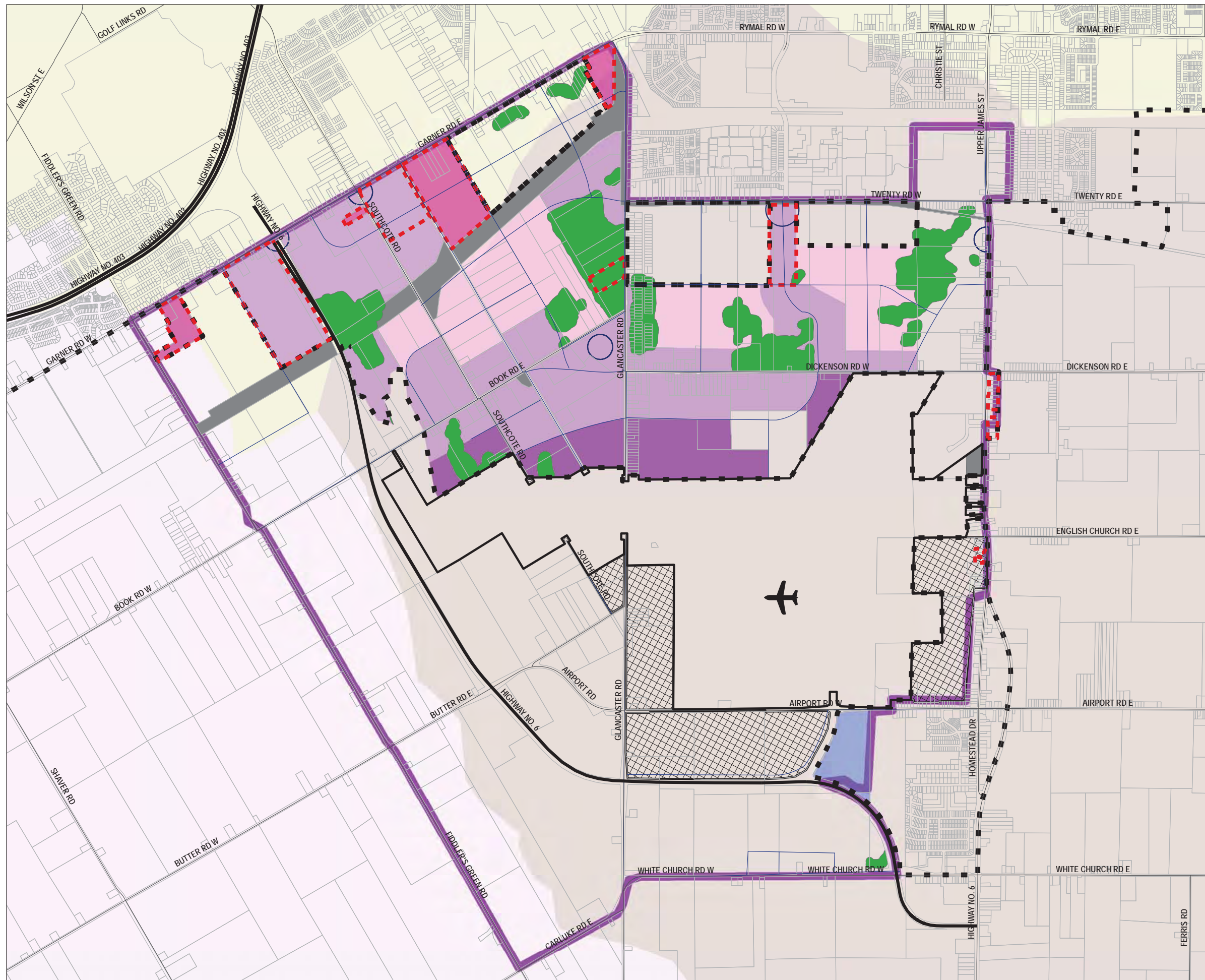
The AEGD study area falls within lands governed by the Rural Hamilton Official Plan (City of Hamilton, 2012) and the Urban Hamilton Official Plan (City of Hamilton, 2013). The Airport Employment Growth District Secondary Plan (Official Plan Amendment 35) provides further direction for land use planning within the study area, and “establishes to phasing, specific land uses, the transportation network, infrastructure requirements, design principles and development standards to guide the development and/or redevelopment of lands in the Airport Employment Growth District Secondary Plan Area” (City of Hamilton, 2015<sup>2</sup>). Land uses specified under the Secondary Plan are illustrated in **Figure 2.4.1** and discussed in **Section 2.4.1**, below.

### **2.4.1 Land Uses**

The AEGD is intended to offer a range of employment and employment-related land uses in the context of an eco-industrial park which effectively integrates with the existing HIA lands. In general, this eco-industrial park concept provides for the following land uses.

- **Prestige Business Park (PBP)** - characterized by high quality urban design and sustainable development standards which focus on business/financial services, research and development, offices, prestige/light industrial, warehousing, wholesale trade, transportation, communication and government services.
- **Airside Industrial (AI)** - characterized by high quality urban design and sustainable development standards which focus on clustering accommodation, food and catering services, convention centres, research & development, offices, business/financial services, automobile rental, taxi terminals, and Employment Support and supporting services.
- **Airport Related Business (ARB)** - located adjacent to the HIA, will have direct access to the airside and will be focused for businesses that require airside access, such as freight-forwarders, regional integrator operations (i.e. FedEx, UPS) and on-site customs brokers. This designation will have minimum standards for urban design but will require a high level of sustainable design.


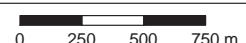
- **Airport Light Industrial (IND)** - designation allows a broad range of employment uses, including light industry, warehousing, repair service, wholesale trade, office, distribution, transportation, communication and utilities. This designation will have minimum standards for urban design but will require a high level of sustainable design.



- Land Use**
- Airport Light Industrial
  - Airport Prestige Industrial
  - Airport Gateway Employment
  - Airport Prestige Business
  - Airside Industrial
  - Institutional
  - Natural Open Space
  - Airport Reserve
  - Utilities
- Other Features**
- Area or Site Specific Policy
  - Employment Supportive Centres
  - + John C Munro Hamilton International Airport
  - Airport Employment Growth District Study Boundary
  - Urban Boundary
- Conservation Authority Jurisdiction**
- Grand River Conservation Authority
  - Hamilton Conservation Authority
  - Niagara Peninsula Conservation Authority

**Notes:**  
Lands within the study area that are not within the Urban Boundary as shown are subject to the policies of the Rural Hamilton Official Plan (2012).

**Figure 2.4.1  
Airport Employment Growth District  
Land Use**



January 2017

Planning and Economic Development Department

## ***2.5 Study Approach – General***

The overall planning for the AEGD project included the development of an overall land use plan and individual component infrastructure studies covering transportation, water and wastewater and stormwater management/natural heritage systems planning.

In part, the end product of this planning exercise was a framework for the development of the AEGD lands that is consistent with municipal and provincial policy and a set of planning documents and urban design guidelines that outline how development and associated infrastructure will be constructed to meet the growth objectives, while protecting human and natural environmental values. In addition, the master plans and capital elements of the infrastructure study components were developed to satisfy the requirements of the Municipal Class Environmental Assessment process for master plans (Approach #2 – A.2.7). The land use planning and infrastructure studies comprehensively addressed planning, development and environmental protection within the study area and were sensitive to the future needs of the Airport and its future land requirements.

Where in the past a Subwatershed Study would be prepared in advance of and separate from the Secondary Planning Study, thus establishing the Natural Heritage system and stormwater/groundwater management framework within which the secondary plan would be developed; in this case (as is becoming more common), the two studies were completed in a fully integrated, yet iterative process, which allowed for the concept of an eco-industrial park concept to be more fully explored, while at the same giving more consideration to subwatershed study components. This also led to the development of a Stormwater Master Plan that is more integrated between the environmental components of the subwatershed plan and the planning and infrastructure elements of the land use plan due to need to utilize Low Impact Development (LID) measures extensively as part of the overall plan.

This study approach involved the preparation of a Master Plan document at the conclusion of Phase 1 and 2 of the Municipal Class EA process. The assessment within the master plan satisfies Phases 1 and 2 of the Class EA process for Schedule B projects.

## **2.6 Study Phases**

The 2011 AEGD Subwatershed Study and Stormwater Master Plan was undertaken in three (3) phases. Phases 1 and 2 are summarized within the subsequent sections.

### **2.6.1 Study Phase 1 & Phase 2**

Phase 1 of the process provided a description of the existing conditions associated with each of the component studies as well as outlining the current planning framework in which the AEGD project has been developed. Phase 1 studies are reported in two separate documents:

- Phase 1- Land Use Planning Report
- Phase 1- Infrastructure Component Report

These documents provided the background and context, key finding and recommendations as they relate to the Natural Heritage System (Terrestrial & Aquatic), Groundwater Resources, and Stormwater Management. These documents were intended to provide guidance and direction for subsequent phases of the study. These Phase 1 documents are stand alone documents that are not included as part of the subsequent Phase 2 study documents.

Phase 2 of this process involved the completion of the Subwatershed Study and the Stormwater Master Plan components as detailed in **Section 2.7**.

### **2.7 Phase 2 - Subwatershed Study & Stormwater Master Plan**

The following section provides a summary of the 2011 Subwatershed Study (**Part A**) and the Stormwater Master Plan (**Part B**) components which collectively comprise Phase 2 of the study. The Subwatershed Study outlines an overall environmental plan for the study area, while the Stormwater Master Plan follows the Class EA process and describes the process of selecting the preferred alternative. In addition, the Stormwater Master Plan identifies the environmental criteria to be addressed in order for development to proceed.



### 2.7.1 Provincial Policy Statement

Since the development of the 2011 Subwatershed Study (Part A) and the Stormwater Master Plan (Part B), the 2005 Policy Statement (PPS) has been updated by the Ontario Ministry of Municipal Affairs and Housing (MMAH) as represented by the 2014 Provincial Policy Statement (PPS).

The Provincial Policy Statement is issued by the MMAH under Section 3 of the Planning Act. The Planning Act sets out the ground rules for land use planning in Ontario and describes how land uses may be controlled, and who may control them.

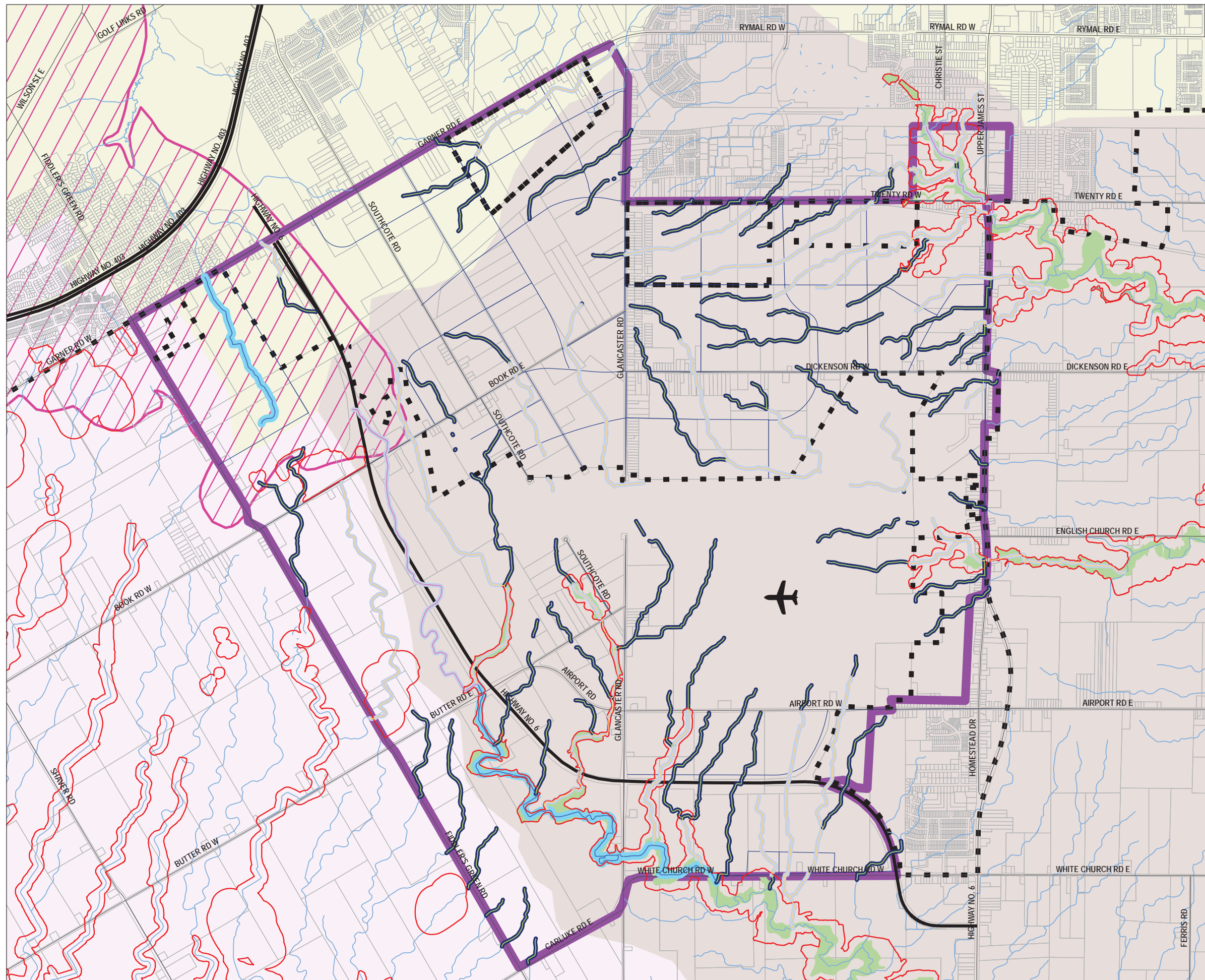
It requires that decisions affecting planning matters in Official Plans “shall be consistent with” the PPS. The PPS provides “for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural environment”. The PPS focuses growth within settlement areas and away from significant or sensitive resources. It directs planning authorities to identify and promote opportunities for intensification and redevelopment where this can be accommodated, taking into account existing building stock, including existing or planned infrastructure. The PPS provides a higher degree of protection for employment lands against conversions to residential uses. The new policies also provide for intensifications and brownfields development to ensure the maximum use of sewer, water and energy systems, roads and transit. The Official Plan is the most important tool to implement the PPS.

Where relevant, the subsequent sections of this Implementation Document detail changes resulting from the 2014 PPS which may impact the 2011 Subwatershed Study (**Part A**) and the Stormwater Master Plan (**Part B**), the associated management plans and the overall implementation processes.

## **2.8 Part A: Subwatershed Study**

The 2011 Subwatershed Study (**Part A**) outlines the environmental plan for the AEGD study area. The Subwatershed Study defined the environmental constraints and opportunities for the AEGD study area through scoped field investigations, aerial reconnaissance, modeling and monitoring. This included the following:

- Select field investigations including a scoped headwaters tributary assessment to assess their current function, physical characteristics, in stream and adjacent vegetation types. Streams were generally classified into five (5) headwater feature types; permanent feature, small stream, urban feature (newly constructed), urban feature (older construction) and agricultural feature.
- Further refinement of Phase 1 fish habitat classification for the purpose of defining preliminary setback / buffer requirements (**Figure 2.8.1: Aquatic Resources**). Vegetation Protection Zone Requirements (i.e. watercourse buffer requirements) are discussed in **Section 2.8.1, Tables 2.8.2 and 2.8.3**.
- Review of background environmental studies, select field investigations and desktop exercises to define surface drainage patterns, drainage mosaic and catchment characteristics for Twenty Mile Creek and Welland River (NPCA), Sulphur Creek (HCA) and Big Creek (GRCA).
- A detailed 12-month field water quality monitoring program including benthic macroinvertebrate sampling, to assess water quality and contaminant loadings at eight (8) study area locations.
- Further refinement to terrestrial mapping through background review and agency consultation (**Figure 2.8.2: Terrestrial Resources**). Note: site specific investigations were not undertaken as part of the Subwatershed Study.
- Review of background environmental studies, field investigations to define the study area soils and groundwater characteristics within the study area, assess infiltration potential and define source water protection implications.



**Fish Community Type**

- Cool/Cold
- Seasonal
- Support/Indirect Fish Habitat
- Warm

**MNRF Fish Habitat Buffers**

- Support/Indirect Fish Habitat (30m)\*†
- Seasonal/Warmwater Habitat (30m)†
- Coldwater Habitat (60m)‡

**Conservation Authority Jurisdiction**

- Grand River Conservation Authority
- Hamilton Conservation Authority
- Niagara Peninsula Conservation Authority

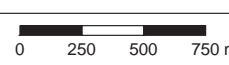
**Other Features**


- High Recharge potential
- Floodplain
- Generic Regulation Lines\*\*
- Airport Employment Growth District Study Boundary
- Urban Boundary

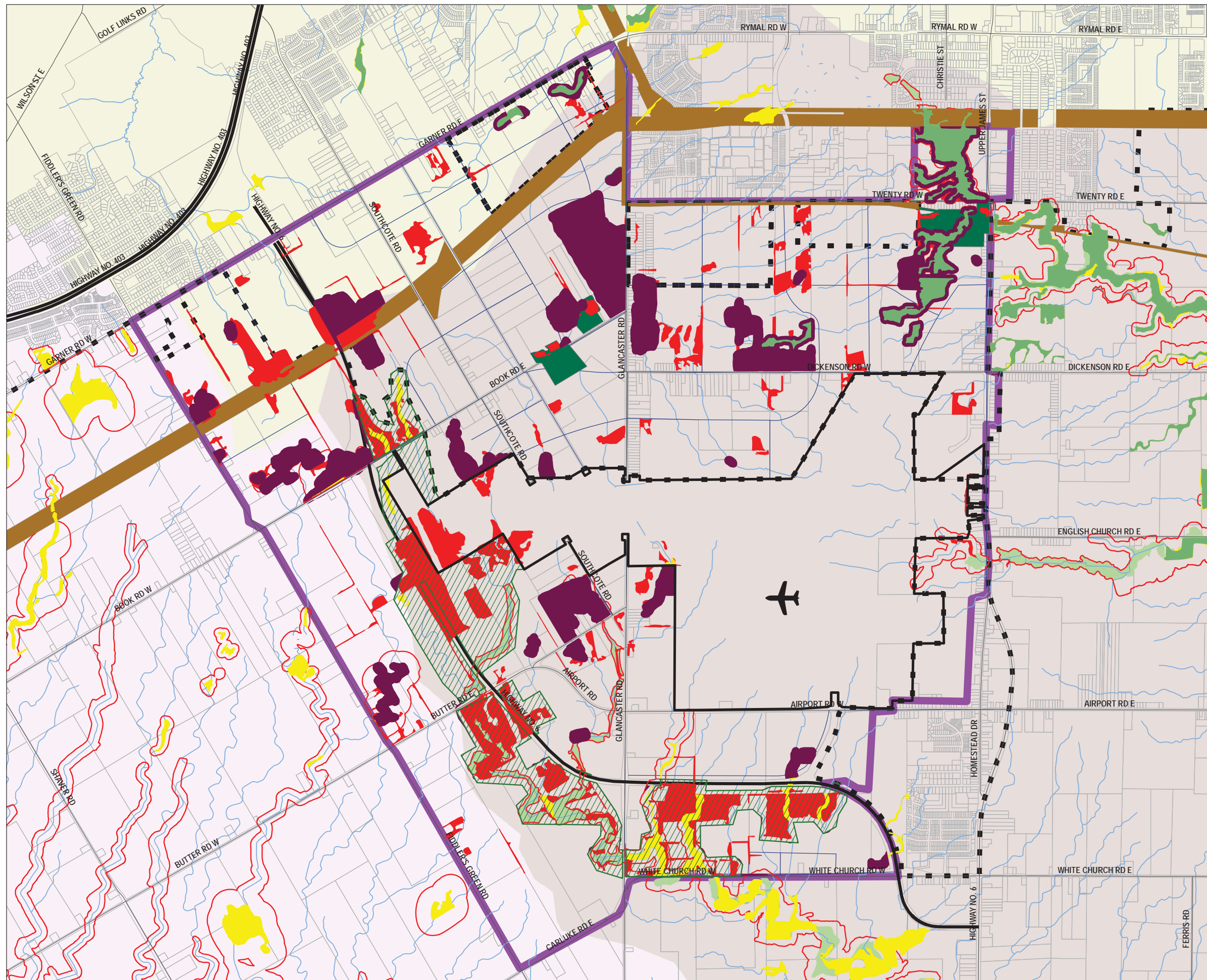
**Notes:**

- \* If watercourse is retained as an enhanced feature.
- \*\* Generic regulations include a 30 m buffer on all watercourses. Not all features regulated by the relevant Conservation Authority are mapped.
- † Buffer based on 15m from each bank
- ‡ Buffer based on 30m from each bank

**Figure 2.8.1**  
**Airport Employment Growth District**  
**Aquatic Resources**

  
 April 2017  
 Planning and Economic Development Department



- Greenbelt Areas
- Provincially Significant Wetlands
- Significant Woodlots
- Local Wetlands
- Other Woodlots
- Linkages - Hydro Corridor
- Linkages - Other\*\*\*
- Conservation Authority Jurisdiction**
- Grand River Conservation Authority
- Hamilton Conservation Authority
- Niagara Peninsula Conservation Authority
- Other Features**
- Airport Boundary
- Floodplain
- Generic Regulation Lines\*\*
- Airport Employment Growth District Study Boundary
- Urban Boundary

Notes:  
 \* If watercourse is retained as an enhanced feature.  
 \*\* Generic regulations include a 30 m buffer on all watercourses. Not all features regulated by the relevant Conservation Authority are mapped.  
 \*\*\*Linkages per AEGD Secondary Plan Natural Heritage System Map B.8-2 (City of Hamilton, Feb 4 2015).  
 † Buffer based on 15m from each bank  
 ‡ Buffer based on 30m from each bank

**Figure 2.8.2**  
**Airport Employment Growth District**  
**Terrestrial Resources**

April 2017

Planning and Economic Development Department

Subsequent activities assessed the issues, opportunities and constraints associated with the study area from a natural environment and water management perspective in order to develop subwatershed goals and objectives, evaluate future land uses and assess potential impacts and ultimately to develop a subwatershed plan.

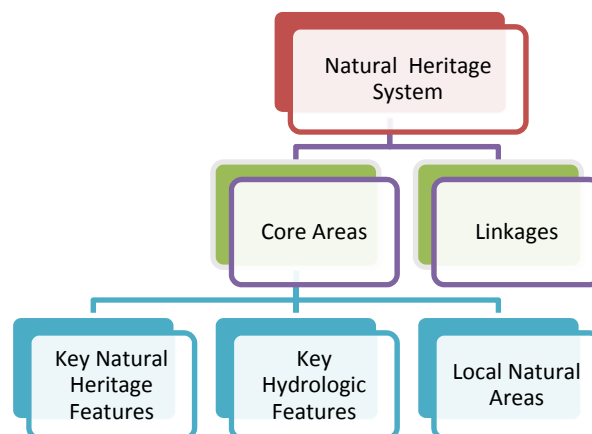
The 2011 AEGD Subwatershed Plan consists of three (3) general components:

1. Natural Heritage Plan component – See **Section 2.8.1**
2. Groundwater Management component - See **Section 2.8.2**
3. Surface Water Management component (Part B – Stormwater Master Plan – See **Section 2.9**)

A summary of the three (3) individual components of each category are discussed in the subsequent sections.

### 2.8.1 Natural Heritage Plan Component

The City of Hamilton has taken a nested approach to natural heritage system planning. The Natural Heritage System (NHS) is comprised of Core Areas and Linkages, as illustrated below in **Figure 2.8.1**. The City of Hamilton (2012, 2013) defines Core Areas as *Key Natural Heritage Features*, *Key Hydrologic Features*, and *Local Natural Areas*. Collectively, Core Areas and Linkages compliment one another in the context of the greater NHS. Associated minimum Vegetation Protection Zones (VPZs) are also considered part of the NHS.



**Figure 2.8.1: The City of Hamilton's Approach to Natural Heritage Planning**

The City of Hamilton's Rural (2012) and Urban (2013) Official Plans defines Core Areas as Key Natural Heritage Features, Key Hydrologic Features and Local Natural Areas. Specific definitions for each of these elements are contained within **Section 4.1.1**

**Key Natural Heritage Features** are defined as:

- Significant habitat of endangered, threatened, and special concern species;
- Fish habitat;
- Wetlands;
- Life Science Areas of Natural and Scientific Interest (ANSIs);
- Significant valleylands;
- Significant woodlands;
- Significant wildlife habitat;
- Sand barrens, savannahs, and tallgrass prairies; and,
- Alvars.

**Key Hydrologic Features** are defined as:

- Permanent and intermittent streams;
- Lakes (and their littoral zones);
- Seepage areas and springs; and,
- Wetlands.

**Local Natural Areas** are defined as:

- Environmentally Significant Areas as identified by the City of Hamilton;
- Unevaluated wetlands; and,
- Earth Science Areas of Natural and Scientific Interest.

The City of Hamilton (2012, 2013) defines **Linkages** as landscape areas that connect natural areas. Linkages may include the following:

- Woodland linkages (e.g. small woodlands);
- Other natural vegetation types (e.g. meadows, old field, thickets); and
- Streams and watercourses that connect Core Areas.

A more thorough definition of Linkages, as provided by the City of Hamilton, is:

Linkages are ... landscape areas that connect natural areas. Linkages are also important natural features, either in their own right or through restoration activities. They are avenues along which plants and animals can propagate, genetic interchange can occur, populations can move in response to environmental changes and life cycle requirements, and species can be replenished from other natural areas. Conserving linkages also protects and enhances Core Areas.

The City of Hamilton’s definitions of (i) woodland linkages and (ii) other natural vegetation types vary between the Urban and Rural Official Plans (**Table 2.8.1**). The primary difference between the two being that the Rural Official Plan does not specify the minimum size criteria for linkages. However, because 0.5 ha is the minimum size for vegetation units on Official Plan maps, despite the specified difference between the two, the definitions are essentially the same because the mapping uses the same minimum designable unit size.

**Table 2.8.1: City of Hamilton definitions of woodland linkages and other natural vegetation types.**

Term	Definition – Urban Official Plan	Definition – Rural Official Plan
Woodland linkage	Any natural or planted wooded area of any size or composition of 0.5 ha or more in size that either connects or lies within 100 m of a Core Area.	Any natural or planted wooded area of any size or composition that either connects or lies within 100 m of a Core Area.
Other natural vegetation types	Any meadow, thicket, or old field at least 0.5 ha in size that connects Core Areas or is situated within 100 m of a Core Area.	Any meadow, thicket, or old field that connects Core Areas or is situated within 100 m of a Core Area.

Specific Linkage types, i.e. Woodland Linkages and Other Natural Vegetation Types, are not recognised in the City’s Urban OP (2013).

In addition to Linkages, there may be Hedgerows that are worthy of protection, especially where:

- a) they are composed of mature, healthy trees and generally provide a wide, unbroken linkage between Core Areas;
- b) there is evidence that wildlife regularly use them as movement corridors or habitat;
- c) they contain tree species which are threatened, endangered, special concern, provincially or locally rare; or,
- d) groupings of trees which are greater than 100 years old. (City of Hamilton, 2013)

**Vegetation protection zones (VPZs)**, sometimes referred to as buffers, are required to aid in mitigating potential adverse environmental impacts to natural features and habitats resulting from development and/or site alteration. VPZs are vegetated physical separations between natural features and development areas intended to preserve the ecological integrity of natural features and their associated processes (MNR 2010). VPZ recommendations for Core natural Heritage Features are discussed below in a general sense given the absence of proposed development plans for each developable area in the study area. Context is of paramount importance: it is recommended that the VPZ widths outlined in this report be revisited through the completion of an EIS as new information regarding potential development proposals becomes available. Once VPZs are determined, they become part of the NHS. VPZs are to be imposed only where new development and/or site alteration is to occur but will not affect lands which are within the study area but not being proposed for development and / or site alteration. Minimum VPZ requirements for Core Natural Heritage Features in Rural and Urban areas as required by the City of Hamilton are summarized in **Table 2.8.2** and **Table 2.8.3**, below. Note that some definitions vary between the two Official Plans.



**Table 2.8.2: Minimum Vegetation Protection Zone Requirements for Rural Areas as Required by the City of Hamilton (adapted from City of Hamilton 2013)**

<b>Core Natural Heritage Feature</b>	<b>Minimum Vegetation Protection Zone Requirements, Rural Areas</b>
<b>Permanent and Intermittent Streams</b>	30 m VPZ on each side of the watercourse, measured from the bankfull channel.
<b>Fish Habitat</b>	30 m VPZ measured from either side of the top of bank or meanderbelt allowance.
<b>Wetlands</b>	30 m VPZ, measured from the boundary of the wetland.
<b>Woodlands</b>	15 m VPZ, measured from the edge (drip line) of the woodland.
<b>Significant Woodlands</b>	30 m VPZ, measured from the edge (drip line) of the significant woodland.
<b>ANSIs</b>	Areas of Natural and Scientific Interest require a 30 m VPZ.
<b>Designated Valleylands</b>	15 m VPZ, measured from the top of bank.

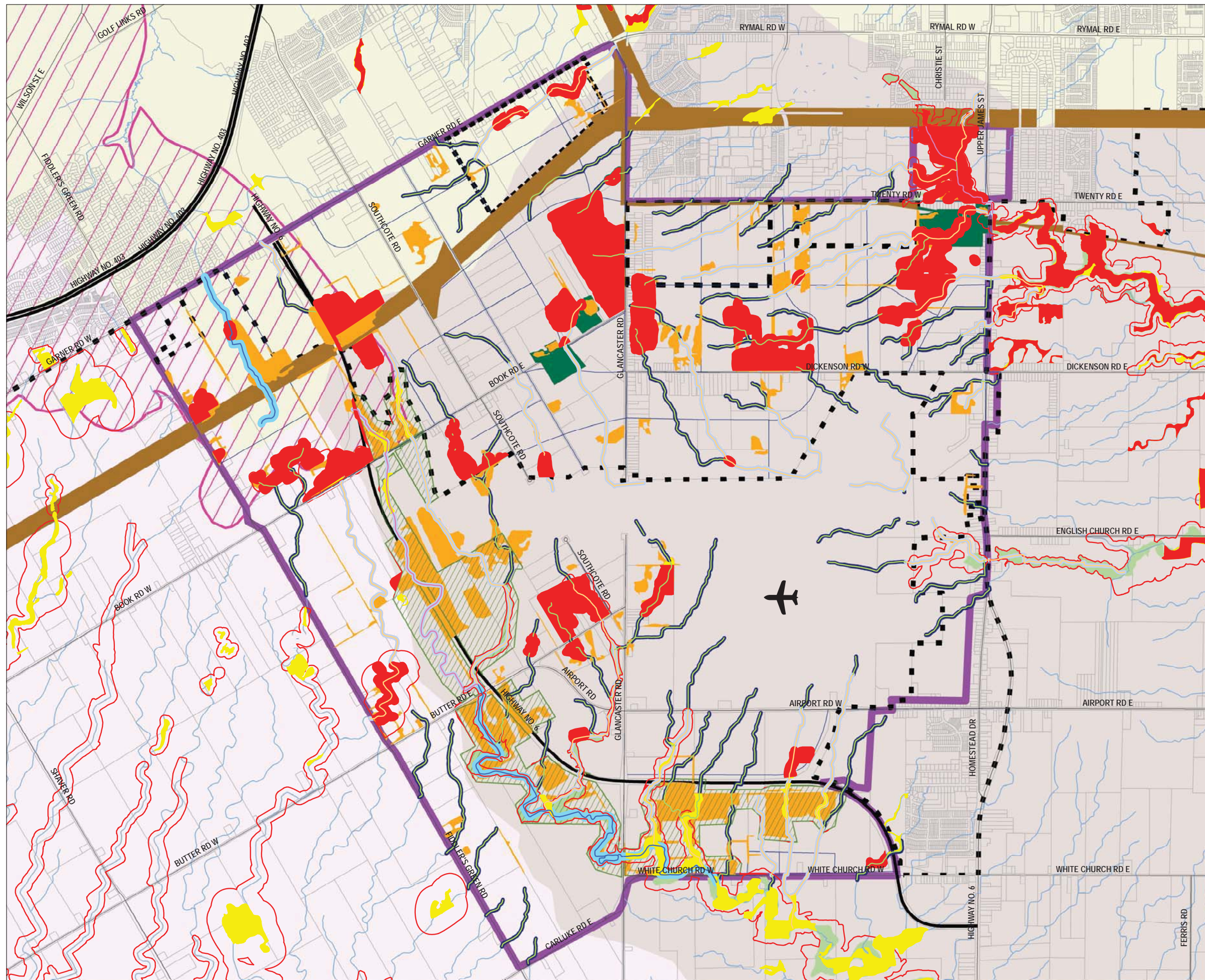
**Table 2.8.3: Minimum Vegetation Protection Zone Requirements for Urban Areas as Required by the City of Hamilton (adapted from City of Hamilton 2012)**

<b>Core Natural Heritage Feature</b>	<b>Minimum Vegetation Protection Zone Requirements, Urban Areas</b>
<b>Coldwater Watercourses and Critical Fish Habitat</b>	30 m VPZ on each side of the watercourse, measured from the bankfull channel.
<b>Warmwater Watercourse and Important and Marginal Fish Habitat</b>	15 m VPZ on each side of the watercourse, measured from the bankfull channel.
<b>Provincially Significant Wetlands</b>	30 m VPZ, measured from the boundary of the wetland, as approved by the Conservation Authority or MNRF.
<b>Locally Significant Wetlands and Unevaluated Wetlands</b>	15 m VPZ, measured from the boundary of the wetland, as approved by the Conservation Authority or MNRF, unless an EIS recommends a more appropriate VPZ.
<b>Woodlands</b>	10 m VPZ, measured from the edge (drip line) of the woodland.
<b>Significant Woodlands</b>	15 m VPZ, measured from the edge (drip line) of the significant woodland.
<b>ANSIs</b>	Areas of Natural and Scientific Interest require a 15 m VPZ.
<b>Designated Valleylands</b>	As required by the Conservation Authority.
<b>Significant Habitat of Threatened or Endangered Species and Significant Wildlife Habitat</b>	The VPZ shall be determined through an EIS, dependent on the sensitivity of the feature.

### ***2.8.1.1 Recommended Natural Heritage System***

The Natural Heritage Plan contained within this document identifies a preliminary NHS consisting of Core Areas and Linkages as defined by the City of Hamilton (2012, 2013) as well as definitions specific to fish habitat as detailed above. The NHS is to be protected within the proposed land use plan. The Natural Heritage Plan also provides guidance for the preparation of Environmental Impact Statements (EIS) for lands within and/or adjacent to the NHS.

The Recommended Natural Heritage System as presented in **Figure 2.8.3** represents a preliminary understanding of the Core Areas and Linkages within the study area as defined by the City of Hamilton (2012, 2013). As detailed site specific field work was not completed as part of the planning process, detailed context-appropriate surveys and assessments must be completed at subsequent stages of the planning process in order to confirm NHS designations as shown in the City of Hamilton's Official Plans and to determine if natural heritage features in addition to those identified by the City are present (i.e. through the completion of an Environmental Impact Statement (EIS); see **Section 4.1: Future Studies** for further direction). As part of an EIS, the proponent must determine if Core Areas and / or Linkages are present within or adjacent to the property of interest and will be responsible for delineating natural heritage feature boundaries as applicable.



**Areas for Protection**

- Greenbelt Areas
- Floodplain
- Core Areas
- Local Wetlands

**Fish Community Type**

- Cool/Cold
- Seasonal
- Support/Indirect Fish Habitat
- Warm

**MNRF Fish Habitat Buffers**

- Seasonal/Warmwater Habitat (30m)†
- Coldwater Habitat (60m)‡

**Potential Enhancement Areas\***

- Linkages - Other Woodlots
- Linkages - Hydro Corridor
- Linkages - Other\*\*\*\*
- Support/Indirect Fish Habitat (30m)\*†
- High Recharge potential
- Generic Regulation Lines\*\*

**Conservation Authority Jurisdiction**

- Grand River Conservation Authority
- Hamilton Conservation Authority
- Niagara Peninsula Conservation Authority
- Airport Employment Growth District Study Boundary
- Urban Boundary

**Notes:**

- \*Subject to detailed EIS study
- \*\*if watercourse is retained as an enhanced feature.
- \*\*\*Generic regulations include a 30 m buffer on all watercourses. Not all features regulated by the relevant Conservation Authority are mapped.
- \*\*\*\*Linkages per AEGD Secondary Plan Natural Heritage System Map B.8-2 (City of Hamilton, Feb 4 2015).

**Figure 2.8.3**  
**Airport Employment Growth District**  
**Recommended Natural Heritage System**

0 250 500 750 m

The Recommended Natural Heritage System (**Figure 2.8.3**) consists of the following areas to be protected:

- Greenbelt Natural Heritage System lands;
- Core Areas;
- Linkages\*;
- Floodplains – Floodplain mapping has been completed through hydraulic and hydrologic modelling for the 2yr-100yr storms for the AEGD, however Regional Floodplain assessments have not been completed for either Tiffany or Ancaster Creek (Sulphur Creek tributaries) upstream of Garner Road. The Regional Floodplain forms the basis of the CA regulations. Although the flood hazards are not expected to be significant given the location in the headwaters of these watercourses, any impacts on existing floodplain will be a consideration for the HCA and other Conservation Authorities in the evaluation of future development through the regulatory process; and,
- MNRF fish habitat corridors:
  - Seasonal/Warmwater Watercourses / Important/marginal Fish Habitat – The corridor width is defined as a 15m setback from each side of the bankfull channel width
  - Cool/Coldwater Watercourses / Critical Habitat – the corridor width is defined as a 30m setback from each side of the bankfull channel width.

\*It is important to note that identification of Linkages will require site-specific assessment that is outside of the scope of this project. As such, not all Linkages are illustrated in this report. See **Table 2.8.4** for further details.

In addition, there are a number of management actions that are recommended to enhance aquatic habitat within the Recommended Natural Heritage System:

- Cool/Coldwater Watercourses / Critical Fish Habitat: undertake a native, woody, riparian vegetation planting program to establish 75% of the stream corridor length in woody vegetation with the remainder as meadow or riparian wetland as appropriate;

- Seasonal/Warmwater Watercourses / Important/Marginal Fish Habitat: undertake a native, woody, riparian vegetation planting program to establish 75% of the stream corridor length in woody vegetation with the remainder as meadow or riparian wetland as appropriate;
- Coldwater and Warmwater Fish Habitat: these features should be protected in their current location and existing functions should be protected or enhanced. Enhancement could include improving morphology (pool/riffle), reducing overland sediment inputs and improving in-stream habitats;
- Seasonal Fish Habitat: these drainage features may be modified and relocated as necessary to facilitate development provided that their natural form and function is enhanced, subject to CA approval and potentially an assessment in accordance with the Evaluation, Classification, and Management of Headwater Drainage Features Guidelines (TRCA & CVC, 2014); and,
- Indirect/Support Fish Habitat / Marginal Fish Habitat: based on a preliminary assessment of these features, they may be replaced by Stormwater Infrastructure, including LID and end-of-pipe facilities to replicate their water quantity and quality function. Alternatively, they may be enhanced and protected within a corridor width of up to 30 m (plus the bankfull channel width). Their location may also be modified and relocated provided that their water quality and quantity functions are maintained and subject to CA approval and potentially an assessment in accordance with the Evaluation, Classification, and Management of Headwater Drainage Features Guidelines (TRCA & CVC, 2014).

Areas for Potential Enhancement (may be protected subject to additional studies) and Management Actions identified within the Natural Heritage Plan have been summarized within **Table 2.8.4: Summary of Natural Heritage Plan Implementation Process**. Additional detail is provided in the subsequent implementation section (**Section 4.0**).

**Table 2.8.4** also identifies the party or parties that are responsible for implementation of the specific management category and feature based on the following:

- **Development Proponents' Responsibility** – these works and measures are either directly related to future development or are expected to provide a direct benefit to the developing lands.
- **City / Agency Responsibility** – these works and measures are not directly related to, or expected to benefit the future urban development lands. Rather, these works are generally recommended to address existing issues, or to protect and enhance existing resources.

**Table 2.8.4: Summary of Natural Heritage Plan Implementation Process**

Feature	Process for Implementation	Responsibility for Implementation	Approval Authority
<p>All areas within or adjacent to identified Core Areas within the Recommended Natural Heritage System (<b>Figure 2.8.3</b>) See Table 2.8.2 for a listing of trigger distances.</p>	<p>Prepare an Environmental Impact Statement (EIS) as prescribed by the policies of the AEGD Secondary Plan to describe proposed development, assess potential environmental impacts and recommend appropriate mitigation measures.</p> <p>The EIS will be submitted to the City of Hamilton and relevant Conservation Authority as part of the development approval process and shall be completed as per the City of Hamilton's EIS Guidelines (2015) or most current. Consultation with the Ontario Ministry of Natural Resources and Forestry (MNR) may be required in order to adequately address species-at-risk.</p>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton In consultation with: NPCA GRCA HCA MNR</p>
<p>Linkages</p>	<p>Prepare a Linkage Assessment to describe proposed development, assess potential environmental impacts and recommend appropriate mitigation measures when development is proposed within Linkages.</p> <p>The Linkages Assessment will be submitted to the City of Hamilton and relevant Conservation Authority as part of the development approval process and shall be completed per the City of Hamilton's Linkage Assessment Guidelines (2015) or most current. On sites where an EIS is being prepared, the Linkage Assessment can be included as part of the EIS report.</p>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton In consultation with: NPCA GRCA HCA</p>
<p>Minimum Vegetation Protection Zones around Core Areas (included within <b>Figure 2.8.3</b>)</p>	<p>Prepare an Environmental Impact Statement (EIS) as prescribed by the policies of the AEGD Secondary Plan to describe proposed development, assess potential environmental impacts and recommend appropriate mitigation measures. Minimum Vegetation Protection Zones (VPZs) are specified in the City of Hamilton's Rural and Urban Official Plans (2012, 2013).</p> <p>The EIS will be submitted to the City of Hamilton and relevant Conservation Authority as part of the development approval process and shall be completed as per the City of Hamilton's EIS Guidelines (2015) or most current.</p>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton In consultation with: NPCA GRCA HCA</p>
<p>CA Generic Regulations setbacks/adjacent land areas abutting valleys, watercourses, wetlands (ranging from 30 – 120 m)</p>	<p>CA Generic Regulations (Regulation of Development, Interference With Wetlands and Alterations to Shorelines and Watercourses)- the regulations are CA specific (GRCA – Reg 150/06; HCA – 161/06; NPCA – 155/06)</p> <p>The final width of this setback would be determined based on a Scoped EIS, Geotechnical Assessment, and/or a Feature-Specific Water Budget Assessment. These studies shall be completed as prescribed by the policies of the AEGD Secondary Plan to describe proposed development, assess potential environmental impacts and recommend appropriate mitigation measure. The required studies will be submitted to the City of Hamilton as part of the development approval process.</p>	<p>AEGD Landowner/ Proponent</p>	<p>NPCA GRCA HCA In consultation with: City of Hamilton</p>
<p>Cool/Coldwater Watercourses / Critical Fish Habitat  Seasonal/Warmwater / Important/Marginal Fish Habitat</p>	<p>Undertake a native, woody, riparian vegetation planting program to establish 75% of the stream corridor length in woody vegetation with the remainder as meadow or riparian wetland as appropriate. Established as part of the development approval process (through the required relevant studies outline above) and required as a condition of approval.</p>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton In consultation with: NPCA GRCA HCA</p>



<p>Coldwater and Warmwater Fish Habitat</p>	<p>As part of development approvals, these features should be protected in their current location and existing functions should be protected or enhanced. Enhancement could include improving morphology (pool/riffle), reducing overland sediment inputs and improving instream habitats. Permits may be required from relevant Conservation Authority under Regulation of Development, Interference With Wetlands and Alterations to Shorelines and Watercourses (regulations are CA specific GRCA – Reg 150/06; HCA – 161/06; NPCA – 155/06).</p> <p>Remedial works shall incorporate fish habitat protection/mitigation or compensation in accordance with the requirements of the Federal Department of Fisheries and Oceans (DFO) and the MNRF.</p>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton In consultation with: NPCA GRCA HCA DFO MNRF</p>
<p>Seasonal Fish Habitat</p>	<p>As part of development approvals, these drainage features may be modified and relocated as necessary to facilitate development provided that their natural form and function is enhanced.</p> <p>Alteration to a regulated watercourse will require a permit from the respective Conservation Authority under Regulation of Development, Interference With Wetlands and Alterations to Shorelines and Watercourses (regulations are CA specific GRCA – O.Reg, 150/06; HCA – 161/06; NPCA – 155/06) and potentially clearance/authorization from the DFO under the Fisheries Act and the MNRF under the Lakes and Rivers Improvement Act).</p> <p>It is recommended that the proponent complete a DFO self-assessment, and if required, consult with the DFO.</p>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton In consultation with: NPCA GRCA HCA DFO MNRF</p>
<p>Indirect/Support Fish Habitat / Marginal Fish Habitat</p>	<p>Current classification based on a preliminary assessment of these features. As part of development approvals, these features may be replaced by Stormwater Infrastructure, including LID and end-of-pipe facilities to replicate their water quantity and quality function. Alternatively, they may be enhanced and protected within a corridor width of up to 30 m (plus the bankfull channel width). Their location may also be modified and relocated provided that their water quality and quantity functions are maintained.</p> <p>Alteration to a regulated watercourse will require a permit from the respective Conservation Authority under Regulation of Development, Interference With Wetlands and Alterations to Shorelines and Watercourses (regulations are CA specific GRCA – O.Reg, 150/06; HCA – 161/06; NPCA – 155/06) and potentially clearance/authorization from the DFO under the Fisheries Act and the MNRF under the Lakes and Rivers Improvement Act).</p> <p>It is recommended that the proponent complete a DFO self-assessment, and if required, consult with the DFO.</p>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton In consultation with: NPCA GRCA HCA DFO MNRF</p>

## 2.8.2 Groundwater Management Component

The Groundwater Management Plan identifies important groundwater features, such as recharge and discharge areas, defines the water balance criteria that need to be maintained as development proceeds and identifies requirements for protection of existing private and public wells in the study area. The features of the 2011 Groundwater Management Plan are presented within **Figure 2.8.4** and **2.8.5**. **Section 2.8.2.4** describes the 2011 Groundwater Management Plan.

When completed in 2011, the Groundwater Management Plan of the Subwatershed Study was taken from current efforts by the three (3) conservation authorities and the City to address the need for groundwater protection and management within the three Source Protection Areas within the study area. Since that time considerable advancements have been made in the form of Source Protection Plans (SPP) which have been developed to meet the objectives of the Clean Water Act (2006).

The following sections identifies and directs the proponent to additional policy, regulation and / or requirements which have changed since the finalization of 2011 Subwatershed and Stormwater Master Plan studies. The modification to the Groundwater Management Plan is discussed in **Section 2.8.2.1** to **Section 2.8.2.4**.

### *2.8.2.1 Clean Water Act*

The Clean Water Act was enacted in 2006 to protect existing and future sources of drinking water. The Clean Water Act (2006) provides a framework for the development and implementation of local, watershed- based source protection plans, and is intended to implement the drinking water source protection recommendations made by Justice Dennis O'Connor in Part II of the Walkerton Inquiry Report.

The Act specifies that drinking water source protection plans (SPP) be developed as a result of an overall assessment report and that the SPP sets forth policies that prevent activities from becoming a significant drinking water threat to surface and groundwater drinking supplies.

Specifically, the regulations define threatened areas to include highly vulnerable aquifers, significant groundwater recharge areas (SGRA), wellhead protection areas (WHPA), and surface water intake protection zones (IPZ). Furthermore, Ontario Regulation 287/07 (as amended), lists 21 prescribed drinking water threats.

### ***2.8.2.2 Source Protection Plans***

The Source Protection Plan, are mandated by the Clean Water Act. The key objectives of the source protection planning process are to complete science- based Assessment Reports that identify the risks to municipal drinking water sources, and to develop local Source Protection Plans that put policies in place to reduce the risks to protect current and future sources of municipal drinking water. Each SPP contains essential policies to ensure that activities that pose significant threats to municipal drinking water sources cease to exist or never become significant.

The three (3) source protection areas are relevant to the AEGD are detailed below. Each has developed a SPP following the completion of the of the Groundwater Management Plan of the Subwatershed Study in 2011. The SPPs may supersede the 2011 Groundwater Management Plan, as such the proponent shall be required to review the relevant SPP to identify policies and / or requirements which may amend the 2011 Groundwater Management Plan as it relates to the subject property within the respective subwatersheds (**Section 2.9.3** for further information). The three (3) source protection areas include:

1. **Sulphur Creek Subwatershed** (see **Figure 2.3.1**):

Source Protection Plans for the Halton Region Source Protection Area and the Hamilton Region Source Protection Area Version 3.2 (July 24, 2015 – effective December 31, 2015)

[http://protectingwater.ca/uploads/Documents/Approved%20documents/V3-2\\_Plan\\_20150724\\_er.pdf](http://protectingwater.ca/uploads/Documents/Approved%20documents/V3-2_Plan_20150724_er.pdf)

**2. Big Creek Subwatershed(see Figure 2.3.1):**

Approved Source Protection Plan for the Grand River Source Protection Area within the Lake Erie Source Protection Region (November 26, 2015 – effective July 1, 2016)

<https://www.sourcewater.ca/en/source-protection-areas/Grand-River-Source-Protection-Plan.aspx>

**3. Welland and Twenty Mile Creek Subwatersheds (see Figure 2.3.1):**

Source Protection Plan for the Niagara Peninsula Source Protection Area (December, 2013 – effective October 1, 2014).

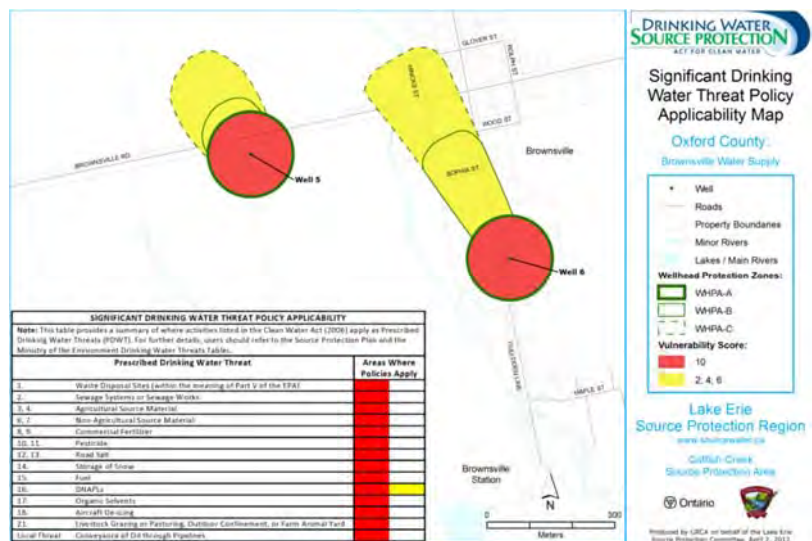
<http://www.sourceprotection-niagara.ca/documents/source-protection-plan/>

The SPP will serve to augment, replace or amend the provisions of the Groundwater Management Plan prepared in 2011. The following four (4) step process for the interpretation of the SPP has been provided to aid practitioners and proponents in understanding and interpreting the relevant SPPs (Source: GRCA). The full document is included **Appendix B**. The four (4) steps include:

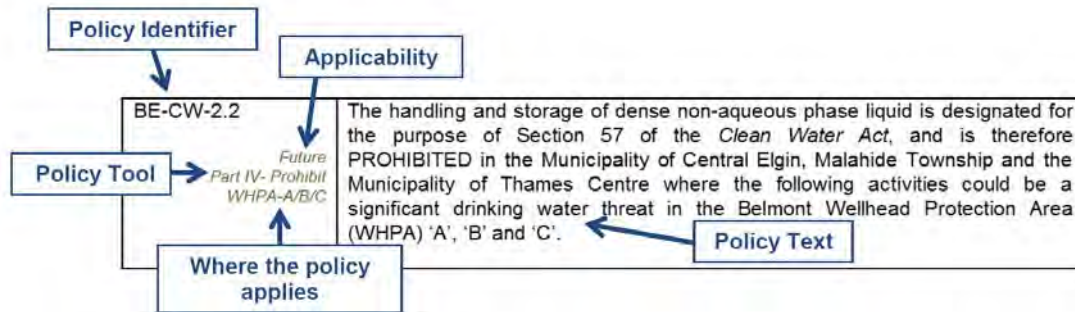
**Step 1:** The first step to determine if the property is subject to a Source Protection Plan policy is to determine if the property is located within an area where a policy applies as shown on the Policy Applicability Map.

Once located, the user should have the following information:

1. Prescribed Drinking Water Threats that would potentially apply to the property.
2. The vulnerability score (how vulnerable the area is to contaminants).
3. The wellhead protection area and/or intake protection zone where the property is location.



**Step 2:** With the above three (3) pieces of information, the reader should then consult the applicable policies listed under the prescribed drinking water threats section of the Source Protection Plan Volume II.



**Step 3:** The user should next consult the Drinking Water Quality Threats Assessment section within the relevant Municipal section of the Assessment Report to locate the Identification of Drinking Water Threats in the (specific wellhead protection table or intake protection zone) Table.

**Step 4:** With this information, the user should now know if the Source Protection Plan policies will apply to the property in question. Based on the implementing body, the reader will also know who is responsible for implementation of the Source Protection Plan policy. If the implementing body is the user, it will be important to also consult the Annual reporting requirements found in the first section of each municipal section of the Source Protection Plan.

### 2.8.2.3 Groundwater Provisions of the PPS (2014)

The Provincial Policy Statement (PPS) updated by the Ontario Ministry of Municipal Affairs and Housing (MMAH) in 2014 has the following provisions which are relevant to the AEGD Groundwater Management Plan.

#### Natural Heritage:

**PPS - Section 2.1.2** - The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and

among natural heritage features and areas, surface water features and ground water features.

## **Water**

**PPS - Section 2.2.1** Planning authorities shall protect, improve or restore the quality and quantity of water by:

- a) using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;
- b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;
- c) identifying water resource systems consisting of ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas, which are necessary for the ecological and hydrological integrity of the watershed;
- d) maintaining linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas;
- e) implementing necessary restrictions on development and site alteration to:
  1. protect all municipal drinking water supplies and designated vulnerable areas; and
  2. protect, improve or restore vulnerable surface and ground water, sensitive surface water features and sensitive ground water features, and their hydrologic functions;
- f) planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality;
- g) ensuring consideration of environmental lake capacity, where applicable; and

- h) ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces.

**PPS - Section 2.2.2** Development and site alteration shall be restricted in or near sensitive surface water features and sensitive ground water features such that these features and their related hydrologic functions will be protected, improved or restored.

Mitigative measures and/or alternative development approaches may be required in order to protect, improve or restore sensitive surface water features, sensitive ground water features, and their hydrologic functions.

#### ***2.8.2.4 Groundwater Management Plan (2011)***

The 2011 the Groundwater Management Plan includes the following recommendations:

1. Maintenance and improvement in the amount of groundwater recharge.
2. To increase and/or maintain the amount of groundwater recharge, it was recommended that infiltration-based lot level and conveyance controls be utilized.
3. Recognizing the vulnerability of significant groundwater recharge areas (SGRAs) and highly vulnerable aquifers (HVAs), requirements for contaminant management plans were also recommended.
4. To address future challenges to the protection of highly vulnerable aquifers which include increased transport pathways that reduce natural protection and may increase groundwater vulnerability i.e. Priority aggregate extraction areas and / or Earth Energy Systems (geothermal systems) although not precluded in Significant Recharge Areas and High Groundwater Susceptibility Areas, they may be permitted provided that a contaminant management plan is prepared.

Additional recommendations identified within the Groundwater Management Plan to protect, improve, and restore groundwater quality and quantity, provide contaminant management and source protection as well as areas of future need and studies have been summarized within **Table 2.8.5: Summary of Groundwater Management Plan Implementation Process.**

**Table 2.8.5** also identifies the party or parties that are responsible for implementation of the specific management category and feature based on the following:

- Development Proponents' Responsibility – these works and measures are either directly related to future development or are expected to provide a direct benefit to the developing lands.
- City / Agency Responsibility – these works and measures are not directly related to, or expected to benefit the future urban development lands. Rather, these works are generally recommended to address existing issues, or to protect and enhance existing resources.

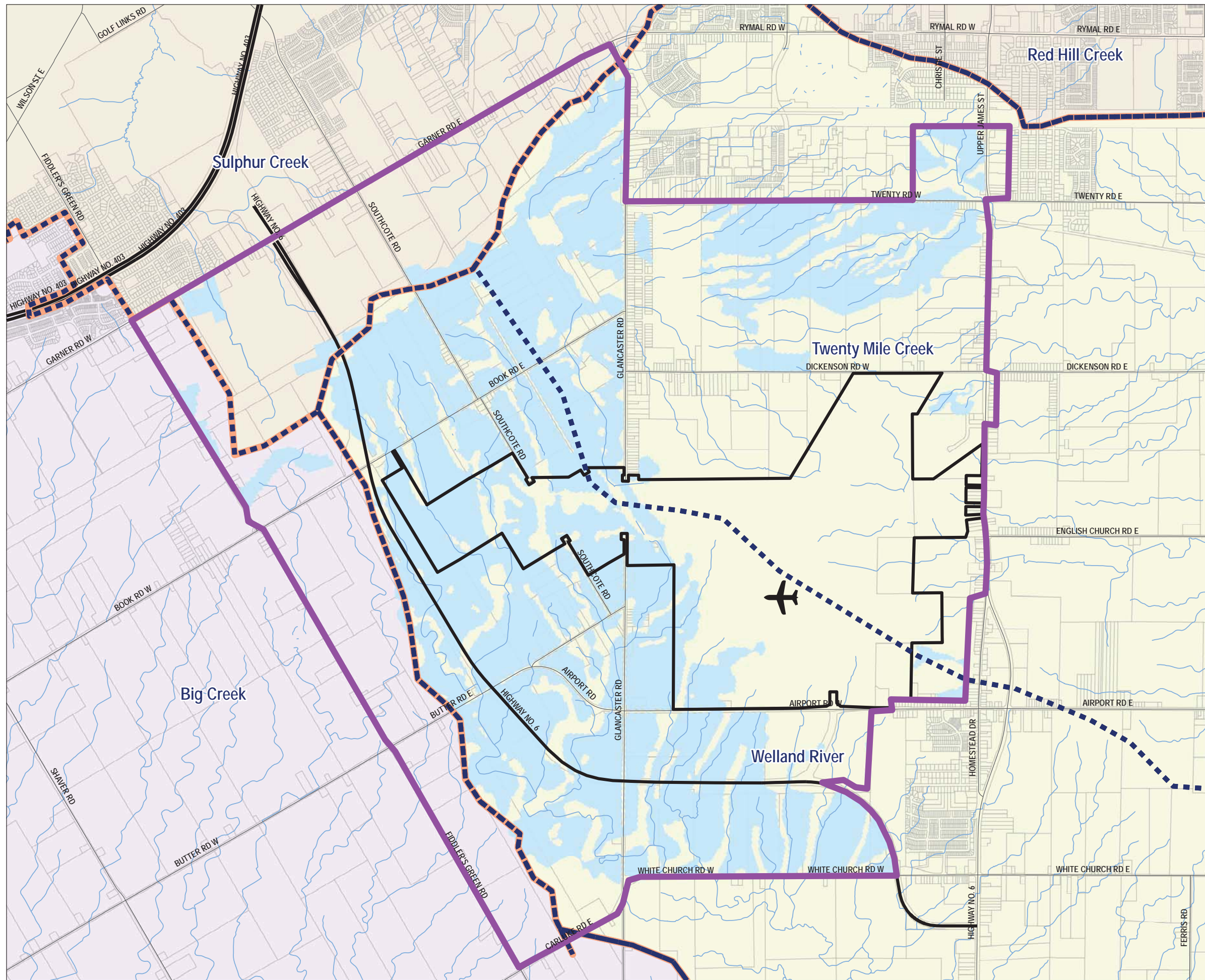


**Table 2.8.5: Summary of Groundwater Management Plan Implementation Process**

Feature	2011 Groundwater Plan Implementation	Amended, Supported or Superseded by:	Responsibility for Implementation	Approval Authority
Significant groundwater recharge areas (SGRAs)	<p>A goal of the Implementation of the Source Water Protection Plan and Provincial Policy Statement in the Niagara Peninsula Source Protection Area it is an improvement in the amount of groundwater recharge. <i>“Development and site alteration shall be restricted in or near...sensitive groundwater features such that these features and their related hydrologic functions will be protected, improved or restored. Mitigative measures and/or alternative development approaches may be required...”</i> (PPS; Ontario Ministry of Municipal Affairs and Housing, 2005)</p> <p>It is recommended that the Source Water Protection Plans include requirements for infiltration-based lot level and conveyance controls in SGRAs. Implemented through Surface Water Management.</p>	<ul style="list-style-type: none"> <li>Amended and/or superseded by:                             <ul style="list-style-type: none"> <li>Source Protection Plans</li> <li>2014 Provincial Policy Statement (PPS)</li> </ul> </li> </ul>	AEGD Landowner/ Proponent	City of Hamilton  NPCA  GRCA  HCA
Greenbelt lands	Protection of greenbelt lands and the proposed natural heritage system should be recognized as providing a significant role in protecting water balance and sustaining local groundwater recharge.	<ul style="list-style-type: none"> <li>2011 Plan remains in effect, amended by:                             <ul style="list-style-type: none"> <li>2014 Provincial Policy Statement (PPS)</li> </ul> </li> </ul>	AEGD Landowner/ Proponent	City of Hamilton
Significant groundwater recharge areas (SGRAs)	<p>Development of a Contaminant management Plan as required by Nutrient Management Act, 2002 or a municipal nutrient management bylaw, or a comparable management and contingency plan for the management of contaminants stored on or discharge from the subject lands and that are not nutrients as defined by the Nutrient Management Act, 2002. A contaminant management plan is binding on successive owners of the subject lands. As part of development approvals, Contaminant management plans for:</p> <ul style="list-style-type: none"> <li>SGRAs,</li> <li>High and moderate threat land uses and/or contaminant storage. Their examples included but were not limited to sewage lagoons, petroleum fuels, road salt and golf courses. This could include site-specific management such as double-walled fuel storage tanks with a monitoring program; and</li> <li>New or expanded agricultural uses greater than 5 nutrient units of manure per year, e.g. more than 3 milking Holstein cows.</li> </ul>	<ul style="list-style-type: none"> <li>2011 Plan remains in effect, amended by:                             <ul style="list-style-type: none"> <li>Source Protection Plans</li> </ul> </li> </ul>	AEGD Landowner/ Proponent	City of Hamilton

<p>Highly Vulnerable Aquifers (HVAs)</p>	<p>Development of a Contaminant management Plan as part of development approvals process for:</p> <ul style="list-style-type: none"> <li>• High and moderate threat land uses and/or contaminant storage. Their examples of high threat land uses included but were not limited to waste management facilities, airports, lagoons for sewage treatment, and auto wrecking and salvage yards. This could include site-specific management such as double-walled fuel storage tanks with a monitoring program</li> <li>• New or expanded agricultural uses greater than 5 nutrient units of manure per year, e.g. more than 3 milking Holstein cows.</li> </ul> <p>Areas identified as highly vulnerable/ susceptible (<b>Figure 2.8.5</b>) will require additional Hydrogeological investigations prior to development as part of the site plan application process.</p>	<ul style="list-style-type: none"> <li>• 2011 Plan remains in effect, amended by:             <ul style="list-style-type: none"> <li>• Source Protection Plans</li> </ul> </li> </ul>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton</p>
<p>High Risk Landuses</p>	<p>Development of a Contaminant Management Plan as part of development approvals for all High Risk Land uses as defined within Part B, Section 3.5.2., Table 3.9 or as deemed appropriate by the City of Hamilton (See <b>Appendix D</b> for a list of high-risk site uses).</p>	<ul style="list-style-type: none"> <li>• Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) – <b>See Section 2.9.4</b> – requires all industrial land uses shall include source controls to contain spills on the subject property. Requirements to prevent spills from infiltrating into the subsurface shall be considered on a case-by-case basis, with consideration for the type of material and the extent of impact. Consultation with City of Hamilton staff shall be required in order to determine specific requirements to provide spill protection for the site.</li> </ul>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton</p>
<p>Airport lands</p>	<p>An EMS system and groundwater monitoring program is recommended for the Airport to reduce potential groundwater contamination impacts</p>	<ul style="list-style-type: none"> <li>• 2011 Plan remains in effect</li> </ul>	<p>Hamilton Airport/landowner</p>	<p>n/a</p>
<p>High Groundwater Susceptibility Area</p>	<p>Consideration should be given to multi-agency policy development, monitoring and approvals. This is to address the complex nature of groundwater protection, supply and legislation. (See Part A, Section 6.3.3 for potential partners and possible approaches)</p>	<ul style="list-style-type: none"> <li>• 2011 Plan remains in effect</li> </ul>	<p>City of Hamilton</p>	<p>n/a</p>

<p>Drinking Water Wells</p>	<p>The development approval process will include the identification of existing or abandoned private servicing infrastructure on the lands through the site plan application process. Commitment to and identification of the process by which wells (O.Reg.903) and sewage disposal infrastructure (Sec. 53 Ontario Water Resources Act) will be appropriately decommissioned prior to the development of the site.</p>	<ul style="list-style-type: none"> <li>• 2011 Plan remains in effect</li> </ul>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton</p>
<p>Groundwater Monitoring Wells</p>	<p>Monitoring program for the existing groundwater monitoring well should be reviewed to ensure that the data collected reflects the future needs of the area with respect to future growth. This may include additional baseline water quality monitoring and the implementation of additional short term wells established as part of hydrogeological studies for proposed development.</p>	<ul style="list-style-type: none"> <li>• 2011 Plan remains in effect</li> </ul>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton</p>

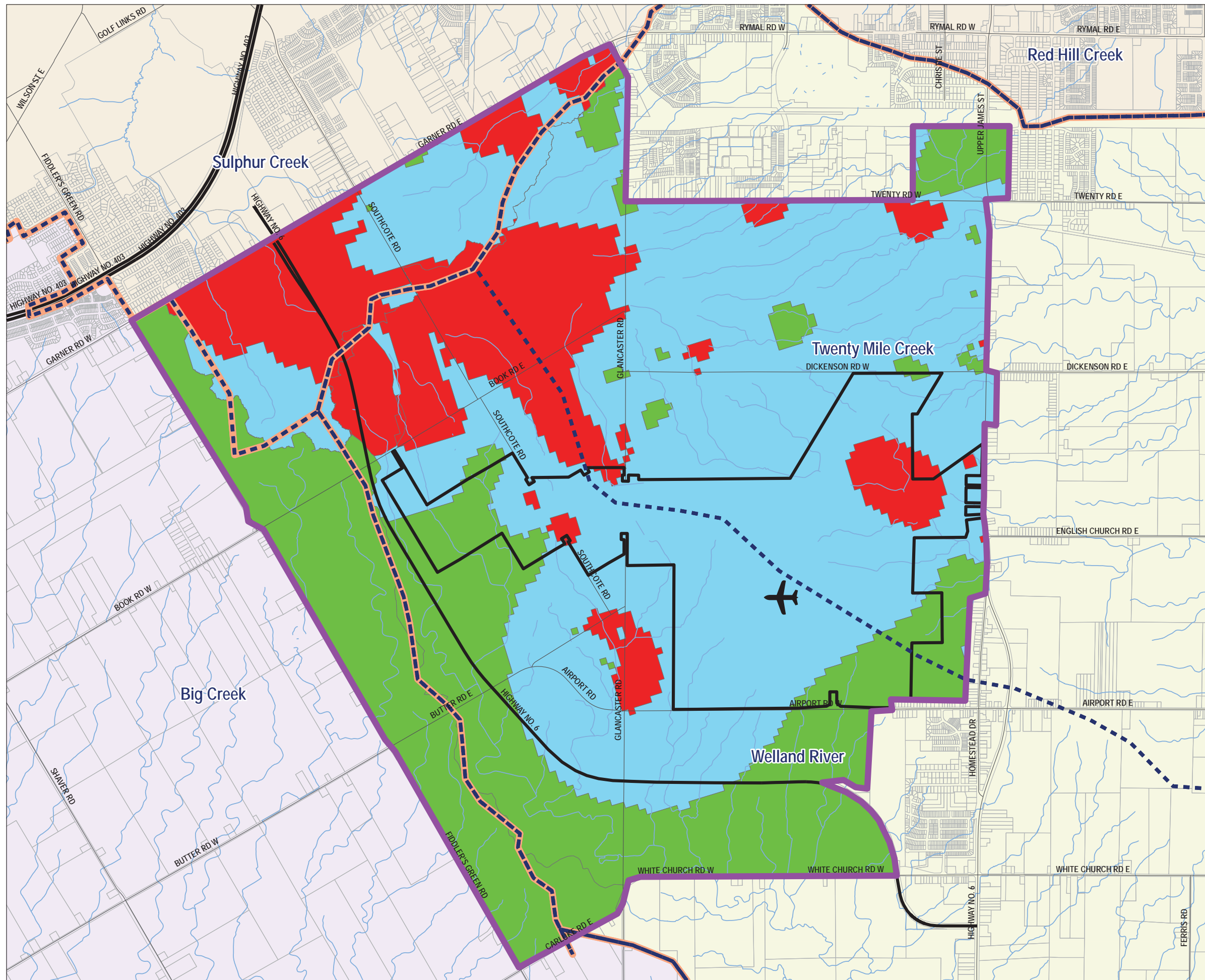


- Significant Groundwater Recharge Areas\*
- Other Features**
- Airport Boundary
- Airport Employment Growth District Study Boundary
- Watershed Boundary
- Conservation Authority Jurisdiction Boundary
- Conservation Authority Jurisdiction**
- Grand River Conservation Authority
- Hamilton Conservation Authority
- Niagara Peninsula Conservation Authority

\* Per Source Protection Policy Mapping as provided by the City of Hamilton.

**Figure 2.8.4**  
**Airport Employment Growth District**  
**Significant Groundwater Recharge Areas**





**Groundwater Susceptibility (GwSI)\***

- High
- Medium
- Low

**Other Features**


- Airport Boundary
- Airport Employment Growth District Study Boundary
- Watershed Boundary
- Conservation Authority Jurisdiction Boundary


**Conservation Authority Jurisdiction**

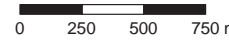
- Grand River Conservation Authority
- Hamilton Conservation Authority
- Niagara Peninsula Conservation Authority

\*Per Source Protection Policy Mapping as provided by the City of Hamilton.

**Figure 2.8.5**  
**Airport Employment Growth District**  
**Groundwater Vulnerability Analysis (2011)**







April 2017

Planning and Economic Development Department

## **2.9 Part B: Surface Water Management Component**

The 2011 Subwatershed Study (**Part B**) addresses, in detail, the Surface Water Management component of the Subwatershed Plan for the AEGD study area. This was completed through background review of previous studies, agency consultation, field investigations and modeling to develop catchment based environmental criteria and targets for flood protection, water quality, erosion, infiltration (water balance); and the protection of natural features. This included the following:

- Completion of MEA Class Environmental Assessment to select the preferred alternative of Low Impact Development (LID) Source Controls in combination with LID Conveyance Controls and end-of-pipe Dry Ponds facilities (along with Stream Restoration Measures) consistent with the Ministry of the Environment's Treatment train approach to stormwater management. A suite of these measures are recommended for each land use category of AEGD.
- Hydrologic, hydraulic and water balance modeling to develop the Stormwater Master Plan.
- Development of catchment based environmental criteria and targets for Flood protection, Water quality, Erosion, Infiltration (Water Balance); and the protection of Natural features (See **Section 2.9.6**).
- Development of pre-development water balances for all sub-catchments with the AEGD study area (with the exception of the Big Creek watershed) as well as infiltration targets for LID techniques for Proposed Conditions Land uses based on the dominant soil types (See **Section 2.9.6.4**).

The following sections also identifies and directs the proponent to additional policy and / or regulation which have changed since the finalization of 2011 Subwatershed and Stormwater Master Plan studies. The modification to the Surface Water Management Plan is discussed in **Section 2.9.1** through **Section 2.9.5**.

### 2.9.1 Surface Water and Stormwater Provisions of the PPS (2014)

The Provincial Policy Statement (PPS) updated by the Ontario Ministry of Municipal Affairs and Housing (MMAH) in 2014 has the following provisions which are relevant to the AEGD Surface Water Management Plan.

#### **Infrastructure and Public Service Facilities**

**PPS - Section 1.6.2** - Planning authorities should promote green infrastructure to complement infrastructure. Green infrastructure is defined as:

“natural and human-made elements that provide ecological and hydrological functions and processes. *Green infrastructure* can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs”

#### **Sewage, Water and Stormwater**

**PPS – Section 1.6.6.7** - Planning for stormwater management shall:

- a) minimize, or, where possible, prevent increases in contaminant loads;
- b) minimize changes in water balance and erosion;
- c) not increase risks to human health and safety and property damage;
- d) maximize the extent and function of vegetative and pervious surfaces; and
- e) promote stormwater management best practices, including stormwater attenuation and re-use, and low impact development.

#### **Water**

**PPS - Section 2.2.2** Development and site alteration shall be restricted in or near sensitive surface water features and sensitive ground water features such that these features and their related hydrologic functions will be protected, improved or restored.

Mitigative measures and/or alternative development approaches may be required in order to protect, improve or restore sensitive surface water features, sensitive ground water features, and their hydrologic functions.

### 2.9.2 Pending Provincial Direction

The Ministry of the Environment and Climate Change (MOECC) released an **Interpretation Bulletin – Expectations Re: Stormwater Management** in February 2015 which detailed the Ministry’s position on stormwater management, specifically that:

- “The natural hydrologic cycle should be maintained to the greatest extent possible.”
- “Too often, preservation of the natural hydrologic cycle is not sufficiently addressed in stormwater management plans submitted to the Ministry for an Environmental Compliance Approval (ECA).”
- “Low Impact Development (LID) is relevant for all forms of development, including urban intensification and retrofit.”
- “LID can be less costly than conventional stormwater practices.”
- “Going forward the Ministry expects that stormwater management plans will reflect the findings of the watershed, subwatershed, and environmental management plans, and will employ LID in order to maintain the natural hydrologic cycle to the greatest extent possible. “

The Interpretation Bulletin was a precursor to the development of the Ministry of the Environment and Climate Change (MOECC) **Low Impact Development Stormwater Management Guidance Document**, a companion document to the 2003 Stormwater Planning and Design Guidance Manual (SWMPD). The pending Low Impact Development Stormwater Management Guidance Manual is anticipated of release in 2017.

At present, the MOECC requires the implementation of water quality controls to reduce the loading of pollutants from development sites to stormwater receivers. The pending Low Impact Development Stormwater Management Guidance Manual will prescribe



volumetric control targets for all new development, redevelopment, infill development, reurbanization, retrofits and linear infrastructure projects. On-site control of the runoff generated from the regionally specific 90<sup>th</sup> percentile rainfall event be required. Maintenance of the pre-development water balance will also be a requirement. Controlled runoff will be managed on-site primarily through the use of Low Impact Development stormwater controls through the natural hydrologic processes of infiltration and evapotranspiration as well as re-use and filtration. This change in provincial SWM policy will require the implementation of infiltration based LID source and conveyance controls for future developments within the AEGD. Upon the release of updated MOECC LID SWM Guidance Manual, provincial control targets will supersede the minimum targets identified for the AEGD for water quality, infiltration and erosion and will contribute the flood control requirement.

### 2.9.3 Source Protection Plans

The use of infiltration practices to reduce runoff and restore natural hydrologic processes is a component of the AEGD approach to stormwater management. As the implementation of infiltration practices are part of development within the AEGD, the City and the proponents has a duty to protect local groundwater resources based on a sound understanding of identified and future risks.

Source Protection Plans as detailed in **Section 2.8.2.2** set out policies to protect sources of municipal drinking water and should be consulted to determine the appropriate stormwater and infiltration actions and policies based on the subject site location within the respective Subwatersheds (see **Figure 2.3.1**). It should be noted that drinking water within the AEGD and the City of Hamilton serviced through intakes for Lake Ontario and that no Wellhead Protection Areas (WHPA) or Intake Protection Zones (IPZs) are located with the study area.

Specific policies relating to Stormwater Management within WHPA and IPZs can be found within the respective SPP as detailed below. It is the responsibility of the proponent to appropriately refer to the respective SPP and ensure that proposed SWM plans are fully in compliance with the plans and policies.

## 1. Sulphur Creek Subwatershed:

Source Protection Plans for the Halton Region Source Protection Area and the Hamilton Region Source Protection Area Version 3.2 (July 24, 2015 – effective December 31, 2015)

[http://protectingwater.ca/uploads/Documents/Approved%20documents/V3-2\\_Plan\\_20150724\\_er.pdf](http://protectingwater.ca/uploads/Documents/Approved%20documents/V3-2_Plan_20150724_er.pdf)

Specific policies relating to Stormwater Management within Wellhead Protection Areas (WHPA) and Intake Protection Zones (IPZs) can be found from policy:

**Policy T-4-C** - For future systems that would discharge **stormwater** from stormwater retention ponds where this activity would be a significant drinking water threat,

- a) the Ministry of the Environment and Climate Change shall ensure that the environmental compliance approvals that govern the systems include appropriate terms and conditions to ensure that the systems do not become significant drinking water threats. As part of its program to review environmental compliance approvals that are affected by source protection plans the following conditions shall be considered for inclusion - the requirement for regular maintenance, periodic removal of accumulated sediment, lining of the pond where warranted, the use of an oil/water separator, and other requirements to address site conditions
- b) the Ministry of the Environment and Climate Change shall document the number and locations of applications received for environmental compliance approvals for these systems and the actions taken and report this information to the Source Protection Authority by February 1 of each year with copies of any issued approvals.

**Policy T-9-C** In consideration of *Planning Act* applications where the future discharge of **stormwater** effluent from stormwater retention ponds would be a significant drinking water threat,

- a) where possible, the municipal planning authority shall require the applicant to locate stormwater retention ponds outside of the vulnerable area.
- b) the municipal planning authority shall document the number of applications reviewed for stormwater retention ponds, whether the application was approved, and whether the pond was located within or outside of the area where a significant drinking water threat would occur and report this information, including the rationale for decisions made, to the Source Protection Authority by February 1 of each year.

**Policy T-53-C a.** To facilitate the effective implementation of policies for significant drinking water threats and assist in municipal decision-making,

- a) the municipal planning authorities are requested to require proponents to disclose whether any of the following activities are expected to occur on the property where they would be significant drinking water threats, as well as the substances utilized or stored and their volume:
  - i. the establishment, operation or maintenance of a system that collects, stores, transmits, treats, or disposes of sewage
  - ii. the application or storage of agricultural source material
  - iii. the application, or handling and storage of commercial fertilizer
  - iv. the application, or handling and storage of pesticide
  - v. the application, or handling and storage of road salt
  - vi. the storage of snow
  - vii. the handling and storage of fuel
  - viii. the handling and storage of a dense non-aqueous phase liquid
  - ix. the handling and storage of an organic solvent

- x. the use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard

## **2. Big Creek Subwatershed:**

Approved Source Protection Plan for the Grand River Source Protection Area within the Lake Erie Source Protection Region (November 26, 2015 – effective July 1, 2016)

<https://www.sourcewater.ca/en/source-protection-areas/Grand-River-Source-Protection-Plan.aspx>

Specific policies relating to Stormwater Management within Wellhead Protection Areas (WHPA) and Intake Protection Zones (IPZs) are not identified for the portion of the Big Creek Subwatershed within the AEGD study area. Proponents are directed to contact the GRCA for further information.

## **3. Welland and Twenty Mile Creek Subwatersheds:**

Source Protection Plan for the Niagara Peninsula Source Protection Area (December, 2013 – effective October 1, 2014).

<http://www.sourceprotection-niagara.ca/documents/source-protection-plan/>

Of note, there are six municipal water treatment plants (WTPs) with surface water intakes in the Niagara Peninsula Source Protection Area (NPSPA) which supply over 80% of the population. The remaining 20% of the population is supplied by private drinking water systems such as residential wells and cisterns. There are no municipal wells in the NPSPA and therefore no Wellhead Protection Area (WHPAs). The six Water Treatment Plants that supply municipal drinking water to residents in Niagara are:

- Welland Water Treatment Plant;
- DeCew Falls Water Treatment Plant;
- Port Colborne Water Treatment Plant;
- Niagara Falls Water Treatment Plant;
- Grimsby Water Treatment Plant; and

- Rosehill (Fort Erie) Water Treatment Plan

Vulnerable areas known as Intake Protection Zones (IPZs) were delineated around each municipal Water Treatment Plant (WTP) intake. As such the policies of the NPSPA SPP apply primarily to the above IPZs and are therefore not specific to the AEGD study area.

#### **2.9.4 Innovative SWM Source Control Policy for ICI Land-uses (2014)**

The City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) represents a companion document to the City of Hamilton Storm Drainage Policy (May 2004) and provides the framework for the incorporation of stormwater source controls for the development and redevelopment of sites to provide or retain institutional, commercial or industrial land uses.

Developed after the finalization of the AEGD Subwatershed and Stormwater Master Plan studies in 2011, the 2014 Innovative SWM Source Control Policy for ICI Land-uses document is intended to be reviewed in conjunction with the current Storm Drainage Policy; as such, the policy is not considered to supercede or replace the current Storm Drainage Policy (May 2004), but rather to complement the current policy specifically with respect to developments or redevelopments to provide or retain institutional, commercial, or industrial land uses.

The Innovative SWM Source Control Policy for ICI Land-uses document supports and aligns with the AEGD Subwatershed and Stormwater Master Plan studies. The Innovative SWM Source Control Policy for ICI land-uses document:

- i. Provides present and future industrial, commercial and institutional businesses with good engineering design that provides a high quality of business environment that protects and enhances natural features and minimizes pollution of water, air, and land resources.
- ii. Provides the City and its businesses with sustainable stormwater management solutions.

- iii. Provides all practitioners (i.e. analysts, designers, planners, and reviewers) with guidance regarding acceptable practices, technologies, and analytical techniques related to the design of source controls for stormwater management, in order to satisfy functional requirements which are considered beyond the current standard provided in the City of Hamilton Storm Drainage Policy.
- iv. Commits to supporting the implementation of privatized stormwater management facilities for industrial, commercial, and institutional land uses which exceed the current Provincial criteria related to flooding, erosion, and stormwater quality control.
- v. Commits to the continuing the support, implementation, and understanding of at-source (lot-level) stormwater management techniques, including Low Impact Development techniques.
- vi. Commits to providing incentives to land developers who chose to integrate Low Impact Development stormwater techniques/features in their development plans, for new or redevelopment projects to provide or retain industrial, commercial, or institutional land uses.

In this manner, the Innovative SWM Source Control Policy for ICI Land-uses document aligns and supports the recommendations of the 2011 AEGD Subwatershed and Stormwater Master Plan studies.

Per the Innovative SWM Source Control Policy for ICI Land-uses document the following is noted in regards to the environmental targets for flood control, erosion control, stormwater quality control, water balance/ surface runoff volume, groundwater recharge and spill protection and containment, which should be considered by development proponent specifically:

- Where a Subwatershed Study or Master Drainage Plan has been completed which includes the subject site, source controls for:
  - flood control,
  - erosion control,
  - stormwater quality control,

- controlling the volume of surface runoff and/or maintaining water balance,
- promoting groundwater recharge.

shall be provided for all industrial, commercial, and institutional land uses in conformance with the governing Subwatershed Study or Master Drainage Plan.

- All stormwater source controls which are recognized to provide flood control, erosion control, stormwater quality control and/or a reduction in surface runoff volume shall be included/considered in the modelling analysis of the proposed flood control system for the site. See Table 4.2 of the Innovative SWM Source Control Policy for ICI Land-uses document.
- Runoff from all rooftops is generally considered "clean water" which would not require stormwater quality pre-treatment for infiltration. The ultimate acceptance of rooftop runoff from industrial buildings as "clean runoff" is at the discretion of the Ministry of the Environment and Climate Change, and is to be determined on a case-by-case basis. All runoff from parking lots and roadways shall require stormwater quality pre-treatment for infiltration.
- All industrial land uses shall include source controls to contain spills on the subject property. Requirements to prevent spills from infiltrating into the subsurface shall be considered on a case-by-case basis, with consideration for the type of material and the extent of impact. Consultation with City of Hamilton staff shall be required in order to determine specific requirements to provide spill protection for the site.
- The design shall include source controls to provide flood control for industrial, commercial, and institutional land uses and shall include equipment and/or appurtenances for remote monitoring or for facilitating field (manual) monitoring, ease of inspection, maintenance, and clean-out.

- Stormwater source controls shall be provided on all private properties for industrial, commercial, and institutional land uses. The source controls shall be planned and designed in order to address the stormwater management requirements for the individual industrial, commercial, or institutional land use as per the requirements and criteria outlined in the Policy.
  
- The following documents are noted to provide sufficient information for the detailed design of the preferred source control practices within the City of Hamilton and the reader is referred to these documents for the detailed screening and design of source controls for industrial, commercial, and institutional sites within the City of Hamilton:
  - Stormwater Infrastructure Design (Philips Engineering Ltd., September 2007),
  - Low Impact Development Stormwater Management Planning and Design Manual, Version 1.0 (CVC/TRCA, 2010) and
  - Stormwater Management Planning and Design Manual (MOE, March 2003).



### 2.9.5 Surface Water Management Plan

The Surface Water Management plan was completed as part of the Stormwater Master Plan Process (Phase 2 - Part B). The Stormwater Master Plan identifies stream corridors that require protection in order to address flood/erosion control and fish habitat requirements (See **Section 2.8.1**), as well as defining stormwater management guidelines to prevent increases in flooding and erosion, enhance water quality and maintain the existing conditions water balance.

Potential locations of end-of-pipe flood control facilities (dry ponds) have also been identified and have been updated per the February 17, 2015 approved Secondary Plan and are shown on **Figure 2.9.5**. (Note: Pond locations as shown are of approximate locations. Furthermore, for clarity and readability of pond labels, the size of the pond location identifiers are not shown to scale). See **Section 3.5** and **Section 4.3** for additional information in regards to Dry pond locations).

Stormwater management controls for the AEGD per the 2011 study consist of the recommended works required to mitigate against the impacts from proposed future development and includes:

- An emphasis on Low Impact Development (LID) “lot level” (source controls) and conveyance control – to provide water quality improvements, promote infiltration and maintain groundwater recharge rates. This approach is consistent with the industrial character of the lands and a predisposition to maintain a rural road cross section in most areas.
- End-of-pipe dry ponds - In compliance with Transport Canada’s Document TP 1247, traditional storm water management wet-ponds (which may attract birds and wildlife) are discouraged in the vicinity of an airport for safety reasons. As, part of the flood control strategy “dry” SWM ponds are proposed. The proposed conceptual locations of these facilities are identified within **Figure 2.9.5**.
- Stream Restoration - limited to defining minimum stream corridor widths and to riparian vegetation plantings to provide flow/water quality attenuation, enhance

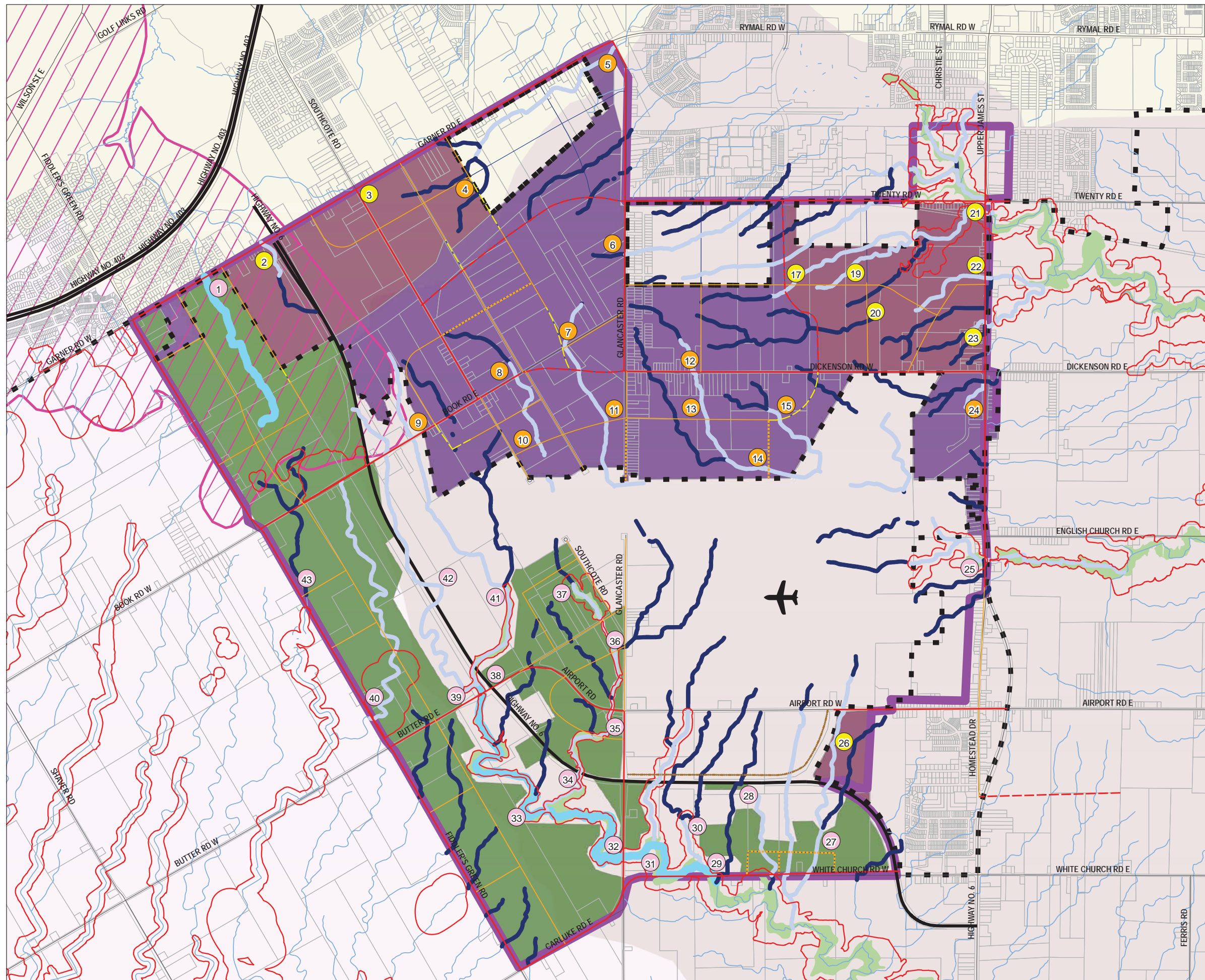
stream shading, minimize stream bank erosion, and create a vegetated buffer along all headwater features (see **Table 2.9.5**). Associated with each dry-pond location, it was assumed that 250m of stream restoration works will be required to obtain a suitable outlet for the proposed facility based on surface drainage conditions and stream classification.

The AEGD Subwatershed Study and Stormwater Management Plan are based on and are consistent with the principle goals and objectives for the improvement and enhancement of the existing conditions in terms of environment and water quality, quantity and erosion as outlined in the City-wide Stormwater Master Plan (2007) completed as part of the GRIDS process. The Stormwater Management Plan is also consistent with the City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014).

Identified within the Surface Water Management Plan are the requirements for additional stormwater management plans, criteria for flood control, water quality, erosion, infiltration (water balance), stream classification, stream restoration, operations and maintenance, policy considerations, stewardship programs, and future studies. All have been summarized within **Table 2.9.5: Summary of Surface Water Management Plan Implementation Process**.

**Table 2.9.5** also identifies the party or parties that are responsible for implementation of the specific management category and feature based on the following:

- Development Proponents' Responsibility – these works and measures are either directly related to future development (e.g. stormwater management LID BMPs) or are expected to provide a direct benefit to the developing lands.
- City / Agency Responsibility – these works and measures are not directly related to, or expected to benefit the future urban development lands. Rather, these works are generally recommended to address existing issues, or to protect and enhance existing resources.



**Phasing**

- Phase 1 - Short Term
- Phase 2 - Medium Term
- Additional Study Area - Long Term

**Transportation Master Plan**

- Major Arterial Road
- Minor Collector Road
- Minor Collector Road (Potential Alignment)
- Major Collector Road (Potential Alignment)
- Major Arterial Road (Potential Alignment)
- Proposed Service Road (Potential Alignment)

**Pond Location**

- Phase 1 Pond Location
- Phase 2 Pond Location
- Long Term Pond Location

**MNRF Fish Habitat Buffers**

- Support/Indirect Fish Habitat (30m)†
- Seasonal/Warmwater Habitat (30m)†
- Coldwater Habitat (60m)‡

**Conservation Authority Jurisdiction**

- Grand River Conservation Authority
- Hamilton Conservation Authority
- Niagara Peninsula Conservation Authority

**Other Features**

- High Recharge potential
- Floodplain
- Generic Regulation Lines\*\*
- Airport Employment Growth District Study Boundary
- Urban Boundary

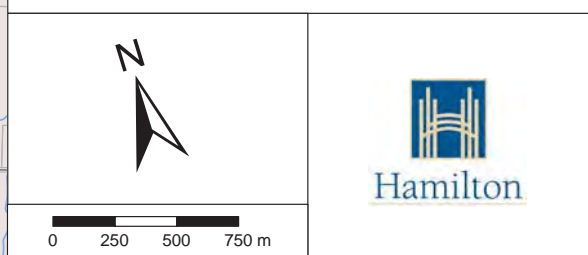
**Notes:**

- \* If watercourse is retained as an enhanced feature.
- \*\* Generic regulations include a 30 m buffer on all watercourses. Not all features regulated by the relevant Conservation Authority are mapped.
- † Buffer based on 15m from each bank
- ‡ Buffer based on 30m from each bank

**Figure 2.9.5**  
**Airport Employment Growth District**  
**Stormwater Master Plan**

April 2017

Planning and Economic Development Department



**Table 2.9.5: Summary of Surface Water Management Plan (SWM Master Plan) Implementation Process**

Management Category	Feature	2011 Groundwater Plan Implementation	Amended, Supported or Superseded by:	Responsibility for Implementation	Approval Authority
Stormwater Management Plan	All proposed development within the AEGD (stormwater management plan)	<p>Stormwater Management Plans are to be completed as part development approvals process and are to consistent with the environmental targets, minimum criteria and recommendations of the Stormwater Master Plan, including addressing the treatment of watercourses, addressing water budget requirement through effective implementation of LID measures. Due to the sensitivity of downstream areas to water quality impacts (fisheries, erosion susceptibility, ESA/wetland features, and Great Lakes Areas of Concern), all proposed development will require level 1 or Enhanced stormwater treatment</p> <p>This will include meetings the CA's regulations with respect to watercourses and wetland impacts.</p>	<ul style="list-style-type: none"> <li>• Source Protection Plans</li> <li>• Low Impact Development Stormwater Management Guidance Manual (Pending 2017) will amend the 2011 Plan.</li> <li>• Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014).</li> </ul>	AEGD Landowner/ Proponent	City of Hamilton NPCA GRCA HCA
Stormwater Management Plan	Flood Control	<p>Control peak outflows to pre-development rates, for design storms with return periods up to 100 years using End-of-pipe dry ponds.</p> <p>Or</p> <p>Upon approval from the City (with all necessary easements Phase 2: Part A- Section 3.0 and Part B - Section 5.1.1) and if site and development conditions allow, on-site flood control may be feasible and should be assessed at the site plan stage. On site flood controls must adhere to AEGD minimum targets.</p> <p>Environmental Criteria and Minimum targets are provided in <b>Section 2.9.6.1, Table 2.9.6.1</b>. Facility outlet location to be approved by respective Conservation Authority.</p>	<ul style="list-style-type: none"> <li>• Low Impact Development Stormwater Management Guidance Manual (Pending 2017) will <u>amend</u> the 2011 Plan. Minimum on-site volume control targets will be required.</li> <li>• Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) – <b>See Section 2.9.4</b></li> </ul>	On-site and temporary facilities - AEGD Landowner/ Proponent Centralized Dry-pond facilities and associated stream restoration – City of Hamilton (funded through DCs)	City of Hamilton NPCA GRCA HCA
Stormwater Management Plan	Water Quality	<p>Control pollutant loadings in accordance with current MOE guidelines. Enhanced level 1 protection as defined in the 2003 Stormwater Management Planning &amp; Design manual – reduce the average long term annual load of suspended sediment by 80% or better. Accomplished through the use of LID source and conveyance controls.</p> <p>Environmental Criteria and Minimum targets are provided in <b>Section 2.9.6.2, Table 2.9.6.2</b>.</p>	<ul style="list-style-type: none"> <li>• Low Impact Development Stormwater Management Guidance Manual (Pending 2017) is anticipated to <u>support and supersede</u> the 2011 Plan. Minimum on-site volume control targets will be required.</li> <li>• Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) – <b>See Section 2.9.4</b></li> </ul>	AEGD Landowner/ Proponent	City of Hamilton MOE

<p>Stormwater Management Plan</p>	<p>Watercourse Erosion Control</p>	<p>1. In accordance with current MOE guidelines: capture the Runoff volume generated by a 25mm event, and release it to the outlet over 24 hrs                  Or                  2. Control the frequency and duration of site outflows such that in-stream index of erosion potential (e.g. multi-year erosive impulse) is not increased.</p> <p>Accomplished through the use of LID source and conveyance controls. Environmental Criteria and Minimum targets are provided in <b>Section 2.9.6.3, Table 2.9.6.3</b> as amended by site specific EIS. Proponent to contact the respective Conservation Authority for watercourse specific guidance and to confirm the need to complete an erosion analysis to determine if any proposed infrastructure will impact erosion within and downstream of the study area. It should be noted that this hazard information may affect development setbacks beyond the 15m-30m natural heritage/fisheries buffers as detailed within this report.</p>	<ul style="list-style-type: none"> <li>• Low Impact Development Stormwater Management Guidance Manual (Pending 2017) is anticipated to <u>support</u> the 2011 Plan. Minimum on-site volume control targets will be required as will a requirement for the maintenance of the pre-development water balance.</li> <li>• Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) – <b>See Section 2.9.4.</b></li> </ul>	<p>AEGD Landowner/Proponent</p>	<p>City of Hamilton                  NPCA                  GRCA                  HCA</p>
<p>Water Balance</p>	<p>Infiltration</p>	<p>As part of the development of the required Stormwater Management Plans as part of the development approval process, a water budget approach is required to maintain the existing hydrologic cycle in newly developed areas. As part of the stormwater management plan development, proponents will be required to maintain groundwater recharge per the pre-development water balance. Because much of the lands in the study area have a low potential for infiltration, innovative source and conveyance control measures will be necessary. Infiltration targets are to be met using infiltration based LID source and conveyance controls.</p> <p>This is in keeping with the eco-industrial development concept being considered for these lands. This is also consistent with a “comprehensive urbanization approach” recommended in the City of Hamilton’s Stormwater Management Strategy (Aquafor Beech, 2007).</p> <p>Environmental Criteria and Minimum targets are provided in <b>Section 2.9.6.4, Table 2.9.6.4</b> and Capture Targets per soil type and land use within <b>Table 2.9.6.5</b>). Proponent to contact respective Conservation Authority for guidance with respect to EGRAs, HVAs and source protection requirements (SPP).</p>	<ul style="list-style-type: none"> <li>• Low Impact Development Stormwater Management Guidance Manual (Pending 2017) is anticipated to <u>support</u> the 2011 Plan. Maintenance of the pre-development water balance will be required. Minimum on-site volume control targets will be required as will a requirement for the maintenance of the pre-development water balance.</li> <li>• Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) – <b>See Section 2.9.4</b></li> </ul>	<p>AEGD Landowner/Proponent</p>	<p>City of Hamilton                  NPCA                  GRCA                  HCA</p>

<p>Planning and Standards</p>	<p>Low Impact Development (LID) techniques (planning &amp; standards)</p>	<p>Incorporation of LID designs, concepts into municipal planning and standards documents. Adoption of standardized LID facility design and construction standards/manual and references i.e. LID SWM Planning and Design Guide (TRCA/CVC, 2010) to complement existing City Standards documents or the preparation of City of Hamilton specific LID manual.</p>	<ul style="list-style-type: none"> <li>• Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) refers the proponent to (<b>See Section 2.9.4</b>):                         <ul style="list-style-type: none"> <li>○ Stormwater Infrastructure Design (Philips Engineering Ltd., September 2007),</li> <li>○ Low Impact Development Stormwater Management Planning and Design Manual, Version 1.0 (CVC/TRCA, 2010) and</li> <li>○ Stormwater Management Planning and Design Manual (MOE, March 2003).</li> </ul> </li> </ul>	<p>City of Hamilton</p>	<p>n/a</p>
<p>Floodplain Requirements</p>	<p>Floodplain Mapping</p>	<p>Floodplain mapping has been completed through hydraulic and hydrologic modelling for the 2yr-100yr storms for the AEGD, however Regional Floodplain assessments have not been completed for either Tiffany or Ancaster Creek (Sulphur Creek tributaries) upstream of Garner Road. The Regional Floodplain forms the basis of the CA regulations. Although the flood hazards are not expected to be significant given the location in the headwaters of these watercourses, any impacts on existing floodplain will be a consideration for the HCA and other Conservation Authorities in the evaluation of future development through the regulatory process.</p>	<ul style="list-style-type: none"> <li>• 2011 Plan remains in effect</li> </ul>	<p>No action required</p>	<p>n/a</p>
<p>Education and Capacity Building</p>	<p>Low Impact Development (LID) techniques</p>	<p>Education of municipal staff in the review/approval of LID measures in development applications through second party courses/ certification (i.e. Canadian Standards Association, CSA) and/or internal workshops and seminars.</p>	<ul style="list-style-type: none"> <li>• On- line E-learning courses available from Sustainable Technologies Evaluation Program (Step):                         <ul style="list-style-type: none"> <li>○ <a href="http://www.sustainabletechnologies.ca/wp/events/">http://www.sustainabletechnologies.ca/wp/events/</a></li> <li>○ Introduction to Low Impact Development E-Learning Course</li> <li>○ Design of Infiltration Practices: Low Impact Development Technical Training E-Learning Course</li> </ul> </li> </ul>	<p>City of Hamilton</p>	<p>n/a</p>
<p>Operation and Maintenance</p>	<p>Low Impact Development (LID) techniques (O&amp;M Municipal Lands)</p>	<p>Review existing Municipal operation and maintenance budgets to ensure that operations and maintenance associated with City-owned LID measures are considered (eg. Landscape-based stormwater management measures). Traditional operations and maintenance budgets do not appropriately cover or consider maintenance of landscaping elements of LID measures.</p>	<ul style="list-style-type: none"> <li>• 2011 Plan remains in effect.</li> <li>• Operation and maintenance plan to be developed in conformance with the following (see <b>Appendix C – LID Resources</b>):                         <ul style="list-style-type: none"> <li>○ Assessment of Life Cycle Costs for LID Stormwater Management Practices (Final Report 2013)</li> <li>○ LID Stormwater Management Practice Inspection and Maintenance Guide</li> </ul> </li> </ul>	<p>City of Hamilton</p>	<p>n/a</p>

Monitoring, Reporting & Operation and Maintenance	Low Impact Development (LID) techniques (O&M Private Property)	<p>As part of development approvals process, monitoring and reporting requirements for landowners should be outlined in order that municipal/CA staff can be assured that LID measures are properly maintained and functioning. City easements are required, that give municipal staff authority to inspect, and repair as necessary LID facilities on private property.</p> <p>Specific wording as part of site plan conditions, requiring performance bonds/warrantees that ensure that LID measures are properly designed, constructed and monitored for a sufficient post construction period to ensure that they are functioning effectively</p> <p>This can be accomplished through the development of appropriate bylaws and the establishment of right to enter easements. Possibly incorporated as part of existing City Bylaws and standards.</p>	<ul style="list-style-type: none"> <li>Sections 9.1 and 9.2 of the Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) describes the submission requirements at the:                             <ul style="list-style-type: none"> <li>Planning Stage</li> <li>Detailed Design Stage</li> </ul>                             See <b>Section 4.6</b> </li> </ul>	City of Hamilton	City of Hamilton NPCA GRCA HCA
Water Quality and Quantity	Airport lands	<ul style="list-style-type: none"> <li>Monitoring offsite water quality to identify problem areas</li> <li>Implement an EMS program on Airport lands to manage potential sources of surface water contamination</li> <li>Identify opportunities to mitigate the effects of uncontrolled airport runoff on receiving waters</li> <li>Encourage the adoption of a similar approach to stormwater management within the airport and areas required to meet its future land requirements</li> </ul>	<ul style="list-style-type: none"> <li>2011 Plan remains in effect</li> </ul>	Hamilton Airport/landowner	n/a
Stream Classification	All watercourse	<p>Stream buffers as presented in <b>Figure 2.9.5: Stormwater Master Plan</b> represents features to be protected based on floodplain and fisheries requirements. Additional studies and site visits with relevant Conservation Authorities' staff will be necessary to finalize which features require protection, versus which may be replaced with stormwater management facilities per CA Generic Regulations (Regulation of Development, Interference With Wetlands and Alterations to Shorelines and Watercourses)- the regulations are CA specific (GRCA – Reg 150/06; HCA – 161/06; NPCA – 155/06). The size of the setbacks from the watercourse edge to developable lands is typically a function of the significance of the valley form, sensitivity of the watercourse and the type of development (building or other).</p> <p>The final width of this setback would be determined based on a Scoped EIS, Geotechnical Assessment, a Feature-Specific Water Budget Assessment. These studies shall be completed as prescribed by the policies of the AEGD Secondary Plan to describe proposed development, assess potential environmental impacts and recommend appropriate mitigation measure. The required studies will be submitted to the City of Hamilton as part of the development approval process</p> <p>It is important to note that most features, except those currently identified as warm or cool water streams, may be altered in terms of their location, although they may still have to be maintained as natural features</p>	<ul style="list-style-type: none"> <li>2011 Plan remains in effect</li> </ul>	Hamilton Airport/landowner	City of Hamilton NPCA GRCA HCA

Stream Restoration Stormwater Management Plan	All watercourse	As part of the Stormwater Management Master Plan, it was assumed that 250m of stream restoration works may be require (not mandatory) required to obtain a suitable outlet for the proposed facility based on surface drainage conditions and stream classification.	<ul style="list-style-type: none"> <li>2011 Plan remains in effect</li> </ul>	Hamilton Airport/landowner	City of Hamilton In consultation with: NPCA GRCA HCA DFO MNRF
Stream Classification	Cool/Coldwater Watercourses / Critical Fish Habitat Seasonal/Warmwater / Important/Marginal Fish Habitat	Undertake a native, woody, riparian vegetation planting program to establish 75% of the stream corridor length in woody vegetation with the remainder as meadow or riparian wetland as appropriate.  Established as part of the development approval process (through the required relevant studies outline above) and required as a condition of approval.	<ul style="list-style-type: none"> <li>2011 Plan remains in effect See <b>Table 2.8.4.</b></li> </ul>	AEGD Landowner/ Proponent	City of Hamilton In consultation with: NPCA GRCA HCA
Stream Classification	Coldwater and Warmwater Fish Habitat	As part of development approvals, these features should be protected in their current location and existing functions should be protected or enhanced. Enhancement could include improving morphology (pool/riffle), reducing overland sediment inputs and improving instream habitats. Permits may be required from relevant Conservation Authority under Regulation of Development, Interference With Wetlands and Alterations to Shorelines and Watercourses (regulations are CA specific GRCA – Reg 150/06; HCA – 161/06; NPCA – 155/06).  Remedial works shall incorporate fish habitat protection/mitigation or compensation in accordance with the requirements of the Federal Department of Fisheries and Oceans (DFO) and the MNRF.	2011 Plan remains in effect See <b>Table 2.8.4</b>	AEGD Landowner/ Proponent	City of Hamilton In consultation with: NPCA GRCA HCA DFO MNRF
Stream Classification	Seasonal Fish Habitat	As part of development approvals, these drainage features may be modified and relocated as necessary to facilitate development provided that their natural form and function is enhanced.  Alteration to a regulated watercourse will require a permit from the respective Conservation Authority under Regulation of Development, Interference With Wetlands and Alterations to Shorelines and Watercourses (regulations are CA specific GRCA – O.Reg, 150/06; HCA – 161/06; NPCA – 155/06) and potentially clearance/ authorization from the DFO) under the Fisheries Act and the MNRF under the Lakes and Rivers Improvement Act).  It is recommended that the proponent complete a DFO self-assessment, and if required, consult with the DFO.	2011 Plan remains in effect See <b>Table 2.8.4</b>	AEGD Landowner/ Proponent	City of Hamilton In consultation with: NPCA GRCA HCA DFO MNRF



<p>Stream Classification</p>	<p>Indirect/Support Fish Habitat / Marginal Fish Habitat</p>	<p>Current classification based on a preliminary assessment of these features. As part of development approvals, these features may be replaced by Stormwater Infrastructure, including LID and end-of-pipe facilities to replicate their water quantity and quality function. Alternatively, they may be enhanced and protected within a corridor width of up to 30 m (plus the bankfull channel width). Their location may also be modified and relocated provided that their water quality and quantity functions are maintained.</p> <p>Alteration to a regulated watercourse will require a permit from the respective Conservation Authority under Regulation of Development, Interference With Wetlands and Alterations to Shorelines and Watercourses (regulations are CA specific GRCA – O.Reg, 150/06; HCA – 161/06; NPCA – 155/06) and potentially clearance/authorization from the DFO under the Fisheries Act and the MNRF under the Lakes and Rivers Improvement Act).</p> <p>It is recommended that the proponent complete a DFO self-assessment, and if required, consult with the DFO.</p>	<p>2011 Plan remains in effect See <b>Table 2.8.4</b></p>	<p>AEGD Landowner/ Proponent</p>	<p>City of Hamilton In consultation with:                  NPCA                  GRCA                  HCA                  DFO                  MNRF</p>
<p>Stream restoration associated with End-of-Pipe dry ponds</p>	<p>Seasonal and Warm water Fish Habitat &amp; Coldwater Fish Habitat</p>	<p>Stream restoration are limited to defining minimum stream corridor widths and to riparian vegetation plantings to provide flow/water quality attenuation, enhance stream shading, minimize stream bank erosion, and create a vegetated buffer along all headwater features.</p> <p>Defined stream corridor has been established adjacent to and downstream of each drainage feature to the downstream limit of the study area or the upstream limit of the mapped floodplain, as follows:</p> <ul style="list-style-type: none"> <li>• 15 m from each side of the bank full channel of the drainage feature for Seasonal and Warm water Fish Habitat</li> <li>• 30 m from each side of the bank full channel of the drainage feature for Coldwater Fish Habitat</li> </ul> <p>The final widths of the defined stream corridors adjacent to each dry pond, will be the greater of these corridor widths and the floodplain width based on detailed hydrologic/hydraulic studies to be completed as development proceeds as part of SWM Plans and the development approvals process.</p>	<ul style="list-style-type: none"> <li>• 2011 Plan remains in effect</li> </ul>	<p>Hamilton Airport/landowner</p>	<p>City of Hamilton                  NPCA                  GRCA                  HCA</p>
<p>Stewardship</p>	<p>Sediment Transport Mitigation</p>	<p>Implement a stewardship program targeting existing agricultural operations to reduce sediment transport and delivery to watercourses through a combination of programs including:</p> <ul style="list-style-type: none"> <li>• Implementing nutrient management plans on farm operations</li> <li>• Utilizing sediment control practices such as conservation tillage and cover cropping practices</li> <li>• Encouraging the planting of buffer strips along drainage features to reduce sediment delivery to these features</li> </ul>	<ul style="list-style-type: none"> <li>• 2011 Plan remains in effect</li> </ul>	<p>NPCA                  GRCA                  HCA</p>	<p>n/a</p>

<p>Future Requirements</p>	<p>Existing stormwater facilities in communities adjacent (Garner Road and Twenty Road)</p>	<p>Existing stormwater facilities in communities adjacent to the study area on the north side along Garner Road and Twenty Road accept surface flows from within the study area and are presently managed privately without the City possessing legal access for inspection, maintenance or upgrade.</p> <p>To appropriately manage drainage from future development within the AEGD, legal access for the purposes of inspection, maintenance or facility upgrade by the City will be required. As such, it is recommended that development draining into existing private facilities be precluded until such time as the City retains easements to access these facilities.</p>	<ul style="list-style-type: none"> <li>It is understood that the City of Hamilton has not and will not assume the approximately 7 private SWM ponds located on the North side along Garner Road and Twenty Road within the Twenty Place Community, but that the owners have completed an Stormwater Management Facility Needs Study in 2013-2014 to develop long-term planning and maintenance of SWM infrastructure to reduce liability and costs.</li> </ul>	<p>City of Hamilton</p>	<p>n/a</p>
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### 2.9.6 Stormwater Management Criteria

The following section is intended to summarize the environmental criteria from the 2011 Stormwater Master Plan (**Part B**) for the for the AEGD.

Stormwater management techniques including source and conveyances systems, end-of-pipe dry ponds and stream restoration (corridor protection and riparian plantings) in the context of the AEGD study area and the four land-uses.

The targets provided are minimum targets only and as such it is anticipated that practitioners applying and implementing the proposed Stormwater Master Plan will do so in full recognition of the Eco-Industrial design approaches which form the foundation of the treatment train approach (LID source and conveyance controls) proposed for the AEGD and will strive for a “best achievable” implementation strategy on a lot level basis based on local soils and other relevant site characteristics. The five (5) primary stormwater design criteria are detailed below:

1. Flood protection;
2. Water quality;
3. Erosion;
4. Infiltration (Water Balance); and
5. Natural features

See **Section 2.9.1** though **Section 2.9.4** and **Table 2.9.5** for additional policy, regulation and / or requirements which have changed since the finalization of 2011 Subwatershed and Stormwater Master Plan studies which may server to amend, supersede or support the SWM criteria for the AEGD.

### **2.9.6.1 Flood Protection**

The preferred Stormwater Master Plan for the AEGD utilizes a suite of LID source and conveyance controls in combination with end-of-pipe dry-ponds. As it relates to flood control within the AEGD, the implementation of a treatment train approach to SWM management that includes dry-pond end-of-pipe controls is essential given the existing airport and drainage feature constraints.

The dry-ponds will form part of the AEGD's major system, consisting of overland flow routes (roads, drainage swales etc) and end-of-pipe stormwater management facilities. LID conveyance controls are intended to function as the minor system only. The major system should be designed in compliance with the:

- City of Hamilton Criteria and Guidelines for Stormwater Infrastructure Design (Phillips- 2007)
- City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014).

While the 2011 Stormwater Master Plan for the AEGD suggested that the use of LID techniques for flood control are not generally not supported by regulatory agencies and as such were not proposed for use within the AEGD study area. However since that time, advances in design and understanding of the performance of LID has led to the use of permeable pavement, sub-surface storage units, soakaway pits, and cisterns etc. as part of on-site flood control within ICI land uses. Table 4.2 of the Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) identifies Rooftop Storage, Parking Lot Storage and Oversized Pipes as preferred source control practices which provide a flood control function, but also acknowledges the volume reduction benefits of other source control practices.

#### **Flood Control Target Development for AEGD**

Based on the hydrologic modeling work for Phase 2 completed in 2011, as well as the regulatory requirements of the three (3) conservation authorities, post to pre peak flow controls for a time series flows from the 2 through 100 year event is required for all dry ponds. Floodplain mapping for AEGD has been completed through hydraulic and

hydrologic modelling for the 2yr-100yr storms for the AEGD, however Regional Floodplain assessments have not been completed for either Tiffany or Ancaster Creek (Sulphur Creek tributaries) upstream of Garner Road. The Regional Floodplain forms the basis of the CA regulations. Although the flood hazards are not expected to be significant given the location in the headwaters of these watercourses, any impacts on existing floodplain will be a consideration for the HCA and other Conservation Authorities in the evaluation of future development through the regulatory process (See **Figure 2.9.5**). **Table 2.9.6.1** summarizes the flood control criteria and minimum targets for the AEGD.

**Table 2.9.6.1: AEGD Flood Control Criteria and Minimum Targets**

Category	Generalized Control Target	AEGD Minimum Targets	Amendments and/or Pending Amendments since 2011
Flood Control	<p>Control peak outflows to pre-development rates, for design storms with return periods up to 100 years using End-of-pipe dry ponds.</p> <p style="text-align: center;"><b>Or</b></p> <p>Upon approval from the City (with all necessary easements – Part A- Section 3.0 and Part B - Section 5.1.1) and if site and development conditions allow, on-site flood control may be feasible and should be assessed at the site plan stage. On site flood controls must adhere to AEGD minimum targets.</p>	<p>Post to Pre, 2 through 100 yr event controlled using Dry-ponds as per the AEGD Stormwater Master Plan</p> <p>Flood control target for the AEGD = 303-438 m<sup>3</sup>/ha (See AEGD Subwatershed and Stormwater Master Plan- Section 4.1.3)</p> <p>Floodplain mapping completed for 2yr-100yr storms for the AEGD, however Regional Floodplain assessments have not been completed for either Tiffany or Ancaster Creek (Sulphur Creek tributaries) upstream of Garner Road</p> <p>On-site flood control facilities may be feasible for large developments provided an appropriate outlet can be obtained. To be confirmed by the City of Hamilton. Consultation with the City is recommended. See <b>Section 4.3</b></p>	<ul style="list-style-type: none"> <li>• Low Impact Development Stormwater Management Guidance Manual (Pending 2017) will amend the 2011 Plan. Minimum on-site volume control targets will be required and will reduce the end-of-pipe retention volume requirement.</li> <li>• Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) – See <b>Section 2.9.4.</b></li> </ul>

### ***2.9.6.2 Water Quality***

LID source and conveyance have been proposed as the preferred SWM techniques to meet the water quality targets for lands within the AEGD.

#### **Water Quality Target Development for AEGD**

The AEGD Stormwater Master Plans identified that due to the sensitivity of downstream areas to water quality impacts (fisheries, erosion susceptibility, ESA/wetland features, the Great Lakes Areas of Concern, the Niagara and Hamilton Harbour Areas of Concern), all proposed development will require Level 1 or enhanced stormwater treatment (per the Ministry of the Environment (MOE) Stormwater Management Planning and Design Manual, 2003).

The “Level 1” or “enhanced” level of water quality protection requires all proposed stormwater management facilities reduce the average long term annual load of total suspended sediment (TSS) by 80% or better.

The Ministry of the Environment’s 2003 Stormwater Management Planning and Design (SWMPD) manual (Table 3.2), although not expressly stated in the manual, predominately deals with end-of-pipe controls. However, the SWMPD manual also contains guidance for stormwater management facilities that employ infiltration including lot level and conveyance controls. More specifically and in relation to the soils within the AEGD, the 2003 SWMPD manual under Section 4.2 and Table 4.1 provides guidance that relates to “physical constraints which could limit the use of lot level, conveyance and end-of-pipe controls”, but does not in any way indicate that area soils with lower relative infiltration rates be excluded from infiltration practices. The infiltration rate of soils will have an obvious effect on the drawdown-time of the facility between events and therefore techniques should be sized accordingly based on design guidance from sources such as:

- Stormwater Infrastructure Design (Philips Engineering Ltd., September 2007),
- Low Impact Development Stormwater Management Planning and Design Manual, Version 1.0 (CVC/TRCA, 2010)
- Stormwater Management Planning and Design Manual (MOE, March 2003); and

- Others – See **Appendix C: LID Resources**

As such, soil infiltration capacity guidance in the SWMPD manual should not be interpreted as a prohibition but as a caution that controls relying primarily on infiltration may not be as effective as they could be on soils with higher relative rate of infiltration.

Furthermore, LID stormwater management practices in soils with lower infiltration capacities can utilize multiple mechanisms (beyond simply infiltration) such as, but not limited to; **Filtration, Retention, Evaporation** and/or **Transpiration**. If sized such that they empty between events and will not be perceived as a nuisance, should not exclude the implementation of such measures to realize water quality, as well as water balance objectives regardless of the native soils. Provided that the proposed LID techniques incorporate the appropriate runoff storage volumes, empty within inter-event periods and are otherwise appropriately sited, designed, monitored and maintained (similar to all other stormwater management facilities), there should be no impediment to the application of infiltration technologies, in all soils type, for the realization of water quality.

This approach is supported by the Ministry of the Environment and Climate Change (MOECC) **Interpretation Bulletin – Expectations Re: Stormwater Management** (February 2015) and aligns with the pending MOECC Low Impact Development Stormwater Management Guidance Manual which will require on-site control of the runoff generated from the regionally specific 90<sup>th</sup> percentile rainfall event; effectively ensuring that water quality control is managed within the boundaries of each individual site within the AEGD study area. From draft MOECC documents, the 90<sup>th</sup> percentile event for the AEGD is estimated to range from 28mm to 29mm. Control targets for the AEGD shall be confirmed upon the final release of the MOECC Impact Development Stormwater Management Guidance Manual.

The AEGD Water Quality Control targets are presented in **Table 2.9.6.2**.

**Table 2.9.6.2: AEGD Water Quality Criteria and Minimum Targets**

Category	Generalized Control Target	AEGD Minimum Targets	Amendments and/or Pending Amendments since 2011
Surface Water Quality	<p>Control pollutant loadings in accordance with current MOE guidelines.</p> <p>Enhanced level 1 protection as defined in the 2003 Stormwater Management Planning &amp; Design manual – reduce the average long term annual load of suspended sediment by 80% or better</p>	<p>Current MOE requirement for end-of pipe infiltration@ 70% TIMP =3.5mm</p> <p><u>Minimum</u> water quality target for the AEGD is the infiltration of 10mm for water quality.</p> <p>It is expected the practitioners will strive for a “best achievable” results which include LID practices that utilize filtration, evaporation, transpiration and retention in order to control greater than 10mm target</p>	<ul style="list-style-type: none"> <li>• Low Impact Development Stormwater Management Guidance Manual (Pending 2017) will superseded the 2011 Plan. Minimum on-site volume control targets will be required. 90th percentile event which, will achieve Level 1 control, is anticipated to range from 28mm to 29mm and will superseded the minimum water quality target.</li> <li>• Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) – See <b>Section 2.9.4</b></li> </ul>



### 2.9.6.3 Erosion

Urban development typically affects the magnitude, duration and frequency of stream flows resulting in an increase of erosion of stream bed and banks. The eroded bed material can have harmful impacts on downstream aquatic habitat. The requirement to prevent erosion associated with development is regulated through the Ontario Water Resources Act (OWRA), The Planning Act, the Federal Fisheries Act and the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation under Section 28(1) of the *Conservation Authorities Act* (CAA).

#### Erosion Target Development for AEGD

The approach used to define erosion control targets in the AEGD study area includes:

- City of Hamilton - Municipal Erosion Control Guidelines; and
- The 2003 MOE Stormwater Management Planning and Design Manual
- Implementation of LID measures to mitigate changes to pre-development hydrology.

Integrated into the definition of erosion control targets for the AEGD and its respective watersheds is the understanding of how hydromodification affects those elements of natural channel form that can lead to watercourse destabilization and destruction of aquatic habitat. Watercourse erosion is caused by hydromodification, which contains three key concepts:

1. **Magnitude (Peak flow rate)** - Excessive erosion occurs post-development, even with the inclusion of 'traditional' erosion controls because peak flow management often results in flows that are in excess of the watercourse erosion thresholds for prolonged periods of time when compared to pre-development.
2. **Duration (Runoff Volume)** - To mitigate the geomorphic impacts that result from current practices, LID practices utilize multiple mechanisms such as infiltration, filtration, retention, evaporation and/or transpiration to reduce runoff volumes and to more closely return the post-development water balance to pre-development

levels. It is however, the water balance that ultimately determines watercourse flow and the flow which dictates the channel form.

3. **Frequency (Number of Runoff Events)** - When dealing with watercourse erosion, the frequency of runoff events is important. It is during these frequent runoff events and corresponding watercourse flows (effective discharge) that the majority of the annual sediment load is conveyed. LID stormwater techniques are inherently designed to manage the smaller, more frequent rainfall events and as such are highly effective at reducing runoff frequency, thereby reducing watercourse erosion.

Therefore, by better matching the pre-development water balance, the effects of hydromodification (magnitude, duration and frequency) can be diminished. The Stormwater Master Plan for the AEGD focuses on the implementation of LID source and conveyance controls in order to maintain the pre-development water balance. In addition, the Stormwater Master Plan identifies the protection of stream corridors and extensive woody riparian planting to improve bank stability and increase out of bank roughness to reduce erosive flows.

The proponent is advised to contact the respective Conservation Authority for watercourse specific guidance and to confirm the need to complete an erosion analysis to determine if any proposed infrastructure will impact erosion within and downstream of the study area. It should be noted that this hazard information may affect development setbacks beyond the 15m-30m natural heritage/fisheries buffers as detailed within this report.

The AEGD Erosion Control targets are presented in **Table 2.9.6.3**

**Table 2.9.6.3: AEGD Erosion Criteria and Minimum Targets**

Category	Generalized Control Target	AEGD Minimum Targets	Amendments and/or Pending Amendments since 2011
Watercourse Erosion Control	1. In accordance with current MOE guidelines: capture the Runoff volume generated by a 25mm event, and release it to the outlet over 24 hrs Or 2. Control the frequency and duration of site outflows such that in-stream index of erosion potential (e.g. multi-year erosive impulse) is not increased.	Match pre-development water balance (See AEGD Subwatershed and Stormwater Master Plan- Sections 4.1.5.2 – 4.1.5.4)  Where matching pre-development water balance is not possible, integrate erosion control within end-of-pipe facility.	<ul style="list-style-type: none"> <li>Low Impact Development Stormwater Management Guidance Manual (Pending 2017) is anticipated support the 2011 Plan. Minimum on-site volume control targets will be required as will a requirement for the maintenance of the pre-development water balance.</li> <li>Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) – See <b>Section 2.9.4.</b></li> </ul>
<ul style="list-style-type: none"> <li>Proponent to contact the respective Conservation Authority for watercourse specific guidance and to confirm the need to complete an erosion analysis to determine if any proposed infrastructure will impact erosion within and downstream of the study area. It should be noted that this hazard information may affect development setbacks beyond the 15m-30m natural heritage/fisheries buffers as detailed within this report.</li> </ul>			

**2.9.6.4 Infiltration**

LID source and conveyance have been proposed as the preferred SWM techniques to meet the infiltration targets for lands within the AEGD.

**Infiltration Target Development for AEGD**

There is a growing body of evidence which suggests that ‘traditional’ end-of-pipe stormwater management techniques are not achieving the level of watershed management we now realize is necessary to protect hydrologic function. Therefore, considerable effort has been placed on the characterization of the pre and post

development water balances as part of the hydrologic analysis within the AEGD Stormwater Master Plan (see Sections 4.1.5 and 4.1.6 of the 2011 Phase 2 Subwatershed Study and Stormwater Master Plan). The intent is to provide planners, designers and other practitioners with catchment based pre-development water balances from which to plan and design LID source and conveyance controls with the goal of re-establishing/matching pre-development infiltration after development has occurred. The AEGD infiltration targets are presented in **Table 2.9.6.4**

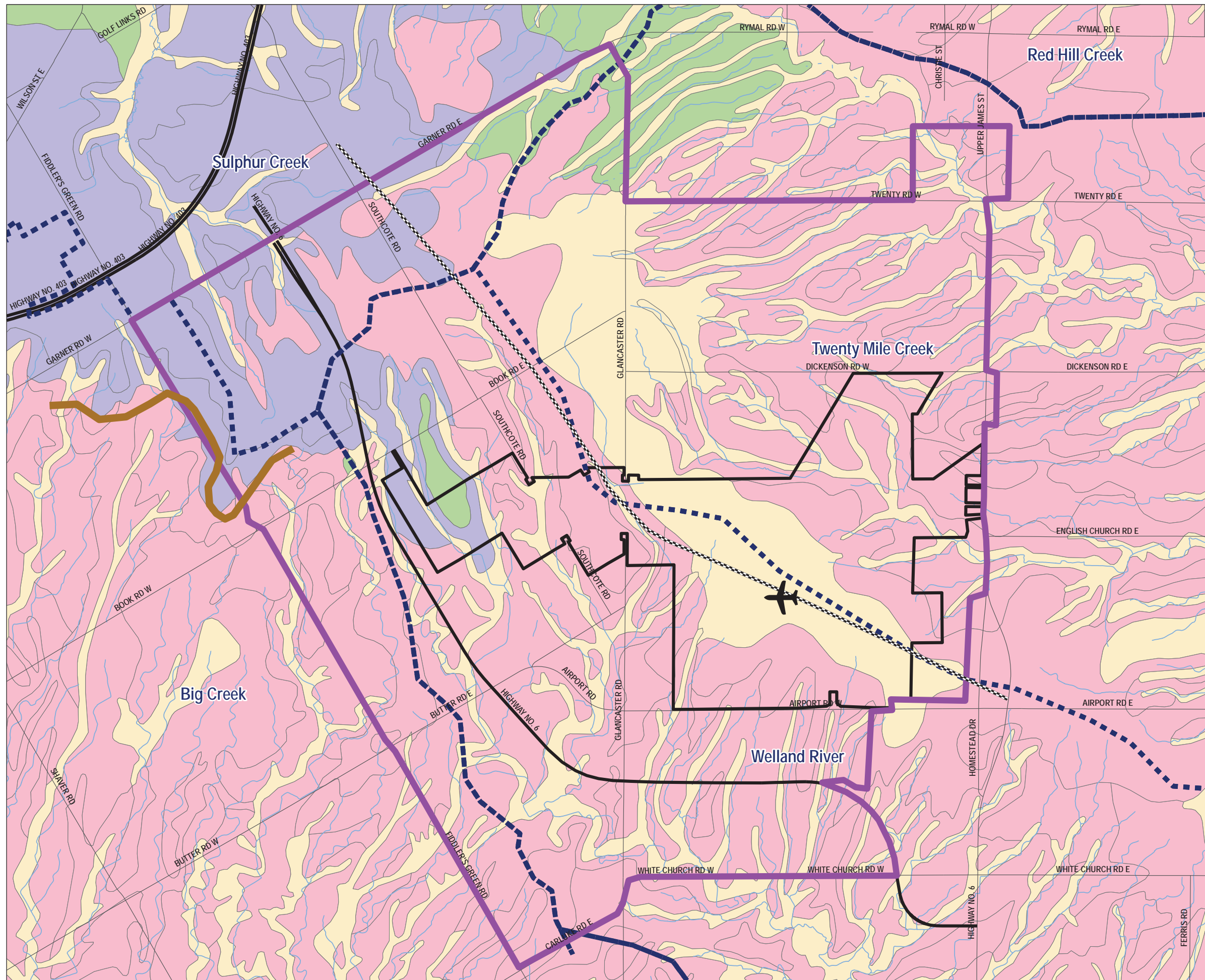
**Table 2.9.6.4: AEGD infiltration Criteria and Minimum Targets**

Category	Generalized Control Target	AEGD Minimum Targets	Amendments and/or Pending Amendments since 2011
Infiltration (Water Balance)	Maintain groundwater recharge per pre-development water balance	<p>At a minimum, maintain groundwater recharge (infiltration) volume as per <b>Table 2.9.6.5 LID Capture Target</b> (m<sup>3</sup>/impervious ha served) for Proposed Conditions Land uses</p> <p>and</p> <p>Verify agreement with catchment based pre-development water balances for the AEGD Sub Watersheds where applicable. (See Sections 4.1.5.2 – 4.1.5.4)</p> <p>Big Creek watershed: Proponent must establish pre and post development water balance and infiltration requirements</p>	<p>Low Impact Development Stormwater Management Guidance Manual (Pending 2017) is anticipated support the 2011 Plan. Minimum on-site volume control targets will be required as will a requirement for the maintenance of the pre-development water balance.</p> <p>Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) – See <b>Section 2.9.4.</b></p>

Detailed hydrologic modeling has produced pre-development water balances for all sub-catchments with the AEGD study area (with the exception of the Big Creek watershed since at the time of the study the majority of the lands, approximately 330ha (330.2ha), are entirely within the Additional Study Area) as well as infiltration targets for LID techniques for Proposed Conditions Land uses based on the dominant soil types (**Table 2.9.6.5**). The AEGD Stormwater Master Plan requires that pre-development infiltration volumes be maintained post development through the use of the LID capture targets. Post development infiltration volumes should be checked against pre-development water balances (for the appropriate area) provided as part of this study.

**Table 2.9.6.5: LID Capture Target (m<sup>3</sup>/impervious ha served) for Proposed Conditions Land uses**

Scenario (See <b>Figure 2.9.6.</b> and <b>Figure 2.9.7</b> for soil types)	LID Facility Design Capture Target		Assumed % Imperviousness of future conditions land use
	(mm)	(m <sup>3</sup> / imp ha)	
Roads AB Soils	9	90	70
Roads BC Soils	8	80	70
Roads CD Soils	7	70	70
Prestige Business Park / Airport Related Business AB Soils	10	100	70
Prestige Business Park / Airport Related Business BC Soils	8	80	70
Prestige Business Park / Airport Related Business CD Soils	6	60	70
Airside Industrial / Light Industrial AB Soils	13	130	80
Airside Industrial / Light Industrial BC Soils	11	110	80
Airside Industrial / Light Industrial CD Soils	8	80	80



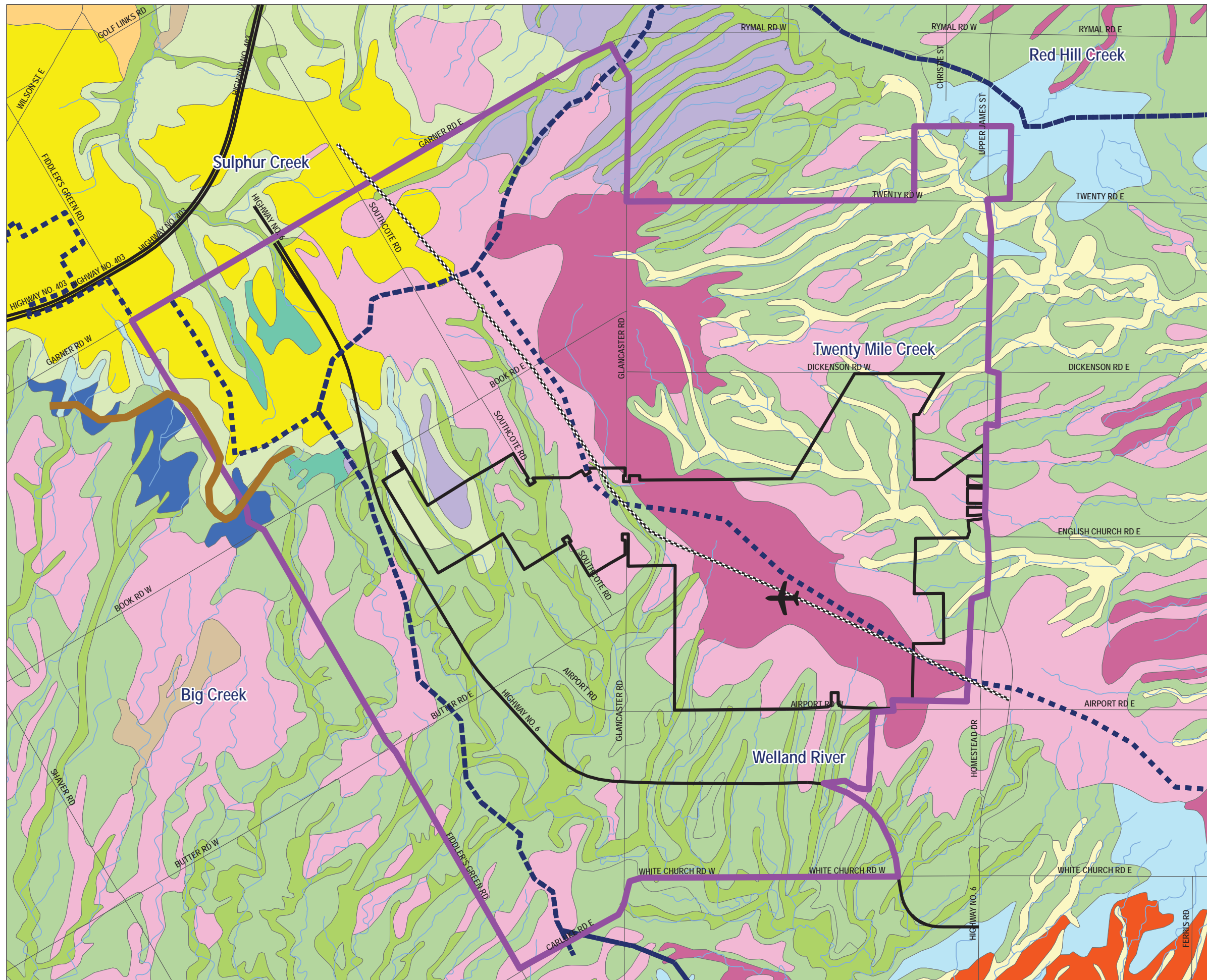
- Fort Erie Moraine
- Scarp
- Hydrologic Soil Group**
- A
- B
- C
- D
- Other Features**
- ✈ Airport Boundary
- ▭ Airport Employment Growth District Study Boundary
- Watershed Boundary

Source: Ontario Soil Survey for Wentworth County (1965)

**Figure 2.9.6**  
**Airport Employment Growth District**  
**Hydrologic Soil Groups**

N





- Fort Erie Moraine
- Scarp
- Soil Type**
- Alberton Silt Loam
- Alberton Silty Clay Loam
- Ancaster Silt Loam
- Beverly Silt Loam
- Binbrook Silt Loam
- Brant Silt Loam
- Brantford Silt Loam
- Colwood Silt Loam
- Grimsby Sandy Loam
- Muck
- Smithville Silt Loam
- Springvale Sandy Loam
- Toledo Silt Loam
- Toledo Silty Clay Loam
- Tuscola Silt Loam
- Other Features**
- ✈ Airport Boundary
- ▭ Airport Employment Growth District Study Boundary
- Watershed Boundary

Source: Ontario Soil Survey for Wentworth County (1965)

**Figure 2.9.7**  
**Airport Employment Growth District**  
**Soil Type Classifications**



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#### ***2.9.6.5 Natural Features***

Natural features, such as existing wetlands, woodlands, and streams are integral components of the natural landscape of the AEGD that can be impacted following urban development. Impacts are typically linked to changes in hydrology, including changes in water quantity, quality, volume, duration, frequency, and spatial distribution of flow. A water balance approach is required in order to demonstrate that flow regimes will be maintained in the post-development scenario.

The four (4) step procedure used to ensure natural features are protected has been undertaken, with steps 1 and 2 integrated into the AEGD Phase 1 Report and Phase 2 methodologies. This includes:

- Needs Establishment (Step 1),
- Baseline Conditions Establishment (Step 2),
- Pre-development Site Characterization (Step 3), and
- Pre-development vs. Post-development Comparison (Step 4).



### **3.0 STORMWATER MANAGEMENT MASTER PLAN GUIDANCE**

The 2011 Stormwater Master Plan provides direction/guidance on the water resources and environmental criteria (**Section 2.9.6**) to be met within each of the drainage features/land use designations in the study area.

The following section details the individual components of the Stormwater Management Master Plan including LID source and conveyance controls, the concepts of dual drainage, summary of LID feasibility in relation to proposed land uses, end-of-pipe controls and stream restoration.

#### ***3.1 Storm Water Management Approaches***

The Stormwater Master Plan for the AEGD utilizes a suite of LID source and conveyance controls in combination with end-of-pipe dry-ponds as part of a treatment train approach. The approach is a state of the art approach to managing stormwater by first and foremost treating runoff (precipitation) at its source, as a resource to be managed and protected rather than a waste. In this regard, the emphasis in managing runoff is to retain/maintain the existing infiltration of water into the ground by managing runoff through source (lot level) and conveyance (street level) measures using what is referred to as a “treatment train” approach to stormwater management and is consistent with the recommendations of the 2003 MOE SWMPD Manual.

Measures such as green roofs, rain gardens, and rainwater harvesting implemented on individual lots, and combined with additional measures such as biofilters, grassed swales, perforated storm sewers within road right of ways, encourage infiltration and reduce the quantity of runoff reaching local drainage features. These measures are part of a suite of stormwater management techniques collectively known as Low Impact Development (LID) and are consistent with the forms of development that are fundamental to the Eco-Industrial land-use concept.

### **3.2 Low Impact Development (LID) – General**

The suite of landscape-based, decentralized, lot-level, micro-control Best Management Practices (BMPs) along with the principles of better site design are collectively known as Low Impact Development (LID). There are many definitions that have been developed in an attempt to define Low Impact Development, with the most widely accepted definition being that used by the United States Environmental Protection Agency (EPA, 2007):

*Low Impact Development (LID) is a stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution. LID comprises a set of site design approaches and small scale stormwater practices that promote the use of natural systems for infiltration, evapotranspiration, and reuse of rainwater. These practices can effectively remove nutrients, pathogens and metals from stormwater, and they reduce the volume and intensity of stormwater flows.*

Subsequent sections provide additional detail with respect to LID source controls and conveyance controls.

### **3.3 Dual Drainage Concept (Minor and Major Systems)**

The Stormwater Master Plan for the AEGD utilizes two distinct storm drainage sub-systems within the *Dual Drainage Concept (Minor and Major Systems)*. Storm drainage system design includes the design of a minor system (LID conveyance controls) and a major system (overland flow routes, stormwater management dry-ponds, etc.).

1. The Minor System: the minor system within the AEGD is to consist of LID conveyance systems designed to remove excess surface runoff from (lot level source controls) as a result of more frequent storms, and deliver it to end-of pipe facilities.
2. The Major System: which is the overland route the excess runoff will follow when the Minor System capacity is surpassed or is inoperable. The major system is primarily composed on intersecting streets and roadways but can also includes such features as natural and constructed open channels, drainage easements such as floodplains and / or end-of-pipe stormwater management facilities. It is

vital in the initial planning stages, to recognize the need for a continuous grade to convey major system runoff to a free outlet.

The Dual Drainage Concept (Minor and Major Systems) approach is consistent with the City of Hamilton Criteria and Guidelines for Stormwater Infrastructure Design, (Philips Engineering, 2007). The subsequent sections provide an overview of the various LID source controls, conveyance controls and end-of-pipe controls.

### **3.4 LID Source and Conveyance Controls**

Source controls are small-scale physical measures that encourage the infiltration of water into the ground and reduce stormwater runoff. These systems that are typically located at the beginning of a drainage system, that is they capture and treat storm water on-site or close to where the rainfall lands. Due to the relatively small area treated by an individual measure, source controls must be well distributed to treat storm water runoff effectively.

Conveyance controls are linear stormwater transport systems that are generally located within the road right-of-way. While still providing conveyance, these features encourage infiltration of water into the ground, improve water quality and reduce runoff. These LID measures are designed to improve water quality conditions and like source controls, these systems remove a portion of the total storm water volume from the system, slow the erosive velocity of storm water entering watercourses, and filter out pollutants. Included in this category are practices such as bio-filters, bio-swales, grassed channels and subsurface perforated pipe systems.

The Stormwater Master Plan for the AEGD calls for the implementation LID conveyance controls within the right-of-way (ROW) to control road runoff per the AEGD Transportation Master Plan. As part of the Transportation Master Plan, a 3m allowance within the standard local, collector and arterial road cross-sections have been reserved for the inclusion of LID conveyance systems (**Figure 3.4.1**). It is intended that LID conveyance systems be implemented on all local, collector and arterial roads within the AEGD, per the AEGD Transportation Master Plan.



**Figure 3.4.1: Example AEGD Cross section with 3m allowance for LID conveyance Controls**

Per Table 4.1 of the City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014), the preferred source control systems (including ROW conveyance controls) within the City of Hamilton for industrial, commercial and institutional use are summarized below.

<b>Table 4.1. Preferred Stormwater Source Control Practices Within the City of Hamilton for Industrial, Commercial, and Institutional Land Uses</b>					
<b>Practice</b>	<b>Land Use</b>				
	<b>Industrial</b>		<b>Commercial</b>		<b>Institutional Site</b>
	<b>Site</b>	<b>Road ROW</b>	<b>Site</b>	<b>Road ROW</b>	
Rooftop Storage	X		X		
Parking Lot Storage	X		X		
Green Roofs	X		X		
Oil/Grit Separators	X	X	X	X	X
Rainwater Harvesting	X		X		
Downspout Disconnections					X
Pervious Pipes	X	X	X	X	X
Oversized Pipes	X		X		X
Permeable Pavement			X		X
Soakaway Pits	X		X		X
Infiltration Trenches	X		X		X
Bumpouts		X		X	
Grassed Swales	X	X	X	X	X
Biofilters	X	X	X	X	X

Source: Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014)

### **3.5 End-of-Pipe Controls**

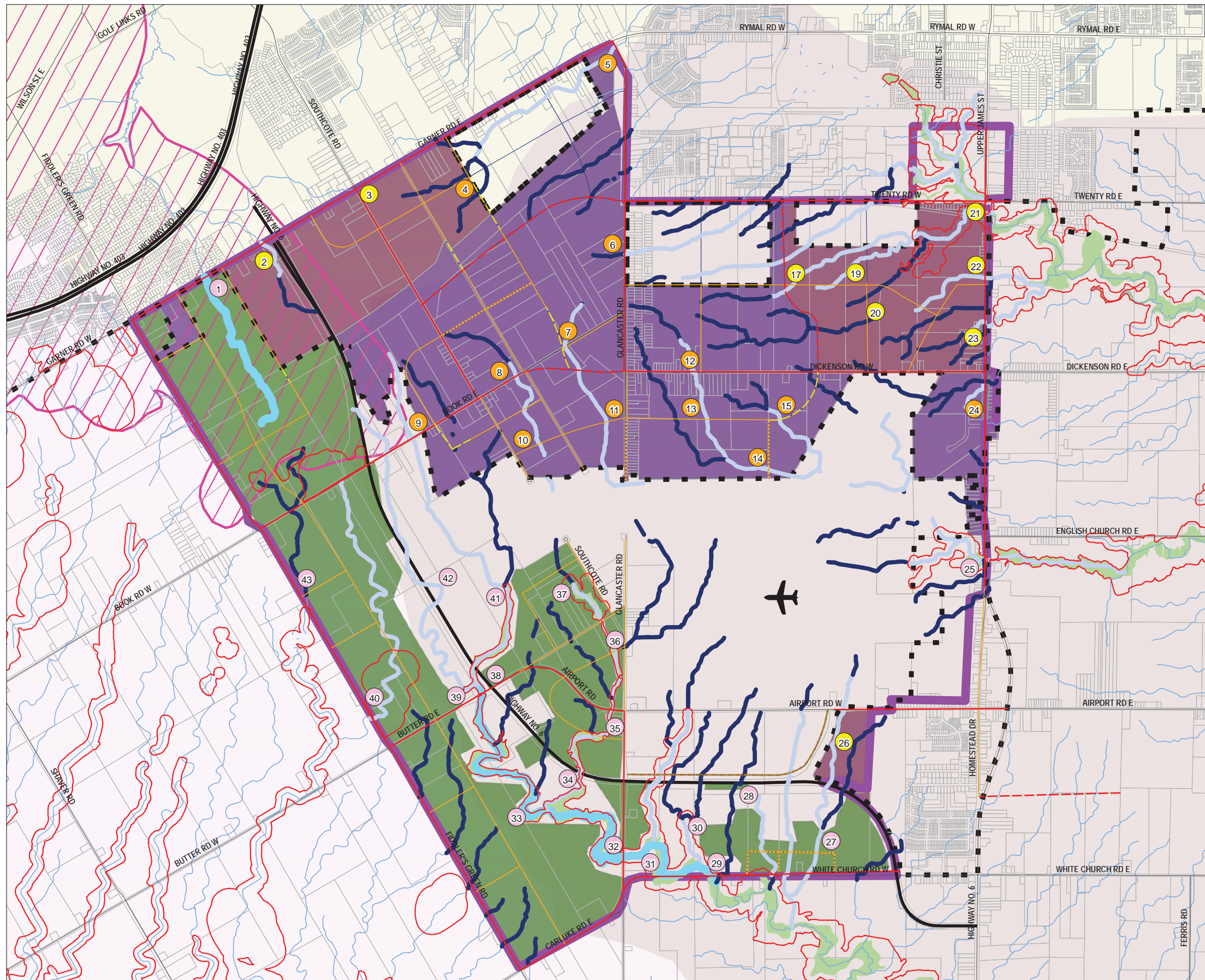
End-of-pipe measures are the most commonly used storm water management measure in most municipalities. End-of-pipe measures are typically implemented in urbanizing areas as a requirement of development.

The Stormwater Master Plan for the AEGD utilizes a suite of LID source and conveyance controls in combination with end-of-pipe dry-ponds. As it relates to flood control within the AEGD, the implementation of a treatment train approach to SWM management that includes Dry-pond end-of-pipe controls is essential given the existing airport constraints and drainage feature constraints.

#### **3.5.1 End-of-Pipe Dry Ponds Locations**

End-of-pipe dry ponds have been proposed as part of the flood control strategy for the AEGD. In response to the Ontario Municipal Board (OMB) approval of the Airport Employment Growth District (AEGD) Secondary Plan (Appendix 24 of the Urban Hamilton Official Plan) on February 17th, 2015, the proposed conceptual locations and phasing of end-of-pipe flood control facilities (dry ponds) have been updated and are shown on **Figure 2.9.5** of the Surface Water Management Plan and has been reproduced as **Figure 3.5.1**. (Note: Pond locations as shown are of approximate locations. Furthermore, for clarity and readability of pond labels, the size of the pond location identifiers are not shown to scale).

Refer to **Section 4.3** for a discussion of on-site (non-centralized) flood control facilities.



- Phasing**
- Phase 1 - Short Term
  - Phase 2 - Medium Term
  - Additional Study Area - Long Term
- Transportation Master Plan**
- Major Arterial Road
  - Minor Collector Road
  - Minor Collector Road (Potential Alignment)
  - Major Collector Road (Potential Alignment)
  - Major Arterial Road (Potential Alignment)
  - Proposed Service Road (Potential Alignment)
- Pond Location**
- Phase 1 Pond Location
  - Phase 2 Pond Location
  - Long Term Pond Location
- MNRF Fish Habitat Buffers**
- Support/Indirect Fish Habitat (30m)†
  - Seasonal/Warmwater Habitat (30m)†
  - Coldwater Habitat (60m)‡
- Conservation Authority Jurisdiction**
- Grand River Conservation Authority
  - Hamilton Conservation Authority
  - Niagara Peninsula Conservation Authority
- Other Features**
- High Recharge potential
  - Floodplain
  - Generic Regulation Lines\*\*
  - Airport Employment Growth District Study Boundary
  - Urban Boundary
- Notes:**
- \* If watercourse is retained as an enhanced feature.
  - \*\* Generic regulations include a 30 m buffer on all watercourses. Not all features regulated by the relevant Conservation Authority are mapped.
  - † Buffer based on 15m from each bank
  - ‡ Buffer based on 30m from each bank

**Figure 3.5.1**  
**Airport Employment Growth District**  
**Stormwater Master Plan**

0 250 500 750 m

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### ***3.5.1.1 Construction Costs End-of-Pipe Dry Ponds***

Corresponding to the update of the proposed conceptual locations and phasing of end-of-pipe flood control facilities (dry ponds) as shown on **Figure 2.9.5** of the Surface Water Management Plan and reproduced as **Figure 3.5.1**, the following section provides detailed information regarding the portion of the Development Charges relating to stormwater management within the AEGD study area for Secondary Plan Area-Phase 1 and 2 development lands.

All components of the drainage works that require development funding have been considered and included in the following assessment, with storm drainage infrastructure classified into three major groups (open watercourses, storm sewers and stormwater management facilities) and 5 categories (A-E) as follows:

- A – Open Watercourses: Erosion Control and Channel System Improvements
- B – Open Watercourses: Erosion Control – Anticipated future works
- C – Stormwater Management (Quality and/or Quantity Facilities)
- D – Over sizing of Trunk Sewers
- E – Culverts and Bridges: Anticipated Future Works

It is important to note that LID Source Controls and Conveyance Controls will be developer funded and as such as are not included in the DC cost estimates. General estimates of LID source and conveyance controls costs are provided in subsequent sections for reference.

### ***DC Cost Estimate Summary***

The following section summarizes the cost associated with the 5 categories of storm drainage infrastructure as per the AEGD Stormwater Management Master Plan. **Table 3.5.1** provides a summary of the associated costs of the AEGD Stormwater Management Master Plan for the 5 categories of storm drainage infrastructure. **Table 3.5.2** provides full costing details for Category B and C. All costs are in 2016 dollars.

**Table 3.5.1: Summary of the associated costs for the 5 categories of storm drainage infrastructure as per the AEGD Stormwater Management Master Plan.**

Category	Comment	Cost (\$)
A	No identified erosion control and/or channel systems improvements	\$ 0
B	<p>On-site erosion control is included in Cat C SWM Quantity control.</p> <ul style="list-style-type: none"> <li>Costs conservatively reflect the high potential for 250m of stream restoration/ outlet modification associated with the construction of each dry-pond quantity control facility</li> </ul>	<p>\$ 8,250,000</p> <p>(Included in Category C costs)</p>
C	<p>Quantity control costs reflect dry pond costs within Secondary Plan Area-Phase 1 and 2. See <b>Figure 3.3</b> for facility locations.</p> <ul style="list-style-type: none"> <li>Table 5.3.1 Provide full costing details.</li> </ul>	<p>Phase 1- \$ 28,865,000</p> <p>Phase 2- \$ 39,081,000</p> <p>(includes Category B costs)</p>
D	No trunk sewers in excess of 1200mm in diameter are identified at this level of investigation as internal road network configuration is unknown and should be investigated at the site plan stage for possible oversized trunk sewer requirements.	\$ 0
E	Costs are included in Transportation Master Plan cost estimates. Costs have been intentionally omitted from the storm drainage costing to avoid double counting.	<p>\$ 0</p> <p>(See Transportation Master Plan for bridge and culvert cost estimates)</p>
<b>Total Cost</b>		<b>\$ 67,946,000</b>



**Table 3.5.2: Detailed Stormwater Infrastructure costs- Category B (Erosion Control –onsite) and C (Quantity Control) for the AEGD Stormwater Master Plan**

Phase	Pond Location (see Figure 3.3)	Drainage Area	Quantity Control Target	Estimated Storage Volume	Assumed Maximum Depth	Estimated Facility Footprint	Land Cost (@\$1,050,175/ha)	Estimated Capital Cost *	Category B		Engineering / Design, Legal & survey (15%)	Total Construction Cost	Total Cost incl. land Cost	Development Charges
									Additional Cost (Stream restoration/outlet improvements) †	Length (m)				
		(ha)	(m³/ha)	(m³)	(m)	(ha)	(2016\$)	(2016\$)		(2016\$)	(2016\$)	(2016\$)	(2016 \$)	(2016\$)
1	2	82	390	31980	1.5	2.13	\$ 2,238,973	\$ 1,539,200	250	\$ 375,000	\$ 230,880	\$ 2,145,080	\$ 4,384,053	\$ 4,384,053
1	3	26	390	10140	1.5	0.68	\$ 709,918	\$ 665,600	250	\$ 375,000	\$ 99,840	\$ 1,140,440	\$ 1,850,358	\$ 1,850,358
1	4	75	390	29250	1.5	1.95	\$ 2,047,841	\$ 1,430,000	250	\$ 375,000	\$ 214,500	\$ 2,019,500	\$ 4,067,341	\$ 4,067,341
1	17	35	390	13650	1.5	0.91	\$ 955,659	\$ 806,000	250	\$ 375,000	\$ 120,900	\$ 1,301,900	\$ 2,257,559	\$ 2,257,559
1	19	35	390	13650	1.5	0.91	\$ 955,659	\$ 806,000	250	\$ 375,000	\$ 120,900	\$ 1,301,900	\$ 2,257,559	\$ 2,257,559
1	20	41	390	15990	1.5	1.07	\$ 1,119,487	\$ 899,600	250	\$ 375,000	\$ 134,940	\$ 1,409,540	\$ 2,529,027	\$ 2,529,027
1	21	35	390	13650	1.5	0.91	\$ 955,659	\$ 806,000	250	\$ 375,000	\$ 120,900	\$ 1,301,900	\$ 2,257,559	\$ 2,257,559
1	22	45	390	17550	1.5	1.17	\$ 1,228,705	\$ 962,000	250	\$ 375,000	\$ 144,300	\$ 1,481,300	\$ 2,710,005	\$ 2,710,005
1	23	40	390	15600	1.5	1.04	\$ 1,092,182	\$ 884,000	250	\$ 375,000	\$ 132,600	\$ 1,391,600	\$ 2,483,782	\$ 2,483,782
1	26	75	390	29250	1.5	1.95	\$ 2,047,841	\$ 1,430,000	250	\$ 375,000	\$ 214,500	\$ 2,019,500	\$ 4,067,341	\$ 4,067,341
<b>10</b>		<b>489</b>				<b>12.71</b>	<b>\$ 13,351,925</b>	<b>\$ 10,228,400</b>	<b>2500</b>	<b>\$ 3,750,000</b>	<b>\$ 1,534,260</b>	<b>\$ 15,512,660</b>	<b>\$ 28,864,585</b>	<b>\$ 28,864,585</b>
2	5	75	390	29250	1.5	1.95	\$ 2,047,841	\$ 1,430,000	250	\$ 375,000	\$ 214,500	\$ 2,019,500	\$ 4,067,341	\$ 4,067,341
2	6	50	390	19500	1.5	1.30	\$ 1,365,228	\$ 1,040,000	250	\$ 375,000	\$ 156,000	\$ 1,571,000	\$ 2,936,228	\$ 2,936,228
2	7	50	390	19500	1.5	1.30	\$ 1,365,228	\$ 1,040,000	250	\$ 375,000	\$ 156,000	\$ 1,571,000	\$ 2,936,228	\$ 2,936,228
2	8	75	390	29250	1.5	1.95	\$ 2,047,841	\$ 1,430,000	250	\$ 375,000	\$ 214,500	\$ 2,019,500	\$ 4,067,341	\$ 4,067,341
2	9	75	390	29250	1.5	1.95	\$ 2,047,841	\$ 1,430,000	250	\$ 375,000	\$ 214,500	\$ 2,019,500	\$ 4,067,341	\$ 4,067,341
2	10	40	390	15600	1.5	1.04	\$ 1,092,182	\$ 884,000	250	\$ 375,000	\$ 132,600	\$ 1,391,600	\$ 2,483,782	\$ 2,483,782
2	11	50	390	19500	1.5	1.30	\$ 1,365,228	\$ 1,040,000	250	\$ 375,000	\$ 156,000	\$ 1,571,000	\$ 2,936,228	\$ 2,936,228
2	12	50	390	19500	1.5	1.30	\$ 1,365,228	\$ 1,040,000	250	\$ 375,000	\$ 156,000	\$ 1,571,000	\$ 2,936,228	\$ 2,936,228
2	13	50	390	19500	1.5	1.30	\$ 1,365,228	\$ 1,040,000	250	\$ 375,000	\$ 156,000	\$ 1,571,000	\$ 2,936,228	\$ 2,936,228
2	14	50	390	19500	1.5	1.30	\$ 1,365,228	\$ 1,040,000	250	\$ 375,000	\$ 156,000	\$ 1,571,000	\$ 2,936,228	\$ 2,936,228
2	15	50	390	19500	1.5	1.30	\$ 1,365,228	\$ 1,040,000	250	\$ 375,000	\$ 156,000	\$ 1,571,000	\$ 2,936,228	\$ 2,936,228
2	24	70	390	27300	1.5	1.82	\$ 1,911,319	\$ 1,352,000	250	\$ 375,000	\$ 202,800	\$ 1,929,800	\$ 3,841,119	\$ 3,841,119
<b>12</b>		<b>685</b>				<b>17.81</b>	<b>\$ 18,703,617</b>	<b>\$ 13,806,000</b>	<b>3000</b>	<b>\$ 4,500,000</b>	<b>\$ 2,070,900</b>	<b>\$ 20,376,900</b>	<b>\$ 39,080,517</b>	<b>\$ 39,080,517</b>
<b>22</b>		<b>1174</b>				<b>30.52</b>	<b>\$ 32,055,542</b>	<b>\$ 24,034,400</b>		<b>\$ 8,250,000</b>	<b>\$ 3,605,160</b>	<b>\$ 35,889,560</b>	<b>\$ 67,945,102</b>	<b>\$ 67,945,102</b>

\* Capital cost based on 80/cu.m for the first 6500cu.m, and \$40/cu.m for the balance of storage volume. †Stream restoration /outlet improvement based on \$1,500/ linear meter.

### **3.6 Stream Restoration**

As part of the 2011 Stormwater Master Plan, stream restoration measures have been identified. These measures are limited to:

- Defined minimum stream corridor widths and to riparian vegetation plantings to provide flow/water quality attenuation, enhance stream shading, minimize stream bank erosion, and create a vegetated buffer along all headwater features (**Figure 2.9.5**). A native, woody, riparian vegetation has been recommended within these corridors to achieve a fisheries target of either 50% or 75% woody, riparian vegetation cover for seasonal/warm water fish habitat or coldwater fish habitat, respectively.
- Associated with each dry-pond location, it was assumed that 250m of stream restoration works would be required to obtain a suitable outlet for the proposed facility based on existing surface drainage conditions and stream classification. The assumed stream restoration component has been included within the category B of the storm drainage infrastructure as part of the Development Charges assessment. (see **Section 3.5**).

The City of Hamilton Criteria and Guidelines for Stormwater Infrastructure Design, (Philips Engineering, 2007) outlines the following as it relates to proposed development where watercourse alterations are proposed. The designs of such alterations shall incorporate and consider the following:

- Channel design is to be based on natural channel forming process to achieve a dynamically stable system consistent with the most current provincial guidelines;
- Alteration to a regulated watercourse will require a permit from the respective Conservation Authority under Regulation of Development, Interference With Wetlands and Alterations to Shorelines and Watercourses (regulations are CA specific GRCA – O.Reg, 150/06; HCA – 161/06; NPCA – 155/06) and potentially clearance/authorization from the Federal Department of Fisheries and Oceans

(DFO) under the Fisheries Act and the Ontario Ministry of Natural Resources and Forestry (MNR) under the Lakes and Rivers Improvement Act).

- Remedial works shall incorporate fish habitat protection/mitigation or compensation in accordance with the requirements of the Fisheries and Oceans (DFO) and the Ontario Ministry of Natural Resources and Forestry (MNR), related to stream type and significance.
- Remedial works shall incorporate the requirements of the governing Official Plan, as well as the requirement of the provincial ministries and other public agencies for protection of associated natural features.

## **4.0 IMPLEMENTATION CONSIDERATIONS**

The previous chapter outlined the findings of Phases 1 & 2 of the AEGD Subwatershed study and the Stormwater Master Plan and described the Natural Heritage Plan, the Groundwater Management Plan and the Surface Water Management Plan.

The following sections describe the various implementation considerations to guide future work so that the recommended strategy is successfully implemented.

Successful implementation of the Subwatershed Strategy will require the combined efforts of the City of Hamilton, development proponents, the relevant CA (Hamilton Conservation Authority, Niagara Peninsula Conservation Authority and Grand River Conservation Authority) and the landowners. As such, this report includes the following implementation considerations:

- Future Study Requirements
- Phasing Considerations;
- Design Guidance;
- Approvals; and
- City of Hamilton Submission Requirements;

A general overview of the above implementation considerations is provided in the subsequent sections.

### ***4.1 Future Study Requirements***

Phase 1 & 2 of the AEGD Subwatershed study and the Stormwater Master Plan have established the environmental management requirements for the AEGD study area at a preliminary level of detail. Implementation of the Study recommendations will require further, progressively more detailed studies at both the “catchment” and/or “site” level, as development planning proceeds.

The majority of the AEGD study area is addressed by the policies of the:

- City of Hamilton Urban Official Plan (Adopted by Council: July 9, 2009, MMAH Approved: March 16, 2011, and Effective Date: August 16, 2013)
- City of Hamilton Rural Official Plan (Adopted by Council: September 27, 2006, MMAH Approved: December 24, 2006, and Effective Date: March 7, 2012)
- A portion of the study area (south west of the airport) is subject to the policies of the Greenbelt Plan (2005). Note: The Minister of Municipal Affairs and Housing is issuing the Proposed Greenbelt Plan (2016) pursuant to the Greenbelt Act, 2005 for consultation. Final release is activated in early 2017.
- Natural Heritage System policies for these lands are addressed by City of Hamilton Rural Official Plan (Adopted by Council: September 27, 2006, MMAH Approved: December 24, 2006, and Effective Date: March 7, 2012)

In regards to future studies as they relate to the Natural Heritage Plan, Groundwater Management Plan and Surface Water Management Plan components, additional studies may include but not limited to:

- Environmental Impact Statement (EIS) including geotechnical assessment, and / or a feature-specific water budget assessment (as required);
- Hydrogeological investigations;
- Geotechnical Investigations;
- In-Situ Hydraulic Conductivity Testing;
- Additional Planning & Design Studies for SWM Infrastructure; and
- Hydraulic and Hydrologic Modelling.

#### 4.1.1 Environmental Impact Statements (EIS)

When development is proposed in or adjacent to a Core Area, the City of Hamilton shall require the proponent to prepare an Environmental Impact Statement (EIS) to the satisfaction of the City and the relevant Conservation Authority (City of Hamilton 2015<sup>1</sup>). EISs may also be subject to review by the Environmentally Significant Areas Impact Evaluation Group (ESAIEG). Potential EIS requirements and the steps required to prepare an EIS are contained within **Section 4.1.1.6**.

As detailed in **Section 2.8.1**, Core Areas of the NHS include the following:

- Key Natural Heritage Features
  - Significant habitat of endangered and threatened species;
  - Fish habitat;
  - Life Science Areas of Natural and Scientific Interest (ANSIs);
  - Significant Valleylands;
  - Significant Wildlife Habitat;
  - Sand Barrens, savannahs, and tallgrass prairies; and
  - Alvars.
- Key Hydrologic Features;
  - Permanent and intermittent streams;
  - Lakes (and their littoral zones);
  - Seepage areas and springs; and
  - Wetlands.
- Local Natural Areas
  - Environmentally Significant Areas (ESAs);
  - Unevaluated wetlands; and
  - Earth science ANSIs.

In addition to or irrespective of the assessment of the ecological form and function of Core Areas, a linkage assessment may be required when development is proposed within a linkage. More information on linkage assessments is found below in **Section 4.1.1.5**.

**Table 4.1** outlines the extent of adjacent lands, that is, the proximity of proposed development to Core Areas outside of the Greenbelt Planning Area that triggers the requirement to complete an EIS. Per Section F.3.2.1.4 of the City of Hamilton's Urban Official Plan, these distances are guidelines only. The City of Hamilton may require the preparation of an EIS for applications for development outside of the adjacent lands if, in its judgment, the proposed development has greater potential to impact natural heritage features and functions (City of Hamilton 2015<sup>1</sup>).

Each EIS is to be prepared according to EIS guidelines adopted by City of Hamilton Council on March 31 2015, or applicable approved update. These guidelines describe the general contents of an EIS and specify the methodology to be used to complete certain EIS elements, such as biological inventories, though the scope of the EIS and survey methodologies may be refined on a case-by-case basis by the City of Hamilton or ESAIEG (City of Hamilton 2015<sup>2</sup>).

**Table 4.1: The Extent of Adjacent Lands - Distance of Proposed Development From Natural Heritage Features that Triggers the Requirement to Complete an EIS (City of Hamilton 2015<sup>1</sup>).**

Natural Heritage Feature	Boundary Definition	Extent of Adjacent Lands
Fish Habitat	Streams, rivers, lakes, ponds and wetlands	30 m from bankfull channel
Provincially Significant Wetlands	Defined by the Province	120 m
Significant Habitat of Threatened and Endangered Species	Defined by the Province and the City of Hamilton	50 m
Non-Provincially Significant Wetlands	Defined by Conservation Authorities and the City of Hamilton	50 m
Significant Woodlands	Defined by the City of Hamilton	50 m (measured from the dripline)
Stream and River Valleys	Conservation Authority regulatory lines, flood plain mapping	30 m (from stable top of bank)
Areas of Natural and Scientific Interest	As defined by the Province	50 m
Significant Valley Lands	As defined by the Province and the City of Hamilton	50 m
Significant Wildlife Habitat	As defined by the Province and the City of Hamilton	50 m
Environmentally Significant Areas	As defined by the Province and the City of Hamilton	50 m
Greenbelt	As defined by the Province	120 m (of a Key Natural Feature with the Greenbelt Natural Heritage System or a Key Hydrologic Feature anywhere in the Protected Countryside)



All Environmental Impact Statements (EISs) shall include identification and assessment of the ecological form and function of the NHS. This may include an assessment of the following Key Natural Heritage Features and Key Hydrologic Features, as applicable:

#### *4.1.1.1 Key Natural Heritage Features*

##### **Significant Habitat of Endangered, Threatened and Special Concern Species**

The City of Hamilton (2015<sup>1</sup>) defines the Significant Habitat of Endangered, Threatened, and Special Concern Species as:

the habitat, as approved by the Ministry of Natural Resources, that is necessary for the maintenance survival and/or recovery of naturally occurring or reintroduced populations of species at risk and where those areas of occurrence are occupied or habitually occupied by the species during all or any part(s) of its life cycle.

To address the Ontario Endangered Species Act (2007) - protection afforded species designated endangered, threatened or special concern by the Committee on the Status of Species at Risk in Ontario (COSSARO), the Ministry of Natural Resources and Forestry (MNRF) recommends that species specific surveys be completed per MNRF-specified protocols to determine whether COSSARO-designated species known or suspected to occur in the City of Hamilton are present at the local (i.e. property-scale) level if potentially suitable habitat for the species is present (MNR 2010). Per the OP, “the City may collaborate with the Province during the early stages of the planning process, to ensure that the significant habitat of threatened or endangered species on lands affected by or contiguous to any proposed development or site alteration is properly evaluated and identified”.

##### **Fish Habitat**

The City of Hamilton’s (2015<sup>1</sup>) definition of fish habitat is in keeping with the definition provided by the Provincial Policy Statement (MMAH 2014) and that of the Federal Fisheries Act. According to the City, fish habitat “means spawning grounds and any other

areas, including nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes”.

### **Life Science ANSIs**

Life Science Areas of Natural and Scientific Interest (ANSI) as defined by the City of Hamilton (2015<sup>1</sup>) consist of:

Lands and waters containing natural landscapes or features that are important for natural heritage protection, appreciation, scientific study, or education. Life Science ANSIs are identified by MNR using evaluation procedures established by that Ministry, as amended from time to time (Greenbelt Plan, 2005).

### **Significant Valleylands**

Significant Valleylands as defined by the City of Hamilton (2015<sup>1</sup>) is as follows:

A natural area that occurs in a valley or other landform depression that has water flowing through or standing for some period of the year which is ecologically important in terms of features, functions, representation, or amount, and contributes to the quality and diversity of an identifiable geographic area or natural heritage system. (PPS, 2005).

Significant Valleylands are designated by the Province and by the City of Hamilton.

### **Significant Wildlife Habitat**

Significant Wildlife Habitat as defined by the City of Hamilton (2015<sup>1</sup>),

means wildlife habitat areas which are ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system. Significant Wildlife Habitat will be identified based on criteria established by the Province.

The province of Ontario (MMAH 2014) defines wildlife habitat as:

Areas where plants, animals and other organisms live and find adequate amounts of food, water, shelter and space needed to sustain their populations. Specific wildlife habitats of concern may include areas where species concentrate at a vulnerable point in their annual or life cycle; and areas which are important to migratory or non-migratory species.

Significant wildlife habitat areas are defined as consisting of one or more of the following (OMNR 2000):

- (a) Critical habitat areas that provide for seasonal concentrations of animals;
- (b) Wildlife movement corridors;
- (c) Rare vegetation communities or specialized habitats for wildlife; and/or
- (d) Habitats for species of conservation concern including provincially and federally threatened, endangered, special concern species, and locally rare species.
- (e) MNR identifies criteria, as amended from time to time for the foregoing.

### **Sand Barrens, Savannahs, and Tallgrass Prairies**

Sand barrens, savannahs (with the exception of cultural savannahs), and tallgrass prairies are provincially rare vegetation communities, and thus are considered significant wildlife habitat (see above). The City of Hamilton (2015<sup>1</sup>) defines these three vegetation community types as follows:

**Sand Barrens:** means land (not including land that is being used for agricultural purposes or no longer exhibits *sand barrens* characteristics) that:

- a) Has sparse or patchy vegetation that is dominated by plants that are:
  - i. Adapted to severe drought and low nutrient levels; and

- ii. Maintained by severe environmental limitations as drought, low nutrient levels and periodic disturbances such as fire;
- b) Has less than 25 per cent tree cover;
- c) Has sandy soils (other than shorelines) exposed by natural erosion, depositional process or both; and
- d) Has been further identified, by the Ministry of Natural Resources or by any other person, according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time (Greenbelt Plan, 2005).

**Savannah:** means land (not including land that is being used for agricultural purposes or no longer exhibits *savannah* characteristics) that:

- a) Has vegetation with a significant component of non-woody plants, including tallgrass prairie species that are maintained by seasonal drought, periodic disturbances including fire, or both;
- b) Has from 25 per cent to 60 per cent tree cover;
- c) Has mineral soils; and
- d) Has been further identified, by the Ministry of Natural Resources or by any other person according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time (Greenbelt Plan, 2005).

**Tallgrass Prairies:** means land (not including land that is being used for agricultural purposes or no longer exhibits tallgrass prairie characteristics) that:

- a) Has vegetation dominated by non-woody plants, including tallgrass prairie species that are maintained by seasonal drought, periodic disturbances such as fire, or both;
- b) Has less than 25 percent tree cover;

- c) Has mineral soils; and
- d) Has been further identified, by the Minister of Natural Resources or by any other person, according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time.

## **Alvars**

Alvars are globally and provincially rare vegetation community types, and like the vegetation communities described above are also considered significant wildlife habitat. The City of Hamilton (2015<sup>1</sup>) defines alvars as “naturally open areas of thin or no soil over essentially flat limestone, dolostone, or marble rock, supporting a sparse vegetation cover of mostly shrubs and herbs”.

### ***4.1.1.2 Key Hydrologic Features***

#### **Permanent and Intermittent Streams**

The City of Hamilton (2015<sup>1</sup>), in keeping with the definitions provided by the Greenbelt Plan (2005), defines permanent and intermittent streams as follows:

**Permanent Stream:** means a stream that continually flows in an average year.

**Intermittent Streams:** means stream-related watercourses that contain water or are dry at times of the year and are more or less predictable, generally flowing during wet seasons of the year but not the entire year, and where the water table is above the stream bottom during parts of the year.

#### **Lakes and their Littoral Zones**

The City of Hamilton (2015<sup>1</sup>) defines lakes and littoral zones as follows:

**Lake:** means any inland body of standing water, usually fresh water, larger than a pool or pond or a body of water filling a depression in the earth’s surface (Greenbelt Plan, 2005).

**Littoral Zones:** means the shallow water areas surrounding the outer boundary of a *lake*, which is usually a highly productive zone.

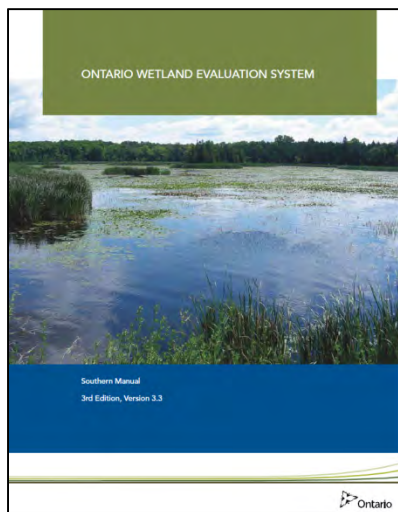
### **Seepage Areas and Springs**

The City of Hamilton (2015<sup>1</sup>), in keeping with the definition provided by the Greenbelt Plan (2005), defines seepage areas as “sites of emergence of groundwater where the water table is present at the ground surface”. Springs can also be considered a type of Significant Wildlife Habitat.

### **Wetlands**

Wetlands as defined by the City of Hamilton (2015<sup>1</sup>) as land such as swamp, marsh, bog, or fen (not including land that is being used for agricultural purposes and no longer exhibits wetland characteristics) that:

- (a) is seasonally or permanently covered with shallow water or has the water table close to or at the surface;
- (b) has hydric soils and vegetation dominated by water-tolerant plants; and
- (c) has been further identified according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time.
- (d) This includes provincially and locally significant wetlands (Greenbelt Plan, 2005)



The Ontario Wetland Evaluation System – Southern Manual (3rd Edition, plus applicable updates) provides guidance for the evaluation of wetlands (MNR 2003). In general, individual contiguous wetlands smaller than 2 ha are not considered under the wetland evaluation unless there is sufficient rationale for inclusion (i.e. provision of important wildlife habitat). The City of Hamilton (2015<sup>1</sup>) considers *unevaluated wetlands* to be Local Natural Areas. Wetlands (both evaluated and unevaluated) are also considered Key Hydrologic Features.

#### 4.1.1.3 Local Natural Areas

##### **Environmentally Significant Areas**

According to the City of Hamilton (2015<sup>1</sup>), ESAs are locally significant areas that meet any one of the following criteria:

- a) The area is a good representative of a biotic community characteristic of the natural landscapes of the City and not adequately represented in existing protected areas or the area is a good representative of pre-settlement biotic community;
- b) There are biotic communities that are rare in the City, Province, or Canada;
- c) The area is a large natural area (20 hectares or more in size); it may be sufficiently large to provide habitat for species requiring large habitat areas;
- d) There is habitat for species considered significant in the City, Province, or Canada;
- e) The site fulfills a significant hydrological function (groundwater recharge or discharge, ground or surface water quality, or flood attenuation);
- f) The site contains a significant earth science feature (distinctive and unusual landform);
- g) There is a high diversity of native species or biotic communities;

- h) The area provides *essential* habitat for the continuation of species; for example, significant areas of species concentrations, areas *essential* for certain stage of the life cycle, source areas for species;
- i) There are significant seasonal concentrations of wildlife;
- j) The area acts as a link between natural areas or functions as a corridor for wildlife;
- k) The area is in good natural condition, with few non-native species, particularly invasive non-natives; or
- l) The area contains significant *fish habitat*.



## **Unevaluated Wetlands**

Unevaluated wetlands are those that have not been evaluated under OWES. See information under Wetlands, above.

## **Earth Science ANSIs**

According to the City of Hamilton (2015<sup>1</sup>), Earth Science ANSI “means areas selected by the Province as representative of Ontario’s geological diversity. They can include outstanding bedrock exposures, fossil beds, and landforms such as karst and drumlins”.

### ***4.1.14 Other***

#### **Significant Woodlands**

The City of Hamilton (2015<sup>1</sup>) defines woodlands as follows:

Treed areas that provide environmental and economic benefits to both the private landowners and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products. Woodlands include treed areas, woodlots or forested areas.

The City of Hamilton (2015<sup>1</sup>) defines significant woodlands as follows:

- An area which is ecologically important in terms of:
  - Features such as species composition, age of trees, stand history;
  - Functionally important due to its contribution to the broader landscape because of its location, size, or due to the amount of forest cover in the planning area; and
  - Economically important due to site quality, species composition or past management history.

The presence of European Buckthorn, Common Lilac, and Staghorn Sumac shall be irrelevant to the determination of whether a woodland is a significant woodland.

Woodlands must meet two or more of the following criteria per **Table 4.2** in order to be considered significant.

**Table 4.2: Criteria for Significant Woodlands**

Criterion	Description	
Size	Forest Cover (By Planning Unit)	Minimum Patch Size for Significance
	< 5%	1 ha
	5-10%	2 ha
	11-15%	4 ha
	16-20%	10 ha
	21-30%	15 ha
Woodlands shall meet a minimum average width of 40 metres.		
Interior Forest	Woodlands that contain interior forest habitat. Interior forest habitat is defined as 100 m from edge.	
Proximity/ Connectivity	Woodlands that are located within 50 metres of a significant natural area, (defined as wetlands 0.5 hectares or greater in size, ESAs, PSWs, and Life Science ANSIs).	
Proximity to Water	Woodlands are considered significant if any portion is within 30 metres of any hydrological feature, including all streams, headwater areas, wetlands, and lakes.	
Age	Woodlands with 10 or more native trees/hectare greater than 100 years old.	
Rare Species	Any woodland containing threatened, endangered, special concern, provincially or locally rare species.	

#### 4.1.1.5 Assessment of Linkages

The City of Hamilton (2015<sup>1</sup>) defines linkages as:

Natural areas within the landscape that ecologically connect *Core Areas*. They are avenues along which plants and animals can propagate, genetic interchange can occur, populations can move in response to environmental changes and life cycle

requirements, and species can be replenished from other natural areas. Conserving linkages also protects and enhances *Core Areas*.

The City of Hamilton recognizes the importance of linkages in reducing the adverse impacts of habitat fragmentation of natural areas and has adopted policies intended to protect and enhance Linkages to sustain the City's NHS wherever possible. In particular, Section F.3.2.1.2 of the City of Hamilton's Urban Official Plan states that where new development or site alteration is proposed within a Linkage within the City's NHS, the proponent shall prepare a Linkage Assessment (City of Hamilton, 2015<sup>1</sup>). Linkage Assessments are to consider both the linkage within the site and connections with other sites and include the following:

- a) identify and assess the linkage including its vegetative, wildlife, and/or landscape features or functions, including:
  - i) the natural areas and habitats/functions linked (number of sites linked and habitat sizes and condition);
  - ii) *linkage* type (e.g. anthropogenic railway or utility corridor, hedgerow, plantation, or natural community);
  - iii) vegetation cover type quality (health, condition, maturity, species, and aesthetic value);
  - iv) width;
  - v) length; and,
  - vi) continuity of vegetation (long gaps greater than 100 metres, gaps containing roads or other barriers, or gaps less than 30 metres wide with no barriers);
- b) assess the potential impacts on the viability and integrity of the *linkage* as a result of the development proposal; and,
- c) make recommendations on how to protect, enhance or mitigate impacts on the *linkage(s)* and its functions through planning, design and construction practices.

#### **4.1.1.6 Steps to Complete an EIS**

Specific requirements of an EIS will be determined in consultation with the City of Hamilton and other applicable review agencies such as Conservation Authorities and the MNR. Proponents are to prepare an EIS in accordance with the City of Hamilton's EIS 2015 Guidelines (City of Hamilton, 2015<sup>1</sup>). These updated guidelines replace the City's 2004 EIS Guidelines. The steps to completing an EIS are as follows:

- 1) Identify known Core Natural Heritage Features within and/or adjacent to the property of interest. Refer to **Figure 2.8.3 – Recommended Natural Heritage System** for an illustration of known Core Natural Heritage Features. Recommended adjacent land distances are listed in **Table 4.1**.
- 2) Refer to the most current version of the City of Hamilton's Natural Heritage System mapping. This data may be supplemented by data from the MNR's Identify known Core Natural Heritage Features make-a-map database (see [http://www.gisapplication.lrc.gov.on.ca/mamnh/Index.html?site=MNR\\_NHLUPS\\_NaturalHeritage&viewer=NaturalHeritage&locale=en-US](http://www.gisapplication.lrc.gov.on.ca/mamnh/Index.html?site=MNR_NHLUPS_NaturalHeritage&viewer=NaturalHeritage&locale=en-US)), information from conservation authorities, etc.
- 3) Consult with the City of Hamilton Natural Heritage Planning Staff and the relevant Conservation Authority to develop an approved Terms of Reference (TOR) for the EIS.
- 4) Conduct the necessary studies to complete the EIS.
- 5) Submit the draft EIS report to the City of Hamilton and other applicable review agencies (e.g. Conservation Authority, MNR, etc.).
- 6) Present EIS findings to the Environmentally Significant Areas Impact Evaluation Group (ESAIEG).
- 7) Revise and resubmit the EIS report for approval as required.

The following checklist (**Table 4.3**) represents what may be required as part of an EIS and is included in this report for information purposes only. As previously mentioned, the final scope of work will be determined through the development of a study TOR with the City of Hamilton and the applicable Conservation Authority.

**Table 4.3: EIS Checklist**

Elements of the EIS	Required?	Notes
<b><u>Mandatory Elements</u></b>		
Title page including address and date		
Table of contents; with list of tables, figures, and appendices		
Executive Summary		
Description and map of subject property location		
Policy and legislative framework		
Description of development proposal, incl. detailed drawing(s)		
Identification of hydrologic features		
Identification of natural hazards		
Species-at-risk screening and MNRF correspondence		
Description of ecologic form and function of natural heritage resources within and adjacent to the subject property		
Description of soils, landforms, and surficial geology		
Description and assessment of Natural Heritage System		
Description of study methodologies		
Review of relevant background information (e.g. natural heritage databases, reports, etc.)		
Description of potential impacts		
Mitigation recommendations		
Restoration and Enhancement Opportunities		
Constraints Map		
Bibliography		
<b><u>Supporting Elements, Biophysical Surveys</u></b>		
Anuran Calling Survey, protocol: MMP		
Aquatic Habitat Assessment		
Benthics		
Botanical Inventory, Autumn		
Botanical Inventory, Spring		
Botanical Inventory, Summer		
Boundary staking (wetland)		
Boundary staking (woodland)		
Boundary staking (other, specify)		
Breeding Bird Survey, protocol: FBMP		
Breeding Bird Survey, protocol: OBBA		
Fish Inventory		
Headwater Drainage Feature (HDF) Assessment		
Lepidopterans Survey		
Mammal Survey		
Marsh Bird Survey, protocol: MMP		

Elements of the EIS	Required?	Notes
Mussel Survey		
Odonates Survey		
Raptor Survey		
Reptile Survey, snakes		
Reptile Survey, turtles		
Salamander/Vernal Pool Survey		
Vegetation Community Classification (ELC)		
Wildlife Habitat Assessment		
Wildlife Survey, other (specify):		
<b><u>Supporting Elements, other</u></b>		
Agency consultation (specify)		
Implementation and Adaptive Monitoring Plan		
Water Balance (Refer to <b>Section 4.2.3 and 4.2.4</b> )		
Wetland Evaluation, per OWES protocols		
DFO Self-Assessment		
Linkages Assessment		
Restoration and/or Enhancement Plan		
Geotechnical Study		
Fluvial Geomorphology study		
Hydrologic study (specify)		
Hydrogeological study (specify)		
Contour mapping		
Other (specify):		

#### 4.2.2 Geotechnical or Feature Specific Water Budget Assessment

In general these studies would be undertaken per the direction of the City and the respective Conservation Authority in the determination of final CA Generic Regulations setbacks/adjacent land areas abutting valleys, watercourses, wetlands (currently ranging from 30 – 120 m) and/or as part of an EIS.

#### 4.2.3 Hydrogeological Investigations

In general these studies would deal with the movement and distribution of groundwater as controlled by local geological materials that make up the solid medium that controls the storage, movement and chemical evolution of groundwater. A study of the geology and hydrogeology of the subject area in order to gain an understanding of the groundwater resources shall be undertaken in areas identified as High Vulnerable Aquifers (HVAs) per the Groundwater Management Plan (**Figure 2.8.5**) and/or as part of an EIS. The proponent should consult the City of Hamilton Public Works Department Hamilton Water Division Guidelines for Hydrogeological Studies and Technical Standards for Private Services (November 2013).

#### 4.2.4 Geotechnical Investigations

These studies would be focused on the local soils information gathered through subsurface geotechnical investigations and undertaken for the purposes of structural design of centralized stormwater management facilities and in the design of LID infiltration techniques.

Geotechnical investigations are necessary to support the design of most LID practices. However, the scope of work will vary depending on the selected LID practice. **Table 4.2.4** below provides a summary of the geotechnical investigation activities which are necessary for the detailed design of select LID measures.

Boreholes are recommended to be advanced a minimum of 1.5m below the proposed invert of proposed LID practices. The resolution of the investigation (i.e. quantity and spacing between boreholes) will vary from site to site and between LID practices.

Resolution of the borehole investigations should be such that sufficient information is collected for detailed design purposes. Appendix C of the LID Stormwater Planning and Design Guide provides guidance with respect to the recommended number of boreholes (see **Appendix C - LID Resources**).

**Table 4.2.4: Geotechnical Investigation Activities for LID Practices Implemented within the ICI Lands**

LID Practice	Geotechnical Investigation Activities			
	Borehole	Piezometers/ Monitoring Wells	Laboratory Soil Testing	Soaked CBR Test
Permeable Pavement	●	●	●	●
Bioretention	●	●	●	
Bioswales	●	●	●	
Soakaway Pits	●	●	●	
Infiltration Chambers	●	●	●	
Perforated Pipe Systems	●	●	●	
Rainwater Harvesting	●		●	
Prefabricated Sub- surface Modules	●		●	

#### **4.2.4.1 Piezometer/monitoring wells**

Monitoring wells typically consist of 50mm diameter piezometers installed to depths of 3.5-4.5 meters and encased within an flush mount or above ground, lockable, steel housing. Monitoring wells are installed to determine the pre and post construction seasonal high water table and groundwater flow direction. Monitoring wells may be implemented when available data from background documentation or previous investigation is not available. The Low Impact Development Stormwater Management Planning and Design Guide Version 1.0 (CVC, 2010) has design criteria regarding groundwater clearance requirements for LID practices (see **Appendix C - LID Resources**).



#### ***4.2.4.2 Geotechnical Laboratory Soil Testing***

Soils samples collected as part of geotechnical investigations characterize the soil properties including natural moisture content, plasticity characteristics, particle size distribution, and analytical results for contaminants. It is beneficial if geotechnical investigations include recommendations regarding soil disposal alternatives.

#### ***4.2.4.3 Soaked California Bearing Ratio (CBR)***

Soaked CBR is only required for the design of permeable pavement. Geotechnical investigations must include recommendation for base and sub-base requirements and other measures required to ensure adequate structural strength such as compaction or geosynthetic requirements. The Low Impact Development Stormwater Management Planning and Design Guide Version 1.0 (CVC, 2010) provides detailed design requirements for permeable pavement (see **Appendix C - LID Resources**). Furthermore, the American Society of Civil Engineers (ASCE) has developed a guidance manual entitled “Design, Construction and Maintenance of Permeable Interlocking Concrete Pavement” which may also provide valuable design insight and direction to practitioners.

#### ***4.2.5 In-Situ Hydraulic Conductivity Testing***

In-situ infiltration testing characterizes the hydraulic conductivity properties of the existing native material on-site. On-site infiltration testing using the Guelph Permeameter test or other suitable approach to determine the in-situ field saturated hydraulic conductivity and the design infiltration rate per the LID Stormwater Planning and Design Guide (Appendix C) is required (see **Appendix C - LID Resources**). Testing should be performed within the approximate location and invert of proposed LID practices and should include an appropriate safety factor.

#### ***4.2.6 Additional Planning & Design Studies for SWM Infrastructure***

Per the City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014), Section 5 of the City of Hamilton Storm Drainage Policy provides a detailed discussion of the planning and design process for stormwater management infrastructure.

As a Subwatershed Study (**Part A**) and the Stormwater Master Plan (**Part B**) have been developed for the AEGD study area, the following section provides a general overview of the planning and design process, specifically related to the application of innovative source controls for industrial, commercial, and institutional land uses.

#### *4.2.6.1 Tertiary Planning and Design Studies*

Per the Innovative Stormwater Source Control Policy for Industrial, Commercial and Institutional Land Uses (2014), Tertiary Planning and Design Studies may be required in areas where multiple land ownership within the subwatershed occurs, and focuses on integrating servicing and stormwater management of adjacent development to a greater level of detail than is normally achieved through the Subwatershed and Master Drainage Plan. The study areas for these studies are typically smaller than those associated with Master Drainage Plans, but also typically include more detailed information for the study area and the receiving systems than is typically associated with Master Drainage Plans. The source control requirements outlined in the Innovative Stormwater Source Control Policy for ICI Land Uses (2014) shall be incorporated into the analysis and design of stormwater management infrastructure through the Tertiary Planning and Design Study process.

#### *4.2.6.2 Site Plan Applications*

Per the Innovative Stormwater Source Control Policy for Industrial, Commercial and Institutional Land Uses (2014), Stormwater management studies are frequently completed for industrial and commercial land uses as part of individual site plan applications. These studies are typically focused on one particular lot, and thus typically involve one development proponent as part of proposed development. The stormwater management studies and analyses completed as part of this process tend to focus on constraints local to the subject property. All stormwater management plans prepared for industrial, commercial, and institutional land uses through the Site Plan process shall be completed in conformance with Innovative Stormwater Source Control Policy for ICI Land Uses (2014) and all applicable planning policies of the City of Hamilton.

### 4.2.7 Hydrologic Modelling

Surface runoff peak flow estimates generated as part of the hydrologic modeling component of the 2011 AEGD Stormwater Master Plan have been calculated at the outlet of each catchment at the indicated flow node locations. Peak flow estimates have been calculated at these flow nodes for the existing and proposed land use conditions using the hydrologic model SWMHYMO (Version 4.02). The John C Munro Hamilton Airport rainfall records were used along with the 24hr SCS Type II Storm distribution to generate the 2yr, 5yr, 25yr, 50yr and 100yr design rainfall events for the SWMHYMO model.

As part of the 2011 AEGD Stormwater Master Plan, hydrologic modelling was not calibrated but was verified through a comparative assessment between the 2011 modelling and past studies including:

1. Welland River Floodplain Mapping Study (Phillips Engineering Ltd., 1999)
2. Garner Neighborhood Master Drainage Plan (Phillips Engineering, 2005)
3. Niagara Peninsula Conservation Authority Twenty Mile Creek Floodplain Mapping, (Aug 2005, revised Aug 2007)

### *Flow Reference Locations*

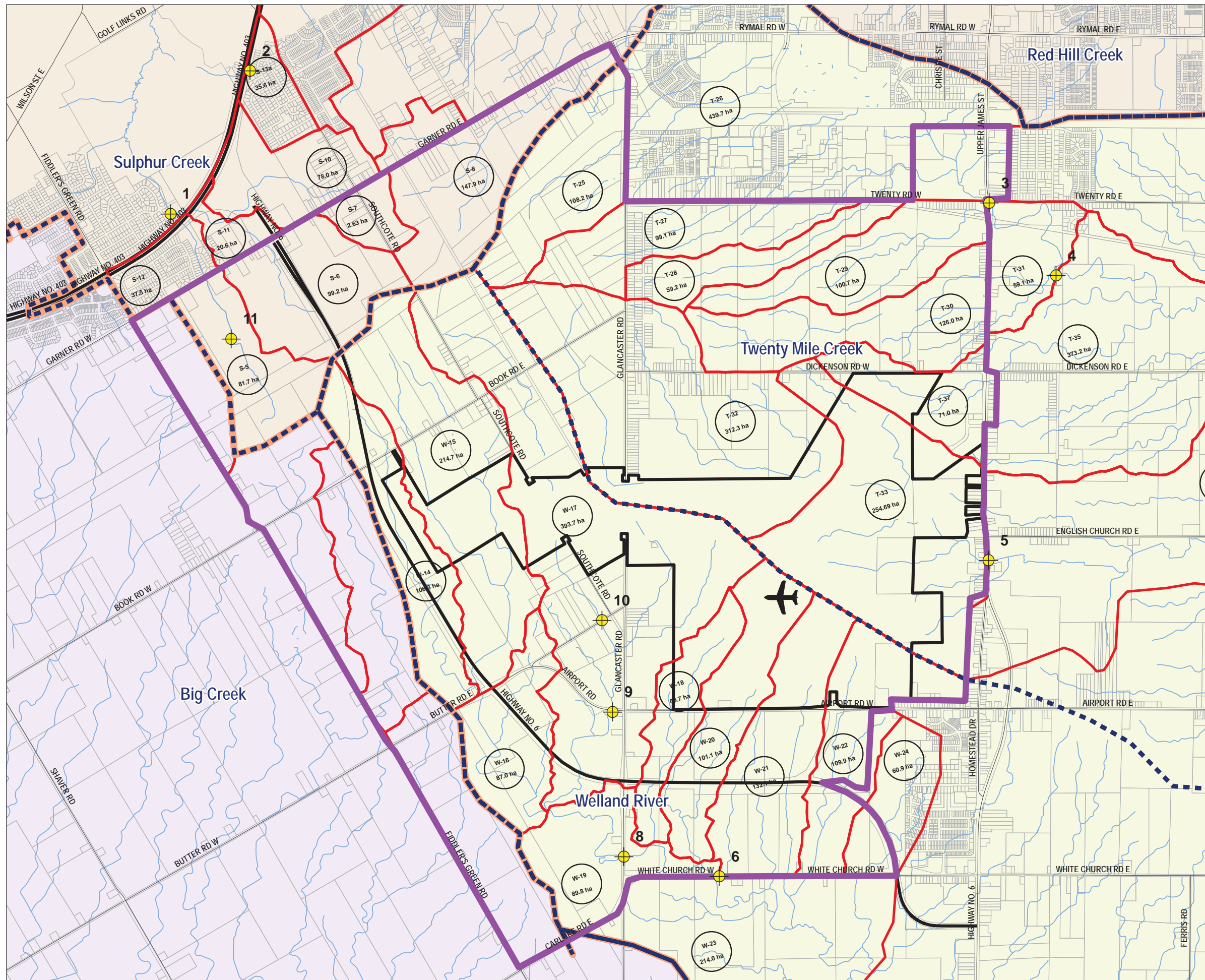
The eight (8) flow reference stations (**Figure 4.2.1**) for the Sulphur Creek, Welland River and Twenty Mile Creek Watersheds are presented in **Table 4.2.7**.

### *Proponent's Responsibility*

The development proponent shall be responsible for the discretization and partitioning of subcatchments within the larger hydrologic catchments developed for the 2011 AEGD Stormwater Master Plan as shown on **Figure 4.2.2** within which the proposed development exists. The development proponent shall demonstrate that the proposed development and stormwater management design is in agreement with the eight (8) flow reference stations (**Figure 4.2.1**) for the Sulphur Creek, Welland River and Twenty Mile Creek Watersheds. Consultation with the City of Hamilton and the relevant Conservation Authority is required prior to completing hydrologic modelling exercises in support of approvals and/or detailed design.

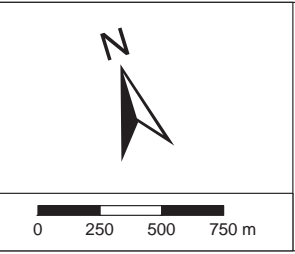
### ***Big Creek Subwatershed***

It should be noted that the Big Creek was not partitioned into catchments, nor set up for SWMM or HSPF modeling since the majority of the lands, approximately 330ha (330.2ha), are entirely within the Additional Study Area. The exception to this is the approximately 12ha at the corner of Garner Rd East and Fiddlers Green Rd (see Section 5.5: Council Directed Additional Lands. Development of the AEGD Subwatershed Study and Stormwater Master Plan, 2011). These Council Directed Additional Lands within the Big Creek subwatershed will be subject to site-specific (lot level) controls and SWM criterion established based on the modeling results obtained from the other watersheds (these SWM criteria can be applied based on dominant soil types). Prior to Development in the remainder of the Big Creek Subwatershed, modeling should be undertaken and this study revisited given the time lapse anticipated between completion of the subwatershed study and Stormwater Master Plan and potential future development.



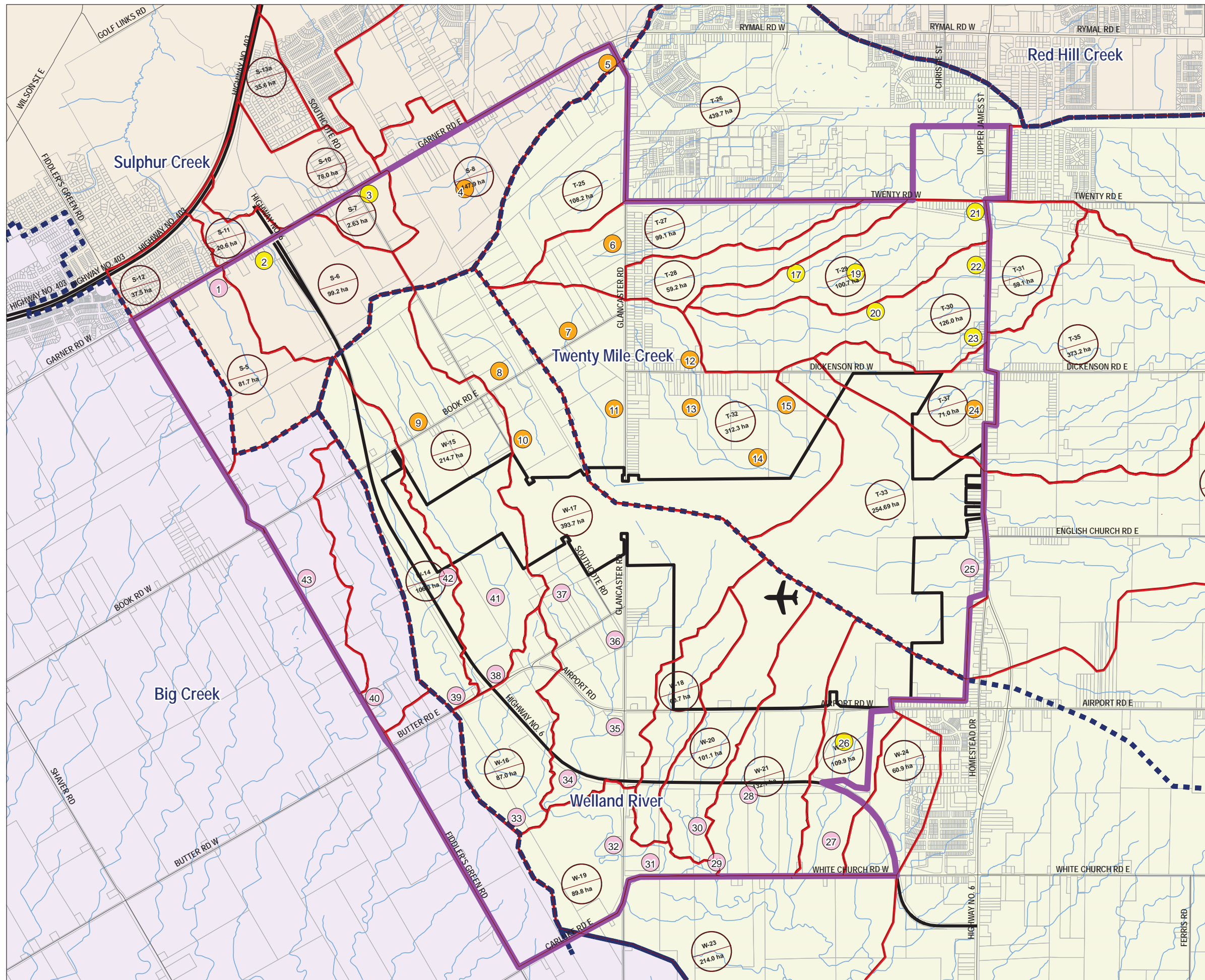
- Flow Reference Stations
- Hydrologic Catchments
- Other Features**
- Airport Boundary
- Airport Employment Growth District Study Boundary
- Watershed Boundary
- Conservation Authority Jurisdiction Boundary
- Conservation Authority Jurisdiction**
- Grand River Conservation Authority
- Hamilton Conservation Authority
- Niagara Peninsula Conservation Authority

**Figure 4.2.1**  
**Airport Employment Growth District**  
**Flow Reference Location**



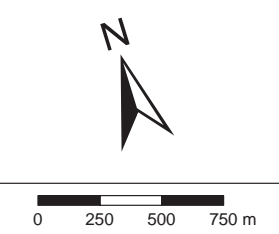
April 2017

Planning and Economic Development Department



- Hydrologic Catchments
- Pond Location**
- 1 Phase 1 Pond Location
- 2 Phase 2 Pond Location
- 3 Long Term Pond Location
- Other Features**
- ✈ Airport Boundary
- Airport Employment Growth District Study Boundary
- Watershed Boundary
- Conservation Authority Jurisdiction**
- Grand River Conservation Authority
- Hamilton Conservation Authority
- Niagara Peninsula Conservation Authority

**Figure 4.2.2**  
**Airport Employment Growth District**  
**Hydrologic Subcatchments**



**Table 4.2.7: Previously Reported Flow Estimates in Comparison to Flows Calculated in this Study for Existing Conditions Modeling**

Watershed	Flow Reference Station (Figure 4.2.1)	Corresponding S/C ID	Location	Drainage Area (ha)	2yr Storm		5yr Storm		10yr Storm		20yr Storm		50yr Storm		100yr Storm	
					Previous Estimate	Current Study	Previous Estimate	Current Study	Previous Estimate	Current Study	Previous Estimate	Current Study	Previous Estimate	Current Study	Previous Estimate	Current Study
Sulphur Creek	11	S- 5	101.1	81.7	0.71	0.33	1.33	0.67	1.81	0.93	2.47	1.29	3.01	1.58	3.58	1.88
	1	S-5 + S-12 + S-6 + S-11 + S-7 + S-10	105.2	343.3	3.04	2.20-4.23	4.88	3.94-6.39	6.38	5.28-7.99	8.63	7.18-10.41	10.42	8.67-12.42	12.37	10.20-14.25
Welland River	9	W-17	Prorated from Node 5 <sup>2</sup>	393.7	11.82	8.72	15.12	13.65	17.23	17.05	19.22	21.41	21.77	24.67	23.64	27.93
	6	W-14 to W-20	Prorated from Node 5 <sup>2</sup>	1053.3	24.72	18.31-21.45	31.64	26.34-30.62	36.05	31.58-36.68	40.21	38.17-44.55	45.53	43.07-55.04	49.45	47.90-63.87
	na	All Welland River Catchments	Prorated from Node 5 <sup>2</sup>	1570.2	33.36	30.76-33.08	42.69	42.95-44.98	48.63	50.44-52.54	54.24	59.62-62.08	61.43	66.27-70.68	66.71	72.82-77.86
	7	na	Node 5 – Hwy6 & Chippewa Rd	2027.2	40.40	na <sup>1</sup>	51.70	na <sup>1</sup>	58.90	na <sup>1</sup>	65.70	na <sup>1</sup>	74.40	na <sup>1</sup>	80.80	na <sup>1</sup>
Twenty Mile Creek	3	T-29	TwCK 57 – Upper James, South of Twenty Mile Rd.	100.7	0.75	0.77	1.31	1.34	-	1.76	-	2.31	-	2.73	3.20	3.16
	4	T-30 + T -31	TwCK-60 – d/s of Upper James	185.1	1.12	1.72	2.16	3.04	-	3.93	-	5.15	-	6.10	5.72	7.05
	5	T-32 + T-33	ThCK 3 – Upper James, South of English Church Rd.	567.3	0.80	4.01	1.36	6.75	-	8.70	-	11.34	-	13.34	3.93	15.42

Notes: 1 Previously reported flows at Node 5 were used to determine flows at points of interest within the current study area using an empirical formula to prorate the flows based on area.  
 2 Flow reported in ranges (e.g. 5.1-6.3) provide a high flow rate for the assumption of no Stormwater management (attenuation) in existing urban areas, and a lower flow rate for the assumption that all existing urban areas flows are controlled to predevelopment levels. If a portion of the existing area receives stormwater treatment then the expected flow would fall somewhere within the given range.  
 3. All flows in cms

#### 4.2.7.1 Approved Hydraulic and Hydrologic Models

The evaluation of the efficacy of the treatment train (LID source, LID conveyance and End-of-Pipe controls) and the dual drainage system proposed /designed as part of subsequent planning phases of development will require analysis and documentation using approved hydraulic and hydrologic models. **Table 4.2.8** below provides a list of approved hydraulic and hydrologic models in the City of Hamilton.

**Table 4.2.8: Approved Hydraulic and Hydrologic Models**

Approved Hydrologic Models*	Approved Hydraulic Models*
SWMHYMO / OTTHYMO	XP-SWMM
VISUAL HYMO	MOUSE (DHI)
SWMM	SWMM
XP-SWMM	HEC-RAS (HEC-2 to be converted to HEC-RAS)
MOUSE (DHI)	Culvert Master
HSPF	
MIDUSS	
* City of Hamilton, Criteria and Guidelines for Stormwater Infrastructure Design (Phillips, September 2007)	

Per the City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014), various analytical methods and techniques for the evaluation of source control requirements and effectiveness are outlined in the Low Impact Development Stormwater Management Planning and Design Manual, Version 1.0 (CVC/TRCA, 2010) and the Stormwater Management Planning and Design Manual (MOE, March 2003). These analytical methods typically require a high level of planning detail (i.e. specific size, type, and location for stormwater source control), hence they are considered more applicable to the detailed design stage for source controls, and are less applicable to the planning stage for the siting of stormwater source controls. Consequently, it is recognized that the development of analytical techniques to



support both the planning and design of source controls represents an emerging and evolutionary field of practice. Such methods have been developed to apply more conceptual systems for higher level studies (See Appendix A of the 2014 document), whereas various hydrologic models (i.e. PCSWMM/EPA SWMM) continue to be updated in order to include commands and routines for the evaluation of specific stormwater source controls. The appropriate methods for the analysis of source control requirements and effectiveness shall be determined consultatively between the practitioner undertaking the design and the City of Hamilton.

While the approaches provided in the foregoing documents are considered to represent the preferred approaches for analyzing the spatial requirements and effectiveness of source controls, pre-consultation with City of Hamilton staff is recommended in order to establish the approved methods and techniques for the subject property.

### ***4.3 Phasing Consideration***

Some components of the Stormwater Master Plan will rely on other components already being in place. For example, the Stormwater Master Plan includes a series of end-of-pipe dry-ponds, which may have a direct impact on the planning and design of the development lands. Therefore, the timing of these flood control works should be reviewed in relation to the development of the individual land parcels as this becomes known (See **Figure 2.3 - Phasing**).

In general, the nature of the land ownership and the uncertainty as to which lands within the Phase 1 area will be first developed may necessitate the need for temporary/ interim stormwater management facilities or controls. The City of Hamilton Criteria and Guidelines for Stormwater Infrastructure Design, Philips Engineering, 2007, permits temporary/interim stormwater facilities in development situation where the ultimate downstream facility have not been constructed. The temporary facility must provide an equivalent level of quantity control as the ultimate facility for the smaller area commensurate with the planned development and will require the developers to be solely responsible for the maintenance, operation and decommissioning of the temporary facility.

#### ***On-site (non-centralized) Flood Control Facilities***

Furthermore, on-site (non-centralized) flood control facilities may be feasible for large developments provided an appropriate outlet can be obtained. The use of on-site flood control facilities for large developments must be confirmed by the City of Hamilton prior undertaking any additional studies or designs. Consultation with the City is required.

#### **4.4 Design Guidance**

The City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) identifies the following documents as providing sufficient information for the detailed design of the preferred source control practices within the City of Hamilton and the reader is referred to these documents for the design of source controls for industrial, commercial, and institutional sites within the City of Hamilton:

- Stormwater Infrastructure Design (Philips Engineering Ltd., September 2007),
- Low Impact Development Stormwater Management Planning and Design Manual, Version 1.0 (CVC/TRCA, 2010) and
- Stormwater Management Planning and Design Manual (MOE, March 2003).

Additional guidance from various sources is provided in **Appendix C**.

#### **4.5 Approvals**

Prior to the construction or implementation of many of the Subwatershed Strategy components (e.g. set-back, limits of development, stream works, stormwater management techniques and facilities), approvals and/or permits may be required from one or more of the following agencies:

- City of Hamilton;
- Hamilton Conservation Authority(HCA);
- Niagara Peninsula Conservation Authority (NPCA);
- Grand River Conservation Authority (GRCA);
- Ministry of Transportation (MTO);
- Ministry of the Environment and Climate Change (MOECC);
- Ministry of Natural Resources and Forestry (MNR);
- Department of Fisheries and Oceans (DFO); and
- Transport Canada and Navigation Canada.

In addition to the above, of particular relevance for all proposed developments within the AEGD, will be the acquisitions of the necessary permits and approvals under the:

1. Conservation Authorities Act (1990), Ontario Regulation 150/06
  - NPCA Ontario Regulation 155/06.
  - GRCA Ontario Regulation 150/06.
  - HCA Ontario Regulation 161/06
2. Ontario Water Resources Act, R.S.O. 1990, c. O.40 and O.Reg. 525/98:  
Approval Exemptions from the Ministry of the Environment and Climate Change (MOECC).
3. The Endangered Species Act (2007).

#### **4.5.1 Conservation Authorities Act (1990), Ontario Regulation 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). (Source GRCA, 2015).

A Conservation Authorities' regulatory powers are granted under Section 28 of the Conservation Authorities Act relating to the following applicable provisions:

- Section 28(3) - A regulation may provide for permission to be granted subject to conditions and for the cancellation of the permission if conditions are not met
- Section 28(16) - Every person who contravenes a regulation or the terms and conditions of a permission of an authority is guilty of an offence
- Section 28(17) - Upon conviction the court may order the removal of the development or the rehabilitation of the watercourse or wetland. Any and all end-of-pipe and outfall retrofit works as well as any stream restoration works will require consultation and permits under this legislation.

Ontario Regulation 150/06 establishes 'Regulated Areas' where development could be subject to flooding, erosion or dynamic beaches, or where interference with wetlands or alterations to watercourses might have an adverse effect.

Ontario Regulation 150/06 defines the permitting process for the regulation of development and placement of fill within the regulated area, construction within the floodplain and/or alteration of a watercourse (including obtaining stormwater outlets), disturbance to a wetland, shoreline or water body and/or the development in the vicinity of hazardous lands.

#### **4.5.2 Ontario Water Resources Act**

The Ontario Water Resources Act (OWRA) O.Reg 525/98 is designed to conserve, protect and manage Ontario's water resources for efficient and sustainable use. The act focuses on both groundwater and surface water throughout the province.

The Ontario Water Resources Act regulates works related to water supplies, the distribution of water and stormwater management and conveyance infrastructure. The act provides for the protection and conservation of water, and the control of the quality of drinking water supplied to the public. Under the Act, stormwater is included in the definition as sewage and, as such is required to be managed properly. Accordingly, the

act “regulates sewage disposal and "sewage works" and prohibits the discharge of polluting materials that may impair water quality”.

Key stormwater-related issues addressed within the Water Resources Act are:

- Prohibiting the discharge of polluting material in or near water (Section 30);
- Prohibiting or regulating the discharge of sewage (Section 31);
- Enabling the issuance of orders requiring measures to prevent, reduce or alleviate impairment of water quality (Section 32);
- Enabling the designation and protection of sources of public water supply (section 33);
- Imposing a duty on corporate officers and directors to take all reasonable care to prevent the corporation from discharging materials into or near water that may impair water quality (Section 116).

### **Recent Modifications/ Amendments**

Recent changes under the act (Consolidation Period: From July 26, 2007 to Current), specifically subsection 53(1) and (3), whereby all Industrial lands are no longer exempt from requiring an Environmental Compliance Approval (ECA - formerly CofA) for their stormwater discharges. O. Reg. 525/98 – Approval Exemption, last amendment O.Reg. 396/0, Section 3, Subsection 53(1) and (3) of the Act apply to the establishment, alteration, extension or replacement of or a change in a stormwater management facility that,

- a) Is designed to service one lot or parcel of land;
- b) Discharges into a storm sewer that is not a combined sewer;
- c) Does not service industrial land or a structure located on industrial land; and
- d) Is not located on industrial land O. Reg 525/98, s. 3.

All designations and permitted uses (**Appendix A**) within the AEGD are industrial in the context of Ontario Water Resources Act, R.S.O. 1990, c. O.40 and O.Reg. 525/98: Approval Exemptions which defines industrial as follows:

“industrial land” means land used for the production, processing, repair, maintenance or storage of goods or materials, or the processing, storage, transfer or disposal of waste, but does not include land used primarily for the purpose of buying or selling,

- (a) goods or materials other than fuel, or
- (b) services other than vehicle repair services;

As such, under the Ontario Water Resources Act, R.S.O. 1990, c. O.40 and O.Reg. 525/98: Approval Exemptions, all lands within the AEGD would require the proponent to obtain an Environmental Compliance Approval (ECA) from the Ministry of the Environment and Climate Change (MOECC).

An ECA will be required by the MOECC for all proposed developments within the AEGD for the establishment, alteration, extension or replacement of or a change in a stormwater management facility for:

- Industrial lands or facilities servicing industrial lands as designated within the AEGD Official Plan, as amended from time to time,
- Facilities servicing more than one lot or parcel of land, including facilities that service the municipal right-of-way, and
- Sites that discharge directly to a watercourse or wetland feature, notwithstanding any required approvals from other agency(ies).

#### **4.5.3 Endangered Species Act**

The Endangered Species Act came into effect in 2007 and provides for broader protection for species at risk and their habitats. In general the purpose of the act includes the preservation and rehabilitation of habitat and the enhancement of other areas so that they can become habitat. Under the act habitat may be described by specific boundaries, features or “in any other manner” and may prescribe areas where species live, used to live or is believed to be capable of living and beyond.

Under Section 10: A person shall not damage or destroy the habitat of a species that is listed as an endangered or threatened species.

Policies under this legislation have relevance to urban development and stormwater management. As an example, the impacts to habitat can be as a result of:

- Alteration to hydrologic regimes (increased runoff, flow regime change and decreased infiltration) and increased water temperature (through increasing impervious surfaces and end-of-pipe discharges);
- Increased sedimentation and erosion through site grading and excavation;
- Releases of untreated stormwater which carry pollutants; and
- General habitat losses through the loss of riparian vegetation, in-stream habitat features, wetland and groundwater sources.

#### ***4.6 City of Hamilton Submission Requirements***

Per the City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) supporting studies and analyses for innovative source controls shall be completed in support of planning applications for the proposed development, and at the detailed design stage for the proposed development. The following section outlines the submission requirements for the planning and design process for innovative source controls.

##### **4.6.1 Submission Requirements at Planning Stage**

Tertiary Plans and Site Plan Applications shall be accompanied by a Functional Stormwater Management Study for the proposed development. These Functional Studies shall include, but not be limited to:

1. A characterization of the study area (i.e. soil types, infiltration rates, local infrastructure constraints, existing land use conditions).
2. A description of the proposed redevelopment.



3. An assessment and screening of alternative source control practices on the basis of functional requirements, local constraints, potential social implications, and economic constraints.
4. Identification of preferred source control practices to be implemented at the detailed design stage.
5. Preliminary sizing and siting of source controls, including a site plan depicting the proposed development/redevelopment and source control footprints.
6. Supporting analyses to demonstrate the performance of the proposed source controls, specifically with respect to the functional criteria outlined in the AEGD Stormwater Master Plan (See **Section 2.9.6**) and Section 5 of the Stormwater Source Control Policy for ICI Land Uses (February, 2014)
7. Any supplemental requirements (i.e. contributions toward a cash-in-lieu program) which may be required in order for the proposed development to satisfy the criteria outlined in Section 5 of the Stormwater Source Control Policy for ICI Land Uses (February, 2014)

The proposed source controls for the site as provided in the engineering submission which accompanies the Tertiary Plan or Site Plan Application shall be reviewed by the City of Hamilton. Subject to the approval of the City of Hamilton, the detailed design of the proposed source controls may then proceed.

#### **4.6.2 Submission Requirements at Detailed Design Stage**

The following shall be submitted to the City of Hamilton for the review and approval of the detailed design of the stormwater source controls:

1. Detailed design drawings for the construction of the proposed stormwater source control.
2. For rooftop storage or green roofs, a supporting study shall be prepared and submitted by a qualified Structural Engineer to prescribe any requirements for the structure in order to support the additional load associated with the proposed source control practice.
3. A Design Brief completed by a qualified Engineer demonstrating that the proposed stormwater source control design would satisfy the functional criteria outlined in the AEGD Stormwater Master Plan (See Section 2.9.6) and Section 5 of the Stormwater Source Control Policy for ICI Land Uses (February, 2014)
4. A detailed outline of the operation and maintenance requirements for the proposed source controls, including the maintenance program to be implemented over the design life of the source control and associated costs. The operation and maintenance plan and cost estimate shall be in conformance with the following (see **Appendix C – LID Resources**):
  - Assessment of Life Cycle Costs for Low Impact Development Stormwater Management Practices (Final Report 2013)
  - Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (Version 1.0, 2016)

The operation and maintenance plan shall include, but is not limited to, the following:

- Inspection frequency of all structures, apertures and functional design elements (minimum of once annually)
- Maintenance activities and frequencies with responsible party identified.
- Repair tasks and procedures
- Landscape and plant maintenance needs and method for the re-stabilization of all disturbed areas

- Sediment removal frequencies and sediments testing protocols and method of disposal (if applicable)
  - Effluent sampling protocol
  - Stormwater feature design life estimates
  - Replacement/ refurbishment recommendations/ plans at the conclusion of stormwater feature life cycle.
  - Maintenance cost estimate: the costs associated with the maintenance of the various stormwater management plan elements may vary with the type and size. The proponents shall submit a maintenance program estimate for the duration of the anticipated life-cycle of each element of the proposed stormwater feature.
5. Recommendations for a monitoring program for the proposed source controls.
6. Opportunities to implement adaptive management over the lifecycle of the source control.

## **5.0 MUNICIPAL IMPLEMENTATION CONSIDERATIONS**

The following section outlines recommended policy considerations, staff training requirements and assumption protocols for the implementation of the Stormwater Management Master Plan for the AEGD study area.

### ***5.1 Policy Considerations***

The following section is intended to provide guidance and recommendations for the updating of the City's municipal standards and codes in response to the proposed implementation of the innovative LID source and conveyance control measures as part of the stormwater management strategy for the AEGD.

The following sections provides policy considerations for:

- 1) Private Stormwater Management Facilities and
- 2) Infiltration Facilities for application within the AEGD study area

and offers additional recommendation for consideration by the City of Hamilton.

#### ***Private Stormwater Management Facilities***

For stormwater management facilities and/or LID designed to service only one property:

- The land required for the private stormwater management facility or LID is to be retained by the owner.
- All costs for constructing and maintaining the stormwater management facility, LID or structure shall be the responsibility of the owner. Covenants placed on title of individually owned lots shall require owners, individually and collectively, to maintain repair and replace infrastructure
- At the discretion of the City of Hamilton, an easement shall be placed over the private facility, including an easement for access from the nearest vehicular entrance connecting to the City's right-of-way and extending to the facility, and shall be dedicated to the City of Hamilton. This easement shall be such that it grants the City with the right-to enter and inspect the facility.

- Maintenance activity requirements and facility function are to be measured against the property specific Environmental Compliance Approval (ECA) as issued and approved by the Ontario Ministry of the Environment.
- The owners of all private stormwater management facilities shall file with the City of Hamilton a copy of the most current ECA for the respective property as a condition of approval.
- The removals of stormwater management facilities and/or LID controls shall be considered unlawful. All stormwater management facilities and/or LID shall be placed on title. Recommendations for consideration by the City:
  - The owner shall grant the municipality the authority to `repair` the facilities as necessary, with all `repairs to be at the owner's expense`. Specific wording is further recommended as part of site plan conditions, requiring performance bonds/warrantees that ensure that LID measures are properly designed, constructed and monitored for a sufficient post construction period to ensure that they are maintained and functioning effectively are also recommended for consideration. This can be accomplished through the development of appropriate area specific bylaws and the establishment of `right to enter easements`.
  - Repairs of private facilities by the City shall be considered a last resort when habitual non-compliance is identified. However, should repairs or maintenance be required and undertaken by the City, the costs incurred shall be collected through an amendment of the existing City of Hamilton property standards by-laws to permit collection of incurred costs through property tax collection. This approach has proven effective in many Ontario municipalities in the collection of maintenance costs for private stormwater facilities and is recommended for consideration.

### ***Infiltration facilities***

Per the City of Hamilton Stormwater Source Control Policy for Industrial, Commercial and Instructional (ICI) Land Uses (February, 2014) the runoff from all rooftops is generally considered "clean water" which would not require stormwater quality pre-treatment for infiltration. The ultimate acceptance of rooftop runoff from industrial buildings as "clean runoff" is at the discretion of the Ministry of the Environment, and is to be determined on a case-by-case basis. All runoff from parking lots and roadways shall require stormwater quality pre-treatment for infiltration.

Recommendations for consideration by the City:

- It is recommended that the City require the submission of a soils report to accompany the design of infiltration facilities to ensure adequate soil permeability and depth to the seasonally high water table. The soils report should include at a minimum:
  - Borehole information, including soil stratigraphy, composition, grain-size and chemical analysis (additional testing may be required for individual LID techniques per the requirement of the LID Management Planning and Design Guide, Version 1.0 (TRCA/CVC - 2010);
  - In-situ infiltration testing using the Guelph Permeameter test (as specified in the LID Stormwater Management Planning and Design Guide, Version 1.0 (TRCA/CVC - 2010) or approved equivalent to confirm site specific design infiltration rates and design specifications. T-test, slug or other generalizes test shall not be accepted for design purposes;
  - Seasonally high groundwater elevation information through the installation of standpipes according to Ontario Regulation 389/09;
- The design shall incorporate an overflow connection to the storm sewer (or suitable surface outlet) where design infiltration rates are below 15mm/hr per the 2010 LID Stormwater Planning and Design Guide (see **Appendix C - LID Resources**).

## **5.2 Training Requirements**

City review staff responsible for approvals, inspections and operations and maintenance activities should be given specific LID SWM training which should include the basics of LID principles and techniques such as LID goals and objectives, function and performance, design basics, approval requirements, operation and maintenance considerations. This can be accomplished through:

- Development of LID seminars or workshops by experienced LID practitioners to address the specific requirements of the City;
- Through existing second party training programs such as the Canadian Standards Association (CSA) Sustainable Stormwater Practices training modules or through on-line E-learning courses available from Sustainable Technologies Evaluation Program (Step): <http://www.sustainabletechnologies.ca/wp/events/>
  - Introduction to Low Impact Development E-Learning Course
  - Design of Infiltration Practices: Low Impact Development Technical Training E-Learning Course

## **5.2 Assumption Protocols**

The following section provides a discussion regarding assumption protocols, specifically a general summary of potential assumption protocols based on the Stormwater Management Certification Protocols for Low Impact Development (CVC, Draft 2012).

### **5.2.1 Summary of Potential Assumption Protocols**

Following a post-construction period of BMP stabilization and vegetation establishment, the site developer may be required to complete a Certificate of Completion that verifies BMP specifications and performance for approval prior to property transfer.

The Stormwater Management Certification Protocols for Low Impact Development (CVC, Draft 2012) document details five (5) levels of SWM Certification Protocols (simple to complex) that can be used to verify a variety of infiltration and filtration practice designs and performance. The certification protocol takes place as a 3rd step, following 1) Design and Plan Review and 2) Construction Inspection & Maintenance (up to assumption by the municipality).

Certification protocols ensure that knowledgeable personnel (e.g. Professional Engineer and/or qualified Certified Engineering Technologist) evaluate whether the LID practices have been installed properly before the contractor is released of responsibility.

The certification process is the last opportunity to identify issues due to improper construction and/or unforeseen site condition issues. These issues can then be addressed before the owner takes over maintenance responsibilities. The approaches can serve to:

- Formally transition from construction and establishment to functioning practice prior to assumption by land owner
- Confirming practice performance for regulatory requirements

### 5.2.2 Principles for LID Certification

When developing a municipal LID BMP certification program, the following principles should be considered:

#### **1. Constructed to Specifications**

Municipalities (and property owners) will need to verify that stormwater BMPs are installed properly, meet or exceed the design standards, and is functioning hydrologically as designed prior to assumption.

#### **2. Public Safety**

While it may be impractical or impossible to eliminate all safety risks associated with stormwater management practices, most risk can be mitigated through proper design. Typical public safety inspection tasks for LID include checking ponding depths and drawdown times, eliminating trip hazards and ensuring that vegetation doesn't obscure important sight lines.

#### **3. Pre-treatment Practices**

Filtration/infiltration BMPs generally include some level of pre-treatment to prevent clogging of filtration beds. Typical pre-treatment measures include the use of perennial grass buffers and vegetated swales, hydrodynamic separators, sedimentation and the



use catch basins with enhanced sedimentation. Issues related to pre-treatment practices should be noted for maintenance or upgrades as required.

#### **4. Transfer of Certification Methodology**

There are broad categories of LIDs in which the certification methodologies will be similar for each (e.g. bioretention, infiltration galleries, permeable pavements, dry swales etc.).

#### **5. Building upon existing municipality capabilities**

Inspection and certification of LID BMPs may be a new task for municipalities. To limit administrative burden, the municipalities may choose from a range of certification methods varying from simple to complex, as best fits their staff's training and experience and management goals (see **Table 5.2**).

#### **6. BMP Verification as Adaptive Management**

The purpose of verification is to maintain or enhanced the performance of existing and future local stormwater infrastructure assets. Field assessments are used to identify which LIDs are working well and which ones require preventative or corrective maintenance. In the case of poorly or non-performing practices, 'forensic' examinations may yield important information for future efforts. In addition, field verification enables the municipality to analyze their inventory of private and public stormwater BMPs to identify which individual projects present the best opportunities for reducing stormwater impacts through retrofits or restoration of existing BMPs.

##### **5.2.3 Levels of Certification**

Property owners and municipalities have varying capacities for performing monitoring and certification protocols. Also, there are LID practices that require varying levels of monitoring.

The Stormwater Management Certification Protocols for Low Impact Development (CVC, Draft 2012) document presents five (5) levels of certification protocols as presented in **Table 5.2**. The advantages and disadvantages of the varying levels are presented in **Table 5.3**. Each approach is summarized in the subsequent section.

**Table 5.2–Level of Certification & Associated Protocols**

Level of Certification	1. Visual Inspection	2. Infiltration Testing	3. Synthetic Runoff Testing	4. Water Level Monitoring	5. Comprehensive Monitoring
Checklist Inspection	✓	✓	✓	✓	✓
Soil Sampling and Testing	✓ (optional)	✓	✓	✓	✓
Sedimentation Monitoring	✓ (optional)	✓ (optional)	✓ (optional)	✓ (optional)	✓ (optional)
Vegetation Surveys, photos over time	✓	✓	✓	✓	✓
As-built Survey, Including topo.		✓	✓	✓	✓
Infiltration Testing		✓	✓ (optional)	✓ (optional)	✓ (optional)
Synthetic Runoff Test			✓	✓ (optional)	✓ (optional)
Water Level Monitoring				✓	✓ (optional)
Flow Monitoring					✓
Water Quality Monitoring					✓
Optional elements = level of certification that can be included if desired but may be redundant or duplicated through the provision of required program elements.					

**Table 5.3 – The Advantages and Disadvantages of the Varying Level of Certification**

<b>Level of Certification</b>	<b>1. Visual Inspection</b>	<b>2. Infiltration testing</b>	<b>3. Synthetic Runoff Testing</b>	<b>4. Water Level Monitoring</b>	<b>5. Comprehensive Monitoring</b>
<b>Objectives</b>	Determine: <ul style="list-style-type: none"> <li>constructed to design plan</li> <li>deficiencies</li> </ul>	Determine: <ul style="list-style-type: none"> <li>storage capacity</li> <li>infiltration rate and drawdown time</li> <li>sedimentation rate</li> </ul>	Determine: <ul style="list-style-type: none"> <li>storage capacity, infiltration rate and drawdown time</li> <li>sedimentation rate</li> </ul>	Determine: <ul style="list-style-type: none"> <li>storage capacity</li> <li>infiltration rate and drawdown under various conditions</li> <li>sedimentation rate</li> <li>volume reduction</li> </ul>	Determine: <ul style="list-style-type: none"> <li>storage capacity</li> <li>infiltration rate and drawdown time</li> <li>sedimentation rate</li> <li>flow, volume, and water quality</li> </ul>
<b>Time Requirement</b>	1 day	1 day – 1 week	1 day – 1 week	1-2 years	1-3 years
<b>Advantage</b>	<ul style="list-style-type: none"> <li>Quick &amp; inexpensive</li> </ul>	<ul style="list-style-type: none"> <li>less expensive, no equipment left in field</li> <li>short timeframe</li> </ul>	<ul style="list-style-type: none"> <li>more accurate than infiltration testing (2)</li> <li>no equipment left in field</li> <li>short timeframe</li> </ul>	<ul style="list-style-type: none"> <li>controlled experiments</li> <li>more accurate</li> <li>equipment left in the field, but hidden in observation well</li> </ul>	<ul style="list-style-type: none"> <li>most comprehensive</li> <li>most accurate</li> <li>includes drainage area specific evaluation</li> </ul>
<b>Disadvantage</b>	<ul style="list-style-type: none"> <li>limited knowledge gained</li> </ul>	<ul style="list-style-type: none"> <li>Requires specialized equipment to perform test.</li> <li>uncertainties in testing can be substantial</li> </ul>	<ul style="list-style-type: none"> <li>Synthetic runoff test cannot be used without sufficient water supply</li> <li>practice may perform differently with varied antecedent conditions</li> </ul>	<ul style="list-style-type: none"> <li>higher cost and time commitment than level 1 and 2.</li> </ul>	<ul style="list-style-type: none"> <li>Requires knowledgeable personnel</li> <li>High cost to undertake</li> <li>Equipment is left in field</li> </ul>

Adapted from University of Minnesota's *Assessment of Stormwater Best Management Practices*

### ***5.2.3.1 Level 1 – Visual Inspection***

Considering to the minimal effort and lowest cost requirement. It is recommended that visual inspection be used as the initial assessment tool for all LIDs. Visual inspection involves inspecting a LID for evidence of malfunction or deviation from the design plans. This can be accomplished with a brief site visit, the original plans and a checklist. Visual inspection can be used to quickly and cost-effectively determine if, and potentially why, an LID practice is not operating properly. Simplified techniques focus on these aspects:

- General confirmation of site draw-down time (hours) and Inspection of soil properties
- Presence of ponded water on site beyond specified time to drain (typically 24- 48 hours following a rainfall event)

Visual inspection alone cannot provide quantitative information about the LID performance. Quantitative information on performance will require additional assessment via capacity testing and monitoring (level 2 -5).

### ***5.2.3.2 Level 2 – Capacity Testing***

A step beyond visual inspection involves the collection of additional data through testing and measurements including:

- Soil characterization sampling and testing - ensures that the installed bioretention soil meets the specification.
- Elevation surveys - confirms that the depths, storage volumes, and drainage areas correspond to the design plan.
- Sedimentation monitoring and vegetation surveys - these tasks help to establish the necessary maintenance schedules for sediment removal from inlets/pre-treatment areas and vegetation care. Due care to observe preferential flow paths that can be prone to plugging.
- Infiltration testing - will provide an estimate of expected drawdown times.

This level of certification will establish if the practice was built to the design plan, including the soil composition, the storage volume, and drainage area.

The infiltration testing will provide an estimation of expected drawdown times depending on the number of infiltrometer or permeameter measurement tests spatially distributed throughout the practice. Capacity testing will not provide the same level of accuracy as the real world monitoring that occurs in level 3 and 4.

#### ***5.2.3.3 Level 3 – Synthetic Runoff Testing***

Synthetic runoff testing, one step beyond infiltration testing, is a more accurate method for determining capacity and infiltration or drawdown performance.

Synthetic runoff testing uses a clean water source (e.g., a fire hydrant or water truck), which is applied to the stormwater treatment practice under well-controlled conditions (to prevent erosion and scouring of the landscaped surfaces) and while performance is measured. For filtration or infiltration rate assessment, the following four conditions must be met for synthetic runoff testing to be feasible:

- There must be a water supply that can provide the required discharge and total volume of runoff needed.
- The BMP must be offline and/or no precipitation is expected for at least 48 hours.
- Outflow paths other than infiltration are either measurable or can be temporarily plugged.
- The water surface elevation in the stormwater treatment practice can be measured

Once the stormwater treatment practice is filled with synthetic runoff, the change in water level with time can be used to evaluate the infiltration rate. A perforated observation well which extends to the bottom of the practice is necessary to measure subsurface water level drawdown within a bioretention soil or other subsurface storage area.

#### ***5.2.3.4 Level 4 - Continuous Water Level Monitoring***

After infiltration testing (level 2) and synthetic runoff testing (level 3) have been considered and either dismissed or performed, low intensity monitoring can be considered to measure LID performance. A newer and innovative method of tracking runoff infiltration through the soils has been developed based on use of inexpensive continuous water level/temperature data loggers. This type of monitoring provides cost-effective monitoring

alternative by tracking temperature and groundwater levels over time including evaluation of seasonal and winter infiltration performance, potentially affected by frozen soils. One of the larger BMP performance questions facing stormwater managers in cold climates is the performance of LIDs during the winter months. Continuous recording water level/temperature data loggers will allow more detailed annual and winter infiltration performance tracking.

Subsurface water levels and temperatures can be continuously monitored with a water level logger installed in an observation port/well. For a continuous water level assessment, the following conditions must be met:

- A perforated observation well (or piezometer) must be installed which extends from the bottom of the practice to 300 mm above the surface.
- Two water level loggers which are small and relatively inexpensive monitoring equipment need to be installed. One logger is installed in the observation well and the other is installed in a protected open air space to measure the atmospheric pressure.
- A rain gauge must be in the vicinity, onsite is preferable, but within 1 km is acceptable. The rainfall data and known drainage area are necessary to know for comparison to the water level drawdown data.

The water level data in combination with the rainfall data can then be used to determine how long it took the practice to drain down after the end of an event and what size events resulted in overflows.

#### ***5.2.3.5 Level 5 - Comprehensive Monitoring***

If capacity testing (level 2) and low intensity monitoring (level 3) are not feasible assessment approaches for a specific location, or do not achieve the goals of the assessment, a more intensive monitoring program should be considered.

Level 5 Monitoring is the most comprehensive and expensive assessment technique and can be used to effectively document water volume reduction and peak flow reduction for

most stormwater treatment practices by measuring discharge during natural runoff events.

This level of monitoring is recommended for larger demonstration purposes when a stormwater practice is being implemented for the first time in a specific jurisdiction or development context (e.g. pilot testing of a new technology, challenging soil or geologic contexts, unique or hybrid facility design).

Another situation where this level of monitoring might be warranted is if the facility has been designed to meet higher standards due to the sensitivity of the receiving water or presence of species of concern.

To assess runoff volume and pollutant load reduction, peak flow reduction, or both by monitoring a stormwater treatment practice, the inflow(s) and outflow(s) must be measured or estimated as in conducting a water budget. The summation of the inflows can then be compared to the summation of the outflows to determine the runoff volume reduction, peak flow reduction, or both.

Typical urban runoff events are flashy (rapid response) and require continuous flow measurement (or estimation). Pollutant loading changes will require state-of-the-art automated sampling devices to obtain flow-weighted or time-weighted sampling that coupled with continuous flows allow estimation of loads and development of Event Mean Concentrations (EMC).

Besides having considerable additional costs, comprehensive monitoring has more potential for missed or erroneous data as compared to synthetic runoff tests for the following reasons:

1. Weather is unpredictable and can produce various runoff volumes of various durations with varying pollutant concentrations at various times.
2. In order for a storm event to be monitored correctly and accurately, all the monitoring equipment must be operating correctly and the parameters (water depth, etc.) must be within the quality control limit ranges for the equipment.

3. Equipment malfunction due to rodents, electrical interferences, routine wear, storm damage/loss, or vandalism are common.
4. State-of-the-art continuous monitoring of stormwater runoff is the most expensive of monitoring techniques as it requires trained technicians, proper installation, frequent inspection, runoff flow-gauging, maintenance and adherence to quality control protocols. Continuous monitoring can provide accurate mass-balance summaries that have been used to accurately assess (NRC/NSF 2008):
  - Individual LID performance (volume and pollutant reductions) over seasons and annually, particularly for new and innovative techniques;
  - Drainage area runoff quality over seasons for comparison to water quality criteria or goals
  - Treatment train performance seasonally and annually.



## 6.0 MUNICIPAL OPERATION AND MAINTENANCE

Adequate maintenance is essential to ensure the long-term achievement of stormwater management performance targets.

The following section sets out potential municipal management and maintenance recommendations that are specific to the landscape components of LID stormwater management techniques. These guidelines are of particular importance due to the shift away from conventional end-of-pipe stormwater management strategy to decentralized, landscape-based Low Impact Development techniques. The inclusion of large quantities of plant material as functional components of the SWM facilities requires that special care be given to operation and maintenance, especially before and after the City assumes them (i.e. ROW conveyance controls).

### 6.1 Management Options

In general there are three (3) conceptual models for maintenance approaches for LID source and conveyance controls (LIDs). They include:

Approach 1: Private Owner Maintenance – private property owners are responsible for performing ongoing on-site stormwater facility maintenance with municipal guidance and oversight.

Approach 2: Municipal Maintenance – the municipality is responsible for performing ongoing on-site stormwater facility maintenance.

Approach 2: Hybrid – a combination of Approach 1 and 2

**Table 6.1** summarizes the requirements/ steps associated with each approach and the advantages and disadvantages to each.

**Table 6.1 Summary of Possible Maintenance Approaches for On-site Source and Conveyance Controls**

<b>Maintenance Approach</b>	<b>Typical Requirements /Steps</b>	<b>Advantages and Disadvantages</b>
1. Private Owner Maintenance	<ol style="list-style-type: none"> <li>1. Develop/ adopt program documents</li> <li>2. Mandatory maintenance plan for site plan approval</li> <li>3. Develop land-owner outreach program and materials</li> <li>4. Develop inspection procedures</li> <li>5. Establish tracking system</li> <li>6. Compliance enforcement procedures</li> </ol>	<p>Reduced costs to the municipality</p> <p>Municipality required to undertake steps 3-6</p> <p>Policy and By-law revision required. See section 6.0</p>
2. Municipal Maintenance	<ol style="list-style-type: none"> <li>1. Collect a detailed inventory of all on-site controls</li> <li>2. Establish maintenance policies</li> <li>3. Mandatory easement requirement for site plan approval (new development)</li> <li>4. Train inspectors and approvals staff</li> <li>5. Develop tracking system</li> <li>6. Perform and document maintenance activities</li> </ol>	<p>High costs, extensive staffing requirements and administrative burden</p> <p>Avoidance of enforcement issues, and increased control over maintenance frequency</p>
3. Hybrid	Combination of Approaches 1 and 2	<p>Provides maximum flexibility ,</p> <p>Ability to shift 'some' (typically more frequent) maintenance to the landowner.</p>

(CWP, 2008)

Regardless of the management model the City selects, there is a general requirement for a transfer of ‘traditional’ SWM maintenance resources and funds (outlet inspections, pond dredging, vacuum trucks to empty OGS systems etc) to a more landscaped based SWM maintenance program. Municipalities generally have the required staff and infrastructure within other departments (such as Parks Departments – arborists, horticulturalists. etc) and as such require only a transfer of funding and additional training (see **Section 5.2**).

Furthermore, in developing the recommendations to guide the maintenance of the landscape components of stormwater management facilities, it must be recognized that the landscape is a living system that evolves in response to the environment and natural successional processes. Consequently, the maintenance program must be implemented with an understanding of the long-term evolution of the landscape and with a view to the desired state of the landscape in the future.

The following are the objectives that served as the basis for developing the landscape maintenance program:

- promote the succession of naturally occurring species and associations;
- support the process of natural succession;
- manage for the control of non-native invasive or undesirable species;
- manage to ensure public safety with respect to preservation of sightlines, removal of hazards and control of noxious species; and
- ensure that the primary stormwater management function of the facility is achieved.

The following section describes key considerations and approaches in the development of a “level of service” model to correspond with the maintenance approach.


### 6.1.1 O&M Level of Service Model

When developing an operation and maintenance program for LID BMPs, the development of a “level of service” model will be required; more specifically at what frequency and scope will the maintenance program be completed. Key considerations include:

- Frequency of inspections— Annual, semi-annually, quarterly inspections etc;
- Scale of implementation - How will size and number of BMPs effect the program;
- Ownership – private of public LID BMPs
- Maintenance triggers – complaints driven, emergency driven, inspection driven
- Risk factors – flooding, water quality etc.

**Table 6.2** below illustrates a maintenance program service model matrix, where the components and maintenance responses can increase or be scaled as the program matures in response to increasing LID implementation. This model allows for minimal upfront investment but is a tool to set priorities and plan for future program expansion.

**Table 6.2 Maintenance Program Service Matrix (CWP, July 2008)**

Program Service Level & Budget Requirements	Elements included in maintenance program	Maintenance task	Maintenance Response	Inspectors	Inspection Response	Program Feedback based on inspection and Maintenance experience
<p><b>LOWER</b></p>  <p><b>HIGHER</b></p>	<p>BMPs on public land and within public rights-of-way</p> <p style="text-align: center;">+</p> <p>High-priority, high-risk, and/or large BMPs on private land with necessary easements and agreements</p> <p style="text-align: center;">+</p> <p>All or most BMPs on private land within easements and covered by deeded maintenance agreement</p> <p style="text-align: center;">+</p> <p>Completely private BMPs</p> <p style="text-align: center;">+</p> <p>All conveyances measures</p>	<p>Repair Immediate threats to public health and safety</p> <p style="text-align: center;">+</p> <p>Repair structural items: erosion, outfalls, clogged or broken pipes</p> <p style="text-align: center;">+</p> <p>Also include routine maintenance: mowing, weeding, removal of trash and debris, replacement of vegetation</p> <p style="text-align: center;">+</p> <p>Program includes system to retrofit or reconstruct BMPs</p>	<p>React to complaints and emergencies</p> <p style="text-align: center;">+</p> <p>Establish schedule for mowing and trash/debris removal</p> <p style="text-align: center;">+</p> <p>Conduct maintenance in response to inspection reports, checklists, and performance criteria</p>	<p>Rely on owners and HOAs to inspect</p> <p style="text-align: center;">+</p> <p>Public inspectors send report to responsible party</p> <p style="text-align: center;">+</p> <p>Co-inspections with public inspector and responsible party</p> <p style="text-align: center;">+</p> <p>System of certified private inspectors with spot inspections and compliance checks by public agency</p>	<p>Complaint-driven</p> <p style="text-align: center;">+</p> <p>Every 3 years</p> <p style="text-align: center;">+</p> <p>Annual or semi-annual</p> <p style="text-align: center;">+</p> <p>More frequent for high-priority BMPs</p>	<p>Feedback is anecdotal</p> <p style="text-align: center;">+</p> <p>Feedback used to modify list of recommended BMPs in design manual based on maintenance burden</p> <p style="text-align: center;">+</p> <p>Feedback used to modify design standards in manual to reduce maintenance burden through initial design</p>

## **6.2 Funding Sources**

The identification of additional funding sources for the implementation of LID operation and maintenance programs (as well as to fund training of management, engineers and approvals staff) is critical to the long term success of LID implementation. Stormwater program managers have a wide range of funding sources to finance implementation of these programs, from general funds to dedicated sources like stormwater utilities. The program manager must assess each funding source to ensure it meets the stormwater program needs.

In this regard, the following funding sources have been identified:

- City General fund – tax based funds are reallocated from the general fund
- Plan review and inspection fees – fee system is enacted for the review of submitted plans and in accordance with proposed City inspection services (i.e. pre-construction, during construction, post construction and at assumption if applicable)
- Maintenance bonds – proponent must calculate the present value of the maintenance cost for the BMP according to a standardized procedure and shall be reviewed by the City. The funds shall be managed by the City for the ongoing O&M of the facility for the duration of its life-cycle. This approach is currently being used by select Ontario municipalities.
- Stormwater Utility – shift from funding stormwater using a tax based systems to a rate based system. This approach is currently utilized by more than 1,600 US municipalities and eight (8) Ontario municipalities according to the Environmental Commissioner of Ontario (Urban Stormwater Fees: How to Pay for What We Need – November 2016).
- Capital Improvement Program - tax based funds are reallocated from the capital works funds.
- Grants – a variety of environmentally based grants and granting agencies (both private and public) are available and may be a potential source of funds for

community based pilot projects, education programs and training expenses. Examples include RBC Blue-Water, TD Green Funds etc.

- Developer Participation – can be a source of funding through fees (as outlined above) or through cash-in-lieu policies, development charges, fee/connection charges, incentives based systems or penalty based systems for non-compliance.
- Combination approach - A combination of one or more of the above funding sources. This option provides for flexibility in the initial phases of program development and allows for a tailored approach to be developed.

Each of these funding sources has advantages and disadvantages that have to be evaluated for compatibility with local needs. Furthermore, there are many other factors to examine when evaluating each funding source, such as state drainage infrastructure needs, and the political climate. For all funding sources, the principle of adaptive management should be employed to feedback the 'actual' O&M costs for regular revision of the proposed fee, tax or rate system.

### ***6.3 Operation and Maintenance Requirements for LID Techniques***

Maintenance requirements for most LID technologies have little difference from most turf, landscaped, or natural areas and do not typically require new or specialized equipment (EPA, 2007). However, LID techniques are green 'infrastructure' and do therefore provide a necessary function in communities. The relative importance of this function requires that maintenance personnel and inspectors are well versed in the design, intended function and maintenance requirements of each system. Just as contractor education is critical to ensure proper post-construction function, the education and training of the individuals servicing LID facilities is vital to their long-continued operation.

In 2016, the Toronto and Region Conversation Authority (TRCA) under the Sustainable Technologies Evaluation Program (STEP) released the Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (Version 1.0).

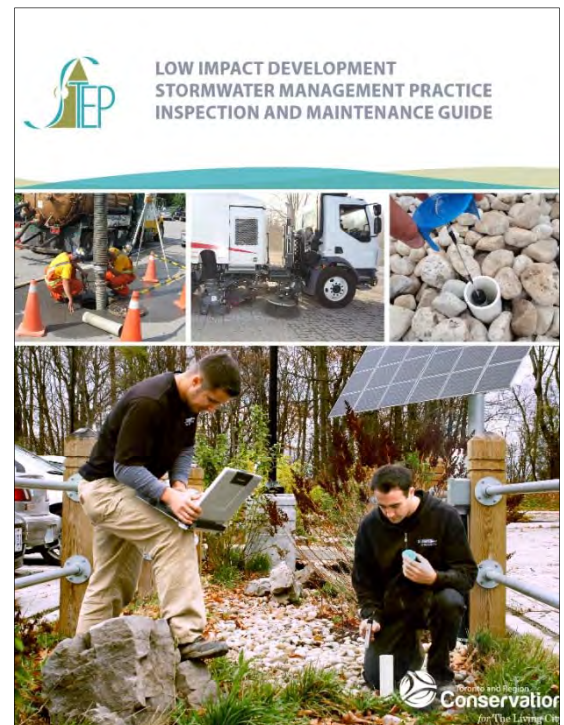
This guidance document is intended to assist municipalities and industrial/commercial/institutional (ICI) property managers with developing their capacity to integrate LID BMPs into their stormwater infrastructure programs. Part 1 of the document provides guidance on designing an effective LID BMP inspection and maintenance program, based on experiences and advice from leading jurisdictions in the United States, adapted to an Ontario context. Part 2 of the document establishes standard cold climate protocols for inspection, testing and maintenance of seven types of structural LID BMPs.

This guidance document has dedicated chapters to:

- Bioretention and Dry Swales
- Enhanced Swales
- Vegetated Filter Strips and Soil Amendment Areas
- Permeable Pavements
- Underground Infiltration Systems
- Green Roofs
- Rainwater Cisterns

## 6.4 O&M Requirements for Dry Pond End-of-Pipe Facilities

Dry pond facilities are a well understood stormwater management technique in terms of operations and maintenance. The facilities typically require little operations and maintenance. **Table 6.4** below provides typical operations maintenance activities for dry ponds in comparison to other stormwater BMPs.





**Table 6.4 Maintenance Requirements for Dry ponds in Comparison to Other BMPs**

Operation or Maintenance Activity	Dry Pond	Infiltration Basin	Infiltration Trench (Soakaways pits, Perforated Pipe Systems etc.)	Underground Storage (RWH, Permeable Pavement etc.)	Filters (Bioretention Bio-swales, Bio-filters etc.)
Inspection	■	■	■	■	■
Grass Cutting	■	■	■	■	■
Weed Control	■	■			■
Upland Vegetation Replanting	□	□	□		
Removal of Accumulated Sediments	■	■	■	■	□
Outlet Valve Adjustment	□				
Trash Removal	■	■	■	■	■
Infiltration Basin Floor Tiling		□			

■ Normally Required      □ May be Required (Source: MOE, 2003)

## 7.0 MONITORING REQUIREMENTS

Monitoring Programs are generally separated into two types:

- **Environmental Monitoring** - designed to assess the environmental health of a watershed or subwatershed (measured based on a range of environmental indicators), in response to land use change.
- **Performance Monitoring** - designed to evaluate whether a measure is implemented properly (compliance monitoring) and how well it performs, based on a range of performance indicators or targets (effectiveness monitoring). Typically performance monitoring is completed for a Stormwater Master Plan and generally includes:
  - Compliance Monitoring
  - Effectiveness Monitoring

The monitoring approach for the Subwatershed Plan and the Stormwater Master Plan utilize an adaptive environmental management approach (see figure below), which achieves the following:

- Promotes flexible decision making
- Monitoring advances scientific understanding and helps policy decisions
- Acknowledges natural variability in contributing to ecological resilience and productivity
- Not 'trial and error' – it is learning while doing



The objective of the environmental monitoring program is: to provide a means of updating the environmental database to reflect temporal changes; to provide a means of determining whether the measures proposed in the study are adequate to meet the goals,

objectives and targets; and to establish a contingency plan in cases where the targets are exceeded. The monitoring program will form an integrated component of implementing an adaptive management approach to subwatershed plan implementation. A monitoring program would include the following:

- network of integrated sampling stations for streamflow, groundwater, water quality, fish and benthic invertebrates, aquatic habitat and fluvial geomorphic conditions;
- methodology for assessing the condition of terrestrial features over the long term;
- sources of funding and reporting requirements; and
- assessment of monitoring results against implementation progress, appropriate enforcement and follow-up activities.

The monitoring program to assess the Stormwater Management Plan utilizes an adaptive environmental management approach design to assess the overall performance of the plan, in terms of compliance and effectiveness monitoring. It is difficult to develop a comprehensive monitoring program at this scale of study, however **Table 7.1** outlines general components of a performance monitoring program. Additional details is provided in subsequent sections.

**Table 7.1 Performance monitoring components for monitoring Stormwater Management Plan**

Monitoring Component	Parameter	Compliance Monitoring	Effectiveness Monitoring
Hydrology (at facility)	<ul style="list-style-type: none"> <li>Capacity -Dry volume</li> <li>Outlet design flows</li> <li>Retention (wet) volume)</li> </ul>	■	■
Hydrology (in receiving stream)	<ul style="list-style-type: none"> <li>Time series flows (continuous flows)</li> <li>Spot flows,</li> <li>Flood flows</li> </ul>		■
Hydrogeology	<ul style="list-style-type: none"> <li>Infiltration /recharge</li> <li>Water Balance</li> </ul>		■
Water Quality (LID Features)	<ul style="list-style-type: none"> <li>Sediment removal</li> <li>Outlet concentrations</li> </ul>	■	
Water Quality (in receiving stream)	<ul style="list-style-type: none"> <li>In stream concentrations</li> <li>Dry and wet events</li> </ul>		■
Erosion & Fluvial Geomorphology (at facility- inlet/outlet – pre/post)	<ul style="list-style-type: none"> <li>Retention volume</li> <li>Flow duration</li> <li>Outlet Design Flows</li> </ul>	■	
Erosion & Fluvial Geomorphology (upstream/ downstream & at ref. site)	<ul style="list-style-type: none"> <li>Channel Stability</li> <li>Erosion indicators</li> <li>Rapid Geomorphic asses.</li> <li>Detailed Geomorphic</li> </ul>		■
Aquatic habitat & Communities (at facility- inlet/outlet – pre/post)	<ul style="list-style-type: none"> <li>Aquatic invertebrate collection</li> </ul>	■	
Aquatic habitat & Communities (upstream/downstream & at ref. site)	<ul style="list-style-type: none"> <li>Aquatic invertebrate collection</li> <li>Habitat parameters</li> <li>Habitat suitability measures</li> </ul>		■

## **7.1 Hydrology (Surface Water Monitoring)**

The purpose of the surface water monitoring program is:

- i) to ensure that the proposed development of the AEGD lands does not negatively affect downstream conditions,
- ii) to ensure that the storm water management strategies outlined in the Stormwater Master Plan report are implemented properly, and
- iii) to ensure that any deficiencies in the storm water management plan are revealed and rectified in a timely and appropriate manner.

### **Pre-Construction Monitoring**

This component of the monitoring program will provide baseline information that will be used for comparative purposes with future monitoring data. Flow data has been collected as part of the AEGD Subwatershed Study and includes continuous and spot flow measurements for eight (8) locations/ watercourses and includes several rainfall events and snowmelt events. Initiation of pre-construction monitoring is not anticipated at this stage, however this requirement should be re-assessed as more detailed studies are completed within respect to the individual watercourses and proposed development.

### **During Construction Monitoring**

During Construction Monitoring will commence when development within any portion of the area tributary to that site (SWM facility) is initiated and will continue until “substantial completion” of development within that area. The monitoring will generally include monitoring of:

- o storm water management and/or temporary erosion and sediment control (ESC) works. Inspection and monitoring of the ESC works is proposed on a weekly basis, in accordance with the Erosion and Sedimentation Control Plan. The ESC Plan will be developed at the final design stage. This monitoring is intended to ensure that any detected deficiency are corrected promptly and appropriately.

### **Post Construction Monitoring**

Post Construction monitoring may include the following activities:

- **Dry- ponds:** Compliance and effectiveness monitoring of the dry-pond capacity (total storage volume) and outlet design flows after construction through submission and approval of as-built drawings for City approval prior to assumption. In addition, monitoring of dry-pond water level and time to draw-down after significant storms events can be incorporated into pre-assumption monitoring requirements. These requirements would be the responsibility of the constructor/developer.
  
- **Receiving Streams:** Effectiveness monitoring shall include in-stream flow monitoring both upstream, downstream and with an appropriate reference location of dry-pond facility outlets to confirm to no adverse effects with respect to increased flows beyond those as submitted within the approved Stormwater Management Plan/ Detailed Design. In-stream flow measurements may include:
  - Time series flows (continuous flows)
  - Spot flows,
  - Flood flows (large event)

Type of in-stream monitoring should be based on sensitivity of receiving stream as determined through the development approval process and the required additional studies.

### **7.2 Hydrogeology**

Monitoring program for infiltration/ recharge and water balance may be require to assess how well infiltration based LID stormwater management techniques are performing with respect to matching pre-development water balances/ recharge targets. The requirement for this monitoring should be confirmed after additional study requirements have been satisfied. Appropriate locations should be selected based on ultimately development pattern and may be integrated within broader based groundwater monitoring programs.

### **7.3 Water Quality**

The storm water management strategy for the AEGD lands specifies that the majority of storm water from the proposed development lands will be treated using Low Impact

Development Source and Conveyance controls. These techniques represent a state-of-the-art approach to stormwater management and as such the monitoring program should provide data to permit the management to continuously evolve to reflect new information learned through the process of implementation and as a result of operation and maintenance feedback process.

This iterative process ensures that even if the initial implementation goals are not achieved, the program can adjust and continue to move forward. In addition, if some actions, projects, or approaches do not achieve their stated aims or are not cost-effective, adjustments can be made as the program evolves. This process is necessary to achieve improvements in water quality and aquatic habitats. Finally, it supports the documentation of program efforts, which can be helpful in both annual reporting and regulatory inspection procedures.

**Previous Results:** water quality sampling completed as part of the subwatershed study indicated the following:

- Elevated chloride and conductivity recorded during winter months, associated with winter melt and spring thaw events. These results are believed to coincide with the use of road de-icing agents (i.e. road salt during winter months).
- Wet event sampling indicated elevated copper and zinc concentrations in relation to PWQOs.

**LID Features:** During the initial stage of implementation, monitoring should include grab sample monitoring of influent and effluent (from underdrain inspection ports, control structures or from discharge points after treatment) for:

- Sediment removal capabilities
- Concentrations of contaminants - heavy metals, nutrients, oil and grease, chlorides as well as pH, conductivity.

Water quality monitoring shall be the responsibility of the proponent/developer and should include a minimum of four sampling events per year in each season (spring, summer, winter and fall). As development proceeds and standardized design approaches

and performance of the features are confirmed, monitoring requirement should be reviewed and requirements re-assessed.

**In-Stream:** Effectiveness monitoring to assess the level of water quality improvements associated with the LID source and conveyance controls for the receiving watercourses.

This may include:

- In stream concentrations for heavy metals, nutrients, oil and grease, chlorides as well as pH, dissolved oxygen and conductivity. Additional monitoring may include benthic macroinvertebrate sampling (see Section 8.5)
- Sampling should take include both dry and wet events and winter melt events if feasible.

In-stream sampling should take place as part of ongoing watershed monitoring programs.

## ***7.4 Erosion & Fluvial Geomorphology***

The erosion and fluvial geomorphology monitoring component is closely linked to the surface water monitoring and may be undertaken in parallel.

- **Dry- ponds:** Compliance and effectiveness monitoring of the dry-pond capacity (total storage volume) and outlet design flows after construction through submission and approval of as-built drawings for City approval prior to assumption. In addition, monitoring of dry-pond water level and time to draw-down after significant storms events can be incorporated into pre-assumption monitoring requirements. These requirements would be the responsibility of the constructor/developer. Monitoring should take place pre and post development. Specific requirements shall be determined after the completion of the required additional studies.
- **Receiving Streams:** Effectiveness monitoring may include in-stream flow monitoring to confirm to no adverse effects with respect to increased flows beyond those as submitted within the approved Stormwater Management Plan/ Detailed Design. Monitoring should



take place at locations, both upstream, downstream of outlets and / or confluences and with an appropriate reference location. The monitoring may include

- Channel Stability assessment
- Erosion indicators
- Rapid Geomorphic assessment
- Detailed Geomorphic assessments

Monitoring requirements should be based on sensitivity of receiving stream as determined through the development approval process and the required additional studies.

### ***7.5 Aquatic Habitat & Communities***

The aquatic habitat and communities monitoring component is closely linked to the water quality monitoring program and may be undertaken in parallel.

Aquatic invertebrate collection should be conducted upstream and downstream of discharge points of LID features (as well as at an appropriate reference station) and should take place pre-development and post development, to assess existing conditions and assess potential impacts respectively. Benthic macroinvertebrate sampling has been conducted by the NPCA as part of past program and was assessed as part of this subwatershed study. The requirement for pre-development testing should be confirmed through the development approval process and the required additional studies (see Section 3.2). Sampling efforts should be directed to effectiveness monitoring of habitat parameters and habitat suitability measures.

## 8.0 REFERENCES

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## **APPENDIX A – AEGD OP DESIGNATIONS AND PERMITTED USES**

<b>OP Designation</b>	<b>Permitted Uses</b>
Airport Related Business	<p><b>Zoning By-Law - M8</b></p> <ul style="list-style-type: none"> <li>Catering Service</li> <li>Commercial Motor Vehicle Sales, Rental and Service Establishment</li> <li>Commercial Parking Facility</li> <li>Conference or Convention Centre</li> <li>Equipment and Machinery Sales, Rental and Service Establishment</li> <li>Financial Establishment</li> <li>Hotel</li> <li>Labour Association Hall</li> <li>Motor Vehicle Rental Establishment</li> <li>Motor Vehicle Service Station</li> <li>Motor Vehicle Sales and Service Establishment</li> <li>Motor Vehicle Washing Establishment</li> <li>Personal Services</li> <li>Restaurant</li> <li>Retail</li> <li>Transportation Depot</li> <li>Trade School</li> </ul>
Airport Prestige Business	<p><b>Zoning By-law - M11</b></p> <ul style="list-style-type: none"> <li>Building and Lumber Supply Establishment</li> <li>Building or Contracting Supply Establishment</li> <li>Commercial Motor Vehicle Sales, Rental and Service Establishment</li> <li>Commercial School</li> <li>Communications Establishment</li> <li>Conference or Convention Centre</li> <li>Courier Establishment</li> <li>Educational Establishment</li> <li>Equipment and Machinery Sales, Rental and Service Establishment</li> <li>Hotel</li> <li>Industrial Administrative Office</li> <li>Laboratory</li> <li>Labour Association Hall</li> <li>Manufacturing</li> <li>Motor Vehicle Collision Repair Establishment</li> </ul>

	<p>Motor Vehicle Service Station          Office          Private Power Generation Facility          Repair Service          Research and Development Establishment          Surveying, Engineering, Planning or          Design Business          Trade School          Tradesperson’s Shop          Transport Terminal          Transportation Depot          Warehouse</p>
<p>Airside Industrial</p>	<p><b>Zoning By-law - M-7</b>          Airport Storage, Maintenance and          Operation Facilities          Airport Waste Processing          Facility          Airport Waste Transfer Facility          Catering Service          Communications Establishment          Courier Establishment          Bulk Fuel and Oil Storage Establishment          Industrial Administrative Offices          Manufacturing          Office          Private Power Generation Facility          Research and Development Establishment          Transport Terminal          Transportation Depot          Warehouse</p>
<p>Airport Light Industrial</p>	<p><b>Zoning By-law M-10</b>          Animal Shelter          Airport Waste Processing Facility          Airport Waste Transfer Facility          Building and Lumber Supply Establishment          Building or Contracting Supply Establishment          Commercial Motor Vehicle Sales, Rental and          Service Establishment          Commercial School          Communications Establishment          Courier Establishment          Dry Cleaning Plant          Educational Establishment</p>

	<p>Equipment and Machinery Sales, Rental and Service Establishment                  Industrial Administrative Office                  Laboratory                  Labour Association Hall                  Manufacturing                  Motor Vehicle Collision Repair Establishment Office                  Private Power Generation Facility                  Repair Service                  Research and Development Establishment                  Surveying, Engineering, Planning or Design Business                  Trade School                  Tradesperson’s Shop                  Transport Terminal                  Warehouse</p>
<p>Airport Reserve</p>	<p><b>Zoning By-law – M-9</b>                  Airport Storage, Maintenance and Operation Facilities                  Uses Existing at the Effective Date of this By-law</p>
<p>Special Policy Area H</p>	<p><b>OP AEGD Secondary Plan</b>  <i>Airport Prestige Business Uses (see above)</i>  <i>Employment Supportive Centre</i>  <i>Additional Uses (ESC)</i>                  Banquet facility                  Conference / Convention Centre                  Commercial Entertainment                  Retail Stores                  Medical Office and Medical Clinic</p>
<p>Special Policy Area I</p>	<p><b>OP AEGD Secondary Plan</b>  <i>Airport Prestige Business (see above)</i>  <i>APB NOT permitted</i>                  Warehousing                  Transportation Terminals                  Private Power Generation                  Utility Activities  <i>Employment Supportive Centre</i>  <i>Additional Uses (ESC)</i>                  Retail stores                  Commercial school</p>

	Day nursery Medical Office and Medical Clinic
Special Policy Area A	<b>OP AEGD Secondary Plan</b> <i>Airport Prestige Business (see above)</i> <i>Additional Uses</i> Golf driving range and accessory uses



## **APPENDIX B – HOW TO READ VOLUME II OF THE SPP (GRCA)**

# HOW TO READ VOLUME II OF THE SOURCE PROTECTION PLAN

## Introduction

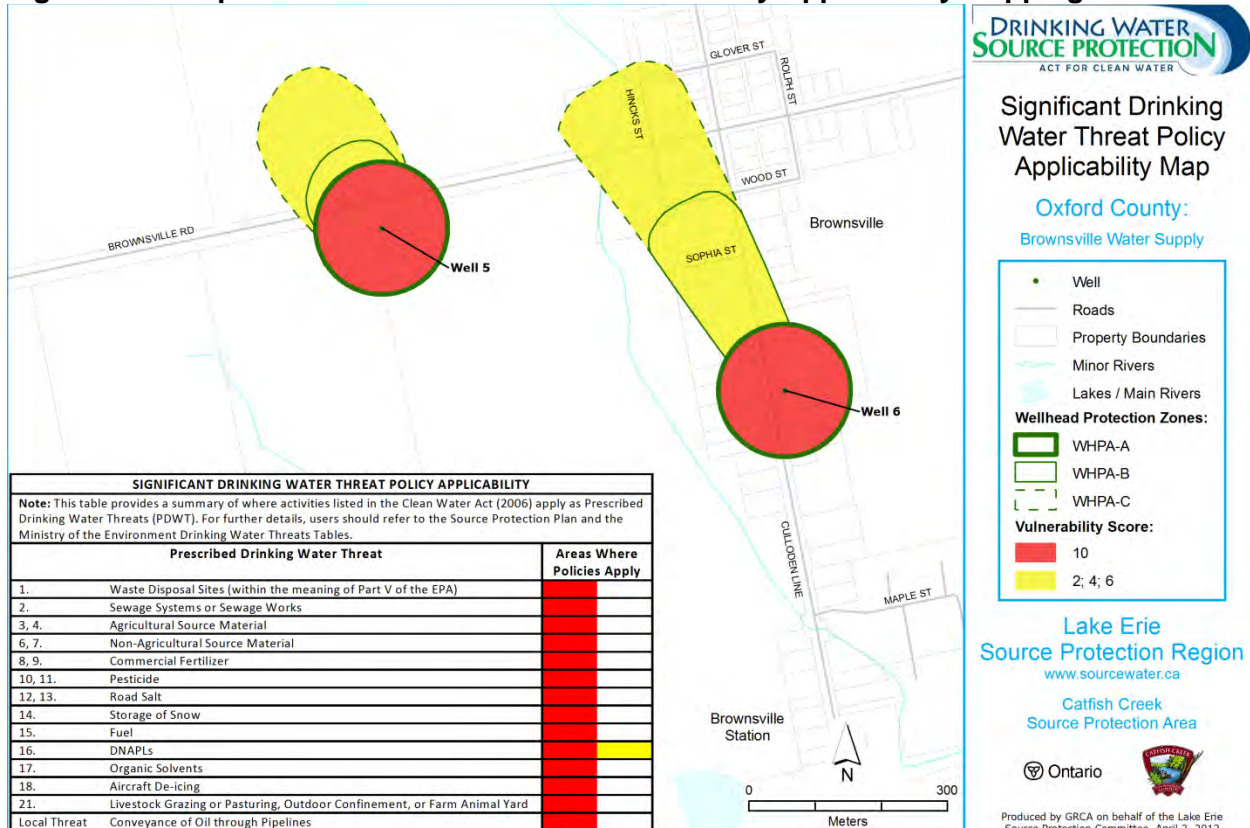
The Source Protection Plan contains the Source Protection Plan policies that have been developed to meet the objectives of the [Clean Water Act](#). The following is a guide to how to read Volume II to determine if a property is or would be subject to the presented Source Protection Plan policies. The beginning sections of Volume II present information required to understand the policies contained in each municipal section. Each municipal section will outline the intakes to which the policies will apply and any specific definitions needed to interpret the Source Protection Plan policies.

## Step One (1)

The first step to determine if the property is subject to a Source Protection Plan policy is to determine if the property is located within an area where a policy applies as shown on the Policy Applicability Map (**Figure 1**). The Policy Applicability Mapping presents a summary of the prescribed drinking water threats and the location where policies will apply based on the [Tables of Drinking Water Threats](#), published under the *Clean Water Act*. Once located, the user should have the following information:

- Prescribed Drinking Water Threats that would potentially apply to the property.
- The vulnerability score (how vulnerable the area is to contaminants).
- The wellhead protection area and/or intake protection zone where the property is location.

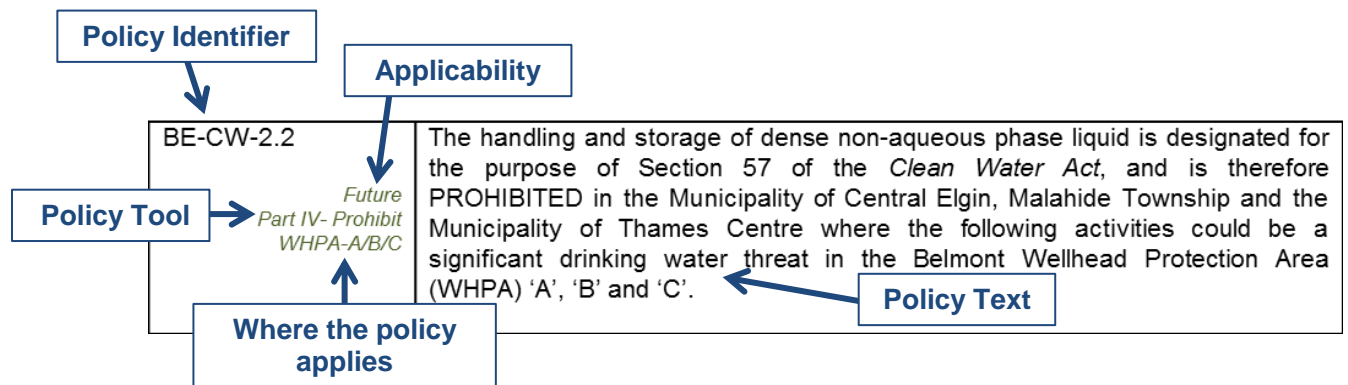
**Figure 1: Example of the Source Protection Plan Policy Applicability Mapping**



## Step Two (2)

With these three pieces of information, the reader should then consult the applicable policies listed under the prescribed drinking water threats section of the Source Protection Plan Volume II. A review of the policies aided by the sidebar notes should indicate which policy would apply to that property based on the activities being conducted. An example of a Source Protection Plan Policy is provided in **Figure 2**. Further information can be found in Volume II of the Source Protection Plan.

**Figure 2: Example of a Source Protection Plan Policy**



### Step Three (3)

The reader should next consult the Drinking Water Quality Threats Assessment section within the relevant Municipal section of the Assessment Report to locate the Identification of Drinking Water Threats in the (specific wellhead protection table or intake protection zone) Table. An example is provided in **Figure 3**. This Provincial Table Reference Code provided in this table (e.g. 12(PW10S)) leads the reader to one of 76 [Provincial Tables of Circumstances](#). The Provincial Table of Circumstances lists the applicable Circumstance ID numbers with which the reader can more easily find the relevant circumstances in the Table of Drinking Water Threats and, therefore, the exact detailed information about the circumstances that would make the activity a drinking water threat.

**Figure 3: Example of the Identification of Drinking Water Threats Tables**

<b>Table 7-21: Identification of Drinking Water Quality Threats in the Drayton and Moorefield Wellhead Protection Areas</b>					
Threat Type	Vulnerable Area	Vulnerability Score	Threat Classification and Provincial Table Reference Code		
			Significant	Moderate	Low
Chemical	WHPA-A	10	01(CW10S) Oil pipeline	03(CW10M)	06(CW10L)
	WHPA-B	6	-	05(CW6M)	08(CW6L)
	WHPA-C	2	-	-	-
	WHPA-D	2	-	-	-
Dense Non-Aqueous Phase Liquids (DNAPLs)	WHPA-A	10	09(DWAS)	-	-
	WHPA-B	6	09(DWAS)	-	-
	WHPA-C	2	09(DWAS)	-	-
	WHPA-D	2	-	-	-
Pathogens	WHPA-A	10	12(PW10S)	13(PW10S)	-
	WHPA-B	6	-	-	16(PW6L)
	WHPA-C	2	-	-	-
	WHPA-D	2	-	-	-

A summary to where activities are drinking water threats is also presented in the Assessment Report in a tabular format. The table, located within each municipal section, is found under the Drinking Water Quality Threats Assessment Section of the Assessment Report. An Example is provided below in **Figure 4**. The table includes of list of the Circumstance ID numbers for the circumstances under which activities are or will be significant drinking water threats. These Circumstance ID numbers will further assist the reader in locating the applicable circumstances in the Tables of Drinking Water Threats.

**Figure 4: Example of Significant Drinking Water Threats Enumeration Table**

Table 7-23: Significant Drinking Water Threats in the Moorefield Wellhead Protection Areas				
Land Use / Activity	Prescribed Drinking Water Threat	Reference Number <sup>1</sup> (Number of Occurrences)	Vulnerable Area	Reg Ref No <sup>2</sup>
Agricultural	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the <i>Environmental Protection Act</i> .	100(1)	WHPA-A	1
Agricultural	The application of agricultural source material to land.	1944(2)	WHPA-A	3
Agricultural	The application of non-agricultural source material to land.	1971(2)	WHPA-A	6
Agricultural	The handling and storage of commercial fertilizer.	1287(1)	WHPA-A	9
Agricultural	The application of pesticide to land.	77(1), 78(1), 79(1), 80(1), 82(1), 83(1), 84(1), 85(1), 86(1)	WHPA-A	10
Agricultural	The handling and storage of pesticide.	1190(1), 1191(1), 1192(1), 1193(1), 1195(1), 1196(1), 1197(1), 1198(1), 1199(1)	WHPA-A	11
Municipal	The handling and storage of fuel.	1359(2), 1360(2)	WHPA-A	15
<b>Total Number of Activities</b>		<b>10</b>		
<b>Total Number of Properties</b>		<b>4</b>		
<small>1: Prescribed Drinking Water Threats correspond to the Reference numbers for Circumstances in the MOE Technical Rules, Table of Drinking Water Threats, as amended.                  2: The Regulation Reference Number refers to the prescribed drinking water threat listed in O.Reg298/07 s.1.1.(1).</small>				

### Step Four (4)

With this information the reader should now know if the Source Protection Plan policies will apply to the property in question. Based on the implementing body, the reader will also know who is responsible for implementation of the Source Protection Plan policy. If the implementing body is the reader, it will be important to also consult the Annual reporting requirements found in the first section of each municipal section of the Source Protection Plan.

## **APPENDIX C – LID RESOURCES**

### Low Impact Development (LID) Resources:

- Low Impact Development Stormwater Planning and Design Guide (2010, v1.0)  
<http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/low-impact-development-stormwater-management-planning-and-design-guide/>
- Low Impact Development Stormwater Management Planning and Design Guide, including Fact Sheets:  
[www.sustainabletechnologies.ca/portal/alias\\_Rainbow/lang\\_en/tabID\\_578/DesktopDefault.aspx](http://www.sustainabletechnologies.ca/portal/alias_Rainbow/lang_en/tabID_578/DesktopDefault.aspx)
- Construction Guide for Low Impact Development Version 1.0 – 2012  
<http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/designers-guide-for-low-impact-development-construction-draft/>
- Landscape Design Guide for Low Impact Development – Version 1.0 June 2010  
<http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/andscape-design-guide-for-low-impact-development-version-1-0-june-2010/>
- Assessment of Life Cycle Costs for Low Impact Development Stormwater Management Practices (Final Report 2013)  
<http://www.sustainabletechnologies.ca/wp/wp-content/uploads/2013/06/LID-LCC-final-2013.pdf>
- Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide  
<http://www.sustainabletechnologies.ca/wp/wp-content/uploads/2016/08/LID-IM-Guide-2016-1.pdf>
- Rain Water Harvesting Design and Costing Tool  
[www.sustainabletechnologies.ca/portal/alias\\_Rainbow/lang\\_en/tabID\\_595/Default.aspx](http://www.sustainabletechnologies.ca/portal/alias_Rainbow/lang_en/tabID_595/Default.aspx)
- LID Retrofit Guides - <http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/>
  - Low Impact Development Road Retrofits
  - Low Impact Development Business and Multi-Residential Retrofits
  - Low Impact Development Public Lands Retrofits
  - Low Impact Development Residential Retrofits

### LID Studies and Research

Sustainable Technologies Evaluation Program (STEP): [www.sustainabletechnologies.ca/](http://www.sustainabletechnologies.ca/)

## **APPENDIX D – HIGH RISK SITE USES**



The selection of appropriate LID techniques must consider the sources of runoff, the typical characteristics of the runoff and therefore the opportunities for its treatment and use (**Table D1**), as well as the acknowledgment of potential high risk land-uses (**Table D2**).

**Table D1 Summary of Sources of Runoff, Typical Characteristics and Opportunities for Treatment and Use** (Source: TRCA, 2008-draft)

Source	Characteristics	Opportunities	Principles
Foundation drains, slab underdrains, road and parking lot sub-drains	Relatively clean, cool water	Suitable for direct infiltration or discharge to receiving watercourse	Should not be directed to stormwater management facility that is tributary to road/parking lot runoff.
Roof drains, roof terrace area drains, overflow from green roof areas	Moderately clean water, contaminants may include asphalt granules, leaves and organic fallout from airborne pollutants, potentially warm water	Infiltration with minor pretreatment through vegetated filter (lawn, grassed swale, storm garden). Recycling through collection in central cistern and reuse as irrigation supply or grey water supply for internal building systems (toilet flushing etc)	Where possible, should not be directed to end-of-pipe facilities in order to capitalize on potential for reuse and infiltration however, flow moderation (quantity control) prior to discharge into the receiving watercourse is required.
Road, sidewalk and parking lot surfaces	Potential for high contamination with hydrocarbons, metals, grit/sediment and chlorides Typically warm	Infiltration after pre-treatment. Filtration after pre-treatment Attenuation and treatment in wet pond, wetland or hybrid facility. Recycling for irrigation purposes after treatment in pond, wetland or hybrid facility	Runoff should be treated in a SWM pond/oil grit separator prior to infiltration or re-use for irrigation purposes. Water quality should be tested prior to use for irrigation purposes
Gas station, auto-repair facilities, outdoor storage, industrial sites  <b>(High Risk Land-uses: Table 3.9)</b>	Potential for high levels of contamination - hydrocarbons, metals, organic and inorganic compounds, sediments and chlorides	Attenuation and treatment in wet pond, wetland or hybrid facility Potential requirement for pretreatment (oil/grit separator) Infiltration and recycling alternatives are not recommended	Runoff from these sources should not be infiltrated or used for irrigation. Spill containment/mitigation devices recommended contingent on size of storage facilities.

### **High Risk Land Use**

As identified in **Table D2**, high risk land uses are those with the potential for high levels of contamination such as hydrocarbons, metals, organic and inorganic compounds, sediments and chlorides. Individual employment land-uses within the AEGD that are listed in **Table D2** will generally be discouraged from incorporating LID techniques that utilize infiltration as its primary function because of the associated risk to groundwater contamination (see **Part A- Subwatershed plan: Section 2.5.6 and 6.3**). However high risk land uses do not preclude the use of those LID techniques that utilize filtration, evapotranspiration (ET) or re-use as the primary processes. This can include bioretention, grassed swales, bio-swales etc which are lined and have an underdrain structure and are therefore impermeable (filtration only); green roofs (ET) or rainwater harvesting (ET and re-use). Additionally, the infiltration of rainwater not directly impacted by the respective high risk land use activity such as rainwater emanating from rooftops or directly falling on permeable surfaces is generally considered relatively ‘clean’ and should not be excluded from infiltration without careful consideration at the individual site plan scale.

**Table D2: High Risk Land Uses**

<ul style="list-style-type: none"> <li>• Landfills, waste transfer stations, &amp; putrescible waste disposal</li> <li>• Storage of hazardous wastes or liquid industrial wastes</li> <li>• Lagoons for sewage treatment</li> <li>• Auto wrecking &amp; salvage yards</li> <li>• Commercial or industrial dry cleaning of textiles</li> <li>• Storage of fertilizers</li> <li>• Foundries, nonferrous metal smelting &amp; refining, &amp; casting operations</li> <li>• Metal finishing operations</li> <li>• (electroplating, electrocoating, galvanizing, painting, application of baked enamel)</li> </ul>	<ul style="list-style-type: none"> <li>• Vehicle stampings</li> <li>• Wood &amp; wood product preservation &amp; treatment</li> <li>• Airports</li> <li>• Bulk liquid trucking</li> <li>• Warehousing, bulk storage or retail sale of:                             <ul style="list-style-type: none"> <li>- Petroleum fuels, oils, chlorinated solvents, - Household or industrial cleaning products</li> <li>- Agricultural pesticides, herbicides, fungicides &amp; fertilizers</li> </ul> </li> <li>• Manufacturing of:                             <ul style="list-style-type: none"> <li>• Petroleum products or asphalt batching (including processing)</li> <li>• Motor vehicles, trucks, &amp; bus bodies</li> <li>• Aircraft &amp; aircraft parts</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Manufacturing (cont’d)                             <ul style="list-style-type: none"> <li>- Rail cars</li> <li>- Mobile homes</li> <li>- Ships &amp; boats</li> <li>- Industrial chemicals</li> <li>- Printing inks</li> <li>- Adhesives</li> <li>- Small electrical appliances</li> <li>- Electric lamps</li> <li>- Wet batteries</li> <li>- Dry electrical industrial equipment</li> <li>- Vehicle engines</li> <li>- Cable &amp; wire</li> <li>- Pharmaceuticals &amp; medicines</li> <li>- Paints &amp; varnishes</li> <li>- Major electric appliances</li> <li>- Plastics &amp; synthetic resins</li> <li>- Lighting fixtures</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Wet electrical equipment</li> <li>- Steering &amp; suspension parts</li> <li>- Motor vehicle wiring</li> <li>- Jewellery &amp; precious metals</li> <li>- Reinforced fiberglass</li> <li>- Electronic components (semiconductors, printed circuit boards, cathode ray tubes)</li> <li>- Unfinished fabricated metal products</li> <li>- Wheels &amp; brakes</li> <li>- Leather products</li> <li>- Soaps &amp; toilet preparations</li> </ul>
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