Town of Oakville - Halton Region

Environmental Implementation Report and Functional Servicing Study (EIR/FSS) East Morrison Creek EM4 Addendum #1 2nd Submission

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1.0 INTRODUCTION

1.1 Study Purpose

This *EM4 Addendum* has been prepared as an Addendum to both the *Upper East Morrison Creek, Subcatchment EM4, Final Environmental Implementation Report and Functional Servicing Study (EIR/FSS)* prepared by Stonybrook Consulting, RAND Engineering et. al. dated June 2017 for the lands west of Trafalgar Road and north and south of Burnhamthorpe Road, as well as the East Morrison Creek EIR/FSS, prepared by Stonybrook Consulting, Urbantech Consulting et. al., dated February 2015 (with a final addendum to that report issued February 2016). For the purpose of this report, the June 2017 report will be referred to as the *Upper EM4 EIR/FSS* while the February 2015/2016 report will be referred to as the *Lower EM4 EIR/FSS*. In addition, this *EM4 Addendum* addresses a small portion of the Joshua's Creek catchment area (JC9). To date, an EIR/FSS has not been prepared for the larger JC9 catchment area however, it is anticipated that one will be prepared in the near future by the landowner(s) to the north of 3301 Trafalgar Road. The scope of the work for this *EM4 Addendum* applies to the lands at 3275 and 3301 Trafalgar Road herein after referred to as the Subject Lands however, subsequent to the first submission of this *EM4 Addendum*, the proposed phasing of development has been revised. Lands located at 3301 Trafalgar Road, as well as the lands on the east side of the Natural Heritage System (NHS) on 3275 Trafalgar Road, will proceed as a future phase. These lands are reliant on the east-west road connection along the northern limit of 3301 Trafalgar Road, which is still under discussion with the adjacent landowner to the north. Given that detailed fieldwork was already completed for 3301 Trafalgar Road, and the limits of the NHS on those lands was established through the first submission of this *EM4 Addendum*, that information continues to be provided in this report. Additional details pertaining to the proposed phasing can be found in **Section 11.5**.

The location of the Subject Lands is indicated in **Figure 1.1**. The majority of the lands are within subcatchment EM4 of the East Morrison Creek with a minor portion of the lands located within Joshua Creek subcatchment JC9 as indicated in **Figures 1.2 and 1.3**.

The purpose of an 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 the proposed development applications, including servicing requirements, on the Natural Heritage System (NHS).

The purpose of an 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 North Oakville Creeks Subwatershed Study (NOCSS) Management and Implementation Reports, the North Oakville East Secondary Plan (NOESP), and the required planning approvals.

An EIR/FSS is intended to assist in the development of draft plans of subdivision, address the requirements of the NOCSS and NOESP, 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.

This *EM4 Addendum* has been prepared in accordance with the requirements of the Town's Official Plan Amendment 272 (OPA 272) and is intended to support the approval of draft plan of subdivision on the Subject Lands.

The work completed as part of this *EM4 Addendum*, was guided by requirements set out in the EIR/FSS TOR (May 2013) approved by the Town and CH and is intended to satisfy the NOESP policy requirements. A copy of the approved TOR is provided in **Appendix A-1**. In addition, Sections 8.1 and 13.0 of the *Upper EM4 EIR/FSS* and *Lower EM4 EIR/FSS*, respectively, provided direction to future EIR/FSS Addendums within the EM4 catchment area. This *EM4 Addendum* has been prepared to address those items that are applicable to the Study Area, as listed in those previous studies.

Subsequent to the first submission, a number of meetings have been held with agency staff to address comments received. Meeting minutes and email correspondence has been included in **Appendix A-2**.

1.2 EIR Subcatchment Area and FSS Study Area

1.2.1 EIR Subcatchment Areas

The EIR Subcatchment Area is defined to be EM4 as per NOCSS Figure 5.1.1, which extends from Trafalgar Road at Culvert ME-T5 to Dundas Street, where there is a confluence with the EM1 catchment. The Subject Lands are located at the upstream end of EM4. The balance of the EM4 catchment has been studied in the original / approved EM4 EIR/FSS (2016 and 2017). **Figure 1.3** presents the boundaries of the EM4 and JC9 subcatchments for the purpose of this *EM4 Addendum*.

This *EM4 Addendum* was prepared and coordinated with the subcatchment limits and recommendations from the *Upper EM4* and *Lower EM4 EIR/FSS* reports noted above.

Table 1.1: Existing Subcatchment Areas in the Subject Lands

Area	Subcatchment Areas		
	East Morrison Creek East Tributary (EM4)	Joshua's Creek Tributary (JC9)	Total
Subject Lands per subcatchment	7.41 ha	0.51 ha	7.92 ha
Percentage (%) of Subject Lands in each subcatchment	93.5%	6.5%	100%
Portion of Subject Lands in Subcatchment within Core 10	0.795	0.025 ha	0.82
Portion of Subject Lands in Subcatchment outside Core (i.e., developable)	6.615	0.482 ha	7.10 a

1.2.2 Functional Servicing Study Area

The FSS Study Area is defined to be 3275 and 3301 Trafalgar Road, which is on the east side of Trafalgar Road, immediately north of the Dundas Trafalgar Inc. (DTI) and Shieldbay lands, as illustrated on **Figure 1.4**.

1.3 EIR/FSS Study Objectives

The objectives to be fulfilled by this EIR/FSS Addendum, 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;
- 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;
- ensure servicing requirements, as determined in the FSS for the areas external to the Draft Plan, are adequate;
- identify details regarding any potential development constraints or conflicts and how they are to be resolved;
- provide any further implementation details as required;
- streamline the Draft Plan approval process; and,
- facilitate the preparation of Draft Plan conditions.

1.4 EIR/FSS Study Team

A multi-disciplinary study team has investigated the ecological character and servicing requirements of the Study Area for the purposes of the *EM4 Addendum*. The various team members and their respective responsibilities are:

- **Jennifer Lawrence and Associates Inc.** – study management/integration and report co-ordination, environmental planning;
- **Urbantech Consulting** – stormwater management, site grading and servicing design;
- **GEI Consultants** - aquatic and terrestrial ecology
- **Landtek Limited** – geology and hydrogeology;
- **GEO Morphix Ltd.** – fluvial geomorphology and wetland water balance; and,
- **Batory Management**– land use planning matters and proposed Development Plan Concept.

1.5 Previous Studies, Reports and Planning Documents

The following approved studies/guidelines/documents were reviewed in preparation of this EIR/FSS Report:

- Town of Oakville North Oakville Creeks Subwatershed Study, August 2006;
- Town of Oakville North Oakville Creeks Subwatershed Study Addendum, September 2007;
- Town of Oakville Official Plan Amendment 272, August 2007;
- Region of Halton Official Plan Amendment 25;
- Ontario Municipal Board Minutes of Settlement, August 2007;
- Ontario Municipal Board Mediation Agreements, 2007;
- North Oakville Environmental Implementation Report and Functional Servicing Study Terms of Reference, August 2007, revised 2013;
- South Halton Water and Wastewater Master Plan Update, Region of Halton, 2007 (Master Plan Update);
- North Oakville Secondary Plan – Area Specific Servicing Plan, Oakville Ontario, MMM Group, June 2008;
- Conservation Halton's Policies and Guidelines for the Administration of Ontario Regulation 162/06 (April 27, 2006, revised 2020);
- Conservation Halton's Interim Policy and Guidelines for the Administration and Implementation of the Conservation Authorities Act and Ontario Regulation 41/24 (Prohibited Activities, Exemptions and Permits) (April 1, 2024);
- Conservation Halton's Guidelines for Stormwater Management Engineering Submissions (June 2024);
- Conservation Halton's Guidelines for Landscaping and Rehabilitation Plans (June 2024);
- Conservation Halton's Guidelines for Wetland Water Balance Assessments (June 2024);
- Toronto Region Conservation Authority Wetland Water Balance Risk Assessment (2017);
- Stormwater Management Planning and Design Manual, Ministry of Environment, March 2003 (SWMP Design Manual);
- Development Engineering Procedures & Guidelines Manual, Town of Oakville, January 2011;
- Design Criteria, Contract Specifications and Standard Drawings, Region of Halton, February 2001 (updated 2007);
- North Oakville Monitoring Guidelines, January 2012;
- Erosion and Sediment Control Guidelines for Urban Construction, TRCA, 2019;
- Final Environmental Implementation Report/Functional Servicing Study Report, East Morrison Creek, Stonybrook Consulting, et. al., February 2015 (with February 2016 Addendum);

- Final Scoped Environmental Implementation Report/Stormwater Management (Scoped EIR/SWM) Report for the East Branch of East Morrison Creek, Subcatchment Upper East Morrison EM4, June 2017; and,
- Final North Oakville East Drainage Area Exchange Report, prepared by Stonybrook Consulting et al, January 2017.

1.6 EIR/FSS Pre-Consultation Meetings

A pre-consultation meeting was held on July 5, 2023. In addition, meetings were held with CH and the Town on July 27, 2023 and April 15, 2024 to discuss the wetland buffer requirements (see **Appendix A-2** for meeting minutes/notes).

2.0 NATURAL HERITAGE SYSTEM FRAMEWORK

2.1 Natural Heritage System Components

The Natural Heritage and Open Space System (NHOSS) for North Oakville East is part of a larger system designed to protect, preserve, and enhance key features and functions of the natural environment throughout North Oakville. The primary purpose of the Natural Heritage component of the NHOSS is to protect, preserve and enhance the natural environment; the main purpose of the Open Space component is to provide for active recreational needs and community facilities, and where possible, to connect to and enhance the Natural Heritage component.

The North Oakville East Secondary Plan (OPA 272) provides the framework for the Natural Heritage component of the NHOSS, with the NOCSS, the NOCSS Addendum, Ontario Municipal Board Minutes of Settlement and Mediation Agreements providing the basis for its establishment and technical guidance for its implementation.

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 was developed to provide guidance for the future management of the North Oakville Creeks Subwatershed and specifically to meet the goals and objectives within the context of future land use and other activities within the watersheds. (NOCSS, 2006). The management strategy outlines specific requirements with respect to the following:

- lands restricted from development;
- lands with development limitations or constraints;
- SWM; and;
- input to land use policies and servicing requirements.

The Implementation Plan provides the requirements for the recommended management strategy components, including environmental reporting requirements, agency responsibilities, and the approval process with the Town, the Region and CH, and, where applicable, the Ministry of Natural Resources (MNR) and the Federal Department of Fisheries and Oceans (DFO).

With respect to the Subject Lands, the EIR Subcatchment Area, and OPA 272, the NOCSS and the NOCSS Addendum identify various environmental features to be protected and/or studied including Core Preserve Areas and High Constraint Stream Corridor Areas. With reference to Figure NOE3 from OPA 272, the following components of the NHS are located within the EIR Subcatchment Area.

Core Preserve Areas

These 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 NHS. Core Preserve Areas are comprised of Environmentally Significant Areas (ESAs), Areas of Natural and Scientific Interest (ANSIs), Provincially Significant Wetlands (PSW) and significant woodlands. Core Preserve Area 10 is located with the EIR Subcatchment Area, as depicted on **Figure 2.1**. Core Preserve Area 10 is located mainly on the lands to the east and south of the Subject Lands however, a small portion of wooded area borders the eastern and southern property boundaries of the Subject Lands. **Figure 2.1A** demonstrates that Core 10 maintains a minimum 200m width, in-keeping with NOCSS Figure 6.3.11.

Discussion on the character of this Core Area and boundary delineation is provided in **Section 3.0** of this Addendum.

High Constraint Stream Corridor Areas

High Constraint Stream Corridors (Red Streams) typically 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 and LPAs but are also found outside such areas. They must be protected in their existing locations for hydrological and ecological reasons.

There is one Red / High Constraint Stream in this EIR Subcatchment Area however, as described later in this report, the portion of the high constraint stream through 3275 Trafalgar Road was altered by a previous landowner and, as such, as part of the proposed development, the low flow channel and associated wetland area will need to be re-instated.

Other Hydrological Features

This classification includes a number of other hydrological features that have been identified in the NOESP that also form part of the NHS to the extent that they are maintained after development occurs. These features include Low Constraint Streams, Hydrologic Features A and Hydrologic Features B. Topographic depressions have also been identified that are not associated with the NHS. There are no low constraint stream corridors, Hydrologic Features A or B or Pits/Depressions within the Subject Lands.

Provincially Significant Wetlands

As recently as 2011, the MNRF updated their mapping of the North Oakville – Milton East Wetland Complex, which includes wetland units within the EM4 Subcatchment Area. One PSW (PSW 25) is present within, and outside of, Core 10 within the EIR Subcatchment Area.

Figure 5.1 illustrates the location of PSW 25 on the Subject Lands and Figure 2.1 illustrates the location of the remaining portion of PSW 25 on the lands to the south. Other PSWs are present in Core 10 but are located in adjacent EIR Subcatchment Areas. The portion of PSW 25 south of the Subject Lands was previously studied as part of the *Lower EM4 EIR/FSS*.

2.2 Permitted Uses in the Natural Heritage System

2.2.1 OPA 272 and NOCSS

OPA 272, Policy 7.4.7.3, provides guidance with respect to potential permitted uses within the NHS. This policy addresses permitted uses including development, land disturbance, roads and related utilities, expansion of existing water and wastewater services, trails and passive recreational uses, SWM facilities, grading, private driveways and adaptive use institutional buildings. **Table 2.1** summarizes policy direction related to permitted uses and notes the 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 each of the Cores within the EIR Subcatchment Area are listed in Section 2.4.

Sections 6.3.5.2 of NOCSS, OMB Minutes of Settlement (MOS) and some Mediation Agreements also address permitted uses in the NHS.

Direction from NOCSS Section 6.3.5.3 on permissible grading in the NHS was also referenced and provided guidance to the preparation of a preliminary grading plan for the Subject Lands.

Table 2.1: Permitted Activities in the Natural Heritage System

OPA 272 Policy Section	Potential Permitted Use and Policy Direction	Report Section of EIR/FSS Addressed
7.4.7.3 c) i)	<u>Development or Land Disturbance</u> Permitted in accordance with the directions of the NOCSS and any related Environmental Implementation Reports, 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.	5.6.3 7.7 7.11
7.4.7.3 c) ii)	<u>Roads and Related Utilities</u> 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 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 part of structures outside the High Constraint Stream Corridor Area	10

OPA 272 Policy Section	Potential Permitted Use and Policy Direction	Report Section of EIR/FSS Addressed
	designated on Figure NOE3 to the maximum extent possible or as defined through an Environmental Assessment.	
7.4.7.3 c) iii)	Expansion to existing Water and Wastewater services Permitted on sites with existing facilities subject to any required Environmental Assessment.	Not applicable to this EIR/FSS
7.4.7.3 c) iv)	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.	6.2
7.4.7.3 c) v)	SWM facilities Permitted in accordance with the directions in the NOCSS provided that the final number, size and configuration of such facilities will be determined through any related Environmental Implementation Report or Functional Servicing Study and as shown conceptually on Figure NOE3.	Not applicable to this EIR/FSS
7.4.7.3 c) vi)	Grading Permitted in accordance with the directions established in the NOCSS or appropriate Environmental Assessment.	5.6.3 7.7 7.11
7.4.7.3 c) vii)	Private Driveways Permitted across the LPA joining the north and south area of the Core Preserve Areas located north of Burnhamthorpe Road and West of Trafalgar Road.	Not applicable to this EIR/FSS
7.4.7.3 c) viii)	The adaptive re-use of Heritage Buildings Art gallery and art school permitted in the LPA associated with Reach JC-7.	Not applicable to this EIR/FSS

2.2.2 Results of OMB Mediation and Minutes of Settlement

Several water resources related agreements were made between the Town, CH and the Landowners during Ontario Municipal Board hearing mediation discussions. Also, MOS were entered into between the Town, CH, and the Landowners. The mediation agreements and MOS have been reviewed and matters relating to EIR study components were addressed through the preparation of this EIR/FSS, where applicable.

The sections of the MOS that are pertinent to this EIR are related to the delineation and dedication of NHS lands and include:

August 13, 2007 MOS, Sections regarding Natural Heritage Lands:

Section 10(b) states that, "*subject to Sections 12 to 15, the Natural Heritage Lands shall be dedicated on an "as-is, where-is" basis. The final precise boundaries of the Natural Heritage Lands shall be determined by an Environmental Implementation Report accepted by the Town in accordance with the Town's proposed Secondary Plan (which is intended to "groundtruth", but not substantially revise, the boundaries).*"

Section 13 states that, "*…the Town will not require the Landowners to undertake or fund, directly or indirectly,*

- *any maintenance after dedication;*
- *any works to enhance the Natural Heritage Lands, other than the restoration/enhancements as identified in Section 4 and 5; and,*
- *any monitoring of the Natural Heritage Lands, other than in respect of the Landowners' stormwater management facilities."*

Section 14 notes, "The Town and Landowners agree that Sections 10(b) and 13 shall not apply:

a) *in respect of any restoration and/or enhancement works provided for in paragraphs 4 and 5 of these Minutes of Settlement;*
b) *respect of lands identified as "Medium Constraint Stream Corridors" on Figure NOE 3 in the Town's Proposed Secondary Plan in respect of which the Landowner has altered or intends to alter the Medium Constraint Stream Corridor in accordance with the provisions of the Town's Proposed Secondary Plan and the Town's Subwatershed Study;*
c) *in respect of lands designated "Natural Heritage System Area" on Figure NOE 2 in the Town's Proposed Secondary Plan in respect of which the Landowner locates stormwater management facilities in accordance with the provisions of the Town's Proposed Secondary Plan and the Town's Subwatershed Study; and*
d) *in respect to works undertaken on the Natural Heritage Lands that relate to municipal services such as roads, watermains, sanitary sewers, stormwater management works or trails (provided that nothing herein shall be deemed to grant any approval or permission to undertake such works)."*

Mediation Agreements 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;
- 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;
- SWM - Temperature and Dissolved Oxygen Targets dated July 12, 2007;
- Monitoring dated July 26, 2007;
- EIR/FSS TOR dated August 2, 2007; and,
- Grading and the NHS, undated.

3.0 CORE 10

3.1 Approach to Core Delineation

Core 10 is located east of Trafalgar Road and is located immediately adjacent to the eastern and southern limits of the Subject Lands.

The boundaries of the southern portion of Core 10 were delineated as part of the *Lower EM4 EIR/FSS*. A portion of the remaining extent of Core 10, where it overlaps with the eastern and southern portion of the Subject Lands, has been delineated based on surveying the limits of the woodland dripline and applying the required buffer, as outlined below and discussed in detail in **Section 3.2**.

To identify the Core boundaries, the following approach was utilized:

- The environmental features of the Core (i.e., woodland dripline) were pre-staked;
- A site visit with the Town and Conservation Halton (CH) occurred on June 9, 2022 to confirm/modify the pre-staked limits;
- Drawings illustrating features and Core boundary, based on the site visit with the Town and CH were prepared and submitted; and,
- Sign-off was received from CH on September 15, 2022 (**Appendix A-2**).

3.2 Core 10

3.2.1 Core Characterization

Core 10 is a large diverse area supporting woodland, wetland, thicket, meadow, stream and agricultural cover types, as noted in **Table 3.1**.

Table 3.1: Core 10 Habitat Types

General Habitat Type	ELC Community Codes	Representation in	
		Entire Core 10 (%)	Subject Lands (%)
Forest (woodlands)	FOD – deciduous forest FOM – mixed (deciduous and coniferous) forest	31	100
Cultural thickets	CUT – thicket	2	0
Cultural meadow	CUM - meadow	4	0
Wetlands	MAM – meadow marsh MAS – shallow marsh SWD – deciduous swamp SWT – thicket swamp OAO – open aquatics	19	0
Agriculture (cropped)	--	44	0
TOTAL		100	100

Additional ecological investigations were undertaken on the Subject Lands in 2022 to further characterize the vegetation and wildlife communities, with the primary purpose of identifying any potential use by species at risk that would require further permitting under the *Endangered Species Act, 2007* (ESA, 2007). These surveys included vegetation characterization through Ecological Land Classification (ELC), breeding bird surveys, amphibian call count surveys, turtle surveys, and snake emergence surveys, and assessed the portions of Core 10, as well as the broader area. Survey results are provided in **Appendix B**. Results as they relate to the wetland communities, specifically for amphibian call count and turtle surveys, are discussed separately in **Section 8.9.2**.

ELC mapping of the Subject Lands and adjacent lands is provided in **Figure 5.2.** No vegetation species at risk were identified during the surveys.

Bird surveys identified 31 species through the Subject Lands and adjacent lands. Of these species, the majority are common within rural areas. One species at risk was identified, Barn Swallow, which is identified as Special Concern on the Species at Risk in Ontario List. Foraging use over the open wetlands of the NHS will continue post development, while the proposed buildings may provide suitable conditions for nesting. Historic nesting was identified within some of the structures on the Subject Lands, and any structures should be assessed for nesting prior to removal to ensure compliance with the *Migratory Birds Convention Act* and the federal *Species at Risk Act* (Barn Swallow remain identified as Threatened on Schedule 1 of SARA but are under consideration for downlisting to Special Concern). Though open field areas were present on portions of the Subject Lands, the vegetation structure was considered not favorable to support either Bobolink or Eastern Meadowlark; neither species were detected during the targeted surveys.

Four Eastern Garter Snakes were observed during area searches around the remnant buildings on the Subject Lands in the spring of 2023. This suggests that the existing foundations may be providing some refuge for hibernating snakes. As a result, it is recommended that removal of foundations occur outside of the hibernation period (typically October through May).

Assessments were also completed of all structures to identify potential bat habitat that could support roosting species at risk bats. Structures were all found to be sealed with no potential bat exits. The barn on 3275 Trafalgar Road was removed in March 2023. Should conditions associated with the house on 3275 Trafalgar Road change prior to its removal, further assessment should be undertaken. The woodland communities of Core 10 are expected to provide maternity roosting habitat for species at risk bats, however as the development is setback from these communities, no impact to the habitat or individual bats will occur, and consultation with the Ministry of the Environment, Conservation and Parks is not required.

Given the above, permitting under the ESA, 2007, is not anticipated to be required at this time. As new species are added to the Species at Risk in Ontario List, this conclusion should be revisited.

3.2.2 Core Boundary Delineation

As detailed on Figure 6.3.11 of NOCSS, the limit of Core 10 on the Subject Lands is based on a 10m setback from the woodland dripline. **Drawing 3.1** illustrates the Core 10 boundary on the Subject Lands, including the 10m woodland dripline setback. In defining the southern limit of the woodland dripline on the Subject Lands, information was obtained from the *Lower EM4 EIR/FSS* to connect the woodland staking into the last northerly stake that was placed to define the dripline on the property to the south.

The surveyed Core 10 area (inclusive of the 10 m woodland dripline setback) within the Subject Lands within the EIR Subcatchment Area covers an area of approximately 0.8 ha. The entire Core 10 area is approximately 68.5 ha, distributed among three subcatchments as noted on **Table 3.2**.

Table 3.2: Core 10 Areas by Subcatchment

Subcatchment	Area of Core 10 (ha)
East Morrison (EM4)	16.7
Joshua's Creek (JC9B)	25.4
Joshua's Creek (JC17)	26.4

In addition to the Core boundary delineation, amphibian, breeding bird and turtle basking surveys were undertaken. Refer to **Figure 5.3** for survey locations. The results of these surveys are provided in **Tables 1 - 5, Appendix B**.

3.2.3 NOCSS Management Recommendations

NOCSS identified a management strategy to, *"…protect and enhance the natural environmental in a sustainable fashion"*. With respect to Core 10, Section 6.3.3.5 lists the management recommendations to be:

- *The existing woodlands and wetlands are recommended for retention.*
- *Within the Core, connectivity between the forested blocks of a minimum 200m width can readily be accommodated and is recommended*.

This latter recommendation applies to the portion of the Core to the east of the Study Area and has not been considered in this *EM4 Addendum*.

These recommendations, along with settlement and mediation agreements, provide direction to the management of Core 10 that were acknowledged and respected during the preparation of this EIR/FSS.

4.0 GEOLOGY AND HYDROGEOLOGY

4.1 Scope of Work

The scope of work completed for the hydrogeological component of this *EM4 Addendum* was designed to address the technical requirements as set out in the EIR Hydrogeological Terms of Reference for North Oakville (2007).

Specifically, the hydrogeological work program was completed to:

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

The detailed scope of work included:

1. Review of Ministry of the Environment, Conservation and Parks (MECP) water supply well records and available geotechnical reports for the *EM4 Addendum* EIR Subcatchment Area to assess the regional hydrogeological setting and soil conditions. A listing of the MECP water supply well records for the area is provided in **Appendix C-1**. The geotechnical borehole logs are provided in **Appendix H**. The locations of the water supply wells (as recorded in the MECP records) and the borehole locations are illustrated on **Figure C-1-1, Appendix C-1**.
2. The installation of eleven (11) groundwater monitoring wells (MW102S, MW102D, MW103, MW106, MW120S, MW120D, MW121S, MW121D, MW13-23, MW4-23 and MW122D-23) in the EM4 Subcatchment Area to supplement the existing monitoring well network and investigate the site-specific soil and groundwater conditions. The borehole and groundwater monitoring well locations in and around the EIR Subcatchment Area are shown on **Figure 4.1** and copies of the borehole logs and observation well construction details are provided in **Appendix C-2**.
3. Single well response testing of seven (7) groundwater monitoring wells, to estimate the in-situ hydraulic conductivity of the geological units. The field-testing results are included 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 was completed for sixteen (16) on-site wells between August 2021 and April 2023. The groundwater monitoring data are summarized in **Table C-4-1** in **Appendix C-4**. Hydrographs are also provided on **Figures C-4-1 to C-4-13** in **Appendix C-4**.

5. Collection of groundwater samples from three (3) monitoring wells (MW106, MW4-23 and MW111-20) to characterize the groundwater quality. Samples were collected on April 5, 2023 and submitted to AGAT Laboratories in Mississauga, Ontario, a qualified laboratory accredited by the Canadian Associations for Laboratory Accreditation Inc. (CALA), for analyses of quality indicators listed in the Provincial Water Quality Objectives (PWQO). The laboratory water quality data report and a summary of the results are provided in **Table C-6-1** in **Appendix C-6**.

6. Surface water quality monitoring commenced in September 2022 at two (2) locations (US and DS); however, no samples were collected in 2022 due to dry conditions. Samples collected to date as part of ongoing 2023 monitoring were submitted to a qualified laboratory for total suspended solids (TSS). Field testing of temperature, conductivity and turbidity was also completed at US and DS surface water stations when flow was present. The 2023 monitoring program is to continue to late November 2023. The field and laboratory water quality data collected to July 2023 are provided in **Appendix D-2.**

7. Pre-development water balance calculations (based on existing land use conditions) and post-development water balance calculations (based on the proposed development plan) for the EIR Subcatchment Area to assess the potential impacts of development on the local groundwater resources. The local climate data and detailed monthly water balance calculations are provided in **Appendix C-7**.

4.2 Physiography and Topography

The EIR Subcatchment Area is 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. The crest of the Moraine forms the regional surface water divide with all subcatchment areas on the south slope draining towards the southeast.

The land surface across the EIR Subcatchment Area slopes towards the watercourse which bisects the site as the lowest elevation at the site. Analysis of the detailed topography indicates that the highest ground elevations (up to 185 to 186 masl - metres above mean sea level) are found at the north central and northeast boundary of the EIR Subcatchment Area. The higher elevation (186 masl) is noted within 3301 Trafalgar Road due to historical fill placement on the eastern portion of the property. The natural relief across the area is about 8 m, with the lower elevations of about 178 masl, found at the south portions of the subcatchment.

4.3 Drainage Conditions

The drainage areas for the EIR Subcatchment Area are provided on **Figure 4.2**. Surface water runoff follows topography and generally flows towards the southwest. The East Morrison Creek (Reach MOC-6) flows through the subcatchment, essentially beginning at the northern limit of 3301 Trafalgar Road, receiving flow from lands upstream of the Subject Lands and west of Trafalgar Road. Within 3275 Trafalgar Road, the low flow channel of the watercourse has been altered as a result of agricultural activity such that it is not possible to identify a low flow channel.

Reach MOC-6 flows onto the property from the lands north of the Subject Lands via two corrugated steel pipe (CSP) culverts, that flow beneath a farm access road. The CSP culverts were perched in May 2022. The reach flows northeasterly within a narrow channel along the northern property line of 3301 Trafalgar Road for approximately 50 m before turning south and flowing for approximately 60 m before entering into the upstream limit of PSW 25 (an online fire pond). Downstream from the fire pond, the reach flows for approximately 120 m through a highly disturbed heavy equipment parking area and agricultural area on 3275 Trafalgar Road before flowing into the upper limit of the Core 10 woodland. There is limited channel definition within the woodland immediately south of the property.

The riparian wetland, previously present on 3275 Trafalgar Road (prior to agricultural impacts) and the fire pond on 3301 Trafalgar Road are mapped by MNRF as a portion of PSW 25 (**Drawing 3.1**). The upper portion of PSW 25 is a relatively wide, flat area corresponding with the fire pond, with a narrow, shore defined watercourse passing into and out of the fire pond through the wetland community before entering the disturbed areas on 3275 Trafalgar Road where the wetland communities of PSW 25 are no longer evident.

The downstream portion of PSW 25 is within Core 10 and was characterized as part of the *Lower EM4 EIR/FSS*.

Surface water flow monitoring stations were established upstream and downstream of the existing pond. Water level was collected at 15-minute intervals between September and November 2022. Monitoring stations were reinstated in April 2023 and will remain in place until November 2023. In addition, measurements of velocity and discharge were recorded, when possible. The location of and data collected at each station is summarized in **Appendix D-2**.

The surface water flow monitoring data show that East Morrison Creek within the Subject Lands typically contains water during the spring freshet and following large rain events. This is consistent with baseline data collected by GEO Morphix downstream of the Subject Lands, as part of a separate monitoring program. As of July 2023, the maximum recorded discharge at sites US and DS were 0.236 m^3/s and 0.151 m^3/s during 10.2 mm and 37.2 mm rainfall events, respectively.

4.4 Climate

CH has requested that the data from the Hamilton Royal Botanical Gardens (RBG) climate station (Station 6153300 - 43°16.8′N, 79°52.8′W, elevation 102.1 masl) be utilized for the water balance work in the EIR studies for the North Oakville area. The long-term average annual precipitation for this station is 893mm. Average monthly records of precipitation and temperature from this station have been used for the water balance calculations in this study (**Table C-7-1, Appendix C-7**). Daily precipitation data from this station using 2022 as a typical year are provided on the hydrographs in **Appendix C-7 (Figures C-7-3**).

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 MOE water well records for local private wells is provided in **Appendix C-1** and the well locations are plotted on **Figure C-1-1, Appendix C-1**. Along with site-specific geological information obtained from geotechnical BHs and groundwater observation wells drilled within the EIR Subcatchment Area (described in **Section 4.5.2**), these MOE records provide geology data that have been utilized to help assess the regional stratigraphy. The characteristics of the overburden sediments and shale bedrock are described in the following sections.

To illustrate the geological conditions, two schematic cross-sections through the EIR Subcatchment Area were prepared. The cross-section locations are shown on **Figure 4.5** and the interpreted cross-sections are provided on **Figures 4.6** and **4.7**. 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 (2007) illustrates that the EIR Subcatchment Area is covered by clayey silt to silt 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.

Site specific geology has been documented through a geotechnical investigation (Landtek, 2021 and 2023), as well as a geotechnical investigation that was completed for the lands immediately to the south as part of the *Lower EM4 EIR/FSS*. The BH locations on the Subject Lands are shown on **Figure 4.1** and copies of the BH logs are provided in the **Appendix C-2**.

The results of the geotechnical investigation confirm the published surficial geology mapping. The BH logs consistently describe the overburden sediments as silty clay till with traces of gravel, occasional sand and silt seams, cobbles, boulders and shale fragments (**Appendix C-2**).

4.5.3 Bedrock Geology

The EIR Subcatchment Area is underlain by Queenston Formation (**Figure 4.4**). 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 overburden sediments tend to be relatively thin, with bedrock encountered in BHs at depths below ground surface ranging from about 1.5 m in BH123, to 6.6 m below ground at BH103 (refer to **Figures 4.1 and 4.5** for BH locations and **Appendix C-2** for BH logs).

As illustrated by the cross-sections (**Figures 4.6** and **4.7**), the bedrock topography is very similar to the ground topography, with an undulating surface that slopes towards the south (the ground surface topography basically mimics the bedrock topography). The bedrock elevations range from about 176.7 masl to 177.8 masl, with the higher elevation found in the northwest portion of the Subject Lands and the lowest elevation found at the central portion of the Subject Lands (refer to **Figures 4.6, 4.7** and **5.2**).

4.5.4 Hydraulic Conductivity

There are various methods that can be utilized to assess soil and bedrock hydraulic conductivity, i.e., the ability of the material to transmit groundwater. Grain-size data and soil characteristics can be used to provide a general estimate of hydraulic conductivity. Single well bail-down tests are used in groundwater MWs to assess site-specific hydraulic conductivity. These methods have been utilized to estimate the hydraulic conductivity of the geologic materials encountered across the Subject Lands as discussed below.

During the geotechnical investigations, representative samples were collected and analyzed for grain-size distribution (**Appendix C-3**). A summary of the hydraulic conductivity estimated from the grain size analyses, using the Hazen estimation method, is provided below in **Table 4.1**. It is acknowledged that the Hazen formula is a method designed to approximate the hydraulic conductivity of more permeable sediments, however, in practice, it is still a useful consideration to evaluate the grain-size curves for an indication of the low range of the hydraulic conductivity values.

Bail-down tests were conducted in the MWs that were installed in MW106, MW120, MW121, MW1D023, MW4-23 and M2122D-23. A summary of the formations screened in the tested wells and the calculated hydraulic conductivities is set out in **Table 4.1** and the results of the tests are provided in **Appendix C-3**.

Table 4.1: Summary of Hydraulic Conductivity Testing

Monitoring Well	Depth (m bgl)	Soil Tested or Formation Screened	Hydraulic Conductivity (cm/sec) Hazen Method	Hydraulic Conductivity (cm/sec) In-Situ Bail Test
MW106	9.5	Shale Bedrock	NA*	7.298×10^{-6}
MW120	7.4	Shale Bedrock	NA*	2.112×10^{-8}
MW121	6.5	Shale Bedrock	NA*	3.944×10^{-7}
MW1D-23	18.72	Shale Bedrock	NA*	4.682×10^{-9}
MW4-23	18.69	Shale Bedrock	NA*	6.227×10^{-8}

Monitoring Well	Depth (m bgl)	Soil Tested or Formation Screened	Hydraulic Conductivity (cm/sec) Hazen Method	Hydraulic Conductivity (cm/sec) In-Situ Bail Test
MW102D	4.50	Silty Clay Till/Shale Bedrock	NA*	4.183×10^{-8}
MW122D-23	18.60	Shale Bedrock	NA*	1.036×10^{-8}

NA* – Applicable to coarse grained soils such as sand.

Silt and clay sediments generally have low hydraulic conductivity, i.e., the ability to transmit significant volumes of groundwater is limited. The soil grain size analyses for these sediments suggest that hydraulic conductivity is about 1×10^{-6} cm/sec. As the amount of silt and sand in the sediment samples increases, the hydraulic conductivity increases, with values estimated at about 1×10^{-5} cm/sec for the sandy silt samples and 3×10^{-4} cm/sec for silty fine sand.

None of the monitoring wells completed by Landtek to supplement existing monitoring wells installed at the site by other consultants were screened in the till overburden which is relatively thin on the Subject Lands. However, the Halton Till unit, underlying the Subject Lands and its vicinity, is generally regarded as an aquitard. A regional summary of hydraulic conductivity values derived from consulting work conducted throughout Halton Region, by Holysh, April 1997 determined the geometric mean of Halton Till to be 1×10^{-9} m/s (1×10^{-7} cm/sec) (Ostry, 1979).

Shale bedrock also generally tends to have low hydraulic conductivity; although weathering and fracturing of the rock can significantly affect the ability of the shale to transmit water. Analyses of the bail-down test results for wells completed within the shale (**Table 4.1**), suggest the hydraulic conductivity ranges from moderate (10^{-6} m/sec) to very low (10^{-9} m/sec).

4.6 Hydrogeology

4.6.1 Local Groundwater Use

In the North Oakville area, there are no high-yielding or extensive water supply aquifers reflecting the general lack of coarse-grained sand and gravels and the relatively low hydraulic conductivity glacial till overburden materials. A review of MOE 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 relatively poor aquifers and the local water yields are typically very low (less than 1.2 L/s).

Municipal water supply for the Town is surface water obtained from Lake Ontario. The proposed development will be municipally serviced from Lake Ontario, and there is no proposed groundwater use for the development (refer to **Section 9** for Water Servicing Details). In the long term, it is anticipated that all existing private water supply wells will be decommissioned, and the entire North Oakville development area will be on lake-based municipal supplies.

It is noted, however, that there may be continued interim use of private wells in the area surrounding the proposed development. Therefore, it is important that the development construction does not disrupt these local groundwater supplies. Monitoring of local supply wells that remain in use will be required before, during and after construction activities (refer to **Section 11.9** for details of the proposed monitoring of local private water supply wells during development).

4.6.2 Groundwater Levels

Groundwater levels in MW101-20, MW111-20, MW117D, MW118-20, MW119-20, MW102S, MW102D, MW103, MW106, MW120S, MW120D, MW121S, MW121D, MW1D-23, MW4-23, and MW122D-23 located within the Subject Lands were measured monthly from August 2021 to May 2023 (**Table C-4-1, Appendix C-4**) to evaluate seasonal variations. Three nested wells (MW102S/MW102D, MW120S/MW120D and MW121S/MW121D) were also installed. The MW locations are shown on **Figure 4.1**.

Manual water level measurements were recorded at each MW. Hydrographs for the MWs are provided on **Figures C-4-1 through C-4-13 in Appendix C-4.**

The groundwater monitoring data indicate the following (refer to **Figure 4.1** for the monitoring locations and the hydrographs in **Appendix C-4** throughout the following discussions):

- In southern Ontario, there is a seasonal pattern that typically appears on groundwater level hydrographs from 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. This type of seasonal water level fluctuation is evident on the hydrographs for the MWs within the EIR Subcatchment Area. The groundwater levels vary seasonally by 4.0 m.

- The groundwater levels in the MWs (completed in shallow shale or at the shale/till contact) are typically found within 0.3 to 2.0 m of ground surface during the spring months and decline to more than 3.0 m below ground surface through the late summer and fall.

- The detailed datalogger hydrographs for all of the monitoring wells indicate that the groundwater levels have a very limited direct response to precipitation inputs (**Figures C-4-1 to C-4-13; Appendix C-4**). Distinct rises in water levels only occur in response to very heavy rainfall events. This is attributed to the low hydraulic conductivity of the surficial till soils which precludes rapid recharge to the subsurface.

- Three pairs of nested monitoring wells were installed (**Figure 4.1**). At these locations, the shallow and deep wells are screened in different formations (shale bedrock, clayey silt, and clayey silt/shale bedrock), and at different depths. The groundwater levels in the nest wells are very similar. The groundwater level in the shallower wells (MW102S, MW120S and MW121S) are typically slightly higher than the groundwater level in the deeper wells (MW102D, MW120D andMW121D) indicating a downward hydraulic gradient and recharge conditions (**Figure C-4-1, Appendix C-4**).

4.6.3 Groundwater Flow Conditions

Groundwater elevation data from **Table C-4-1** are provided on **Figure 4.8**, along with the interpreted groundwater elevation contours for the EIR Subcatchment Area. The groundwater elevation contours mimic the topography of the area and groundwater flow moves towards the south. This interpretation is consistent with the regional groundwater flow mapping that indicates groundwater flows from the topographic high of the Trafalgar Moraine south-southwest across the North Oakville East area towards Lake Ontario (NOCSS, 2006).

It is interpreted that a groundwater flow direction is southwest (**Figure 4.8**). Groundwater inputs are not sufficient to maintain baseflow in the watercourse.

4.6.4 Recharge and Discharge Conditions

As discussed in **Section 4.6.2**, the monitoring data have indicated that groundwater recharge is downward. The recharge conditions (vertically downward gradients) are generally found in the wetland areas.

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 in 1979, the MOE characterized water from the Queenston Formation shale 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. 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 (MOE, 1979). 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 shallow groundwater quality in the Study Area, groundwater samples were collected on April 5, 2023. The samples were analyzed for PWQO parameters. The chemistry results are summarized in **Table C-6-1, Appendix C-6**. The shallow groundwater is not used for drinking in the area; however, the ODWQS exceedances are listed on **Table C-6-1** for water quality comparison purposes (**Appendix C-6**).

4.7.2 Surface Water Quality

Two (2) monitoring locations were established in September 2022 to characterize surface water quality conditions upstream (US) and downstream (DS) of the online pond. Refer to the Figure in **Appendix D-2** for monitoring locations. The program included continuous water level and temperature monitoring as well as discrete instream measurements of velocity, temperature, total suspended solids (TSS), turbidity, dissolved oxygen, and conductivity during a variety of seasonal conditions (i.e., 3 wet weather events and 4 dry weather events). Wet events required greater than 10 mm of rainfall 24 hours prior to sampling, and dry events required more than two consecutive days without rain before sampling. Daily precipitation data from April to December was acquired from a GEO Morphix telemetry-based weather station situated approximately 0.75 km west of the Subject Lands. Although suitable wet and dry weather events occurred during the 2022 monitoring period, both monitoring stations were dry during all site visits and as such, no water quality data was collected.

Surface water quality monitoring resumed in 2023, with instrumentation installed between April and November at which time the equipment was removed. In 2023, there were 14 occurrences of daily rainfall > 10mm. Water quality data and samples for all parameters were collected during 4 wet events and 4 dry events in 2023.

TSS and turbidity were elevated in the spring and during precipitation events. Water temperatures also increased between April and September 2023. During relatively dry periods, dissolved oxygen concentrations decreased, with DS values generally higher relative to US values during dry weather sampling events. The maximum conductivity value measured in 2023 occurred on June 5th. This may be attributed to the release of water from the pond with a relatively high concentration of chloride during drier conditions. Conductivity was generally substantially lower during wet weather sampling events due to diluted flows. Additional information regarding surface water quality results are provided in the East Morrison Creek Baseline Monitoring Report in **Appendix D-2**. GEO Morphix has continued the surface water quality monitoring program in 2024, with wet and dry weather water quality sampling being conducted between April and November.

5.0 STREAM SYSTEMS, FISH HABITAT AND FISH COMMUNITIES

5.1 Overview of East Morrison Creek Subcatchment EM4 Characteristics

Within North Oakville, there are two tributaries of East Morrison Creek that converge just north of Dundas Street, west of Trafalgar Road. The East Tributary to East Morrison Creek drains the EIR Subcatchment Area of this EIR/FSS, as shown on **Figure 1.2**.

This tributary has a drainage area of approximately 150.5 ha to its confluence with the main channel of East Morrison Creek. The headwater area of this tributary is located north of Burnhamthorpe Road, west of Trafalgar Road and north/west of the Subject Lands (**Figure 1.2**). Upstream (north and west) of the Subject Lands, the drainage area is approximately 45 ha.

As documented in the *Lower EM4 EIR/FSS*, the East Tributary drainage area originates north of Burnhamthorpe Road, in the easterly portions of Core 8 (refer to **Drawing 2**). Also, a small portion of Core 9 is captured within this subcatchment. Other than these small areas of Cores (approximately 2.5 ha of Core 8 and approximately 1.4 ha of Core 9), the remainder of the Subcatchment Area upstream of the Subject Lands, west of Trafalgar Road, is currently cropped agricultural fields or small residential lots. No riparian zone exists in these upstream areas west of Trafalgar Road as the flow path is completely ploughed through. The substrate consists of silt and muck through these ploughed fields. There are no other natural features upstream of the Subject Lands and west of Trafalgar Road, outside of the boundaries of Cores 8 and 9. There are three Hydrologic Feature Bs in this area (i.e., west of Trafalgar Road), and their storage requirements will be addressed by FSS(s) for lands in this upstream portion of the catchment, when development advances west of Trafalgar Road.

No defined channels have been identified by NOCSS in the subcatchment upstream of the Subject Lands, west of Trafalgar Road. Contribution of overland flow, from the upstream area, crosses via a culvert under Trafalgar Road (culvert ME-T5), approximately 1.3 km north of Dundas Street. NOCSS identifies the East Tributary of East Morrison Creek as becoming a defined channel approximately 180m southeast of this culvert. Reach delineation, characterization of existing conditions, and delineation of meander belt width dimensions was previously completed for the East Tributary of East Morrison Creek within the Subject Lands through the NOCSS. Based on underlying geomorphic controls, the NOCSS delineated the East Tributary into two reaches (MOC-2 and MOC-6) from the confluence downstream of Trafalgar Road, to the upstream limit of the Subject Lands.

MOC-6 is defined as a High Constraint (Red) Stream for a length of approximately 555 m after which it becomes a Medium Constraint (Blue) Stream (Reach MOC-2) as illustrated on NOCSS Figure 6.3.16.

Within the Subject Lands, existing land uses consist of rural residences and a church in proximity to Trafalgar Road, and open and disturbed areas to the east. PSW 25 is centrally located within the Subject Lands and has been significantly disturbed through the placement of fill and grading changes on 3275 Trafalgar Road. Reach MOC-6, as delineated in NOCSS, flows through PSW 25 in a generally northwest to southeast orientation. An additional reach, MOC-6a has been included as part this study to differentiate between the high constraint stream segment delineated in NOCSS (MOC-6) and the upstream drainage feature that was not given any constraint ranking in NOCSS (MOC-6a). Both reaches contained poorly defined channels with predominantly fine-grained substrates that have been historically impacted by agricultural land use (i.e., straightening and natural riparian vegetation removals) and more recent activities onsite (i.e., fill placement).

5.2 Comparison of EIR/FSS Drainage Areas to NOCSS Drainage Area

Table 5.1 provides a comparison of existing drainage areas as provided in NOCSS (2006) versus the 2007 LiDAR.

Table 5.1: Existing Drainage Areas

Subwatershed	Pre-Development Area (ha)		
	NOCSS [ha]	2007 LiDAR [ha]	Differences (%)
Culvert ME-T5	43.80	40.63	-7.2%
Culvert ME-T1	150.20	144.07	-4.1%
Culvert ME-D3	313.94	310.06	1.2%

5.3 Confirmation of East Tributary of East Morrison Creek Reach Breaks

Reaches are homogenous sections of channel with regard to form and function, with consideration to channel gradient, hydrology, surficial geology, land use, and vegetative controls (Montgomery and Buffington, 1997; Richards et al., 1997). Each reach is therefore expected to adjust in a generally uniform manner along its full length to changes in hydrology and sediment supply, as well as other modifying factors.

Based on underlying geomorphic controls, the NOCSS delineated East Morrison Creek as a single reach (MOC-6) within the Subject Lands. The reach was characterized as a modified agricultural swale with poorly defined banks and intermittent streamflow generated through surface runoff. Existing conditions were not characterized using the Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment Technique (RSAT) tools as the reach had poor channel definition and was ploughed through at the downstream extent. Substrate consisted of silt and muck. Poor riparian conditions were noted, with grasses being the predominant riparian vegetation community. As a portion of Reach MOC-6 flows through PSW 25, the feature was classified as a high constraint stream. Reach MOC-6a, not previously identified by NOCSS, has no constraint designation. Relevant characteristics as reported in the NOCSS for Reach MOC-6 are presented in **Table 5.2**.

Table 5.2: Reach Characteristics and Existing Conditions, East Morrison Creek (NOCSS, 2006)

Reach	Length (m)	Gradient (%)	Sinuosity	RGA	RSAT
MOC-6	1,788*	0.64	1.07	Not Assessed**	

** Length of entire Reach MOC-6 as outlined in the NOCSS*
***RGA/RSAT were not applicable due to feature form*

To facilitate a systematic evaluation of the watercourse within the Subject Lands, reach limits originally established in the NOCSS were reviewed and refined. GEO Morphix delineated a sub-reach, MOC-6a, along the northern portion of the Subject Lands, flowing approximately 53 m downstream of Trafalgar Road to the upstream limit of Reach MOC-6. Within the Subject Lands, Reach MOC-6 is approximately 278 m long and includes the online pond and associated PSW and the poorly defined swale that flows southeast to the downstream property boundary. Reach characteristics for the portion of East Morrison Creek relevant to the Subject Lands are summarized in **Table 5.3.**

Table 5.3: EIR/FSS Modified Reach Characteristics – East Morrison Creek

Reach	Length (m)	Gradient (%)	Sinuosity
MOC-6a	53	0.47	1.07
MOC-6	278	0.35	1.07

5.4 Characteristics of East Tributary of East Morrison Creek Stream Reaches

To characterize existing geomorphic conditions along relevant sections of East Morrison Creek within the Subject Lands, field reconnaissance was undertaken by GEO Morphix on August 19, 2021 and August 23, 2022. A photographic record of field conditions at the time of survey is included in **Appendix D-1.**

As noted previously, Reach MOC-6 was divided into two sub-reaches within the Subject Lands. Reach MOC-6a is approximately 53 m in length and comprised of the portion of the Tributary of East Morrison Creek from the northwest property boundary to the upstream extent of MOC-6. MOC-6a would be considered a low constraint stream corridor (green stream) however, NOCSS did not provide any classification for MOC-6a. Reach MOC-6, originates upstream of the online pond / PSW 25 and flows for approximately 278 m to the southern property boundary. Reach MOC-6 is considered a high constraint stream (red stream) as it flows through the Subject Lands.

5.4.1 Reach MOC-6a

Reach MOC-6a enters the northwestern property boundary through culverts beneath a farm crossing and flows for 53 m to the upstream extent of MOC-6. This reach was historically straightened for agricultural purposes, had an intermittent flow regime and was situated in an unconfined flood plain. A homogeneous bedform comprised of runs was observed and feature width and depth were 1.81 m and 0.50 m, respectively. The riparian zone was continuous, spanning 1 to 4 channel widths and consisted of primarily grasses that heavily encroached the channel. Bank materials were predominantly silt and clay and no bank erosion was observed along the reach.

5.4.2 Red Stream Reach (MOC-6)

Reach MOC-6 originates near the northern property boundary of 3301 Trafalgar Road and flows southeast through fallow agricultural lands, PSW 25 (as it currently exists on 3301 Trafalgar Road), agricultural lands (formerly PSW 25 on 3275 Trafalgar Road) and a woodland where it exits the Subject Lands. No bank erosion was observed along the upper portion of MOC-6.

South of the online pond, the lower portion of MOC-6 within the Subject Lands was characterized as relatively straight within an unconfined flood plain. The low-flow channel through the former wetland (now agricultural lands) was difficult to discern and substrate consisted of silt and clay. The reach appears to become sufficiently dry during the spring period that the tenant farmer is able to plough through this reach. **Table 5.4** provides a summary of the existing conditions of MOC-6 and MOC-6a.

Table 5.4: Summary of Existing Conditions – East Morrison Creek

Sub-Reach	Feature Width (m)	Average Feature Depth (m)	Bed Substrate	Riparian Vegetation	Notes
MOC-6a	1.81	0.5	Clay and silt	Continuous buffer, grasses spanning 1 - 4 channel widths, heavily encroached with vegetation	Modified for agricultural practices, unconfined floodplain with poorly defined flow path
MOC-6	12 to 21	0.11	Clay and silt	Fragmented buffer, grasses and trees spanning 1 - 4 channel widths	Channel ploughed through at downstream extent, unconfined floodplain with poorly defined low flow channel

5.4.3 Rapid Geomorphological Assessment Tools

Rapid assessments are typically completed to identify dominant geomorphic processes, document stream health, and to identify any areas of concern regarding erosion or instability. Channel instability can be objectively quantified through the application of the Ontario Ministry of the Environment's (2003) Rapid Geomorphic Assessment (RGA) where observations are quantified using an index that identifies channel sensitivity based on evidence of aggradation, degradation, channel widening, and planimetric adjustment.

The Rapid Stream Assessment Technique (RSAT) can also be employed to provide a broader view of the system as it considers the ecological function of the watercourse (Galli, 1996). Observations are made of channel stability, channel scouring or sediment deposition, instream and riparian habitats, and water quality.

Reaches can also be classified according to the Downs (1995) Channel Evolution Model. The Downs Model describes successional stages of a channel because of a perturbation, namely hydromodification. Understanding the current stage of the system is beneficial as this allows one to predict how the channel will continue to evolve or respond to an alteration to the system.

Given that reaches MOC-6a and MOC-6 did not contain natural, defined channels or discernible geomorphic units, the RGA and RSAT tools were not applied. The lower portion of Reach MOC-6 was also highly altered, further impacting the ability to assess the reach utilizing the RGA and RSAT protocols. Refer to **Appendix D-1** for a photographic record and further details regarding existing conditions within each reach.

5.4.4 Scoped Detailed Geomorphological Assessment

Restoration of that portion of PSW 25 and Reach MOC-6 on 3275 Trafalgar Road is proposed as part of the development due to impacts from historical and recent land use activities. A scoped detailed geomorphic assessment was completed on August 23, 2022 downstream of the online pond to support the restoration design (**Appendix D-1)**. Detailed geomorphic assessments are typically utilized to determine bankfull channel characteristics, including cross-sectional geometry and hydraulics, and characterize bed and bank material composition and structure. In this case, the scope of the survey was limited to approximately 45 m of MOC-6 and 2 cross-sections due to limited low flow channel definition with PSW 25. Bankfull measurements could not be collected. The surveyed feature gradient was determined to be 0.64%. As noted in **Table 5.5**, Reach MOC-6 contained relatively fine-grained sediments. Given extensive modifications to Reach MOC-6, the detailed assessment was not used to inform the proposed wetland restoration design.

Table 5.5: Measured Channel Parameters

Channel Parameter	MOC-6
Channel bed gradient (%)	0.64
D_{50} (mm)	0
D_{84} (mm)	20
Manning's 'n'-value	0.043
Sinuosity	1.07

5.5 Surface Water Monitoring

Baseline instream water quality monitoring was initiated by GEO Morphix in 2022. Two (2) monitoring locations (i.e., US and DS) were established to characterize conditions along

Reach MOC-6. These locations coincide with surface water quality sampling locations. Refer to the Figure in **Appendix D-2** for monitoring locations.

Monitoring commenced on September 1, 2022 to capture summer and fall conditions (September 1 to November 30, 2022). Instrumentation was reinstated in April 2023 and monitoring continued until November 30, 2023. The following activities were conducted at each location:

- Conduct continuous water depth and temperature monitoring at 15-minute intervals using a HOBO U20 Water Level Logger pressure sensor, with an additional control sensor installed nearby to monitor atmospheric pressure and correct instream measurements; and,
- Collect monumented photographs of all site visits to verify location, timing and instream conditions

Surface water monitoring site visits coincided with discrete water quality sampling events. US and DS stations were dry in September and October 2022. Maximum water levels were observed in response to significant precipitation events and were dependent on the magnitude of the rainfall event and antecedent conditions. Maximum water level observed at both US and DS in 2022 occurred on November 21following a 13.0 mm rain event, and ranged between 0.019 m and 0.042 m, and 0.004 m and 0.005 m, respectively.

In 2023, there were 14 occurrences of daily rainfall > 10mm. Consistent with 2022 observations, water level monitoring and observations in 2023 suggest that the channel is only active during the spring freshet and following large rainfall events. The maximum water level at sites US and DS was recorded as 0.88 m and 0.76 m, respectively in 2023. Discrete measurements of velocity and discharge were recorded, when possible and ranged from 0 to 0.236 m^3/s and 0 to 0.151 m^3/s for sites US and DS, respectively. Water temperature, air temperature, water level, and daily rainfall records are provided in **Appendix D-2**. GEO Morphix is continuing with surface water monitoring until November 2024.

5.6 Stream Corridor Boundaries

There is one Red Stream Reach in the EIR Subcatchment.

The NOCSS and NOCSS Addendum set out the approach to the delineation of stream corridor widths. In the NOCSS, stream corridor widths were identified on a broad scale and were noted to be preliminary, subject to refinement during the EIR/FSS studies.

Figures 6.3.15a, 6.3.15b and 6.3.15c in the NOCSS Addendum and an Appendix of the Secondary Plan provide illustrations clarifying the stream corridor delineation process.

Depending upon the tributary, the factors that are utilized to define the corridor widths:

- fluvial geomorphologic requirements;
- stable slope top-of-bank;
- regulatory floodplain;
- fish and fish habitat protection requirements;

- preservation of hydrogeologic functions;
- Hydrologic Feature "A"; and,
- setback and buffer requirements.

Unlike Core boundaries, setbacks from various vegetation types (i.e., woodland, non-PSW wetlands that form channel riparian habitat) are not used to delineate corridors.

The approaches utilized for meander belt calculations, flood plain calculations, fisheries setbacks and wetland are described in the following sections, concluding with the presentation of the existing corridor widths on **Drawing 3.1.**

5.6.1 Meander Belt Width Assessment

Most watercourses in southern Ontario have a natural tendency to develop and maintain a meandering planform, provided there are no spatial constraints. A meander belt width assessment estimates the lateral extent that a meandering channel has historically occupied and will likely occupy in the future. This assessment is therefore useful for determining the potential erosion hazard to proposed activities adjacent to a given watercourse.

Reach MOC-6 is located within an unconfined system and contains a poorly defined channel. In unconfined systems, a meander belt width can be applied based on 20 times the bankfull channel width. Alternatively, the meander belt width can be determined through a detailed geomorphological study that examines the largest channel meanders observed through historical and recent aerial photograph interpretation. The meander belt width can then be graphically defined using orthorectified aerial imagery by determining the channel centerline and the channel's central tendency (i.e., meander belt axis). In cases where the channel is not discernible in aerial photographs or the channel has been substantially modified, empirical models can be used to estimate the meander belt width.

Meander belt width and stream corridor dimensions were determined for Reach MOC-6 through the NOCSS (see **Table 5.6**) based on desktop assessments and aerial imagery. The geomorphic corridor dimension was reflective of three components: the meander belt width, erosion setback (factor of safety) and environmental setback allowance (access allowance). Belt widths were measured using available digital and topographic mapping at a scale of 1:5,000 and were considered preliminary (i.e., subject to refinement as development plans proceeded). The erosion setback or factor of safety was defined as either 10% of the belt width dimension on either side or 6m, whichever was larger. East Morrison Creek is considered a minor valley system by CH; as such, a 7.5m regulatory allowance was applied to either side of the meander belt width in order to address regulatory requirements.

Table 5.6: NOCSS Meander Belt Width and Corridor Dimensions (NOCSS, 2006)

Reach	Meander Belt Width (m)	Factor of Safety (m)	Access Allowance (m)	Corridor Dimension (m)
MOC-6	35	7	15	57

Geomorphic Solutions completed a meander belt width analysis for the two properties downstream of the Subject Lands as part of the *Lower EM4 EIR/FSS* completed for two properties located directly downstream of the Subject Lands. At the time of the *Lower EM4 EIR/FSS*, site access to 3301 and 3275 Trafalgar Road was not granted and the meander belt width determined for MOC-6 was based on observations downstream of the Subject Lands. Based on the poorly defined nature of Reach MOC-6 it was determined that the empirical models identified an overly conservative belt width dimension. As such, the meander belt width delineated for Reach MOC-2/2a was used as a reference condition, resulting in a recommended dimension of 25 m for Reach MOC-6 as part of the *Lower EM4 EIR/FSS*.

GEO Morphix has further refined the extent of the meander belt width based on a review of recent aerial imagery, topographic mapping, and site-specific field observations. As the reach lacks a defined channel and has been significantly modified, an empirical modelling approach was used to refine the meander belt width. These models are scientifically defensible and have been verified in past projects as suitable for use in southern Ontario. For comparison purposes, the meander belt width was calculated using two different empirical models, with a summary of the results outlined in **Table 5.7**.

The empirical relations from Williams (1986) were modified to include channel width, and applied using the bankfull channel dimensions such that:

$$B_w = 18A^{0.65} + W_b \quad \text{[Eq. 1]}$$

$$B_w = 4.3{W_b}^{1.12} + W_b \quad \text{[Eq. 2]}$$

where B_w is meander belt width (m), A is bankfull cross-sectional area (m^2), and W_b is bankfull channel width. An additional 20% buffer, or factor of safety, was applied to the computed belt widths. This addresses issues of under prediction and provides a factor of safety. A 12 m feature width was measured upstream of the existing pond along Reach MOC-6; however, this portion of reach displayed wetland characteristics and is not an appropriate representation of bankfull channel width. As a low flow channel could not be discerned along Reach MOC-6, the bankfull channel dimensions observed during field reconnaissance along Reach MOC-6a were used to inform the empirical models.

The Ward et al. (2002) model was also used to determine a meander belt width (ft), *Bw*:

$$B_w = \left(6{W_b}^{1.12}\right) + W_b \quad \text{[Eq. 3]}$$

The resulting value was then converted to the metric system (m). A 20% factor of safety was not applied to this value due to the approach used in the modelling (i.e., hazard envelope rather than a linear relationship).

A meander belt width was also calculated based on TRCA's (2004) empirical model:

$$B_w = -14.827 + 8.319\ln\left(\rho g Q S * DA\right) \quad \text{[Eq. 3]}$$

where ρ is water density (1000 kg/m^3), g is acceleration due to gravity (9.8 m/s^2), Q is discharge (m^3/s), S is channel slope (m/m), and DA is drainage area (km^2). The TRCA meander belt width values were determined using a drainage area of 0.501 km^2 for MOC-6 as well as a 2-year discharge of 0.70 m^3/s. Channel slope was estimated to be approximately 0.64%. These values are based on information available through the Ontario Watershed Information Tool (OWIT). With regard to the 2-year discharge, the values were calculated using the Index Flood Method (Moin and Shaw, 1985) as documented in the User Guide for Ontario Flow Assessment Tool (OFAT) (MNRF, 2020). Although gradients of 0.47% (upper portion of Reach MOC-6) and 0.35% (lower portion of Reach MOC-6) were calculated using the topographic survey, a conservative approach was taken by using a slope of 0.64%, which is equivalent to the gradient surveyed in the field as part of the detailed geomorphological assessment and the gradient presented in NOCSS for the overall reach.

The empirical modelling exercise provides meander belt widths ranging from 11 m to 22 m for Reach MOC-6 (**Table 5.7**). Due to historical modifications and limited channel form, the bankfull channel measurements collected along the upper portion of Reach MOC-6 are likely not representative. A meander belt width of 20 m is therefore recommended for Reach MOC-6. The feature showed little to no evidence of erosion or active migration. As such, the 20 m meander belt width is likely conservative with regard to addressing the erosion hazard. The meander belt width is graphically displayed in **Appendix D-1.**

Table 5.7: Modelled Meander Belt Widths for Reach MOC-6

Reach	Meander Belt Width (m)					Recommended Meander Belt Width (m)
	Williams (1986) Area*	Williams (1986) Width*	Ward (2002) Width	TRCA (2004)	TRCA (2004)**	
MOC-6	22	12	13	11	20	20

** Includes a 20% factor of safety*
*** Includes 1 standard error of 8.63 m (assuming no changes to hydrology)*

5.6.2 Regulatory Floodplain

A 7.5m setback has been applied to the existing regulatory (Regional) flood plain. The flood plain mapping and supporting model descriptions are provided in **Section 5.7.**

5.6.3 Fisheries Setback Requirements

The East Tributary of East Morrison Creek and its tributaries require a 15m fisheries buffer on both sides of the creek, as measured from the frequent flow channel (Section 6.3.4.2 and Table 6.3.4a of the NOCSS). The fisheries setbacks are contained within the meander belt plus 7.5 m regulatory allowance (i.e., 10 m on each side of the watercourse + 7.5 m).

5.6.4 Provincially Significant Wetland 25

There is one PSW, located along Reach MOC-6 as illustrated on **Figure 5.1**.

The current limit of PSW 25 on the Subject Lands was delineated on site with CH on June

9, 2022, which identified that the limits of the wetland around the fire pond on 3301 Trafalgar Road had expanded from that which was previously delineated (based on air photo interpretation) by MNRF. Through discussions with CH, the Town of Oakville and applicant, it was agreed that a backwater effect may have been created on PSW 25 through previous unauthorized works immediately to the south. As such, it was agreed that the 2012 MNRF wetland delineation limits would be used on the western side of the PSW when delineating the 30m buffer requirement.

The subsequent restoration of the channel downstream of the fire pond will likely restore natural water regimes and drainage patterns within this area leading to a likely eventual return to the approximate wetland limits as delineated by MNRF. This change would likely result in some minor reduction in the extent of cattail mineral shallow marsh surrounding the shallow aquatic community. When considered in context with the restoration of the broader wetland community which has been designed to provide a range of natural floodplain wetlands providing increased opportunity for wildlife foraging, movement and basking (see **Appendix D-1** for targets), it is anticipated that there will be an overall increase in ecological function within the wetland community. At present, the cattail mineral shallow marsh community is likely providing limited habitat for wildlife species associated with the wetland, and these species are expected to colonize the restored wetland community immediately downstream such that an overall increased availability of habitat will be provided.

It should be noted that although the natural water regime will be restored, an open pond associated with the fire pond on 3301 Trafalgar Road will remain present in the landscape. This feature, which was found to provide habitat for over-wintering turtles, is not expected to be impacted by the proposed restoration of wetlands downstream on 3275 Trafalgar Road, and as a result, there would be no impact to the ability of this feature to provide turtle over-wintering habitat post-development.

In one location on 3301 Trafalgar Road, the wetland setback is proposed to be reduced to approximately 22.42 m (**Drawing 3.1**). This reduction has been discussed with Town and CH staff and is required from an engineering and planning perspective for the following reasons:

- The intersection of the proposed East-West road (along the northern limit of the Subject Lands) at Trafalgar Road is fixed and cannot be shifted further north;
- The location of the North-South collector road (William Coltson Avenue) connection to the proposed East-West road needs to maximize distance between the two intersections (Trafalgar Road and William Coltson Avenue) while maintaining safe turning radii along the North-South collector road;
- The connection to the existing alignment of William Coltson Avenue at the southern limit of 3275 Trafalgar Road is fixed;
- The planned widening of Trafalgar Road through this area creates a pinch point on the Subject Lands between the widened Trafalgar Road and the existing wetland limit plus 30 m, making it difficult to construct William Coltson Avenue (as required by the NOESP) and provide for a reasonable sized development block between Trafalgar Road and William Coltson Avenue;
- William Coltson Avenue is identified as a transit route, which requires sidewalks on both sides of the road. Efforts have been made to reduce the width of the William Coltson

Avenue right of way, such as through the provision of the NHS trail in place of the sidewalk on the east side of William Coltson Avenue, thereby reducing to the extent feasible the encroachment into the 30 m setback from the original MNRF wetland limit.

The wetland communities associated with PSW 25 are predominantly associated with a cattail marsh surrounding the shallow aquatic fire pond. The cattail marsh community is a common type of wetland, often found in proximity to development, and would be tolerant to the slightly reduced buffer along the western extent.

As a result of the minor reduction in buffer width in this one location, the NHS is proposed to be supplemented through extension of the NHS along the eastern extent of the PSW by providing the 30 m buffer from the wetland as staked with CH in 2022, rather than from the original MNRF wetland limit. This results in a significant addition to the NHS as compared to what would have been realized if the MNRF wetland limit had been used to delineate the 30 m buffer along the eastern side of the wetland. In total, approximately 374 m^2 of additional NHS area is provided while the encroachment into the 30 m buffer is only 263 m^2, a gain of 111 m^2. In addition to the increased NHS area as a result of the enlarged wetland on 3301 Trafalgar Road, and its associated 30m buffer, three NHS Restoration Areas have been identified (one on 3301 Trafalgar Road and two on 3275 Trafalgar Road) totaling 388m^2. As a result, the NHS within the Subject Lands is significantly larger than what was anticipated through the mapping in NOCSS and the NOESP.

In addition, the 30 m buffer on 3275 Trafalgar Road will be restored with plantings to enhance the ecological function of the NHS on the Subject Lands, even though NOCSS and the NOESP do not require buffer plantings. The wetland buffer on 3301 Trafalgar Road is already in meadow habitat and, for the most part, will remain undisturbed due to grading. In those areas where grading is required within the 30m buffer, restoration plantings will be provided as a condition of draft plan approval.

5.6.5 Existing Corridor Boundaries

As discussed above, the factors to be considered in the refinement of the stream systems and corridor widths are:

- Fluvial geomorphologic requirements;
- Stable slope top-of-bank;
- Regulatory floodplain;
- Fish and fish habitat protection requirements;
- Preservation of hydrogeologic functions;
- Hydrologic Feature "A"; and,
- Setback and buffer requirements.

Each of these factors, where applicable, has been considered and calculated. **Drawing 3.1** illustrates the extent of the applicable factors along the existing channel of the East Tributary of East Morrison Creek corridor. As the creek is unconfined, no stable slope top-of-bank is indicated.

5.6.6 Proposed Reach MOC-6 Creek Corridor

As previously stated, Reach MOC-6 is a High Constraint Stream Corridor. OPA 272 policies state that these types of stream corridors cannot be altered however, a portion of MOC-6 (and the surrounding PSW) through 3275 Trafalgar Road has been effectively eliminated as a result of agricultural grading activities. It is proposed that, through the development process, the low flow channel and surrounding wetland community be re-created.

Considerations for the design of the re-instated stream corridor of Reach MOC-6 include flood conveyance, riparian storage, geomorphic factors, restoration of PSW wetland components, fisheries habitat integration, and a naturalization plan. Each of these design elements is discussed below along with the channel corridor design rationale, analyses and recommendations and described further in **Appendix D-1**.

5.7 Flooding Hazards, Flood Conveyance and Flood Storage Analysis, Existing Online Pond and Proposed Re-Created Channel

5.7.1 Background

The existing regulatory floodline and impacts related to the proposed channel alignment through the DTI lands were confirmed using HEC-RAS in the *Lower EM4 EIR/FSS*. The *Lower EM4 EIR/FSS* and detailed channel design brief delineated the existing floodplain within the Subject Lands, up to the limits of MOC-6 / pond area (see EM4 EIR/FSS Drawing 1). Since the drainage area contributing to this feature was less than 50 ha, it was agreed through the Lower EM4 EIR/FSS review to cut off the Regional floodplain at this location. Improvements and restoration of the wetland area is proposed, which involves re-shaping a portion of the corridor in this area as shown on **Drawing 7.1**.

5.7.2 Model Scenarios

The ultimate model scenario from the approved detailed channel design for MOC-2 was used to assess changes to the corridor within MOC-6. This scenario was originally named Ultimate in the DTI detailed design. A new scenario, Wetland Restoration 2024 has been created to simulate the future changes on the Subject Lands.

5.7.3 Model Setup

5.7.3.1 Model Geometry

In the original Ultimate scenario from the DTI channel design, the Subject Lands were treated as "existing conditions" with respect to the model geometry (i.e., no changes from existing ground conditions). A Manning's roughness of 0.05 was used in the approved model to represent the flood plain areas within the DTI study area.

The Ultimate 2023 HEC-RAS model geometry, incorporating the proposed changes on the Subject Lands, was based on the available LiDAR information for the Subject Lands with refinements made to reflect the ground survey in the vicinity of the channel. Note that the LiDAR surface was adjusted where necessary to align with the vertical datum for the project (CVGD 1928). The proposed model geometries were based on the proposed grading for the realigned / recreated features. The ultimate geometry for the balance of MOC-2 was used since the channel downstream of PSW 25 has been constructed and stabilized. This model has been re-named to "Current" as it represents the current conditions based on the approved / constructed channel design downstream of the Subject Lands.

5.7.3.2 Model Flows

Flows from the original model were used to simulate the changes to the Subject Lands resulting from the proposed wetland restoration. The original approved HEC-RAS model flows (existing external flows) represents the most conservative conditions for the Subject Lands – existing flows from the existing (>40 ha) drainage area to the northwest via culvert ME-T5 versus the future controlled / reduced flows from future Pond 29, or ultimate flows from the Subject Lands. The ultimate condition flows to ME-T5 are reduced since Pond 29 west of Trafalgar Road will ultimately discharge flows to the south, directly to the realigned MOC-2A channel. Under ultimate conditions, only a small portion of the existing flow will be discharged to MOC-6 from the Subject Lands and from the proposed Pond 29 flow splitter to maintain drainage to PSW 25 (estimated to be the 5-year flow based on NOCSS targets, between 200 L/s to 300 L/s).

5.7.4 Hydraulic Modelling Parameters

<u>Manning's Roughness and Losses</u>

For the proposed conditions model, the Manning's roughness coefficient assumed for the low flow channel in existing and proposed conditions is 0.035, and the overbank/floodplain roughness was assumed to 0.08 to represent the ultimate conditions of the landscaping/channel restoration (low to no maintenance) or densely vegetated areas. Note that changes were only made upstream of existing cross-section 2205. The proposed conditions model roughness is higher than the current/approved model from the DTI channel design (0.05 representing managed agricultural area/lower vegetation). For ease of comparison, a second "current" scenario was created, identical to the approved design but with higher Manning's roughness within the study area (n=0.08, consistent with the proposed conditions).

Contraction losses of 0.1 and expansion losses of 0.3 were used for the uniform channel sections and 0.3 and 0.5, respectively for sections upstream and downstream of crossing locations.

<u>Boundary Conditions</u>

The boundary conditions are consistent with the *Lower EM4 EIR/FSS*. The ultimate flow ME-D3 will match the existing flow calculated at ME-D3. Therefore, the downstream boundary condition used in the GHD model for MOC-4 / MOC-1 was assumed to match the existing conditions boundary conditions. The flood elevations in MOC-4 have been coordinated with the East Morrison Creek EIR/FSS (GHD, 2012/2013) for lands west of Trafalgar Road.

5.7.5 Model Results

The resulting existing and ultimate flood mapping is provided on **Drawings 3.1 and 7.1**.

The existing water levels at the upstream cross-section in the study area are not significantly impacted. Comparison beyond this point cannot be accurately made since the existing model did not include the culvert/driveway upstream of the Subject Lands. However, given that the flows are the same and the proposed culvert is larger than the existing culvert, the water levels further upstream of the Subject Lands should not increase. Refer to **Appendix E-1** for the model files. Under ultimate conditions, the majority of the flow will be directed away from MOC-6 and therefore the water levels and corresponding hazard limits will decrease as compared to the original approved condition.

Table 5.8: Hydraulic Model Results (Regional Storm)

HEC-RAS Cross-Section	Scenario	Regional Water Level (m)	Difference (proposed vs current approved)
2519 (u/s limit of Study Area)	Proposed (Manning's n=0.08)	179.03	-0.01
	Current (Approved 2016 design; n=0.05)	179.04	
	Current (n=0.08)	179.06	
`			
2486	Proposed (Manning's n=0.08)	178.97	-0.01
	Current (Approved 2016 design; n=0.05)	178.98	
	Current (n=0.08)	178.99	
2485	Proposed (Manning's n=0.08)	178.93	-0.01
	Current (Approved 2016 design; n=0.05)	178.94	
	Current (n=0.08)	178.96	
2464	Proposed (Manning's n=0.08)	178.91	
2463	Proposed (Manning's n=0.08)	178.89	0.12
	Current (Approved 2016 design; n=0.05)	178.77	
	Current (n=0.08)	178.78	
2436	Proposed (Manning's n=0.08)	178.82	0.32
	Current (Approved 2016 design; n=0.05)	178.5	
	Current (n=0.08)	178.53	
2346	Proposed (Manning's n=0.08)	178.79	
2345.7	Proposed (Manning's n=0.08)	178.76	
2345.4	Proposed (Manning's n=0.08)	178.71	
2345.3	Proposed (Manning's n=0.08)	178.62	

HEC-RAS Cross-Section	Scenario	Regional Water Level (m)	Difference (proposed vs current approved)
2345.2	Proposed (Manning's n=0.08)	178.59	
2345	Current (Approved 2016 design; n=0.05)	178.14	
	Current (n=0.08)	178.14	
2344.8	Proposed (Manning's n=0.08)	178.5	
2344.6	Proposed (Manning's n=0.08)	178.46	
2344.3	Proposed (Manning's n=0.08)	178.42	
2344.05	Proposed (Manning's n=0.08)	178.28	
2344	Proposed (Manning's n=0.08)	178.2	0.23
	Current (Approved 2016 design; n=0.05)	177.97	
	Current (n=0.08)	177.97	
2290	Proposed (Manning's n=0.08)	178.16	
2289.4	Proposed (Manning's n=0.08)	178.11	
2289	Proposed (Manning's n=0.08)	178.08	0.24
	Current (Approved 2016 design; n=0.05)	177.84	
	Current (n=0.08)	177.84	
2207	Proposed (Manning's n=0.08)	178.01	
2206	Proposed (Manning's n=0.08)	177.8	
2205	Proposed (Manning's n=0.08)	177.67	0.03
	Current (Approved 2016 design; n=0.05)	177.64	
	Current (n=0.08)	177.64	

In terms of riparian storage, the proposed wetland restoration design provides additional storage beyond the current channel conditions (with the exception of the 2-year event). This is likely due to the wider floodplain created through the proposed restoration/grading and the increased Manning's roughness. Note that under ultimate conditions however, the flow entering this system will be reduced based on the development of the external catchment / implementation of Pond 29. Therefore, the ultimate flood storage and floodplain within the Subject Lands will decrease. The riparian storage assessment will be revisited through future phases of development and ultimate conditions analysis.

Table 5.9: Riparian Storage Results

Design Event	Current (Approved 2016 Design)	Proposed
	(1000m^3)	**(1000m^3)**
2 Year	0.22	0.12
10 Year	0.45	1.49
25 Year	0.56	1.87
50 Year	0.6	2.22
100 Year	0.65	2.3
Regional	1.4	3.45

5.8 Preliminary Natural Channel Design Analysis

The portion of Reach MOC-6 and PSW 25 downstream of the existing online pond is proposed for restoration as part of the development of the Subject Lands. The restoration design provides an opportunity to replace the existing degraded drainage feature with a naturalized low flow channel that significantly improves form and function. In addition to the channel re-creation, the previously impacted wetland will be rehabilitated / re-instated and enhanced with online and offline wetland pockets, plantings and habitat features. An existing culvert at the upstream end of the PSW is proposed for removal and that area will be restored with a natural channel, which will improve flow conveyance to the PSW.

Reinstatement of the low flow channel and wetland naturalization provide opportunities for improved riparian conditions and a well-developed bankfull channel with morphological variability. Improvement in morphology and function provides additional benefits to sediment balance, floodplain storage, vegetation communities, terrestrial habitat features, edge impacts, water balance, fish passage and water quality. From a habitat perspective, the important contributions of the watercourse include the provision of seasonal habitat, organic inputs to the system, provision of a more complex corridor system with elements that have a wide range of hydroperiods, and aquatic and terrestrial habitat elements.

The primary objectives of the design are to:

- Restore the physical form of the channel, including planform and in-channel characteristics;
- Improve the function of the channel by increasing flow interactions with the floodplain;
- Create a floodplain that includes interconnected wet meadow features of variable depth, shape, and hydroperiod;
- Provide a mix of coarse and fine sediment sources throughout the low-flow channel and floodplain;
- Enhance aquatic habitat through the provision of a morphologically diverse channel with spatially varied flows;

- Improve riparian habitat by installing woody plantings and dynamic floodplain features; and,
- Mitigate potential hazards to the development and adjacent lands

In the development of a natural channel design, the length of the watercourse proposed to be realigned is typically replicated or exceeded, to provide an overall gain in habitat. The existing length of Reach MOC-6 proposed for realignment is approximately 180 m. It is understood that approximately 8 m of the channel at its most upstream extent will be enclosed as part of the future east-west road crossing. The designed low flow channel is approximately 205 m long. When the proposed enclosure, designed low flow channel and removal of the existing approximately 10 m long, 400 mm diameter CSP (located immediately upstream of the online pond) are considered, it results in an increased channel length of approximately 27 m.

Notably, the existing channel length measurement is based on watercourse linework available prior to significant disturbance to PSW 25 and the low flow channel was difficult to discern during field work completed in 2021 and 2022. The proposed channel will therefore result in a significant increase in the area of restored and enhanced habitat. A summary of the bankfull channel geometries, corridor requirements and wetland features is provided below. Refer to **Appendix D-1** for further details regarding the proposed design.

5.8.1 Bankfull Channel

The existing limited channel form and impacts from previous land uses along Reach MOC-6 and PSW 25 provide opportunities to improve and enhance riparian conditions and restore a well-developed bankfull channel with morphological variability. Due to significant historical channel modifications a discharge based on hydrologic modelling was determined for **Reach MOC-6** and then used to define the channel bankfull geometry. The bankfull discharge used to model the sections was assumed to be equivalent to the modelled 2-year flow, which was determined to be 0.09 m^3/s (Urbantech Consulting (2023). Proposed bankfull channel parameters are summarized in Error! Reference source not found. **5.10** and are to be refined at the detailed design stage. The proposed conceptual design is described in further detail in **Appendix D-1**.

Table 5.10: Designed Bankfull Channel Parameters for Reach MOC-6

Channel Parameter	Riffle	Pool
Bankfull width (m)	1.50	2.00
Average Bankfull depth (m)	0.11	0.19
Maximum Bankfull depth (m)	0.15	0.30
Bankfull width-to-depth ratio	10.00	6.65
Channel gradient (%)	1.20	0.30
Bankfull gradient (%)	0.30	
Radius of curvature (m) †	4	
Riffle-pool spacing (m) ††	14	
Manning's n roughness coefficient	0.03	0.04
Mean bankfull velocity (m/s)*	0.77	0.40
Bankfull discharge (m^3/s)*	0.13	0.15
Discharge to accommodate (m^3/s)	0.09	
Tractive force at bankfull (N/m^2)	18	9
Stream power (W/m)	15	5
Unit stream power (W/m^2)	10	2
Froude Number (unitless)	0.74	0.30
Max. Grain size entrained (m)**	0.02	0.01
Mean grain size entrained (m)**	0.01	0.01

† Based on bankfull gradient
†† Based on riffle gradient
* Based on Manning's equation; as pools contain ineffective space, the velocity and discharge conveyed in them are not representative
** Based on a modified Shields equation (Miller et al. 1977), assuming Shields parameter equals 0.06 for gravel

5.8.2 Corridor Sizing

With regard to delineating the hazard associated with channel migration, the MNRF treats confined and unconfined systems differently. Unconfined systems are those with poorly defined valleys or slopes well outside where the channel could realistically migrate. In unconfined systems, the hazard is assumed to be from channel migration and meander belt width delineation is typically required. Given the size of the channel compared to the floodplain, this channel can be considered unconfined. In addition, Conservation Halton has attended on-site and confirmed that a top of bank is not present, thereby confirming the system is unconfined from a regulatory perspective.

As part of the design, a meander belt width was calculated based on design bankfull dimensions to ensure that the planform has a meander belt width that falls within the proposed corridor requirements. Given the scale of the watercourse and limited migration potential for the system, the hazard limits calculated can be considered conservative. The designed meander belt widths provided are based on modelled relations from Williams (1986) (Eqs. 1 and 2), which were modified to include channel width and a factor of safety and applied using the bankfull channel dimensions. An additional 20% buffer, or factor of safety, was applied to the computed belt width values. This addresses issues of under prediction and provides a factor of safety. The bankfull channel dimensions of the proposed channel have an average width of 1.75 m. The resulting meander belt width estimates are provided in **Table 5.9**.

Table 5.11: Meander Belt Width Estimate for Realigned Reach MOC-6

Reach	Meander Belt Width (m)		Recommended Meander Belt Width (m)	Valley Bottom width (m)
	Williams – Area (1986)	Williams – Width (1986)		
MOC-6	14	12	14	20 to 25

The proposed valley corridor bottom width for **Reach MOC-6** ranges from 20 m to 25 m. It is anticipated that the channel through these sections will be stable given the low gradient and vegetation control. The predicted meander belt widths outlined above fit well within the proposed valley bottom width. It should be noted that the meander belt widths are theoretical and given the limited energy and vegetation control in the proposed system, the channel is unlikely to migrate or adjust its planform within the bounds calculated. All meander belt width calculations are based on channels where instream energy is greater than the potential resistance of bank materials. As such, they over predict the potential extent of meandering and the erosion hazard. The corridor arrangement addresses the theoretical meander belt widths and more than adequately addresses any potential erosion hazard.

5.8.3 Corridor Wetland Features

5.8.3.1 PSW 25 Wetland Design

In addition to the Reach MOC-6 channel design, several online and offline wetland features are proposed for construction in the floodplain. The wetlands aim to restore the southern portion of PSW 25 on the Subject Lands, which was impacted by previous landowners through vegetation clearing, the placement of fill and periodic ploughing. The wetland features will enhance terrestrial and aquatic habitats by increasing diversity and providing a more natural floodplain form. They also provide functional benefits such as short-term water retention and sediment banking. They will be irregularly shaped to maximize the perimeter for a given area, which increases the potential for edge effects. Submerged and dry mounds are proposed within the online wetlands to provide a topographically complex bottom to increase habitat heterogeneity.

The short-term water retention function of these wetland types helps polish water and moderate water discharge into the channel. The majority of proposed wetlands have maximum water depths of approximately 0.5 m to provide water levels that support the marsh community that was previously identified by the MNRF. Select wetlands also include a 1.5 m deep pool to accommodate potential turtle overwintering habitat; however, under existing and historical conditions, the portion of wetland to be restored does not/likely did not provide turtle overwintering habitat. The existing pond at 3301 Trafalgar Road is to be retained in the northern portion of PSW 25 and is anticipated to continue to provide turtle overwintering habitat.

It is anticipated that the wetlands will receive water 2 to 3 times annually due to contributions from snowmelt, riparian flooding and local drainage during rainfall events. A landscape architect will complete the proposed planting plan and provide the appropriate plant species for the restoration at detailed design.

5.8.3.2 Stone Core Wetland Design

Stone core wetlands are proposed at the future outfall on the east side of the NHS (further details to be provided as part of a future EIR/FSS Addendum when those lands advance), downstream of the Street A crossing and where culverts are present along the proposed trail. Construction of stone core wetlands should be completed in tandem with associated infrastructure. This will avoid potential construction challenges due to changes in tie-in elevations at detailed design as future phases proceed. It is anticipated that the stone core wetland in the southwest corner of the proposed wetland restoration area will be constructed during Phase 1, while the remaining stone core wetland outlet treatments will be constructed as part of future phases in tandem with the overall wetland restoration implementation.

These features will provide a treatment train that complements the site-level stormwater management plan. Benefits include organic inputs, temperature regulation, energy dissipation, and dispersion of flows. Additionally, by retaining flows, the wetlands can provide opportunities for infiltration, evapotranspiration, and detention. While this is referred to as a treatment train, the required MECP level of treatment for stormwater and FDC flows will be provided prior to discharge to the NHS.

The proposed wetlands should be constructed as over-excavated depressions lined with a mix of soil and granular materials to provide both depressional and subsurface storage (within the interstitial space of the sediment and soil). The stone core refers to hydraulically sized rounded stone, which is the subsurface material used to ensure wetland stability. The stone should be hydraulically sized during detailed design and include a factor of safety. The larger stone size increases stability at the maximum pipe capacity, allowing for storage and infiltration at lower flows. The short-term water retention function of these wetland types helps to polish water and moderate discharge of water into the channel (in addition to the functions provided by stormwater management infrastructure). A layer of topsoil will be installed on top of the stone cores to improve vegetation establishment.

An aggressive landscape restoration plan is proposed around the outlets to provide shading over the features. Live staking around the periphery will provide thermal mitigation through shade and will also provide a source of coarse organic matter. The incorporation of a native seed mix within the wetlands will promote polishing of flows once the vegetation has established. A detailed landscaping plan will be provided as a condition of draft plan approval.

6.0 LAND USE

6.1 General Description of Draft Plan

The Subject Lands will be developed in phases with Medium and High Density residential land uses as well as Institutional uses consistent with the Secondary Plan and Master Plan for North Oakville East. Phase 1 of the proposed Draft Plan of Subdivision (**Figure 6.1**) illustrates the proposed blocks while Figure 6.1A illustrates the proposed phasing for the Subject Lands.

The proposed Draft Plan of Subdivision protects Core 10, as defined in consultation with the Town and CH, and provides a block for the re-creation of PSW 25 in the same location, pre-disturbance, on 3275 Trafalgar Road.

The NHS, shown on the draft plan, is consistent with the NOCSS recommendations and OPA 272 policies. Permitted uses within the NHS are outlined in **Section 2**, including trails, stormwater management outfalls and road infrastructure. No development or site alteration is proposed within Core 10 with the exception of a trail within the outer portion of the 10 m dripline buffer. The NHS associated with PSW 25, outside of Core 10, will have a trail and associated culverts/stone core wetlands within the outer portion of the 30 m buffer and, when the future phases advance, one stormwater outfall is anticipated on the east side of the wetland. This future outfall is shown on **Drawing 7.1** and has been shown a minimum of 10m from the wetland in-keeping with NOCSS requirements. A minor encroachment into the 30 m wetland buffer is proposed to accommodate the alignment of William Coltson Avenue, as described earlier in **Section 5.6.4**. This encroachment will require a Permit form CH pursuant to Ontario Regulation 41/24 pursuant to CH Policy 2.48 (Public Infrastructure Utilities, Trails and Transportation).

As outlined in an email from the Town of Oakville dated July 24, 2024 (D. McPhail:P. Demczak) PSW 25 and its associated buffer, including additional compensation land (in exchange for buffer lands within the future William Coltson Boulevard right-of-way) have been identified as an NHS block within the Draft Plan of Subdivision. The Town has advised that this block should be transferred to the Town following the registration of the first phase of development. The Owner of the Subject Lands has engaged in discussions with CH's Restoration Team to ascertain whether they would be interested in undertaking the restoration works. The Town has advised that, if CH's Restoration Team is engaged, money may be collected by either CH or the Town prior to registration of Phase 1 such that CH can conduct the restoration at the appropriate time, which may be subsequent to the registration of the remaining lands on the east side of 3275 Trafalgar Road and/or subsequent to the registration of the lands at 3301 Trafalgar Road (**Appendix A-2**).

6.2 Trail Planning

Policy 7.4.7.3 of OPA 272 notes that one of the potential permitted uses in the NHS is:

iv) Trails, interpretative displays or signage or other similar passive recreation uses consistent with the purpose of the applicable designation and provided that:

- *for lands in the Linkage Preserve Area designation on Figure NOE3, such uses shall generally be located in the Linkage Preserve Area, 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 Natural Heritage System Area designation be designed and located to minimize any impact on the natural environment.*

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 however, it is our experience that MNRF is no longer involved. In addition, given recent changes to CH's plan review role, the Town will be involved in the review of the trail placement within the 10 m woodland dripline buffer.

Overall, trail planning for North Oakville East is established through the *North Oakville East Trails Plan,* May 2013 (**Figure 6.2**)*.* This document outlines the proposed trail locations within the NOESP area. The location of trails, within that document, is consistent with the OPA 272 Transportation Plan (Figure NOE4).

6.3 Location of Trails in NHS

The trail locations indicated on **Drawing 7.1** are consistent with the general requirements for recreational trails for pedestrian and bicycle use, as discussed in the NOCSS, Section 6.3.5.2 and the requirements of Policy 7.4.7.3 of OPA 272.

The trail location on Phase 1 lands will potentially cross two naturally vegetated communities, a cultural woodland and a small portion of cultural thicket. These locations were screened in accordance with the requirements of Section 3.7.2 of the EIR/FSS TOR for occurrence of significant wildlife habitat and species at risk:

- Species at Risk – Detailed ecological surveys of the Subject Lands did not identify any species listed as Threatened or Endangered on the Species at Risk in Ontario list within either of the naturally vegetated communities. As a result, there will be no impact to species at risk or their habitat associated with the trail.
- Significant Wildlife Habitat – Consideration was given to habitat types associated with CUW and CUT units, as outlined below:
    - Waterfowl Stopover and Staging Areas (Terrestrial) – Potentially associated with the CUT, this habitat type is not present as there was no evidence of seasonal flooding of this area.
    - Raptor Wintering Area/Migratory Butterfly Stopover Areas – Potentially associated with the broader area of Core 10, the small extent of CUT and CUW present on the Subject Lands are not anticipated to form an important component of this habitat type and are not considered to be part of the candidate significant wildlife habitat associated with Core 10.
    - Colonially Nesting Bird Breeding Habitat (Bank and Cliff/Ground) – Potentially associated with CUT units, no evidence of Bank Swallow or Brewer's Blackbird breeding was observed during field investigations.
    - Shrub/Early Successional Bird Breeding Habitat - Potentially associated with CUT units, the extent of this habitat on the Subject Lands is below the minimum size required.
    - Special Concern and Rare Wildlife Species – Two special concern species were identified: Monarch and Barn Swallow. Neither of these species have habitat associations with CUW and CUT communities.

The tree inventory and protection plan has been prepared as a component of the overall development application (**Kuntz, 2024).** Given the grading required, it is not anticipated that any trees will remain present within the CUW and CUT areas, however a conceptual planting plan has been prepared for the NHS with the detailed design to be provided as a condition of draft plan approval.

It is noted that an assessment, similar to that above, will be completed, as necessary, for the remainder of the trail network in subsequent phases.

6.4 Location of Roads in NHS

Significant discussion and collaboration has taken place between the Town, CH and the Study Team related to the alignment and design of the William Coltson Avenue ROW design (**Appendix A-2**). The provision of a north-south roadway (i.e., William Coltson Avenue), as identified in the NOESP, results in the need to encroach into the 30m wetland buffer in order to maintain the existing connection point at the southern limit of the Subject Lands and to maintain a safe road design through the Subject Lands. The alignment and ROW have been designed to balance the sometimes competing objectives associated with NHS buffers, transportation safety and Secondary Plan compliance.

Through the pinch-point, the ROW is proposed at 22m to minimize encroachment into the wetland buffer to the extent feasible. Refer to **Drawing 10.2A** for details. Within the 22m ROW, on the east side, 0.4m of the limestone trail will be within the ROW however, the remainder of the trail (2m) will be outside of the ROW and within the buffer to the wetland. This will result in a wetland buffer of 22.24m along a short length of the ROW (**Drawing 7.1**) and a total encroachment of the ROW into the wetland buffer of 263 m^2. To address this impact, lands have been added to the NHS at a 1:1 ratio, outside of the required buffers, as shown on **Drawing 7.1**. The majority of this added NHS area will be within 3275 Trafalgar Road however, a portion will be accommodated when 3301 Trafalgar Road develops.

Details with respect to the transportation safety aspects of the William Coltson ROW as well as the pedestrian crossing are provided in the Transportation Impact Study (TIS) (Paradigm, 2024).

7.0 GRADING, DRAINAGE AND STORMWATER MANAGEMENT

7.1 OPA 272 and NOCSS Recommendations

Preparation of the SWM Plan for the Subject Lands has been guided by OPA 272 and the NOCSS recommendations.

OPA 272 policy 7.4.5 states that,

"The management of water resources within the North Oakville East 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 7.6.2.2 a) of this Plan".

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 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.

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 5.4.1 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 update subcatchment boundaries.

Sections 7.2 and **7.3** of this EIR/FSS address drainage boundaries and present target peak flows for the East Morrison Creek Subcatchment EM4 at Trafalgar Road.

OPA 272 Policy 7.4.13.2 and the NOCSS Addendum identify that within East Morrison Creek Regional Storm controls are necessary. **Section 7.5** addresses the requirement for Regional

Storm controls.

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 Feature A; all others were defined to be Hydrologic Feature B.

The NOCSS recommended that the form and function of Hydrologic Feature 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 Feature 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 the Mediation Agreement on Depression Storage dated May 30, 2007 (see Section 7.12.2) and include providing the 2-year depressional storage volume within the total water quality (extended detention / permanent pool) volume of the pond and the greater of the 100-year / Regional storm depressional storage volume within the total storage volume of the SWM facility (permanent pool and active storage).

There are no Hydrologic Features A or B on the Subject Lands, although a depression area has been noted within the wetland at the south limit of the property (this will not be altered).

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.

Section 7.6 of this EIR/FSS presents the erosion threshold analyses and erosion control modelling required to address the NOCSS erosion control requirements.

Erosion targets were established in the approved EM4 EIR/FSS and used in the design of the approved / constructed Pond 32 on the DTI lands to the south.

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 East Morrison 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 and temperature recommendations as per NOCSS Table 6.2.1 and the Mediation Agreement on these topics.

- Chloride recommendations relate to the Town's management of salt applications and do not require any further analyses in the EIR/FSS.

Water quality control for the west side of the Subject Lands will be provided by the existing Pond 32. Future phases, east of the NHS, will require other quality control measures including, but not limited to, on-site filtration, retention/infiltration, oil/grit separators and LID measures, subject to site constraints and a future EIR/FSS Addendum.

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 and discusses LID techniques for promoting 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 East. NOCSS Figure 7.4.6 illustrates no potential SWM ponds on the Subject Lands. The western portion of the Subject Lands flow to Pond 32, which was designed to accept the flows from this portion of the Subject Lands (albeit at a lower imperviousness than what is currently proposed). As part of the future development phases, the eastern portion of the Subject Lands, the majority of which are already within the EM4 catchment area, will drain directly into MOC-6 after quality and quantity control measures are applied. Under interim conditions (i.e., prior to development of the future phases) no stormwater management measures are required east of the PSW or on the west side of the PSW on 3301 Trafalgar Road. Stormwater management for the future phases will be addressed through a future Addendum as outlined in **Section 13**.

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. Regional Storm controls are necessary for the East Morrison Creek Tributaries.

Section 5 of this Addendum presents floodline mapping for the East Morrison Creek Tributary through the Subject Lands.

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. **Section 7.3** herein presents the evaluation of alternative SWM measures.

7.2 Pre-Development Flows at Culvert Crossings

7.2.1 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 EM4 subcatchment. The NOCSS unit flow rates and the resulting pre-development flows at Trafalgar Road and Dundas Street are summarized in **Table 7.1.**

Table 7.1 – NOCSS Unit Rates for EM Subcatchment at Key Nodes

		Return Period						
		2	5	10	25	50	100	REG
		Unit Rates [m³/s/ha]*						
NOCSS Unit Rates at ME-D3		0.005	0.008	0.01	0.013	0.015	0.016	0.044
Location	Area [ha]	Existing (Target) Flow [m³/s]						
East Morrison Creek subwatershed (to culvert ME-T1)	65.38	0.327	0.523	0.654	0.850	0.981	1.046	2.877
East Morrison Creek Drainage Area at future EM-1 confluence / Node B	147.89	0.739	1.183	1.479	1.923	2.218	2.366	6.507
East Morrison Creek Drainage Area at ME-D3 / EIR/FSS Node A	310.10	1.551	2.481	3.101	4.031	4.652	4.962	13.644

*Note: these rates represent the ‘rounded’ NOCSS rates

These pre-development flows were used in the *Lower EM4 EIR/FSS* for assessing culvert capacities at Trafalgar Road and Dundas Street for the purposes of mapping the existing floodlines and defining the allowable peak flows.

7.3 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 in the development design to satisfy NOCSS SWM goals, objectives and targets. SWM for the west portion of the Subject Lands will be provided in the existing Pond 32 as originally intended. A separate SWM strategy will be required for the future phases east of PSW 25.

Stormwater management practices are specific planning and technical measures that 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 or LID 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 stormwater management measures 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 Low Impact Development (LID) techniques as outlined in the TRCA/CVC LID Guidelines (2014).

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.

The NOCSS identified examples of LID measures to include conservation of natural features (i.e., Hydrologic Features B), reducing impervious areas, bioretention areas, rain gardens, green roofs, use of rain barrels and cisterns, vegetated filter strips and permeable pavements.

The proposed development will introduce impervious areas in the form of medium and high-density residential uses, institutional uses, parking lots and roads with an overall density higher than traditional single family housing developments. The proposed urban form, as set out in OPA 272, 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 OPA 272 provide for the retention and enhancement of significant environmental areas and features to maintain and enhance the existing environmental functions and linkages throughout North Oakville. Preserve Core Areas, Linkage Preserve Areas, and High and Medium Constraint Stream Corridors combine to provide a large, connected NHS covering 603 ha or 27% of North Oakville East; 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. Due to the housing form, which includes vast areas of underground parking, opportunities to provide lot level controls are somewhat limited but could include: disconnected roof leaders, green roofs, infiltration measures and water re-use. The ability to implement these measures must be assessed at detailed design based on the geotechnical / hydrogeological conditions, 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. For the purpose of providing a site wide water balance, the LID measures that have been identified include disconnected roof leaders within the townhouse units and tree pits within the William Coltson ROW.

From a conveyance perspective, the density of development required in OPA 272 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 OPA 272 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.

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 Addendum have confirmed that the Subject Lands are characterized by silty clay till with traces of gravel, occasional sand and silt seams, cobbles, boulders and shale fragments, with limited opportunity for infiltration.

The existing end-of-pipe SWM Pond 32 is proposed to provide the required Enhanced Level of water quality control, erosion control and flood control storage volume requirements for the western portion of the Subject Lands. The eastern portion of the Subject Lands (east of the NHS), including the small area (0.51 ha) currently within the JC9 catchment area, will be directed to MOC-6. This diversion has no negative impacts to the JC-9 catchment since it is a small fraction (<0.4%) of the total JC-9 catchment area (>140 ha). Since the area and imperviousness of the western parcel are similar to the area and imperviousness accounted for in the approved Pond 32 detailed design, the need for on-site controls of the west parcel is minimized. A GAWSER verification was completed to assess the following:

1) the impact of the development on the west side of the Subject Lands on Pond 32;
2) the impact of the development on the east side of the Subject Lands on the downstream watercourse; and,
3) the impact of the proposed development on the downstream targets at Dundas Street.

Appendix E-2 includes the GAWSER model verification, which concludes that there is no impact to Pond 32, no impact on flows in the existing watercourse and associated hazard mapping and no impact to the target flows at Dundas Street (ME-D3).

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 the responsibility of the municipality. 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.

7.4 Downstream Investigations Regional Storm Controls

Policy 7.4.13.2 of OPA 272 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.

Through discussions with the Town, it has been agreed, in principle, that SWM facilities be utilized to control peak flows from the Regional Storm by providing additional runoff storage above the 100 year extended detention elevation. The Town and CH do not accept Regional storage on private site plan areas.

Pond 32 was studied, designed, and approved through the *Lower EM4 EIR/FSS* and detailed subdivision design process for the DTI lands. This facility was designed to accommodate flows from the western portion of the Subject Lands (draining to the south). Based on the foregoing, the existing SWM controls in Pond 32 will control peak flows to the NOCSS Addendum unit target flows rates for the 2 year to 100 year events and the Regional Storm for the western portion of the Subject Lands. Refer to **Section 7.6.1** for additional details pertaining to the analysis of the imperviousness level assumptions in the design of Pond 32 as compared to the proposed imperviousness level on the western portion of the Subject Lands.

The eastern portion of the Subject Lands will discharge directly into MOC-6. The GAWSER model verification analysis has confirmed the associated storage requirements to avoid impacts to the MOC-2 / MOC-4 channel flows and target flows downstream. Refer to **Section 7.6.1** for additional details.

7.5 Erosion Control Analysis

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 East Morrison Creek and continuous hydrologic modelling were completed as part of the *Lower EM4 EIR/FSS* to determine appropriate levels of discharge control for the downstream SWM pond to ensure that erosion and aggradation are not exacerbated in receiving stream system. The analysis was also utilized to evaluate the potential implications of changes in peak flows and velocities along stream reach MOC-4 and PSW 74 based on implementation of the proposed realignment and redesign of MOC-2 and MOC-2a. Additional erosion control analysis including an assessment of Cumulative Effective Work (CEW) and Cumulative Effective Discharge (CED) was completed prior to draft plan approval. This analysis, including additional continuous hydrologic modelling, was presented in two EIR/FSS Response Documents dated April 30, 2014, and June 11, 2014 that accompanied the approved Lower EM4 EIR/FSS.

7.5.1 Erosion Thresholds

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 East Morrison Creek was completed as part of the *Lower EM4 EIR/FSS* to determine appropriate levels of discharge control for SWM Pond 32 to ensure that erosion and aggradation are not exacerbated in the receiving stream system. As documented in **Section 7.6** below, no impacts to the operation of Pond 32 are anticipated to result from the proposed development and as such, no additional analysis is required.

7.6 Proposed SWM Controls and Post-Development Hydrology

7.6.1 Hydrologic Modelling

Updates to the most recent GAWSER model for the East Morrison Creek catchment were made to assess impacts to SWM Pond 32 resulting from a higher level of imperviousness for the west side of the Subject Lands as compared to the original assumptions in the *Lower EM4 EIR/FSS* (and verification of flows at Dundas Street).

Two scenarios were evaluated. In both cases, all areas are developed and SWM ponds are assumed to be in place, with the exception of the ~29 ha area tributary to future Pond 29 on the StarOak lands:

Interim "A" - both the 3275 Trafalgar Road and 3301 Trafalgar Road properties on the **west** side of the Subject Lands were assumed to be developed to evaluate the maximum potential impact to Pond 32. Since the proposed development area on the west side of the Subject Lands is slightly more impervious, albeit a smaller area than was originally assumed in the *Lower EM4 EIR/FSS* and detailed subdivision design, there are only marginal impacts to Pond 32 downstream as shown in **Table 7.2** below.

Interim "B" – the entirety of the 3275 Trafalgar Road and 3301 Trafalgar Road properties on the east and west sides of PSW 25 were assumed to be developed to assess the maximum potential impact downstream at Dundas Street (due to uncontrolled release of Regional flows through from the east portion of the Subject Lands). Refer to **Table 7.4** for the impacts at Dundas Street.

Interim "A" scenario was used to assess the impacts to Pond 32, since the east portion of the Subject Lands does not drain to Pond 32. This table compares the approved Pond 32 targets, as well as the as-built volumes to the updated results based on the proposed development on the west side of the Subject Lands.

Development of the east portion of the Subject Lands was always considered in the Pond 32 drainage area (as 2.17 ha at 78.6% imperviousness = 1.71 imp ha; the new area is 1.88 ha at 93% imperviousness = 1.75 imp ha). Overall, the total area to Pond 32 becomes slightly less impervious due to the reduction in drainage area.

The original drainage area based on the approved design was 66.38 ha at 69.2% imperviousness, for a total impervious area of 45.935 ha.

The updated drainage area is 66.09 ha at 69.5% imperviousness, for a total impervious area of 45.932 ha, which is marginally lower.

Note that the GAWSER model updates were based on the as-built rating curve for Pond 32 that was described in the approved September 2016 certification letter.

Table 7.2 – Confirmation of Pond 32 Performance (no tailwater scenario)

Events	Approved Design Flow	Approved As-built Flow	Proposed Update	Approved Design Volume	Provided As-built Volume	Proposed Update
	Final DTI Inc. SWM Report (Sept 2016)	As-constructed Certification (Sept 2016)		Final DTI Inc. SWM Report (Sept 2016)	As-constructed Certification (Sept 2016)	
	(m^3/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)
Extended Detention	0.03	0.03	0.03	12,125 (10,760)*	12,198	12,125 (10,803)*
2-year	0.34	0.377	0.340	16,514	16,932	16,415
5-year	0.52	0.54	0.529	20,396	20,579	20,268
10-year	0.65	0.67	0.657	22,829	23,692	22,846

Events	Approved Design Flow	Approved As-built Flow	Proposed Update	Approved Design Volume	Provided As-built Volume	Proposed Update
	Final DTI Inc. SWM Report (Sept 2016)	As-constructed Certification (Sept 2016)		Final DTI Inc. SWM Report (Sept 2016)	As-constructed Certification (Sept 2016)	
	(m^3/s)	(m^3/s)	(m^3/s)	(m^3)	(m^3)	(m^3)
25-year	0.77	0.80	0.789	26,955	27,168	26,898
50-year	0.90	0.92	0.912	29,405	29,525	29,299
100-year	1.04	1.07	1.055	32,082	32,404	31,970
Regional	2.40	2.40	2.362	81,970	82,935	81,541

*Note – 12,125m^3 is the extended detention volume at the extended detention elevation used for drawdown time calculations. Value in brackets is the GAWSER model volume required for the 25mm event.

As shown in **Table 7.2**, the updated flows are slightly lower than the previously approved detailed design flows and as-built model flows. Similarly, the required volumes under the proposed conditions can be provided within the as-constructed volumes. No water level changes are anticipated.

The preliminary storage volumes on the east side of the Subject Lands, which were not considered to be developed in the *Lower EM4 EIR/FSS* or subsequent detailed design submissions, have been established as follows according to the NOCSS unit rates. These targets will be re-evaluated as the subsequent phases of the development proceed through a future EIR/FSS Addendum process. The Interim "B" scenario was used for this scenario. Water quality control measures will be evaluated through the future EIR/FSS Addendum for the eastern portion of the Subject Lands. As per current Town and CH recommendations, Regional Storm control will not be proposed for the private site plan areas.

Table 7.3 – East Parcel Target Flow and Storage

East Parcel Flow Storage Targets		
Storm Event	Target Flow (m^3/s) (based on NOCSS unit rates x 1.93 ha drainage area)	Required Storage Volume (m^3)
Extended Detention	0.009	354
2-year	0.010	658
5-year	0.015	878
10-year	0.019	994
25-year	0.025	1169
50-year	0.029	1273
100-year	0.031	1462

Note that the Regional flow discharges from the storage with negligible peak flow routing (0.223 m^3/s inflow, 0.222 m^3/s outflow). This was deemed acceptable for assessing the uncontrolled regional flow impacts downstream.

At Node ME-D3 (Dundas Street), the updated flows (assuming full build-out of the EM4 catchment) have been evaluated against the NOCSS targets. As shown in **Table 7.4**, the targets are not exceeded under ultimate conditions. Note that the ultimate conditions results will be updated through completion of the EM4 Addendum supporting the Star Oak / Crystal Homes lands including Pond 29; the ultimate results noted in **Table 7.4** are therefore considered preliminary/work-in-progress.

Table 7.4 – Comparison of Flows at ME-D3

		Return Period						
		2	5	10	25	50	100	REG
		Unit Rates [$m^3/s/ha$]*						
NOCSS Unit Rates at ME-D3		0.005	0.008	0.01	0.013	0.015	0.016	0.044
Location	Area [ha]	Existing (Target) Flow [m^3/s]						
East Morrison Creek Drainage Area at ME-D3 / EIR/FSS Node A	310.10	1.551	2.481	3.101	4.031	4.652	4.962	13.644
Interim "A" – Flows at ME-D3 / EIR/FSS Node A	329.31	1.240	2.264	2.858	3.718	4.278	5.000	14.283
Interim "B" - Flows at ME-D3 / EIR/FSS Node A	329.80	1.240	2.258	2.851	3.707	4.269	4.988	14.349
Ultimate – Flows at ME-D3 / EIR/FSS Node A	325.99	1.233	2.211	2.753	3.574	4.111	4.743	13.586

Under interim conditions, there are exceedances of the 100-year and Regional storm targets. However, this exceedance is not attributed to the development of the Subject Lands, but rather the combination of peak flow timing between existing and developed areas. This was described as follows in the approved SWM report for Pond 32 (September 2016).

Under interim conditions, a portion of the catchment is developed and controlled by SWM facilities while the rest of the catchment (i.e., approximately 29 ha west of Trafalgar Road) is considered as existing conditions. Therefore, one would intuitively assume that the smaller drainage area, reduced imperviousness, and partial SWM control plus pre-development areas would result in lower peak than the ultimate conditions model. However, as shown in the preceding tables, the interim peak flows at Point A exceed the target flows for the infrequent events.

The following items were considered and *ruled out* as the source of the increase in flows:

- **Insufficient SWM controls** - All development areas are controlled by SWM facilities that restrict flows to the NOCSS unit rates for node ME-D3 or lower. For example, Pond 32 provides overcontrol beyond the NOCSS targets. Therefore, the increase in interim flows is not caused by insufficient SWM controls.

- **Increased Drainage Area** - The effects of the larger drainage area (compared to pre-development conditions) is eliminated by the SWM facilities, which control post-development flows to the pre-development targets for the pre-development drainage areas. Therefore, the increase in interim flows is not caused by a larger drainage area.

The cause of the increase was linked to changes in undeveloped areas. The remaining pre-development drainage areas are less than or equal to the pre-development areas and have been disaggregated from the original NOCSS (larger) catchments. A significant difference was noted between flows generated by the pre-development catchments tributary to the MOC-2 and MOC-4 watercourse and the discretized NHS areas modelled under interim conditions (i.e., the C1 / C2 areas). Despite the fact that these areas are modelled with pre-development parameters, the fact that they have been discretized / modelled as separate catchments compared to the pre-development NOCSS model results in unit rates higher than the pre-development values.

The Pond 32 SWM report completed for DTI (September 2016) includes a detailed comparison of unit rates calculated for the disaggregated catchments vs the applicable NOCSS targets. The increase in interim peak flow results from the GAWSER model interpretation of the discretized areas versus the pre-development lumped areas, specifically the NHS / open channel corridor area which has been divided into multiple catchments to generate peak flows at different points along the channel. The interim flow exceedance is an artifact of the modelling approach only, rather than a result of insufficient SWM controls or the addition of uncontrolled, developed areas. Due to the changes in the GAWSER model hydrology resulting from discretization of the natural heritage areas, the interim flows increase slightly, but only due to the modelling approach. If the existing drainage area was similarly discretized, it is expected that the existing peak flow targets would be consistent with the modelled interim peak flows. This issue is resolved under ultimate conditions.

7.7 Conveyance of Minor System Flows

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 the Town's IDF curves. The storm sewer design has taken into account the major system capture areas / low points where all surface flows must be directed into the minor system. These areas are illustrated on **Drawing 7.4**. The minor system design calculations are included in **Appendix F-1.**

The storm flows on the west side of the Subject Lands will be directed to the existing Pond 32 (north corner of Dundas Street East and Trafalgar Road), where the runoff will be treated for water quality and quantity control.

The storm flows on the eastern side of the Subject Lands will not drain to Pond 32 due to grading constraints. Storm flows from this area will be directed to MOC-6 / PSW 25 via quantity and quality controls.

External storm flows are conveyed from Street A and future development lands to the north (Tribaden Investments Inc.) and west of Trafalgar Road (Mel-Oak) directed to PSW 25 via quantity and quality controls, including future SWM Pond 29 (SWMP 29). Sizing of external infrastructure will be refined in the future in coordination with upcoming EM4 addendum(s) associated with future development lands.

The conceptual storm servicing scheme is illustrated in **Drawing 7.4.**

7.8 Conveyance of Major System Flows

A continuous overland flow route has been provided on the Subject Lands in order to safely convey major system flows in excess of the minor system up to the 100 year event. The excess flows will be contained within either the private right-of-ways or on public roads or easements. 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 $0.65m^2/s$.

The storm flows on the west side of the Subject Lands will be directed to the existing Pond 32 where the runoff will be treated for water quality and quantity control.

The storm flows on the east side of the Subject Lands will not drain to Pond 32 due to grading constraints. Storm flows from this area will be directed to PSW 25 via quantity and quality controls.

External storm flows are conveyed from Street A and future development lands to the north (Tribaden Investments Inc.) and west of Trafalgar Road (Mel-Oak) directed to PSW 25 via quantity and quality controls, including future SWMP 29. Sizing of external infrastructure will be refined in the future in coordination with upcoming EM4 addendum(s) associated with future development lands.

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. Calculations for the critical locations on site (i.e., narrowest right-of-way vs. highest accumulated flow) are included in **Appendix F-1.**

The conceptual major storm system is illustrated in **Drawing 7.4**.

7.9 PSW Drainage

One PSW (PSW 25) is located within the Addendum EIR Subcatchment Area. This PSW has been studied to address potential impacts of changes to runoff volumes resulting from development in its surface water catchment and identify mitigative measures under both interim (Phase 1) and ultimate development condition in the EM4 subcatchment. Refer to **Section 8.9** for additional discussion on this PSW.

The surface water inputs to PSW 25 were evaluated under existing and interim (Phase 1) conditions. **Section 8.9** describes the water balance analysis, results, and required mitigation to ensure that the post-development runoff discharged into the PSW is consistent with existing conditions such that the form and function of the PSW is not negatively impacted.

7.10 Preliminary Grading Plans

A preliminary grading plan has been prepared for the Subject Lands based on the engineering constraints such as NHS limits, servicing and proposed road patterns. The conceptual grading is illustrated in **Drawing 7.1** and conceptual grading cross sections are provided in **Drawing 7.2**.

The grading strategy is consistent with the Town's standards and compatible with the NOCSS recommendations for grading adjacent to the NHS. In this regard, preliminary grading of all lots/blocks adjacent to Cores include appropriate freeboard from the regulatory floodline along the existing (and future) NHS boundaries. Based on the Town's North Oakville Trails Plan, a trail surrounding the perimeter of the NHS is required (i.e., within the 30 m wetland buffer, within the 10 m woodland dripline buffer and within 7.5 m of the greater of the Regional Storm flood plain or the meander belt).

Once detailed design proceeds, changes to the preliminary grading plan may result in additional grading into the buffers and will be implemented in accordance with NOCSS recommendations (i.e., no grading within 1 m of dripline or within 10 m of a PSW and grades not to exceed 3:1 slopes).

8.0 WATER BALANCE

In order to assess potential development impacts of Phase 1 on the local groundwater resources, a site wide water balance and a feature-based water balance analysis have been completed to determine the pre-development recharge volumes (based on existing land use conditions) and the post-development recharge volumes that would be expected based on the proposed land use plan. The detailed site wide water balance calculations are provided in **Appendix C-5**. The detailed feature-based water balance calculations are provided in **Appendix D-3**.

The Thornthwaite water balance (Thornthwaite, 1948; Mather, 1978; 1979) is an accounting type method used to analyze the allocation of water among various components of the hydrologic cycle. Inputs to the model are monthly temperature, site latitude, precipitation, and stormwater run-on. Outputs include monthly potential and actual evapotranspiration, evaporation, water surplus, total infiltration, and total runoff.

8.1 Components of the 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 average annual precipitation for the area is 897 mm based on long-term data (1981 to 2010) from the Hamilton RBG climate station (Station 6153300 - 43°16.8′N, 79°52.8′W, elevation 102.1 masl) for the period between 1981 and 2010. The average monthly precipitation totals are provided on **Table 2** in **Appendix C-5**.

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 annual ET 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 shallow soil 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. Interflow tends to move relatively quickly and often re-emerges locally as seepage at the ground surface. Typically, the horizontal hydraulic conductivity of the shallow soil profile tends to be higher than the vertical hydraulic conductivity, aiding lateral interflow. Fracture patterns in the relatively low hydraulic conductivity till that blankets the EIR Subcatchment Area may also affect the shallow water movement.

Interflow is more closely associated with runoff (because of its relatively short residence time) than with baseflow which is fed by groundwater (net recharge). As such, interflow is considered as 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 distinguish between interflow from direct runoff and baseflow is not a simple task. This is related to the complexity of subsurface geological and hydrogeological environments. Because of this, there has been a lack of adoption of a standard separation or partitioning method and therefore, interflow and direct surface (overland) flow are simply considered together as the total runoff component in this report.

8.2 Approach and Methodology

The analytical approach to calculate a water balance for Phase 1 involved monthly daily average temperature to determine the actual evapotranspiration and the corresponding water surplus components. A soil-moisture balance approach assumes that soil does not release water as "potential infiltration" 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 (deep infiltration).

The water holding capacity of the surficial soils depends on the types of soil as well as the type of vegetation and rooting depth. A soil moisture storage capacity of 100 mm was utilized to represent the clayey silt till soils and predominantly short-rooted vegetation (grassy open space and agricultural fields) and a soil moisture capacity of 250 mm was used to represent the more deeply-rooted wooded areas within the EIR Subcatchment Area (i.e., the Core 10 area). Monthly Potential Evapotranspiration is provided **Appendix H of Appendix C-5** and details the monthly potential evapotranspiration calculations accounting for latitude and climate, and then calculate the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions.

The infiltration and runoff volumes for Phase 1 were then calculated for the pre-development (based on the existing land use) and post-development (based on the proposed development concept plan) conditions. The MOE SWMP Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover, was used for the soil moisture storage conditions for both pre- and post-development conditions. The annual pre-development and post-development water balance component calculations are shown in **Tables 4 and 5** in **Appendix H of Appendix C-5**.

As noted in **Section 8.1**, the infiltration component will divide into shallow interflow and deeper groundwater recharge components. Although there is no specific methodology for calculating this division of flow and few studies have attempted to quantify this value with any degree of precision, reasonable estimates can be made based on the nature of the surficial soils. For soils underlain by very permeable sand, it is considered that the interflow component would likely approach 0% with most of the infiltrating water moving vertically to recharge the water table. For soils underlain by very low hydraulic conductivity sediments, the interflow component would likely approach 100%, with most of the water that infiltrates into the topsoil layer just seeping along the topsoil/till contact to re-emerge locally at surface. Although the topsoil in the EIR Subcatchment Area is underlain by low hydraulic conductivity till sediments, fracturing may improve the recharge capabilities. In water balance analyses completed for the North Oakville East Subwatershed Study (NOMI, 2004), an interflow component value of 50% of the total infiltration was found to correlate reasonably well with numerical modeling results of the regional groundwater flow conditions. Therefore, this estimate has been utilized in this study to calculate the effective recharge and total runoff components of the water balance (**Tables 4 and 5, Appendix C-5**).

The calculated water balance components are utilized to assess the pre-development infiltration volumes based on the existing land use characteristics within the Phase 1 Area. Then a post- development water balance scenario is calculated based on the proposed land development plan to assess the potential impacts of development on the local groundwater resources. It is noted that the calculations are completed assuming no mitigation strategies or LID measures for SWM and infiltration are in place (i.e., the calculations present a 'worst-case scenario' of the potential reductions in infiltration that may occur in the developed area). As noted in **Section 8.8** however, LID measures are recommended for the development; the worst-case scenario calculations are simply intended to identify the need for LIDs and aid in the analysis of potential impacts on natural features.

The post-development land uses have been broken down into land use categories and assigned an average percentage of imperviousness for the water balance calculations as summarized in **Table 8.1**.

Table 8.1 Water Balance Land Use Categories (Phase 1)

Land Use Category	Total Area (ha)
Building Roofs	0.036
Impervious Area	0.699
Landscape Area	0.300
Total Area (Phase 1)	1.035

8.3 Component Values

The detailed calculations of the water balance components are provided in **Appendix H** in **Appendix C-5**. The calculations indicate that there is an annual water deficit of 68% as a result of the proposed Phase 1 development. The water balance calculations illustrate how infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements.

The calculations provide estimates of the annual water balance component values (**Tables 4 and 5, Appendix C-5**). A summary of these values is provided in **Table 8.2** (note that the values from **Tables 4 and 5** in **Appendix C-5** have been rounded accounting for the minor variances in balance additions).

Table 8.2 Water Balance Component Values

Water Balance Component	Phase 1 (m^3)
Average Precipitation	9,285
Actual Evapotranspiration	1,889
Water Surplus	7,396
Recharge	150
Interflow (indirect runoff)	150
Total Infiltration	300
Direct Runoff	6,946
Total Runoff (direct and indirect components)	7,096 m^3/a

It is acknowledged that the recharge and runoff values presented in **Table 8.2** are estimates. Single values are utilized for the water balance calculations, but it is important to understand that infiltration rates are dependent upon the hydraulic conductivity of the surficial soils which may vary over several orders of magnitude. As such, the margins of error for the calculated infiltration and runoff component values are potentially quite large. These margins of error are recognized, but for the purposes of this assessment, the numbers used in the water balance calculations are considered reasonable estimates based on the site-specific conditions and useful for comparison of pre- to post-development conditions. The estimates for groundwater recharge are consistent with the previous subwatershed studies completed for the area, including the NOCSS (2006) and NOMI (2004) studies, and a comprehensive hydrogeological study of aquifers throughout the Region that included regional groundwater flow modeling by Holysh (1995).

8.4 Pre-Development Water Balance (Existing Conditions)

A summary of the pre-development Phase 1 site coverage is provided in **Table 8.1**. The pre-development water balance calculations ,based on the existing land use, are presented in **Appendix H** of **C-5**. The building roof area, impervious area and landscaped areas of the site and the water balance component values from **Table 2, Appendix C-5** were used to calculate the average annual volume of recharge and run-off that occurs across the proposed Phase 1 development area. Based on the component values, the average pre-development recharge/infiltration volume is estimated to be approximately 936 m^3/year, while run-off was determined to be 2,452 m^3/year (**Table 4, Appendix C-5**). It is noted that recharge rates are based on estimated average component values and assumed consistent soil and drainage conditions across the Subject Lands. The calculated numbers are considered as reasonable representations of the magnitude of the recharge volume, not the precise volume that occurs.

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; however, this is relatively minor (estimated to be 10% to 20% of precipitation) compared to the evapotranspiration component that occurs with vegetation (65% to 70% of precipitation) in this area. 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.

Therefore, the increase in run-off at the site is the result of developing and installing hard surfaced or impermeable areas within Phase 1.

Based on the water balance calculations, infiltration values were determined to decrease.

8.6 Post-Development Water Balance

The proposed Phase 1 development concept is provided on **Figure 6.1A**. As described in **Section 8.2**, the FSS Study Area has been broken down into proposed land use areas and each land use has been assigned an average percentage of imperviousness as summarized in **Table 8.1**. As discussed in **Section 8.2**, these data have been used to calculate the potential post-development runoff and recharge volumes assuming no mitigation or LID measures are in place. The calculations are presented on **Table 2, Appendix C-5**.

The building roofs area, impervious area, and landscape area of the site, and the water balance component values from **Table 2, Appendix C-5** were used to calculate the average annual volume of recharge that occurs across the proposed Phase 1 development area. Based on the component values, the average post-development recharge/infiltration volume was estimated to be approximately 300 m^3/year, while the run-off was determined to be 7,096 m^3/year (**Table 5, Appendix H** of **Appendix C-5**). It should be noted that recharge rates are based on estimated average component values and assumed consistent soil and drainage conditions across the Subject Lands. The calculated numbers are considered as reasonable representations of the magnitude of the recharge volume, not the precise volume that occurs.

8.7 Comparison of Pre- and Post-Development Water Balance

A comparison of pre-and post- development water balance is present in **Table 8.3**.

Table 8.3 Comparison of Pre and Post-Development Water Balance

Development Phase	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)
Pre-Development	9,285	5,896	936	2,452
Post-Development	9,285	1,889	300	7,096

Comparatively, the pre- and post-development calculated volumes indicate that there is potential for a decrease in recharge to the groundwater regime of about 68% (from 936 m^3 to 300 m^3).

The increase in run-off from 2,352 m^3 to 7,096 m^3 is the result of the construction of hard surfaces or impermeable areas within Phase 1. The post-development impermeable areas also result in the decrease of evapotranspiration and infiltration across Phase 1.

The above-noted values and associated detailed calculations presented in the detailed water balance calculations in **Appendix C-7** are considered to be conservative and based on the following assumptions:

- No infiltration will occur beneath the internal roads, public walkways, buildings or driveways.
- No evapotranspiration will occur from the internal roads, public walkways, buildings or parking areas.

The site is considered not to have significant amounts of groundwater recharge due to the relatively low-permeable soils encountered at surface. Infiltration value is expected to decrease from 936 m^3/year to 300 m^3/year, based on the water balance calculations detailed in **Appendix H** of **Appendix C-5**.

8.8 Low Impact Development (LID) Measures

Low impact development (LID) measures are proposed to be included in the design of the development towards addressing the infiltration deficit of 636 m^3. The LID measures to be implemented include roof leader disconnection with discharge to pervious area and tree pits on William Coltson Avenue within Phase 1.

8.8.1 Roof Leader Disconnection

Based on the Water Balance calculations in **Appendix H** of **Appendix C-5**, building roof run-off, from the townhouse units, was determined to be 327 m^3. This is regarded as contribution to recharge from roof leader disconnection and discharge and subsequent infiltration to pervious areas.

8.8.2 Tree Pits

Tree Pits are proposed to make up for remaining 309 m^3 of infiltration deficit.

It is understood that the typical tree pit will be 1.0 m in radius and typically 0.75 m deep. The storage capacity for tree pits is therefore approximately 0.72 m^3 based on a porosity value of 30% for the mainly clayey silt soils. With 48 events per year, the volume available for recharge per year from a tree is approximately 34.56 m^3/year.

It is anticipated that the tree pits will receive runoff from the area immediately around the tree pit and that the tree pits will receive the first 5 mm of every storm event. As per the climate normal data from the Hamilton RBG climate station, there are about 48 events per year that meet the greater than or equal to 5 mm threshold. This number of events was used to estimate the annual volume being infiltrated by the tree pits.

With 48 events of 5 mm storm events per year, the volume available for recharge per year from a tree is approximately 34.56 m^3/year. Based on the foregoing, approximately nine tree pits (309 m^3/year/34.56 m^3/year) will be required to meet the water balance deficit of 309 m^3. **Table 8.4** summarizes the post-development recharge with LID measures.

The tree pits are proposed along the future William Coltson Avenue as shown on **Figure 7**, **Appendix A** of **Appendix C-5** and are shown on the landscaping plans.

Table 8.4 Post-Development Recharge with LID Measures

Post-Development Deficit (m^3/year)	Rooftop Downspout Disconnection (m^3/year)	Tree Pit (m^3/year)	Post Development Deficit (m^3/year)
636	327	309	0

Based on the above a combination of downspout disconnections and tree pits will result in a recharge condition that meets the pre-development recharge condition.

8.9 Water Balance Impact Assessment

8.9.1 Water Quantity

The increases in surface water runoff that will occur with urban development are typically addressed through the use of appropriate SWM techniques and best management practices to control the runoff volumes. 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 urban development suggests that, without mitigation, the developed area will receive a reduction of about 68% to the current amount of average annual recharge (refer to **Section 8.6**). As discussed in **Section 4.6.4**, the natural recharge conditions in the subcatchment are limited due to the low hydraulic conductivity surficial soils and gradients. The reduction in recharge that may occur with land development is not expected to result in any significant impacts to the local groundwater flow patterns but there is potential to lower the groundwater table. During construction dewatering requirements are outlined in **Section 11.6**. Underground parking structures are proposed to be bathtubbed. As a result, no mitigation measures (i.e., foundation drain collection system) are required.

Monitoring that was completed as part of the *Lower EM4 EIR/FSS* illustrated that the seasonal high water table conditions are important for the vegetation in PSW 25, downstream of the Subject Lands, and for contributing to seasonal discharge in specific areas along the East Morrison Creek East Tributary watercourse (i.e., areas where the seasonally high water table intersects the ground surface of the channel resulting in seepage; refer to Sections 4.6.2 and 4.6.5 in the *Lower EM4 EIR/FSS*). Although the groundwater discharge volumes are also minor (because of the low hydraulic conductivity soils, gradients and limited recharge conditions), it is important to maintain the local groundwater table conditions along the watercourse channels such that the discharge conditions can be maintained. Therefore, it is recommended to minimize potential changes to the water balance, where possible, through the incorporation of LID measures into the stormwater management strategy for the development. These LID measures are discussed in **Section 8.8**. Of note, groundwater discharge was not identified along MOC-6 within the Subject Lands.

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. Over the long term, these impacts can lower the groundwater table across the subcatchment. Services will be constructed to prevent redirection of flow and overall lowering of the water table. This will involve the use of trench collars or clay plugs to provide barriers to flow and prevent groundwater flow along granular bedding material (**Section 11.3**).

In addition to buried services, underground parking structures will be bathtubbed (thereby having no impact on the groundwater)

8.9.2 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. With the exception of the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater transport through the soils, and therefore, the potential for effects on local groundwater quality from infiltration in the urban areas is expected to be limited. The natural groundwater quality in this area is considered poor, and any potential changes to the groundwater quality would not be expected to influence conditions in surface water features where groundwater discharge occurs.

8.9.3 Private Services

The proposed development will be serviced by municipal water supply and wastewater services. As a result, there will be no impact on the local groundwater or surface water quantity and quality conditions related to any on-site groundwater supply pumping or disposal of septic effluent. Any existing wells and septic 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 **Section 11.10**.

8.10 Water Balance Mitigation Measures

LID techniques to minimize urban development impacts on the water balance will be incorporated into the SWM plans for the development. Techniques to maximize the water availability for infiltration, such as designing grades to direct roof runoff towards pervious areas where possible (e.g., lawns, side and rear yard swales predominantly associated with the church) and increasing topsoil thickness (to about 300 mm) to help to retain moisture for infiltration, can increase recharge in developed areas and reduce the volume of runoff directed to SWM facilities. Incorporating such SWM techniques into the development design can also help to minimize development impacts to the water balance by reducing the post-development groundwater recharge deficit. It is noted, however, that choosing such LID options in unsuitable soils can lead to undesirable wet soil conditions and possible water ponding at grade.

The relatively low hydraulic conductivity of the local surficial till and shale materials limit infiltration potential. Large engineered facilities or constructed ‘active’ infiltration measures, such as infiltration trenches, pervious storm pipe systems and infiltration pits, are generally not considered suitable for the development given this hydrogeological setting as well as the proposed underground parking which will occupy a significant area of the eastern and western portions of the Subject Lands. As noted earlier, opportunities to improve water balance include disconnected roof leaders / townhouse rooftops directed to pervious areas and the use of tree pits within the William Coltson ROW.

8.11 Feature Based Water Balance to Provincially Significant Wetland

8.11.1 Background

One PSW (PSW 25) is located within the EIR Subcatchment Area.

This PSW has been studied to address potential impacts of changes to runoff volumes resulting from development in its surface water catchment and identify mitigative measures under both interim and ultimate development conditions in the EM4 subcatchment.

The following report sections outline existing PSW drainage conditions, areas, water balance analyses, recommended mitigation and implications to wetland vegetation.

8.11.2 Existing PSW Conditions

Figure 5.2 illustrates the PSW 25 wetland vegetation units on the Subject Lands. The portion of PSW 25 located on the Subject Lands includes a Mineral Cattail Shallow Marsh (MAS2-1) community surrounding a Shallow Aquatic (SA) community. The MAS2-1 community is dominated by Hybrid Cattail (*Typha xglauca*), with Narrow-leaved Cattail (*Typha angustifolia*) also abundant. Other vegetation species within the community include Climbing Nightshade (*Solanum dulcamara*), Reed Canarygrass (*Phalaris arundinacea*), Purple Loosestrife (*Lythrum salicaria*), and Lance-leaved Aster (*Symphyotrichum lanceolatum*). Furthermore, a patch of Common Reed (*Phragmites australis* ssp. *australis*) is located at the southern end of the MAS2-1 and extends beyond its boundaries into an anthropogenically disturbed area. South of these communities, PSW 25 has been heavily impacted by pre-existing agricultural and other activities on the Subject Lands to the point where wetlands are no longer present until the Core 10 woodlands are reached.

Wildlife investigations completed on the Subject Lands determined that the SA community associated with the online (fire) pond is providing habitat for species of turtles and amphibians, with Midland Painted Turtle, Spring Peeper, American Toad, Gray Treefrog, and Green Frog recorded within the pond. Red-winged Blackbirds were observed calling from the MAS2-1 community associated with PSW 25, and both Barn Swallows and Tree Swallows were observed foraging over the SA community associated with the wetland.

Within Core 10, the *Lower EM4 EIR/FSS* described PSW 25 as follows:

- The middle portion of PSW 25 (upper Reach MOC-2 between points B and C on Figure 7.2c of the *Lower EM4 EIR/FSS*) is defined by the watercourse flowing through a maple mineral swamp, west of primarily lowland deciduous forest types and east of dry-fresh to fresh-moist deciduous forest types. The channel is well defined at this location and enters portions of red-osier mineral thicket and silver maple swamps.

- The lower portion of PSW 25 (upper Reach MOC-2 between points C and D on Figure 7.2c of the *Lower EM4 EIR/FSS*) occurs where the watercourse flows southwesterly through a riparian lobe at the south end of the wetland, comprising primarily reed canary grass/forb mineral marshes and some cattail shallow marsh in the wettest deepest portions. Individual trees (ash, elm, willow) are scattered along the well-defined, likely historically, ditched channel.

  Within the *Lower EM4 EIR/FSS*, it was noted that monitoring in the PSW found water in the spring, but on the other monitoring occasions throughout the year, the wetland did not exhibit surface water. As such, this wetland typically is flooded in the spring but dries out in the summer months, with occasional inputs of water during storm events. As discussed in the *Scoped EM4 EIR/SWM Report*, groundwater monitoring at piezometers installed along PSW 25 showed relatively high water table conditions in the wetland. The groundwater levels are seasonally at or above ground surface with the exception of the northern area of the wetland within Core 10, where the spring groundwater levels were found to remain about 1 m below grade. When the water table is below grade and there is standing water in this area, there is a downward gradient (i.e., upper portion of the wetland has a recharge function). Occasional seasonal groundwater discharge to surface has been observed in the lower portion of the PSW, but flow is rarely recorded down-gradient of the PSW indicating the discharge volumes are very limited and are either taken up by vegetation or simply re-infiltrated downstream along the channel.

It was concluded in the *Lower EM4 EIR/FSS* that the high water table conditions may assist in supporting the wetland vegetation; however, much of the wetland area generally loses water to the subsurface, and in those lower areas where seasonal discharge occurs, the groundwater discharge volumes are not sufficient to maintain standing water or baseflows. The wetland primarily relies on precipitation and surface water runoff for water supply.

The location of PSW 25 within the EM4 subcatchment is shown on **Figure 7.3** (pre-development drainage) and **Figures 7.5** and **7.5A** (interim and ultimate post-development drainage). As shown, a number of different tableland areas contribute overland flow to PSW 25, some of which contribute to other areas, and some of which are entirely within Core 10. **Figures 7.3**, **7.5** and **7.5A** (interim drainage) illustrate the portions of the Subject Lands directed to PSW 25. This does not include the total drainage area to the feature, which includes additional areas from the Shieldbay Inc. and DTI lands. **Table 8.3** is a high-level comparison between the various scenarios to indicate the size and location of the contributing areas associated with the study area only. There is an overall increase in impervious area (and hence, runoff) directed to PSW 25 as shown in **Table 8.5**.

Table 8.5 – Contributing Drainage Areas to PSW 25

Overview Description	Existing Area (ha) (Drawing 7.3)	Proposed / Interim Area (ha) (Drawing 7.5A)	Proposed / Ultimate Area (ha) (Drawing 7.5)
External to Subject Lands, the majority of which is located west of Trafalgar Road; developable; flow contributions to upstream end of PSW 25	34.2 (0% IMP)	33.95 (10% IMP)	29.2 ha (0% IMP) + 3.80 ha (90% IMP)
Study Area	7.42 (0% IMP)	6.13 (0% IMP) + 0.13 (65% IMP)	0.13 ha (65% IMP) + 2.4 ha (90% IMP) + 0.19 ha (25% IMP) + 3.12 ha (0%IMP)
Total	41.62 ha 0%IMP *IMP Area = 0 ha*	40.21 ha 9% IMP *IMP Area = 3.61 ha*	38.84 ha 15% IMP *IMP Area = 5.83*

8.9.3 Water Balance Analyses

The potential changes in impervious cover and change in catchment size associated with the development of Phase 1 were assessed against the TRCA's Wetland Water Balance Risk Evaluation (TRCA 2017). Through this analysis it was determined that:

- There are no locally significant recharge areas identified;
- The development of Phase 1 would result in a low magnitude of change in impervious cover within the catchment area (Impervious Cover Score of 1.6% increase in impervious cover) and a low magnitude of change in catchment area for PSW 25 (2% reduction); and,
- The development of Phase 1 would have a low magnitude of water takings required (50,000 to 400,000 L/d for <6 months; see **Section 11.6**).

Given this, it was determined by the risk evaluation that there is a low magnitude of hydrological change, resulting in a low risk to PSW 25 from the changes to the water balance.

Notwithstanding this low risk, a water balance assessment was conducted to assess potential impacts to PSW 25 associated with the Phase 1 development within the Subject Lands. The upstream portion of PSW 25, located within the Subject Lands, was historically disturbed by activities from a previous landowner, resulting in a lack of wetland communities at this location. Therefore, the majority of the upper portion of PSW 25 is proposed for restoration as part of the ultimate development plan. Existing runoff to the upper, degraded portion of PSW 25 was compared against Phase 1 post-development runoff volumes to determine the extent and potential impact of the development on the wetland restoration plan and the downstream portions of PSW 25.

Under existing conditions, runoff to the upper portion of PSW 25 originates from the Upper EM4 subcatchment located west of Trafalgar Road, and from the Subject Lands. Pre-development, the entire Phase 1 development area (1.04 ha) drains to PSW 25 via overland flow. Following development of the Phase 1 lands, drainage to upper PSW 25 will consist of the Upper EM4 subcatchment, undeveloped lands within the Subject Lands, and a small portion (0.13 ha) of the Phase 1 lands. The remaining 0.91 ha from the Phase 1 lands will be directed south to SWM Pond 32. Under existing, Phase 1 and ultimate conditions (full development of the EM4 catchment), the total drainage areas to upper PSW 25 are 41.6 ha, 40.7 ha and 38.8 ha, respectively. The pre- and post-development contributing areas to PSW 25 are provided in **Table 8.6.**

Table 8.6 - Contributing Drainage Areas to the Upper Portion of PSW 25

Scenario	Total drainage to upper PSW 25	Phase 1 Lands	Proportion of Phase 1 drainage to upper PSW 25
Existing	41.6 ha	1.04 ha	2.5%
Phase 1 post-development	40.7 ha	0.13 ha	0.32%

Scenario	Total drainage to upper PSW 25	Phase 1 Lands	Proportion of Phase 1 drainage to upper PSW 25
Ultimate Scenario	38.8 ha	0.13 ha	0.34%

Existing runoff contributions to upper PSW 25 were assessed using the catchment-scale continuous hydrologic simulation model developed for the EM4 catchment as part of the urban planning review process for the DTI/SBI Final EIR/FSS. Existing runoff contributions specific to Phase 1 lands were derived from the site-wide water balance for the Subject Lands detailed in **Section 8.7**. While the two models use different methods and are based on different spatial scales, the site-wide water balance estimates provide a reasonable estimate of Phase 1 contributions relative to the total catchment runoff to PSW 25 derived from the catchment-scale model. The results from the catchment-scale and site-scale hydrological models are summarized below as average annual and seasonal runoff volumes in **Table 8.7.** The Phase 1 lands contribute 3.5% of the average annual growing season runoff (i.e. April-October) while covering approximately 2.5% of the total PSW 25 catchment area, indicating the runoff calculations from the site-wide water balance area are consistent with the Phase 1 contributing area size as a proportion of the total contributing area.

Table 8.7 – Runoff volumes (m^3) to PSW 25 – Existing Conditions

Period	Catchment-scale model EM4 (m^3)	Site-scale model Phase 1 lands (m^3)	Proportion of total catchment runoff Phase 1 (%)
"Annual" (April – October)	42,143	1,471	3.5%
Seasonal			
Spring (April – May)	14,033	693	4.9%
Summer (June – August)	16,931	480	2.8%
Fall (September – October)	11,318	298	2.6%

Following the Phase 1 development, the contributing area to PSW 25 from Phase 1 lands will be reduced by 0.91 ha (81%). Although the proportional pre- to post-development reduction in Phase 1 contributing area to PSW 25 is significant, it is important to note that the Phase 1 lands occupy approximately 14% of the Subject Lands with the remaining portions either protected NHS areas or undeveloped lands. Based on the site-wide water balance, runoff contributions from Phase 1 lands will decrease by 81.4%, from 1,471 m^3 pre-development, to 273 m^3 post-development during the growing season.

Reductions in runoff to PSW 25 resulting from the Phase 1 development were assessed at a catchment-scale by subtracting the Phase 1 existing runoff volumes from the estimates obtained from the catchment-scale model, which did not incorporate development within the Subject Lands. These estimates are considered provisional as they do not account for future development within the PSW 25 catchment area. Pre- and post-development runoff volumes to PSW 25 following the Phase 1 development are provided in **Table 8.8**. Results demonstrate that during the provisional condition, there is an estimated annual runoff reduction of 1,198 m^3 to PSW 25, representing a 2.8% reduction in total runoff to the upper portion of PSW 25. The reduction in runoff is minimal, suggesting that the Phase 1 development will not negatively impact the wetland restoration plan or the downstream portions of PSW 25. The reduction in runoff volume to PSW 25 attributed to the Phase 1 development are anticipated to be temporary, with surplus runoff expected from the portion of the Subject Lands proposed for future development.

Table 8.8 – Catchment-scale Pre- and Post-Development Runoff to PSW 25 (Phase 1)

Period	**Pre-development** (m^3)	**Post-development** (m^3)	**Pre- to Post-development change** (m^3)	**Pre- to Post-development change** (%)
Annual (April – October)	42,143	40,945	-1198	-2.8
Seasonal				
Spring (April – May)	14,033	13,469	-564	-4.0
Summer (June – August)	16,931	16,540	-391	-2.3
Fall (September – October)	11,318	11,075	-243	-2.1

Under 'Ultimate' conditions, runoff to East Morrison Creek and PSW 25 will reflect future developments within the PSW 25 catchment, including those proposed for the areas upstream of Trafalgar Road (Upper EM4 Subcatchment). Post-development flows from the Upper EM4 Subcatchment will be routed to PSW 25 via stormwater management Pond 29. The modeled flow to PSW 25 under these conditions, as described in the 2017 EIR/SWM Report for Upper EM4, is provided in **Table 8.9** below. Results are not yet final as ultimate post-development conditions are still being refined as the urban planning review process progresses. However, the current data indicates that the post-development runoff decrease from Phase 1 will be offset by an increase in runoff to PSW 25 from future development in the EM4 catchment.

Table 8.9 - Catchment-scale Pre- and Post-Development Runoff to PSW 25 (Ultimate)

Period	**Pre-development** (m^3)	**Post-development** (m^3)	**Pre- to Post-development change** (m3)	**Pre- to Post-development change** (%)
Annual (April – October)	42,143	44,353	2110	5.2
Seasonal				
Spring (April – May)	14,033	15,053	1020	7.3
Summer (June – August)	16,931	16,936	5	0.0
Fall (September – October)	11,318	11,528	210	1.9

The feature-based water balance analysis conducted for PSW 25 detailed in this section demonstrates that any changes in runoff volumes to PSW 25 resulting from the Phase 1 development are minimal and are expected to be compensated for by runoff surplus from future developments within the EM4 catchment. Thus, impacts on the proposed restoration plan for PSW 25 or on the downstream wetland hydrological regime and wetland communities associated with the Phase 1 development are not anticipated. Additional details pertaining to the wetland water balance analysis can be found in **Appendix D-3**.

9.0 WASTEWATER AND WATER SERVICING

9.1 North Oakville East – Area Servicing Plan (ASP)

In support of the North Oakville East Secondary Plan, on behalf of the North Oakville Community Builders Inc. (NOCBI), the Area Servicing Plan (ASP) for North Oakville East 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 East Secondary Plan. The proposed water and wastewater servicing strategies, outlined in this *Addendum*, 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.

9.2 Wastewater Servicing

9.2.1 Wastewater Design Criteria

Wastewater infrastructure will be designed in accordance with the latest Region's 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
Apartment	Greater of: • 285 persons/hectare, or • 1.655 persons/unit (Table A-3, Region of Halton 2022 Development Charges Background Study)
Community Services	40 persons/hectare
Light Commercial Areas	90 persons/hectare

9.2.2 Existing Wastewater Services

An existing 2400 mm diameter wastewater main is located on the north side of Dundas Street at Third Line, approximately 7 km west of the Subject Lands. In accordance with the Master Plan, this existing 2400 mm diameter trunk main is proposed to function as the outlet for the lands located within the NOESP. A 900 mm sanitary sewer has been constructed along Dundas Street between Sixth Line and Ernest Appelbe Boulevard. This sewer will serve as the outlet for the majority of the Subject Lands via Trafalgar Road and Wheat Boom Drive, with a 600 mm connection at Street "A" (Road 'C').

An existing 200 mm diameter wastewater main is located on William Coltson Avenue at the property boundary with Subject Lands, also tributary to Dundas Street. This sewer will serve as the outlet for a portion of the west side of the Subject Lands.

9.2.3 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 majority of local sewers will convey flows into the 600 mm diameter Regional sub-trunk wastewater main within Trafalgar Road.

A portion of the west side of the Subject Lands will convey flows into the 200 mm diameter local wastewater main within William Coltson Avenue. At the William Coltson Avenue connection (EX.MH1A), the development proposal population (1368) exceeds the population allowance (293) made with the development of the DTI lands. To test the development proposal, the DTI as-constructed sanitary sewer design sheet has been updated to reflect the development proposal such that the impact to downstream sewers can be assessed. No downstream surcharging is projected. At the discretion of Halton Region, a direct connection to Trafalgar Road at MH11A could be coordinated with the Region's consultant for Trafalgar Road urbanization to eliminate concern regarding DTI.

The conceptual wastewater servicing scheme is illustrated in **Drawing 9.1**. Sanitary sewer design sheets are included in **Appendix F-2**.

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's 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 litres per capita
Maximum Hourly Demand Peaking Factor	
Residential	4.00 litres per capita
Community Services	2.00 litres per capita
Commercial	2.00 litres per capita

Population Criteria

Single Family	55 persons/hectare
Semi-detached	100 persons/hectare
Townhouse	135 persons/hectare
Apartments	• Greater of: • 285 persons/hectare, or • 1.655 persons/unit (Table A-3, Region of Halton 2022 Development Charges Background Study)

Community Services	40 persons/hectare
Commercial	90 persons/hectare

9.3.2 Pressure Zone Boundaries

The Subject Lands are located within the Zone 4 pressure district of Halton's water distribution system. A summary of the Zone 4 elevations is provided in **Table 9.1**.

Table 9.1: Summary of Zone Elevations

Zone	Lower Elevation(m)	Upper Elevation(m)
4	165	198

9.3.3 Existing Water Supply

Existing watermains are currently available in the vicinity of the lands as set out in **Table 9.3**.

Table 9.2: Summary of Existing Watermains

Street	Size(mm)	Location	Zone
Trafalgar Road	750	Trafalgar Road from Existing Zone 4 elevated tank (north of Burnhamthorpe Road) to Dundas Street	4
William Coltson Avenue	200	William Coltson Avenue from Threshing Mill Boulevard to boundary with Subject Lands	4

The existing watermains are illustrated in **Figure 9.2**.

9.3.4 External Water Supply Requirements

In accordance with the Region's Master Plan Update, water infrastructure is planned to service lands throughout Zone 4 pressure district. This infrastructure includes transmission mains, PS, storage facilities and distribution mains.

9.3.5 Proposed Water Servicing

A network of new local watermains designed in accordance with the Region's design criteria and MECP's guidelines will service the Subject Lands.

Conceptual watermain sizing is illustrated in **Figure 9.2** based on recommended sizing as outlined in North Oakville East Secondary Plan – ASP, prepared by MMM Group. Connections to the existing watermains are proposed at the following locations:

- William Coltson Avenue at boundary with the Subject Lands (200 mm)
- Trafalgar Road (300 mm internal watermain on Future Road 'D' connection to existing 750 mm watermain on Trafalgar Road). This connection is required to either precede development or be delivered by development as external services.

Final sizing for watermains, less than the minimum 300 mm diameter mains modelled in the ASP, will be completed at the detailed design stage based on the actual development characteristics.

10.0 ROADS

10.1 Policy Direction

OPA 272 provides policies for the provision of roads through the NHS. Policy 7.4.7.3 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*."

In 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.

10.2 Creek Road Crossing Design Requirement

10.2.1 Road Crossing Locations

Drawing 7.1 illustrates the one location where a street will cross the top end of the NHS within the FSS Study Area. The general location of this road is provided in Figure NOE4 of OPA 272 and the Master Plan.

The new road crossing is located at the reach break between MOC-6a and MOC-6. MOC-6a is not classified as a stream with an associated constraint in NOCSS whereas MOC-6 is a red stream. A small portion of the upstream limit of MOC-6 will be crossed by the new east-west road, when the lands to the north develop. Given the location of the crossing at the very upstream extent of MOC-6, the NHS does not extend further north of the crossing and the fact that there will be no flow into the upstream end of the crossing, the design of the new creek crossing did not need to address fluvial geomorphology, hydraulics or wildlife movement. The grading and abutments along the southern side of the crossing however, have been designed to minimize the amount of MOC-6 that is disturbed as a result of the crossing. Based on the preliminary design, only approximately 8 m of MOC-6 will be removed as a result of the crossing. The removal of an existing culvert crossing upstream of the online pond will create an additional 10m of stream length and the re-creation of the low flow channel within 3275 Trafalgar Road will result in an additional length of stream of 25 m. As such, there will be no loss in red stream length and there will be a gain of 27m.

10.2.2 Recommended Creek Crossing Sizing

The proposed crossing must be sized for the greater of the existing or ultimate Regional flow from the external area / culvert ME-T5. The existing conditions represents the more conservative flow, as compared to the future controlled / split flow from Pond 29. The resulting culvert crossing is summarized in **Table 10.1**.

The recommended design is summarized in **Table 10.1**.

Table 10.1: Design Recommendation for Road Creek Crossing

Creek Crossing	Width (m)	Height (m)	Length (m)	Downstream Invert (m)	Upstream Invert (m)	Top of Road Elevation (m)
Street A	1500mm circular culvert		32	178.60	178.65	183.50

10.2.3 Road Crossing Fluvial Geomorphology Design Requirements

Based on the fluvial geomorphological assessment, Reach MOC-6a and MOC-6 display limited channel definition, potential for erosion and have an intermittent flow regime (i.e., generally contain flow in the spring and in response to large rainfall events). During the interim condition, prior to development north of the Subject Lands, flows north of Street A will be conveyed in a realigned, temporary swale and pass under the roadway via a temporary 1500 mm diameter culvert. When development proceeds to the north, the portion of Reach MOC-

6a east of Trafalgar Road is to be piped and outlet on the south side of Street A. Given existing and proposed interim and ultimate conditions, there are no crossing span requirements from a fluvial geomorphological perspective, however, the crossing should be hydraulically sized to ensure adequate flow conveyance under interim conditions. Notably, the proposed design includes a stone core wetland at the outlet downstream of Street A to dissipate energy and provide long-term stability.

10.3 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. In accordance with the ROWs depicted on the draft plan, standard ROW cross-sections are provided on **Figures 10.1 and 10.2**.

Significant discussion and collaboration has taken place between the Town, CH and the Study Team related to the alignment and design of the William Coltson Avenue ROW design (**Appendix A-2**). The provision of a north-south roadway (i.e., William Coltson Avenue), as identified in the Secondary Plan, results in the need to encroach into the 30m wetland buffer in order to maintain the existing connection point at the southern limit of the Subject Lands and to maintain a safe road design through the Subject Lands. The alignment and ROW have been designed to balance the objectives of NHS buffers, transportation safety and Secondary Plan compliance.

Through the pinch-point, the ROW is proposed at 22m to minimize encroachment into the wetland buffer to the extent feasible. Refer to **Drawing 10.2A** for details. Within the 22m ROW, on the east side, 0.4m of the limestone trail will be within the ROW however, the remainder of the trail (2m) will be outside of the ROW and within the buffer to the wetland. This will result in a wetland buffer of 22.24m along a short length of the ROW (Drawing 7.1) and a total encroachment of the ROW into the wetland buffer of 263 m^2. To address this impact, lands have been added to the NHS at a 1:1 ratio, outside of the required buffers, as shown on **Drawing 7.1**. The majority of this added NHS area will be within 3275 Trafalgar Road however, a portion will be accommodated when 3301 Trafalgar Road develops.

Details with respect to the transportation safety aspects of the William Coltson ROW as well as the pedestrian crossing are provided in the Transportation Impact Study (TIS) (Paradigm, 2024).

10.4 Sidewalk Design

The preliminary sidewalk locations are illustrated in **Drawing 7.1**. OPA 272 contemplated sidewalks being generally provided on both sides of all streets but also provided conditions for exceptions to permitting only one sidewalk for some local roads. In the area of the pinch-point with the wetland buffer and William Coltson Avenue, it is proposed that the NHS trail will replace the sidewalk, to avoid the need for a sidewalk and trail adjacent to one another on the east side of the road. This will also help reduce the extent of encroachment into the buffer as a result of the road right-of-way.

11.0 CONSTRUCTION PRACTICES

11.1 Protection of Exposed Shale and Sewers Installed in Shale

Shale has the characteristics of becoming soft or degraded after excavation and being exposed to weather, and the effects on trenching would be bottom heaving and squeezing. It would be prudent to minimize these effects during construction. The construction program should be well planned so that the excavation and construction of the sewers would minimize the exposure time for the shale. Otherwise, the application of a thin layer of lean concrete or sprayed concrete may be required. Suitable trench backfill materials, preferably sand for the protection of the sewer and manholes against squeezing shale, should be used.

11.2 Anti-seepage Collars

For sewer trenches dug in shale (weathered or un-weathered) and sewers installed under the groundwater table, seepage between the trench backfill material and the trench wall may cause erosion of the backfill materials. If sand is utilized as the backfill, it is recommended that nominal anti-seepage collars be provided to prevent erosion of the sand placed in the sewer trench.

The anti-seepage collar may consist of a clay plug surrounding the sewer pipe. A typical clay plug will be about 1m thick and extends laterally to a minimum distance of 0.5m from the pipe circumference, with a minimum of 0.3m embedment into the shale. The on-site native clayey till deposit may be suitable for such purpose, subject to additional sampling and testing.

11.3 Topsoil Management

Increased topsoil depths are proposed as one LID measure to be implemented within the Subject Lands. Topsoil will be managed to avoid compaction and degradation of topsoil quality to maintain its ability to effectively infiltrate surface runoff.

11.4 Erosion and Sediment Controls

An Erosion and Sediment Control (ESC) strategy will be prepared and implemented in accordance with the *Erosion and Sediment Control Guideline for Urban Construction* (TRCA, 2019) 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.;
- environment fencing;
- stone mud mat at all construction entrances;
- regular inspection of the ESC devices; and,
- removal and disposal of the ESC devices after the site has been stabilized.

11.5 Construction Phasing

The Subject Lands are anticipated to be developed in at least two phases (see **Figure 6.1**). Phase 1 (The condominium block, townhouse block and a portion of William Coltson Avenue) is located on 3275 Trafalgar Road, west of the proposed NHS. The future phase(s) consist of the remainder of 3275 Trafalgar Road and the lands at 3301 Trafalgar Road. .

At this time, the wetland re-creation works are scheduled to take place after the majority of the development has been completed surrounding the feature in order to minimize potential impacts on the newly created wetland during construction of the surrounding lands. The restoration works are proposed to restore a feature that has been continuously impacted by the prior landowner for at least 15 years. As such, there is no ecological concern with wildlife being displaced or a loss of wetland communities in the short term. While there is certainly value in restoring the wetland in this location as soon as possible, that must be balanced against other considerations in recognition of the proposed construction activities surrounding this location. The wetland is the downstream receiver of any unanticipated impacts from the adjacent construction activities. As a result, should restoration occur in the near term, there would be a greater potential of impact to the restored wetland throughout the construction of all phases of the development. Planted vegetation will have the greatest potential for success should this occur following construction. Given the cessation of active disturbance undertaken by the prior landowner, wetland vegetation will re-establish within portions of these disturbed areas. This will provide some ecological benefit to the watercourse in the interim scenario. It is acknowledged that the extent of wetland that may naturally re-establish cannot be accurately estimated at the time given the uncertainty with respect to the extent of fill imported by the previous landowner. While the wetland re-creation is anticipated to take place during the later phases of development, the agencies can ensure that this work takes place through draft plan conditions. The timing of the wetland re-creation will be addressed through discussions with the Town and CH. Discussions between the landowner and CH's Restoration Team have taken place to determine whether CH would be interested in undertaking the wetland creation works.

11.6 Dewatering Requirements

Four levels of underground parking in Phase 1 were considered for the dewatering requirement assessment. The assumed maximum depth of the underground levels was estimated to be 13.1 mbgs. Assuming a depth of 1.5 m for the elevator shaft, a total excavation depth of 14.6 mbgs is required for the construction. A dewatering depth of approximately 0.5 m below the excavation bottom (15.1 mbgs) is assumed in order to keep the bottom of the excavation dry during construction.

Depth to groundwater at the Phase 1 underground parking area (**Figure 11.1**) was determined based on the monitoring wells located at or in close proximity to the building location.

The groundwater dewatering rates for the proposed underground parking levels excavation in Phase 1 were determined to be ~76,826 L/day (~0.89 L/s). An Environmental Activity and Sector Registry (EASR) Registration is required for this volume of water taking, as the estimated water taking is more than 50,000 L/day and less than 400,000 L/day.

Based on the results of the hydraulic conductivity tests, seepage through the overburden and bedrock beneath the Site should be feasible to be handled by a sump and/or well point dewatering system. The type of dewatering system to be used should be discussed with a dewatering contractor and evaluated based on anticipated low and high volumes estimates.

Additional details pertaining to the dewatering requirements can be found in **Section 4** and **Appendix G** of **Appendix C-5**. Preliminary details pertaining to dewatering requirements for future phases will be addressed through an EIR/FSS Addendum when those phases advance.

Consideration was given to potential impacts of dewatering associated with Phase 1 on PSW 25. It is expected that the wetlands are predominantly surface water fed with no evidence of groundwater discharge to the watercourse / wetlands within the Study Area. As such, the wetlands are considered to be predominantly a groundwater recharge area. As a result, localized dewatering associated with the construction of Phase 1 would not be anticipated to have a measurable impact on the wetland communities upstream and downstream of 3275 Trafalgar Road (i.e., there are no existing wetlands remaining on 3275 Trafalgar Road to be impacted by dewatering). In addition, the zone of influence associated with the construction dewatering has been determined to be 14m. The wetland is a minimum of 30m away from the development limit and, as such, the dewatering will not impact PSW 25.

11.7 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. Typically, the Region requests that the survey be completed within 500 m of the planned construction area.

With permission of the well owners of active and accessible water supply wells, the static water levels (i.e., water level under non-pumping conditions) will be measured prior to the commencement of earthworks. A water sample will be collected from each well water supply for analysis of background water quality. The water quality analyses will include general water quality indicator parameters including chloride, nitrate, turbidity and e-coli. The recommended monitoring program for the local private wells includes quarterly water level measurements throughout the subsurface construction activities (if the wells remain in use). At the end of the earthworks, a water sample will again be collected from each of the monitored water supply wells to confirm the post-development water quality.

11.8 Well Decommissioning

Ontario Regulation 903 requires that, prior to construction, all inactive water supply wells, within the development footprint, are located and properly decommissioned by a licensed water well contractor. In addition, all groundwater monitoring wells 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.

12.0 MONITORING PROGRAM

12.1 OPA 272 Monitoring Requirements

Policy 7.9.5.2 of OPA 272 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;*
> *b) supply of existing lots and number of building permits granted;*
> *c) the general achievement of housing mix targets;*
> *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:

- erosion and sediment control (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. Only those that are applicable to the Subject Lands have been included (i.e., SWM Facilities monitoring requirements are not included).

12.2.1 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 TSS 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.

12.2.2 Monitoring of the MOC-6 Modified Stream

Although the watercourse is not proposed to be modified as part of the development, the previous landowner at 3275 Trafalgar Road effectively removed the low flow channel and PSW 25 surrounding the low flow channel, on those lands. As such, as part of the proposed development, that portion of MOC-6 will be re-instated and, as such, will require monitoring as follows:

1. A multi-disciplinary monitoring program, approved by the Town and CH, will be implemented for the proposed stream modifications. The monitoring program will be implemented by the landowner.

2. Notwithstanding Item 1 immediately above, additional monitoring associated with DFO approvals under the *Federal Fisheries Act* may be required and shall be the responsibility of the landowner.

12.2.3 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 landowners.

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. The *Erosion and Sediment Control Guidelines for Urban Construction* (TRCA, 2019), 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 Monitoring of Modified/Re-instated Streams and Restored Wetlands

Reach MOC-6 is proposed to be modified (re-instated) in conjunction with the restoration of a portion of PSW 25. Natural channel design and ecological monitoring is required to assess near-term adjustments after the completion of construction. Monitoring observations can also be used to determine the need for remedial works. Monitoring is recommended for two full calendar years (natural channel design) and five full calendar years (wetland restoration) following the year of construction. The following monitoring and reporting activities are suggested for the constructed channel and wetland system:

- Collection of general observations of the channel works after construction and after the first large flooding event to identify any potential areas of erosion concern;
- Completion of bi-annual visual inspections along the restored corridor to observe and document any areas of concern;
- Collection of a monumented photographic record of site conditions during each visit;
- Completion of a total station survey of the longitudinal profile and monumented cross sections following construction to serve as the as-built reference condition for use in comparing surveys completed in subsequent monitoring years;
- Re-survey of the longitudinal profiles and monumented cross sections on an annual basis following construction;
- Installation of erosion pins at monumented cross sections to be remeasured annually;
- Characterization of bed material using a modified Wolman (1954) pebble count or bed sample (as appropriate) annually;
- Completion of three-season general vegetation surveys in Years 1, 2, 3 and 5 to assess establishment, species composition, presence of invasives, growth rates, survivorship, performance, and coverage;
- Completion of wildlife surveys including breeding bird, amphibian, turtle basking and insects associated with the restored wetlands in years 1, 2, 3 and 5; and,
- Preparation of year-end reporting summarizing construction activities (i.e., design implementation), and subsequent year-end reports for the duration of the monitoring period

The monitoring period may be extended in the event that concerns are identified in the first two years.

12.3.3 Monitoring in Relation to Municipal Services and Trails Installed by an Owner within the NHS

This EIR/FSS identifies a future trail location around the perimeter of Core 10 (i.e., within the woodland dripline 10 m buffer) and within the 30 m buffer associated with PSW 25. The location of the trail is indicated on **Drawing 7.1**. The monitoring requirements associated with trail design should be established at the time the trail design is completed. This would be undertaken as a condition of Draft Plan approval.

All municipal services are located within road ROWs. There are no other proposed servicing crossings of the NHS.

13.0 SUMMARY OF RECOMMENDATIONS

This *Addendum* builds upon the information provided in both the *Upper* and *Lower EM4 EIR/FSS* reports and identifies and characterizes the natural heritage features and functions within the Study Area 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. The *Addendum* provides a link between the Town's NOCSS Management and Implementation Report, the North Oakville East Secondary Plan and the required planning approvals. The following table summarizes main report findings and recommendations and notes the Section(s) of this report that can be referenced for more details.

Topic	Conclusions/Recommendations	Report Section for Further Details
Areas Studied	In accordance with OPA 272 requirements, a portion of East Morrison Creek Subcatchment Area EM4 has been studied as part of this Addendum. The bulk of this subcatchment has already been studied as part of the Upper and Lower EM4 EIR/FSS reports. This Addendum builds upon the findings of those reports in relation to detailed fieldwork and assessments on the Subject Lands. The Subject Lands include one draft plan of subdivision east of Trafalgar Road. The Subject Lands have been divided into Phase 1 and future phase(s) of development. Phase 1 will proceed first while the remainder of the lands (3301 Trafalgar Road and the eastern portion of 3275 Trafalgar Road) will proceed as subsequent phases. The limits of the NHS have been delineated for the entirety of the Subject Lands and the alignment of William Coltson Avenue has been determined through this Addendum given the impacts associated with the road alignment and the NHS, specifically on 3301 Trafalgar Road. When the future phases advance, additional detail will need to be provided pertaining to servicing, including stormwater management and wetland water balance through a further Addendum.	1.2
Draft Plan of Subdivision	The proposed Draft Plan of Subdivision (**Figure 6.1**) proposes residential development for Phase 1 and anticipates residential and institutional development for the future phases of development of the Subject Lands. **Figure 6.1A** provides the Development Concept Plan for reference. Proposed residential uses in Phase 1 consists of a condominium and townhouse complex while the anticipated residential uses in Phase 2 include condominiums and an institutional use (church). For the remainder of the Subject Lands the NHS, associated with PSW 25 as well as Core 10, is protected.	6.0
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 and comparison to the previous Upper and Lower EM4 EIR/FSS reports.	5.2

Topic	Conclusions/Recommendations	Report Section for Further Details
NHS Framework and Associated Components	Components of the NHS framework in the EIR Subcatchment Area are identified on **Figure 5.1**. They include: • A small portion of Core 10; • One High Constraint Stream reach (MOC-6); and, • One PSW (PSW 25).	2.0
NHS Boundaries	The boundary of Core 10 on the Subject Lands has been staked in field with agencies and survey plans prepared delineating the Core boundary to the satisfaction of the Town and CH. A Reference Plan illustrating the final Core boundaries on the Subject Lands will be prepared and submitted to the Town and CH as a condition of draft plan approval.	3.0
High Constraint Reach	The existing limits of the one High Constraint Stream (Red Stream) of the East Tributary of East Morrison Creek within the FSS Study Area are shown on **Figure 5.1.** Where this stream is present (i.e., on 3301 Trafalgar Road) it will be retained as is, in its current state and location. Where the stream has been altered/removed by a previous landowner, the watercourse will be re-instated, using natural channel design, as a condition of draft plan approval. Consultation with DFO, with respect to fish habitat and the re-created watercourse, will be undertaken at detailed design.	5.4 and 5.6.3
Trail System	A Major Trail has been sited for the Subject Lands (**Drawing 7.1**), in accordance with OPA 272, NOE4 and the North Oakville East Trails Plan. Trail impact assessment for Phase 1 is provided in **Section 6.3**. An impact assessment for the trails in the future phases will be required as part of a future Addendum.	6.3
Target Flows	NOCSS target peak flows were used when sizing Pond 32 (as part of the approved development to the south). Pond 32 was designed to accept flows from the western portion of the Subject Lands. Storm flows from the eastern portion of the Subject Lands cannot access Pond 32 due to grading constraints and, as such, will have a separate underground SWM facility. NOCSS target peak flows were used to confirm the sizing of this separate facility. Target unit rates as shown in **Table 7.2.**	7.2
Erosion Threshold Analysis	Erosion threshold analysis was used to confirm SWM pond sizing for erosion control purposes for Pond 32, as part of the approved development to the south. As noted above, the western portion of the Subject Lands drain to Pond 32 and it was designed to accept those flows. The assessment, undertaken as part of the *Lower EM4 EIR/FSS*, included field surveys of sensitive creek locations, determination of in-stream erosion threshold levels, an analysis of the duration and number of exceedances above the erosion thresholds, and an analysis of cumulative effective work and cumulative effective discharge, under comparative existing and proposed conditions. Extended detention was utilized to meet targets on a system wide basis to ensure that erosion potential does not adversely increase under future development. It was determined that the erosion threshold for the reach downstream of MOC-2a, is $0.16m^3/s$, resulting in a unit release rate for development in the subject drainage area of $0.0011m^3/s/ha$. Post development	7.5

Topic	Conclusions/Recommendations	Report Section for Further Details
	conditions require 7,632m^3 of erosion control volume for SWM Pond 32.	
SWM Facilities	One SWM pond is identified to service the western portion of the Subject Lands (i.e., lands west of the NHS associated with PSW 25 on both 3275 and 3301 Trafalgar Road), consistent with requirements from NOCSS – i.e., Pond 32. This existing facility provides water quality control (Level 1), erosion control requirements in accordance with recommendations from the comprehensive erosion assessment results (GHD) and flood control storage to control the 2yr to 100yr storms and Regional Storm to existing peak flow rates. Pond 32 is already constructed to the south of the Subject Lands. Stormwater management for the lands east of PSW 25 will need to be assessed as part of a future Addendum.	7.6
Water Balance to PSW 25	A portion of PSW 25 is located within the EIR Subcatchment Area. This PSW has been studied to address potential impacts of changes to runoff volumes resulting from development in its surface water catchment and identify mitigative measures under both interim and ultimate development condition in the EM4 subcatchment. Analyses concluded that there is sufficient surface water runoff to ensure that the existing average volume contributions are sustained and that maximum and minimum runoff volumes are within the natural variability of the PSW 25 wetland. The EIR/FSS Addendum has demonstrated that there will be no negative impact to PSW 25 as a result of the proposed development.	8.9.3
LID Measures	Large scale subsurface infiltration measures are not feasible within Phase 1 due to the urban 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 pervious areas where feasible (e.g., lawns, side and rear yard swales, boulevards, parks, and other open space areas), as well as increased topsoil depths to improve the potential for water storage and infiltration. The site wide water balance has taken into consideration the tree pits required within the Town ROW and has confirmed that the infiltration deficit can be addressed through roof leader disconnection within the townhouse units and tree pits within the William Coltson ROW.	8.7
Grading in Buffers	A grading plan for the Subject Lands is illustrated on **Drawing 7.1**. In general, on 3301 Trafalgar Road, the proposed grading design will match the existing ground elevations at the NHS boundary, and will not require grading within the buffer, with the exception of some localized areas where grading into the NHS is required adjacent to William Coltson Avenue, the road crossing at the upstream limit of MOC-6, and the trail within the 30 m wetland buffer and within the 10 m woodland dripline buffer. Within 3275 Trafalgar Road, grading will be required within the NHS associated with the re-creation of the MOC-6 low flow channel as well as the re-creation of PSW 25. Where grading is required within the buffers of undisturbed natural areas (i.e., Core 10 and PSW 25 on 3301 Trafalgar Road), it will be undertaken in accordance with the NOCSS recommendations. If a stormwater outfall is required into the NHS from the future phases	7.10

Topic	Conclusions/Recommendations	Report Section for Further Details
	of development east of the NHS associated with PSW 25, the grading associated with that outfall will need to be addressed as part of a future Addendum. At a minimum, the outfall will need to be located 10m from the edge of the wetland, as per NOCSS and the conceptual location has been shown on **Drawing 7.1**.	
Sanitary Servicing	A 900 mm sanitary sewer has been constructed along Dundas Street between Sixth Line and Ernest Appelbe Boulevard. This sewer will serve as the outlet for the majority of the Subject Lands via Trafalgar Road and Wheat Boom Drive, with a 600 mm connection at Street “A” (Road ‘C’). An existing 200 mm diameter wastewater main is located on William Coltson Avenue at the property boundary with Subject Lands, also tributary to Dundas Street. This sewer will serve as the outlet for a portion of the west side of the Subject Lands. **Drawing 9.1** illustrates conceptual wastewater servicing.	9.2
Water Servicing	Conceptual watermain sizing is illustrated in **Figure 9.2** based on recommended sizing as outlined in North Oakville East Secondary Plan – ASP, prepared by MMM Group. Connections to the existing watermains are proposed at the following locations: • William Coltson Avenue at boundary with the Subject Lands (200 mm) • Trafalgar Road (300 mm internal watermain on Future Road ‘D’ connection to existing 750 mm watermain on Trafalgar Road). This connection is required to either precede development or be delivered by development as external services.	9.3
Street across Reach MOC-6	One crossing of the upper limit of Stream Reach MOC-6 has been sited to meet OPA 272 requirements. Grading associated with the abutments on the south side of the crossing has been designed to minimize grading requirements into the NHS.	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.	11.4
Construction Below Water Table	Services and underground parking constructed below the water table will be constructed using best management practices to prevent lowering of the water table and redirection of groundwater flow. The condominium underground parking will be bathtubbed.	11.2 and 11.6
Well Decommissioning	Prior to construction, all inactive wells (including water supply and monitoring wells) within the development footprint are to be decommissioned by a licensed contractor in accordance with Ontario Regulation 903.	11.7
Monitoring of Re-instated Stream Channel and Wetland	Post-construction channel design and wetland monitoring for that portion of MOC-6 and the associated PSW 25 that will be re-instated will include geomorphic surveys, photo inventory, restoration planting surveys, and field observations to summarize channel stability, fish habitat, and overall corridor function as well as wildlife surveys as outlined in **Section 12.2.2**.	12.3.2