PALERMO VILLAGE
ENVIRONMENTAL IMPLEMENTATION REPORT AND FUNCTIONAL SERVICING STUDY

NORTH OAKVILLE WEST

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1 INTRODUCTION

1.1 PLANNING CONTEXT

The Subject Lands are located north of Dundas Street, south of Highway 407, east of the Fourteen Mile Creek West valley and east and west of Bronte Road. These lands, illustrated on **Figure 1.1**, encompass a combined gross area of approximately 71.2 ha. As shown on **Figure 1.1**, a portion of the Subject Lands (47.89 ha) are owned by Palermo Village Corporation; some of the adjacent Zenon Environmental Holdings Inc. (Zenon) lands are also included in the Subject Lands.

The Subject Lands are located within the North Oakville West Secondary Plan area; however, Palermo Village Corporation remains a site-specific appellant to LOPA 289 (North Oakville West Secondary Plan), LOPA 306 (Palermo Village North Urban Core Area) and ROPA 38 (Sustainable Halton). Therefore, the policies of the above listed amendments do not apply to the Subject Lands. As shown on **Figure 1.2**, the majority of the Subject Lands remain undesignated in the North Oakville West Secondary Plan (NOWSP), with a portion of the western boundary designated Natural Heritage System (NHS) (i.e., those lands not subject to the site-specific appeals).

In 2018, the Town of Oakville initiated their Palermo Growth Area Review to recommend updated policies to guide the development of the Growth Area, including the lands on the north side of Dundas Street. Palermo Village is identified as a Strategic Growth Area where mixed use development and intensification is to be accommodated. On April 12, 2021, Town Council adopted LOPA 34 which extended the Palermo Village Growth Area boundary and as shown on **Figure 1.3**, designated the lands 'Urban Centre', 'High Density Residential', 'Natural Area', and 'Parks and Open Space'. As shown on **Figure 1.3**, LOPA 34 also brings the NOWSP into the northwest area of the Livable Oakville Plan, save for the lands between the proposed northerly limit of the expanded Palermo Village Growth Area and Highway 407. On July 5, 2021, Town Council adopted LOPA 37 (relating to cultural heritage and area-specific parking) and LOPA 38 (relating to lands between the proposed northerly limit of the expanded Palermo Village Growth Area and Highway 407). LOPA 38 designates the northern half of the property as 'Business Employment' and separates it from the Palermo Village Growth Area to the south with an NHS linkage (**Figure 1.4**). OPA 34, 37, and 38 were approved with modifications by the Region of Halton on March 13, 2023 all of which have been appealed by Palermo Village Corporation.

On June 15, 2022, the Region of Halton adopted Regional Official Plan Amendment No. 49 (ROPA 49) to implement the Region's Integrated Growth Management Strategy,

which considers how to accommodate growth in Halton to the 2051 planning horizon. ROPA 49 was approved with modifications by the Ministry of Municipal Affairs and Housing on November 4, 2022. As shown on **Figure 1.5**, ROPA 49 removed the Regional Employment Area overlay from the northern half of the Palermo Village Corporation property and expanded the Palermo Village Strategic Growth Area up to Highway 407. Palermo Village Corporation is working with the Town of Oakville to amend OPA 34, 37 and 38 to fully implement ROPA 49 and the vision for the Palermo Village Corporation lands.

1.2 STUDY PURPOSE

Notwithstanding the above-summarized status of the relevant designations applicable to the Subject Lands, this Environmental Implementation Report (EIR) and Functional Servicing Study (FSS) is being prepared in accordance with the requirements of the Town of Oakville's (the Town) Official Plan Amendment 289 (OPA 289), and the recent Town adopted OPA 34 and OPA 38 for a portion of the lands located in the North Oakville West Secondary Plan Area illustrated on **Figure 1.4**.

As outlined in **Section 1.1**, although the land use designations have been appealed by Palermo Village Corporation, this EIR/FSS has been prepared to address the following recently Town adopted OPA 34 policy requirements in support of a development concept for the Subject Lands:

- Policy 26.7.4(f) of OPA 34 requires that an Environmental Implementation Report (EIR) be prepared for each subcatchment area, to the satisfaction of the Town.

- Policy 26.7.9(a) requires that planning applications and supporting technical studies have regard for implementation guidelines and terms of reference including the North Oakville Creeks Subwatershed Study (NOCSS) and the Environmental Implementation Report/Functional Servicing Study (EIR/FSS) terms of reference.

The work completed as part of this EIR/FSS and documented in this report, was guided by requirements set out in the EIR/FSS TOR (May 2013) approved by the Town and Conservation Halton (CH) and is intended to satisfy the above policy requirements of OPA 34. A copy of the approved TOR is provided in **Appendix A**.

The purpose of the EIR is to characterize and analyze the natural heritage features and functions within the study area and to determine and address the potential impacts of a proposed development application, including servicing requirements, on the NHS.

The purpose of the FSS is to identify servicing requirements related to roads, water supply, sanitary sewers, storm drainage, stormwater, and site grading. Further, the purpose of both the EIR and FSS is to provide a link between the Town's NOCSS

Management Report and Implementation Report, the NOWSP, OPA 34, OPA 38, and the required planning approvals.

The EIR/FSS is intended to assist in the formulation of draft plans of subdivision, address the requirements of the NOCSS, the NOWSP, OPA 34 and OPA 38, and ensure that the site characteristics are understood in sufficient detail to provide the information necessary to process draft plans and identify conditions of approval.

As set out in the TOR, the EIR/FSS for the Subject Lands has been prepared as a joint report to fully integrate environmental and engineering recommendations to protect the function of the NHS and service the Subject Lands.

This EIR/FSS supports the Draft Plan of Subdivision (August 2023) submitted for the Subject Lands, and addresses EIR/FSS requirements for other lands in the FSS Study Area that do not currently have Draft Plans of Subdivision applications. Supplementary information, in subsequent submissions of this EIR/FSS, may be required to support draft plan approval of lands within the Study Areas. Based on the extent of environmental and servicing work completed as part of this EIR/FSS specific to the Subject Lands, this further study may only be confirmation that information contained in this EIR/FSS remains current and is consistent with the development concept for the Subject Lands. Where a future draft plan may deviate from the development concept shown in this EIR/FSS, an update to the servicing plans may be required. For other lands within the EIR Subcatchment Area (i.e., non-participating lands east of Bronte Road) where the same degree of EIR/FSS analyses has not been included in this EIR/FSS, depending upon location in the EIR Subcatchment Area, additional study may include environmental analyses addressing field verification of NHS boundaries, trail location and design, confirmation of servicing, grading, SWM pond design, Species at Risk analyses and consistency with this EIR/FSS. Prior to the preparation of further studies, the specific scope of study should be addressed with the Town and CH.

1.3 EIR SUBCATCHMENT AREA AND FSS STUDY AREA

1.3.1 EIR Subcatchment Areas

The Subject Lands lie within several subcatchments within the Fourteen Mile Creek watershed including FM1109, FM1110, FM1110.1 and FM1111 as defined by NOCSS EIR Subcatchments **Figure 7.4.2**. The limits of these Fourteen Mile Creek subcatchments, within and adjacent to the Subject Lands, are illustrated on **Figure 1.6**. **Table 1.1** lists the subcatchments draining the Subject Lands and notes the areas/percentages of the Subject Lands lying within the subcatchment defined in NOCSS.

Table 1.1 - Existing Subcatchment Areas in the Subject Lands

Area	Subcatchment Areas*				
	FM1109	FM1110	FM1110.1	FM1111	Total
Subject Lands (ha) (total landholding)	42.7	14.1	11.6	2.8	71.2
Percentage (%) of Subject Lands in each subcatchment	60.0	19.8	16.3	3.9	100
Total Area of NOCSS Subcatchment	340	16.9	26.2	247.9	631.0
Percentage of Subject Lands in NOCSS Subcatchment Area	12.6	83.4	44.1	1.1	11.3

*as defined in NOCSS

The EIR/FSS TOR differentiates between the Study Area for the FSS and the Subcatchment Study Area for the EIR. The EIR is to be completed on a subcatchment basis. The NOCSS provides direction to the preparation of EIRs, including the delineation of EIR Subcatchment Areas. The attached **Figure 7.4.2** from the NOCSS Addendum illustrates all NOCSS EIR Subcatchment Areas.

With reference to NOCSS **Figure 7.4.2** and direction from the TOR, the appropriate 'EIR Subcatchment Area' for this EIR/FSS is defined to include the Fourteen Mile Creek subcatchments FM1110, FM1110.1 and parts of FM1109 and FM1111. They are illustrated on **Figure 1.7**. For the purposes of this EIR/FSS, FM1109 has been divided into two parts, FM1109A and FM1109B. Only the eastern portion of subcatchment FM1109 (i.e., FM1109A) is included in this EIR Subcatchment Area. The western limit of FM1109A follows the estimated west top of bank along the Fourteen Mile Creek West valley.

This EIR Subcatchment Area includes all of the FM1109A, FM1110 and FM1110.1 subcatchments, and only a very small portion of the FM1111. Large portions of FM1111 east of Bronte Road, not part of the EIR Subcatchment Area, are NHS containing Core 2 and Glenorchy Conservation Area, and have not been studied except in the context of the Enhanced Linkage Preserve Area described in various sections of this report.

As noted in **Table 1.1**, the majority of the Subject Lands lie within FM1109A; small portions lie within Subcatchments FM1110 and FM1110.1; very little of the Subject lands lie within the FM111 subcatchment.

While the Subject Lands lie within the above four subcatchments, they cover only 11.3 percent of the area of these subcatchments.

The proposed EIR Subcatchment Area was discussed with the Town and CH at the North Oakville Agency Review Meeting held on April 19, 2021.

1.3.2 Functional Servicing Study Area

The FSS is to address specific servicing requirements in support of draft plans of subdivision and therefore FSS Study Area boundaries generally follow the extent of

ownership of the landowner(s) preparing the FSS. **Figure 1.7** illustrates the extent of the FSS Study Area. **Table 1.2** notes the extent of the FSS within each subcatchment.

Table 1.2 – Existing Subcatchment Areas in the FSS Study Area

Area	Existing Subcatchment Area				
	FM1109A	FM1110	FM1110.1	FM1111	Total
FSS Study Area (ha)	45.4	17.4	15.3	5.0	83.1
Percentage (%) of FSS Study Area in each subcatchment	54.6	20.9	18.5	6.0	100

The FSS Study Area was discussed with the Town and CH at the North Oakville Agency Review Meeting held on April 19, 2021.

1.4 EIR/FSS STUDY OBJECTIVES

The objectives to be fulfilled by the EIR/FSS are set out in the approved TOR. They are:

- to demonstrate how the subwatershed requirements set out in the NOCSS Management Report (including targets), the Implementation Report, and the Secondary Plan are being fulfilled in all proposed Draft Plans;
- to provide sufficient level of conceptual design to ensure that the various components of the NHS and infrastructure can be implemented, as envisaged in the NOCSS and Secondary Plan and to ensure that the Draft Plans are consistent with this conceptual design;
- to ensure servicing requirements, as determined in the FSS for the areas external to the Draft Plan, are adequate;
- to identify details regarding any potential development constraints or conflicts and how they are to be resolved;
- to provide any further implementation details as needed;
- to streamline the Draft Plan approval process; and,
- to facilitate the preparation of Draft Plan conditions.

1.5 EIR/FSS STUDY TEAM

A multi-disciplinary study team has analyzed the environment and servicing of the Study Areas. Their responsibilities include:

- Stonybrook Consulting Inc. and Jennifer Lawrence and Associates Inc. – Lead consultants addressing limits of development, study integration and team management;
- David Schaeffer Engineering Ltd. – Lead FSS consultant addressing municipal servicing, SWM and site grading;

- Beacon Environmental - addressing aquatic and terrestrial ecology;
- GEO Morphix Limited – addressing fluvial geomorphology and erosion thresholds;
- R. J. Burnside & Associates Limited – addressing hydrogeology;
- DS Consultants – addressing geology and slope stability;
- J. F. Sabourin and Associates Inc – addressing hydrology and hydraulics;
- Korsiak Urban Planning – addressing municipal planning matters; and,
- NAK Design – addressing landscape design, parks, and trail planning.

1.6 PREVIOUS STUDIES, REPORTS AND PLANNING DOCUMENTS

The following approved studies/guidelines/documents were reviewed in preparation of this EIR/FSS. A complete listing of references is provided at the end of this report:

- Town of Oakville North Oakville Creeks Subwatershed Study, August 2006;
- Town of Oakville North Oakville Creeks Subwatershed Study Addendum, September 2007;
- Ontario Municipal Board Mediation Agreements, 2007;
- Town of Oakville Official Plan Amendment 289, August 2007;
- Town of Oakville Official Plan Amendment 34, April 2021;
- Town of Oakville Official Plan Amendment 38, July 2021;
- Region of Halton Official Plan Amendment 25;
- NOCSS Mediation Agreements, 2007
- North Oakville Environmental Implementation Report and Functional Servicing Study Terms of Reference, May 2013;
- Halton Water and Wastewater Master Plan Review, KMK Consultants Limited, October 2002 (Master Plan);
- South Halton Water and Wastewater Master Plan Update;
- Region of Halton, 2007 (Master Plan Update);
- Conservation Halton's Policies and Guidelines for the Administration of Ontario Regulation 162/06, November 26, 2020;
- Stormwater Management Planning and Design Manual, Ministry of Environment, March 2003 (SWMP Design Manual);
- Fourteen Mile Creek West and the Lazy Pat Farms Property EIR/FSS, 3269 Dundas Street West, North Oakville West, WSP, dated September 2020
- Development Engineering Procedures & Guidelines Manual, Town of Oakville, May 2007;

- Design Criteria, Contract Specifications and Standard Drawings, Region of Halton, February 2001 (updated 2007); and,
- Erosion and Sediment Control Guidelines for Urban Construction, TRCA, 2019.

1.7 EIR/FSS CONSULTATION

On April 19, 2021, the EIR/FSS Study Team met with representatives from the Town of Oakville, Region of Halton and CH at the North Oakville Agency Review Meeting. The EIR/FSS Study Team provided an overview of the Palermo Village Corporation lands, the planning history and Palermo Village Corporation's vision for the land use in this area. The extents of the proposed EIR/FSS Study Areas were discussed as well as the scope of the study contents. Draft meeting minutes are included in **Appendix B**. Town and CH staff did not provide comments on the draft meeting minutes given the on-going land use planning appeal associated with these lands.

2 NATURAL HERITAGE SYSTEM FRAMEWORK

2.1 NATURAL HERITAGE SYSTEM COMPONENTS

OPAs 289, 34 and 38, the Town's NOCSS and the NOCSS Addendum provide policies and/or directions with respect to the protection and management of the North Oakville West Natural Heritage/Open Space System. The NOCSS is divided into four sections, which follow the four phases of a subwatershed management approach. They include Characterization, Analysis, Management Strategy and Implementation.

The Management Strategy outlines requirements with respect to lands restricted from development, lands with development limitations or constraints, SWM, input to land use policies and servicing requirements. The Implementation Plan outlines the implementation requirements for the recommended management strategy, studies required in subsequent stages of the development process, environmental reporting requirements, and the authorities responsible for review and approvals.

With respect to the Subject Lands and the EIR Subcatchment Area, OPAs 289, 34 and 38, the NOCSS and the NOCSS Addendum identify various environmental features to be protected and/or studied further during the EIR/FSS. **Figure 2.1**, prepared from Figure NOW3 of OPA 289, illustrates these features:

- *Core Preserve Area* – Core Preserve Areas include key natural features or groupings of key natural features, together with required buffers and adjacent lands intended to protect the function of those features and ensure the long-term sustainability of the Natural Heritage component of the System within the urban context.

  Core 1, the Fourteen Mile Creek (Main) Core, is located in the western portions of the Subject Lands and forms the western boundary of the development proposed within the Subject Lands. Extending northerly from Dundas Street upstream to Hwy 407, this Core contains the Fourteen Mile Creek and adjacent areas composed of wooded areas, wetlands, active agricultural lands, cultural meadows, thickets and fish habitat.

  Section 3.0 of this EIR/FSS addresses the Core 1 east boundary delineation.

- *Linkage and Optional Linkage Preserve Areas* – Linkage and Optional Linkage Preserve Areas include areas which are designed to link the Core Preserve Areas together to maintain and enhance their environmental sustainability. They follow natural features whenever possible and are intended to be of sufficient size and character, including buffers, to ensure the functionality and sustainability of the NHS.

NOCSS and OPAs 289, 34 and 38 include one Linkage Preserve Area (LPA) crossing the Subject Lands intended to connect Core 1 on the west side of Bronte Road to Core 2 on the east side of Bronte Road. **Section 6.2** provides further discussion of this LPA and proposes a preferred alternate LPA location.

- *High Constraint Steam Corridor (Red Stream)* – High Constraint Stream Corridor areas include certain watercourses and adjacent riparian lands, as well as buffers measured from the stable top-of-bank or meander belts. These areas are located primarily inside Core Preserve Areas, and LPAs, but also are found outside such areas, as per OPAs 289 and 34. They are to be protected in their existing locations for hydrological and ecological reasons.

  There are five Red Streams (Reaches 14W-1, 14W-1A, 14W-2, 14W-3 and 14W-4) in the EIR Subcatchment Area located along the Main Fourteen Mile Creek. To the east of the EIR Subcatchment Area, east of Bronte Road, there is a Red Stream (Reach 14E-7) that provides an outlet to drainage from a small portion of the Subject Lands. These stream reaches are discussed **in Sections 3.4 and 5.5**.

- *Medium Constraint Stream Corridor (Blue Stream)* – Medium Constraint Stream Corridor areas include certain watercourses and adjacent riparian lands, including buffers measured from the stable top-of-bank or meander belts. These areas are located primarily inside Core Preserve Areas and LPAs, but also are found outside such areas. As set out in OPA 289 and OPA 34 policies, these watercourses may be deepened and/or re-located, but must be left open for hydrological and ecological reasons.

  There is one Blue Stream (Reach 14E-8) in the EIR Subcatchment Area. Its management is further discussed in **Section 5.5**.

- *Other Hydrological Features* - In addition to the High and Medium Constraint Stream Corridor Areas, there are a number of other hydrological features that also form part of the Natural Heritage and Open Space System to the extent that they are maintained after development occurs. These Features include Low Constraint Streams, Hydrologic Features A and Hydrologic Features B as described in the following points.

  - *Low Constraint Stream Corridor (Green Stream)* – These streams do not need to be maintained, but the function of the watercourse must be sustained in accordance with the directions established in the NOCSS and Federal, Provincial and Conservation Authority regulations.

There are four Green Streams (Reaches 14W-20, 14W-18, 14E-9, 14E-10) in the EIR Subcatchment Area. Management of these stream reaches is discussed in **Section 5.5**.

- *Hydrologic Feature A* – Hydrologic Features "A" are defined in NOCSS to be hydrological features located within Blue or Red Streams. The NOCSS (page 7-5) states that *"Hydrologic Features A have hydrological functions and consequently both their form and function shall be considered through hydrological and hydrogeological assessment as part of an EIR. This review will also consider the ecological benefits of these features. Further, any required buffers associated with these features will be determined through the preparation of the EIR, and will only be related to the hydrologic function of the feature."*

  There is no Hydrologic Feature A in the EIR Subcatchment Area or the FSS Study Area.

- *Hydrologic Feature B* – Hydrologic features not associated with the NHS, are called Hydrologic Feature B. The NOCSS states that *"Hydrologic Features B may be relocated and consolidated with other wetlands, water features or SWM facilities…".* OPAs 289 and 34 further state *"Hydrologic Features "B" may be relocated and consolidated with other wet features, wetlands or stormwater management ponds, provided the hydrologic function of the feature is maintained."*

  As indicated on OPA 289 Figure NOW3 and OPA 38 Schedule B2, there are four Hydrologic Features B in the EIR Subcatchment Area, all within the Subject Lands (**Figure 2.1**). Three of these features are also considered to be topographic depressions, as noted below. These features are addressed in **Sections 4.3.2 and 7.12.2**.

- *Topographic Depressions* – These depressions do not form part of the NHS, however, NOCSS identifies topographic depressions, ponds and pits (DPP) and indicates that they must be addressed as part of the SWM system design. Constructed ponds do not have to be included in the assessment of depression storage. As noted above, four depressions are present (D-86, D-87, D-91 and D-92) on the Subject Lands. The management of these features is set out in *Mediation Item: Depression Storage* (May 30, 2007). **Table 2.1** lists these depressions and the approach to assessing their storage functions.

Table 2.1 – Depressions and Hydrologic Features B

Feature Type *	Feature Identification	Origin	Comment
HYDFB	Depressions D-86 and D-87	Natural	The origin of this pond is unknown. To be conservative, it has been assumed to be of natural origin however, its shape suggests that it could be man-made. As per the OMB Mediation Agreement, storage comparisons (depressions versus SWM pond storage) have been completed; see **Appendix I**. Analyses concluded that storage functions are included in the SWM pond design.
HYDFB	Depression D-91	Natural	These areas are natural depressions in topography. As per the OMB Mediation Agreement, storage comparisons (depressions versus SWM pond storage) have been completed; see **Appendix I**. Analyses concluded that storage functions are included in the SWM pond design.
HYDFB	Depression D-92	Natural	

*HYDFB = Hydrologic Feature B

- *Provincially Significant Wetlands* – the EIR Subcatchment Area contains five wetlands, identified through NOCSS, that form part of the larger North Oakville-Milton Provincially Significant Wetland Complex including wetland units 6, 7, 8, 10, and 12. Wetlands 6, 8 and 12 are located in Core 1; Wetland 10 is located in the LPA identified within NOCSS; and Wetland 7 is located east of Bronte Road north of Dundas Street.
- In December 2022, the Province issued a new version of the Ontario Wetland Evaluation System (OWES) that allows for wetlands to be re-evaluated by an OWES Certified Wetland Evaluator. Under this new system, a wetland re-evaluation is deemed complete following submission to MNRF, the landowner, and to the local municipality. In undertaking this EIR/FSS, Wetland 10 has been re-evaluated by an OWES Certified Wetland Evaluator and it has been determined that this unit does not meet the criteria to be considered a PSW under the new OWES. This re-evaluation was submitted to the Town on June 20, 2023 and MNRF on June 29, 2023. As of August 18, 2023, this wetland is no longer identified as a PSW on the Province's LIO mapping. Additional details are provided in **Section 3.3**.

2.1.1 Permitted Uses in the Natural Heritage System

2.1.1.1 OPAs 289 and 34 and NOCSS

OPA 289, Policy 8.4.7.3 and OPA 34, Policy 26.7.6 identify generally identical permitted uses in the NHS including flood and stream bank erosion control, fish, wildlife and conservation management, stormwater outfalls, relocated or deepened Medium Constraint Stream channels, roads and related utilities, expansion of existing water and wastewater services, trails and passive recreational uses, SWM facilities and grading. **Table 2.2** summarizes policy direction on permitted uses and notes report sections in this EIR/FSS that address these permitted uses.

Section 7.3.1 of NOCSS also lists permitted uses in Cores, Linkages and High and Medium Constraints Stream Corridors. These include:

- Development or land disturbances required for flood and stream bank erosion control and protection of fish, wildlife and conservation management;
- Infrastructure/utility access and crossings;
- Public pedestrian trails; and,
- SWM facilities.

These uses are subject to studies such as this EIR/FSS to address the placement of facilities/uses to ensure that they are compatible with core area management set out in Section 6.3.5 of NOCSS. Management recommendations for Core 1 are listed in **Section 3.1.**

Sections 6.3.5.2 and 6.3.5.3 of NOCSS and some OMB Mediation Agreements also address permitted uses in the NHS. With respect to this EIR/FSS, in preparing the grading plan and trails plan, consideration was given to this guidance to be consistent with NOCSS objectives.

2.1.1.2 Technical Mediation Agreements

A number of NOCSS technical matters were clarified through a series of Mediation Agreements associated with the Ontario Municipal Board hearing for the North Oakville East Secondary Plan. Since these are general technical interpretations of the NOCSS, they will apply anywhere within North Oakville. They include:

- Stage-Storage-Discharge Characteristics dated February 21, 2007;
- Infiltration dated February 22, 2007;
- Depressional Storage dated May 30, 2007;
- Regional Storm Flood Protection dated May 30, 2007;
- Total Phosphorus dated May 31, 2007;
- Erosion Control for SWM and Erosion Thresholds dated May 31, 2007;

- Hydrology model and hydraulics model for a portion of Joshua's Creek floodplain mapping dated May 31, 2007;
- Stream Corridor Components dated May 31, 2007;
- SWM Ponds Outside of Core and Linkages dated June 19, 2007;
- Changes to EIR Subcatchment Boundaries dated June 29, 2007;
- Flow Rates/Hydrology dated July 4, 2007;
- Stormwater Management - Temperature and Dissolved Oxygen Targets dated July 12, 2007;
- Monitoring dated July 26, 2007;
- EIR/FSS Terms of Reference dated August 2, 2007 (that have since been amended in May 2013); and,
- Grading and the Natural Heritage System, undated.

Table 2.2: Summary of Policy Direction on NHS Permitted Uses

OPA Policy Number	Potential Permitted Use	Policy Direction	Addressed in EIR/FSS Sections
OPA 289 8.4.7.3 c) i) OPA 34 26.7.6(b)(i-iv)	Development or land disturbance	Permitted in accordance with the directions of the North Oakville Creeks Subwatershed Study and any related Environmental Implementation Report, and Federal, Provincial and Conservation Authority regulations for required flood and stream bank erosion control; for fish, wildlife and conservation management; to accommodate a stormwater outfall; or in Medium Constraint Stream Corridor Areas.	Sections 6.1, 6.3, 7.7, 7.11 and 10
OPA 289 8.4.7.3 c) ii) OPA 34 26.7.6(b)(v,vi)	Roads and related utilities	Permitted provided the roads and related utilities: • use non-standard cross sections designed to minimize any impacts on the natural environment; • only be permitted to cross the designation in the general area of the road designations shown on Figures NOW2 and NOW4 or as defined through an Environmental Assessment; and, • be designed to minimize grading in accordance with the directions established in the NOCSS. Provided that such corridors shall: • be required as transit routes or utility corridors; • be located outside natural features to the maximum extent possible, and where the applicable designation is narrowest and along the edges of applicable designations, wherever possible; • provide for the safe movement of species in accordance with the directions established in the NOCSS in the design and construction of any road or utility; • be kept to the minimum width possible; and, • be designed to keep any related structures or parts of structures outside the High Constraint Stream Corridor Area designated on Figure NOW3 to the maximum extent possible or as defined through an EA OPA 34 specifies that roads and related utilities crossings identified on Schedule C and/or Schedule K, provided structures are located outside High Constraint Stream Corridor Areas identified on Schedule B2.	Section 10

OPA Policy Number	Potential Permitted Use	Policy Direction	Addressed in EIR/FSS Sections
OPA 289 8.4.7.3 c) iii) OPA 34 26.7.6(b)(vii)	Expansion to existing Water and Wastewater services	Expansion permitted to existing Water and Wastewater services which are located on sites with existing facilities subject to any required Environmental Assessment	Not applicable to this EIR/FSS
OPA 289 8.4.7.3 c) iv) OPA 34 26.7.6(b)(viii)	Trails, interpretative displays or signage or other similar passive recreation uses	Permitted if consistent with the purpose of the applicable designation and criteria listed in policy and provided that: • for lands in the LPA designation on Figure NOW3, such uses shall generally be located in the LPA, but adjacent to the boundary of the linkage; • trails shall be permitted within the setback from the edge of the Sixteen Mile Creek Valley, and may be permitted within the Valley subject to the review of their impact on any environmentally sensitive features; • trails in stream corridors other than the Sixteen Mile Creek shall be permitted adjacent to the valley in the buffer; and, • trails in the NHS Area designation be designed and located to minimize any impact on the natural environment	Section 6.3

OPA 289
8.4.7.3 c) v)
 	
OPA 34
26.7.6(b)(ix, x)
	Stormwater management facilities	Permitted subject to directions of the North Oakville Creeks Subwatershed Study, conformance with technical performance specifications listed in policy and as shown conceptually on Figure NOW3. In addition, provided such facilities shall:
		
		• not be permitted in Core Preserve Areas and Glenorchy Conservation Area;
		• be limited where located in or adjacent to High and Medium Constraint Stream Corridor Areas which are not located within LPAs as designated conceptually on Figure NOW3, to areas:
		  • outside the 100 year floodline;
		  • outside the meander belt allowance which is the meander belt plus the factor of safety;
		  • outside the erosion/access allowance measured from the meander belt or stable top-of-bank, except that some overlap of the access required for the SWM facility and the erosion/access allowance may be permitted in accordance with the directions established in the NOCSS, and to the satisfaction of the Town and CH;
		  • outside the confined valley; and,
		  • provided that there is no loss of flood storage or conveyance; and,
		  • not be permitted in or adjacent to High and Medium Constraint Stream Corridors which are located within LPAs as designated conceptually on Figure NOW3
			Section 7.0

OPA Policy Number	Potential Permitted Use	Policy Direction	Addressed in EIR/FSS Sections
OPA 289 8.4.7.3 c) vi) OPA 34 26.7.6(b)(xi)	Grading in the Natural Heritage component of the Natural Heritage and Open Space System	Permitted in accordance with the directions established in the North Oakville Creeks Subwatershed Study or appropriate Environmental Assessment.	Section 7.0
OPA 289 8.4.7.3 c) vii)	Corridor to facilitate the construction of a trunk sanitary sewer	A corridor shall be identified and may traverse the Core and LPAs, the Glenorchy Conservation Area and High or Medium Constraint Stream Corridor Areas to facilitate the construction of a trunk sanitary sewer from the Burnhamthorpe Road/Highway 407 area to Third Line/Dundas Street in accordance with the Halton Water and Wastewater Master Plan Review (KMK, 2002). The location of the corridor shall be refined through a Municipal EA process by Halton Region in consultation with CH and other stakeholders and facilitates the construction of a sewer which does not exceed Halton Region's standard for depth of sewer and is at such grade which meets the existing trunk sewer at Third Line and Dundas Street and maintains the capacity requirements identified in the Region of Halton's Water and Wastewater Master Plan.	Not applicable to this EIR/FSS

3 NHS DELINEATION

As described in **Section 2.1**, the NHS framework in North Oakville, as identified on Figure NOW 3 of the NOWSP, is comprised of Core Preserve Areas, Linkage Preserve Areas (LPA), High Constraint, Medium and Low Constraint Stream Corridor Areas, and Other Hydrological Features.

The Subject Lands overlap either entirely or in part with the following NHS components as identified in NOCSS and the NOWSP (**Figure 2.1**):

- **Core Preserve Area 1** – A 39 ha area of valleylands and tablelands largely centered along Fourteen Mile Creek West. The EIR Subcatchment Area overlaps with the western portion of Core 1.
- **Linkage Preserve Area (LPA)** - a 100 m wide strip of primarily tableland traversing the central portion of the site and intended to provide ecological connectivity between Core 1 and Core 2 located east of Bronte Road in the Glenorchy Conservation Area. The LPA overlaps with agricultural fields, hedgerows and a small meadow marsh wetland (Wetland 10).
- **High Constraint Stream Corridor** (Red Stream) – Fourteen Mile Creek West (Reaches 14W1, 14W1A, 14W-2, 14W-3, and 14W-4). All reaches are contained within Core 1.
- **Medium Constraint Stream Corridor** (Blue Stream) – Tributary of Fourteen Mile Creek East (Reach 14E-8) located along west side of Bronte Road immediately south of Highway 407.
- **Other Hydrological Features –** There are four Hydrologic Features 'B' within the EIR Subcatchment Area. They are associated with low-lying areas on the Subject Lands outside of Core 1. There are no Hydrologic Features 'A' within the EIR Subcatchment Area.

While not part of the NHS, there are also four Topographic Depressions identified within the EIR Subcatchment Area (ref. NOCSS Figure 7.3.1). Three of these are associated with the agricultural fields on the Subject Lands and another is associated with the Fourteen Mile Creek West flood plain in Core 1.

NHS components on and adjacent to the Subject Lands have been studied to identify NHS boundaries on the Subject Lands.

Section 3.1 describes how the eastern boundary of Core 1 has been further refined to establish the NHS limits. **Section 3.2** provides a discussion regarding the functional limitations of the LPA between Cores 1 and 2, as shown in NOCSS and the NOWSP and proposes establishing a more suitable Enhanced LPA further north where an ecopassage can be accommodated under Bronte Road. **Section 6.2.2** provides more detail on the Enhanced LPA. **Section 3.3** provides an overview of the MNRF wetland

evaluations completed in North Oakville as part of NOCSS, as well as discussion of the 2022 OWES which permits existing wetlands to be re-evaluated. This section also outlines a proposal to replace Wetland 10 with larger and a higher functioning wetland within the proposed Enhanced LPA to be located north of the NOCSS proposed LPA. **Section 6.2.2.2** provides details of the proposed form, function and design of the new wetland. **Sections 3.4 and 5.5** describe the High and Medium Constraint Stream Corridors associated with the Subject Lands and how their boundaries have been identified and delineated.

3.1 CORE 1 BOUNDARY CONFIRMATION AND DELINEATION

As noted in NOCSS, Core 1 has a total combined area of 39 ha (including portions outside the Subject Lands). Core 1 is comprised of woodland, successional habitats, agricultural lands and small wetlands associated with the Fourteen Mile Creek West valleylands and some adjacent tablelands in agricultural production, mainly to the east and north of the valleylands.

As illustrated on **Figure 2.1**, Core 1 extends from Dundas Street in the south to the Future 407 Transitway corridor in the north. The western limit of Core 1 is generally defined by the limit of development associated with Zenon and Church Without Walls located at 3239 and 3175 Dundas Street West, respectively. The eastern limit of the Core 1 is generally defined by a 200m wide area that includes the valley and agricultural lands, and a woodland to the north. The western boundary of the EIR Subcatchment Area is generally defined by Fourteen Mile Creek West valleylands.

To better understand how the boundaries of Core 1 were originally defined in NOCSS, the following materials were reviewed:

- NOCSS mapping for Core 1 as presented on NOCSS Figure 6.3.4.
- Preferred Management Approach for Core 1 presented in NOCSS Section 6.3.3.5.
- Themes and Management for Core 1 presented in NOCSS Tables 6.3.2.
- Proposed NHS Management for Core 1 presented on NOCSS Figure 7.6.1.

NOCCS identifies ecological “themes” for Core Areas based on existing features and functions within a specific Core Area. These themes include Forest Interior, Open Country, Habitat Connectivity within Cores and Special Considerations. These themes are used to define and delineate Cores and to guide their management.

For Core 1, NOCSS identified the following ecological “themes”:

- ***Forest Interior****: associated with woodland in northern portion of core*
- ***Linkage****: habitats provide a potential linkage to lands north of Highway 407 and*

south of Dundas Street

- ***Open Country****: open country habitats are found along the northern and eastern edges of this area*
- ***Redside Dace****: population of known redside dace in lower portions of creek in this area*

In relation to these ecological themes, NOCSS developed the following general management recommendations for Core 1:

- *"The existing woodlands and wetlands are recommended for retention.*
- *…linkages between the forested component of the Core and lands to the south should be connected with linkages approximately 200m in width. Significant gaps in these connections will be created by major roadways and highways in the area. As well, the connections should be wooded.*
- *The presence of the wooded and linkage themes in this Core override the management of the open habitats. The configuration of the Core would allow for minimal open country habitat. The majority of the Core should be wooded, including the open area in the centre of the main woodland towards the north of the Core."*

A review of the NOCSS mapping for Core 1 (NOCSS Figure 6.3.4), and the management recommendations, confirms that the Core 1 limits were established as follows:

- Northern limit of Core 1 is defined by the right-of-way of the Future 407 Transitway Corridor;
- Southern limit of Core 1 defined by Dundas Street West;
- Northwestern limit of Core 1 defined by a 30 m buffer to Medium Constraint (Blue Stream) 14W-10 (which includes the wetland buffer);
- Northeastern limit of Core 1 defined by the 50 m wide corridor associated with High Constraint (Red Stream) Reach 14W-4;
- Between the 14W-10 and 14W-4 stream corridors, south of the Future 407 Transitway Corridor and north of the Woodland, Core 1 is to include 5.2 ha of agricultural field as Open Country Habitat;
- For the northern half of Core 1, the eastern and western boundaries are to be defined by applying a 10 m buffer to the dripline of the large woodland;
- Core 1 is to be a minimum of 200 m in width between Woodland and Dundas Street; and
- For the southern half of Core 1, the western boundary is defined by a 30 m setback to the top of valley slope and the eastern boundary is defined by applying a minimum 200 m offset from the western boundary. The eastern boundary is further defined by the retention of an 8.8 ha area of tableland Open Country Habitat comprised of agricultural fields.

For the purposes of this EIR/FSS, direction from NOCSS Figure 6.3.4 was utilized to delineate the boundary of Core 1. As the linework from Figure 6.3.4 was not available digitally, the NOCSS mapping was scanned and confirmed using NHS mapping from the Region of Halton and then imported into the survey base. This linework was used to establish the NOCSS Core 1 limits to ensure consistency with NOCSS and OPA 289 and OPA 34 policies.

The NOCSS Core 1 boundary and NHS limits have been further refined through this EIR/FSS using a combination of desktop analyses, field verification, and agency staking and surveying of certain features (i.e., physical top of bank and woodland dripline) and application of required buffers as prescribed by NOCSS.

Feature staking was completed along the eastern boundary of Core 1 on the Subject Lands with the Region of Halton, Town of Oakville and CH on August 30, 2021 and April 7, 2022. The staked and surveyed limits of the top of bank and woodland dripline are illustrated on **Figure 3.1**. Details of the feature staking are provided in Beacon's memorandum of August 16, 2022 (**Appendix B**).

Through desktop review and field verification, several other natural heritage and natural hazard constraints were also identified in the EIR Subcatchment Area that were considered in the delineation of the eastern boundary of Core 1 as identified in NOCSS. These constraints include the following:

- **Regulated Habitat for Endangered Redside Dace** associated with Fourteen Mile Creek West. MECP has identified Reaches 14W-1, 14W-1A, 14W-2 and the lower portion of 14W-3 as occupied habitat for endangered Redside Dace. Under the *Endangered Species Act* and its regulations, habitat for Redside Dace is defined as lands within 30 m of the meander belt of reaches identified as occupied or recovery habitat by MECP. A meander belt analysis was completed by Beacon (2021) (see **Appendix E**) to confirm the extents of regulated Redside Dace habitat and to verify that the regulated habitat is fully contained within the NHS limits established through this EIR/FSS.

- **Top of Bank** along the eastern side of the Fourteen Mile Creek West valleylands. The physical top of bank was staked by CH on August 30, 2021 and April 7, 2022. The staked limit was surveyed by RPE Surveyors. A 7.5 m setback was applied to the staked top of bank to establish the NHS limit. This resulted in extending the existing NOCSS mapped Core 1 boundary outward slightly in several locations.

- **Long Term Stable Slope** along the eastern boundary of the Fourteen Mile Creek West valley was assessed by DS Consultants. An assessment of the long term stable slope (LTSTOS) is provided in **Appendix J-2**. For the majority of the slope, the staked top of bank represents the LTSTOS with the exception of two

locations in proximity to points S9 and S14 on **Drawing 1, Appendix J-2**, where the LTSTOS is greater than the staked top of bank. For the un-staked segment of valley slope between points S15B and S19A, where the woodland boundary extends beyond the physical top of bank, the LTSTOS does not exceed the staked dripline.

- **Woodland Limits** along the eastern edge of the forest block that defined the northern half of Core 1. The limits of the woodland were established through dripline staking completed by CH and the Town on April 7, 2022. The staked limit was surveyed by RPE Surveyors. This resulted in extending the existing NOCSS mapped Core 1 boundary outward in several locations. A 10m buffer was applied to the woodland dripline as per NOCSS requirements.

- **Regulatory Floodline** – The Fourteen Mile Creek West regulatory floodline has been reviewed and refined through EIR/FSS work as described in **Section 5.5**. The floodline plus 7.5m was identified and does not define the Core boundary.

- **High Constraint (Red Stream) Corridor for 14W-4** – NOCSS recommended that the northeastern boundary of Core 1, immediately north of the large woodland, be based on the 14W-4 stream corridor which was identified as being 50 m in width. Through field verification as part of this EIR/FSS, it has been confirmed that this red stream reach is contained in a confined valley system. To ensure that the stream corridor boundary for Reach 14W-4 is consistent with NOCSS management requirements, the staked top of bank and 7.5 m setback were used to establish eastern side of this stream corridor. This refinement resulted in extending the eastern boundary Core 1 boundary further outward than originally mapped and described in NOCSS. (See **Sections 3.4 and 5.5** for additional discussion on stream corridor boundary determination of Stream Reach 14W-4).

- **Low Constraint (Green Stream) Corridor 14W-20** – While green stream corridors are not included in the NOCSS, OPA 289 or OPA 34 NHS, a closer examination of 14W-20 has identified that the lower portion of this stream corridor that overlaps with the NOCSS Core 1 boundary lies within a confined valley system. While NOCSS, OPA 289 and OPA 34 do not require green stream corridors to be defined, it was determined that because the top of bank of this stream corridor extends outside the NOCSS mapped Core 1 boundary, that the Core 1 boundary should be extended outward to include the 7.5 m setback to the staked top of bank.

In summary, this EIR/FSS has relied upon the NOCSS mapping and principles, agency feature staking and geotechnical and geomorphological assessments to establish the eastern limits of the Core 1 boundary consistent with the NOCSS management

recommendations. Various natural heritage and natural hazard constraints were identified and mapped along with appropriate buffers and setbacks as prescribed by OPA 289 and OPA 34. The most restrictive of these were used to establish the NHS limits. **Figure 3.1** illustrates the various biophysical constraints that were used to establish the NHS limits along the eastern boundary of Core 1.

3.2 LINKAGE PRESERVE AREA

The NOWSP identified an LPA across the central portion of the Subject Lands as shown on Figure NOW1-4. This area (100 m wide x 411 m long on the Subject Lands) was identified as a potential linkage (i.e., a conceptual linkage) through NOCSS that was intended to provide connectivity between the woodland habitats in Cores 1 and 2 (ref. NOCSS Figure 6.3.3).

The NOCSS describes primary linkages as including:

- *"Existing linkages (primarily associated with riparian habitats and hedgerows, but including some existing field linkages);*
- *Potential linkages which take advantage of some pockets of vegetation, hedgerows or other natural features; and*
- *General locations of potential linkages where no existing natural feature currently exists, generally associated with the shortest distance between end habitats."*

One of the key objectives of the NOCSS subwatershed strategy is Objective 3.2 which states:

> *"To ensure that existing wildlife linkages are preserved and that opportunities for improving these linkages are considered/implemented as part of any future development."*

The NOCSS noted that there is a deficit of linkages in the subwatershed study area, particularly those connecting forest habitat blocks, but also that "*ecological linkages must be designed with an understanding of the species that will use the connection*" [underlining added].

NOCSS established the following targets for linkages:

- *Minimize the discontinuities in linkages (especially >20m).*
- *Linkages to be 100m wide.*
- *Allow for linkages to habitats or other linkages located outside the study area (for example Sixteen Mile Creek valley and Bronte Creek).*

Additionally, the NOCSS Section 6.3.3.5 outlines the following management approach for primary linkages:

> *"Primary Linkage to provide connections of suitable habitat between Cores. Recommended habitat of the linkage is to be the same as the Cores it connects, which is forested in almost all cases."* [underlining added].

As shown on **Figure 2.1**, the NOCSS proposed LPA between Cores 1 and 2 is illustrated as being 100 m wide by approximately 564 m in length and forms a slight arc. Approximately 411 m of this linkage overlaps with the Subject Lands, 47 m overlaps with Bronte Road, and another 106 m overlaps with three residential properties on the east side of Bronte Road. The Town of Oakville owns a small parcel east of Bronte Road immediately north of the NOCSS proposed LPA. On the Subject Lands, the NOCSS proposed LPA overlaps with cultivated agricultural fields, a discontinuous hedgerow, and a small wetland (Wetland 10).

Upon review of the NOCSS proposed LPA in the field, it is apparent that implementing an effective and safe ecological linkage in this location is not feasible as there is no grade separation to construct a suitable ecopassage across Bronte Road. As per NOCSS Objective 3.2, future developments are to consider opportunities to improve linkages. In examining the available opportunities, an alternate LPA has been identified to the north of the NOCSS proposed LPA, where sufficient grade separation exists to accommodate a suitable ecopassage that can provide for ecological connectivity between the Cores. **Section 6.2.*1*** and a technical memo in **Appendix B-2** describes in detail the existing conditions and challenges with the NOCSS proposed LPA and the benefits of shifting the LPA northward to create an Enhanced LPA that can achieve the NOCSS linkage objectives.

3.3 WETLAND CREATION AND ENHANCEMENT WITHIN ENHANCED LINKAGE PRESERVE AREA

As was noted in the preceding section, portions of the Subject Lands are mapped as LPA in NOWSP Figures NOW1–4 and overlap with agricultural fields, a hedgerow and a small agricultural wetland. This wetland (Wetland 10) was evaluated by MNRF in 2002 and was included in the North Oakville – Milton West Provincially Significant Wetland Complex (MNRF 2006).

Wetland 10 is the only wetland feature in the North Oakville – Milton West Provincially Significant Wetland Complex that is located outside of a NOCSS Core Area or Stream Corridor. This wetland feature appears to have been included in the PSW complex because it overlaps with the NOCSS proposed LPA. No other unique qualities of Wetland 10 were provided as rationale for complexing (MNRF 2006). It should be noted that the scoring of Provincial significance of this complex was largely driven by the presence of: (1) habitat of an endangered fish species; (2) a wide variety of regionally/locally rare plant species along with one provincially rare plant species; and, (3) fish spawning and nursery habitat. Wetland 10 did not drive this score, as it only had one species of locally rare plant, Necklace Sedge (*Carex projecta*).

Throughout North Oakville, other tableland wetland features of similar size, function and quality to Wetland 10 were excluded from the PSW complex during the NOCSS and Secondary Plan process on the basis of being isolated, low functioning, often in agricultural use, and/or difficult to maintain in an urban setting and located outside of the NOCSS NHS.

Wetland 10 is a small, isolated wetland with limited ecological functions that is regularly farmed. The 2006 MNRF wetland evaluation data record describes Wetland 10 as a 0.26 ha palustrine wetland comprised of three marsh sub-units (M4-B, M4-C and M5-D) that are dominated by grasses and sedges, forbs and cattails.

As part of the work in this EIR/FSS, Wetland 10 was re-evaluated and its mapping updated in accordance with Provincial standards (**Appendix D-1**). Based on field studies conducted by Beacon between 2019 and 2023, the re-evaluation concluded that Wetland 10 does not meet the criteria to be considered Provincially Significant.

Of note, the extent of Wetland 10 has increased to 0.43 ha since MNRFs evaluation in 2005. This change is attributable to farming practices which have spread populations of Blunt Spikerush (*Eleocharis obtusa*), a locally rare wetland plant species. It is important to note that Wetland 10 is regularly farmed and cropped. Evidence of farming in this wetland goes back to 1954 and, in many months of the year, wetland vegetation is diminished or absent.

Considering that Wetland 10 is an agricultural wetland with limited functions (non-PSW) and overlaps with the NOCSS proposed LPA, which has been determined cannot fulfill the NOCSS primary linkage objective of connecting Cores 1 and 2, due to physical constraints associated with Bronte Road as is explained further in **Section 6.2.1** and **Appendix D-1**, it is proposed that Wetland 10 be removed and replaced by creating a wetland within the proposed Enhanced LPA further to the north, where it can complement the linkage functions and provide enhanced wetland functions. Refer to **Section 6.2.2.2** for further discussion regarding the proposed wetland creation in the Enhanced LPA.

3.4 STREAM CORRIDOR BOUNDARIES

NOCSS defines stream or riparian corridors according to their geomorphological, hydrological, hydrogeological and ecological characteristics and functions and assigns constraint ratings of High (Red Streams), Medium (Blue Streams) and Low (Green Streams) based on their sensitivities to future land use changes. High Constraint (Red) and Medium Constraint (Blue) stream corridors form part of the NHS.

The EIR Subcatchment Area contains five High Constraint (Red) Stream Reaches (14W-1, 14W-1A, 14W-2, 14W-3 and 14W-4), one Medium Constraint (Blue) Stream Reach (14E-8), and four Low Constraint (Green) Stream Reaches (14W-18, 14W-20, 14E-9, 14E-10) (**Figure 2.1**).

Section 6.3.4.5 of NOCSS outlines the management requirements as follows:

High Constraint Streams *must be protected (and/or enhanced) in their current location. The only modifications permitted would be through local enhancement or rehabilitation works. The streams included in this group typically have conditions that are unique to the stream that lend to a high value from an environmental, geomorphologic, hydrologic, or hydrogeologic standpoint (i.e., significant aquatic or vegetative condition, defined valley or steam definition, significant discharge/base flow function that would be disrupted by any changes to the stream).*

Medium Constraint Streams *require preservation as a riparian corridor considering their environmental, geomorphologic, hydrologic, and hydrogeologic functions. It is judged, however that their function can still be preserved if the current stream is either relocated or deepened, and, in most cases enhancements can be provided to improve the overall resiliency of the stream network and subwatershed. Any alteration, including lowering of the channel and channel crossing, is of course subject to acquiring approval (DFO, HRCA, MNR, and Oakville).*

Low Constraint Streams *can be replaced through infrastructure or SWM.*

The criteria to define the widths of medium and high constraint stream corridors were included in NOCSS and are to be refined through EIR/FSS studies. As per NOCSS and the NOWSP, low constraint stream reaches can be removed and replaced through infrastructure or SWM if necessary.

This EIR/FSS has identified medium and high constraint stream corridors and their locations in the NHS. Depending on whether the stream is associated within a confined or unconfined valley system, factors governing the delineation may include:

- fluvial geomorphologic requirements (meander belt);
- stable top-of-bank;
- regulatory floodplain;
- fish and fish habitat protection requirements;
- preservation of hydrogeologic functions;
- Hydrologic Features A; and
- setback requirements from these factors/conditions.

Diagrammatic representations of how stream corridors are to be delineated are presented in NOCSS Figures 6.3.15a, 6.3.15b and 6.3.15c in the NOCSS Addendum.

Section 5.5 provides a discussion on calculation methodologies for the determination of each of the factors noted above, the approaches used for meander belt calculations, floodplain calculations, fisheries setbacks, top-of-bank, etc., and resulting stream corridor boundaries. Results are summarized below:

- **High Constraint (Red Stream) – Reaches 14W-1, 14W-1A, 14W-2, 14W-4**
  All High Constraint Stream reaches in the EIR Subcatchment Area are associated with the Fourteen Mile Creek West and are contained within the existing NOCSS Core 1 boundary. The stream corridors of these reaches were established to contain the meander belt, regulatory floodplain, fisheries setbacks, physical/stable top of bank and associated setbacks. In addition, as reaches 14W-1, 14W-1A, 14W-2 and the lower portion of 14W-3 are regulated Redside Dace Habitat, a 30 m setback was also applied to the meander belt to establish the regulated habitat limit for this species. All red stream corridor boundaries are contained within the current NOCSS mapped Core 1 boundary. As Reach 14W-4 was determined to be within a confined valley system, it is proposed that the eastern limits of this stream corridor be adjusted to follow the 7.5 m setback to the staked top of bank. This would result in extending the NOCSS mapped Core 1 boundary outward slightly.

- **Medium Constraint (Blue Stream) – Reach 14E-8**
  This Blue Stream consists of a ditch flowing along the west side of Bronte Road. Stream corridor boundaries to this feature include the greater of the meander belt or floodplain plus 7.5m. Stream Reach 14E-8 will be contained entirely within the NHS and Enhanced LPA as discussed in **Section 6.2.2**.

- **Low Constraint (Green Stream) – Reach 14W-18**
  This green stream consists of an agricultural swale. The lower portions of this reach south of the future transitway corridor are contained in a confined valley system. The swale is farmed and has no natural vegetation associated with it. Drainage is intermittent and flows only during larger precipitation events. There is no evidence of sustained baseflow. While NOCSS management requirements do not require protection of green streams, as described in Section 6.2.2.2, Reach 14W-18 has been included in the proposed Enhanced LPA.

- **Low Constraint (Green Stream) Corridor 14W-20** – While green stream corridors are not included in the NOCSS, OPA 289 or OPA 34 NHS, a closer examination of 14W-20 has identified that the lower portion of this stream corridor that overlaps with the NOCSS mapped Core 1 boundary is contained within a confined valley system, but that the confined valley extends slightly

beyond the NOCSS mapped Core 1 limits. As was discussed in **Section 3.1**, to refine the limits of Core 1, a 7.5m setback from the staked top of bank was applied.

4 GEOLOGY AND HYDROGEOLOGY

4.1 SCOPE OF WORK

The hydrogeological scope of work was designed to address the technical requirements as set out in the EIR Hydrogeological Terms of Reference for North Oakville (TOR, 2013). Specifically, the hydrogeological work program was completed to:

- review the regional hydrogeological setting;
- characterize the local soil, groundwater, and surface water flow conditions, including the surface water and groundwater quality
- assess the local groundwater/surface water interactions and identify recharge/discharge areas and functions;
- calculate the pre- and post-development water balance conditions;
- identify hydrogeological opportunities and constraints to maintaining the water balance;
- evaluate opportunities for augmenting groundwater infiltration through appropriate and practical best management practices;
- identify the type, location and size of infiltration measures that may be feasible for use based on the local soil and groundwater conditions;
- identify potential construction constraints related to the hydrogeological conditions.

The detailed scope of work included:

1. Review of the Ministry of Environment, Conservation and Parks (MECP) water supply well records and available geotechnical reports for the EIR Subcatchment Area to assess the hydrogeological setting and soil conditions. The locations of the water supply wells (as recorded in the MECP records) and the borehole locations are illustrated on **Figure 4.5.** A listing of the MECP water supply well records for the area is provided in **Appendix C-1** and the geotechnical reports are provided in **Appendix I**.

2. The installation of a network of groundwater monitoring wells and shallow drive-point piezometers across the Subject Lands to investigate the site-specific soil and groundwater conditions. Monitoring wells were installed in February and March 2021 and eight additional wells were installed in March 2022. Shallow drive-point piezometers were installed in April 2021 and four additional piezometers were installed in June 2022. The hydrogeological monitoring locations are shown on **Figure 4.1**. Copies of the borehole logs and monitoring well construction details are included in **Appendix C-2**.

3. Single well response testing of four groundwater monitoring wells to estimate the in-situ hydraulic conductivity of the surficial soils. The field-testing results and calculations are provided in **Appendix C-3**.

4. Monitoring of groundwater levels to measure the depth to the water table and assess the horizontal and vertical groundwater flow conditions. For this study, water level monitoring

began in May 2021 and is proceeding on a monthly basis. In addition to manually recorded groundwater levels, automatic water level recorders (dataloggers) were installed in four monitoring locations to record detailed and continuous water level measurements. The available groundwater monitoring data are summarized in **Table C-4-1** in **Appendix C-4** and hydrographs of the data for each location are also provided in **Appendix C-4**.

5. Inspection and monitoring of surface water flow conditions at 7 locations (**Figure 4.1**) began in April 2021 and is proceeding on a monthly basis in association with the groundwater monitoring program. Spot flow, when present, is estimated using a stream area - velocity method. The surface water flow data are summarized in **Table C-5-1** in **Appendix C-5**.
6. Water level monitoring in surface water features. Staff gauges were installed in 4 locations to assess surface water depths in features and drainage courses and water levels are measured monthly as part of the monitoring program. The staff gauge (SG) locations are illustrated on **Figure 4.1** and the monitoring data are summarized in **Table C-5-2** in **Appendix C-5**.
7. Collection of water samples from 2 monitoring wells to characterize the background groundwater quality. Groundwater samples collected on July 14, 2021, were submitted to a qualified laboratory for analyses of general quality indicators (e.g., pH, hardness, conductivity), basic ions (including chloride and nitrate) and selected metals. There was insufficient flow at any of the monitoring locations to date to permit sampling of the surface water, however, some field-testing data of the surface water quality was gathered. The groundwater quality data are summarized in **Table C-6-1** in **Appendix C-6**. Field monitoring data for salinity, temperature, dissolved oxygen, pH, conductivity, total dissolved solids and total suspended solids in the surface water runoff are provided in **Table C-6-2** in **Appendix C-6**.
8. With respect to the groundwater conditions, pre-development water balance calculations (based on existing land use conditions) and post-development water balance calculations (based on the proposed development plan) were completed for the Subject Lands by subcatchment area to assess the potential impacts of development on the local groundwater resources and establish recharge targets for stormwater management measures to promote recharge and make best efforts to maintain the groundwater conditions. The groundwater balance calculations are provided in **Appendix C-7**.
9. To investigate the potential for subsurface infiltration measures in select locations, infiltration testing using a Guelph Permeameter was conducted and the data used to assist in the design of LID measures to reduce the post-development recharge deficit. The infiltration test data are included in **Appendix C-8**.

4.2 PHYSIOGRAPHY AND TOPOGRAPHY

The Subject Lands are located on the south slope of the Trafalgar Moraine, a 'till moraine' originally mapped by Chapman and Putnam (1951, 1984) and, more recently, by the Ontario

Geological Survey (Barnett, 1992a). The Trafalgar Moraine consists of a belt of gently undulating topography extending across the North Oakville area, and the crest of the Moraine is located north of the Subject Lands.

The land surface across the Subject Lands is characterized by an undulating till surface. Analysis of the detailed topography shows that land is gently sloping to the south (**Figure 4.2**). The maximum relief across the area is about 20 m, with the higher elevations of about 165 metres above mean sea level (masl) found along the northwest boundary of the Subject Lands and the lowest elevations of about 145 masl found along a low constraint stream (14W-20) in the southwest corner of the Subject Lands (**Figure 4.2**).

4.3 DRAINAGE

The Subject Lands straddle the drainage divide between Fourteen Mile Creek West and Fourteen Mile Creek East and lie within three EIR Subcatchment Areas that were identified in the NOCSS as shown on **Figure 4.2**. FM1109A and FM1110 drain to Fourteen Mile Creek West and FM1110.1 and FM1111 drain to Fourteen Mile Creek East. There are no permanent watercourses on the Subject Lands. Surface water runoff is directed overland via a series of drainage swales through the fields and ditches along the roads, some of which are identified as low and medium constraints streams.

To monitor drainage to Fourteen Mile Creek West, surface water flow monitoring locations were set up along several low constraint streams at SS2, SS3, SS5, and SS7 (**Figure 4.2**). To monitor drainage to Fourteen Mile Creek East, surface water flow monitoring stations were established at three culvert locations under Bronte Road (SS1, SS4 and SS6, **Figure 4.2**). At these monitoring stations, surface water flow conditions are observed monthly and measured if sufficient flow is present. The SS monitoring station data are provided in **Table C-5-1** in **Appendix C-5** and the results are discussed in **Section 4.3.1**.

The NOCSS identified four shallow topographic depressions that occasionally hold water within the Subject Lands, and these are labelled as D-86, D-87, D-91 and D-92 on **Figure 4.2**. It is not clear why two numbers were assigned at location D-86/D-87 as there is only one depression present in this location. These depressions were also identified as Hydrologic Features B on OPA 34 Schedule B2, along with an additional location in the northern part of the Subject Lands, labelled as HYDB1on **Figure 4.2**.

A number of staff gauges (SG) and drive point piezometer nests (PZ) were installed to monitor the surface water and shallow groundwater conditions near selected stream reaches and depressions. These included SG1 and PZ1s/d along Stream Reach 14E-8, SG2 and PZ2s/d along Stream Reach 14W-18, SG3 and PZ3s/d at Wetland 10, SG4 and PZ4s/d in D-86/D-87, PZ6 in D-92, and PZ7s/d along Stream Reach 14W-20 (**Figure 4.2**). The SG monitoring data are provided in **Table C-5-2**, **Appendix C-5** and the piezometer data are provided in **Table C-6-2**, **Appendix C-2**. The drainage swales, depressions and wetland monitoring results are discussed in **Sections 4.3.1** and **4.3.2** below.

4.3.1 Drainage Swale Conditions

The drainage observations and monitoring data gathered to date for the low constraint streams across the Subject Lands show that the swales are ephemeral and only have a surface water conveyance function. The monitoring data are discussed below by subcatchment area. Supporting data for these discussions are provided in **Appendices C-4** (groundwater) and **C-5** (surface water). Further discussion of the drainage conditions within and downstream of the Subject Lands is provided in **Sections 5.3 and 5.5**.

Subcatchment FM1109A

Two drainage swales directing flows southwest to Fourteen Mile Creek West are mapped within the Subject Lands and these have been identified as low constraint Stream Reaches 14W-18 and 14W-20 (**Figure 4.2**).

Flow conditions in Stream Reach 14W-18 have been monitored at SS2 and SS3 (**Figure 4.2**). During the spring, some standing water and minimal flow (<0.1 L/s, not measurable) is observed at both locations however, the swale was dry in June 2021 and June 2022. To date, measurable surface water flows at these locations have only been recorded after recent rain and the measured flows ranged from 0.1 to 1 L/s at both locations (**Table C-5-1, Appendix C**). When present, the depth of standing water was recorded at SG2 (located at SS2; **Figure 4.2**) and ranged between 1 cm and 13 cm of water (**Table C-5-2, Appendix C**).

A piezometer nest was installed beside Stream Reach 14W-18 to assess the potential for groundwater/surface water interaction (PZ2s/d; **Figure 4.2**). The groundwater variations at PZ2s/ follow typical seasonal patterns, with elevations rising in the late fall to spring and declining in the summer and fall (**Figure C-4-22, Appendix C-4**). The data show the groundwater surface fluctuates between approximately 1.0 mbgs and 0.1 m above grade. The hydraulic gradient at this location along the bank of the swale was downwards (recharge conditions) from installation in April 2021 to April 2022 and upward from June 2022 to September 2022. It is interpreted that the piezometers in this area are installed in the weathered zone at the top of the shale, and that the swale intersects the bedrock in this area. The groundwater surface is interpreted to represent the potentiometric elevations from the bedrock /overburden interface and are higher than the swale elevation suggesting that the groundwater surface is within this top of shale zone. There is no evidence of actual groundwater seepage into the swale, but having high potentiometric elevations (saturated ground in the base of the swale) would help to support ponding in depressions in the base of the swale when surface water is present in the swale. Flow conditions in Stream Reach 14W-20 have been monitored at SS5 and SS7 (**Figure 4.2**). To date, no flowing water has been observed at SS5. Standing water and frozen conditions were observed between December 2021 and March 2022, with dry conditions observed all other months (**Table C-5-1, Appendix C-5**). Further downstream at SS7, minor flow and standing water was observed during the late fall and early spring. However, the swale was dry between May and September in both 2021 and 2022 except during rain (July 2021, **Table C-5-1, Appendix C-5**).

A piezometer nest was installed beside Stream Reach 14W-20 to assess the potential for groundwater/surface water interaction (PZ7s/d; **Figure 4.2**). The groundwater levels to date at PZ7s/d indicate a downward gradient (recharge conditions) and data show groundwater levels at about 1.8 m below ground.

The monitoring data suggest that low constraint streams 14W-18 and 14W-20 convey surface water runoff from snow melt or precipitation events. It is interpreted that potentiometric elevations may be seasonally at or above ground surface at the south end of 14W-18 and 14W-20 as they approach Fourteen Mile Creek West, but groundwater discharge contributions to visible flow are precluded by the low hydraulic conductivity of the surficial clayey till soils. These ephemeral conditions are consistent with the low constraint ranking identified in NOCSS.

Subcatchment FM1110

There are no stream reaches within this Subcatchment Area on the Subject Lands. Surface water conditions were monitored at a catchbasin in the ditch on the west side of Bronte Road (SS6 on **Figure 4.2**). In April 2021, there was some shallow standing water noted around the catchbasin, however, the location has been dry or frozen on all monitoring occasions since then (**Table C-5-1, Appendix C-5**).

Subcatchment FM1110.1

Low constraint Stream Reach 14E-10 directs flows southeast to Fourteen Mile Creek East. Flow conditions in Stream Reach 14E-10 have been monitored at SS4, at the culvert that directs flow to the east under Bronte Road (**Figure 4.2**). Flowing conditions have only been observed on two occasions (in October and December 2021). For the remaining months in 2021, the culvert was noted to have standing water or dry conditions and in 2022 the culvert was frozen or dry during every monitoring round (**Table C-5-1, Appendix C-5**). Monitoring of the groundwater conditions in nearby monitoring well MW21-2 shows the groundwater is about 1.5 m below grade in this area (**Figure C-4-2, Appendix C-4**), so the standing water is interpreted to be just surface water ponded on the clay soils.

Near the upper end of this reach, there are two depressions that hold water. If they overtopped, would drain to Stream Reach 14E-10. The two depressions form Wetland 10 as shown on **Figure 4.2**. This area has been instrumented with a staff gauge (SG3) to measure depth of standing water in Wetland 10 and a drive-point piezometer nest (PZ3s/d) to assess shallow groundwater/surface water interactions in this area (SG3; **Figure 4.2**). When present, the depth of standing water recorded at SG3 has ranged between 3 cm and 23 cm of water (**Table C-5-2**, **Appendix C-5**). The feature was observed to be dry in June 2021 but had standing water in the agricultural fields from rainfall events preceding the July reading.

The groundwater elevations at PZ3s/d rose steadily after installation until July 2021 (**Figure C-4-23, Appendix C-4**), and the very slow recovery is indicative of very low soil hydraulic conductivity and limited movement of groundwater (refer to **Section 4.6.2** for a discussion of the hydraulic conductivity). Since stabilizing, the groundwater surface has been very close to grade, ranging from 0.4 mbgs to 0.04 m above grade, with a downward gradient (recharge gradient). The groundwater elevations are also generally below the surface water elevation in

the feature (**Figure C-4-23**, **Appendix C-4**). This shows that the standing water in the feature results in a downward gradient, i.e., the feature has a recharge function. The ponding and recharge function is interpreted to sustain high water table conditions (saturated ground) beneath the feature.

Subcatchment FM1111

A medium constraint stream crosses the northeast corner of the Subject Lands and directs flow southeast to Fourteen Mile Creek East. This swale is identified as Stream Reach 14E-8 on **Figure 4.2**.

Flow conditions in reach 14E-8 are monitored at SS1, a culvert where flow crosses Bronte Road (**Figure 4.2**). On most of the monitoring dates, some standing water has been observed in the culvert, but there was only measurable surface water flow recorded on a rainy day in July 2021, with a flow of 0.3 L/s (**Table C-5-1**, **Appendix C-5**). There is also a staff gauge along the swale to measure depth of surface water (SG1; **Figure 4.2**). The depth of standing water recorded at SG1 has ranged between 2 cm and 16 cm of water (**Table C-5-2**, **Appendix C-5**). Monitoring of the groundwater conditions at this location in PZ1s/d shows the groundwater in the shallow piezometer has recovered to grade in this area and is found at or above the surface water level (**Figure C-4-2**, **Appendix C-4**). There is a strong downward gradient between PZ1s and PZ2d. These data suggest the shallow soils are a little more permeable than the deeper till, and there is a more active groundwater/surface water interaction in the surficial soils. Although there is a recharge gradient, it is likely that the volume of recharge reaching depth would be very limited.

Flow conditions in reach 14E-8 are monitored at SS1, a culvert where flow crosses Bronte Road (**Figure 4.2**). Conditions at SS1 have generally ranged from standing water to dry, with frozen conditions observed in the winter months. Flow has only been measured on a rainy day in July 2021, on a day following rain in December 2021, and in April 2022. The three recorded flows ranged from 0.3 to 5 L/s (**Table C-5-1, Appendix C**). There is also a staff gauge along the swale to measure depth of surface water (SG1; **Figure 4.2**). The depth of standing water recorded at SG1 has ranged between 2 cm and 18 cm of water (**Table C-5-2, Appendix C**). Piezometer PZ1d is interpreted to represent potentiometric elevations from the bedrock / overburden interface while PZ1s is assumed to represent the overburden. The groundwater elevations at PZ1d rose steadily after installation until January 2022 (**Figure C-4-21, Appendix C-4**), and the very slow recovery is indicative of very low soil hydraulic conductivity and limited movement of groundwater (refer to **Section 4.6.2** for a discussion of the hydraulic conductivity). Since stabilizing, there is an upward gradient between PZ1d and PZ1s. These data suggest the shallow soils are a little less permeable than the deeper soils and restrict the discharge of groundwater at surface. Due to its low hydraulic conductivity and the underlying high potentiometric elevations, the surface layer may become saturated and seep back out into the swale, with more lateral water movement than vertical, i.e., an active interflow situation would occur along the swale. Although there is a discharge gradient, dry conditions have been recorded at SG1 between June and August 2022. The data indicate that despite above-ground potentiometric elevations at PZ1d during this period, the volume of discharge is likely very limited due to the low hydraulic conductivity of the overlying soils.

4.3.2 Hydrologic Features

Hydrologic Features A are defined in NOCSS to be hydrological features located within Blue or Red Streams. There are no Hydrologic Features A within the Subject Lands.

Hydrologic features not associated with the NHS, are called Hydrologic Features B. As noted in **Section 2.0**, there are 4 Hydrologic Features B within the Subject Lands labelled as HYDB1, D-86/D-87, D-91, and D-92 on **Figure 4.2**. These are small and shallow closed depressions in the till that result from the hummocky topography. HYDB1 and D-86/D-87 are isolated features in FM1109A (**Figure 4.2**). D-91 is located on the drainage divide between FM1109A and FM1110.1 and D-92 is located in Subcatchment Area FM1110 (**Figure 4.2**).

The D-86/D-87 area was instrumented with a staff gauge (SG4) and a piezometer nest (PZ4s/d; **Figure 4.2**). When standing water has been observed in the feature, the water depth recorded at SG4 has ranged between 8 cm and 15 cm (**Table C-5-2, Appendix C-5**). The groundwater levels at PZ4s/d rose steadily after installation until July 2021 (**Figure C-4-16**, **Appendix C-4**), and this very slow recovery is indicative of very low soil hydraulic conductivity of the clay soils and limited movement of groundwater (refer to **Section 4.6.2** for a discussion of the hydraulic conductivity). The water levels indicate static conditions were reached in July 2021, when the levels declined slightly during the dry end of summer conditions. The water levels than rose to approximately 0.1 and 0.2 m below ground at PZ4s and PZ4d, respectively, in June 2022 and then declined to dry conditions in September 2022. The water levels show a strong downwards (recharge) hydraulic gradient at this location. The groundwater elevations are below the surface water elevations, supporting the interpretation that this depression fills up with surface water and has a recharge function. The storage available in the Hydrologic Features B and topographic depressions is addressed in **Section 7.12.2**.

The D-92 area was instrumented with piezometer (PZ6; **Figure 4.2**) in June 2022. Between June and September 2022, the groundwater levels have fluctuated between 0.3 and 0.6 m below ground (**Figure C-4-26, Appendix C-4**).

While not specifically measured at HYDB1 and D-91, visual field observations of these features suggest they have a similar function as recorded at D-86/D-87, and at Wetland 10 (discussed in **Section 4.3.1**), i.e., they hold some shallow ponding of water in wet conditions that supports a minor recharge function and then they dry out during periods of low precipitation. Ponding in the Hydrologic Features B is supported by the very low hydraulic conductivity clayey silt soils.

The storage available in the Hydrologic Features B and topographic depressions is addressed in **Section 7.12.2**.

4.4 CLIMATE

Conservation Halton has requested that the data from Royal Botanical Gardens (RBG) site be used for the water balance work in the EIR studies for the North Oakville area. As such, the long-term average annual precipitation and temperature data for the period between 1981 and 2010 from the Hamilton RBG climate station (Station 6153300 - 43°16.8'N, 79°52.8'W, elevation

102.1 masl) have been utilized in this study. Daily precipitation data from this station are provided on the datalogger hydrographs in **Appendix C-4**.

4.5 GEOLOGY

4.5.1 Stratigraphy

The MECP maintains a database that provides geological records of water supply wells drilled in the province. A list of the available MECP water well records for local private wells is provided in **Appendix C-1** and the well locations are plotted on **Figure 4.5**. The local surficial soil conditions have been investigated with an array of geotechnical boreholes (BH; **Figure 4.5**) drilled across the Subject Lands in 2021 and 2022. The drilling programs included a series of boreholes drilled to install monitoring wells (MW; **Figure 4.5**). The geotechnical investigation reports are provided in **Appendix I**. The borehole logs for the monitoring wells are provided in **Appendix C-2**.

The MECP water supply well logs, along with the geotechnical boreholes and groundwater observation well logs have been used to assess the local stratigraphy. The characteristics of the overburden sediments and shale bedrock are further described in **Sections 4.5.2** and **4.5.3**.

To illustrate the stratigraphy, five schematic cross-sections have been prepared. The cross-section locations are shown on **Figure 4.5** and the interpreted cross-sections are shown on **Figures 4.6**, **4.7**, **4.8**, and **4.9**. The cross-sections illustrate the basic stratigraphy typical of the North Oakville area, with glacial till overburden sediments overlying shale bedrock.

4.5.2 Surficial Geology

Surficial geology mapping published by the Ontario Geological Survey (2003) indicates that the EIR Subcatchment Area is covered by clayey silt to silt glacial till deposits (**Figure 4.3**). Regionally, the overburden sediments range in thickness from 0m to 25m. Detailed geological work in the North Oakville East area by Eyles & Eyles (2003) identified two layers of glacial till within the overburden deposits: an upper silt-rich till referred to as the Wildfield till, and a lower coarser-grained silty sand till referred to as the Halton till. The Eyles study noted that the Halton till generally occurs north of Burnhamthorpe Road and is not continuous throughout the North Oakville area so that in most places, the Wildfield till directly overlies the shale bedrock.

The borehole logs for the Subject Lands (**Appendix C-2** and **Appendix I**) describe the overburden sediments as predominantly clayey silt till overlying a transition zone containing till and weathered shale pieces overlying the bedrock (weathered shale). The overburden thickness varies across the Subject Lands from about 1 m to 20 m. Several boreholes encountered thin layers of sandy silt till underlying the clayey silt till containing traces of gravel and clay. As shown on **Figures 4.6** and **4.7**, this sandy till was only encountered in the southern half of the Subject Lands, infilling depressions or valleys on the bedrock surface. The clayey silt till is interpreted as the upper Wildfield till and the coarser grained till as Halton till as described by Eyles & Eyles (2003).

4.5.3 Bedrock Geology

As indicated on published bedrock geology mapping of the area (**Figure 4.4**), the EIR Subcatchment Area is underlain by shale bedrock of the Queenston Formation. This late-Ordovician aged bedrock consists of relatively soft, friable, red and green shale containing thin (< 30cm) interbeds of fine sandstone and siltstone. Within the Subject Lands, the depth to bedrock varies with the bedrock elevation ranging between about 136 masl to 164 masl (**Figures 4.6**, **4.7**, **4.8**, and **4.9**).

In the northern portion of the Subject Lands, bedrock is very close to surface (**Figure 4.6**). The bedrock surface is gently undulating and the regional bedrock contours (shown on **Figure 4.4**) show the surface slopes to the south; a bedrock valley has been regionally mapped to the west of Subject Lands. As shown on **Figure 4.7**, the depth of overburden is thickest in the south portion of the Subject Lands, with bedrock encountered at about 20 m below grade at a local depression in the bedrock surface.

4.6 HYDROGEOLOGY

4.6.1 Local Groundwater Use

In the North Oakville area there are no high-yielding water supply aquifers reflecting the general lack of coarse-grained sand and gravels and the relatively low hydraulic conductivity of the glacial till and shale materials. A review of MECP water well records (**Appendix C-1**) indicates that local water supply wells generally tap the upper portions of the Queenston shale bedrock. The till and shale materials are generally considered to be poor aquifers and the local water yields are typically very low (less than 0.15 L/s).

Municipal water supply for the Town is surface water obtained from Lake Ontario. The proposed development will be municipally serviced, and in the long term, it is anticipated that the entire North Oakville area will be on lake-based municipal supplies. There is no proposed groundwater use for the proposed development (refer to **Section 9.3** for Water Servicing Details).

It is noted that there may be continued interim use of groundwater for private well supplies in the Palermo Village area east of Bronte Road. It is important that the development does not disrupt these local water supplies and monitoring of selected supply wells before, during and after construction will be required (refer to **Section 11.5** for details of the recommended monitoring of local private water supply wells still in use during development).

4.6.2 Groundwater Levels

In southern Ontario, there is a seasonal pattern that typically appears on groundwater level hydrographs, particularly in shallow wells. The groundwater levels tend to be the highest in the spring, decline throughout the summer and early fall and then rise again in the late fall/early winter, however, this seasonal pattern is highly dependent on the annual and seasonal climate variations. Based on long-term monitoring data available in similar hydrogeological settings in

North Oakville, the seasonal variation in the till and shale layers is expected to be generally less than about 2 m.

The groundwater monitoring data gathered to date show the following (refer to **Figure 4.1** for the monitoring locations and the hydrographs in **Appendix C-4**). The hydrographs show the water levels generally follow the typical seasonal trends. The seasonal fluctuation at the wells installed in 2021 has ranged from approximately 0.4 to 2.3 m, except at MW21-4 where the monitoring well fluctuated by approximately 3.3 m (**Figure C-4-5, Appendix C-4**). This well is screened at the top of the shallow weathered shale in the northwest corner of the Subject Lands (**Figure 4.1**). It is beside an incised drainage swale (14W-8) that intersects the shale (refer to cross-section C-C' on **Figure 4.8**), suggesting the groundwater may flow along the top of the shale towards the watercourse in this area. As discussed in **Section 4.3.1**, there has been no evidence of groundwater seepage to the swale; flow volumes are likely just too low to result in visible flow. Seven monitoring wells were installed in March 2022, and seasonal trends have been obscured at two of these wells (MW22-9 and MW22-18) where the groundwater levels were recovering from March to July 2022. Dataloggers were installed in MW21-5 (completed in the shallow clayey silt till) and MW21-15 (completed in the deeper silty clay layer overlying the bedrock). The detailed datalogger hydrographs available for these wells show that the groundwater levels do not appear to respond directly or rapidly to precipitation inputs, suggesting that the till layers have low hydraulic conductivity and are not heavily fractured (**Figures C-4-5** and **C-4-9**; **Appendix C-4**). The significant water level changes shown by the datalogger in MW21-15 occurred when a well development and sample tube was removed and reinstalled and then the well was bailed down for hydraulic conductivity testing (**Figure C-4-9**, **Appendix C-4**). The well recovery to static after bailing these wells took several days, again showing how little groundwater is moving through these tight soils.

The ground elevations at each well location are provided on the hydrographs in **Appendix C-4**. The recorded depths to groundwater in the monitoring wells to date ranges from approximately 0.2 m (at MW21-5 and MW22-6) to about 7 m below ground (at MW22-16) and 15.1 m below ground at MW22-17. The low water levels at MW22-17 are interpreted to be due to its proximity to the bank of the Fourteen Mile Creek West where ground surface drops approximately 8m to the level of the creek. The piezometer data were discussed in **Section 4.3** and showed high water table conditions along the incised drainage swale in the northwest corner of the Subject Lands (14W-18; **Figure 4.2**) and in the central areas beneath Wetland 10 and D-92.

4.6.3 Hydraulic Conductivity

The grainsize analyses for the till materials were reviewed, and the data show very high percentages of clay and silt (**Figure C-3-5 to C-3-8**, **Appendix C-3**). Bail-down tests were conducted in two monitoring wells to estimate the hydraulic conductivity of these soils. The water level responses were too slow to record recovery on the day of testing, and staff had to return several days later. Based on the observations, it is concluded that the hydraulic conductivity of the clayey silt till and shale layers is less than 1 $x10^{-7}$cm/sec. The testing data are provided in **Appendix C-3**.

Most of the hydrographs for monitoring wells and piezometers also confirm the low hydraulic conductivity of the soils, with groundwater levels being slow to stabilize to static conditions after drilling, and in some cases, taking several months for the water levels to recover (refer to hydrographs in **Appendix C-4** and discussion in **Section 4.6.2**). This shows how limited the movement of groundwater is through these 'tight' soils.

4.6.4 Groundwater Flow Conditions

Groundwater elevation data from June 3, 2022, are shown on **Figure 4.10**, along with the interpreted groundwater elevation contours for the Subject Lands. The interpreted groundwater elevation contours suggest that lateral groundwater flow is generally moving south and is influenced by the topography, with components of groundwater flow converging along the lower portions of 14W-18 and 14W-20 and the incised Fourteen Mile Creek West valley (**Figure 4.10**).

The lateral flow gradient across the Study Area is low (about 0.01). The low gradient and the low hydraulic conductivity of the till and underlying shale materials restrict groundwater movement and suggest that the groundwater flux (quantity or volume of water flow) that moves through the area is limited.

4.6.5 Recharge and Discharge Conditions

Groundwater elevations in some of the monitoring wells and piezometers were very slow to recover and, in some cases, may be yet to reach static. The data obtained to date show downward gradients (recharge gradients) at the shallow piezometers, but when compared to groundwater elevations measured in deeper monitoring wells, the downward vertical gradients are very low to flat. Due to the very low hydraulic conductivity of the clayey till overburden layer, the data suggest that infiltrating precipitation will recharge into the top meter or so of soil and predominantly remain shallow, moving in and out of the topsoil layers as interflow. A small volume of water will recharge deeper downwards through the surficial tills and to the top of the bedrock. It is likely that infiltration to the water table and groundwater movement, throughout the area, is predominantly controlled by fracturing. The top layer of broken and weathered shale is considered to be relatively transmissive and a zone of preferential groundwater movement; groundwater reaching this layer would be expected to seep laterally along the top of the shale with the flow directions influenced by the bedrock topography. Discharge conditions are expected along the Fourteen Mile Creek West valley, and likely along the lower incised portions of 14W-18 and 14W-20 where the streams intersect the shale bedrock and the lateral groundwater flow is interpreted to converge (**Figure 4.10**), although no groundwater discharge has been observed.

Within the Subject Lands, surface water ponding occurs in topographic depressions, Wetland 10 and Hydrologic Features B (refer to discussions in **Section 4.3**). Such depressional features are generally considered to function as groundwater recharge features as the presence of standing water increases the availability of water for infiltration into the underlying sediments. This recharge will maintain high water table conditions below the features.

4.7 WATER QUALITY

4.7.1 Groundwater Quality

The local groundwater quality in the North Oakville area is considered to be relatively poor in terms of drinking water supplies. In a regional water resources study of the area by the Ministry of the Environment in 1979 (now MECP), water from the Queenston Formation shale was characterized as having high total dissolved solids (TDS) and elevated chloride, sodium, and sulphate concentrations compared to water from other types of bedrock or overburden materials. The 1979 study reported minimum, maximum and mean concentrations of these parameters (based on 14 samples). Chloride concentrations, for example, were highly variable and ranged from 6 mg/L to 495 mg/L with a mean of about 150 mg/L. The Ontario Drinking Water Quality Standards (ODWQS) set the aesthetic drinking water objective for chloride at 250 mg/L. Water, with a chloride concentration above about 250 mg/L, may have a salty taste and often residents will rely on bottled water for drinking supplies.

In order to characterize the groundwater quality within the surficial clayey silt till, groundwater samples were collected on July 14, 2021 from two monitoring wells (MW21-5 and MW21-8). The samples were sent to an accredited laboratory and analyzed for general water quality indicator parameters (pH, conductivity, hardness, total suspended solids, etc.), basic ions such as chloride and nitrate, and selected metals. The groundwater chemistry results are summarized in **Table C-6-1**, **Appendix C-6**. The shallow groundwater is not used for drinking on the Subject Lands; however, the ODWQS are listed on **Table C-6-1** for water quality comparison purposes (**Appendix C-6**).

The key groundwater quality characteristics are summarized as follows:

- The results for MW21-5, screened across the silty clay till and the shale bedrock at 3.7 m below grade, indicate that the groundwater has elevated amounts of total dissolved solids (1,640 mg/L) and sulphate (831 mg/L). Chloride is reported at 28 mg/L. Sodium (151 mg/L) was above the aesthetic objective (20 mg/L) for which the local medical officer of health needs to be informed when water is proposed for domestic use. There is no domestic use of groundwater proposed in the area and hence the finding has no implementation requirements. In addition to these parameters, total hardness and turbidity exceed the ODWQS. Iron is fractionally below the ODWQS.

- MW21-8 was screened in the silty clay till and only touches the shale bedrock. The water quality data for this well had lower concentrations of total dissolved solids (706 mg/L) and sulphate (130 mg/L). Chloride was also slightly lower at this location (24 mg/L) and sodium (61 mg/L) was still above the aesthetic objective of 20 mg/L. Other parameters in exceedance of the ODWQS at MW21-8 included total hardness, alkalinity and turbidity.

4.7.2 Surface Water Quality

There has been insufficient flow to date at any of the monitoring locations on the Subject Lands to permit sampling of the surface water for laboratory testing, however, field monitoring data was measured with handheld probes if any flow was noted in the swales. Flow monitoring will continue through 2021. The salinity, temperature, dissolved oxygen, pH, conductivity, total dissolved solids and total suspended solids in the surface water runoff are provided in **Table C-6-2** in **Appendix C-6**. The salinity readings of 0.8 to 2.2 ppt and the conductivity readings in the range of 1400 to 4100 us/cm suggest the runoff water is somewhat mineralized. Temperature readings reflected air temperatures with readings from 1.6 to 22.5 degrees, dissolved oxygen is low (1.1 to 5.8 mg/L) and TSS was recorded from 0 to 45 mg/L.

5 TERRESTRIAL, AQUATIC AND STREAM SYSTEMS, INCLUDING SPECIES AT RISK

5.1 OVERVIEW OF SUBCATCHMENT CHARACTERISTICS

The Subject Lands straddle the drainage divide between Fourteen Mile Creek West and Fourteen Mile Creek East and lie within three designated EIR Subcatchment Areas that were identified in the NOCSS as shown on **Figure 4.2**. FM1109 and FM1110 drain to Fourteen Mile Creek West and FM1110.1 and FM1111 drain to Fourteen Mile Creek East. Surface water runoff is directed overland via a series of drainage swales through the fields and ditches along the roads as shown on **Figure 4.2**.

The main branch of Fourteen Mile Creek West originates from a series of woodlands north of Highway 407 and flows south through Core 1. Consistent with NOCSS findings, Core 1 is comprised of woodlands, wetlands, meadows and agricultural vegetation communities. Remaining areas on the Subject Lands are largely agricultural.

At the downstream end of the Highway 407 culvert, the Stream Reach 14W-4 is comprised predominantly of riprap, rock and boulders. Riparian vegetation is composed of grasses and shrubs that provide little cover to the stream. Further downstream from the highway, Reach 14W-4 flows through a meadow where channel substrate is composed of silt, clay, muck, gravel and cobble with boulder present in isolated areas. Channel morphology is defined by riffle and pool sequences. In-stream habitat is provided by woody debris, boulders, and undercut banks. Reach 14W-4 terminates at the northern edge of the mature woodland associated with Core 1.

Reach 14W-3 flows through the eastern side of the mature woodland associated with Core 1. It is represented by a series of riffle and pool sequences. In-stream habitat is provided by backwatered areas, woody debris, and undercut banks. Channel substrate is comprised of silt, clay, muck, cobble, sand and gravel. The forest canopy provides shading to the channel, allowing for thermal regulation.

South of the woodland, the channel flows through a riparian meadow extending south to Dundas Street as represented by Reaches 14W-2, 14W-1A and 14W-1. Channel morphology is defined by riffle and pool sequences. Substrate is composed of silt, clay, sand, gravel and cobble. Riparian vegetation consists of grasses, forbs, scattered shrubs and small trees. In-stream habitat is provided by substrate, overhanging vegetation and backwatered areas.

Fish community sampling results from NOCSS indicate that Fourteen Mile Creek West within the Subject Lands predominantly supports a warmwater fish community. One provincially and regionally significant species, Redside Dace, was found in the lower reaches of Fourteen Mile Creek West. Redside Dace are considered a coolwater species that require clear flowing water with overhanging vegetation.

There are two Provincially Significant Wetlands (PSWs) within the EIR Subcatchment Area (PSWs 6 and 7) (**Figure 5.1**).

Wetland 10 was formerly included in the PSW complex and occurs in the agricultural fields, located centrally on the Subject Lands and is isolated from Core 1 and other natural features. As part of this EIR/FSS, Wetland 10 has been re-evaluated under the *Ontario Wetland Evaluation System, 4th edition* (MNRF 2022) and has been confirmed to not meet the criteria to be considered Provincially Significant. The re-evaluation has been submitted to the Town and MNRF to reflect the change in status and a recent review of the LIO database reveals that this wetland is no longer identified as a PSW. PSW 6 is situated within Core 1 immediately south of the confluence of Reaches 14W-12 and 14W-11. Finally, PSW7 is located east of Old Bronte Road immediately north of Dundas Street.

There are also three Provincially Significant Wetlands (PSW) in Core 1 outside of the EIR Subcatchment Area (PSWs 8, 11 and 12).

5.2 TERRESTRIAL FIELD INVESTIGATIONS

In 2021, field surveys were carried out to screen the Subject Lands and Core 1 for Species at Risk (SAR). The screening methods and results are described below in the following section, and **Table 5.1** includes a summary of screening surveys undertaken by Beacon on the Subject Lands in 2021.

Table 5.1 - Summary of Natural Heritage Surveys for SAR Completed by Beacon for Subject Lands

Survey Type	Date of Survey
General Vegetation	July 12, 2021
Winter Wildlife Survey	January 22 and 28, February 10, 18 and 24, and December 22, 2021; January 26, March 1 and March 12, 2022
Amphibian Survey	April 5, May 25, and June 23, 2021
Snake Survey	April 7, 8 and 19, 2021
Breeding Bird Survey (including Bird Marsh Surveys)	June 2 and 25, 2021

During all surveys, field staff screened for the presence of any provincially endangered or threatened species, as well as any other federally, provincially or locally significant species.

5.2.1 Ecological Communities (ELC) and Vegetation Resources

Ecological communities associated with the Subject Lands were reviewed on July 12, 2021, to verify the ELC mapping presented in the NOCSS. A summary of the ecological communities is provided in **Table 5.2** and ELC mapping is provided in **Figure 5.1**.

Based on field verification in 2021, several minor refinements were made to the NOCSS ELC community classifications and mapping. These changes are described below.

Units 4a and 4b are successional communities dominated by hawthorns which were previously mapped as part of unit 6a (Dry-Fresh Sugar Maple-Oak Deciduous Forest). Based on field review, these communities were re-classified as cultural thicket (CUT1) to reflect their structure and dominant species composition. In the NOCSS, Unit 7b (Dry-Fresh Oak-Hardwood Deciduous Forest) was mapped along the western edge of the valley slope, extending up to Dundas Street. Based on Beacon's review, the south end of this unit was revised to exclude a portion of the valley slope where tree cover becomes more open and sporadic and a small patch of Black Locust (*Robina pseudoacacia*) just north of Dundas Street. The patch of Black Locust, a non-native invasive species, was mapped and classified as a Cultural Woodland (CUW) (ELC unit 5).

Units 9b, 9c, and 9d (Mineral Meadow Marsh) approximately correspond with a small group of wetlands mapped on agricultural lands outside of Core 1 in the NOCSS. The composition and boundaries of these features have been modified as a result of on-going farming practices. The boundaries and classification have been revised to reflect existing conditions as illustrated in in **Figure 5.1**.

Table 5.2 - Vegetation Communities for the EIR Subcatchment Area

Unit	ELC Community Type	ELC Code	Description
1	Agricultural	AG	Fields consisting of agricultural row crops (soya and corn)
2	Hedgerow	HE	Dominated by Common Buckthorn (*Rhamnus cathartica*), Hawthorns (*Crataegus* spp.), Apple (*Malus pumila*), and Common Pear (*Pyrus communis*). Occasional taller trees include mature Bur Oak (*Quercus macrocarpa*) and Shagbark Hickory (*Carya ovata*).
3	Cultural Meadow	CUM1	Meadows consisting of typical old fields species including Smooth Brome Grass (*Bromus inermis*), Tall Goldenrod (*Solidago altissima*), Tufted Vetch (*Vicia cracca*), asters (*Symphyotrichum* spp.), and Creeping Thistle (*Cirsium canadensis*).
4	Cultural Thicket	CUT1	Thicket communities within the study area are dominated by hawthorns and Common Buckthorn.
5	Cultural Woodland	CUW1	Small woodland feature dominated by non-native Black Locust (*Robinia pseudoacacia*).

Unit	ELC Community Type	ELC Code	Description
6	Dry-Fresh Sugar Maple-Oak Deciduous Forest	FOD5-3	Mature forest community dominated by Sugar Maple (*Acer saccharum*), Red Oak (*Qurecus rubra*), Shagbark Hickory, and Bur Oak. Understory comprised of Sugar Maple and Chokecherry (*Prunus serotina*). Ground covers include Sugar Maple, Garlic Mustard (*Alliaria petiolata*), Herb Robert (*Geranium robertianum*), and Pennsylvania Sedge (*Carex pennsylvanica*).
7	Dry-Fresh Oak-Hardwood Deciduous Forest	FOD2-4	Forest dominated by Oak with Sugar Maple, White Ash (*Fraxinus americana*), Beech (*Fagus grandifolia*), Basswood (*Tilia americana*), Ironwood (*Ostrya virginiana*), and Black Cherry (*Prunus serotina*) associates.
8	Dry-Fresh Sugar Maple-Hickory Deciduous Forest	FOD5-5	Forest dominated by Sugar Maple in association with Bitternut Hickory and Shagbark Hickory.
9a	Mineral Meadow Marsh	MAM2-2	Dominated by Common Reed (*Phragmites australis*) and Narrow-leaved cattail. Water-plantain (*Alisma trivale*) and Purple Loosestrife (*Lythrum salicaria*) are lesser associates
9b	Mineral Meadow Marsh	MAM2	Agricultural wetlands periodically farmed through, supporting minimal wetland vegetation – Common Reed, Lance-leaved Aster, Purple Loosestrife.
9c,9d (Wetland 10)	Mineral Meadow Marsh	MAM2	Agricultural wetlands farmed and cropped, supporting minimal wetland vegetation – Willow, Common Reed, Lance-leaved Aster.
9e	Mineral Meadow Marsh	MAM2-2	Common Reed (*Phragmites australis*) marsh.
10	Reed Canary Grass Mineral Meadow Marsh	MAM2-2	Small marsh dominated by Reed Canary Grass (*Phalaris arundinacea*).
11	Cattail Mineral Shallow Marsh	MAS2-1	Small marsh dominated by Narrow-leaved cattails in association with Water-plantain and Purple Loosestrife.
12 PSW6	Duckweed Floating-leaved Shallow Aquatic	SAF1-3	Small pond dominated by Lesser Duckweed (*Lemna minor*). North Oakville – Milton West Provincially Significant Wetland Complex – Unit 6.

A checklist of vascular plants associated with the Subject Lands, including their significance status is presented in **Appendix D-2**. No species at risk vegetation have been recorded on the Subject Lands.

5.2.2 Wildlife Resources

5.2.2.1 Amphibian Surveys

Within NOCSS, eight species of amphibians were noted for Core 1, which are listed in **Appendix D-3**.

Amphibian call surveys were undertaken to document species richness and abundance of frog and toad populations associated with the Subject Lands in 2021. Because there is variation in the breeding periods during which different frog and toad species frogs are calling and detectable, surveys were completed at three different periods between April and June to ensure coverage of the full range of early to late breeding species.

In 2021, Beacon conducted surveys on April 5, May 25, and June 23 using the survey protocols developed for the Marsh Monitoring Program (MMP) (Bird Studies Canada, 2009 Edition). On each occasion the Subject Lands were visited at least 0.5 hours after sunset during suitable weather conditions to listen for calling frogs and toads. The locations of these amphibian monitoring stations are illustrated in **Figure 5.2**. Amphibians observed or heard calling in other locations on the property during these and other surveys were also recorded as incidental observations.

Surveys were conducted using the point count method whereby the surveyor stands at a set point or station for a specific period of time and records all species that can be heard calling within the sample area. A minimum of three minutes was spent listening at each station. The approximate locations of calling amphibians were noted on a standard MMP data sheet and chorus activity for each species was assigned a call code as follows:

0 - No calls;
1 - Individuals of one species can be counted, calls not simultaneous;
2 - Calls of one species simultaneous, numbers can be reliably estimated; and
3 - Full chorus, calls continuous and overlapping, individuals indistinguishable.

In addition to recording species and call levels, weather conditions (i.e., air temperature, precipitation, wind speed, and cloud cover) at the time of survey were also recorded. Weather conditions for the 2021 surveys are summarized in **Table 5.3** below.

Table 5.3 - Amphibian Survey Details (2021)

	Survey 1	**Survey 2**	**Survey 3**
Date	April 5, 2021	May 25, 2021	June 23, 2021
Start time	20:20	21:16	21:33
Temperature	9 °C	27°C	20°C
Wind speed	0 km/h	11 km/h	11 km/h
Cloud cover	60%	90%	20%
Precipitation	None	None	None

Two frog species were recorded from twelve stations on the Subject Lands during the 2021 nocturnal amphibian call surveys. Species included Gray Tree Frog (*Hyla versicolor*), and

Spring Peeper (*Pseudacris crucifer*). The findings of the amphibian breeding surveys are summarized in **Table 5.4**.

The primary amphibian breeding areas on the Subject Lands include: Station 1, located in ELC wetland unit 9b, and Station 4, near ELC unit 4a in Core 1 on the Subject Lands (**Figure 5.2**).

Table 5.4 - Breeding Amphibian Survey Results for the Subject Lands (2021)

Location (Figure 5.2)	Survey 1 (April 5, 2021)	Survey 2 (May 25, 2021)	Survey 3 (June 23, 2021)
1	SPPE – 3 SPPE*	0	0
2	SPPE*	0	0
3	SPPE – 1(1) SPPE*	GRTR*	0
4	SPPE*	GRTR – (2)2	GRTR*
5	SPPE*	GTRT*	GRTR*
6	0	GRTR*	0
7	SPPE – 2(4)	0	0
8	SPPE – 1(1)	GRTR*	GRTR*
9	SPPE*	GRTR*	0
10	SPPE*	0	0
11	SPPE*	0	0
12	SPPE*	0	0

* = Call recorded from outside of station area
GRTR = Gray Tree Frog, SPPE = Spring Peeper,
Code 0 - No calling
Code 1 - Individuals can be counted; calls not simultaneous. Estimated number of individuals indicated in brackets.
Code 2 - Calls distinguishable, some simultaneous calling. Estimated number of individuals indicated in brackets.
Code 3 - Full chorus; calls continuous and overlapping.

Fewer species were noted during surveys of the Subject Lands in 2021 when compared to NOCSS in surveys completed prior to 2006. This may be due in part to the changes in the broader landscape, much of which has since been urbanized, or due to the drier than usual spring conditions. It should however be noted that Gray Treefrog was observed in 2021 but not during previous NOCSS surveys. No endangered or threatened species were observed. The species that were observed are all considered common or abundant in Halton Region and were observed in low numbers.

5.2.2.2 Reptile Surveys

Surveys for turtles were not conducted on the Subject Lands due to the absence of suitable aquatic habitat (ponds). The closest suitable habitat are the dug ponds that are located on the Zenon lands immediately to the west of Core 1, outside of the EIR Subcatchment Area.

The Subject Lands contain structures such as building foundations, slash piles, yard waste piles, concrete stockpiles and rodent holes / dens that could potentially be used as hibernacula for overwintering snakes. Eastern Milksnake (*Lampropeltis triangulum*) and Eastern

Gartersnake (*Thamnophis sirtalis sirtalis*) were previously recorded in Core 1 during NOCSS, so it is possible these species may be present on the Subject Lands.

To confirm if these species are present or if hibernacula exist on the Subject Lands, surveys were completed in accordance with the *Survey Protocol for Ontario's Species at Risk Snakes* (MNRF 2016). This survey protocol is intended to assess the presence of snakes during key emergence periods (early spring) and to locate potential hibernacula sites. Snakes hibernate throughout the winter seasons and become active in April or May as temperatures rise. During the active seasons, snakes regulate their body temperatures to be between 25-34 °C which is why snakes are most likely to bask on sunny days when ambient temperature is lower than preferred body temperatures (MNRF 2016). Surveys are focused on microhabitats that include heat conductive features such as rock piles, open grassy fields, hedgerows, concrete pads and leaf piles.

Surveys of potential basking sites consisted of examining rock piles, existing foundations, culverts, ditches, anthropogenic items and gardens on and adjacent to the Subject Lands. Three surveys were completed and details of the surveys are summarized in **Table 5.5**.

Table 5.5 - Survey Details for Snake Hibernaculum Surveys

	Survey 1	Survey 2	Survey 3
Date	April 7, 2021	April 8, 2021	April 19, 2021
Start time	9:45	12:45	10:10
End time	12:45	15:30	11:45
Temperature	13-18 °C	20 °C	17 °C
Wind	0-10km/hr	0-10km/hr	~20km/hr
Cloud cover	0%	0%	25%
Precipitation	None	None	None

The Subject Lands support a variety of habitats that could be used by snakes such as broken concrete piles, rock piles, concrete buildings, and brush piles. In addition, the Subject Lands support a number of rodent burrows (voles, rabbit) that could be used by snakes as overwintering habitat.

No snakes were observed during any of the surveys suggesting that hibernacula are not likely present. An individual Eastern Gartersnake was observed incidentally on April 23, 2021, and June 30, 2021.

5.2.2.3 Breeding Bird Surveys

Appendix D-4 provides a summary of just those bird species observed during the 2021 field surveys. To confirm the composition of the avian community on the Subject Lands, Beacon biologists completed two surveys for breeding birds. Surveys were conducted using the protocols provided in the *Ontario Breeding Bird Atlas (OBBA) Guide for Participants* (Cadman *et al*. 2007) at an appropriate time of day (i.e., between dawn and five hours after dawn) and under suitable weather conditions (i.e., no thick fog or precipitation; winds generally less than 20

km/h). Survey details are presented in **Table 5.6**. In addition, marsh bird call recordings were played near wetland habitats to confirm presence/absence of marsh species. The locations of marsh bird survey sites are illustrated on **Figure 5.2**.

Table 5.6 - Breeding Bird Survey Details

	Survey 1	Survey 2
Date	June 2, 2021	June 30, 2021
Time of Survey	5:30 - 9:00	5:30 – 9:15
Temperature (°C)	12 °C	24 °C
Wind Speed (km/h)	0 km/h	0 km/h
Cloud Cover (%)	0%	100%
Precipitation	None	None

A total of 45 species of birds were recorded on the Subject Lands in 2021, 33 of which were breeding or suspected to be breeding. Six species were observed flying over the site or were recorded outside of breeding periods, and not considered to be breeding.

All of the species documented are considered common, abundant and widespread in Ontario (S5) or uncommon in the Province (S4), or are considered exotic (SE). Also, a majority of species are considered common or abundant in Halton Region (McIlveen 2006).

Of the species considered to be breeding, three regionally uncommon species were observed including: Sora (*Porzana carolina*), Horned Lark (*Eremophila alpestris*) and Vesper Sparrow (*Pooecetes gramineus*).

A complete list of bird species documented on the Subject Lands along with their status is provided in **Appendix D-2**. One avian SAR species were recorded during the breeding bird surveys in 2021: Barn Swallow (*Hirundo rustica).* This species is listed as threatened provincially and federally and were only observed flying over the site. No breeding evidence for this species was observed on the Subject Lands.

5.2.2.4 Winter Wildlife Monitoring

To better understand how wildlife use the Subject Lands, wildlife cameras were installed in strategic locations and track surveys were completed during the winter months after snow events. These winter wildlife surveys were focused primarily on mammals for the purpose of identifying areas where wildlife may be utilizing existing culverts to cross roads and to identify potential wildlife concentration areas.

5.2.2.4.1 Wildlife Camera Monitoring

Winter wildlife camera monitoring was conducted in 16 locations across the two winter seasons shown on **Figure 5.2**. An example of a typical camera is shown in **Photo 5-1**. These cameras were deployed in both the winter of 2021 and 2022: from February 10, 2021, to May 26, 2021, and from December 22, 2021, to May 25, 2022. Note that camera locations were periodically moved throughout the winter of 2022 to ensure adequate coverage.

Most camera observations were Coyote (**Photo 5-2** [*Canis latrans*]), followed by Gray Squirrel (*Sciurus carolinensis)*, and White-tailed Deer (*Odocoileus virginianus*). Coyote use was frequently observed throughout the site, including the culverts beneath Highway 407, Bronte Road, and Dundas Street West. White-tailed Deer observations were concentrated at camera locations 3D, 4B, and 4C. Deer were also observed at 1E, 2D, and 7D, but in lesser abundance.

Other species detected by the wildlife cameras included American Crow (*Corvus brachyrhynchos*), American Robin (*Turdus migratorius*), American Tree Sparrow (*Spizella arborea*), Blue Jay (*Cyanocitta cristata*), Blue-winged Teal (*Anas discors*), Canada Goose (*Branta canadensis*), Eastern Cottontail (*Sylvilagus floridanus*), Great Blue Heron (*Ardea herodias*), Mallard (*Anas platyrhynchos*), Mink (*Mustela vison* [**Photo 5-3**]), Muskrat (*Ondatra zibethicus*), Raccoon (*Procyon lotor* [**Photo 5-4**]), Red-winged Blackbird (*Agelaius phoeniceus*), Song Sparrow (*Melospiza melodia*), Virginia Opossum (*Didelphis virginiana*), White-crowned Sparrow (*Zonotrichia leucophrys*), and Wood Duck (*Aix sponsa*).

All wildlife camera observations are summarized in **Appendix D-5**.

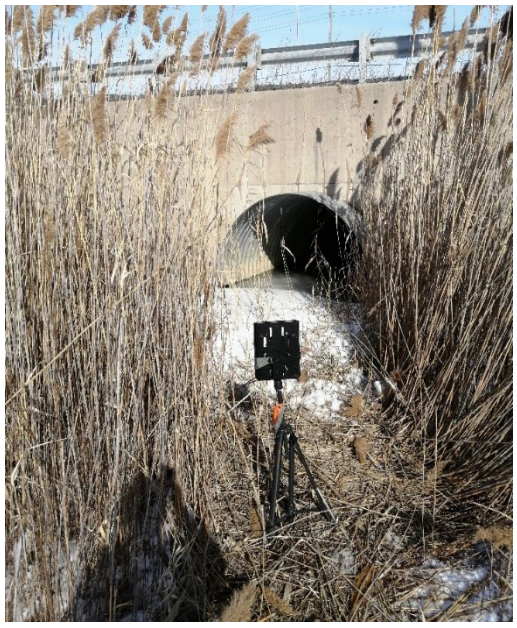

Photo 5-1
Wildlife Camera Location 1 (2020–2021) – existing CSP culvert under Bronte Road

Photo 5-2
Wildlife Camera Location 5 (2021–2022) – Coyote utilizing existing culvert under Dundas

	Street West
	
Photo 5-3 **Wildlife Camera Location 1 (2020–2021) – Mink utilizing existing culvert in Proposed Enhanced LPA to cross Bronte Road**	**Photo 5-4** **Wildlife Camera Location 2 (2020–2021) – Racoon utilizing existing culvert under Highway 407**

5.2.2.4.2 Winter Wildlife Track Surveys

Winter wildlife track surveys consisted of biologists visiting the site on nine (9) occasions within 48 hours of a snowfall when probabilities of detecting fresh tracks was highest. Five surveys were conducted in 2021 and four surveys were conducted in 2022. Stick nests of raptor species or herons were also noted at this time for follow-up in the field season. Site visit details are included in **Table 5.7** and **Table 5.8**.

Table 5.7 - Winter Wildlife Survey Details (Winter 2020/2021)

	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5
Date	Jan 22, 2021	Jan 28, 2021	Feb 10, 2021	Feb 18, 2021	Feb 24, 2021
Start time	10:00	9:30	8:00	8:00	8:00
Temperature	-4°C	-10°C	-15°C	-7°C	0-6°C
Wind speed	0 km/h	11 km/h	5 km/h	19 km/h	5 km/h

	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5
Cloud cover	30%	0%	10%	100%	100%
Precipitation	None	None	None	None	None
Personnel	R. Aiken	R. Aiken, A. Cunningham	G. Coker, R. Aiken, A. Cunningham	G. Coker, A. Cunningham	G. Coker, A. Cunningham

Table 5.8 - Winter Wildlife Survey Details (Winter 2021/2022)

	Survey 1	Survey 2	Survey 3	Survey 4
Date	Dec 22, 2021	Jan 26, 2022	Mar 1, 2022	Mar 12, 2022
Start time	11:00	NR	NR	7:00
Temperature	2°C	-14°C	-1°C – 6°C	-6°C
Wind speed	25 km/h	35 km/h	5 km/h	10 km/h
Cloud cover	100%	100%	100%	100%
Precipitation	Light snow	None	None	None
Personnel	D. Krivenko	D. Krivenko	D. Krivenko, G. Bolton	G. Bolton

A total of 12 species were identified through tracking surveys, all of which are commonly associated with rural landscapes within southern Ontario. These species included Beaver (*Castor canadensis*), Canada Goose, Coyote, Eastern Cottontail, Gray Squirrel, Mink, Mouse species (*Peromyscus* sp.), Raccoon, Red Squirrel (*Tamiasciurus hudsonicus*), Vole species (*Microtus* sp.), White-tailed Deer, and Wild Turkey (*Meleagris gallopavo*). Small passerine bird tracks were also noted in understory locations, and these may have been caused by Dark-eyed Junco (*Junco hyemalis*). Except for beaver, these species were all previously recorded within Core 1 in NOCSS, and based on those previous records, other species that are likely to occur are Striped Skunk (*Mephitis mephitis*), Eastern Chipmunk (*Tamias striatus*), Red Fox (*Vulpes vulpes*), and other mammals as listed in **Appendix D-5.**

Information collected through these observations informed the analysis of how wildlife utilize the Subject Lands. The most notable observation, which was supported in both winter seasons, was that deer did not utilize the EIR Subcatchment Area in great numbers, and coyote was the most prominent species recorded.

As confirmed through the wildlife camera observations, coyote activity was frequently observed throughout the Subject Lands, including in the vicinity of the large culverts. Coyote was most

frequently detected along the riparian corridor of Fourteen Mile Creek and also concentrated along treed hedgerows. There were very few areas on the Subject Lands where coyote activity was undetected.

Utilization of the Subject Lands by deer was very low, which is expected given the high usage by coyote which can predate deer. Deer use was concentrated along the southern hedgerows and the cultural meadow adjacent to Fourteen Mile Creek. Although infrequently observed in other areas, deer evidence was limited to some hedgerows and the Core 1 area.

Small mammal evidence included Beaver, Eastern Cottontail, Gray Squirrel, Mink, Mouse species (*Peromyscus* sp.), Raccoon, Red Squirrel (*Tamiasciurus hudsonicus*), Vole species (*Microtus* sp.). Beaver and mink signs were observed in the riparian corridor in Core Area 1. Note that mink was also observed using the Bronte Road culvert, at Camera Monitoring Station 1. The remaining small mammal signs were mostly limited to the hedgerow at the north end of the Subject Lands and the Core Area 1 forest.

Bird track evidence included Canada Goose, Wild Turkey, and small passerine tracks. These observations were primarily limited the hedgerows; however, Wild Turkey were observed feeding on soybean in the southern field adjacent to the Fourteen Mile Creek riparian corridor . Based on the concentration of small passerine tracks under hedgerows, these tracks may be assumed to be Dark-eyed Junco.

No raptors or stick nests were observed during the winter wildlife surveys in 2021 or 2022. However, during the winter wildlife surveys in 2021, Red-tailed Hawk (*Buteo jamaicensis*) and Northern Harrier (*Circus cyaneus*) were observed flying through the Fourteen Mile Creek West valleyland and briefly over the EIR Subcatchment Area. Other bird species that were noted during these surveys are included as incidentals in **Appendix D-5**.

5.3 AQUATIC RESOURCES

5.3.1 Confirmation of Reach Breaks

NOCSS identifies a number of stream reach breaks for Fourteen Mile Creek, and its tributaries, illustrated on **Figure 4.2**. Based on site visits conducted by Beacon on March 12, 2021, March 18, 2021, and June 7, 2021, this EIR/FSS concurs with the locations of the NOCSS reach breaks.

5.3.2 Aquatic Habitat

NOCSS used various habitat components to determine the classification of the nine (9) reaches of Fourteen Mile Creek West within the EIR Subcatchment Area and management recommendations were provided (Table 5.10.2 – Aquatic Habitat Characterization System). Four (4) categories of stream characterization were used to describe the quality of habitat present. The categories are as follows – Critical Habitat, Important Habitat, Marginal Habitat and

No Habitat. This EIR concurs with the aquatic habitat characterizations and management recommendations presented by NOCCSS (Appendix FF– Aquatic Characterization). **Table 5.9** summarizes the management recommendations and aquatic habitat characterizations from NOCSS. **Table 5.10** summarizes the stream reach characteristics and surrounding ELC vegetation communities.

Table 5.9 - NOCSS Reach Length, Management Recommendation, Aquatic Habitat

Stream Reach	Length (m)	Management Recommendation	Aquatic Habitat Characterization
14E-8	545	Medium Constraint (Blue Stream)	Marginal
14E-10	473	Low Constraint (Green Stream)	Marginal
14W-1	122	High Constraint (Red Stream)	Critical Habitat
14W-1A	509	High Constraint (Red Stream)	Critical Habitat
14W-2	356	High Constraint (Red Stream)	Important Habitat
14W-3	649	High Constraint (Red Stream)	Important Habitat
14W-4	544	High Constraint (Red Stream)	Important Habitat
14W-18	373	Low Constraint (Green Stream)	No Habitat
14W-20	800	Low Constraint (Green Stream)	No Habitat

Table 5.10 - Stream Reach Characteristics and Surrounding ELC Vegetation Communities

Stream Reach	Management Recommendation	Characteristics	ELC Code
14E-8	Medium Constraint (Blue Stream)	Vegetated swale adjacent to Bronte Road and Highway 407	MAM2
14E-10	Low Constraint (Green Stream)	Vegetated swale flows across agricultural fields to concrete catchbasin	AG
14W-1	High Constraint (Red Stream)	Well defined channel, flows south of Subject Lands	CUM1, CUT1
14W-1A	High Constraint (Red Stream)	Well defined channel, flows into 14W-1	AG, CUT1
14W-2	High Constraint (Red Stream)	Well defined channel, flows into 14W-1A	FOD2-4, CUT1
14W-3	High Constraint (Red Stream)	Well defined channel, flows into 14W-2	FOD5-3, FOD2-4, CUT1
14W-4	High Constraint (Red Stream)	Well defined channel, flows into 14W-3	CUM1

Stream Reach	Management Recommendation	Characteristics	ELC Code
14W-18	Low Constraint (Green Stream)	Vegetated swale flows across agricultural fields, flows into reach 14W-3	AG
14W-20	Low Constraint (Green Stream)	Vegetated swale flows across agricultural fields, flows into reach 14W-1	AG

5.3.2.1 Green Streams

There are three Low Constraint (Green) Stream Corridors in the EIR Subcatchment Area: Reaches 14E-10, 14W-18 and 14W-20 (refer to **Figure 4.2**).

Reach 14E-10

Reach 14E-10 was characterized as an undefined, vegetated swale with minimal sinuosity situated within an unconfined valley system. This feature flows across an agricultural field and exits the Subject Lands under Bronte Road via a concrete catchbasin. Substrate is comprised of clay, silt and sand. This reach provides marginal fish habitat.

Reach 14W-18

Reach 14W-18 was characterized as a minorly defined, vegetated swale with minimal sinuosity within an unconfined valley system. This feature flows across an active agricultural field and is therefore heavily modified. This reach connects with the main branch of Fourteen Mile Creek West (Reach 14W-3) downstream. Substrate is composed of clay, silt and sand. This reach does not provide direct fish habitat.

Reach 14W-20

The upper portion of Reach 14W-20 was characterized as a minorly defined, vegetated swale with moderate sinuosity within an unconfined valley system that flows across an active agricultural field. Substrate is composed of clay, silt and sand. This reach does not provide direct fish habitat. The lower portion of Reach 14W-20 (approximately 40 m upstream of 14W-1) was characterized as a defined, vegetated swale with moderate sinuosity within a confined valley system. Riparian vegetation consists of shrubs, grasses and herbaceous plants. Substrate is composed of clay, silt and sand. This lower portion of the reach is considered to provided important fish habitat as it is directly connected to critical habitat downstream. Due to its low gradient, fish may also be able to migrate into the lower portion of this reach in the spring from Fourteen Mile Creek West.

5.3.2.2 Blue Streams

There is one Medium Constraint Stream Corridor (Blue Stream) in the EIR Subcatchment Area: Reach 14E-8 (refer to **Figure 4.2**).

Reach 14E-8

Reach 14E-8 was characterized as an undefined, vegetated swale with minimal sinuosity situated within an unconfined valley system. The feature is densely vegetated with wetland species. Existing disturbances included the Bronte Road and Highway 407 crossings. Substrate is comprised of clay, silt and sand. This reach provides marginal fish habitat within the EIR Subcatchment Area as it is highly vegetated and lacks definition, however, a reach immediately downstream (on the east side of Bronte Road) has been identified as 'Redside Dace Occupied' indicating a connection to critical fish habitat downstream.

5.3.2.3 Red Streams

There are five High Constraint Stream Corridors (Red Streams) in the EIR Subcatchment Area: Reaches 14W-1, 14W-1A, 14W-2, 14W-3 and 14W-4 (refer to **Figure 4.2**).

Reach 14W-1

Reach 14W-1 was characterized as a well-defined, moderately sinuous channel situated within a confined valley system. Riparian vegetation consists of shrubs, grasses and herbaceous plants. Riffle substrate consists of sand and gravel sized materials. Pool substrate consists of clay, silt, sand, and gravel. The NOCSS classifies this reach as critical fish habitat and MECP maps this reach as occupied Redside Dace habitat.

Reach 14W-1A

Reach 14W-1A was characterized as a moderately sinuous, well-defined channel situated within a confined valley setting. Riparian vegetation consists of trees, shrubs, grasses and herbaceous plants. Riffle substrate consists of gravel and cobble sized materials. Pool substrate consists of clay, silt and sand sized materials, with localized areas of exposed shale. In-stream cover is provided by substrate and large woody debris. Near the upstream limit of the reach, a series of beaver dams were observed with an associated backwater zone extending into Reach 14W-2. The NOCSS classifies this reach as critical fish habitat and MECP maps this reach as occupied Redside Dace habitat.

Reach 14W-2

Reach 14W-2 was characterized as a moderately sinuous, well-defined channel situated within a confined valley setting. Riparian vegetation consists of trees, shrubs, and herbaceous plants. Riffle substrate consisted of gravel and cobble sized materials. Pool substrate consists of sand and gravel, with exposed underlying consolidated till. In-stream cover is provided by substrate and large woody debris. The NOCSS classifies this reach as important fish habitat and MECP maps this reach as occupied Redside Dace habitat.

Reach 14W-3

Reach 14W-3 was characterized as a moderately sinuous, well-defined channel situated within a confined valley setting. Riparian vegetation consists predominantly of trees with herbaceous plants. Riffle substrate consists of gravel and cobble sized materials, with exposed shale bedrock. Pool substrate consists of sand, gravel and till. The NOCSS classifies this reach as important fish habitat and MECP maps the lower portion of this reach as occupied Redside Dace habitat.

Reach 14W-4

Reach 14W-4 was characterized as a moderate to highly sinuous, well-defined channel situated within a confined valley setting. Riparian vegetation consists of shrubs, grasses, and herbaceous vegetation. Riffle substrate consists of gravel and cobble sized materials, with areas of exposed shale bedrock. Pool substrate consists of clay, silt, gravel, cobble and exposed bedrock. This reach provides important fish habitat.

5.3.3 Fish Community

Beacon did not complete fish community sampling due to the presence of Redside Dace in Fourteen Mile Creek. Electrofishing within critical habitat is generally not permitted by the MNRF and therefore this EIR/FSS relies on background fisheries data.

Fish community sampling was completed in April and May 2002, and April 2005 as part of the NOCSS. A Smith Root Model 12 backpack electrofisher was used to conduct the sampling at that time. A total of seven (7) fish species were found in Fourteen Mile Creek West including Goldfish (*Carassius auratus*), Creek Chub (*Semotilus atromaculatus*), Brook Stickleback (*Culaea inconstans*), White Sucker (*Catostomus commersonii*), Fathead Minnow (*Pimephales promelas*), Redside Dace (*Clinostomus elongatus*), Largemouth Bass (*Micropterus salmoides*), Brown Bullhead (*Ameiurus nebulosus*), and Blacknose Dace (*Rhinichthys obtusus*).

The MNR also conducted fish community sampling in 2002 and 2003 and documented additional species such as Common Shiner (*Luxilus cornutus*) and Fantail Darter (*Etheostoma flabellare*).

Fish community sampling results from NOCSS indicate that Fourteen Mile Creek West within the Subject Lands predominantly supports a warmwater fish community. One provincially and regionally significant species, Redside Dace, was found in the lower reaches of Fourteen Mile Creek (14W-1A, 14W-1). This species is a coolwater fish species that requires clear flowing water with overhanging vegetation for its survival.

5.4 SPECIES AT RISK

In addition to the field investigations, MECP was contacted on January 29, 2021, to request records for any SAR species that may be associated with the EIR Subcatchment Area and

environs. Correspondence was received from MECP on March 1, 2021, indicating that records exist for the following SAR:

- Snapping Turtle (Special Concern)
- Eastern Meadowlark (Threatened)
- Bobolink (Threatened)
- Henslow's Sparrow (Endangered)
- Mottled Duskywing (Endangered)
- Redside Dace (Endangered)

In addition, MECP noted that treed habitats could potentially support the following:

- Little Brown Myotis (Endangered)
- Northern Myotis (Endangered)
- Eastern Small-footed myotis (Endangered)
- Tricolored Bat (Endangered)

Where habitat exists for threatened or endangered species, such habitats are to be protected in accordance with the provisions of the Act and its regulations (Ontario Regulation 242/08). If a proposed activity has the potential to impact the habitats of threatened or endangered species, then the activity must be authorized by MECP. In some cases, a permit may be required to undertake an activity, while in other cases a Notice of Activity may be registered with the MECP. The Regulation provides exemptions for some species and certain types of activities.

The review of habitat conditions present and discussions with MECP confirmed the following:

Redside Dace

MECP correspondence dated March 1, 2021, from Christopher Martin, Management Biologist included mapping of Redside Dace regulated habitat indicating that Fourteen Mile Creek West Reaches 14W-1, 14W-1A, 14W-2 and the lower portion of 14W-3 are considered occupied Redside Dace habitat and protected by clause 29.1 1i of O. Reg 242/08. The extent of Redside Dace occupied habitat has been delineated on **Figure 3.1**. The extent of regulated habitat is defined by the meander belt to the channel and the 30m area on either side, excluding any constructed elements. As is shown on **Figure 3.1** the regulated habitat of Redside Dace is contained entirely within the Core 1 boundaries. The proposed grading limits associated with the development and SWM facilities is located outside of the regulated habitat. A road crossing of Fourteen Mile Creek West is proposed (William Halton Parkway), in-keeping with the North Oakville West Master Plan. This crossing will overlap with the Redside Dace regulated habitat in one location generally shown on **Figure 10.4**. A permit will need to be obtained from MECP for this crossing in the future.

Barn Swallow

Barn Swallow often live in close association with humans, building their cup-shaped mud nests almost exclusively on human-made structures such as open barns, under bridges and in culverts. The species is attracted to open structures that include ledges where they can build their nests, which are often re-used from year to year. They prefer unpainted, rough-cut wood, since the mud does not adhere as well to smooth surfaces (COSEWIC 2011).

During field investigations in 2021, three Barn Swallow were observed foraging over the Subject Lands. There are no suitable structures within the EIR Subcatchment Area upon which this species could nest. Therefore, no barn swallow habitat is present on the Subject Lands.

Bats

The EIR Subcatchment Area supports vegetated features that could potentially support habitat for bats, including SAR species such as Little Brown Myotis, Eastern Small-Footed Myotis Northern Myotis and Tri-Colored Bat. Under the provisions of the *Endangered Species Act*, the habitats of endangered or threatened species are protected. As species specific habitat regulations have not yet been developed for endangered bats, the general habitat provisions of the Act apply. Because bats are highly vagile and can migrate and forage great distances, their habitat can be extensive and include not only their maternity roosts and hibernacula, but also the air space through which they forage and migrate. In the absence of species-specific habitat regulations, MECP have focused efforts primarily on protecting maternity roosts and winter hibernacula and have developed guidance documents to assist proponents with identification of such habitats.

To assess whether the EIR Subcatchment Area supports habitat for bats, including SAR species, Beacon has relied upon MNRF guidance documents as well as direction received from MNRF and MECP on other recent projects. With respect to hibernacula or overwintering sites, these are generally associated with caves and mines and no such features exist within the EIR Subcatchment Area or within the broader NOCSS study area. As such, it can be confirmed that no hibernacula are present.

With respect to maternity roosts, these are generally associated with larger mid-aged to mature woodlands. The *Guelph District MNRF Survey Protocol for Species at Risk Bats within Treed Habitats Little Brown Myotis, Northern Myotis & Tri-Colored Bat* (MNRF 2017) recommend that treed features such as coniferous, deciduous or mixed forest and swamp ecosites be considered for potential maternity roost habitat. Cultural treed features are not considered for maternity roosts. As part of this study, all vegetation features within the EIR Subcatchment Area were classified according to the *Ecological Land Classification System for Southern Ontario* (Lee *et al*. 1998). A map illustrating the various ELC ecosites is presented in **Figure 5.1**. Based on this mapping, all treed features corresponding with forest and swamp ecosites are contained within the boundaries of Core 1 and will be protected. Under the MNRF (2017) guidance, it is recommended that if forest and swamp ecosites are being protected, that

additional assessments (i.e., snag tree surveys and acoustic monitoring) are not required. Treed features situated outside the NHS are limited to several hedgerow features that do not correspond with the listed ecosites. Additionally, there are no structures on the Subject Lands that could be used for roosting, though there are some buildings outside of the Subject Lands within the EIR Subcatchment Area.

Eastern Wood-pewee

Eastern Wood-pewee (*Contopus virens*) is a species listed in Ontario as Special Concern that was noted breeding within Core 1 just east of the creek. It was noted within ELC Unit 6a within Core 1, which will be protected from proposed development. The Eastern Wood-pewee lives in the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It is most abundant in intermediate-age and mature forest stands with little understory vegetation. It is an aerial insectivore, a group of birds that has been declining rapidly in the past few decades to a variety of factors including potential changes in insect populations and loss of habitat on their wintering grounds in Latin America. Though Wood-pewee numbers have declined by about 25% in the past decade, they are still common in forests throughout eastern North America and seem to be able to breed in relatively small forest patches and woodlots (COSEWIC, 2012a).

5.5 STREAM CORRIDOR BOUNDARIES

The NOCSS and NOCSS Addendum sets out the approach to the delineation of stream corridor widths. In the NOCSS, stream corridor widths were identified at a broader subwatershed scale with the understanding that the widths would be subject to refinement as part of future EIR/FSS studies.

Figures 6.3.15a, 6.3.15b and 6.3.15c in the NOCSS Addendum provide illustrations clarifying the stream corridor delineation process.

Depending upon whether a stream reach is confined or unconfined, the width of the stream corridor is defined through consideration of the following:

- fluvial geomorphologic requirements;
- stable top-of-bank;
- regulatory floodplain;
- fish and fish habitat protection requirements;
- preservation of hydrogeologic functions;
- Hydrologic Features A; and,
- setback and buffer requirements from these factors/conditions.

The corridors are continuous from ‘Blue’ to ‘Red’ Stream Reaches, and thus the discussion on corridor boundary delineation is discussed in terms of groupings of continuous channel lengths. To reduce repetitive discussion on calculation methodologies for the determination of each of the factors noted above, the approaches used for meander belt calculations, floodplain

calculations, fisheries setbacks, top-of-bank, etc., are described in the following sections and **Table 5.10** summarizes the findings by stream reach.

5.5.1 Methodologies

5.5.1.1 Meander Belt Allowance Calculations

A geomorphic assessment of Red and Blue Streams within the EIR Subcatchment Area was completed by Beacon. The *Palermo Village Geomorphic Assessment* (Beacon 2021), has been included in **Appendix E.** The purpose of the geomorphic assessment was to characterize existing geomorphic conditions of stream reaches and inform the determination of stream corridor boundaries through delineation of the meander belt. Key findings were as follows:

- Based on a review of available mapping and field observations, reach limits as delineated through the NOCSS were confirmed;
- Consistent with the NOCSS, Blue Stream Reach 14E-8 was characterized as a vegetated swale feature;
- RGA results characterized Reaches 14W-1, 14W-1A and 14W-2 as being 'in adjustment';
- While Reaches 14W-3 and 14W-4 were characterized as 'in transition', RSAT results characterized the overall ecological condition of these reaches as fair to good. These results were generally consistent with the NOCSS;
- Based on historical channel planform information and field-based observations, meander belt dimensions were recommended for Reaches 14W-1, 14W-1A, 14W-2, 14W-3, and 14W-4 (30 m, 30 m, 30 m, 35 m and 42 m, respectively). A meander belt of 20 m was recommended for Reach 14E-8; and
- In conformity with Ontario Regulation 242/08, lands within 30 m of the meander belt of stream reaches mapped as Redside Dace occupied habitat by MECP were identified.

5.5.1.2 Presence of Existing Physical Top of Bank and Stable Slope Calculations

The EIR/FSS Study Team has assessed in the field all stream corridors to confirm where a physical top-of-bank exists or where no well-defined valley features are present along all Blue and Red Streams. **Table 5.11** summarizes these conditions. As noted, a well-defined top of bank exists along the eastern boundary of all Red Stream reaches associated with the Fourteen Mile Creek West valley. The physical top-of-bank was staked by Beacon with agency staff on August 30, 2021 (Town, CH and Region) and April 7, 2022 (CH and Town) and surveyed by RPE Surveyors. Site visit notes are provided in **Appendix B-3**. There is no physical top-of-bank along Blue Stream reach 14E-8.

- DS Consultants prepared a *Slope Stability Assessment* (January 2023) for the east side of Fourteen Mile Creek West valley (**Appendix J-2)**. For the majority of the slope, the staked top of bank represents the LTSTOS with the exception of two locations in proximity to points S9 and S14 on **Drawing 1, Appendix J-2**, where the LTSTOS is

greater than the staked top of bank.

5.5.1.3 Regulatory Flood Plain

Pre-Development (Existing Conditions) Floodline Updates – Fourteen Mile Creek West

Watershed hydrology and hydraulics models for the Fourteen Mile Creek subwatershed were prepared as part of the NOCSS. The HEC-RAS model for Fourteen Mile Creek West was obtained from CH for review and updating as part of this EIR/FSS. As discussed in **Section 7.2**, the EIR Subcatchment boundaries have been delineated using updated (2018) LiDAR information. The updated pre-development subcatchment boundaries have been used to calculate pre-development flows. The updated subcatchment drainage boundaries have changed less than 10% from the NOCSS drainage boundaries, and as such the hydrology model (GAWSER) has not been re-run. To update the pre-development flows, the NOCSS unitary flow rates for the culverts at Highway 407 and at Dundas Street were applied to the updated catchment boundaries. The updated flows used in the updated pre-development HEC-RAS model, as well as digital modeling files, are provided in **Appendix F-4.**

In addition to updating the pre-development flows, the topographic information used for cross sections has been compared to the updated LiDAR information within the EIR Subcatchment Area for Reaches 14W-1, 14W-1A, 14W-2, 14W-3, and 14W-4. There were no major differences in the topographic information, and therefore no cross sections within the Fourteen Mile Creek West valley were updated and no additional cross sections have been added to the pre-development model. The culvert information at Dundas Street has been updated to reflect the latest work done by the Region of Halton, post-NOCSS.

The updated pre-development HEC-RAS model was run and compared to pre-development model results that were computed from the model received from CH. A table comparing water surface elevations for the two models is provided in **Appendix F-1**. The updated pre-development model water surfaces have changed by - 0.05 m and +0.09 m north of Dundas Street, and between 0.01 m and 0.06 m south of Dundas Street for a distance of 60 m downstream of Dundas Street. The increase in water levels is a result of the refined drainage boundaries (1% changed at Culvert FM-D5) described in **Section 7.2**. The existing conditions floodline has been plotted on **Drawing 1**.

Post-Development (Proposed Conditions) Floodline Updates – Fourteen Mile Creek West

There are no proposed modifications to the Fourteen Mile Creek West valley landscape from the pre-development model updates with the exception of the two proposed future road crossings of Core 1 described in **Section 10**. The updated pre-development HEC-RAS model for Fourteen Mile Creek West has been modified to add proposed road crossings, and associated culverts and grading, to demonstrate that road crossings will not affect NHS limits. The locations of the future road crossings of Fourteen Mile Creek are shown on **Figure 6.1**.

The post-development hydraulic model was also updated with post-development flows to reflect the proposed Palermo Village land uses and stormwater management strategy described in **Sections 7.4** and **7.7**, which changes the flows between Highway 407 and Dundas Street in the model. A table outlining the post-development flows is provided in **Appendix F-2**.

The Bronte Green PCSWMM model was updated with the Subject Lands for the downstream peak flow comparison (south of QEW) only, while NOCSS unitary release rates were still used to determine allowable peak flows in Fourteen Mile Creek for the purposes of floodplain mapping. Therefore **Table 5.10** is a comparison pre and post development Regional Storm water levels using NOCSS unitary release rates only. The PCSWMM modeling is only considered to compare downstream flood elevation levels to existing conditions, since PCSWMM flows were found to be overly conservative for the purposes of flood plain mapping due to the lumped catchment in the model and short flow path.

The post-development water levels and digital modelling files are provided in **Appendix F-2** and **F-4**, respectively.

A comparison of pre-development and post-development Regional Storm water levels is provided below in **Table 5.11**. The proposed conditions regional water level change from existing is minimal (0.03 m to 0.05 m) and the floodline change from pre-development is indistinguishable for most of the Fourteen Mile Creek West valley. There are two exceptions: near the proposed SWM pond outfall where the water level change is noted to be 0.11 m; and, at the northern road crossings where water level changes 0.49 m. Both increases are fully contained within the defined valley system. The floodline has been updated to reflect the backwater from the preliminary culvert designs associated with the road crossings of Core 1 and is provided on **Drawing 1** and **Figure 5.3**. It should be noted that the culvert size / road grading is preliminary and subject to change through further study. While the two road crossings of Core 1 will be designed by others, preliminary culvert sizes have been established to demonstrate the potential impact to flood lines from the crossings. Based on this assessment and floodlines shown on **Drawing 1**, it is clear that the regulatory floodline does not, and will not, govern the NHS boundaries in any location.

Table 5.11 – Fourteen Mile Creek West,
Regional Flood Level Summary (Upstream of Dundas St. Model)

River	Reach	Station	Regional Water Level (m)			Difference (m)		
			Existing (CH) (1)[1]	Existing (JFSA) (2)[2]	Proposed (DSEL) (3)[3]	Ex. JFSA - Ex. CH (2) - (1)	Pr. DSEL - Ex. CH (3) - (1)	Pr. DSEL - Ex. JFSA (3) - (2)
River 5	Reach-1	44	165.33	165.28	165.28	-0.05	-0.05	0.00
River 5	Reach-1	43	165.05	165.04	165.04	-0.01	-0.01	0.00
River 5	Reach-1	42	163.32	163.27	163.27	-0.05	-0.05	0.00
River 5	Reach-1	41	163.19	163.15	163.15	-0.04	-0.04	0.00
River 5	Reach-1	40	162.11	162.09	162.09	-0.02	-0.02	0.00
River 5	Reach-1	39	159.16	159.14	159.14	-0.02	-0.02	0.00
River 5	Reach-1	38	156.21	156.18	156.18	-0.03	-0.03	0.00

River	Reach	Station	Regional Water Level (m)			Difference (m)		
			Existing (CH) (1)[1]	Existing (JFSA) (2)[2]	Proposed (DSEL) (3)[3]	Ex. JFSA - Ex. CH (2) - (1)	Pr. DSEL - Ex. CH (3) - (1)	Pr. DSEL - Ex. JFSA (3) - (2)
River 4	Reach-1	37	157.87	157.87	157.91	0.00	0.04	0.04
River 4	Reach-1	36	156.61	156.61	156.65	0.00	0.04	0.04
River 4	Reach-1	35	154.17	154.17	154.22	0.00	0.05	0.05
River 4	Reach-1	34	152.66	152.67	152.71	0.01	0.05	0.04
River 4	Reach-1	33	150.29	150.29	150.33	0.00	0.04	0.04
River 4	Reach-1	32	148.19	148.19	148.22	0.00	0.03	0.03
River 4	Reach-1	31	145.14	145.14	145.18	0.00	0.04	0.04
RIVER-2	Reach-1	30	160.55	160.55	160.55	0.00	0.00	0.00
RIVER-2	Reach-1	29	160.29	160.30	160.31	0.01	0.02	0.01
RIVER-2	Reach-1	28	159.04	159.04	159.02	0.00	-0.02	-0.02
RIVER-2	Reach-1	27	158.51	158.52	158.54	0.01	0.03	0.02
RIVER-2	Reach-1	26	157.40	157.40	157.37	0.00	-0.03	-0.03
RIVER-2	Reach-2	25	155.15	155.12	155.16	-0.03	0.01	0.04
RIVER-2	Reach-2	24	152.49	152.46	152.33	-0.03	-0.16	-0.13
RIVER-1	Reach-1	23	156.02	156.02	156.02	0.00	0.00	0.00
RIVER-1	Reach-1	22	155.71	155.71	155.71	0.00	0.00	0.00
RIVER-1	Reach-1	21	154.55	154.55	154.55	0.00	0.00	0.00
RIVER-1	Reach-1	20	154.25	154.26	154.26	0.01	0.01	0.00
RIVER-1	Reach-1	19.5	153.32	153.32	153.32	0.00	0.00	0.00
RIVER-1	Reach-1	19	150.31	150.32	150.27	0.01	-0.04	-0.05
RIVER-1	Reach-2	18.6	148.05	148.02	148.51	-0.03	0.46	0.49
RIVER-1	Reach-2	18	-	148.02	148.20	-	-	0.18
RIVER-1	Reach-2	17.9	**Street E, East Culvert**					
RIVER-1	Reach-2	17	146.79	146.76	146.30	-0.03	-0.49	-0.46
RIVER-3	Reach-1	16	157.30	157.31	157.31	0.01	0.01	0.00
RIVER-3	Reach-1	15	157.18	157.18	157.18	0.00	0.00	0.00
RIVER-3	Reach-1	14	155.39	155.40	155.40	0.01	0.01	0.00
RIVER-3	Reach-1	13	155.17	155.20	155.20	0.03	0.03	0.00
RIVER-3	Reach-1	12	153.68	153.71	153.71	0.03	0.03	0.00
RIVER-3	Reach-1	11	152.67	152.72	152.72	0.05	0.05	0.00
RIVER-3	Reach-1	10.6	-	152.72	152.72	-	-	0.00
RIVER-3	Reach-1	10.2	-	152.72	152.72	-	-	0.00
RIVER-3	Reach-1	10.1	**Street E, West Culvert**					
RIVER-3	Reach-1	10	152.67	152.72	152.72	0.05	0.05	0.00
RIVER-3	Reach-1	9	152.65	152.70	152.70	0.05	0.05	0.00
RIVER-3	Reach-1	8.5	**Existing Zenon Drive**					
RIVER-3	Reach-1	8	150.27	150.40	150.40	0.13	0.13	0.00
RIVER-3	Reach-1	7	147.72	147.75	147.75	0.03	0.03	0.00

River	Reach	Station	Regional Water Level (m)			Difference (m)		
			Existing (CH) (1)[1]	Existing (JFSA) (2)[2]	Proposed (DSEL) (3)[3]	Ex. JFSA - Ex. CH (2) - (1)	Pr. DSEL - Ex. CH (3) - (1)	Pr. DSEL - Ex. JFSA (3) - (2)
RIVER-1	Reach-3	6.375	**William Halton Parkway Extension**					
RIVER-1	Reach-3	6	145.96	145.95	145.94	-0.01	-0.02	-0.01
RIVER-1	Reach-3	5	144.37	144.35	144.35	-0.02	-0.02	0.00
RIVER-1	Reach-4	4	143.92	144.01	144.03	0.09	0.11	0.02
RIVER-1	Reach-4	3	143.17	143.23	143.24	0.06	0.07	0.01
RIVER-1	Reach-4	2.5	**Existing Dundas Street**					
RIVER-1	Reach-4	2	142.37	142.43	142.44	0.06	0.07	0.01
RIVER-1	Reach-4	1	141.84	141.85	141.85	0.01	0.01	0.00

1 – HEC-RAS model received from CH
2 – Updated pre-development catchment delineation per **Figure 7.0** drainage areas, updated pre-development flows in **Appendix F-1** and crossing information at Dundas Street since NOCSS was completed. Modeling files included in **Appendix F-4**.
3 – Post-development flows updated between Highway 407 and Dundas Street per drainage areas on **Figure 7.2** included in **Appendix F-2**. Core 1 road crossing culverts added to model, and modeling files included in **Appendix F-4.**

Pre-Development Floodline – Blue Stream Reach 14E-8

Although Medium Constraint Stream Reach 14E-8 is shown with a meander belt hazard on CH's online mapping, a regulatory floodplain is not shown for this reach, likely because of its relatively small drainage area. The EIR/FSS has calculated the regulatory floodline along this Blue Stream to assist in delineating stream corridor boundaries. Based on updated pre-development catchment delineation using LiDAR mapping, the catchment to Stream Reach 14E-8 from north of Highway 407 and through the Subject Lands was determined to be approximately 81.2 ha. The drainage area to this stream reach is greater than 50 ha, which is typically the minimum drainage area to map floodplains as defined in several conservation authority jurisdictions. As such, a 100-year and Regional Storm floodline has been calculated for Stream Reach 14E-8 as illustrated on **Drawing 1**. The existing watercourse is not proposed to be realigned, however, as requested by the agencies during the April 19, 2021, North Oakville Agency Review Meeting, further discussion could take place in concert with the overall Enhanced LPA design.

For this EIR/FSS, the water level for the Regional Storm was modeled using updated pre-development catchment and flows (unitary rates from NOCSS). A summary of the modifications to the model received from CH (14_Mile_E_ Bronte_19Jun14.prj) include:

- Re-run in HEC-RAS v6.0.0
- Georeference River 3 Reach 1, River 1 Reach 2, and River 1 Reach 1 based on CAD / GIS data provided in NAD 83 / UTM Zone 17N (CH cross-section locations, DSEL channel centreline)

- Georeference channel centreline only for all other reaches based on CAD data provided in NAD 83 / UTM Zone 17N (DSEL channel centreline; CH cross-section locations not provided)

- Update flows in River 3 Reach 1 upstream of Bronte Road crossing (cross-sections 31.4 to 31.2) based on pre-development flows calculated by DSEL using the NOCSS unit flows at Dundas Street culvert FM-D7 and a drainage area of 81.2 ha.

- Update Bronte Road crossing in River 3 Reach 1 (station 31.05) to reflect culvert replacement and relocation per as-built Drawing C1, "Bronte Road Reconstruction - Phase 1, Bronte Road, Town of Oakville, Culvert No. 1, General Arrangement and Restoration" dated December 2007, by SNC Lavalin, and CAD data provided by DSEL.

- Update cross-sections 31.4 to 31 in River 3 Reach 1 between Highway 407 and Bronte Road (with cross-section 31 on the downstream side of Bronte Road) based on relocation of Bronte Road crossing and topographic data provided by DSEL. Cross-sections coded left to right facing downstream. Increase contraction / expansion coefficients around the Bronte Road crossing from 0.1/0.3 to 0.3/0.5 at cross-sections 31.2, 31.1 and 31.

The resulting Regional Storm water level is shown on **Drawing 1**. The water level extends beyond the proposed Enhanced LPA into the developable area to the south by approximately 1,080 m^2. Cut/fill is proposed in this area to contain the floodline within the Enhanced LPA. Filling of this small area (approx. 0.5m deep over 1,082m^2 = 540m^3) will be compensated for by cutting an equivalent volume in the area shown on **Drawing 3A**. A riparian storage model has not been run given the relatively small volume of riparian storage volumes relative to the overall system and given there is sufficient cut volume within the linkage to compensate for the proposed fill.

Additionally, there is a spill towards Fourteen Mile Creek West at an elevation of approximately 164.29 m which is simulated to occur infrequently between the 100 year and the Regional Storm. Should it be desirable to eliminate this spill, minor re-grading in the outer portion of the floodplain would contain the Regional Storm floodline within the Fourteen Mile Creek East subcatchment within the Enhanced LPA.

5.5.1.4 Fisheries Setback Requirements

Fish community sampling results from the NOCSS indicate that Fourteen Mile Creek West within the Subject Lands predominantly supports a warmwater fish community. The NOCSS applies a 15 m fisheries setback on both sides of the creek measured from the frequent flow channel in warmwater systems. For those reaches that are known to support Redside Dace, 30 m from the meander belt is identified consistent with how habitat for Redside Dace is defined under Ontario Regulation 242/08. The NOCSS Figure 5.10.1 identifies Reaches 14W-1 and 14W-1A as critical habitat, however the 2020 mapping provided by MECP identifies Reaches 14W-1, 14W-1A, 14W-2 and the lower section of Reach 14W-3 as occupied habitat.

For the purposes of defining this stream corridor component, a 15 m fisheries setback was applied to all Red and Blue Streams in the EIR Subcatchment Area. For those reaches that are mapped by MECP as Redside Dace regulated habitat, the area for fish habitat protection corresponds with the limits of Redside Dace habitat.

5.5.2 Stream Corridor Boundary Delineation

The above methodologies were applied to each of the stream reaches in the EIR Subcatchment Area. **Table 5.12** summarizes how the various stream corridor components were determined. The stream corridor boundaries were then established using the greatest of the following: meander belt, floodline, physical top-of-bank and long term stable top of bank and their associated 7.5m setbacks; the fisheries setback; or, Redside Dace habitat.

Table 5.12 – Summary of Stream Corridor Elements by Reach

<table>
<tr><th rowspan="2">Stream Corridor Element</th><th colspan="2">Stream Reaches</th></tr>
<tr><th>14W-1, 14W-1A, 14W-2, 14W-3, 14W-4
(Red Stream)</th><th>14E-8
(Blue Stream)</th></tr>
<tr><td>Geomorphic Considerations
(meander belt width)</td><td>The meander belt widths for these reaches were all determined using the largest meander amplitude based on current and historical aerial photographs. The bankfull width plus a 20% factor of safety (10% on each side) in accordance with the NOCSS was applied to the largest meander amplitude.
Meander Belt Component (excluding setbacks) = Meander Belt + Factor of Safety (20%)
<table>
<tr><th>Stream Reach</th><th>Meander Belt (m)</th><th>Factor of Safety (m)</th><th>Meander Belt Component (m)</th></tr>
<tr><td>14W-1</td><td>30</td><td>6</td><td>36</td></tr>
<tr><td>14W-1A</td><td>30</td><td>6</td><td>36</td></tr>
<tr><td>14W-2</td><td>30</td><td>6</td><td>36</td></tr>
<tr><td>14W-3</td><td>35</td><td>7</td><td>42</td></tr>
<tr><td>14W-4</td><td>42</td><td>8.5</td><td>50.4</td></tr>
</table></td><td>Meander Belt Component (excluding setbacks) = Meander Belt + Factor of Safety (20%) = 20m + 4m = 24 m.</td></tr>
<tr><td>Regional Storm Floodline</td><td>The existing flood plain limits are shown on Drawing 1. Floodplain limits associated with these streams are all contained within the Fourteen Mile Creek West valley.</td><td>The existing floodline calculated as part of this EIR/FSS is shown on Drawing 1. With proposed small areas of cut/fill, the regulatory floodline can be contained within the Enhanced LPA. If desirable, grading in the Enhanced LPA would eliminate a spill.</td></tr>
</table>

Stream Corridor Element	Stream Reaches	
	14W-1, 14W-1A, 14W-2, 14W-3, 14W-4 (Red Stream)	**14E-8 (Blue Stream)**
Fisheries Setback	14W-1A, 14W-2 and lower portions of 14W-3 are mapped as regulated habitat for Endangered Redside Dace based on a 30 m setback on both sides of the meander belt. Upper half of 14W-3 and 14W-4: 15 m fisheries setback, as measured from the frequent flow channel (Section 6.3.4.2 and Table 6.3.4a of the NOCSS).	15 m fisheries buffer, as measured from the frequent flow channel (Section 6.3.4.2 and Table 6.3.4a of the NOCSS). This buffer is fully contained within the Enhanced LPA.
Physical Top-of-Bank	Physical top-of-bank is present along all stream reaches and has been staked with CH staff.	N/A
Long Term Stable Slope	Stable Slope Assessment has been completed; see **Appendix J-2**.	N/A
Hydrologic Features A	N/A	N/A

6 LAND USE

6.1 GENERAL DESCRIPTION OF DEVELOPMENT CONCEPT PLAN

The Subject Lands will be developed with a range of residential, employment, commercial, institutional, and open space uses. The North Oakville West Secondary Plan Land Use Plan (Figure NOW2) is included as **Figure 1.2** and identifies the Palermo Village lands, amongst others, as being under appeal. The Land Use Plan identifies a component of the Natural Heritage System (Linkage Preserve Area - LPA) through the north-central portion of the Palermo Village lands, connecting Core 1 on the west side of Bronte Road to Core 2 on the east side of Bronte Road.

The Subject Lands were included in two recent Town of Oakville Official Plan Amendments (OPA 34 and OPA 38). The Land Uses endorsed by the Town through OPA 34 and OPA 38 are shown on **Figures 1.3** and **1.4**, respectively. On June 15, 2022, the Region of Halton adopted Regional Official Plan Amendment No. 49 (ROPA 49) to implement the Region's Integrated Growth Management Strategy, which considers how to accommodate growth in Halton to the 2051 planning horizon. ROPA 49 is currently with the Minister of Municipal Affairs and Housing awaiting a decision. As shown on **Figure 1.5**, ROPA 49 removed the Regional Employment Area overlay from the northern half of the Palermo Village Corporation property and expanded the Palermo Village Strategic Growth Area up to Highway 407. As a result, LOPA 34, 37 and 38 will need to be re-evaluated to ensure conformity with ROPA 49.

Figure 6.1 provides the proposed Draft Plan of Subdivision (August 2023) for the Subject Lands and illustrates the proposed mix of land uses. High Density Mixed-Use Blocks will be located at the intersections of Dundas Street with Bronte Road and Old Bronte Road, and at the northeast quadrant of the site facing Bronte Road. In general, densities within the proposed development increase toward Dundas Street and Bronte Road, with the highest density residential uses focused along Bronte Road. Low density uses are located along the NHS, and medium density residential uses are proposed in the centre of the proposed development.

Large areas of the NHS are located within or adjacent to the Subject Lands to the north and west. This includes portions of Core 1 including several Red Streams, an Enhanced LPA and a Blue Stream as shown on **Figure 6.2**. The NOCSS LPA, shown in the north-central portion of the Palermo Village lands in **Figure 1.2**, is proposed to be shifted to the northern limits of the Subject Lands in order to provide for a more functional linkage between Cores 1 and 2 that will allow for safe wildlife passage, as opposed to the location as shown in NOCSS**.** The Development Concept Plan has been designed to accommodate this alternate Enhanced LPA. This Enhanced LPA will be 100 m in width, similar to the NOCSS proposed LPA, but is situated further north where it aligns with an existing culvert and proposed ecopassage under Bronte Road and can actually meet the NOCSS objective of establishing a primarily linkage. The Enhanced LPA will be the same width (100m) as the NOCSS proposed LPA, but because of its

new location, will include more land within the NHS and will be functionally supported by additional greenspace located along the future 407 transitway. The Enhanced LPA will add 0.9 ha of additional area to the NHS as compared to the NOCSS NHS. The rationale for relocating the NOCSS LPA is provided in **Section 6.2**.

A +/-4 ha SWM pond will service the Subject Lands under ultimate conditions, which is located primarily on the Zenon lands. An interim pond is proposed in Block 32 of the Palermo Village Draft Plan of Subdivision in the event Zenon lands do not develop. A community park and a number of parkettes are also proposed.

As shown on **Figure 6.1**, the main access to the proposed development is gained from Dundas Street at three locations and from Bronte Road at four locations. Access is gained to Dundas Street opposite the existing intersections with Valleyridge Drive, Old Bronte Road and a future proposed location on the Development Concept Plan. Access is gained from Bronte Road opposite the existing intersection of William Halton Parkway and three proposed locations on the Development Concept Plan.

A Draft Plan of Subdivision application, illustrated on **Figure 6.1**, is being submitted with this EIR/FSS for the Palermo Village lands. A separate Draft Plan application will be required for the Zenon lands located to the west of the Palermo Village lands.

6.2 LINKAGE PRESERVE AREA

6.2.1 NOCSS Linkage Preserve Area

As shown on **Figure 2.1**, the NOCSS proposed a 100 m wide LPA between Cores 1 and Core 2, approximately 564 m in length. It forms a slight arc on the Subject Lands through cultivated agricultural fields, a portion of a discontinuous hedgerow and Wetland 10 for 411 m then crosses Bronte Road (47 m) and three residential properties adjacent to Core 2 (106 m). NOCSS does not provide specific details regarding how the location for this LPA was selected or how Bronte Road factors into achieving the objective of end to end connectivity between the woodland habitats in Cores 1 and 2.

There are a number of important considerations that support reviewing the location of the NOCSS proposed LPA and relocating it to the north. They include:

1. Review of the configuration of Bronte Road and impacts on wildlife movement and vehicular conflicts were not considered in NOCSS. Detailed site specific field survey information pertaining to the existing conditions along the NOWSP LPA has been obtained and evaluated as part of this EIR/FSS. Results conclude that the NOWSP LPA crossing location of Bronte Road is not technically feasible and therefore does not provide a functional safe location for a wildlife crossing;

2. This EIR/FSS has assessed the feasibility of a wildlife ecopassage location across Bronte Road and recommends a functional safe LPA location at the north end of the Palermo Village Corporation lands, south of Highway 407. It is noteworthy, that the Bronte Road design did not include an ecopassage at the NOWSP LPA location but did include a small ecopassage south of Highway 407 in the location of the proposed Enhanced LPA;

3. The updated wetland evaluation (June 2023) results in the removal of the provincially significant designation on Wetland 10 within the NOCSS proposed LPA, introducing opportunities for implementation of alternative wetland management approaches. The removal of Wetland 10 and re-creation of a new larger wetland, with greater habitat complexity is proposed within the Enhanced LPA This goes beyond current policy requirements for the management of small, isolated wetlands in North Oakville;

4. The Enhanced LPA in this location results in an increase in NHS area of 0.9 ha as compared to the NOCSS NHS;

5. The extent of the Palermo Village Growth Area has changed since NOCSS / NOWSP approvals, influencing the context and crossing requirements of the NOWSP LPA. The implications of additional crossings of the NOCSS proposed LPA should be considered; and,

6. While NOCSS proposed the LPA location, OPA 34 policies are under appeal, and as such, there is currently no land use designation associated with the NOCSS proposed LPA.

The above points are explored in more detail below as well as in **Appendix B-2**.

In 2006, when NOCSS was being finalized, Bronte Road was only a two-lane road. In 2007/2008, Bronte Road was widened to four lanes and realigned to the west. NOCSS does not refer to the planned road widening and realignment or its effect on establishing an LPA in this location. The design for the widening and realignment of Bronte Road also did not consider the LPA or its function as no culverts or ecopassages were provided.

It is likely that the location of the NOCSS proposed LPA was selected based on what appears to be the shortest distance between the Core 1 and Core 2 woodlands that also incorporates existing features such as hedgerows and a small wetland (Wetland 10).

Consistent with NOCSS Objective 3.2, the EIR/FSS Study Team has examined opportunities to improve linkage functions between Cores 1 and 2 by assessing existing and future conditions. The assessment of the NOCSS proposed LPA determined that Bronte Road represents a significant barrier to wildlife. Bronte Road is a four-lane Regional road with a posted speed limit of 70 km/hr and is proposed to be widened further in the future to a 6-lane urban road cross section. When the NOCSS proposed LPA was originally conceived, Bronte Road was only two-lanes and did not support the high level of traffic volumes it does today or will in the future.

Additionally, no consideration was provided regarding the feasibility of establishing an ecopassage to safely pass the wildlife species for which this primary linkage was intended. **Figure 6.3** provides a schematic illustration of the NOCSS proposed LPA relative to the OPA 34 Land Use Plan.

In examining opportunities to improve connectivity between Cores 1 and 2, the EIR/FSS Study Team reviewed the potential to establish an ecopassage in the location of the NOCSS proposed LPA, however it was determined that this is not feasible as there is insufficient grade separation between Bronte Road and the surrounding lands. Furthermore, the elevations of existing services (sewers) under Bronte Road preclude installing culverts under the road. The existing grade conditions along Bronte Road at the NOCSS proposed LPA are reflected on **Photo 6-1**.

Photo 6-1 Looking north on the west side of Bronte Road at the NOCSS proposed LPA crossing location

Based on this detailed review of the NOCSS proposed LPA, it was concluded that implementation in the location currently identified on NOWSP Figures NOW1-4 will not achieve the desired objectives as established by NOCSS.

It is the opinion of the EIR/FSS Study Team that implementing an LPA in this location will have the undesirable effect of bringing wildlife closer to Bronte Road and encouraging crossing at grade which will result in increased roadkill and vehicle/wildlife collisions, the impacts of which cannot be avoided or mitigated. In the absence of an ecopassage that can provide for safe crossing, the NOCSS proposed LPA is not recommended. In keeping with this NOCSS Objective 3.2, the EIR/FSS Study Team has recommended an alternate location for the LPA that is situated further to the north where implementation of an ecopassage is feasible. This alternate LPA is discussed in further detail below and in **Appendix B-2**.

6.2.2 Proposed Enhanced Linkage Preserve Area

In evaluating opportunities for an improved primary linkage between Cores 1 and 2, the EIR/FSS Study Team has examined grades and locations of services under Bronte Road in the vicinity of the linkage previously identified in the *North Oakville Natural Heritage Inventory and Analysis* (LGL 1999; 2002). In examining the Regions' design drawings for Bronte Road (Drawing #63 - Contract R-2048B-05) it was determined that there is only one possible location between Dundas Street and Highway 407 where there is sufficient grade separation to accommodate an ecopassage, and there are no existing or planned services that would conflict with creating an ecopassage. This area is located just south of the Highway 407 interchange. Refer to **Figure 6.4** which compares the grade differences along Bronte Road where it rises to go over Highway 407 with that of the location of the NOCSS proposed LPA. In the northern location, there already exists a 1.8 m diameter CSP culvert associated with Medium Constraint Stream (Blue Stream) 14E-8 (**Photo 6-2**).

Through wildlife track monitoring, it has been confirmed that this culvert, while periodically flooded, is utilized by local wildlife. From information collected during winter wildlife track surveys completed by Beacon in 2021 and 2022 (**Section 5.2.2.4**), it was determined that coyotes generally cross Bronte Road randomly but that raccoon, mink and the occasional coyote do utilize some of the larger culverts under Highway 407 as well as the single culvert under Bronte Road immediately south of Highway 407 ramp through which Stream Reach 14E-8 flows.

Photo 6-2 Looking east from the west side of Bronte Road, south of Highway 407, at the existing culvert that conveys Stream Reach 14E-8

The ability to establish a functional primary linkage that connects Core 1 and Core 2 requires consideration of the following:

1. Is there a location along Bronte Road, between Dundas Street and Highway 407, where an ecopassage already exists or could be enhanced or created to accommodate wildlife passage and mitigate vehicle-wildlife collisions?

2. Is there a location where a continuous LPA between Cores 1 and 2 can be established uninterrupted by roads or development?

Wildlife are known to utilize culverts to pass under roadways, however the culverts must be appropriately designed to be effective. In general, wildlife prefers to cross roadways at grade and only use culverts when other alternatives are not available. Encouraging wildlife to use culverts requires that the culverts be sized with some level of 'openness' so that wildlife can see their way through. It also requires implementation of barriers such as fencing to funnel wildlife to the culverts to prevent at grade crossings. Shorter and more open culverts are more effective at facilitating movement. Given the width of Bronte Road, any culvert would need to be longer than 40 m. To facilitate passage by small and medium sized mammals, the culvert would need to be at least 1.5 m in height, with a dry bench incorporated (if the culvert is also designed to convey drainage).

Regarding the ability to provide a functional culvert design, as previously noted, Bronte Road grades increase as this road rises to go over Highway 407 providing grade separation between Bronte Road and the adjacent Subject Lands. The feasibility of constructing a culvert in this location to accommodate an LPA alignment was examined. The vertical grade separation at this location is 2.75 m to 3.0 m from road surface at centreline to bottom of ditches on either side of Bronte Road (**Photo 6-3**). Also, there are no existing or planned storm sewers in the road at this location. Accounting for a 2.0 m high culvert, a 0.3 m thickness, and 1.0 m of cover, it was determined that minimal vertical distance of approximately 3.3 m (from culvert invert to road surface at centreline) exists in the proposed location. It is anticipated that the ecopassage will be a dry culvert and that Stream Reach 14E-8 will continue to flow through the existing culvert to the south. Based on winter wildlife tracking surveys completed in 2021 and 2022, the existing arch culvert accommodates some wildlife movement. Raccoon, coyote and mink have been observed using this existing culvert for passage beneath Bronte Road. As this culvert does not have a dry bench, it is mainly functional for mammals during the winter when there is no flow, or during other periods of low/no flow, however mink likely use it year-round.

From a functional perspective, shifting the NOCSS proposed LPA northward to take advantage of the existing grade separation and locating it adjacent to the 407 transitway corridor would solve the discontinuity issue and provide opportunities for enhanced connectivity with reduced roadkill and vehicle/wildlife collisions, as compared to the NOCSS proposed LPA location. This Enhanced LPA would include an ecopassage in the form of a large culvert that would facilitate safe passage of wildlife under Bronte Road and would compliment the existing culvert that

conveys Stream Reach 14E-8, thus fulfilling the NOCSS objectives and management recommendations for establishing a primary linkage between Cores 1 and 2.

Photo 6-3 Looking east, from the west side of Bronte Road, south of Highway 407, towards the grade separation along Bronte Road.
Note elevation of truck on Bronte Road in relation to farm field in the foreground

In addition to the benefits of connecting to the Red Stream Reach 14E-7 on the east side of Bronte Road, this location provides an opportunity to provide for a more direct terrestrial connection to Core 2, as shown on **Figure 6.2**.

6.2.2.1 Characteristics and Ecological Benefits of the Proposed Enhanced LPA

Based on the analyses in the preceding section, the Enhanced LPA and refined Core 1 boundary as illustrated on **Figure 6.2** form the framework for the proposed Development Concept Plan. The following points describe the characteristics, attributes, functions and benefits of the Enhanced LPA schematically shown on **Figure 6.5.**

The Enhanced LPA:

- provides an alternate LPA in a location and configuration that provides significant ecological benefits in terms of its enhanced potential to function as a primary linkage that connects the Fourteen Mile Creek West NHS (Core 1) west of Bronte Road to the Glenorchy NHS (Core 2) and high constraint Stream Reach 14E-7 east of Bronte Road;
- is located immediately south of the future 407 transitway lands approximately 300 m north of the NOCSS proposed LPA and is bound by proposed development to the south;
- is 100 m in width and 302 m in length on the Subject Lands

- is 100 m shorter in total length than the NOCSS proposed LPA (i.e., 462 m vs 564 m between Cores 1 and 2);
- integrates low constraint Stream Reach 14W-18 and medium constraint Stream Reach 14E-8 on the Subject Lands;
- includes naturalization of the current agricultural fields in this area through the creation of a wetland, wooded areas, thickets and meadow habitats that will provide for enhanced native biodiversity and i wildlife habitat for a broad range of taxa;
- introduces a large ecopassage (2 m high x 6 m wide) designed to facilitate safe wildlife passage under Bronte Road for small and medium sized wildlife and supplements the existing ecopassage (culvert for Stream Reach 14E-8);
- provides for a 4.7 ha area of future NHS along the northern limit of the property that will be supported by an additional 2.8 ha area of additional greenspace along the future 407 transitway through openings planned under the transitway near the east and west ends of the Enhanced LPA; and,
- provides a large open space transitional area between highway uses and new development.

The proposed Enhanced LPA will enhance the overall size of the NHS, by introducing a diversity of habitats (wetland, woodland, thicket, meadow), and most importantly provides a safe and functional ecopassage for local wildlife under Bronte Road. **Figures 6.6** and **6.7** presents conceptual renderings of the Enhanced LPA. It eliminates the NOCSS proposed LPA that is not practically feasible or functional, and also eliminates a second crossing of the NOCSS proposed LPA that was identified in the NOWSP Master Plan, thereby minimizing additional future road conflicts with wildlife.

While not fundamental to the Enhanced LPA, as illustrated on **Figure 6.2**, opportunities may exist on the east side of Bronte Road to provide for an expanded terrestrial linkage.

6.2.2.2 Wetland Creation in Enhanced LPA

As was noted in the preceding sections, the NOCSS proposed LPA overlaps with agricultural fields, a hedgerow and a small wetland feature (Wetland 10) but, in order to provide a functional primary linkage between Cores 1 and 2 that meets NOCSS objectives, it will be necessary to shift the NOCSS proposed LPA further north to a location where it is possible to create an ecopassage under Bronte Road.

As previously discussed in **Section 3.3**, Wetland 10 was complexed with the North Oakville Milton Provincially Significant Wetland Complex as part of NOCSS. As part of this EIR/FSS, this wetland unit has been re-evaluated and determined to not meet the criteria to be considered significant. It is proposed that Wetland 10 be removed and a new wetland be created within the Enhanced LPA.

NOCSS generally identified non-PSWs as either Hydrologic Features A (located along high and medium constraint watercourses) or Hydrologic Features B (located outside of the NHS). With the re-evaluation complete, the small wetland on the Palermo Village Corporation lands would be considered a Hydrologic Feature B, which as outlined in policy, can be relocated and

consolidated with other wet features, wetlands or SWM ponds, provided the hydrologic function of the feature is maintained. It has been the EIR/FSS Study Team's experience that the hydrologic function of most Hydrologic Feature B's in North Oakville is maintained in the SWM facilities with no wetland replication or consolidation.

The change in wetland status introduces the ability to remove this wetland however, rather than simply replacing its hydrologic function in the SWM facility, the creation of a new wetland is proposed within the Enhanced LPA.

The EIR/FSS Study Team has examined the technical feasibility of constructing a wetland of similar form and function to Wetland 10 within the Enhanced LPA and determined that based on the existing hydrogeological conditions and future drainage catchments it is possible not only to replicate the form and function to Wetland 10, but to also establish other wetland forms with enhanced ecological functions that can provide an overall net ecological gain and complement the linkage functions of the Enhanced LPA.

To offset for the removal of Wetland 10, the following ecological design criteria were developed:

- the created wetland shall be larger than the existing 0.43 ha wetland and provide improved ecological functions;
- a minimum 15 m buffer shall be applied to the boundaries of the created wetland to be consistent with CH policies;
- the created wetland shall be designed to support improved ecological attributes and functions by:
    - establishing new forms of wetland (i.e., meadow marsh and shallow marsh) and an aquatic habitat (open water/shallow aquatic) component to support amphibians.
    - increasing overall floral and faunal diversity by planting native species and providing wildlife habitat elements and
    - increasing connectivity by providing contiguous vegetation cover.
- the created wetland shall be designed to emulate natural hydroperiods;
- the created wetland shall be hydrologically connected to Tributary 14W-18; and
- the created wetland shall be self-sustaining and require no management or maintenance.

Using the above ecological design criteria as guidance, the EIR/FSS Study Team identified an area within the Enhanced LPA that can accommodate a created wetland that meets the sizing and setback criteria and proceeded to test the suitability of these areas by examining: (a) hydrogeological conditions to determine groundwater elevations and substrate permeability; (b) identifying desired wetland form and hydroperiod, and; (c) undertaking hydrologic modelling to confirm water levels under various conditions.

The proposed wetland design is depicted schematically on **Figure 6.2** and described in the points below:

- The proposed wetland is situated centrally within the Enhanced LPA;
- The proposed wetland achieves a minimum of 15 m setback from the limits of future development to the south and the limits of the future 407 transitway to the north, consistent with CH regulatory policy requirements however, the Concept Plan currently provides a 30 m setback between the wetland and all proposed and existing development, thereby exceeding CH's policy requirements;
- The proposed wetland is comprised of two cells, an East Cell and a West Cell, each of which contains a shallow wetland pocket and a deeper wetland pocket;
- The conceptual design includes an East Cell (0.27 ha) and a West Cell (0.30 ha), providing for a total area of 0.57 ha, which is greater than the existing size of Wetland 10 (0.43 ha);
- Both wetland cells will intercept the water table, but due to the extremely low permeability substrates present, infiltration/exfiltration will be nominal and it is assumed water table levels will remain relatively static. The surficial sediments are clayey silt till. These are fine grained soils with very low hydraulic conductivity that will support ponding of surface water;
- The wetland cells will be sustained mainly by surface runoff from the local catchment area. In the interim condition, the catchment will be limited to the NHS. In the ultimate condition, there will be an additional 1 ha of catchment in the adjacent Mixed-Use Block. Run-off from the additional Mixed-Use Block catchment will consist of clean roof top water and potentially water treated by an OGS (see **Section 7.7.1.2**). Once the East Cell fills it will flow to the West Cell and from there flows will outlet to Tributary 14W-18 via a spreader swale;
- The wetland will remain wetted throughout the year with typical highs in the spring, followed by draw down in the summer, and recharge in the fall;
- The wetland has been continuously modelled using 44 years of data and PCSWMM to determine hydrology under interim and future conditions (See **Section 7.11.3**);
- The wetland cells will be planted with locally native material which will contribute to conserving local biodiversity;
- Target communities include shallow aquatic, shallow marsh and meadow marsh (low and high) which will provide supportive habitat functions, but also be configured to enhance connectivity between the proposed ecopassage and Core 1 (ref **Figure 6.2A**); and,
- The wetland will be supplemented with artificial wildlife habitat elements to promote recruitment of wildlife.

Specific design parameter for the East and West Cells are summarized below:

East Wetland Cell Design Parameters

- Total Area 0.27 ha;
- Groundwater elevation assumed to be at 162.25 masl;
- Comprised of both shallow and deep pockets;

- Shallow pocket #1 sits at groundwater elevation 162.25 masl, while deep pocket #1 extends 1.5m into groundwater;
- East Cell will receive drainage from the future Mixed-Use Block and fills the 0.27 ha area to a depth of 10-15 cm before overtopping to the West Cell;
- The model demonstrated the average depths above groundwater during ultimate conditions as follows:
    - Winter Months: 16-18 cm depths
    - Spring Months: 27-29 cm depths
    - Summer Months: 13-25 cm depths
    - Fall Months: 13-16 cm depths
- Average monthly depth fluctuation is 0.13 to 0.30 m above assumed groundwater elevation

West Wetland Cell Design Parameters

- Total Area = 0.30 ha
- Groundwater elevation assumed to be at 161.50 masl;
- Comprised of both shallow and deep pockets;
- Shallow pocket #2 sits 0.50 m into groundwater, while deep pocket #2 extends 2.0 m into groundwater;
- Bottom of deep pool is 2.0 m below groundwater and is assumed to be 'permanent pool' (i.e., groundwater is at this elevation, or higher, continuously). Deep pool can be lined with clay to hold water (if needed), and the wetland is filled initially to 2.0 m depth;
- Receives flows from East Cell once berm overtops;
- Some infiltration component;
- Will overtop and spill to receiving watercourse throughout the year;
- The model demonstrated the average depths above groundwater as follows:
    - Winter Months: 85-90 cm depths
    - Spring Months: 88-100 cm depths
    - Summer Months: 92-100 cm depths
    - Fall Months: 85-87 cm depths
- Average monthly depth fluctuation is 0.85 to 1.0 m above permanent pool (groundwater elevation), for a total depth of 2.8 to 3.0 m in deep pocket.

6.2.3 Comparing the LPAs – Form, Function and Area

The Enhanced LPA will have a significant net positive impact on the NHS relative to the NOCSS proposed LPA. The form and function of the Enhanced LPA provides for the following ecological benefits when compared to the NOCSS proposed LPA:

- The Enhanced LPA is proposed in a location that already supports an existing ecopassage under Bronte Road and where it is technically feasible to implement an additional larger ecopassage in the future. In contrast, the NOCSS proposed LPA is in an area where there are not any existing ecopassages and where it is technically infeasible to implement an ecopassage. Given the lack of ecopassage potential at the NOCSS proposed LPA, a linkage at this location would create unsafe conditions for both wildlife and motorists given that wildlife movement would take place at grade across the road;

- The Enhanced LPA is 100 m shorter than the NOCSS proposed LPA. Shorter linkages are better for wildlife connectivity;
- The location of the Enhanced LPA and its interface with Core 1 results in the enlargement of the NHS by 0.9 ha as compared to the NOCSS NHS. (i.e., NOCSS proposed LPA NHS size is 3.8ha and the Enhanced LPA NHS size is 4.7 ha for an increase of 0.9 ha);
- The Enhanced LPA will be flanked by the future 407 Transitway to the north and development to the south. The lands associated with the 407 Transitway include 2.8 ha of additional greenspace (excluding the road footprint), that will provide supportive functions and ancillary benefits to the Linkage. Pairing wildlife linkage corridors with transportation and utility corridors is common practice internationally when designing ecological corridors. In fact, the NOCSS LPA between Core 3 and Core 4 also flanks the future 407 Transitway. In contrast, the NOCSS proposed LPA will be flanked on both sides by future development and unsupported by the additional 2.8 ha of greenspace provided by the future 407 Transitway lands; and,
- The Enhanced LPA is associated with two stream corridors: 14W-18 to the west and 14E-8/14E-7 to the east. Linkages that support drainage features are functionally superior as watercourses provide natural avenues for wildlife movement. In contrast, the NOCSS proposed LPA is not associated with any watercourses.

Based on this comparison, the form and function of the Enhanced LPA is considered to be ecologically superior to the NOCSS proposed LPA.

Figure 6.8 provides a visual summary comparing and contrasting the ecological functions and benefits of the Enhanced LPA relative to the NOCSS proposed LPA.

Refer to **Appendix B-2** for additional information pertaining to the justification and rationale for relocating the LPA.

6.3 TRAIL PLANNING

Section 6.3.5.2 of the NOCSS states that:

"Recreational trails for pedestrian and bicycle use will require special consideration and evaluation when planning their location within the NHS. A designated trail system associated with the NHS will be the best strategy to discourage informal trail creation (i.e., trail blazing) for the public wishing to gain access to the NHS.

The following should be considered when planning the location of future trail systems:

- *Trails should cross the NHS (cores, linkages and stream corridors) with existing and proposed road crossings;*
- *Locations where roads are flanking core areas, trails should be substituted for sidewalks provided winter maintenance is feasible;*

- *Where trail systems are proposed to cross the NHS at locations other than where a road crossing is proposed, an impact assessment will be required to ensure no negative impacts to the NHS (i.e., species migration, impacts to drainage);*
- *Trail systems requiring winter maintenance will need to be located outside the NHS to minimize disturbance (i.e., ploughing, sand and salt); and*
- *Trail systems are not permitted in stream valleys."*

The NOCSS further notes that the MNRF and CH will need to be consulted as part of the evaluation of placement of trails within the NHS.

Overall trail planning for North Oakville West is established through the *North Oakville Trails Plan,* May 2013. This document outlines the proposed trail locations within the North Oakville West Secondary Plan area. The location of trails, within that document, is generally consistent with the OPA 34 Active Transportation Plan (Schedule D). As well, in May 2013, a revised EIR/FSS TOR document was issued. The revised TOR provides explicit direction for the study requirements for trails that are required to be included in an EIR/FSS. This EIR/FSS addresses all trail requirements as per the TOR.

The locations of trails within the Study Area as proposed by the *Trails Plan* can be seen on **Figure 6.8** (Figure 1 from the *Trails Plan* document). Within the Study Area, the *Trails Plan* indicates a Major Trail along the east, north and west sides of Core 1 and along the south side of the NOCSS LPA. The alignments proposed for the trails meet the intent of the *Trails Plan* but are altered in specific locations in some places; for instance, the trail continues to be shown along the southern limit of the LPA however, the LPA has been shifted northerly on the Subject Lands. The proposed trail system on the Subject Lands is presented on **Drawings 3A to 3C**.

6.4 LOCATION OF TRAILS

6.4.1 Overview

The trail locations provided on **Drawings 3A to 3C** are consistent with general requirements for recreational trails for pedestrian and bicycle use as discussed in the NOCSS, Section 6.3.5.2. Minor modifications to these alignments are recommended, based on minimizing/avoiding impacts to natural heritage features and functions.

Recommendations for specific locations of sections of the Major Trail (TR) within the NHS are shown on **Drawings 3A to 3C** and summarized below. The final trail corridor will be 3.4m wide, comprising a 2.4m travel surface and a 0.5m cleared area (but with no trail surface) on either side. The design and construction will meet the requirements of the *Trails Plan* and appropriate erosion and sediment control will be put in place at the time of construction.

The majority of the alignment for the Major Trail on the Subject Lands will be located within buffers and setbacks to natural heritage features or natural hazards that define the NHS. Its alignment is largely located on lands currently in agricultural production. Minor disturbance will be required where the trail intersects with hedgerow trees; some removals may need to occur.

Based on the Study Team's experience in North Oakville, where a trail is located within a buffer area (where the habitat primarily is agriculture and where grading can occur), through direction from CH, the trail's preferred alignment is close to the development edge of the buffer to provide as much separation as possible between the trail and the features within the NHS. The ultimate alignment will be determined at detailed design through discussions with Town Parks staff in consultation with CH.

6.4.2 Species at Risk in Trail Vicinity

The TOR, Section 3.7.1 states that "*Trail sections that are exclusively located within buffers that are active agricultural lands (row crops) must undertake Species at Risk (SAR) screening and complete appropriate seasonal field surveys*." In addition, for these areas, as a condition of draft approval, the TOR indicates that "a plan identifying hazard trees" will be required.

The proposed trails are located in agricultural areas with the exception of several locations where it will cross existing treed/shrub hedgerows. Hazard trees and opportunities to preserve specimen trees within hedgerows will be completed in an arborist report as a condition of draft plan approval.

The entire Subject Lands, including the trail segments TR-1 to TR-5, were assessed for SAR species, as discussed in **Section 5.4**. No SAR species were found to be associated with the agricultural fields and hedgerow features that will be intersected by the proposed trail. Additionally, the proposed trail alignment and associated grading is located outside of any regulated habitat of endangered Redside Dace. It is recommended that mitigation include removing trees outside of roosting season.

In the future, when the non-participating lands east of Bronte Road proceed to development, SAR surveys may be required where trails are proposed.

6.4.3 Description of Trail Alignment Sections

The majority of the trail sections on the Subject Lands are located in areas where agricultural practices are currently occurring. As well, there are a few locations, within buffer areas where there are small groupings of regenerating trees and shrubs associated with hedgerows, which are not a defining feature of Core 1.

The trail sections (see **Drawings 3A to 3C**) associated with Core 1, including their general location and grading requirements are presented in **Table 6.1**.

Table 6.1 – Summary of Trail Segments on Subject Lands

Trail Section	Location	Comment
TR1	This trail segment corresponds with the southeasterly limit of Core 1 and maintenance access road for the proposed SWM pond. The access road flanks the north, west and	The proposed alignment for this trail segment follows the SWM Pond access road. (**Drawing 3A**). The trail segment will double as the pond access road, and the trail will have a cross slope of 2% towards the pond. There will be no runoff across the trail, except the rain that falls on the trail. The trail will be

Trail Section	Location	Comment
	south side of the SWM pond and connects to the future Valleyridge Drive providing trail access to the community.	located on the pond berm and will have 0% longitudinal slope.
TR2	This trail segment, situated immediately north of TR1, follows the Core 1 boundary. The Core boundary in this location was established through NOCSS and is represented by an arched line that generally corresponds with a 200 m offset from the west boundary of Core 1 as defined by application of a 30 m setback to the western valley top of bank	The proposed alignment for this trail section is offset 1.5 to 2.0 m from the limits of development. Proposed grading for the trail and a drainage swale along this trail segment will generally extend between 3.5 to 7.0 m into the Core (ref. **Drawing 3B**) with two exceptions. The first exception being as TR2 meets the Core 1 road crossing (William Halton Parkway) where grading extends approximately 10 to 12 m beyond the development limit, and a 40 m long by 0.1 m deep cut-of swale where grading extends approximately 10 m to 12 m into Core 1. The trail segment does not traverse or run adjacent to any natural heritage features. This trail segment overlaps with existing agricultural fields and will bisect 3 hedgerow features comprised primarily of shrubs (Common Buckthorn) and small trees. An evaluation of vegetation to be removed will be detailed in an Arborist Report. Portions of this trail segment are proximal to the valley top of bank. Only a short segment overlaps with the setback to the top of bank. Areas affected by the proposed grading are comprised entirely of agricultural lands cultivated with row crops and will be naturalized to created Open Country habitat. Construction and operation of the trail, cutoff swale and infiltration galleries within this portion of Core 1 are not anticipated to adversely impact natural features and functions provided recommended mitigation measures such as erosion and sediment controls are implemented. The trail has a 2% cross slope towards the interior of Core 1, away from the development limit. Longitudinal slope will not exceed 5 % for TR2. As described in **Section 7.8.1**, it is anticipated that all backyard drainage backing onto the NHS will be captured into the storm system, however, through detailed design there may be some drainage from the lots backing onto Core 1 directed to the Core. It is not anticipated that there will be sheet drainage across the trail, from the lots. Appropriate measures such as culverts under the trail at strategic locations can be considered at detailed design, if necessary. Runoff from the backyards adjacent to the NHS will be captured in rear yard catchbasins and connect sub-surface to infiltration galleries adjacent-to and under the trail. Any runoff that cannot infiltrate will be directed to the SWM pond in storm sewers. This will provide some infiltration, while ensuring major system storm events are routed to the pond or other outlet. Additional information on water balance, and infiltration trenches adjacent/under the trails, parks, and boulevards in the municipal right-of-way is provided in **Section 8.8**.
TR3	This trail segment, situated immediately north of TR2, follows	The proposed alignment for this trail section is offset 2.0m from the limits of development.

Trail Section	Location	Comment
	the Core 1 boundary. The Core boundary in this location was established through NOCSS and is represented by the 10m buffer to the large woodland dripline (ELC Unit 6a) or the 7.5 m setback to the valley top of bank, whichever is greater.	For most of its length, the proposed trail alignment will be contained within the 10 m woodland buffer, except for the northern potion where the setback to valley top of bank extends beyond the woodland buffer. Proposed grading for the trail will extend approximately 5-6 m into the Core (ref. **Drawing 3A**). No grading is proposed within 2.0m of the dripline. Areas affected by the proposed grading are comprised entirely of agricultural lands cultivated with row crops and will be naturalized. There are three hedgerows that will be bisected by the proposed trail. An evaluation of trees to be removed/retained will be detailed in an Arborist Report. Construction and operation of the trail within the Core is not anticipated to adversely impact natural features and functions provided recommended mitigation measures such as erosion and sediment controls are implemented. The trail grading of TR3 will be the same as TR2. TR3 has a 2% cross slope towards the interior of Core 1, away from the development limit. Longitudinal slope will not exceed 5% for TR3. TR3 will have the same drainage conditions as TR2. Backyard drainage adjacent to TR-3, and infiltration measures, will be similar to TR-2 as described above and in **Section 8.8.**
TR4	This trail segment is situated along the southern limits of the proposed Enhanced Linkage Preserve Area. It will provide a trail connection between Core 1 and Bronte Road.	The proposed alignment for this trail section is offset 2.0m from the limits of development. The proposed trail alignment overlaps with existing agricultural fields. There are no natural heritage features or natural hazards in this area. The proposed trail alignment will bisect a single hedgerow feature. An evaluation of trees to be removed/retained will be addressed in an Arborist Report. It is anticipated that grading for the trail will be completed in conjunction with grading of the Enhanced LPA and development. TR4 has a 2% cross slope away from the development limits towards the Enhanced LPA. Longitudinal slope of the trail will not exceed 5%. There will be no sheet drainage across the trail, except drainage originating on the trail itself. Clean drainage from the Mixed-Use block adjacent to TR-4 will be directed under TR-4 (via culvert), and discharge to the created wetland in the Enhanced LPA. No sheet drainage across the trail is expected.
TR5	This trail segment is located east of TR4 and includes a short segment of trail along the southern boundary of the Enhanced LPA immediately adjacent to Bronte Road. This trail segment has been treated separately as it is located proximal to a Blue Stream Corridor (Reach 14E-8) and an associated wetland	The proposed alignment for this trail section is offset 2.0m from the limits of development. The proposed trail alignment overlaps with existing agricultural fields. The proposed trail alignment will be located outside the adjacent Blue Stream Corridor of Reach 14E-8 but will encroach slightly into the 30 m buffer to the existing riparian wetland. TR5 has a 2% cross slope away from the development limits towards the Enhanced LPA. Longitudinal slope of the trail will

Trail Section	Location	Comment
	feature and buffer	not exceed 5%. There will be no sheet drainage across the trail, except drainage originating on the trail itself.

6.4.4 Trail Restoration Plantings

For locations within the NHS where disturbance will occur due to the construction of the trail/swale features, a detailed landscape naturalization-restoration plan will be required as a condition of draft approval and prepared to the satisfaction of the Town (Parks) and CH, following CH's Landscaping Guidelines, including:

- Drawings would include a plan view with planting locations, species and quantities, a detail showing the installation, and a note listing the species, size, and condition (e.g., bareroot, balled and burlapped, potted).

- The locations for construction barriers and hoarding to protect retained vegetation, including specific trees as identified in trail section descriptions, should be identified, along with the timing of their installation.

- The specific locations for plantings would include the areas between the trail and property lot lines, swales and flow spreader areas, if applicable, and any other locations within the NHS that may be disturbed by construction activities.

- Passive restoration is not recommended as there is a high probability that the areas would be colonized by non-native species. Bare soil areas in the vicinity of trail/swale features (i.e., buffers previously under agriculture), if applicable, should be seeded with a suitable seed mixture, in addition to the requirements for herbaceous and woody materials.

- The species recommended for plantings should contain a characteristic assemblage of species that occur in the natural areas in the vicinity and should provide the potential for an appropriate community structure with both vertical and horizontal stratification. They should be native, indigenous to the area, suitable to the micro-ecological conditions into which they will be placed; and, provide diversity and habitat functions for the area. Non-native species and cultivars of native species should be avoided. The preference would be to obtain plant material derived from locally adapted sources within the bioregion.

- Recommendations for stabilizing the drainage swales, if applicable, should be made, including seeding, or hydro-seeding; after seeding has occurred, it should be recommended that the site be inspected to identify locations where overland flow has the potential to direct sediments to the seeded areas and ensure that suitable sediment control measures are installed in those locations.

- Hazard trees in close proximity to the trail and property lines should be identified and pruning requirements established.

- The timing of implementation of all planting plans should be specified.

- The warranty period should be established during which time the planted materials would be monitored and managed appropriately, including mulching, weeding, watering as required. This would include the planted drainage swale areas, where applicable. Any additional monitoring requirements would be specified, including during and after installation. The duration of the warranty period and the required survival rate of the planted materials should be specified.

- Discussions with agency regarding permitting requirements, if any.

7 GRADING, DRAINAGE AND STORMWATER MANAGEMENT

7.1 OPA 298, OPA 34 AND NOCSS RECOMMENDATIONS

Preparation of the SWM Plan for the Subject Lands has been guided by OPAs 289 and 34 and the NOCSS recommendations.

OPA 289 policy 8.4.5 states that,

"The management of water resources within the North Oakville West Planning Area shall be undertaken in accordance with the directions established in the North Oakville Creeks Subwatershed Study. No amendments to the Secondary Plan shall be required to implement the recommendations of the Subwatershed Study or for changes to the number or location of stormwater management facilities in accordance with the policies of Section 8.6.2.2 a) of this Plan".

OPA 34 policy 26.7.4(f), related to Stormwater Management states that,

i) "An Environmental Implementation Report (EIR) shall be prepared for each subcatchment area identified on Appendix 5, North West Subcatchment Areas, to the satisfaction of the Town.

ii) Water resource management shall be undertaken in accordance with the overall concept and objectives of the applicable subwatershed study.

iii) Changes to the number or location of stormwater management facilities in accordance with the applicable subwatershed study may be permitted without amendment to this Plan.

iv) Stormwater management facility sites and development standards shall be consistent with the policies of this Plan and in accordance with the applicable subwatershed study and any approved Environmental Implementation Report and Functional Servicing Study.

Section 6.0 of the NOCSS presents the recommended Management Strategy for North Oakville. It includes strategies for natural heritage protection, SWM, terrestrial and wetland resources management, riparian corridor management, rehabilitation plans, remediation plans and monitoring. The goals, objectives, and targets of the Management Strategy are set out in Section 6.2 of the NOCSS.

The recommended NOCSS Management Strategy addresses the development of an approach to SWM that will, "…*protect and enhance environmental characteristics through managing*

stormwater response and conveyance processes". The water resource related goals, objectives and targets from the Management Strategy are presented in **Table 7.1** of this EIR/FSS.

The NOCSS Section 6.3.6 discusses the SWM component of the Management Strategy. It includes discussion on hydrology, peak flow control, hydrogeology, water quality, fisheries protection, LID, source pollution protection and various types of SWM measures.

Table 7.1 - North Oakville Creeks Subwatershed Study
Meeting the Subwatershed Goals & Objectives - Target Setting

Goals	Objectives	Targets
1. To minimize the threat of life and destruction of property and natural resources from flooding, and preserve (or re-establish, where possible) natural floodplain hydrologic functions.	1.1 To ensure that runoff from developing and urbanized areas is controlled such that it does not increase the frequency and intensity of flooding at the risk of threatening life and property.	• Maintain existing peak discharge rates for all design events, particularly high flows. • Target discharge rates required for each catchment (unit area). • Stream reach floodplain storage targets to protect existing floodplain storage. • Remove flood potential at identified locations within the Study Area. • Delineate floodplains to provide development limits. • Restrict development in the floodplains as per Provincial and CA policies.
	1.2 To adopt appropriate land use controls and development standards to prevent development in natural flood hazard and erosion hazard areas.	• Delineate floodplains to provide development limits. • Restrict development in the floodplains as per Provincial and CA policies. • Delineate meander belt and erosion setback to be applied on all streams designated to be left as open watercourse (providing erosion protection). • Apply valley wall setback standard (slope plus top of valley setback). • Develop SWM plan to replicate flow-frequency-duration from existing conditions. • Meet threshold tractive force targets. • Use Distributed Runoff Control (DRC) approach.
	1.3 To ensure that new development incorporates the most appropriate development form and mitigation measures necessary to optimize compatibility with natural features and their associated functions.	• Aquatic protection based upon resident fish community and existing aquatic habitat conditions. • Achieve MOE 'enhanced' level of SWM protection (80% TSS removal) for all reaches of streams supporting resident Redside Dace populations (Fourteen Mile and Morrison Creeks). • For all other stream reaches, achieve 'normal' level of SWM protection (70% TSS removal) to adequately protect aquatic habitat and resident fish. Note that 'enhanced' protection of

Goals	Objectives	Targets
		these streams will be required for reasons not directly related to aquatic habitat and resident fish (see Section 2.2 regarding Phosphorus loadings).
2. To restore, protect, and enhance water quality and associated aquatic resources and water supplies for watercourses, including their associated hydrologic and hydrogeologic functions, within the subwatershed areas.	2.1 Protect stream morphological and fluvial character; restore, where appropriate and feasible, sinuosity; maintain physical habitat attributes (e.g., pools and riffles), diversity and fluvial processes (e.g., bedload transport and energy reduction through sinuosity); and prevent increase in erosions and deposition, through maintenance of hydrological regime.	• Streams that displayed a high sensitivity to change and have a well-developed geomorphic form and function. • Streams that exhibited some sensitivity to change and geomorphic function with a moderate degree of form. • Streams that lacked a defined form but still had a geomorphic function such as sediment transport, flow conveyance, and connectivity to other features.
	2.2 To prevent the accelerated enrichment of streams and contamination of waterways from runoff containing nutrients, pathogenic organisms, organic substances, and heavy metals and toxic substances.	• Control current nutrient levels in the streams to mitigate the potential increases in nutrients and associated impacts on algae growth. • The potential increase in suspended solids and associated urban pollutants. • The level of chloride and potential increase. • The need to manage stream temperature for fisheries protection.
	2.3 To maintain or restore a natural vegetative canopy along streams, where required, to ensure that mid-summer stream temperatures do not exceed tolerance limits of desirable aquatic organisms.	• Maintain existing riparian vegetation associated with watercourses, where feasible. • Active restoration of riparian zones with native plantings, in cases where watercourse modifications/alterations require permitting/authorization.
	2.4 To minimize the disturbance of the streambed and prevent streambank erosion and, where practical, to restore eroding streambanks to a natural or stable condition.	• Targets as outlined in Objectives 2.1 and 2.2.
	2.5 To restore, rehabilitate, or enhance water quality and associated resources through the implementation of appropriate best management practices on the land.	• Targets for surface water as outlined in Objective 2.2. • For groundwater, target of no detrimental change in existing groundwater quality.
	2.6 To ensure that hydrogeologic functions are preserved and maintained and take full advantage of stream and groundwater discharge/baseflow enhancement opportunities.	• Maintaining groundwater supplies for existing residents while development and servicing proceed. • Keeping changes in the depth to the local water table to within the seasonal fluctuations normally experienced. • Maintaining the groundwater contribution to stream health

Goals	Objectives	Targets
		(groundwater quantity and quality), where it currently exists.
	2.7 To maintain and enhance the aquatic habitat.	• The targets relating to biodiversity for Fourteen Mile, Morrison, and Joshua's Creeks should be that the biodiversity of the fish community be, at a minimum, maintained at existing levels and increased if possible. • Identify stream corridors for protection.
		• Fluvial geomorphology/erosion control targets under Objective 2.1. • Water quality targets under Objective 2.2. • Designate reaches, which support Redside Dace populations, as "no touch" areas where stream sections cannot be relocated. • Enhanced level of stormwater quality control for Fourteen Mile and Morrison Creeks. • Retain wetlands associated with streams if possible and incorporate into drainage system.
	2.8 To minimize disturbance of wetlands, preserving and/or enhancing the habitat and functions they provide.	• Minimize fragmentation of wetlands. • Maintain the function of all wetlands associated with watercourses. • Maintain the function and structure of wetlands within woodlands.
	2.9 Provide appropriate buffers to wetlands, watercourses, and valleylands to maintain or enhance their biological health and meet objectives of long-term sustainability of these features.	• Establish appropriate feature-specific buffers for protection of natural habitats.
3. To restore, protect, develop, and enhance the natural heritage, historic cultural, recreational, and visual amenities of rural and urban	3.1 To ensure that environmental resource constraints are fully considered in establishing land use patterns in the subwatershed.	• Minimize the fragmentation of woodlands. • Maintain the function of all woodlands that are >200m in width (i.e., provide potential interior conditions). • Maintain the function of woodlands associated with watercourses.

Goals	Objectives	Targets
stream corridors.	3.2 To ensure that existing wildlife linkages are preserved and that opportunities for improving these linkages are considered/implemented as part of any future development.	• Minimize the discontinuities in linkages (especially >20m). • Linkages to be 100m wide. • Allow for linkages to habitats or other linkages located outside the study area (for example Sixteen Mile Creek valley and Bronte Creek).
	3.3 To retain, preserve, or maintain natural heritage features (i.e., open space and visual amenities) in urban and rural areas by establishing and maintaining greenbelts along stream corridors and adjacent natural areas and maintaining linkages between these areas.	• See discussions under Objectives 2.8, 3.1, and 3.2.
	3.4 To ensure that development in the stream corridor is consistent with the historical and cultural character of the surroundings and reflects the need to protect visual amenities.	• Presence of visual and historic amenities through the subwatershed and secondary planning processes.
	3.5 To ensure that the recreational and fisheries potential of a stream corridor are developed to the fullest extent practicable.	• See discussion under Objectives 1.3, 2.3, and 2.7.

* Reproduced from NOCSS

The NOCSS Management Strategy presents the following recommendations regarding the design of SWM systems in support of development in North Oakville:

- **Peak Flow Control** – The NOCSS recommends that SWM systems be designed to control post development peak flows to target unit flow rates presented in NOCSS' Table 7.4.1 for the 2 year to 100 year events and Regional Storm. No new hydrologic modelling of existing conditions in the subcatchment is necessary to establish existing conditions target peak flows; however, the NOCSS notes that more accurate topographic information is required to define subcatchment boundaries. Target peak flows for the full range of events are to be calculated at the EIR/FSS stage on the basis of updated subcatchment boundaries. **Sections 7.2 and** Error! Reference source not found. of this EIR/FSS address drainage boundaries and present target peak flows for the Palermo Lands subcatchments at Dundas Street.

  OPA 289 Policy 8.4.13.2 and the NOCSS Addendum identify that, within the Fourteen Mile Creek watershed, Regional Storm controls are necessary. **Section 7.5** addresses the requirement for Regional Storm controls.

  The Town of Oakville commissioned a flood study of Fourteen Mile Creek and McCraney Creek watersheds however, the report is not yet finalized. As part of the flood analysis for Fourteen Mile Creek, a PCSWMM hydrology model was prepared to calculate existing conditions peak flows in Fourteen Mile Creek. The Fourteen Mile Creek PCSWMM model includes the Subject Lands, which were considered un-developed in the model. The Fourteen Mile Creek PCSWMM model was later updated through the Bronte Green Subdivision development draft plan approval process in 2016.

  This EIR/FSS updates the latest pre-development and post-development Fourteen Mile Creek PCSWMM models to demonstrate there is no increase to downstream peak flows resulting from the development of the Subject Lands. The hydrology modeling is not a criterion of NOCSS but has been completed to demonstrate that development does not impact downstream conditions given that Fourteen Mile Creek and McCraney Creek flooding were studied subsequent to NOCSS completion. Additional discussion on the downstream hydrology modeling in PCSWMM is provided in **Section 7.10**.

- **Role of Topographic Depressions/Hydrologic Features A and B** – The NOCSS Analysis Report and Management Strategy address the hydrologic function of terrestrial features (woodlands, wetlands) and stream riparian corridors in the formulation of the recommended NHS and SWM systems. These reports also identified numerous topographic depressions across the landscape in North Oakville. The NOCSS GAWSER hydrologic model accounted for the storage function of these topographic depressions in the simulation of existing conditions peak flows and the setting of target unit flow rates for SWM facility design. The NOCSS Addendum recommends that the storage functions of these depressions be confirmed through the completion of the EIR/FSS when more detailed topographic information would be available.

Some topographic depressions that are wetland or pond features were noted to be Hydrologic Features A and B. Wetlands or ponds that were located online or within the stream corridor of a Medium or High Constraint Stream generally were defined to be a Hydrologic Features A; all others were defined to be Hydrologic Features B.

The NOCSS recommended that the form and function of Hydrologic Features A be carefully considered as part of the EIR studies. If relocating these features, the form and function must be maintained.

With respect to Hydrologic Features B, the NOCSS notes that their preservation is encouraged but not required. If they are proposed for removal, the active storage volume of these features must be addressed as part of the SWM facility design. Requirements for the replacement of storage were further clarified in Mediation Agreement on Depression Storage dated May 30, 2007.

In accordance with the NOCSS Addendum requirements and depression storage mediation agreement, this EIR/FSS has field verified each of the natural topographic depressions and Hydrologic Features B located with the EIR Subcatchment Areas (presented on NOCSS Figure 6.3.15). There are no Hydrologic Features A located in the Subject Lands. The calculated storage volumes within the natural topographic depressions and Hydrologic Features B were calculated, and the necessary comparisons of storage volumes to SWM facility volumes were made. In total, there are four topographic depressions and four Hydrologic Features B within the Subject Lands. **Sections 2.1** and **7.12.2** further address these areas.

- **Erosion Control** – The NOCSS identifies the need to complete erosion threshold and erosion control analyses as part of an EIR/FSS so that existing channel erosion or aggradation is not exacerbated by development. The recommended approach to erosion threshold analyses is set out in the NOCSS Addendum.

  A continuous erosion analysis was completed for the Subject Lands; its results are discussed in **Section 7.6** and **Appendix L.**

- **Water Quality Control** – The NOCSS recommendations for water quality control focus on the management of phosphorus, suspended solids, chloride, dissolved oxygen and temperature. The focus on these water quality parameters is, "… *intended to provide controls to the meet the objective of not permitting further enrichment of the streams (i.e., nutrient control), fisheries protection and overall water quality protection"*. It further notes that SWM systems are to be designed to meet targets set out in NOCSS Section 6.0 and outlined in NOCSS Table 6.2.1.

  With respect to each of these water quality parameters, the following are NOCSS recommendations, specific to Fourteen Mile Creek:

  – Provide Enhanced Level of water quality protection. This level of control provides for the removal of 80% of suspended solids, will meet the target of no net increase in phosphorus loading and will provide the recommended control for overall water quality protection. No further analysis of phosphorus loading is necessary.

- Dissolved oxygen target of 6 mg/L should apply to Fourteen Mile Creek and temperature recommendations consistent with Redside Dace protection.
- Chloride recommendations relate to the Town's management of salt applications and do not require any further analyses in the EIR/FSS.

- **Infiltration** - The NOCSS notes that the management of groundwater resources focuses on the management of the hydrologic cycle. For groundwater, the overall goal was stated, "*to maintain infiltration as close to current levels as possible*". It further notes that the soils in North Oakville are, "… *poorly permeable, resulting in little infiltration*" and that the "*infiltration targets are very difficult to meet*". As such, best efforts are to be made to address maintenance of groundwater recharge.

  Section 8.0 of this EIR/FSS addresses the post-development water balance conditions with respect to groundwater and discusses Low Impact Development (LID) techniques to promote groundwater recharge.

- **SWM Facility Numbers/Locations** – The NOCSS completed a preliminary assessment of the required numbers and locations of SWM ponds to meet the SWM design criteria. It presented preliminary locations for ponds in each subcatchment in North Oakville West on Figure 7.4.6. NOCSS Section 6.3.5.2 provides direction to locating SWM ponds in or adjacent to the NHS.

  There are two versions of NOCSS Figure 7.4.6 in circulation with the same date; they are provided in **Appendix G-1**. A description of each follows:

  - DSEL received the first version in August 2006 in hard copy as the final version of NOCSS. This version of Figure 7.4.6 illustrates two ponds within the Subject Lands (FM408 and FM409). Pond FM408 is located adjacent to Stream Reach 14W-3 outside of Core 1. Pond FM409 is located adjacent to Stream Reach FMW-1 inside of Core 1. A portion of the Subject Lands is shown tributary to an offsite pond (FM414) located east of Old Bronte Road, outside of the FSS Study Limit, adjacent to Stream Reach 14E-9 outside of Core 2. CH has advised that this is the same version of Figure 7.4.6 they currently have and use for review.
  - The second version is available on the Town of Oakville website. This version of Figure 7.4.6 illustrates three ponds within the Subject Lands (FM_9, FM_10 and FM_12). Pond FM_9 is located adjacent to Stream Reach 14W-3 outside of Core 1. Pond FM_10 is located adjacent to Stream Reach FMW-20 outside of Core 1. Pond FM_12 is located adjacent to Dundas Street and Stream Reach FMW-1 outside of Core 1. A portion of the Subject Lands is shown tributary to an offsite pond (FM_11) located east of Old Bronte Road, outside of the FSS Study Limit, adjacent to Stream Reach 14E-9 discharging to Culvert FM-D6a at Dundas Street. The Town of Oakville has advised that this is the version of Figure 7.4.6 they use for review.

It is unclear which version of Figure 7.4.6 is intended to be the final version. The Palermo Village EIR/FSS proposes one SWM facility, adjacent to Stream Reach 14W-20, partially within Core 1. The proposed SWM Pond is shared 50%/50% based on area within the NHS (i.e., Core 1) and within the development lands as illustrated on **Figure 7.3**. Additional SWM facilities (on-site control) may be required within the FSS Study Area to achieve the SWM objectives. For additional discussion on the SWM pond and facility location selection refer to **Section 7.7**.

- **Floodplain Mapping** - The NOCSS analyses included preliminary floodline mapping along each of the watercourses in North Oakville. However, recommendations were made that final floodlines be determined through the EIR/FSS. It was acknowledged in the NOCSS that the existing conditions hydrology (peak flows) could be utilized for the determination of existing conditions floodlines. If Regional Storm controls were concluded not to be necessary, future conditions hydrology models would be prepared to calculate uncontrolled Regional Storm flows for use in establishing future floodlines.

  Section 5.5.1.3 presents floodline mapping for Fourteen Mile Creek West. Also, there is a Medium Constraint Stream located in the northeast corner of the Subject Lands (Reach 14E-8) that does not have NOCSS or CH floodplain mapping. The upstream tributary to Stream Reach 14E-8 is approximately 81 ha. As part of this EIR/FSS, a regulatory floodline has been calculated. See **Section 5.5.1.3**.

- **Evaluation of SWM Measures, LIDs and Source Pollution Prevention** – While the NOCSS identifies the requirement for end-of-pipe SWM facilities for water quality and quantity control, it also recommends that consideration be given to alternative management measures to meet the SWM objectives and targets. In this regard, the NOCSS discusses alternative LID techniques, various source pollution protection programs and alternative SWM practices to be considered.

  Sections 7.4 and **8.8** present the evaluation of LID and SWM measures.

7.2 UPDATED SUBCATCHMENT BOUNDARIES

The NOCSS identified drainage boundaries are based on the best topographic information of the day. Detailed LiDAR topographic mapping was obtained to refine the EIR Subcatchment Area drainage boundaries for each subcatchment and to have more detailed mapping available for engineering design. The LiDAR accuracy description, as received from First Base Solutions (flown by Aerial Imagery), is provided in **Appendix G-2A**. Using the LiDAR mapping and Digital Elevation Model, the culvert inventory and review of engineering drawings along major roads, existing subcatchment drainage boundaries were delineated and compared to the NOCSS drainage area boundary for the EIR Subcatchment Area boundaries. This EIR/FSS re-delineated drainage boundaries for NOCSS EIR Subcatchments FM1110, FM1110.1, and portions of FM1109 and FM1111 using LiDAR mapping.

It should be noted that, since NOCSS was completed in 2007, Dundas Street and Bronte Road have been reconstructed and urbanized. Furthermore, development of lands immediately south of Dundas Street has occurred. These construction projects have altered the existing conditions catchments outlined in NOCSS. Bronte Road Existing Drawings are provided in **Appendix G-2B**. For example, Bronte Road has been reconstructed and realigned; drainage from the roadway itself is now collected in storm sewers and conveyed south reducing the FM1110 catchment size. For the purpose of this EIR/FSS, the existing conditions described herein reflect the revised drainage patterns that have occurred post-NOCSS as a result of these major road projects at the boundaries of the Subject Lands.

The reconstruction of Bronte Road has directed approximately 8.0 ha (west side of Bronte Road) and 2.1 ha (east side of Bronte Road) of catchment FM1110 from culvert FM-D6 to the upstream side of culvert FM-D5 (into catchment 1109A). The drainage from Bronte Road is now directed south of Dundas Street in storm sewers, directing 1.3 ha, 1.5 ha, and 2.0 ha away from catchments FM1111, FM1110.1, and FM1110, respectively. The Bronte Road drainage flows in storm sewers south of Dundas Street to an existing pond near Richview Boulevard and Bronte Road.

The reconstruction of Dundas Street has directed approximately 2.4 ha of catchment FM1110 from culvert FM-D6 to the upstream side of culvert FM-D5 (into catchment 1109A).

Tables 7.2 summarize these changes to drainage areas. The drainage area comparison of NOCSS catchments to the LiDAR delineated catchments is provided on **Figure 7.0**, and additional detail in **Appendix G-3**.

Table 7.2 - Drainage Areas to Dundas Street

Subwatershed	Pre-Development Area (ha) (no Dundas Street)			
	NOCSS	LiDAR + Road Construction	% Difference	Differences
FM1109 to Culvert FM-D5 Drains to Main Tributary of Fourteen Mile Creek West north of Dundas Street	340	344.1	1%	Minor differences along subcatchment boundaries; difference largely due to redirection of drainage to FM1109A from FM1110 as a result of Dundas Street and Bronte Road reconstruction
FM1110 to Culvert FM-D6 Drains to Main Tributary of Fourteen Mile Creek West north of Dundas Street	16.9	5.3	-69%	Difference largely due to redirection of drainage to FM1109A from FM1110 as a result of Dundas Street, and Bronte Road reconstruction directing drainage south of Dundas Street in Bronte Road to downstream existing pond

FM1110.1 to Culvert FM-D6a Drains to Tributary of Fourteen Mile Creek East	26.3	26.6	1%	Minor differences in drainage boundary at northwest limit of catchment based on LiDAR topographic information, and redirection of Bronte Road drainage south to downstream existing pond
FM1111 to Culvert FM-D7 Drains to Main Tributary of Fourteen Mile Creek East	247.9	268.7	8.5%	Difference largely due to drainage boundary along northwest limit with catchment FM1109A, and southeast boundary with external EIR catchment FM1112 at Dundas Street to the east.

A further review and updating of catchment modeling areas is provided **Appendix F-0**. The delineated subcatchment drainage areas have been used for updating existing conditions hydraulic modeling, as described in **Section 5.5.1.3**.

It is important to note that there are differences between NOCSS subcatchment area numbering on NOCSS **Figure 7.4.2**, illustrating EIR Subcatchment Areas, and NOCSS **Figure 5.1.1**, illustrating modeling subcatchment areas. For consistency with NOCSS, **Figure 5.1.1** subcatchment numbering has generally been used for hydraulic modeling purposes with a few exceptions noted below. Catchment IDs, referred to as modeling catchment areas herein, are provided on **Drawing 5**:

- The notation 'FM' preceding the ID # on Figure 5.1.1 has been removed so the catchment labels are not confused with the EIR Subcatchment IDs, which use 'FM' notation.
- FM1006 and FM1006a have been combined into one area identified as catchment 1006
- FM1007a and FM1007b have been combined into one area identified as catchment 1007
- FM1007c and FM1007d have been combined into one area identified as catchment 1007A
- FM1107, FM1108, and FM1009 have combined been into two catchments identified as catchment 1009 and 1009A to represent the main branch catchment south of Highway 407 and north of Dundas Street located inside and outside of the EIR Subcatchment Area.
- Some additional modeling catchments have been added to align with the hydraulic model flow input locations as outlined in **Appendix F-0**.

7.3 PRE-DEVELOPMENT FLOWS AND DUNDAS STREET CULVERT CAPACITIES

7.3.1 Pre-Development Flows

The NOCSS established target unit peak flows for the 2 year to 100 year events and the Regional Storm utilizing the GAWSER model. It is also noted that further modelling of existing conditions target flows is not required at the EIR/FSS stage. In accordance with the NOCSS recommendations, NOCSS unit flow rates have been utilized, along with the updated pre-

development drainage areas based on LiDAR mapping, to calculate pre-development peak flows at Dundas Street for the Fourteen Mile Creek subcatchments.

The NOCSS unit flow rates and the resulting pre-development flows at Dundas Street are summarized in **Table 7.3**. These flow rates have been calculated with the inclusion of the Dundas Street drainage area since drainage from the road discharges to the upstream side of the culverts under existing conditions. These flows rates to culvert FM-D5 have been calculated with inclusion of the approximately 10.1 ha of drainage from catchment 1110 to catchment 1109A that discharges to the upstream side of Dundas Street as a result of the Dundas Street reconstruction project.

Table 7.3 - Fourteen Mile Creek Pre-Development Flows at Dundas Street

Return Period (Yr)	Unit Flow Rates* ($m^3/s/ha$)				Pre-Development Flow Rates (m^3/s)			
	FM-D5	FM-D6	FM-D6a	FM-D7	FM-D5 (344.1 ha)**	FM-D6 (5.3 ha)**	FM-D6a (26.6 ha)	FM-D7 (268.7 ha)
2	0.006	0.007	0.007	0.005	2.06	0.04	0.19	1.34
5	0.010	0.011	0.011	0.009	3.44	0.06	0.29	2.42
10	0.013	0.014	0.013	0.011	4.47	0.07	0.35	2.96
25	0.017	0.017	0.017	0.014	5.85	0.09	0.45	3.76
50	0.019	0.019	0.019	0.016	6.54	0.10	0.51	4.30
100	0.021	0.021	0.022	0.019	7.23	0.11	0.59	5.10
Regional	0.055	0.052	0.053	0.048	18.93	0.28	1.41	12.89

* Unit flow rates taken from Table 7.4.1 from the Mediation Agreement on Flow Rates, July 2007

** The drainage areas to Culvert FM-D5 reflects the 10.1 ha drainage directed to this culvert as a result of the Dundas Street reconstruction project as well as the 2.4 ha of Dundas Street drainage which is directed to the north side of Dundas Street. The drainage to culvert FM-D6 reflects the reduction in drainage of 10.1 ha that has been directed to culvert FM-D5 as a result of Dundas Street reconstruction.

The unit flow rates noted above were taken from the NOCSS Table 7.4.1 within the Mediation Agreement on Flow Rates and were utilized to establish allowable release rates for each SWM facility.

As described in **Section 7.1**, this EIR/FSS updates the existing and proposed conditions PCSWMM model for Fourteen Mile Creek and McCraney Creek. The purpose of the PCSWMM model update is to demonstrate there are no downstream peak flow increases as a result of the development of the Subject Lands. The updated pre-development PCSWMM model is not intended to replace or supersede the GAWSER model peak flows. The GAWSER unitary flow rates from NOCSS have been used to establish the pre-development peak flows in **Table 7.3** and used for establishing target release rates for the SWM Facilities.

7.3.2 Dundas Street Culvert Capacities

The pre-development flows from **Table 7.3** have been used for assessing culvert FM-D5 capacity at Dundas Street. Given the reduction in drainage to culvert FM-D6 as a result of Dundas Street reconstruction, there is no need to check its capacity as part of this report. Existing culvert FM-6 has been replaced by a 525mm STM pipe that conveys an equivalent of 5 ha of pre-development drainage to the existing Valleyridge SWM pond (at Richview Boulevard and Bronte Road) to the south of Dundas Street, which ultimately drains to Fourteen Mile Creek West approximately 800 m south of Dundas Street.

Similarly, under proposed conditions, there will be a reduction in drainage to culvert FM-D6a as described in **Section 7.7,** so the existing conditions culvert capacity has not been checked.

Culvert FM-D7's existing capacity has not been checked because the Subject Lands comprise less than 1% of the total drainage area to FM-D7.

Existing culvert FM-D5 under Dundas Street conveys flow from Fourteen Mile Creek West into downstream areas. This culvert is a concrete box culvert with dimensions of 5.6m x 2.7m.

The locations of these culverts are shown in **Figure 7.0**.

The existing conditions of the FM-D5 culvert capacities were analyzed using the HEC-RAS model provided by CH for Fourteen Mile Creek West. Based on the HEC-RAS results, **Table 7.4** provides the culverts' hydraulic capacities for three conditions:

- upstream water elevation at the obvert of the culverts;
- upstream water elevation equal to the maximum elevation before spilling over Dundas Street, less 0.3m freeboard; and
- upstream water elevation equal to the maximum elevation before spilling over Dundas Street.

As shown in **Table 7.4**, existing culvert FM-D5 has the capacity to convey Regional Storm flows without overtopping of the road. The Regional Storm flow at FM-D5 is 18.92 m^3/s.

Table 7.4: Dundas Street Culvert Capacities

Upstream Water Level Condition	Fourteen Mile Creek West Culvert at Dundas (FM-D5)	
	Water Elevation (m)	Culvert Capacity (m^3/s)
At culvert obvert	142.86	3.0
0.3m below elevation to Dundas Street roadway	146.20	51.5

Upstream Water Level Condition	Fourteen Mile Creek West Culvert at Dundas (FM-D5)	
	Water Elevation (m)	Culvert Capacity (m^3/s)
At overtopping elevation of Dundas Street	147.0	52.3

7.4 STORMWATER MANAGEMENT PLAN SELECTION PROCESS

As required by the NOCSS and the EIR/FSS TOR, alternative approaches to SWM have been identified and evaluated to assess and incorporate appropriate Stormwater Management Practices (SWMP) in the development design to satisfy NOCSS SWM goals, objectives and targets.

SWMP are specific planning and technical measures, which are implemented to manage the quantity and quality of urban runoff. The SWM measures specifically required to manage urban runoff and mitigate potential drainage impacts are able to be grouped into three main categories:

- lot level, or source control measures (i.e., reduced lot grades, roof drainage control or storage, porous pavements, rain gardens, grassed swales, etc.);
- infiltration measures (i.e., infiltration basins and trenches, exfiltration pipes or porous pavement, etc.); and,
- end-of-pipe measures (i.e., detention wet ponds or wetlands, oil/grit separators, etc.).

In reviewing these options for inclusion in the proposed SWM plan, these alternatives were evaluated on the basis of capabilities, limitations and physical constraints associated with their implementation. This included the following factors:

- their ability to meet SWM goals, objectives and targets discussed in **Section 7.1** herein and listed in **Table 7.1**;
- suitability of soils and groundwater conditions;
- site topography and size of contributing drainage areas;
- compatibility with urban form and natural features; and,
- municipal servicing requirements.

The evaluation of alternative SWMPs has made use of guidelines in the *MOE Stormwater Management Planning and Design Manual, March 2003,* (referred to here as the MOE SWMP Design Manual) and has considered the practical feasibility of implementing alternative LID techniques.

LID is a comprehensive land planning and engineering design approach, the goals of which include preserving natural heritage areas and managing stormwater to minimize increases in surface flow and pollutants. The LID approach combines planning with micro-management techniques to reach these goals. Many of the SWM practices outlined above are considered types of LID measures.

NOCSS provided examples of LID measures such as reducing impervious surfaces and incorporating into future developments bioretention areas, rain gardens, green roofs, use of rain barrels and cisterns, vegetated filter strips and permeable pavements, where feasible.

The proposed development will introduce impervious areas in the form of residential, mixed use, hardscaping in parks and retail buildings, parking lots and roads with an overall density higher than traditional single family housing developments. The proposed urban form combines the protection of large tracts of lands in the NHS along with higher density development in the remaining areas for development. In this regard, the NOCSS and North Oakville West Secondary Plan provides for the retention and enhancement of significant environmental areas and features to maintain and enhance the existing environmental functions and linkages throughout North Oakville. Core 1, the LPA and the High and Medium Constraint Stream Corridors combine to provide a portion of the large, connected NHS in North Oakville; all development is confined to areas outside of the NHS. This approach results in more compact forms of development with generally smaller lots, higher density residential products and reduced setbacks. The reduced building setbacks result in relatively small yard surfaces limiting the practical feasibility of at-source measures. Depending on the housing form, there may be some opportunities to introduce lot level controls to address stormwater quantity and quality. Opportunities include disconnected roof leaders, and grassed swales in side yard and rear yard areas, bioswales in parking lots, and rooftop and parking lot storage, as appropriate. The discharge of roof runoff to grassed areas and the provision of rear-yard grass swales are recommended on all single detached units. The ability to implement these measures on other unit types must be assessed at detailed design based on the building form, building setbacks, location of impervious surfaces, and the ability to direct flows away from areas where there is the potential for icing problems.

From a conveyance perspective, the density of development required in OPAs 289 and 34 is not compatible with the use of rural road cross-sections with ditch/swale systems. In all areas, urban road cross-sections are proposed, compatible with higher density housing forms proposed in OPAs 289 and 34 and Town standards.

With respect to the LID measure of “reduced impervious areas”, as discussed above, the implementation of the proposed NHS has resulted in a more compact built form on lands

outside the NHS. This is achieved through higher density residential product and reduced building setbacks. As a result, the total development is confined to a smaller footprint. While the total building coverage may not be reduced, the amount of road required to serve the development is reduced. As such, the total impervious area associated with the roads has been reduced.

Dependent upon municipal budgets, there may be more opportunity to implement LID measures on public lands. **Figure 7.5** illustrates a sub-surface infiltration gallery in the neighbourhood park. The Draft Plan is largely made up of blocks for future private condo developments. As such, a centralized infiltration gallery in the park is proposed to promote infiltration in public space.

In addition to the proposed urban form, the natural soil and groundwater conditions provide important considerations for the selection of effective SWM measures. Consistent with the findings of the NOCSS, the drilling and soil testing completed in this EIR have confirmed that the Subject Lands are characterized by dense silt till soils having a low infiltration potential and there are areas of seasonal high water table. As such, constructed subsurface infiltration facilities have limited application on the Subject Lands.

The potential for the use of other LID measures has been assessed based on site conditions and proposed land uses as well as the Town‘s preference for siting such measures. Tree pits of specific size and design are required by the Town. These tree pits provide for water retention as well as interception, evapotranspiration and some infiltration; however, the exact effect of tree pits on the stormwater system is difficult to model for such a large subcatchment with currently unknown numbers of trees, potential sharing of trenches, variable contributing surface drainage areas, and potential design changes that may occur to address some potential issues with tree pit drainage. Street trees and the associated tree pits will be provided as per the Town’s requirements resulting in approximately 30 cubic metres of soil/media per tree. Generally, one tree per lot plus trees along open space blocks consistent with Town standards will be provided that will result in a substantial number of new trees within the EIR Subcatchment Area that will provide benefits associated with water retention, evapotranspiration and infiltration. Tree pit design details will be addressed with the Town at detailed design.

Grading will be designed to direct roof runoff towards pervious areas (e.g., lawns, side and rear yard swales) throughout the development, where possible, as well as construction of tree pits along all roads where technically feasible. Rear-yard infiltration galleries are proposed backing on the NHS along the west limit of the Subject Lands. The rear-yard infiltration galleries can be located in the private lot, or in the adjacent NHS buffer beside the trail (if the Town desires the galleries in public ownership). The final location can be determined through detailed design.

End-of-pipe SWM wet pond and on-site control measures with OGS are proposed to provide the required Enhanced Level of water quality control, erosion control and flood control storage volume requirements. No amount of source control, conveyance controls or other LID measures will eliminate the need for these end-of-pipe solutions in North Oakville West.

With respect to Source Pollution Prevention, the NOCSS identifies a number of source pollution prevention measures including reduced fertilizer and pesticide use, alternate lawn practices, pet litter control, street cleaning, salt management, and sewer use by-law enforcement. Many of these measures are municipalities' responsibilities. The preparation of a homeowner's manual is recommended to provide information to new homeowners on reduced fertilizer/pesticide use, alternate lawn practices, rain gardens, rain barrels, pet litter control, and environmental sensitivities of the NHS.

7.5 DOWNSTREAM INVESTIGATIONS REGIONAL STORM CONTROLS

Policy 8.4.13.2 of OPA 289 states,

"*The North Oakville Creeks Subwatershed Study recommends that stormwater targets include control of the peak flow to predevelopment levels for various return periods, including the Regional Storm. Through the land development application process, an investigation of the potential increase to flood risk may be carried out to confirm if Regional Storm controls are necessary, in accordance with the directions established in the North Oakville Creeks Subwatershed Study*."

NOCSS recommends that SWM targets include the control of peak flows to pre-development levels for the 2 year to 100 year return period events and the Regional Storm. However, it notes that future land use applications may carry out an investigation of the potential increase to flood risk to confirm if Regional Storm controls are necessary. This analysis is to include the increase in risk to life and to private, municipal, regional, provincial and federal property under Regional Storm conditions.

Since the completion of the NOCSS, a downstream flood study has not been prepared for the Fourteen Mile Creek subcatchments within these study limits to address the need for Regional Storm controls. A flood study for Fourteen Mile Creek and McCraney Creek was commissioned by the Town of Oakville to assess flood mitigation opportunities downstream of Upper Middle Road to Lake Ontario however, this study is not complete. This EIR/FSS uses the NOCSS targets and the proposed SWM controls will control peak flows to the NOCSS Addendum unit target flows rates for the 2 year to 100 year events and the Regional Storm. The Fourteen Mile Creek and McCraney Creek PCSWMM model was updated for pre-development and post-development conditions to demonstrate the SWM pond, controlled to NOCSS target release rates including Regional Storm controls, does not increase downstream flooding. See **Section 7.10** for details.

7.6 EROSION CONTROL ANALYSES

The NOCSS identifies the need to complete erosion threshold and erosion control analyses as part of the EIR/FSS so that existing channel erosion or aggradation is not exacerbated by

development. Analysis of erosion thresholds along Fourteen Mile Creek and continuous PCSWMM hydrologic modelling (prepared by J.F. Sabourin and Associates) were completed to determine appropriate levels of discharge control for SWM ponds to ensure erosion and aggradation are not exacerbated in receiving stream systems. The erosion analyses were completed by GEO Morphix Limited. Erosion threshold analyses, hydrologic modelling and erosion exceedance analyses are discussed in the following report section. The full GEO Morphix Ltd. report, entitled *Erosion Threshold and Mitigation Assessment, Palermo Village and Additional Lands,* dated October 4, 2023, is provided in **Appendix L-2**.

7.6.1 Erosion Thresholds

Erosion thresholds are used to determine the magnitude of flow required to potentially entrain and transport bed and/or bank material. As such, they are used to inform erosion mitigation strategies in channels influenced by conceptual flow and stormwater management plans. Erosion thresholds were modelled from detailed field observations of reach **14W-1a**, which was identified as the most sensitive reach based on results from a Rapid Geomorphic Assessment conducted by GEO Morphix Ltd. (**Appendix L-2**).

The erosion threshold was quantified as a critical discharge based on bed and bank materials and local channel geometry. Materials for Reach 14W-1a were identified as sandy loam for the bank and silty clay to cobbles for the bed, leading to a critical velocity of 0.53 m/s for the bank, and a critical shear stress of 21.49 N/m^2 for the bed based on methods from Julien (1994) and Miller et al. (1977). Using these criteria, critical discharge was determined for both the bed and banks, by calculating the shear stress and velocity at different depths above the bed for a representative cross-section, until values slightly exceeded the pre-determined critical shear stress or velocity.

Model parameters and results from the erosion threshold analysis are provided in **Table 3, Appendix L-2,** The critical discharge for entrainment of bed and bank materials was determined to be 0.332 m^3/s and 0.289 m^3/s, respectively. For a conservative approach, the lesser of the two is used as the erosion threshold for Reach 14W-1a, yielding a unitary erosion threshold of 0.00086 $m^3/s/ha$**.** Theoretically, above this discharge, entrainment and transport of sediment can occur.

Based on the provided erosion threshold, target release rates for the SWM ponds were developed to ensure existing rates of erosion within **Reach 14W-1a** are not exacerbated beyond a natural range of variability observed in the pre-development conditions. A continuous erosion analysis was conducted to guide the mitigation approach and ensure minimal impact to the channel.

7.6.2 Continuous Erosion PCSWMM Hydrology Modeling

A continuous PCSWMM erosion model was prepared by J.F. Sabourin and Associates to model existing conditions and proposed conditions, for the scenarios described below. The digital

modeling files are included in **Appendix L-1**. A description of the model scenarios is provided below.

- **Scenario 1: Existing Conditions**
  - Palermo Village and Zenon lands are not developed. See the Pre-Development Model Catchment Delineation Drawing in **Appendix F-0** for drainage areas

- **Scenario 2: Interim Proposed Conditions** – Theoretical Release Rate for Interim pond on Palermo Village Lands
  - Palermo Village lands developed, but Zenon lands east of Fourteen Mile Creek are not developed. See **Figure 7.2** for the interim drainage area to the interim pond**.**
  - The modeled release rate from the interim pond on Palermo Village lands is based on hitting the 7-day drawdown time for the 25 mm storm event, without consideration of a preliminary pond control structure design.

- **Scenario 3: Interim Proposed Conditions** – Preliminary Control Structure Release Rate for Interim Pond on Palermo Village Lands
  - Same as Scenario 2; however, the interim pond on the Palermo Village lands is designed with a preliminary control structure in the model

- **Scenario 4: Ultimate Proposed Conditions** – Theoretical Release Rates for Ultimate Pond on Zenon Lands
  - Palermo Village and Zenon Lands (east of 14 Mile Creek) are fully developed and drain to ultimate pond on Zenon Lands. See **Figure 7.2** for ultimate drainage area total to ultimate pond.

- **Scenario 5: Ultimate Proposed Conditions** – Preliminary Control Structure Release Rate for Ultimate Pond on Zenon Lands
  - Same as Scenario 4; however, the ultimate pond on Zenon lands is designed with a preliminary control structure in the model.

The existing conditions model and proposed conditions scenarios were run on a continuous basis with 43 years of precipitation data, and peak flow hydrographs were provided to GEO Morphix. The results of the Erosion Exceedance Analysis are described in **Section 7.6.3**.

7.6.3 Erosion Exceedance Analysis

Utilizing the results of erosion threshold analysis, continuous PCSWMM hydrology modelling analysis was applied to produce hydrographs for use in the exceedance analysis. A detailed description of the hydrologic modelling procedure and results are provided in **Section 7.6.2**, and modeling files are included in **Appendix L-1**.

Exceedance analysis results are provided in the report produced by GEO Morphix Ltd. (2023), found in **Appendix L-2,** and are based on four erosion indices:

1) Cumulative effective volume (CEV);
2) Cumulative effective work index/stream power (ω_{eff});
3) Cumulative time of exceedance events (t_{ex}); and
4) Number of exceedance events.

These indicators have been applied elsewhere in CH, Toronto Region Conservation Authority (TRCA), Credit Valley Conservation (CVC), and other jurisdictions. They, as a product, provide an evaluation of the number of events, period of transport, and magnitude. The most relevant indicator is the cumulative effective stream power, as it incorporates both the duration and magnitude of erosion events. Erosion exceedance was calculated using an iterative process to determine velocity and water depth based on the time step discharge passing through a representative cross-section. Velocity is calculated using the Manning's approach to achieve a conservative approach which includes dissipation of flood energy along the flood plain. The detailed methods are further explained in **Appendix L-2**.

Preferred exceedance model results minimize change in pre- and post- development cumulative effective work, cumulative effective volume, duration and number of exceedances. Natural channels exhibit a range in variability of +/-5%, within which a channel's assimilative capabilities are sufficient to accommodate changes.

Erosion exceedance results were generated for Scenarios 2 through Scenario 5 described in **Section 7.6.2**. Pre- and post- development hydrographs from 1960-2003 were provided by J.F. Sabourin and Associates to compare proposed conditions (interim and ultimate conditions, with theoretical and preliminary control structure design) to existing conditions. The proposed conditions model scenarios utilized a 7-day drawdown time for the 25 mm storm event as the target release rate for erosion control volumes. Results from these modelled scenarios were used to assess the preferred SWM design scenario to ensure minimal impact on downstream channel erosion. **Table 7.5** summarizes the results of the erosion analyses for the various scenarios presented above.

Table 7.5: Proposed Conditions Erosion Analysis Results Summary

Simulation		CEV (m^3)	ω_{eff} (N/m2)	T_{ex} (hrs)	# of Exceedances
Interim Conditions					
Scenario 2 14W-1a Theoretical Interim	(Pre)	7,376,309	57,921	3,321	638
	(Post)	7,646,165	60,077	3,515	640
	Change (%)	**3.7**	**3.7**	**5.9**	**0.3**

Simulation		CEV (m^3)	ω_{eff} (N/m2)	T_{ex} (hrs)	# of Exceedances
Scenario 3 14w-1a Actual Interim	(Pre)	7,376,309	57,921	3,321	638
	(Post)	7,709,053	60,699	3,554	641
	Change (%)	**4.5**	**4.8**	**7.0**	**0.5**
Ultimate Conditions					
Scenario 4 14w-1a Theoretical Ultimate	(Pre)	7,376,309	57,921	3,321	638
	(Post)	7,399,840	58,616	3,498	639
	Change (%)	0.3	1.1	5.3	0.2
Scenario 5 14w-1a Actual Ultimate	(Pre)	7,376,309	57,921	3,321	638
	(Post)	7,662,215	60,707	3,616	642
	Change (%)	**3.9**	**4.8**	**8.9**	**0.6**

Overall, results presented in the GEO Morphix report show a very slight increase in erosive potential for both the theoretical and actual scenarios, across all four erosion indices. However, for the two most important indices, cumulative effective volume and stream power, the results for the post-development conditions fall within 5% of the pre-development conditions. As shown on the hydrographs included in **Appendix L-2**, post-development peak flows during larger storm events were found to be on average lower than existing peak flows. The theoretical scenario yielded a better match between pre- and post- development conditions; however this improvement is marginal, and ultimately both scenarios fall within an acceptable range. Therefore, changes in channel form and function, or increases in erosion within the channel are not anticipated.

7.7 PROPOSED SWM POND

As noted in **Section 7.1**, NOCSS completed a preliminary assessment of the required numbers and locations of SWM ponds to meet the SWM design criteria. It presented preliminary locations for ponds in each subcatchment in North Oakville West. As described in **Section 7.1**, there are two different versions of NOCSS Figure 7.4.6 in circulation that illustrate two or three SWM ponds in the FSS Study Area. The two versions of Figure 7.4.6 are provided in **Appendix G-1**.

The Subject Lands are tributary to four distinct outlets under existing conditions. Two of these culverts are tributary to the Fourteen Mile Creek West, and two are tributary to the Fourteen Mile Creek East. The proposed SWM strategy in the Fourteen Mile Creek West and East branch catchments are described in **Sections 7.7.1** and **7.7.2**, respectively.

NOCSS concluded that the number, location and size of ponds will be finalized through EIR studies. Based on drainage and grading analyses completed as part of this EIR, one SWM pond is proposed within the FSS Study Area, which is located entirely on the Subject Lands.

7.7.1 Fourteen Mile Creek West

7.7.1.1 Stormwater Management Pond (Main Pond)

Under existing conditions, Subcatchment FM1109A drains westerly towards Fourteen Mile Creek West and culvert FM-D5 under Dundas Street.

As previously noted, NOCSS presented preliminary SWM pond locations. NOCSS Figure 7.4.6, showing SWM Pond locations, is noted to be conceptual, illustrating the general number of ponds and their location. NOCSS notes that, at the EIR stage, the number, location and size of SWM ponds will be finalized. In other locations in North Oakville, SWM ponds have been removed or relocated supported by EIR level of detail on site grading, servicing and environmental matters. Consistent with this direction, based on analyses completed as part of this EIR/FSS, proposed SWM ponds to service the Palermo Village lands, as presented in NOCSS, have been modified in number and locations. The rationale for these changes is outlined below.

Ultimate Conditions

Under proposed ultimate conditions, a SWM pond, referred to as the Main Pond, will be located on the east side of the Fourteen Mile Creek West as shown on **Figure 7.1**. The pond is primarily located on the Zenon lands. It is a wet extended detention pond approximately 4 ha in size that will control future flows to acceptable levels to achieve the required erosion control, flood control, water quality control and thermal mitigation. Approximately 50% of the Main Pond is proposed in a portion of Core 1 that is currently comprised of agricultural lands and outside of all natural hazard and natural heritage constraints, including their associated buffers as described in **Section 3.1**. It is located within the outer 80 to 100 m of the 200 m wide Core 1. The

remaining 2 ha of pond area is located on adjacent Palermo Village tablelands, outside of Core 1. The facility will outlet to Fourteen Mile Creek via a small drainage feature that lies within the Core. The SWMF will be restored in accordance with guidance from Conservation Halton's Guidelines for Landscaping and Rehabilitation Plans (2022). Restoration is proposed in other active agricultural portions of Core 1 to the north of the proposed SWMF, in-keeping with the approaches used in other similar situations in North Oakville East when a SWMF was permitted to extend into a Core Area. The location of the proposed Main Pond was recommended on the basis of ecological, fluvial geomorphological, hydrogeological, hydrological and municipal servicing inputs, as well as a review of the experiences where naturalized SWMFs are permitted within or proximal to the NHS, in North Oakville, in other locations in the GTA and in Greenbelt Plan areas. The most relevant are examples from North Oakville East (NOE) where SWMFs were considered ecologically and technically appropriate and were permitted in select areas within the NHS. Within NOE, ten SWM facilities are permitted within or partially within the NHS. Three of the SWMFs are located partially within Core Preserve Areas; one facility is located entirely within a Core Preserve Area; and six facilities are located in Linkage Preserve Areas and along Medium or High Constraint Stream Corridors. A similar approach was considered and applied to determine the location of the proposed Main Pond. Aside from ecological and technical considerations, locating part of the SWMF within the outer portion of the Core Preserve Area that is currently agriculture in an area compatible with Core objectives, facilitates a compact built form to make efficient use of land and infrastructure in accordance with the policies of the Provincial Policy Statement (2020) and Provincial Growth Plan (2020 Office Consolidation).

The portion of the proposed Main Pond within Core 1 overlaps with agricultural fields that were included in this NOCSS Core for the purposes of retaining and/or creating habitat for open country bird species. The proposed Main Pond will complement this habitat objective by providing for meadow habitat along the perimeter of the pond as well as foraging habitat over the pond. The Main Pond will be landscaped using native plants that will help support open country birds in this area.

As previously noted, the two versions of NOCSS Figure 7.4.6 include either two or three ponds discharging to Fourteen Mile Creek West. Both versions show a pond in the northwest area of the FSS Study Area discharging to Stream Reach 14W-3. A SWM pond discharging to Stream Reach 14W-3 is no longer required under the proposed development concept as an Enhanced LPA has been proposed for this area and will remain un-developed therefore not requiring SWM controls.

The second version of NOCSS Figure 7.4.6 illustrates a pond discharging to Culvert FM-D6. Since NOCSS was prepared, approximately 12.1 ha of this pond's catchment area have been re-directed away from this culvert as a result of the Region of Halton's reconstruction of Dundas Street and the new alignment of Bronte Road. The remaining approximately 5.3 ha of pre-development drainage discharges to Culvert FM-D6 under existing conditions, and as described below, this area can be directed to the Main Pond location proposed in this EIR/FSS.

Based on the EIR/FSS review, only the Main Pond is proposed to outlet to Fourteen Mile Creek West as shown on **Figures 7.1** and **7.3**. The Main Pond drainage area is illustrated on **Figure 7.3**.

Interim Conditions

The Zenon lands may not develop at the same time as the Palermo Village lands. As such, an interim pond option is proposed on Block 32 of the Palermo Village Draft Plan. The interim pond is sized to service the Palermo Village lands, and the Zenon lands are assumed to be un-developed. The interim pond will discharge at the property limit with the Zenon lands, immediately west of Valleyridge Drive, to Fourteen Mile Creek. Interim pond sizing is provided in **Appendix G-9** to support the Draft Plan application and development of the lands in advance of Zenon lands proceeding.

The 5.3 ha of existing condition drainage to Culvert FM-D6 will be conveyed to the proposed Main Pond. A drainage area of 5 ha is approximately the cut-off for conventional wet ponds based on MECP SWMP Guidelines. A private underground storage measure or an additional SWM Pond would be required to control 5.3 ha of post-development drainage to the equivalent runoff of 5 ha pre-development. Given that the size of the catchment area is minimal (i.e., just greater than 5 ha), the downstream system is routed through another SWM Pond, and the downstream sewer system would require a hydraulic grade line analysis which will likely further restrict allowable release rates, this EIR/FSS proposes to direct the 5.3 ha to the Main Pond. This consolidates the number of required facilities and avoids potential impacts on the downstream existing storm system and downstream pond operation. Culvert FM-D6 flows confluence with the Fourteen Mile Creek West approximately 800 m downstream of Dundas Street. Given the relatively small distance downstream of Dundas Street to the confluence, no over-controls are proposed for the 5.3 ha drainage area that is directed to the Main Pond and ultimately to culvert FM-D5. To demonstrate there are no impacts, the post-development flows to Fourteen Mile Creek West have been modeled in HEC-RAS from the Main Pond outlet to the confluence (800 m downstream). The maximum water level increase downstream of Dundas Street is 1 cm, which is fully contained within the publicly owned valley system between Dundas Street and the confluence. The water level comparison of pre-development and post-development conditions for Fourteen Mile Creek West is provided in **Appendix F-1**.

As shown on **Drawing 5**, approximately 11.6 ha of drainage from modelling catchment 1110.1A plus 1.2 ha of drainage from modelling catchment 1111 is being directed from Fourteen Mile Creek East to the Main Pond under proposed conditions. Refer to **Sections 7.7.2.1** and **7.7.2.2** for additional discussion on drainage from the Fourteen Mile Creek East to the Main Pond. **Section 7.9** outlines the comparison of pre-development and post-development drainage areas to various nodes.

7.7.1.2 Uncontrolled Runoff from Mixed Use Block to Enhanced LPA Wetland

As described in **Section 6.2**, a wetland feature, comprised of two cells will be created within the proposed Enhanced LPA at the north end of the Subject Lands. To sustain this wetland, runoff

from the Enhanced LPA (2.4ha) as well as clean drainage from the Mixed-Use Block (approximately 1 ha) at the north end of the site will be directed to the created wetland. The area of the Enhanced LPA and Mixed-Use Block will not require quantity controls to reduce peak flows. The drainage area from the Mixed-Use Block is approximately 1 ha in size at 99% imperviousness. It is recommended that clean drainage from the roof area and landscaped areas of the Mixed-Use Block be directed to the wetland. In addition to targeting clean roof top water from the block, a Jelly Fish OGS unit can be sized to provide 80% Enhanced Level TSS removal as part of a multi-barrier approach, if needed.

The runoff will be discharged through a level flow spreader to dissipate erosive potential before entering the wetland. The wetland will provide passive retention and some peak flow reduction, albeit not specifically designed to do so. The flows through the wetland will discharge to Green Stream Reach 14W-18 of the Fourteen Mile Creek West main branch, which is being retained on the landscape and forms part of the Enhanced LPA.

The peak flows from the Mixed-Use Block will likely not coincide with the peak outflow flows from the Main Pond described above given the timing and routing of the system, which would effectively mitigate any increases of total peak flows at Dundas Street. On-site controls are not recommended for quantity control for the Mixed-Use Block drainage to the wetland. The wetland has been modeled in the Fourteen Mile Creek watershed model (PCSWMM), and there are no increases to peak flows downstream resulting from the wetland or the Main Pond.

Erosion controls are not required for the Mixed-Use Block. The Mixed-Use Block runoff has been modelled as part of the continuous erosion analysis and erosion controls are only required for the Main Pond.

7.7.1.3 Valleyridge Drive Extension Runoff to Dundas Street

There is a portion of the proposed Valleyridge Drive extension (roadway immediately north of Dundas Street) that is at too low of an elevation to drain by gravity to the Main Pond. The drainage area is approximately 0.16 ha. The post-development drainage boundaries are shown on **Figure 7.1**.

The runoff from the portion of Valleyridge Drive will be connected to the FM-D6 culvert under Dundas Street for treatment in the existing downstream pond, in place of the 5 ha of pre-development catchment that is currently tributary to this culvert that will be directed to the proposed Main Pond on-site.

There are no anticipated conveyance capacity issues in the downstream system as the runoff from the 0.16 ha post-development condition will be less than the 5 ha of pre-development runoff that is currently tributary to the culvert FM-D6. Quality and quantity control will be provided in the existing downstream pond at Richview Boulevard and Bronte Road before discharging to Fourteen Mile Creek West.

7.7.1.4 On-Site Control Area #1 (Mixed-Use / High Density Block between Bronte Road and Old Bronte Road)

The portion of the Subject Lands located between Bronte Road and Old Bronte Road are approximately 1.8 ha in size. As shown on **Figure 7.2**, this area, along with a block of land outside the Subject Lands (0.3 ha), currently drains southeast to a ditch-inlet catchbasin (DICB) located on the west side of Old Bronte Road, approximately 40 m north of Dundas Street. The total drainage area of 2.1 ha is part of catchment 1110 that drains to culvert FM-D6 in NOCSS but has been directed to culvert FM-D5 as part of the Dundas Street reconstruction that has occurred post-NOCSS. Under proposed conditions, the area will be controlled to NOCSS allowable release rates with on-site controls for quantity, erosion, and quality controls before discharging to the existing DICB. See **Figure 7.3B** for the proposed connection and drainage area for On-Site Control Area #1. The required volumes for On-Site Control Area #1 are provided in **Section 7.12**, and **Appendix G-4**. Preliminary OGS sizing is provided in **Appendix G-5**.

7.7.2 Fourteen Mile Creek East

7.7.2.1 Drainage to Bronte Road North Culvert

There is a 2.6 ha area, the Subject Lands portion of the 7.8 ha area shown on **Drawing 5**, on the west side of Bronte Road within catchment 1111A, that flows to the North Culvert on Bronte Road and to Stream Reach 14E-7. The North Culvert location is illustrated on **Drawing 5**.

Under proposed conditions approximately 0.7 ha of the 2.6 ha will be directed to the LPA wetland, and 1.2 ha of the 2.6 ha will be directed to the Main Pond and the Fourteen Mile Creek West. The total reduction in area under proposed conditions to the North Culvert is 1.9 ha.

The total pre-development drainage area to the North Culvert on Bronte Road is 81.2 ha. Therefore, the proposed reduction in drainage area is approximately 1.4% of the total drainage area to the North Culvert (Node E). The reduction in peak flows to the Fourteen Mile Creek East is further discussed in **Section 7.7.2.2**.

The 1.2 ha that will flow to the Main Pond will be overcontrolled so as to not increase peak flows to the Fourteen Mile Creek West. Further discussion on the Main Pond controls and Fourteen Mile Creek West is provided in **Section 7.7.1.1 and 7.12**.

7.7.2.2 Drainage to Bronte Road South Culvert and to Culvert FM-D6A

Under existing conditions, the eastern portion of the Subject Lands drain towards Bronte Road as part of catchment 1110.1A, to culvert FM-D6a at Dundas Street, as illustrated on ***Figure 1.5***.

NOCSS Figure 7.4.6 (both versions of the figure provided in **Appendix G-1**) illustrate a SWM Pond immediately upstream of Culvert FM-D6a. This off-site pond is located outside the FSS Study Limits and will be subject to a future EIR/FSS once the lands east of Old Bronte Road have assembled for development. The off-site pond is not currently available, or planned to be

available in the foreseeable future, to receive runoff from the Subject Lands. Additionally, there is significant Region of Halton infrastructure within the west side of Old Bronte Road that is relatively shallow and will be difficult to cross with a future storm sewer. The storm sewer from the Subject Lands would have to be a large diameter to allow for 100-year capture to avoid major system flows over a Regional Road. Given all the constraints noted above, approximately 11.3 ha of the 12 ha (catchment 1110.1A) will be directed to the Main Pond located within the Subject Lands and will discharge to the Fourteen Mile Creek West. The Main Pond has been designed to provide overcontrol for the 11.3 ha area from catchment 1110.1A, as described in **Section 7.7.3**. Approximately 0.2 ha of the 12 ha that is part of the Mixed-Use drainage to the Enhanced LPA wetland (**Section 7.7.1.2**) will be directed north to the wetland. The remaining 0.40 ha will discharge uncontrolled to the existing Bronte Road South Culvert. **Section 7.7.3** describes how the Main Pond target release rates are set.

A comparison of the existing conditions and post-development flow to the Bronte Road culvert is provided in **Table 7.6**.

Table 7.6 - Existing Conditions Peak Flows versus Proposed Conditions Peak Flows to Bronte Road South Culvert

Storm Event	NOCSS Unit Flow Rate	Existing Conditions Flows from 12 ha to Bronte Rd. Culvert	Post-Development Flows from 0.40 ha at 0.9 RC to Bronte Rd. Culvert*	% Difference at Bronte South Culvert
(yr)	(m^3/s/ha)	(m^3/s)	(m^3/s)	
2	0.007	0.084	0.084	0%
5	0.011	0.132	0.118	-11%
10	0.013	0.156	0.140	-10%
25	0.017	0.204	0.169	-17%
50	0.019	0.228	0.190	-17%
100	0.022	0.264	0.210	-20%
Reg.	0.053	0.636	0.056	-91%

* Post-Development flows for the 0.40 ha at 0.9 RC are modeled in SWMHYMO.

As can be seen in **Table 7.6**, the post-development uncontrolled flows do not exceed the pre-development flows to the Bronte South Culvert (location of culvert shown on **Figure 7.3A**). The 2-year through 100-year post-development peak flows are less than pre-development by 0% to 20%. This is not unlike a SWM facility control structure releasing less than the target release rate as a result of limitation of real-world control structure design.

The 0.40 ha area will be clean roof drainage from the Mixed-Use Block located adjacent to Bronte Road within the Subject Lands. This will mitigate the need for quality controls from the 0.40 ha to the Bronte Road South Culvert. As noted in **Section 7.6**, a continuous erosion analysis has been completed. Erosion controls for a 25 mm storm event released over 7 days

for the 0.40 ha area is approximately 90 m^3 at a release rate of 1 L/s. It is likely that a Vortex ™ or equivalent product will be required to achieve the small release rate while respecting minimum orifice size diameter of 75 mm (MOE SWMP Manual, 2003). The volume is minimal and is proposed to be provided within the Mixed-Use Block.

The direction of 11.5 ha of pre-development area from the Fourteen Mile Creek East to Fourteen Mile Creek West will have minimal impact on the peak flows to the downstream system if offset with the 0.40 ha uncontrolled drainage area at 0.9 Runoff Coefficient. The uncontrolled drainage area of 0.30 ha was sized based on matching the 2-year target flows while not exceeding pre-development peak flows under larger storm events. Maintaining peak flows for smaller more frequent events (i.e., 2-year storm and less) is preferred as these frequent events account for the majority of all rainfall events. There is a reduction in peak flows for the 5-year through Regional, however, this is not anticipated to be an issue. As described above, this post-development reduction to peak flows as compared to pre-development is not unlike a SWM facility control structure releasing less than the target release rate as a result of limitation of real-world control structure design. The 11.5 ha area will be overcontrolled for in the Main Pond to mitigate any peak flow increases to the Fourteen Mile Creek West.

7.7.3 Stormwater Management Target Release Rates

The total drainage area within the FSS Study Area, tributary to Node A, is 12.4 ha, of which 9.5 ha is outside the Core 1 limits. The location of Node A is illustrated on **Drawing 5**. Of the 9.5 ha outside the Core 1 limits, only 1.98 ha is outside of the proposed Enhanced LPA. As such, the drainage area of 1.98 ha was used to establish the allowable release rate for the Mixed-Use Block to support the Enhanced LPA wetland. Any drainage area that is not directed to the created wetland will be directed to the Main Pond and controlled to the Main Pond's allowable release rate.

Similar to above, the total drainage area from catchment 1109 and 1109A to Node B, not including the 12.4 ha to Node A, is 81 ha (1109 + 1109A = 93.4 ha; 93.4 ha – 12.4 ha to Node A = 81 ha of incremental drainage area to Node B). Of the 81 ha of drainage from 1109 + 1109A only 16.6 ha is within the FSS Study Limits and outside of Core 1. Approximately 0.2 ha of the 16.6 ha will drain directly to Dundas Street as it is too low to drain to the Main Pond. Therefore, 16.4 ha of catchment 1109A, outside of Core 1, was used to establish the allowable release rates from the Main Pond.

In addition to the 16.4 ha from 1109A, there is 10.1 ha of catchment 1110 that currently discharges to Node B as a result of Dundas Street reconstruction. There is an additional 4.2 ha of catchment 1110 on the west side of Bronte Road that currently drains to the existing culvert FM-D6, and 1.1 ha on the east side of Bronte Road that drains with Bronte Road south of Dundas Street. It is proposed that the 4.2 ha area be directed to the Main Pond, and the 1.1 ha drain to On-Site Control Area #1 (OSC#1).

The 4.2 ha area west of Bronte Road will be directed to Node B under proposed conditions along with the 8 ha of catchment 1110 drainage that currently drains to Node B under existing

conditions, representing a total of 12.2 ha from catchment 1110 to the Main Pond. The 12.2 ha will not be overcontrolled for in the Main Pond as 8 ha already drains to Node B under existing conditions, and the additional 4.2 ha flows would confluence with Node B flows 800 m south of Dundas Street in a confined valley system.

The 1.1 ha will be overcontrolled for in OSC#1 to ensure the existing storm sewer on Dundas Street can convey flows.

The two areas of 16.4 ha (from catchment 1109A) and 12.2 ha (8 ha + 4.2 ha = 12.2 ha) have different unit-release rates in NOCSS. An area weighted average unit release rate was calculated and applied to the 28.6 ha area (16.4 ha + 12.2 ha = 28.6 ha area). Details of this are provided in **Appendix G-6**. The post-development drainage area to the Main Pond is 44.9 ha, as such the pond will be overcontrolling for approximately 16.3 ha.

The OSC #1 Area for the Subject Lands, located between Bronte Road and Old Bronte Road, is based on the pre-development area that currently drains to the Dundas Street storm system and outlets to Node B. The pre-development area is 2.1 ha between Old Bronte and New Bronte Road that is tributary to Node B, but in NOCSS is part of the FM-D6 culvert unit release rates. The 2.1 ha and the FM-D6 culvert NOCSS Unit Release Rates are used to establish the post-development target release rates for OSC#1. The post-development drainage to OSC#1 is 3.1 ha.

The pre-development and post-development Regional Storm peak flow and resulting water levels in Fourteen Mile Creek West are provided in **Appendix F-1**.

The target release rates for the Mixed-Use Block draining to the Enhanced LPA wetland, and the Ponds are summarized in **Tables 7.7, 7.7A, 7.8** and **7.9**.

Table 7.7 – Ultimate Conditions Main SWM Pond Target Release Rates

	Drainage Area (ha)	2-year	5-year	10-year	25-year	50-year	100-year	Regional
FM-D5 NOCSS Unit Release Rate ($m^3/s/ha$)	16.4	0.006	0.010	0.013	0.017	0.019	0.022	0.055
FM-D6 NOCSS Unit Release Rate ($m^3/s/ha$)	12.2	0.007	0.011	0.014	0.017	0.019	0.021	0.052
Area Weighted Average Unit Release Rate ($m^3/s/ha$)		0.006	0.010	0.013	0.017	0.019	0.022	0.054
Target Release Rate (m^3/s)	28.6	0.184	0.298	0.384	0.486	0.543	0.617	1.536

Table 7.7A – Interim Conditions Main SWM Pond Target Release Rates

	Drainage Area (ha)	2-year	5-year	10-year	25-year	50-year	100-year	Regional
FM-D5 NOCSS Unit Release Rate ($m^3/s/ha$)	9.06	0.006	0.010	0.013	0.017	0.019	0.022	0.055
FM-D6 NOCSS Unit Release Rate ($m^3/s/ha$)	12.2	0.007	0.011	0.014	0.017	0.019	0.021	0.052
Area Weighted Average Unit Release Rate ($m^3/s/ha$)	-	0.007	0.011	0.014	0.017	0.019	0.021	0.054
Target Release Rate (m^3/s)	21.26	0.140	0.225	0.289	0.361	0.404	0.456	1.148

Table 7.8 - Mixed-Use Block Target Release Rates

	Drainage Area (ha)	2-year	5-year	10-year	25-year	50-year	100-year	Regional
FM-D5 NOCSS Unit Release Rate ($m^3/s/ha$)	-	0.006	0.010	0.013	0.017	0.019	0.022	0.055
Target Release Rate (m^3/s)	1.98	0.012	0.020	0.026	0.034	0.038	0.044	0.109

Table 7.9 - OSC Area #1 Target Release Rates

	Drainage Area (ha)	2-year	5-year	10-year	25-year	50-year	100-year	Regional
FM-D6 NOCSS Unit Release Rate ($m^3/s/ha$)	-	0.006	0.010	0.013	0.017	0.019	0.022	0.055
Target Release Rate (m^3/s)	2.1	0.015	0.023	0.029	0.036	0.040	0.044	0.109

7.8 MINOR AND MAJOR SYSTEM DESIGNS

7.8.1 Minor System Design

The Subject Lands will be serviced by a conventional storm sewer system designed in accordance with the Town's standards. The storm sewers will be sized using a 5-year return frequency and Town IDF curves.

The post-development drainage boundaries are illustrated on **Figure 7.1** and **Figure 7.2**. The FSS Study Area is approximately 71.4 ha. Minor system drainage areas and outlets are described in **Table 7.10**. Design sheets are provided in **Appendix G-7**.

Table 7.10 - Breakdown of Post-Development Minor System Drainage Areas

Drainage Area within FSS Study Area	Drainage Area (ha)	Minor System Outlet
FSS STUDY LANDS EXTERNAL TO SUBJECT LANDS		
Bronte Road and Old Bronte Road	4.8	Existing Minor System within Bronte Road directs drainage to existing SWM Pond south of Dundas Street. Old Bronte Road is a rural cross section and ditches flow southeasterly to culvert FM-D6a and FM-D7
SUBJECT LANDS WITHIN FSS STUDY AREA		
NHS lands associated with the Fourteen Mile Creek West valley	16.5	N/A – Natural area will not be captured to minor system
Enhanced Linkage Preserve Area	5.8	N/A - Natural area will not be captured to minor system
SWM Main Pond to Fourteen Mile Creek West	41.4	Minor System catchment for all lands within the SWM Main Pond catchment shown on **Figure 7.3**.
On-Site Control Area #1 (High Density / Mixed-Use Block) between Bronte Road and Old Bronte Road	1.9 **	All minor system flows captured on-site to on-site storage, and discharged to existing storm sewer in Dundas Street to culvert FM-D5*
Clean Drainage to Wetland in Enhanced LPA	1.0	Rooftop runoff directed to created wetland via an outlet on the north side of the Mixed-Use Block adjacent to the Enhanced LPA
Valleyridge Road Extension Drainage to Culvert FM-D6	0.16	Minor system capture at low point on north side of Dundas Street within Subject Lands and discharged to the existing culvert FMD-6 at Dundas Street
Total	**71.4**	

* On-Site Control Area #1 minor system flows controlled to pre-development allowable release rates discharge to the existing sewer on Dundas Street. Valleyridge Road Extension drains to the existing SWM Pond south of Dundas Street

** The total area between Old Bronte and Bronte Road, and south of William Halton Parkway is 3.1 ha for which the OSC#1 will be designed, however, only 1.9 ha are within the Subject Lands

Runoff from the rear roof and rear lots will be directed to rear yard swales providing an opportunity for infiltration. The runoff that does not infiltrate will be picked up in RLCBs and directed to the Main Pond before discharging to the creek. Despite the rear lot elevations frequently being lower than the centre line of the road elevations, the catchbasins can drain to the storm sewers within the right of ways for minor system storms. The backyards adjacent to the NHS, for example, are lower than the road grades. The hydraulic grade line during less frequent storm events may be surcharged to the road and capture of runoff in these backyards may not be possible. The backyards would be provided a safe and continuous flow path to the channel in this case for the less frequent storm events. This can be studied during detailed design as it will not impact the size of the Main Pond, which has been designed to account for the backyards adjacent to the NHS. The backyard drainage adjacent to the NHS will also discharge partially to infiltration galleries. The trenches are sized to accept the 25 mm storm event, with larger storm events generally directed to the pond for quantity control. As noted in **Section 7.4**, the rear-yard infiltration trenches may be located in the private lot or in the adjacent NHS buffer under the trail if the Town wishes to maintain the galleries in public ownership. If the galleries are located in the NHS, the rear yard catchbasins will be connected to infiltration galleries located beside and below the trail system in the NHS to maintain water balance as shown on **Figure 7.6A**. Water will preferentially fill the infiltration galleries (lower elevation) before discharging through the rear-yard catchbasin leads (higher elevation) to the storm sewers in the municipal right-of-ways. Exact locations of these infiltration galleries can be determined at detailed design. Further discussion on LID strategy is provided in **Section 8.1.**

There are no external drainage areas proposed to enter the minor system to the Main Pond. Bronte Road and Dundas Street do not drain to the Subject Lands. All future development on the east side of Old Bronte Road will drain to a future SWM Facility to be studied under a future EIR/FSS. There is approximately 1.2 ha of lands external to the Subject Lands between Bronte Road and Old Bronte Road, that have been accounted for in the OSC#1 for the purposes of preliminary sizing. However, these lands may have independent on-site control when they proceed with development.

It should be noted that the presence of shallow shale bedrock throughout much of the community, as well as the desire to minimize SWM pond block sizing, will require the construction of shallow storm sewers through portions of the community. In order to facilitate service and utility crossings, a minimum 1.5m of cover will be provided in all cases. It should be further noted that gravity house connections will not be installed where a storm sewer is not provided within the road right-of-way. In these locations, sump pumps will be installed within the residential units to discharge to grade or storm sewer connections. Where a storm sewer is available on the road right-of-way, a storm connection for the individual units will be provided, and the sump pump must lift the foundation drainage above the critical hydraulic grade line to prevent storm runoff from backing up into the unit. Areas within the development requiring sump pumps will be determined at the detailed design stage. A typical sump pump detail is provided in **Figure 7.4.**

7.8.2 Major System Design

A continuous overland flow route has been provided through the FSS Study Area in order to safely convey major system flows in excess of the minor system up to the 100 year event.

Flows in excess of the capacity of the minor system will be contained within either the right-of-way or by other lands in the Town's ownership. For all classes of roads, the product of depth of water (m) at the gutter times the velocity of flow (m/s) shall not exceed $0.65m^2/s$. All major overland flow routes will be directed to the Main Pond located in the Subject Lands. As noted in **Section 7.8.1**, the backyards adjacent to the NHS are intended to drain to the Main Pond however, if the hydraulic grade line is elevated relative to the backyards, the backyards may be sent directly to the creek. This can be determined at detailed design as it does not impact the Main Pond size, which has accounted for the major system flows from these backyards.

Should the major system flow exceed the conveyance capacity of any given road, the storm sewer will be sized to accommodate the excess flows such that the road capacity is not exceeded.

The major system flows will be attenuated in the Main Pond to achieve the allowable release rates as defined by the NOCSS.

The post-development drainage boundaries are illustrated on **Figure 7.1**. The FSS Study Area is approximately 83.1 ha. Major system drainage areas and outlets are described in **Table 7.11**.

OSC Area #1 major system flows, controlled to pre-development allowable release rates, discharge to the existing sewer on Dundas Street. In the event the Dundas Street system is surcharged during less frequent events, the on-site controls will be designed accordingly. This will be addressed at detailed design. Valleyridge Road Extension drains uncontrolled to existing culvert FM-D6, which connects to the storm system in the subdivision south of Dundas Street and is treated in an existing SWM pond at Richview Road and Bronte Road. If the Dundas Street sewer is surcharged under major system events, there may be overland flow to Dundas Street from the 0.16 ha area that will be captured at the 100-year intake at FM-D5 culvert crossing.

Table 7.11 - Breakdown of Post-Development Major System Drainage Areas

Drainage Area within FSS Study Area	Drainage Area (ha)	Major System Outlet
FSS STUDY LANDS EXTERNAL TO SUBJECT LANDS		
Bronte Road and Old Bronte Road	4.8	Existing Major System within Bronte Road directs drainage to existing SWM Pond south of Dundas Street. Old Bronte Road is a rural cross section and ditches flow southeasterly to culvert FM-D6a and FM-D7

Drainage Area within FSS Study Area	Drainage Area (ha)	Major System Outlet
SUBJECT LANDS WITHIN FSS STUDY LANDS AREA		
NHS lands associated with the Fourteen Mile Creek West valley	16.5	N/A – Natural Area will not be captured to minor system
Linkage Preserve Area	5.8	N/A - Natural Area will not be captured to minor system
SWM Pond to Fourteen Mile Creek West Branch	41.4	Major overland flow route provided to direct runoff in excess of the minor system events to the SWM Pond as shown on **Drawing 3A to 3C***
On-Site Control Area #1 (High Density / Mixed Use Block) between Bronte Road and Old Bronte Road	1.9**	All major system flows captured on-site to on-site storage, and discharged to existing storm sewer in Dundas Street to culvert FM-D5
Clean Drainage to Created Wetland in Enhanced LPA	1.0	Rooftop runoff directed to created wetland via an outlet on the north side of the Mixed-Use Block adjacent to the Enhanced LPA
Valleyridge Road Extension Drainage to Dundas Street	0.16	Minor system captured at low point on north side Dundas Street within Subject Lands and discharged to existing culvert FM-D6
Total	**71.4**	

* Backyards of lots backing on to NHS have been accounted for in the SWM Block, however, if the hydraulic grade line is elevated under infrequent events these areas may be directed to the channel. This will be determined through detailed design

** The total area between Old Bronte and Bronte Road, and south of William Halton Parkway is 3.1 ha for which the OSC#1 will be designed, however, only 1.9 ha are within the Subject Lands

7.8.3 External Drainage

As required by NOCSS, SWM requirements for areas external/adjacent to the FSS Study Area, within the EIR Subcatchment Area, have been investigated to ensure that they have been addressed and that the proposed SWM Plan does not negatively affect future development potential of these areas from a SWM perspective.

West Boundary of FSS Study Limit

To the west of the FSS Study Area are other lands owned by Zenon Environmental Holdings Inc., which are separated from the Subject Lands by the Fourteen Mile Creek West valley system. The drainage from the Zenon Lands west of the FSS Study Area are not able to drain to the Main Pond within the Subject Lands and therefore the design of the Main Pond is independent from future development to the west. The Zenon Lands, if and when they redevelop, will be treated in a future SWM Pond that will discharge to Fourteen Mile Creek West on the west side of the valley.

North Boundary of FSS Study Limits

Along the north limit of the FSS Study Area is the proposed 407 transitway. The 407 transitway is intended to be a grade separated transit corridor located along the south side of the existing Highway 407. The Environmental Project Report (EPR) for the 407 transitway shows a section of transitway through the Subject Lands as elevated on a berm and a smaller area elevated to fly over Bronte Road all sloping from east to the west. SWM measures to address transitway drainage are independent from the SWM Plan for the Subject Lands.

The drainage from the 407 transitway is described in Appendix C – Drainage Report (Parson, March 2020) and shows that the existing drainage courses entering from north of Highway 407 will drain under the proposed 407 transitway. The proposed Enhanced LPA within the FSS Study Area will not impact the existing drainage patterns in or from the transitway. Stream Reaches 14W-18 and 14E-8 will enter the Enhanced LPA and flow out of the Enhanced LPA in the same locations as under existing conditions.

The 407 transitway proposes to treat surface runoff with enhanced swales for quality and LIDs for quantity control where feasible. These features are intended to be spaced such that maximum 5 ha drainage areas are maintained to any given outlet. Given the elevated nature of the 407 transitway through the FSS Study Area (berm with vertical retaining walls, and bridge deck on concrete columns to overpass Bronte Road) it will not be possible to use enhanced swales adjacent to the Enhanced LPA for stormwater treatment associated with road drainage. The drainage will need to be directed to the west where there are no longer vertical retaining walls or bridge decking on piers to allow drainage to be treated in grassed swales. The SWM planning for the 407 transitway is preliminary for planning purposes, however, it is not expected to be treated outside of the MTO lands based on the EPR material.

East Limit of FSS Study Limit

Bronte Road and Old Bronte Road have existing drainage systems that direct runoff south of Dundas Street. Bronte Road has a system of catchbasins and sewers that collect runoff and direct drainage south of Dundas Street to a SWM pond near Richview Boulevard before discharging to Fourteen Mile Creek West. Old Bronte Road is a rural cross section that conveys drainage in roadside ditches south and east to Culvert FM-D6A. Old Bronte Road, immediately north of Dundas Street has catchbasins that collect local drainage to the Dundas Street storm system along with the Mixed-Use Block between Bronte Road and Old Bronte Road and conveys flows westerly to the north side of culvert FM-D5. In the future, it is likely that Old Bronte Road will urbanize and that the storm system will outlet to a future SWM facility on the east side of Old Bronte Road in the location shown on NOCSS Figure 7.4.2, in **Appendix G-1**. Old Bronte Road and Bronte Road will not drain to the Main Pond within the Subject Lands.

The lands east of Old Bronte Road and west of Core 2 will develop in the future. These lands will be subject to an EIR/FSS to address their SWM requirements. The future development lands are downstream of the FSS Study Area and will require an independent SWM strategy. It

is likely that these lands will either provide independent on-site controls (as there are many individual land parcels that will be difficult to assemble). Alternatively, a storm sewer will be installed in Old Bronte Road that will collect drainage from the properties and convey it south and east to a future SWM facility east of Old Bronte Road. The storm sewer will be on the east side of the Old Bronte Road right-of-way to avoid crossings with the existing trunk watermain and sanitary sewers that are located along the west limit of Old Bronte Road right-of-way.

In summary, the lands east of Old Bronte Road will develop with an independent SWM strategy that is not precluded by development of the Subject Lands.

South Limit of FSS Study Limit

Dundas Street forms the south boundary of the FSS Study Area. Dundas Street has been designed with a storm sewer system to collect and convey flows west to the Fourteen Mile Creek West branch. Dundas Street is serviced independently, and the existing stormwater system does not flow into the FSS Study Area.

7.9 FOURTEEN MILE CREEK SUBCATCHMENT DRAINAGE AREA MODIFICATIONS

A pre-development and post-development drainage boundary comparison of the Fourteen Mile Creek internal subcatchments has been prepared, as provided on **Drawing 5**, to support the proposed SWM strategy and Main Pond location. The results of the pre- and post-development drainage area comparison at key nodes, within the Fourteen Mile Creek EIR Subcatchment Area, are provided in **Table 7.12**. Locations of the nodes were chosen to allow for comparison of existing conditions subcatchment areas relative to post development flow inputs from the Subject Lands. Additional discussion on the SWM drainage strategy for post-development conditions is described in **Section 7.7.1** and **Section 7.7.2** for the Fourteen Mile Creek West and East, respectively.

The drainage area modification proposed under post-development conditions in **Table 7.12** must also be compared to the resulting flows. The drainage areas may be reduced under post-development conditions to an outlet however, the pre-development peak flows can generally be matched. As an example, see Section **7.7.2.2** and **Table 7.6** for comparison of a drainage area reduction to an outlet under post-development conditions that is able to generally maintain pre-development peak flows. Similarly, the drainage area may be increased to nodes under post-development conditions, but through use of over-control the peak flow impacts can be mitigated.

Table 7.12 - Comparison of Pre-Development and Post Development Subcatchments

Node	Pre-Development Contributing Areas	Pre-Development Area (ha)	Post-Development Contributing Areas (ha)	Post-Development Area (ha)	Drainage Area Change at Node (%)
Fourteen Mile Creek West					
A	1007, 1007A, 1008, 5.4 ha HWY 407, portion of 1109A (12.4 ha of 93.4 ha)	182.6	1007, 1007A, 1008, 5.4 ha HWY 407, portion of 1109A (10.9 ha of 93.4 ha), portion of 1111A (0.7 ha)	181.9	-0.4%
B (Culvert FM-D5)	Node A, 1005, 1006, 1.1 Ha of HWY 407, portion of 1109 A (81 ha of 93.4 ha), 10.3 ha from 1110, Dundas Street	344.1	Node A, 1005, 1006, 1.1 Ha of HWY 407, portion of 1109 A (82.6 ha of 93.4 ha), 1.2 ha from 1111A, 11.6 ha of 1110.1A, 15.3 ha from 1110, Dundas Street	362.6	5.3%
C	1110 (17.4 ha - 10.3 ha directed to 1109A via Dundas Reconstruction - 2.0 ha of Bronte Road that drains along Bronte Road = 5.1 ha),	5.1	Valleyridge Extension (0.16 ha)	0.2	-96.1%
Bronte Road South of Dundas St. to Ex. Pond	Bronte Road (1.3 ha from 1111, 1.5 ha from 1110.1, and 2 ha from 1110)	4.8	Bronte Road (1.3 ha from 1111, 1.5 ha from 1110.1, and 2 ha from 1110), 1110 (sliver of frontage along east side of Bronte Road)	4.8	0.0%
Fourteen Mile Creek East					
D	1110.1A, 1110.1	26.6	0.38 ha from 1110.1A, 1110.1	14.98	-43.7%
E	1009, 1111A	81.2	1009, 5.4 ha of 1111A	80.1	-1.4%
F	Node E,1010A, 1111	268.7	Node E, 1010A, 1111	267.6	-0.4%

Node A

Node A is a minimal (0.4%) decrease in drainage area. The drainage area reduction is not anticipated to have any impact on the Fourteen Mile Creek West main branch from a flow or erosion perspective.

Node B

Node B is a 5.3% increase (18.3 ha) in area at Dundas Street as compared to existing conditions. This is largely the result of the proposed conditions stormwater strategy including:

- 11.5 ha of the 18.3 ha total area increase to Node B is from catchment 1110.1A (Node D). The 11.5 ha will be directed to the Main Pond and discharge to Node B. The Main Pond will over control for this 11.5 ha drainage area increase to mitigate impacts of increased peak flows. The flows from Node B and Node D confluence south of Upper Middle Road, approximately 2.8km downstream of Dundas Street, at which point there is no change in peak flows.

- 5.1 ha of the 18.3 ha total area increase to Node B is from catchment 1110. The 5.1 ha currently drains to DICBs at Dundas Street, and through the subdivision on the south side of Dundas Street to an existing SWM pond approximately 800 m downstream of Dundas Street. The existing SWM pond discharges to Fourteen Mile Creek West and confluences with flows from Node B. The confluence is a relatively short distance downstream of Dundas Street so no over control for the 5.1 ha is proposed. An analysis of the post-development flood elevations between the proposed Main Pond and the confluence of flows with the existing SWM pond flows (800 m south of Dundas Street) is provided in **Appendix F-1** and **F-2**.

- 1.2 ha of the 18.3 ha total area increase to Node B is from 1111A. The 1.2 ha will be directed to the proposed Main Pond and overcontrolled to mitigate any peak flow increases to Fourteen Mile Creek West.

- 0.7 ha of the 18.3 ha area increase to Node B is from 1111A directed to the Enhanced LPA to provide runoff volume for the proposed wetland.

- Note: areas may not add exactly 18.3 ha due to rounding.

- The above changes in drainage areas result in post development flows slightly less than existing peak flows at Node B; see **Table 7.13**.

Table 7.13 - Comparison of Pre-development and Post-Development Peak Flows at Node B (Culvert FM-D5)

	Area (ha)	Flow (m^3/s)						
		2	5	10	25	50	100	Reg.
Existing Conditions to Node B	344.1	2.065	3.441	4.473	5.850	6.538	7.570	18.926
Proposed Conditions to Node B	362.3	1.971	3.383	4.406	5.606	6.546	7.431	18.802

* Refer to **Appendix F-2** for post-development peak flow calculations

A continuous erosion analysis has been carried out to determine the required erosion control volumes for the Main Pond. The continuous erosion analysis has taken into account the increased drainage area in post-development conditions to Node B, and the Main Pond provides erosion control volume and drawdown durations to mitigate downstream erosion impacts as described in **Section 7.6**.

Node C

There is 0.16 ha proposed drainage to Node C under post-development conditions. As described above, the flows to Node C under existing conditions confluence with flows in Fourteen Mile Creek West approximately 800 m downstream. The flows to Node C under existing conditions are currently piped to their location of discharge to Fourteen Mile Creek, 800 m south of Dundas Street. As such, there is no decrease in flow to an open watercourse as a result of directing Node C drainage to Node B. There is an increase in drainage area to Node B as discussed above.

Node D

Approximately 11.5 ha of the 26.6 ha that drains to Node D will be directed to Node B. Approximately 0.43 ha (at 0.9 runoff coefficient) of the remaining drainage area will flow uncontrolled to Node D to maintain some peak flows to the Fourteen Mile Creek East branch. **Section 7.7.2.2** discusses the drainage being directed to Node B and the uncontrolled drainage area to Node D.

Node E

Node E experiences a minor 1.4% reduction in drainage area and is not anticipated to have any impacts on the downstream system.

Node F

Node F experiences a minor 0.4% reduction in drainage area and is not anticipated to have any impacts on the downstream system.

7.10 DOWNSTREAM PEAK FLOW MODELING

An investigation of downstream Regional flooding is included in this EIR/FSS. Although atypical for EIR/FSS studies in North Oakville, it is understood that through other development applications downstream of the Subject Lands that Fourteen Mile Creek is sensitive to peak flow increases. A PCSWMM model was prepared for Fourteen Mile Creek by the Town of Oakville and their consultant AMEC, and the hydrology flows from the model are used for floodplain mapping in the Fourteen Mile Creek system. The AMEC Fourteen Mile Creek Model has been modified through other development applications south of Dundas Street (Bronte Green, Bronte River, etc.) in Oakville to demonstrate that development activity does not increase peak flows at critical nodes in Fourteen Mile Creek. This similar exercise of updating the Fourteen Mile Creek PCSWMM model to demonstrate the development of the Subject Lands does not increase downstream peak flows at critical nodes is undertaken in this report as described below.

The downstream Regional flooding investigation was completed to understand potential Regional downstream peak flow changes, and is not related to sizing Regional controls for SWM ponds as outlined in the NOCSS ToR (NOCSS Section 3.4.4). Furthermore, the downstream Regional flood modeling is not intended to be used for flood mapping in the Fourteen Mile Creek in North Oakville for the Subject Lands. Floodplain mapping flows are based on NOCSS unitary flows from the GAWSER modeling completed in support of the North Oakville Secondary Plans as provided in **Appendix F**.

As discussed above, the proposed drainage plan includes a SWM pond, a wetland feature draining to Fourteen Mile Creek West, an on-site control area, and a small uncontrolled area draining to Fourteen Mile Creek East.

In addition to meeting the NOCSS targets to each branch of Fourteen Mile Creek, the proposed site development has been incorporated into the overall Fourteen Mile Creek PCSWMM model. The model incorporates Fourteen Mile Creek, and its tributaries, from the headwaters to Lake Ontario. This is to ensure that peak flows and water levels throughout Oakville are maintained at or below existing conditions.

There are currently 4 PCSWMM models representing different stages of development within the Fourteen Mile Creek watershed:

- The **Existing Conditions** model represents the development in Oakville prior to the Bronte Green, Deerfield and Enns developments.
- The **Scenario 2** model builds on existing conditions with the downstream Bronte Green development incorporated (no SWM controls assumed for Bronte Green), and the Subject Lands proposed conditions added with SWM controls assumed.
- The **Scenario 4** model is the same as Scenario 2, except SWM controls are assumed for the Bronte Green development.
- The **Scenario 5** model includes the Bronte Green, Deerfield and Enns developments built out as well as the Subject Lands with SWM controls assumed for all developments.

Each of the above scenarios was updated to incorporate the Palermo Village lands as discussed below.

7.10.1 Existing Conditions

Palermo Village is located towards the northeast corner of the watershed. To more accurately capture the flow conditions in this area, LiDAR was obtained, and used to refine the catchment boundaries, as shown in **Appendix G-3**. In addition, the catchments around the Palermo site were further discretized into order to reflect the existing NOCSS catchments. All parameters were maintained as per existing conditions consistent with the PCSWMM model.

7.10.2 Scenario 2

As noted above, the base Scenario 2 model includes the Bronte Green development under built conditions, without SWM controls in place. This model was revised to include the LiDAR refinement, and the proposed Palermo Village catchments with SWM controls. These catchments are represented in the model as follows:

- Catchment 1114 – Represents the majority of the Palermo Village property that will be diverted to the proposed SWM pond. The catchment has a high level of imperviousness (82%), reflecting the proposed development. The catchment flow length was also increased to mimic the future routing of the runoff through the internal streets and features established at detailed design. Under existing, and NOCSS conditions, Catchment 1114 flows split between the east and west branches of the Fourteen Mile Creek. In proposed conditions, all of Catchment 1114 will ultimately outlet to Fourteen Mile Creek West. The pond therefore over controls the peak flows from Catchment 1114 to achieve the Fourteen Mile Creek West peak targets only.
- Catchments 1112 and 1113 – Catchment 1112 is a 2.4 ha area at the north end of Palermo Village which is to be redeveloped into a wetland feature. Catchment 1113 represents 1.1 ha of impervious development that will feed into the wetland. Flows that exceed the wetland capacity will be conveyed to Fourteen Mile Creek West.
- Catchment 1116 – This catchment will be controlled via an On-Site Control (OSC) system, meeting the targets outlined in NOCSS. Controlled flows will discharge toward Fourteen Mile Creek East.
- Catchment 1115 – This area will remain uncontrolled under proposed conditions and also discharge to Fourteen Mile Creek East. By reducing the total area of this catchment, post development peak flows were maintained below the NOCSS targets.

Surrounding catchments were revised as necessary to reflect adjusted drainage boundaries for pre-development catchments external to the Subject Lands and proposed conditions boundaries for the Subject Lands.

7.10.3 Scenario 4 Conditions

As noted above, the base Scenario 4 model includes the Bronte Green development under built conditions, with SWM controls in place. This model was revised to include the LiDAR refinement, and the proposed Palermo Village catchments with SWM controls. These catchments are represented in the model as follows:

- Catchment 1114 – Represents the majority of the Palermo Village property that will be diverted to the proposed SWM pond facility. The catchment has a high level of imperviousness (82%), reflecting the proposed development. The catchment flow length was also increased to mimic the future routing of the runoff through the internal streets and features established at detailed design. Under existing, and NOCSS conditions, catchment 1114 flows split between the east and west branches of the Fourteen Mile Creek. In proposed conditions, all of 1114 will ultimately outlet to Fourteen Mile Creek West. The pond therefore over controls the peak flows from 1114 to achieve the Fourteen Mile Creek West peak targets only.
- Catchments 1112 and 1113 – Catchment 1112 is a 2.4 ha area at the north end of Palermo Village which is to be redeveloped into a wetland feature. Catchment 1113 represents 1.1 ha of impervious development that will feed into the wetland. Flows that exceed the wetland capacity will be conveyed to Fourteen Mile Creek West.
- Catchment 1116 – This catchment will be controlled via an On-Site Control (OSC) system, meeting the targets outlined in NOCSS. Controlled flows will discharge toward Fourteen Mile Creek East.
- Catchment 1115 – This area will remain uncontrolled under proposed conditions and also discharge to Fourteen Mile Creek East. By reducing the total area of this catchment, post development peak flows were maintained below the NOCSS targets.

Surrounding catchments were revised as necessary to reflect adjusted boundaries, while maintaining existing conditions.

7.10.4 Scenario 5 Conditions

The base Scenario 5 model includes the Bronte Green, Deerfield and Enns developments under built conditions, with SWM controls in place. This model was revised to include the LiDAR refinement, and the proposed Palermo Village catchments with SWM controls identified above.

7.10.5 Results

The four models, Existing Conditions, Scenario 2, Scenario 4 and Scenario 5, were run for the 2 through 100-year 24-hour Chicago storm events and the Regional Storm. It was determined that Scenario 2, Scenario 4 and Scenario 5 do not increase the peak flows or hydraulic grade lines (HGL) throughout the watershed. The key points of comparison used in previous peak flow comparisons in the Bronte Green Subdivision and Bronte River development modeling are shown in **Table 7.14**.

Table 7.14 - Node Comparison Locations

Node Name	Location
DF001	Culvert under QEW
E153	Tributary 14W-W1, at confluence
E733	Tributary 14W-W1-3 at Bronte Road
EBS1	Bronte Road southside ditch
J1388.055	Dundas Street – Fourteen Mile Creek West
J2546.464	Speers Road
J3150.013	Storm Confluence

Node Name	Location
J3411.51	Dundas Street – Fourteen Mile Creek East
J4232.339	Main crossing at QEW
J438.5957	Lakeshore Road
J982.0328	Rebecca Street

As per the downstream peak flow comparison results found in **Appendix M-1**, all proposed conditions peak flows are less than or match existing conditions peak flows with two exceptions at Node E153 (within the Bronte Green subdivision site) and J982.0328 (Rebecca Street). At both these locations the exceedance is in the approved model for the Bronte Green subdivision, and not caused by development of the Palermo Village lands.

The overcontrol of Catchment 1114 in Palermo Village has reduced the total flow discharging to Fourteen Mile Creek (east and west branch), and slowed down the peak flows reaching Fourteen Mile Creek, resulting in a general reduction in Regional peak flows downstream for Scenarios 2, 4 and 5 as compared to the approved Bronte Green model.

The controlled peak flows from the Palermo Village Main Pond in the Fourteen Mile Creek PCSWMM Model, and the water levels, are summarized below for interim and ultimate conditions.

Table 7.15 - Interim Conditions Main Pond Results

Design Storm (24 hr Chicago)	Target (m^3/s)	Palermo Village Main Pond Peak Outflow (m^3/s)	Palermo Village Main Pond Water Level (m)
2-year	0.184	0.139	151.75
5-year	0.298	0.170	151.95
10-year	0.384	0.287	152.07
25-year	0.486	0.351	152.21
50-year	0.543	0.400	152.31
100-year	0.617	0.442	152.42
Regional	1.536	1.125	154.20

Table 7.15A – Ultimate Conditions Main Pond Results

Design Storm (24 hr Chicago)	Target (m^3/s)	Palermo Village Main Pond Peak Outflow (m^3/s)	Palermo Village Main Pond Water Level (m)
2-year	0.184	0.176	151.17
5-year	0.298	0.205	151.37
10-year	0.384	0.330	151.49
25-year	0.486	0.488	151.63

Design Storm (24 hr Chicago)	Target (m^3/s)	Palermo Village Main Pond Peak Outflow (m^3/s)	Palermo Village Main Pond Water Level (m)
50-year	0.543	0.554	151.72
100-year	0.617	0.616	151.83
Regional	1.536	1.519	153.95

The above analysis has demonstrated that the development of Palermo Village will not increase Regional Storm peak flows downstream in the Fourteen Mile Creek watershed based on the overall Fourteen Mile Creek watershed model. Additionally, the development is compliant with the NOCSS targets. Modeling files for the overall Fourteen Mile Creek watershed are included in **Appendix M-2**.

7.11 WETLAND 10 DRAINAGE

7.11.1 Drainage to Wetland 10

As discussed in **Section 5.1**, there are two PSWs within the EIR Subcatchment Area (PSWs 6 and 7) (**Figure 5.1**). Wetland 10 was formerly a PSW but was re-evaluated by Beacon in 2023 and determined to be a non-PSW. Wetland 10 is located centrally on the Subject Lands and associated with cropped agricultural fields. It is isolated from Core 1 and other natural features.

PSW6 is situated within Core 1 immediately north of the confluence of Reaches 14W-12 and 14W-11. Finally, PSW7 is located in Core 2 east of Old Bronte Road immediately north of Dundas Street.

Drainage areas to each PSW and Wetland 10 were identified to determine if any of the Subject Lands contribute surface runoff to the features. Contributing drainage areas to PSW6 and PSW7 lie within Core areas outside of the Subject Lands; drainage from agricultural fields on the Subject Lands contribute runoff to Wetland 10.

7.11.2 Wetland 10

Wetland 10 is a small wetland unit associated with the central portion of the Subject Lands that overlaps with the NOCSS proposed LPA. While the current size of Wetland 10 is 0.43 ha, it was originally mapped by MNRF in 2005 as 0.26 ha, which is the value that has been used for this analysis.

Drawing 2 illustrates its existing contributing drainage area of approximately 5.1 ha. Uses in this drainage area are entirely agriculture. There is no defined inlet or outlet from this wetland. Topography indicates an ill-defined drainage path through agricultural fields to the southeast to Green Stream **14E-10** although there is no evidence of regular drainage from this wetland to this downstream area.

Wetland 10 is supported by surface runoff from its catchment area. To characterize wetland hydrology, a continuous SWMHYMO model was prepared to simulate average annual runoff volume, seasonal runoff volumes, and monthly runoff volumes to Wetland 10. The results of the continuous model are presented in **Table 7.16**, and a digital copy of the model is included in **Appendix G-8**.

Table 7.16 – Existing Runoff Volumes to Wetland 10

Season / Month	Pre-Development Runoff Volumes m^3 (5.10 ha Agricultural field)
Annual	3,164
Winter	559
Spring	594
Summer	1,317
Fall	1,291
January	158
February	140
March	114
April	233
May	361
June	208
July	481
August	628
September	508
October	458
November	326
December	146

7.11.3 Drainage to New Wetland in Enhanced LPA

This EIR/FSS recommends that the NOCSS proposed LPA be shifted northward to a location that can accommodate an ecopassage and provide for primary linkage functions. The proposed Development Concept Plan integrates an Enhanced LPA at the north end of the Subject Lands.

As noted in **Section 6.2**, the removal of Wetland 10 is proposed along with the creation of a new wetland with enhanced functions in the Enhanced LPA. The Enhanced LPA wetland will consist of two cells with a combined area of approximately 0.5 ha. It will outlet surface flows westerly towards the Fourteen Mile Creek West under storm events greater than the 100-year design storm. Runoff from the created wetland does not need to be collected or conveyed within the future development.

Drawing 2 illustrates the location and contributing surface drainage areas to the Enhanced LPA wetland under interim and ultimate conditions. Interim conditions drainage is described as the

Mixed-Use Block (1.0 ha) is not yet developed, and only the 2.4 ha of the undeveloped Enhanced LPA drains to the wetland for a total of 2.4 ha at 7% average imperviousness. Ultimate conditions drainage is the Mixed-Use Block fully developed and the Enhanced LPA area drainage to the wetland for a total drainage area of 3.4 ha at 34% average imperviousness.

A continuous water balance analysis has been prepared to confirm that the design can provide sufficient surface water inputs to support the created wetland. The water balance analysis is based on forty-four years of rainfall data (Toronto International Airport) that was simulated to the Enhanced LPA to determine the average annual runoff volume, seasonal runoff volumes, monthly runoff volumes to the new created wetland, and storage depths in the wetland cells. The model included evaporation, outflows through a 10 m x 0.1 m weir, snowfall data, and an infiltration component. There were no infiltration rates applied to the shallow and deep pocket bottoms due to tight soils and presence of groundwater table. Infiltration was assumed along the walls of the wetland at 2.5 mm/hr and applying a safety correction factor of 2.5. The results of the continuous model are provided below, and a digital copy of the model and wetland modelling summary write up is included in **Appendix G-8**.

Table 7.17 – Interim and Ultimate Runoff Volumes to New Wetland

Season / Month	**Interim Pre-Development Runoff Volume (m^3)** (2.4 ha of Linkage Area @ 0.25 RC)	**Ultimate Post-Development Runoff Volume (m^3)** (2.4 ha of Linkage Area + 1.0 ha @ 0.9RC of Mixed-Use Block clean drainage)
Annual	692	4,903
Winter	126	977
Spring	126	1,059
Summer	304	1,843
Fall	287	1,695
January	38	226
February	26	216
March	23	253
April	48	454
May	78	605
June	42	465
July	120	668
August	142	710
September	111	641
October	107	550
November	70	504
December	38	282

The model has demonstrated that, under both interim and ultimate conditions, the Enhanced LPA wetland will receive water throughout the year to sustain the proposed wetland communities. A water depth summary table has been prepared to summarize the average depth

of water in the wetland. Because of the low infiltration rates and high groundwater table it is anticipated that once the cells are full of water, they will not draw down past the groundwater elevation.

The bottom elevation of the east cell deep pocket is 160.75 m, and groundwater is approximately 162.25 m, indicating the east cell could hold 1.5 m of water. Similarly, the bottom elevation of the west cell deep pocket is 159.50 m, and groundwater is approximately 161.50 m, indicating the west cell could hold up to 2 m of water. The 1.5 m and 2 m depths are proposed to be a consistent depth, and the continuous modeling results are shown in **Table 7.18**.

As discussed in **Appendix G-8**, the ultimate conditions modeling was completed assuming the wetland was completely empty at the start of the simulation. It was determined that it will take approximately 3 months for the East Cell to achieve the original groundwater elevation (162.25 m) and 4 months for the West Cell to achieve the groundwater elevation (161.5 m). This analysis was conducted to ensure that if there was a very dry year, or the wetland once dug started from empty, they would fill up and sustain a steady state water elevation.

Table 7.18 – Average Depth from Bottom of Wetland Cells (Interim and Ultimate Conditions)

Month	East Cell Interim Depth (m) - Average	East Cell Ultimate Depth (m) - Average	West Cell Interim Depth (m) - Average	West Cell Ultimate Depth (m) - Average
Jan	1.37	1.67	2.43	2.86
Feb	1.38	1.69	2.42	2.88
Mar	1.59	1.77	2.64	2.96
Apr	1.78	1.80	2.99	3.02
May	1.80	1.80	3.03	3.04
Jun	1.72	1.75	2.97	3.00
Jul	1.57	1.68	2.81	2.92
Aug	1.46	1.64	2.67	2.87
Sep	1.41	1.63	2.57	2.85
Oct	1.38	1.64	2.52	2.85
Nov	1.38	1.67	2.49	2.88
Dec	1.39	1.68	2.49	2.90
Average	**1.52**	**1.70**	**2.67**	**2.92**

As shown in **Table 7.17,** in the interim condition the average depth of water from the cell bottom elevation in the east cell is maintained at a depth of 1.52 m, and 2.67 m for the East and West Cells, respectively.

Once the Mixed-Use Block is built and drainage is directed to the wetland, the ultimate conditions result in an average depth of water above groundwater in the east cell of 1.70 m, and 2,.92 m for the west cell. A cross-section of the average monthly water levels in the wetland

under ultimate conditions is shown in **Figure 6.2b**. A hydraulic memo describing model assumptions and continuous results is included in **Appendix G-8A** and PCSWMM modeling files are included in **Appendix G-8B**.

These water levels have been confirmed by Beacon to be suitable to sustain the desired wetland forms and ecological functions required to satisfy the established ecological design criteria for the removal and replication/enhancement of Wetland 10 (**Section 6.2.2.2**).

7.12 PRELIMINARY GRADING PLANS

A preliminary grading plan has been prepared for the FSS Study Area based on the engineering constraints such as NHS limits and elevations, SWM pond locations and outlet elevations, watercourse configurations and proposed road patterns. The conceptual grading is illustrated in **Drawings 3A to 3C**. Grading details are consistent with the Town's standards and compatible with the NOCSS recommendations for grading adjacent to the NHS. In this regard, preliminary grading of the majority of the lots adjacent to Core 1 is approximately 0.1 m to 0.2 m above existing grade. This 0.1 m to 0.2m elevation difference above existing grade at the rear lot line allows for positive drainage of the trail that runs parallel to the rear lot line, such that sheet drainage to the Core is possible. The trail grading matches existing grades within the Core.

There is a proposed road crossing of Core 1. At the location of the crossing, transition grading outside the right-of-way will be required. The preliminary grading plan shows the extent of grading. The NOCSS recommendations allow for grading in the NHS associated with road crossings.

Road grades have been designed to tie-in to existing grades on Bronte Road and Dundas Street. As discussed in **Section 7.7.1.3,** there is a section of Valleyridge Road extension that is too low to drain to the Main Pond, and to minimize this drainage to Dundas Street, the road is transitioned to a high-point as close as possible to Dundas Street.

The high-density block fronting Dundas Street will be elevated above Dundas Street to direct drainage back towards the Main Pond. This similar situation has occurred on other Dundas Urban Core projects in Oakville. To address the grade difference, it is possible to use the architectural product and design.

The majority of grading within the NHS is associated with the trail system, as illustrated on **Drawings 3A to 3C**. The existing topography generally slopes from west to east in the location of the proposed trail. As noted above, the trail is used to transition 0.1 to 0.2 m of grade towards the Core interior to promote positive drainage off the trail. There are no required cut-off swales associated with the trails. The trail does not exceed 5% longitudinal slope.

Cross sections have been prepared on **Drawing 4** to illustrate typical trail grading, and the transition of grade through the high-density block fronting Dundas Street.

7.13 SWM POND OPERATING CHARACTERISTICS

The multi-function Main Pond is proposed within the FSS Study Area, and there is one on-site control area (OSC#1). The locations of the pond and OSC#1 are illustrated in **Figure 7.1**.

Sections 7.7.1.2, 7.7.1.3, and **7.7.2.2** discuss the proposed uncontrolled drainage areas to the Enhanced LPA wetland from the Mixed-Use Block, the Valleyridge Road extension drainage to culvert FM-D6, and to the Bronte South culvert, respectively. As identified in those sections, on-site control is not recommended. However, if erosion controls are required (i.e., uncontrolled drainage to Bronte South culvert) these can be implemented.

The interim and ultimate conditions Main Pond has been designed in accordance with directions of the NOCSS and the MOECC SWM Design Manual, Guidance for Activities in Redside Dace Protected Habitat, MNRF (March 2016) and the Thermal Mitigation Checklist for Stormwater Management Ponds Discharging into Redside Dace Habitats, MNRF (July 2014). Design requirements include:

Sediment Forebay	• to improve sediment removal prior to entering the pond
Permanent Pool and Extended Detention Storage	• to provide erosion control in accordance with recommendations of erosion threshold analyses; 7 day drawdown for the 24 hour, 25 mm event • to satisfy Enhanced Level of protection requirements (i.e., capture of 80 percent Total Suspended Solids)
Redside Dace Design Requirements	• SWM pond outflows should target: - Discharge water temperatures below 24 degrees Celsius; - Dissolved oxygen levels above 7 mg/L; and, - TSS levels less than 25 mg/L above background conditions.
Quantity Control Storage	• to attenuate post development flows to the unit flow release rates as per the NOCSS for the 2 year through 100 year storms and Regional Storm, and the overcontrol drainage as required through stormwater management strategy

Actual release rates have been provided based on a conceptual outlet structure for the Main Pond and are provided in **Appendix G-9**. Actual release rates have not been provided for OSC#1 as the exact manner of storage for the site plan is not known at this time. Typically, on-site control area storage is provided through a combination of roof storage, surface storage, and underground storage. Depending on the configuration of the site plan, and timing of flows, the outlet structure design will change.

The conceptual design parameters for the Main Pond interim and ultimate conditions are outlined in **Table 7.19**.

Table 7.19 – Summary of Required Stormwater Management Facility Characteristics

Pond I.D.	Pond Type	Drainage Area (ha)	Imp. Coverage (%)	Permanent Pool Volume* (m^3)	Water Quality Volume (m^3)**	100 Year Flood Volume (m^3)	Regional Storm Flood Volume (m^3)	SWM Facility Area (ha)
Main Pond (Interim)	Wet	36.10	90	7,581	1,444	27,808	67,029	2.4
Main Pond (Ultimate)	Wet	44.61	90	9,368	1,784	36,021	81,534	3.54
OSC#1	On-site Control Measures	3.1	99	N/A – Jellyfish OGS***	N/A – Jellyfish OGS***	2,100	5,081	TBD

* All pond volumes in this table are the required volumes, and not the provided volumes.
** Quality control volume based on 40 m^3/ha; erosion control volume is to be provided in addition to quality control volume based on pond specific requirements as described in Section 7.6.
*** Preliminary Jellyfish OGS sizing provided in Appendix G-5.

Table 7.20A – Interim Main Pond Volume Characteristics

Return Period (Yr)	Drainage Area (ha)	Imp. (%)	Target Outflow (m^3/s)	Actual Outflow (m^3/s)	Storage Requirements Based on Actual Outflow (m^3)
2	36.10	90	0.184	0.139	15,030
5	36.10	90	0.298	0.170	18,877
10	36.10	90	0.384	0.287	21,817
25	36.10	90	0.486	0.351	23,797
50	36.10	90	0.543	0.400	25,794
100	36.10	90	0.617	0.442	27,808
Regional	36.10	90	1.536	1.125	67,029

Table 7.20B – Ultimate Main Pond Volume Characteristics

Return Period (Yr)	Drainage Area (ha)	Imp. (%)	Target Outflow (m^3/s)	Actual Outflow (m^3/s)	Storage Requirements Based on Actual Outflow (m^3)
2	44.61	90	0.184	0.176	18,810
5	44.61	90	0.298	0.205	23,630
10	44.61	90	0.384	0.330	27,301
25	44.61	90	0.486	0.488	31,011
50	44.61	90	0.543	0.554	33,507
100	44.61	90	0.617	0.616	36,021
Regional	44.61	90	1.536	1.519	81,534

Table 7.21 - On-Site Control Area #1 Volume Characteristics

Return Period (Yr)	Drainage Area (ha) *	Imp. (%)	Target Outflow (m^3/s)	Storage Requirements (m^3)
2	3.1	99	0.016	999
5	3.1	99	0.025	1,283
10	3.1	99	0.032	1,479
25	3.1	99	0.039	1,740
50	3.1	99	0.044	1,912
100	3.1	99	0.048	2,100
Regional	3.1	99	0.120	5,081

* Target release rates based on pre-development drainage area of 2.1 ha

7.13.1 Main Pond Design Elements – Interim and Ultimate Conditions

Sediment Forebay

The Main Pond includes a sediment forebay in order to improve the pollutant removal by trapping larger particles near the inlet of the pond. The forebay has been designed with a length to width ratio of approximately 3:1 and does not exceed one third of the permanent pool surface area for wet ponds, as required in the MOECC SWMP Design Manual. Furthermore, the forebays have a minimum depth of 1.5m to minimize the potential for re-suspension. The preliminary forebay sizing calculations are provided in **Appendix G-10**.

Permanent Pool

The permanent pool is approximately 3m deep, as required in the Redside Dace Thermal Mitigation Design Checklist.

The permanent pool has been sized to provide Enhanced Level protection in accordance with the MOECC SWMP Design Manual.

Slopes of 7:1 (H:V) or flatter will be provided for 3m (horizontally) on either side of the permanent pool wetted perimeter. The sloping below the permanent pool wetted perimeter will provide a planting shelf as required in the Redside Dace Thermal Mitigation Design Checklist. Below this level, slopes will be graded at 4:1 (H:V).

The permanent pool will be designed with a minimum volume of the 10 mm storm event below 1.5 m depth in the permanent pool.

Extended Detention/Flood Control Storage

The extended detention storage comprises two components: water quality and erosion control.

The water quality requirements are based on Enhanced Level controls as per the MOECC SWMP Design Manual. The erosion control volume is described in **Section 7.6**.

The extended detention/flood control storage up to the 100 year event will not exceed 2.0m in accordance with the MOECC SWMP Design Manual. As per the approved design standard for the Town, the Regional Storm water level does not exceed a maximum active storage depth of 3.5m, or an overall depth of 6.5m (3 m deep permanent pool + 3.5 m active storage).

The extended detention/flood control component has been provided with side slopes of 5:1 (H:V) with minor localized variations, and in accordance with the Town of Oakville design criteria.

Pond Outlet

The extended detention pond volume will outlet through a reverse graded pipe. An orifice will be provided to discharge the water quality extended detention volume over a seven (7) day period or less per the above noted erosion control requirements.

Quantity control will be provided by a combination orifice/notched weir located in the outlet structure. Reverse graded pipes will be provided at the outlet to address thermal mitigation. Ponds have been designed to satisfy the minimum length-to-width ratio of 3:1.

Preliminary outlet location for the Main Pond is shown on **Figure 7.3C** (Interim) and **Figure 7.3** (Ultimate); the specific outfall location will be refined, if needed, at detailed design. The Main Pond will outlet to low constraint Stream Reach 14W-20 inside Core 1 under both interim and ultimate conditions; however, will be at different locations along Reach 14W-20 for interim and ultimate conditions.

Pond Lining

As noted in **Section 4.5.3**, shale bedrock is close to surface through the central portion of the EIR Subcatchment Area. There are also areas, generally in the topographically lower areas close to the streams, where the water table elevation is close to surface (refer to **Sections 4.3 and 4.6.2**). Considering these subsurface conditions, as described in **Appendix J-3**, the base and/or walls of the Main Pond could occur in shale or along the shale/till contact and intersect the local groundwater table. The upper layers of the bedrock are weathered and may be fractured providing moderate hydraulic conductivity. Under such conditions, a pond liner is generally recommended to minimize groundwater infiltration into the pond or stormwater exfiltration from the pond. Clay or synthetic liners may be considered for pond design based on geotechnical recommendations for construction. Subdrains under the liner or perimeter drainage systems surrounding the ponds may be used to direct local groundwater flow around the ponds where necessary. The need for an impermeable liner and perimeter or subdrains will be further assessed at detailed design.

The proposed bottom of pond elevation is anticipated to be generally at or below the existing groundwater table. Groundwater elevations may vary seasonally and with long term climatic conditions by up to about 2m (refer to **Section 4.6.2**). Based on the interpreted groundwater flow conditions, an estimate of the average groundwater elevation at the Main Pond location is provided in **Table 7.22** for comparison with the proposed pond elevation and permanent pool elevation.

Table 7.22 - Comparison of Pond Elevation vs. Groundwater Elevation

Pond	Bottom of Pond Elevation (masl)	Permanent Pool Elevation (masl)	Estimated Average Groundwater Elevation in Pond Area (masl)	Depth from Estimated Average Groundwater Elevation to Bottom of Pond (m)
Main Pond (Interim)	147.9	150.90	152.5	4.6
Main Pond (Ultimate)	147.3	150.30	152.0	4.7

Based on the native soil conditions within the Study Area and experience in North Oakville in general, DS Consultants and R.J. Burnside believe that migration of water through the soil will not necessitate mitigation measures to counteract groundwater pressures on the clay liner of the ponds. Typically, the clay liner thickness is designed to counteract upward pressures of groundwater when conditions are in the range of depths below groundwater noted above. The pond excavations should be carried out under full-time supervision of a geotechnical engineer and/or hydrogeologist to assess the need for mitigation measures.

If deemed necessary, some possible measures for mitigating against groundwater pressures acting on clay liners include:

- Using a subdrain network installed at, and below the permanent pool with a gravity frost-free outlet. This subdrain network can be used to move water around the clay liner to not impede normal groundwater flow direction to avoid pressures on the upgradient side of the pond. It can also be used where there is concern over upward pressure on the clay liner exceeding the counter force of gravity from the volume of permanent pool water, and possibly puncturing the liner. The subdrain in this case would alleviate the upward pressure by controlling the amount of vertical head that could act on the clay liner, essentially controlling the groundwater elevation to a manageable level that would not exceed the clay liner design.

- A subdrain network can also be designed where there is less concern about groundwater flow direction and where the pond liner is stable under normal operating conditions (i.e. permanent pool is full). The purpose of this subdrain network is just to allow for cleaning out of the permanent pool. As the permanent pool is pumped down there is less force acting down on the clay liner to counteract the upward forces of groundwater. To alleviate

the upward pressure, the groundwater is temporarily lowered by pumping during the clean-out operation and then allowed to normalize once the permanent pool has re-filled.

Either subdrain system can be used if determined necessary during time of excavation by the geotechnical engineer and/or hydrogeologist.

Access Road

In accordance with the Town's standards, 3.0m wide access roads are provided above the active storage elevation and 4.0m below the active storage elevation. Access roads are provided in order to facilitate routine inspection and maintenance activities. The maximum slope of access roads is 10:1 (H:V). The preliminary location of the pond access road is presented on **Figure 7.3C** (Interim) and **Figure 7.3** (Ultimate).

Emergency Overflows

In the event of a blockage or a storm greater than the design horizon, an emergency overflow weir will be provided and the overflow elevation will ensure that 0.3m freeboard is provided to the top of pond berm, and 0.1m from the Regional Storm water level to the emergency overflow weir. Refer to **Figure 7.3C** (Interim) and **Figure 7.3** (Ultimate). for conceptual location of emergency overflow weirs.

Pond Stability

Although not part of the EIR/FSS Terms of Reference, the Town and CH typically request that global stability analyses be completed in support of pond designs that involve a berm with a height greater than 0.5 m. At this time, preliminary geotechnical recommendations have been provided by DS Consultants for the Main Pond (ultimate conditions) design in their letter report provided in **Appendix J-3**. DS Consultants reviewed the Main Pond design as well as soil boreholes near the pond location, and made recommendations regarding clay liner requirements, berm material and compaction, and inside and outside berm side slopes relative to pond water levels. Recommendations made as a result of that review have been incorporated into the Main Pond design. Detailed pond berm slope stability analyses will be provided in subsequent submissions.

Under interim conditions, the pond will be located in-board to the subdivision and will not be bermed adjacent to the NHS.

Pond Landscaping

In accordance with CH guidelines, the proposed SWM Pond will be landscaped using native vegetation. Landscaping plans for the SWM Pond will be prepared using criteria presented in CH's 2021 Guidelines for Landscaping and Rehabilitation Plans as a condition of draft plan approval.

7.13.2 Comparison of Topographic Depression Volumes to SWM Pond Design

As discussed in **Sections 2.0 and 7.1**, the NOCSS Addendum recommendations require that the surface storage volumes in topographic depressions be identified, and comparisons made to SWM pond storage design. Refer to **Table 7.25** for list of pits, depressions, and hydrologic features that require detailed analysis. The determination of the need for further analyses was based upon requirements set out in the NOCSS Mediation Agreement for Depression Storage dated May 30, 2007, that states that there are no requirements to assess or replicate the storage in artificially created depressions such as those created by embankments or dug facilities.

The detailed analysis of the four features requiring storage compensation, outlined in **Section 2.1** and illustrated on **Figure 2.1**, is presented in **Appendix I**. These analyses conclude that no adjustments are required to the SWM pond design noted above to accommodate depression storage volumes.

7.13.3 Operations and Maintenance

A detailed operations and maintenance manual for the Main Pond and related infrastructure will be submitted at the time of detailed design. The operations and maintenance manual will be prepared in conformance with the *Town of Oakville Stormwater Monitoring Program for Ponds located in North Oakville,* and the *MOE SWMP Design Manual.*

The typical operations and maintenance activities for the SWM features and the respective costs are set out in the *SWMP Design Manual*. Refer to Sections 6.0 of the *SWMP Design Manual, Operation, Maintenance and Monitoring*, and Section 7.0, *Capital and Operational Costs* for additional details.

8 GROUNDWATER IMPACT ASSESSMENT

In order to assess potential land development impacts on the local groundwater conditions, a water balance analysis has been completed for the Subject Lands. The purpose of the overall water balance analysis is to determine the pre-development groundwater recharge volumes (based on existing land use conditions) and the potential post development groundwater recharge volumes that may occur with the proposed SWM or LID measures in place based on the proposed land use plan. It is noted that this report section addresses what may be referred to as the 'groundwater balance' to differentiate the analysis from the surface water feature and stormwater management analyses discussed in **Section 7**. The groundwater balance calculations provided in **Appendix C-7** have been completed on a monthly basis.

8.1 COMPONENTS OF A WATER BALANCE

A water balance is an accounting of the water resources within a given area. As a concept, the water balance is relatively simple and may be estimated from the following equation:

$$P = S + R + I + ET$$

where:

- P = precipitation
- S = change in groundwater storage
- R = surface water runoff
- I = infiltration
- ET = evapotranspiration/evaporation

The components of the water balance vary in space and time and depend on climatic conditions as well as the soil and land cover conditions (e.g., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). Runoff, for example, occurs particularly during periods of snowmelt when the ground is frozen, or during intense rainfall events. Precise measurement of some of the water balance components is difficult and as such, approximations and simplifications are made to characterize the water balance of a study area. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important input considerations for the water balance calculations.

The water balance components are discussed below:

Precipitation (P) - The long-term average annual precipitation for the area is 897mm based on data from the Hamilton RBG climate station (Station 6153300 - 43°16.8'N, 79°52.8'W, elevation 102.1 masl) for the period between 1978 and 2010.

Storage (S) - Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero so this term is dropped from the equation.

Evapotranspiration (ET) - Evapotranspiration varies based on the land surface cover (e.g., type of vegetation, soil moisture conditions, impervious surfaces, etc.). Potential evapotranspiration (PET) refers to the water loss from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of evapotranspiration (AET) is generally less than the PET under dry conditions (e.g., during the summer when there is a soil moisture deficit). The mean AET has been calculated for this study using a monthly soil-moisture balance approach considering the local climate conditions.

Water Surplus (R + I) - The difference between the mean annual P and the mean annual ET is referred to as the water surplus. Part of the water surplus travels across the surface of the soil as surface or overland runoff (R) and the remainder infiltrates the surficial soil (I). Infiltration is comprised of two components: shallow infiltration that migrates laterally through the topsoil profile and discharges to surface at some short time following cessation of precipitation and a deeper infiltration that reaches the water table and recharges the groundwater flow system. The shallow infiltration component may be referred to as interflow or throughflow and the deeper component may be referred to as percolation, deep infiltration or net recharge. The interflow moves relatively quickly and often re-emerges locally as seepage at the ground surface. Typically, the horizontal hydraulic conductivity of the soil profile tends to be higher than the vertical hydraulic conductivity, aiding the lateral interflow movement. Local weathering and fracture patterns in the low hydraulic conductivity till that blankets the Subject Lands may also affect the vertical and lateral water movement.

Interflow is more closely associated with runoff (because of its relatively short residence time) than with baseflow which is fed by groundwater recharge. As such, the interflow is considered an “indirect” component of runoff, as opposed to the “direct” component of surface runoff (overland flow) that occurs across the ground surface during precipitation or snowmelt events. The ability to precisely separate interflow from direct runoff or baseflow is a not a simple task. This is related to the complexity of subsurface geological and hydrogeological environments, and because of this, there has been a lack of adoption of a standard separation method. Since it is generally very difficult to distinguish between interflow and direct surface (overland) flow, they are often considered together as the total runoff component that contributes water to surface water features.

8.2 APPROACH AND METHODOLOGY

The analytical approach to calculate a water balance involved monthly soil-moisture balance calculations (based on the Thornthwaite and Mather methodology) to determine the evapotranspiration and the corresponding water surplus components. A soil-moisture balance approach assumes that soils do not release water as “potential recharge” while a soil moisture deficit exists. During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deeper infiltration).

A soil moisture storage capacity of 200mm was utilized to represent the predominant pasture and shrub vegetation in clayey soils. **Table C-7-1** in **Appendix C-7** details the monthly potential evapotranspiration calculations accounting for local latitude and climate, and then calculates the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions. The SWMP Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used and a corresponding runoff component was calculated for both pre- and post-development conditions.

As noted in **Section 8.1**, the infiltration component will divide into shallow interflow and deeper groundwater recharge components. Although there is no widely-accepted standard methodology for calculating this division of flow, reasonable estimates can be made based on the nature of the surficial soils. For example, for soils underlain by very permeable sand, it is considered that the interflow component would likely approach 0% with most of the infiltrating water recharging downwards to the water table. For soils underlain by very low hydraulic conductivity sediments, the interflow component would likely approach 100%, with most of the water infiltrating into the topsoil just seeping laterally along the topsoil/till contact to re-emerge locally at surface.

Although the topsoil is underlain by very low hydraulic conductivity till sediments, weathering and fracturing of the shallow soils may locally improve the recharge capabilities. In other EIR studies completed in North Oakville, an interflow component value of 50% has been used in the soil moisture balance calculations and this was found to correlate very well with numerical modelling results of the regional groundwater flow conditions, as well as the study findings of the NOCSS (2006) and other regional modeling completed by the Region (1995). This estimate has been used in this study also to calculate the direct and indirect runoff components of the water balance (**Table C-7-1, Appendix C-7**).

As discussed in **Section 4.3**, the majority of the Subject Lands lie within three EIR Subcatchment Areas and these are identified as Subcatchments FM1109 (East of Creek), FM1110 and FM1110.1 on **Figure 1.5**. Only a small area (5 ha) of the Subject Lands drain east to FM1111 and of that area, only 1.6 ha will be developed (the remainder is linkage). Given the very large size of the FM1111 Subcatchment Area (~247 ha north of Dundas Street), water balance calculations for this subcatchment are not warranted in this study. Therefore, the approach for the overall water balance calculations for this study has been to use the calculated water balance components to estimate the total annual recharge volumes for the FSS Study Areas that falls within each of the three main EIR Subcatchment Areas. The calculations are done for the pre-development conditions (based on the existing land use characteristics), and then re-calculated based on the proposed development plan land uses. The post development recharge volumes were calculated assuming roof-leader disconnection will be used throughout the low density residential areas.

The pre- and post-development infiltration volume calculations for the Subject Lands are presented on tables for each EIR Subcatchment Area in **Appendix C-7** and the results are summarized below.

8.3 COMPONENT VALUES

The detailed monthly calculations of the water balance components are provided on **Table C-7-1** in **Appendix C-7**. The monthly calculations are summed to provide estimates of the annual water balance component values and a summary of these values is provided in **Table 8.1** (note that the values have been rounded accounting for the minor variances in balance additions).

Table 8.1 - Water Balance Component Values – Existing Conditions

Water Balance Component	Agricultural/Open Space
Average Precipitation	897 mm/year
Actual Evapotranspiration	626 mm/year
Water Surplus	271 mm/year
Total Infiltration	81 mm/year
Direct Runoff	190 mm/year
Recharge	41 mm/year
Interflow (indirect runoff)	41 mm/year
Total Runoff (direct and indirect components)	230 mm/year

It is acknowledged that the infiltration, recharge and runoff values presented in **Table 8.1** are estimates. These values are utilized for the water balance calculations, but it is important to understand that infiltration rates are directly dependent upon the hydraulic conductivity of the surficial soils and this may vary over several orders of magnitude. As such, the margins of error for calculated infiltration and recharge rates are large. The margins of error are recognized, but for the purposes of this type of assessment, the numbers used in the water balance calculations are all considered reasonable estimates based on the site-specific conditions. It is noted further that the estimates for groundwater recharge are consistent with the previous subwatershed study completed for the area (NOCSS, 2006), and a comprehensive hydrogeological study of aquifers throughout the Region that included regional groundwater flow modeling by Holysh (1995).

The calculations in **Table C-7-1 (Appendix C-7)** show that a water surplus is generally available from December to May. The monthly water balance calculations illustrate how infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. In winter, frozen climate conditions may affect when the actual runoff and infiltration will occur; however, the monthly balance calculations indicate the potential volumes available for these water balance components.

8.4 PRE-DEVELOPMENT RECHARGE VOLUMES (EXISTING CONDITIONS)

The pre-development water balance calculations for the portions of the FSS Study Area within each of the EIR Subcatchment Areas are presented in **Tables C-7-2, C-7-3** and **C-7-4** in **Appendix C-7**. The calculated pre-development groundwater recharge volume by subcatchment is summarized below in **Table 8.2**. It is noted that the numerical values presented in the tables are based on estimated average annual water balance component values and assumed consistent soil and drainage conditions and have been rounded. The calculated recharge volumes are considered as reasonable representations of the magnitude of the recharge volume, not the precise water volume that occurs.

Table 8.2 - Pre-Development Recharge Volumes

Subcatchment	Total Subcatchment Area (ha)	Total Pre-Development Recharge Volume(m^3/year)	Draft Plan Area Pre-Development Recharge Volume (m^3/year)
FM1109	48.39	22,200	5,400
FM1110	17.39	7,200	6,500
FM1110.1	28.43	10,000	5,400

8.5 POTENTIAL DEVELOPMENT IMPACTS TO WATER BALANCE

Development of an area affects the natural water balance. The most significant difference is the addition of impervious surfaces as a type of surface cover (e.g., roads, parking lots, driveways, and rooftops). Impervious surfaces prevent infiltration of water into the soils and the removal of the vegetation removes the evapotranspiration component of the natural water balance. There is still an evaporation component from impervious surfaces as well as some losses of water through cracks in pavements, etc.; however, this is a relatively minor volume (estimated to be 10% to 20% of precipitation) compared to the evapotranspiration component that occurs with vegetation in this area (about 65% of precipitation). The net effect of the construction of impervious surfaces is that most of the precipitation that falls onto impervious surfaces becomes surplus water and direct runoff.

A calculation of the potential water surplus for impervious areas is provided at the bottom of **Table C-7-1** in **Appendix C-7**. Assuming a maximum evaporation loss from impervious surfaces of up to 20% of the precipitation of 897 mm/year (i.e., 179 mm/year), there is a potential water surplus (runoff) from the impervious areas of 718 mm/year.

8.6 POST-DEVELOPMENT RECHARGE VOLUMES

The post-development land uses for the subcatchments have been broken down into categories and assigned an average percentage of imperviousness for the water balance calculations as

summarized in **Table 8.3** (note that the values have been rounded accounting for the minor variances in additions).

Table 8.3 - Water Balance Land Use Categories

Land Use Category	Imperviousness (%)	Subcatchment Area (ha)		
		FM1109	FM1110	FM1110.1
Low density (Singles)	67	1.0	-	0.3
Med. Density (TH, RLTH, B2B)	86	11.2	3.5	6.4
High Density/ Mixed Use	100	0.1	7.2	3.1
Roads	100	4.7	5.1	5.9
Park	29	1.2	1.6	-
Pond	50	4.0	-	-
Rural Estate Lots	36	-	-	8.4
NHS	0	26.3	-	4.0
	Total Area (ha)	48.5	17.4	28.1

These data have been applied to calculate the potential post-development recharge volumes assuming only roof-leader disconnection and no other mitigation or LID measures are in place (**Tables C-7-2, C-7-3** and **C-7-4**, **Appendix C-7**). The post development groundwater recharge volumes for each subcatchment without roof-leader disconnection are summarized below in **Table 8.4**.

Table 8.4 - Potential Post-Development Recharge Volumes with no LID Contribution

EIR Subcatchment	Total Pre-Development Recharge Volume*(m^3/year)	Total Post-Development Recharge Volume*(m^3/year)	Potential % Reduction in Recharge	Potential Recharge Deficit (m^3/year)
FM1109	22,143	14,271	36	6,780
FM1110	7,245	745	90	6,500
FM1110.1	10,058	4,766	53	4,981

* It is acknowledged that recharge rates are directly dependent upon the hydraulic conductivity of soils that may naturally vary over several orders of magnitude. Recognizing the wide margins of error associated with this analysis, the recharge volumes presented above are considered simply as reasonable estimates for comparison purposes. Note that values have been rounded from calculations in **Appendix C-7**.

8.7 WATER BALANCE IMPACT ASSESSMENT

8.7.1 Water Quantity

The increases in surface water runoff that will occur with urban development are typically addressed through the use of appropriate SWM techniques to control the runoff peak flows. Details of the proposed SWM plans for the FSS Study Area are provided in **Section 7**.

The predicted decreases in recharge that will occur due to the nature of the proposed development suggests that, without mitigation or LID measures, recharge throughout the developed area potentially would be reduced by about 30 to 90% of the current amount of average annual recharge (refer to **Table 8.4**). Reductions in recharge volumes would not be expected to result in any significant impacts to the local groundwater flow patterns (the flow directions are related to the overall regional topography), however, there is potential to lower the local water table.

High water table conditions support wetland features and groundwater potentiometric surfaces that intercept ground surface in some areas such as along Fourteen Mile Creek West and in the lower reaches of 14W-18 and 14W-20 have the potential for groundwater discharge to surface. Although the potential groundwater discharge volumes are minor because of the low hydraulic conductivity soils, it is important to maintain the local high water table conditions around wetlands and high potentiometric elevations along the watercourse valleys such that the function of existing groundwater and surface water features can be maintained. Therefore, it is recommended to minimize potential changes to the recharge volumes, where possible and to promote the maintenance of groundwater and surface water functions through the use of LID measures. LID measures are discussed in **Section 8.8**.

In addition to the loss of direct recharge, the construction of buried services below the water table has the potential to capture and redirect groundwater flow through more permeable fill materials typically placed in the base of excavated trenches. Shallow groundwater may also infiltrate into joints in storm sewers and manholes. Over the long term, these impacts can lower the local groundwater table. Mitigation strategies to prevent this lowering are discussed in **Section 11.1**.

8.7.2 Water Quality

Depending on land use, runoff from urban developments may contain a variety of dilute contaminants such as suspended solids, chloride from road salt, oil and grease, metals, pesticide residues, bacteria and viruses. For the surface water, the SWM ponds will be designed to meet Enhanced Level quality controls (**Section 7**). For groundwater, generally, with the exception of the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater transport through the soils. No impact to local groundwater quality would be anticipated from direction of roof runoff to pervious areas within the development. The potential for effects on local groundwater quality from infiltration in the urban areas is therefore expected to be limited. Any potential changes to the groundwater

quality are not expected to significantly influence conditions in surface water features given the limited groundwater movement and discharge volumes.

8.7.3 Private Services

The proposed development will be serviced by municipal water supply and wastewater services. Therefore, there will be no impact on the water balance and local groundwater or surface water quantity and quality conditions related to any on-site groundwater supply pumping or disposal of septic effluent. There may be some existing groundwater supply wells and septic systems in vicinity of the proposed development; however, it is anticipated that all of these systems will be decommissioned or removed during the development process. Further discussion on interim monitoring and decommissioning of any active private wells is provided in **Sections 11.5** and **11.6**.

8.8 WATER BALANCE MITIGATION MEASURES

Where feasible, LID measures for SWM will be incorporated into the development design to minimize development impacts on the natural water balance and control runoff. The basic premise for LID is to manage stormwater to minimize the runoff of rainfall and increase the potential for infiltration through the use of various design techniques. As outlined in the SWMP Design Manual (2003) and Low Impact Development Stormwater Management Planning and Design Guide published by the CVC and TRCA (2010), there are a suite of LID techniques that can be considered to increase the potential for post-development infiltration and mitigate the reductions in recharge volumes that may occur with urban land development.

Techniques to maximize the water availability in pervious areas such as designing grades to direct roof runoff towards open space areas throughout the development where possible (e.g., yards, boulevards, landscaped areas, swales, green space in parking lots, etc.), can increase recharge in the developed area. These types of surface LID techniques promote natural infiltration simply by providing additional water volumes in the pervious areas (i.e., these areas would receive precipitation as well as extra water from roof runoff). This may be particularly effective in the summer months, when natural infiltration would not generally occur because the additional water overcomes the natural soil moisture deficit. Where possible, increasing the topsoil thickness in pervious areas to a minimum of 30 cm is also considered as beneficial to enhance storage capacity of water in the topsoil and increase the potential for infiltration.

Incorporating these measures into the SWM strategy and development design can assist in minimizing development impacts to the water balance by reducing the post development groundwater recharge deficit. The NOCSS (2006) identified examples of other LID measures that may be implemented in North Oakville including bioretention areas, rain gardens, green roofs, use of rain barrels and cisterns, vegetated buffer strips and permeable pavements (**Section 7.4**). The Town also has advocated for the use of tree pits in boulevards and, in other draft plans within North Oakville East, the use of these tree pits has been accepted as an effective LID measure.

Due to the very low hydraulic conductivity of the surficial till and shale materials and locally high water table conditions, there are limited enhancement opportunities for infiltration on the Subject Lands. The use of large, engineered facilities and constructed subsurface infiltration measures such as infiltration trenches may function, but will be limited in where they can be applied due to high groundwater and infiltration rates. The use of subsurface infiltration measures are to be located within public ownership for the purpose of long-term maintenance – this further restricts the locations that subsurface infiltration measures can be used.

As noted in **Section 7.1**, NOCSS recognized that the hydrogeological conditions in North Oakville make infiltration targets very difficult to meet and hence, NOCSS requirements for infiltration are 'best efforts'. Through various LID techniques discussed below, it is possible to reduce the water balance deficits summarized in **Table 8.4**..

For the Subject Lands, LID techniques to be implemented are discussed in **Section 7.4**. LID techniques are shown on **Figure 7.5** and include:

- increased topsoil depth;
- designing grades to direct roof runoff from single detached units towards pervious areas (e.g., lawns, side and rear yards) throughout the development;
- tree pits within municipal boulevards;
- Infiltration trenches adjacent to and/or under the trail system in the NHS;
- Infiltration galleries inside the Community Park

Quantification of such surficial LID techniques is challenging and there are no widely accepted quantification standards. The TRCA and CVC in their LID SWM Planning and Design Guide allow for a 25% runoff reduction (contribution to recharge) from roof leader disconnection and discharge to pervious areas. This credit can be applied in the land use areas where roof leader disconnection is proposed.

This 25% credit is a conservative estimate and corresponds to the hydrologic soil group C soils being present at the site. Based on the previous calculations and geological and soil information from previous studies it was confirmed that hydrologic soil group C is present across the Study Area. Use of the 25% estimate also requires the following requirements are met:

- A minimum 5 m length flow path from the downspout across a pervious area;
- The flow path grading is between 1% and 5%;
- The receiving soils are tilled to a depth of 300 mm and have organic content between 8 and 15% by weight (30 to 40% by volume); and
- The area of roof drainage contributing to individual downspouts should not be greater than 100 m^2.

The 25% runoff reduction was applied to the volume of direct runoff calculated for low density residential areas (see **Table C-7-2, C-7-3 and C-7-4**). The 25% reduction in runoff and resulting increase in recharge was incorporated into the post-development water balance results. The effect of the roof-leader disconnection is summarized in **Table 8-5**.

Table 8.5 - Potential Post-Development Recharge Volumes with LID Measures

Subcatchment	Draft Plan Area Post Development Recharge Volume NO LID Measures (m^3/year)*	Recharge Volume from Roof-Leader Disconnection (m^3/year)	Draft Plan Area Post Development Recharge Volume WITH Roof-Leader Disconnection (m^3/year)
FM1109	900	1,100	2,000
FM1110	800	0	800
FM1110.1	450	300	750

* Note that values have been rounded from calculations in Appendix C-7.

The infiltration trenches should be designed to be easily accessible to allow for future maintenance and inspection to promote long-term viability. Trenches are to be located away from structures and utilities. Based on the CVC LID Design Guide, the design of infiltration LIDs should consider the following:

- Soil Characteristics and Infiltration Rates
- Water Table
- Drainage Area
- Pollution to Hot Spot Runoff
- LID Sizing and Drawdown Time

LID infiltration trenches should ensure adequate clearance from the groundwater table. According to the MOECC SWM Planning and Design Manual (2003) the seasonally high-water table depth should be >1 m below the bottom of the infiltration trench and the depth to bedrock should be >1m below the bottom of the infiltration trench. It may be possible to design LID measures with less than 1 m of clearance to the seasonal high groundwater elevation, however, these LID measures may not be as effective during seasonal high groundwater conditions, and this should be considered. To assist with the evaluation of the potential for implementation of infiltration trenches, infiltration testing using a Guelph Permeameter was conducted and the results are included in **Appendix C-8**. The infiltration test results indicate that infiltration may be possible in some areas and that, in these areas, the rates range between 10 mm/hr to 72 mm/hr.

8.1.1 Infiltration Trenches Adjacent To and/or Under the Trail System in the NHS

Groundwater elevations are anticipated to be greater than 1.0 m below the bottom of the proposed trenches near the trail system in the NHS. Therefore, drainage was maximized to these trenches. As discussed in **Section 7.4**, the infiltration trenches may be located within the private lot (those lots that are adjacent to NHS) or located in the NHS buffers if the Town wishes to have access for maintenance. Exact location can be refined through detailed design.

The infiltration trenches are proposed as shown in **Figure 7.5** with sizes proposed between 1-2 m width, 0.5 m high, with 1.2 m of frost cover protection. Backyard drainage backing onto the NHS will discharge flows to approximately 806 linear metres of infiltration trenches. The infiltration trenches will either be located in the private rear-yards or placed between the trail system and the NHS boundary (i.e., within the NHS). The rear yard catchbasins will be

connected to infiltration trenches located in private lots along the rear yard property line, or beside and below the trail system in the NHS to maintain water balance as shown in **Figure 7.6a**. Water will preferentially fill the infiltration trench at a lower elevation before discharging through the higher elevation rear-yard catchbasin leader to the storm sewers in the municipal right-of-ways. In some cases, the hydraulic grade line of the subdivision storm sewers may exceed the rear-yard catchbasin grate elevation and act as a discharge. In this case, a safe overland flow route will be provided to the NHS. The hydraulic grade line analysis will be completed at detailed design.

8.1.2 Infiltration Trenches in the Community Park

Groundwater elevations are anticipated to be less than 1 m from the bottom of infiltration galleries in the Community Park, and only 0.5 m of frost cover protection was provided. Soil cover for frost protection (1.2 m) of sub-surface infiltration measures is recommended to maintain function during winter months. Frost cover will promote infiltration of mid-winter snow-melts while the ground is still frozen to frost depth. It is expected that these infiltration galleries may be less effective during winter months and before spring thaw. The trenches were sized to capture the 25 mm rainfall event and ensure drawdown time was less than 48 hours, depending on measured infiltration rates. Detailed calculations are shown in **Appendix K**.

Two infiltration galleries are proposed in the public park with dimensions of 24 m x 23 m and 34 m x 24 m, respectively. Infiltration galleries are proposed as shown in **Figure 7.5**. Drainage from the parks will be directed to catchbasins connected to the infiltration galleries. Again, flows collected by the catchbasin will fill the infiltration trench before spilling out to an insulated 250mm sewer to the storm sewers in the municipal right-of-ways as shown in **Figure 7.6A**.

8.1.3 Conceptual Infiltration Trench Sizing Estimate

As discussed above, infiltration trenches and galleries are proposed to promote rainfall retention on the Subject Lands inside public parks, trails within the NHS, and within select municipal boulevards to achieve the pre-development infiltration targets. The preliminary infiltration trench sizing and drawdown times were calculated using the LID Design Guide within the Subject Lands and detailed in **Appendix K**. The design guidelines have been used to calculate the allowable reservoir depths of the trenches, as well as the required trench footprints. Site specific infiltration tests were completed by RJB and summarized in **Appendix C-8.** The site-specific infiltration rates were used as described below.

The preliminary infiltration trench sizing is based on a drawdown of designed storage volume within 48 hours with a void ratio of 0.4 and a CVC Correction Factor of 2.5. The LID Design Guide recommends a safety correction factor be applied to the measured infiltration rates in order to calculate a design infiltration rate. The safety correction factor is used to compensate for potential reductions in soil permeability due to compaction or smearing during construction, gradual accumulation of fine sediments over the life span of the trench, and uncertainty in measured values when less permeable soil horizons exist within 1.5 m below the proposed bottom elevation of the trench. The parameters of this preliminary infiltration trench sizing should be confirmed and refined through detailed design. It is also recommended that, at

detailed design, two infiltration tests are completed per borehole as recommended by the LID Design Guide to confirm the Safety Correction Factor that should be applied.

25 mm storm events were used to estimate the runoff volume to size the trench volume for trenches proposed adjacent to or under the trails, and for the Community Park. The trench volume was then used based on providing proper maximum allowable depth a 48 hours drawdown, using the formula below (LID Design Guide, pg. 4-57):

$$d_{max} = \frac{i * t}{V_r}$$

Where:

d_{max} = maximum allowable depth of the trench
i = percolation rate of surrounding soils (mm/hr)
ts = drawdown time
Vr = void space ratio

The maximum trench depth, required trench footprint, and time to drain calculations are found in **Appendix K.** A typical LID infiltration trench cross section is shown in **Figure 7.6A.** The actual size of trenches, configuration, applicability, design storm, infiltration rates, depth to water table and frost cover should be refined through detailed design.

Table 8.6 takes the total post development recharge targets provided in **Table 8.4** and estimates the potential post-development recharge volumes for each catchment.

Table 8.6 - Potential Post-Development Recharge Volumes with SWM/LID Measures

EIR Catchment	Infiltration Target* Draft Plan Area	Roof Leader Disconnection*	LIDs in NHS and Community Park	LIDs in 7.5m Municipal ROW	Total	% of Target
	(m^3/yr)	(m^3/yr) [1]	(m^3/yr) [2]	(m^3/yr) [3]	(m^3/yr) [1]+[2]+[3]	
FM1109	4,540	1,146	7,755	562	9,463	208%
FM1110	4,753	0	1,107	444	1,551	33%
FM1110.1	4,918	311	0	1,043	1,354	28%
Total	14,211	1,457	8,861	2,049	12,367	87%

Target infiltration values from **Appendix C-7, Table C-7-2, C-7-3, and C-7-4*

As shown in **Table 8.6**, the water balance targets for subcatchment FM1109 are achieved by approximately 200%, while FM1110.1 and FM1110 are able to achieve approximately 30% of their respective targets. This is anticipated to be acceptable given the overall water balance targets between the three catchments is 90% of the total predevelopment infiltration volume. As a result of high groundwater and low infiltration rates it was not possible to achieve 100% of the water balance targets. Recognizing the geologic and hydrogeologic conditions within North Oakville, NOCSS direction is for best-efforts to address recharge volumes. This approach provides 90% of the target and is considered to be an effective best-efforts approach.

9 WASTEWATER AND WATER SERVICING

9.1 407 WEST EMPLOYMENT LANDS – AREA SERVICING PLAN (ASP)

In support of the North Oakville West Secondary Plan, on behalf of bcIMC Realty Corp., the Area Servicing Plan (ASP) for the 407 Employment Lands was prepared by MMM Group. The ASP is intended to satisfy the Secondary Plan requirement for a Master Servicing Plan.

The ASP provides a conceptual framework for the extension and development of water and wastewater systems to the North Oakville West Secondary Plan. The proposed water and wastewater servicing strategies, outlined in this EIR/FSS, have been prepared in accordance with the strategies put forth in the ASP and comments received from the Region on the proposed water and wastewater servicing in North Oakville.

An addendum to this ASP is currently being completed by David Schaeffer Engineering Limited (DSEL) on behalf of Palermo Village Corporation. The ASP addendum will cover the 407 West Employment Area including the Palermo Village lands. The EIR/FSS provides relevant information from the ASP for the 407 Employment Lands as well as the ASP Addendum being prepared concurrently with this EIR/FSS.

9.2 WASTEWATER SERVICING

9.2.1 Wastewater Design Criteria

Wastewater infrastructure will be designed in accordance with the latest Region design standards and specifications, as follows:

Sewer Design Criteria

• Average Dry Weather Flow	275 litres per capita per day
• Infiltration	286 litres per second per hectare
• Peaking Factor	Harmon Formula

Population Criteria

• Single Family	55 persons/hectare
• Semi – detached	100 persons/hectare
• Townhouse	135 persons/hectare
• Apartments (over 6 stories)	285 persons/hectare
• Community Services	40 persons/hectare
• Light Commercial Areas	90 persons/hectare

9.2.2 Existing Wastewater Services

Existing wastewater mains are currently available in the vicinity of the lands as shown in **Table 9.1.**

Table 9.1 - Existing Watermains in Vicinity of the Subject Lands

Street	Size	Location
To Mid-Halton Wastewater Treatment Plant		
Old Bronte Road	825 mm	Henderson Road to Bronte Road
Valleyridge Drive	300 mm	Dundas Street to Bronte Road
Grand Oak Trail	675 mm	Dundas Street to Upper Middle Road
Colonel William Parkway	600 mm	Dundas Street to Valleyridge Drive

9.2.3 External Wastewater Requirements

In accordance with the Region's Master Plan Update, the Region is planning future wastewater infrastructure to service lands throughout North Oakville and Milton. This will be achieved through a series of trunk mains, pumping stations (PS) and forcemains. The projects servicing the FSS Study Area are listed in **Table 9.2** and are illustrated in **Figure 9.1**.

Table 9.2 - Summary of Proposed Regional Wastewater Infrastructure

Class EA Schedule	IPFS	Year	Project Description
B	7528	2026-2028	WWPS Expansion of 1,200 L/s at the Mid-Halton WWTP

9.2.4 Proposed Wastewater Servicing

The Subject Lands will be serviced by a network of local gravity sewers designed in accordance with the Region's standards and specifications. The local sewers will convey flows to existing wastewater mains located on Valleyridge Drive and Old Bronte Road.

The conceptual wastewater servicing scheme is illustrated in **Figure 9.2**. A local trunk sewer, within the Subject Lands, will drain to the existing 300 mm gravity trunk sewer on Valleyridge Drive south of Dundas Street and accept flows from approximately 9,600 people. A second local trunk sewer will drain to the existing 825 mm gravity trunk sewer in Old Bronte Road and accept flows from approximately 5,700 people. Population assumptions were determined from the Perkins & Will Massing Study (June 2023) for high density land uses, and Gerard Design lotted concept plan (version CP-69, Dated June 2023) for the mid-rise and low-rise areas.

Design sheets and tributary area plans are included in **Appendix H-3.** A downstream analysis of the proposed sanitary outlet is discussed in **Section 9.4**.

The existing sewer on Valleyridge Drive must be extended from the south side of Dundas Street to the Subject Lands. The sewer must cross two existing storm sewers and a trunk watermain. The existing infrastructure within Dundas Street restricts the depth of sanitary sewer on the north side of Dundas Street. The extension of the Valleyridge sewer into the Subject Lands is sloped between 0.3% and 1.1%, which is done to balance the sewer capacity with limiting how much the site grading must be raised. A section of the Valleyridge sewer system within the Subjectt Lands is flowing at 80% capacity between Dundas Street and the first major east west collector road (William Halton Parkway). The Region of Halton standards for new sewers is to be designed between 60% and 70% full. The outlet at Dundas Street is fixed due to crossing existing infrastructure, and the sewer can only be steepened so much before the site needs to be raised excessively to accommodate the pipe slope. As such, the ability to achieve the Regional Design Standards for this section of sewer is not possible, albeit the sewer will still function at 80% full. It may be possible to upsize the sewer to a 375 mm diameter within the Subject Lands and discharge to the existing 300 mm diameter at Valleyridge Drive so the Q/Qfull is less than 90%. North of William Halton Parkway (extension) the sewers are sized per Region of Halton Design standards. Refer to **Appendix H-1** for design sheets illustrating the pipe capacity and slopes.

Due to the crossing and depth constraints discussed above, it is proposed that the Valleyridge Drive sewer will accept drainage from approximately 34 ha and a population of approximately 9,600. The remaining high-density population inside the Subject Lands and lands outside the Subject Lands between Bronte Road is proposed to send 6.2 ha and a population of approximately 5,700 to the Old Bronte Trunk sewer. After the large trunk sewer built in Regional Road 25 was installed to accept flows from Milton, flows from the Old Bronte Trunk sewer were diverted to Regional Road 25, significantly increasing the available capacity in the Old Bronte Trunk Sewer. Directing flows to the Old Bronte Road Trunk Sewer makes use of existing infrastructure with available capacity, and **Section 9.4** discusses the downstream sanitary analysis that was completed. The profile for the Old Bronte Road trunk sewer is shown in **Figure 9.5**, and sanitary tributary boundaries to each trunk sewer are shown in **Figure 9.2**.

The ASP for the 407 Employment Lands provided two potential outlet options for the Subject Lands: one to Valleyridge Drive, and one to Colonel William. The EIR/FSS and ASP Addendum have determined that Valleyridge Drive and the Old Bronte Sewer are the preferred outlet for the Subject Lands.

External Drainage

The lands to the east of Bronte Road, outside the FSS Study Limit, are proposed to drain to the existing 900mm diameter trunk sewer at Dundas Street within Old Bronte Road. A new local trunk sewer will be extended north from Dundas Street to service the lands east of Old Bronte Road. The ASP for the 407 Employment Lands contemplated this as the servicing strategy for

the lands east of Old Bronte Road. The ASP Addendum currently being prepared will maintain this strategy, however, will be updated to recognize potential increase in development density as compared to the original ASP.

There is external drainage from the Temple Property located on the east side of Bronte Road (3259 Bronte Road). The purpose for allowing these lands into the subdivision is that this will limit the amount of new sewer that will need to be installed within Bronte Road. The proposed servicing strategy allows for a perpendicular crossing of Bronte Road as opposed to having to extend a sewer ~ 200 m north within Bronte Road to service this property. Furthermore, the property is far enough north of Dundas Street that it can be serviced within the proposed Old Bronte Sewer System and contributes along with the FSS Study Area to maximizing use of the available capacity in that system.

9.2.5 Interim Wastewater Servicing

There is no interim wastewater servicing proposed for the Subject Lands. However, should the downstream system capacity be limited at the time of development, an interim strategy may be required.

9.3 WATER SERVICING

9.3.1 Water Supply Design Criteria

Water servicing for the Subject Lands will be designed in accordance with the latest Region standards and specifications such that adequate pressures and fire flows are achieved. Water design flows will be designed with the following criteria:

Water Design Criteria

• Average Daily Demand	275 litres per capita
• Maximum Daily Demand Peaking Factor	2.25
• Maximum Hourly Demand Peaking Factor	
Residential	4.00
Community Services	2.00
Commercial	2.00

Population Criteria

• Single Family	55 persons/hectare
• Semi–detached	100 persons/hectare
• Townhouse	135 persons/hectare
• Apartments (over 6 stories)	285 persons/hectare
• Community Services	40 persons/hectare
• Light Commercial Areas	90 persons/hectare

9.3.2 Pressure Zone Boundaries

The Subject Lands are located within the Zone O3 pressure district of Halton's water distribution system. The Region of Halton is proposing a pressure zone realignment within the existing Milton and Oakville (Zone O3 and O4) pressure zones. The Subject Lands will remain within pressure Zone O3 as part of this proposed realignment.

A summary of the zone elevations is provided in **Table 9.3.**

Table 9.3 - Summary of Zone 3 Elevations

Zone	Lower Elevation (m)	Upper Elevation (m)
O3	127.6	164

9.3.3 Existing Water Supply

Existing watermains are currently available in the vicinity of the lands as shown in **Table 9.4.**

Table 9.4 - Summary of Existing Watermains

Street	Size (mm)	Location	Zone
Dundas Street	1200	South side of Dundas Street, from east of Bronte Road to Tremaine Road	O3
Old Bronte Road	900	Western boulevard of Old Bronte Road from north of the 407 to south of Dundas Street	O3

The existing watermains are illustrated in **Figure 9.3**.

9.3.4 External Water Supply Requirements

In accordance with the Region's Master Plan Update, water infrastructure is planned to service the North Oakville Lands between Bronte Road and Tremaine Road. This infrastructure includes the construction of a 600mm WM spanning from Bronte Road to Tremaine Road.

The Regional projects related to the FSS Study Area, as outlined in the Halton Master Plan Update, are listed in **Table 9.5**.

Table 9.5 - Summary of Proposed Regional Water Infrastructure

Class EA Schedule	IPFS	Year	Project Description
B	5627	2023-2025	600mm WM through North Oakville Lands from Bronte Rd to Tremaine Rd to (Zone O3)

9.3.5 Proposed Water Servicing

The Subject Lands will be serviced by a 600mm watermain, identified as IPFS #5627 in the Region's Master Plan, and a network of new local watermains designed in accordance with the Region's design criteria and MOE's guidelines. Furthermore, the water distribution system will be looped in order to provide system security.

The Watermain Analysis completed by Municipal Engineering Solutions noted pressures north of the 600 mm watermain that are slightly under Regional requirements under peak hour demand. To ensure the condo blocks can be serviced under pressure Zone O3, internal boosters will be required for condo townhomes and high-density blocks which are typically seen in high rise buildings in higher density blocks. There are no freehold townhouse units being serviced below the 40 psi requirement, however, this is subject to the Region's review and approval. The water servicing strategy can be refined and/or revised under subsequent submission.

The upper-end of the operating levels of Zone O3 is 164.4 m. The existing grades north of Street "E" in the Subject Lands are approximately 164 m to 165 m. It has been determined through modeling that proposed surface grades should be lower than existing grades, and approximately 162 m, to achieve the peak hour demand pressures. Proposed grading of the Subject Lands (north of the proposed 600 mm trunk watermain on Street "E") has been lowered to the extent possible, with up to 2 m of cutting below existing grade, to increase peak hour pressure. It is not possible to lower the site further. The peak hour pressures for the freehold units are close to 40 psi.

The condo blocks and high density blocks north of Street "E", Block 29, 30, 36 and 37 of the Draft Plan (**Figure 6.1B**), will require internal booster pumps to achieve 40 psi under peak hour demand. It is not possible to lower the grades of these blocks more than shown on the grading plans due to tying into existing Bronte Road grades, matching existing grades in the Linkage to the north, and the cutting exceeding 2.5 m below existing grade (e.g., extraneous earthworks condition). It may be appropriate to boost these pressures through other means such as:

- A PRV connection to the existing watermain on Bronte Road that services Milton, a higher pressure than Zone O3.
- Operational adjustments to the Zone O3 booster pumps at the Kitchen Zone Reservoir
- Local booster pumping station (i.e., in a manhole structure) located north of Street "E" to boost local pressures.

The above options can be explored with the Region of Halton to refine the water servicing strategy.

The conceptual watermain sizing is illustrated in **Figure 9.4**. Trunk watermains are based on recommended sizing as outlined in the 407 Employment Lands - ASP, prepared by MMM

Group. Additionally, the Region of Halton watermain model has been updated with the Subject Lands demands. The updated watermain analysis is included in **Appendix H-2**.

9.3.6 Interim Water Servicing

In the event that Regional water projects are not completed at the time of development, interim water servicing alternatives will be investigated to meet the servicing requirements for the initial phases of the Subject Lands.

9.4 DOWNSTREAM SANITARY ANALYSIS

The ASP for the 407 West Employment lands intended for the Evergreen lands (west of Tremaine Road), the 407 West Employment lands, and the Palermo Village lands to discharge to the existing 600mm sanitary sewer on Colonel William Parkway. The ASP also investigated an alternative sanitary alignment in which the lands east of Fourteen Mile Creek (i.e., the Palermo Village lands) would discharge to the existing 300mm sanitary sewer on Valleyridge Drive. This alternative alignment was referred to in the ASP as “Option 2”.

The proposed sanitary design presented in this EIR/FSS is consistent with Option 2 of the ASP. Lands west of Fourteen Mile Creek can be directed to the trunk sewer on Colonel William Parkway. Design sheets for Colonel William Parkway were updated to include the latest population from the Evergreen lands and to remove the Palermo Village lands. The resultant population sent to Colonel William Parkway is 1,954 persons greater than what was assumed in the original ASP. The updated design sheets for Colonel William Parkway, from Dundas Street to Bronte Road, can be found in **Appendix H-1.** As demonstrated in the design sheets, the sanitary trunk sewer on Colonel William Parkway has capacity for the updated population estimates.

The population from the Palermo Village lands directed to the Valleyridge Drive sanitary is approximately 9,700. The design sheet for the Valleyridge Drive sanitary sewer system was re-created and updated to include the increased population from the Palermo Village lands. The Valleyridge Drive design sheets, from Dundas Street to Bronte Road, can be found in **Appendix H-1**. As demonstrated in the design sheets, the sanitary trunk sewer on Valleyridge Drive has capacity for the Palermo Village lands, and no upsizing within the local system is required.

A downstream sanitary capacity analysis has been completed by Civica Infrastructure Inc. to assess the impacts between existing and proposed sanitary conditions for Colonel William Parkway, Richview Boulevard, Valleyridge Drive, Rochester Circle, Bronte Road, and Old Bronte Road. The Region of Halton’s InfoSewer Model was used and verified to accurately represent the existing sewer system, including any recent updates to the model along with cross-referencing the model with as-builts provided by the Region. Two development scenarios were used for the model consisting of existing conditions (2021-Peak-WWF), and proposed conditions (2031-Peak-WWF + Proposed Flows). Using a proposed population of 10,300 persons to the Valleyridge Drive sewer (greater than the estimated 9,700 populations being directed to Valleyridge Drive from the Subject Lands, to be conservative), it was determined that

there are three locations downstream that will be surcharged. The locations are identified in Appendix B of the report. Although areas of surcharge were identified in the sewer, there is at least 1.8 m freeboard from basements to avoid backflow conditions. It is also quite possible that these conditions may not translate into a bottleneck surcharge condition using a dynamic hydraulic analysis model. A dynamic model will need to be conducted to verify this. Alternatively, there is an opportunity to send additional flows from the property to the Old Bronte Road sewer to eliminate the surcharge conditions at the Valleyridge Drive sewer. Further investigation to confirm capacity will be provided in a subsequent submission. All other sewer lines are well under the threshold for surcharge and have capacity under proposed sanitary conditions. Please refer to **Appendix H-1** for the Mid Halton WWTP Sanitary Capacity Analysis for reference.

The remaining population (approximately 5,700) from the Palermo Village lands is to be directed to the Old Bronte Road Sewer, and to ensure there was available capacity in the downstream system a total flow and resulting hydraulic gradeline (HGL) analysis was conducted using a calibrated pipe-by-pipe InfoSewer model. The model was developed and calibrated by the Region in 2011 and updated in 2016. As noted above, two scenarios were analyzed:

1. Existing Conditions (2021-Peak-WWF)

2. Proposed Conditions (2031-Peak-WWF + Proposed Flows)

Scenario 1 represents existing conditions calibrated by the Region, and Scenario 2 includes existing conditions, the Palermo Village lands (including the Subject Lands), and 1,541.75 L/s of additional flow added to the proposed conditions model by the Region. Under Scenario 2 the sewers were able to accommodate the existing and proposed flows without causing surcharge, and the HGL is anticipated to be greater than basement level (1.8m below surface level) at any point within the system. Please see **Appendix H-4** for more details on the downstream Mid-Halton WWTP Sanitary Capacity Analysis.

10 ROADS

10.1 POLICY DIRECTION

OPA 289 provides policies for the provision of roads through the NHS. Policy 8.4.7.3 c) ii) identifies potential permitted uses within the NHS to include:

"*Roads and related utilities which shall:*

- *use non-standard cross-sections designed to minimize any impacts on the natural environment;*
- *only be permitted to cross the designation in the general area of the road designations shown on Figures NOE2 and NOE4 or as defined through an Environmental Assessment; and,*
- *be designed to minimize grading in accordance with the directions established in the North Oakville Creeks Subwatershed Study.*

Provided that such corridors shall:

- *be required as transit routes or utility corridors;*
- *be located outside natural features to the maximum extent possible, and where the applicable designation is narrowest and along the edges of applicable designations, wherever possible;*
- *provide for the safe movement of species in accordance with the directions established in the North Oakville Creeks Subwatershed Study in the design and construction of any road or utility;*
- *be kept to the minimum width possible; and,*
- *be designed to keep any related structures or parts of structures outside the High Constraint Stream Corridor Area designated on Figure NOE3 to the maximum extent possible or as defined through an Environmental Assessment*."

Within section 6.3.5.2 of the NOCSS, general direction is provided with respect to road crossings of natural features, indicating that the "*provision of suitable culverts and bridges should be considered on a site specific basis"* and "*considerations to prevent wildlife-vehicular interactions should also be considered."*

With respect to road crossings of streams, measures to be considered include:

"*Selecting roadway and linkage alignments to avoid unsafe intersections (e.g., at curves);*

- *Use of plantings and wing-walls to direct wildlife using the linkage to culvert/bridge crossings; and,*
- *Design of culverts/bridges to accommodate wildlife movement*."

The EIR/FSS TOR require that road crossings of creeks and Cores be identified and recommendations made regarding preferred crossing locations and configurations, road design standards, and mitigative measures to minimize impacts to the NHS.

The Development Concept Plan illustrated on **Figure 6.1** includes one crossing of Fourteen Mile Creek West. The design of the extension of William Halton Parkway westerly from its current terminus at Bronte Road will be subject to future study. As such, this future road crossing has not been addressed in detail in this EIR/FSS. As noted in **Section 5.5**, a hydraulic model run of a potential road crossing location and design was included herein only to demonstrate that the regulatory floodline, with a road crossing in place, will not affect NHS boundaries.

A second crossing of Fourteen Mile Creek West, north of the future William Halton Parkway is proposed in OPA 34; see **Figure 1.3**. Similar to the William Halton Parkway extension, a preliminary culvert design was completed to demonstrate the proposed conditions floodlines north of the NHS crossing will not impact the development limits as described in **Section 5.5**.

10.2 Road Allowance Design

Through the Secondary Plan process, alternate road allowance design standards were proposed by the Town. The road allowance design was sufficient to support the establishment of right-of-way (ROW) widths for the various road types.

The road allowance design has continued to evolve to accommodate the detailed requirements for the various stakeholders within the proposed road allowances. The Development Concept Plan follows Town of Oakville standard ROW cross-sections with one exception - the northern NHS road crossing. This right-of-way will include a 600 mm diameter watermain as well as a local watermain. The proposed cross section is illustrated in **Figure 10.1**.

10.3 Sidewalk Design

The preliminary sidewalk locations are illustrated in **Figure 10.2**.

10.4 Utility Crossings of Creeks

A trunk watermain crossing of Core 1 is required as outlined in the Area Servicing Plan (AECOM, 2014) and the Region of Halton Master Plan (2017). Depending on the road crossing design, the watermain may be able to cross over the culvert. Alternatively, the watermain will need to cross under the culvert, and trenchless installation will likely be required to minimize disturbance to the valley floor. It is expected that the proposed watermain crossing design will be addressed through the future design of William Halton Parkway.

11 CONSTRUCTION PRACTICES

11.1 SUMMARY OF KEY GEOTECHNICAL FINDINGS

The subsurface conditions within the area were evaluated through two geotechnical investigations by DS Consultants Ltd (**Appendix I**). The key findings are summarized below.

1. Palermo (Bartman) 3278 Bronte Road
   DS Consultants Ltd. Preliminary Geotechnical Investigation, dated June 2021

   The site was investigated by drilling and sampling 3 boreholes across the site. Based on the soil conditions encountered at the borehole locations, the soil profile predominantly consisted of topsoil and ploughed fill extending down to about 1.8m to 2.4m below existing grade. This was then generally underlain by till deposits consisting of a damp and stiff to hard clayey silt till extending to a depth of 4.6m. Till-shale and weathered shale were encountered at depths ranging from 4.6m to 6.0m, where shale bedrock was then encountered from 6.0m to 6.2m depths below ground surface. The groundwater condition at the site was monitored during drilling and upon completion of the boreholes, 1 borehole (MW21-3) was found to be dry. Boreholes MW21-1 and MW21-2 recorded groundwater at depths of 2.4m and 5.3m respectively.

2. Palermo Lands Dundas Street West & Bronte Road
   DS Consultants Ltd. Revised Preliminary Geotechnical Investigation, dated September 2022

   The site was investigated by drilling and sampling a total of 84 borehole locations across the site. Based on the soil conditions encountered at the borehole locations, the soil profile predominantly consisted of topsoil and ploughed fill extending down to 0.15m to 0.28 m below existing grade. This was then generally underlain by fill and weathered soils consisting of a soft to firm consistency soil extending to 0.8m below ground surface. All boreholes were then supported by glacial till deposits consisting of a damp and stiff to hard clayey silt till extending to depths of 2.1m to 7.3m. Shale bedrock was encountered from 3.1 m to 13.7 m depths below ground surface. Stabilized groundwater levels in the monitoring wells were recorded at depths ranging from 0.8 to 6.7 m below the existing grade.

Considering the above findings at the two properties listed above, some of the key geotechnical recommendations are summarized below:

- The undisturbed native deposits will provide a suitable bearing surface for house footings.
- Excavations for the footings and services, within the overburden deposits, could be carried out with conventional equipment. However, when the excavation is extended

down into the weathered shale, the heaviest available single tooth ripper equipment or jackhammer would be required.

- Considering the groundwater conditions encountered at the borehole locations, the amount of seepage from the glacial clayey silt and sandy silt till deposits is expected to be small and manageable by sump pumps. However, increased seepage may be encountered from perched groundwater and/or surface run-off that should be manageable with increased sump pumps. Further recommendations regarding groundwater control can be found in **Section 11.4**.
- Considering the occurrence of Queenston shale at the sites, some key geotechnical recommendations are provided below. This shale is susceptible to degradation and swelling when exposed to weather elements.

Protection of Exposed Shale and Sewers Installed in Shale

For deep trenches (if any), (i.e., more than 2.0 m below the shale surface), a minimum 50 mm thick polystyrene etc. layer will be required at both sides of the pipe to avoid rock squeezing. The polystyrene layer should extend vertically to at least 0.3 m above the pipe. The rock trench should be wide enough so that at each side, the horizontal distance between the pipe side and the cut rock surface is at least 0.3 m.

Anti-seepage Collars

For sewer installed under the groundwater table, seepage between the trench backfill material and the trench wall may cause erosion of the backfill materials. It is recommended that nominal anti-seepage collars (maximum spacing 50m) be provided to prevent erosion of the backfill materials. Anti-seepage collars should not be located at the pipe joint.

The anti-seepage collar may consist of a clay plug surrounding the sewer pipe. A typical clay plug will be about 1 m thick and extends laterally to a minimum distance of 0.5 m from the pipe circumference with a minimum of 0.3 m embedment into the shale or native sub-grade.

The on-site native silty clay soils may be suitable for such purpose subject to additional sampling and testing.

SWM Pond Liner

If the pond bottom and excavated side slopes consist of clayey silt till to silt clay deposit, as encountered in BH21-52, BH21-55, BH22-14, BH22-15, BH22-16 and BH22-18/18A a clay liner should not be required.

Where the pond bottom and excavated side slopes consist of sandy silt till deposit and other cohesionless (sandy) soils, a clay liner will be required to retain water in the pond. The clay liner

should be minimum 0.6m in thickness. Additional details with respect to specific soil types in the vicinity of the SWM Pond can be provided at detailed design.

The preliminary geotechnical investigation reports are presented in **Appendix J-1**.

11.2 EROSION AND SEDIMENT CONTROLS

An Erosion and Sediment Control (ESC) strategy will be prepared and implemented in accordance with the Town and CH's *"Erosion and Sediment Control Guideline for Urban Construction"* (Greater Golden Horseshoe Conservation Authorities – Toronto and Region Conservation Authority, Conservation Halton, Credit Valley Conservation, Nottawasaga Valley Conservation Authority, Lake Simcoe Region Conservation Authority, Grand River Conservation Authority, Niagara Peninsula Conservation Authority, Hamilton Conservation Authority, 2006) prior to any earthworks or grading activities on the Subject Lands. The ESC strategy will include the following:

- methods for constructing SWM and environmental features in the dry;
- methods to stabilize disturbed areas to minimize transfer of sediment;
- special measures for works in or adjacent to stream corridors, such as culvert crossings, wetland construction, etc.;
- environmental fencing;
- stone mud mat at all construction entrances;
- consideration for proper topsoil stockpiling (location, height, side slopes), exclusion of compaction activities, good site management control (i.e., no waste additions), and avoidance of dust control application that may adversely affect soil integrity (e.g., use of water only; no oil-based sprays, etc.);
- use of the permanent ponds as temporary silt basins during site construction activities;
- regular inspection of the ESC devices; and,
- removal and disposal of the ESC devices after the site has been stabilized.

11.3 CONSTRUCTION PHASING

No construction phasing is required which is considered non-standard under this application. The general approach is summarized as follows.

General

- Obtain all approvals, permits, authorizations, etc. for work near or within watercourses in accordance with local, provincial, and federal legislation and regulations.
- Obtain approval for replicated wetland feature from CH.
- Complete a flora and fauna salvage plan and implement prior to site alteration.
- Install all silt control measures (fences, sediment basins, etc.), as required.
- Commence earthworks in accordance with industry standards.

11.4 DEWATERING REQUIREMENTS

There are areas of high water table within the surficial till and shale bedrock. Dewatering may be required where sewer trench grades and excavations encounter groundwater, however, the amount of seepage from the clayey silt and sandy silt till deposits is expected to be small and manageable by sump pumps. When excavating in glacial till, there is always a potential to encounter local sandier layers or heavily fractured sediments that may have higher hydraulic conductivity and groundwater seepage may be more appreciable. This is also true of excavations into the shale bedrock, with the most permeable zone likely to be encountered is at the till/shale contact and along the top of the shale where weathering and fracturing is expected. Should such permeable zones be encountered during construction, more active dewatering may be required, however, no significant or extensive dewatering for excavations is anticipated.

The undertaking of dewatering, according to industry standards and in accordance with MECP processes will ensure that adequate attention is paid to potential adverse impacts to the environment. Currently the MECP allows for construction dewatering of less than 400,000 L/d to proceed under the Environmental Activity Sector Registry (EASR) process. If dewatering is to occur above this threshold, then the standard Permit to Take Water (PTTW) process will apply. In both cases, a scientific study is required in support of EASR registration or PTTW application. This scientific study must review the potential for environmental impacts and provide mitigation and monitoring measures to the satisfaction of the MECP. The requirements for construction dewatering will be confirmed by geotechnical/hydrogeological investigations completed in support of detailed design.

11.5 PRIVATE WATER WELLS

The proposed development will be municipally serviced and therefore, in the long term, it is expected that any existing domestic water supply wells in the area will no longer be used. In the interim, however, it is important to ensure that construction does not adversely affect local groundwater supplies while the private water supply wells are still in use. Prior to construction activities, it will be necessary to complete a house-to-house survey to determine the precise well locations and uses of local groundwater supply wells.

With permission from well owners, water levels will be measured in active and accessible water supply wells during non-pumping conditions prior to the commencement of site construction activities, and a water sample will be collected from each well for analysis of background water quality. The water analysis will include general water quality indicator parameters including chloride, nitrate, turbidity and conductivity. The recommended monitoring program for the local private wells includes quarterly water level measurements throughout the earthworks period (if the wells remain in use). At the end of the construction period, a water sample will again be collected from each of the monitored supply wells to confirm the water quality has not been affected.

11.6 WELL DECOMMISSIONING

Prior to construction, it will be necessary to ensure that all inactive water supply wells within the development footprint have been located and properly decommissioned by a licensed water well contractor according to Ontario Regulation 903. In addition, all groundwater monitoring wells and standpipes installed for this study must be decommissioned in accordance with provincial regulations prior to or during the site development, unless they are maintained throughout the construction for monitoring purposes.

11.7 TOPSOIL MANAGEMENT

Increased topsoil depths are one of the proposed LID measures for the development. Topsoil should be carefully managed to ensure its viability for use for LID purposes. This should be considered during the Site Alteration process.

12 MONITORING PROGRAM

12.1 OPA 289 MONITORING REQUIREMENTS

Policy 8.9.5.2 of OPA 289 requires that an annual monitoring program be completed as follows:

A program shall be established by the Town in consultation with the Region of Halton and Conservation Halton to monitor the development in the Planning Area on an annual basis. The monitoring program shall be in accordance with directions established in the North Oakville Creeks Subwatershed Study and shall also consider such factors as:

a) relationship and level of population and employment growth in North Oakville;

b) supply of existing lots and number of building permits granted;

c) the general achievement of housing mix targets in North Oakville;

d) the functioning of stormwater management facilities to ensure they are constructed and operate as designed,

e) stream alterations/relocations to ensure that natural channel designs were implemented and operate as designed;

f) erosion and operation of sediment controls during construction;

g) utilization of wastewater treatment and water supply system capacity; and,

h) development application status.

12.2 NOCSS MONITORING REQUIREMENTS

The NOCSS includes monitoring requirements for:

- ESC;
- SWM facilities;
- monitoring of modified streams; and,
- monitoring of SWM works, municipal services and trails installed by a landowner within the NHS.

With respect to the above monitoring components, the principles of monitoring, for which the landowners are responsible, include the following, as set out in OMB Monitoring Mediation Agreement dated July 27, 2007. Although the Monitoring Mediation Agreement is specifically related to the North Oakville East Secondary Plan Area, the requirements have been included in this EIR/FSS for consistency across North Oakville.

Erosion and Sediment Control

1. An ESC plan will be required to be submitted to the Town. The plan must be reviewed and approved by the Town prior to any clearing and grading.

2. The ESC requirements will follow applicable approved guidelines and bylaws in effect at the time of development. Deliverables will include a site alteration design report, an existing site conditions survey plan, an ESC plan, and a schedule of monitoring and reporting.

3. The ESC plan will include inspection, sampling for total suspended solids at all outlets from the site and reporting of results.

4. Remedial action to correct deficiencies of ESC practices and facilities may be required based on either inspection or sampling results

Stormwater Management Facilities

1. SWM facilities constructed in the conveyance system and at the end-of-pipe will be included in the monitoring program, which applies to the period prior to the assumption of the facilities by the Town. The monitoring plan will include monitoring of the receiving system for the effectiveness of the SWM facilities at the location of the outfall for the purpose of water quality monitoring, and at a location or locations to be determined through the EIR for the purpose of erosion control. Monitoring will follow applicable approved guidelines in effect at the time of development. These guidelines will replace Appendix KK – Stormwater Pond Monitoring Protocol from the Subwatershed Study. The Town and CH will consult with the North Oakville landowners in the preparation of such guidelines. Monitoring requirements will be reflected in subdivision agreements.

2. Privately owned SWM facilities are not included in this mediation document and will be subject to site specific requirements at the time of application.

3. All SWM facilities to be assumed by the Town will be monitored by the owner for design conformance, maintenance of function and hydraulic performance. Monitoring and reporting requirements are to be reviewed and approved by the Town.

4. Facilities with water quality function(s) will be monitored by the owner for performance in meeting the specific pond design target for total suspended solids (80% removal). Total phosphorus and temperature sampling will also be required.

5. Facilities subject to *Ontario Water Resources Act* approval may be required to do additional monitoring as a condition of the Certificate of Approval.

Monitoring in Relation to SWM Works, Municipal Services and Trails Installed by an Owner within the NHS

1. A monitoring program will be implemented for all municipal services such as roads, watermains, sanitary sewers, SWM works or trails within the NHS.

2. A monitoring program, approved by the Town and CH, is to be developed based on the natural features and functions potentially affected by the specific works noted above.

3. The details of the monitoring program are to be included in the EIR.

4. The monitoring program will be implemented by the landowners installing the SWM works, municipal services and trails.

12.3 PROPOSED MONITORING

Consistent with the monitoring principles set out above, the following monitoring will be undertaken by the landowner.

12.3.1 Erosion and Sediment Control

Section 11.0 of this report discusses the need for an ESC strategy in accordance with Town and CH guidelines and sets out typical components of the strategy. Guidelines endorsed by CH entitled, *Erosion and Sediment Control Guidelines for Urban Construction* (December 2006), will be applied to site construction plans at the detailed design stage to identify specific details of an ESC strategy, including the type and location of control measures to be implemented, timing of implementation, details of responsibilities for monitoring, reporting and maintenance needs. Deliverables will include a site alteration design report, an existing site conditions survey plan, an ESC plan and a schedule of monitoring and reporting.

12.3.2 Stormwater Management Facilities

SWM facilities to be assumed by the Town will be monitored by the owner for design conformance and hydraulic performance. Monitoring and reporting requirements are to be reviewed and approved by the Town and CH.

The Town has prepared comprehensive monitoring requirements for SWM ponds, as set out in *Town of Oakville Guidelines for Operation, Maintenance, and Monitoring of Stormwater Management Facilities South of Dundas Street.* Furthermore, the Town has prepared monitoring guidelines for North Oakville. All monitoring will be prepared in accordance with the final, approved version of "*North Oakville Monitoring Program for Stormwater Management Facilities*".

The North Oakville Monitoring Program Guidelines requires "*Baseline temperature and TSS monitoring be undertaken in the receiving watercourse upstream and downstream of the anticipated SWM pond outlet; temperature monitoring be undertaken during the months of July, August and September prior to construction of the SWMF. Temperature monitoring should be carried out as per Section 5 of the Ontario Stream Assessment Protocol; and the TSS monitoring should be undertaken during 3 dry weather sampling events and during at least 4 wet weather events prior to the construction of the SWMF*".

A baseline monitoring program will be required prior to site alteration on the Subject Lands. A draft of the monitoring program is to be submitted to the agencies prior to any site works.

A detailed post construction monitoring program will be provided for each facility at the time of detailed design. At detailed design, the requirement for monitoring of LID measures will be addressed with the Town.

12.3.3 Monitoring of Modified Streams

There are no proposed channel realignments within the Subject Lands. However, there may be minor works required at the William Halton Parkway road crossing of Fourteen Mile Creek West. Detailed design of the road crossing, by others, will include a preliminary monitoring plan.

12.3.4 Monitoring in Relation to Municipal Services and Trails Installed by an Owner within the NHS

All municipal services are located within ROWs, including the crossing of Stream Reach 14W-1A. There are no other proposed servicing crossings of the NHS.

This EIR/FSS identifies future trail locations along the eastern limit of Core 1. The location of the trail is shown on **Drawings 3A to 3C.** With respect to the trails proposed through portions of the perimeter of Core 1, the monitoring requirements associated with trail design would be finalized at the time the trail design is completed. This would be undertaken as a condition of Draft Plan approval. The primary focus of this monitoring is associated with the construction and the naturalization/planting requirements for locations where disturbance to the natural cover would occur. Specifically, monitoring should occur to ensure that:

- the habitat protection requirements outlined in **Section 6.4** are implemented and maintained in good working order until construction is completed;

- disturbed zones adjacent to trails/swales, primarily between the edge of these features and the NHS Core boundary, and in the vicinity of any other works within the NHS (e.g., in the vicinity of flow spreaders, if applicable) are landscaped with native indigenous species as outlined in **Section 6.4.4** and in consultation with CH and Town (Parks); and,

- during the plantings warranty period, all planted materials would be managed appropriately, as outlined in **Section 6.4.4** and in consultation with CH and Town (Parks).

12.4 MONITORING OF ENHANCED LPA, ECOPASSAGE AND CREATED WETLAND

The Enhanced LPA that has been proposed on the northern portion of the Subject Lands has been designed to achieve the following objectives:

- To provide connectivity for wildlife between Cores 1 and 2;
- To provide for safe wildlife passage under Bronte Road by taking advantage of the existing grade separation immediately south of the Highway 407 off ramp;
- To address the removal of Wetland 10 (a Hydrologic Feature B) through the creation of an enhanced wetland; and,
- To provide a diversity of habitat types including wetland, woodland, thicket and meadow.

A summary of the proposed monitoring program is provided below and will be further detailed through the preparation of a separate Environmental Monitoring Plan (EMP) that will be developed in consultation with the Town and CH and provided as a condition of draft plan approval.

It is proposed that the environmental monitoring be comprised of Compliance Monitoring and Performance Monitoring.

The objective of Compliance Monitoring is to verify that the proposed Enhanced LPA, ecopassage and created wetland have been constructed and implemented as per the approved design. Compliance Monitoring will consist of:

- On-Site Supervision during construction of the wetland;
- As-Built Surveys; and,
- Landscaping Inspections

The objective of Performance Monitoring is to confirm that the constructed Enhanced LPA, ecopassage and created wetland are performing the various ecological functions consistent with the design objectives. This will be achieved through monitoring of:

- Wildlife (breeding birds, waterfowl, mammals, amphibians, reptiles and insects) and usage of the Enhanced LPA;
- Wildlife movements through the existing culvert and proposed ecopassage under Bronte Road;
- Wildlife mortality (roadkill) to verify if fencing and other measures intended to funnel wildlife to the ecopassage are functioning;
- Wetland water levels and use by target species (amphibians, birds, waterfowl); and

- Vegetation monitoring (cover, structure and composition) of target communities (woodlands, wetland, thickets and meadows)

A draft monitoring framework is included in **Table 12.1**. Specific monitoring methods will be detailed in an EMP that will be prepared as a condition of draft plan approval.

Table 12.1 – Draft Monitoring Framework

Ecosystem Component	Monitoring Objective(s)	Monitoring Measures	Anticipated Methods
Wildlife Habitat	To document wildlife usage of the Enhanced LPA	The diversity of wildlife species utilizing habitats within the Enhanced LPA will documented through repeated surveys of key taxa.	Standardized and repeatable wildlife surveys will be completed at regular intervals from fixed stations in accordance with accepted monitoring protocols. (i.e., Marsh Monitoring Program)
Ecopassage Use	To document and quantify utilization of the existing culvert and proposed ecopassage over time to assess their performance.	Frequency of utilization or completed passes through the existing culvert and ecopassage.	Determined using automated wildlife cameras or other sensors at each end of the existing culvert and proposed ecopassage.
Safe Passage	To monitor whether wildlife are bypassing the existing culvert and proposed ecopassage.	Assess the condition of fencing and other measures intended to funnel wildlife to the crossing area.	Fence inspections and road mortality surveys.
Created Wetlands	To assess if the wetland is functioning from a hydrological perspective to support wetland functions and target species.	Wetland functions, including water levels and hydroperiod	Water levels will be measured continuously over a period of time. Vegetation establishment will be visually assessed. Wildlife will be inventoried in the wetland using standard survey protocols.

13 SUMMARY OF RECOMMENDATIONS

This EIR/FSS identifies and characterizes the natural heritage features and functions within the Study Areas and recommends measures to mitigate any potential impacts of the proposed development and associated servicing requirements on the NHS within the EIR Subcatchment Area. It also identifies servicing requirements related to roads, water supply, storm drainage, SWM, sanitary sewage and site grading. This EIR/FSS provides a link between the Town's NOCSS Management and Implementation Report, OPAs 289, 34 and 38 and the required planning approvals for the FSS lands.

Table 13.1 summarizes main report findings and recommendations and notes the Section(s) of this report that can be referenced for more details.

Section 13.1 lists the recommendations contained in this EIR/FSS regarding study requirements and design direction for future EIR/FSS(s) or EIR/FSS Addendums, for lands within the EIR Subcatchment Area outside the FSS or within the FSS on the non-participating landholdings for which a draft plan application currently is not being made (**Section 13.1.2**).

Section 13.2 lists the recommendations contained in this EIR/FSS regarding the detailed design and study requirements for the Subject Lands where a draft plan application will be made.

13.1 DIRECTION TO FUTURE EIR/FSS ADDENDUMS

This EIR/FSS has addressed the required environmental and engineering matters set out in the EIR/FSS TOR (May 2013) for the FSS lands in support of a future draft plan of subdivision for the Subject Lands. This work also has anticipated the development of lands within the EIR Subcatchment Areas outside the Subject Lands. These areas have been addressed to the level of detail possible without having specific development plans (i.e., draft plans of subdivision) and, outside the Subject Lands, without access permissions.

For these other lands within the EIR Subcatchment Area (i.e., non-participating lands east of Bronte Road) where the same degree of EIR/FSS analyses has not been included in this EIR/FSS, depending upon location in the EIR Subcatchment Area, additional study may include environmental analyses addressing field verification of NHS boundaries, trail location and design, confirmation of servicing, grading, SWM pond design, Species at Risk analyses and consistency with this EIR/FSS.

The following summary presents additional work for the EIR and FSS Subcatchment Areas for non-participating landholdings:

a) The boundary of the western portion of Core 1, located on the west side of the Fourteen Mile Creek West valley, will be staked and surveyed through future EIR/FSS Addenda

prepared by others, if required since top of bank and woodland dripline may have previously been staked as part of the Zenon development;
b) The boundary of the western portion of Core 2, located on the east side of Bronte Road, will be staked and surveyed through future EIR/FSS Addenda prepared by others;
c) The trail alignment along the western limit of Core 2 will need to be determined in consultation with agency staff by others; and,
d) Species at Risk surveys.

13.2 SUMMARY OF REQUIREMENTS AT DETAILED DESIGN

This EIR/FSS supports the Development Concept Plan submitted for the Subject Lands. Outside the Subject Lands, for the purposes of the FSS analyses, the Development Concept Plan (**Figure 6.1**) shows conceptual road layouts. When these areas proceed with development applications, they will confirm or modify the development concepts shown and further study, including potential Addendums to this EIR/FSS, will be required to support planning approvals of other lands within the Study Areas.

The following summary presents additional work for the Subject Lands to be completed at detailed design:

a) A Reference Plan illustrating the final NHS boundaries on the Subject Lands will be prepared on a draft plan basis and will be submitted to the Town and CH;
b) Detailed Monitoring Plans for the Enhanced LPA and SWM Pond;
c) Refinements to the drainage area from the Mixed-Use Block to be directed to the Enhanced LPA;
d) A Wildlife Relocation Plan will need to be approved by MNRF as well as a Wildlife Scientific Collectors Permit prior to removing Wetland 10; and,
e) Arborist Report and Tree Inventory identifying hazard trees and opportunities for tree retention in relation to the trail alignment through hedgerows.

Table 13.1 Summary of EIR/FSS Recommendations

Topic	Recommendations	Report Section
Areas Studied	Fourteen Mile Creek subcatchments FM1110 and FM1110.1, portions of FM1109 and FM1111 have been studied as part of this EIR/FSS. The FSS Study Area encompasses all of the Palermo Village Corporation lands within these subcatchments.	1.2
Subcatchment Drainage Boundaries	As required by NOCSS, the subcatchment drainage boundaries have been confirmed through the review of additional more detailed topographic work and field investigations. Using the LiDAR mapping and DEM, the culvert inventory and review of the engineering drawings along major roads, existing subcatchment drainage boundaries were delineated and compared to the NOCSS drainage area boundary for the EIR Subcatchment Area. For the purposes of floodplain mapping, the total Fourteen Mile Creek drainage areas to Dundas Street were identified. The total pre-development drainage area of 644.7 ha to Dundas Street (delineated based on LiDAR, see **Figure 1.5**) compares well with the NOCSS drainage area of 631.1 ha considering that the Regional road works associated with Bronte Road and Dundas Street resulted in changes to drainage outlets post-NOCSS.	4.3 and 7.2
Development Concept Plan	The Development Concept Plan (**Figure 6.1**) illustrates the proposed development on the Subject Lands. Proposed residential uses consist of detached and townhouse dwellings and mixed use residential. The development plan also includes parkland, NHS associated with Core 1, an Enhanced LPA and a SWM pond. Outside the Subject Lands, a conceptual road layout is shown for the lands east of Bronte Road and Old Bronte Road. The conceptual road layout can be adjusted in the future as development applications come forward for those lands.	6.1
NHS Framework and Associated Components	Components of the NHS framework in the EIR Subcatchment Area are identified on **Figure 2.1**. They include: • Portions of Core Preserve Area 1; • Five High Constraint Streams Reaches within Core 1; • One Medium Constraint Stream Reach; • Four Low Constraint Stream Reaches; • One Linkage Preserve Area; • Four Hydrologic Features B; • Four PSWs	2.1, 3.1 - 3.4

Topic	Recommendations	Report Section
NHS Boundaries	Boundaries of Core 1 features on the Subject Lands have been staked in the field with agency staff and survey plans prepared to assist in delineating the eastern edge of Core 1. In addition, a detailed slope stability analysis was prepared to confirm the long term stable top of slope. A Reference Plan illustrating the final NHS boundaries on the Subject Lands will be prepared on a draft plan by draft plan basis and will be submitted to the Town and CH. The boundary of the western portion of Core 1, located on the west side of the Fourteen Mile Creek West valley, and the western portion of Core 2 on the east side of Bronte Road, will be staked and surveyed, as required, through future EIR/FSS Addenda prepared by others. The EIR/FSS has demonstrated that the LPA, as identified in NOCSS, will not provide a functional and safe wildlife linkage between Cores 1 and 2, due to the lack of grade separation at Bronte Road at the location of the NOCSS proposed LPA crossing. Instead, an Enhanced LPA has been proposed, at the northern limit of the Subject Lands, that takes advantage of the existing grade separation along Bronte Road, immediately south of the Highway 407 transitway, to provide for functional and safe wildlife passage and connectivity between Cores 1 and 2. In this regard, a large ecopassage (2 m high x 6 m wide) is proposed to facilitate safe wildlife passage under Bronte Road for small and medium sized wildlife and supplement the existing culvert. In addition to providing a functional ecopassage under Bronte Road, the Enhanced LPA will restore current agricultural lands with wetland, wooded areas, thickets and meadow habitats and native biodiversity and introduce wildlife habitat for a broad range of taxa. A created wetland is proposed to replace/enhance the removal of Wetland 10 located the NOCSS proposed LPA. The created wetland will consist of two cells and designed to provide an enhanced level of function relative to Wetland 10. Each of the two wetland cells will include a deep and shallow sub-cell to support different marsh types and habitats that can support amphibian breeding and waterfowl staging. The conceptual design for the created wetland meets a number of ecological criteria, including a net increase in wetland area	3.1 13.2 13.2 3.2, 3.3, 6.2
Fourteen Mile Creek Low Constraint Reaches	Consistent with NOCSS recommendations, the downstream portion of one Low Constraint Stream Reach (14W-20) is located within Core 1 and therefore forms part of the Core and will function as the outlet channel for the Main Pond under proposed conditions. Minor modifications to the portion of 14W-20 downstream of the Main Pond may be required to support proposed flows. The upstream portion of Reach 14W-20, outside of Core 1, will be removed.	3,4, 5.5, 6.2.2

Topic	Recommendations	Report Section
	Low Constraint Stream Reach 14W-18, which could have been removed based on the North Oakville West Secondary Plan, will instead be maintained on the landscape and incorporated into an expanded NHS area and the Enhanced LPA. No further site visits or analyses are required in these areas.	
Fourteen Mile Creek Medium Constraint Reaches	There is only one Medium Constraint Stream within the FSS Study Area (14E-8) located in the northeast corner of the Subject Lands. This stream flows within a ditch adjacent to the western side of Bronte Road, immediately south of the Highway 407 off ramp. This Blue Stream, and its associated hazard lands (i.e., flood plain and meander belt) and natural heritage features (i.e., riparian wetland) are proposed to be maintained in-situ and is included within the Enhanced LPA.	3.4, 5.5, 6.2.2
Fourteen Mile Creek High Constraint Reaches	The existing limits of the five High Constraint Streams (Red Streams) of Fourteen Mile Creek West, within the FSS Study Area, are shown on **Figure 4.2**. These streams are within the Fourteen Mile Creek West valley and will be retained in-situ.	3.4, 5.5
Trail System	A Major Trail system has been sited along the eastern periphery of Core 1 and along the southern periphery of the Enhanced LPA, in accordance with the North Oakville Trails Plan.	6.3 and Drawings 3A to 3C
Target Flows	NOCSS target peak flows are appropriate for SWM design and were applied to determine target outflow rates for the proposed SWM facilities for the 2 year to 100 year events and the Regional Storm event. Target unit rates are shown in **Tables 7.4** and **7.7** to **7.9.**	7.3, 7.7.3
Erosion Threshold Analysis	Analysis of erosion thresholds along Fourteen Mile Creek and continuous PCSWMM hydrologic modelling were completed to determine appropriate levels of discharge control for SWM ponds to ensure erosion and aggradation are not exacerbated in receiving stream systems. Controls providing a 7-day drawdown of the 24 hour 25mm event show a very slight simulated increase in erosive potential for both the theoretical and actual scenarios, across all four erosion indices. However, for the two most important indices, cumulative effective volume and stream power, the results for the post-development conditions with the proposed controls fall within 5% of the pre-development conditions. Further discussion is provided in **Section 7.6** and **Appendix L-2**.	7.6 and Appendices L-1 and L-2

Topic	Recommendations	Report Section
SWM Facilities	One SWM pond and one on-site control area are identified for incorporation into development design within the FSS Study Area.	7.7
Main SWM Pond	NOCSS Figure 7.4.6 is noted to be conceptual, illustrating the general number of proposed SWM ponds and their location. NOCSS notes that, at the EIR stage, the number, location and size of SWM ponds will be finalized. In other locations in North Oakville, SWM ponds have been removed or relocated supported by EIR level of detail on site grading, servicing and environmental matters. Consistent with this direction, based on analyses completed as part of this EIR/FSS, proposed SWM ponds to service the Palermo Village lands, as presented in NOCSS, have been modified in number and locations. The rationale for these changes is outlined in **Section 7.7**. The location of the proposed Main Pond was recommended on the basis of ecological, fluvial geomorphological, hydrogeological, hydrological and municipal servicing inputs, as well as a review of the experiences where naturalized SWMFs are permitted within or proximal to the NHS elsewhere in North Oakville. The ultimate conditions Main Pond is located partially within Core 1, approximately 220 m north of Dundas Street, on the Zenon lands to the west of the Palermo Village Lands. The pond will discharge to the Green Stream 14W-20 in Core 1. Approximately 50% of the Main Pond is proposed in a portion of Core 1 that is currently comprised of agricultural lands and outside of all natural hazard and natural heritage constraints, including their associated buffers as described in **Section 3.1**. The remaining 50% of pond area is located on adjacent tableland. It is located within the outer 80 to 100 m of the 200 m wide Core 1. The remaining 2 ha of pond area is located on adjacent Palermo Village tablelands, outside of Core 1. An interim conditions pond is proposed on Block 32 of the Draft Plan on the Palermo Village lands, in the event the Zenon lands do not develop. The interim and ultimate SWM ponds are designed to provide Enhanced Level quality control, erosion control volume and control of the 2 to 100 year storms and Regional Storm to NOCSS target unit flow rates. The ponds will outlet to Fourteen Mile Creek. The preliminary ultimate and interim SWM pond designs are provided in **Figures 7.3** and **7.3C,** respectively. The portion of the proposed ultimate SWM pond within Core 1 overlaps with agricultural fields that were included in Core 1 for the purposes of retaining and/or creating habitat for Open Country bird species. The proposed ultimate SWM pond will complement this habitat objective by providing for meadow habitat along the perimeter of the pond as well as foraging habitat over the pond. The ultimate SWM pond will be landscaped using native plants that will also	7.7

Topic	Recommendations	Report Section
	support Open Country birds.	
On Site Control Area	The portion of the Subject Lands located between Bronte Road and Old Bronte Road is approximately 1.8 ha. This area, along with a block of land outside the FSS Study area (0.3 ha), currently drains southeast to a ditch-inlet catchbasin (DICB) located on the west side of Old Bronte Road, approximately 40 m north of Dundas Street. The total drainage area of 2.1 ha is part of catchment FM1110 that drains to culvert FM-D6 in NOCSS but has been directed to culvert FM-D5 as part of the post-NOCSS Dundas Street reconstruction. Under proposed conditions, the drainage area for on-site control is 3.1 ha and will be controlled to NOCSS allowable release rates with on-site controls for quantity, erosion, and quality controls before discharging to the existing DICB. See **Figure 7.3B** for the proposed connection and drainage area for On-Site Control Area #1.	7.7.1.4 and 7.12, Figure 7.3B
Drainage to Enhanced LPA, Created Wetland	To maintain runoff volume to the created wetland within the Enhanced LPA, drainage from a combination of undeveloped catchment area (LPA) and development area (clean drainage from Mixed-Use Block at north end of site) will be directed to the feature. The undeveloped catchment area (LPA) and Mixed-Use Block will not require quantity controls to reduce peak flows. The drainage area from the Mixed-Use Block is approximately 1.2 ha in size (0.3% of pre-development catchment area), and the 2.4 ha of undeveloped Enhanced LPA drainage area will support the created wetland. Clean drainage from the roof area and landscaped areas of the block will be directed to the new wetland. In addition to targeting clean roof top water from the block, a Jelly Fish OGS unit can be sized to provide 80% Enhanced Level TSS removal as part of a multi-barrier approach, if needed.	7.7.1.2
Drainage to Existing Off-Site Pond	There is a portion of Valleyridge Drive extension (roadway immediately north of Dundas Street) that is at too low of an elevation to drain by gravity to the SWM Pond on the Subject Lands. The drainage area is approximately 0.18 ha. The post-development drainage boundaries are shown on **Figure 7.1**. Runoff from this portion of Valleyridge Drive will be connected to the FM-D6 culvert under Dundas Street for treatment in the existing downstream pond, in place of the 5 ha of pre-development catchment that is currently tributary to this culvert that will be directed to the proposed SWM Pond on-site. Quality and quantity control will be provided in the existing downstream pond at Richview Boulevard and Bronte Road before discharging to Fourteen Mile Creek West. Refer to **Figure 7.3**.	7.7.1.3, Figure 7.3
LID Measures	LID options have been evaluated. Large scale infiltration measures are not feasible over the majority of the study area due to the urban	7.4 and 8.8,

Topic	Recommendations	Report Section
	form of the proposed development and surficial soil characteristics; however, other LID measures have been recommended including techniques such as designing grades to direct roof runoff towards lawns, as well as increased topsoil depths to improve the potential for water storage and infiltration. In select areas, where feasible, infiltration trenches and infiltration galleries have been proposed to further reduce the post-development deficit. The Town of Oakville standard tree-pit detail will also act as increased topsoil LID in the boulevards. Given the presence of Redside Dace Occupied Habitat within the Fourteen Mile Creek West branch, the provision of infiltration trenches are proposed within the NHS, in proximity to the trail to ensure maintenance access for the Town if require, or alternatively the backyards immediately adjacent to the NHS if no future maintenance is required. Preliminary LID locations and details are illustrated on **Figures 7.5** and **7.6A**.	Figures 7.5 and 7.6A
Grading in Buffers	A grading plan for the Subject Lands is illustrated on **Drawings 3A to 3C**. Grading details are consistent with the Town's standards and compatible with the NOCSS recommendations for grading adjacent to the NHS. Preliminary grading of the majority of the lots adjacent to Core 1 is approximately 0.1 m to 0.2 m above existing grade. This 0.1 m to 0.2 m elevation difference above existing grade at the rear lot line allows for positive drainage of the trail that runs parallel to the rear lot line, such that sheet drainage to the Core is possible. The trail grading matches existing grades within the Core.	7.11
Sanitary Servicing	The Subject Lands will be serviced by a network of local gravity sewers designed in accordance with the Region's standards and specifications. The local sewers will convey flows to existing wastewater mains located on Valleyridge Drive and Old Bronte Road. The conceptual wastewater servicing scheme is illustrated in **Figure 9.2**. Design sheets and tributary area plans are included in **Appendix H-1** and a downstream capacity analysis prepared by Civica is provided in **Appendix H-4.**	9.2 and 9.4, Appendix H-4
Water Servicing	The Subject Lands will be serviced by a 600mm watermain, identified as IPFS #5627 in the Region's Master Plan, and a network of new local watermains designed in accordance with the Region's design criteria and MOE's guidelines. The conceptual watermain sizing is illustrated in **Figure 9.4**. Trunk watermains are based on recommended sizing as outlined in the 407 Employment Lands - ASP, prepared by MMM Group, and updated based on watermain modeling. Preliminary watermain sizing model and report is provided in **Appendix H-2**.	9.3, Figure 9.4, Appendix H-2

Topic	Recommendations	Report Section
Road Crossings of Fourteen Mile Creek Valley West	In-keeping with the North Oakville West Master Plan, there are two proposed road crossings of Core 1; one crossing associated with the extension of William Halton Parkway; and a second crossing located to the north (Street "E" on the Draft Plan). It is anticipated that future study will be required for these crossings as part of detailed design, by others.	7.11, 10.0
Erosion and Sediment Controls	Controls are to be implemented prior to construction and remain in working condition for the duration of construction activity. Erosion and Sediment Control plans are to be submitted and approved by the Town and CH.	11.2
Construction Below Water Table	Services below the water table will be constructed to prevent lowering and redirection of groundwater flow.	11.1
Well Decommissioning	Prior to construction, all inactive wells (including both water supply and monitoring wells) within the development footprint are to be decommissioned in accordance with Ontario Regulation 903.	11.6
Post Construction SWM Pond Monitoring	The monitoring program will include performance assessments of SWM facilities and erosion and sediment control measures. A detailed monitoring program will be provided for the SWM Pond at the time of detailed design.	12.3.2
Future EIR/FSS Study Recommendations	This EIR/FSS addresses environmental and servicing requirements of the Subject Lands. Throughout this EIR/FSS, there are references to design work required at the detailed design stage. A summary of the detailed design work requirements for these lands is presented in **Section 13.2**. As well, **Section 13.1** outlines future work that should be undertaken when lands outside the current development concept lands proceed to development.	13.1, 13.2