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Memo

To:	Diana Addley, Environmental Planner Stantec Consulting Ltd. 150-1555 Wentworth Street Whitby, ON L1N 9T6	From:	Claire Phelps, Water Resources EIT Stantec Consulting Ltd. 100-300 Hagey Boulevard Waterloo, ON N2L 0A4
File:	165001090	Date:	October 13, 2020

Reference: **Highway 401 Planning Study, from Cobourg to Colborne and Nagle Road Interchange Study, Erosion and Sediment Overview Risk Assessment, GWP 4060-11-00 and GWP 4059-17-00**

BACKGROUND AND APPROACH

The Ontario Ministry of Transportation (MTO) has retained Stantec Consulting Ltd. to undertake a Planning, Preliminary Design and Class Environmental Assessment (Class EA) Study on Highway 401 for the replacement and rehabilitation of structures, interchange modifications, establishing future footprints of the highway, and commuter parking lot expansions, from 2.0 km east of Nagle Road to 0.8 km east of Percy Street (GWP 4ooo060-11-00).

The Ontario Ministry of Transportation (MTO) and the Town of Cobourg have also retained Stantec Consulting Ltd. to undertake a Planning, Preliminary Design, and Class Environmental Assessment (Class EA) Study on Highway 401 for a new interchange near Nagle Road in the Town of Cobourg and the Township of Hamilton (GWP 4059-17-00). The purpose of the study is to identify a Recommended Plan that addresses future transportation and planning needs in the study area. The interchange study is the Town of Cobourg's initiative and is being completed concurrently with the MTO's Highway 401 Planning Study from Cobourg to Colborne.

Under existing conditions, Highway 401 is classified as a freeway within the study limits. A typical cross-section of Highway 401 in the study area consists of two paved lanes and a paved shoulder in each direction separated by a paved median. Within the study area, Highway 401 is a four-lane divided freeway with a posted speed of 100 km/h. The western 1.7 km has a grassed median while the remaining eastern portion has a concrete barrier.

This memo presents the Erosion and Sediment Overview Risk Assessment for the proposed design work associated with both study areas. The objective of this assessment is to evaluate the probability of erosion and sediment migration off-site during construction and associated risks.

Previous studies and technical guidance documents related to this project have been reviewed and referenced during the preparation of this report, including:

- *MTO Erosion and Sediment Control Guide.* Ministry of Transportation, 2015.
- *MTO Environmental Reference for Highway Design.* Ministry of Transportation, 2013.
- *Fish and Fish Habitat Existing Conditions Report* – Highway 401 Planning Study from Coburg to Colborne (GWP 4060-11-00) and Highway 401 Nagle Road Interchange Study (GWP 4059-17-00). Stantec Consulting Ltd., 2018.

Reference: **Highway 401 Planning Study, from Cobourg to Colborne and Nagle Road Interchange Study, Erosion and Sediment Overview Risk Assessment, GWP 4060-11-00 and GWP 4059-17-00**

- *Terrestrial Ecosystems Existing Conditions Report – Highway 401 Expansion from Cobourg to Colborne*. Stantec, 2018.
- *Groundwater Overview Assessment Memo, Highway 401 Planning Study from Cobourg to Colborne, Ministry of Transportation (GWP 4060*-11-00). Stantec, 2019.

The approach to completing the risk assessment for this development is summarized in the following tasks:

- An overview of the risk of the study area;
- An overview of the expected construction activities; and
- An assessment of erosion and sediment risk based on construction activities and environmental features.

SITE DESCRIPTION

The study limits for the MTO project, GWP 4060-11-00, includes the eastbound and westbound lanes from 2 km east of Nagle Road to 0.8 km east of Percy Street, a distance of approximately 18 km. The study area passes through the following municipalities within Northumberland County: Town of Cobourg, Township of Cramahe, Hamilton Township and Alnwick/Haldimand Township.

The study limit for the Town of Cobourg's initiated project, GWP 4059-17-00, is the Nagle Road and Highway 401 interchange, immediately west of the GWP 4060-11-00 limit. This study area is within the Town of Cobourg and the Township of Hamilton.

A key plan of the study areas, both of which were considered in this Erosion and Sediment Overview Risk Assessment, are shown on Figure 1.

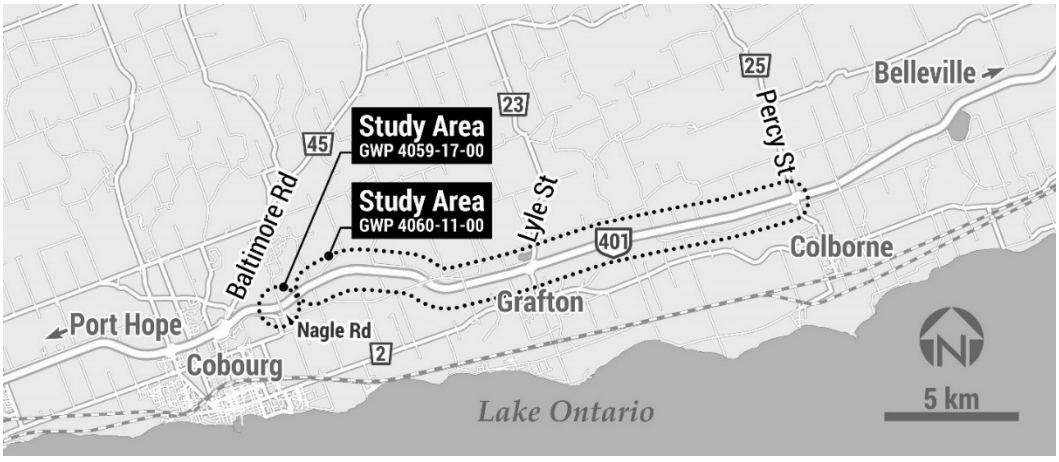

Figure 1: Study Area

PROPOSED PROJECT ACTIVITIES

The proposed project activities include establishing the HWY 401 future footprints within the study limits for a six-lane cross-section with interchange improvements/modifications to accommodate an ultimate eight-lane highway. At this stage of the Preliminary Design and Environmental Assessment it is expected that the project will involve the following existing structure and interchange modifications to the study area:

Reference: **Highway 401 Planning Study, from Cobourg to Colborne and Nagle Road Interchange Study, Erosion and Sediment Overview Risk Assessment, GWP 4060-11-00 and GWP 4059-17-00**

- Shelter Valley Road and Creek (Site 21-272/C) – construct one new bridge over roadway and creek.
- Vernonville Road (Site 21-274) – construct new bridge on existing horizontal alignment.
- Boyce Road (Site 21-275) – construct new bridge on existing horizontal alignment.
- Percy Street (Site 21-276) – construct new bridge on east side of the existing bridge, and construct new ramps to the Highway 401.
- Danforth Road (Site 21-268) – construct new bridge on existing horizontal alignment.
- Gully Road (Site 21-269) – construct new bridge on existing horizontal alignment.
- Lyle Street (Site 21-271) – construct new bridge on the east side of the existing bridge, and construct new ramps to the Highway 401.

In addition, a total of 33 centerline/mainline/and crossing culverts are within the GWP 4060-11-00 study area. Replacement and/or rehabilitation recommendations will be made for specific culverts based on condition state and hydraulic capacity.

GWP 4059-17-00 includes a new interchange at or near the existing Nagle Road and Highway 401 bridge.

The specific construction activities associated with these modifications will include stripping, site grading, placement of granular material, paving works, pile-driving, groundwater dewatering, stormwater sewer/pond construction, bridge demolition and retaining wall construction and potential realignment of existing channels. This construction work will involve staging and will require temporary storage areas and construction yards.

EXISTING ENVIRONMENTAL CONDITIONS

TOPOGRAPHY AND SURFACE WATER FEATURES

Various watercourses cross Highway 401 through centerline culverts and drain south to Lake Ontario. These watercourses generally drain at a slope of less than 2%. The surrounding area is generally rural with agricultural and wetland/forested areas. The generally topography is rollings hills to hilly with grades in the vicinity of the project area consistently less than 5%.

The Nagle Road interchange, Lyle Street underpass and Shelter Valley overpass are areas identified with steeper grades in existing conditions. Upon review of the available topographic information from the Ontario Ministry of Natural Resources and Forestry, the grades in the vicinity of these locations are 2 %, 2.5% and 11% respectively.

SOILS AND HYDROGEOLOGY

Soil data was confirmed using data from the Ontario Geological Survey 2010 and OMAFRA mapping. It was confirmed that the soil is predominantly coarse-textured glaciolacustrine deposits with areas of silty to sandy loam.

A previous study to the immediate west to the project area had sandy soils that exhibited movement during construction activities, especially on embankment slopes. As this current project is in the same geographic vicinity, it is anticipated that erodible soils be similarly exhibited on site during construction activities.

Reference: **Highway 401 Planning Study, from Cobourg to Colborne and Nagle Road Interchange Study, Erosion and Sediment Overview Risk Assessment, GWP 4060-11-00 and GWP 4059-17-00**

ENVIRONMENTALLY SENSITIVE FEATURES

The Groundwater Overview Assessment Memo identified existing sensitive groundwater and surface water features within the proximity of study area (Stantec, 2019). It was confirmed that shallow (<12 m BGS) and deep (>12 m BGS) water supply wells exist within the study areas. More specifically, the study area intersects a portion of the WHPA-B/C of the Colborne municipal production wells, meaning the anticipated construction works potentially pose a drinking water risk.

It was confirmed that the Cranberry Lake Provincially Significant Wetland is located within the study area. Other unevaluated wetland areas and streams are located downstream of the study area, and are anticipated to have coldwater thermal regimes. Portions of the study area are classified as a Highly Sensitive Aquifer and Significant Groundwater Recharge Area. As it is anticipated that the proposed construction activities will require groundwater dewatering based on the existing groundwater elevations, there is a potential for the existing hydrologic regime to be negatively impacted by the anticipated construction activities.

As part of the completed Terrestrial Ecosystems Existing Conditions Report (Stantec, 2018), it was confirmed that no observed vegetative communities are provincially at risk or of conservation concern, and no Species At Risk are confirmed within the study area. An Impact Assessment Report will be completed during preliminary design to provide more detailed recommendations based on the Recommended Plan for required mitigation measures for significant natural features.

As part of the completed Fish and Fish Habitat Existing Conditions Report (Stantec, 2018), seventeen watercourses were identified within the study limits and sixteen were identified as providing fish habitat. The majority of the watercourse crossings investigated within the Study Areas are natural, coldwater watercourses that drain to Lake Ontario and provide fish habitat. One species at risk, American Eel was recorded in Shelter Valley Creek, and therefore the construction work of this Overpass will require consideration of the American Eel and their habitat. The flow regimes present were assessed against the DFO Drain Classification, and it was confirmed that eight of the watercourses present are Type D Drains (permanent coldwater, sensitive species present) and one is a Type E Drain (permanent warmwater, sensitive species present). Coldwater thermal regimes are considered sensitive environmental features due to fish habitat provided.

EROSION AND SEDIMENT OVERVIEW RISK ASSESSMENT

An Erosion and Sediment Overview Risk Assessment was performed for the study area to determine which Erosion and Sediment Control (ESC) approach is best suited for the anticipated construction works. To complete the assessment, the study areas were divided into the evaluation areas using surficial geology data. These areas were each assigned a Soil Erodibility Rating based on soil type, and an Erosion Potential Rating considering soil type as well as the proposed slope gradient and proposed slope length.

The site soils are generally sandy loams and have a low to medium erosion potential. Generally, sand soils were assigned a low soil erodibility rating, sandy loam was assigned a medium soil erodibility rating and silt loams were assigned a high soil erodibility rating, as per the MTO Erosion and Sediment Control Guide (2015).

Also based on the MTO Erosion and Sediment Control Guide, the Erosion Potential Rating was assigned considering the proposed polygon gradient and slope length. The gradient discretization considered was less than 10%, between 10% and 20% and greater than 20%. The slope length discretization considered was less than or greater than 70 m (Table 5.2, Environmental Guide for Erosion and Sediment Control During Construction of Highway Projects MTO, 2015). The slope gradient across the study area was consistently

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less than 5 %, with the greatest slope gradient of 11 % found in the vicinity of Shelter Valley Road. The slope lengths across each evaluated area typically ranged from 100 m to 120 m in areas intersecting the Highway 401 cross-section (this is longer than the 70 m slope length threshold). Three areas intersected interchanges (at Nagle Road, County Road 23 and Country Road 25), and had a longer slope length, ranging from approximately 800 to 1200 m. Three evaluated areas intersected small portions of the project and therefore had an associated slope length less than the 70 m threshold.

The risk factor for the receiving Environment Consequence rating was assigned based on the sensitivity of the nearby environmental features to construction activity. The sensitive environmental features within the project area include downstream wetlands, water supply wells, and coldwater thermal regime watercourses, all of which result in a high environmental consequence rating.

The three ratings (Soil Erodibility, Erosion Potential and Environment Consequence) were all considered to assign the cumulative Erosion and Sediment Risk rating to each evaluated area. Figure 2 (attached) illustrates the evaluated areas and the associated Soil Erodibility Ratings. Results of the completed evaluation, including rational for the assigned Erosion Potenial Rating, Environmental Risk Rating and cumulative Erosion Sediment Risk rating are shown in Table 1 below.

Table 1: Erosion and Sediment Overview Risk Assessment Summary

Polygon No.	Soil Type	Soil Erodibility Rating	Slope Gradient (%)	Slope Length (m)	Erosion Potential	Rationale for Erosion Potential	Enviro Consequence Rating	Rationale for Consequence Rating (Receiving Environment Sensitivity)	ES Risk
1	Sandy Loam	M	<10	>70	M	Relatively flat with long slope lengths, medium soil erodibility	H	Wetland located downstream; 2 deep water supply wells located within polygon;2 cold thermal regime watercourse crossings	H
2	Sand	L	<10	>70	L	Relatively flat with long slope lengths, low soil erodibility	H	Wetland located downstream	M
3	Sandy Loam	M	<10	>70	M	Relatively flat with long slope lengths; medium soil erodibility	H	Wetland located downstream; 2 deep water wells a located within polygon; 1 cold thermal regime watercourse crossing	H
4	Silt Loam	H	<10	>70	H	Relatively flat with long slope lengths; high soil erodibility	H	Wetland located downstream	H

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5	Sandy Loam	M	<10	>70	M	Relatively flat with long slope lengths; medium soil erodibility	H	Wetland located downstream; 1 deep water supply well located within polygon; 1 cold thermal regime watercourse crossing	H
6	Sand	L	<10	>70	L	Relatively flat with long slope lengths; low soil erodibility	H	Wetland located downstream;	M
7	Sandy Loam	M	<10	<70	M	Relatively flat with short slope lengths; medium soil erodibility	H	Wetland located downstream	H
8	Muck	H	<10	>70	H	Relatively flat with long slope lengths; high soil erodibility	H	Wetland located downstream;	H
9	Sand	L	<10	>70	L	Relatively flat with long slope lengths; low soil erodibility	H	Wetland located downstream; 1 coldwater thermal regime watecourse	M
10	Sandy Loam	M	<10	>70	M	Relatively flat with long slope lengths; medium soil erodibility	H	Wetland located downstream; 2 deep water wells located within polygon; 1 coldwater thermal regime watercourse crossing	H
11	Sandy Loam	M	<10	<70	M	Relatively flat with long slope lengths; medium soil erodibility	L	No sensitive environmental features in vicinity of polygon	M

Reference: **Highway 401 Planning Study, from Cobourg to Colborne and Nagle Road Interchange Study, Erosion and Sediment Overview Risk Assessment, GWP 4060-11-00 and GWP 4059-17-00**

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12	Sandy Loam	M	<10	<70	M	Relatively flat slopes with high slope length; medium soil erodibility	L	No sensitive environmental features in vicinity of polygon	M
13	Sand	L	<10	>70	L	Relatively flat slopes with low slope length; low soil erodibility	L	No sensitive environmental features in vicinity of polygon	L
14	Sandy Loam	M	<10	>70	M	Relatively flat with long slope lengths; medium soil erodibility	H	Wetland located downstream; 6 deep water supply well located within polygon; PSW located upstream of polygons	H
15	Sand	L	<10	>70	L	Relatively flat with long slope lengths; low soil erodibility	L	No sensitive environmental features in vicinity of polygon	L
16	Sandy Loam	M	>10 (11%)	>70	H	Relatively flat with long slope lengths; medium soil erodibility	H	Wetland located downstream; 1 deep water well in vicinity of polygon; 1 coldwater thermal regime watercourse crossing	H
17	Sand	L	<10	>70	L	Relatively flat with long slope lengths; low soil erodibility	H	Wetland located downstream	M
18	Sandy Loam	M	<10	>70	M	Relatively flat with long slope lengths; medium soil erodibility	H	Wetland located downstream; 3 coldwater thermal regime watercourse crossing	H

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19	Gravelly Sand	L	<10	>70	L	Relatively flat with long slope lengths; low soil erodibility	H	Wetland located downstream; 3 coldwater thermal regime watercourse crossing	M
20	Sandy Loam	M	<10	>70	M	Relatively flat with long slope lengths; medium soil erodibility	L	No sensitive environmental features in vicinity of polygon	L
21	Gravelly Sand	L	<10 (10%)	>70	M	Relatively flat with long slope lengths; low soil erodibility	H	No sensitive environmental features in vicinity of polygon; 1 coldwater regime watercourse crossing	M
22	Sandy Loam	M	<10	>70	M	Relatively flat with long slope lengths; medium soil erodibility	H	Wetland located downstream	H
23	Organic Matter	H	<10	>70	H	Relatively flat with long slope lengths; high soil erodibility	H	Wetland located downstream	H

As described in the previous section, the site soils are generally sandy loams and have a high erosion potential. The study area environmental features include water supply wells, downstream wetlands, and cold-water regimes, which are all anticipated to be impacted by the construction activities (specifically the activity of groundwater dewatering), and therefore have a medium-high environmental consequence risk. An exception to this trend were three evaluated areas that exhibited low soil erodibility (sand/gravel soil type), and low environmental consequences (limited sensitive features in vicinity) and an overall low erosion and sediment risk rating.

It is further expected that erosion potential exists as part of the project due to the anticipated grading work associated with the interchange modifications and overall highway widening. As a conservative best management practice, it is recommended that the erosion and sediment control measures consider the study area to have a moderate-high erosion and sediment risk.

Reference: **Highway 401 Planning Study, from Cobourg to Colborne and Nagle Road Interchange Study, Erosion and Sediment Overview Risk Assessment, GWP 4060-11-00 and GWP 4059-17-00**

EROSION AND SEDIMENT CONTROL RECOMMENDATION

Based on the preceding assessment, it is recommended that Approach 3: Two Part ESCP – Main and Supplemental be implemented for the sites during detailed design, in accordance with MTO Guidelines. This approach will provide the contractor with the ability to adapt the Erosion and Sediment Control Plan without having to go through the change control process for the supplemental plan, should the site conditions found during construction differ than conditions assumed during design, as part of a Best Management Practice.

The following ESC procedures will be considered for the ESCP:

- Procedural Best Management Practices (BMPs).
- Various ESC measures and structural BMPs.
- Divert runoff around site.
- Staged construction and progressive rehabilitation.
- More intensive sediment control BMPs.
- Construction monitoring and maintenance requirements of the ESC measures.
- Ensure construction activities in the proximity of a watercourse follow the allowable in-water work period.
- A Technical Memo to record information and provide guidance for recommended ESC measures, including installation requirements.

CONCLUSION

The majority of evaluated areas had an overall medium-high erosion and sediment risk rating based on medium erodibility soils and environmental sensitive features. An erosion and sediment control plan will be developed for all construction zones during detailed design to mitigate the erosion and sediment risk and minimize impacts downstream.

We trust this memo meets your requirements at this time. Should you have questions regarding this Erosion and Sediment Overview Risk Assessment please contact the undersigned.

STANTEC CONSULTING LTD.

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Green Infrastructure Sector Leader
Phone: 519-575-4123
Jennifer.Young@stantec.com

Attachment: Figure 2 – Erosion Risk and Sediment Overview Assessment Figure

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Legend

- Study Area
- Watercourse
- Wetland, Not evaluated per OWES
- Erodibility - Medium

0 200 400 Meters

1:10,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
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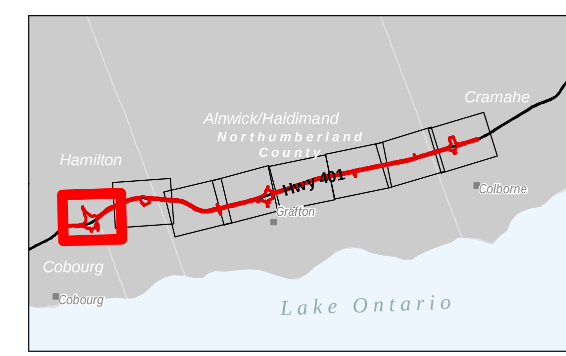

Project Location
County of Northumberland

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Client/Project
ONTARIO MINISTRY OF TRANSPORTATION
HIGHWAY 401 PLANNING STUDY (GWP 4060-11-00) AND NAGLE INTERCHANGE STUDY (GWP 4059-17-00)

Figure No.
2 - 1

Title
Erosion and Sediment Overview Risk Assessment

Stantec

Legend
- Study Area
- Watercourse
- Wetland, Not evaluated per OWES
- Erodibility - High
- Erodibility - Medium
- Erodibility - Low

0 200 400 Meters

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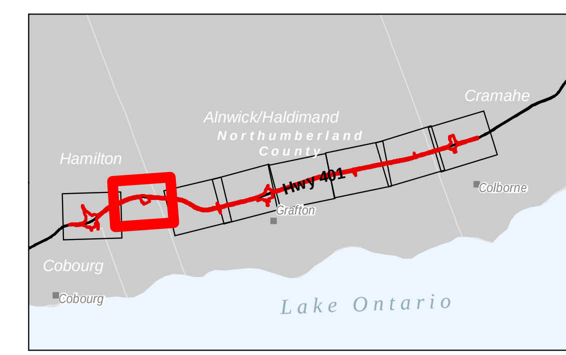

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Figure No.
2 - 2

Title
Erosion and Sediment Overview Risk Assessment

Stantec

Legend

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- Erodibility - High
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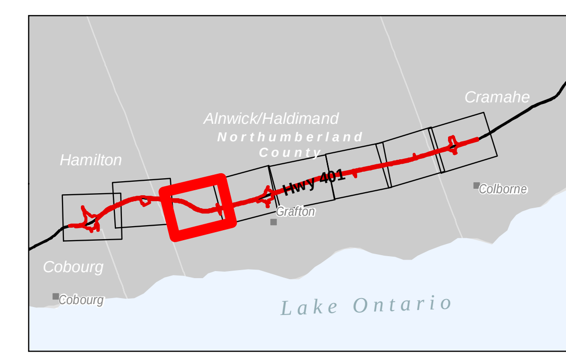

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Figure No.
2 - 3

Title
Erosion and Sediment Overview Risk Assessment

Stantec

Legend
- Study Area
- Watercourse
- Wetland, Provincially Significant
- Wetland, Not evaluated per OWES
- Erodibility - Medium
- Erodibility - Low

0 200 400 Meters

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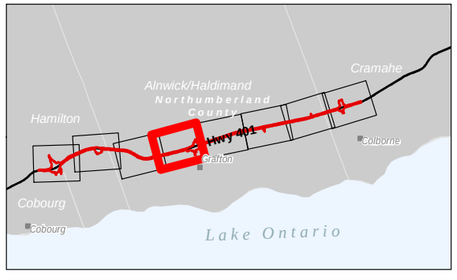

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HIGHWAY 401 PLANNING STUDY (GWP 4060-11-00) AND NAGLE INTERCHANGE STUDY (GWP 4059-17-00)

Figure No.
2 - 4

Title
Erosion and Sediment Overview Risk Assessment

Stantec

Legend

- Study Area
- Watercourse
- Wetland, Not evaluated per OWES
- Erodibility - Medium
- Erodibility - Low

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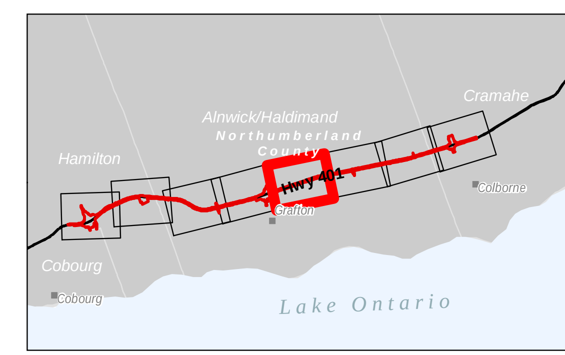

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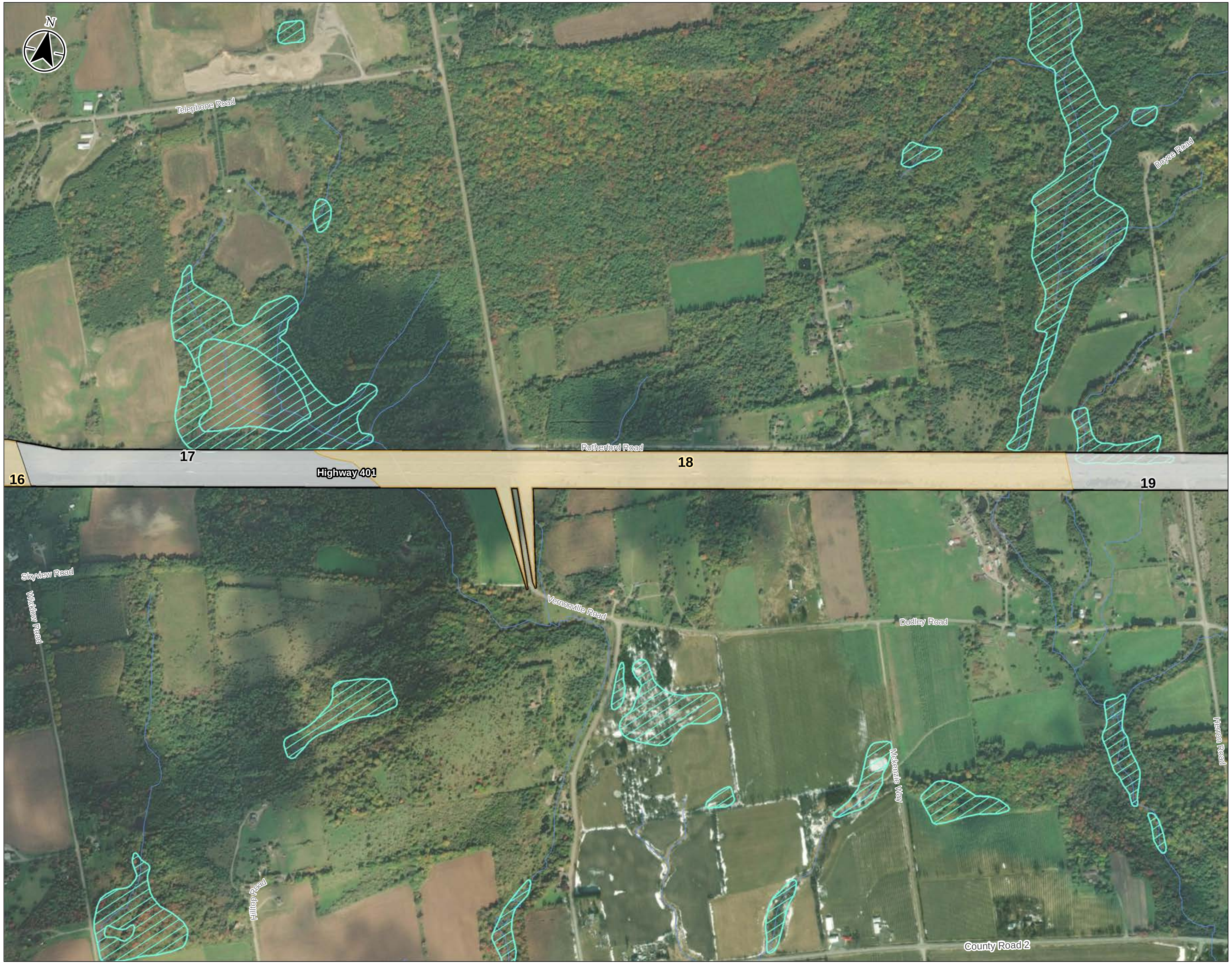
Figure No.
2 - 5

Title
Erosion and Sediment Overview Risk Assessment



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Legend
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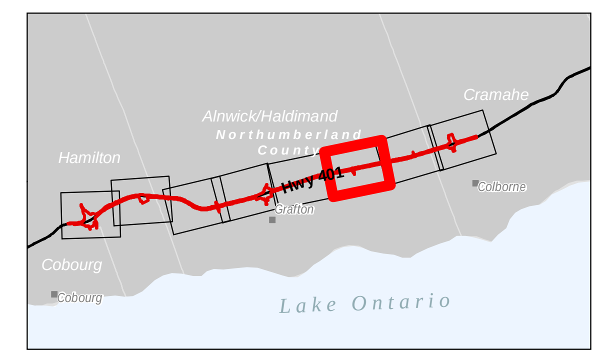

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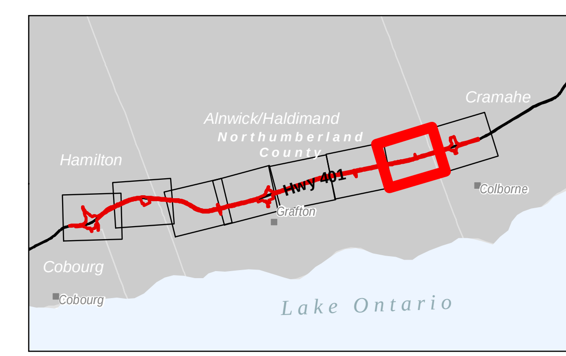

Project Location
County of Northumberland

165001090 REVA
Prepared by JW on 2020-10-27

Client/Project
ONTARIO MINISTRY OF TRANSPORTATION
HIGHWAY 401 PLANNING STUDY (GWP 4060-11-00) AND NAGLE INTERCHANGE STUDY (GWP 4059-17-00)

Figure No.
2 - 7

Title
Erosion and Sediment Overview Risk Assessment

Stantec

Legend

- Study Area
- Watercourse
- Wetland, Not evaluated per OWES
- Erodibility - High
- Erodibility - Medium

0 200 400 Meters

1:10,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2019.
3. Orthoimagery Sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Communitycontributors, and the GIS User Community, 2017.

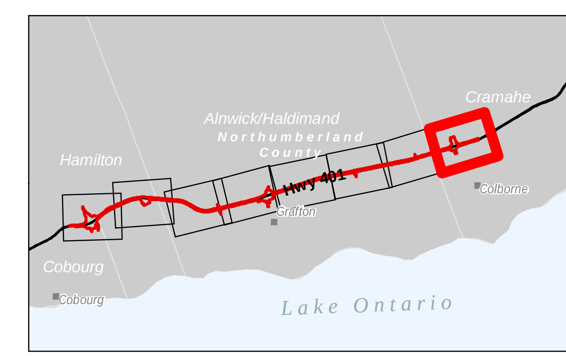

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Figure No.
2 - 8

Title
Erosion and Sediment Overview Risk Assessment