Teston Road Area Transportation Improvements Individual Environmental Assessment

Drainage and Stormwater Management Report

Presented to:

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1. INTRODUCTION

1.1 Project Overview

Currently, Teston Road (York Region Road 49) is an east-west arterial road with a 4-lane cross section between Highway 400 and Keele Street and a 2-lane cross section from Keele Street to Rodinea Road and from Dufferin Street to Bathurst Street. There is a discontinuity along Teston Road between Keele Street and Dufferin Street.

The Regional Municipality of York (Region) initiated the Individual Environmental Assessment (IEA) process in 2016 and completed the Teston Road Area Transportation IEA Terms of Reference (ToR) in 2018. In 2020, the Region retained Morrison Hershfield (MH) to conduct the IEA for transportation improvements in the Teston Road area. The IEA was completed in accordance with the IEA ToR. Figure 1 shows the location of the study area of IEA.

A systematic evaluation of a full range of alternatives, based on both transportation planning issues and environmental criteria factors, was conducted through the EA process. A new 4-lane Teston Extension between Keele Street and Dufferin Street with new pedestrian/cycling facilities and transit service/routes on the corridor was identified as the preferred alternative, as shown in Figure 1. Details of the IEA process and the generation and evaluation of alternative methods were documented in the three Transportation System Technical Reports dated on February 12, 2021, April 21, 2022, and October 21, 2022, respectively.

After the technically preferred alternative was identified, it was developed to the Preliminary Design (PD) level of detail to assess the potential effects and develop specific mitigation measures.

The preliminary design limits extend from the west of Keele Street to Bathurst Street, as shown in Figure 1.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.

1.2 Study Scope

A drainage and hydrology study has been completed to assess existing drainage conditions, identify deficiencies in the system and develop a stormwater management (SWM) plan to address any impact as a result of the proposed work. The scope of this study includes:

- Review background information and previous studies;
- Assess the existing and proposed drainage conditions;
- Complete hydrologic and hydraulic assessments; and
- Propose measures utilizing best management practices for the runoff quantity and quality control.

This Stormwater, Drainage and Hydrology Report is a part of the overall IEA submission, in support of the Preliminary Design (PD) of the preferred alternative.

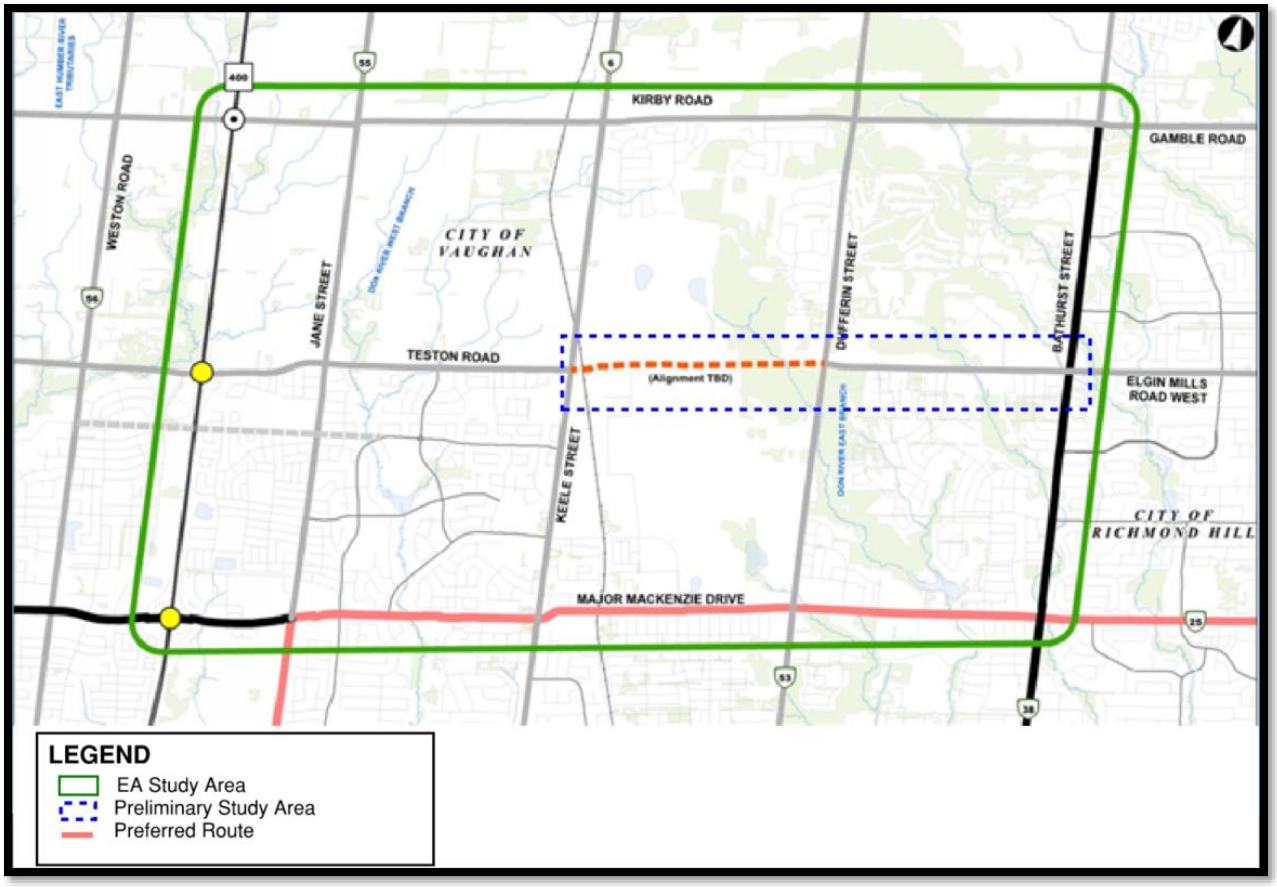


Figure 1: IEA Study Area, Preferred Alignment and Preliminary Design Limits

1.3 Background Information

The following background information were reviewed in the preparation of the current report:

- Class Environmental Assessment Widening and Reconstruction of Teston Road (Y.R.49) from Pine Valley Drive (Y.R.57) to Bathurst (Y.R.38), Giffels Associates Limited, 2003.
- Various as-built drawings provided by the Region of York.
- Existing storm sewer layout in GIS, provided by the Region of York.
- Don River Hydraulics HEC-RAS model and Floodplain Sheets (Don River Sheet #11), 2020, provided by TRCA.
- On-going New Subdivision Design Information.
- Various As-Built Drawings for Subdivisions adjacent to Teston Road, provided by the City of Vaughan.
- Block 12 Stormwater Management Plan Schaeffers, 2005.
- Stormwater Management Final Report – Block 12 Pond 4, Schaeffers (2013).

A number of studies were completed as part of this assignment and should be reviewed in conjunction with this report:

- Topographic Survey by Tulloch
- Subsurface Utility Engineering by T2UE
- Fluvial Erosion Hazard Study (Draft) by GeoProcess
- Pavement and Foundation Reports by Golder
- Fish and Fish Habitat Existing Conditions and Impact Assessment (on-going) by MH
- Preliminary Roadway Design Plan and Profile for Preferred Alternative (on-going) by MH
- Hydrogeology Reports (on-going) by MH
- Don River Bridge General Arrangement Drawing by MH

2. DESIGN CRITERIA

The drainage and stormwater management criteria for this project were established based on the following documents:

- Teston Road Area Transportation Improvements Individual Environmental Assessment Terms of Reference, WSP (2018)
- Regional Municipality of York, Road Design Guidelines (2023)
- City of Vaughan Engineering Design Criteria and Standard Drawings (2020)
- MTO Highway Drainage Design Standards (2008)
- MTO Drainage Management Manual (1997)
- TRCA Stormwater Management Guidelines and Criteria (2012)
- MOE Stormwater Management Planning and Design Manual (2003)
- TRCA Crossing Guideline for Valley and Stream Corridors (2015)
- American Railway Engineering and Maintenance-of-Way Association Manual Railway Engineering

Applicable design criteria were identified as below.

2.1 Watercourse Crossings

The proposed Teston Road at the study area is classified as Urban Arterial. Applicable hydraulic design criteria for bridges and culverts on a watercourse are identified in MTO's Drainage Design Standard (HDDS) as below:

- Design storm of a 50-year return period for the crossing with a total span less than or equal to 6 m or a 100-year return period storm when span greater than 6 m
- A minimum 1 m freeboard during the design flood
- No overtopping during check flow (1.3 time of 100-year flow)
- The ratio of headwater depth to rise of culvert (HW/D) less than 1.5 or less than 1 for erodible stream bed
- A minimum 1 m clearance during the design flood and zero clearance under Regulatory Flood for a bridge

The hydraulic criteria of a culvert under railway were outlined in American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual Railway Engineering.

- HW/D <1 during 25-Year return period flood
- HW/D<1.5 during 100-year return period flood
- A minimum freeboard of 0.6 m to the base of rail during a 100-year period food.

In addition, any alterations to the existing crossings by the proposed works should not increase upstream flooding risks.

2.2 Stormwater Management Objectives

The stormwater management and drainage design requirements are set by the Toronto and Region Conservation Authority (TRCA), Ministry of the Environment, Conservation and Parks

(MECP) and Regional Municipality of York design standards. These key SWM criteria include water quantity, water quality, and erosion control.

- **Water Quantity Control:** control post-development flows for the 2-year to 100-year storm events to pre-development level to ensure no peak flow impacts to downstream properties.
- **Water Quality Control:** 80% TSS removal for the proposed work.
- **Erosion Control:** a minimum of 5 mm of storm runoff retention as per the TRCA erosion control requirements.
- **Water Balance:** Due to the site being located within a High-Volume Groundwater Recharge Area (TRCA SWM Criteria), maintaining pre-development groundwater recharge rates and appropriate distribution to ensure the protection of related hydrologic and ecologic functions shall be considered.

2.3 Surface Drainage Design Criteria

Road drainage design flow is defined as the 10-year and 100-year return period flow for minor system and major system design, respectively. The new storm sewer and its ancillary structures shall be designed in accordance with the latest standards from the Region.

2.4 Rainfall Data

The rainfall data were taken from the Region's IDF curves (South of Bloomington Road) within Road Design Guidelines. Refer to **Appendix A2.**

3. EXISTING CONDITIONS

The following sections summarize the results of the background data review and discuss the existing servicing and drainage conditions. The existing drainage features and drainage patterns within the study area are illustrated in Figure 2, as well as **Exhibits 1.a** to **1.c**.

3.1 Watershed Context

The study area is situated within the Don River watershed, which falls under the jurisdiction of TRCA (Toronto and Region Conservation Authority). As shown in Figure 2, a sub-watershed boundary is located approximately 400 meters east of Rodinea Road, which divides the study area into West Don River and East Don River sub-watersheds. Several headwater streams traverse the Teston Road right-of-way. Two streams within the study area are regulated by TRCA with mapped floodplain, including:

- East Don River (Reach 18, as labelled in TRCA Hydraulics Model) transvers the Teston Road right-of-way west of Dufferin Street and create a deep valley ravine. There is no Teston Road currently over the valley.

- McNair Creek (a tributary of Patterson Creek) crosses Teston Road via a box culvert (ED04). This tributary was classified as Redside Dace habitat. Teston Road is not overtopped during the Regional Storm as per Floodplain Map Sheet (Don #11) at the McNair Creek. Refer to **Appendix A3**.

There are five (5) centerline culvert crossings with the study area, which convey flows from the north to the south in general and discharge to either municipal sewer systems or open channel systems. The crossing ID in this study adopted the same naming convention as in the previous EA study completed by Giffels Associates Limited in 2003.

Significant portion of the study corridor is located within the Oak Ridges Moraine planning area. This area was identified as High-Volume Groundwater Recharge Area (HVRAs) as per TRCA Stormwater Management Criteria.

The study area consists primaily of Sandy Loam which is classified as Hydrologic Soil Group “A” or “B” with small portion adjacent to Bathurst Street coverred by Clay Loam which is classified as Hydrologic Soil Group “C”.

Generally, the lands to the north of Teston Road have remained as undeveloped, while the lands to the south of Teston Road are occupied by residential areas. Landfill areas of the City of Vaughan is located between Keele Street and the East Don River, and the natural areas are generally situated along the stream valley/corridor.

Two developments are currently underway in the study area. One is located at the northwest corner of the Keele/Teston intersection, while the other is situated at the northeast corner of the East Don River and Teston corridor.

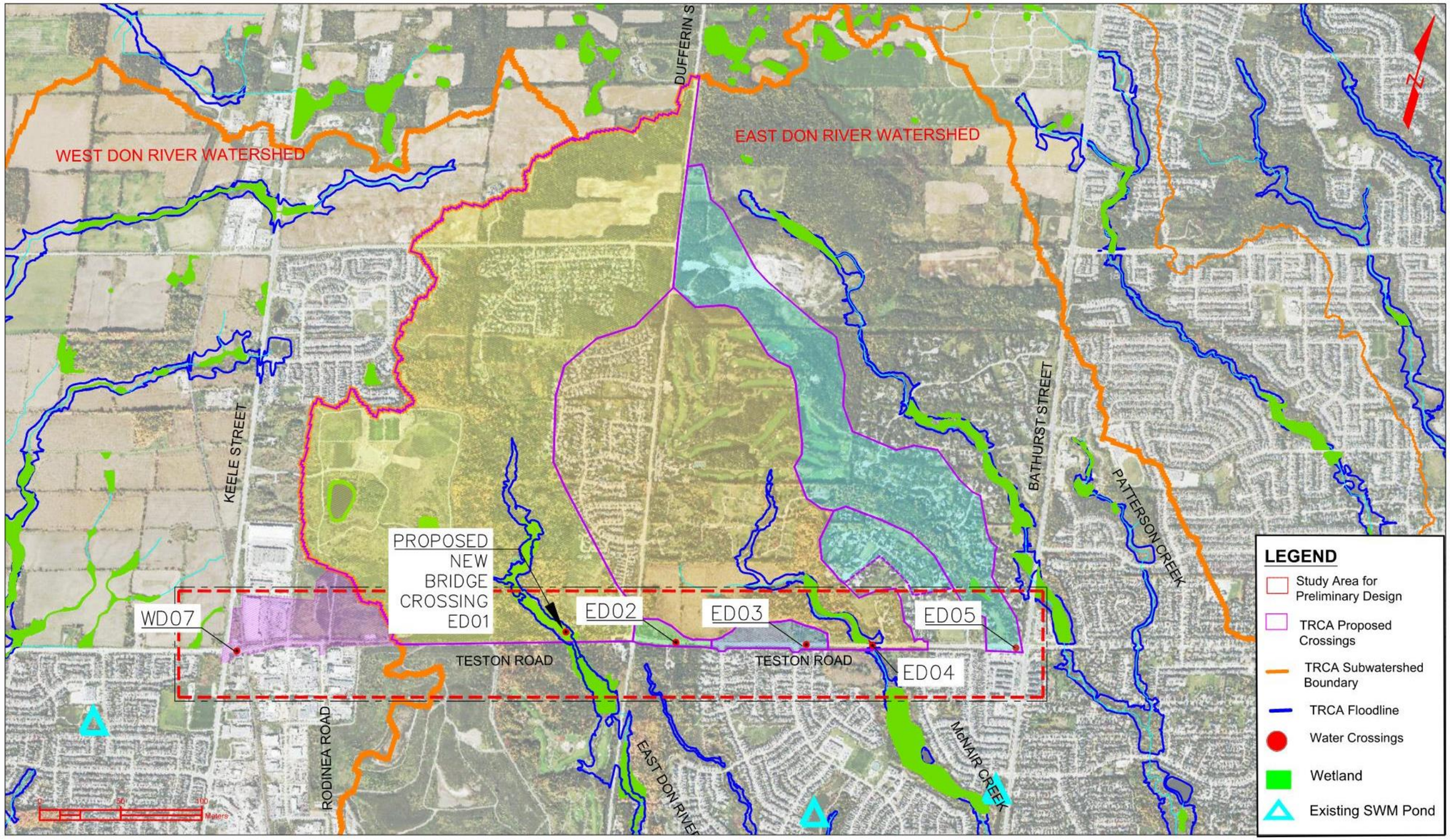


Figure 2: Drainage Features within Study Area

3.2 Roadway Conditions

A description of existing road conditions is provided below:

- Keele Street to Dufferin Street

Within this section, the Teston Road corridor is located adjacent to the City of Vaughan Landfill and Keele Valley Landfill areas and traverses East Don River valley. Barrie's Go Transit intersects the roadway at grade level, just east of Keele Street. There is no continuous traffic route across the East Don River. East portion of Teston Road consists of two-lane asphalt access road and gravel trails to the landfill areas.

- Dufferin Street to Bathurst Street

The section of Teston Road from Dufferin Street to Torah Gate consists of a four-lane roadway with a rural cross-section, while the section of Teston Road east of Torah Gate is a four-lane roadway with a semi-urban cross-section.

3.3 Drainage Pattern and Outlets

Teston Road within the study area predominantly has a rural cross-section, with pockets of urbanization near intersections. Roadway drainage is serviced through a combination of roadside ditches and storm sewers. These drainage systems direct runoff from the right-of-way to various outlets along the corridor. A total of ten (10) outlets have been identified, with seven (7) of them representing either storm sewer or enclosed drainage systems. Detailed information regarding the contributing catchment and receiving drainage system characteristics can be found in

Table 1. Refer to **Exhibits 1.a** to **1.c** for the outlet locations.

Table 1: Existing Drainage Outlets

Outlet ID		Catchment ID	Outlet Description	ROW Area (ha)	Impervious Area		Existing Roadway Condition
					Existing (ha)	Ex. Imp. (%)	
Outlet #1		101	Existing Storm Sewer (300 mmØ along Teston)	0.41	0.22	54%	Urban
Outlet #2		102	Existing Storm Sewer (1200 mmØ along Isaac Murray Ave)	0.8	0.35	44%	Urban
Outlet #3		103	Ditch,then to sewer (1200 mmØ to Isaac Murray Ave)	4.48	1.43	32%	Local road
Outlet #4	4.1	141	East Don River (From West)	3.1	0.00	0%	No road
	4.2	142	East Don River (From East)	0.72	0.04	5%	No road
Outlet #5		105	Existing Storm Sewer (375 mmØ along Dufferin St)	0.41	0.23	56%	Urban
Outlet #6		106	Culvert ED02 (Trib. of East Don River)	1.64	0.74	45%	Rural
Outlet #7		171	Existing Storm Sewer (1050 mmØ along Via Romano Blvd)	2.67	1.16	43%	Rural
Outlet #8	8.1	181	Culvert ED04, McNair Creek (From West)	0.97	0.36	37%	Rural
	8.2	182	Culvert ED04, McNair Creek (From East)	1.33	0.63	47%	Rural
Outlet #9		109	Existing Storm Sewer (975 mmØ along Torah Gate)	1.23	0.60	49%	Rural
Outlet #10		110	Culvert ED05 (Enclosed pipe to Patterson Creek)	0.9	0.53	59%	Urban/Rural

3.4 Drainage Infrastructure

3.4.1 Culverts

There are five (5) centerline culvert crossings within the study area, as well as two (2) side road culverts parallel to Teston Road crossing the railway. Site investigation was conducted on October 26th, 2022. The characteristics of the existing culverts and conditions based on visual inspection at the culvert ends are presented in

Table 2 with detailed inspection sheet and photos in **Appendix B**.

Table 2: Inventory of Existing Culverts

Culvert ID	Configuration	Size (mm)[1]	Conditions		Preliminary Recommendation
			U/S End	D/S End	
Teston Road Mainline Culverts					
WD07	Corrugated Steel Pipe	1300 mmØ	Good Condition; 50 mm standing water	Collapsed End	Relocation/Reconstruction with HDPE/Concrete Pipe
ED02	Concrete Pipe w. Headwalls	800 mmØ	Good Condition; 10 mm sediment within pipe	Good Condition	Extension
ED03	Concrete Pipe w. Headwalls	900 mmØ	Good Condition	Good Condition	Extension
ED04 (McNair Creek)	Rigid Frame Open Footing	5700 mm (Span)*1500 mm (vertical opening)	Good Condition	Good Condition	To be retained; Add headwall if needed
ED05	Concrete Pipe with Gabion Headwall (Upstream side)	1050 mmØ at Upstream End	Good Condition	Connect to a manhole chamber; Not inspected	To be retained; modification on the upstream headwall if required
Side Road (Go Rail) Culverts					
RN (Railway – North)	Concrete Pipe	900 mmØ	Good condition; 180mm standing water; 50mm sedimentation.	Good Condition	Relocation
RS (Railway – South)	Concrete Pipe	300 mmØ	Good Condition at U/S End	D/S end buried; Could not be located	Rehabilitation / Combining drainage with new storm sewer

Note: [1]. Dimensions of the culverts were provided by the recent survey or field measurement by MH

3.4.2 Storm Sewers

There are seven (7) existing storm sewer systems. An inventory of the existing storm sewers, together with the preliminary recommendation of improvement are presented in

Table 3.

Table 3: Inventory of Existing Storm Sewers

Locations	Discharge Outlets	Descriptions	Preliminary Recommendation
West of Keele	Outlet 1; Part of Teston Road Storm Sewer	300 mmØ	No impacts / no changes
West of Keele	Outlet 2; Discharge to a larger storm system running to the south	300 mmØ to 450 mmØ	To be modified and direct flow to the proposed pond (SWMF 1)
Keele to East Don River	Outlet 3 and 4	No Storm Sewer	No Storm Sewer
Dufferin/Teston Intersection	Outlet 5; Discharge into Dufferin St storm sewer system	Multiple segments 300 mmØ	To be retained with adjustment of catchbasin locations
Dufferin to Lady Fenyrose Ave	Outlet 6	No Storm Sewer	No Storm Sewer
Lady Fenyrose Ave to Via Romano	Outlet 7; Discharge to 1050mm STM along Via Romano Blvd	DIs and 525 mmØ STM along EBL	To be replaced by a new storm sewer system
West of Quail Run	Outlet 8; Discharge to McNair Creek upstream side of ED04	85 m - 375/525 mmØ along WBL	To be replaced by a new storm sewer system
Quail Run to Torah Gate	Outlet 9; Discharge to 975mm STM along Torah Gate	360 m - 525 mmØ to 900mmØ STM connecting between Quail Run and Torah Gate	Maintain the mainline pipes with a parallel storm line along WBL for stormwater management and conveyance
Torah Gate to Bathurst St	Outlet 10; Discharge to a drainage conduit (ED05)	300 mm - 450mm ØSTM	Maintain the mainline pipes with a parallel storm line along WBL for stormwater management and conveyance

Note: the storm sewer inventory was compiled from the Region's GIS storm servicing layer, SUE data and previous as-built records (excerpts from previous drawing records in Appendix A4).

3.5 Existing Stormwater Management Facilities

There are no documented stormwater management facilities within the right-of-way, except for grassed swales along the road. Nevertheless, runoff from various sections of the existing road is directed into storm sewers, which outlet to the existing stormwater management facilities outside of the right-of-way as part of subdivisions in the City of Vaughan. As shown in Figure 2, there are 3 stormwater facilities currently servicing runoff from Teston Road. The existing Pond 3 and Pond 4 within Block 12 of the City of Vaughan provides quantity and quality treatment of runoff originating from the Teston Road right-of-way. Two ponds were designed to meet stormwater treatment targets defined in the relevant MESP/EIS, in accordance with Stormwater Management Plan for Brock 12 (Schaeffers, 2005) and Stormwater Management Pond 4 Final Report (Schaeffers 2013). However, the SWM Pond 4 was only sized to accommodate the 5-year flow from Teston Road (approximate 1.5 ha with imperviousness of 79%). Refer to **Appendix A6** for the excerpts from Brock 12 Stormwater Management Plan/Report.

3.6 Existing Municipal Servicing

In additional to the storm sewer system, there are various sanitary and water servicing infrastructure within the right-of-way of Teston Road. The details of these infrastructure were presented in the Subsurface Utility drawings.

- Sanitary

Sanitary servicing pipes are located at the intersection of Keele Street and Teston Road with the diameters ranging between 200 to 375mm and at the intersection of Dufferin Street and Teston Road with the diameters ranging between 200 to 600mm.

- Water

A pumping station owned by the Region is situated on the east side of Keele Street, north of Teston Road. There are 900 mm trunk watermains running along Keele Street and Teston Road east of Keele. These watermains converge at the intersection. Additionally, a 300 mm watermain pipe runs along the south side of Teston Road, stretching from Keele Street to Rodinea Road.

A 900 mm trunk watermain runs along the eastbound boulevard of Teston Road, extending from Dufferin Street to Bathurst Street. This trunk is accompanied by several branch pipes measuring 200 mm and 300 mm in diameter. In addition to the 900 mm trunk line, there are three other trunk lines (two in 750 mm diameter and one in 1050 mm diameter) running within the right of way of Teston Road, extending from Quail Run Boulevard to Bathurst Street.

3.7 Hydrologic and Hydraulic Assessment

3.7.1 Peak Flows

Hydrologic modelling based on Visual OTTHYMO was conducted to determine existing peak flows to each drainage outlet and peak flows to the culvert crossings. The Intensity-Duration-Frequency curves (IDF) in the York Region Design Manual was used. The 12-hour SCS storm distribution, which was adopted for the Don River Hydrology by TRCA, was used to generate design storm hyetographs in Visual OTTHYMO model.
Peak flows of the East Don River and McNair Creek were taken from the TRCA HEC-RAS model directly.

Table 4 and Table 5 summarize the peak flows from the right-of-way to each outlet and peak flows to crossings respectively. The detailed modelling inputs/outputs were included in **Appendix C1**.

Table 4: Summary of Peak Flows from Right-of-Way to Each Outlet (Existing)

Outlet ID	ROW Catchment	DA (ha)	5-year (m^3/s)	10-year (m^3/s)	25-year (m^3/s)	50-year (m^3/s)	100-year (m^3/s)	Source
1	101	0.41	0.05	0.06	0.07	0.08	0.09	V.OTTHYMO
2	102	0.80	0.09	0.11	0.13	0.15	0.16	V.OTTHYMO
3	103	4.48	0.33	0.42	0.54	0.62	0.70	V.OTTHYMO
4.1	141	3.10	0.05	0.07	0.09	0.11	0.13	V.OTTHYMO
4.2	142	0.72	0.02	0.03	0.04	0.05	0.06	V.OTTHYMO
5	105	0.41	0.05	0.06	0.07	0.08	0.09	V.OTTHYMO
6	106	1.64	0.16	0.19	0.24	0.27	0.30	V.OTTHYMO
7	171	2.67	0.24	0.30	0.37	0.42	0.47	V.OTTHYMO
8.1	181	0.97	0.08	0.10	0.12	0.14	0.16	V.OTTHYMO
8.2	182	1.33	0.13	0.16	0.20	0.23	0.25	V.OTTHYMO
9	109	1.23	0.13	0.16	0.19	0.22	0.24	V.OTTHYMO
10	110	0.90	0.12	0.15	0.18	0.20	0.23	V.OTTHYMO

Table 5: Summary of Peak Flows at Crossings (Existing)

Culvert ID	Drainage Area (ha)	5-year (m^3/s)	10-year (m^3/s)	25-year (m^3/s)	50-year (m^3/s)	100-year (m^3/s)	Regional (m^3/s)	Source
ED01 (Future bridge over East Don River)	310	0.34	0.38	0.43	0.52	0.65	36.87	TRCA HecRAS model @xs 3324.56
ED02	3.65	0.22	0.28	0.35	0.41	0.46	-	V.OTTHYMO
ED03	7.11	0.27	0.34	0.43	0.49	0.55	-	V.OTTHYMO
ED04 (McNair Creek)	196	0.29	0.35	0.57	0.79	0.96	20.3	TRCA model @xs 5818.14
ED05	111[(1)]	0.93	1.19	1.28	1.50	1.78	-	V.OTTHYMO

Note: [(1)] drainage area to ED05 includes 16.9 ha minor drainage area.

3.7.2 Existing Culvert Hydraulic Capacity Analysis

The existing hydraulic conditions of the centerline and side road culvert crossings were assessed using HY8 to determine if the current culverts have adequate capacity. As the centerline culvert east of Keele Street (WD07) and the railway culvert on the north side of Teston Road will be relocated as part of the proposed Teston Road realignment, no evaluation of their existing hydraulic conditions was conducted.

The railway culvert on the south side of Teston Road will not be impacted by the proposed roadway improvement works. The culvert crosses both Metrolinx's property and Region's property. The ownership of the culvert is unknown. The culvert downstream end is buried based on site investigations conducted in 2022 and 2023. It is recommended that the Region to rehabilitate/reconstruct this culvert and restore its hydraulic capacity. Other option is to combine the upstream drainage with the new Teston Road storm sewer system. This option will cause a minor external drainage to be treated by the new SWMF 1.

The received TRCA HEC-RAS model was reviewed and modified to establish baseline conditions for the future East Don River bridge (ED01) and McNair Creek culvert (ED04).

ED05 is a segment of an enclosed pipe system that runs beneath Teston Road and Bathurst Street, which outlets to Patterson Creek. According to the previous design drawing (**Appendix A4**), this drainage conduit is composed of a concrete pipe (CP) for the upstream section and a 1400mm diameter corrugated steel pipe (CSP) for the downstream section. The 1050 mm diameter CP has a similar normal capacity to the 1400mm diameter CSP. As such, the HY8 model was established for the segment featuring the 1050mm diameter CP under Teston Road, assuming that the downstream portion of the conduit does not experience hydraulic control.

Hydraulic conditions of the existing crossings are summarized in Table 6. As shown in Table 6**,** the existing culverts (ED02, ED03, ED04 and ED05) have sufficient capacity and replacement is not required. The detailed modelling inputs/outputs were included in **Appendix D1**.

Table 6: Summary of Hydraulic Anaylsis of Culvert Crossing (Existing Condition)

Culvert ID	Roadway Edge of Pavement (m)	Culvert Information					Hydraulics						Meet Criteria? (YES/NO)
		Size	Inverts (m)		Length (m)	Slope (%)	Head Water Elevation		Freeboard		HW/D		
			U/S	D/S			Design Flood (50-yr)	Check Flood (1.3 X 100- yr)	Design Flood (50-yr)	Check Flood (1.3 X 100-yr)	Design Flood (50-yr)	Check Flood (1.3 X 100 -yr)	
ED02	273.26	800 mmØ CON Pipe	271.47	271.17	37.04	0.81	272.03	272.18	1.23	1.08	0.70	0.89	YES
ED03	266.60	900 mmØ CON Pipe	264.87	264.47	29.82	1.34	265.46	265.61	1.14	1.00	0.66	0.83	YES
ED04	253.70	RFO 5700 mm (Span) X 1500mm (Hydraulic Vertical Opening)	250.79	250.46	36.00	0.92	251.30	252.96[1] (Regional)	2.40	0.74 (Regional)	0.34	1.44 (Regional)	YES
ED05	252.64	1050 mmØ Concrete Pipe & 1400 CSP (Portion under Teston Road)	248.68	248.31	58.89	0.63	249.78	250.31	2.86	2.33	1.05	1.55	YES

Note: [1.] Regional flood elevation taken from TRCA floodplain map Sheet 11.

4. PROPOSED CONDITIONS

4.1 Overview of Roadway Improvements

The proposed roadway improvements include a new 4-lane Teston Extension between Keele Street and Dufferin Street, as well as new pedestrian/cycling facilities and transit service/routes along the corridor from Keele Street to Bathurst Street. The preferred alternative alignments and cross-sections for four sections, as shown in Figure 3, are as follows:

- Section 1 (Keele to Rodinea -GO Rail Crossing): 4-lanes, 3m MUP north side, planted boulevards, 36m RoW (with protection for future sidewalks and cycle tracks – both sides); At-Grade GO Rail Crossing includes improved Teston Road alignment (shift to north) with long term property protection for GO Rail Grade Separation.

- Section 2 (Rodinea to Valley - Landfill Area): 4-lanes, constrained cross section (3m MUP north side, south side boulevard) with property protection for future full width (36m) cross section (sidewalks and cycle tracks – both sides)

- Section 3 (Valley Crossing): 4-lanes, constrained cross section (3m MUP north side, south side boulevard) on west and east bridge approaches with property protection for future full width (36m) cross section; Box girder steel bridge with inclined bridge legs, 2:1 embankments

- Section 4 (Dufferin to Bathurst): Widen equally on both sides 4-lanes to provide sidewalks, cycle tracks, planted boulevards, 36 m RoW.

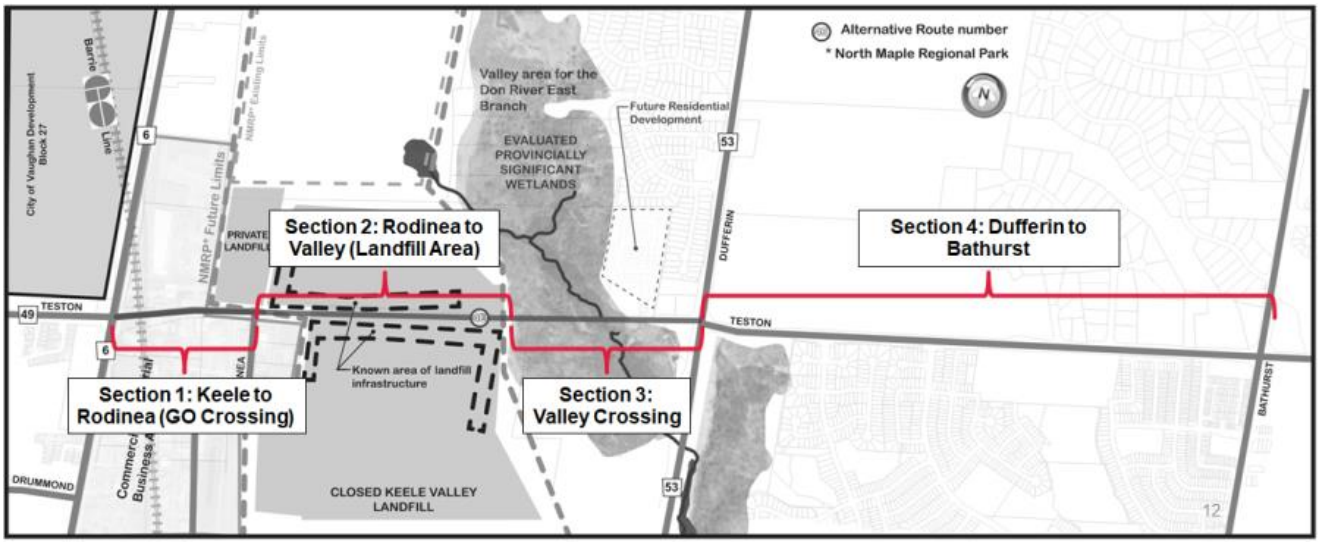


Figure 3: Roadway Improvements

4.2 Proposed Drainage Conditions and Design Concept

In general, the existing drainage pattern will be maintained. The following drainage improvements were proposed to accommodate the roadway improvements:

- Construction of a new storm sewer system to accommodate the urban roadway cross-section.
- Extension and/or relocation of the existing culverts to accommodate roadway widening and realignment.
- Construction of a single span bridge structure with span length of approximately 40 meters over the East Don River valley.
- The proposed roadway improvement will increase impermeability at each drainage outlet. Therefore, a comprehensive stormwater management plan needs to be developed to mitigate the potential impact.

The following sections discuss the preliminary design details and considerations related to each drainage element.

Exhibits 2.a to 2.c presents the proposed drainage conditions and proposed drainage design concepts and stormwater management strategy.

5. PROPOSED BRIDGE AND CULVERT CROSSINGS

5.1 East Don River Bridge (ED01)

After evaluating the overall benefits, including factors such as cost, environmental impacts, transportation, hydraulic and fluvial geomorphology requirements, a single-span bridge with a span of 40 meters and a height of approximately 14 meters at its tallest point was selected as the preferred configuration for the East Don River bridge. Refer to the preliminary General Arrangement drawing in **Appendix D2**.

At the proposed bridge location, the existing watercourse has an inline concrete flow control structure, which creates an artificial impoundment area and 1 m vertical channel invert drop. The width of the regulated floodplain upstream of the future bridge is approximately 74 meters, narrowing down to 20 meters downstream of the future bridge. The river valley does not run perpendicular to the proposed Teston Road alignment. An approximate skew angle of 30 degrees is expected from the direction of high flow to the alignment. Meander belt width is 43.1 meter as per Fluvial Report.

Relocation and reconstruction of the existing pond and its outlet structure are required to accommodate the new bridge. This also provides an opportunity to align the channel and improve upon fisheries and fluvial conditions. Relevant details are to be considered in the detailed design stage.

It is anticipated that the soffit elevation of the future bridge will have a clearance of more than 10 meters above the Regulatory flood level. As a result, there are no concerns regarding the compliance of the new bridge crossing with hydraulic criteria in terms of freeboard and clearance. To assess the potential floodplain impact resulting from the encroachment by the proposed abutment and embankment, the cross-sections in the baseline HEC-RAS model were modified to reflect the geometry of the abutment wall and road embankment. The square bridge structure represents the worst case from hydraulic impact perspective. The simulated results indicate that there will be a maximum of 8 cm increase in the Regional flood level. Table 7 summarizes the proposed Don River Bridge dimensions and the associated hydraulic results. Table 8 presents a comparison between existing and proposed conditions for Regional flood level for upstream, in middle, and downstream of the proposed bridge. Inputs and outputs of the hydraulics analysis are presented in **Appendix D2**.

Table 7: Summary of Hydraulic Characteristics of East Don River Bridge

Roadway EP	Bridge Dimension			
	Span (m)	Length (m)	Top of Deck Elev. (m)	Min. Soffit (m)
260	40	28.70	263.66	259.66

Peak Flow (m^3/s)			Hydraulic Results (Reach 18, XS 3324.56)					Meet Criteria
Design Storm (100-yr)	Check Storm (1.3X100-yr)	Regional	Upstream Headwater Elev. (m)			Freeboard for Design Storm (m)	Clearance for Design Flood (m)	
			Design (100 year)	Check (1.3*100yr)	Regional			
0.65	0.84	36.87	250.47	250.48	251.24	13.16	9.16	YES

Table 8: Regulatory Flood Level Comparison at the East Don River Bridge (Existing vs. Proposed)

Cross-section ID[1]		Existing (m)	Proposed (m)	Difference (m)
Upstream XS	3512.22 (245m upstream of new Bridge)	252.36	252.36	0.00
	3432	251.84	251.86	0.02
	3369.23	251.28	251.31	0.03
	3324.56	251.19	251.24	0.05
Middle XS (Bridge Location)	3270.27	250.99	251.06	0.07
Middle XS (Bridge Location)	3207.34	250.45	250.45	0.00
Downstream XS	3169	249.39	249.39	0.00

Note: [1]. Refer to Appendix D2 for cross section location.

5.2 McNair Creek Culvert (ED04)

As presented in **Section 3.7.2**, the existing culvert has sufficient capacity to convey 100-year and Regional storms without overtopping the road. The culvert also meets hydraulic criteria in terms of freeboard, clearance, and HW/D ratio. Under the proposed conditions, it is recommended to install headwall/retaining wall at both upstream and downstream ends. The headwall/retaining wall is to accommodate the roadway widening and prevent the need of culvert extension, as well as preventing embankment encroachment into the wetland area.

It is expected that the culvert will maintain its existing hydraulic functionality under the proposed modifications. Furthermore, there are no anticipated adverse effects on the Regulatory Floodplain as a result of these changes. Outputs of TRCA HECRAS model are presented in **Appendix D2**.

5.3 Roadway Culverts

WD07 and the culvert under the railway north of Teston Road will be replaced and relocated due to shifting of the future road alignment. The new culvert locations were selected with consideration of the future grade separation with the rail corridor. The proposed culvert WD07 has the capability of being extended once the new overpass structure is in place. Alternatively, in the future, a ditch along the roadway corridor could be constructed within the new overpass structure to accommodate surface drainage flow path, eliminating the need for culvert WD07.

The culvert under the Go Rail north of Teston Road should be designed to meet hydraulic criteria listed in AREMA and loading criteria as per Metrolinx standards. As the railway base information is not available, the culvert size, material and construction strategy should be further confirmed during the detailed design stage.

ED02 and ED03 will be retained and lengthened to accommodate the widened roadway. ED05 has sufficient length to accommodate the widened corridor with a minor modification of the upstream retaining wall.

A hydrological and hydraulic analysis has been conducted for the proposed conditions using the same approach as the one for the existing conditions to size the new culverts (WD07 and Railway North). Under the proposed conditions, the roadway drainage will be conveyed by a new storm sewer system and directed to the proposed stormwater management pond (SWMF1). The catchment to the new culvert is only from external area (19.32 ha). Peak flows are summarized in the Table 9. The new culverts were sized to meet hydraulic criteria listed in **Section 2** and summarized in Table 10.

Table 9: Summary of Peak Flow to New Culverts

Culvert ID	Drainage Area (ha)	5-year (m^3/s)	10-year (m^3/s)	25-year (m^3/s)	50-year (m^3/s)	100-year (m^3/s)	Regional (m^3/s)	Source
WD07 & Railway North	19.32	1.34	1.68	2.05	2.35	2.86	-	V.OTTHYMO

Table 10: Summary of Hydraulic Anaylsis of New Culverts

Culvert ID	Design Flood / Check Flood	Roadway Edge of Pavement (m)	Culvert Information					Hydraulics						Meet Criteria? (YES/NO)
			Size	Inverts (m)		Length (m)	Slope (%)	Head Water Elevation (m)		Freeboard (m)		HW/D		
				U/S	D/S			Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	
WD07	50-yr / 1.3*100-yr	266.78	900 mmØ Twin Pipe (smooth inner)	264.59	264.11	60.34	0.80	265.64	266.30	1.14	0.48	1.17	1.90	YES
Railway North	25-yr / 100-yr	267.17	1350mmØ Pipe(smooth inner)	264.87	264.71	20.85	0.77	266.01	266.65	1.16	0.52	0.84	1.32	YES

The existing driveway culverts running parallel to Teston Road will be removed or replaced as the result of the road widening and urbanization. The driveway culverts will be designed in the detailed design stage.

5.4 Summary

Recommendations for all new and existing crossings, as well as preliminary sizing are summarized in Table 11.

Table 11: Summary of Recommendations on Water Crossings

Culvert ID	Station[1]	Recommendations	Existing Size	Recommended Size
WD07	1+334	Relocation/Reconstruction	1300 mm CSP	Twin 900 mm pipe culvert
ED01	3+040	New bridge	-	Single span of 40 m
ED02	3+510	Extension (U/S end)	800 mm CP	Extension with existing culvert size
ED03	4+270	Extension (U/S and D/S ends)	900mm CP	Extension with existing culvert size
ED04	4+605	Install headwall at upstream/downstream ends	5700mm (Span)X1500 mm (hydraulic vertical opening)	N/A
ED05	5+350	Modification on headwall	1050mm CP(U/S end)	N/A
Railway North	1+360	Relocation/Reconstruction	900mm CP	1350 mm pipe culvert
Railway South	1+360	Rehabilitation/Reconstruction or Combining to Teston Storm Sewer	300mm CP	N/A

Note: [1]. Refer to station of future Teston Road alignment.

6. ROADWAY DRAINAGE SYSTEM

6.1 Storm Sewer

In order to accommodate the proposed road widening, urbanization, localized realignment, and new road connection, a storm sewer dominated surface drainage system was proposed. The following design aspects were taken into consideration (refer to sewer design summary in Table 12):

- Four existing storm sewer networks will be retained with appropriate adjustment of manholes and relocation of catchbasins. Totally eleven (11) new storm sewer networks need to be constructed to accommodate the urban cross-section.

- A preliminary storm sewer sizing was completed using Rational Method. The new storm sewer system was sized to convey 10-year storm without surcharging. At the location without proper overland flow route, the pipe segments were sized to convey 100-year storm. The IDF Curves in the York Region standard (refer to **Appendix A2**) were used for this preliminary sizing exercise.

- The new storm sewer systems generally maintain the same discharge points as the existing. Four new storm sewer outfalls were introduced at both sides of East Don River and McNair Creek valley. It is recommended that headwalls, plunge pools and / or enhanced swales are to be constructed at the sewer outfalls upstream of the watercourses to minimize erosion impacts and to meet design standards per the TRCA Living City Policies.

- The summarized details of the proposed storm sewer networks are provided below, with preliminary sizing sheet available in **Appendix E**. **Exhibits 2.a to 2.c** illustrate the preliminary storm sewer layout.

Table 12: Summary of Proposed Storm Sewer System

Network ID	Station	Serving Area	Description	Outlet Location and Treatment
1*	1+160	West of Keele Street, Catchment 202	Modify existing storm sewer system and direct roadway drainage to the proposed SWMF	Proposed Pond (SWMF1)
2	1+250 to 2+220	From 440 m east of Rodinea Road to Keele Street; Catchment 203	Main pipe along EBL with a total length of 750 m and sizes ranging from 300 mm to 975mm	Proposed Pond (SWMF1) and OGS1
3	2+220 to 3+080	From 440 m east of Rodinea Road to East Don River; Catchment 241 and Catchment 501 minor system	Main pipe along EBL with a total length of 750 m and sizes ranging from 300 mm to 600mm	West bank of East Don River; OGS 2 and Underground Storage (SWMF2)
4	3+080 to 3+320	From west of Dufferin to East Don River; Catchment 242	Main pipe along EBL with a total length of 250 m and sizes ranging from 300 mm to 450mm	East bank of East Don River; OGS3 and Underground Storage (SWMF3);
5	3+380 to 3+510	From Dufferin to Culvert ED02; Catchment 206	Main pipe along EBL with a total length of 80 m	ED02; OGS4 and Underground Storage (SWMF4);
6	3+780 to 3+510	West of Lady Fenyrose to to Culvert ED02; Catchment 206	Main pipe along EBL with a total length of 260 m and sizes ranging from 300 mm to 375mm	ED02; OGS5 and Underground Storage (SWMF5);

Network ID	Station	Serving Area	Description	Outlet Location and Treatment
7	3+780 to 4+310	Lady Fenyrose to Via Romano Blvd; Catchment 271	Main pipe along WBL with a total length of 500 m and sizes ranging from 300 mm to 525mm	Existing MH @ Via Romano Blvd; OGS6 and Underground Storage (SWMF6);
8	4+310 to 4+600	Via Romano Blvd to McNair Creek; Catchment 281	Main pipe along WBL with a total length of 280 m and sizes ranging from 300 mm to 525mm	McNair Creek; OGS7 and Underground Storage (SWMF7);
9	4+860 to 4+600	Quail Run Rd to McNair Creek; Catchment 282	Main pipe along WBL with a total length of 220 m and sizes ranging from 300 mm to 525mm	McNair Creek; OGS8 and Underground Storage (SWMF8);
10*	4+860 to 5+200	Quail Run Rd to Torah Gate; Catchment 209	Main pipe along WBL with a total length of 200 m and sizes ranging from 450 mm to 525mm	Treatment requirement TBD (potential for oil/grit separator, infiltration facility and/or underground storage)
11*	5+200 to 5+400	Torah Gate to Bathurst; Catchment 210	Main pipe along WBL with a total length of 100 m and sizes ranging from 300 mm to 450mm	Patterson Creek; treatment requirement TBD (potential for oil/grit separator, infiltration facility and/or underground storage)

Note: *indicates modification on the existing storm sewer system or adding an additional parallel storm sewer into existing storm sewer

6.2 External Drainage

Currently there are several external areas draining towards the ditches along Teston Road. These external needs to be captured and directed to a suitable outlet location under the proposed conditions. Where possible, it is advisable to separate all external drainages from the roadway drainage to avoid the need for larger storm sewer systems and stormwater management facilities.

Generally, a drainage ditch will be graded outside of the boulevard to intercept the flow and convey it to the adjacent crossing. For the area at the northeast quadrant of the intersection of Keele/Teston where the ditch cannot be graded due to limited space within the right-of-way (ROW), a parallel storm sewer is proposed.

7. STORMWATER MANAGEMENT

7.1 Potential Impact Assessment

The proposed Teston Road improvements would result in an increase in pavement areas. The total increase in pavement area is approximately 20 ha, approximately 25 % of the overall existing pavement area which will result in higher pollutant loading and peak flow.

The potential impact to each outlet in terms of imperiousness is summarized Table 13 below.

Table 13: Summary of Potentail Impacts on Outlet Basis

Outlet ID	Catchment ID	ROW Area (ha)	Impervious Area				Existing Condition	Proposed Work
			Existing (ha)	Ex. Imp. (%)	Proposed (ha)	Prop.Imp. (%)		
Outlet #1	101/201	0.41	0.22	54%	0.22	54%	Urban	Transition
Outlet #2	102/202	0.80	0.35	44%	0.40	50%	Urban	Transition/ Realignment
Outlet #3	103/203	4.48	1.43	32%	3.20	71%	Local road	Widening/ Realignment/ New Road
Outlet #4.1	141/241	3.10	0.00	0%	2.06	66%	No road	New Road
Outlet #4.2	142/242	0.72	0.04	5%	0.50	70%	No road	New Road
Outlet #5	105/205	0.41	0.23	56%	0.30	73%	Urban	Widening
Outlet #6	106/206	1.64	0.74	45%	1.20	73%	Rural	Additional Cycle and Sidewalk
Outlet #7	171/271	2.67	1.16	43%	1.74	65%	Rural	Addition Cycle and Sidewalk
Outlet #8.1	181/281	0.97	0.36	37%	0.64	66%	Rural	Addition Cycle and Sidewalk
Outlet #8.2	182/282	1.33	0.63	47%	0.96	72%	Rural	Addition Cycle and Sidewalk
Outlet #9	109/209	1.23	0.60	49%	0.90	73%	Rural	Addition Cycle and Sidewalk
Outlet #10	110/210	0.90	0.53	59%	0.62	69%	Urban/Rural	Addition Cycle and Sidewalk

7.2 Stormwater Management Control Requirements

A stormwater management plan was developed to meet the stormwater management objectives in terms of water quantity, water quality, erosion and water balance as outlined in **Section 2.2**. A hydrologic analysis was undertaken to quantify the required retention and detention volume on the outlet basis. The required storage was subsequently used to select feasible SWM features and determine property requirement at the preliminary design level.

Water Quantity Requirements

As per TRCA SWM criteria, unit flow rates should be used for all the sites located north of Steeles Ave that are greater than 5 ha. Linear infrastructure projects often have limited space available

within the right-of-way and multiple outlets with small catchment areas for each outlet. Therefore, it may be difficult to meet unit flow target for linear infrastructure project. Based on consultations with TRCA, TRCA had indicated that it would be acceptable to apply a best effort approach with post-to-pre control as a minimum. Refer to TRCA consultation meeting minutes in Appendix A1.

For comparison purposes, Visual OTTHYMO hydrologic model was used to quantify the required detention volumes for both post-to-pre control and unit flow rate control criteria for each outlet, as listed in Table 14. The proposed quantity control facilities presented in this report are based on detention volumes derived assuming post-to-pre flow controls. Visual OTTHYMO hydrologic model inputs and outputs are included in Appendix C.2 and preliminary facility sizing is included in Appendix F.

Erosion and Water Balance Requirements

5 mm retention from increased imperious area was set as a minimum target for the erosion control and water balance. Due to the site being located within HVRAs, maintaining pre-development groundwater recharge rates is required by TRCA. It is recommended to conduct water balance analysis and further evaluate the feasibility of enhance recharging measures during the detailed design stage. It is recommended that any recharging facilities be situated at a distance of more than 250 meters from the boundary of landfill sites.

Table 14: Stormwater Management Detention and Retention Requirements

Outlet ID	Catchment ID	ROW Area (ha)	SWM Requirements				
			Water Quantity Control				Erosion Control (m^3) (5mm Runoff from Inc.Imp)
			Detention Storage (m^3)		Target Release Rate (L/s)		
			Based on Post to Pre-Controls (100-Yr)	Based on Post to Unit Rate Controls (100-Yr)	Pre-dev. Flows (100-Yr)	Unit Rate (100-Yr)	
Outlet #2	202	0.8	1095	-	163	-	3
Outlet #3	203	4.48		2291	704	64	89
Outlet #4.1	241	3.1	1088	1435	132	44	103
Outlet #4.2	242	0.72	212	358	55	10	23
Outlet #5	205	0.41	79	210	88	6	4
Outlet #6	206	1.64	249	835	303	23	23
Outlet #7	271	2.67	319	1092	471	38	29
Outlet #8.1	281	0.97	139	458	160	14	14
Outlet #8.2	282	1.33	206	666	253	19	17
Outlet #9	209	1.23	173	620	241	18	15
Outlet #10	210	0.9	90	495	234	13	5

Note: Outlet 1 was excluded from SWM requirement table, as there is no impact to this outlet.

7.3 Screening of Alternatives

Several stormwater management practices (SWMPs) were screened for this study along with the "do nothing" alternative against general advantages and disadvantages, such as effectiveness, experience from similar conditions, and site-specific constraints or opportunities. The following are seven of the considerations:

- Land availability within the right-of-way;

- Outlet types, locations and elevations;
- Difficulty of separating roadway drainage from external drainage;
- Opportunity of using existing/potential SWM facilities within adjacent areas;
- Groundwater table and sub-surface soil type for feasibility of infiltration facility implementation;
- Constraints of landfill area and cold-water fish habitat requirements; and
- Practicality of small orifice sizes to control peak outflow and future maintenance.

It was determined that “do nothing” is not an acceptable course of action, particularly in view of the numerous municipal storm connections. The proposed increase in pavement area and the associated potential increase in pollutant loading to the receiving watercourses would result in negative effects such as reduced stream water quality, degraded aquatic habitat, and flooding, which necessitate provision of appropriate mitigation measures.

The list of SWMPs reviewed for appropriateness included:

- Storage SWMPs such as wet ponds, dry ponds, constructed wetlands and underground storage tanks/pipes;
- Infiltration SWMPs such as infiltration basins, infiltration trenches and porous pavement;
- Vegetative SWMPs such as buffer strips, grassed swales, rain garden/bioretention and filter strips; and
- Special purpose SWMPs such as oil/grit separators and filter devices.

Alternative SWMP options were identified at several outlet locations (i.e. Outlet 2,3, 4, 6, 8, and 9) for more detailed screening. These SWMP alternatives were presented to the Region and determined to be not feasible at this time. Table 15 summarizes the alternatives considered and rationale for exclusion.

Table 15: Alternative SWMP Options at Select Outlet Locations

Outlet ID	Alternative SWMP	Rationale for Exclusion
Outlet #2/3	A central SWMF for both roadway drainage and external drainage	This option would result in greater property impacts and therefore not considered feasible.
Outlet #4.1	Alternative 1: Infiltration Facility at the north of Teston Road and west of the valley Alternative 2: Wetland/Pond adjacent to TRCA's Floodplain	Alternative 1: infiltration facility will be too close to the landfill area and would be at risk of groundwater contamination. Alternative 2: The proposed facility will result in significant vegetation removal from the pond and access road construction. It was determined that the ecological impacts outweigh the benefits of a surface pond.
Outlet #4.2	Alternative 2: Wetland/Pond adjacent to TRCA's Floodplain	The proposed facility will result in significant vegetation removal from the pond and access road construction. It was determined that the ecological impacts outweigh the benefits of a surface pond.
Outlet #6	Enhanced Swale	Possible to implement but has property impacts. Excluded from further consideration under this study.
Outlet #7/9	Utilize the existing SWM facilities within subdivision	Documentation is not available to verify whether the existing facility has sufficient capacity to service the future ROW runoff. Either onsite control or checking the pond capacity will be required later for the detailed design submission.

Outlet ID	Alternative SWMP	Rationale for Exclusion
Outlet #10	Combine stormwater management treatment with Egin Mill Roadway widening.	This option will require further consultation with the Elgin Mills Road widening and has not been considered under this study.

Based on an initial screening of SWMPs, it was concluded that:

- The implementation of surface storage stormwater management practices (such as wet ponds, dry ponds, and constructed wetlands) can be effective in providing combined quality and quantity control, especially when there are sufficient drainage areas and available space. However, the use of surface storage SWMPs for the linear infrastructure project within urban setting is limited due to space constraints. In such cases, underground storage tanks and pipes become the main measures for water quantity control.

- SWMPs based on infiltration can be effective in treating stormwater runoff and recharging groundwater, but their effectiveness is limited with respect to flood control. The implementation of infiltration facilities is typically constrained by a high groundwater table and the infiltration rate of the sub-surface soil. It should also be noted that infiltration facilities cannot be applied to landfill areas due to the potential impact on groundwater patterns and concerns regarding re-contamination.

- Vegetative SWMPs such as grassed swales, bioretention cells, filter strips, provide water quality treatment primarily by filtering out fine sediments and promoting infiltration. Due to the urban corridor, vegetative buffers, filter strips and enhance swale along the corridor are not practical. An alternative solution could be incorporating enhanced swale at the storm sewer outlet. In additional, bioretention cells can be integrated into boulevards where the space is available.

- Oil/grit separators are popular and practical measures that can be incorporated into a storm sewer system. They can be used in conjunction with other SWMPs as part of a treatment train.

- Documentation is not available to verify whether the existing SWM facilities (within the subdivisions) have sufficient capacity to service the future Teston Road widening. Verification of the pond treatment capacity is required during detailed design. Notwithstanding this uncertainty, ROW controls have been included to address downstream minor system constraints and to achieve additional water quality control benefits.

- Integration with future/ongoing SWM facilities from private development applications were also deemed not feasible.

7.4 Proposed Stormwater Management Strategy

In general, the feasibility of implementing a particular SWMP is dependent on the size of the contributing area, available grade separation (i.e., top of road profile versus ditch profile), local topographical constraint and land availability. The criteria used in the selection of the preferred stormwater management alternative also include the potentials for upstream or downstream

impacts, the environmental and hydraulic sensitivity of the downstream receiver and maintenance.

Table 16 summarizes the recommended SWM measures on an outlet-by-outlet basis. The proposed stormwater management plan is illustrated in **Exhibits 2.a** to **2.c**.

Table 16: Stormwater Management Stragegy on Outlet Basis

Outlet ID	Outlet To	Constraints and Opportunities	SWM Plan	
			Water Quantity and Water Quality	Erosion and Water Balance
Outlet #1	Existing Storm Sewer	1.Discharge to municipal sewer	N/A	N/A
Outlet #2	Existing Storm Sewer	1. Discharge to municipal sewer 2. Future Grade Separation	1. Outlet to New Wet/Dry Pond (SWMF#1)	
Outlet #3	Ditch, Then Sewer	1. Future Grade Separation 2. External drainage 3. Discharge to Sewer system 4. Railway drainage 5. Utility	1.New Pond (SWMF#1) 2.OGS (OGS#1)	Bio Retention Cells along Blvd
Outlet #4.1	East Don River	1. East Don River Valley 2. Landfill area	1. Underground Storage (SWMF#2) 2. OGS (OGS#2); 3. Enhanced swales at sewer outlet	Infiltration combined with underground storage
Outlet #4.2	East Don River	1.East Don River Valley 2.On-going development	1. Underground Storage (SWMF#3) 2. OGS (OGS#3); 3. Enhanced Swales at sewer outlet	Infiltration combined with underground storage
Outlet #5	Existing Storm Sewer	1. Discharge to municipal sewer along Dufferin St. 2. On-going Dufferin improvement works	0.41ha will be diverted to Outlet 4.2 by a new sewer. No stormwater management is required.	
Outlet #6	Culvert ED02	1. External drainage 2. Watercourse	1. Superpipes (SWMF#4,5) 2. OGS (OGS#4,5); 3. Enhanced Swale	1. Enhanced Swale; 2. Infiltration combined with underground storage; 3. Perforate Pipe or infiltration trench.
Outlet #7	Existing Storm Sewer	1. External drainage; 2. Discharge to sewer system 3. WM 900 EB	1. Underground Storage (SWMF#6) 2. OGS (OGS#6); 3. Utilizing existing SWMF beyond ROW	1.Perforate Pipe or infiltration trench.
Outlet #8.1	McNair Creek (ED04)	1. Discharge to environmental sensitive watercourse	1. Underground Storge (SWMF#7) 2. OGS (OGS#7);	Perforate Pipe or infiltration trench.
Outlet #8.2	McNair Creek (ED04)	1. Discharge to environmental sensitive watercourse	1. Underground Storge (SWMF#8) 2. OGS (OGS#8);	Perforate Pipe or infiltration trench.
Outlet #9	Existing Storm Sewer	1. External drainage 2. Discharge to sewer 3. Utility and limited room	1. Underground Storge 2. Utilizing existing SWMF beyond ROW	Perforate Pipe or infiltration trench.

Outlet ID	Outlet To	Constraints and Opportunities	SWM Plan	
			Water Quantity and Water Quality	Erosion and Water Balance
Outlet #10	Culvert (ED05) /Closed system	1.Discharge to closed system; 2. Utility 3. Limited room	1. Underground Storge	Perforate Pipe or infiltration trench

8. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are provided:

- This study investigated the hydraulics for a new 40m span bridge crossing the East Don River and two other existing crossings of minor tributaries (an unnamed tributary and McNair Creek).

- The proposed bridge configuration will not result in any significant hydraulic impacts for the Regulatory storm.

- Preliminary design recommendations confirmed that minor lengthening of the existing culvert crossings at ED02 and ED03 do not result in any hydraulic impacts.

- A road drainage assessment was completed to identify the existing road drainage patterns, assess external drainage areas (generally runoff north of the ROW), evaluate existing drainage deficiencies, and confirm outlet locations. This assessment was used as a basis to inform preliminary drainage design considerations.

- There are four existing storm sewer networks that will be fully or partially maintained and determined to be sufficient to service the proposed road improvements.

- There are eleven new storm sewer networks proposed to service the proposed road improvements.

- At Outlet 3 (generally at the Teston Rd/Keele St intersection), flows from a large external area (catchment EXT.1) will be kept separate from the ROW flows. As such a separate conveyance system was developed to convey external flows through the rail corridor and ROW towards the existing drainage system on Keele St, south of the intersection. This separate drainage system was designed to convey the 100-year flows and developed with consideration for the future grade separate with the rail corridor.

- The proposed stormwater management plan for the ROW improvements will include the use of underground facilities for quantity control and water balance (via infiltration) and OGS units placed upstream of outlets for quality control. A surface SWM facility (SWMF1) is proposed at Outlets 2 and 3 for water quality and quantity control.

- SWMF1 is situated on lands owned by the City of Vaughan and will require further consultation with the City to confirm the feasibility of the proposed SWM plan.

- There are opportunities to integrate SWM controls for Outlet 10 with the future widening of Elgin Mills Road (east of Bathurst St). Further coordination will be required between the two projects to identify SWM constraints and opportunities as both projects share an outlet to Patterson Creek.

TRCA PRESENTATION
SPRING 2023

TESTON ROAD AREA TRANSPORTATION IMPROVEMENTS

Individual Environmental Assessment
Spring 2023 Stakeholder Meetings
May 24, 2023

York Region

PURPOSE OF THE MEETING

- Project Overview/ Schedule Update
- Review of Recommended Alternative Design
- Preliminary Impact Assessment and Proposed Mitigation Measures
- Next Steps

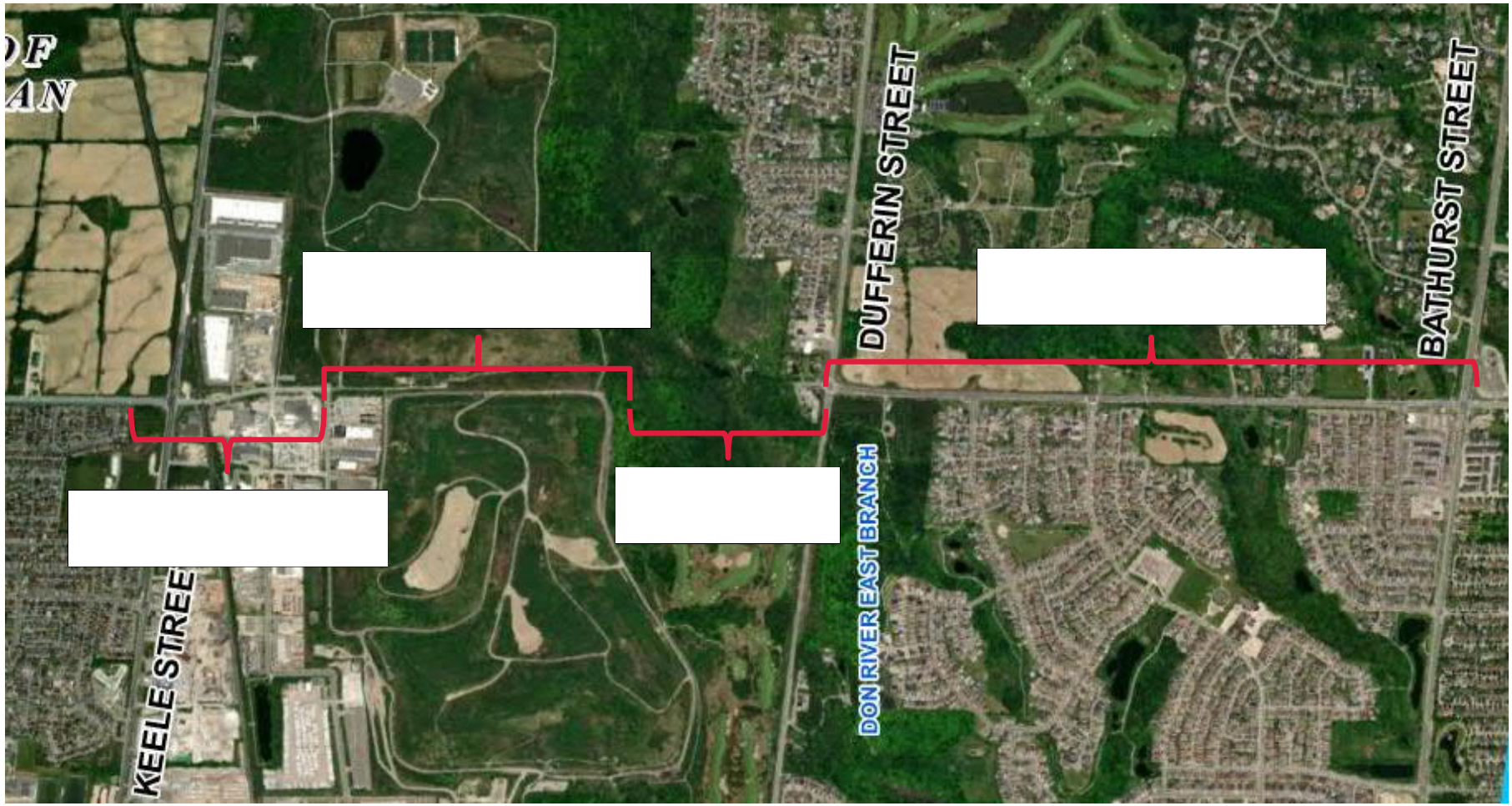
STUDY SCHEDULE

IEA KEY MILESTONES	COMPLETION DATE
Identification of Problems and Opportunities	Spring to Fall 2020
Generation of Alternatives to the Undertaking	Winter to Spring 2021
Open House #1	June 2021
Confirm Preferred Alternative to the Undertaking	Summer 2021
Generation of Alternative Methods	Summer/Fall 2021
Open House #2	Fall 2021
Select Preferred Alternative Method	Fall 2021
Open House #3	Spring 2022
Preliminary Design – WE ARE HERE	Spring 2023
Open House #4	Summer/Fall 2023
Draft IEA Report (Public and Government Review)	Winter 2024
Final IEA Report MECP	Spring 2024

WORK COMPLETED SINCE OPEN HOUSE #3

- Advanced various field studies, including:
  - Subsurface Utilities
  - Geotechnical/Foundations
  - Hydrogeology, Drainage, Fluvial Geomorphology
  - Soil Contamination
  - Natural Environment
  - Archaeology (ongoing)
- Drafting of the Preliminary Design
  - Evaluation to assess alternatives for embankments/retaining walls
  - Evaluation to assess alternatives for bridge design

DESIGN ALTERNATIVES ROADWAY SECTIONS



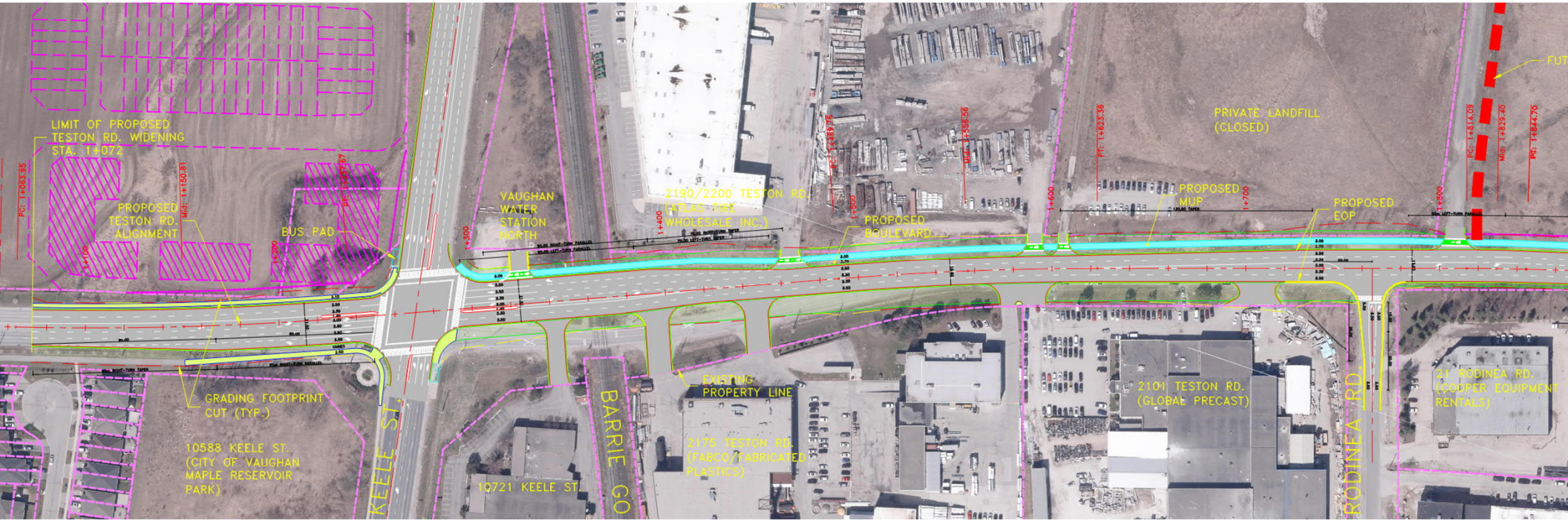
SUMMARY OF RECOMMENDED DESIGN ALTERNATIVES

Alignment Section	Recommended Design Alternative
Section 1: Keele to Rodinea (GO Rail Crossing)	• 4-lanes, 3m MUP north side, planted boulevards, 36m RoW (with protection for sidewalks and cycle tracks – both sides) • At-Grade GO Rail Crossing – with improved Teston Road alignment (shift to north) • Long term property protection for GO Rail Grade Separation.
Section 2: Rodinea to Valley (Landfill Area)	• 4-lanes, constrained cross section (3m MUP north side, south side boulevard) with property protection for future full width (36m) cross section (sidewalks and cycle tracks – both sides)
Section 3: Valley Crossing	• 4-lanes, constrained cross section (3m MUP north side, south side boulevard) on west and east bridge approaches with property protection for future full width (36m) cross section • Box girder steel bridge with inclined bridge legs, 2:1 embankments
Section 4: Dufferin to Bathurst	• Widen equally on both sides • 4-lanes, sidewalks, cycle tracks, planted boulevards, 36m RoW

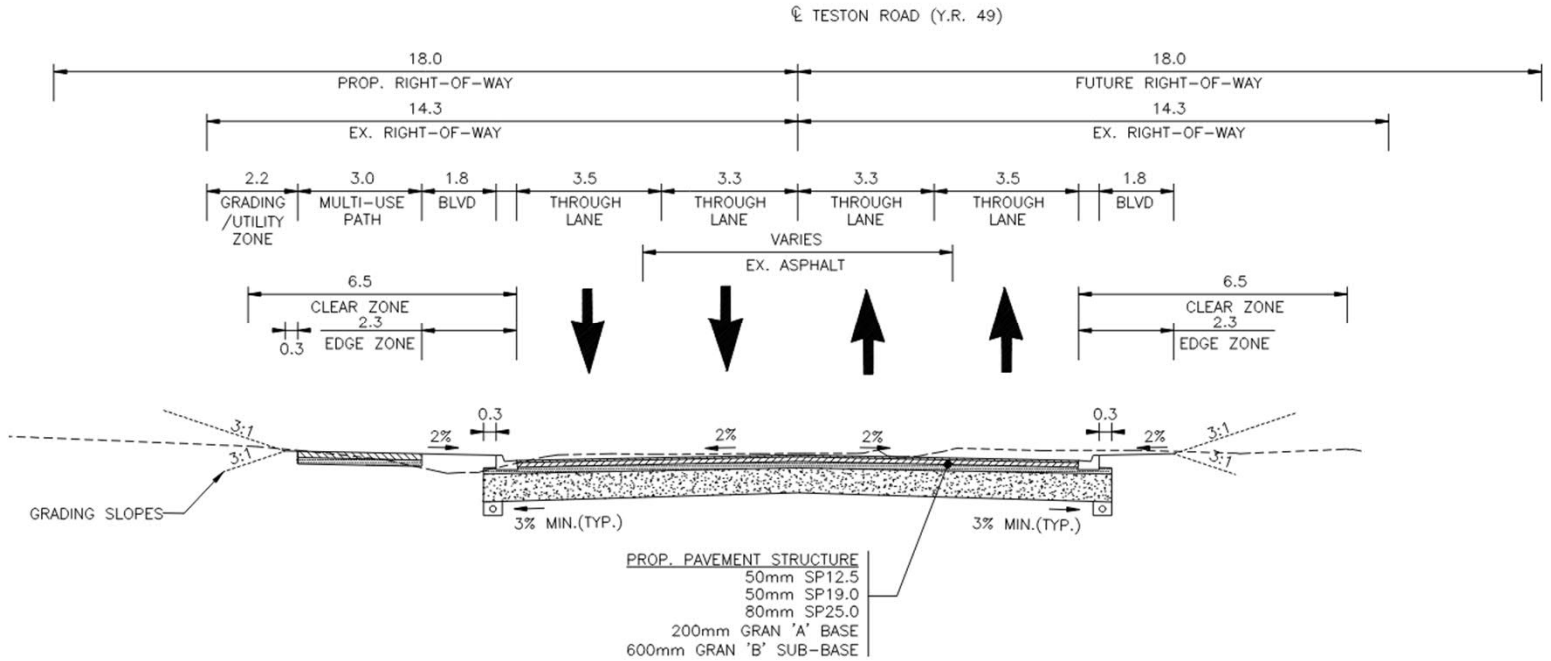
SECTION 1 PRELIMINARY DESIGN CONSIDERATIONS

- New 4-lane roadway with 3m north side multi-use pathway and south side boulevard (with protection for sidewalks and cycle tracks – both sides)
- GO Rail Crossing – proximity to the intersection and at-grade vs. grade separation
- Planned Block 27 development within the northwest quadrant of Keele/Teston
- Pumping station in the northeast quadrant
- Industrial developments and accesses west of Keele
- City owned lands, natural areas, and existing residential in the southwest

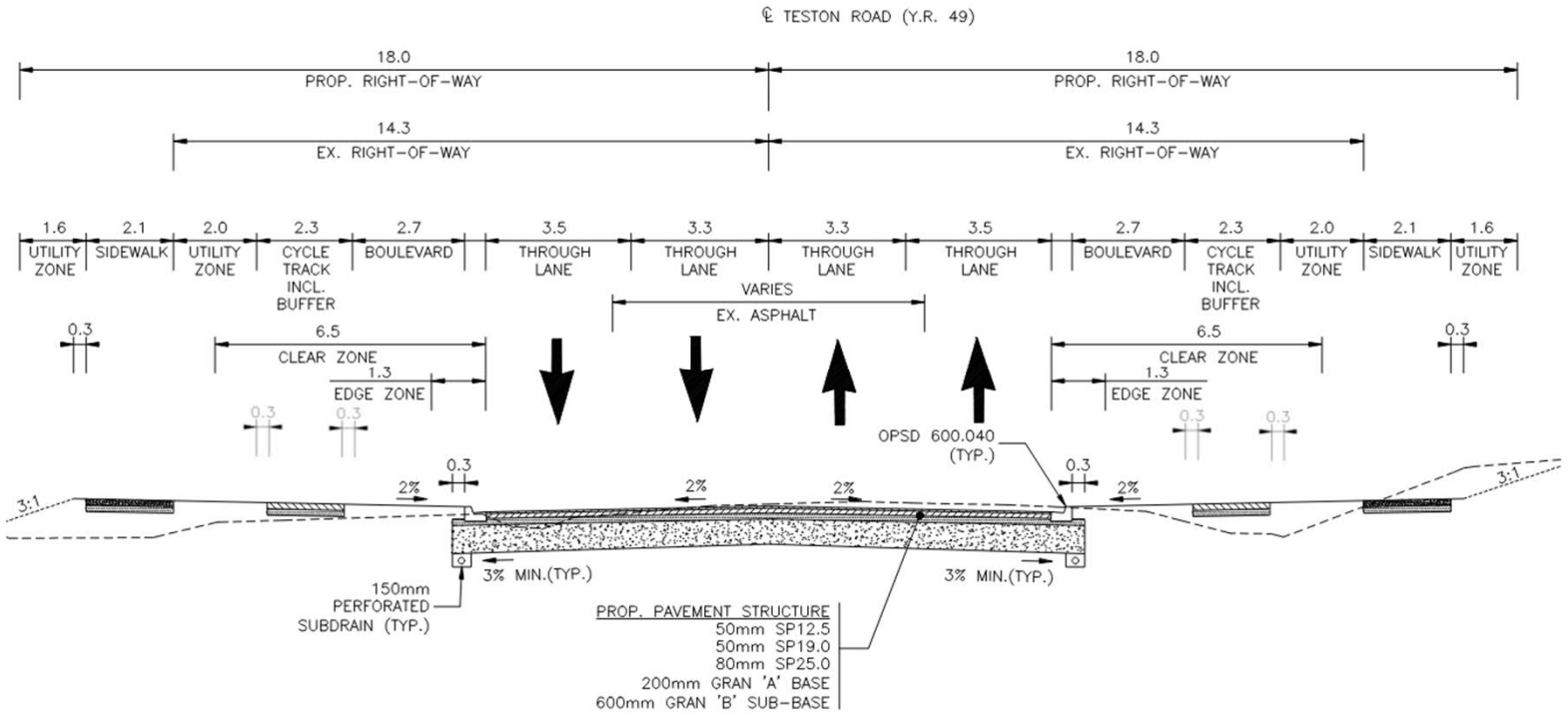
SECTION 1: ROADWAY DESIGN – INTERIM DESIGN



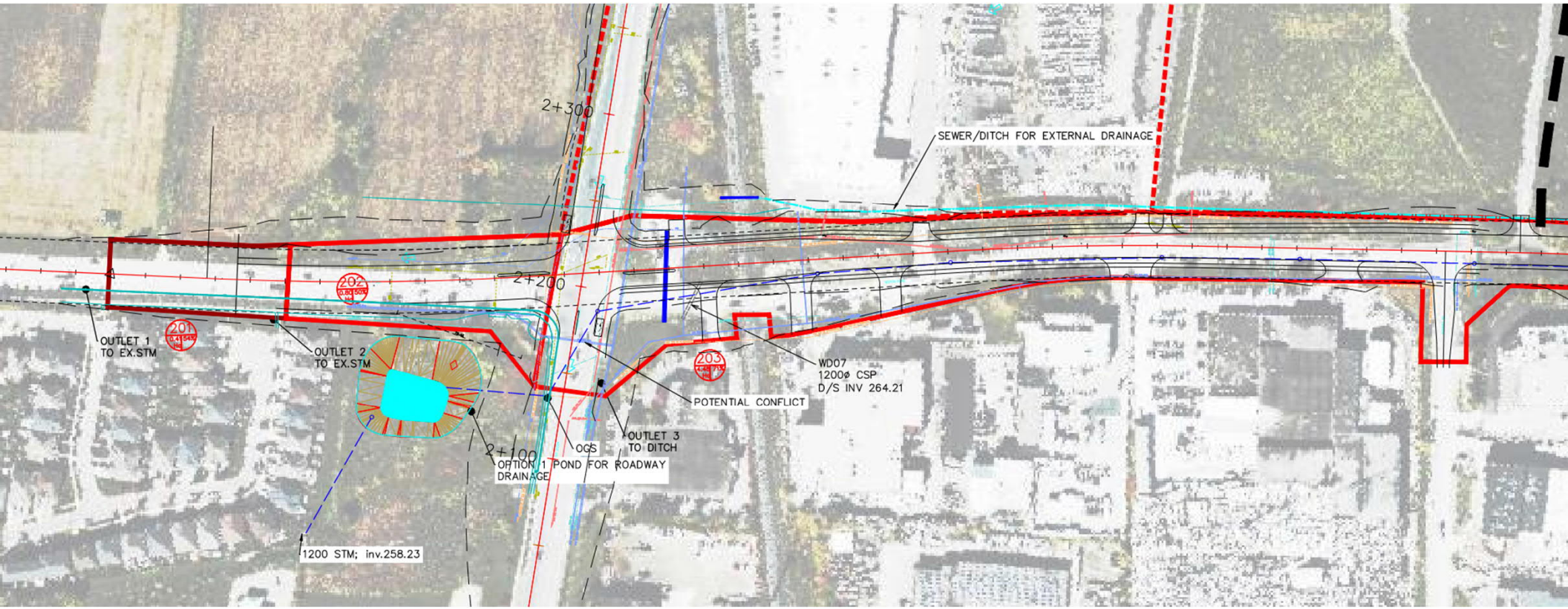
SECTION 1: ROADWAY DESIGN – INTERIM TYPICAL SECTION



SECTION 1: ROADWAY DESIGN – FUTURE TYPICAL SECTION



SECTION 1: STORMWATER MANAGEMENT DESIGN



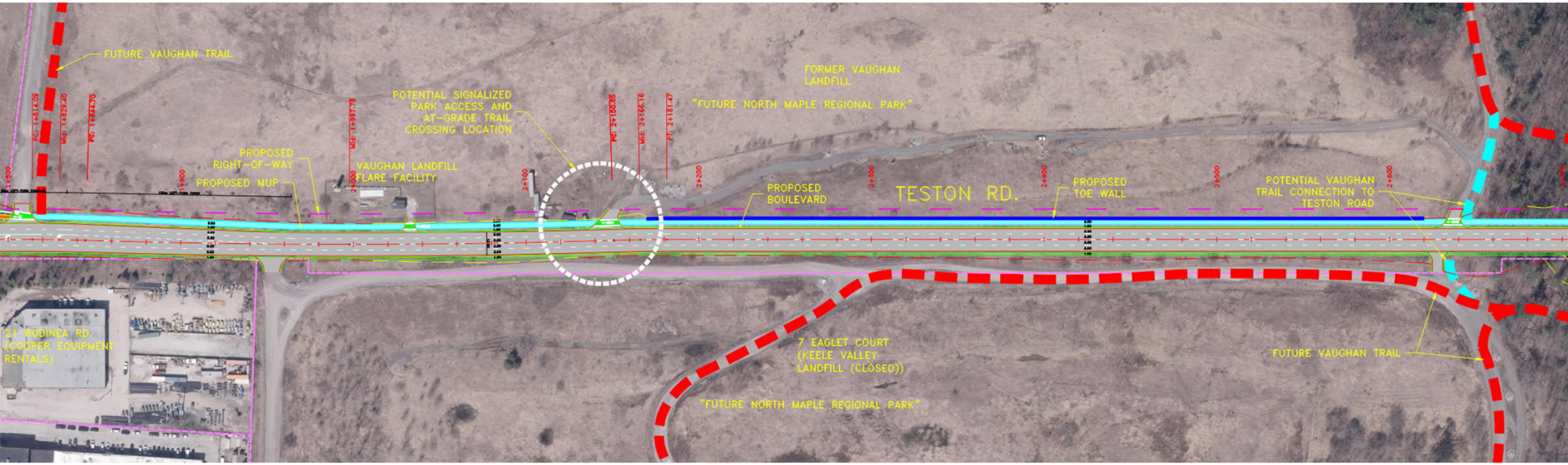
SECTION 1 POTENTIAL IMPACTS & MITIGATION MEASURES

- Limited natural environment impacts associated with footprint increases and new stormwater management pond in the southwest quadrant.
- Stormwater flows directed to the new pond in southwest quadrant of Teston/Keele via ditching/culverts.
- At-grade GO rail crossing fits within existing right-of-way, future grade separation requires easements/property for grading.
- Some property accesses impacted by grade separation but can be accommodated in alternative ways.
- Future GO rail grade separation may require additional noise mitigation to residential properties in the southwest quadrant of Teston/Keele.

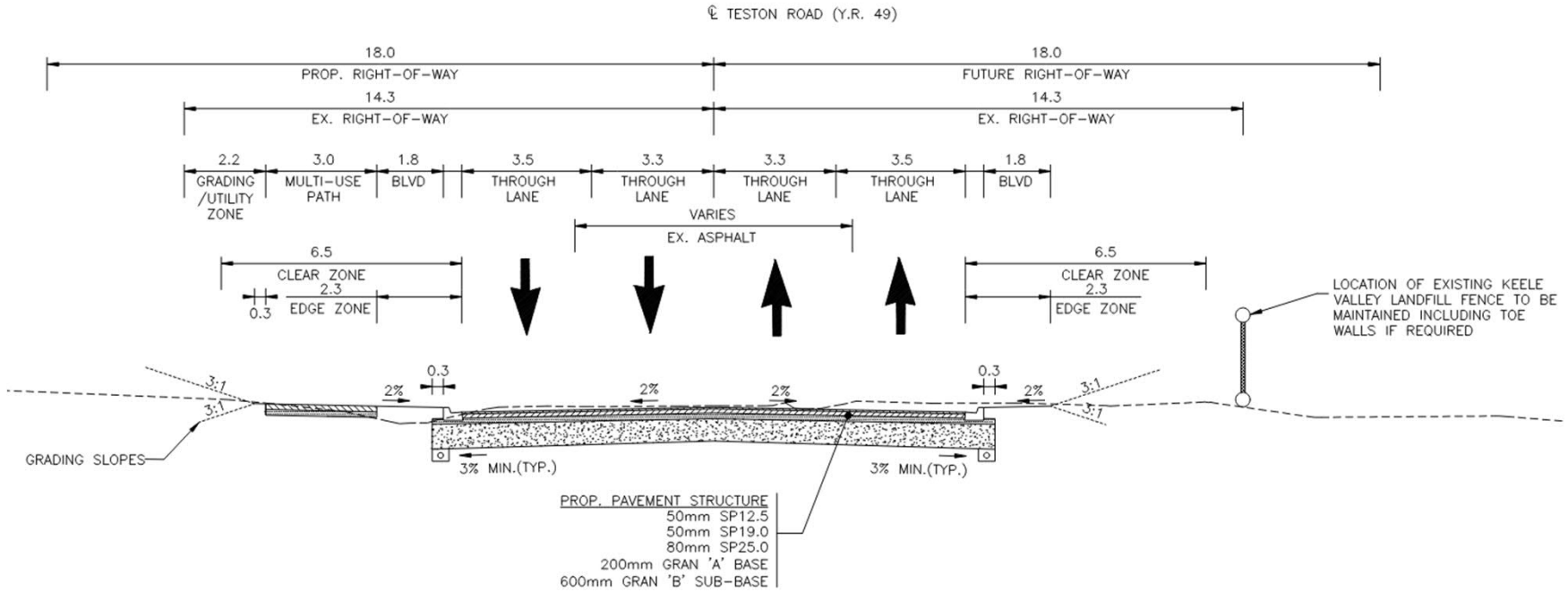
SECTION 2 PRELIMINARY DESIGN CONSIDERATIONS

- Due to the landfill constraints in this section, a constrained cross-section is being recommended with long term protection for a full-width cross-section
- New 4-lane roadway with 3m north side multi-use pathway and south side boulevard (with protection for sidewalks and cycle tracks – both sides)
- Need for continued access to north and south side landfills
- Coordination with City of Vaughan on integration with North Maple Regional Park

SECTION 2: ROADWAY DESIGN

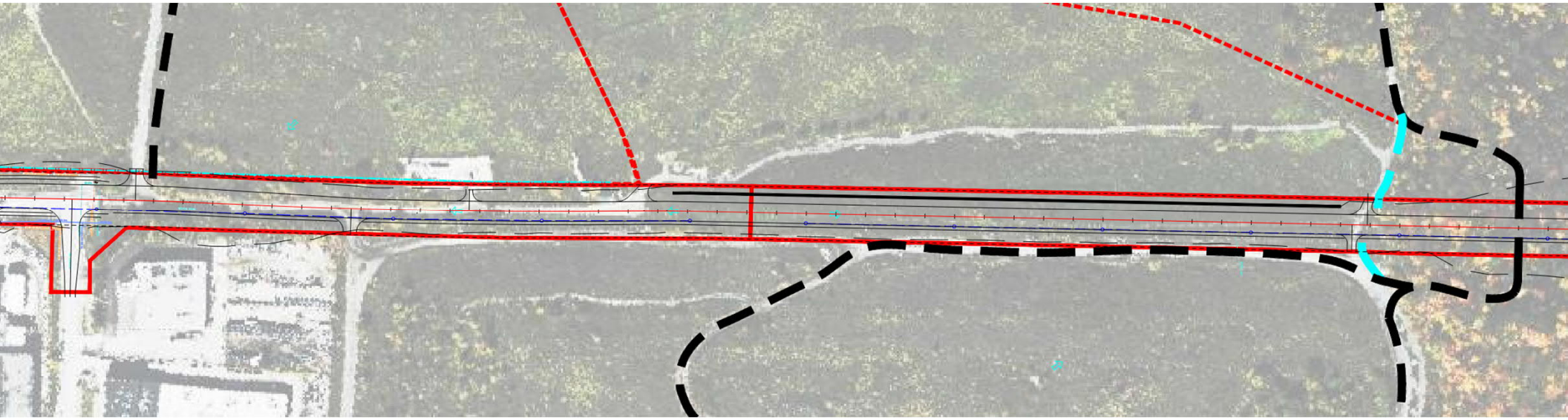


SECTION 2: ROADWAY DESIGN – TYPICAL SECTION



TESTON ROAD – SECTION 2 – RODINEA ROAD TO DON RIVER VALLEY
STA. 1+800 TO 2+300
LOOKING EAST
N.T.S.

SECTION 2: STORMWATER MANAGEMENT DESIGN



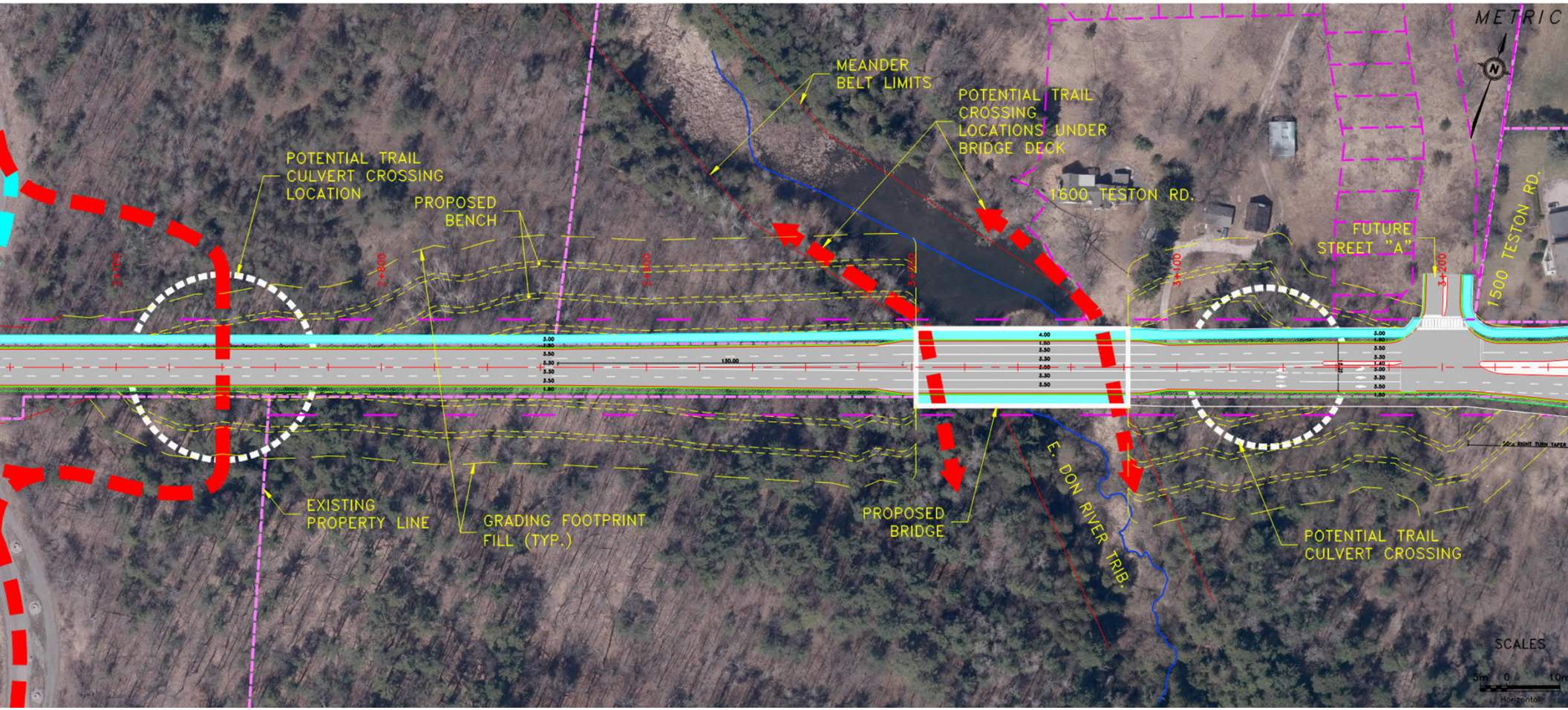
SECTION 2 POTENTIAL IMPACTS & MITIGATION MEASURES

- Natural environment impacts associated with new roadway footprint, however, use of the existing access road reduces overall impacts
  - Parklands/landfills are species at risk grassland bird habitat
- Constrained cross section fits within existing York Region right-of-way, however, protection for future 36m RoW required
- Stormwater management split between flowing westerly to Section 1 facilities and easterly to Section 3 facilities
- Consideration to be given to existing landfill groundwater plumes and isolation from impacts resulting from road salt application

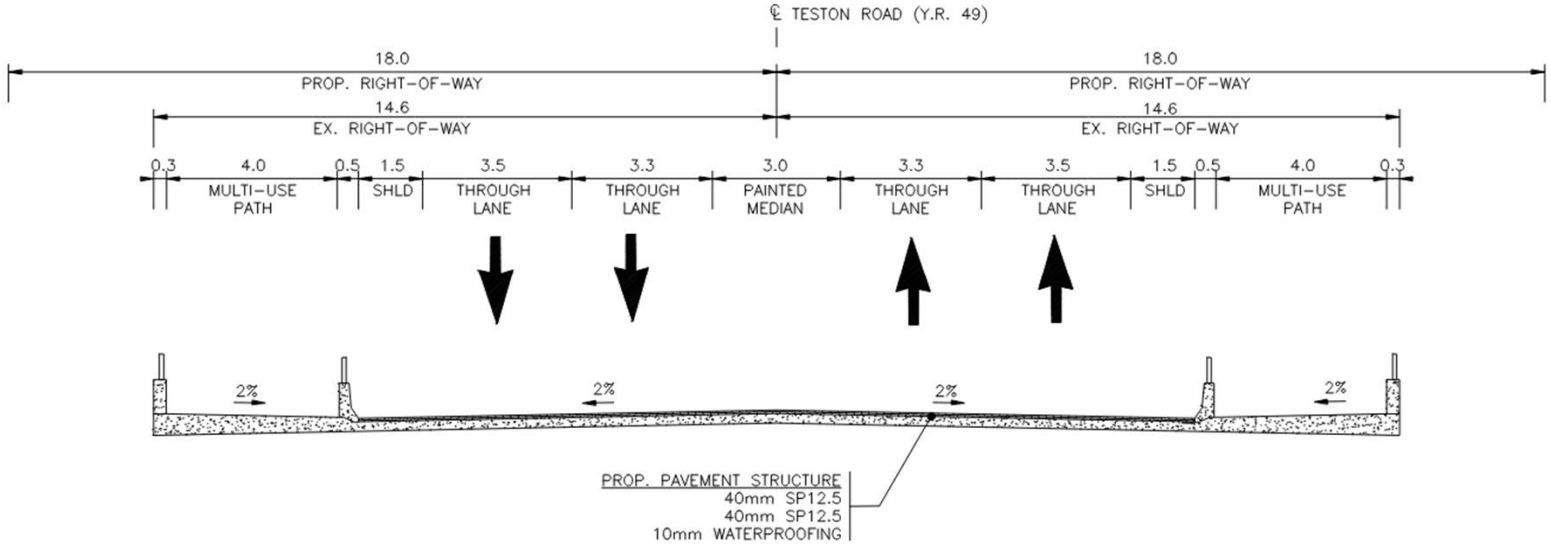
SECTION 3 PRELIMINARY DESIGN CONSIDERATIONS

- Constrained cross section (3m MUP north side, south side boulevard) on west and east bridge approaches with property protection for future full width (36m) cross section (sidewalks and cycle tracks – both sides)
- A short span structure was recommended during previous phase
  - Evaluation completed to determine exact length and bridge type
  - Recommended Option: Box girder steel bridge with inclined bridge legs
- Evaluation determined that 2:1 benched and planted embankments were preferred over retaining walls for bridge approaches due to opportunities to revegetate, similar construction footprint, maintenance, and costs
- Access to existing and future developments

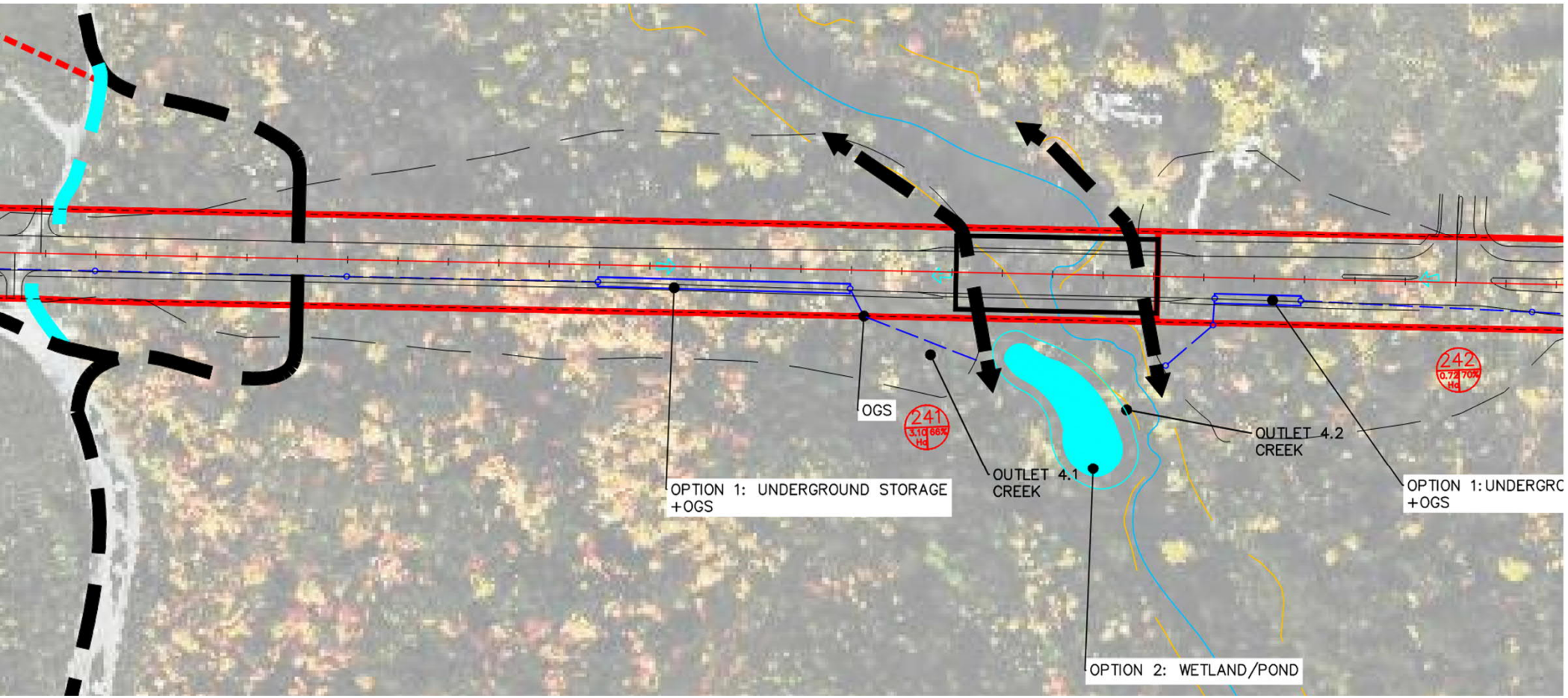
SECTION 3: ROADWAY DESIGN



SECTION 3: ROADWAY DESIGN – BRIDGE CROSS SECTION



SECTION 3: STORMWATER MANAGEMENT DESIGN



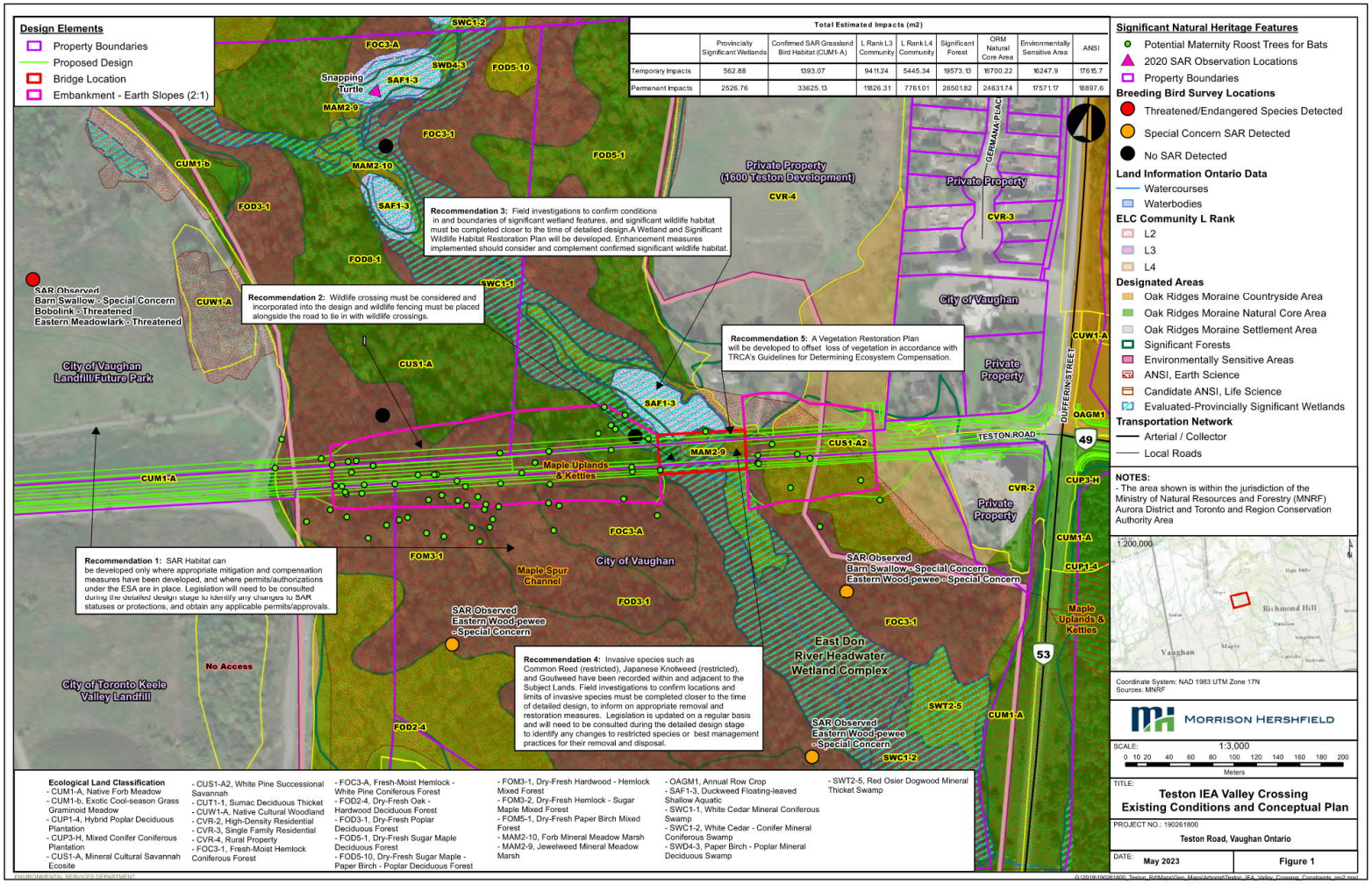
SECTION 3 POTENTIAL IMPACTS & MITIGATION MEASURES

Natural Environment

- Total footprint impacts include 22ha. Additional 18ha temporary impacts from construction that will be restored (embankments to be replanted)
- Vegetation Restoration Plan will include planting of native species and compensation will be calculated in accordance with the TRCA's *Guideline for Determining Ecosystem Compensation*
- Wildlife fencing and wildlife passage under the structure to be considered to address habitat connectivity and to prevent roadway crossings
- The valley likely contains Species at Risk Bat habitat (suitable habitat is present, acoustic surveys not completed). Offsetting plans typically include installation of artificial habitat structures (e.g., bat boxes), planting plans, monitoring and reporting
- Restoration and planting plans within and adjacent to wetlands and along the tributary can focus on improving riparian conditions and functions to improve habitat quality and water quality at the bridge as well as downstream
- Invasive species removal/management

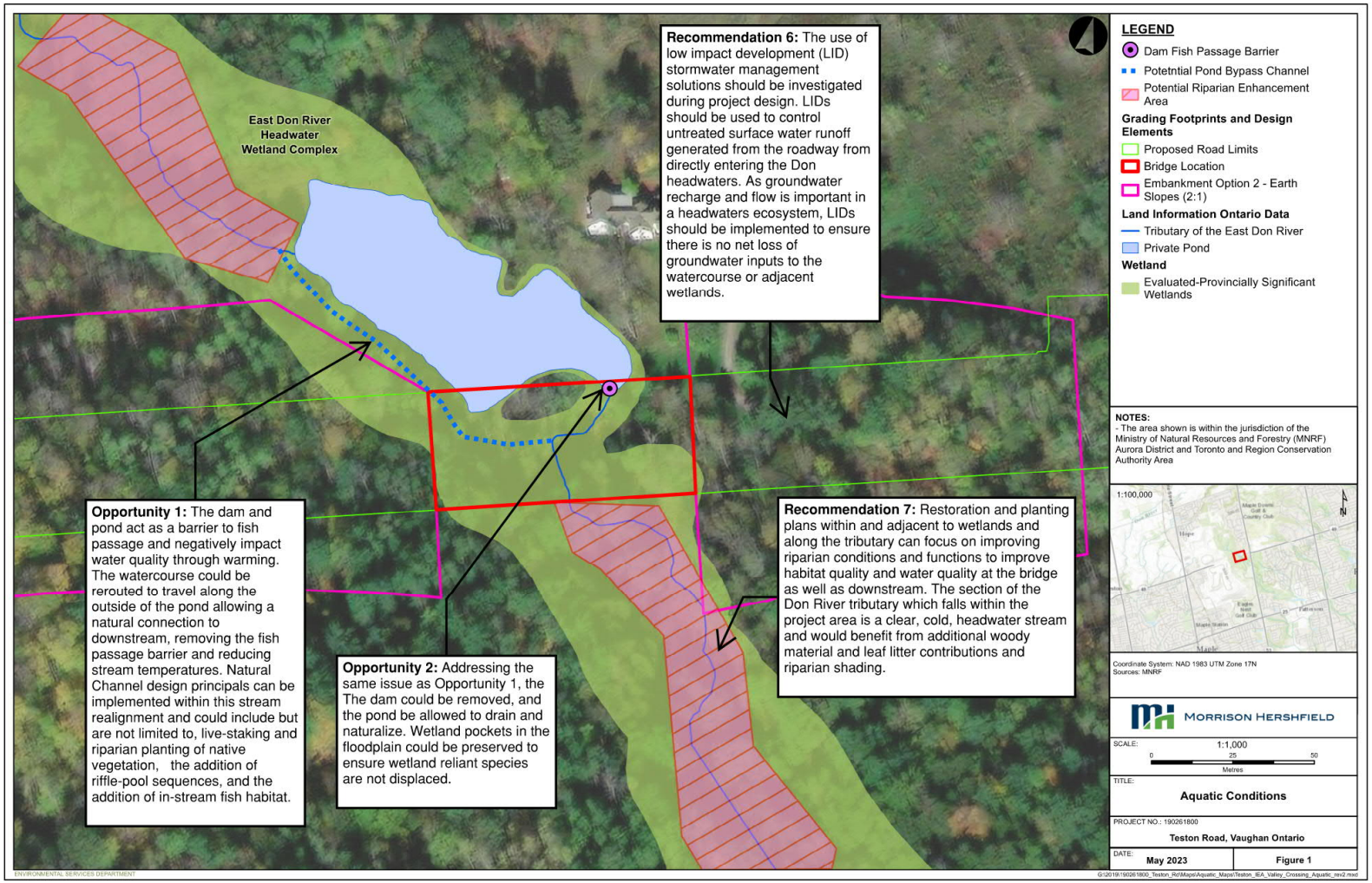
SECTION 3 POTENTIAL IMPACTS & MITIGATION MEASURES

Natural Environment



SECTION 3 POTENTIAL IMPACTS & MITIGATION MEASURES

Natural Environment



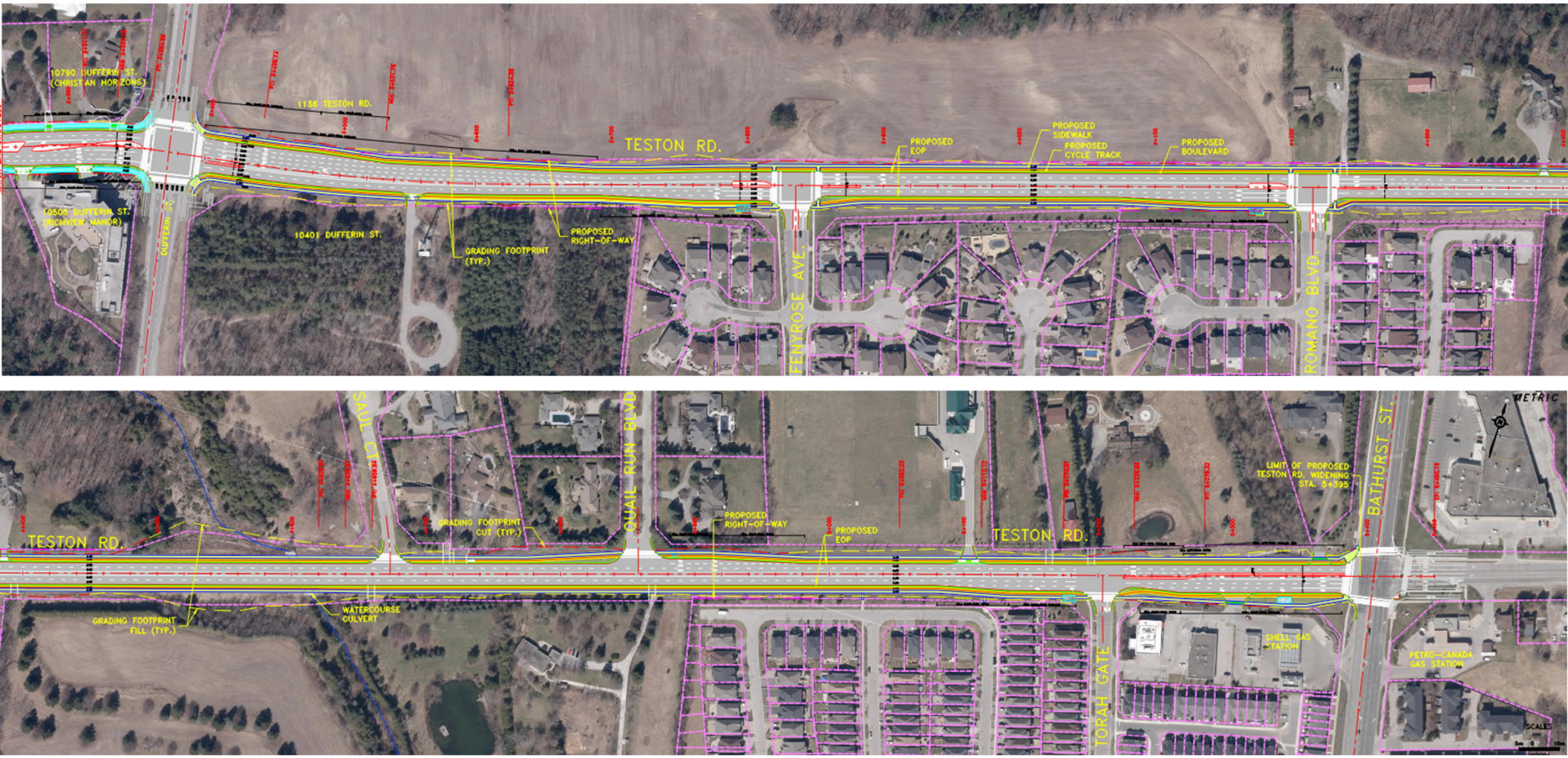
SECTION 3 POTENTIAL IMPACTS & MITIGATION MEASURES

- Stormwater management being addressed by storage/treatment facilities under the roadway and outlets to stream
- Property easements will be required to construct embankments outside the existing ROW
- Potential additional archaeological (Stage 3) investigations required
- Acoustic fencing to be installed by developers during construction of properties in the 1600 Teston Road (Teston Sands) development north of Teston Road

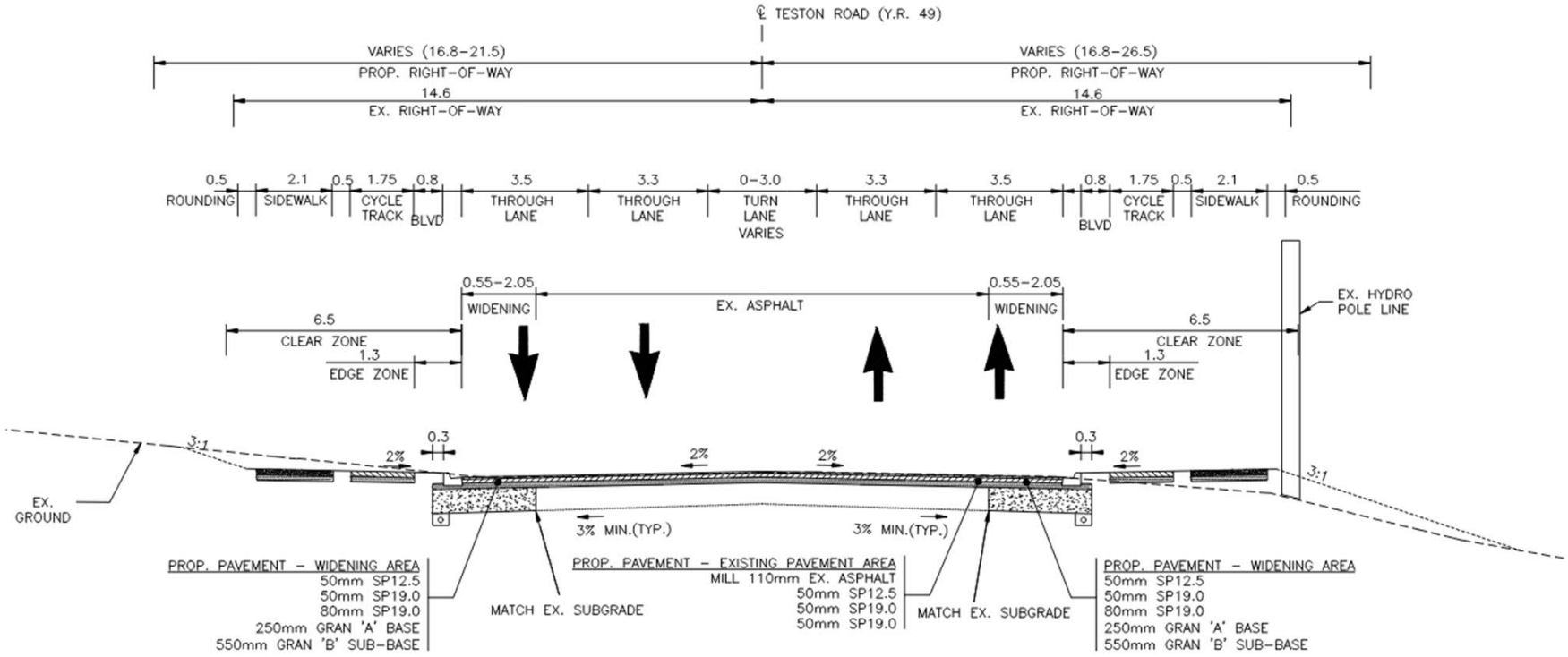
SECTION 4 PRELIMINARY DESIGN CONSIDERATIONS

- Recommended widening on both sides
- 4-lanes, sidewalks, cycle tracks, planted boulevards, 36m RoW
- Reduce impacts to property
- Existing culvert is of sufficient length to accommodate widening
- Transition AT infrastructure at Bathurst to match infrastructure to the east

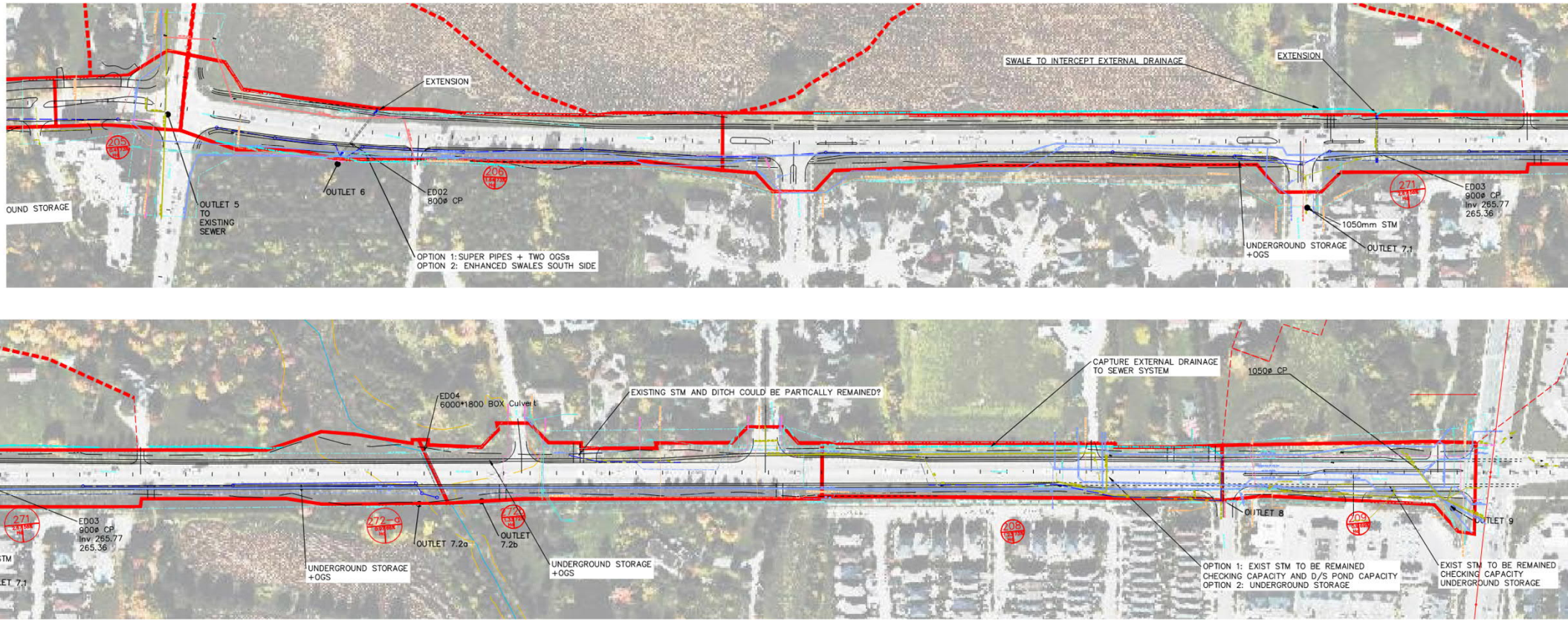
SECTION 4: ROADWAY DESIGN



SECTION 4: ROADWAY DESIGN



SECTION 4: STORMWATER MANAGEMENT DESIGN



SECTION 4 POTENTIAL IMPACTS & MITIGATION MEASURES

- Limited natural environmental impacts due to footprint increases occurring within the existing right-of-way
- Limited grading requirements outside of ROW along north side of Teston from Dufferin to Fennyrose Ave
- Stormwater proposed to be managed through upgrades to existing facilities along this section
  - Need confirmation of capacity for sewer at Torah Gate and associated downstream pond
- Noise abatement not required

CLIMATE CHANGE AND AIR QUALITY

Air Quality

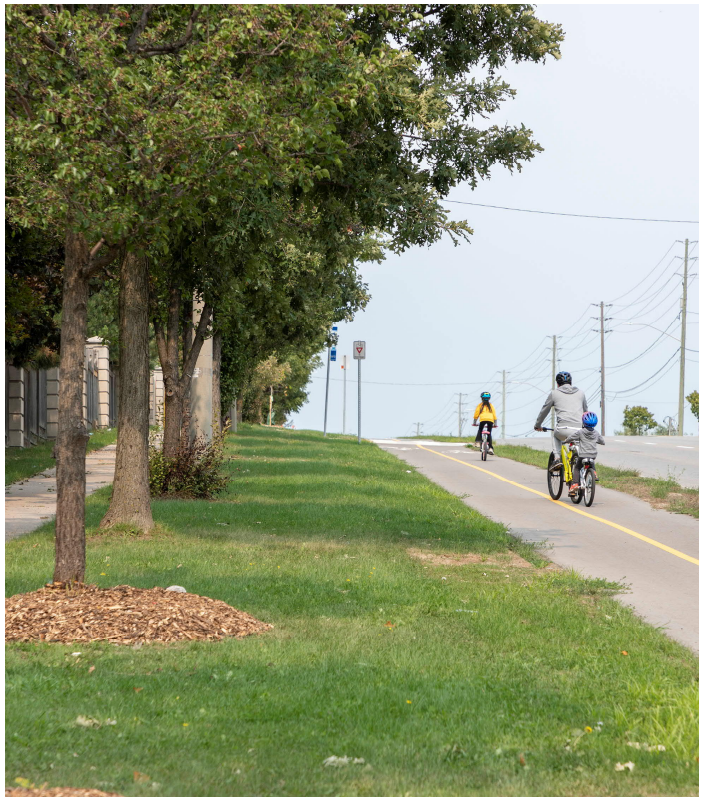
- Maximum combined concentrations below guidelines, except where background concentrations exceeded the guideline.
- Overall contribution from the roadway emissions to the combined concentrations was small. Mitigation measures are not warranted.

Climate Change

- Recommendations divided into design and policy categories (i.e., monitoring and inspection) measures.
- Potential greenhouse (GHG) mitigations from construction equipment emissions, maintenance equipment emissions and embodied carbon in materials.

NEXT STEPS

- Review feedback received from various meetings
- Refine Preliminary Design and prepare OH#4 Materials
- Provide opportunity for review of OH#4 materials by Stakeholders
- Further refinements/discussion based on OH#4 public feedback.
- Develop the IEA report, review and seek approval from the Minister of Environment Conservation and Parks (MECP)



THANK YOU