APPENDIX S – Structural Design Report

INDIVIDUAL ENVIRONMENTAL ASSESSMENT FOR TESTON ROAD AREA (Y.R. 49) BETWEEN HIGHWAY 400 AND BATHURST STREET (Y.R. 38)
RFP NO. P-19-218

STRUCTURAL DESIGN REPORT
EAST DON RIVER TRIBUTARY CROSSING

40 m Single-Span Bridge Option

June 30, 2024

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East Don River Tributary Crossing
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40 m Single-Span Bridge Option

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Executive Summary

The Regional Municipality of York Region (the Region) retained Morrison Hershfield Limited (MHL) (now Stantec) to complete the Individual EA and Preliminary Design for Teston Road. This document is the Structural Design Report for the East Don River Tributary crossing, based on the 40 m single-span bridge option selected by the Region during the evaluation of alternatives.

The contemplated East Don River Tributary crossing is located along the alignment of existing Teston Road, in a greenfield location approximately 300 m west of Dufferin Street. The preferred alternative includes connecting Teston Road on either side of the valley by constructing a new roadway through the valley, including the subject 40 m span structure over the tributary. The posted speed on Teston Road east of the site is 60 km/h. For structural design purposes, an AADT of 25,000 for the new structure has been assumed.

WSP/Golder was retained by MH to performed geotechnical investigation and provide recommendations for new bridge structure foundations. The available physiographic mapping indicates that the site is within the region of the Oak Ridges Moraine, bordering on the South Slope physiographic region, which is mapped as a kame moraine. The subsurface generally consists of glaciofluvial sands and gravels, with shale and limestone bedrock 60 to 100 m below the valley floor. Spread footings were recommended as the preferred bridge foundation type.

The proposed horizontal alignment is straight, with no bridge skew. The roadway design features a sag curve in the valley in order to minimize the height of the required new embankments. The proposed bridge structure is located to the east of the low point. The structure accommodates 2 traffic lanes in each direction (3.3 and 3.5 m wide) with 1.5 m side clearance (or shoulders) on each side, a 3 m flush-painted median, and a 4 m MUP on each side. The overall deck width is 28.7 m. Long-term plans may include a sidewalk and a cycle track on each side.

The proposed design features 10-1800 mm deep prestressed concrete NU girders supporting a 225 mm (minimum) cast-in-place concrete deck. The girders are sloped down to the west to follow the grade of the roadway, with variable-depth haunches in the concrete deck to achieve the required vertical profile. Bridge articulation is proposed as expansion-expansion with laminated elastomeric bearings and semi-integral abutments. This type of articulation avoids transverse expansion joints at the abutments, which are high-maintenance items typically. With semi-integral abutments, the 250 mm approach slabs are connected to the deck and the foundations behave rigidly with minimal movement, which is consistent with spread footing foundations. The proposed substructures are CIP concrete abutment caps/bearing seats with CIP concrete circular columns down to CIP concrete spread footings. The use of MSE false abutments tied-back into the soil is recommended, with precast concrete facing in front of the abutments.

The proposed traffic barriers are 825 mm high (from top of asphalt) concrete parapet walls without railings, and the proposed railings along the edges of the deck are 1370 mm bicycle railings. The proposed new embankments in the valley are approximately 10 m high, so retaining systems are required at the bridge

location. Vertical MSE (or RSS) walls with precast concrete facing units are proposed, with structural separations from the bridge structure. The MSE systems would form both the bridge wing walls parallel to the roadway in all 4 quadrants, and flared and tapered retaining walls in all 4 quadrants.

The new bridge would be designed for a minimum 75-year service life (or design life) as required by the CHBDC. The Region would need to secure additional property in order to construct the bridge and roadway embankments. The embankment side slopes and MSE walls in each quadrant are beyond the proposed property lines. The proposed bridge is considered to be readily constructible using standard construction methods for Ontario roadway bridges.

The Region requested that a wildlife crossing be incorporated into the proposed design. Preliminarily, a precast concrete arch structure on CIP inverted T-shaped footings, with natural ground surface, has been assumed under the west approach embankment.   A 3658 mm x 1200 mm rise arch has been assumed for costing purposes. With the height of the footing walls, the vertical clearance would be about 2 m. During subsequent design stages the size of this culvert should be reviewed in more detail in terms of wildlife needs, including the openness ratio. It should also be noted that a culvert or tunnel of this type could become a liability to the Region in terms of human security and safety, being a protected but hidden location in a public area.   It could also be considered to include the wildlife crossing under the bridge span, adjacent to the abutment wall.

A cost estimate was prepared for the proposed bridge structure to Class ‘C’ level. The estimate for construction in 2024 Canadian dollars is $12.8M, including 25% contingency.   The estimate for the project including design and contract administration fees is $14.8M.   These estimates do not include the roadway embankments and associated elements or taxes, they are structure only but including the MSE walls.   The estimate does include the wildlife culvert under the west approach.

The estimate construction duration for the bridge structure alone is one construction season, approximately 40 weeks.   Environmental work timing restrictions for fish spawning, breeding birds and possibly SAR bats would apply.

Acronyms / Abbreviations

AADT	Average Annual Daily Traffic
CHBDC	Canadian Highway Bridge Design Code
CIP	Cast-In-Place
EA	Environmental Assessment
GFRP	Glass Fibre Reinforced Polymer
km/h	kilometres per hour
m	metre
m^3/s	Cubic metres per second
mm	millimetre
MSE	Mechanically Stabilized Earth
MUP	Multi-Use Pathway
OPSS	Ontario Provincial Standard Specification
OSPD	Ontario Provincial Standard Drawing
ROW	Right-of-Way
RSS	Reinforced Soil Slope
SAR	Species at Risk
TAC	Transportation Association of Canada

Glossary

Service Life	The actual period of time during which a structural component or a system of components is to be used for its intended purpose with appropriate maintenance activities and planned rehabilitation, but without major repair.
Design Life	A period of time during which a structure is intended to perform its design function for the intended use(s).

1 Introduction

The **Regional Municipality of York** (the Region) retained Morrison Hershfield Limited (MHL) (now Stantec) to complete the Individual Environmental Assessment (EA) and Preliminary Design for Teston Road and Area Improvements from Highway 400 to Bathurst Street. It entailed the work required to obtain the necessary approvals, including the preparation of a Preliminary Design Report (PDR) and a Transportation Environmental Study Report (TESR).

The scope of work for bridge engineering consisted of the following:

- Review of any existing drawings and reports;
- Input into the assessment and evaluation of alternative route alignments and crossing options;
- Development of structural alternatives for new crossings;
- For the East Don River tributary crossing, careful assessment of alternatives including structural types, construction methods and potential impacts to properties, traffic and environmental features;
- Liaison with the Foundation Engineer to identify any constraints that may affect substructure construction;
- Assessment of pre-fabricated structural components where appropriate;
- After identification of the Technically Preferred Alternative, carry out preliminary design of major structures including preparation of a Structural Design Report (SDR). SDR to include: summary of geotechnical and foundation report recommendations; confirmation of the structure geometric design criteria including number and widths of traffic lanes, side clearances, barrier types, and clear zones; constructability review; preliminary General Arrangement drawing; and preliminary cost estimate.

This document is the Structural Design Report for the East Don River Tributary crossing, based on the 40 m single-span concrete girder bridge option selected by the Region during the evaluation of alternatives. Mr. Praveen John of York Region provided email authorization to proceed with this report based on the 40 m concrete bridge option on March 12, 2024.

2 Existing Conditions

2.1 Site Location

The contemplated East Don River Tributary crossing is located along the alignment of existing Teston Road, in a greenfield location approximately 300 m west of Dufferin St. (Y.R. 53). The Eagles Nest Golf Club is located south of the site. There is an existing pond located just north of the proposed road. The East Don River Tributary is considered a Provincially Significant Wetland. Several historic landfill sites are present in the general area.

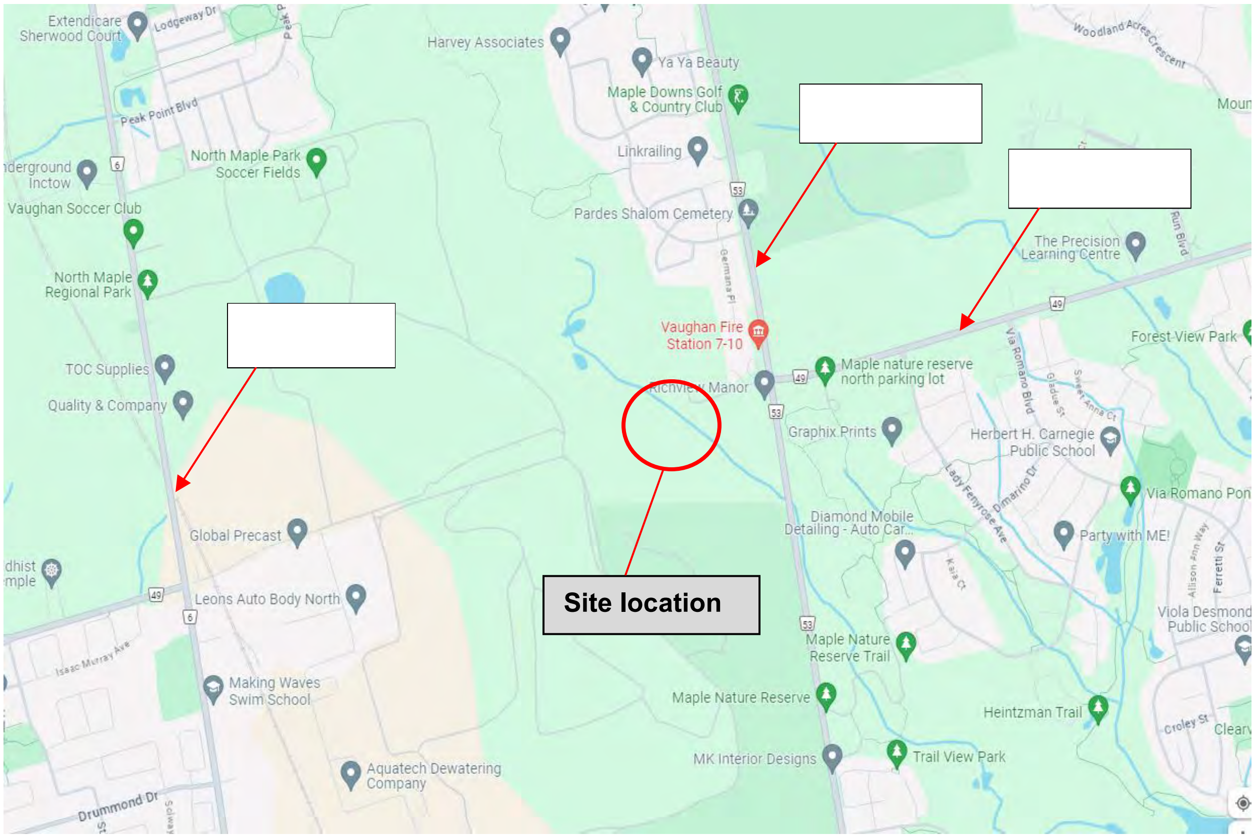


Figure 1 – Site Location (copyright Google 2024)

2.2 Available Background Information

No existing drawing or reports were available for the site. There is an existing stream proceeding from the outlet of the pond that is currently controlled by a small dam structure (see **Figure 2** below). The unofficial pedestrian trail at this location crosses the stream about 10 m south of the dam, with a step-over. Flow is from north to south.

Figure 2 – Existing Dam at Pond Outlet

2.3 Roadway

There is no existing roadway at the site. The preferred alternative includes connecting Teston Road on either side of the valley by constructing a new roadway through the site, including the subject 40 m span structure over the tributary. The posted speed on Teston Road east of the site is 60 km/h.

2.4 Traffic Data

The following table provides the historic and projected AADT figures for the site.

Table 1 – Average Annual Daily Traffic Estimates (vehicles per day)

Location	Historical AADT (by Year)	Estimated 2041 AADT (Do Nothing Option)	Estimated 2041 AADT (Preferred Alternative New 4-Lane Teston Rd. between Dufferin St. and Keele St.)
Hwy. 400 to Jane St.	5,309 (2019)	29,060	31,660
Jane St. to Keele St.	6,476 (2018)	22,500	25,760
Keele St. to Dufferin St. (to Rodinea Rd.)	2,222 (2019)	Missing Link (NA)	27,790
Dufferin St. to Bathurst St.	16,285 (2018)	19,480	23,350
Bathurst St. to Yonge St.	NA	25,330	25,970

The Region recommended assuming 5-6% truck traffic for study purposes. For structural design purposes, an AADT of 30,000 for the new structure has been assumed.

3 Geotechnical Investigation and Recommendations

3.1 General

WSP/Golder was retained by MH to performed geotechnical investigation and provide recommendations for new bridge structure foundations. The following summary is based on their Preliminary Foundation Report dated April 21, 2023, which is provided under separate cover.

3.2 Existing Conditions and Foundation Recommendations

3.2.1 SUB-SURFACE CONDITIONS

The available physiographic mapping indicates that the site is within the region of the Oak Ridges Moraine, bordering on the South Slope physiographic region, which is mapped as a kame moraine. The surface generally consists of glaciofluvial sands and gravels. The sandy soil is commonly under pressure. In the site area, the surface sands and gravels are typically underlain by an extensive lacustrine clay and silt deposit. According to bedrock mapping, the western portion of the site consists of shale of the Blue Mountain Formation and the eastern portion consists of shale and limestone of the Georgian Bay Formation. The bedrock surface is estimated to be at about elevation 90 to 145 m, or 60 to 100 m below the valley floor (very deep bedrock).

Four boreholes were taken near the location of the proposed bridge at the East Don River Tributary. 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 shallow depth of 0.9 m below ground surface.

3.2.2 FOUNDATION DESIGN RECOMMENDATIONS

WSP/Golder provided the following geotechnical parameters and recommendations for preliminary design purposes:

- Compacted Granular ‘B’ Type II embankment backfill underneath new bridge spread footings, extending at least 3 m beyond footing edges and then with 1:1 slopes;
- 1. 2 m of frost protection for footings, or equivalent rigid insulation;
- Compacted Granular ‘A’ foundation pads for spread footings, extending at least 1 m beyond footing edges and then with 1:1 slopes;
- ULS bearing capacity ranging from 600 kPa to 850 kPa depending on footing width (see report for details);

- SLS bearing capacity ranging from 150 to 250 kPa depending on footing width (see report for details);
- Coefficient of friction of 0.62 between concrete footing and Granular ‘A’ pad;
- Provide longitudinal drains and weep holes to relieve hydrostatic pressure behind bridge substructures;
- Coefficients of lateral earth pressure ranging from 0.27 to 0.50 (see report).
- Embankment side slopes of 2 horizontal : 1 vertical;
- Strip all unsuitable and organic fill materials prior to road embankment construction.
- Bench new fill materials into existing slopes as per OPSD 208.010.
- Rip-rap for erosion protection to be in accordance with OPSD 810.010, at a minimum.
- Existing site soils considered Type 3 and Type 4 for excavation purposes.

Following the geotechnical recommendations, the expected short-term settlement of the new roadway embankment is large, about 250 mm including both the embankment fill and the native sub-soil. However, because both the fill and native materials are non-cohesive and generally compact to dense, the settlement would be expected to occur during construction and therefore settlement mitigation measures are not required.

4 Proposed Structure

4.1 General

The need for a larger-span structure is driven by fluvial geomorphological (meandering) requirements at the site. A single 40 m clear opening was selected for preliminary design. This span is within the range of prestressed concrete NU girders, which are favoured by the Region mainly because of their durability and low maintenance needs (i.e. no coatings to maintain). The very deep bedrock at the site precludes the use of end-bearing deep foundations; accordingly, spread footings were selected for the bridge foundations. A preliminary General Arrangement drawing of the proposed bridge is included in **Appendix A**.

4.2 Design Standards

The design of the bridge is governed by the Canadian Highway Bridge Design Code, CSA S6 (2019 version) and Commentary. Other relevant standards include the MTO Structural Manual, the TAC Geometric Design Guide for Canadian Roads, the MTO Structural Planning Guidelines, MTO RSS Design Guidelines, Ontario Provincial Standard Drawings (OPSDs) and Ontario Provincial Standard Specifications (OPSSs).

4.3 Horizontal Alignment and Vertical Profile

The proposed roadway horizontal alignment is straight, with no bridge skew.

The overall proposed roadway design features a sag curve in the valley in order to minimize the height of the required new roadway embankments. The proposed bridge structure is located to the east of the low point with an approach grade from the east of -6.00%. The preliminary drawing in **Appendix A** illustrates the proposed vertical profile diagram. The vertical clearance under the bridge does not dictate the proposed vertical alignment of the roadway.

4.4 Bridge Geometry

The proposed clear opening for the bridge, between the MSE false abutments (see below) is 40 m. The span between centrelines of bearings would be approximately 46.4 m.

The structure accommodates 2 traffic lanes in each direction (3.3 and 3.5 m wide) with 1.5 m side clearance (or shoulders) on each side, a 3 m flush-painted median, and a 4 m MUP on each side. The overall deck width is 28.7 m. The roadway surface and MUPs incorporate 2% transverse crossfalls. There is longitudinal slope down to the west, as well. Long-term plans may include a sidewalk and cycle track on each side. The following figure illustrates the proposed bridge cross-section.

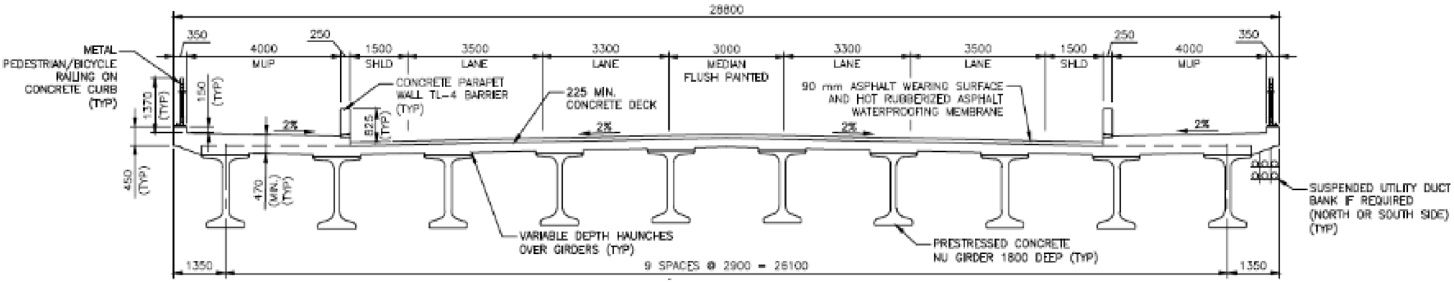


Figure 3 – Proposed Bridge Cross-Section

4.5 Bridge Structure

The proposed design features 10-1800 mm deep prestressed concrete NU girders supporting a 225 mm (minimum) cast-in-place concrete deck. Precast concrete deck panels with CIP closure strips could also be considered, to reduce forming costs. The girders are sloped down to the west to follow the grade of the roadway, with variable-depth haunches in the concrete deck to achieve the required vertical profile. Girders would be composite with the deck.

The bridge articulation is proposed as expansion-expansion with laminated elastomeric bearings and semi-integral abutments. This type of articulation avoids transverse expansion joints at the abutments, which are high-maintenance items typically. With semi-integral abutments, the 250 mm approach slabs are connected to the deck and the foundations behave rigidly with minimal movement, which is consistent with spread footing foundations. Integral abutments require flexible foundations such as a single row of piles and so would not be appropriate for this structure. For this 46 m span, only sealed asphalt joints would be required at the ends of the approach slabs, not sleeper slabs with strip seal expansion joints. We recommend that the sidewalks in the approaches be connected to the approach slabs.

The proposed substructures are CIP concrete abutment caps/bearing seats with CIP concrete circular columns down to CIP concrete spread footings. As noted previously, the very deep bedrock at the site does not allow the use of deep foundations such as end-bearing steel H-piles. At least 1.2 m fill cover would be provided to underside of footings for frost protection.

The use of MSE false abutments tied-back into the soil is recommended, with precast concrete facing in front of the abutment columns, to reduce lateral earth pressure loads on the abutments and so reduce the size and CIP concrete volume of the abutments and footings (reference Figure 4.10 from the 2008 MTO RSS Manual included in **Appendix B**). The face of the MSE walls in front of the abutments are proposed to be 1.2 m in front of the abutment caps to provide structural separation and mitigate differential settlement issues, as well as to provide inspection access for the bearing seats. MTO recommends that separations be provided between MSE walls and bridge structures to mitigate differential movements as have occurred on several past projects.

4.6 Hydraulics and Scour

Refer to the accompanying Drainage and Stormwater Management Report for a hydraulic assessment of the proposed bridge structure.

Scour is not expected to be a significant issue for the proposed structure, because the expected 100-year flow rate is only 0.65 m^3/s. Scour protection is normally designed for 1.3x the 100-year flow, based on MTO criteria. The existing pond outlet will be relocated and the flow channel under the bridge will be realigned. These details would be part of detailed design. Scour potential largely depends on the future pond outlet and channel design. River stone slope protection has been included in the proposed bridge concept on the sides of the flow channel.

The Regional flood flow rate at the site is much higher, at 36.87 m^3/s. During subsequent design stages it could be considered to add additional scour protection for this very rare flood event, potentially including buried sheet pile scour protection in front of the footings.

4.7 Traffic Barriers

Assuming a design speed of 80 km/h, the required barrier test level in accordance with the CHBDC (Section 12) is TL-4. In accordance with MTO standard drawing S110-110 (included in **Appendix B**), the proposed traffic barriers are 825 mm high (from top of asphalt) concrete parapet walls without railings, and the proposed railings along the edges of the deck are 1370 mm high open bicycle railings. It is recommended that the Region confirm acceptance of the relatively low barrier height separating bicycle (MUP) and vehicle traffic, in future design stages.

4.8 MSE Walls

The proposed new road embankments in the valley are approximately 10 m high, so retaining systems are required at the bridge location. Vertical mechanically-stabilized earth (MSE) walls with precast concrete facing units are proposed. The MSE systems would form both the bridge wing walls parallel to the roadway in all 4 quadrants, and flared and tapered retaining walls in all 4 quadrants. MSE walls offer significant cost savings over CIP concrete walls for heights greater than 4 m, especially with the large area of walls proposed. MSE walls are typically designed by the supplier at the detailed design stage and include tie-backs into the backfill materials for structural support.

4.9 Seismic Design

Preliminary review of the structure seismic design in accordance with Section 4 of the CHBDC was conducted. Assuming Site Class ‘D’ corresponding to “stiff soils”, using seismic data from the Earthquakes Canada website, the Seismic Performance Category is 1. According to Cl. 4.4.5 of the CHBDC, bridges in Category 1 need not be analyzed for seismic loads, regardless of their importance and geometry. Only minimum horizontal restraints between superstructure and substructures need to be provided, as well as minimum bearing seat dimensions.

Conceptually, the proposed bridge design would be expected to perform well in a major earthquake. Additional longitudinal restraint would be provided by the integral approach slabs and backfill pressures on the semi-integral deck extensions. Transversely, the structure would be very stiff and well-supported. It could be considered to design the abutment columns as capacity-protected elements, as they would be difficult to repair, being concealed behind the false MSE abutments. Shear keys between the superstructure and substructures should be considered. Potential liquefaction of the non-cohesive native sub-soils should be considered in subsequent design stages.

4.10 Durability

The new bridge would be designed for a minimum 75-year service life (or design life) as required by the CHBDC. All the proposed bridge components are commonly used, durable materials. All non-replaceable components would be designed for the full service life of the bridge.

Prestressed concrete girders are generally recognized in the industry as being durable bridge components. The prestressing minimizes crack formation in the girders, which increases service life for reinforced concrete. The shape of the concrete NU girders promotes drainage off the bottom flanges.

Construction joints in concrete substructures in contact with backfill would be waterproofed to prevent water ingress.

Bearing pedestals (or plinths) would be provided to avoid bearing contact with de-icing salts, water runoff, leakage, and debris. The surfaces around and between bearing seats would be sloped so that they are self-draining away from the bearings. Concrete diaphragms and level areas for jacking of the superstructure for bearing replacement would be provided.

The design of the MSE walls would provide for long-term monitoring of the condition of the soil reinforcement using sacrificial coupons or electrochemical methods.

The MTO Structural Manual recommends the use of premium reinforcement in areas exposed to road salt spray. Premium reinforcement means either stainless steel (2205 Duplex, 2304 Duplex or 316LN) or GFRP bars. Although MTO does not use it, hot-dipped galvanized reinforcing is also used by some owners. The use of stainless steel reinforcing has been assumed for the subject structure in the following areas, in accordance with the Structural Manual:

- Top mat in the deck-slab;
- Sidewalks, fascias and deck cantilever soffits;
- Sidewalks and curbs;
- Concrete traffic barriers;
- Stirrups projecting from concrete girders;
- Upper surfaces of semi-integral deck extensions; and
- Bars connecting approach slabs to deck; and
- Upper 5 m of MSE walls within 7 m horizontally of sidewalk.

4.11 Material Availability

The proposed materials for the bridge structure are all commonly used and readily available. However some components would require supplier design, working drawings and off-site fabrication and therefore would have significant lead times. These components include:

- Precast prestressed concrete NU girders. Girders up to 50 m long are available in the Toronto area from such suppliers as Decast Ltd.;
- Reinforcing steel;
- Pedestrian/bicycle railings;
- Bridge bearings;
- Forming and temporary support systems; and
- MSE walls.

5 Miscellaneous

5.1 Property

The proposed bridge structure footprint is beyond the existing property lines. The preliminary drawing in **Appendix A** shows the existing and proposed property lines. The Region would need to secure additional property in order to construct the bridge and roadway embankments. The embankment side slopes and RSS walls in each quadrant are beyond the proposed property lines, as well. Property issues are discussed at more length in the overall EA study report.

5.2 Construction Staging

Construction of the bridge would take place on a greenfield site with no active traffic, so no staging would be required. The sequence of construction activities would be roughly the following:

- Clearing and grubbing;
- Sub-grade preparation, removal of organic material, grading;
- Placement of compacted granular materials for the new road embankment and engineered backfill to support the new bridge footings;
- Installation of the new precast concrete wildlife culvert under the west approach, including concrete footings;
- Forming, reinforcing steel and concrete placement for new bridge footings;
- Forming, reinforcing steel and concrete placement for new abutment columns and new abutment caps/bearing seats;
- Construction of MSE walls and roadway embankments up to bearing seat level;
- Erection of concrete NU girders with the use of cranes positioned in the bridge approaches;
- Forming, reinforcing steel and concrete placement for new concrete deck-slab, semi-integral deck extensions, sidewalks/MUPs, approach slabs and traffic barriers;
- Completion of backfill and MSE walls;
- Installation of new pedestrian/bicycle railings;
- Application of hot-applied rubberized asphalt waterproofing membrane on the deck top and 1 m onto approach slabs.
- Installation of guiderail and energy-attenuating end treatments;
- Asphalt paving and sealed joints at ends of approach slabs;
- Placement of rip-rap erosion protection; and
- Landscaping, pathways below the bridge, seeding and mulching.

The proposed bridge is considered to be readily constructible using standard construction methods for Ontario roadway bridges.

5.3 Utilities

The need for new utilities is beyond the scope of this report. If it is necessary to run utilities along the structure, the Region would prefer to use embedded ducts in the barrier walls only. Suspending utilities from the deck cantilevers would not be preferred. Utility conduits must be provided with wobble joints which allow movement and rotation at the ends of the structure.

5.4 Drainage

According to the CHBDC, the spacing and capacity of bridge deck drains established by hydraulic design and testing must be sufficient to ensure that for a 10-year design storm the runoff flowing in the gutter will not encroach more than 1.5 m into the traffic lane. Bridge deck drain inlets should be provided only where this requirement would otherwise not be met.

For the proposed bridge, longitudinal deck drainage into the west approach should be adequate to avoid unacceptable encroachment of flow into the traffic lanes. The proposed crossfalls would direct surface runoff towards the edges of the roadway, where it would flow to the west. Catch basins and storm drains should be provided in the low point of the sag curve in the roadway. During subsequent design stages hydraulic analysis should be performed in detail to assess the expected drainage patterns.

No stormwater practices or controls have been identified at this stage to address salt contamination from roadway run-off. There are no common mitigation measures that can be practically implemented for a road project. The usual way to address road salt concerns is through road operations and maintenance practices. The Region’s trucks salt responsibly by using a liquid solution that uses less salt, along with spreaders that control the precise amount for application, ensuring there is no excess. A pickled sand treated salt is also used as an environmentally-safe alternative to traditional winter salt (www.york.ca/newsroom/campaigns-projects/salt-responsibly).

5.5 Aesthetics

MTO publishes Aesthetic Guideline for Bridges which contain interesting information on concepts and details for improving bridge aesthetics. For the proposed structure, at a minimum the following elements should receive some aesthetic consideration:

- Pedestrian/bicycle railings: geometry, details, paint colours; and
- MSE wall precast concrete facing: “High” appearance rating recommended.

5.6 Illumination

Illumination is beyond the scope of this report and will be addressed elsewhere in the overall study.

5.7 Wildlife Culvert

The Region requested that a wildlife crossing be incorporated into the proposed design. Preliminarily, a precast concrete arch structure on CIP inverted T-shaped footings, with natural ground surface, has been assumed under the west approach embankment. A 3658 mm x 1200 mm rise arch has been assumed for costing purposes. With the height of the footing walls, the vertical clearance would be about 2 m. During subsequent design stages the size of this culvert should be reviewed in more detail in terms of wildlife needs, including the openness ratio. Other structure types could also be considered for this culvert, including: precast concrete box, precast concrete frame (3-sided) on footings and a corrugated steel arch on footings. It could also be considered to have the wildlife crossing next to the watercourse under the bridge span.

It should also be noted that a culvert or tunnel of this type could become a liability to the Region in terms of human security and safety, being a protected but hidden location in a public area. Sometimes structures of this type end up having to be fenced off for security reasons.

6 Estimated Construction Cost

A cost estimate was prepared for the proposed bridge structure to Class 'C' level. The estimate was based on government cost databases (particularly the MTO HiCO system), past project costs, published cost information, and supplier budget quotes. The cost represents our opinion of probable cost, does not include taxes, and is in 2024 Canadian dollars. The itemized cost estimate is included in **Appendix C** and summarized in the table below. The cost estimate includes all the MSE walls and the wildlife culvert.

The estimated cost does not include:

- Approach embankments;
- Excavation, engineered fill and backfill;
- Guiderail and end treatments;
- Roadways, sidewalks, railings, and barriers beyond approach slabs;
- Electrical and lighting;
- Utiities; and
- Traffic and pedestrian control (greenfield site).

Table 2 – Estimated Structure Cost (2024 $CAD)

Item	Estimated Cost
Construction cost	$10.2M
25% Contingency	$2.6M
Construction Total	**$12.8M**
Construction cost per m^2 deck (1,320 m^2)	*$9,638*
20% Design and Contract Administration	$2.0M
Project Total	$14.8M

7 Estimated Construction Schedule

The estimate construction duration for the bridge structure alone is one construction season, approximately **40 weeks**. A probable construction schedule would involve the construction of the road embankment through the valley in Year 1, construction of the bridge in Year 2, and completion of the roadway and ancillary works towards the first part of Year 3.

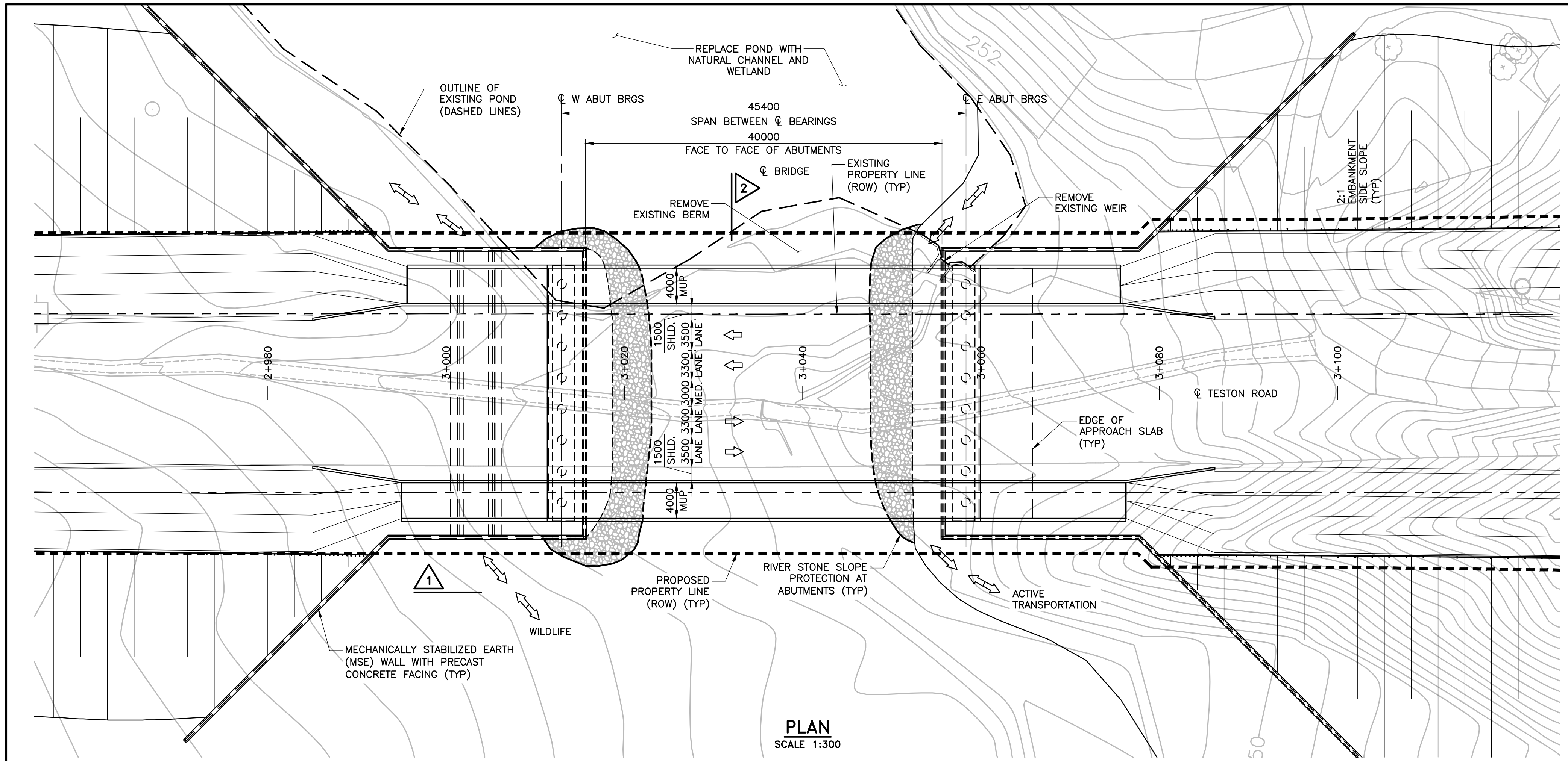
Environmental work timing restrictions would also apply to certain activities. Any in-water works would be limited to June 15 to September (of any year), to avoid harming fish spawning cycles. With respect to breeding birds, vegetation removals must be completed after August 31 and before April 1. There is also a high likelihood of SAR bats (to be confirmed during detailed design) which might shorten this window to September 30 to April 1.

8 Closure

We trust that the foregoing sufficiently addresses the required scope of work for this report. Please contact us with any comments or questions. We look forward to assisting you further with this interesting project.

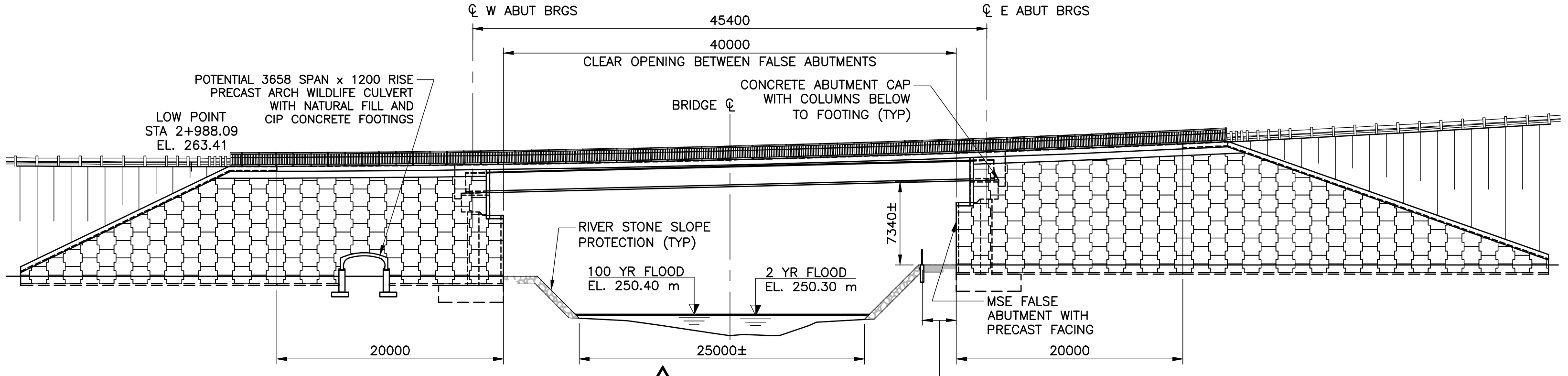
Appendix A

Preliminary General Arrangement



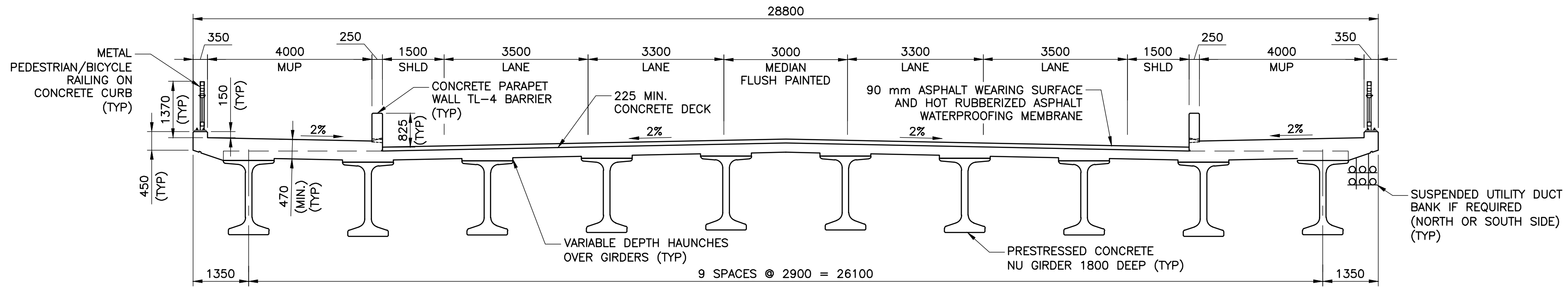
PLAN

SCALE 1:300



1 ELEVATION

SCALE 1:300



2 SECTION

SCALE 1:75

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

GENERAL NOTES

CONCRETE

SPECIFIED 28-DAY COMPRESSIVE STRENGTH

PRECAST NU GIRDERS	60 MPa
CONCRETE DECK	30 MPa
REMAINDER	30 MPa

CLEAR COVER TO REINFORCING STEEL

PRECAST NU GIRDERS	40±10 mm
DECK SOFFIT	50±10 mm
DECK TOP	70±20 mm
COLUMNS, SHAFTS AND CAPS	70±10 mm
SURFACES CAST AGAINST EARTH	100±20 mm
REMAINDER	70±20 mm
ALL EXPOSED CORNERS TO BE CHAMFERED	20x20 mm

REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 500W UNLESS OTHERWISE SPECIFIED.

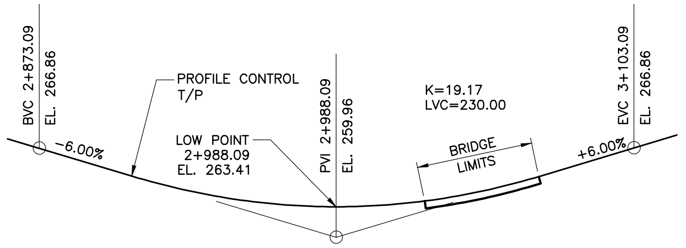
STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN OR DUPLEX 2205 AND HAVE A MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.

UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES SHALL BE CLASS 'B'.

BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1 UNLESS INDICATED OTHERWISE.

CONSTRUCTION NOTES

1. NEW BRIDGE DECK TO DRAIN LONGITUDINALLY TO LOW POINT BEYOND WEST APPROACH.
2. NEW BRIDGE TO HAVE SEMI-INTEGRAL ABUTMENTS, LACKING EXPANSION JOINTS OVER THE ABUTMENTS.
3. WETLAND COMPENSATION MEASURES HAVE BEEN PROPOSED TO OFFSET ENVIRONMENTAL EFFECTS.
4. SPREAD FOOTINGS BASED ON SLS BEARING CAPACITY OF 250 kPa PER WSP GEOTECHNICAL REPORT.
5. ABUTMENT CONCRETE AND MSE WALL FACING MAINTAINED STRUCTURALLY SEPARATE PER MTO GUIDANCE, TO MITIGATE RISK OF DIFFERENTIAL SETTLEMENT ISSUES.
6. MSE WALLS SHALL HAVE THE FOLLOWING ATTRIBUTES:
   - APPLICATION: FALSE ABUTMENT AND WALL/SLOPE
   - PERFORMANCE: HIGH
   - APPEARANCE: HIGH



PROFILE OF TESTON RD

N.T.S.

PROGRESS DRAWING
APRIL 03, 2024

DRAWING PATH AND NAME: X:\Proj\2019\190261800-P-19-218-Teston Road IEA\09. CAD\07 Sheets\1902618 Teston Road IEA - GA.dwg
DRAWING LAYOUT: GA - 40 m LAST UPDATED: Apr 5, 2024-14:38
PRINTED: Apr 5, 2024-14:39

MORRISON HERSHFIELD

No.	DATE	REVISIONS	BY
-	27/03/24	STRUCTURAL DESIGN REPORT	BDM

York Region Transportation Services

DESIGN	B.D.M.
DRAWN	D.A.S.
CHECKED	B.D.M.

TESTON ROAD IEA
EAST DON RIVER TRIBUTARY BRIDGE
40 m SPAN OPTION
PRELIMINARY
GENERAL ARRANGEMENT

DWG. NO.	XXX-XXXXXX
CONT. NO.	XX-XXX
SHEET NO.	1

Appendix B

References

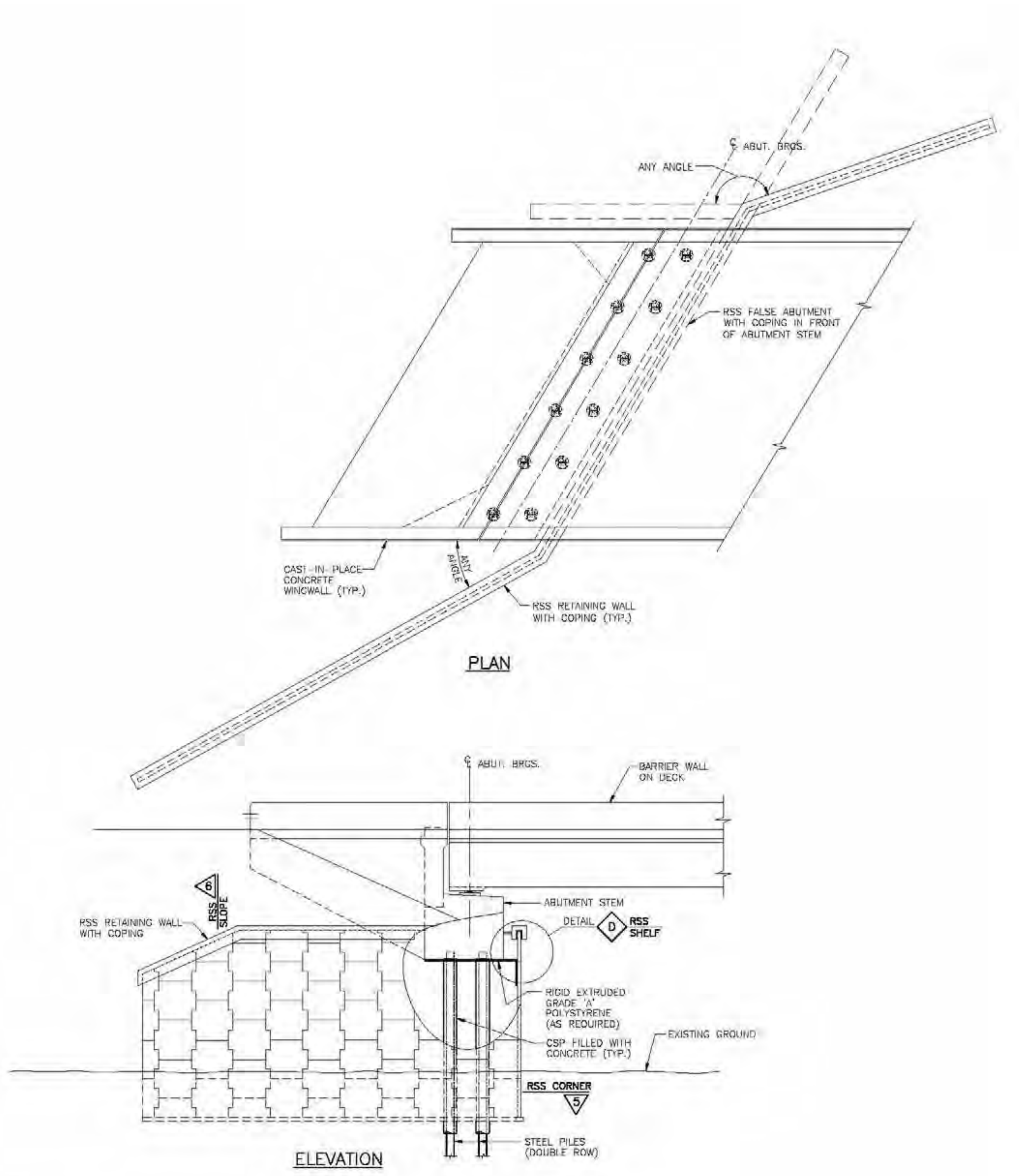


Figure 4.10: Rigid Piled Bridge with RSS False Abutment and Flared RSS Walls. For Section 5 and 6, see Figures 5.15 and 5.16 respectively. For Detail D, see Figure 5.9.

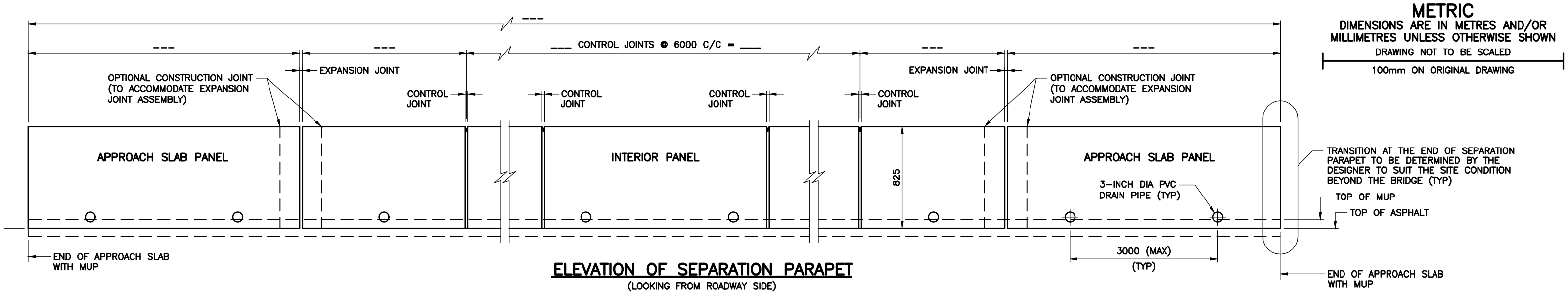
Ontario Ministry of Transportation

CONT
WP

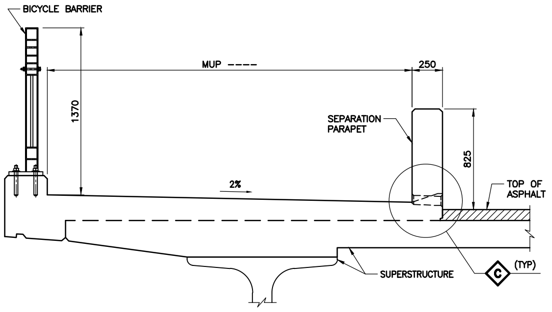
SHEET

**MULTI USE PATH (MUP)
SEPARATION BARRIER (PARAPET)
TL-4**

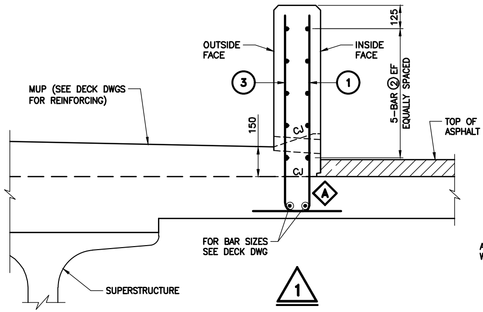
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN
DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING



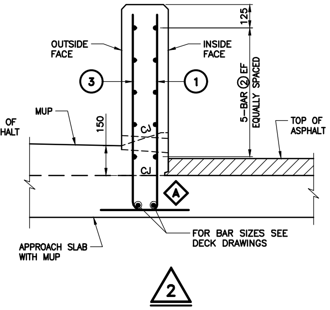
ELEVATION OF SEPARATION PARAPET
(LOOKING FROM ROADWAY SIDE)



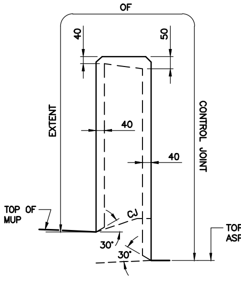
SEPARATION PARAPET ON STRUCTURE FOR MULTI USE PATH



PARAPET WALL ON DECK



PARAPET WALL ON APPROACH SLAB

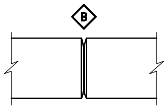


EXTENT OF CONTROL JOINT IN PARAPET WALL

NOTES:

1. SYSTEM CONFIGURATION MEETS THE REQUIREMENTS OF NCHRP 350.
2. CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
3. CONCRETE COVER TO REINFORCING STEEL 60 ±10mm EXCEPT AS NOTED.
4. REINFORCING STEEL SHALL BE STAINLESS TYPE 316LN OR DUPLEX 2205 WITH A MINIMUM YIELD STRENGTH OF 500 MPa.
5. BAR LAP SPLICE FOR HORIZONTAL REINFORCEMENT MUST NOT LAP THROUGH CONTROL JOINT.
6. MINIMUM BAR LAP SPLICE TO BE 550mm.
7. LENGTH OF HORIZONTAL BAR TO SUIT CONTRACTOR'S OPERATIONS. BAR LENGTHS NEED NOT TO MATCH DISTANCE BETWEEN CONTROL JOINTS.
8. DRAIN PIPES SHALL BE SCHEDULE 20 OR 40 PVC PIPE.
9. CONTROL JOINT TO BE FORMED.
10. SAWCUTS NOT PERMITTED.
11. CONTROL JOINT FORM HARDWARE NOT TO BE LEFT IN PLACE.
12. OPTIONAL CONSTRUCTION JOINTS TO BE LOCATED WITHIN LIMITS OF CONCRETE DAMS ON DECK OR BALLAST WALL.
12. LEGEND:
    - EF– DENOTES EACH FACE
    - IF – DENOTES INSIDE FACE
    - OF– DENOTES OUTSIDE FACE
    - CJ– DENOTES CONSTRUCTION JOINT
    - MUP– DENOTES MULTI USE PATH

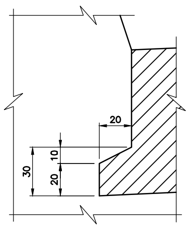
BAR MARK	SIZE	SHAPE
①	S15M	1040 300
②	S15M	STRAIGHT
③	S10M	1040 300



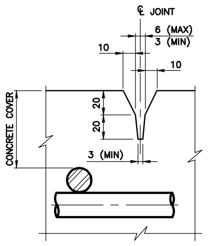
TYPICAL CONTROL JOINT

NOTES TO DESIGNER:

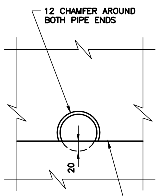
1. BICYCLE BARRIER IS SHOWN FOR ILLUSTRATION ONLY AND SHALL BE DESIGNED AS PER CSA-S6. FOR BRIDGES WITH PEDESTRIAN ONLY PATH, A PEDESTRIAN BARRIER SHALL BE DESIGNED AS PER CSA-S6.
2. DESIGNER SHALL DETAIL TRANSITION AT THE END OF SEPARATION PARAPET.
3. DESIGNER SHALL DESIGN DECK SLAB, MUP SLAB, SIDEWALK SLAB AND APPROACH SLAB AS PER CSA-S6.
4. DESIGNER SHALL PERFORM DRAINAGE ANALYSIS OF MUP/SIDEWALK TO EVALUATE DRAINAGE DETAIL SHOWN ON THIS DRAWING FOR SITE CONDITIONS. ADDITIONAL MEASURES MAY BE REQUIRED.
5. INCREASE THE THICKNESS OF THE BARRIER WALL FROM 250mm TO 300mm WHEN 75mm DIA ELECTRICAL DUCTS ARE REQUIRED.
6. THE 'NOTES TO DESIGNER' SHALL BE DELETED FROM THIS DRAWING PRIOR TO ISSUING.



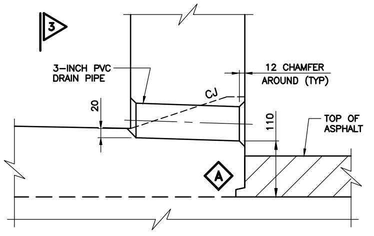
A **CHASE DETAIL**



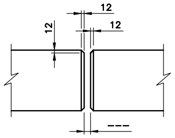
B **CONTROL JOINT DETAIL**



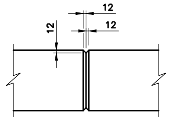
3



C **WALL DRAIN DETAIL**

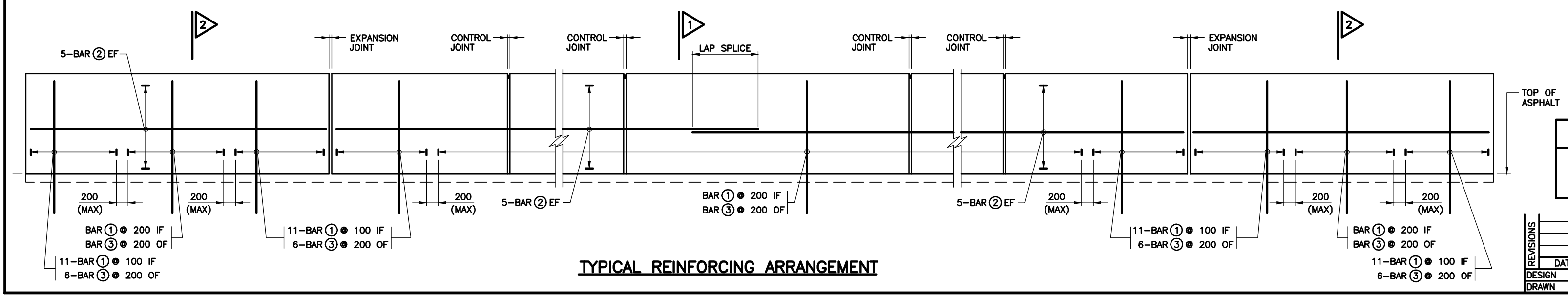


TYPICAL EXPANSION JOINT



TYPICAL OPTIONAL CONSTRUCTION JOINT

REFER TO 1.1.8 IN THE STRUCTURAL MANUAL FOR PROFESSIONAL ENGINEER STAMPING REQUIREMENTS.



TYPICAL REINFORCING ARRANGEMENT

STANDARD DRAWING
JUNE 2020

SS110–110

**MULTI USE PATH (MUP)
SEPARATION BARRIER (PARAPET), TL-4**

REVISIONS DATE	BY	DESCRIPTION		
DESIGN	CHK	CODE CHBDC-19	LOAD –	DATE
DRAWN	CHK	SITE		DWG

FILE NAME: C:\Users\WeziakVi\Desktop\S110-110 June 2020.dwg
MODIFIED: 2020-06-02 19:18

MINISTRY OF TRANSPORTATION, ONTARIO ANSI-D 2017-06

Appendix C

Cost Estimate

NEW CONSTRUCTION 10-Apr-24

40 m SINGLE SPAN CONCRETE BRIDGE OPTION

Item	Unit	Quantity	Unit Rate	Cost
Staging areas	LS	1	$25,000	$25,000
Temporary access/ work platforms	LS	1	$75,000	$75,000
Environmental mitigation measures	LS	1	$50,000	$50,000
Dewatering	LS	1	$15,000	$15,000
Concrete in footings (bridge)	m3	580	$1,500	$870,000
Concrete in footings (culvert)	m3	130	$1,500	$195,000
Concrete in abutment walls/caps	m3	170	$2,000	$340,000
Concrete in abutment columns	m3	150	$2,000	$300,000
Concrete in wing walls	m3	15	$2,000	$30,000
Bearings	each	20	$2,000	$40,000
Precast girder fabrication	m	460	$2,000	$920,000
Precast girder delivery	m	460	$250	$115,000
Precast girder erection	m	460	$500	$230,000
Concrete in deck	m3	420	$3,200	$1,344,000
Concrete in sidewalks	m3	155	$1,500	$232,500
Concrete in barriers	m3	25	$3,200	$80,000
Concrete in approach slabs	m3	60	$1,500	$90,000
Reinforcing steel black	tonne	125	$5,000	$625,000
Reinforcing steel stainless	tonne	67	$14,500	$971,500
Hot rubber waterproofing	m2	960	$70	$67,200
RSS walls (all)	m2	2500	$1,200	$3,000,000
Asphalt	tonne	290	$350	$101,500
Metal pedestrian/bicycle railings	m	120	$800	$96,000
Rip-rap slope protection	m3	700	$200	$140,000
Utility racks	m	42	$600	$25,200
Precast arch culvert	m	32	$6,000	$192,000
Culvert waterproofing	m2	160	$60	$9,600
			Construction	$10,179,500
		25%	Contingency	$2,544,875
			Deck Area (m2)	1,320
			Per sq. metre deck	$9,638
		20%	Design and CA	$2,035,900
			Total	$14,771,233

Not included:

- Approach embankments
- Excavation, engineered fill materials and backfill
- Guiderail and end treatments
- Roadways, sidewalks, railings and barriers beyond approach slabs
- Electrical and lighting
- Utilities
- Traffic and pedestrian control (greenfield site)

- All quantities are approximate
- Class 'C' estimate