REPORT – FINAL (REVISED)

Teston Road Area Transportation Improvements Individual Environmental Assessment

Hydrogeology Study

Presented to:

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EXECUTIVE SUMMARY

Morrison Hershfield Limited now Stantec (MHnS) was retained by The Regional Municipality of York (York Region) to conduct a Hydrogeological Assessment study for the proposed improvements to Teston Road between Keele Street and Bathurst Street. The proposed improvements include realignment of Teston Road between Keele Street and about 500 m east of Keele Street, constructing a new segment of Teston Road from 500m east of Keele Street to Dufferin Street, and widening and rehabilitation of Teston Road between Dufferin Street and Bathurst Street. The proposed right-of-way travels between three landfills namely the Disposal Services Landfill (DSL), Vaughan Landfill (VL), and the Keele Valley Landfill (KVL).

This report documents the existing conditions and discusses the potential impacts of the proposed road improvements on groundwater, generally, and on groundwater and leachate-related infrastructure associated within the three closed landfills and provides recommendations and mitigation measures. The key findings of the Study are summarized below:

- Some groundwater and leachate-related landfill infrastructure is in conflict with the proposed road design. Detailed assessment of the severity of the conflict and the appropriate mitigation measures is recommended in later design stages. Any changes to the landfill infrastructure will require amendments to the Environmental Compliance Approval (ECA) under which the affected landfill operates. Significant collaboration will be required between York Region, the engineering team working on the road design and the owners of the landfills (particularly with City of Vaughan who own the Vaughan Landfill and the City of Toronto who own the Keele Valley Landfill). Typical minimum turn-around time by Ministry of the Environment Conservation and Parks for ECA approval reviews is one year.
- In addition to amendments to ECAs, the project, which will change the way certain lands are accessed and used, may require amendments to a long-established easement agreement and transfer agreement, both between the City of Vaughan and what is now the City of Toronto.
- Most of the proposed construction work is above the water table, and dewatering will be limited to certain areas near the water crossings and related to the deepest parts of the storm water system (including storm water storage facilities). The protections of the permit to take water (PTTW) or environmental activity site registry (EASR) system are sufficient to mitigate potential impacts.
- Despite any desire to practice Low Impact Development as part of this project, the storm water from the road should not be infiltrated into the sandy soils that host the landfills. Practically, this means that infiltration shall not be incorporated into the project design anywhere between Keele Street and the crossing of the Don River East Branch at chainage 3+040. This is to avoid impacting the chloride plumes located beneath the Vaughan Landfill and the Keele Valley Landfill.
- There may be some limited domestic use of groundwater in the area which should be further explored during design stages.

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1. INTRODUCTION

Morrison Hershfield Limited now Stantec (MHnS) was retained by The Regional Municipality of York (York Region) to conduct an Individual Environmental Assessment (IEA) for the proposed improvements to Teston Road between Keele Street and Bathurst Street (Project Area). This technical report supports the IEA by documenting existing conditions, quantifying the potential effects of the proposed improvements on an aspect of the environment and recommending mitigation measures.

1.1 Project and Study Area

The proposed improvements include realignment of Teston Road between Keele Street and about 500 m east of Keele Street, constructing a new segment of Teston Road from 500 m east of Keele Street to Dufferin Street, and widening and rehabilitation of Teston Road between Dufferin Street and Bathurst Street (Project Area). The Study Area extends to a 500 m buffer radius around the Project Area. The Project Area and Study Area are shown in **Figures 1 through 5** in **Appendix A**.

It is useful for the reader to know that the chainage of the project starts at 1+000, just west of Keele Street. Key points along the road alignment are noted in **Table 1**:

Table 1: Key Points Along the Road Alignment

Location	Chainage (Approx.)
Keele Street	1+271
West side of Disposal Services Landfill (DSL)	1+600
Rodinea Road	1+765
West side of Vaughan Landfill (VL)	1+800
West side of Keele Valley Landfill (KVL)	1+950
High point of land	2+250
East side of VL and KVL (approx.)	2+650
East Don River Tributary	3+040
Dufferin Street	3+375
Watercourse, existing box culvert	4+607
Bathurst Street	5+405

1.2 Scope of Work

The purpose of this groundwater study is to assess groundwater resources and determine and mitigate impacts associated with the proposed improvements to Teston Road between Keele Street and Bathurst Street. The scope of the groundwater study incorporates the following elements: 1) establishment of a Study Area; 2) compilation and assessment of background information such as geological and topographic mapping, water well records, geological information, published hydrogeological, water resources studies, and geotechnical studies; 3) field investigation as necessary to meet the objectives, conducted in conjunction with the

geotechnical investigation; 4) hydrogeological assessment and determination of significance; 5) assessment of impacts; and 6) proposed environmental protection/mitigation measures.

The current report has a specific focus on three closed landfills that are adjacent to the Teston Road right-of-way. These are the DSL, the VL, both north of the right-of-way and the KVL, south of the right-of-way. The current report should be read in conjunction with the Soil, Waste and Landfill Gas Study Report, and the breakdown of the various landfill components and how they are addressed in each of these two studies is summarized in **Table 2**.

Table 2: Landfill Components Addressed in this and a Companion Study

Landfill Component	Hydrogeology Study	Soil, Waste and Landfill Gas Study
Groundwater Monitoring Systems	X	
Groundwater and leachate collection systems	X	
Landfill liner and cap	X	X
Administrative systems including property considerations and ECA	X	
Waste		X
Landfill gas monitoring and collection systems		X

The scope of work for the Study included the following field-specific elements:

- Monitoring groundwater levels and determining the hydraulic conductivity in monitoring wells installed during a concurrent soil investigation and geotechnical investigation.
- Collecting water samples from the monitoring wells installed during a concurrent soil investigation and geotechnical investigation.
- Comparing water analytical results with Provincial Water Quality Objectives (PWQOs) (Ministry of the Environment, Conservation and Parks (MECP), 1994) and the Sewer Use Bylaw for York Region (York Region Bylaw) to establish the water quality and any notable exceedances.

2. METHODS

This section describes the methods used in this study. Specifics to the project, including dates, specific data sources and specific details of the chosen methodology are included as part of the results.

2.1 Background Data Review

Background data review was conducted in accordance with industry standard practices using readily available information from federal, provincial, municipal, and other sources of information.

The background review included analysis as necessary to develop an overall understanding of the hydrogeological setting. In this case, the analysis included the tabulation and use of the Water Well Information System (WWIS) to determine depths and available drawdown in area wells; plan view plotting of surface water features such as streams, rivers, lakes and wetlands to assess groundwater and surface water interaction; and plan view plotting of surficial and bedrock geology to determine the likely occurrence of surficial deposits as well as the occurrence and thickness of aquifers.

2.2 Water Investigation

In hydrogeological studies, especially at a regional scale, it is necessary to understand the interaction of groundwater and surface water. This section describes methods used to assess this.

2.2.1 Groundwater Level Monitoring and Hydraulic Testing

Water levels were measured by MHnS staff relative to the top of the monitoring well casings using an electronic water level tape. Groundwater elevations were determined by subtracting the measured depth to water from the estimated elevation of the casing top.

The soil hydraulic conductivities for the project area were calculated by MH. The hydrogeological properties were measured through rising head hydraulic conductivity tests (bailer test). A known volume of water was removed from the well, and the displacement and gradual re-equilibration of the water level in the well was measured using an electronic pressure transducer (data logger). The hydraulic conductivity was calculated using Hvorslev method (Freeze and Cherry, 1979):

$$K = r^2 \ln\left(\frac{L_e}{R}\right) / 2L_e t_{37} \qquad (1)$$

where:

K	=	hydraulic conductivity [m/s]
r	=	effective radius of the monitoring well (m)
L_e	=	screen length (m)
R	=	radius of the well including gravel pack (m)
t_{37}	=	time lag when $h_t/h_0 = 0.37$ (s)
h_t	=	displacement as a function of time (m)
h_0	=	initial displacement (m)

2.2.2 Water Inspection & Sampling

MHnS collected water samples from monitoring wells using a peristaltic pump. All equipment was decontaminated prior to and after each use with Alconox and distilled water. The pump collected the water sample at a low flow setting to avoid any disturbance to the sediment that might be present in the well. Water samples were kept in cooler with ice and were shipped to Eurofins Environment Testing Canada Inc (Eurofins), Toronto, Ontario under a Chain of Custody.

The samples were submitted for the analysis of the one or more of the following parameters as regulated under the York Region Bylaw:

- General Chemistry – pH, cyanide (CN), phenols, total suspended solids (TSS), biochemical oxygen demand (BOD).
- Nutrients – total phosphorous (TP) and total kjeldahl nitrogen (TKN)
- Metals and Inorganics – Total aluminum (Al), total antimony (Sb), total arsenic (As), total cadmium (Cd), total chromium (Cr), total cobalt (Co), total copper (Cu), total lead (Pb), total manganese (Mn), total mercury (Hg), total molybdenum (Mo), total nickel (Ni), total selenium (Se), total silver (Ag), total tin (Tn), total titanium (Ti), total zinc (Zn), and total cyanide (CN).

In addition, the samples were submitted for the analysis of the one or more of the following parameters as regulated under the PWQO:

- Metals: Total as well as dissolved aluminum (Al), total antimony (Sb), total arsenic (As), total beryllium (Be), total boron (B), total cadmium (Cd), total chromium (Cr), total cobalt (Co), total copper (Cu), total iron (Fe), total lead (Pb), total manganese (Mn), total as well as dissolved mercury (Hg), total molybdenum (Mo), total nickel (Ni), total selenium (Se), total silver (Ag), total strontium (Sr), total thallium (Tl), total uranium (U), total vanadium (V), total zinc (Zn), total zirconium (Zr).

2.3 Impact Assessment

Groundwater impacts are generally assessed based on calculated or estimated drawdown of the water table/potentiometric surface, and on calculated or estimated changes in volumetric flow (such as loss of baseflow to local streams). The impact assessment is made by considering the impacts of these project-induced calculated or estimated hydrogeological effects on the following potential receptors:

- Wells and Aquifers
- Actual or Potential Contamination
- Surface Water
- Structures
- Ecology

As noted above, the current study also considers the impacts of the project on the three closed landfills. This required a very detailed review of the specifics of the landfills including their infrastructure and regulatory requirements.

3. RESULTS

This section discusses the regional and local scale geography, geology and hydrogeology as well as providing site specific information on the three closed landfills. It is noteworthy that the area has been extensively studied because of these landfills, especially the KVL. Also included in this section are the results of the water investigations.

3.1 Physiography & Topography

The Oak Ridges Moraine is a massive ridge of glacial drift extending between Caledon and Rice Lake, near Peterborough, containing significant amounts of sand and gravel. The moraine has a geographic area of 1,900 square kilometres with overburden that is up to 200 m thick. According to Chapman and Putnam (1984), a lobe of the moraine proper occupies the central part of the Study Area (see **Figure 1** in **Appendix A**), which is flanked on either side by the till plains of the area known as the South Slope of the Oak Ridges Moraine.

According to the Atlas of Canada (Natural Resources Canada, 2014), the topography of the Study Area drops from (approximately 310 m elevation in the) northwest to (approximately 230 m elevation in the) southeast, towards Lake Ontario, as is consistent with the South slope physiography. The northwestern part of the Study Area is a height of land, on the other side of which the topography drops off towards King City in the northwest.

Multiple tributaries of the Don River East Branch originate in the Study Area, flowing toward Lake Ontario, incised 10 to 20 m into the landscape.

Along the alignment of the proposed Teston Road, the topography is highest (approximately 285 m elevation) just east of Rodinea Road and drops into the valley of Don River East Branch which crosses the alignment at just less than 250 m elevation. Moving east, the topography climbs back up as the alignment crosses Dufferin Street, to approximately 280 m elevation, before dropping back below 250 m elevation at another branch of the Don River East Branch (mid-block). The topography climbs again and drops again to another branch of the Don River East Branch, approximately coincident with Bathurst Street.

Waste piles associated with the three closed landfills dominate the topography on either side of the alignment. On the north side, just north of Rodinea Road, the DSL rises to a peak of approximately 311 masl. East of this, the VL rises to a peak of approximately 304 masl. South of the alignment, between Rodinea Road and the East Branch of the Don River, the KVL rises to a peak of 300 masl.

3.2 Drainage & Surface Water (Hydrology)

The central and eastern parts of the Study Area are located in the headwaters of the Don River East Branch. The area west of the height of land and west of Keele Street is within the watershed of the Don River West Branch. Whether East or West Don, these rivers are sourced by the lobe of the Oak Ridges Morraine which traverses approximately north south through the Study Area. Within their incised valleys these streams are surrounded by wetlands. The wetlands surrounding the branch of the Don River East Branch that traverses the proposed road alignment west of Dufferin Street have been evaluated and are Provincially Significant. The wetlands surrounding the other more easterly branches are unevaluated. The water bodies in and around the project area are shown on **Figure 1 through 5** in **Appendix A**.

3.3 Geology

A generalized description of the geology of the region between lakes Simcoe and Ontario is given in Amstrong *et al. (2007),* and Gerber *et al.* (2018), much of which is based on the work of Sharpe *et al.* (2007). The main geological units are identified as (*i*) bedrock; (*ii*) the "Lower sediment" consisting of pre-Thorncliffe Formation which includes Sunnybrook drift and Scarborough Formation and Thorncliffe Formation; (*iii*) the Newmarket Till; (*iv*) Oak Ridges Moraine; (*v*) Halton Till; and (*vi*) overlying glaciolacustrine sediment fill. The Lower sediment is 75 to 160 m thick and is formed of poorly exposed, interbedded lake sediment and till, comprised of sand, silt, clay, till, and distinctive organic-rich and fossil-bearing beds. The Newmarket Till is up to 25 m thick and is dense, pebbly, sandy silt diamicton. The Oak Ridges Moraine rises to 300 metres above Lake Ontario and contains deposits of sand and gravel up to 200 metres thick. Overlying the northern and southern flanks of the Oak Ridges Moraine, the Halton Till is predominantly a massive to laminated mud unit with local interbeds of sand and gravel. On the northern flanks of the Oak Ridges Moraine the unit is 1 to 5 m thick and on the southern flanks it is up to 30 m think.

According to "Quaternary Geology of Ontario, Southern Sheet" (Ontario Geological Survey, Map 2556, Scale 1:1,000,000), and "Surficial Geology of Southern Ontario" (2010, Northern Development and Mines), the quaternary deposit at the edges of the Study Area consists of Halton Till. Where the Oak Ridges Moraine occupies the central part of the Study Area, the geology is mapped as glaciofluvial ice-contact deposits consisting of gravel and sand, minor till, including esker, kame, end moraine, ice-marginal delta and subaqueous fan deposits. The surficial geology of Study Area is provided on **Figure 3** in **Appendix A.**

A review of wells in the WWIS indicates that in areas mapped as gravel and sand, the sand is often described as very fine, and interbedded with silt and clay. In areas mapped as till, the soils are typically described as clay or clayey, interbedded with silt, and sometimes sandy. Between the VL and the KVL, the upper 30 m to 50 m is typically sand and gravel before the first significant silty or clayey layer appears. South of Teston Road, mid-block between Dufferin Street and Bathurst Street, the overburden is 136 m thick, as one well in this area extended into bedrock. This particular well was entirely clayey and produced no water.

According to "Bedrock Geology of Ontario, Southern Sheet" (Ontario Geological Survey, Map 2544), the underlying bedrock within Study Area is Upper Ordovician aged shale of the Georgian Bay, Blue Mountain and Lindsay Formation. Bedrock is encountered at depths ranging from approximately 80 meters below ground surface (mbgs) at the southern limit to approximately 250 mbgs at the northern limit of the Study Area. The bedrock geology of the Study Area is provided on **Figure 4** in **Appendix A.**

3.4 Hydrogeology

3.4.1 Regional Groundwater Flow

Referring again to Gerber *et al.*, 2018 and Sharpe *et al.*, 2007, the Lower sediment, which is characterized by sandy formations with good hydraulic conductivity, is considered an aquifer, or containing significant regional aquifers. The Lower sediment is confined by the Newmarket Till and, where present, the Halton Till. The Oak Ridges Moraine is an unconfined aquifer (except where it underlies and is confined by the Halton Till) with good hydraulic conductivity and an aquifer potential that is one of the highest of the country. The Oak Ridges Moraine forms a

major recharge area, being the source of baseflow in dozens of headwater stream springs and also the source of water in underlying aquifers within the Lower sediment. Within the Oak Ridges Moraine, the water table can be 30 m to 40 m below ground surface while in the tills beyond the Oak Ridges Moraine, the water table is generally within a few (5-10) metres of surface.

Within that regional context, the hydrogeology of the three closed landfills has been studied extensively. Within the upper 100 m of soil there exist sand and gravel aquifers interbedded with 10-20 m thick layers of finer-grained confining material (Dixon, 2000). At Teston Road, the upper aquifer within the water table sits atop the first confining layer at approximately 30 m depth. The 10 m thick intermediate aquifer sits atop the next confining layer at approximately 70 m depth, and the lower aquifer sits atop confining material at about 100 m depth. That first confining layer pinches out to the south (below the KVL), combining the upper and intermediate aquifers.

Groundwater flow within this system of interbedded aquifers and aquitards follows the regional trend from northwest to southeast, providing baseflow to the various emerging tributaries of the Don River East Branch. The flow system is in essence uniform flow with recharge, with a gradient of approximately 1 percent. According to Dixon (2000) and Golder (2020), a 1 km wide swath of this flow within the upper aquifer is captured by the Teston Road Purge Well System (TPWS), a series of pumping wells along the southern edge of the VL. The same swath of flow within the upper/intermediate aquifer is captured by the Southern Purge Well System (SPWS) at the southeast corner of the KVL.

The water table across the entire Project Area is also shown in Cross Section AA' on **Figure 6** and in Plan view on **Figure 7** in **Appendix A**. Between the landfills the water table is tens of metres below ground, while elsewhere the water table is less than 10 m below ground.

3.4.2 Groundwater Contaminant Plumes

Due to the lack of liner or leachate collection system beneath, multiple contaminant plumes have migrated south and southeasterly from DSL and VL. KVL monitoring includes nine distinct plumes that have been historically identified, including those originating upgradient of that site and non-landfill derived plumes at the site. Typical conditions of these plumes are shown on **Figure 7 and Figures 7a-c**. The largest plume that covers the DSL and VL and which migrates beneath the lined KVL is referred to as the "Vaughan Landfill Chloride Plume" (also referred to as the "Main Plume" in Dixon (2000) and in KVL annual monitoring reports (City of Toronto)). The plume located to the west of the KVL is referred to as the "Industrial Park Chloride Plume" (also referred to as one of two "West Plumes" in Dixon (2000) and in the KVL annual monitoring reports (City of Toronto)). These plumes are composed of leachate impacted groundwater for which chloride is one (of many) indicator parameters. The chloride concentrations are known to be greater than 15 mg/L and up to 750 mg/L. It should be noted that elevated concentrations of multiple volatile organic compounds (VOC) have also been identified in wells along the southeastern limit of the KVL.

One of the isolated plumes, located northeast of the southern Industrial Park Chloride Plume on **Figure 7**, investigated by Dixon Hydrogeology in 1996, migrates easterly towards the East Branch of the Don River and is confined to the upper aquifer.

3.4.3 Wells

The MECP Water Well Information System (WWIS) database was queried for records of water supply wells within 500 m of Study Area (MECP, 2020). A total of approximately nine-hundred and forty (940) water well records were identified including: one-hundred and ninety-three (193) domestic supply wells, one-hundred and eighty-five (185) monitoring wells, twenty-two (22) commercial use wells, eighteen (18) agricultural wells, sixteen (16) industrial use wells, and ten (10) irrigation wells. The well installation dates ranged from 1947 to 2020. The locations of the wells are shown on **Figure 2** in **Appendix A**. The stratigraphy, water found, and static water levels noted by the well drillers are shown in cross-sections AA' and BB' on **Figure 6** in **Appendix A**.

Despite the relatively large number of wells in the MECP database, it is considered that the actual use of groundwater for domestic, agricultural or industrial purposes is minimal. The main reason for this is that municipal/piped water supply is available throughout the study area. Areas with existing subdivisions east of the valley may still have a small number of domestic wells in use. A desktop survey is recommended to identify the areas that may still be using groundwater wells for domestic or agricultural use. Review of aerial imagery can be used in identifying the approximate age of the houses in Study Area to determine the potential for the presence of domestic well(s) on the property. Houses built as part of a residential subdivision are unlikely to rely on groundwater as a source of domestic supply. A well survey may then be required to confirm the existence of in-use wells within specific identified areas.

3.4.4 Wellhead Protection Areas, Highly Vulnerable and Significant Groundwater Recharge Areas

These areas were delineated for the protection of Ontario's drinking water, under the Clean Water Act, 2006 (CWA). The CWA has a focus on sources of water that have been designated by a municipality as being a current or future source of residential municipal drinking water for the community. These sources are protected in each Source Protection Region (SPR) through the development and implementation of a Source Protection Plan (SPP). These areas are all shown on the Source Water Protection Information Atlas which is compiled by the Ontario Ministry of the Environment, Conservation and Parks.

The Project is entirely contained within the CTC (Credit Valley-Toronto and Region-Central Lake Ontario) SPR. As such, the policies of the Approved Source Protection Plan (SPP): CTC Source Protection Region (CTC SPR, 2024) apply. In the following discussion, the site-specific applicability of these policies is identified and discussed.

3.4.4.1 Wellhead Protection Areas

A Wellhead Protection Areas (WHPA) is the area or capture zone surrounding the wellhead where land use activities have the greatest potential to affect the quality of groundwater within the aquifer from which the well derives its source. In Ontario WHPAs have been delineated for all municipal wells. According to Source Protection Information Atlas, no WHPAs are within the Study Area. The closest WHPA was identified more than a kilometer away from the Project Area. Hence, no impacts to this WHPA are anticipated from the Project.

The entire Study Area falls within the WHPA-Q1 (for the York-Durham Municipal wells, Map 3.4 in the SPP). WHPA-Q1 refers to an area where activities that take water without returning it to the same source may be a threat. Other than minor and temporary water taking that may be

required for construction dewatering, the Project is not an activity that takes water without returning it to the same source. As such, none of the SPP policies that would be triggered by WHPA-Q1 (specifically, DEM-1, DEM-2, DEM-3, DEM-4, DEM-9, and DEM-10, see the Section 10 of the SPP) result in any EA commitments.

The entire Study Area falls within the WHPA-Q2 (also for the York-Durham Municipal wells, Map 3.4 in the SPP). WHPA-Q2 refers to the area where activities that reduce recharge may be a threat. The only SPP policy triggered by WHPA-Q2 is REC-1, which is to be implemented by the Planning Approval Authority. The policy requires the Planning Approval Authority to act in certain ways with respect to their role in land use planning and applications under the Planning Act. The following is the most applicable part of the policy to the Project:

> *For applications under the Planning Act within the Tier 3 Water Budget WHPA-Q2 identified as having significant water quantity threats, the relevant Planning Approval Authority shall ensure recharge reduction does not become a significant drinking water threat by:*
>
> *2) Requiring that that all site plan (excluding an application for one single family dwelling) and subdivision applications for new residential, commercial, industrial and institutional uses provide a water balance assessment for the proposed development to the satisfaction of the Planning Approval Authority which addressed each of the following requirements:*
>
> > *a) maintain pre-development recharge to the greatest extent feasible through best management practices such as LID, minimizing impervious surfaces, and lot level infiltration; and*
> >
> > *b) where pre-development recharge cannot be maintained on site, implement and maximize off-site recharge enhancement (within the same WHPA-Q2) to compensate for any predicted loss of recharge from the development*

The Project will not result in an application under the Planning Act, and, as such, the above policy is not applicable. It is noted, however, that the project will incorporate “best management practices such as LID”. Caution is required to ensure that any infiltration of potentially salt-impacted road runoff does not interfere with the monitoring of the landfills in the area (see Section 3.5)

3.4.4.2 Highly Vulnerable Aquifers

A highly vulnerable aquifer (HVA) is an aquifer that is rapid to recharge from precipitation or other water at the ground surface. Such aquifers are, by virtue of the short travel time between ground surface and water table more vulnerable to contamination. These aquifers typically occur in areas of coarse or sandy soils with a high groundwater table. According to Source Protection Information Atlas, an HVA was found over the majority of the Teston Road right-of-way, from approximately 900 m east of Keele Street eastwards to Bathurst Street. The location and extent of this HVA within the Study Area is shown on **Figure 5.**

SPP policies triggered by HVA include four related to the protection of aquifers from application and/or handling and storage of road salt (specifically, SAL-10, SAL-11, SAL-12, and SAL-13, see the Section 10 of the SPP). These policies are to be implemented by various bodies, and generally relate to when a salt management plan shall be required as part of a development application, when to encouraging the use of best management practices, when to require e use

of trained individuals in the application of road salt, and when to require trends in sodium and chloride monitoring to be reported to the Source Protection Authority. The most applicable policy is SAL-10, excerpted here:

> *Where the application of road salt would be a moderate or low drinking water threat, the planning approval authority is encouraged to require a salt management plan, which includes a reduction in the future use of salt, as part of a complete application for development… Such plans should include, but not be limited to, mitigation measures regarding design of parking lots, roadways and sidewalks to minimize the need for repeat application of road salt such as reducing ponding in parking areas, directing stormwater discharge outside of vulnerable areas where possible, and provisions to hire certified contractors.*

The aquifer beneath the Study Area is sensitive to contamination by road salt specifically because of the existence of landfill-related chloride plumes within it (see Section 3.5). Where small changes in chloride concentration in other parts of Ontario may go unnoticed or have no material impact, such changes to this aquifer may significantly complicate a longstanding groundwater monitoring program. Stormwater discharge to ground should be directed outside the area where these plumes exist and are monitored.

Other SPP policies triggered by HVA are for the protection of aquifers from contamination by the handling and storage of Dense Non-Aqueous Phase Liquids (DNAPLs) and Organic Solvents. As such, none of the SPP policies that would be triggered by HVA (specifically, DNAP-3, and OS-3, see the Section 10 of the SPP) result in any EA commitments.

3.4.4.3 Significant Groundwater Recharge Areas

Most groundwater recharge occurs from the downwards percolation of precipitation/surface water from the ground surface to the water table. The rate of recharge is proportional to the permeability of the shallow soils but is also affected by a number of other factors, such as depth to water table. Significant Groundwater Recharge Areas (SGRAs) are characterized by the Province of Ontario as having highly permeable soils at surface, such as sand and/or gravel, which allows water to readily pass from the ground surface to an aquifer. These areas are considered significant when they aid in maintaining the water level in an aquifer that provides water for potable means or supplies groundwater to a cold-water ecosystem. According to Source Protection Information Atlas, the Teston Road right-of-way is within an SGRA from approximately the center line northerly, from 300 m west of Keele Street to the center line of Keele Street, and from 35 m east of Dufferin Street to 630 m east of Dufferin Street. The location and extent of this SGRA within the Study Area is shown on **Figure 5**.

The same policies are triggered by SGRA as are triggered by HVA (specifically, SAL-10, SAL-11, SAL-12, SAL-13, DNAP-3, and OS-3, see the Section 10 of the SPP). As such, the reader is referred to the previous section for a discussion of EA commitments.

3.4.4.4 Intake Protection Zones

The closest intake protection zone is identified in Lake Ontario, located more than 25 kilometers away from the Study Area. No impacts to this intake protection zone are anticipated from this Project.

3.5 Landfills

Based on a historical records review, it appears Study Area was primarily agricultural land with a gravel pit in operation prior to 1956. The gravel pit was eventually transformed into three landfills: VL starting in the mid-1960s, DSL starting in the mid-1970s and the KVL starting in the mid-1980s. The properties surrounding the landfills have experienced major development in the southwest, southeast and northeast quadrants of Study Area. The development has consisted of industrial, commercial and residential properties. The northwest quadrant remains primarily used for agricultural purposes.

Table 3: Summary of Current and Past Uses of Study Area

Year or Period	Description of Study Area Use
Prior to 1956	The gravel pit is in operation at the location of the VL and KVL. The remainder of the Study Area is used for agricultural purposes.
1964	Minor residential development near Major Mackenzie Drive West and Keele Street
Mid-1960s	VL begins operation north of Teston Road.
1973	Development of industrial park west of the landfill begins. Further residential development at Major Mackenzie Drive West and Keele Street.
1983	KVL begins operation south of Teston Road.
1984	VL closes. Further development of industrial park. Development of multiple residential neighborhoods.
2003	KVL closes.
2004	Industrial park development similar to present day. Residential developments found throughout southwest, and northeast quadrants of Study Area. Southeast and northwest portions of Study Area still used for agricultural purposes.
Present	Southeast quadrant of project area is now primarily residential. Northwest portion of Study Area is still used for agricultural purposes.

In total, twelve (12) potentially contaminating activities (PCA) were identified within the Study Area. The PCA identified include:

- Waste Disposal and Waste Management, including thermal treatment, landfilling and transfer of waste, other than use of biosoils as soil conditioners
- Chemical Manufacturing, Processing and Bulk Storage
- Asphalt and Bitumen Manufacturing
- Concrete, Cement and Lime Manufacturing
- Plastics (including Fibreglass) Manufacturing and Processing
- Metal Treatment, Coating, Plating and Finishing
- Electronic and Computer Equipment Manufacturing
- Commercial Trucking and Container Terminals
- Rail Yards, Tracks and Spurs
- Commercial Autobody Shops
- Gasoline and Associated Products Storage in Fixed Tanks

- Operation of Dry Cleaning Equipment (where chemicals are used)

The main contamination concerns with the Project Area include the three landfills and the northern portion of the industrial park.

A significant number of landfill related environmental/hydrogeology reports and documents were referred by MHnS to obtain historical and/or operational details of the three landfills.

3.5.1 Disposal Services Landfill

The DSL is a privately owned and operated landfill located north of the intersection of Teston Road and Rodinea Road. The DSL is a privately owned and operated closed landfill located north of the intersection of Teston Road and Rodinea Road. The landfill is operated under Provisional Certificate of Approval No. A230604 dated July 31, 1974, as amended on February 9, 1999, July 27, 2001, March 31, 2003, April 15, 2016, 27 September 2017, and December 13, 2018. The size of the waste disposal area and the total site area are not mentioned on the ECA documents that were available for viewing.

Based on a review of 'Teston Road from Keele Street to Bathurst Street, Individual Environmental Assessment, Terms of Reference, Appendix G - Consultation Record', and on other background data, MHnS noted the following:

- It is owned by Teston View Holdings Inc. and was operated between 1974 and 1986 and then it was closed.
- Soil was imported to this landfill in 1999 following an Environmental Compliance Approval (ECA) amendment.
- An additional 390,200 m^3 of apparently clean fill was imported to the landfill between 2006 and 2015 with no formal design plans or specific ECA amendment.
- The landfill is equipped with monitoring wells combined with gas probes, the southerly ones of which are shown on **Figures 7** and **7a**. All these monitoring points are north of the existing Teston Road right-of-way (Stantec, 2022).
- The landfill is equipped with a leachate collection system consisting of north-south and east-west oriented piping from within the landfill footprint to a subsurface storage tank whose top is approximately 4 m below ground where it abuts the southern property boundary (Stantec, 2019 and 2022). It appears that the storage tank discharges via piping to a maintenance hole within the existing Teston Road right-of-way from where it flows into a sanitary sewer.
- According to a cross-section (Stantec, 2019), the waste is capped with 1-1.5 m of sandy silt and/or silty clay, including an overlying typical thickness of topsoil.

3.5.2 Vaughan Landfill

3.5.2.1 Site Boundaries

The VL is a 28-hectare waste disposal site within a total area of 40 hectares, subject to Environmental Compliance Approval No. A230601 issued on September 19, 1977, and amended on November 14, 1994, December 1, 1994, March 19, 1996, July 5, 1996, July 31, 1996, September 2, 1997, September 26, 1997, September 29, 1998 and August 19, 2021. The

28-hectare waste disposal site area and 12-hectare buffer lands are shown on **Figures 7** and **7a-c**. The south property boundary is the north side of the Teston Road allowance.

3.5.2.2 Site Configuration

The site was originally operated as a gravel pit and transitioned into a landfill in the mid-1960s. The landfill accepted domestic, commercial and industrial waste until its closure in 1984. The landfill was never equipped with a liner or leachate collection system. The original final cover was composed of a sandy till with varying thicknesses from 0.5 to 6.5 metres. In 1997, the final cover was upgraded to a clayey soil with a thickness ranging from 1.5 to 6.5 m. The waste is approximately 20 to 23 m thick in the central portion of the site and decreases to approximately 15 m near the east and west ends. Although the landfill is closed, the only reference to a closure plan found as part of MHnS research is in the August 19, 2021, amendment to the ECA. That amendment required submission of such a plan within 2 years of the date of approval.

3.5.2.3 Groundwater Monitoring System

At present the only VL plume that is actively monitored by the City of Vaughan is one that is not captured by the TPWS, and which is on the east side of the landfill. The maximum concentration of chloride measured in 2019 in the VL groundwater monitoring wells located east of the landfill, (see the monitoring well symbols shown on **Figure 7 and Figures 7a-c**) was reported to be 148 mg/L (AECOM, 2020). The concentration measured in ten (10) other monitoring wells ranged from 2.9 mg/L to 21.2 mg/L. AECOM (2020) presented rationale for the use of Ontario Drinking Water Standards (ODWS) for assessment of groundwater quality, as opposed to a mix of brownfields redevelopment standards (Table 3 Site Condition Standards under O.Reg. 153/04) and Provincial Water Quality Objectives (PWQO). The plume tracked during the VL groundwater monitoring round in 2019 met the ODWS at the property boundary.

3.5.2.4 Leachate Collection and Groundwater Monitoring Systems

The VL does not have a leachate collection system. The TPWS is on VL property but is part of KVL and is discussed below.

The VL does have a series of groundwater monitoring wells. These are all east of the landfill, as shown on **Figure 7** and **Figures 7a-c**.

3.5.2.5 Sewage System, Other Approvals

There is no separate ECA for a sewage system, and there are no ponds or other noticeable storm water management facilities. There is a storm sewer system connected to and draining the landfill gas collection system in the southwest corner of the site. This discharges to a ditch on the north side of Teston Road, south of the DSL.

The landfill gas flare system is subject to a separate ECA (8-8-3487-96-988 Air).

3.5.3 Keele Valley Landfill

3.5.3.1 Site Boundaries

The former Metropolitan Toronto purchased land from Superior Sand and Gravel Ltd. (“Superior”) to operate the KVL Site by agreement dated May 11, 1983. The landfill is a 99.2-

hectare waste disposal site within a total site area of 375.9 hectares, subject to Environmental Compliance Approval No. A230610 issued on May 26, 1983, and amended approximately 100 times since then.

According to Schedule B of an easement agreement between the Town of Vaughan and Metropolitan Toronto established in 1983 (Instrument 320409), the 99.2 hectares waste disposal site is made up of Parts 10 and 17 of Reference Plan 65R-5832. Generally, and according to most documents reviewed, the north limit of waste is the north limit of Part 17 of the Reference Plan, and this is the red dash-dot line at the north end of the KVL on **Figures 7b** and **7c**. Part 10 is the approximately 8 m wide by 340 m long area, shown as primary buffer, north of the east side of the waste.

According to Schedule C of the same agreement the 40.3 hectare Buffer Area of the landfill is made up of Parts 11, 16, 22 and 41. This is shown as the Primary Buffer Area surrounding the waste on **Figures 7** and **7a-c**. Together the waste and the primary buffer make up an area of 139.5 hectares, and the remaining 236.4 hectares of "total site area" was made up of various other parts of Reference Plan 65R-5832, including the City-purchased Avondale Area (Parts 1 and 59 of Reference Plan 65R-5832 being the Avondale Area) and the City-purchased parcel fronting on Dufferin Street (Part 59 of Reference Plan 65R-5832) which is now part of the Eagles Nest Golf Club. Parts of these 236.4 hectares have been deleted from the landfill site area by amendment of the ECA (for example, Notice No. 44 issued February 16, 2010, deleted the Avondale Area). Today, approximately 90 hectares remains as the Secondary Buffer Area, as shown in blue on **Figures 7** and **7a-c**. This property is owned by York Major Holdings and amendments to the ECA allowed for the construction of the Eagles Nest Golf Club on these lands. It is noteworthy that around 2003/04, York Major Holdings Inc. was added, in addition to the City of Toronto, as a holder of the ECA.

According to the 1983 easement agreement (Instrument 320409, including Schedule F), Vaughan granted Metro an easement to enter on Parts 8 and 53 of Reference Plan 65R-5832 for the purposes of constructing and maintaining purge and observation wells (the "wells"). The agreement states that "Vaughan proposes to change the elevation of the Teston Sideroad, and the said lands and that Metro will be responsible for any resulting changes to the wells, pipes and appurtenances". Parts 8 and 53 mentioned above are the lands between the south limit of waste for the VL (red dash-dot line) and the south limit of the buffer lands for the VL (blue dash-dot line) on **Figures 7b** and **7c**.

According to the 1983 easement agreement (Instrument 320409, including Schedule E), Vaughan granted Metro an easement to enter on Parts 6, 9 and 51 "for the purpose of transferring clay till from the Avondale area to the disposal site and for the passage of vehicles and persons for all purposes in connection with the establishment of operation of the landfill disposal site". Part 6 is the easement between the DSL and the VL and Parts 9 and 51 are Teston Road allowance. Since ownership of the Avondale site has been transferred back to the City of Vaughan and since it has been deleted from the ECA (see below) the applicability of this easement is unclear.

In the paragraph on Parts 8 and 53, the easement agreement further stated that "Upon completion of the purchase, Metro shall convey to Vaughan, without payment, the lands shown as Part 10 on Reference Plan 65R-5491 which are required for the reconstruction of Teston Sideroad". MHnS can find no other reference to "Reference Plan 65R-5491" in the agreement or on the internet, and wonders if this is a clerical error.

A transfer agreement between the City of Vaughan and Metropolitan Toronto for Part 9 (the road allowance) and Part 10 of Reference Plan 65R-5832 was established in 1996 by Instrument R675034. This transfer agreement was for the purpose of a Gas Balancing Header Pipe and similar devices and allowed Toronto access to the lands through an easement (or 'rights in the nature of an easement'). The agreement states that the land shall remain clear of buildings or structures, pavements, physical encumbrances except as approved by the Commissioner of Works for Toronto. The agreement also states that "the Transferee (Toronto) covenants and agrees with the Transferor (Vaughan) that: 1) it shall construct the Pipe as close as possible to the south limit of the Teston Road, road allowance, in order to minimize possible conflicts with the future construction of Teston Road; and 2) It shall be responsible for any alterations, relocation or removal of the Pipe which may be required for the future construction of Teston Road." That this transfer agreement exists implies that the City of Toronto is not the owner of Part 10 of Reference Plan 65R-5832. As noted above, on **Figure 7** and **7a-c**, this is land is shown as the sliver of Primary Buffer Area on the northeast boundary of the waste. The agreement also clearly anticipates and protects for the future construction of Teston Road.

3.5.3.2 North Fence

In discussing the north KVL fence line, it is useful to know that from about Rodinea Road east to Dufferin Street, the north side of the Teston Road, road allowance makes a straight line. At the west end of the KVL, the road allowance (Part 9 on Reference Plan 65R-5832) is 28 m wide. Eastward approximately mid-way across the KVL, the road allowance may narrow to 20 m, depending on legal definitions around Part 10, or it may continue at 28 m width for an additional 340 m eastward (to the eastern end of Part 10). Regardless of the location of the jog in the road allowance, the northern KVL fence line marks a straight line that is approximately 20 m south of the northern edge of the road allowance.

The fence line is north of the KVL perimeter road and is important because it marks the operational limit of the landfill at its northern end. Other than the TWPS and associated piping and a few groundwater monitoring wells, all the landfill infrastructure is south of this fence line, and monitoring and maintenance of this infrastructure can all, presumably, be done from "inside the fence".

3.5.3.3 Liner, Leachate Collection and Groundwater Control Systems

Similar to the VL the KVL was set in the footprint of the former gravel pit. Unlike the VL, the KVL was constructed with a compacted 1.2 m thick clay liner with a minimum permeability of 1×10^{-8} cm/sec along the base and side slopes which is used to contain leachate and gas. The liner was constructed in four stages with the final stage being completed in 1994.

The KVL's leachate collection system consists of 200-millimeter (mm) diameter perforated high density polyethylene pipes and gravel drains located above the liner. Based on a schematic drawing of the system, the approximate locations of the leachate collection pipes, and maintenance holes and cleanouts are shown on **Figures 7**, and **Figure 7a-c**. Of particular note are the two maintenance holes on the north side of the approximate northerly approved limit of waste. On drawings, the westerly of these is shown just north of the waste while the easterly of these is shown just north of the thin sliver of buffer lands in this area. Both are shown to be within the Teston Road road allowance. The actual locations of these are unknown, but it is speculated that these must be two or more of the concrete chambers that are clearly visible in satellite imagery. The closest of these to the locations shown on the schematic drawing are marked on

Figure 7b and **7c**. The leachate is directed towards the pumping station and discharged into the sanitary sewer system.

To intercept the Vaughan Landfill Chloride Plume, a purge well system was installed in 1984 at the southern limit of that landfill. The TPWS is operated by the City of Toronto and consists of thirteen (13) purge wells in addition to approximately 21 observation wells. The TPWS collects approximately 384 m^3/day of contaminated groundwater. These wells are operated under Permit to Take Water (PTTW) Number 6724-AZ4P7K with a taking category of Remediation, and the allowable takings are 1,046,880 Litres per Day. The water taken is sent to the sanitary sewer by way of a leachate collection pipe which runs beneath the proposed Teston Road in a north-south orientation between 21 Rodinea Road and KVL as shown on **Figure 7a**. This system is scheduled to stay in operation until at least 2040.

An additional purge well system is located at the southern limit of the KVL. The Southern Purge Well System (SPWS) is operated by the City of Toronto and consists of five (5) operating purge wells and three (3) stand by purge wells. The SPWS collects approximately 641 m^3/day of contaminated groundwater. These wells are also operated under PTTW Number 6724-AZ4P7K with a taking category of Remediation, and the allowable takings are 1,834,128 Litres per Day. The collected groundwater is discharged to the sanitary sewer system. This system is scheduled to stay in operation until the year 2200 at minimum (City of Toronto, personal communication during meetings).

3.5.3.4 Groundwater Monitoring System

Groundwater level and quality has been monitored in a series of more than 200 monitoring wells spread out across the original landfill's 376 hectares. The monitoring continues post-closure, but the number and location of wells or the frequency of their monitoring is unknown. Several monitoring wells are located close to the Teston Road right-of-way at the north side of the KVL, and at the south end of the VL, and west towards Keele Street, as shown on **Figures 7** and **7a-c**. It is noted that MHnS did not have access to recent KVL monitoring data as part of this assessment. The City of Toronto has indicated that there are site specific site boundary criteria and triggers for groundwater compliance for the KVL.

3.5.3.5 Sewage System, Other Approvals

The storm water system is subject to a separate ECA (originally 3-0029-94-006 Sewage). The system includes stormwater management ponds in the Primary Buffer Area more than 400 m south of the Teston Road right-of-way, both east and west of the approximate approved limit of waste and ponds on the golf course. It is not known if the golf course ponds are used for landfill-related work or for irrigation of the golf course, but they are included on the ECA as these lands are part of the overall site area (see Section 3.5.3.1).

The City of Toronto has advised that the northern flank of the Keele Valley Landfill Site was designed to facilitate stormwater management of the site. This slope was re-engineered in the 1990s to incorporate gravel swales as part of the site's integrated storm management system.

The landfill gas flare system is subject to a separate ECA (originally .8-3097-86-876 Air). The waste, air, and sewage ECAs are being considered for consolidation into a single approval. See the Soil, Waste and Landfill Gas report for more information.

3.5.3.6 Closure Plan

The KVL began operation in 1983 and remained in operation until 2002. During this time, KVL accepted 28.1 million tonnes of domestic, commercial and industrial waste, including biomedical waste and asbestos.

A key amendment to the ECA was the December 20, 2006, Notice of Amendment #35 which incorporates the Closure Plan and long-term site maintenance, monitoring and management requirements. The Closure Plan "Closure Plan, Keele Valley Landfill Site, Volumes I and II" dated December 2005, reissued April 18, 2006, as amended December 13, 2006 was prepared by Conestoga-Rovers & Associates and detailed the approach to end use planning, closure procedures, final cover, liner performance, groundwater performance, leachate collection system and management, surface water management, landfill gas management, record keeping and reporting and contingency planning.

The Closure Plan has the following relevant text regarding the Primary Buffer Area:

> *The operations and maintenance of the systems installed in the primary buffer will restrict public use of the primary buffer areas to the KVL as long as these systems are required. The leachate, purge water, and landfill gas management systems incorporate buried piping and related appurtenances throughout the primary buffer lands surrounding the fill areas. The contaminating lifespan of the KVL is currently projected to be greater than 100 years in duration. The City will require continued and unobstructed access to all of the engineered systems through this entire period.*
>
> *The northern perimeter of the KVL does not have any extensive primary buffer because the closed Vaughan Landfill immediately abuts the Teston Road right-of-way.*
>
> *No permanent use of the lands that in any way restricts post-closure operating and maintenance activities for the KVL, including any contingency measures that may be contemplated, will be permitted during the contaminating life of the KVL.*

The placement of the final cover soils commenced in 1995 and was completed by 2005. The final cover of the landfill is approximately 1 m thick (Golder, 2018b).

3.6 Water Investigation

3.6.1 Groundwater Monitoring

Five monitoring wells were installed as part of the concurrent geotechnical and hydrogeological investigations, at locations shown on **Figure 8** in **Appendix A**. Monitoring well construction details are provided in the borehole logs in **Appendix C**. These were monitored for groundwater levels on March 28, 2023. Monitoring wells MH-BH2 and MH-BH3 were found to be dry, while A22-3 was inaccessible due to a thick layer of mud. The groundwater level was measured at 0.28 meters below ground surface in A22-2 and 0.25 meters above ground surface in C1.

3.6.2 Horizontal Hydraulic Conductivity

The horizontal hydraulic conductivities of monitoring wells A22-2 and C1 were calculated from the data collected during the rising head hydraulic conductivity test (bailer test) conducted on March 29, 2023. The horizontal hydraulic conductivity was calculated to be 8.5×10^{-7} meters per second (m/s) in monitoring well A22-2 and 8.8×10^{-6} m/s in C1.

3.6.3 Water Inspection and Sampling

MHnS collected water samples from two monitoring wells A22-2 and C1 on March 29, 2023. All the analytical results are summarized in Table B1 and Table B2 in **Appendix B** and are illustrated on **Figure 8** under **Appendix A**. Laboratory Certificates of Analysis are provided in **Appendix D**.

The analytical results for metals were compared to the PWQOs and York Region Sewer-Use Bylaw. The summary of the exceedances is described below:

- Sample from both wells exceeded PWQOs for cobalt, copper, iron, lead, molybdenum, vanadium and/or zinc.
- Samples from both wells exceeded the York Region Bylaw for total suspended solids (TSS), compared against both storm and sanitary sewer use guidelines.

Elevated TSS in the samples indicates that, despite the use of low-flow sampling techniques, some sediment was entrained in the water, as it was collected into the sample bottles. The elevated metals concentrations, relative to PWQO, likely reflects the presence of this sediment.

4. IMPACT ASSESSMENT

Impact assessment was carried out for all receptors within 500 m of the proposed construction. Impacts of potential waste and landfill gas in the ground are assessed in the Soil, Waste and Landfill Gas Study Report under separate cover.

4.1 Description of the Project

The proposed improvements include realignment and widening of Teston Road between Keele Street and about 500 m east of Keele Street, constructing a new segment of Teston Road from 500m east of Keele Street to Dufferin Street, and widening and rehabilitation of Teston Road between Dufferin Street and Bathurst Street (Project Area).

Teston Road is proposed to cross the East Branch of the Don River at 3+036 (centreline) approximately 14 m above original grade, and significant grade raise is required for this from 2+700 to 3+300. The grade raise will be achieved by embankments, a mechanically stabilized earth wall with precast concrete facing (2+290 to 3+100, approximately, but not including the bridge span), and a 45 m long (40 m clear opening between abutments), single-span bridge. Spread footings are proposed for the MSE wall and the bridge and based on the preliminary general arrangement drawing for the bridge, these are proposed to be not significantly below the original ground.

At the other crossing of the East Branch of the Don River (McNair Creek east of Dufferin Street, at 4+600), an existing box culvert will have minor modifications to accommodate grading impacts (headwall and wingwall installation).

Storm sewers will be constructed beneath the road effectively across the entire alignment, generally at depths ranging between 4 and 6 m. A stormwater management area is proposed just southwest of the intersection of Keele Street and Teston Road, which will accept runoff from west of the height of land at 2+250. Underground storage (in pipes/chambers of larger diameter) of stormwater is proposed east and west of the Tributary of the East Branch of the Don River. These will be built effectively within the proposed embankment, and will not require significant subsurface work.

Underground storage of stormwater is also proposed west of the box culvert in the east segment of the alignment. At 4+450, the invert of this storage chamber will be approximately 12 m below original ground, which represents the deepest excavation in the project.

Section 2 of the project (Rodinea Road to the West Edge of the Valley), is the section through the landfill area. Two cross-sections were considered for the extension of Teston Road within Section 2. The first cross-section is a full width (36.0 m right-of-way) four-lane road section with curbs, sidewalks and cycle tracks on both north and south sides. The second is a smaller cross-section with only a multi-use pathway on the north side of Teston Road that could allow the roadway to pass between the landfills to the north and south with minimal impacts (see the interim cross section in the IEA report). The full width cross-section was selected for longer term implementation with the narrower cross-section selected for initial implementation to minimize impacts to the landfills.

The narrower interim cross section has approximately 6.8 m width of pavement on the south side of centreline, followed by curb and 1.8 m boulevard. This leaves approximately 9 m of land

between the south edge of the boulevard and the southern edge of the ultimate 36.0 m right-of-way, and typically approximately 1 m between the south edge of boulevard and the existing KVL fence line. It is understood that the preferred design for the initial implementation will not interfere with the majority of the current northern fenceline for the KVL (except along the northwest edge of the KVL where the proposed Teston Road widens to accommodate a westbound left-turn lane approaching Rodinea Road). It is a basic assumption of this impact assessment that wherever the northern fence line remains where it is, there will be no change in the way the City of Toronto is able to access and use the landfill infrastructure.

4.1.1 Preliminary Description of Dewatering

The majority of the proposed infrastructure will be above the water table however dewatering will likely be required at the bridge crossing of the East Branch of the Don River at 3+036

(centreline), and potentially at the other (culvert) crossing at 4+600. WSP (2023) drilled four geotechnical boreholes (22-1 to 22-4) at the bridge crossing and one geotechnical borehole (C1) at the culvert crossing and installed a monitoring well/piezometer in C1. The sub-soil conditions encountered along the alignment generally consisted of fill material underlain by silty sand and sandy silt. Localized deposits of glacial till were encountered on the east slopes of the valley. Groundwater in the valley floor was found at varying depths and as shallow as 0.9 m. Groundwater at the culvert crossing was found at ground surface.

In commenting on groundwater control during construction, WSP stated that the bridge footings would be within the engineered fill above the water table and that dewatering is not expected to be required. It is noted, however, that the design of the bridge is preliminary, and the actual depth of the spread footings is not finalized. It is prudent to consider that dewatering of silty sand and lowering of the water table by up to two metres may be required. Grain size analysis contained in WSP (2023), when analysed using the Hazen method (where K (in m/s) is estimated as $0.01D_{10}$ (in mm), see Craig1987) suggest a typical hydraulic conductivity for the silty sand of 3x10-5 m/s or less. Dewatering of this extent would typically require registration of the water taking activity on the Environmental Activity and Sector Registry (EASR). Water table lowering of 2 m in these types of soils would, when analysed using the method of Sichart and Kryieleis in Powers et al., 2007 [where the radius of influence, R_5, is estimated by multiplying the drawdown, s (in m), by the square root of the hydraulic conductivity, K, (in m/s)], typically have a radius of influence of much less than 100 m.

In commenting on the groundwater control during construction, WSP stated that dewatering will be necessary for construction on the existing culvert at 4+600. Considering the smaller extent of the works proposed at this site, relative to the bridge site, and considering the similarity in soils, the same approximate calculations that were discussed above for the bridge site also apply to the culvert site.

Detailed dewatering calculations to determine flow rate and radius of influence will be required during detailed design. Measures for environmental protection during dewatering will be built into the requirements for registering the activity on the EASR.

4.2 MECP D-Series Guidelines on Land Use and Compatibility

MECP maintains a series of guides and resources that summarize environmental considerations and requirements for industrial land use, sensitive lands, sewage and water services, and private wells. The D-Series Guidelines include the following most relevant documents:

- **D-1 Land Use and Compatibility** which is a guide for land use planning authorities on how to decide whether new development or land uses are appropriate to protect people and the environment.
- **D-1-1 Land Use Compatibility: Procedure for Implementation** which is a guide for land use planning authorities on how to protect people and the environment from the nuisance impacts from facilities like landfills, sewage treatment plants and factories through land use planning tools.
- **D-1-2 Land Use Compatibility: Specific Applications** which is a supplementary document to D-1, outlining the publications that can be referenced for specific examples.
- **D-1-3 Land Use Compatibility: Definitions** which is a supplementary document to D-1 and provides definitions to the related terms of land use compatibility.
- **D-4 Land Use on or Near Landfills and Dumps** which is a guide for land use planning authorities on how to decide what types of land uses are appropriate near landfilled waste. As noted within it, D-4 “specifies restrictions and controls on land use that the Ministry wishes to see implemented in the vicinity of landfills and dumps, in order to protect the health, safety, convenience and welfare of residents near such facilities”.

The D-Series Guidelines provide roles and responsibilities for proponents of projects, approval agencies and the Ministry. Guideline D-1 indicates the importance of various buffers (whose definition is provided in D-1-3) to prevent or minimize 'adverse effects'. Section 3.4 of Guideline D-1 describes “irreconcilable incompatibilities” as “when impacts from discharges and other compatibility problems cannot be reasonably mitigated or prevented to the level of a trivial impact” (defined in D-1-3), and states that new development causing as much “shall not be permitted”.

Guideline D-1-1 provides more information on buffers including on their purpose “to minimize or prevent adverse effects associated with facilities” and type. The guideline states that “in addition to separation distance, adverse effects may be able to be minimized or prevented at the site-specific planning stage by incorporating other buffering techniques”. The guideline goes on to state that “other types of buffers, on a case-by-case basis, may include berms, walls, fences, vegetation, and/or location and orientation of buildings and activity areas” and that “this list is not all-inclusive, and one or a number of combinations might be used to achieve the desired results”.

Of relevance to the current project is the guidance in D-4 on land use within 30 m of a fill area of a non-operating site. Specifically, Section 5.2.2 states the following:

> *“Where technical controls for leachate, or leachate and gas are required surrounding a fill area, no land use may take place within 30 metres of its perimeter. This distance may be reduced to 20 metres in cases where only gas controls are necessary.”*

With this background information in mind, it is clear that special care must be taken by the Region in planning, design, construction and operation of the current project to avoid landfill-related adverse effects, and to protect from the landfills "the health, safety, convenience and welfare" of residents and indeed all people. It is also clear that it is the Region's responsibility to consider various ways to reasonably mitigate or prevent "irreconcilable incompatibilities" even if the first line of defense, being a buffer of 30 m from the fill area, cannot be achieved.

As noted by Golder (2018a and 2018b), in reporting on the end use feasibility and remedial options for, respectively, the Vaughan Township Landfill Site and the Keele Valley Landfill Site, there are many closed landfills in Canada and the United States that have been successfully redeveloped for a range of recreational end uses, incorporating the required engineered control measures and design approaches to achieve an acceptable level of risk to allow public access. Golder goes on to state that there "are numerous examples of where mitigation measures have been successfully applied to both expedite and enable recreational (and other) end use development at a closed municipal solid waste landfill."

4.3 Involvement of the MECP

As described in the following sub-sections, mitigation of incompatibilities will likely require changes to landfill infrastructure and lands that are governed under various ECAs. Such changes as are recommended in this report are considered feasible by the authors and are further evaluated through the impact assessment process described in the main IEA report.

As part of the IEA, it is expected that MECP will provide comments on the feasibility of the proposed changes. The specifics of the changes will require approval by MECP by proponent-driven amendment of the relevant ECAs. Applications for amendments to an ECA are typically prepared by the owner of the landfill.

It is useful to know that the MECP has commented on the process to redevelop these (VL and KVL) closed landfills lands before. This happened during studies that were done to assess the feasibility of potential recreational end uses on the lands (Golder, 2018a and 2018b). The study reports indicated the following:

> *At a consultation meeting with the Ministry of the Environment and Climate Change (Ministry, or MOECC) to discuss and confirm the approvals requirements for implementing an end use plan for the VTLS, the Ministry indicated that the implementation of the proposed end use will require submission of an application for the amendment of the CofA including a Closure and End Use Plan report, supported by technical documents that: i) describe the proposed end use; ii) present the proposed modifications to (the landfill) infrastructure; iii) demonstrate that the site can perform acceptably in terms of environmental effects; and iv) show that allowing public access to the (landfill) poses an acceptable level of risk.*

4.4 Impacts on Landfills

This section describes the potential hydrogeological impacts of the project on the three closed landfills. The reader is reminded that an assessment of impacts related to waste and landfill gas is made in an accompanying report (see Section 1).

Each of the closed landfills are regulated under an Environmental Compliance Approval (ECA) and are subject to the conditions of the ECA, as well as requirements under Section 46 of the

Environmental Protection Act. Almost any change that could be contemplated for these lands as part of the Teston Road project, including the taking of land from them, will eventually require MECP approval by way of an ECA amendment. To sum up this requirement, the design and construction of the project must ensure that it does not in any way restrict post-closure operating and maintenance activities for the landfill, including any contingency measures that may be contemplated, during its contaminating lifespan.

With one small exception that is addressed in the Soil, Waste and Landfill Gas report, the proposed road improvements do not extend onto landfill final cover materials and are not expected to impact the function of the landfill final cover. Of the three closed landfills, only the KVL is lined, and no impacts to that liner are ancicipated.

4.4.1 Disposal Services Landfill

Potential impacts to the Disposal Services Landfill (DSL) from the proposed road improvements are as follows:

- Landfill infrastructure including monitoring wells (specifically MW10/GP10-19) and leachate collection piping and storage tank are not in direct conflict with the project however these shall be protected during construction, as appropriate. These discharge to a maintenance hole (MH3) on the existing Teston Road (see **Figure 7a**) which would be incorporated into the improvements to this area.
- The slight possibility of waste being encountered at the south end of the DSL is addressed in the Soil, Waste and Landfill Gas report, and removal of such waste, if any, is considered the most likely option to mitigate this concern. The minor impact of this waste removal on the landfill cover is considered negligible from a hydrogeological perspective.

4.4.2 Vaughan Landfill

Potential impacts to the Vaughan Landfill (VL) from the proposed road improvements are as follows:

- The Vaughan Landfill Chloride Plume, a chloride contamination plume, exists in the groundwater below the VL approximately below 260 masl. The road improvements will reduce the perviousness of the area and may result in slightly reduced groundwater recharge to the aquifer, which could slightly increase the chloride plume concentrations.

  Across the 1 km width of this plume, and assuming a 20 m wide hard surfacing, approximately 2 hectares of land would run off via storm sewers to the creek rather than flowing overland and/or infiltrating as it likely now does. Taking a daily precipitation of 2.3 mm per day and assuming the infiltration rate will drop from 50% (for undeveloped well vegetated land in a sandy upland) to zero, approximately 23 cubic metres of recharge would be lost each day by the construction of the road. That is to say, the combined volume of water pumped fom the TPWS and SPWS might reduce by about 2% and/or the landfill indicator parameter concentrations in that water might increase by about the same factor. This level of increase in plume concentrations will likely be impercepible in the monitoring program for the landfill.
- The possibility of waste being encountered at the southwest corner of the VL is addressed in the Soil, Waste and Landfill Gas report, and removal of such waste, if any, is considered the most likely option to mitigate this concern. The minor impact of this

waste removal on the landfill cover is considered negligible from a hydrogeological perspective.

- The proposed road improvements will most likely result in the use of salt-application in the winters which, if not properly managed, could potentially contribute to (increase) the chloride plume concentrations. It is expected that the road runoff will be collected in storm drains, which should remove most of the chloride from the groundwater environment. Storm drains should be designed to minimize leakage of storm water from the storm drains into the subsurface. Storm drain outlets, particularly if they are designed to encourage infiltration, should be located outside the area of the chloride plumes (see **Figure 7**).
- The groundwater dewatering associated with the proposed bridge constuction across the valley east of VL may slightly and temporarily influence the groundwater flow which could, in theory, slightly and temporarily affect the movement of the chloride plume. Significant impacts on the plume are considered unlikely given the more than 300 m distance between the future bridge and the existing plume and the fact that dewatering of a few metres is highly unlikely to have a radius of influence of more than 100 m in silty sand soil (see Section 4.1.1). The annual monitoring program can verify that this is the case.
- Based on the proposed relatively shallow depth of storm sewers, it is unlikely that the associated excavation will intercept any leachate from the landfill.
- The transfer of property from the VL to the Teston Road allowance may be required, which will require an amendment to the ECA.

4.4.3 Keele Valley Landfill

Potential impacts to the KVL due to the proposed road improvements are as follows:

- The purge wells and observation wells of the TPWS are well outside the limit of grading and access to these for monitoring and maintenance will be unaffected by the project. There are no direct conflicts with these purge wells, however they may be impacted by ground disturbance associated with the construction and excavation activities.
- A leachate collection main runs underneath the proposed road in a north-south orientation between 21 Rodinea Road and KVL which may be impacted by ground disturbance associated with the construction and excavation activities.
- The preferred design for the initial implementation will cause construction on or within metres of the following observation wells:
  - 3/92 which is at the south end of the DSL, possibly at the north edge of grading for the project (see **Figure 7a**). This may require protection during construction.
  - 8/83, 7/83, and 9/83 all three of which are at or just south of the north perimeter road (see **Figure 7b**). These may require protection during construction.
  - 16/88 and 17/88 both of which are north of the KVL perimeter road, seemingly right at the fence line (see **Figure 7c**). These are metres from the proposed south curb of the road and may be difficult to protect during construction although short retaining walls along the back of boulevards may avoid encroachment to these monitoring wells.
  - 4/91 and 13/84 which are northeast of the approximate approved limit of waste and the perimeter road, at the northeast corner of primary buffer area (see **Figure 7c**). These may be within the cut and fill grading limits associated with the proposed roadway

however the use of retaining walls in these areas can be considered to avoid encroachment on these monitoring wells.

- Considering the large number of observation wells in the monitoring program and the well-established nature of the program, if one or more observation wells are in conflict with the project, with careful consideration and planning, deletion of or relocation of these observation wells to a safe distance from the proposed road may be a reasonable solution. Any changes to the monitoring program will require amendments to the ECA under which the KVL operates.

- The preferred design for the initial implementation will cause construction to occur within metres of at least one leachate collection maintenance access chamber (see the theoretical and most likely locations shown on **Figures 7b** and **7c**). Mitigation measures for the protection of this infrastructure are recommended in Section 5.1.
- The transfer of property from the KVL to the Teston Road allowance may be required, which will require an amendment to the ECA.

4.5 Impact on Wells & Aquifers

4.5.1 Water Levels & Well Yields

Well yields are sometimes negatively affected by temporary or permanent lowering of the groundwater level in aquifers. Temporary groundwater level lowering is typically associated with construction dewatering when excavations are pumped to keep them dry and safe for workers. Permanent groundwater level lowering is commonly associated with permanent topographic changes, such as when deep rock cuts are blasted for highway construction. Permanent groundwater level lowering can also result from permanent major groundwater takings (for irrigation, industry, etc.), and from drainage at sumps (in mines, quarries, etc.) and foundations. Permanent groundwater level lowering may also be associated with reduced recharge of aquifers caused by development and associated increased imperviousness.

As noted above, a small number of water wells may still be in use, particularly east of the valley. The impact of road improvements on these well yields, if in use at all, will depend on the specifics such as distance from the road, depth of well, etc. A desktop and potentially in-field well survey is recommended at a later design stage, to determine these details. The availability of municipal water supply throughout the study area tends to mitigate risk related to water wells and provide a ready contingency in the event of well impacts.

4.5.2 Water Quality

Water quality in aquifers and wells may be negatively affected by introduced contaminant sources, by mobilization of existing contaminant sources and by ground movement. During construction, introduced contaminant sources may include degraded surface water caused by poor erosion and sediment control, and fuel and chemical spills from construction equipment. The risk of aquifer and well contamination due to these possible sources of contamination must be managed through proper construction practices and mitigation measures as set out in Section 5.

The main contaminant sources of concern in this study area are the three closed landfills. Mobilization of these existing contaminant sources is addressed in detail in Section 4.4. The risk that the increased imperviousness associated with the roadway will affect concentrations in the groundwater plumes being monitored is considered low. Similarly, the risk that construction

dewatering at the crossing of the Don River, East Branch will impact plume concentrations is considered low.

Following construction, improper use of road de-icing materials may result in impairment of groundwater quality in previously undeveloped areas. These risks are managed through proper design and by following best management practices for road de-icing.

Overall, there will be minimal temporary and residual effects to the groundwater quality resulting from the project.

4.6 Impact on Surface Water

4.6.1 Surface Water Flow Amounts

Flow amounts in surface water may be affected by temporary or permanent changes in groundwater discharge rate or location. Dewatering at a bridge abutment, for example, may temporarily change the way groundwater discharges into a stream bed, or may result in greater volumes of groundwater being discharged than would occur naturally. Generally, these are minor changes and temporary, with negligible impact on surface water flow.

Given the potential for construction dewatering in select areas of the project there is some potential for temporary changes to the groundwater discharge to the tributaries of the Don River East Branch and in the smaller watercourses. Given the small size of the areas that will be dewatered and the short duration, such impacts are likely to be minor. Regardless, impacts will be managed through mitigation measures developed as part of permitting for the water taking. Erosion and sedimentation caused by dewatering discharge should be controlled by proper construction practices.

In the naturalized part of the study area (the landfill area and the valley), a small reduction in groundwater recharge can be expected due to the paving of a currently naturalized area. Ordinarily, and depending on the length of the flow path, such recharge would eventually become groundwater discharge/baseflow at a water course. In this case, however, the vast majority of the recharge that will be lost (redirected to surface water via storm sewers) is currently being captured by the two purge well systems and sent to sanitary sewer. Thus, there is no negative impact to the environment from this change.

Outside the naturalized part of the study area (the industrial and residential areas), the loss of recharge from hard surfacing is expected to be offset through low-impact-development (LID) methods.

4.6.2 Surface Water Quality

Water quality in surface water can sometimes be affected by changes in the rate of groundwater discharge, by changes in the quality of groundwater discharge, or by contaminants introduced by way of a dewatering system.

As noted above, the rate of groundwater discharge to local surface water features is not expected to change due to the project and the risk of a groundwater-related change to surface water quality is considered negligible.

If groundwater becomes contaminated due to construction operations (e.g., vehicle refueling), then this contamination will tend to be discharged into the surface water either naturally as groundwater discharge or via the dewatering system. The risk of releases of hydrocarbons (diesel, gas, or hydraulic oil) can be minimized or managed by implementing prevention measures discussed in Section 5.

4.7 Impact on Structures

Structures can be affected by settlement caused by soil consolidation related to groundwater level lowering. Generally, this is a concern where structures are founded on thick clay deposits, which are permanently dewatered (by under-draining, for example).

The overburden material within the Project Area does consist of silt and clay components but there are no elements of the project (significant road cuts, deep sewers, etc.) with the potential to cause permanent lowering of the water table.

Impacts on structures from dewatering will be evaluated as part of the permitting of these activities.

4.8 Impact on Ecology

There is a Provincially Significant Wetland, other wetlands, swamps, and surface water features connected to the construction area. The minor changes in hydrogeology associated with the hard surfacing and the temporary construction dewatering are not anticipated to have any impact on ecology. Notwithstanding, additional impact assessment will occur as part of the permitting process for any construction dewatering.

5. ENVIRONMENTAL PROTECTION/MITIGATION

5.1 Mitigation Measures for Impacts to Landfill Infrastructure

All the conflicts identified with the VL, KVL and DSL infrastructure should be communicated to the landfill owners. Although the current study finds these conflicts to be relatively minor (see Section 4.4), detailed assessment of the severity of the conflict and the appropriate mitigation measures is recommended in later design stages. It is important to note that the design and construction of the Teston Road project can not in any way restrict post-closure operating and maintenance activities for these landfills, including any contingency measures that may be contemplated, during their contaminating lifespan.

Any transfer of property from the landfill property and/or any changes to the landfill infrastructure will require amendments to the ECA under which the affected landfill operates. As part of consultation for the EA, MECP suggested two possible paths for ECA amendment, assuming that a parcel of land is transferred from a landfill owner to the York Region for construction of the Teston Road project. In the first method, the transferred lands would be severed from the ECA (i.e., are removed from the waste or buffer area) and the owner of the landfill would submit an application with supporting information to demonstrate that the transferred lands are no longer required for long-term landfill operations. In the second method, the transferred lands would not be severed from the ECA and the owner of the landfill would submit an application with supporting information to demonstrate that their new use (as a publicly-accessible roadway, for example) is compatible with long-term landfill operations. In this example, the York Region, as owners of the transferred lands, would have responsibilities under the ECA, and would be added as a party to it.

ECAs for these landfills are complex and have been developed over several decades. Significant collaboration between York Region and the landfill owners will be required to undertake the design of any necessary changes to landfill infrastructure or operating procedures and to prepare the ECA applications for approval by MECP. ECA applications are typically prepared by the owner of the landfill, and this is recommended in this case. Typical minimum turn-around time for ECA application review is one year.

In addition to any necessary amendments to ECA's amendments to the following agreements may also be necessary because of the project:

- An easement agreement between the Town of Vaughan and Metropolitan Toronto, established in 1983 by Instrument 320409.
- A transfer agreement between the City of Vaughan and Metropolitan Toronto for Part 9 and Part 10 of Reference Plan 65R-5832, established in 1996 by Instrument R675034.

The following are recommendations for assessing and mitigating specific and identified impacts to landfill infrastructure:

- Field studies should be carried out to determine the actual location of the leachate collection maintenance access chambers on the north side of the KVL waste, and these shall be protected during construction. If minor modifications are required, such as casing extension at the access chambers, these shall be incorporated into the project design to ensure compatibility with surrounding grades.

- The purge well leachate main should be protected during the construction activities and the proposed design should provide adequate protection against the dynamic load of future traffic on Teston Road. A subsurface utility investigation is recommended to determine the depth and condition of this pipe.
- The groundwater monitoring program for the KVL shall be re-assessed in light of the long record of monitoring available and in light of the fact that certain on-site groundwater monitoring wells may be impacted by the road improvements, as noted in Section 4.4.3. Strategies for the protection, repair, relocation or replacement of monitoring wells shall be developed, and these shall be incorporated into the design of the project, as necessary.

5.2 Other Mitigation Measures

- All storm drains between Keele Street and the Don River East Branch should be designed to minimize leakage of storm water from the storm drains into the subsurface.
- While the infiltration of storm water is a common practice for “Low Impact Development” or LID, it should not be included in the design of the current project between Keele Street and the Don River East Branch.
- Effective erosion and sediment control measures shall be put in place at all outfalls to prevent surface water contamination by sediment.
- Follow all Ontario regulations concerning the taking and discharging of water. This may include application for a permit to take water (PTTW), or registration in the Environmental Activity and Sector Registry (EASR), depending on the nature and duration of each taking. In either case, due to the presence of suspended solids with associated elevated total metals in groundwater, treatment of discharge from dewatering may be required prior to release to the environment.
- Develop and implement a Spill Management Plan (SMP) for all construction activities. The contractor will develop and implement the SMP to ensure the construction activities do not increase the risk of release of fuel, oils, or other hazardous materials to the environment which could impact the aquifer systems and/or surface water. The SMP will describe the procedures and equipment in place to minimize spills, leaks, or releases of hazardous materials. In addition, the plan will address the reporting and response procedures in the event of an incident.
- Perform a desktop and possibly a field survey to further identify in-use water wells within 500 m of the proposed road alignment. Inform all well users withing 500 m of the construction project and its potential effect on wells.
- In the event that property transfers are required, Record of Site Condition may also be required. The process for this typically starts with completion of a Phase One Environmental Site Assessment, and it is noted that seven of these were prepared as part of the IEA for 8 specific parcels. Groundwater sampling carried out as part of the current assessment did not specifically address the APECs and PCAs identified in these reports. It will be the responsibility of the Qualified Person filing for RSC to ensure that groundwater is properly considered under that process.

6. LIMITATIONS & USE

This report has been prepared for the exclusive use of The Regional Municipality of York (York Region), by Morrison Hershfield now Stantec. Morrison Hershfield now Stantec hereby disclaims any liability or responsibility to any person or party, other than York Region and any other user approved in writing by Morrison Hershfield now Stantec, for any loss, damage, expense, fines, or penalties which may arise from the use of any information or recommendations contained in this report by a third party.

The report, which specifically includes all tables, figures and appendices is based on data and information collected during investigations conducted by Morrison Hershfield now Stantec and is based solely on the conditions of the site at the time of the investigation, supplemented by historical information and data obtained by Morrison Hershfield now Stantec as described in this report.

Morrison Hershfield now Stantec has exercised professional judgment in collecting and analyzing the information and formulating recommendations based on the results of the study. The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to this study. No other warranty or representation, either expressed or implied, as to the accuracy of the information or recommendations included or intended in this report.

7. CLOSURE

We trust the above meets with your current requirements. Should you have any comments, questions, or require additional information, please do not hesitate to contact this office.

Respectfully submitted,

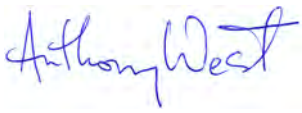
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Note: The majority of this report was written by Sarth Sheth before he left Stantec in April 2025. The report was finalized without edits in June 2025 and A. West signed on behalf of Mr. Sheth. Subsequent to that, small but important edits were made based on comments provided by the MECP District Engineer. Given the time since Mr. Sheth was last involved in the report, his signature block has been left blank.

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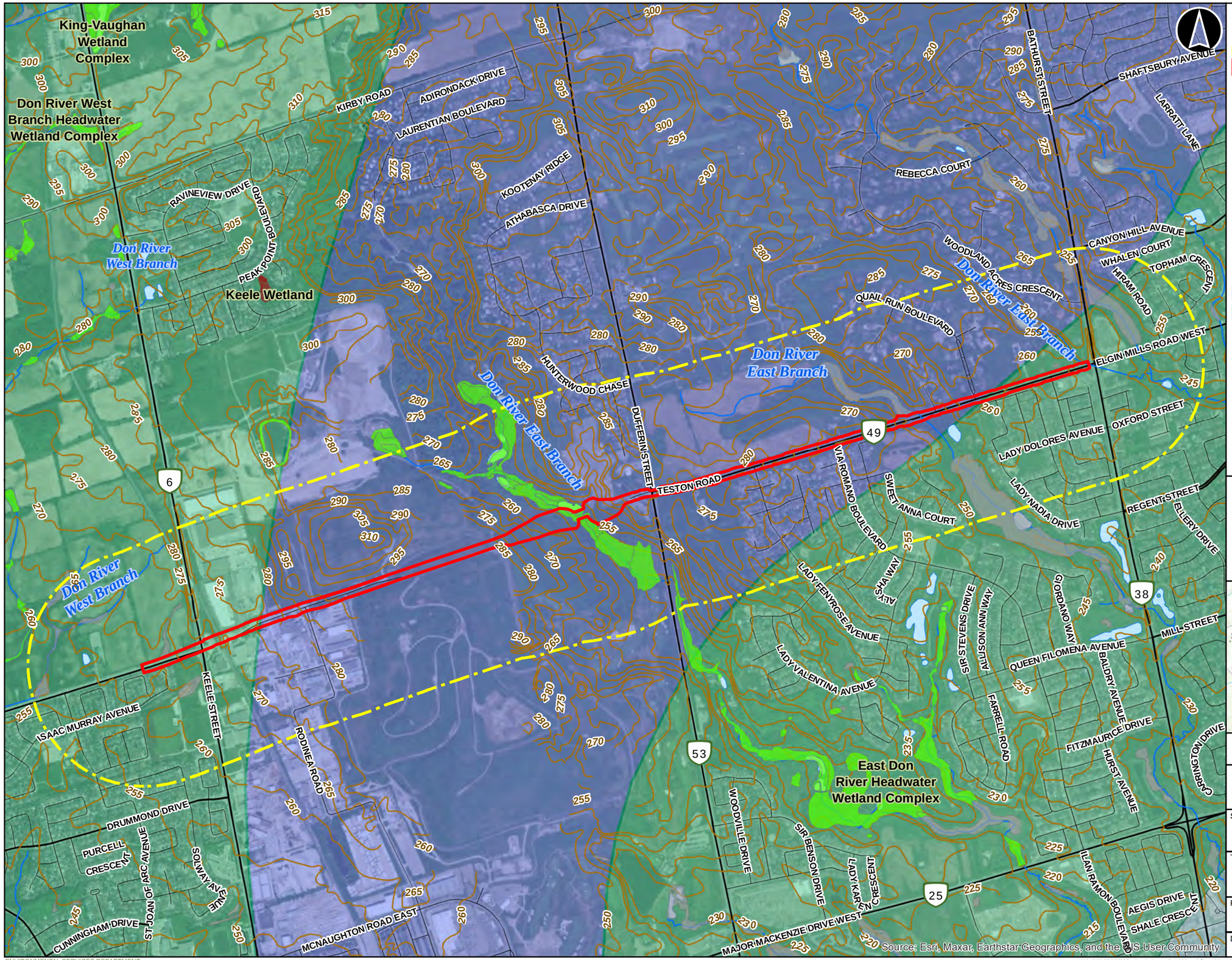
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APPENDIX A – Figures



LEGEND

- Study Area (500 m)
- Project Area

Geospatial Ontario (GEO)

- Contours (mASL)
- Watercourse
- Waterbodies

Wetlands

- Evaluated-Other Wetlands
- Evaluated-Provincially Significant Wetlands
- Unevaluated Wetlands

Physiographic Regions

- Bevelled Till Plains
- Oak Ridges Moraine
- South Slope

Transportation Network

- Arterial / Collector
- Local Roads

NOTES:

- The area shown is within the jurisdiction of the Ministry of Natural Resources (MNR) Aurora Midhurst Owen Sound District and theToronto and Region Conservation Authority Area



Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNR, ESRI Basemaps, Government of Canada

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

Stantec

SCALE: 1:16,000

0 125 250 500 750 1,000

Meters

TITLE:

Physiography and Topography

PROJECT NO.: 190261800

Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **March 2025**

Figure 1

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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King-Vaughan Wetland Complex

Don River West Branch Headwater Wetland Complex

Keele Wetland

East Don River Headwater Wetland Complex

KIRBY ROAD
RAVINEVIEW DRIVE
STAWAY VILLAGE VI
PEAK POINT BOULEVARD
ADIRONDACK DRIVE
LAURENTIAN BOULEVARD
KOOTENAY RIDGE
ATHABASCA DRIVE
DUFFERIN STREET
KEELE STREET
HUNTERWOOD CHASE
QUAIL RUN BOULEVARD
WOODLAND ACRES CRESCENT
BATHURST STREET
REBECCA COURT
SHAFTSBURY LANE
LARRATT LANE
CANYON HILL AVENUE
WHALEN COURT
TOPHAM CRESCENT
HIRAM ROAD
ELGIN MILLS ROAD WEST
TESTON ROAD
OXFORD STREET
LADY DOLORES AVENUE
LADY NADIA DRIVE
REGENT STREET
FILLEY DRIVE
VIA ROMANO BOULEVARD
SWEET ANNA COURT
LADY FENYROSE AVENUE
ALI HAI WAY
ALLISON ANN WAY
SIR STEVENS DRIVE
GIORDANO WAY
MILL STREET
QUEEN FILOMENA AVENUE
LADY VALENTINA AVENUE
BALDRY AVENUE
FARRELL ROAD
FITZMAURICE DRIVE
HURST AVENUE
GARRINGTON DRIVE
ISAAC MURRAY AVENUE
RODINEA ROAD
DRUMMOND DRIVE
PURCELL CRESCENT
ST JOAN OF ARC AVENUE
SOLWAY AVENUE
CUNNINGHAM DRIVE
FLETCHER DRIVE
MCNAUGHTON ROAD
MCNAUGHTON ROAD EAST
EAGLE ROCK WAY
WOODVILLE DRIVE
SIR BENSON DRIVE
LADY KAREN CRESCENT
VALLEY VISTA DRIVE
MAJOR MACKENZIE DRIVE WEST
ILAN RAMON BOULEVARD
AEGIS DRIVE
SHALE CRESCENT
A
A'
B
B'
53
25
38

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

LEGEND

- Study Area (500 m)
- Project Area
- Cross Sections (shown in white)
- MECP Wells in Provincial System

Land Information Ontario Data
- Watercourse
- Waterbodies
- Wooded Areas
- Environmentally Sensitive Areas
- Significant Forests
- Oak Ridge Moraine Conservation Plan Boundary
- ANSI, Earth Science
- Candidate ANSI, Life Science

Greenbelt Designation
- Protected Countryside
- Urban River Valley

Wetlands
- Evaluated-Provincially Significant Wetlands
- Evaluated-Other Wetlands
- Unevaluated Wetlands

Oak Ridge Moraine Conservation Plan
- Countryside Area
- Natural Core Area
- Natural Linkage Area
- Settlement Area

Transportation Network
- Arterial / Collector
- Local Roads

NOTES:
- The area shown is within the jurisdiction of the Ministry of Natural Resources and Forestry (MNRF) Aurora midhurst Owen Sound District and theToronto and Region Conservation Authority Area

1:1,000,000

Aurora, Richmond Hill, Vaughan, Markham, Pickering, Bolton, Brampton, 502m

Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNRF, ESRI Basemaps

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

SCALE: 1:16,000

0 125 250 500 750 1,000

Meters

TITLE:

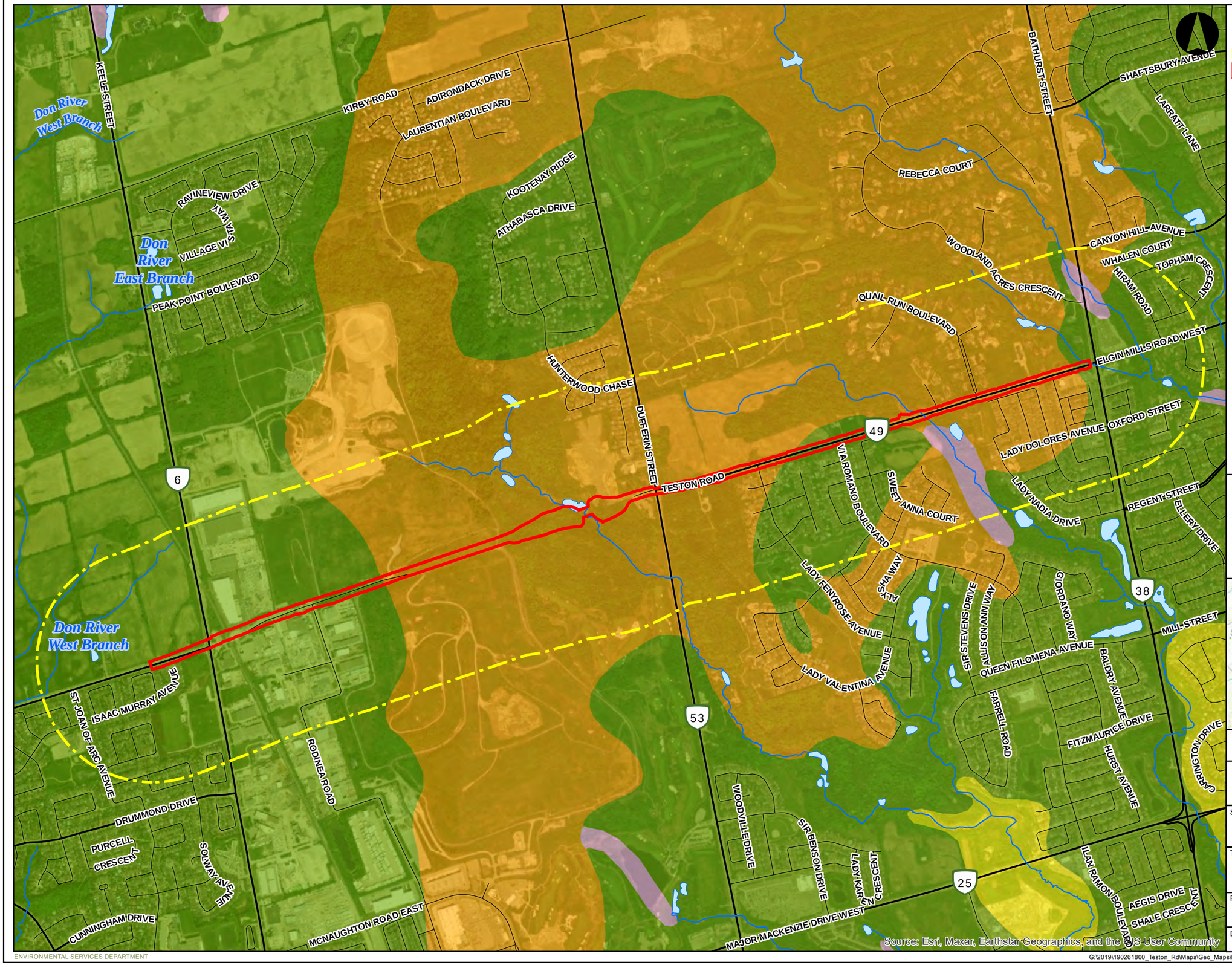
MECP Records

PROJECT NO.: 190261800

Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **March 2024**

Figure 2



LEGEND

- Study Area (500 m)
- Project Area

Surficial Geology

- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 9c: Foreshore-basinal deposits
- 20: Organic deposits

Land Information Ontario Data

- Watercourse
- Waterbodies

Transportation Network

- Arterial / Collector
- Local Roads

NOTES:

- The area shown is within the jurisdiction of the Ministry of Natural Resources and Forestry (MNRF) Aurora midhurst Owen Sound District and theToronto and Region Conservation Authority Area



Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNRF, ESRI Basemaps

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

SCALE: 1:16,000

0 125 250 500 750 1,000

Meters

TITLE:

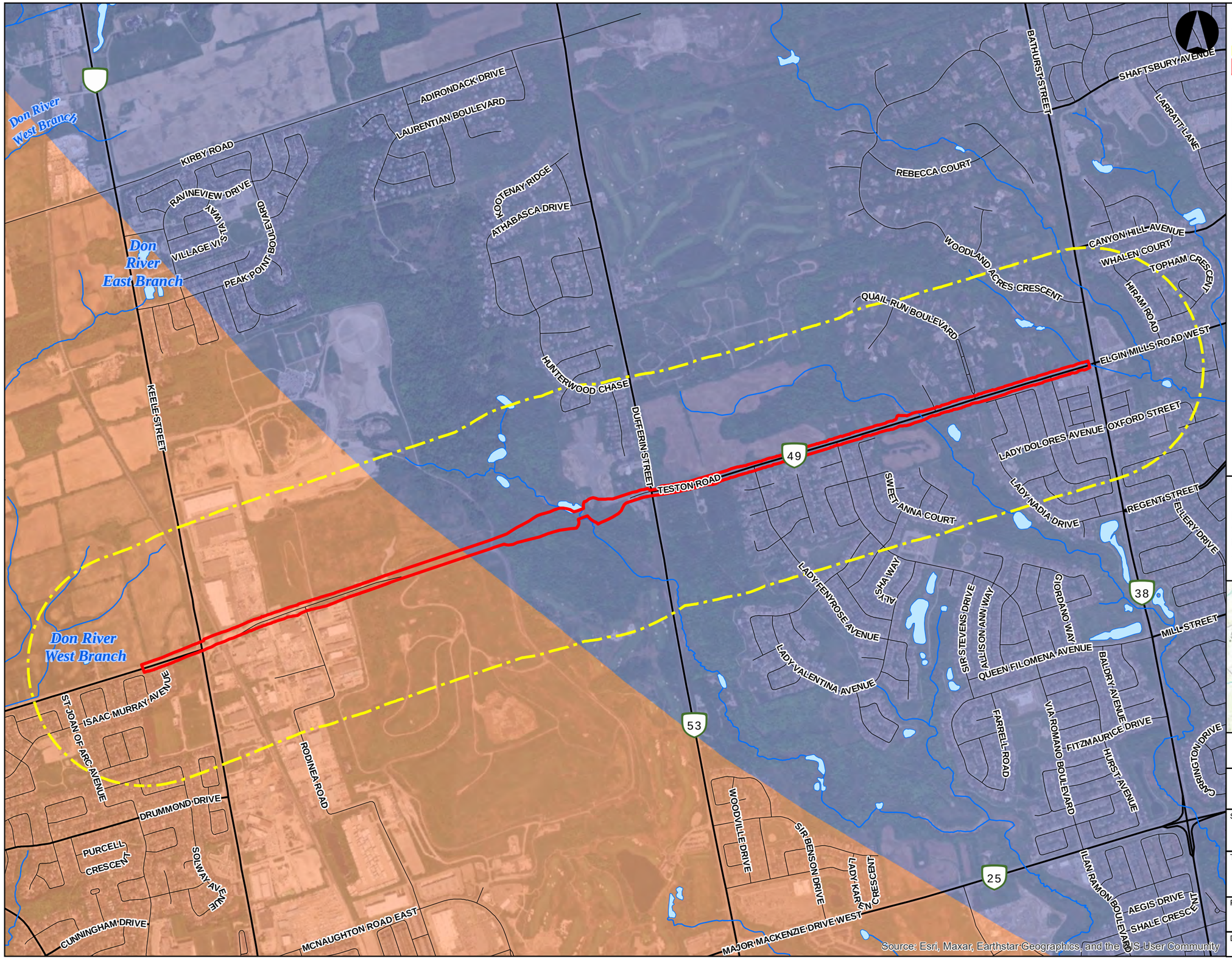
Surficial Geology

PROJECT NO.: 190261800

Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **April 2024**

Figure 3



LEGEND

- Study Area (500 m)
- Project Area

Bedrock Geology

- 14: Georgian Bay - shale
- 12: Blue Mountain - shale

Land Information Ontario Data

- Watercourse
- Waterbodies

Transportation Network

- Arterial / Collector
- Local Roads

NOTES:

- The area shown is within the jurisdiction of the Ministry of Natural Resources and Forestry (MNRF) Aurora midhurst Owen Sound District and theToronto and Region Conservation Authority Area



Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNRF, TRCA, ESRI Basemaps, York Region Official Plan, 2022.7
Map 7 - Vulnerable Aquifers Within the ORM Plan and Clean Water Act

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

SCALE: 1:16,000

0 125 250 500 750 1,000

Meters

TITLE:

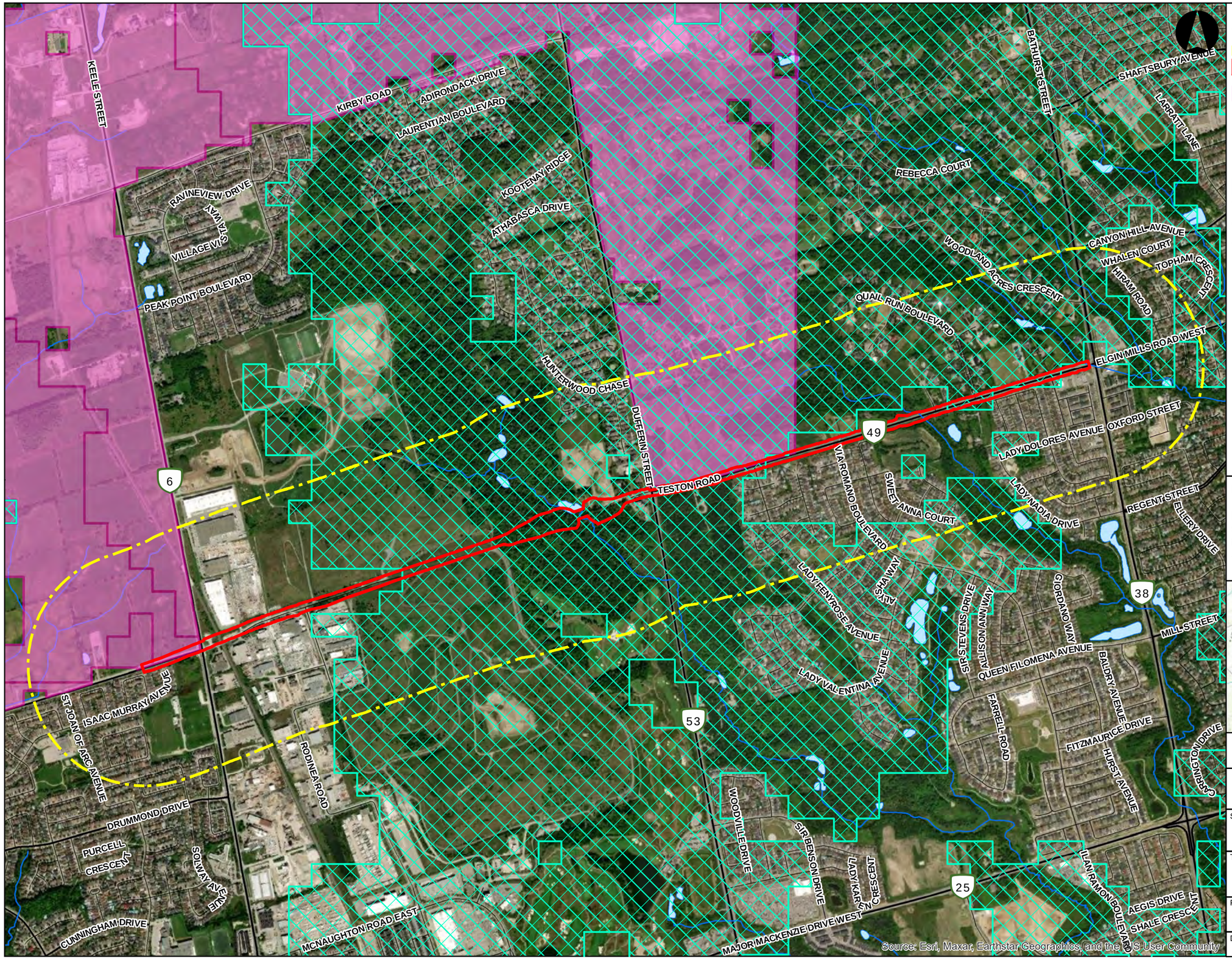
Bedrock Geology

PROJECT NO.: 190261800

Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **April 2024**

Figure 4



LEGEND

- Study Area (500 m)
- Project Area
- Significant Groundwater Recharge Area (SGRA)
- Highly Vulnerable Aquifers (HVA)

Land Information Ontario Data

- Watercourse
- Waterbodies

Transportation Network

- Arterial / Collector
- Local Roads

NOTES:

- The area shown is within the jurisdiction of the Ministry of Natural Resources and Forestry (MNRF) Aurora midhurst Owen Sound District and theToronto and Region Conservation Authority Area



Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNRF, TRCA, ESRI Basemaps, York Region

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

SCALE: 1:16,000

0 125 250 500 750 1,000

Meters

TITLE:

HVAs and SGRAs within Study Area

PROJECT NO.: 190261800

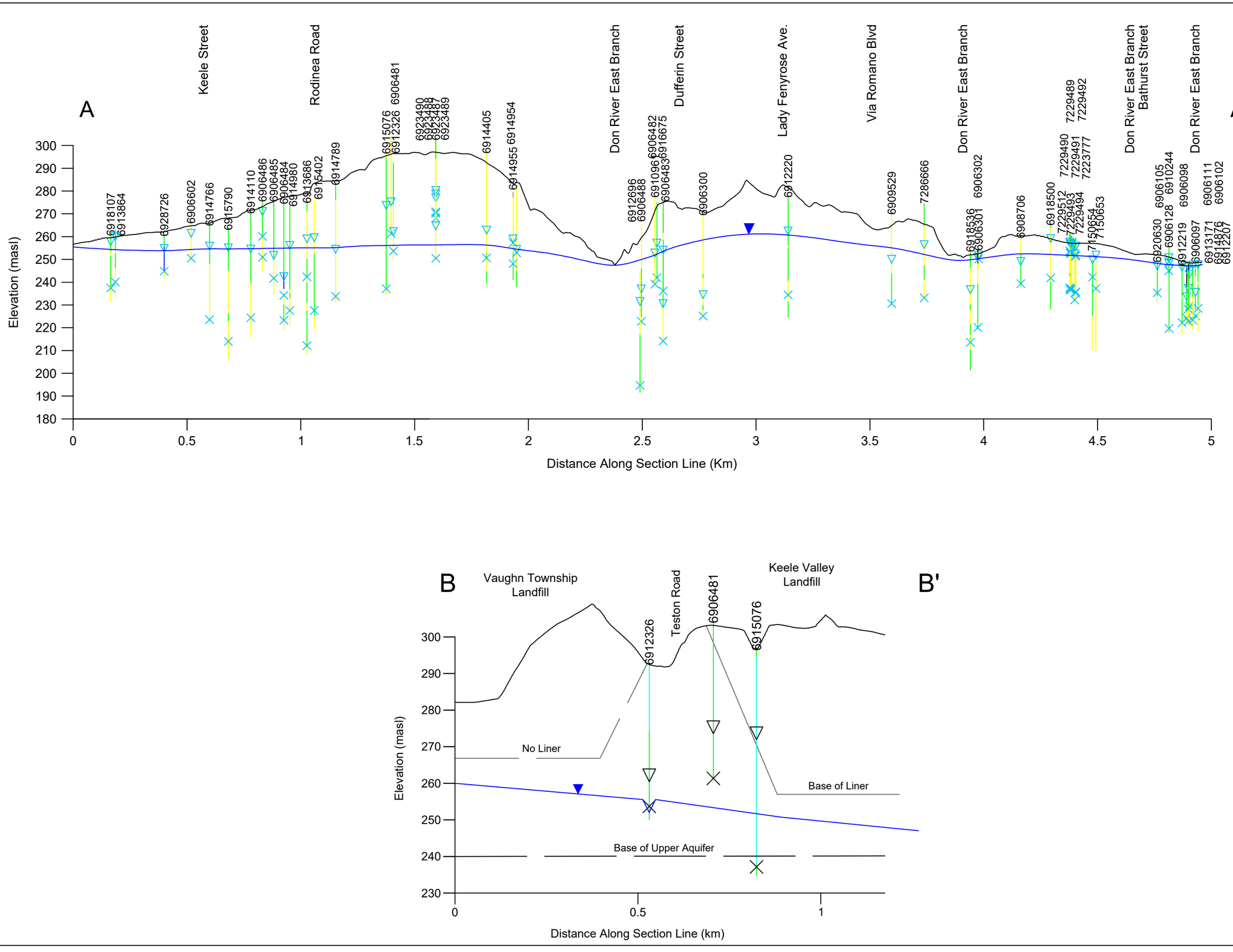
Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **March 2024**

Figure 5

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

G:\2019\190261800_Teston_Rd\Maps\Geo_Maps\DesignandWatercourse\April_2023_Proposed_Phase_I_ESA\May_2023\SGA_Mapping.mxd



LEGEND

- Silt and/or Clay
- Sand and/or Gravel
- Garbage/Fill
- Water Table or Deeper Potentiometric Surface
- Groundwater Elevation
- Elevation of Water Found

NOTES

Morrison Hershfield now Stantec

PROJECT:
Teston Road, Vaughn, Ontario,
(From Keele to Bathurst Street)

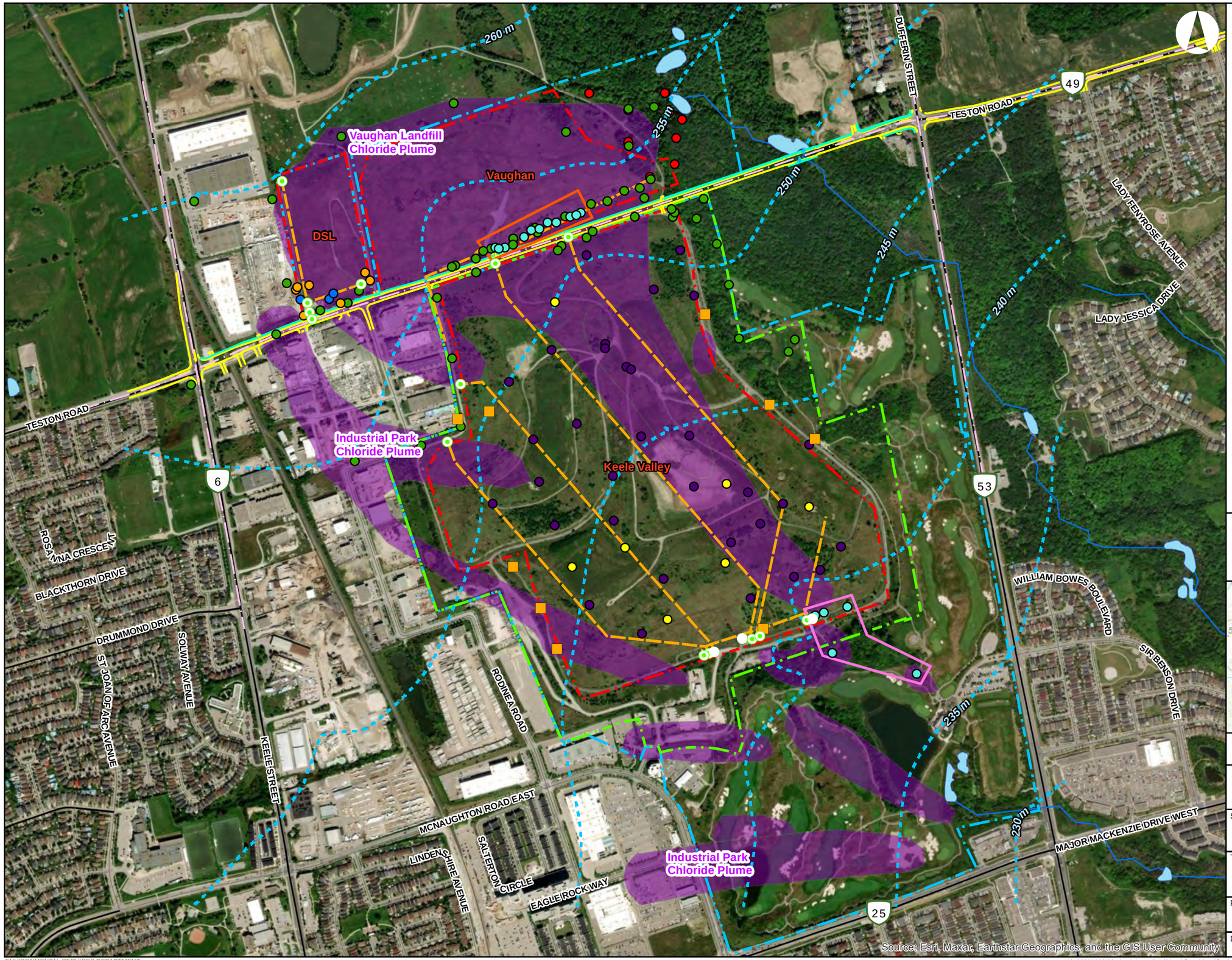
PREPARED FOR:
York Region

DESIGNED BY:	I.B
DRAWN BY:	N.M
CHECKED BY:	A.W
DATE:	March 2024
SCALE:	See axes
PROJECT NO:	190261800

TITLE:
Geological and Hydrogeological Cross-Sections

FIGURE NO:
6

\\EgnyteDrive\MH Cloud\Proj\2019\190261800-P-19-218-Teston Road IEA\08. Working\Contamination-Waste\Hydro G\Cross Sections\Nick\Teston_road_xsection update.dwg



LEGEND

- Instrumentation Monitoring Station (Approximate Location)
- Monitoring Wells (Other) (Approximate Location)
- Purge Well (Approximate Location)
- Sub-Liner Sampler (with VWP in Sampler Nest) (Approximate Location)
- Vibrating Wire Piezometer Above-Liner (Approximate Location)
- Disposal Services Landfill Monitoring Well/ Gas Probe (Approximate Location)
- Keele Valley Landfill Observation Wells (Approximate Location)
- Vaughan Landfill Groundwater Monitoring Wells (Approximate Location)
- Leachate Maintenance Hole or Cleanout (Approximate Location)
- Groundwater Contours (m) by Golder Associates
- Leachate Collection System Piping (Approximate Location)
- Approved Limit of Waste (Approximate)
- KVLS Primary Buffer Lands (Approximate Location)
- Landfill (including KVLS Secondary) Buffer Lands (Approximate Location)
- Chloride Plumes identified by Dixon Hydrogeology (Concentrations ranging from 15mg/L to 750mg/L)
- Southern Purge Well System (SPWS)
- Teston Road Purge Well System (TPWS)
- Waterbodies
- Watercourses

Design Features

- Edge of Pavement
- Proposed Multi-Use Pathway
- Proposed C/L

Transportation Network

- Arterial / Collector
- Local Roads

NOTES:

- The area shown is within the jurisdiction of the Ministry of Natural Resources (MNR) Aurora Midhurst Owen Sound District and the Toronto and Region Conservation Authority Area



Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNR, Golder, Dixon Hydrogeology

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

Stantec

SCALE: 1:10,000

0 60 120 240 360 480

Meters

TITLE:

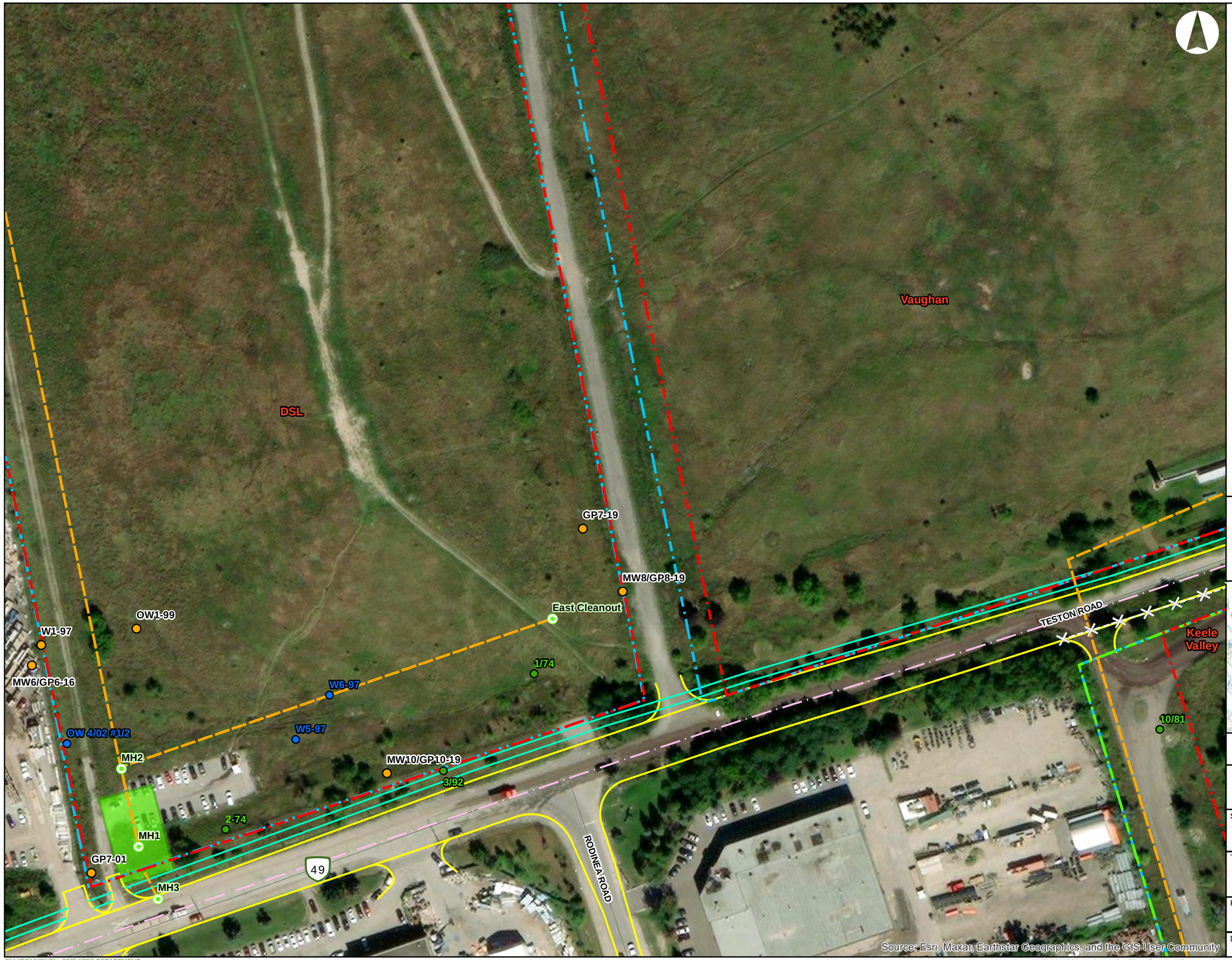
Landfill Infrastructure, Groundwater and Leachate Focus

PROJECT NO.: 190261800

Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **March 2025**

Figure 7



LEGEND

- Monitoring Wells (Other) (Approximate Location)
- Keele Valley Landfill Observation Wells (Approximate Location)
- Disposal Services Landfill Monitoring Well/ Gas Probe (Approximate Location)
- Leachate Maintenance Hole or Cleanout (Approximate Location)
- Leachate Collection System Piping (Approximate Location)
- North Fence of KVL (shown in white on map)
- Approved Limit of Waste (Approximate)
- KVLS Primary Buffer Lands (Approximate Location)
- Landfill (including KVLS Secondary) Buffer Lands (Approximate Location)
- Subsurface Leachate Storage Tank (Approximate Location)

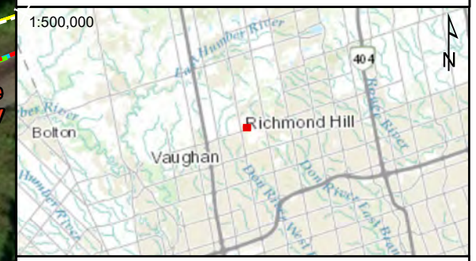
Design Features

- Edge of Pavement
- Proposed Multi-Use Pathway
- Proposed C/L

Transportation Network

- Local Roads

NOTES:
- The area shown is within the jurisdiction of the Ministry of Natural Resources (MNR) Aurora Midhurst Owen Sound District and the Toronto and Region Conservation Authority Area



Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNR, Golder, Dixon Hydrogeology

Sources: Esri, HERE, Garmin, intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

SCALE: 1:1,250

0 25 50

Meters

TITLE:

Landfill Infrastructure, Groundwater and Leachate Focus, DSL

PROJECT NO.: 190261800

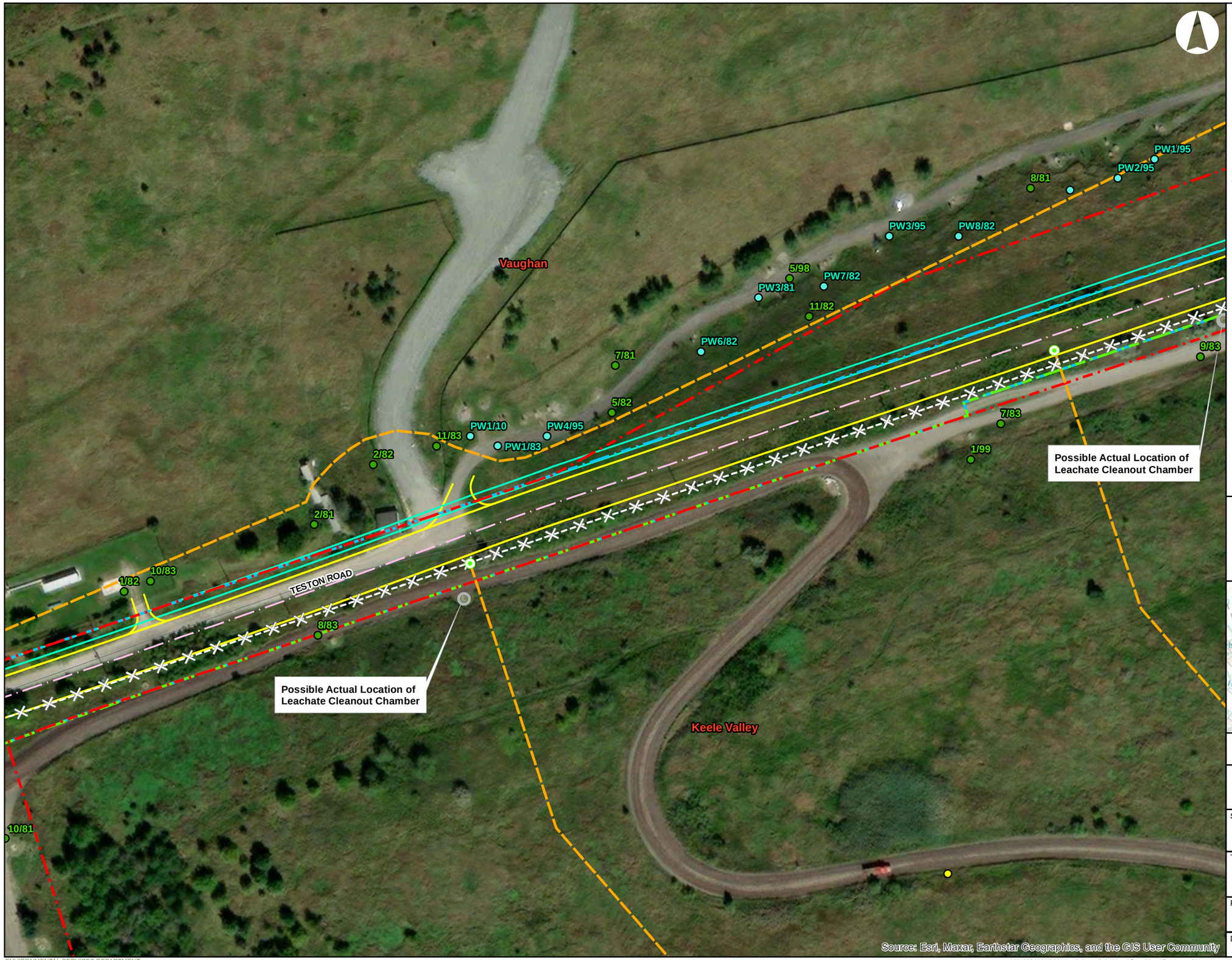
Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **March 2025**

Figure 7a

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

U:\135800052\03_data\gis_cad\gis\Maps\Geo_Maps\DesignandWatercourse\April_2023_Proposed_Phase_I_ESA\January_2025\Figure_7a_GWandL_DSL_rev2.mxd



LEGEND

- Purge Well (Approximate Location)
- Vibrating Wire Piezometer Above-Liner (Approximate Location)
- Keele Valley Landfill Observation Wells (Approximate Location)
- Leachate Maintenance Hole or Cleanout (Approximate Location)
- Leachate Collection System Piping (Approximate Location)
- North Fence of KVL (shown in white on map)
- Approved Limit of Waste (Approximate)
- KVLS Primary Buffer Lands (Approximate Location)
- Landfill (including KVLS Secondary) Buffer Lands (Approximate Location)

Design Features

- Edge of Pavement
- Proposed Multi-Use Pathway
- Proposed C/L

Transportation Network

- Local Roads

NOTES:
- The area shown is within the jurisdiction of the Ministry of Natural Resources (MNR) Aurora Midhurst Owen Sound District and the Toronto and Region Conservation Authority Area



Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNR, Golder, Dixon Hydrology

Basemaps: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

SCALE: 1:1,250

0 25 50

Meters

TITLE:

Landfill Infrastructure, Groundwater and Leachate Focus, KVL and VL

PROJECT NO.: 190261800

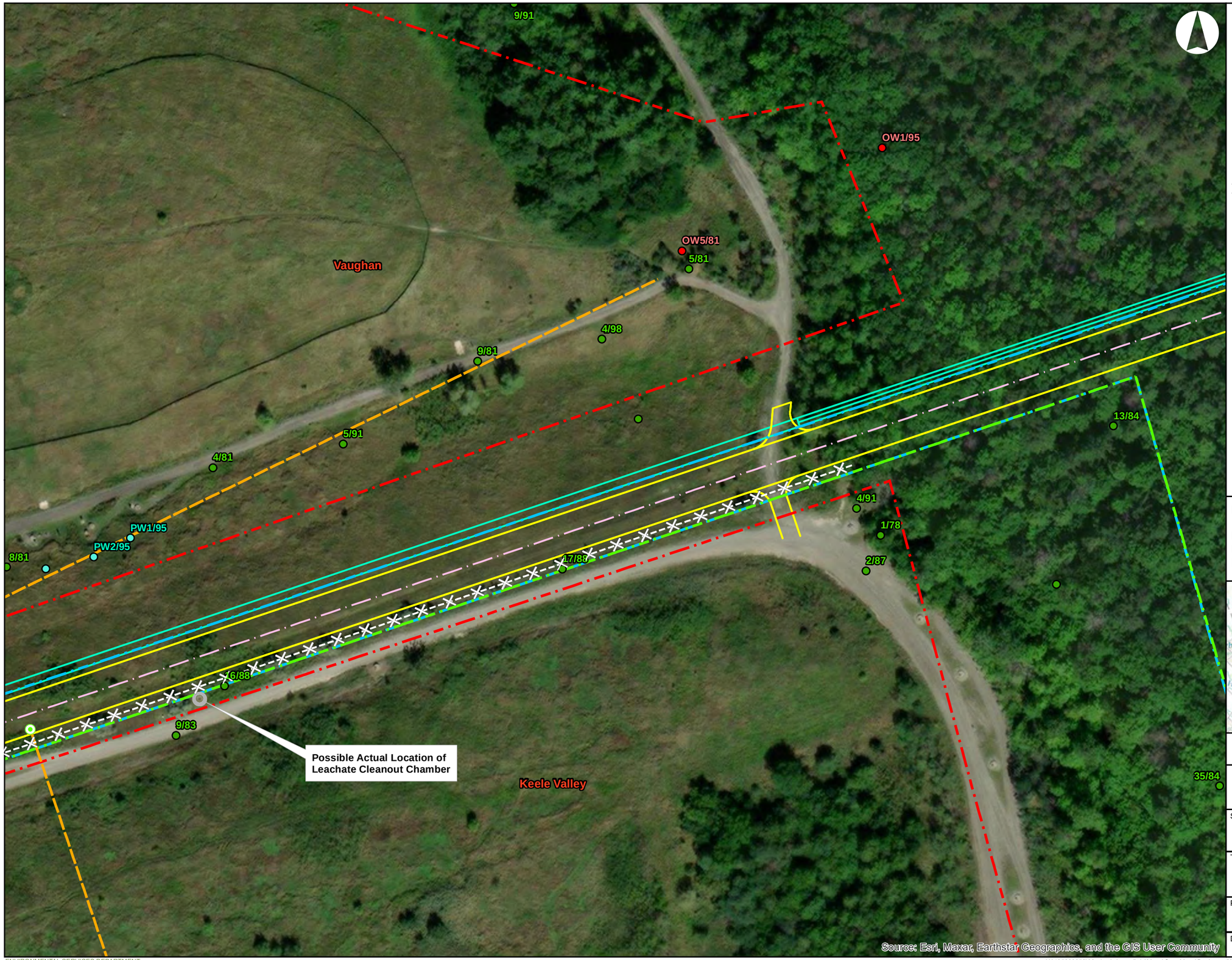
Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **March 2025**

Figure 7b

ENVIRONMENTAL SERVICES DEPARTMENT

U:\135800052\03_data\gis_cad\gis\Maps\Geo_Maps\DesignandWatercourse\April_2023_Proposed_Phase_I_ESA\January_2025\Figure_7b_GWandL_KVLandVL_rev2.mxd



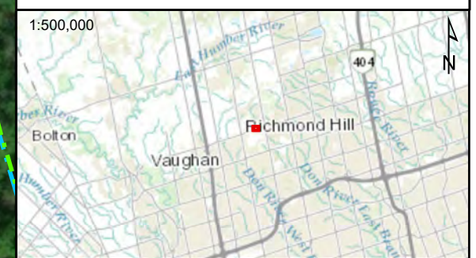
LEGEND

- Purge Well (Approximate Location)
- Keele Valley Landfill Observation Wells (Approximate Location)
- Vaughan Landfill Groundwater Monitoring Wells (Approximate Location)
- Leachate Maintenance Hole or Cleanout (Approximate Location)
- Leachate Collection System Piping (Approximate Location)
- North Fence of KVL (shown in white on map)
- Approved Limit of Waste (Approximate)
- KVLS Primary Buffer Lands (Approximate Location)
- Landfill (including KVLS Secondary) Buffer Lands (Approximate Location)

Design Features

- Edge of Pavement
- Proposed Multi-Use Pathway
- Proposed C/L

NOTES:
- The area shown is within the jurisdiction of the Ministry of Natural Resources (MNR) Aurora Midhurst Owen Sound District and the Toronto and Region Conservation Authority Area



Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNR, Golder, Dixon Hydrogeology

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

Stantec

SCALE: 1:1,250

0 25 50
Meters

TITLE:
Landfill Infrastructure, Groundwater and Leachate Focus, KVL and VL

PROJECT NO.: 190261800
Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **March 2025**

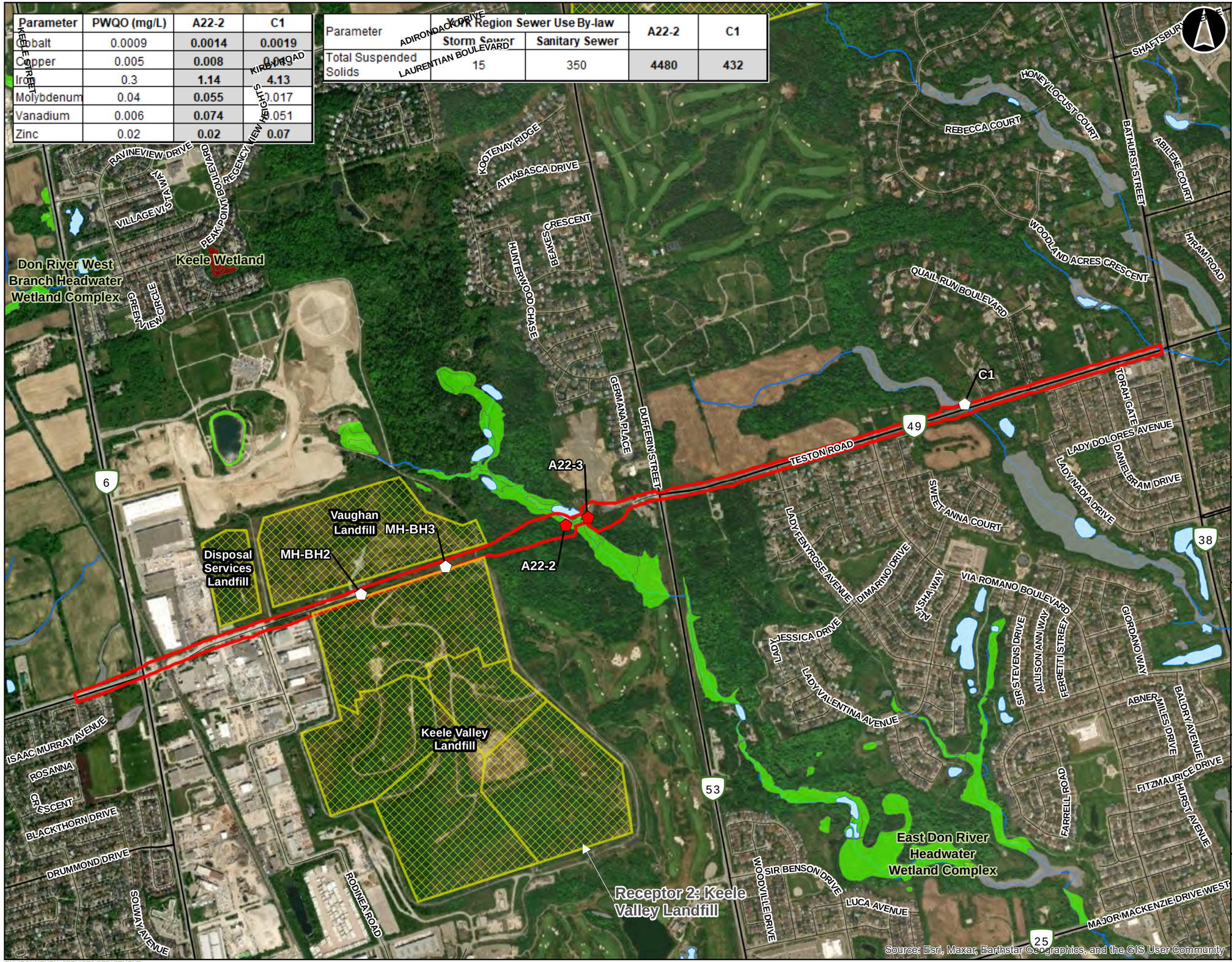
Figure 7c

ENVIRONMENTAL SERVICES DEPARTMENT

U:\135800052\03_data\gis_cad\gis\Maps\Geo_Maps\DesignandWatercourse\April_2023_Proposed_Phase_I_ESA\January_2025\Figure_7c_GWandL_DSL.mxd

Parameter	PWQO (mg/L)	A22-2	C1
Cobalt	0.0009	**0.0014**	**0.0019**
Copper	0.005	**0.008**	**0.043**
Iron	0.3	**1.14**	**4.13**
Molybdenum	0.04	**0.055**	**0.017**
Vanadium	0.006	**0.074**	**0.051**
Zinc	0.02	**0.02**	**0.07**

Parameter	York Region Sewer Use By-law		A22-2	C1
	Storm Sewer	Sanitary Sewer		
Total Suspended Solids	15	350	**4480**	**432**



LEGEND

- Monitoring Wells
- Monitoring Wells sampled for and exceeded select parameters against PWQO and York Region Sewer Use By-law
- Landfill
- Approximate Project Area

Geospatial Ontario (GEO)

- Watercourse
- Waterbodies

Wetlands

- Evaluated-Other Wetlands
- Evaluated-Provincially Significant Wetlands
- Unevaluated Wetlands

Transportation Network

- Expressway / Highway / Freeway
- Arterial / Collector
- Local Roads

NOTES:

- The area shown is within the jurisdiction of the Ministry of Natural Resources (MNR) Aurora Midhurst Owen Sound District and theToronto and Region Conservation Authority Area



Coordinate System: NAD 1983 UTM Zone 17N
Sources: MNR, ESRI Basemaps

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN,

MORRISON HERSHFIELD

SCALE: 1:14,000

0 125 250 500 750

Meters

TITLE:

Analytical Results Exceedance Summary Map

PROJECT NO.: 190261800

Teston Road, Vaughan Ontario
(From Keele Street to Bathurst Street)

DATE: **March 2025**

Figure 8

U:\135800052\03_data\gis_cad\gis\Maps\Geo_Maps\DesignandWatercourse\April_2023_Proposed_Phase_I_ESA\May_2023\Analytical_Results_Exceedance_Summary.mxd

APPENDIX B – Analytical Tables

Table B-1: Summary of Groundwater Samples Analytical Results
PWQO Metals

Teston Road IEA			Groundwater Investigation	
Sample ID:	**Units**	**PWQO[1]**	A22-2	C1
Sample Date:			29-Mar-23	29-Mar-23
Certificate of Analysis			1679593	1679594
Parameter				
Alluminium (Dissolved)	mg/L	0.075	<0.01	<0.01
Antimony	mg/L	0.02	0.0008	0.0006
Arsenic	mg/L	0.005	0.004	0.003
Beryllium	mg/L	0.011	<0.0005	<0.0005
Boron	mg/L	0.2	0.09	0.05
Cadmium	mg/L	0.001	<0.0001	0.0001
Chromium	mg/L	NV	0.042	0.048
Cobalt	mg/L	0.0009	**0.0014**	**0.0019**
Copper	mg/L	0.005	**0.008**	**0.019**
Iron	mg/L	0.3	**1.14**	**4.13**
Lead	mg/L	0.001	0.001	0.004
Mercury (Dissolved)	mg/L	NV	<0.0001	<0.0001
Molybdenum	mg/L	0.04	**0.055**	0.017
Nickel	mg/L	0.025	<0.005	0.016
Selenium	mg/L	0.01	<0.001	0.001
Silver	mg/L	0.0001	<0.0001	<0.0001
Thallium	mg/L	0.003	<0.0001	<0.0001
Tungsten	mg/L	0.03	0.02	0.003
Uranium	mg/L	0.005	0.002	0.002
Vanadium	mg/L	0.006	**0.074**	0.051
Zinc	mg/L	0.02	0.02	**0.07**
Zirconium	mg/L	0.004	<0.002	<0.002

Notes:

All values in µg/L

ND - Not detected above the reporting detection limits (RDL)

NV - No Value

NA - Not Analyzed

Screening:

BOLD

Parameter exceeded PWQO Standards[1]

References:

1- Water Management: Policies, Guidelines, Provincial Water Quality Objectives, Table 2, July 1994.

Prepared by: SS
Reviewed by: AW
Date: 5/26/2023
Analytical Results

Table B-2: Summary of Groundwater Samples Analytical Results
York Region Sewer Use By-law

Teston Road IEA				Groundwater Investigation	
Sample ID:	**Units**	**Storm Sewer**	**Sanitary Sewer**	A22-2	C1
Sample Date:				29-Mar-23	29-Mar-23
Certificate of Analysis				1679593	1679594
Parameter					
Conventional					
Phenolics (4AAP)	NV	NV	NV	8.53	8.08
Biochemical Oxygen Demand	mg/L	15	300	<1	1
Total Kjeldahl Nitrogen	mg/L	1	100	0.325	0.55
Phenolics (4AAP)	mg/L	0.008	1	<0.002	<0.002
Total Phosphorous	mg/L	0.4	10	0.143	0.165
Total Suspended Solids	mg/L	15	350	**4480**	**432**
Other					
Total Cyanide	mg/L	0.02	2	<0.005	<0.005
Aqua-Regia Digest	NA	NV	NV	Yes	Yes
Total Metals					
Aluminium	mg/L	NV	50	NA	NA
Antimony	mg/L	NV	5	0.0008	0.0006
Arsenic	mg/L	0.02	1	<0.02	<0.02
Cadmium	mg/L	0.008	0.7	<0.008	<0.008
Chromium	mg/L	0.08	2	0.05	0.06
Cobalt	mg/L	NV	5	0.0014	0.0019
Copper	mg/L	0.05	3	<0.01	0.02
Lead	mg/L	0.12	1	<0.01	<0.01
Manganese	mg/L	NV	5	0.04	0.2
Mercury	mg/L	0.0004	0.01	<0.0001	<0.0001
Molybdenum	mg/L	NV	5	NA	NA
Nickel	mg/L	0.08	2	<0.01	0.02
Selenium	mg/L	0.02	1	<0.02	<0.02
Silver	mg/L	0.12	5	<0.01	<0.01
Tin	mg/L	NV	5	NA	NA
Titanium	mg/L	NV	5	NA	NA
Zinc	mg/L	0.04	2	<0.04	0.08
Organics					
Benzene	µg/L	2	10	<0.5	<0.5
Chlorofrom	µg/L	2	40	<0.5	<0.5
1,2 - dichlorobenzene	µg/L	5.6	50	<0.4	<0.4
1,4 - dichlorobenzene	µg/L	6.8	80	<0.4	<0.4
Cis-1,2 - dichloroethylene	µg/L	5.6	4000	<0.4	<0.4
Trans-1,3 - dichloropropylene	µg/L	5.6	140	<0.5	<0.5
Ethylbenzene	µg/L	2	160	<0.5	<0.5
Methylene Chloride	µg/L	5.2	2000	NA	NA
1,1,2,2 - tetrachloroethane	µg/L	17	1400	<0.5	<0.5
Tetrachloroethylene	µg/L	4.4	1000	<0.3	<0.3
Toluene	µg/L	2	270	<0.4	<0.4
Toluene-d8	%	NV	NV	75	97
Trichloroethylene	µg/L	8	400	<0.3	<0.3
Xylenes (Total)	µg/L	4.4	1400	<0.5	<0.5
Xylenes (m,p)	µg/L	NV	NV	<0.4	<0.4
Xylenes (o)	µg/L	NV	NV	<0.4	<0.4
Di-n-butyl phthalate	µg/L	15	80	<1.3	<1.3
Bis (2-ethylexyl) phthalate	µg/L	8.8	12	3.6	0.7
PCBs	µg/L	0.4	1	<0.1	<0.1
Methyl Ethyl Ketone	µg/L	NV	8000	NA	NA
Styrene	µg/L	NV	200	NA	NA
Nonylphenols	µg/L	NV	20	NA	NA
Nonylphenol ethoxylates	µg/L	NV	200	NA	NA
1,2-dichloroethane-d4	%	NV	NV	119	112
4-bromofluorobenzene	%	NV	NV	83	75
Dichloromethane	µg/L	NV	NV	<4.0	<4.0

Notes:

NV - No Value

NA - Not Analyzed

Screening:

BOLD

Parameter exceeded York Region Sewer Use By-law for Storm Sewer

BOLD

Parameter exceeded York Region Sewer Use By-law for Sanitary Sewer

Prepared by: SS
Reviewed by: AW
Date: 5/26/2023
Analytical Results

APPENDIX C – Borehole Logs

BOREHOLE MH-BH1

Morrison Hershfield Ltd

CLIENT The Regional Municipality of York
PROJECT NAME Teston Road IEA
PROJECT NUMBER 190261800
PROJECT LOCATION Teston Road between Keele Street and Bathurst Street
DATE STARTED 1/19/23 **COMPLETED** 1/19/23
DRILLING CONTRACTOR MH
GROUNDWATER LEVELS:
DRILLING METHOD Hand Augur
STATIC WATER LEVEL ---
LOGGED BY SS **CHECKED BY** AW
MEASUREMENT DATE

DEPTH (m)	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	Headspace Organic Vapour Concentrations ▲ IBL (ppm) 500 1000 1500 2000	Headspace Combustible Vapour Concentrations ✠ HEX (ppm) 125 250 375 / ◔ HEX (%LEL) 25 50 75	ANALYSES	WELL DIAGRAM
0		**Silty sand,** brown, moist.	SS1			Metals, Inorganics, PHC, VOC, PAH	
0.8		Borehole Terminated at 0.76 mbgs					

ENVIRONMENTAL BH PLOTS 200148008 BH.GPJ GINT STD CANADA LAB.GDT 4/11/23

BOREHOLE MH-BH2

Morrison Hershfield Ltd

CLIENT The Regional Municipality of York
PROJECT NAME Teston Road IEA
PROJECT NUMBER 190261800
PROJECT LOCATION Teston Road between Keele Street and Bathurst Street
DATE STARTED 12/12/22 **COMPLETED** 12/12/22
DRILLING CONTRACTOR Landshark
GROUNDWATER LEVELS:
DRILLING METHOD Geoprobe-Direct Push
STATIC WATER LEVEL ---
LOGGED BY SS **CHECKED BY** AW
MEASUREMENT DATE

DEPTH (m)	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	Headspace Organic Vapour Concentrations: ▲ IBL (ppm) 500 1000 1500 2000	Headspace Combustible Vapour Concentrations: ✠ HEX (ppm) 125 250 375; ◔ HEX (%LEL) 25 50 75	ANALYSES	WELL DIAGRAM
0		**Sand and Gravel,** greyish-brown, moist.	SS1	0	0	Metals, Inorganics, PHC, VOC, PAH	
0.8		**Sandy Silt,** brown, trace gravel, moist. Traces of asphalt present between 0.76 and 1.52 mbgs.	SS2	1	0		
1			SS3	1	0		
2			SS4	0	0		
3							
3.0		Borehole Terminated at 3.1 mbgs					

ENVIRONMENTAL BH PLOTS 200148008 BH.GPJ GINT STD CANADA LAB.GDT 4/11/23

Monitoring Well MH-BH3

Morrison Hershfield Ltd

CLIENT The Regional Municipality of York
PROJECT NAME Teston Road IEA
PROJECT NUMBER 190261800
PROJECT LOCATION Teston Road between Keele Street and Bathurst Street
DATE STARTED 12/12/22 **COMPLETED** 12/12/22
DRILLING CONTRACTOR Landshark
GROUNDWATER LEVELS:
DRILLING METHOD Geoprobe-Direct Push
STATIC WATER LEVEL 4.56 m
LOGGED BY SS **CHECKED BY** AW
MEASUREMENT DATE 4/4/2023

DEPTH (m)	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	Headspace Organic Vapour Concentrations: IBL (ppm) 500 1000 1500 2000	Headspace Combustible Vapour Concentrations: HEX (ppm) 125 250 375 / HEX (%LEL) 25 50 75	ANALYSES	WELL DIAGRAM
0		**Fill: Sand and Gravel,** brown, trace organics, moist.	SS1	1	0	Metals, Inorganics	
0.8		**Sand,** brown, trace gravel, moist.	SS2	1	0	PHC, VOC, PAH	
1			SS3	1	0		
2			SS4	0	0		
3			SS5	0	0		
4			SS6	0	0		
4.6		bgsBorehole Terminated at 4.56 mbgs					

ENVIRONMENTAL BH PLOTS 200148008 BH.GPJ GINT STD CANADA LAB.GDT 4/11/23

Monitoring Well MH-BH4

Morrison Hershfield Ltd

CLIENT The Regional Municipality of York
PROJECT NAME Teston Road IEA
PROJECT NUMBER 190261800
PROJECT LOCATION Teston Road between Keele Street and Bathurst Street
DATE STARTED 12/12/22 **COMPLETED** 12/12/22
DRILLING CONTRACTOR Landshark
GROUNDWATER LEVELS:
DRILLING METHOD Geoprobe-Direct Push
STATIC WATER LEVEL 4.56 m
LOGGED BY SS **CHECKED BY** AW
MEASUREMENT DATE 4/4/2023

DEPTH (m)	GRAPHIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	Headspace Organic Vapour Concentrations: IBL (ppm)	Headspace Combustible Vapour Concentrations: HEX (ppm)	Headspace Combustible Vapour Concentrations: HEX (%LEL)	ANALYSES	WELL DIAGRAM
0				500 1000 1500 2000	125 250 375	25 50 75		
		Fill: Sand and Silt, brown, trace organics, moist.	SS1	0	0		Metals, Inorganics	
0.8								
1		**Sand,** brown, moist.	SS2	0	0		PHC, VOC, PAH	
			SS3	1	10			
2								
			SS4	1	0			
3								
			SS5	0	15			
4								
			SS6	0	0			
4.6		Borehole Terminated at 4.56 mbgs						

ENVIRONMENTAL BH PLOTS 200148008 BH.GPJ GINT STD CANADA LAB.GDT 4/11/23

APPENDIX D – Laboratory Certificates of Analyses

Certificate of Analysis

Client: Morrison Hershfield Limited
2440 Don Reid Drive, Suite 200
Ottawa, ON
K1H 1E1
Attention: Mr. Sarth Sheth
PO#:
Invoice to: Morrison Hershfield Limited

Report Number: 1995273
Date Submitted: 2023-03-29
Date Reported: 2023-04-03
Project:
COC #: 221770

Dear Sarth Sheth:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____
Raheleh Zafari, Environmental Chemist

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: https://directory.cala.ca/.

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Certificate of Analysis

eurofins | Environment Testing

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K1H 1E1
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PO#:
Invoice to: Morrison Hershfield Limited

Report Number: 1995273
Date Submitted: 2023-03-29
Date Reported: 2023-04-03
Project:
COC #: 221770

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1679595 SURF W 2023-03-29 A22-2	1679596 SURF W 2023-03-29 C1
Metals	Ag	0.0001	mg/L	PWQO 0.0001		<0.0001	<0.0001
	Al (dissolved)	0.01	mg/L	IPWQO 0.075		<0.01	<0.01
	As	0.001	mg/L	PWQO 0.100		0.004	0.003
	B	0.01	mg/L	IPWQO 0.200		0.09	0.05
	Be	0.0005	mg/L	PWQO 0.011		<0.0005	<0.0005
	Cd	0.0001	mg/L	PWQO 0.0002		<0.0001	0.0001
	Co	0.0002	mg/L	PWQO 0.0009		0.0014*	0.0019*
	Cr	0.001	mg/L			0.042	0.048
	Cu	0.001	mg/L	PWQO 0.005		0.008*	0.019*
	Fe	0.03	mg/L	PWQO 0.30		1.14*	4.13*
	Hg Dissolved	0.0001	mg/L			<0.0001	<0.0001
	Mo	0.005	mg/L	IPWQO 0.040		0.055*	0.017
	Ni	0.005	mg/L	PWQO 0.025		<0.005	0.016
	Pb	0.001	mg/L	PWQO 0.005		0.001	0.004
	Sb	0.0005	mg/L	IPWQO 0.020		0.0008	0.0006
	Se	0.001	mg/L	PWQO 0.100		<0.001	0.001
	Tl	0.0001	mg/L	IPWQO 0.0003		<0.0001	<0.0001
	U	0.001	mg/L	IPWQO 0.005		0.002	0.002
	V	0.001	mg/L	IPWQO 0.006		0.074*	0.051*
	W	0.002	mg/L	IPWQO 0.030		0.020	0.003
	Zn	0.01	mg/L	PWQO 0.030		0.02	0.07*
	Zr	0.002	mg/L	IPWQO 0.004		<0.002	<0.002

Guideline = PWQO - Ontario *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

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Invoice to: Morrison Hershfield Limited

Report Number: 1995273
Date Submitted: 2023-03-29
Date Reported: 2023-04-03
Project:
COC #: 221770

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 439416 **Analysis/Extraction Date** 2023-03-30 **Analyst** SD **Method** EPA 200.8			
Silver	<0.0001 mg/L	108	80-120
Al (dissolved)	<0.01 mg/L	107	80-120
Arsenic	<0.001 mg/L	90	80-120
Boron (total)	<0.01 mg/L	100	80-120
Beryllium	<0.0005 mg/L	100	80-120
Cadmium	<0.0001 mg/L	97	80-120
Cobalt	<0.0002 mg/L	102	80-120
Chromium Total	<0.001 mg/L	101	80-120
Copper	<0.001 mg/L	103	80-120
Iron	<0.03 mg/L	105	80-120
Hg Dissolved	<0.0001 mg/L	90	
Molybdenum	<0.005 mg/L	93	80-120
Nickel	<0.005 mg/L	104	80-120
Lead	<0.001 mg/L	101	80-120
Antimony	<0.0005 mg/L	114	80-120
Selenium	<0.001 mg/L	92	80-120

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Date Submitted: 2023-03-29
Date Reported: 2023-04-03
Project:
COC #: 221770

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Thallium	<0.0001 mg/L	99	80-120
Uranium	<0.001 mg/L	99	80-120
Vanadium	<0.001 mg/L	97	80-120
W	<0.002 mg/L	90	80-120
Zinc	<0.01 mg/L	100	80-120
Zr	<0.002 mg/L	76	80-120

Guideline = PWQO - Ontario *** = Guideline Exceedence**

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Attention: Mr. Sarth Sheth
PO#:
Invoice to: Morrison Hershfield Limited

Report Number: 1995272
Date Submitted: 2023-03-29
Date Reported: 2023-04-05
Project:
COC #: 221769

Dear Sarth Sheth:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____
Raheleh Zafari, Environmental Chemist

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Report Number: 1995272
Date Submitted: 2023-03-29
Date Reported: 2023-04-05
Project:
COC #: 221769

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1679593 STRM W 2023-03-29 A22-2	1679594 STRM W 2023-03-29 C1
General Chemistry	BOD5	1	mg/L	MAC 15		<1	1
	Cyanide (total)	0.005	mg/L	MAC 0.020		<0.005	<0.005
	pH	1.00		6.0-9.0		8.53	8.08
	Phenols	0.002	mg/L	MAC 0.008		<0.002	<0.002
	Total Suspended Solids	2	mg/L	MAC 15		4480*	432*
Mercury	Hg	0.0001	mg/L	MAC 0.0004		<0.0001	<0.0001
Metals	Ag	0.01	mg/L	MAC 0.120		<0.01	<0.01
	Aqua-Regia Digest		mg/L			Y	Y
	As	0.02	mg/L	MAC 0.020		<0.02	<0.02
	Cd	0.008	mg/L	MAC 0.008		<0.008	<0.008
	Cr	0.05	mg/L	MAC 0.080		0.05	0.06
	Cu	0.01	mg/L	MAC 0.050		<0.01	0.02
	Mn	0.01	mg/L	MAC 0.150		0.04	0.20*
	Ni	0.01	mg/L	MAC 0.080		<0.01	0.02
	Pb	0.01	mg/L	MAC 0.120		<0.01	<0.01
	Se	0.02	mg/L	MAC 0.020		<0.02	<0.02
	Zn	0.04	mg/L	MAC 0.040		<0.04	0.08*
Nutrients	Total Kjeldahl Nitrogen	0.100	mg/L	MAC 1		0.325	0.550
	Total P	0.020	mg/L	MAC 0.400		0.143	0.165
PCBs	Polychlorinated Biphenyls (PCBs)	0.1	ug/L	MAC 0.4		<0.1	<0.1
Semi-Volatiles	Bis(2-ethylhexyl)phthalate	0.4	ug/L	MAC 8.8		3.6	0.7
	Di-n-butylphthalate	1.3	ug/L	MAC 15.0		<1.3	<1.3
VOCs Surrogates	1,2-dichloroethane-d4	0	%			119	112
	4-bromofluorobenzene	0	%			83	75
	Toluene-d8	0	%			75	97

Guideline = Storm Sewer - York

*** = Guideline Exceedence**

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Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1679593 STRM W 2023-03-29 A22-2	1679594 STRM W 2023-03-29 C1
Volatiles	1,1,2,2-tetrachloroethane	0.5	ug/L	MAC 17.0		<0.5	<0.5
	1,2-dichlorobenzene	0.4	ug/L	MAC 5.6		<0.4	<0.4
	1,4-dichlorobenzene	0.4	ug/L	MAC 6.8		<0.4	<0.4
	Benzene	0.5	ug/L	MAC 2.0		<0.5	<0.5
	c-1,2-Dichloroethylene	0.4	ug/L	MAC 5.6		<0.4	<0.4
	Chloroform	0.5	ug/L	MAC 2.0		<0.5	<0.5
	Dichloromethane	4.0	ug/L	MAC 5.2		<4.0	<4.0
	Ethylbenzene	0.5	ug/L	MAC 2.0		<0.5	<0.5
	m/p-xylene	0.4	ug/L			<0.4	<0.4
	o-xylene	0.4	ug/L			<0.4	<0.4
	t-1,3-Dichloropropylene	0.5	ug/L	MAC 5.6		<0.5	<0.5
	Tetrachloroethylene	0.3	ug/L	MAC 4.4		<0.3	<0.3
	Toluene	0.4	ug/L	MAC 2.0		<0.4	<0.4
	Trichloroethylene	0.3	ug/L	MAC 8.0		<0.3	<0.3
	Xylene; total	0.5	ug/L	MAC 4.4		<0.5	<0.5

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Report Number: 1995272
Date Submitted: 2023-03-29
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Project:
COC #: 221769

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 438460 **Analysis/Extraction Date** 2023-03-31 **Analyst** C_M **Method** B 625/P 8270			
Bis(2-ethylhexyl)phthalate	<0.4 ug/L	108	20-140
Di-n-butylphthalate	<1.3 ug/L	80	20-140
Run No 439407 **Analysis/Extraction Date** 2023-03-30 **Analyst** SKH **Method** EPA 351.2			
Total Kjeldahl Nitrogen	<0.100 mg/L	103	70-130
Run No 439408 **Analysis/Extraction Date** 2023-03-30 **Analyst** SKH **Method** EPA 365.1			
Total P	<0.020 mg/L	102	80-120
Run No 439415 **Analysis/Extraction Date** 2023-03-31 **Analyst** SKH **Method** C SM2540			
Total Suspended Solids	<2 mg/L	96	90-110
Run No 439433 **Analysis/Extraction Date** 2023-03-30 **Analyst** AET **Method** SM2320,2510,4500H/F			
pH		100	90-110
Run No 439488 **Analysis/Extraction Date** 2023-03-31 **Analyst** SD **Method** EPA 200.8			
Silver	<0.01 mg/L	110	70-130

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QC Summary

Analyte	Blank	QC % Rec	QC Limits
Arsenic	<0.02 mg/L	98	70-130
Cadmium	<0.008 mg/L	103	70-130
Chromium Total	<0.05 mg/L	112	70-130
Copper	<0.01 mg/L	111	70-130
Manganese	<0.01 mg/L	110	70-130
Nickel	<0.01 mg/L	110	70-130
Lead	<0.01 mg/L	96	70-130
Selenium	<0.02 mg/L	91	70-130
Zinc	<0.04 mg/L	98	70-130
Run No 439489 **Analysis/Extraction Date** 2023-03-31 **Analyst** SD **Method** EPA 200.8			
Aqua-Regia Digest			
Run No 439501 **Analysis/Extraction Date** 2023-04-03 **Analyst** R_G **Method** EPA 8081B			
Polychlorinated Biphenyls	<0.1 ug/L	91	60-140
Run No 439506 **Analysis/Extraction Date** 2023-04-03 **Analyst** IP **Method** SM5530D/EPA420.2			
Phenols	<0.002 mg/L	106	50-120

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Date Reported: 2023-04-05
Project:
COC #: 221769

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 439510 **Analysis/Extraction Date** 2023-04-01 **Analyst** PJ **Method** EPA 8260			
Tetrachloroethane, 1,1,2,2-	<0.5 ug/L	99	60-130
Dichlorobenzene, 1,2-	<0.4 ug/L	94	60-130
Dichlorobenzene, 1,4-	<0.4 ug/L	90	60-130
Benzene	<0.5 ug/L	94	60-130
Dichloroethylene, 1,2-cis-	<0.4 ug/L	90	60-130
Chloroform	<0.5 ug/L	93	60-130
Methylene Chloride	<4.0 ug/L	97	60-130
Ethylbenzene	<0.5 ug/L	90	60-130
m/p-xylene	<0.4 ug/L	97	60-130
o-xylene	<0.4 ug/L	92	60-130
Dichloropropene,1,3-trans-	<0.5 ug/L	86	60-130
Tetrachloroethylene	<0.3 ug/L	90	60-130
Toluene	<0.4 ug/L	88	60-130
Trichloroethylene	<0.3 ug/L	89	60-130
Run No 439513 **Analysis/Extraction Date** 2023-04-03 **Analyst** PJ **Method** EPA 8260			

Guideline = Storm Sewer - York

*** = Guideline Exceedence**

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Project:
COC #: 221769

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Xylene Mixture			
Run No 439516 **Analysis/Extraction Date** 2023-04-03 **Analyst** Z_S **Method** SM4500-CNC/MOE E3015			
Cyanide (total)	<0.005 mg/L	90	61-139
Run No 439525 **Analysis/Extraction Date** 2023-04-03 **Analyst** AaN **Method** M SM3112B-3500B			
Mercury	<0.0001 mg/L	101	76-123
Run No 439626 **Analysis/Extraction Date** 2023-04-05 **Analyst** AET **Method** SM 5210B			
BOD5	<1 mg/L	89	75-125

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