GeoPro Consulting Limited

Geotechnical-Hydrogeology-Environmental-Materials-Inspection

Geotechnical and Hydrogeological Desktop Review

Norval West Bypass Transportation Corridor
Guelph Street (Highway 7) to Side Road (RR 10)
Halton Hills, Region of Halton, Ontario

Prepared For:

Stantec Consulting Limited

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1.0 Introduction

GeoPro Consulting Limited ("GeoPro") was retained by Stantec Consulting Limited (the "Client") to conduct a geotechnical and hydrogeological desktop review for the Norval West Bypass Transportation Corridor in Halton Hills, the Region of Halton, Ontario (the "Site"). The approximate site location is shown on Drawing No. 1. The desktop study was conducted focusing on the area within a 500 m radius of the Site (the "Study Area").

The desktop study is a combined geotechnical and hydrogeological assessment which includes comments and observations made from a site walk-by on May 20, 2020. The objective of the desktop study is to provide a review of available site information, preliminary geotechnical and hydrogeological issues, and assessment of the likely risks associated with potential soil and groundwater contamination within the study area. No site-specific geotechnical and hydrogeological field investigation was carried out as part of this desktop study.

2.0 Scope of Work

The scope of the work was limited to a desktop study (i.e., without any intrusive fieldwork) based on available information and a one-day site visit (site walkover) by an engineer of GeoPro. The work was completed consisting of the following tasks:

- Conducting a search and review of the available data resources for the site background information, including geology, hydrogeology and Ministry of the Environment, Conservation and Parks ("MECP") Water Well Records ("WWR");
- Conducting site visits to observe the site features for potential constraints and impact to the proposed development from a geotechnical and hydrogeological perspective.
- Completing data processing, interpretation and report preparation.

3.0 Records Review

3.1 Aerial Photograph

Aerial photographs were reviewed for a visual chronology of previous land uses on the Site and its surrounding area. Aerial photographs for the years 1950, 1994, 1999, 2004, 2009, 2013 and 2018 were obtained from the Google Earth-Historical Photograph, The Town of Halton Hills, Brampton Maps, and University of Toronto Libraries-Map and Data Library. Copies of the aerial photographs are presented in Figures No. 1 to No. 7. A summary of the observed features in the aerial photographs of the Site and its surrounding area is presented in the following table.

Year	The Site	Surrounding Area
1950	· Sections of the roadways of Guelph Street, Adamson Street South, Winston Churchill Boulevard, 10th Side Road, and 10th Line as labeled on the figure · Most of the Site appears to be used for agricultural purposes. · Residential houses were observed on the northern border of the Site along Guelph Street. · A tributary of Black Creek transects the northwest corner of the Site · A line passing through the center of the Site indicates a hydro line or other utility aspect. · A structure was observed in the center of the Site as well as a northeastern and eastern passing roadway	· Draper Street, Russell Street, Hall Road, Bovaird Drive West, and Louisa Street as labeled on the figure. · South, southeast and southwest of the Site are likely used for agricultural purposes. · A tributary of Black Creek transects the northwest portion. Woodland was noted along the tributary. · North of the creek appears to be used for agricultural purposes. · Credit River meanders through the northeastern portion. · North of Credit River appears to be used for agricultural purposes. · Residential houses were observed on the north and south side of Guelph Street west of Adamson Street South.

Year	The Site	Surrounding Area
	that connect to Adamson Street South. · A creek-like feature passes through the south portion of the Site.	
1994*	Similar to the 1950 aerial photograph.	· Morden Neilson Way, Fagan Drive, Chelvin Drive, Gooderham Drive, Gollop Crescent, Split Maple Lane, Kay Lane, Argyll Road, Watson Road, and Davis Crescent as labeled on the figure. · Structures were observed in the southeast portion. · Residential houses were observed along Louisa Street and Bovaird Drive West, east of Adamson Street South
1999	Similar to the 1950 aerial photograph.	· Residential communities were observed to the west of the Site, on the north and south side of the creek. · A disturbed area was observed along Russell Street.
2004	Similar to the 1999 aerial photograph.	· Residential communities were noted along Russell Street. · Residential houses were observed south of Davis Crescent. · Disturbed areas were observed to the southeast and southwest of the Site. · A water body was observed to the south of the Site.
2009	Similar to the 2004 aerial photograph.	· Monarch Drive and Beaumont Court as labeled on the figure. · Disturbed areas were noted around Beaumont Court.
2013	Similar to the 2009 aerial photograph.	· A residential community was noted around Beaumont Court.

Year	The Site	Surrounding Area
		· A disturbed area was noted north of Guelph Street in the northwest portion.
2018	Similar to the 2013 aerial photograph.	· Morningside Drive, Upper Canada Court and Danby Road as labeled on the figure. · Residential houses were noted along Morningside Drive and Upper Canada Court. · Water body to the south of the Site split into two (2) smaller water bodies.

Note: 1950*= the aerial photographs took in the year with "*" could not cover the whole area of the Study Area.

3.2 Local Physiographic, Geological, Geotechnical and Hydrological Information

As shown on Drawing No. 2, the Site is located within the physiographical regions of the Sand Plains and drumlinized till plains according to the "Physiography Map of South Central Portion of Southern Ontario" (Map 2226, Scale 1:253,440) prepared by the Ontario Department of Mines and Northern Affairs, and based on the database maintained by Ontario Geological Survey ("OGS").

Surficial geology of the Site and the surrounding area is shown on Drawing No. 3, obtained through the surficial geology information database maintained by OGS. The northern portion of the Site alternates between Paleozoic bedrock, older and modern alluvial deposits, and clay to silt textured till. Alluvial deposits are comprised of clay, silt, sand, gravel, and possible organic remains. The till unit is determined to originate from glaciolacustrine deposits or shale. This till is also found in the southern portion of the Site. The central portion of the Site is generally covered with glaciolacustrine deposits. Glaciolacustrine deposits on the Site map range from fine-textured deposits consisting of silt, clay, minor sand and gravel, interbedded silt and clay, and gritty, pebbly flow till and

rainout deposits on the western side to coarse-textured deposits of sand, gravel, minor silt and clay, with foreshore and basinal deposits on the eastern side.

Based on Bedrock Geology of Ontario Southern Sheet, Map 2544 (1: 1,000,000) and database maintained by OGS, the bedrock at the Site consisted of the Queenston Formation, Upper Ordovician shale, limestone, dolostone and siltstone, as shown on Drawing No. 4. The Upper Ordovician Queenston Formation consists of a mixed terrigenous-carbonate succession composed of shale, limestone, dolostone and siltstone

The Site is located within the boundary between Levi Creek Subwatershed, Silver Creek and Norval to Port Credit Subwatershed in the Credit River Watershed, under the jurisdiction of Credit Valley Conservation (“CVC”). The Credit River west branch, located within north portion of the Site and Levi Creek, located within south portion of the Site, both run southeasterly and drain into Lake Ontario about 25.3 km south to southeast of the Site. A copy of the watershed map is included in Appendix A and the flood plain of the Credit River West Branch is shown in Drawing No. 5.

As shown on Drawing No. 6, most of the entire site area is generally rolling with the elevations changing from 224 m above sea level (“mASL”) to 230 mASL. The north portion of the site area slopes greatly towards north and northeast, with the elevations changing from 230 mASL to 210 mASL. The shallow groundwater flow at the north portion of the site is expected to flow in a general direction of east, towards Credit River; the shallow groundwater flow at the south portion of the site is expected to flow in a general direction of southeast, towards Levi Creek.

Based on the data obtained from the database maintained by Ministry of Natural Resources and Forestry (“MNRF”), wetland, woodland and provincial park areas considered as a feature pertaining to the Natural Heritage System were indicated adjacent to the north portion of the Site and Study Area. Wetland and woodland areas were also indicated adjacent to the southeast portion of the Study Area. A copy of Natural Heritage Map is included in Appendix B.

3.3 Ministry of the Environment, Conservation and Parks (MECP) Water Well Records

A search of the Ministry of the Environment, Conservation and Parks Water Well Records ("MECP WWR") database was conducted focusing on the area within a 500 m radius of the Site. A total of eighty-three (83) water well records were found and fifty-three (53) of them were recorded for domestic use, five (5) of them were recorded for livestock use, three (3) of them were recorded for commercial use, one (1) of them was recorded for irrigation use, and one (1) of them was recorded for cooling and A/C use. The locations of the MECP water wells are shown in Drawing No. 6. A summary of water well records is included in Appendix C and presented in the following table.

Type of Well Record	Number of Record
Domestic	53
Livestock	5
Commercial	3
Irrigation	1
Cooling And A/C	1
Public	2
Monitoring and Test Hole	1
Monitoring	1
Not Used	6
Unknown Use	10
Total	83

Based on the water well records, water was found at the depths ranging from about 1.5 m below ground surface ("mBGS") to 36.9 mBGS in overburden deposits and bedrock. The water was encountered at Well IDs 2801587 and 2803969, respectively, and they can be located on Drawing No. 6: MECP Water Well Location Plan. The soils in the Study Area mainly consists of fill materials, cohesionless silty/sandy/gravelly soils and cohesive

clayey soils and glacial tills. Bedrocks were encountered at the depths ranging from 0 to 35.7 mBGS, found at Well ID 2801569 and 2806709, respectively, which can be located on Drawing No. 6: MECP Water Well Location Plan.

3.4 Highly Vulnerable Aquifer ("HVA")

Based on the Ontario Source Protection Information Atlas, the Site is located in an area with a Highly Vulnerable Aquifer ("HVA") as delineated according to Technical Rules under the Clean Water Act. In general, an HVA will consist of source granular aquifer materials or fractured rock that have a high permeability and are exposed near the ground surface with a relatively shallow water table.

An aquifer is indicated as vulnerable, if possible, contaminants could quickly flow into it and impact water quality. In addition, the plume of the possible contaminants would migrate quickly to an HVA.

3.5 Wellhead Protection Area ("WHPA")

Based on the Ontario Source Protection Information Atlas, the Site and its neighboring properties are not located within a municipal Wellhead Protection Area ("WHPA").

3.6 Intake Protection Zone ("IPZ")

Based on the information obtained from the Ontario Source Protection Information Atlas, the Site is not located within a water intake protection zone ("IPZ").

4.0 Site Reconnaissance

Visual inspection of the Site and the Study Area was conducted by an engineer of GeoPro on May 20, 2020. The other observations were summarized as follows:

- The Site is located in the area between Guelph Street and 10th Sideroad, 10th Line and Winston Churchill Boulevard and situated in a rural area consisting predominantly of agriculture and woodland properties. Residential properties are

located near Green Street within the site area. Residential and commercial properties were observed to the north, east and west of the subject site.

- Credit River West Branch was observed approximately 100 m north of the Site, and branches to Silver Creek which passes through the northwest corner of the Site. Levi's Creek was observed at the southeast portion of the Site.
- Catch basins, surface drain, pipe culvert and manholes were observed along the roadways on or near the Site.
- A pond was observed at the corner of 10 Side Road and Tenth Line N approximately 120 m south of the Site.
- A cemetery was observed at the intersection of 10 Side Road and Winston Churchill Boulevard east of the Site.

In addition, a car dealer and auto garages (auto service shops) which may result in environmental concerns were observed within the Study Area and summarized as below:

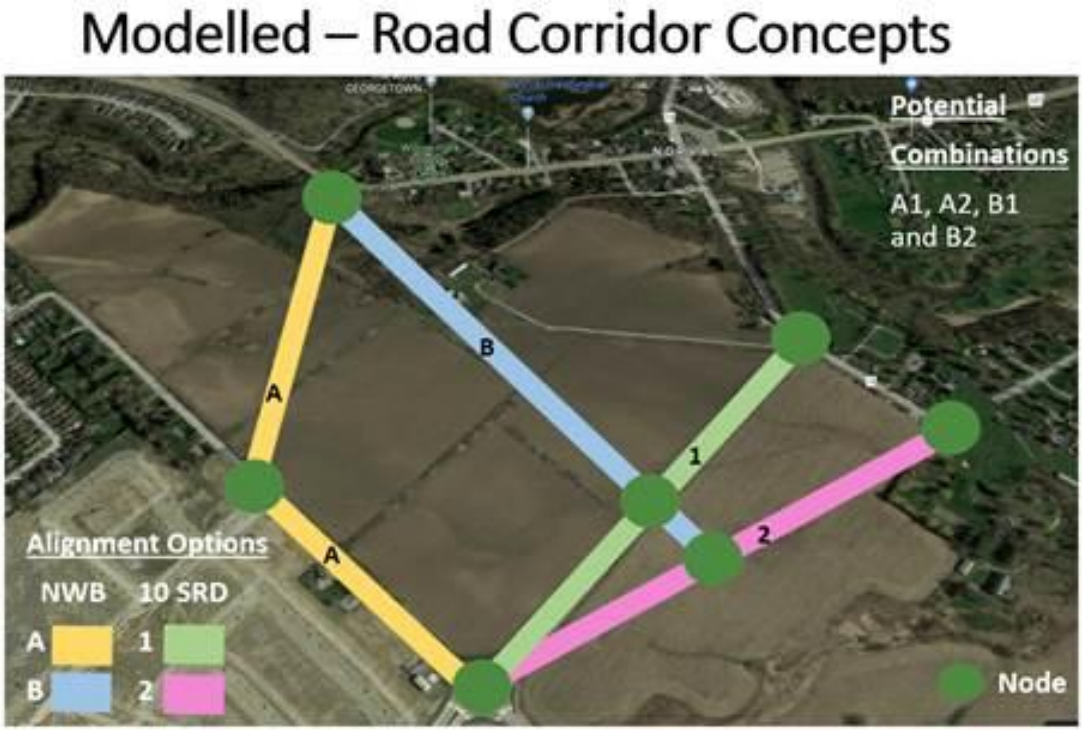
- NexGen Cars Canada (at 481 Guelph Street) across Guelph Street north of Site.
- Fix Auto Georgetown (at 411 Draper Street) about 150 m north beyond the Site.
- Arnie's Collision Centre (at 490 Guelph Street) northeast corner of the Site.
- GT Auto Work and Trillium Auto Glass & Tire (at 546 Guelph Street) approximately 500 m northeast beyond the Site.

5.0 Preliminary Geotechnical and Hydrogeological Input

The following section of this desktop study report provides preliminary geotechnical and hydrogeological comments regarding the suitability of the site for the proposed development, as well as potential constraints to development, from a geotechnical and hydrogeological engineering perspective. The preliminary comments provided herein are based only on the available subsurface data available in the vicinity of the site, previously published information, site reconnaissance, our experience on similar projects, and our understanding of the project requirements.

It is understood that the alternatives are now being examined as shown in the following map. At present, route B for the bypass is the preferred from a traffic perspective. Routes 1 and 2 were reviewed under a separate MCEA by Peel Region, and route 2 was identified as the recommended route. That EA has not yet been finalized, and part of this project is to review and confirm that the proposed bypass *route* meshes with either 10 side road route.

Modelled Road Corridor Concepts



Summary of the Anticipated Subsurface Conditions

Based on the assessment of the available hydrogeological and geotechnical information, the local surficial geology information and the site reconnaissance, the subsurface soil and bedrock conditions at the site are anticipated to consist of shallow shale bedrock, older and modern alluvial deposits, fine to coarse textured glaciolacustrine deposits of silty/sandy/gravelly soils and clay to silt textured till.

Preliminary Geotechnical and Hydrogeological Input

1. Where pavement structures are required, the new pavement structure thickness should be based on the anticipated traffic volumes on the road section, type and strength of subgrade soils and the Region of Halton Design Guidelines. The recommended pavement materials are Hot-Mix Asphalt (OPSS1150/OPSS 1151) and Granular A Material (OPSS 1010) as base/subbase course. Existing topsoil, organic matter and any deleterious materials need to be completely removed to the depth required to accommodate the new pavement structure.
2. Provisions for drainage improvements are recommended to control surface water. Subdrains should be designed and built in accordance with OPSS or local municipality specifications, and the subdrain pipe should be connected to a positive outlet. Use of properly built side ditch leading to a positive outlet should be considered for the section of roadway.
3. Installation sewer/watermain can be carried out by conventional open trench method. In consideration of the anticipated silty/sandy/granular deposits at shallow depths and anticipated groundwater tables at the site, groundwater seepage may be expected from the wet silty/sandy/granular deposits encountered at the site, which may pose difficulties in the sewer installations. Also, shale bedrock is anticipated, which pose difficulties in the trench excavation for utilities.

4. For trenching options, conventional bedding consisting of at least 150 mm of TS 1010 Granular A or 19 mm crusher run limestone material. The thickness of the bedding may, however, have to be increased (i.e. 300 mm to 450 mm) depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered, especially when the soil at the trench base level consists of wet sandy/silty deposits. Styrofoam may be considered for the utility pipes in shale bedrock in case of the potential of rock squeeze.
5. Where the sewer/watermain lies within the existing roadway allowance, the backfilling and the roadway restoration should be carried out in accordance with the Region of Halton standard procedures and specifications.

6. Based on the local geological information, cobbles and boulders are anticipated and the amount of the cobbles and boulder could be significant. Should this be the case, it will pose a great difficulty should any trenchless installation be considered.
7. Subject to the extent and thickness of the shallow cohesionless silty/sandy deposits and the groundwater tables, the groundwater control may be handled by conventional sump pumping. For the clayey deposits and glacial tills, the groundwater control should be able to be handled by conventional sump pumping. However, should extensive thick cohesionless silty/sandy deposits be present below groundwater, a positive groundwater control measures, such as deep wells and well points would be required. Significant groundwater seepage may be expected at the interface of overburden and shale bedrock.
8. There is no significant difference for the Option A and Option B shown in the above map from the geotechnical and hydrogeological perspective.

The information in this portion of the report is provided for the guidance of the proposed development and preliminary design or planning purposes and is not sufficient for detailed design purposes. In this regard, a site-specific intrusive geotechnical and hydrogeological investigation will be required prior to carrying out detailed designs for the proposed development.

6.0 Limitations

This desktop study report was prepared for the exclusive use of the Client. This report is based on data and information collected during the preliminary hydrogeological and geotechnical site assessment (site reconnaissance) of the Site carried out by GeoPro as described above and is based solely on the information reviewed as described herein.

In assessing the Site, GeoPro has relied in good faith on information provided by others as noted in this report. We assume the information is factual and accurate. We accept no

responsibility for any deficiency, misstatements or inaccuracies contained in this report as a result of omissions, misinterpretations or fraudulent acts of others.

GeoPro accepts no responsibility for the consequential effects of this report on the real or perceived value of the property, on its saleability, or on the ability to gain financing.

No direct subsurface hydrogeological and geotechnical investigation has been completed by GeoPro at the site. As previously noted, a site-specific geotechnical and hydrogeological investigation must be carried out prior to the detailed design of the proposed development. If new information is discovered during any future work, GeoPro should be requested to re-evaluate the prelim input presented in this report and provide amendments as required.

7.0 Closure

We trust that the information contained in this report is complete within our terms of reference. If you have any questions or require further information, please do not hesitate to contact our office.

Sincerely,

GeoPro Consulting Limited

Iris Guardian, P.Eng.

David Liu, P. Eng., Principal

8.0 References

1. Ministry of Environment, Conservation and Parks (“MECP”) interactive database
2. Ministry of Natural Resources and Forestry interactive database
3. Ontario Geological Survey (“OGS”) interactive database
4. The Atlas of Canada - Toporama
5. Google Maps
6. Google Earth
7. ArcGIS Basemap
8. City of Toronto Aerial Photograph Database
9. Toronto and Region Conservation – Don River Watershed