Final Erosion and Sedimentation Overview Risk Assessment (ESORA) Report

Highway 400 - Highway 404 Link (Bradford Bypass)
Town of Bradford West Gwillimbury, Township of King and Town of East Gwillimbury – Assignment # 2019-E-0048

Ministry of Transportation of Ontario

60636190

September 2023

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AECOM: 2015-04-13

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1	March 30, 2023	AECOM	DRAFT Erosion and Sedimentation Overview Risk Assessment (ESORA)
2	April 14, 2023	AECOM	DRAFT Erosion and Sedimentation Overview Risk Assessment (ESORA)
3	May 11, 2023	AECOM	DRAFT Erosion and Sedimentation Overview Risk Assessment (ESORA)
4	September 9, 2023	AECOM	FINAL Erosion and Sedimentation Overview Risk Assessment (ESORA)

Distribution List

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1. Introduction

1.1 Overview

The Ontario Ministry of Transportation (the Ministry) has retained AECOM Canada Ltd. (AECOM) to undertake a Preliminary Design and project-specific assessment of environmental impacts for the proposed Highway 400 to Highway 404 Link (Bradford Bypass). The Bradford Bypass (the project) is being assessed in accordance with Ontario Regulation 697/21 (the Regulation).

The Bradford Bypass is part of Ontario's plan to expand highways and public transit across the Greater Golden Horseshoe to fight congestion, create jobs and prepare for the massive population growth expected in the next 30 years. Simcoe County's population is expected to increase to 416,000 by 2031, with the Regional Municipality of York growing to 1.79 million by 2041. The Bradford Bypass has been proposed as a response to this dramatic growth in population and travel demand in the area and the forecasted increase in congestion on key roadways linking Highway 400 to Highway 404.

The Bradford Bypass is a proposed 16.3 kilometre controlled access freeway. that will extend from Highway 400 between 8th Line and 9th Line in Bradford West Gwillimbury, will cross a small portion of King Township, and will connect to Highway 404 between Queensville Sideroad and Holborn Road in East Gwillimbury. There are proposed full and partial interchanges, as well as grade separated crossings at intersecting municipal roads and watercourses, including the Holland River and Holland River East Branch. This project also includes the design integration for the replacement of the 9th Line structure on Highway 400, which will accommodate the proposed future ramps north of the Bradford Bypass corridor. The Ministry is considering an interim four-lane configuration and an ultimate eight-lane design for the Bradford Bypass. The interim condition will include two general purpose lanes in each direction and the ultimate condition will include four lanes in each direction (one high-occupancy vehicle lane and three general purpose travel lanes in each direction). The interim and ultimate designs are being reviewed as the project progresses. This Report and its findings are based on the project footprint identified within this Report. Should the footprint change or be modified in any way, a review of the changes shall be undertaken, and the report will be updated to reflect the changes, impacts, mitigation measures, and any commitments to future work.

The purpose of this Erosion and Sedimentation Overview Risk Assessment Report is to document the erosion potential within a broad area where the proposed Bradford Bypass works will take place. Based on the Erosion and Sedimentation Overview Risk Assessment (ESORA) requirements included in MTO's *Environmental Guide for Erosion and Sediment Control During Construction of Highway Projects* (September, 2015) herein referred to as the ESORA Guide, the risk for erosion potential is evaluated accounting for the characteristics of a broad area in terms of soils type and erodibility, slopes gradient and length, sensitivity of environmental features, the existing drainage pattern, and the nature of the proposed highway works.

The broad area is divided into polygons of similar erosion potential and a qualitative erosion and sedimentation risk value (rating) is assigned to each polygon based on the erosion and sediment risk rating assigned to each polygon. The erosion and sediment risk is a product of erosion potential and consequence rating.

In accordance with the assigned erosion potential ratings, an Erosion and Sediment Control Plan (ESCP) is developed to integrate it into the highway development plan. The incorporation of the ESCP will provide the appropriate level of protection measures intended to minimize erosion potential and sedimentation and to protect sensitive environmental areas that may be impacted by the proposed highway works.

2. Background Information

To complete the assessment under the ESORA Guide, the following documents and files were used and/or consulted in the preparation of this ESORA:

- MTO Environmental Guide for Erosion and Sediment Control During Construction of Highway Projects (Sept. 2015),
- MTO Environmental Reference for Highway Design (June 2013). (Hereinafter referred as ERD Guide),
- MTO ESORA Guide Appendix E: Fact Sheets: Best Management Practices for Erosion and Sediment Control during Construction, February 2007. (Hereinafter referred as ESORA Guide – Appendix E)
- LSRCA Report on Promoting Adoption of Erosion and Sediment Control Standards, December 18, 2017
- Terrestrial Ecosystem Existing Conditions and Impact Assessment Report – Highway 400 to Highway 404 Link (Bradford Bypass), (AECOM, August 2023) (hereinafter referred as the Terrestrial Report)
- Fish and Fish Habitat - Existing Conditions and Impact Assessment Report – Highway 400 to Highway 404 Link (Bradford Bypass), (AECOM, August 2023) (hereinafter referred as the Fish Report)
- Fluvial Geomorphological Assessment Report – Bradford Bypass Crossings – Highway 400 to Highway 404 Link (Bradford Bypass), (AECOM, August 2023) (hereinafter referred as the Fluvial Report)
- Drainage, Hydraulic and Stormwater Management (SWM) Report – Highway 400 – Highway 404 Link (The Bradford Bypass) (GWP 2008-21-00), (AECOM, August 2023) (hereinafter referred as the Drainage Report)
- Hydrogeological Data Report, Highway 400 – Highway 404 Link (Bradford Bypass, (AECOM, August 2023)
- Preliminary Foundation Investigation and Design Report (PFIDR, Dec. 2022 to April 2023, WSP Golder)
- Soil Survey Map of Simcoe County, Province of Ontario – Soil Survey Report No. 29
- Soil Survey Map of York County (Regional Municipality of York), Province of Ontario – Soil Survey Report No. 19
- Canada Köppen Climate Classification Map, 2023 plantmaps.com
- Mitasova, Brown, Hohmann, and Warren, (2001). Using Soil Erosion Modeling for Improved Conservation Planning: A GIS-based Tutorial. Retrieved from http://fatra.cnr.ncsu.edu/~hmitaso/gmslab/reports/CerlErosionTutorial/denix/denixstart.html,
- Land Information Ontario Data Description, Soil Survey Complex, 2019, and
- Aerial photographs.

The ESORA Guide provides the details, the procedures and tools for the development of effective Erosion and Sediment Control Measures and Plans. In addition, this document provides the procedures and technical practices for developing and documenting effective Erosion and Sediment Control (ESC) through a variety of delivery methods. The ERD Guide addresses all the environmental assessment issues (including ESC) for both preliminary and detailed design highway projects.

The Terrestrial Report and Fish Report were consulted to obtain information about sensitive areas in terms of existing characteristics of the fish habitat, terrestrial features, and potential impact on these environmental sensitive areas due to the proposed highway works. The Fluvial Report was consulted to obtain information related to the geomorphological characteristics of the watercourses and to identify mitigation measures to address erosion potential risk for both, the structures and watercourse.

3. Existing Site Characteristics

3.1 Study Area

As shown in **Figure 1**, the Bradford Bypass project is a new 16.3 kilometre (km) controlled access freeway. The proposed highway will extend from Highway 400 between 8th Line and 9th Line in Bradford West Gwillimbury, will cross a small portion of King Township, and will connect to Highway 404 between Queensville Sideroad and Holborn Road in East Gwillimbury (Regional Municipality of York). See **Section 5** for information related to the proposed Bradford Bypass works.

The west limits of the Study Area, including Highway 400, falls within the Penville Creek watershed (Innisfil Creek) and is under the jurisdiction of the Nottawasaga Valley Conservation Authority (NVCA). The remainder of the Study Area falls within the Holland River Watershed and is within the jurisdiction of the Lake Simcoe Region Conservation Authority (LSRCA). The limits of the Study Area are summarized below:

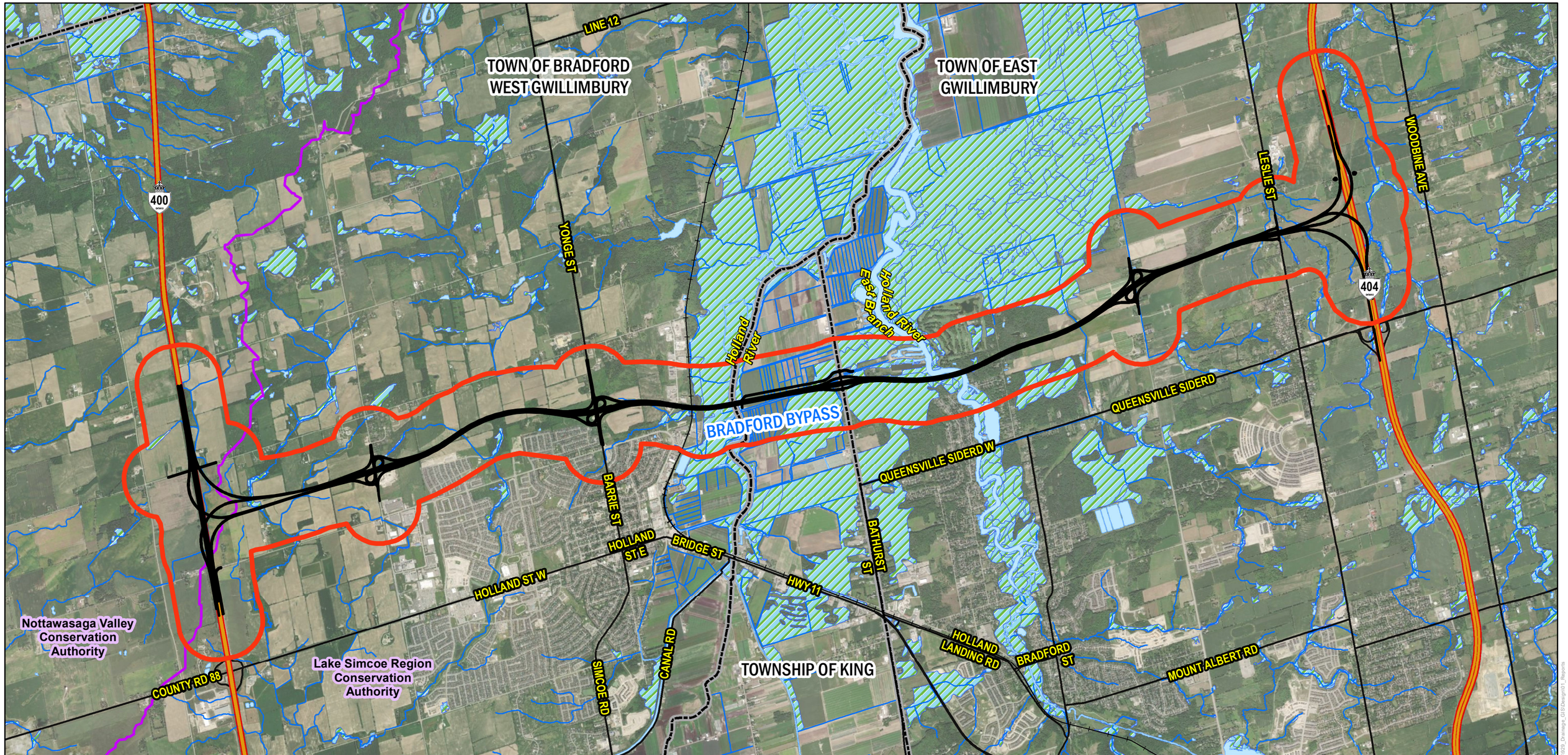
The land use consists of agricultural lands with some rural low-density residential and residential lands located south of Bradford Bypass between 10th Sideroad and the Holland River, and between Bathurst Street and 2nd Concession Road. Rural residential areas are encountered around the intersection between Leslie Street and Queensville Side Road. The topography of the site generally slopes towards the Holland River and Holland River East Branch, which ultimately convey flow north to Cook's Bay (Lake Simcoe).

AECOM staff completed site inspection on October 13th, 2020, to inspect the existing drainage system along the Bradford Bypass. A second site inspection was carried out on September 15th, 2022, to review in more details the areas were the new 10th Sideroad and 2nd Concession Road interchanges are proposed. Existing drainage features were evaluated on site, and any drainage issues or concerns were documented. The field reconnaissance was completed to clarify the following within the existing drainage system:

- Confirm the direction of surface flow;
- Confirm the location of culverts (sizes, material, physical conditions, outfalls etc.);
- Confirm drainage area dividers and natural flow paths;
- Characteristics and amount of sedimentation at culvert inlet and outlet ends;
- Inspect downstream conditions of the culverts to identify any obstructions to flows and to confirm tailwater conditions; and
- Identify erosion sites and drainage related deficiencies.

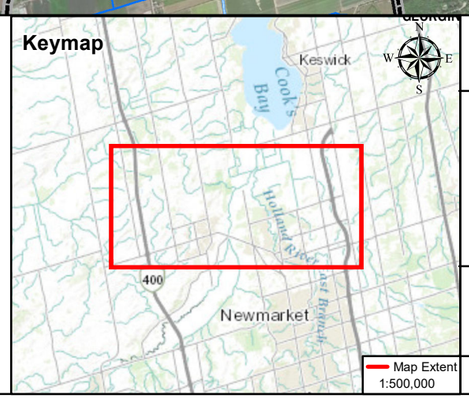
3.1.1 Unconsolidated Material and Topsoil

The Preliminary Foundation Investigation and Design Report (PFIDR, prepared for AECOM by WSP Golder) for the proposed Bradford Bypass (BBP) provides preliminary information that can be related to thickness and classification of unconsolidated material that may be exposed at various stages of construction, topsoil characteristics and quantities. The PFIDR were prepared for the following interchange, 10th Sideroad, Artesian Industrial Parkway, Bathurst Street, Highway 400, Highway 404, Metrolinx, the Holland River and the Holland River East Branch.



- Alignment - Bradford Bypass (Highway 400-404)
- Railway
- Existing Watercourse
- Waterbody
- Wetland
- Municipal Boundary
- Study Area

Note: Points of interest and proposed highway alignment are shown for information purposed only.



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Ontario Ministry of Transportation

N W E S

Datum: NAD 1983 CSRS MTM 10

Source: Contains information licensed under the Open Government Licence Ontario. Base map provided by ESRI.

0 500 1,000
Meters

May 2023

Scale: 1:50,000

Ontario Ministry of Transportation
Central Region

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Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

Figure 1 - Study Area

3.2 Drainage System

In order to illustrate the existing drainage system along the Bradford Bypass, **Exhibits 3.1** to **Exhibit 3.7**, **Exhibit 3.8** and **Exhibit 3.9** were obtained from the Drainage Report. These exhibits are provided in **Appendix A**.

Exhibits 3.1 to **3.7**, show that the existing drainage system along Highway 400, Highway 404 and sideroads consists of roadside ditches, transverse, sideroad and entrance culverts, catchbasins located along municipal roads, ditch inlets and watercourses.

As shown in **Exhibits 3.8 and 3.9**, runoff generated within the Study Area drains to the three main drainage features that cross the proposed Bradford Bypass alignment, as listed below:

- Runoff from the western portion of the Study area is conveyed westerly to Penville Creek by the existing culverts located under Highway 400. These culverts discharge to a tributary of Penville Creek that runs southerly along the east side of Highway 400.
- Flows along the tributary drain westerly across the highway to Penville Creek, which is within the Innisfil Creek Watershed and in the jurisdiction of the NVCA.
- Runoff generated within the center portion of the Study Area drains to Holland River and Holland River East Branch. These rivers run northerly and ultimately discharge to Lake Simcoe.

Exhibit 3.8 shows that the existing Culvert EX-CL-404-2 (4880 mm x 3050 mm structural concrete) drains an approximate area of 36.35 ha from a west area of Highway 404 to Maskinonge River, which drains northerly to Lake Simcoe. Holland River East Branch and Maskinonge River are located within the jurisdiction of Lake Simcoe Region Conservation Authority (LSRCA).

The Holland River subwatershed (**Exhibit 3.8**) is drained by the Holland River, which flows in a northeast direction into Cook's Bay (Lake Simcoe). The main tributaries of the Holland River include: Ansnorveldt Creek, Glenville Creek, East Kettleby Creek, 400 Creek, Pottageville Creek, South Schomberg River, North Schomberg River,

Fraser Creek, Scanlon Creek, William Neeley Creek, Coulson's Creek, and the Holland Marsh and its extensive canal and Municipal Drain system (LSRCA, 2010).

The Holland River East Branch flows generally in a northerly direction into Cook's Bay (Lake Simcoe). The main tributaries of the Holland River East Branch include the Main Branch, flowing westward from a point west of Musselman's Lake, the Aurora Branch, Wesley Corners Creek, and Bogart Creek (LRSCA, 2010). The Main Branch and the Aurora Branch join north of the Town of Aurora to form the Holland River East Branch and continue to flow north to discharge into Cook's Bay (LSRCA, 2010).

For additional information about the characteristics of the existing culverts and their hydrologic and hydraulic assessments including the hydraulic assessment of the Holland River and Holland River East Branch refer to the *Drainage, Hydraulic and Stormwater Management (SWM) Report – Highway 400- Highway 404 Link (The Bradford Bypass) (GWP 2008-21-00),* (AECOM, April 2022).

3.3 Topographic Characteristics

3.3.1 Surficial Soils

As shown of **Figure 3** (provided at the back of the report), west of the Holland River, the predominant soils along the Bradford Bypass are Loam, Gravelly Loam Sand, and Silty Clay Loam. The soil erodibility rating for these soils vary from Low to High.

To the east of Holland River, the predominant soils are Sandy Loan, Gravelly Loam, and Silt Loam. The soil erodibility rating for these soils varies from Low and Medium.

The soil types were obtained from the Soil Survey Map of Simcoe County, Province of Ontario – Soil Survey Report No. 29 and the Soil Survey Map of York County (Regional Municipality of York), Province of Ontario – Soil Survey Report No. 19, and Land Information Ontario Data Description, Soil Survey Complex, 2019.

In the areas adjacent to Holland River and Holland River East Branch the predominant soils is muck/organic that are preserved by a high water table. Based on the ESORA Guide.

3.3.2 Soil Slopes and Soil Slopes Length

As shown on **Figure 4** and **Figure 5** (provided at the back of the report) show the slope gradient and slope length which were acquired from the Land Information Ontario (LIO) open access website (https://www.javacoeapp.lrc.gov.on.ca/geonetwork/srv/en/main.home) via their Soil Survey Complex layer. The data was compiled by the Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA) and Agri-Food Canada, in cooperation with the Ministry of Natural Resources and Forestry (MNRF), from a collection of southern Ontario soil survey data previously mapped between 1920 and 1990. A digital elevation model (DEM) was also acquired from the LIO open access website in order to later calculate slope length using the RUSLE3d method (Mitasova, Brown, Hohmann, and Warren - 2001).

3.4 Terrestrial Features – Wetland and Vegetation

Agricultural lands largely represent the Study Area with some industrial, and commercial properties also present. Natural areas are generally limited to remnant woodlands and wetlands persisting in an otherwise agriculturally dominated landscape, with some larger naturalized areas intersecting the Study Area at the Holland River and Holland River East Branch and associated wetlands, including the Holland Marsh (BW5) PSW and Holland Marsh Wetland Complex PSW.

The Terrestrial Report identified several vegetation communities including deciduous, coniferous, and mixed forests, plantations, cultural woodlands, thickets and meadows, wetlands and open water communities as well as coniferous and deciduous swamps and swamp thickets. One rare vegetation community (Dry – Fresh Hickory Deciduous Forest) was identified within the Study Area, west of County Road 4 outside of the proposed right-of-way (ROW). No other rare vegetation communities were identified within the Study Area during field investigations.
Natural features and areas identified for protection in the Provincial Policy Statement (PPS) and other legislation (e.g., *Greenbelt Act, 2005*) are collectively referred to as 'designated natural areas'. These include, but are not limited to, Areas of Natural and Scientific Interest (ANSIs), significant wetlands, Environmentally Significant/Sensitive Area, etc. These may be identified by the planning authority (e.g., province, municipality, conservation authority).

Refer to the Terrestrial Report for additional details about the locations and characteristics of the wetlands, the vegetation, wildlife, species at risk, and soils within the Bradford Bypass study area.

3.5 Fish Habitat

Fifty-one (51) crossings were assessed along thirty-four (34) watercourses as part of this preliminary impact assessment. All the crossings that contain fish habitat in the East Holland River Subwatershed, West Holland River Subwatershed and the Maskinonge Subwatershed support warmwater fish communities. Only the crossings in the Innisfil Creek Subwatershed support coolwater fish communities. The East and West Holland River crossings (20-A-1 and 17-A-1, respectively), as well as C16-A-1, are known spawning habitat for muskellunge species.

Through the background information review, consultation with MNRF, and fish habitat and fish community assessments, it was determined that 17 crossings were permanent features that provided direct fish habitat,5 were intermittent features that provided direct fish habitat, 6 were intermittent and provided indirect habitat, and 2 were ephemeral and provided indirect habitat. Of the remaining 21 aquatic features, 20 were ephemeral and did not provide habitat, and 1 crossing was permanent, but did not provide habitat.

Critical Habitat (SARA) was not identified at any site; however, C17-A-1 and C20-A-1 act as migratory corridors for fish to reach upstream specialized habitat that fish use for spawning and nursery. A full description of existing conditions is available in the Final Environmental Conditions Report (AECOM, 2022) on the Project Website.

In total, 23 crossings have been identified that may require in-water works such as like-for-like replacement, grading, culvert extension, new culvert installation, watercourse realignment, and new bridge construction. No records of aquatic SAR were found at any culverts within the Study Area. Records of American Eel were identified in the Holland River and Holland River East Branch where the associated bridge works are located. Full details are documented in the Fish Report (AECOM, 2023).

3.6 Fluvial Geomorphologic Considerations

The following general fluvial geomorphology recommendations based on the fluvial geomorphological assessment and meander belt assessment completed for the project:

- A total of 43 features were investigated with 26 features identified as ephemeral and 17 permanent / intermittent features
- Defined (intermittent or permanent) features were described and photographed in the field and a Rapid Geomorphic Assessment (RGA), cross section, and bank data assessment, were completed as close to the proposed crossing location as possible to help inform crossing structure sizing and to document any evidence of channel instability
- Undefined (ephemeral) channels were described in the field and photographed. Ephemeral features typically have small drainage area and limited seasonal flows. They are not typically strong enough to form defined channel boundaries or to cause erosion within the reach
- The majority of permanent/intermittent features investigated (17 in total) were found to be “In Regime” and with low erosion risk as per the field investigations and the results of the RGA (Table 4-2). Only Reach HR-Trib-06 was found to be in “Transitional or Stressed” conditions and with “Moderate” erosion risk
- The majority of permanent/intermittent features investigated (17 in total) were found to be “In Regime” and with low erosion risk as per the field investigations and the results of the Rapid Geomorphic Assessment (RGA).
- Determination of the meander belt width considered whether the features were confined (within a valley) or unconfined (access to the floodplain). For unconfined features the 100-year erosion rates (erosion allowance) were calculated using Toronto and Region Conservation Authority’s (TRCA)“Crossings Guideline for Valley and Stream Corridors (2015)”.

An erosion risk table (see Table 7-1 included in the the Fluvial Report) was provided and discussed with the fisheries and drainage team to help inform crossing’s design sizing from a fluvial geomorphology perspective and

the erosion risks for all the watercourses were noted. For additional information consult the Fluvial Report (AECOM, 2023).

3.7 Local Precipitation and Climatic Data

Based on the MTO Drainage Management Manual (1995), the 2021 MTO IDF Curves were used to generate the 12-hour and 24-hour SCS Type II, 12-hour AES and 12-hour and 24-hour Chicago rainfall distributions. Intensity Duration Frequency (IDF) Curve for the year 2021 have been obtained from the MTO's Lookup Tool.

An hydrologic model was developed to estimate the 2-year and up to the 100-year peak flow values for al the aforementioned rainfall distributions. The peak flow values were compared to identify conservative storm events for the purpose of culvert and bridge assessments. It was determined that the 24-hour SCS Type II rainfall distribution generated the highest peak values and consequently was used in the hydraulic assessment of the drainage system within the Bradford Bypass Project limits.

For the major bridge crossings at the Holland River and Holland River East Branch the hydrologic inputs were obtained from the Visual OTTHYMO (VO) model provided by the Lake Simcoe Region Conservation Authority (LSRCA). Flow hydrographs for the 2-year and up to the 100-year including the Regional storm events were extracted from the model at the nearest nodes to the crossing locations, these are node 8234 and 8184 for the Holland River and Holland River East Branch, respectively.

The flow hydrographs were generated using the 12-hour SCS Type II rainfall distribution and are shown in Section 5.1 of the Drainage Report. These flow hydrographs were applied to the Holland River HEC-RAS hydraulic model that was developed as part of the preliminary assessment.

Refer to the Drainage Report for additional information related to local precipitation and climate data for the existing drainage system along the proposed Bradford Bypass.

The Canada Köppen Climatic Classification map identifies the area of the proposed Bradford Bypass as Class D – Continental (Microthermal) Climates (Dfb). Class D-Dfb climates are humid continental mid summer, wet all year. This climate class has the coldest month averaging below 0 °C (32 °F), all months with average temperatures below 22 °C (71.6 °F), and at least four months averaging above 10 °C (50 °F). No significant precipitation difference between seasons (neither abovementioned set of conditions fulfilled).

The LSRCA's *Lake Simcoe Climate Data – A referenced Document to Support the Completion of Water Balance Assessments* (April 2017, Version 1.0), provides information about the attempt to standardize water balance assessments completed to support development applications that will be reviewed by LSRCA. The document specifies that water balance methods are appropriate for predicting the changes to the hydrologic cycle that results from new developments.

In addition, the documents provides in Appendix A (Climate Data Tables) information related to subwatershed area (km^2), mean annual precipitation (mm/yr.), actual evapotranspiration (mm/yr.) and precipitation surplus (mm/yr.). This information is provided for the Holland River subwatershed, Holland River East Branch subwatershed, Maskinonge River subwatershed,

4. Proposed Works

4.1 Overview

The project includes the Preliminary Design and project-specific assessment of environmental impacts for the proposed Highway 400 – Highway 404 Link (Bradford Bypass). The project is a new 16.3 kilometre (km) controlled access freeway. The proposed highway will extend from Highway 400 between 8th Line and 9th Line in Bradford West Gwillimbury, will cross a small portion of King Township, and will connect to Highway 404 between Queensville Sideroad and Holborn Road in East Gwillimbury.

4.2 Project Scope of Work

The scope of work for this project includes the following:

- Review of the Recommended Plans from the 2002 Approved Environmental Assessment (2002 Approved EA) mainline alignment and interchange crossing (subsequently updated by AECOM in advanced works)
- Development of alternatives for the Bradford Bypass mainline alignment, grade separated crossings and interchanges
- Development of alternatives for freeway to freeway interchanges that mitigate weaving distance concerns with the adjacent Highway 404/ Queensville Sideroad and Highway 400/Simcoe Road 88 interchanges
- Undertake supplemental environmental investigations and impact assessment work, building off the retainer work undertaken by AECOM in 2019, and evaluate each of the alternatives that are developed
- Further development of the Recommended Plan (Updated Technically Preferred Route) encompassing the preferred mainline, grade separation and interchange alternatives to a preliminary level of design
- Preparation of a Preliminary Design Report to document the development and evaluation process for the Recommended Plan (Updated Technically Preferred Route), and

As part of the project-specific assessment of environmental impacts as identified in Ontario Regulation 697/21, an Environmental Conditions Report was prepared to document the:

- Updates to the description of the environmental conditions from the 2002 Approved EA
- Description of all studies undertaken in relation to updating the environmental conditions in the Study Area
- Identification and description of any changes to the technically preferred route, as identified in the 2002 Approved EA, as a result of changes to the environmental conditions, and
- Consultation record with Indigenous communities, regulatory agencies and interested stakeholders, etc.

As part of the project-specific assessment of environmental impacts as identified in Ontario Regulation 697/21, an Environmental Impact Assessment Report (EIAR) will also be prepared to document the:

- Description of environmental conditions within the Bradford Bypass corridor
- Description of all studies undertaken
- Assessment and evaluation of preliminary design alternatives

- Description of any measures proposed to mitigate any negative impacts that the preliminary design alternatives may have on the environment and the criteria for assessment and evaluation of those impacts
- Description of the methods to monitor the effectiveness of the mitigation measures proposed
- Description of any municipal, provincial, federal or other approvals or permits that may be required, and
- Consultation record with Indigenous communities, regulatory agencies and interested stakeholders etc.

Drainage and Hydrology assessments and design have been developed in consultation with the MTO and external agencies. The proposed drainage works includes the following:

- Preliminary layout and design of the roadside ditches, flat-bottom and enhanced grassed swales and any other ancillary flow elements to convey the highway runoff to a sufficient outlet
- Accommodation of major overland flow along the Bradford Bypass corridor and other major flow paths
- Preliminary layout and design of culvert sizes and locations including erosion protection and associated structures that are part of the surface drainage system
- Identify the location of the outlet and preliminary design of outfall including connections to outlets and outfall protection, and
- Preliminary layout and design of storm water management (SWM) facilities for the quality and quantity control of runoff.

For additional information about the characteristics of the proposed culverts, the hydraulic assessment of the Holland River and Holland River East Branch bridge structures and the proposed SWM plan refer to the *Drainage, Hydraulic and Stormwater Management (SWM) Report – Highway 400- Highway 404 Link (The Bradford Bypass) (GWP 2008-21-00),* (AECOM, Dec. 2022).

4.3 Local Precipitation

The design storms were generated using the Rainfall Intensity-Duration-Frequency (IDF) parameters obtained from the MTO Rainfall IDF On-line. The IDF curves were projected to the year 2097 (75-year service life) to account for the climate change effect on rainfall intensities and peak flows.

The hydrologic assessment of the proposed culverts was completed using the MTO 2097 IDF Curves corresponding to the 75 years service life of the Bradford Bypass proposed drainage system including the new culverts and bridges. The IDF parameters were input into the hydrologic model to generate the 2-year and up to the 100-year peak flows based on the 24-hour SCS Type II rainfall distribution.

Refer to the Drainage Report for additional information related to local precipitation and climate data for the proposed Bradford Bypass drainage system.

5. Erosion and Sedimentation Overview Risk Assessment (ESORA)

The purpose of this ESORA is to assess site specific erosion potential based on topographic characteristics, and to identify the erosion and sedimentation risk (ES risk) which includes an assessment of the receiving environmental sensitivity. Based on the ES risk, an Erosion and Sediment Control (ESC) approach is identified that will provide the appropriate level of protection and that will minimize any adverse impact on the surrounding environment due to the proposed Bradford Bypass works.

5.1 MTO Erosion and Sediment Control Plan Approaches

The three MTO approaches of Erosion and Sediment Control (ESC) are summarized in the ESORA Guide (see Table 3.1 and discussed in more detail in Sections 3.1.1, Section 3.1.2 and Section 3.1.3 of the ESORA Guide).

These approaches differ by the level of effort and/or the responsibilities of the Design Consultant and the Contractor. **Appendix B** includes Table 3.1 and Table 3.2 which were obtained from the ESORA Guide. See also **Section 6** in this report. A summary of the three approaches is provided below:

- **Approach 1 – Applicable Best Management Practices:**

  This approach is for lower risk areas where a lesser amount of effort in ESC is justified. There are no regulatory requirements (e.g., Fisheries Act Authorization) that require an ESCP. Typically, this approach is applied in less complex sites and construction approaches and projects with minor grading or cuts and fills.

- **Approach 2 – Develop an Erosion and Sediment Control Plan:**

  This approach is implemented for higher risk areas / projects where a higher amount of effort in ESC is warranted. An ESCP is required (e.g., for Fisheries Act Authorizations). Some confidence exists in predicting construction methods. The need exists to limit the Contractor's ability to modify the ESCP's. This approach is typically incorporated in scenarios involving stream crossings and/or moderate grading.

- **Approach 3 – Develop a Two-Part ESCP: Main and Supplemental:**

  This approach is required for higher risk areas / projects where additional provisions in ESC is warranted. An ESCP is required from the Contractor (e.g., for Fisheries Act Authorizations). Construction methods are complex and may need to be adapted to address on-going site-specific challenges. "Adaptive Management" is also required as the project progresses.

5.2 Applicable Regulations to Sediment and Erosion Control

- **Fisheries Act**

  No person shall carry out any work or undertaking that results in the harmful alteration, disruption, or destruction of fish habitat, without prior approval by the Department of Fisheries and Oceans, or an agency authorized to work on their behalf

- **Species at Risk Act**

  No person shall destroy any part of the critical habitat of any listed endangered species or of any listed threatened species – or of any listed extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada

- **Canadian Environmental Protection Act**

  The goal of the Canadian Environmental Protection Act is to contribute to sustainable development through pollution prevention and to protect the environment, human life and health, from the risks associated with toxic substances

- **Ontario Water Resources Act**

  An act which was developed to conserve, protect, and manage Ontario's water resources for efficient and sustainable use. The act focuses on both groundwater and surface water throughout the Province of Ontario. The act governs both water quantity and quality, and

- **Conservation Authorities Act**

  The Conservation Authorities Act was created to ensure the conservation, restoration, and responsible management of water, land, and natural habitat, through programs that balance human, environmental, and economic needs.

The selection of the recommended ESCP approach(es) is based on the specific characteristics of the project and the resulting erosion potential, the consequence rating, and the erosion and sedimentation risk

5.3 Erosion and Sediment Risk - Consequences

The ESORA Guide states the need for Erosion and Sediment (ES) risk assessment based on the ES Control Failures outlined in the ESORA Guide that can result in three types of potential consequences which are describe below:

- **Ecological Consequences** can be the results from discharging sediment laden runoff to stream and low laying areas that support fish habitat (i.e., wetlands, floodplains, marshes, etc.).
- **Project Consequences** can be related to the need to respond to and repair erosion damage and the implications to the project schedule and adverse implication to the project cost.
- **Legal Consequences** are in general associated with the deposition of sediment in receiving waterbodies and ecologically significant areas.

Uncontrolled land management practices during construction can significantly influence the risk of erosion. Removal of vegetation, soil compaction, and slope changes can all increase the rate of erosion. The lack of effective ESC measures can result in significant erosion and sediment transport.

All of these potential consequences must be considered when determining the best approach to develop the ESCP. Risk assessment is a key element in assessing the extent and degree to which appropriate Erosion and Sediment Control (ESC) measures need to be integrated into the Bradford Bypass development plan.

5.4 ESORA Methodology

Erosion Potential Rating (EPR)

The ESORA involves a classification of a broad area, which is broken down into smaller areas (polygons) of similar erosion potential. Each polygon is evaluated in terms of surficial soil type, slope gradient, slope length and soil erodibility rating of Low, Moderate / Medium, or High erosion potential is assigned to each polygon. Thirteen (13) polygons were identified for the Bradford Bypass project.

Consequence Rating (CR)

Once the erosion potential rating has been identified, an additional consequence rating is assigned to each of the thirteen polygons. The consequence rating is based on the receiving environment sensitivity, the direct / indirect connectivity, and the existence of water bodies, wetlands and sensitive areas within each polygon.

Erosion and Sedimentation Risk

The Erosion and Sedimentation (ES) risk rating is then assigned to each polygon based on the erosion potential and consequence ratings. Judgement is exercised to adjust the erosion potential to account for features or procedures not included in the assessment of the erosion potential. The factors considered in providing the appropriate ES risk are described below.

- erosion potential (based on soil type, topography, cover characteristics, shallow groundwater conditions)
- sensitivity of the water body receivers
- location of environmental features such as ESA's ANSI's, wetlands, etc.
- location of water intakes and recreational areas
- urban sewer systems that will receive highway runoff, and
- potential cut and fill slopes greater than 2 m in height and steeper than 1(v):4(h).

Table 1. Hierarchy of Soil Erodibility

Erodibility Classification	Soil Type	Soil Erodibility Rating
Most	Silt	High
	Silty Loam	High
	Loam	High
	Silty Sand	High
	Sandy Loam	Medium
	Silty Clay Loam	Medium
	Sandy Clay Loam	Medium
	Silty Clay	Medium
	Sandy Clay	Low
	Clay	Low
	Heavy Clay	Low
	Loamy Sand	Low
	Sand	Low
	Poorly Graded Gravel	Low
Least	Well-Graded Gravel	Low

5.5 Soil Erodibility

Soil erodibility is the soil's inherent susceptibility to erosion by runoff and the impact of rainfall drops on the soil surface. The soil erodibility is dependent primarily on soil type. This is defined by the predominant soils within each polygon.

Table 1 (obtained from the ESORA Guide), outlines the hierarchy of soil erodibility rating for various soil types. As noted in **Section 3.3.1**, west of the Holland River, the predominant soils along the Bradford Bypass are Loam, Gravelly Loam Sand, and Silty Clay Loam. The soil erodibility rating for these soils varies from Low to High. The soil erodibility rating for an area west of Holland River and south of Cunty Road 4 is unknown as database is not available at the time of preparing this report. To the east of Holland River, the predominant soils are Sandy Loan, Gravelly Loam, and Silt Loam. The soil erodibility rating for these soils varies from Low and Medium.

Table 3 includes the identified thirteen polygons along the Bradford Bypass along with the soil erodibility rating for the predominant surficial soils within each polygon.

5.6 Slope Gradient and Slope Length

The ESORA Guide states that steeper slopes increase erosion potential because they allow water to flow faster and the longer the slope the greater the erosion potential because they collect larger quantities of water and offer more potential for flow concentration.

Table 2 (obtained from the ESORA Guide), includes the erosion potential associated with slope length, slope gradient, and soil erodibility ratings. The soils gradient within the polygons varies from 0 to 9% and the slope length was found to be greater than 70 m for all the polygons. A summary of the slope gradient and slope length for each polygon is presented in **Table 3**.

Table 2. Erosion Potential Associated with Slope Length, Slope Gradient and Soil Erodibility Rating

Slope Gradient	Soil Erodibility (Table 5-1)	Slope Length	
		< 70 m	> 70 m
0-10%	Low	Low	Low
	Medium	Low	Moderate
	High	Moderate	High
10-20%	Low	Low	Moderate
	Medium	Moderate	High
	High	High	High
>20%	Low	Moderate	Moderate
	Medium	High	High
	High	High	High

5.7 Potential Impacts and Consequence Rating

A summary of potential impacts to existing receiving watercourses/waterbodies, vegetation and wetlands are provided below as a result of the proposed project works. The summary was obtained from the assessments and findings documented in the Terrestrial Report and Fish Report. Based on these findings and additional review of sensitivity / connectivity rating values are assigned.

Existing Receiving Watercourses / Waterbodies

The west limits of the Study Area, including Highway 400, falls within the Penville Creek watershed (Innisfil Creek), which is located in the jurisdiction of Nottawasaga Valley Conservation Authority (NVCA). The remaining of the Study Area falls within the jurisdiction of Lake Simcoe Region Conservation Authority (LSRCA) that includes the

Holland River and Holland River East Branch watersheds, and the Maskinonge River watershed, which covers the east limits of the Study Area at Highway 404.

Of the proposed seventy-four culverts, fifty-one (51) crossings are located along thirty-four (34) watercourses. All the crossings that contain fish habitat in the East Holland River Subwatershed, West Holland River Subwatershed and the Maskinonge Subwatershed support warmwater fish communities. Only the crossings in the Innisfil Creek Subwatershed support coolwater fish communities.

Appendix C provides the fish and fish habitat conditions summary table, which includes the watercourse and/or waterbody name, type of flow and thermal regimes, fish habitat characteristics, type of substrate, channel morphology, recommendations to maintain wetland and cattail marsh to the extent possible, vegetation and surrounding forest characteristics, constraints and opportunities to restore channel form. In addition, the appendix includes thirteen figures that depicts the locations of waterbodies/watercourses, provincial significant wetlands (PSW) the Bradford Bypass project limits.

Vegetation

Forest, wetland, and cultural vegetation communities were identified adjacent to the proposed ROW throughout the Bradford Bypass Study Area. This includes one rare vegetation community that was observed west of County Road 4. Additionally, two plant Species at Risk, butternut and black ash were identified in several communities throughout the Study Area and are likely to occur in vegetation communities adjacent to the proposed ROW. Please refer to the *Highway 400 to Highway 404 Link (Bradford Bypass) Terrestrial Ecosystems Existing Conditions and Impact Assessment Report* (AECOM, 2023) for details regarding vegetation communities identified within the Study Area.

Wetlands

There are three Provincial Significant Wetlands (PSW) located within the Study Area. Holland Marsh (BW5) PSW is located along the western bank of the Holland River. Holland Marsh Wetland Complex PSW is located along the Holland River and Holland River East Branch. Maskinonge Rive Wetland Complex PSW is located west of Highway 404. The PSW is mapped along the banks of the Maskinonge River.

The Terrestrial Report states that there are 19 unevaluated wetlands present within the Study Area between Highway 400 and Highway 404 including three large (>5ha) unevaluated wetlands present between the Holland River and Holland River East Branch. Refer to the Terrestrial Report for the locations of these PSW's and wetland complexes.

CONSEQUENCE RATING

Consequence Rating is the potential for sediment to cause unacceptable adverse impacts to environmental sensitive areas and the due to construction activities, and it is expressed in a scale of Low, Moderate and High. The consequence rating is determined from the sensitivity of the receiving environment to sedimentation, and the connectivity that is defined as the likelihood that a significant amount of sediments will reach the receiving environment and it can be Direct, Indirect and No Connectivity. **Table 3** provides the consequence rating and potential impact to sensitive areas located along the Bradford Bypass.

5.8 Erosion and Sedimentation (ES) Risk

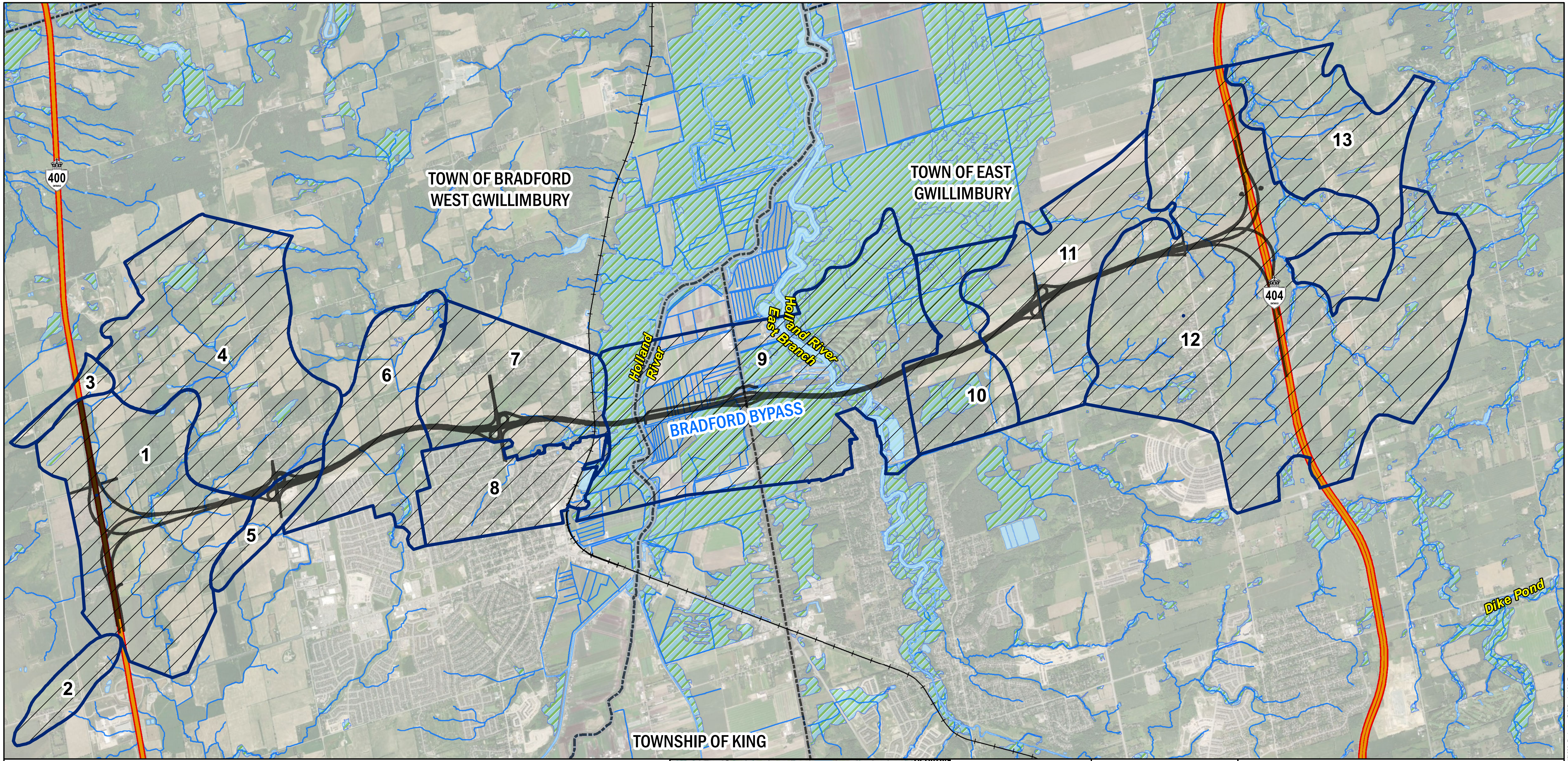
The ESORA Guide states that sedimentation can adversely impact aquatic habitats, affect the aquatic environment, wetlands and ecologically significant areas, including fish and fish habitat, and specialized wildlife habitats, notably those supporting species at risk. Depositing fine sediment in spawning areas can smother eggs and make streambed materials unusable for spawning. Ecologically significant areas and wildlife habitats may be destroyed or significantly impacted by smothering of vegetation and impairment to their ecological functions.

Erosion at construction sites can affect project costs and timelines. For example, repair of damage due to large soil movement or gully formation may require resources to be diverted from other construction activities. Damage to adjacent private properties or receiving waterbodies, caused by soil leaving the site, can be costly to repair. In extreme cases, this can also affect project completion schedules.

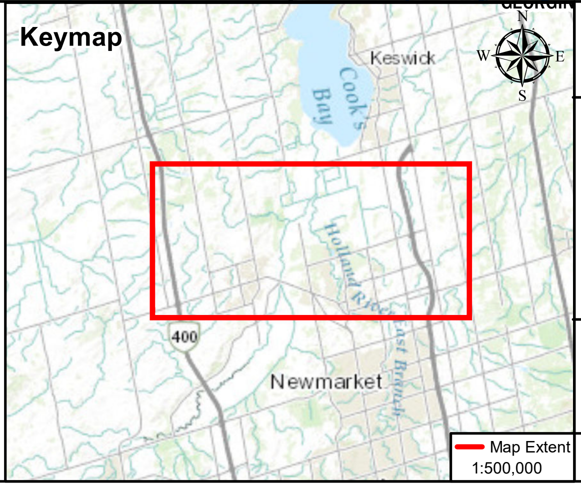
The final step in the Bradford Bypass erosion and sediment site assessment is to identify the risk of erosion due to construction activities. **Table 3** summarizes the Erosion and Sedimentation Risk for all the polygons. The estimated EC Risk is used to assist in specifying appropriate levels of effort for the Erosion and Sediment Control Plan (ESCP).

Table 3. Erosion and Sediment Overview Risk Assessment Summary

Polygon No. (See Figure 2)	Surficial Soil Type / Classification	Soil Erodibility Rating	Slope Gradient (%)	Slope Length (m)	Erosion Potential	Rational for Erosion Potential	Consequence Rating	Rationale for Consequence Rating (Receiving Environment Sensitivity)	Erosion and Sedimentation Risk
1	Silty Clay Loam	Medium	2 – 5	>70	Moderate	Moderate risk for both surface soil, slope and slope length.	High	A High risk is adopted due to the presence of the Tributary of Penville Creek which required protection	**High**
2	Loam	High	2 – 5	>70	High	High risk for surface soil, slope and slope length.	High	High risk due to the presence of the Tributary of Penville Creek to the north	**High**
3	Loam	High	2 – 5	>70	High	High risk for surface soil, slope and slope length.	High	High risk due to the presence of the Tributary of Penville Creek to the north	**High**
4	Gravelly Loamy Sand	Low	5 - 9	>70	Low	Low risk for surface soil, slope and slope length.	Moderate	Discharge to a tributary of the Holland River	**Moderate**
5	Loam	High	2 – 5	>70	High	High risk for surface soil, slope and slope length.	High	The polygon drains to a watercourse and ultimately discharge to Holland River	**High**
6	Silty Clay Loam	Medium	2 - 5	>70	Moderate	Moderate risk for surface soil, slope and slope length.	Moderate	Discharge to a tributary of the Holland River	**Moderate**
7	Loam	High	2 - 5	>70	High	High risk for surface soil, slope and slope length.	High	Directly connected to sensitive areas adjacent to Holland River	**High**
8	Urban	High	2 - 5	>70	High	Unknown risk for surface soil, slope and slope length. No data based available	High	Discharge to sensitive areas adjacent to Holland River	**High**
9	Sandy Loam (70% and Organic (30%)	Low	0 - 9	>70	Low	Low risk for surface soil, slope and slope length.	High	Discharge to sensitive areas adjacent to Holland River and Holland River East Branch	**High**
10	Sandy Loam (60% and Organic (40%)	Low	0 - 9	>70	Low	Low risk for surface soil, slope and slope length.	High	Discharge to Holland River East Branch	**High**
11	Silt Loam	High	0 - 2	>70	High	High risk for surface soil, slope and slope length. However, the slope gradient 0-2% and the slope length is >70m.	Moderate	Does not discharge directly to sensitive areas	**Moderate**
12	Sandy Loam (80%) and Clay Loam (20%)	Low	2 - 9	>70	Low	Low risk for surface soil, slope and slope length.	High	High risk due to tributaries of Holland River East Branch that cross the Bradford Bypass and different locations	**High**
13	Loam	High	2 - 5	>70	Low	High risk for surface soil, slope and slope length.	Moderate	Discharge to tributaries of the Maskinonge Rive that drains away from the Bradford Bypass	**Moderate**



- Alignment - Bradford Bypass (Highway 400-404)
- Railway
- Existing Watercourse
- Waterbody
- Wetland
- Municipal Boundary
- Erosion Potential Polygons



AECOM

Ontario
Ministry of Transportation

Datum: NAD 1983 CSRS MTM 10

Source: Contains information licensed under the Open Government Licence Ontario. Base map provided by ESRI.

0 500 1,000
Meters

May 2023

Scale: 1:50,000

Ontario Ministry of Transportation Central Region

60636190
Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

Figure 2 - Erosion Potential Polygons

5.9 Revised Universal Soil Loss Equation (RUSLE)

The Revised Universal Soil Loss Equation (RUSLE) is used for evaluating erosion potential over extended periods of time. It is an empirical equation and was developed to predict average annual soil loss (tons / hectares / year) due to sheet and rill erosion in agricultural areas. The method does not estimate erosion in channels, gully, stream banks, and does not calculate sediment deposition. The RUSLE equation can be expressed as follows:

A = R x K x LS x C x P

The variables included in the above equation can be grouped into four general categories: climate, soil type / characteristics, topography, and land-use / cover. These variables are defined as: R=soil erosivity due to rainfall runoff (climate factor); K=soil type / erodibility (soil factor); LS=slope length and slope steepness (topography factor); C=cover management; and P=erosion control practice. C and P are grouped into the cover management category and are the easiest and most cost-effective factors that can be manipulated to control erosion.

Despite that the RUSLE equation is generally used only for agriculture activities; an understanding of the variables included in the equation provides useful tool in assessing the factors that influence erosion and their relative contribution to the process.

Table 4 extracted from the ESORA Guide provides a summary description of the variables included in the RUSLE equation.

Table 4. Summary Description of RUSLE Variables

Factor and Description	Category	Effect	Control
A = Average annual soil loss	*A = R x K x LS x C x P*		
R = Rainfall-runoff erosivity	Climate	Climates with more frequent or intense runoff events will have greater soil loss.	Can be controlled by avoiding seasons with heavy rainfall or snowmelt.
K = Soil erodibility	Soil Factor	Soil erodibility is affected by particle size, texture, chemistry, water content, organic content and permeability	Relatively difficult to control, however proper planning can help to avoid problem areas and appropriate mitigation will be dependent on soil characteristics.
L = Slope length	Topography Factor	Longer slope lengths increase erosion potential because they collect larger quantities of water and offer more potential for flow concentration.	Site drainage density can be planned to introduce drainage swales or watercourses at regular intervals to reduce slope lengths. Landscaping can be planned to minimize steep slopes. This may affect earthworks quantities.
S = Slope steepness		Steeper slopes increase erosion potential because they allow water to flow faster.	
C = Cover management	Cover Management	Large values of *C* and *P* factors represent relatively erosive conditions, including no cover (*C* = 1) and no erosion control practice applied (*P* = 1).	Cover management and erosion control practice factors are the easiest and most cost-effective factors that can be manipulated to control erosion.
P = Erosion control practice			

6. Erosion and Sediment Control Plan

6.1 Overview

Based on the results presented in **Table 3**, the Erosion and Sedimentation Risk values within the polygons are Moderate and High. Polygon areas with an ES Risk value of Moderate will require an Erosion and Sediment Control Plan (ESCP) based on **Approach 2** and **Approach 3**. **Approach 2** generally includes the development of an Erosion and Sediment Control Plan (ESCP) that involves stream crossings and/or moderate grading. Polygon areas with an ES Risk value of High will require an ESCP based on Approach 3 (Two-Part ESCP: Main and Supplementary). **Approach 3** is typically applied to higher risk areas where a higher amount of effort in Erosion and Sediment Control is warranted.

Table 5 (copied from the ESORA Guide), outlines considerations that are applicable to areas with a ES Risk values of Moderate and High. For the Bradford Bypass project, the development of the ESCP will follow **Approach 2** and **Approach 3** considerations and should be carried out during the detailed design and construction phases.

Table 5. Considerations in Selecting Erosion and Sediment Control (ESC) Approaches

Approach	Considerations
1 **Best Management Practices (BMPs)**	• Typically for lower risk areas where a lesser amount of effort in ESC is justified. • There are no regulatory requirements (e.g., *Fisheries Act* Authorization) that require an ESCP. • Typically for less complex sites and construction approaches. • Projects with minor grading or cuts and fills.
2 **Erosion and Sediment Control Plan (ERCP)**	• Typically for higher risk areas / projects where a higher amount of effort in ESC is warranted. • An ESCP is required (e.g., for *Fisheries Act* Authorizations). • Some confidence exists in predicting construction methods. • The need exists to limit the Contractor's ability to modify the ESCPs. • Project involving stream crossings and/or moderate grading.
3 **Two-part ESCP - Main & Supplemental**	• Typically for higher risk areas / projects where a higher amount of effort in ESC is warranted. • ESCP is required from the Contractor (e.g., for *Fisheries Act* Authorizations). • Little confidence in predicting construction methods. • "Adaptive Management" is needed. • The need to allow the Contractor to adapt the ESCPs because the site and/or the construction methods are complex.

Table 6 (copied from the ESORA Guide), shows a sample framework for selection the appropriate level of effort for erosion and sediment control measures based on erosion potential and consequence rating.

Table 6. Framework of Level of Erosion and Sediment Control for Various Risks

Erosion and Sediment Risk[5]		Level of Erosion and Sediment Control					
Erosion Potential (Table 5-2)	Consequences	Procedural BMPs	ESCP and Structural BMPs	Divert Runoff Around Site	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Construction Monitoring[c]
Low	Low	X[b]	-	-	-	-	-
	High	X	X	-	-	-	-
Moderate	Low[a]	X	-	-	-	-	-
	High	X	X	X[b]	X[b]	X[b]	X[b]
High	Low[a]	X	X	X	X	X	X[b]
	High	X	X	X	X	X	X[d]

6.2 Preliminary ESC Recommendations

Based on an assessment of the existing conditions of the Bradford Bypass project, and the proposed highway works the following Ontario Provincial Standard Specifications (OPSS) for erosion and sediment control during construction are recommended. If revised and/or additional provisions/specifications are developed in the future, ESC recommendations should be assessed and considered during the detail design phase.

- **Ontario Provincial Standard Specifications (OPSSs):**
  - OPSS Prov. 100: MTO General Conditions of Contract
  - OPSS Prov. 180: Management of Excess Materials
  - OPSS Prov. 801: Protection of Trees
  - OPSS Muni. 802: Topsoil
  - OPSS Prov. 803: Vegetative Cover
  - OPSS Prov. 804: Temporary Erosion Control
  - OPSS Prov. 805: Temporary Sediment Control
  - OPSS Prov. 517: Dewatering, and
  - Special Provision No. 100S19 Amendment to MTO General Conditions of Contract, April 2022.
- **Working Area Perimeter - Sediment Control BMPs:**
  - OPSD 219.110 Light Duty Straw Bale Barrier

- OPSD 219.130 Heavy Duty Straw Bale Barrier
- MTOD 219.110 Sediment Fence Barrier
- MTOD 219.120 Fibre Roll Barrier
- MTOD 219.131 Wire-Backed Sediment Fence Barrier
- OPSD 219.150 Sandbag Barrier, and
- OPSD 219.160 Fibre Roll Grade Breaks.

- **Drainage, Check Dams and Sedimentation Basin BMPs:**
  - OPSD 219.180: Straw Bale Flow Check Dam (OPSD 219.191, 219.200, 219.210 and 219.211 are favored options over 219.180)
  - OPSD 219.191 Fibre Roll Flow Check Dam
  - OPSD 219.200 Sandbag Flow Check
  - MTOD 219.210 Rock Flow Check Dam V-Ditch
  - MTOD 219.211 Rock Flow Check Dam Flat Bottom Ditch
  - OPSD 219.220 Sediment Trap in Ditch
  - MTOD 219.230 Slope Drain for Sediment Trap
  - MTOD 219.231 Berm Barrier for Slope Drain, and
  - OPSD 219.240 Sediment Trap for Dewatering.
- **In-Water and Near-Water Works BMPs:**
  - OPSD 219.260 Turbidity Curtain
  - OPSD 219.261 Turbidity Curtain, Seam Detail
  - OPSD 221.010 Temporary Water Passage System – Culvert in Watercourse
  - OPSD 221.020 Temporary Water Passage System – Pumping and Piping, and
  - Specific in-water works will need to be designed, which are not depicted through.

In addition to the above-mentioned specifications, the types of Best Management Practices (BMP) that should be implemented as part of the Bradford Bypass project are described below:

- ***Project Planning and Design BMPs*** – these BMP were discussed during the design process to consider erosion potential along the Bradford Bypass corridor, to avoid areas with higher risk of erosion and higher adverse impacts along the highway (wetlands), and waterbody crossings.
- This includes the decision that was taken to shift the right-of-way, to the feasible extent, on the west side of the highway to avoid impacts on the wetland complexes located in the areas adjacent to Holland River and Holland River East Branch.
- ***Procedural BMPs*** – these measures are considered good housekeeping, and include site management, and scheduling practices; such as, minimize exposed soils, perimeter control, site access management, stockpile management as required, dust management, optimize construction sequence, and install BMPs early and restore early (see ESORA Guide **Table 8.1**).
- ***Water Management BMP's*** – these BMP's are recommended to minimize watercourse disturbance, keep clean water clean, and anticipate and manage groundwater where possible. (see ESORA Guide **Table 8.2**).
- ***Erosion Control BMP's*** – these BMP's are recommended to reduce potential for erosion due to wind, rain splash, and flowing water. Cover is the single most effective erosion control practice. (see ESORA Guide **Table 8.3**).

Appendix D provides Table 8.1, Table 8.12 and Table 8.3 obtained from the ESORA Guide.

6.2.1 General Mitigation Measures

Appendix E includes a Mitigation Table that provides further information about the issues/concerns of potential effects, concerned agencies, and recommendations for mitigating, protecting, and monitoring of the environmental features in terms of erosion and sediment control, fish and fish habitat, vegetation impacts, wildlife and wildlife habitat impacts, SAR and Significant Wildlife Habitat Impacts, land use, designated substances, construction noise and air quality impacts.

In addition, implementation of the following standard mitigation (also identified in the Fish and Terrestrial Reports) will assist in addressing erosion and sediment control for this project:

- OPSS-180: General Specification for the Management of Excess Materials
- OPSS-201: Construction Specification for the Clearing, Close Cut Clearing, Grubbing and Removal of Surface and Piled Boulders
- OPSS-804: Construction Specification for the Seed and Cover
- Any woody vegetation removed during the proposed works will be replaced with a similar native species
- Areas of herbaceous vegetation disturbed during proposed works will be seeded with MTO's Custom Roadside Pollinator Mix
- Temporary Flow Diversions shall be conducted in accordance with OPSS182 and OPSS517
- Dewatering and the Use of Pumps shall be conducted in accordance with OPSS 182 and OPSS 518 (combined with OPSS185 and replaced by a revised OPSS517 in 2017)
- Fish Protection shall be conducted in accordance with OPSS 182
- Preservation of Riparian Vegetation shall be in accordance with OPSS 182
- Erosion and Sediment Controls shall be in accordance with OPSS 182 and OPSS 805, and
- Restoration of Disturbed Areas shall be in accordance with OPSS 182 and OPSS 804.

In addition to the recommendations provided in the Terrestrial Report and Fish Report, it will be the responsibility of the contractor to review the preliminary ESCP and potentially develop a supplementary ESCP should the contractor use construction staging and methods different from those addressed in this ESORA. The contractor should implement the Main and Supplemental ESCP by adhering to the following recommendations:

- An ESCP should be designed and implemented to contain/isolate exposed soils, stockpiled materials and unstable areas in the work zone, prevent the release of sediment to a waterbody and assure the work site is stabilized prior to removal following construction
- Sediment fencing should be installed along the construction limits as detailed in the Contract Drawings to prevent contamination of watercourses, waterbodies and wetlands
- Fencing should be installed around potentially suitable Blanding's Turtle habitat, which should protect it from degradation by sediment deposition or other contaminants
- The extent and duration that disturbed soils are exposed to the elements shall be minimized
- Seed mix and / or mulch, and topsoil shall be placed in areas of soil disturbance to provide adequate slope protection and long-term slope stabilization
- Rock-check dams (or equivalent flow checks) will be placed as necessary at appropriate intervals in roadside ditches down gradient from areas of soil disturbance to trap suspended sediments and reduce the erosive force of runoff

- Delineate storage, stockpiling and staging areas prior to construction and inspect them in accordance with the Ontario Ministry of Transportation Construction Administration and Inspection Task Manual
- Assure that material generated during maintenance of sediment control measures (i.e., silt fence, flow checks dams, etc.) will be taken off-site for disposal, and
- Following construction, once disturbed areas have stabilized, all temporary erosion and sedimentation controls shall be removed.

Erosion and sediment control structures shall be routinely inspected as well as checked after storms and repaired as required. The structures will be cleaned out when accumulated sediment reaches half the design height.

7. Erosion and Sediment Control Accountability and Administration

7.1 Contractor's Responsibility

The contractor will be required to review the preliminary ESCP and potentially develop a supplementary ESCP should the contractor use construction staging and methods different from those addressed in this ESORA and associated ESCP. The contractor should implement the Main and Supplemental ESCP by:

- Adhering to OPSS 805 and MTO NSSP: Erosion and Sediment Control
- Reviewing, changing and/or adapting the ESCP during the life of the project as needed to assure that it continues to be effective (i.e., meets all legislative requirements and project commitments)
- In-water and near-water work should be monitored to assure mitigation measures are properly implemented, functioning, maintained and repaired as needed, and removed following construction
- Dewatering operations should be managed to prevent erosion or the release of sediment-laden water to a waterbody
- An ESCP should be designed and implemented to contain/isolate exposed soils, stockpiled materials and unstable areas in the work zone, prevent the release of sediment to a waterbody and assure the work site is stabilized prior to removal following construction
- Erosion ad Sediment Control measures are required to be installed along the construction limits as detailed in the Contract Drawings to prevent contamination of watercourses, waterbodies and wetlands
- Fencing should be installed around potentially suitable Blanding's Turtle habitat, which should protect it from degradation by sediment deposition or other contaminants
- Any SAR observations should be reported to MNRF and MTO and protection must be implemented immediately to assure compliance with the ESA. Should SAR be observed within the work area, works in the immediate vicinity should be stopped and an on-site qualified biologist shall be contacted to confirm the species identification and, if necessary, relocate the individual to suitable habitat outside of the zone of design areas.

8. Conclusions

This ESORA has been prepared for the Preliminary Design and project-specific assessment of environmental impacts for the proposed Highway 400 – Highway 404 Link (Bradford Bypass) (GWP 2008-21-00). Based on the results from the ESORA calculations, a preliminary Erosion and Sediment Control Plan (ESCP) is developed that will address ESC issues and will need to be carried forward and further developed during the detail design and construction phases as appropriate when details are developed.

Section 3 documents the existing drainage characteristics of the Bradford Bypass study area. **Exhibits 3.1 to 3.7**, **Exhibit 3.8** and **Exhibit 3.9** were included in this report for illustration purposes of the existing drainage system.

Section 4 documents the proposed work. The project is a new 16.3 kilometre (km) controlled access freeway. The proposed highway will extend from Highway 400 between 8th Line and 9th Line in Bradford West Gwillimbury, will cross a small portion of King Township, and will connect to Highway 404 between Queensville Sideroad and Holborn Road in East Gwillimbury. For additional information about the proposed drainage system refer to the *Drainage, Hydraulic and Stormwater Management (SWM) Report – Highway 400- Highway 404 Link (The Bradford Bypass) (GWP 2008-21-00),* (AECOM, Dec. 2022).

Section 5 documents the Erosion and Sediment Overview Risk Assessment (ESORA). The purpose of this ESORA is to assess site specific erosion potential based on topographic characteristics, and to identify the erosion and sedimentation risk (ES risk) which includes an assessment of the receiving environmental sensitivity. Based on the ES risk, and Erosion and Sediment Control (ESC) approach is identified that will provide the appropriate level of protection and that will minimize any adverse impact on the surrounding environment due to the proposed Bradford Bypass works.

The ESORA involves a classification of a broad area, which is broken down into smaller areas (polygons) of similar erosion potential. Each polygon is evaluated in terms of surficial soil type, slope gradient, slope length and soil erodibility rating of Low, Moderate / Medium, or High erosion potential is assigned to each polygon. Thirteen (13) polygons with similar erosion potential were identified for the Bradford Bypass project.

Once the erosion potential rating has been identified, an additional consequence rating is assigned to each of the thirteen polygons. The consequence rating is based on the receiving environment sensitivity, the direct / indirect connectivity, and the existence of water bodies, wetlands and sensitive areas within each polygon.

The Erosion and Sediment (ES) risk rating is then assigned to each polygon based on the erosion potential and consequence ratings. Judgement is exercised to adjust the erosion potential to account for features or procedures not included in the assessment of the erosion potential. The factors considered in providing the appropriate ES risk are described below.

- erosion potential (based on soil type, topography, cover characteristics, shallow groundwater conditions)
- sensitivity of the water body receivers
- location of environmental features such as ESA's ANSI's, wetlands, etc.
- location of water intakes and recreational areas
- urban sewer systems that will receive highway runoff, and
- potential cut and fill slopes greater than 2 m in height and steeper than 1(v):4(h).

Table 3 includes the identified thirteen polygons along the Bradford Bypass along with the soil erodibility rating for the predominant surficial soils within each polygon. In addition, this table provides the erosion potential, the consequence rating and the erosion and sedimentation risk. The Erosion and Sediment Control Plan (ESCP) has been identified based on the erosion and sedimentation risk for each polygon.

Based on the results presented in **Table 3**, the Erosion and Sedimentation Risk values within the polygons are Moderate and High. Polygon areas with an ES Risk value of Moderate will require an ESCP based on Approach 2 and Approach 3. Approach 2 generally includes the development of an Erosion and Sediment Control Plan (ESCP) that involves stream crossings and/or moderate grading. Polygon areas with an ES Risk value of High will require an ESCP based on Approach 3 (Two-Part ESCP: Main and Supplementary). Approach 3 is typically applied to higher risk areas where a higher amount of effort in Erosion and Sediment Control is warranted.

In addition, **Section 6** provides preliminary erosion and sediment control recommendations such as Ontario Provincial Standard Specifications (OPSSs). Further, in addition to the OPSSs, the types of Best Management Practices (BMP) that should be implemented as part of the Bradford Bypass project are provided.

Appendix E includes a Mitigation Table that provides further information about the issues/concerns of potential effects, concerned agencies, and recommendations for mitigating, protecting, and monitoring of the environmental features in terms of erosion and sediment control, fish and fish habitat, vegetation impacts, wildlife and wildlife habitat impacts, SAR and Significant Wildlife Habitat Impacts, land use, designated substances, construction noise and air quality impacts.

It will be the responsibility of the contractor to review the preliminary ESCP and potentially develop a supplementary ESCP should the contractor use construction staging and methods different from those addressed in this ESORA. The contractor should implement the Main and Supplemental ESCP by adhering to the recommendations included in **Section 6.2.1**.

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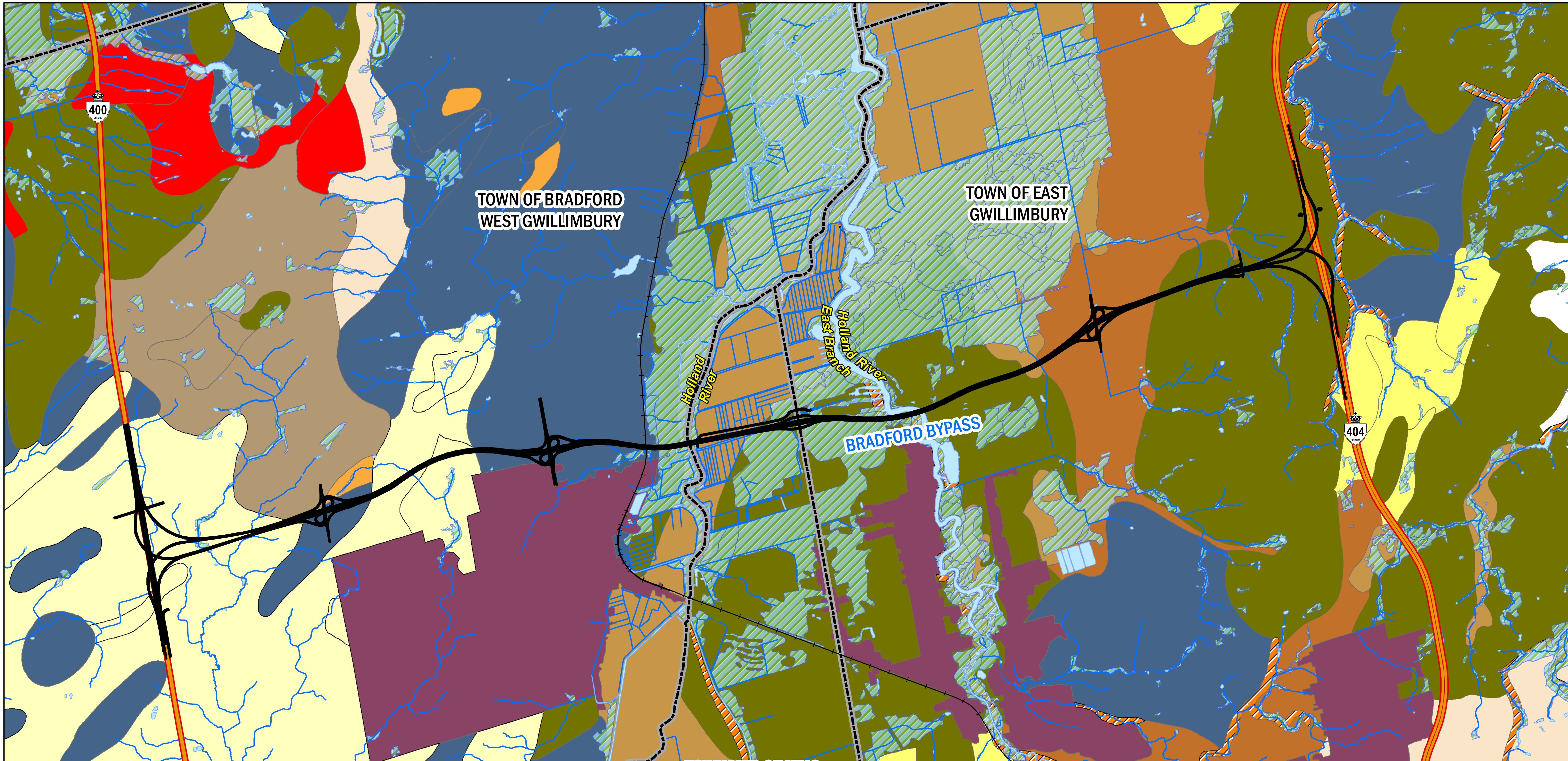
Figures

Existing Bradford Bypass Site - Topographic Characteristics:

- Figure 3 – Surficial Soils
- Figure 4 – Surficial Soil Slopes
- Figure 5 – Surficial Soil Slope Lengths

Erosion and Sedimentation Overview Risk Assessment (ESORA) Figures:

- Figure 6 – Surficial Soils within Erosion Potential Polygons (EPP)
- Figure 7 – Surficial Soil Slopes within EPP
- Figure 8 – Surficial Soil Slope Lengths within EPP
- Figure 9 – Consequence Rating Map within EPP



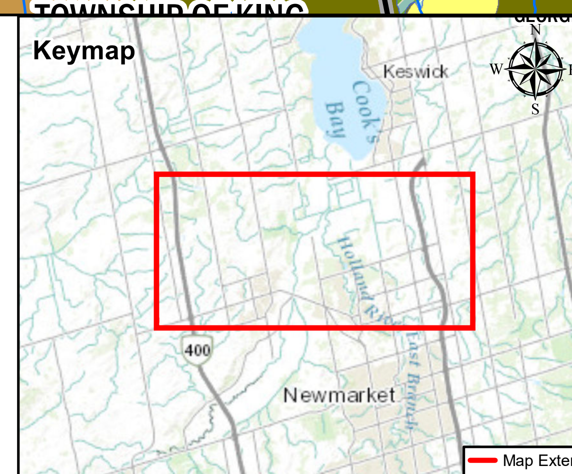
Alignment - Bradford Bypass (Highway 400-404)
Railway
Existing Watercourse
Waterbody
Wetland
Municipal Boundary

Soil Texture

- CL - Clay Loam
- FSL - Fine Sand Loam
- GL - Gravelly Loam
- GSL - Gravelly Loamy Sand
- L - Loam
- LS - Loamy Sand
- Urban
- ORG - Organic
- SICL - Silty Clay Loam
- SIL - Silt Loam
- SL - Sandy Loam
- VAR - Variable

Note: Soil texture information provided in this drawings is based on Land Information Ontario Data Description, Soil Survey Complex, 2019.

Keymap



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Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

Figure 3 - Surficial Soils

TOWN OF BRADFORD
WEST GWILLIMBURY

TOWN OF EAST
GWILLIMBURY

TOWNSHIP OF KING

400

404

Holland River

East Branch

Holland River

BRADFORD BYPASS

- Alignment - Bradford Bypass (Highway 400-404)
- Railway
- Existing Watercourse
- Waterbody
- Wetland
- Municipal Boundary

Soil Slope

- A - 0 - 0.5% (Level)
- B - 0.5 - 2% (Nearly Level)
- C - 2 - 5% (Very Gentle Slopes)
- D - 5 - 9% (Gentle Slopes)
- E - 9 - 15% (Moderate Slopes)
- F - 15 - 30% (Strong Slopes)
- G - 30 - 45% (Very Strong Slopes)
- Assumed - 2 - 5% (Very Gentle Slopes)

Note: Soil gradient information provided in this drawings is based on Land Information Ontario Data Description, Soil Survey Complex, 2019.

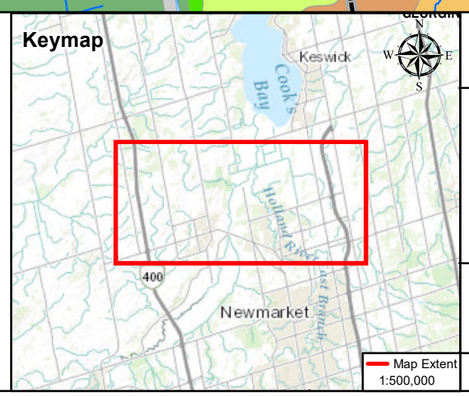

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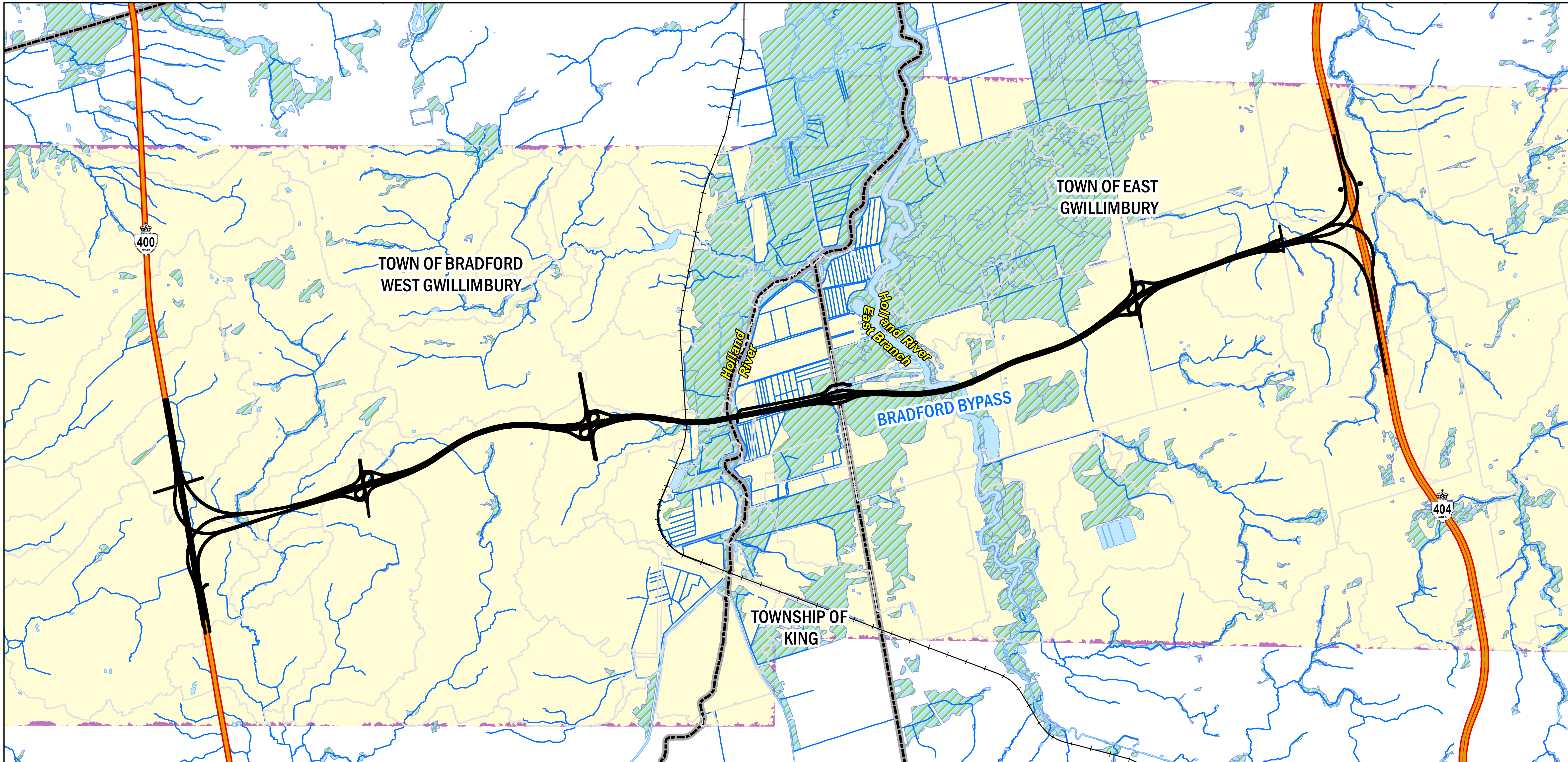
Figure 4 - Surficial Soil Slopes



- Alignment - Bradford Bypass (Highway 400-404)
- Railway
- Existing Watercourse
- Waterbody
- Wetland
- Municipal Boundary

Slope Length

- Slope Length < 70 m
- Slope Length > 70 m

Note: Slope length was estimated based on flow length data. This information is preliminary and should be confirmed during the detailed design phase.

Keymap

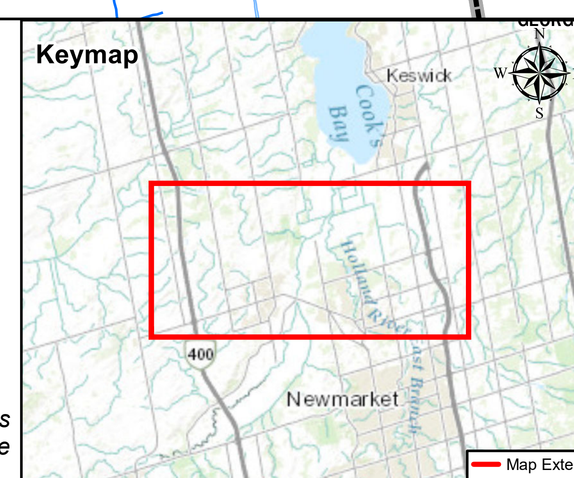


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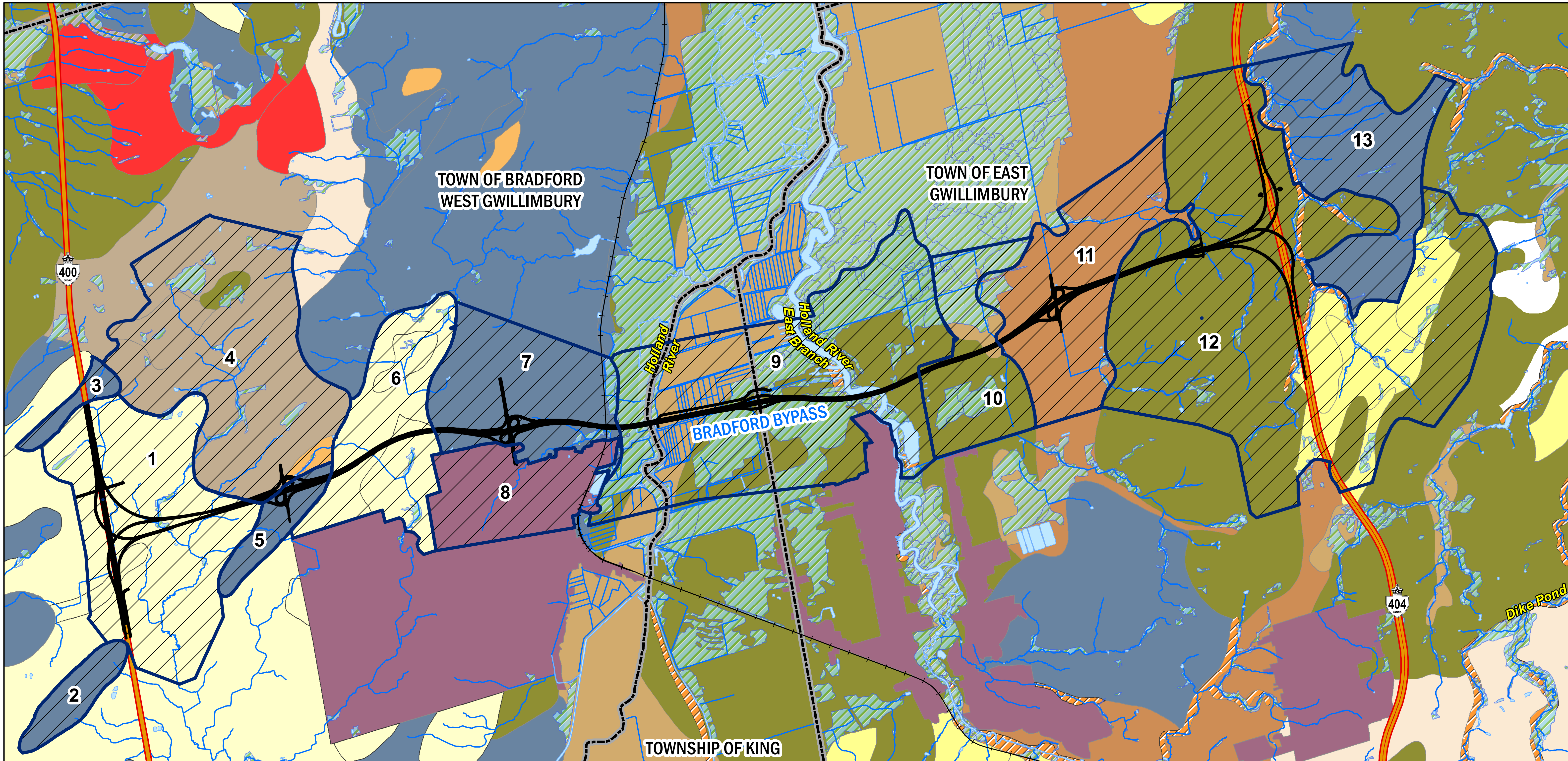
Figure 5 - Surficial Soil Slope Length



- Alignment - Bradford Bypass (Highway 400-404)
- Railway
- Existing Watercourse
- Waterbody
- Wetland
- Municipal Boundary
- Erosion Potential Polygons

Soil Texture

- CL - Clay Loam
- FSL - Fine Sand Loam
- GL - Gravelly Loam
- GSL - Gravelly Loamy Sand
- L - Loam
- LS - Loamy Sand
- Urban
- ORG - Organic
- SICL - Silty Clay Loam
- SIL - Silt Loam
- SL - Sandy Loam
- VAR - Variable

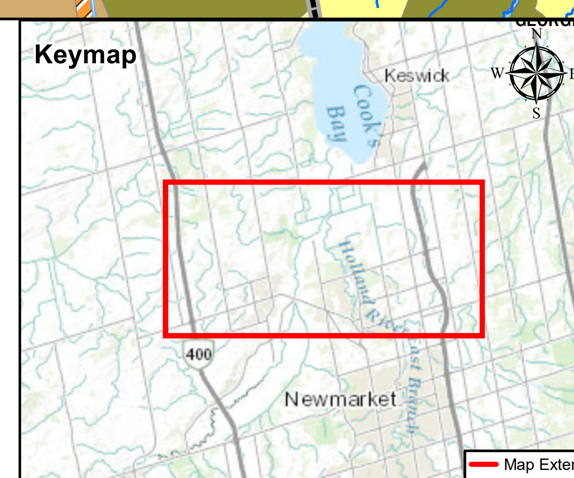


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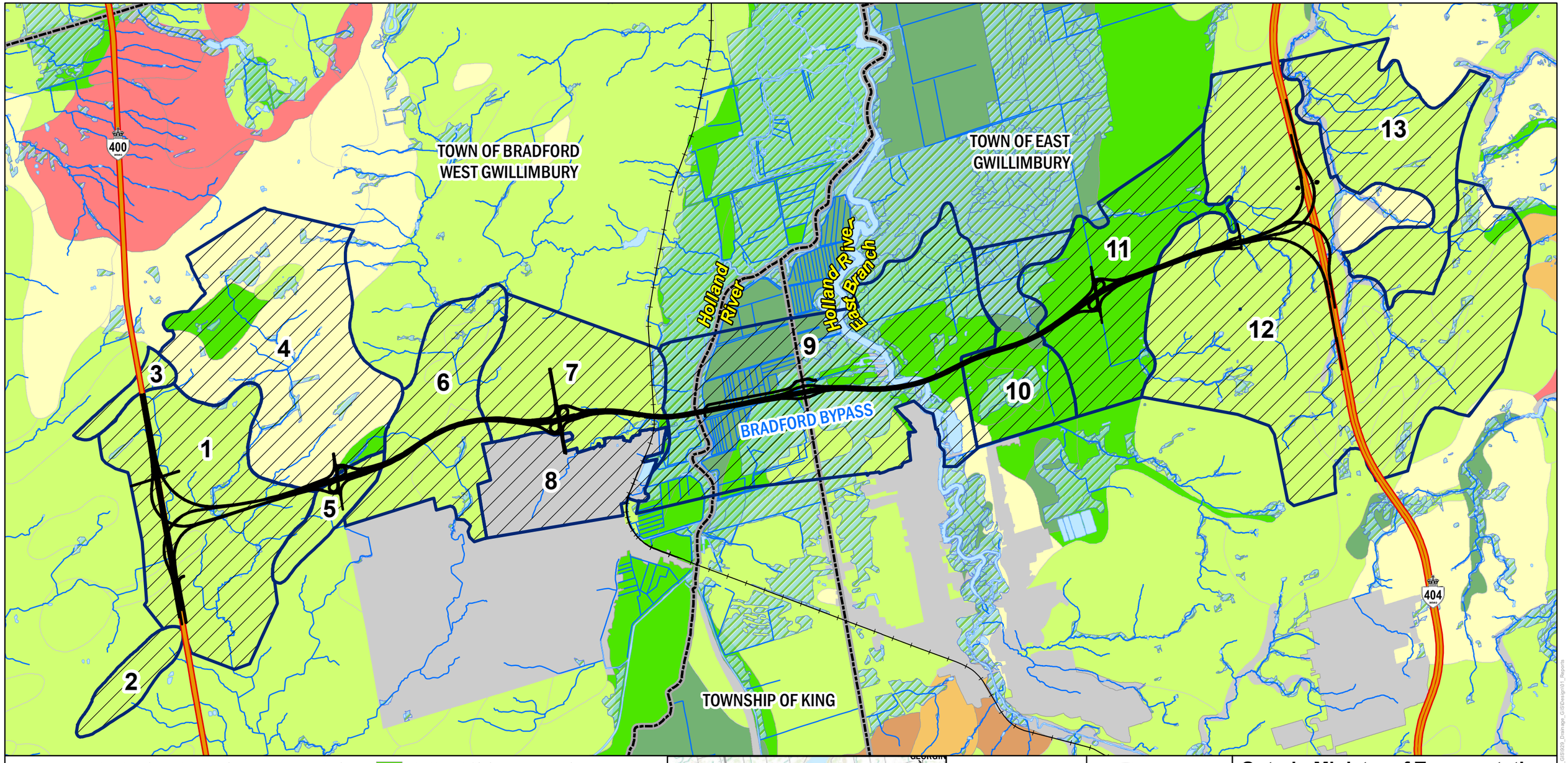
Figure 6 - Erosion Potential Polygons - Surficial Soils



- Alignment - Bradford Bypass (Highway 400-404)
- Railway
- Existing Watercourse
- Waterbody
- Wetland
- Municipal Boundary
- Erosion Potential Polygons

Soil Slope

- A - 0 - 0.5% (Level)
- B - 0.5 - 2% (Nearly Level)
- C - 2 - 5% (Very Gentle Slopes)
- D - 5 - 9% (Gentle Slopes)
- E - 9 - 15% (Moderate Slopes)
- F - 15 - 30% (Strong Slopes)
- G - 30 - 45% (Very Strong Slopes)
- Assumed - 2 - 5% (Very Gentle Slopes)

Note: Soil gradient information provided in this drawings is based on Land Information Ontario Data Description, Soil Survey Complex, 2019.

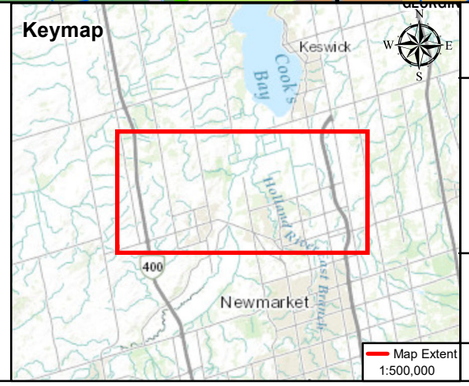


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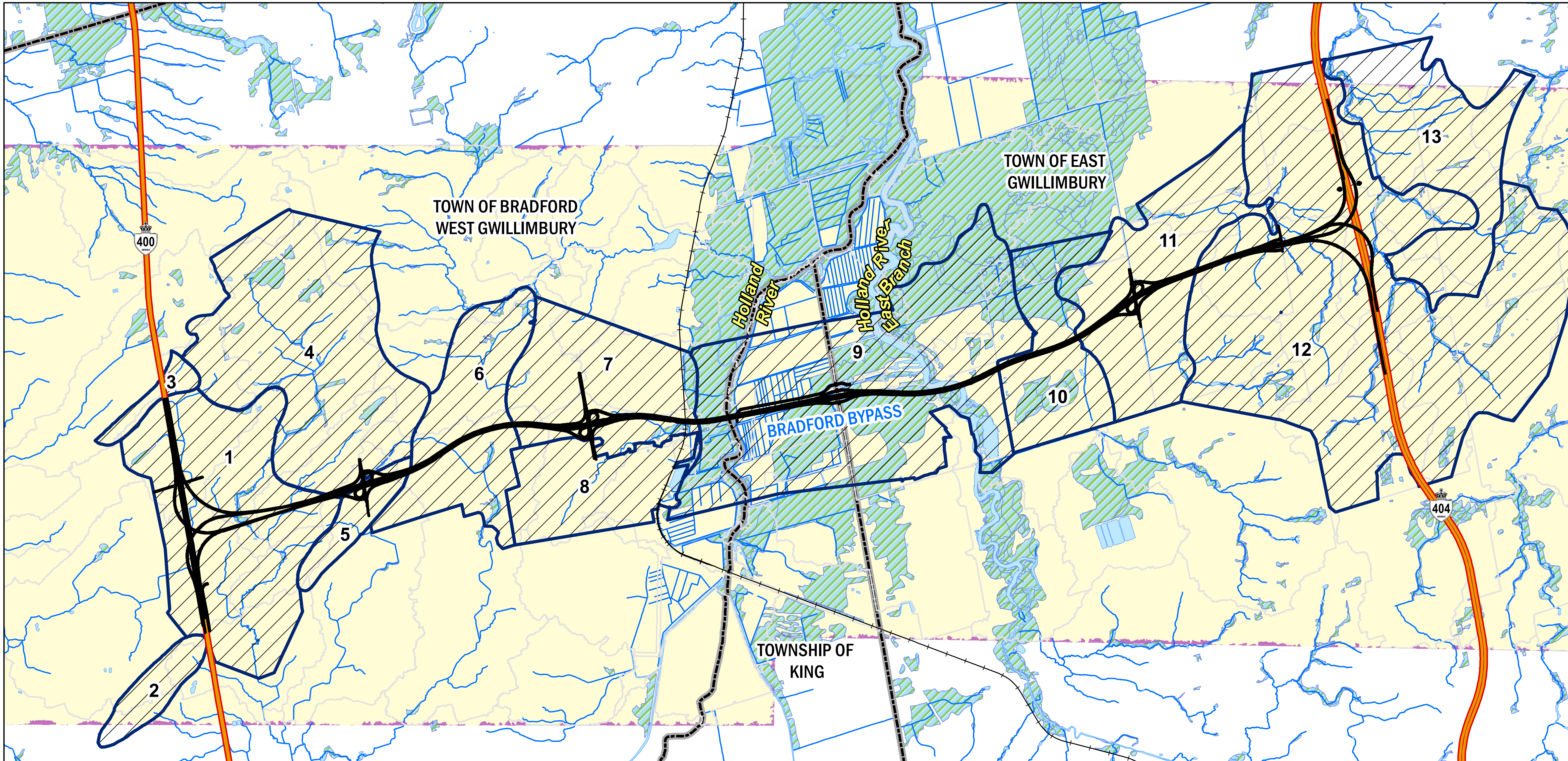
Figure 7 - Erosion Potential Polygons - Surficial Soil Slopes



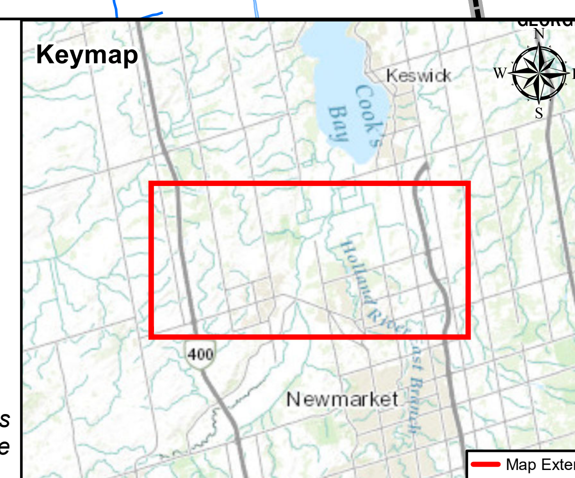
Legend

- Alignment - Bradford Bypass (Highway 400-404)
- Railway
- Existing Watercourse
- Waterbody
- Wetland
- Municipal Boundary
- Erosion Potential Polygons

Slope Length

- Slope Length < 70 m
- Slope Length > 70 m

Note: Slope length was estimated based on flow length data. This information is preliminary and should be confirmed during the detailed design phase.



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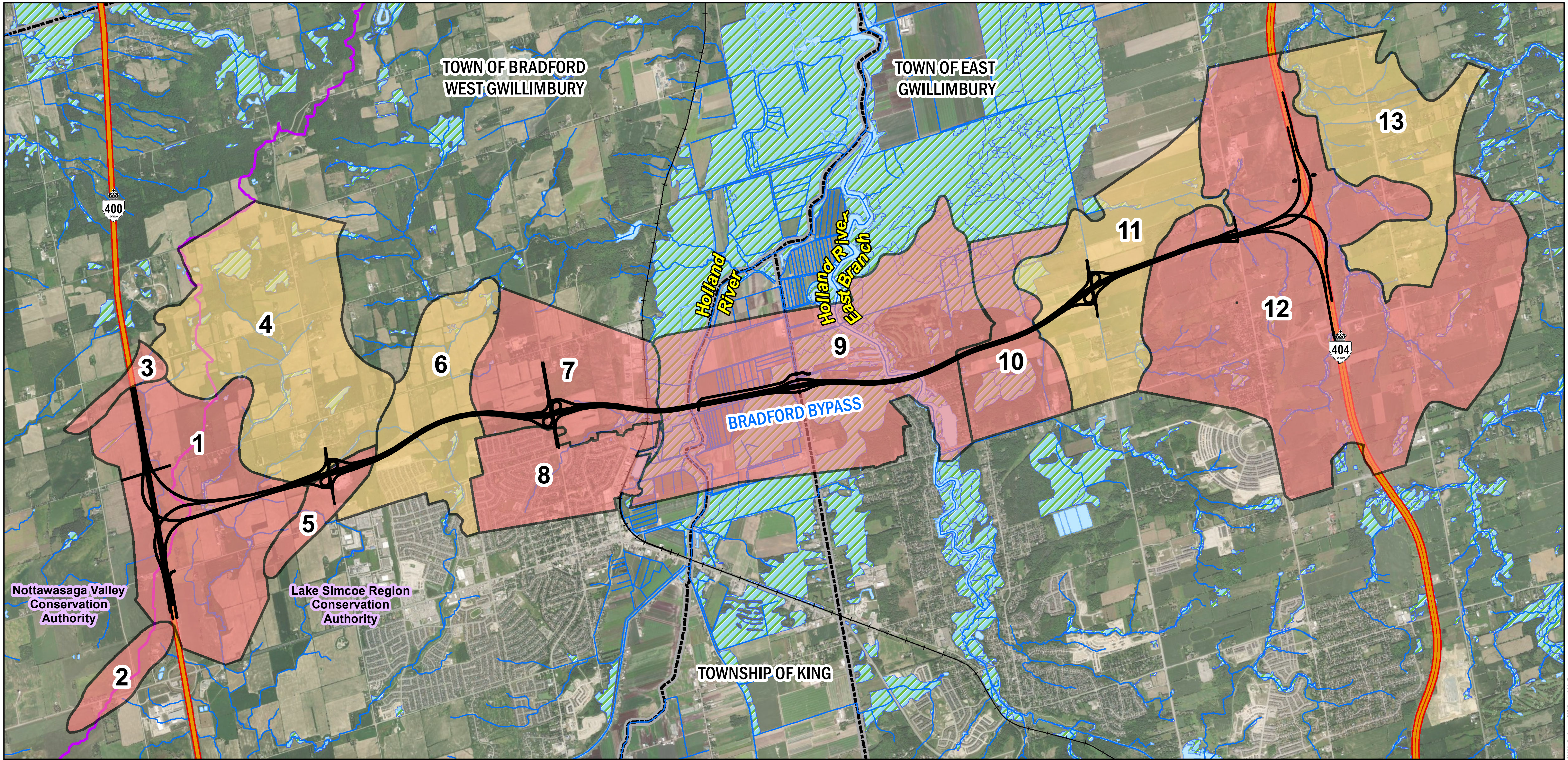
Assignment Number: 2019-E-0048

Figure 8 - Erosion Potential Polygons - Soil Slopes Length



- Alignment - Bradford Bypass (Highway 400-404)
- Railway
- Existing Watercourse
- Waterbody
- Wetland
- Municipal Boundary

Consequence Rating within Erosion Potential Polygons

- Low
- Moderate
- High

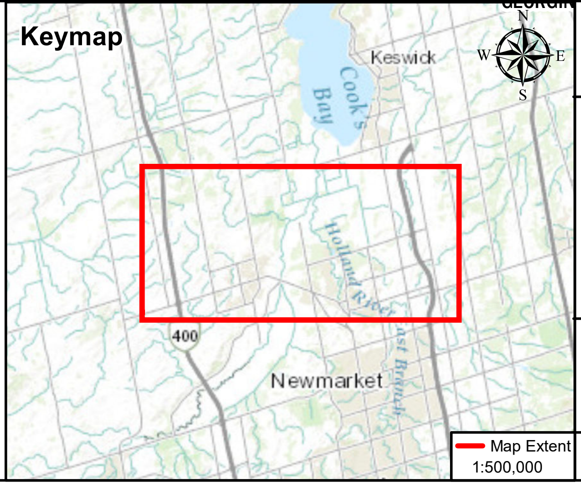


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Figure 9 - Consequence Rating Map

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Appendix A

Existing Drainage System Exhibits

(Exhibits Included for Illustration Purposes of the Drainage System)

TOWN OF BRADFORD
WEST GWILLIMBURY

TOWNSHIP OF KING

The alignment of the Bradford Bypass is shown in these maps for illustration purposes and for reference

Nottawasaga Valley Conservation Authority

Lake Simcoe Region Conservation Authority

YONGE ST

Holland River

BARRIE ST

SIMCOE RD

HOLLAND ST E

HOLLAND ST W

BRIDGE ST

CANAL RD

HWY 11

EX-CL-1 (163 ha)
EX-CL-400-1 (48.8 ha)
EX-CL-400-2 (14.4 ha)
EX-CL-400-3 (6.2 ha)
EX-CL-400-5 (40.5 ha)
EX-CL-400-6 (26.7 ha)
C10-A-5 (24 ha)
C10-C-2 (535.1 ha)
C10-C-3 (13.7 ha)
C10-D-1 (42.9 ha)
EX-CL-3 (30 ha)
EX-CL-26 (29.9 ha)
EX-CL-26-South (15.4 ha)
EX-CL-27 (46.2 ha)
EX-CL-28 (145.7 ha)
EX-CL-29 (37.3 ha)
C11-A-1 (83.3 ha)
C11-B-1
C11-B-2
C13-A-1 (89.9 ha)
C14-A-1 (53.7 ha)
EX-CL-6 (12.7 ha)
SWMF - Crossland Blvd (59.3 ha)
SWMF - McKenzie Way (37.3 ha)
BWG-Sewer (Line 8 at Yonge St) (89.5 ha)
EX-CL-7
C15-A-1 (4.4 ha)
C15-B-1
EX-CL-8 (18.8 ha)
EX-CL-9 (8.3 ha)
C16-A-2 (13.2 ha)
EX-CL-10
EX-CL-11 (2.1 ha)
EX-CL-12
EX-CL-13 (38 ha)
EX-CL-14 (10.1 ha)
SWMF - Meadowview Drive (20 ha)
BWG-Sewer (Line 8 at Yonge St)
C17-B-1 (68 ha)
C18-G-1 (61.4 ha)

- Alignment - Bradford Bypass (Highway 400-404)
- ROW - Bradford Bypass (Highway 400-404) shown for illustration purposes
- Direction of Flow
- Subcatchment Pour Point - Existing Culvert
- Subcatchment Pour Point - Point of Interest
- Existing Culverts Outside Study Area (Not Evaluated)
- Subcatchment Boundary
- Contours (5 m)
- Existing Watercourse
- Waterbody
- Wetland
- Existing Freeway
- Existing Major Road
- Existing Local Road
- Railway
- Conservation Authority Boundary
- Municipal Boundary

EX-CL-1 (164 ha) **Subcatchment ID Area**

Note: Points of interest and proposed highway alignment are shown for information purposed only.

Keymap

INNISFIL
GEORGINA
Cook Bay
EAST GWILLIMBURY
BRADFORD WEST GWILLIMBURY
KING
NEWMARKET
AURORA
Holland River
Map Extent 1:500,000

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Ontario Ministry of Transportation
Central Region

60636190
Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

DRAFT
Overall Existing Conditions Drainage Mosaic

Exhibit 3.1

TOWN OF EAST GWILLIMBURY

Holland River

Lake Simcoe Region Conservation Authority

LESLIE ST

QUEENSVILLE SIDERD

QUEENSVILLE SIDERD W

YONGE ST

BATHURST ST

WOODBINE AVE

Harrison Creek

404

EX-CL-24

EX-CL-21

EX-CL-404-1

EX-CL-18

EX-CL-17

EX-CL-19

EX-CL-20

EX-CL-16

EX-CL-404-2

EX-CL-25

EX-CL-23

EX-CL-22

C23-A-2

C23-A-1

C23-B-2

C23-B-1

C22-B-1

C22-A-1

C21-A-1

C24-A-1

C25-A-1

C25-C-1

C25-B-2

C25-B-1

C26-A-1

C17-B-1 (68 ha)

C18-G-1

C18-G-1 (61.4 ha)

C23-A-2 (49.4 ha)

C22-B-1 (35.9 ha)

C21-A-1 (90.8 ha)

C22-A-1 (163.1 ha)

C24-A-1 (39.5 ha)

C25-A-1 (39 ha)

EX-CL-21 (36 ha)

EX-CL-17 (19.9 ha)

EX-CL-18 (27.5 ha)

EX-CL-19 (18.7 ha)

EX-CL-20 (24.3 ha)

EX-CL-404-2 (36.4 ha)

C25-C-1 (119.6 ha)

C23-A-1 (251.8 ha)

C26-A-1 (701.3 ha)

EX-CL-24 (357.1 ha)

- Alignment - Bradford Bypass (Highway 400-404)
- ROW - Bradford Bypass (Highway 400-404)
- Direction of Flow
- Subcatchment Pour Point - Existing Culvert
- Subcatchment Pour Point - Point of Interest
- Existing Culverts Outside Study Area (Not Evaluated)
- Subcatchment Boundary
- Contours (5 m)
- Existing Watercourse
- Waterbody
- Wetland
- Existing Freeway
- Existing Major Road
- Existing Local Road
- Railway
- Conservation Authority Boundary
- Municipal Boundary

EX-CL-1 (164 ha) Subcatchment ID Area

Note: Points of interest and proposed highway alignment are shown for information purposed only.

Keymap

INNISFIL
GEORGINA
Cook Bay
EAST GWILLIMBURY
BRADFORD WEST GWILLIMBURY
NEWMARKET
KING
AURORA
Holland River
Map Extent 1:500,000

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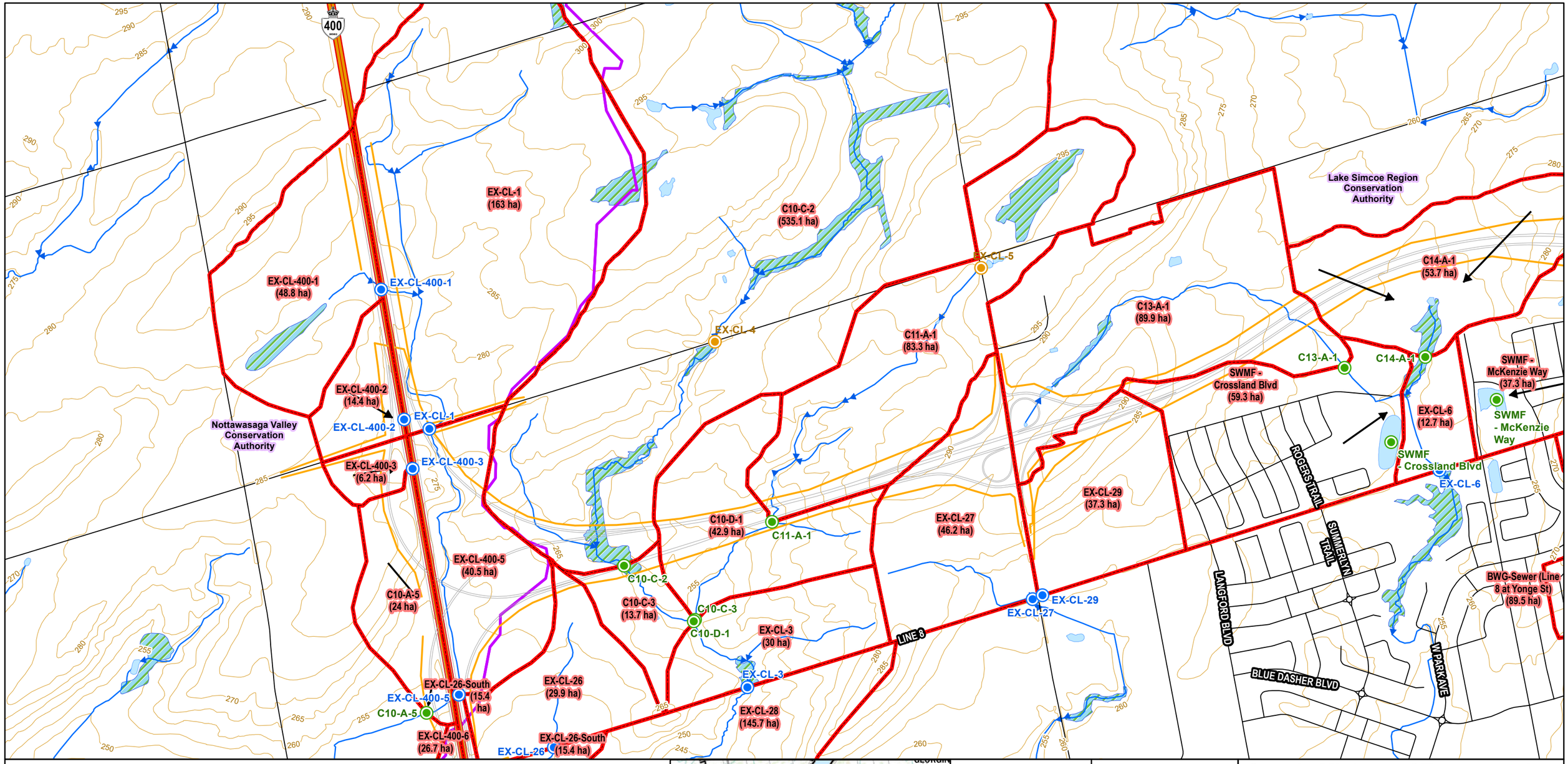
Overall Existing Conditions Drainage Mosaic

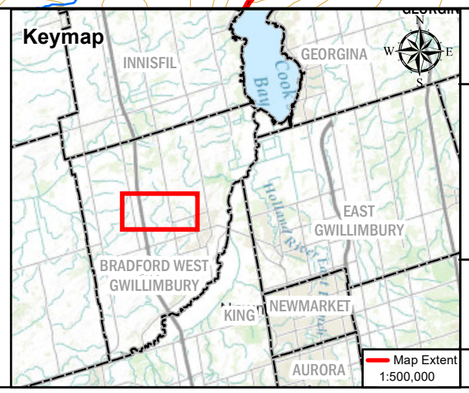
Exhibit 3.2



- Alignment - Bradford Bypass (Highway 400-404)
- ROW - Bradford Bypass (Highway 400-404)
- Direction of Flow
- Subcatchment Pour Point - Existing Culvert
- Subcatchment Pour Point - Point of Interest
- Existing Culverts Outside Study Area (Not Evaluated)
- Subcatchment Boundary
- Contours (5 m)
- Existing Watercourse
- Waterbody
- Wetland
- Existing Freeway
- Existing Local Road
- Railway
- Conservation Authority Boundary
- Municipal Boundary

EX-CL-1 (164 ha) Subcatchment ID Area

Note: Points of interest and proposed highway alignment are shown for information purposed only.



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Meters

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Central Region

60636190
Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

DRAFT
Overall Existing Conditions Drainage Mosaic

Exhibit 3.3

EX-CL-400-1 (48.8 ha)
EX-CL-400-2 (14.4 ha)
EX-CL-1 (163 ha)
EX-CL-400-2
EX-CL-1
EX-CL-400-3
EX-CL-400-3 (6.2 ha)
C10-C-2 (535.1 ha)
C11-A-1 (83.3 ha)
C13-A-1 (89.9 ha)
SWMF - McKenzie Way
SWMF - McKenzie Way (37.3 ha)
EX-CL-6 (12.7 ha)
SWMF - Crossland Blvd (59.3 ha)
SWMF - Crossland Blvd
EX-CL-6
ROGERS TRAIL
SUMMERKYN TRAIL
EX-CL-29 (37.3 ha)
C10-D-1 (42.9 ha)
C11-A-1
EX-CL-27 (46.2 ha)
LINE 6
EX-CL-400-5 (40.5 ha)
C10-C-2
C10-C-3 (13.7 ha)
C10-A-5 (24 ha)
EX-CL-29
EX-CL-27
C10-C-3
C10-D-1
EX-CL-3 (30 ha)
EX-CL-3
BWG-Sewer (Line 8 at Yonge St) (89.5 ha)
W PARK AVE
BLUE DASHER BLVD
EX-CL-26 (29.9 ha)
EX-CL-400-5
C10-A-5
Nottawasaga Valley Conservation Authority
EX-CL-26
LANGFORD BLVD
Lake Simcoe Region Conservation Authority
EX-CL-26-South (15.4 ha)
EX-CL-400-6
EX-CL-26-South
EX-CL-400-6 (26.7 ha)
EX-CL-28 (145.7 ha)
HOLLAND ST W
MCKINSTRY RD
COUNTY RD 88
400
EX-CL-28

- Alignment - Bradford Bypass (Highway 400-404)
- ROW - Bradford Bypass (Highway 400-404)
- Direction of Flow
- Subcatchment Pour Point - Existing Culvert
- Subcatchment Pour Point - Point of Interest
- Existing Culverts Outside Study Area (Not Evaluated)
- Subcatchment Boundary
- Contours (5 m)
- Existing Watercourse
- Waterbody
- Wetland
- Existing Freeway
- Existing Major Road
- Existing Local Road
- Railway
- Conservation Authority Boundary
- Municipal Boundary

EX-CL-1 (164 ha) Subcatchment ID Area

Note: Points of interest and proposed highway alignment are shown for information purposed only.

Keymap
INNISFIL
GEORGINA
Cook Bay
EAST GWILLIMBURY
BRADFORD WEST GWILLIMBURY
NEWMARKET
KING
AURORA
Holland River
Map Extent 1:500,000

AECOM

Ontario Ministry of Transportation

N W E S

Datum: NAD 1983 CSRS MTM 10

Source: Contains information licensed under the Open Government Licence Ontario. Base map provided by ESRI.

0 250 500 1,000
Meters

January 2023

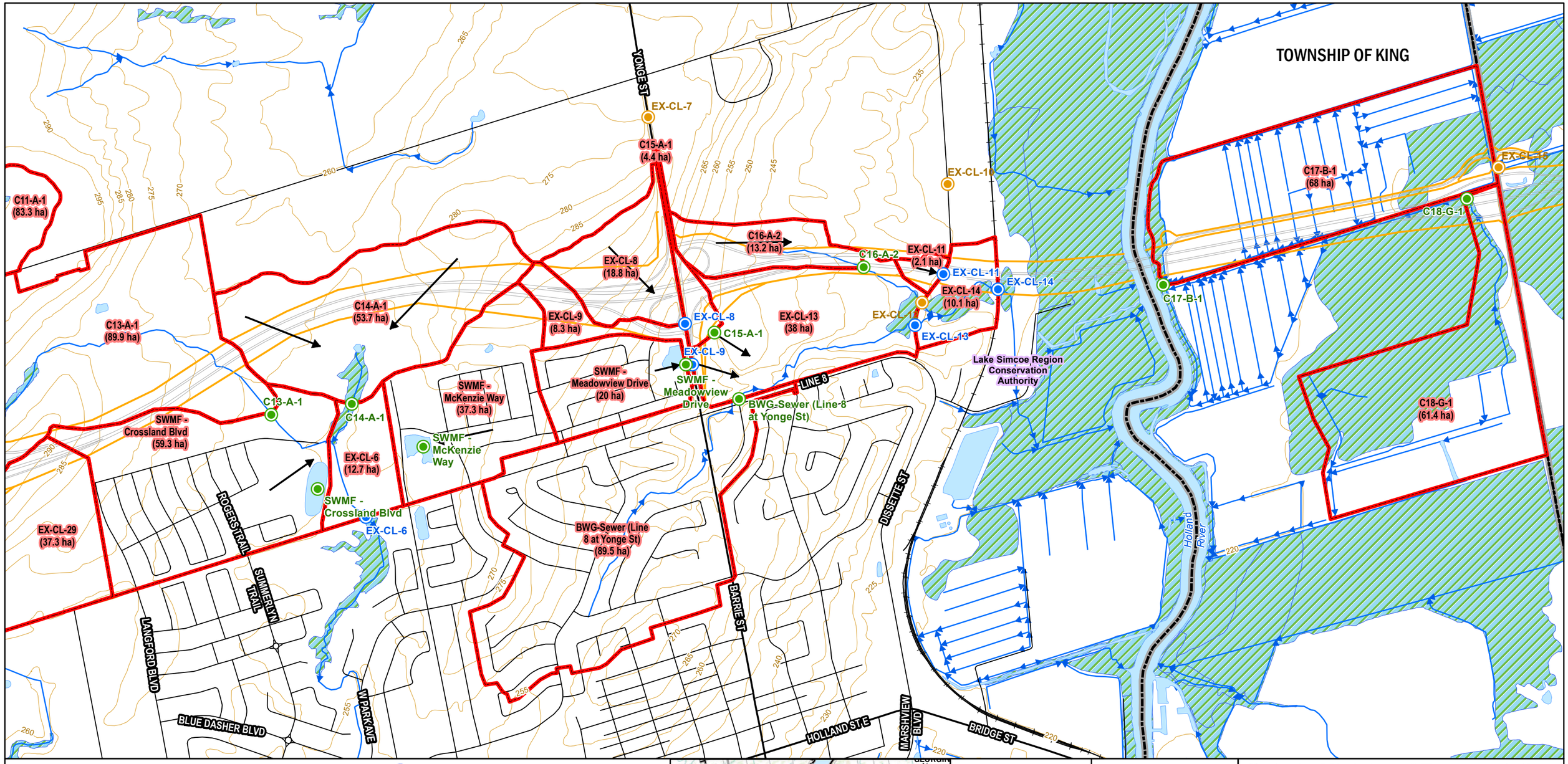
Scale: 1:15,000

Ontario Ministry of Transportation
Central Region

60636190
Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

DRAFT
Overall Existing Conditions Drainage Mosaic

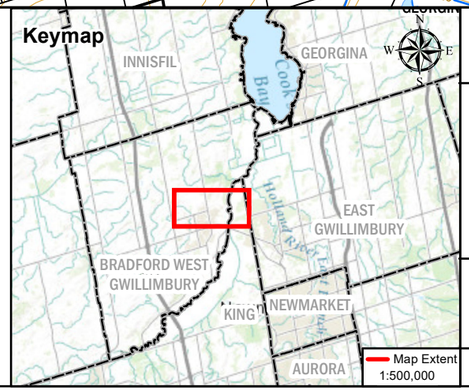
Exhibit 3.4



- Alignment - Bradford Bypass (Highway 400-404)
- ROW - Bradford Bypass (Highway 400-404)
- Direction of Flow
- Subcatchment Pour Point - Existing Culvert
- Subcatchment Pour Point - Point of Interest
- Existing Culverts Outside Study Area (Not Evaluated)
- Subcatchment Boundary
- Contours (5 m)
- Existing Watercourse
- Waterbody
- Wetland
- Existing Major Road
- Existing Local Road
- Railway
- Conservation Authority Boundary
- Municipal Boundary

EX-CL-1 (164 ha) **Subcatchment ID Area**

Note: Points of interest and proposed highway alignment are shown for information purposed only.



AECOM

Ontario Ministry of Transportation

Datum: NAD 1983 CSRS MTM 10

Source: Contains information licensed under the Open Government Licence Ontario. Base map provided by ESRI.

0 250 500 1,000

Meters

January 2023 | Scale: 1:15,000

Ontario Ministry of Transportation
Central Region

60636190
Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

DRAFT
Overall Existing Conditions Drainage Mosaic

Exhibit 3.5

Alignment - Bradford Bypass (Highway 400-404)
ROW - Bradford Bypass (Highway 400-404)
Direction of Flow
Subcatchment Pour Point - Existing Culvert
Subcatchment Pour Point - Point of Interest
Existing Culverts Outside Study Area (Not Evaluated)
Subcatchment Boundary
Contours (5 m)
Existing Watercourse
Waterbody
Wetland
Existing Major Road
Existing Local Road
Railway
Conservation Authority Boundary
Municipal Boundary

EX-CL-1 (164 ha) Subcatchment ID Area

Note: Points of interest and proposed highway alignment are shown for information purposed only.

Keymap

Map Extent 1:500,000

AECOM

Ontario Ministry of Transportation

Datum: NAD 1983 CSRS MTM 10

Source: Contains information licensed under the Open Government Licence Ontario. Base map provided by ESRI.

0 250 500 1,000
Meters

January 2023

Scale: 1:15,000

Ontario Ministry of Transportation
Central Region

60636190
Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

DRAFT
Overall Existing Conditions Drainage Mosaic

Exhibit 3.6

TOWN OF EAST GWILLIMBURY

Lake Simcoe Region Conservation Authority

LESLIE ST

WOODBINE AVE

WARDEN AVE

QUEENSVILLE SIDERD

404

EX-CL-24

EX-CL-21

EX-CL-18

EX-CL-17

EX-CL-19

EX-CL-404-1

EX-CL-21 (36 ha)

EX-CL-24 (357.1 ha)

EX-CL-18 (27.5 ha)

C25-C-1

C25-A-1

EX-CL-20

EX-CL-19 (18.7 ha)

EX-CL-17 (19.9 ha)

EX-CL-16

C24-A-1

C26-A-1

C23-A-2

EX-CL-404-2

EX-CL-20 (24.3 ha)

C23-A-1

C23-A-2 (49.4 ha)

C24-A-1 (39.5 ha)

C25-A-1 (39 ha)

EX-CL-404-2 (36.4 ha)

C22-B-1 (35.9 ha)

C25-C-1 (119.6 ha)

EX-CL-25

C26-A-1 (701.3 ha)

EX-CL-23

C23-A-1 (251.8 ha)

EX-CL-22

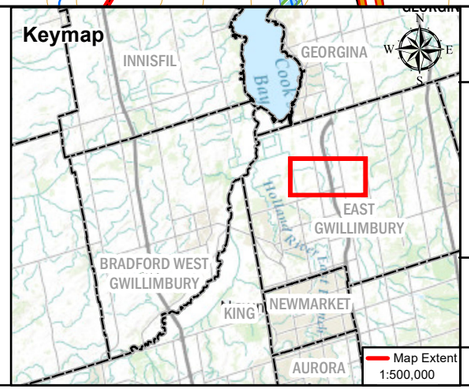
C22-A-1 (163.1 ha)

- Alignment - Bradford Bypass (Highway 400-404)
- ROW - Bradford Bypass (Highway 400-404)
- Direction of Flow
- Subcatchment Pour Point - Existing Culvert
- Subcatchment Pour Point - Point of Interest
- Existing Culverts Outside Study Area (Not Evaluated)
- Subcatchment Boundary
- Contours (5 m)
- Existing Watercourse
- Waterbody
- Wetland
- Existing Freeway
- Existing Major Road
- Existing Local Road
- Railway
- Conservation Authority Boundary
- Municipal Boundary

EX-CL-1 (164 ha) **Subcatchment ID Area**

Note: Points of interest and proposed highway alignment are shown for information purposed only.

Keymap



AECOM

Ontario Ministry of Transportation

Datum: NAD 1983 CSRS MTM 10

Source: Contains information licensed under the Open Government Licence Ontario. Base map provided by ESRI.

0 250 500 1,000

Meters

January 2023

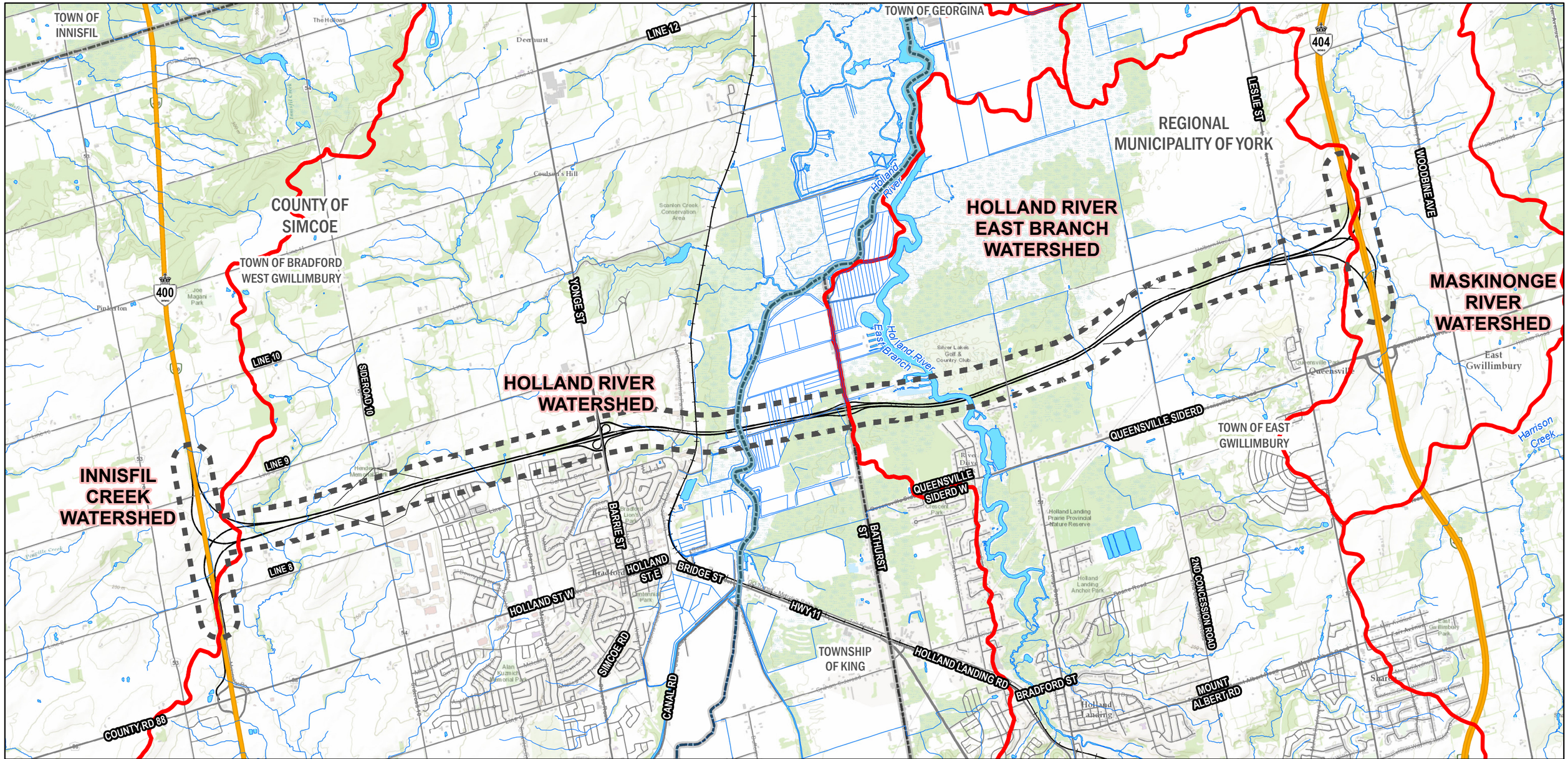
Scale: 1:15,000

Ontario Ministry of Transportation
Central Region

60636190
Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

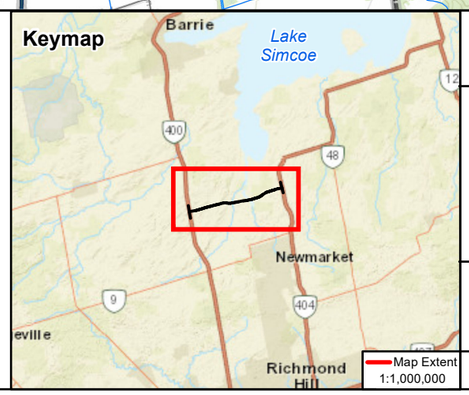
DRAFT
Overall Existing Conditions Drainage Mosaic

Exhibit 3.7



Legend

- Study Area Limits
- Watershed Boundary
- Bradford Bypass Alignment
- Existing Freeway
- Existing Major Road
- Existing Local Road
- Railway (Metrolinx)
- Municipal Boundary



AECOM

Ontario Ministry of Transportation

N W E S

Datum: NAD 1983 CSRS MTM 10

Source: Contains information licensed under the Open Government Licence Ontario. Base map provided by ESRI.

0 0.5 1 2 3

Kilometers

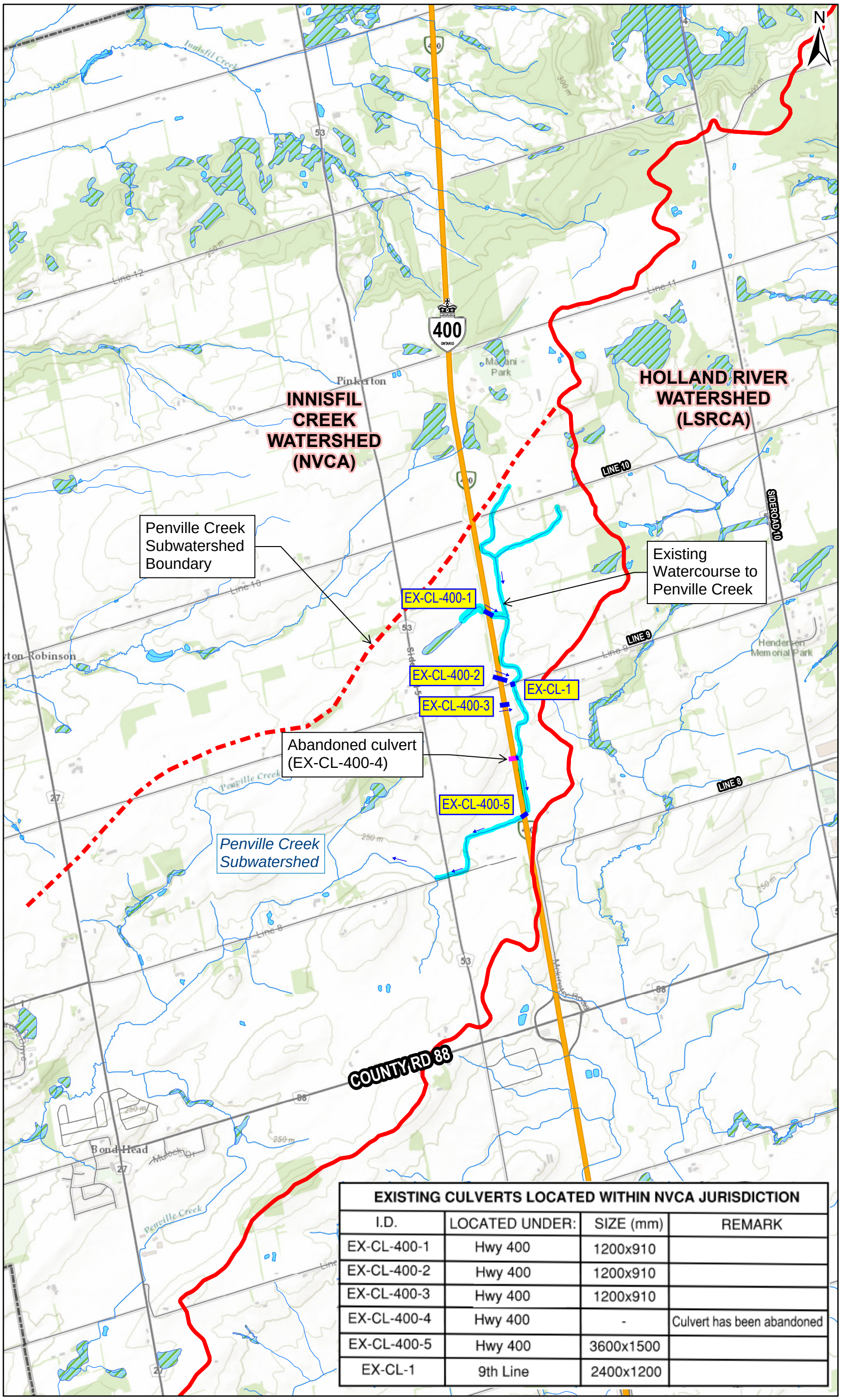
June 2022

Scale: 1:50,000

Ontario Ministry of Transportation
Central Region

60636190
Highway 400 - Highway 404 Link (The Bradford Bypass)
WO # 19-2001
Assignment Number: 2019-E-0048

Exhibit 3.8
River Watersheds within the Study Area



EXISTING CULVERTS LOCATED WITHIN NVCA JURISDICTION			
I.D.	LOCATED UNDER:	SIZE (mm)	REMARK
EX-CL-400-1	Hwy 400	1200x910	
EX-CL-400-2	Hwy 400	1200x910	
EX-CL-400-3	Hwy 400	1200x910	
EX-CL-400-4	Hwy 400	-	Culvert has been abandoned
EX-CL-400-5	Hwy 400	3600x1500	
EX-CL-1	9th Line	2400x1200	

Exhibit 3.9

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Appendix B

MTO ESORA Guide – Table 3.1, Table 3.2

Table 3.1 Outline of MTO's Three Erosion and Sediment Control Approaches

Erosion and Sediment Control Approaches	During Design	During Construction
1 **Best Management Practices (BMPs)**	The Design Consultant provides BMPs as per Section 8 on contract drawings and specifies measures through contract package content (e.g., OPS 805).	The Contractor installs, maintains and removes the BMPs as designed and described in the contact documents and follows any procedural BMPs. The Contractor can change the BMPs through the Change Proposal Process.
2 **Erosion and Sediment Control Plan (ESCP)**	The Design Consultant is required to develop an ESCP that is consistent with Section 6 to cover all aspects of the construction. The Design Consultant provides: • one or more drawings • Non-Standard Special Provision (NSSP) containing the pertinent aspects of the ESCP • ESC technical memo that includes design considerations and assumptions	The Contractor implements the ESCP: • installs, maintains and removes the BMPs • follows the procedural BMPs (e.g., construction sequencing and emergency preparedness) • is responsible for erosion and sedimentation from their operations. The Contractor can change the ESCP through the Change Proposal Process.

Erosion and Sediment Control Approaches	During Design	During Construction
3 **Two-Part** **ESCP –** **Main & Supplemental**	The Design Consultant develops the "main" part of the ESCP that addresses design-related issues but not construction methods[2]. The Main ESCP includes: • one or more drawings • NSSP containing the pertinent aspects of the ESCP • ESC technical memo that includes design considerations and assumptions The NSSP will contain a requirement for the contractor to provide and maintain the" supplemental" part of the ESCP that addresses issues under the control of the Contractor.	The Contractor: • develops the Supplemental ESCP to address construction methods • installs, maintains and removes the BMPs • follows procedural BMPs • maintains and updates the Supplemental ESCP as needed The Contractor can change the Main ESCP through the Change Proposal Process.

[2] Construction methods used in this context refers to the construction means, methods, techniques, sequences and procedures and their co-ordination for which the Contractor is responsible (from MTO's *General Conditions of Contract*, April 2005).

Table 3.2 Differences in MTO's Three Approaches to Erosion and Sediment Control

Aspects of Approach	Approach: 1 BMPs	Approach: 2 ESCP	Approach: 3 Main & Supplemental ESCP
Sediment and Erosion Control BMPs are included in contract documentation.	Yes	Yes	Yes
The Design Consultant is required to address erosion and sediment from construction methods.	Yes	Yes	No
An ESCP is developed that is consistent with Section 6.	No	Yes	Yes
The Contractor is explicitly made responsible for the erosion and sediment caused by their operations.	No	Yes	Yes
Two-part ESCP developed: Main (Design Consultant) and Supplemental (Contractor).	No	No	Yes
Contractor uses Change Proposal Process to change ESC.	Yes	Yes	Yes for Main No for Supplemental

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Appendix C

Fish and Fish Habitat Existing Conditions Summary Table and Figures

Fish and Fish Habitat Existing Conditions Summary Table (Template D2A)

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
Waterbody Name: Tributary to Penville Creek – 1 **Crossing Locations:** C10-A-A (WC-1)	2022-06-09	Intermittent	Cool (MNRF, 2019a)	**Indirect** **Habitat**: No defined channel and no flowing water could be observed. Dense phragmites were present for approximately 80 m along the east ditch along Highway 400 and for approximately 40 m east downstream of the culvert outlet. The phragmites were present within the entire highway ROW within the assessed reach.	Muck, detritus, silt.	NA – no defined feature observed.	Dense phragmites**.**	**Opportunity:** Remove invasive phragmites.	N/A
Waterbody Name: Tributary to Penville Creek – 1 **Crossing Locations:** C10-A-B, C10-A-C (WC-1)	2022-06-09	Permanent	Cool (MNRF, 2019a)	**Direct** **Upstream Habitat**: C10-A-B – consisted predominately of runs (90%) with sparse riffles (10%). No pools were noted, and no fish were observed during the site visit. No barriers to fish passage were noted throughout the ROW. **Downstream Habitat**: C10-A-C – the ROW portion of the channel was straightened but consisted of runs, pools, riffles, and flats. Grasses lined the channel banks, and no riparian trees or shrubs were noted. Within the modified portion of the channel downstream, dense cattails were present for approximately 80 m as the channel travelled east between two residential properties. The channel banks throughout this portion of the reach were less prominent, and flow appeared to disperse through the cattails. Soil has also been pushed into the bankfull limits on the north side of the channel, which may have altered the flow path of the channel. Further downstream, the channel meanders south through a narrow (10 m) grassed area between a gravel driveway and manicured lawn. This area was predominantly riffles and runs with cobble and gravel substrate. Riparian trees provided shade over the watercourse, and defined banks were present throughout this section.	**Upstream**: Silt/sand/ gravel. **Downstream:** silt/sand/cobble/muck.	**Upstream:** runs (90%) with sparse riffles (10%). **Downstream:** runs (50%), riffles (30%), pools (10%), flats (10%).	Cattails and phragmites patches at the downstream end.	**Opportunity:** Remove invasive phragmites. Restore channel form at impacted/ straightened section where the soil has been pushed into bankfull limits.	N/A
Waterbody Name: Tributary to Penville Creek – 1	2020-09-14 and	Permanent	Cool (MNRF, 2019a)	**Direct** **Upstream Habitat**: Permanent watercourse runs south through the agricultural field	**Upstream**: Silt/clay/ gravel **Downstream:** Clay/silt/gravel/cobble	**Upstream:** Channelized, narrow width, incised and a	**Upstream:** no vascular macrophytes or woody debris to provide in-stream cover. Bank and overhanging vegetation are	**Opportunity**: Channelized watercourse morphology from C10-A-2 to the	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
Crossing Locations: C10-A-1, C10-A-2, C10-A-3 and C10-A-4 (WC-1)	2020-09-21			before becoming channelized adjacent to Highway 400. The Channel upstream of the Highway crossing is deeply incised (evidence of high flow periods) and densely vegetated. Banks were steep but stable due to vegetation. Undercut banks and organic debris provided minimal instream cover. Bank vegetation provided overhanging cover that resulted in 90 – 100% shore cover. Riparian vegetation was dominated by wet meadow herbaceous cover and the occasional riparian shrub. **Downstream Habitat**: Permanent watercourse which runs west through the Highway ROW and into an agricultural field to the west. Channel is widened in this reach, with a more naturalized substrate morphology (i.e., run, riffle and pool sections). Banks were steep but stable due to vegetation. The in-stream cover was low and was comprised of cobble and overhanging banks. Shore cover was low (1-29%). The riparian buffer between the agricultural field and the channel was approx. 15 m across. Riparian vegetation was dominated by wet meadow herbaceous cover and the occasional riparian shrub.		90% run with 10% riffle morphology. **Downstream:** Channelized, wide channel deeply incised, and a 70% run, 10% flat and 10% riffle morphology.	dense and dominated by vascular macrophytes and wet meadow herbaceous species. **Downstream:** no aquatic macrophytes providing in-stream cover. Bank vegetation is dense and dominated by vascular macrophytes and wet meadow herbaceous species.	culvert inlet at C10-A-4 could be naturalized.	
Waterbody Name: **Crossing Locations:** C10-A-5, (WC-1b)	2022-06-09	Intermittent	Warmwater (AECOM, 2022)	**Indirect** **Habitat:** WC-1b was dominated by dense cattails within and along the banks of the channel. Cattails were present throughout the entire cross-section of the feature. Lands directly on either side of the channel consisted of active agricultural cropland. The average depth was approximately 3 cm, and the average wetted width was 0.8 m. The channel was historically altered/straightened between the two farm fields downstream, which gave the channel defined, steep banks. The entire channel length observed consisted of a run, with no pools observed. No substrate sorting was noted, and the channel had a U-shaped cross-section with no clear transition	Silt/sand/gravel/muck.	Straightened/ channelized.	Cattails.	**Opportunity:** Restore/widen riparian vegetation lands.	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				between the bottom of the channel and the banks.					
Waterbody Name: **Crossing Locations:** C10-A-6, (WC-1c)	2022-06-09	Ephemeral/ Intermittent	Warm (NDMNRF, 2022)	**Not fish Habitat** **Upstream Habitat:** a channelized drainage system with large riverstone bank stabilization in place. The feature morphology was confined to largely the culvert inlet pool (20%), which was approximately 30cm deep, and inside the culvert (80%). An approximately 3m drop in elevation was present just before the culvert inlet, creating a possible barrier to fish passage. Water was present in the culvert inlet, but it should be noted that it had rained significantly within the 72hrs prior to the inspection. **Downstream Habitat:** wetland feature with no defined channel beyond the culvert outlet. A debris jam was present at the culvert outlet. Approximately 5m downstream from the culvert outlet.	Silt (80%)/sand (20%)	Culvert inlet plunge pool (20%); inside culvert (80%)	Water-tolerant terrestrial vegetation and cattails were present throughout the feature, choking the "channel" both in the upstream and downstream reaches	**Opportunity:** Remove debris jam from culvert outlet and downstream of culvert; repair bottom of the culvert	N/A
Waterbody Name: Tributary to Fraser Creek – 1 **Crossing Locations:** C10-B-1 and C10-B-2 (WC-2a)	2020-09-14	Ephemeral	Warm (MNRF, 2019a)	**Not Fish Habitat** **Habitat:** Ephemeral drainage swale in an actively farmed agricultural field. No substrate sorting and no defined channel were observed. Swale is actively farmed through and appears to be planted/tilled regularly.	topsoil/sand/clay.	N/A	Agriculture	N/A	N/A
Waterbody Name: Tributary to Fraser Creek – 2 **Crossing Locations:** C10-C-1 and C10-C-2 (WC-2)	2020-09-14 and 2021-06-02	Permanent (dries up downstream at crossing C10-C-2).	Warm (MNRF, 2019a)	**Direct** **Upstream Habitat:** Moderate flow, natural morphology. Channel lined with heavy woody debris provides instream and overhanging cover. Undercut banks and boulders provide additional instream cover. Evidence of high flows and eroding banks on both sides of the channel. The surrounding forest provides 90-100% shore cover. **Downstream Habitat:** Channel was partially dry during the investigation; water was only	**Upstream:** Clay/cobble. **Downstream:** Clay/silt/muck	**Upstream:** **Summer:** run/ pool/riffle **Spring:** no pools observed. **Downstream:** **Summer:** pool/riffle (i.e., cobble substrates, dry during the investigation) **Spring:** flats	The surrounding forest is dominated by willow and cedar species, lowland shrubs.	**Constraints:** Vulnerable (severe erosion) left bank at C10-C-2 crossing. Log jams observed may hinder fish passage, most notably during low flow conditions. Potential seasonal obstructions due to low flow. **Opportunities**:	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				present in pools sections. The substrate was consistent throughout the reach. Steep incised valley lands surrounding channel. Surrounding forest provides 90-100% shore cover. **Spring:** No aquatic vegetation observed. No aquatic life noted - no fish, frogs, tadpoles observed.				Restore and repair left bank erosion; remove seasonal obstructions to fish passage; and remove invasive species present on site.	
Waterbody Name: Tributary to Fraser Creek – 3 **Crossing Locations:** C11-A-1 (WC-3)	2020-09-21 And 2021-06-02	Permanent	Warm (MNRF, 2019a)	**Direct** **Upstream Habitat:** Natural watercourse flows south through a wet meadow that transitions to a dense thicket below the north ROW. Watercourse exhibits a natural channel and substrate morphology. Channel is heavily incised, and the left bank is severely eroded. Evidence of high flow periods and sediment deposition. Surrounding thicket provides 90-100% shore cover. **Spring:** Channel has a natural meandering profile through the forested area. Steep slightly unstable banks provide undercut cover and resulted in a large amount of instream and overhanging woody debris. Pools were observed, most notably at upstream end and center ROW point that provide refuge during summer months for fish. Small-bodied fish were observed at both pool locations. **Downstream Habitat:** Semi-channelized watercourse flows out of the thicketed area upstream in a southwest direction through agricultural fields. There is a thin riparian buffer parallel to the channel. This reach had a deeper, more incised channel that contained deeper water that flowed at a slower velocity. Banks were both unstable due to high flow periods. Dense vegetation provided seasonal stability to the steep, vulnerable banks. Surrounding herbaceous and shrub vegetation provides 60-90% shore cover. **Spring:** Similar channel morphology and characteristics as upstream end. No significant pools features observed at downstream end. Channel enters farm field and channelized drainage swale between	**Upstream**: Clay/cobble/silt/boulder **Downstream:** clay/silt/ sand	**Upstream:** Run/ riffle/ pool **Downstream:** Flat/ pool	**Upstream:** Dense thicket dominated by riparian shrubs (dogwood, cherry) and trees (green ash, buckthorn, elm) surrounds channel, no in-stream vegetation. **Downstream:** Dense overhanging vegetation consisting of aquatic macrophytes, wet meadow herbaceous species and riparian shrub. Limited instream cover consisting of aquatic macrophytes and undercut banks.	**Constraint:** Banks were slightly unstable, works in the area should consider avoiding and/or stabilizing these areas.	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				two farm fields, which probably provides poor fish habitat. Clay substrate noted through run sections at downstream end.					
Waterbody Name: Tributary to Fraser Creek – 4 **Crossing Locations:** C11-A-2 (WC-4)	2020-09-21 and 2021-06-02	Ephemeral	Warm (MNRF, 2019a)	**Not Fish Habitat** **Habitat:** Phragmites lined channel is approximately 20 cm wide. The substrate looks wet, but the channel was dry upon inspection. **Spring**: Indirect fish habitat. Feature consists of a farm field drainage swale at the upslope end to the east, which originates in an actively cropped farm field. A poorly defined eroded swale was observed in the hedge row, and a tile drain outlet was noted in the forested area which outlets into a man-made ditch. The ditch runs along the southern edge of the forested area, 3-5 m into the forest from the fields edge. Drainage channel outlets into C11-A-1 near a phragmites patch. Channel was entirely dry at time of site visit.	Silt/sand/clay	N/A	Dense in channel vegetation growth dominated by phragmites and cattail near the channel outlet into C11-A-1. Narrow riparian buffer (1 m) on both sides of the channel.	N/A	N/A
Waterbody Name: Tributary to Fraser Creek – 5 **Crossing Locations:** C12-A-1 (WC-5)	2020-09-17 and 2021-06-02	Ephemeral (upstream of pond), permanent (pond), intermittent (downstream of pond).	Warm (MNRF, 2019a)	**Indirect** (channel); **Direct** (pond) **Habitat:** Swale runs north through thicket and forest. The ground was wet and muddy throughout, but there was no defined banks/channel. The thicket was dominated by willow trees, buckthorn, sensitive fern, jewelweed wet and riparian species. A small cattail depression at the origin of the swale contains stagnant water. No substrate sorting, small pockets of standing water in cattails. Sparse trees and dense shrubs shade area to the northeast of road. Feature enters wooded lands further to the northeast on private lands. Approximately 180 m downstream (northeast) of Sideroad 10, the feature outlets into an online pond. The pond is approximately 15 m wide and 60 m long, with a depth of greater than 2 m. The pond outlets at the northeast end of the pond, crosses a residential driveway, and continues to flow through a forested area.	Clay/detritus/silt/muck	N/A	Small depression was filled with phragmites and cattail. Swale runs through dense forest/ thicket. Pond: Submerged aquatic vegetation was present along the shoreline, and sparse cattails were present at the northwest end of the pond. Algae was also present along the border of the pond.	N/A	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				The pond itself has sparse riparian trees that provided minimal shading, and the lands surrounding the pond were manicured lawn. An abundance of small-bodied fish were observed, and seine pulls were competed along the shoreline. Downstream of the pond, the channel was poorly defined with non-continues banks and substrate sorting in some sections of the channel. Average wetted depth was less than 3 cm, and the wetted width was 0.8 m on average.					
Waterbody Name: Tributary to Fraser Creek – 5 **Crossing Locations:** C13-A-1 (WC-5)	2020-09-18 and 2021-06-02	Intermittent	Warm (MNRF, 2019a)	**Direct** **Habitat:** Natural swale through meadow and agricultural field. Riparian buffer runs parallel to the swale and is approximately 15 m wide. There is no defined channel nor distinct morphology present. **Spring:** Entire feature within the ROW consists of a 15 m grassed area with a channelized feature through the middle. Dense grasses noted along the wetted channel with clear water observed. No pools observed. Channel originated from hedgerow upstream to the north and enters scrubland to the south with sparse shrubs and trees. Patch of phragmites noted at the downstream end. Farm field access road cuts through center of grasses riparian feature and disrupts channel flow and form.	Muck/detritus	N/A	Swale is densely vegetated with cattail and phragmites. Riparian vegetation is a mixture of wet and dry tolerant species.	N/A	N/A
Waterbody Name: Tributary to Fraser Creek – 6 **Crossing Locations:** C14-A-1 (WC-6)	2020-09-18 and 2021-06-02	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Swale with origin in small wetland depression surrounded by thicket that is dominated by wet tolerant species. There was no standing water present at the time of inspection. There is no defined channel nor distinct morphology present upstream or downstream of ROW crossing area. Lowland swale feature with no defined edges was noted in the forested area downstream of the ROW, but area was dry with no standing water and no wet soils. Approximately 200 m downstream there is	Muck/detritus	N/A	Forest (white birch, poplar, conifer), with wetland depression and wet open meadow.	N/A	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				a poorly defined feature that was dry, with cattails and pockets of moist soils.					
Waterbody Name: Pond 1 **Crossing Locations:** NA	2022-06-09	N/A	N/A	**Not fish habitat** **Habitat:** The pond is an offline feature. The pond was an oval shaped and measures approximately 15 m wide and 25 m long, with a depth of over 1 m. The surround lands consisted of dense forested lands and shrubs. The middle of the pond was open water, but no fish were observed during the field investigation. Cattails were present along the shoreline, and riparian trees/shrubs provided shading of approximately 25% of the pond.	Detritus/muck.	N/A	Cattails	N/A	N/A
Waterbody Name: Tributary to West Holland River – 3 **Crossing Locations:** (WC-7)	NA	Ephemeral	Warm (AECOM, 2021)	**Not fish habitat** **Upstream Habitat:** WC-7 flows southwest in a similar manner as WC-8 through an actively farmed agricultural field. WC-7 was not investigated in the field because there was not a crossing location associated with this feature, but it appears to be a poorly defined ephemeral drainage swale similar to WC-7. Therefore, this feature is not fish habitat.	N/A	N/A	Agricultural crop	N/A	N/A
Waterbody Name: Tributary to West Holland River – 1 **Crossing Locations:** C16-A-1 (WC-9)	2020-09-18, 2021-06-15, and 2021-08-12	Permanent	Warm (MNRF, 2019a)	**Direct** **Upstream Habitat:** Watercourse has a moderate flow that drains east through an industrial area, then continues under a railway crossing heading south/ southeast until its confluence with West Humber River. Valley land surrounding channel is dense thicket/forest on the upstream reaches then open wet meadow/wetland towards the downstream reach. Watercourse has a natural morphology and is deeply incised through a primarily clay substrate. Channel is completed shaded by thicket and woody debris overhanging the channel. **Downstream Habitat:** Watercourse enters a wetland feature with multiple channels and backwater locations. No defined bankfull or channel banks. with riparian grass hummocks and deep (>1 m) water	**Upstream**: Clay/gravel/silt/cobble Downstream: muck	**Upstream:** Flat/ run/ pool Downstream: Flat/ Pool	**Upstream:** upstream is dominated by an agricultural thicket/ deciduous swamp community that transitions into a shallow cattail marsh community close to the rail crossing and downstream. **Downstream:** Overhanging cattails and grasses shaded parts of the channel; grass hummocks provide additional shading.	**Constraints:** N/A **Opportunities:** Maintain wetland and cattail marsh to the extent possible to ensure Northern Pike spawning habitat.	Mapped Northern Pike spawning habitat

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				observed. Dense riparian grasses and cattails.					
Waterbody Name: Tributary to West Holland River – 2 **Crossing Locations:** C16-A-2 and C16-A-3 (WC-8)	2020-09-18, 2021-06-15, and 2021-08-12	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Upstream (A-3):** Data for this agricultural swale was taken at approx. 15 m downstream from the crossing location. Watercourse has its origin in an agricultural field west of a hedgerow where the investigation was completed. The watercourse was a dry swale that transected multiple agricultural fields (soy). The swale seems to have a natural meander and a poorly defined channel; however, the surrounding crop was not growing within the channel, suggesting that the swale may have flow during spring and high flow periods. During the spring field visit, the entire drainage swale was dry and planted with crops. **Downstream (A-2):** Downstream habitat homogenous to upstream habitat.	Clay/ sand (dry)	N/A	Agricultural crop	N/A	N/A
Waterbody Name: Tributary to West Holland River – 1 **Crossing Locations:** C16-A-4 (WC-9)	2022-06-09	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** a poorly defined swale feature with no defined banks nor flow was observed during the site visit. The feature crosses a farm access road via a partially crushed, old CSP culvert.	topsoil	Swale feature	Terrestrial grasses were growing throughout the feature	N/A	N/A
Waterbody Name: West Holland River **Crossing Locations:** C17-A-1 (WC-10)	2020-09-15 and 2021-06-14	Permanent	Warm (MNRF, 2019a)	**Direct** **Upstream Habitat:** River flows in a northeast direction. Wide (+ 90 m), deep and slow-moving river bordered by wetland (open fen and shallow marsh) on the west bank and a narrow wetland (shallow marsh) riparian buffer that transitions to agriculture on the east bank. Banks were stable and are bordered by thick vegetative growth; no signs of erosion were observed. Water is turbid and sediment laden. River displays a natural morphology. Algae blooms observed during the investigation suggests nutrient loading from surrounding agricultural drains and adjacent agriculture practices.	It is estimated to be dominated by silt/ muck/ clay.	Flat (homogenous throughout investigated reach)	Instream vegetation was dominated emergent and submergent (dominated by cattail and aquatic macrophytes along the shoreline and floating (dominated by duckweed and along the river's littoral zone). Little overhanging cover or shade in main channel Riparian grass and scrub land. Agricultural crop land use to the east, forested lands and wetland to the west. Cattail thicket along shoreline can be walked through during spring conditions (was not possible to walk through during 2020 investigations)	N/A	Acts as a migratory corridor for fish to reach upstream spawning habitat and specialized habitats that fish use for spawning, nursery (e.g. slower moving areas with instream cover). Confirmed spawning habitat for muskellunge species (MNRF, 2019).

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				Downstream Habitat: Downstream habitat feature homogenous to upstream habitat.					
Waterbody Name: Tributary to West Holland River – 2 **Crossing Locations:** C17-B-1 (WC-11)	2020-09-15 And 2021-06-14	Permanent	Warm (MNRF, 2019a)	**Direct** **Upstream Habitat:** Wide (+ 5m), deep and channelized agricultural drain that collects and conveys all the surrounding agricultural drains in the adjacent fields. The channel flows south through the alignment to its confluence with the West Holland River, approximately 20 m from the south ROW. Highly productive, evidence of intensive nutrient loading. Water in the channel obscured by a thick layer of duckweed and algae blooms. **Downstream Habitat:** **Summer investigation:** Downstream habitat feature homogenous to upstream habitat. **Spring investigation:** Steep berm bank on west side separating channel from West Holland River. Small shrubs and riparian cattails along the west bank, with a narrow (1m) strip of cattails before actively farmed crop field on the east side.	Silt/muck/detritus.	Flat	Cattails, milfoil, duckweed	**Constraint:** Downstream right bank classified as unstable and vulnerable during spring investigations. **Opportunity:** Restore and stabilize vulnerable bank.	N/A
Waterbody Name: Unnamed Drain – 1 **Crossing Locations:** C17-C-1 (WC-12)	2020-09-15 And 2021-06-14	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Channelized agricultural drain through a cornfield. No water was present in the channel upon inspection. The soil was dry, and there was dense vegetative growth within the channel.	N/A	N/A	Agriculture	N/A	N/A
Waterbody Name: Unnamed Drain – 2 **Crossing Locations:** C17-D-1 (WC-13)	2020-09-15 And 2021-06-14	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Channelized agricultural drain through a cornfield. No water was present at the time of inspection. However, the soil was still saturated, and there was minimal vegetation growth in the channel. Banks were shallow; however, there was a defined U shape to the channel. The channel substrate is composed of the same fine silt and clay soil present in the surrounding agricultural fields.	N/A	N/A	Agriculture	N/A	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
Waterbody Name: Unnamed Drain – 3 **Crossing Locations:** C17-E-1 (WC-14)	2020-09-15 And 2021-06-14	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Conditions are the same as what was recorded for the C17-D-1 crossing location.	N/A	N/A	Agriculture	N/A	N/A
Waterbody Name: Unnamed Drain – 4 **Crossing Locations:** C17-F-1 (WC-15)	2020-09-15 And 2021-06-14	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Conditions are the same as what was recorded for the C17-D-1 crossing location.	N/A	N/A	Agriculture	N/A	N/A
Waterbody Name: Unnamed Drain – 5 **Crossing Locations:** C18-A-1 (WC-16)	2020-09-15 and 2021-06-14	Ephemeral	Warm (MNRF, 2019a)	Direct – poor seasonal habitat. Small-bodied fish were observed in channel. Fish likely accessed the ditch during overnight rainfall. Poor seasonal habitat at best. Fish become stranded after rainfalls. **Habitat:** Channelized agricultural drain adjacent to access road and mixed vegetable crop. The channel's upstream reach was dry with saturated soil, and the downstream reach contained standing water. The channel was narrow (0.5 m wide), the banks were shallow, and there was no in-stream vegetative growth. The ground is composed of the same fine silt and clay soil present in the surrounding agricultural fields.	Summer: Clay/silt/sand Spring: Downstream: Muck	Flat	Agriculture	**Opportunity:** Downstream outlet into the ditch at Hochreiter Road is elevated, which cuts off access into the ditch. **Constraint:** Downstream banks are unstable and vulnerable	N/A
Waterbody Name: Unnamed Drain – 6 **Crossing Locations:** C18-B-1 (WC-17)	2020-09-15 And 2021-06-14	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Channelized agricultural drain through cabbage crop. Channel was dry upon investigation; however, the soil was partially saturated in sections. Banks were steep straight banks with a deeply incised channel. Channel contained minimal vegetation growth. The ground is composed of the same fine silt and clay soil present in the surrounding agricultural fields.	Silt/clay/sand	N/A	Agriculture	N/A	N/A
Waterbody Name: Unnamed Drain **Crossing Locations:** WC 18	2020-09-15 And 2021-06-14	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Channelized agricultural drain through cabbage crop. Channel was dry upon investigation. Banks were steep straight banks with a deeply incised channel. No direct connection to Hochreiter Road ditch. The ground is composed of the	Silt/clay/sand	N/A	Agriculture	N/A	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				same fine silt and clay soil present in the surrounding agricultural fields.					
Waterbody Name: Unnamed Drain – 7 **Crossing Locations:** C18-C-1 (WC-19)	2020-09-15 and 2021-06-14	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Conditions are the same as what was recorded for the C18-B-1 crossing location.	Silt/clay/sand	N/A	Agriculture	N/A	N/A
Waterbody Name: Unnamed Drain – 8 **Crossing Locations:** C18-D-1 (WC-20)	2020-09-15 And 2021-06-14	Intermittent	Warm (MNRF, 2019a)	**Direct** **Habitat:** Channelized roadside / agricultural drain that collects flow from all the surrounding agricultural drains and drains west into C17-B-1 and, ultimately, the West Holland River. Channel is deeply incised, and the banks are steep and densely vegetated. There was no in-stream vegetation or shore cover. The water was turbid (dark brown) and appeared to be slow or stagnant.	Silt/muck/clay	Flat	Agriculture Spring: milfoil and algae	**Opportunity/ Constraint:** Downstream and upstream left banks were vulnerable upon spring inspection while downstream and upstream right bank was eroding upon spring inspection. Downstream fish passage obstructions were observed.	N/A
Waterbody Name: Unnamed Drain – 9 **Crossing Locations:** C18-E-1 (WC-22)	2020-09-15, and 2021-08-12	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Channelized roadside drain that runs on the parallel, 10 m south of Hochreiter Road. Channel was dry upon investigation. Channel runs through a forest dominated with deciduous species (white cedar and sugar maple dominated). Banks are shallow, and the channel was not well defined. Channel was densely lined with woody debris; however, there was no vegetation growth. Shore cover was high (90-100%) due to the surrounding forest community. Ground cover was partially saturated soil and leaf litter. Not directly connected to fish habitat.	N/A	N/A	Forest	N/A	N/A
Waterbody Name: Tributary to West Holland – 2 **Crossing Locations:** C18-F-1 (WC-24)	2020-09-16 and 2021-06-14	Permanent	Warm (MNRF, 2019a)	**Direct** **Habitat: Summer:** Channelized roadside drain that runs parallel to Bathurst Street. The channel flows north to another sizeable agricultural drain through forest and agricultural fields until its confluence with the West Holland River. The deeply incised channel contains slow to stagnant flow. Banks are well vegetated and stable, although steep. There is limited in-stream cover that is dominated by woody debris and leaf litter. Shore cover is dense and	Silt/detritus/muck/clay	Flat	The surrounding forest is dominated by white cedar, sugar maple, birch and ash. Wet meadow herbaceous species dominate bank vegetation. There was no in-stream vegetation present.	N/A	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				dominated by forest (White Cedar, Sugar Maple dominated). **Spring:** No observable flow throughout assessed area. Deep 80cm pool of standing water at SW corner of Dense overhanging trees provide 80+% shading through assessed area. Assessed channels appear to be ditch features that were created near wetland or lowland features that now hold water - may not be watercourse features with flow.					
Waterbody Name: Tributary to West Holland – 3 **Crossing Locations:** C18-G-1 (WC-23)	2020-09-15, 2021-06-16, and 2021-08-12	Intermittent	Warm	**Direct** **Habitat:** **Summer:** The crossing location for C18-G-1 is in the adjacent forest, where a small ephemeral swale runs through the forest and connects with the road drainage along Bathurst Street. However, upon investigation, the watercourse is channelized along Bathurst Street as a roadside drain. The roadside drain flows north and drains into C18-E-1 at the Bathurst Street and Hochreiter Road intersection. The deeply incised channel contains slow to stagnant flow. Banks are well vegetated and stable, although steep. There is limited in-stream cover that is dominated by woody debris, aquatic macrophyte and leaf litter. Shore cover is dense and dominated by forest (White Cedar, Sugar Maple dominated).	Silt/ detritus/ muck/ clay	Flat	The surrounding forest is dominated by white cedar, sugar maple, birch and ash. Wet meadow herbaceous species dominate bank vegetation—limited aquatic macrophytes dominated by cattail.	N/A	N/A
Waterbody Name: Tributary to East Holland River **Crossing Locations:** C18-H-1 (WC-23)	2020-09-15 and 2021-06-14	Intermittent	Warm (MNRF, 2019a)	**Direct** **Habitat: summer:** The roadside drain collects flow from several road drains along the east side of Bathurst Street and flows north to a large drain that ultimately conveys all flow into East Holland River. The deeply incised channel contains slow to stagnant flow. Banks are well vegetated and stable, although steep. The in-stream cover was moderate and was dominated by aquatic macrophytes and woody debris. Shore cover is low and dominated by riparian shrubs and overhanging woody debris.	Silt/ detritus/ muck/ clay	Flat	Surrounding riparian buffer was dominated by willow and wet tolerant herbaceous species. Beyond the riparian buffer, there is mowed grass and a cultural meadow. Aquatic macrophytes provide in-stream cover and are dominated by sedges and rushes with cattails and milfoil present	N/A	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				Spring: No flow observed throughout assessed downstream reach. No flow direction observed at entrance culvert underneath marina driveway. Dense duckweed and cattails at northeast channel at Bathurst and marina entrance. East along marina entrance on south side, channel is well shaded by overhanging trees and woody debris with minimal floating or emerging aquatic vegetation in this area.					
Waterbody Name: East Holland River **Crossing Locations:** C20-A-1 (WC-25)	2020-09-16 and 2021-06-15	Permanent	Warm (MNRF, 2019a)	**Direct** **Upstream Habitat:** River flows north to its confluence with the Main branch of the Holland River. Wide (+ 80 m), deep and slow-moving river bordered by wetland (MAS3 and SWD6 and Golf course) on the east bank and a narrow wetland (CUM1 and SWD3 and Marina) west bank. Banks were stable and are bordered by thick vegetative growth; no signs of erosion were observed. Water is turbid and sediment laden. River displays a natural morphology. **Downstream Habitat:** Downstream habitat feature homogenous to upstream habitat.	Estimated to be dominated by silt/muck/clay.	Flat (homogenous throughout investigated reach)	Instream vegetation was dominated by emergent and submergent (cattail and milfoil) along the shoreline and floating (duckweed and pond lilies) along the river's littoral zone.	N/A	Acts as a migratory corridor for fish to reach upstream spawning habitat and specialized habitats that fish use for spawning, nursery (e.g. slower moving areas with instream cover). Confirmed spawning habitat for muskellunge species (MNRF, 2019).
Waterbody Name: Silver Lakes Golf Course Pond **Crossing Locations:** C20-B-1	2020-09-16	Permanent	Unknown	**Not fish habitat** **Habitat:** The pond is next to Hole 2 on the golf course. The golf course maintains the area surrounding the pond right up to within 0.5m of the riparian zone. The riparian zone is comprised of wetland vegetation, and the banks are sloped. Discussions with the maintenance superintendent revealed that the river floods over Hole 2 and impacts this pond every couple of years (AECOM, 2020).	Estimated to be dominated by clay/silt/sand	Pond – not connected to East Holland River. Shore cover shaded 1-29% of pond.	Along the edge of the pond, submergent and emergent vegetation was dominated. The most dominant species included: duckweed, white water lily, coon-tail, cattails	N/A	N/A
Waterbody Name: Holborn Drain **Crossing Locations:** C22-A-1 (WC-27)	2020-09-16 and 2021-06-15	Permanent pond with intermittent drainage channel to the south.	Warm (MNRF, 2019a)	**Direct** **Habitat: summer:** The crossing location for C22-A-1 is in the middle of an agricultural area where the water feature separates two fields that were actively being farmed. The water feature, which flows north, consisted of a wetland area with an approximate 3m riparian buffer upstream	Estimated to be dominated by Silt/clay/muck	**Upstream:** channelized 100% flats (homogeneous throughout the area of investigation) **Downstream:** channelized	**Upstream:** emergent and floating vegetation dominated. cattails, duckweed, grass **Downstream:** Floating and emergent vegetation dominated: duckweed, cattails. goldenrod, asters	N/A	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				of the ROW and two water retention ponds on the downstream side of the ROW. The agricultural field on the west side of the watercourse was wet at the time of inspection, and a water pump was observed in most southern water retention pond. **Spring:** Channel was dry north of culvert to the pond. Pond was covered in consistent layer of algae and duckweed. Pond connects to additional pond further north under farm access road. Drainage ditches enter channel from hedgerows to the east and west, both of which were also dry. Pond is used for watering field - pumps installed.					
Waterbody Name: Ravenshoe/ Boag Drain **Crossing Locations:** C23-A-1 (WC-27)	2020-09-16 and 2021-06-15	Intermittent	Warm (MNRF, 2019a)	**Not fish habitat** **Upstream Habitat: Spring:** Channelized roadside drain that runs parallel with 2nd Concession Road. Channel looked as if it had been dredged recently (within the past year or so). Both banks appeared slightly unstable throughout the entire reach. However, the left bank was protected by vegetation, while the right bank was vulnerable to erosion. **Summer:** Dry ditch feature with sparse cattails and grasses. No water observed throughout entire ROW, and no direct connections observed to nearby watercourses. Sod farm to the east, crop field to the west. **Downstream Habitat:** Downstream habitat feature homogenous to upstream habitat.	N/A	N/A	Dominated by emergent vegetation within ditch line. (dominant species was cattails)	N/A	N/A
Waterbody Name: Tributary to Ravenshoe/ Boag Drain – 1 **Crossing Locations:** C24-A-1 (WC-28)	2020-09-17 and 2021-06-17	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Dry agricultural swale with no defined feature and actively planted crops.	N/A	N/A	Agricultural crops.	N/A	N/A
Waterbody Name: Tributary to Ravenshoe/ Boag Drain – 2	2020-09-17 and 2021-06-17	Ephemeral	Warm (MNRF, 2019a)	**Indirect** **Habitat:** No defined channel through grass swale separating two actively farmed crop fields. A small ponded area (15x15m) was present in the northern end of the	N/A	N/A	Agricultural crops, goldenrod, aster, grass sp.	N/A	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
Crossing Locations: C25-A-1 (WC-29)				assessment area, potentially caused by small earth berm from access road construction. Pond has cattails and shallow waters. Swale captures overland flow from farm fields, no water present in swale other than ponded area.					
Waterbody Name: Tributary to Ravenshoe/ Boag Drain – 3 **Crossing Locations:** C25-B-1 (WC-30) Summer 2020: Watercourse observed from Leslie Road 130 m d/s from crossing due to PTE Access	2020-09-17 and 2021-06-17	Ephemeral	Warm (MNRF, 2019a)	**Not fish habitat** **Habitat:** Dry agricultural swale in actively farmed field with no defined feature.	N/A	N/A	Dominated by goldenrod and grass species	N/A	N/A
Waterbody Name: Tributary to Ravenshoe/ Boag Drain – 4 **Crossing Locations:** C25-C-1 (WC-31)	2020-09-17 and 2021-08-12	Pond – permanent; channel upstream/downstream – intermittent.	Warm (MNRF, 2019a)	**Direct** **Habitat:** Online man-made pond with drop structure outlet. Dense grasses and cattails with sparse riparian trees. Downstream of pond - 30 metres wide riparian section with grasses and trees between two active crop fields. Pond drop outlet structure appears to be a type of hicken-bottom feature, but unclear. May be simple overflow type structure. Not passable upstream for fish. May allow unintended downstream passage of fish during storm events. Earth berm approximately 5 m wide at top, and 8 m from top to bottom on downstream (west) side. Channel is dry downstream of outlet pool with moist soils. No pools or standing water observed. Patch of Phragmites around outlet pool.	Silt/muck	Flat	Dominated by cattails and grasses with some phragmites	**Constraint:** Upstream banks both slightly unstable and vulnerable. **Opportunity:** Online pond creates fish passage barrier and alters flow of watercourse.	N/A
Waterbody Name: Tributary to Maskinonge (Jersey) River – 1 **Crossing Locations:** C25-A-2 and C26-A-1 (WC-32)	2020-09-16 and 2021-06-17	Intermittent	Warm (MNRF, 2019a)	**Indirect** **Upstream Habitat: C26-A-1:** This section was dry upon inspection, with the majority of plant species present being drought tolerant terrestrial species. There was no defined channel, but the crossing was in a valley created by the adjacent agricultural	Silt/sand/muck/detritus	**Upstream:** swale **Downstream:** Wetland, small meandering channel within wetland observed during	**Upstream:** Dominated by grasses, asters, and goldenrods, but there were cattails present. Riparian grasses and shrubs along drainage swale for 50 m before swale enters forested area. 50 m. **Downstream:**	N/A	N/A

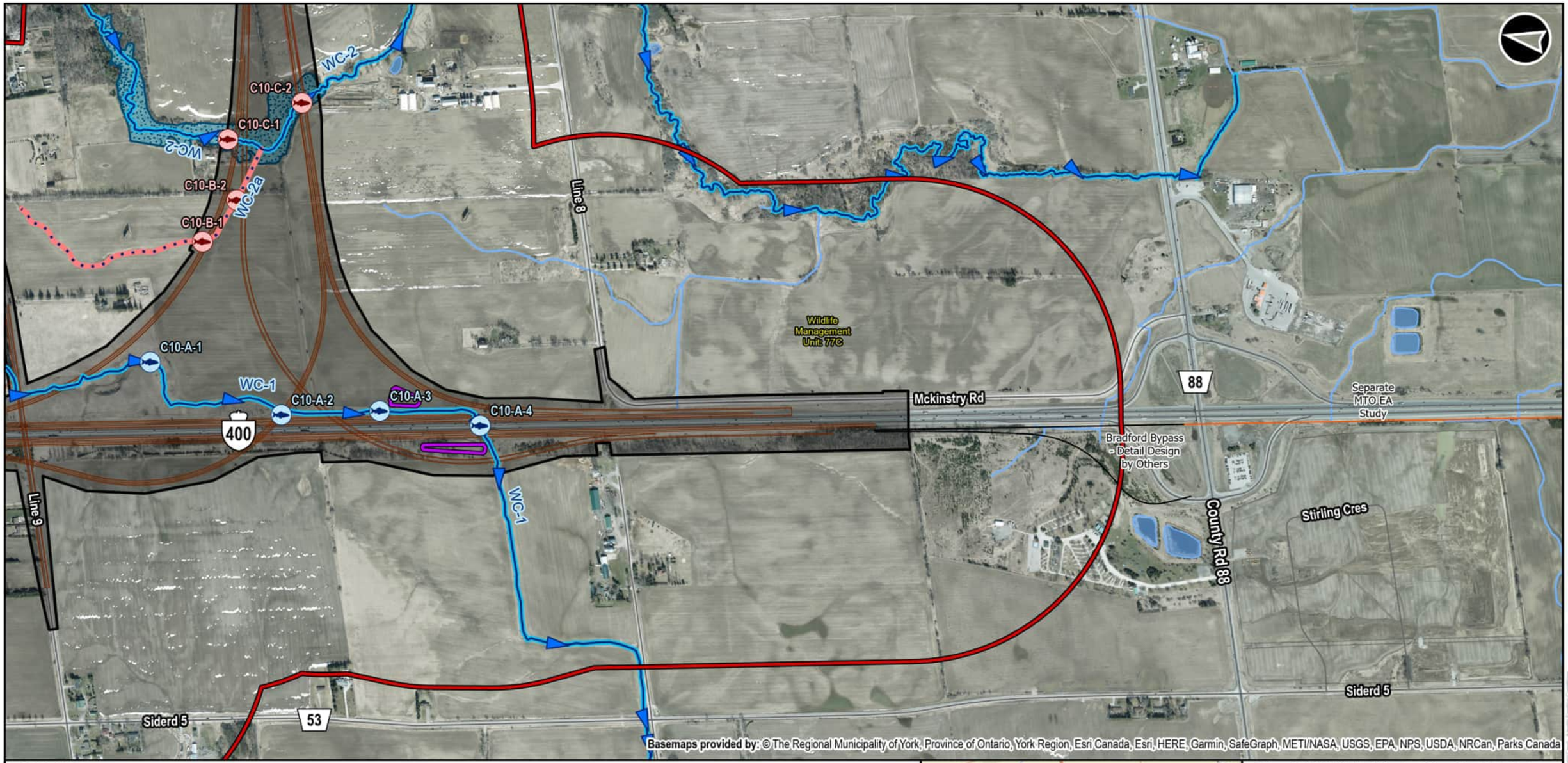
Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				field and Highway 404. It appeared that the channel might diverge at culvert when it does run. Just over 200m upstream from the crossing, the channel becomes more defined with steep banks and exposed tree roots. **Downstream Habitat: C25-A-2:** This section was dry at the culvert at the time of inspection. Once beyond the section of the water feature that was altered for the highway, the feature opened into a wetland. Wetland vegetation species were dominated by cattail and phragmites. The wetland became channelized approximately 200m downstream from the crossing. The channel's flow is controlled by the wetland vegetation that thickly grows over the entire water feature.		fluvial geomorphology assessment.	dominated by cattail and phragmites		
Waterbody Name: **Crossing Locations:** C27-A-1, (WC-33)	2022-05-19	Permanent	Warm (MNRF, 2019a)	**Direct** **Habitat:** naturalized, meandering channel with a riffle run morphology. Clear water was flowing south to north. Some bank slumping was observed but the banks were well vegetated with water tolerant species. Woody debris was observed throughout the reach and shore cover was moderate (60-90%).	Silt (65%), sand (25%), boulder (5%), gravel (5%)	Run (95%), riffle (5%)	Unidentified submergent vegetation and various grass species	N/A	N/A
Waterbody Name: **Crossing Locations:** C28-A-1, (WC-34)	2022-05-19	Permanent	Warm (MNRF, 2019a)	**Direct** **Upstream Habitat:** Wetland feature with no defined banks throughout most of reach; water was present, but not confined within the wetland feature. A pool was present at the culvert inlet. Vegetation cover was high (90-100%) and was dominated by phragmites and cattails. **Downstream Habitat:** channelized feature that narrows by riprap placement at the culvert exit and remains slightly incised. Bank erosion was observed on the left bank and undercut banks were observed throughout the reach. The in stream cover was moderate (60%) and was comprised of the undercut banks and the vascular	**Upstream:** wetland feature: detritus, silt, muck **Culvert pool:** Cobble, gravel, sand **Downstream:** muck (60%), silt (30%), and detritus (10%).	**Upstream:** wetland (90%); culvert pool (10%) **Downstream:** run (60%); pool (40%).	**Upstream:** phragmites, cattails, herbaceous vegetation **Downstream:** Phragmites, cattails, herbaceous vegetation	**Opportunity:** Remove phragmites Stabilize eroding banks.	N/A

Waterbody ID	Date	Flow	Thermal Regime	Fish Habitat*	Substrate Type (in order of dominance)	Channel Morphology	Vegetation	Constraints and Opportunities	Significant Fish Habitat
				macrophytes, both instream (20%) and overhanging (50%).					

* Fish habitat is defined in subsection 2(1) of the Fisheries Act to include all waters frequented by fish and any other areas upon which fish depend directly or indirectly to carry out their life processes. The types of areas that can directly or indirectly support life processes include but are not limited to spawning grounds and nursery, rearing, food supply and migration areas.

Table Description:

Waterbody ID	Name of waterbody and Crossing # / Station
Date	Insert date field investigations occurred (DD/MM/YYYY), as applicable
Flow	Ephemeral, Intermittent, Permanent
Thermal Regime	Warm, Cool, Cold
Fish Habitat	Direct, Indirect, Not Fish Habitat
Substrate Type	Boulder, cobble, rubble, gravel, sand, muck, etc.
Channel Morphology	E.g., Riffles, runs, pools, undercut banks, etc.
Vegetation	Riparian & In-stream species; emergent, submergent and floating aquatic vegetation
Constraints and Opportunities	E.g., Perched culvert, eroding bank, fish passage barrier, undersized CSP
Significant Fish Habitat	E.g., specialized habitat that supports critical life functions, areas contributing to fisheries productivity, etc.



LEGEND

- Study Area (500 m)
- ROW - Bradford Bypass (Highway 400-404)
- Bradford Bypass Works (Highway 400-404)
- Detail Design by Others
- Separate MTO EA Study
- Backwater Bay/Refuge Area
- Online Pond
- Storm Water Pond

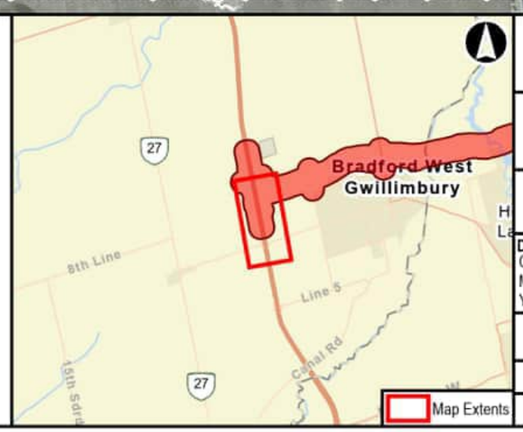
Thermal Regime
- Cool
- Warm
- Unknown

Fish Habitat
- Direct
- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency
- Permanent
- Intermittent
- Ephemeral
- Dirrection of Flow

General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
- Unevaluated Wetland



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Fish and Fish Habitat Existing Conditions

0 100 200 400 600 M

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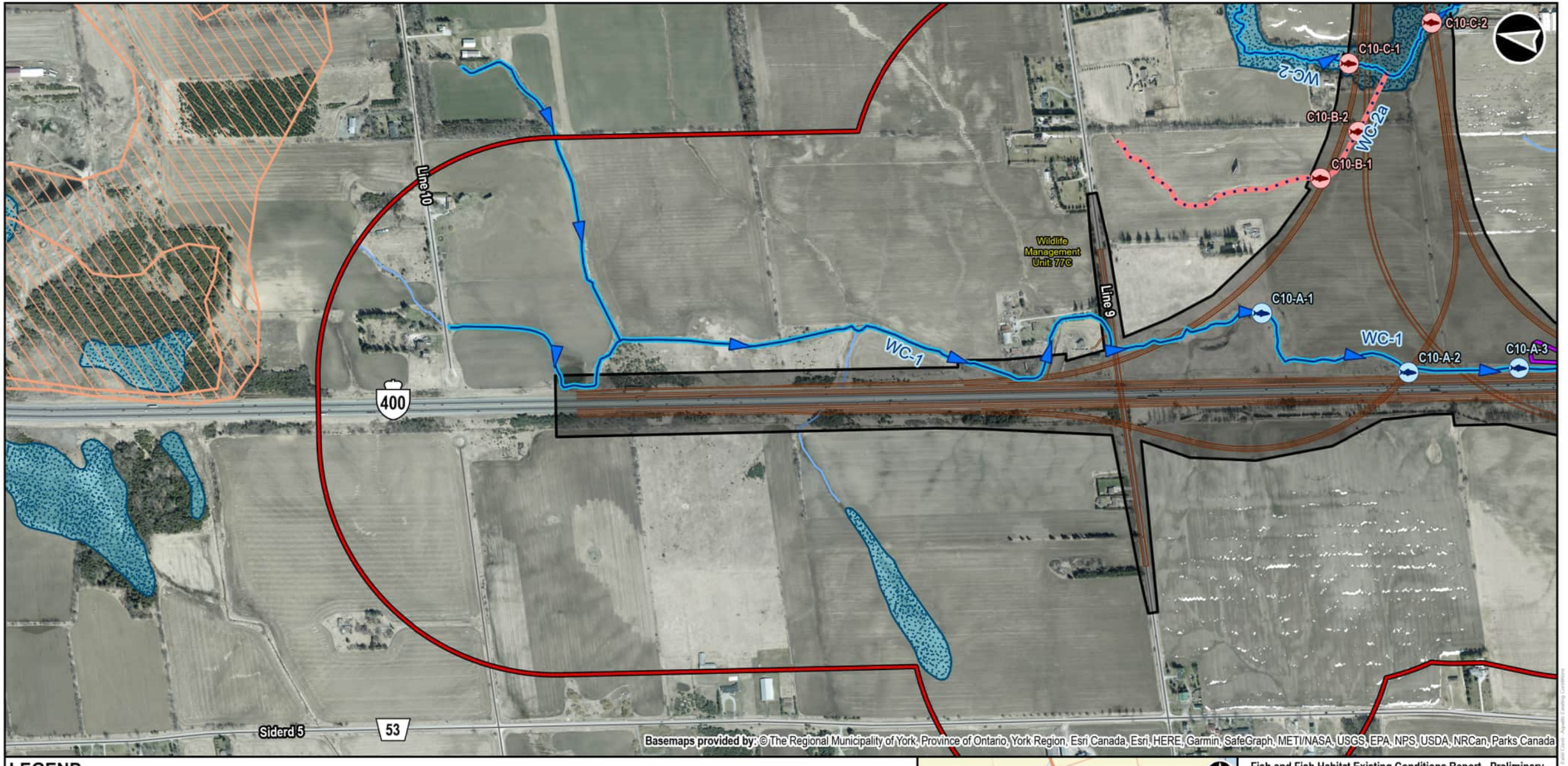
Figure: 2-1



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Thermal Regime
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- Warm
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Fish Habitat
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Flow Permanency
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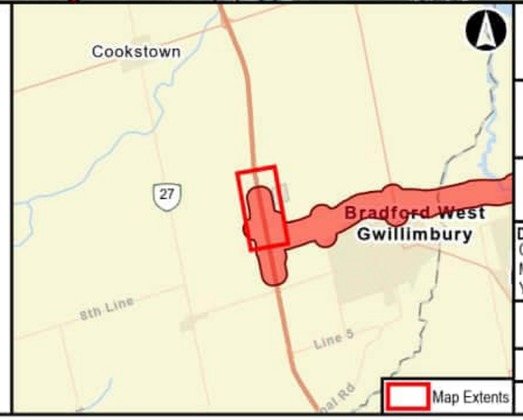
- Intermittent
- Ephemeral
- Dirrection of Flow

General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
- Unevaluated Wetland
- Deer Wintering Areas - Stratum 2



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Fish and Fish Habitat Existing Conditions

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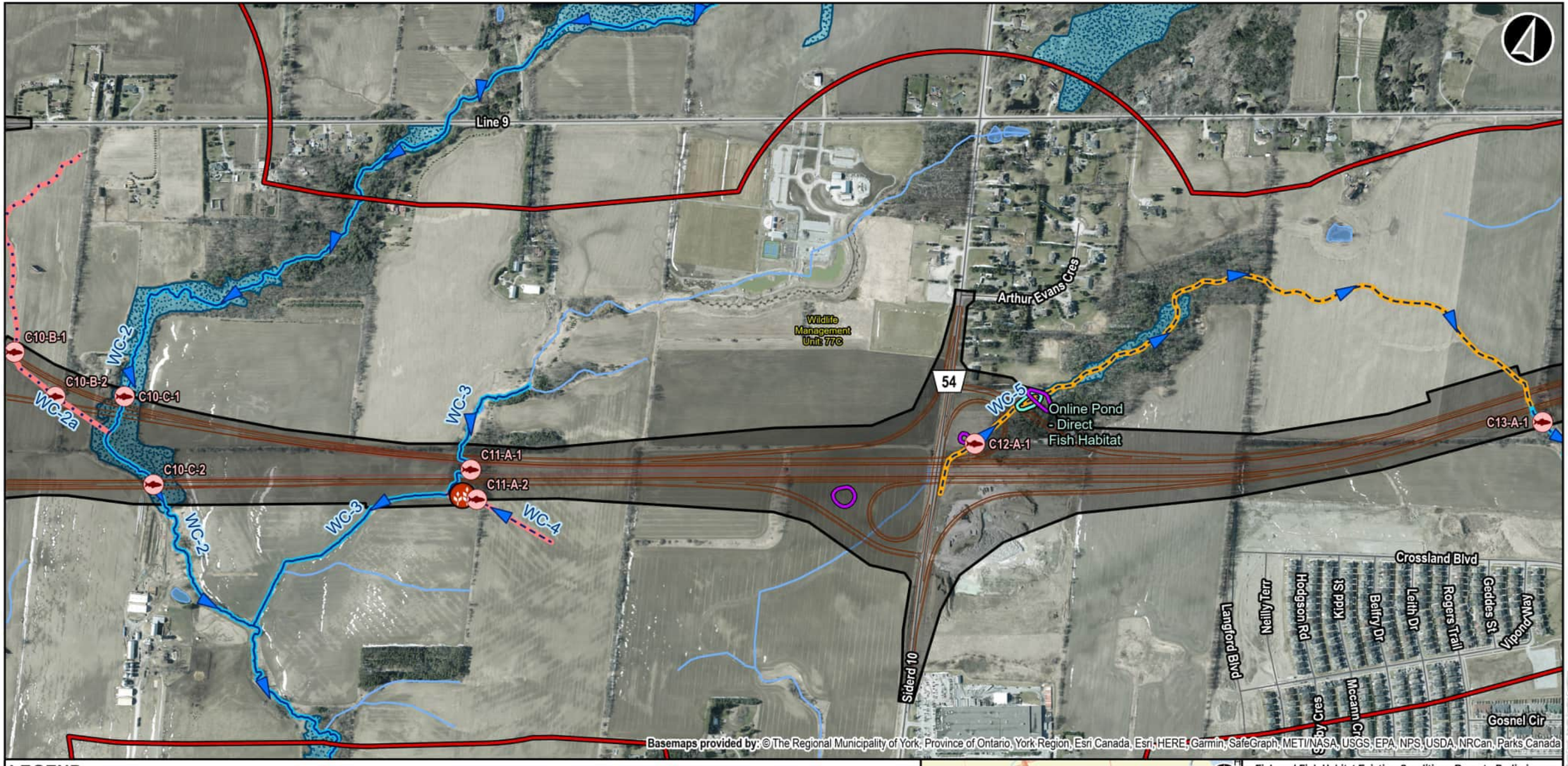
Figure: 2-2



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Thermal Regime
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Fish Habitat
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Flow Permanency
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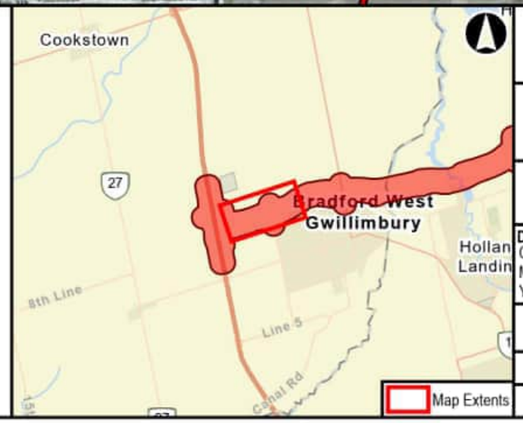
- Intermittent
- Ephemeral
- Dirrection of Flow

General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
- Unevaluated Wetland



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Fish and Fish Habitat Existing Conditions

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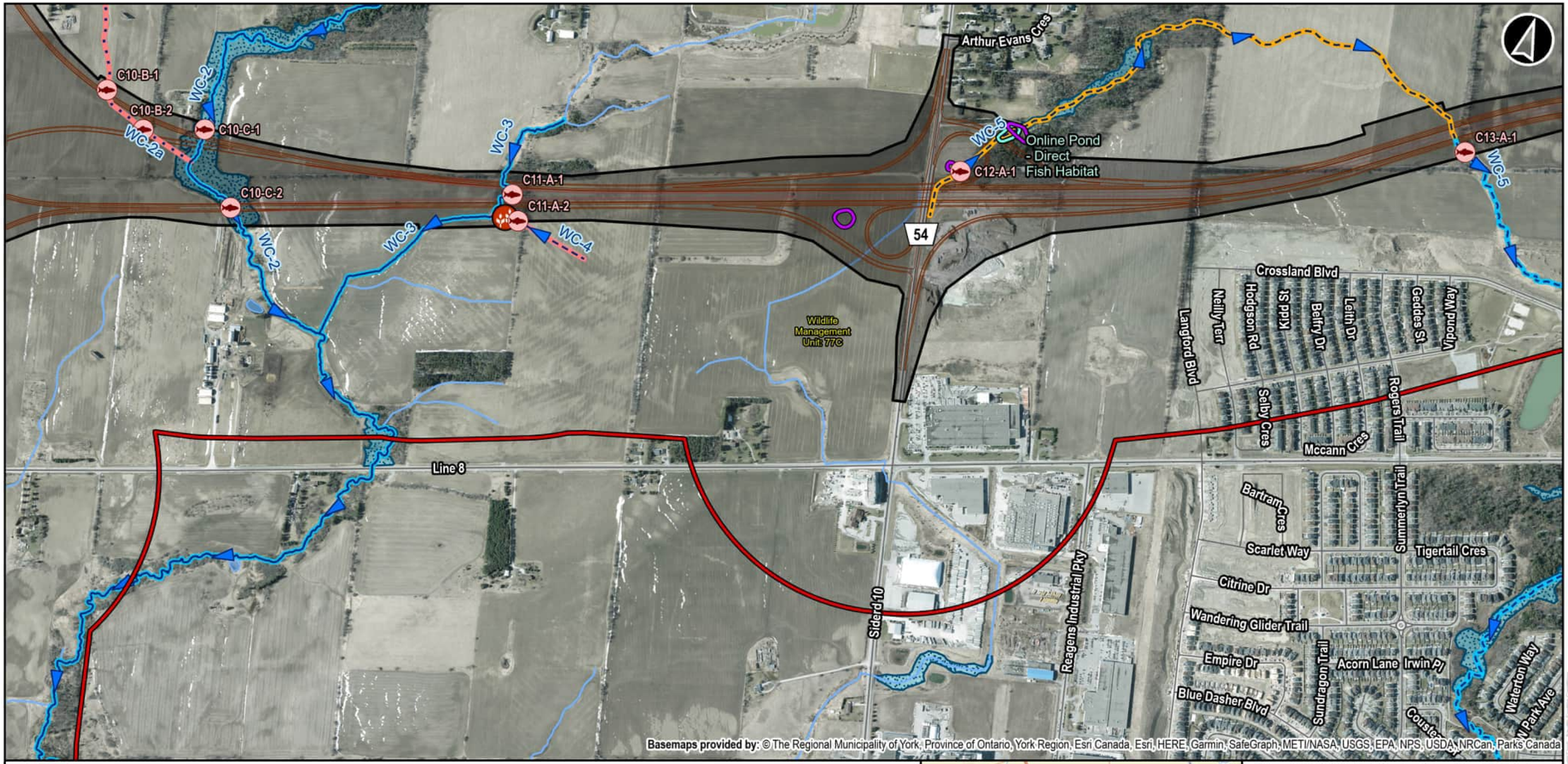
Figure: 2-3



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- ROW - Bradford Bypass (Highway 400-404)
- Bradford Bypass Works (Highway 400-404)
- Detail Design by Others
- Separate MTO EA Study
- Backwater Bay/Refuge Area
- Online Pond
- Storm Water Pond

Thermal Regime
- Cool
- Warm
- Unknown

Fish Habitat
- Direct
- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency
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- Ephemeral
- Dirrection of Flow

General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
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Fish and Fish Habitat Existing Conditions

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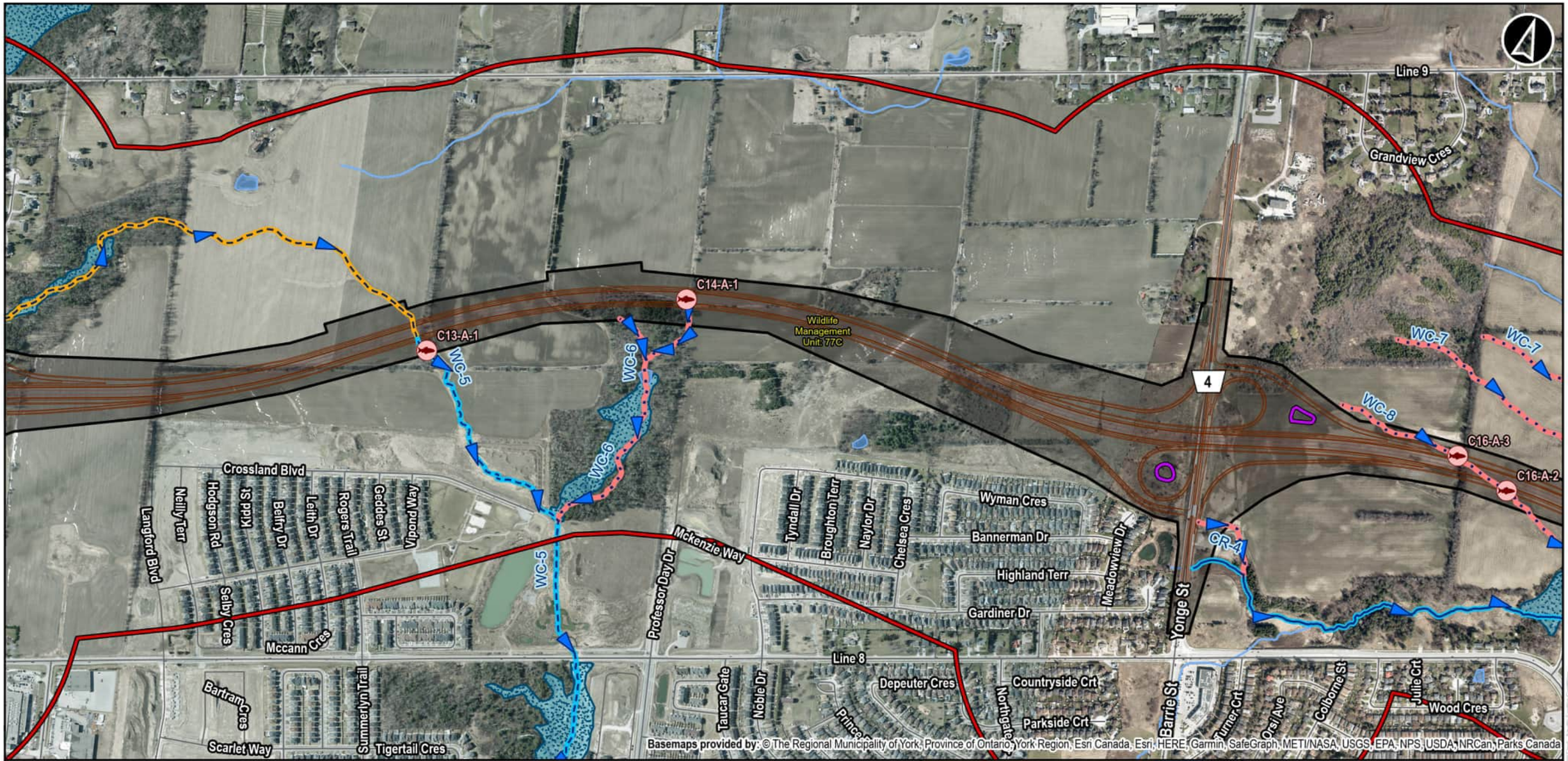

LEGEND

- Study Area (500 m)
- ROW - Bradford Bypass (Highway 400-404)
- Bradford Bypass Works (Highway 400-404)
- Detail Design by Others
- Separate MTO EA Study
- Backwater Bay/Refuge Area
- Online Pond
- Storm Water Pond

Thermal Regime

- Cool
- Warm
- Unknown

Fish Habitat

- Direct
- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency

- Permanent
- Intermittent
- Ephemeral
- Dirrection of Flow

General Features

- Waterbody
- Watercourse

Environmentally Significant Areas

- Unevaluated Wetland

Fish and Fish Habitat Existing Conditions Report - Preliminary Design and Class Environmental Assessment (EA) Study for Highway 400 – Highway 404 Link (Bradford Bypass)

Fish and Fish Habitat Existing Conditions

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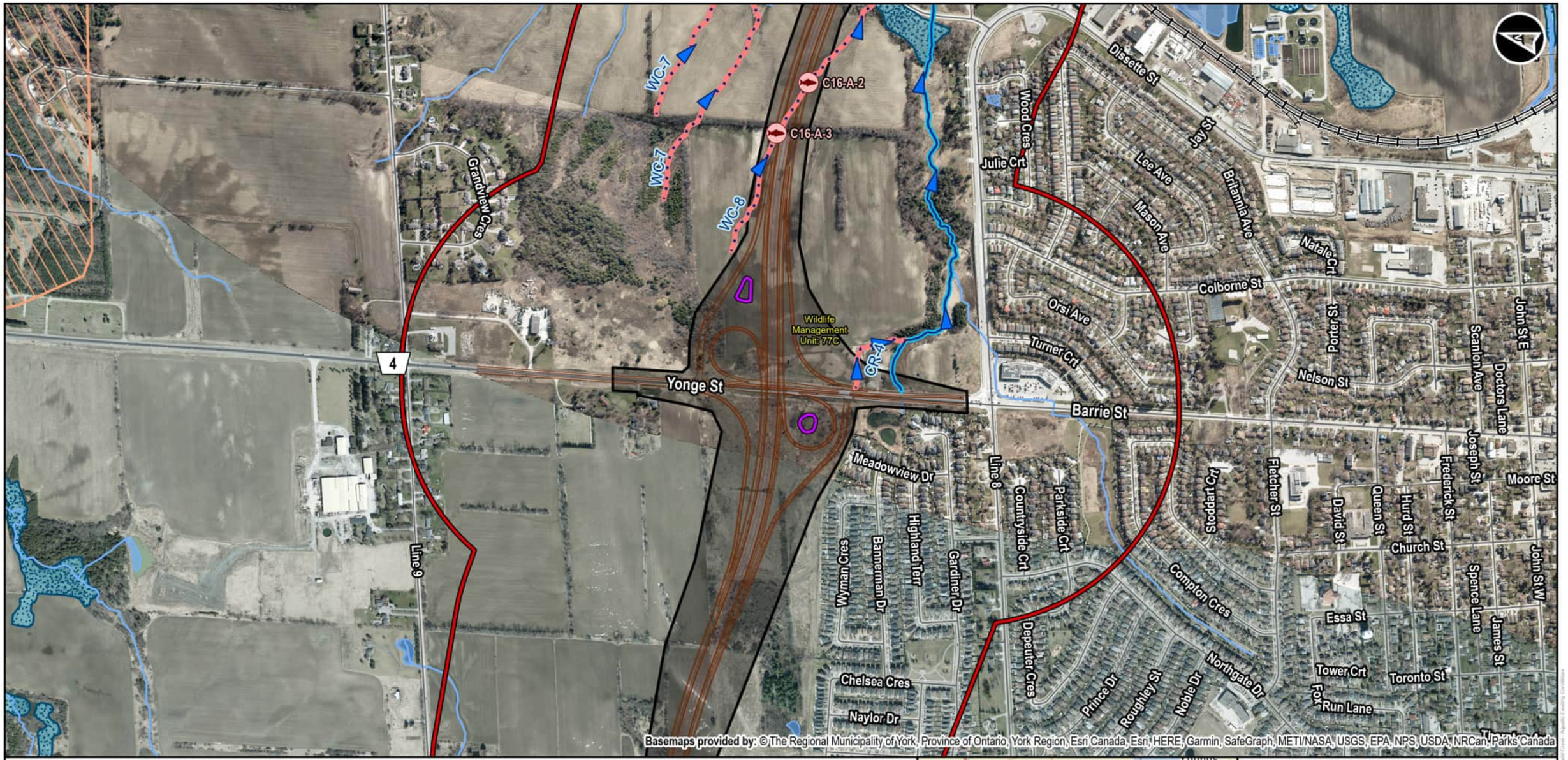
Figure: 2-5



LEGEND

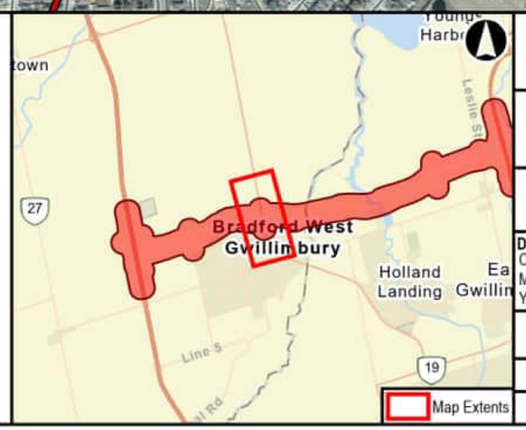
- Study Area (500 m)
- ROW - Bradford Bypass (Highway 400-404)
- Bradford Bypass Works (Highway 400-404)
- Detail Design by Others
- Separate MTO EA Study
- Backwater Bay/Refuge Area
- Online Pond
- Storm Water Pond

Thermal Regime
- Cool
- Warm
- Unknown

Fish Habitat
- Direct
- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency
- Permanent
- Intermittent
- Ephemeral
- Dirrection of Flow

General Features
- Waterbody
- Watercourse



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Fish and Fish Habitat Existing Conditions

0 100 200 400 600 M

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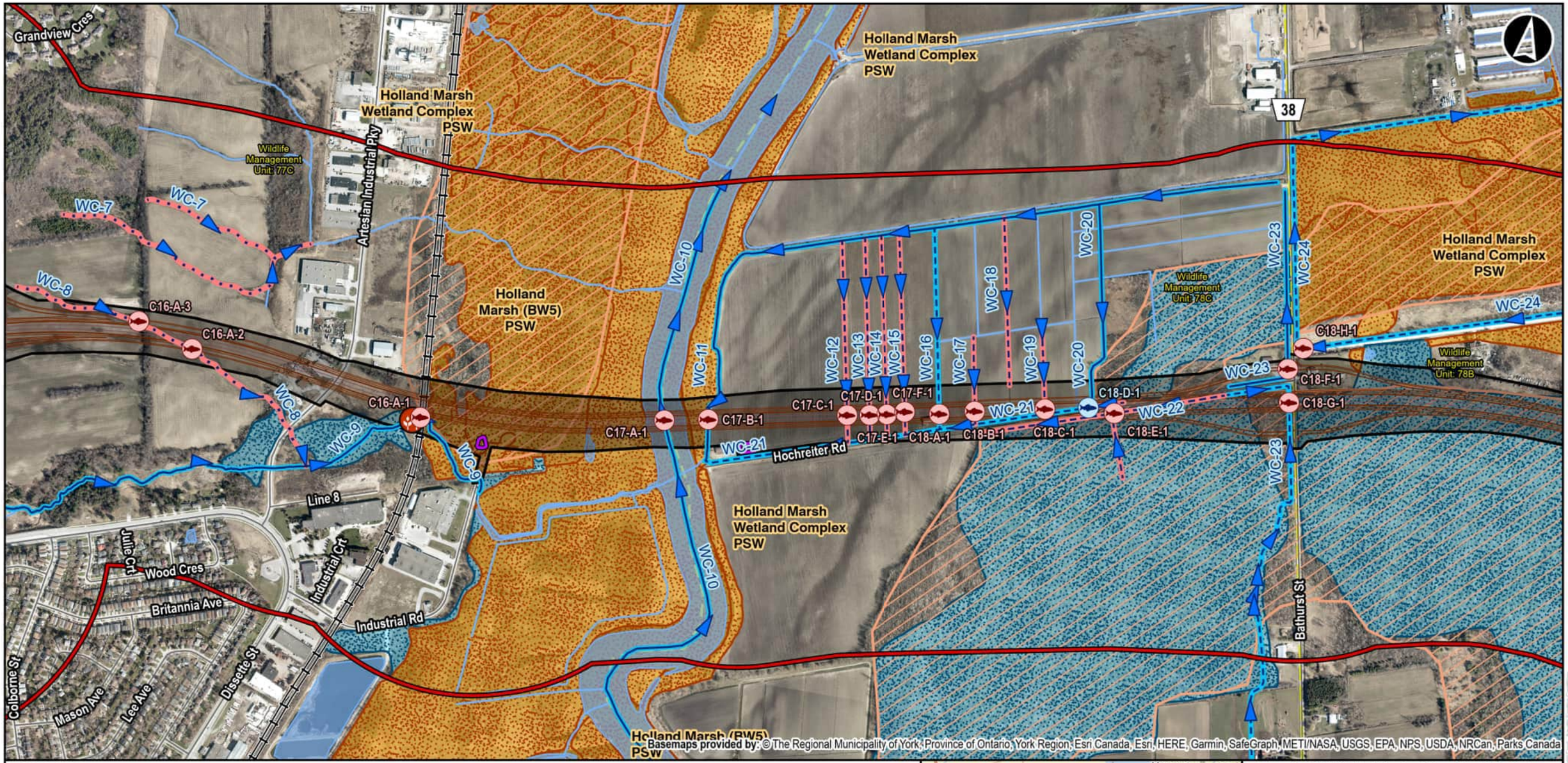
Figure: 2-6



LEGEND

- Study Area (500 m)
- ROW - Bradford Bypass (Highway 400-404)
- Bradford Bypass Works (Highway 400-404)
- Detail Design by Others
- Separate MTO EA Study
- Backwater Bay/Refuge Area
- Online Pond
- Storm Water Pond

Thermal Regime
- Cool
- Warm
- Unknown

Fish Habitat
- Direct
- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency
- Permanent
- Intermittent
- Ephemeral
- Dirrection of Flow

General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
- Provincially Significant Wetland (PSW)
- Unevaluated Wetland
- Deer Wintering Areas - Stratum 2

Fish and Fish Habitat Existing Conditions Report - Preliminary Design and Class Environmental Assessment (EA) Study for Highway 400 – Highway 404 Link (Bradford Bypass)

Fish and Fish Habitat Existing Conditions

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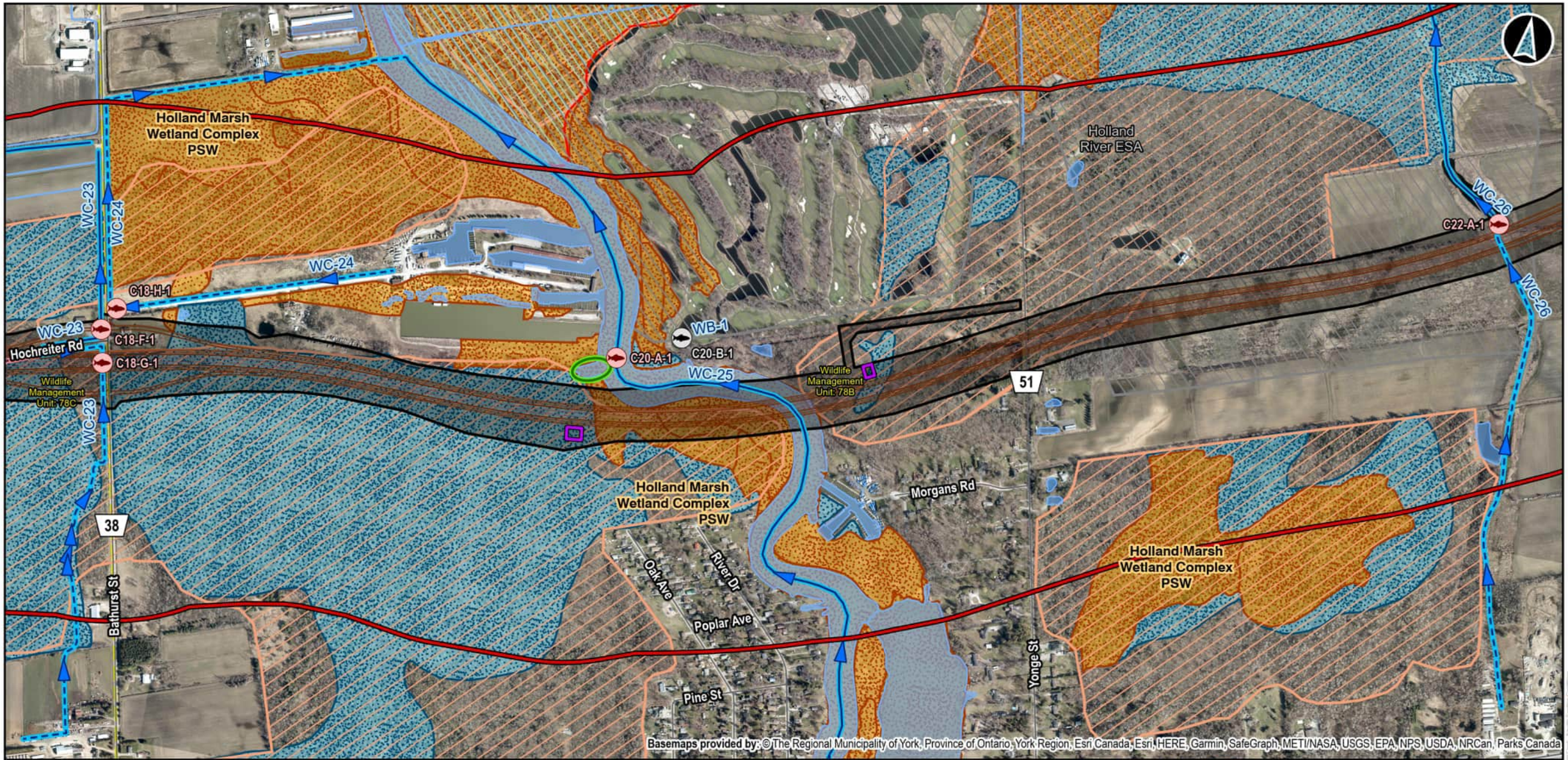
Figure: 2-7



LEGEND

- Study Area (500 m)
- ROW - Bradford Bypass (Highway 400-404)
- Bradford Bypass Works (Highway 400-404)
- Detail Design by Others
- Separate MTO EA Study
- Backwater Bay/Refuge Area
- Online Pond
- Storm Water Pond

Thermal Regime
- Cool
- Warm
- Unknown

Fish Habitat
- Direct
- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency
- Permanent
- Intermittent
- Ephemeral
- Dirrection of Flow

General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
- Provincially Significant Wetland (PSW)
- Unevaluated Wetland
- Lake Simcoe Region Conservation Authority - Environmentally Significant Area
- Deer Wintering Areas - Stratum 2

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Fish and Fish Habitat Existing Conditions

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Figure: 2-8

Holland Marsh Wetland Complex PSW

Holland Marsh Wetland Complex PSW

2Nd Con Rd

34

Holborn Rd

Wildlife Management Unit 78B

Holland River ESA

WC-27

C24-A-1

C23-A-1

WC-26

C22-A-1

WC-26

WC-27

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LEGEND

- Study Area (500 m)
- ROW - Bradford Bypass (Highway 400-404)
- Bradford Bypass Works (Highway 400-404)
- Detail Design by Others
- Separate MTO EA Study
- Backwater Bay/Refuge Area
- Online Pond
- Storm Water Pond

Thermal Regime

- Cool
- Warm
- Unknown

Fish Habitat

- Direct
- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency

- Permanent
- Intermittent
- Ephemeral
- Direction of Flow

General Features

- Waterbody
- Watercourse

Environmentally Significant Areas

- Provincially Significant Wetland (PSW)
- Unevaluated Wetland
- Provincial ANSI - Life Science
- Lake Simcoe Region Conservation Authority - Environmentally Significant Area
- Deer Wintering Areas - Stratum 2

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Fish and Fish Habitat Existing Conditions

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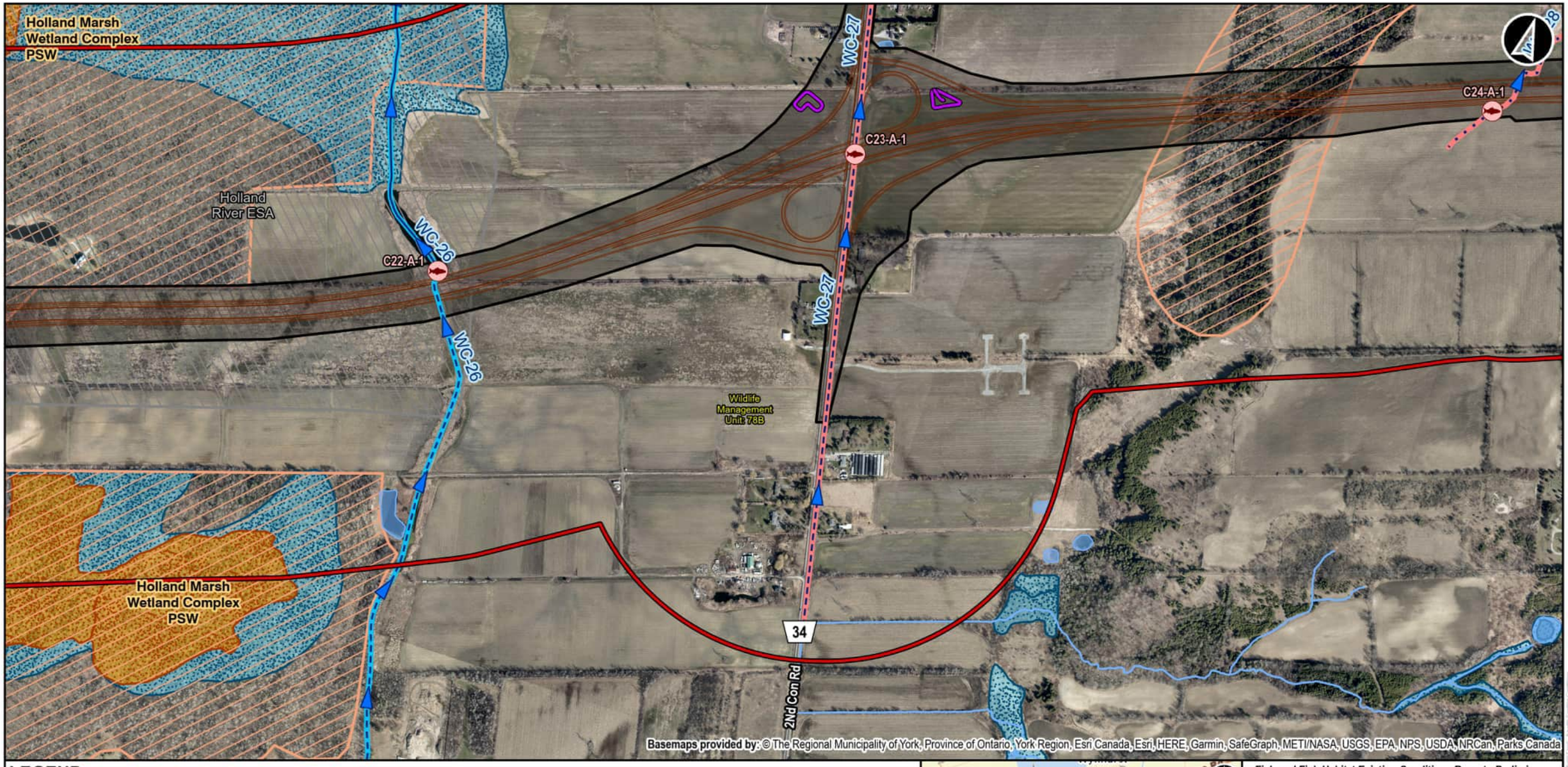
Figure: 2-9



LEGEND

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- ROW - Bradford Bypass (Highway 400-404)
- Bradford Bypass Works (Highway 400-404)
- Detail Design by Others
- Separate MTO EA Study
- Backwater Bay/Refuge Area
- Online Pond
- Storm Water Pond

Thermal Regime
- Cool
- Warm
- Unknown

Fish Habitat
- Direct
- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency
- Permanent
- Intermittent
- Ephemeral
- Dirrection of Flow

General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
- Provincially Significant Wetland (PSW)
- Unevaluated Wetland
- Lake Simcoe Region Conservation Authority - Environmentally Significant Area
- Deer Wintering Areas - Stratum 2

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Fish and Fish Habitat Existing Conditions

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Figure: 2-10

Holland Marsh Wetland Complex PSW
Holland River ESA
2Nd Con Rd
34
Holborn Rd
Holborn Rd
WC-27
C23-A-1
Wildlife Management Unit 78B
WC-28
C24-A-1
WC-29
C25-A-1
WC-30
C25-B-1
WC-31
C25-C-1
12
WC-29
WC-30
WC-31
Leslie St
Maskinonge River Wetland Complex PSW
C25-A-2
WC-32
404
WC-27

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Thermal Regime
- Cool
- Warm
- Unknown

Fish Habitat
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Flow Permanency
- Permanent
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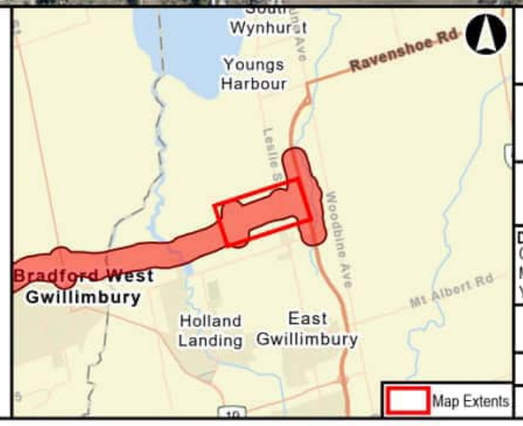
- Dirrection of Flow

General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
- Unevaluated Wetland
- Deer Wintering Areas - Stratum 2



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Fish and Fish Habitat Existing Conditions

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Figure: 2-11

Woodbine Ave
8
77
404
Holborn Rd
Queensville Sideroad
Maskinonge River Wetland Complex PSW
Wildlife Management Unit 78B
Maskinonge River
WC-33
WC-34
WC-32
WC-31
C26-A-1
C25-A-2
C28-A-1
C25-C-1
Separate MTO Study

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Thermal Regime
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- Warm
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Fish Habitat
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- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency
- Permanent
- Intermittent
- Ephemeral
- Dirrection of Flow

General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
- Provincially Significant Wetland (PSW)
- Unevaluated Wetland

Fish and Fish Habitat Existing Conditions Report - Preliminary Design and Class Environmental Assessment (EA) Study for Highway 400 – Highway 404 Link (Bradford Bypass)

Fish and Fish Habitat Existing Conditions

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Figure: 2-12

LEGEND

- Study Area (500 m)
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- Storm Water Pond

Thermal Regime
- Cool
- Warm
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Fish Habitat
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- Indirect
- Not Fish Habitat
- Invasive Phragmites

Flow Permanency
- Permanent
- Intermittent
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General Features
- Waterbody
- Watercourse

Environmentally Significant Areas
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- Unevaluated Wetland

Fish and Fish Habitat Existing Conditions Report - Preliminary Design and Class Environmental Assessment (EA) Study for Highway 400 – Highway 404 Link (Bradford Bypass)

Fish and Fish Habitat Existing Conditions

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Appendix D

MTO ESORA Guide – Table 8.1, Table 8.2 and Table 8.3

Table 8.1 Procedural BMPs for ESC on Highway Construction Sites

Name		Applicability							Comments
		Slopes	Watercourses	Drainage Channels	Pipes and Culverts	Large Flat Surface	Borrow / Stockpile	Adjacent Properties	
Site Management	Design and Implement ESC Plan	✓	✓	✓	✓	✓	✓	✓	It is essential to properly design and implement a site-specific ESCP to reduce erosion and ensure that sediment is not released from the construction site. This includes monitoring, maintenance and decommissioning, as discussed in Section 8.
	Minimize Exposed Soils	✓	✓	✓	✓	✓	✓		By minimizing the total disturbed soil area and the disturbed soil area at any time, the erosion potential is reduced and the quantity of sediment control measures is reduced. Stripping of new areas should be delayed as long as possible and restoration of constructed areas should be done as soon as possible. Grubbing of roots should also be delayed as long as possible based on work schedules - as root systems will help to stabilize soils even after surface vegetation has been cleared.
	Perimeter Control	✓	✓	✓	✓	✓	✓	✓	During clearing and grubbing, the minimized limits of construction activity should be clearly marked.
	Site Access Management	✓				✓		✓	The site should be accessible from a limited number of points. Frequently-used access roads should be paved or graveled to minimize the tracking of material off site. Vehicle washing on stabilized worksite entrances will minimize off-site sediment tracking.
	Stockpile Management						✓		Stockpiles should not be located near watercourses, adjacent developed areas or environmentally sensitive areas. Stockpiles should be protected against erosion by water and wind immediately after they are established. This can be done by seeding, hydroseeding or applying a synthetic cover.
	Dust Management	✓				✓	✓		Wind-blown dust from disturbed soil and surfaces can be minimized by: • Seeding or mulching areas that will not be traveled on; • Constructing wind breaks or screens; • Enforcing reduced vehicle speeds on unpaved roads; and • Using water or chemicals for dust control. Note that care must be taken to prevent mud tracking if this is done.
	Sensitive Area Signage	✓	✓	✓	✓	✓	✓	✓	Areas that are sensitive to disturbance and areas that must not be disturbed should be clearly signed to convey that message. Areas that represent a safety hazard, such as deep ponds, should be signed as such and barricaded if necessary.
Scheduling	Maximize Favorable Weather	✓	✓	✓	✓	✓	✓	✓	Erosion potential is reduced by working during relatively dry conditions. This includes consideration of the season of construction and may require a larger number of resources to complete the project in a shorter time.
	Operate During Fisheries Windows		✓	✓					It is not acceptable to release sediment to receiving waterbodies at any time. However, scheduling work in or near fish-bearing waterbodies during open fisheries windows is recommended to reduce potential effects on fish and fish habitat. Note that this will not necessarily reduce the risk of harmful alteration, disruption or destruction (HADD) of fish habitat.
	Optimize Construction Sequence	✓	✓	✓	✓	✓	✓	✓	The sequence of construction should be specified with consideration of site management and scheduling BMPs. The construction sequence should be compatible with plans for progressive reclamation, instream works, stockpile operation, etc.
	Install BMPs Early	✓	✓	✓	✓	✓	✓	✓	Erosion potential can be minimized by installing ESC BMPs as soon as practical and always before soil is exposed. Early installation may require site access or traffic control considerations.
	Restore Early	✓	✓	✓	✓	✓			Erosion potential can be minimized by restoring or reclaiming constructed areas as soon as possible by topsoiling and seeding. Temporary works (i.e. detention ponds, sediment controls) should be removed as soon as practical when they are no longer needed.

Table 8.2 Surface Water Management BMPs for ESC on Highway Construction Sites

Name	Applicability							Comments
	Slopes	Watercourses	Drainage Channels	Pipes and Culverts	Large Flat Surface	Borrow / Stockpile	Adjacent Properties	
Divert Clean Water Around the Site	✓	✓	✓	✓	✓	✓	✓	Clean water drainage from upstream areas should be diverted around the construction site wherever practical, to reduce the quantity of water that must be managed on site. This can be done using ditches, berms, pipes, hoses or temporary culverts as appropriate.
Keep Clean Water on the Site Clean	✓	✓	✓	✓	✓	✓		Clean water drainage from undisturbed areas within the construction site should be collected and allowed to discharge to receiving streams without being mixed with runoff from disturbed areas.
Use Existing Drainage		✓	✓	✓				Existing watercourses tend to be well-vegetated and have natural rates of erosion. Discharges from the construction site containing natural levels of sediment should be conveyed to existing, undisturbed watercourses. Care should be taken to ensure that peak flows in the existing watercourse should not be increased significantly (i.e., more than 30% increase in the 10-year flood event).
Integrate New Drainage into the Project Design		✓	✓	✓				If it is necessary to construct new ditches, pipes or culverts for on-site surface water management, integrating these with the project design will prevent future disturbance due to removal of temporary measures.
Keep Drainage Areas Small	✓	✓	✓	✓	✓	✓		Smaller drainage areas generally require less complex erosion control BMP arrangements and smaller drainage channels, so they are preferred if local topography permits. By discharging from a number of small discharge points rather than a few large ones, the size of sediment control measures is reduced and the magnitude of effects from a potential failure is reduced.
Design Drainage Channels Appropriately		✓	✓					Drainage channels should be designed with appropriate depths, slopes, cross-sections and linings (armored or vegetated). Natural channel design is recommended for watercourse diversions.
Manage Shallow Groundwater	✓					✓		Slopes, excavations and areas around retaining walls may be sensitive to piping failure or erosion due to high pore water pressures. These can be managed by temporary dewatering or by incorporating permanent drains to reduce pore water pressures. Aggregate or rock covers (refer to erosion control BMPs) can also be installed to protect the ground surface. Dewatering wells, if properly screened, may produce clean water and be suitable for direct discharge to receiving streams.

Table 8.3 Erosion Control BMPs for ESC on Highway Construction Sites

Name			Applicability							Comments	Temporary	Permanent	BMP
			Slopes	Watercourses	Drainage Channels	Pipes and Culverts	Large Flat Surface	Borrow / Stockpile	Adjacent Properties				
Exposed Surface Protection	**Vegetated**	Topsoiling	✓		✓		✓	✓	✓	Topsoil absorbs energy from rain splash and provides water storage and an essential medium to support vegetation. It must be applied with seed or sod and soil moisture must be managed. Topsoil should not be applied to slopes steeper than a target maximum of 3H:1V with an absolute maximum of 2.5H:1V to 2H:1V, depending on the region.		✓	1
		Seeding	✓		✓		✓	✓	✓	Applying seed during restoration allows control over vegetation that will develop. Seeded areas are susceptible to erosion until leaf and root masses are developed, so monitoring is needed. Contouring and reseeding will be required if erosion occurs.	✓	✓	2
		Mulching	✓		✓		✓	✓	✓	Mulching is effective at protecting exposed areas from rain splash erosion for short periods. It preserves soil moisture and protects germinating seeds to promote revegetation. Mulching on steep slopes may not be effective.	✓	✓	3
		Hydro-Seeding or Hydro-Mulching	✓		✓		✓	✓	✓	Seeding with mulch is an effective way of achieving higher germination rates and reducing erosion potential before substantial revegetation. Tackifier applied during hydro-seeding or hydro-mulching can provide immediate protection during germination and revegetation and is more effective on steep slopes.	✓	✓	4
		Sodding	✓		✓	✓	✓	✓	✓	Sod placement provides immediate cover protection, buffer strip and vegetated channel lining. It is more expensive and labor intensive than various methods of seeding.		✓	5
		Riparian Zone Preservation		✓						Watercourse erosion potential is significantly reduced by preserving natural vegetation, to reduce runoff velocity and enhance infiltration.		✓	6
	Non-Vegetated	Riprap/ Riverstone Armouring	✓	✓	✓	✓				Riprap and riverstone provide a flexible channel lining for protection against flowing water and can be used to construct drop structures and energy dissipation structures. Rock structure construction is relatively expensive and labor-intensive.		✓	7
		Gabions	✓	✓	✓	✓				Gabions provide a flexible channel lining for protection against flowing water and can be used to construct drop structures and energy dissipation structures.		✓	8
		Aggregate Cover	✓	✓	✓	✓				Gravel and rock blankets can stabilize soil surfaces including areas with seepage piping erosion. Rock revetments are increasingly used to restore slumping areas in high precipitation regions. Aggregate and rock covers should be designed by a qualified engineer.		✓	9

Name			Applicability							Comments	Temporary	Permanent	BMP
			Slopes	Watercourses	Drainage Channels	Pipes and Culverts	Large Flat Surface	Borrow / Stockpile	Adjacent Properties				
		Stabilized Worksite Entrances							✓	Gravel pads located at site entrances can reduce the amount of sediment carried off construction sites by vehicles, by collecting sediment from vehicle washing. They should include a water supply to wash off excess soil from vehicles prior to leaving the site	✓		10
		Rolled Erosion Control Products	✓		✓			✓		Rolled Erosion Control Products (RECP) provide a high degree of uniform and long-lasting erosion protection. Care should be taken to ensure that the product is suitable for the intended application and that it is applied in accord with the manufacturer's specifications. Permeable RECP's are used in conjunction with vegetation. Impermeable RECP's may be used for protection of stockpiles and if used as such, it may be necessary to protect areas where runoff is concentrated.	✓	✓	11
		Plastic sheeting	✓							Plastic sheeting can be used on sloped to provide immediate protection against erosion. It is relatively easy and inexpensive to install.	✓		12
		Cellular Confinement System	✓	✓	✓			✓		Cellular confinement systems are lightweight and use locally available soils or grout for fill. They may be used on slopes as steep as 1H:1V. They are relatively expensive and labor-intensive to install.		✓	13
		Chemical Stabilization	✓		✓			✓		Chemical treatments can be applied to increase soil cohesion. It may be applied in conjunction with hydro-treatments. Chemical treatments may be expensive and must be designed for site-specific conditions.	✓		14
Runoff Control		Slope Texturing / Grading	✓				✓	✓	✓	Slopes or flat surfaces may be textured using tracked equipment or a sheepsfoot packer. A rough slope retains more water, sediment and seed. This method is most suitable for application to clayey soils. Where possible, slopes can be graded and shaped to divert flows away from sensitive areas. Flatter slopes have less erosion potential. Where steep slopes are unavoidable, interceptor ditches can be effective in reducing effective slope lengths.	✓	✓	15
		Slope Drains	✓			✓				Slope drains convey surface water downslope through a pipe rather than over erodible soils. Pipes must be sized appropriately, anchored to the slope and provided with inlet and outlet erosion protection.	✓	✓	18
		Groundwater Control	✓							Subsurface drains can be used to lower the groundwater table, minimize piping erosion and enhance slope stability. They should be designed by a qualified professional.		✓	19

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Appendix E

Mitigation, Protection and Monitoring Table

I.D. #	Issues/Concerns Potential Effects	Concerned Agencies	Mitigation/Protection/Monitoring
	General Environmental Protection		–
1	**Erosion and Sediment Control** *Potential sedimentation and erosion associated with disturbance of embankments, ditch lines, watercourse banks at access roads and laydown area/construction staging)*	MTO/MECP/ DFO	– OPSS 805: Temporary Erosion and Sediment Control Measures o In-water and near-water work should be monitored to ensure mitigation measures are properly implemented, functioning, maintained and repaired as needed, and removed following construction. o Dewatering operations should be managed to prevent erosion or the release of sediment-laden water to a waterbody. o An Erosion and Sediment Control Plan should be designed and implemented to contain/isolate exposed soils, stockpiled materials and unstable areas in the work zone, prevent the release of sediment to a waterbody and ensure the work site is stabilized prior to removal following construction. o Sediment fencing should be installed along the Construction Disturbance Area to prevent contamination of watercourses, waterbodies and wetlands; o Fencing should already be installed around potentially suitable Blanding's Turtle habitat, which should protect it from degradation by sediment deposition or other contaminants; and ▪ On-site staff shall receive training on SAR potentially present within the CDA and understand the reporting requirements should a SAR be observed; and ▪ Any SAR observations should be reported to MNRF and MTO and protection must be implemented immediately to ensure compliance with the ESA. Should a SAR be observed within the work area, works in the immediate vicinity should be stopped and an on-site qualified biologist shall be contacted to confirm the species identification and, if necessary, relocate the individual to suitable habitat outside of the CDA. o Disturbed areas of terrestrial Crayfish and Monarch SWH due to construction activities should be restored to suitable Cultural Meadow habitat. It is recommended that the proponent use the St. Williams Pollinator Garden Seed Mix (SWNEC, 2018). – MTO NSSP: Erosion and Sediment Control
2	**Fish and Fish Habitat** *Potential Impacts to fish and fish habitat as a result of structural culvert rehabilitation*	MNRF/DFO	– OPSS 182: Environmental Protection During Work in Watercourses and on Watercourse Banks; o Environmental protection during work in watercourses and on watercourse banks in accordance with OPSS 182 o Limit access to waterbodies and banks to protect riparian vegetation and to minimize bank disturbance;. o Materials used or generated during construction (i.e. organics, soil, woody debris, temporary stockpiles, construction debris, etc.) must be stored and managed in a way that prevents the release of these materials to a waterbody. This may include storing materials a safe distance from a waterbody and/or isolation measures; o Operate, store and maintain equipment and associated materials in a manner and at a distance that prevents the entry of any deleterious substance from entering a waterbody. Any part of equipment entering the waterbody or operating from the bank must be cleaned, free of fluid leaks and in good working condition; and. Limit riparian vegetation removal and use proper clearing techniques. Herbicides should not be used; o Re-stabilize any portion of the bed of a waterbody disturbed during construction to pre-construction conditions (or better). This could include morphological elements and substrate; o Re-stabilize the banks of a waterbody that have been disturbed during construction to pre-construction conditions or better. This could include riparian vegetation or stone material, temporary measures and the avoidance of hard engineering; and o Re-stabilize and re-vegetate soils exposed or disturbed during construction, including new or cleaned-out ditches. – Operational Constraint (Environmental)- Spill Prevention and Response Contingency Plan o Prepare a Spills Management Plan including materials, instructions, education and emergency numbers. Have the plan kept on-site at all times, communicated to work crews and have the plan properly implemented in the event of accidental spills; – OPSS 803 o The application of fertilizer should be avoided within 30 m of a watercourse. When the use of fertilizer is necessary, it shall be in a form and

I.D. #	Issues/Concerns Potential Effects	Concerned Agencies	Mitigation/Protection/Monitoring
			analysis ratio as specified in OPSS 803 and shall be applied as per OPSS 803. o – SSP101F23: o In-water work below the HWM and work on watercourse banks shall be carried out between July 2nd and February 28th; or conversely restricted (i.e., not allowed) March 1st to July 1st of any given year; o Design and implement an in-water work area isolation plan to maintain clean flow around the work area. The design should: ▪ Use only clean materials free of particulate matter for temporary coffer dams; ▪ Manage flow withdrawal and discharge to prevent erosion and the release of sediment to a waterbody; and ▪ Ensure work zones are stabilized against high flows at the end of each work day. o Design and implement a work area containment plan to isolate all above-water work to prevent the release of sediment or other contaminants to a waterbody. The design should include regular inspection, repair, removal and disposal of isolation measures and materials. o Limit riparian vegetation removal and use proper clearing techniques. Herbicides should not be used. – OPSS 100: MTO General Terms of Contract – OPSS 180: Management of Excess Materials; – OPSS 517: Construction Specifications for Dewatering – MTO NSSP: General Environmental Protection; – MTO NSSP: Maintenance of Existing Drainage; – MTO NSSP: Equipment Refueling, Maintenance and Washing. – See also the mitigation proposed in Item #1.
4	**Vegetation Impacts** *Potential impacts to vegetation and vegetation communities*	MTO/MNRF	– SP 199S56: Control of Emissions During Structural Work; o Vehicles should not idle unnecessarily during construction activities. – OC_EN_06: Operation Constraint – Control Measures during Removal of Concrete, Concrete, Repair / Construction, and Concrete Sawcutting; – OC_EN- Cleaning of Equipment and Invasive Species Prevention; o All machinery, construction equipment and vehicles should be washed prior to entering the construction site, as well as when leaving the construction site, in order to prevent the spread of invasive species into vegetation communities within the Study Area, or to natural areas outside of the Study Area. – OPSS-201: Construction Specification for Clearing, Close Cut Clearing, Grubbing and Removal of Surface and Piled Boulders; o Vegetation removal, grading and soil compaction should be kept to a minimum. – OPSS-804: Construction Specification for the Seed and Cover; and o Disturbed areas shall be restored to the extent possible; the restoration of the disturbed areas will be required in accordance with OPSS-804: Construction Specification for the Seed and Cover. – OPSS-180: General Specification for the Management of Excess Materials. o Construction material should be stored within an authorized location and any soil stockpiles should be located within a suitable sediment fenced and protected location only. – See also the mitigation proposed in Item #1.
5	**Wildlife and Wildlife Habitat Impacts** *Potential impacts to wildlife (including migratory birds nesting in the area of work) by construction activities*	MTO/MNRF	– NSSP: Operational Constraint- Migratory Bird Protection. o Vegetation removal must be scheduled to occur outside of the breeding bird window of April 1 to August 31 to avoid disturbance to breeding birds and destroying active nests, including any bird SAR. If vegetation removal must occur within this time period, active nest searches may be conducted prior to vegetation removal by a qualified biologist within 'simple habitats' to ensure that no active nests of breeding birds or bird SAR are destroyed, in order to prevent any contravention of the MBCA and/or the ESA.
6	**SAR and Significant Wildlife Habitat Impacts** *Potential disturbance to SAR , SOCC and Significant Wildlife Habitat*	MTO/MNRF/MECP	– OC_EN_07: Protection of Species at Risk; o While Barn Swallow nests were confirmed absent during the 2018 field season, should construction commence on or after April 1, 2019 (i.e., commencement of the breeding bird window) structure surveys must be repeated prior to any construction activities in, on or above structures in order to prevent a potential contravention of the ESA; o All vegetation removal within potently suitable bat SAR habitat shall occur outside of the bat maternity roosting window (March 31 – October 1) and can only proceed upon confirmation from MNRF;

I.D. #	Issues/Concerns Potential Effects	Concerned Agencies	Mitigation/Protection/Monitoring
			○ During the maternity roosting season for bats, March 31 to October 1 of any calendar year, any construction activities within 30 m of known cavity trees or identified structures will be restricted to daylight hours when possible. While bats could be affected by construction activities (noise, vibration, lighting etc.) occurring equally during the day and night, nightly construction activities would interfere with bats while they are actively foraging and moving around the area creating additional disturbances that can essentially be controlled. Therefore, limiting construction activities to a specific period during daylight hours reduces the timing and duration of disturbance in these areas to resident bats and other wildlife; and ○ If clearing of vegetation must occur during the May 1 to September 1 timing window, then bat exit surveys must be performed 30 minutes before dusk until 60 minutes after dusk, a maximum of 24 hours prior to the removal of candidate maternity roost trees in accordance with the *Technical Note Species at Risk (SAR) Bats* (MNRF, 2015a). – See also the mitigation proposed in Item #1.
7	**Land Use** *Potential impacts to Land Use associated with the detour route.*	MTO/MECP	See Mitigation Measures in I.D # 10 and # 11 for *Potential for nuisance due to construction noise disturbance.*
8	**Land Use** *Potential for traffic staging to impact municipal and emergency responders and school bus service providers*	Municipal Offices, Police, Fire Departments, Ambulance Services, School Bus Service Providers	– NSSP: Operational Constraint -Emergency Service Notification. ○ Identify municipal, Emergency Response agencies and school bus providers to be notified prior to construction and prior to lane closures and reopening.
9	**Designated Substances** *Potential for presence of, and contractor interaction with, designated substances / hazardous materials during construction*	MTO/MECP	– SSP 101 F21 'Occupational Health and Safety Compliance - List of Designated Substances'. ○ The contractor is to be notified, in accordance with the Occupational Health and Safety Act, of the presence of designated substances.
10	**Construction Noise Impacts** *Potential for nuisance due to construction noise disturbance*	MTO/MECP/ Municipality	– Special Provision No 199F33; and ○ Identify the extent of noise sensitive areas; ○ Stipulate constraints on construction noise with respect to Town of Fort Erie noise control By-laws, equipment sound emission standards, equipment maintenance, and equipment operation, as follows: Operation of construction equipment from 9:00pm – 7:00am the next day is not permitted unless an exemption has been granted through a municipal noise control bylaw exemption, as specified elsewhere in the Contract; Equipment shall comply with the sound emission standards for construction equipment outlined in Ministry of Environment, Conservation and Parks (MECP) publications NPC-115 and NPC-118 (contractor to confirm latest version by contacting MECP[1]), which are the following: Where feasible, equipment with broadband backup alarms instead of the tonal backup alarms/beepers shall be utilized; Equipment shall be maintained in an operating condition that prevents unnecessary noise, including but not limited to non-defective muffler systems, properly secured components, and the lubrication of moving parts; Idling of equipment shall be restricted to the minimum necessary to perform the specified work; and Stationary equipment shall be located as far away from sensitive locations as feasible. – Special Provision No. 199F31, Environmental Exemptions and Permits. ○ Identifies the municipal noise control bylaw for which an exemption has been granted; and ○ Provides the details of exemption from night time construction noise / operation of equipment and the hours and days of the week for which that exemption applies.
11	**Air Quality Impacts**	MTO/MECP	– OPSS 100: General Conditions of Contract; and ○ Contract to include requirement to control dust so that it does not affect traffic, enter surface waters. or escape beyond the right-of-way to cause a nuisance to residents, business or utilities; and

[1] Available from the Ontario Ministry of Environment, Conservation and Parks – Client Services and Information Branch or Environmental Assessment and Permissions Branch
Phone: 416-314-8001 or 1-800-461-6290

I.D. #	Issues/Concerns Potential Effects	Concerned Agencies	Mitigation/Protection/Monitoring
	Potential for nuisance due to the release of dust and other emissions into the local environment and atmosphere		○ Contract to include requirements for containment, notification and cleanup of dust. – NSSP: Operational Constraint (Environmental) – General Environmental Protection. ○ Requirement that environmental protection comply with the conditions of approvals and permits exemptions, agreements, reports and clearances provided by the owner or obtained by the contractor; and ○ Requirement to control material, equipment and construction operations to avoid and minimize direct physical damage; sediment, noise, vibration, dust, chemical, and other emissions; and interference with local use, access and passage.
12	*Potential impacts to environment due to water taking*	MTO/MECP	–

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