



Drainage and Stormwater Management Report

North Halton Coordinated Municipal Class
Environmental Assessment Study

Regional Road 25 from Fifth Side Road to Tenth
Side Road, Town of Halton Hills

*Regional Municipality of Halton
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1 Introduction

The Regional Municipality of Halton is undertaking a Schedule 'C' Municipal Class Environmental Assessment (MCEA) Study to review the transportation improvements along three roadway corridors:

- James Snow Parkway (Regional Road 4) from Britannia Road (Regional Road 6) to just south of Highway 401;
- Regional Road 25 from Fifth Side Road to Tenth Side Road; and
- Steeles Avenue (Regional Road 8) from Regional Road 25 to Trafalgar Road (Regional Road 3).

This Drainage and Stormwater Management Report has been prepared for the segment 'Regional Road 25 from Fifth Side Road to Tenth Side Road' in support of the MCEA Study and complies with the Ministry of the Environment, Conservation and Parks (MECP), Conservation Halton (CH), Regional Municipality of Halton, and the Town of Halton Hills Policies and Standards. The study limits are illustrated in **Figure 1-1**.

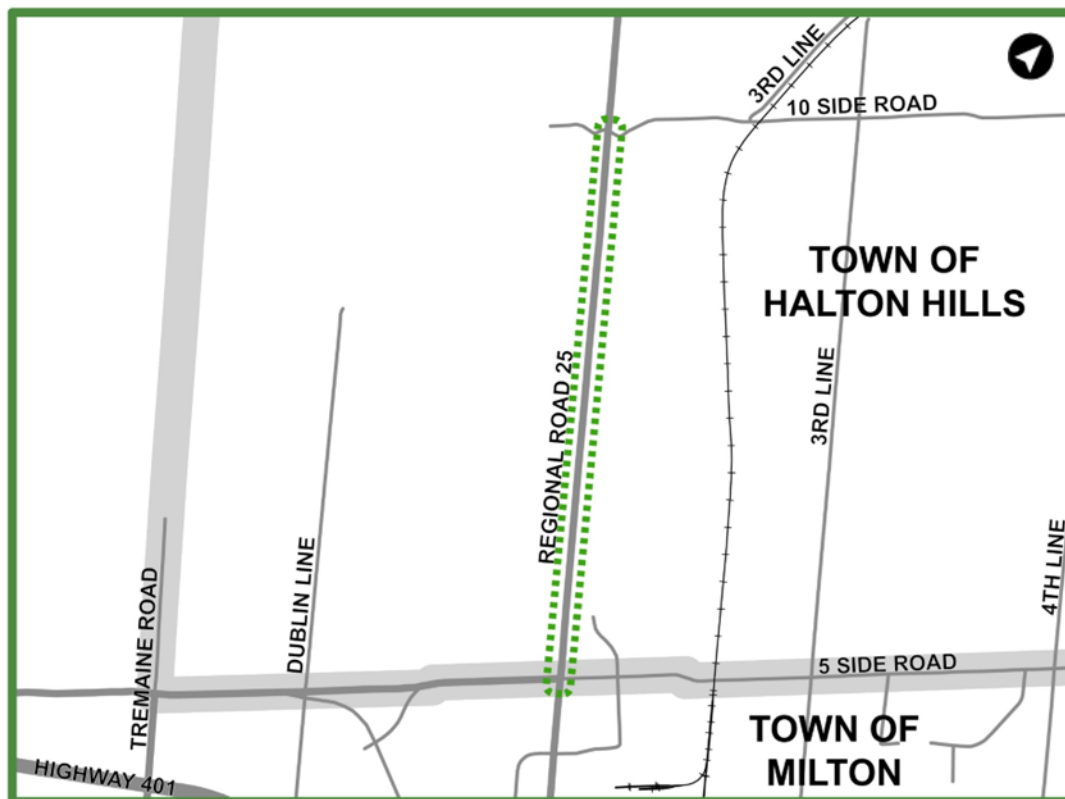


Figure 1-1. Study Area

Within the study limits, Regional Road 25 is currently a 3 km north-south rural arterial road. The current right-of-way includes two lanes (one in each direction).

The objective of the Drainage and Stormwater Management Report is to:

- Review available drainage information for existing conditions, including storm drainage area plans, reports and previous studies, plan-and-profile drawings and hydraulic and hydrologic models;
- Identify and evaluate existing drainage patterns and transverse culvert locations;
- Identify local hydrologic and hydraulic constraints;
- Establish design criteria for stormwater management to meet the requirements of the various Regulatory and approval agencies, and guidance from governing studies;
- Identify potential stormwater runoff quality and quantity impacts to the receiving watercourses/storm sewer system resulting from changes to the roadway cross-section (i.e. increased pavement area); and
- Propose an appropriate drainage system, transverse culvert upgrades, and a stormwater management strategy in conjunction with the proposed road widening to mitigate any potential impact.

1.1 Background information

In preparation of the Regional Road 25 MCEA Drainage and Stormwater Management Report, the following documents were obtained and reviewed:

1. Regional Municipality of Halton SWM CLI-ECA, July 2022;
2. Ministry of the Environment, Conservation and Parks (MECP) Low Impact Development Stormwater Management Guidance Manual, January 2022 (Draft for Consultation)
3. Ministry of the Environment, Conservation and Parks (MECP) Stormwater Management Practices Planning and Design Manual, March 2003;
4. Ministry of Transportation (MTO) Highway Drainage Design Standards, November 2023;
5. Town of Halton Hills, Stormwater Master Plan Report, Aecom, July 2024;
6. Conservation Halton Guidelines for Stormwater Management Engineering Submissions, November 2021;
7. Sustainable Technologies Evaluation Program (STEP) Low Impact Development Stormwater Management (LID SWM) Planning and Design Guide, 2020;
8. North Halton Environmental Assessment Fluvial Geomorphology Assessment Report, prepared by Matrix Solutions Inc., July 2024;
9. Preliminary Hydrogeological Investigation Report, North Halton Coordinated Municipal Class Environmental Assessment Study, Halton Regional Road 25 from 5 Side Road to 10 Side Road, prepared by Thurber Engineering Ltd., February 2025;
10. Preliminary Geotechnical Investigation Report, North Halton Coordinated Municipal Class Environmental Assessment Study, Halton Regional Road 25 from 5 Side Road to 10 Side Road, prepared by Thurber Engineering Ltd., February 2025;

11. Regional Road 25 Removal and New Construction, Built As Per Design, DS-Lea Associates, 2000;
12. Topographic surveys, prepared by Tham Surveying Limited, dated June 2024;
13. Ortho imagery, received from Halton Region;
14. North Halton Coordinated EA – Regional Road 25 Improvements Natural Environment Report Draft, prepared by Natural Resource Solutions Inc. (NRSI), dated August 2025; and
15. Ontario Structure Inspection Manual (OSIM) reports, received from Halton Region (located in **Appendix A**).

The following model was also provided by Conservation Halton for the watercourse crossing Regional Road 25:

- Conservation Halton GIS Data Viewing Geodatabase; and
- Middle Branch Sixteen Mile Creek HEC-2 – crossing Regional Road 25 information extracted from the GIS Data Viewing Geodatabase, dated 2011, and HEC-2 Output file.

2 Existing Drainage Conditions

2.1 Watershed and Subwatershed

The Regional Road 25 study corridor is located within the Sixteen Mile Creek watershed. Most of the corridor lies within the Middle Branch subwatershed, while a smaller southern portion is situated within the West Branch subwatershed. The Sixteen Mile Creek watershed falls under the jurisdiction of Conservation Halton (CH). The study corridor includes a crossing of the Middle Sixteen Mile Creek, which is further discussed in **Section 2.6** below.

2.2 Land Use

The Regional Road 25 study corridor is predominantly rural, encompassing a mix of agricultural protected countryside and minor urban land uses. It includes Greenbelt and Niagara Escarpment lands, which are designated as Greenlands under the Halton Hills Official Plan. Development within the corridor must follow the Town of Halton Hills' Environmental and Open Space Land Use Policies. Key features and landmarks in the area include the Chisholm Homestead and Towercliffe House, both heritage properties, St. Mathews Mar Thoma Church, Chudleigh's Entertainment Farm, and the Middle Sixteen Mile Creek crossing along with its regionally significant woodlands. Additionally, the Glencairn Golf Club is a notable recreational facility within the vicinity.

As of July 1, 2024, the Halton Region Official Plan is no longer recognized as the official plan for the Regional Municipality of Halton. Under the Planning Act, Halton Region is now identified as an upper-tier municipality without planning responsibilities. As a result, the Halton Region Official Plan is now deemed to be the official plan of each of the local municipalities within Halton, including the Town of Halton Hills, until such time as it is amended or revoked by the respective municipality.

For roadways and related planning matters within the Town of Halton Hills, the former Regional Official Plan is currently under review as part of the Town's own planning process.

2.3 Hydrogeological Conditions

Preliminary geotechnical and hydrogeological investigations were conducted by Thurber Engineering Ltd. A field investigation program was carried out in September and included the drilling of twelve (12) boreholes, three (3) of which were equipped with monitoring wells. Groundwater levels were measured manually between October 26 and December 21, 2023.

The borehole investigation along Regional Road 25 indicated that the subsurface stratigraphy typically consisted of a pavement structure (ranging from 0.5 m to 1.8 m thick, comprising asphalt overlying granular material), underlain by silty clay fill in several locations. This fill extended to depths between 1.8 m and 3.0 m below ground surface. In some areas, alluvial deposits of silt and gravel were identified below the fill layer, encountered at depths starting around 2.2 m and extending to approximately 4.1 m. Beneath the pavement structure and fill, the native soils generally consisted of cohesive

silty clay to clayey silt, with localized layers of cohesionless silt and sand. A silty clay to clayey silt till deposit was encountered beneath the overlying materials and native soils in multiple locations. The boreholes were advanced to depths ranging from 2.1 m to 11.3 m and were generally terminated within the till deposits.

Measured groundwater levels in the monitoring wells ranged from 1.7 mbgs to 4.4 mbgs (elevations ranging from 224.2 m to 244.7 m). Prior to conducting in-situ infiltration testing, a preliminary assessment of the infiltration potential of the native soils should be completed at detailed design. This can be based on available geotechnical data, soil surveys, or field observations.

During the detailed design stage, in-situ infiltration rate measurements should then be completed at any future potential LID locations to confirm the soil infiltration rates and groundwater levels.

2.4 Existing Drainage Pattern

Regional Road 25, from Fifth Side Road to Tenth Side Road, features a rural cross-section with roadside ditches along the entire corridor. These ditches discharge into existing watercourse crossings or surface drainage outlets. **Table 2-1** summarizes the existing drainage outlet locations.

Table 2-1. Summary of Existing Drainage Outlets

Drainage Outlet ID	Location	Description
OUT-1	West side, 5 th Side Road	This area is connected to the underground stormwater system located south of 5 th Side Road.
OUT-2	East side, 5 th Side Road	This area is connected to the underground stormwater system located south of 5 th Side Road.
OUT-3	East side, 680 m north of 5 th Side Road	The flow outlets to the farmland overland and ultimately discharges into the swale further east.
OUT-4	East side, 1150 m north of 5 th Side Road	The flow outlets to the wetland and ultimately discharges into the downstream reach (Culvert D).
OUT-5	East side, 1670 m north of 5 th Side Road	Middle Sixteen Mile Creek (Culvert C-2)
OUT-6	West side, 860 m south of 10 th Side Road	Wetland
OUT-7	West side, 640 m south of 10 th Side Road	Wetland
OUT-8	West side, 470 m south of 10 th Side Road	The flow outlets overland and potentially discharges into the downstream reach.
OUT-9	West side, 120 m south of 10 th Side Road	The flow outlets overland and potentially discharges into the downstream reach.
OUT-10	West side, 10 th Side Road	To the ditch and ultimately discharges into the Middle Sixteen Mile Creek further north.
OUT-11	East side, 10 th Side Road	To the ditch and ultimately discharges into the Middle Sixteen Mile Creek further north.

The existing drainage outlets locations are illustrated in **Figure 2-1**.

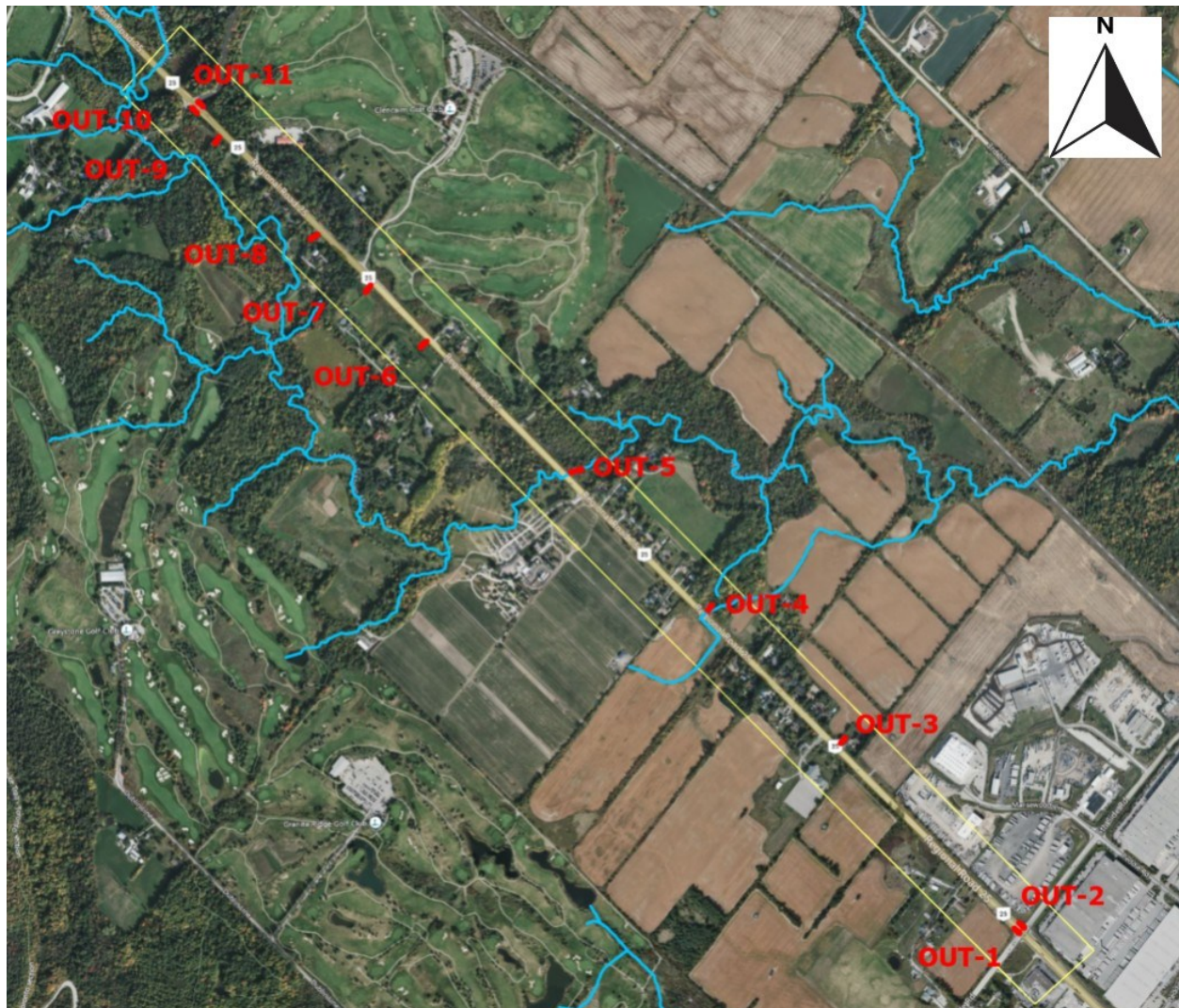


Figure 2-1. Existing Drainage Outlets Locations

The outlet locations presented above will be confirmed during future design stages.

2.4.1 External Areas

Based on a review of aerial imagery and street view, no external drainage areas contribute to the rural sections of Regional Road 25. External runoff is conveyed through two primary hydraulic structures, both of which cross Middle Sixteen Mile Creek. The first is located at Outlet 5, and the second lies immediately north of 10th Side Road, serving as the ultimate outlet for Subcatchments 10 and 11. The contributing drainage area to these crossings consists predominantly of agricultural (farmland) and woodland areas, along with some recreational land use associated with a nearby golf club.

2.5 Aquatic Resources and Wetlands

A Natural Environment Report Draft was prepared by NRSI (NRSI, 2025) to document the existing conditions and constraints.

Middle Sixteen Mile Creek is the largest and most ecologically significant watercourse within the study area. This watercourse originates northwest of the area and flows southeast through a meandering, low-gradient channel. It was assessed at two locations (AHP-002 and AHP-005) along the Regional Road 25 right-of-way.

Within the study area, Middle Sixteen Mile Creek is classified as a permanent coldwater system that supports direct fish habitat, as designated by the Ontario Ministry of Natural Resources (OMNR, 2025b). Channel conditions include riffle-run-pool sequences with wetted widths ranging from 3.0–4.8 m and bankfull widths between 4.5–5.5 m.

Although no aquatic Species at Risk (SAR) were documented within the watercourses of the study area, 19 fish species have been recorded in this section of Middle Sixteen Mile Creek (OMNR 2025a, b; DFO 2024). Notably, Redside Dace (Endangered federally and provincially) has been reported in the broader area but not within the study area itself. Observations of small-bodied fish and fry indicate the continued function of the system as fish habitat, although no new sampling was undertaken due to the availability of recent data.

A tributary of Middle Sixteen Mile Creek (AHP-004) originates within a Mineral Thicket Swamp (SWT2) but was observed to be ephemeral and hydrologically disconnected from the main creek at the time of assessment. This tributary does not provide direct fish habitat.

Fish habitat within the study area is considered a Key Feature of the Regional Natural Heritage System (NHS). As such, development and site alteration are generally prohibited, except for permitted infrastructure under Section 117.1 of the Regional Official Plan (OP), provided impacts are avoided, minimized, or mitigated. Similarly, the Town's OP allows for "essential transportation and utility facilities" in "Greenlands B" areas, which include fish habitat, under similar constraints.

Federally, fish habitat is regulated under the Fisheries Act, administered by Fisheries and Oceans Canada (DFO). Any activities that may result in the harmful alteration, disruption, or destruction (HADD) of fish habitat are subject to federal review and may require authorization.

All watercourses, including those lacking direct fish habitat, are also regulated as hazard features by Conservation Halton, under Ontario Regulation 41/24. Development within these areas, such as road crossings, is prohibited without explicit permission from the conservation authority.

Wetland features within the study area are varied and play a key role in contributing to the local hydrology and ecological function of the Middle Sixteen Mile Creek watershed. Mapping from Land Information Ontario (LIO) identified both evaluated and unevaluated wetlands along riparian corridors and in isolated areas. These were further delineated through field surveys conducted by NRSI biologists using the Ontario Wetland Evaluation System, with boundary confirmation by Tham Surveying. Conservation Halton reviewed

this mapping and determined that additional fieldwork was not required, as sufficient data already existed from previous studies.

The Chudleigh Swamp is the only evaluated wetland identified within the study area. It is currently designated as non-provincially significant (MNRF 2024) but may qualify as a Provincially Significant Wetland (PSW) upon re-evaluation due to the potential presence of regionally or provincially significant species (MNRF, pers. comm., 2023). Notably, NRSI confirmed the presence of Black Ash (SAR) within the SWM1-1 vegetation community of Chudleigh Swamp.

Updated mapping refined the boundaries of previously known wetlands and identified new roadside wetland features, such as SWT2 and MAM2-2 communities along the west side of Regional Road 25 (Maps 3a and 3b). However, forested areas within the Glen Cairn Golf Club property were assessed and confirmed not to meet wetland criteria, despite previous classifications.

Under the Regional Official Plan (OP), both significant and non-significant wetlands are considered Key Features of the Regional Natural Heritage System (NHS). Within NEP and Greenbelt Plan areas, all wetlands are deemed Key Natural Heritage Features and are therefore treated as Significant Wetlands for planning purposes. Conversely, wetlands such as the MAM2-2 features on the west side of Regional Road 25, which fall outside of these policy areas and do not make a substantial ecological contribution, are not considered significant, though they still qualify as Key Features.

Policy frameworks such as the Regional OP, NEP, and Greenbelt Plan generally prohibit development and site alteration within significant and non-significant wetlands. However, infrastructure projects deemed essential to the public interest may be permitted if no alternative exists, and impacts are avoided or minimized to the extent possible. These permissions are subject to review under multiple levels of policy and regulation.

Wetlands are also regulated hazard features under Ontario Regulation 41/24 by Conservation Halton. As such, any development or site alteration within wetland boundaries is prohibited unless explicitly permitted by the conservation authority.

The updated wetland mapping, produced by NRSI and aligned with ELC classification standards, enhances the accuracy of existing data and will inform impact assessment and management strategies for the area. Historical studies and input from the Region (prior to the dissolution of its planning authority) have been incorporated into this refined evaluation.

2.6 Transverse Crossings

Under existing conditions, Regional Road 25 crosses a single watercourse, the Middle Sixteen Mile Creek regulated by Conservation Halton that has a defined flood hazard (refer to **Appendix B** for Conservation Halton Regulation Limits map). **Table 2-2** summarizes the size, type, and location of the hydraulic structure at the Regional Road 25 crossing.

Table 2-2. Summary of Watercourse Crossings

Crossing ID	Watercourse Crossing	Location of Crossing	Culvert/Bridge Description	Crossing Length (m)
C-2	Middle Sixteen Mile Creek	1.30 km South of No. 10 Side Road	7 m span concrete box bridge	29 m

A Municipal Structure Inspection Report (AUE Structural Inc., June 2022) indicated that the concrete bridge at Crossing C-2 is generally in good condition, concrete repairs at soffit and abutment walls are recommended in the next one to five years.

There are a number of smaller transverse crossings within the corridor conveying local drainage, which do not have an established hydraulic model and are not included within this assessment. The crossing at Outlet 4 (Culvert D) conveys runoff from lands located on the west side of Regional Road 25 to the east side. The structure consists of a 0.91 m x 0.91 m concrete box culvert with an approximate length of 24.6 m. Culvert D is located within a headwater drainage feature that lies within a regulated area due to the presence of a downstream wetland hazard on the east side of RR25. The 30 m wetland allowance extends onto the west side of the road, overlapping the proposed culvert extension.

2.6.1 Hydraulic Criteria

In view of the proposed improvements, a hydraulic assessment of the existing transverse crossings within the study corridor was undertaken to confirm whether the existing structures satisfy the hydraulic criteria per the Ontario Ministry of Transportation's Highway Drainage Design Standards (2023). Since Regional Road 25 is currently classified as a Rural Arterial Road, the hydraulic assessment was conducted using the Rural Arterial design flow criteria. The transverse culverts within the project limits can also be classified as culverts not on a watercourse and culverts on a watercourse as per the MTO Drainage Design Standards. A summary of the design criteria is provided in **Table 2-3**.

Table 2-3. Summary of Design Criteria

Criteria	MTO Drainage Design Standard	
	Watercourse	Headwater Drainage Feature
Design Flow	Based on the MTO Drainage Standard WC-1, the design flow for structures crossing Rural Arterial roadways with spans less than 6.0 m is the 25-year flow. For structures with spans greater than 6.0 m, the design flow is the 50-year flow. The Check Flow is specified as 115% of the 100-year flow.	Based on MTO Drainage Standard SD-13, culverts under roadways that are associated with runoff from roadways and local external catchment areas (i.e. not on a watercourse) shall be designed to convey the Minor and Major System design flows. Standard SD-1 defines the Minor and Major System design flows as the 10-year and 100-year storm events peak flows, respectively.

Table 2-3. Summary of Design Criteria

Criteria	MTO Drainage Design Standard	
	Watercourse	Headwater Drainage Feature
Freeboard	The minimum required freeboard for culvert crossings of Urban Arterial roadways is specified as 1.0 m between the design high water level and the edge of the travelled way as per the MTO Drainage Standard WC-7. As per the MTO Drainage Standard WC-7, the upstream water level generated by the Check Flow shall not exceed the elevation of the edge of the traveled lane.	In accordance with Standard SD-13 of the Highway Drainage Design Standards, the minimum freeboard requirement for culverts not on a watercourse is 0.3 m from the high water level to the top of sub-grade upstream of the culvert under the Minor System design flow. There is no minimum freeboard associated with the Major System design flow.
Clearance	For open footing culverts, a minimum clearance of 0.3 m between the design high water level and the top of the culvert opening is specified as per MTO Drainage Standard WC-7. For closed footing culverts with a maximum diameter or rise of 3.0 m on Freeways, Arterials, and Collector roadways, a maximum ratio of flood depth to the diameter or rise of the culvert (HW/D) of 1.5 is specified as per WC-7.	N/A
Minimum Culvert Size	As per standard WC-8, the minimum culvert size crossing an urban arterial is 800 mm diameter for circular culverts or 900 mm rise for box culverts. For local roads and private entrances, the minimum culvert size is 500 mm diameter if the length > 10 m, or 400 mm diameter if the length < 10 m.	N/A

2.6.2 Hydraulic Assessment of Existing Watercourse Crossings

Extracted information from the currently approved HEC-RAS hydraulic model was used to assess the performance of the existing transverse crossing in terms of freeboard, clearance, and depth of overtopping. The latest model was obtained from Conservation Halton for the regulated watercourse and includes the peak flows draining to each crossing.

Design Flows

The design flows have been retained from the Middle Branch Sixteen Mile Creek HEC-2 Output file. A summary table of the storm design peak flows of the transverse crossing is presented in **Table 2-4**.

Table 2-4. Design Peak Flow for Transverse Crossings

Crossing ID	Watercourse Crossing	Peak Flow (m³/s)		
		50-year frequency flows	100- year frequency flows	Regional storm
C-2	Middle Sixteen Mile Creek	37.37	42.63	235.16

It is recommended that during detailed design, the assessment results be reviewed and verified to confirm any changes to the land-use and associated hydrologic information that may affect the peak flow presented in this MCEA study.

Hydraulic Assessment

As per the MTO Highway Drainage Design Standards, hydraulic capacities were assessed based on the 50-year storm event peak flow for structures with spans greater than 6.0 m to determine the available freeboard and clearance.

Table 2-5 summarizes the hydraulic analysis results for the Middle Sixteen Mile Creek along the study corridor. The HEC-RAS model output files are provided in **Appendix C**.

Table 2-5. Hydraulic Analysis Results for Transverse Bridge (Existing Condition)

Crossing ID and Description	Top of Road Elev. (m)	Soffit Elev. (m)	Freeboard (m)		Clearance 50-Yr (m)	HW/D	Remarks
			50-Yr	Reg.			
C-2 7 m span, 29 m long bridge	226.8	225.2	0.56	-1.05	-1.04	N/A	Does not meet MTO freeboard and clearance criteria. Regional storm overtops road

The results presented in **Table 2-5** indicate that the Middle Sixteen Mile Creek crossing does not fully meet MTO criteria, and overtopping is observed under multiple storm events. This finding is notably common for rural roads which often predate contemporary hydraulic and drainage design standards.

3 Proposed Conditions

The preferred design concept for the Regional Road 25 improvement project proposes a combination of three alternative solutions to accommodate future travel demand and ensure a connected, inclusive transportation system:

- Active Transportation Facilities (Alternative Solution #2);
- Intersection and Operational Improvements (Alternative Solution #3); and
- Roadway Improvements to Regional Road 25 (Alternative Solution #4).

The study area is divided into two segments based on land use, environmental features, and existing infrastructure:

- Segment 1 – From 5 Side Road to Chudleigh's Entertainment Farm Access. Improvements include maintaining two general-purpose lanes (one in each direction) with the addition of a continuous two-way left-turn lane to improve access and traffic flow. Planned active transportation (AT) facilities will be introduced south of 5 Side Road. This segment includes a new roundabout at 5 Side Road and features diverse land uses including light industrial areas, approximately 30 residential properties with direct road access, wetlands, woodlands, agricultural lands, and Chudleigh's Entertainment Farm. Paved shoulders (3.0 meters wide) with painted buffers are proposed on both sides to support active transportation users.
- Segment 2 – From Chudleigh's Entertainment Farm Access to 10 Side Road. This segment retains two general-purpose lanes (one in each direction), with localized intersection improvements and turn lane enhancements. It is environmentally sensitive, containing two fish habitat watercourse crossings, regionally significant wetlands and woodlands, and approximately 10 residential properties. It also includes the Glencairn Golf Club and its access road. Planned 3.0-meter paved shoulders with painted buffers will enhance active transportation, although no AT connections currently exist at the 10 Side Road intersection.

Throughout the corridor, the existing right-of-way (ROW) generally ranges from 30 to 36 meters, while the protected/planned ROW is up to 42 meters, consistent with the 2011 Transportation Master Plan and Halton Region ROW Guidelines.

3.1 Proposed Drainage Pattern

The proposed drainage pattern for the road expansion will generally be consistent with the existing conditions. To accommodate the proposed changes within right-of-way, the proposed roadway runoff will be collected and conveyed by roadside ditches to the existing drainage outlet locations, maintaining the rural drainage system.

The proposed drainage areas were delineated based on the proposed road profile and right-of-way width. The proposed discharge locations were determined using the existing outlet locations discussed in **Section 2.4**.

Refer to the Drainage Plans in **Appendix D** for additional details. **Table 3-1** summarizes the locations and areas for each of the drainage areas.

Table 3-1. Summary of Proposed Drainage Areas

Drainage Area ID	Description	Drainage Area (ha)	From Station	To Station	Discharge Location
R1	5 th Side Road to 460 m north of 5 th Side Road (west side)	0.77	10+120	10+580	This area is connected to the underground stormwater system located south of 5 th Side Road.
R2	5 th Side Road to 460 m north of 5 th Side Road (east side)	0.97	10+120	10+580	This area is connected to the underground stormwater system located south of 5 th Side Road.
R3	460 m north of 5 th Side Road to 820 m north of 5 th Side Road	1.28	10+580	10+940	The flow outlets to the farmland overland and ultimately discharges into the swale further east.
R4	820 m north of 5 th Side Road to 1240 m (east) / 1500 m (west) north of 5 th Side Road	1.64	10+940	11+360 east / 11+620 west	The flow outlets to the wetland and ultimately discharges into the downstream reach.
R5	1240 m (east) / 1500 m (west) north of 5 th Side Road to 2080 m north of 5 th Side Road	2.30	11+360 east / 11+620 west	12+200	Middle Sixteen Mile Creek
R6	2080 m north of 5 th Side Road to 580 m (east) / 700 m (west) south of 10 th Side Road	0.70	12+200	12+460 east / 12+340 west	Wetland
R7	580 m (east) / 700 m (west) south of 10 th Side Road to 510 m south of 10 th Side Road	0.83	12+460 east / 12+340 west	12+600	Wetland
R8	510 m south of 10 th Side Road to 200 m south of 10 th Side Road	0.99	12+600	12+910	The flow outlets overland and potentially discharges into the downstream reach.
R9	200 m south of 10 th Side Road to 70 m south of 10 th Side Road	0.49	12+910	13+040	The flow outlets overland and potentially discharges into the downstream reach.
R10	70 m south of 10 th Side Road to 10 th Side Road (west side)	0.17	13+040	13+110	To the ditch and ultimately discharges into the Middle Sixteen Mile Creek further north.
R11	70 m south of 10 th Side Road to 10 th Side Road (east side)	0.18	13+040	13+110	To the ditch and ultimately discharges into the Middle Sixteen Mile Creek further north.
Total		10.32			

Tentative discharge outlets will be confirmed during future design stages.

3.2 Watercourse Crossings

Based on the existing condition assessment, natural heritage considerations, fluvial geomorphologic evaluations, proposed roadway geometry, grading impacts, and hydraulic performance, no upgrades or extensions are required for the Middle Sixteen Mile Creek structure crossing to support the proposed roadway improvements. The hydraulic analysis indicates minimal benefit in reducing roadway overtopping by modeling a larger structure span. Furthermore, improving hydraulic performance by raising the road profile is prohibitive due to grading constraints imposed by accesses to adjacent properties and businesses. Therefore, it is recommended to maintain the existing bridge structure and road profile, with no extensions needed. As a result, no changes to the hydraulic conditions at this crossing location are anticipated.

The corridor includes several existing drainage culverts that must be reviewed in relation to the proposed works.

Between 5 Side Road and Chudleigh's entrance, the proposed widening to accommodate a centre turning lane and a multi-use path on the west side may require extension or replacement of existing culverts to suit the revised roadway cross-section. As a structural assessment of these drainage culverts is outside the current scope, the need for extensions or replacements will be confirmed during detailed design following further investigation.

Between Chudleigh's entrance and 10 Side Road, the proposed design generally maintains existing roadway conditions. Culvert extensions are not anticipated in this section; however, confirmation of structural condition and any replacement requirements will be undertaken during detailed design.

Final determinations regarding culvert modifications will be completed at the detailed design stage.

4 Stormwater Management Plan

The stormwater management plan for the study area within the Sixteen Mile Creek watershed shall be developed to comply with the Regional Municipality of Halton SWM CLI-ECA, Conservation Halton (CH) Guidelines for Stormwater Management Engineering Submissions, MECP Stormwater Management Guidelines.

4.1 Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA) Criteria

Regional Municipality of Halton CLI-ECA was issued on July 27, 2022, and includes performance criteria for development and retrofit scenarios for any stormwater management works within the Region. The proposed works for the Regional Road 25 MCEA Study includes the impervious area increase, and is categorized as development under the CLI-ECA.

The Draft Low Impact Development Stormwater Management Guidance Manual (2022) was released by the Ministry of the Environment, Conservation and Parks in January of 2022 for consultation. This manual is intended to be used as a baseline reference document in the review of stormwater management applications for approval, providing flexible guidance for implementing a holistic treatment train approach to stormwater management in Ontario.

Runoff volume control targets in Ontario, which are the local 90th percentile precipitation event, have been established within the Draft Guidelines (2022) to maintain the natural hydrologic cycle to the greatest extent possible. These criteria are also referenced in the CLI-ECA, hence are considered applicable and governing for the proposed works. The Draft Guidelines outline a hierarchical approach to the application of measures to achieve the Runoff Volume Control Target for new development, redevelopment, linear development, and stormwater retrofit projects. The steps for applying the Runoff Volume Control Target are described as follows:

1. Control Hierarchy Priority 1 Retention – LID retention practices which utilize the mechanisms of infiltration and/or evaporation to recharge groundwater and return collected rainwater to the atmosphere. The target volume is controlled and does not become runoff.
2. Control Hierarchy Priority 2 LID Filtration – LID technologies which utilize appropriate filter media. The controlled volume is filtered and released to municipal sewer networks or surface waters at a reduced rate and volume.
3. Control Hierarchy Priority 3 Conventional Treatment – other stormwater technologies which utilize filtration, hydrodynamic separation and/or sedimentation to detain and treat runoff. The controlled volume is treated and released to municipal sewer networks or surface waters at a reduced rate.

In recognition of potential site conditions that pose challenges for LID practices, the Draft Guidelines (2022) acknowledge that stormwater management for constrained sites are to be provided to the maximum extent possible (MEP). For linear development sites with restrictions, where management of 100% of the geographically specific 90th percentile

precipitation event is not feasible through Better Site Design, Pollution Prevention, and Control Hierarchy Priorities 1 and 2, the alternative is to achieve volume control to the MEP. After the application of LID retention and filtration practices to the MEP, Control Hierarchy Priority 3 measures can be applied to meet the remaining stormwater control requirements.

4.2 Runoff Volume Control Criteria

It is understood that the Draft LID Stormwater Management Guidance Manual (2022) indicates a runoff volume control target of 27 mm – 28 mm, which is the regionally specific 90th percentile precipitation event depth. A depth of 28 mm is used for stormwater management calculation purposes.

4.2.1 Water Quality Control

Watercourses within the CH's jurisdiction are classified as requiring an "Enhanced" level of protection, which equates to 80% Total Suspended Solids (TSS) removal.

Based on the Regional Municipality of Halton SWM CLI-ECA for water quality control, the following criteria are applicable, in consideration of the hierarchical approach and MEP, as per the MECP Draft LID Guidelines (2022):

- Water quality control for the 90th percentile storm event is to be provided for all surfaces (i.e. existing and new pavement area) to the maximum extent possible;
- Water quality control to an "Enhanced" standard is to be provided for an area of pavement equal to or exceeding the area of new pavement for the 90th percentile event; and
- Water quality control for the existing pavement is to be provided to the maximum extent possible for the 90th percentile event.

4.2.2 Water Balance

Based on the Regional Municipality of Halton SWM CLI-ECA for water balance, the following criteria are applicable, in consideration of the hierarchical approach and MEP, as per the MECP Draft LID Guidelines (2022):

- Water balance for the 90th percentile event is to be provided for all surfaces (i.e. existing and new pavement) to the maximum extent possible;
- Water balance is to be provided for new pavement area to maintain existing groundwater recharge to the maximum extent possible; and
- Water balance is to be provided for existing pavement to the maximum extent possible.

4.2.3 Erosion Control

Based on the Regional Municipality of Halton SWM CLI-ECA for erosion control, the following criteria are applicable:

- As per erosion assessment completed in watershed/subwatershed plan, Master Stormwater Management Plan, Master Environmental Servicing Plan, Drainage Plan, MCEA, local site study, geomorphologic study, or erosion analysis;
- As per the Detailed Design Approach or Simplified Design Approach methods described in the Stormwater Management Planning and Design Manual; and
- In the absence of separate assessments or guiding studies, 24 to 48 hour detention of runoff from the 25 mm storm event is to be provided.

Where the road crosses the CH regulation limits, the criteria in the Conservation Halton Guidelines for Stormwater Management Engineering Submissions shall apply, which require 24-hour detention of the 25 mm storm.

4.2.4 Water Quantity Control

For locations where the runoff discharges into an existing system, the minor system design storm (5-year storm) peak flows must be controlled to the existing peak flows, for which the receiving system was designed. In accordance with the Regional Municipality of Halton SWM CLI-ECA, post-development flows are to be controlled to pre-development levels along the receiving watercourses.

Where the road crosses the CH regulation limits, the criteria in the Conservation Halton Guidelines for Stormwater Management Engineering Submissions shall apply. In the absence of higher-level studies, the guidelines require post-development flows to be controlled to pre-development levels for the 2-year through 100-year storm events.

4.3 Proposed Stormwater Management Strategy

The overall drainage pattern will generally remain consistent with existing conditions. To accommodate the proposed changes within the right-of-way, roadway runoff will be collected and conveyed via roadside ditches to the existing drainage outlet locations.

Since the increase in impervious surface area is anticipated to be approximately 19%, based on the pavement analysis summarized in the **Appendix E**, stormwater management measures, including enhanced roadside ditches, Low Impact Development (LID) features where feasible, and check dams as required, are proposed to address potential increases in runoff, peak flows, and erosion potential associated with the roadway improvements..

To meet stormwater management (SWM) objectives related to quantity control, water quality, water balance, and erosion control, the following enhancements are proposed within the roadside ditch system:

- Flatter, wider-bottom ditches will be incorporated along the corridor to improve infiltration and reduce flow velocities;
- Opportunities for implementing Low Impact Development (LID) features such as bioswales or rain gardens should be investigated during future phases of design. Specifically, opportunities to integrate LID's within the ditches to promote water quality treatment and water balance restoration through enhanced infiltration and evapotranspiration should be considered. LID features should be situated where

soil permeability is favourable for infiltration and where groundwater levels are at least 1 metre below the base of the LID; and

- Check dams will be installed within the ditches as required to slow runoff, promote sedimentation, and provide additional quantity control by reducing peak flows.

These measures are intended to maintain or improve pre-development hydrologic conditions while complying with applicable stormwater management criteria.

The Stormwater Management (SWM) strategy is to be refined and finalized at the Detailed Design stage to include a comprehensive assessment demonstrating how the proposed measures will achieve the required water quality and quantity control objectives. This will be supported by detailed design information and quantitative analyses, confirming that all applicable performance targets are met under post-development conditions.

Formulation of final recommendations will be based on detailed technical assessments, site-specific constraints, and stakeholder feedback.

The Stormwater Management (SWM) facilities are to be designed at the Detailed Design stage in accordance with applicable MECP guidelines, including the Stormwater Management Practices Planning and Design Manual (2003) and the Low Impact Development Stormwater Management Guidance Manual (2022). Site-specific infiltration testing is to be completed to confirm the feasibility of any proposed infiltration-based LID measures and to support the final design.

4.4 Erosion and Sediment Control During Construction

Erosion and sediment control measures should be implemented and monitored through the construction period. Construction activities should be conducted during periods that are least likely to result in in-stream impacts to fish habitat.

Detailed erosion and sediment control plans will be required as part of the detail design component for all phases of the construction. The erosion and sediment control plans will be subject to review and approval by the various external agencies involved in the project, including the CH.

During construction, disturbances to watercourse riparian vegetation should be minimized. If riparian vegetation is removed or disturbed, erosion and sediment control measures such as silt fences, rock flow check dams and sedimentation ponds should be utilized to provide a maximum protection of local and downstream aquatic resources. These measures should be maintained during construction and until disturbed areas have been stabilized with seed and mulch. Additionally, topsoil should not be stockpiled close to the watercourses and water should not be withdrawn from these sensitive streams for construction purposes.

The site engineer and contractor will be responsible for delineating work areas and ensuring that erosion and sediment control measures are functional. In addition, the engineer will ensure that provisions related to fisheries and watercourse protection is met and that any required fish habitat compensation measures are implemented in accordance with the terms and conditions of the Fisheries Act Authorization.

5 Conclusions

A preferred solution has been identified for Regional Road 25 from Fifth Side Road to Tenth Side Road that combines three alternative solutions to address future travel demand and support a connected, inclusive transportation network: active transportation facilities, intersection and operational improvements, and roadway enhancements. The project corridor is divided into two segments based on surrounding land use, environmental sensitivity, and infrastructure. In Segment 1, from 5 Side Road to Chudleigh's Entertainment Farm Access, improvements include maintaining two general-purpose lanes with a continuous two-way left-turn lane, the addition of paved shoulders, a 3.0m multi-use pathway on the western side of the Regional Road 25 right-of-way for active transportation, and a new roundabout at 5 Side Road (the improvement is not a part of this EA Study; the roundabout is being evaluated under a separate study). Segment 2, from Chudleigh's Entertainment Farm Access to 10 Side Road, retains two lanes with targeted intersection and turn lane improvements, also featuring paved shoulders to support active transportation. This segment traverses environmentally sensitive areas, including wetlands, watercourses, and woodlands. Throughout the corridor, the right-of-way generally ranges from 30 to 36 meters, with a planned width of up to 42 meters, in alignment with Halton Region planning guidelines.

The overall drainage pattern will generally remain consistent with existing conditions. To accommodate the proposed changes within the right-of-way, roadway runoff will be collected and conveyed via roadside ditches to the existing drainage outlet locations.

No extension or replacement is anticipated for the Middle Sixteen Mile Creek structure crossing (Bridge C-2; 7 m span and 29 m length) to accommodate the proposed roadway improvements within the study area, which is regulated by Conservation Halton. The determination is based on the existing condition assessment, natural heritage considerations, fluvial geomorphologic evaluations, proposed roadway geometry, grading constraints, and hydraulic performance of the structure.

Hydraulic analyses were completed using the most recently approved HEC-RAS model obtained from Conservation Halton, which reflects current regulated conditions and incorporates the peak flows draining to the crossing location. The model was used to evaluate the structure's performance in terms of freeboard, clearance, and overtopping during major storm events. The structure is subject to overtopping under multiple storm events, including the regional storm. The 100-year and regional storm flows exceed the structure's available capacity, and the MTO Highway Drainage Design Standards for freeboard and clearance are not met.

Despite the overtopping conditions observed under major storm events, the hydraulic analysis indicates that upsizing the structure would provide minimal benefit in reducing the frequency or depth of overtopping, given existing grading constraints and roadway geometry. Improving hydraulic performance by raising the road profile is prohibitive due to grading constraints imposed by accesses to adjacent properties and businesses. Furthermore, the existing bridge was not originally designed for freeboard compliance under regional storm events, and the road profile has not significantly changed to warrant structural modification.

As such, no structural upgrades or extensions are recommended for the existing bridge at this location. The proposed improvements can be implemented without adversely affecting hydraulic performance or increasing flood risk. No changes to the hydraulic conditions at this crossing are anticipated as part of the current improvements. Final design should confirm these findings with updated hydrologic data, if land-use or watershed conditions have changed since the current model was developed.

To meet the stormwater management (SWM) objectives related to quantity control, water quality protection, water balance restoration, and erosion control, a series of functional enhancements are proposed within the roadside ditch system along the study corridor. Specifically, flatter and wider-bottom ditches will be implemented to promote increased infiltration capacity and reduce runoff velocities, thereby minimizing erosion potential and supporting groundwater recharge. These regraded ditches will provide enhanced conveyance while also offering opportunities for integrated stormwater treatment.

Low Impact Development (LID) features—such as bioswales or rain gardens—will be incorporated within the roadside ditch system to facilitate water quality improvement through filtration, sedimentation, and biological uptake. These features will also support water balance objectives by promoting infiltration and evapotranspiration, contributing to the restoration of more natural hydrologic conditions.

In addition, the installation of check dams at strategic locations within the ditches is proposed as required to slow down runoff, encourage sediment deposition, and further reduce peak flow rates during storm events. These structures will enhance both erosion control and quantity control by providing localized detention and improved flow regulation.

Collectively, these measures aim to maintain or improve pre-development hydrologic conditions while ensuring compliance with applicable municipal and provincial stormwater management guidelines. The report emphasizes that all current findings are preliminary and must be validated through detailed engineering and municipal consultation.

During detailed design, the following activities will be completed:

- The recommended mitigation measures identified in the Fluvial Geomorphic Assessment will be incorporated into the detailed design of Culvert C-2, located north of Chudleigh's Entertainment Farm.
- A flood hazard assessment will be completed for the regulated crossing at Culvert C-2 to demonstrate that the proposed works will not result in unacceptable impacts to the floodplain, including hydraulic analysis of all proposed alterations within the floodplain (including buffered shoulders and multi-use pathways) and application of the most current watershed hydrology, hydraulic modelling, and topographic information available at the time of detailed design.
- The drainage and stormwater management design will be refined to incorporate final design details, including inlet and outlet erosion protection measures as required, and grading modifications necessary to support roadway improvements while maintaining drainage functionality.

- Hydrologic analyses and supporting calculations will be conducted to confirm compliance with post-development to pre-development flow targets and achievement of stormwater quantity control requirements.
- The proposed locations for recommended drainage and SWM measures in the regulated areas will be assessed during the detailed design phase.
- A summary of the key hydrologic modelling parameters, assumptions, inputs, and methodologies will be provided to support the detailed design analyses.
- Coordination with adjacent development proponents will continue during detailed design to facilitate the development of an integrated and coordinated drainage and stormwater management strategy for the area.