DILLON CONSULTING

CITY OF TORONTO

# Functional Design Report (Draft)

## Maxwell's Bridge (#802) on Twyn Rivers Drive
## Rouge Park Bridges Transportation Master Plan

February 2025 - 19-1924

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# 1.0 Introduction

## 1.1 Project Description

The City of Toronto (City) has retained Dillon Consulting Limited (Dillon) to complete a Transportation Master Plan (TMP) focused on the development of renewal strategies for the following five municipal bridges located on City rights-of-way within the Rouge National Urban Park (RNUP):

- Maxwell's Bridge on Twyn Rivers Drive (No. 802)
- Stotts Bridge on Twyn Rivers Drive (No. 803)
- Hillside Bridge on Meadowvale Road (No. 806)
- Sewell's (Suspension) Bridge on Sewell's Road (No. 812)
- Milne (Bailey) Bridge on Old Finch Avenue (No. 813).

These bridges have been designated under *The Ontario Heritage Act, R.S.O. 1990, c. O.18* as amended, with the exception of the Milne Bridge, which was listed by the City in 2006 and has not yet been designated.

The Rouge Park Bridges TMP will be completed in accordance with the provisions of the Municipal Class Environmental Assessment (EA) process, Approach #2. The purpose of the TMP is to undertake a comprehensive review, develop and evaluate Alternative Solutions for each of the bridges, including the retention, rehabilitation, or replacement of each, and prioritize the implementation of the recommended solutions.

This Functional Design Report is focussed on bridge engineering factors, with reference to roadway geometrics and other factors as appropriate. This report provides input to the "Rouge Park Bridges Transportation Master Plan Report", which documents the evaluation of alternative solutions from a comprehensive, multi-factored perspective, and identifies a recommended solution, and is supported by other technical and professional studies and reports.

This report summarizes the existing conditions and provides an assessment of alternative solutions for retaining, rehabilitating, or replacing the **Maxwell's Bridge on Twyn Rivers Drive (No. 802)** from a bridge engineering perspective**.** It also provides functional design recommendations for the recommended alternative.

## 1.2 Project Location

Maxwell's Bridge is located on Twyn Rivers Drive between Shepard Avenue East and the City limits adjoining the City of Pickering, crossing over the Little Rouge River.
The Little Rouge River flows west to east at the bridge. For reporting purposes the bridge spans in a north-south direction.

The site location is labelled as site “D” in **Figure 1.**

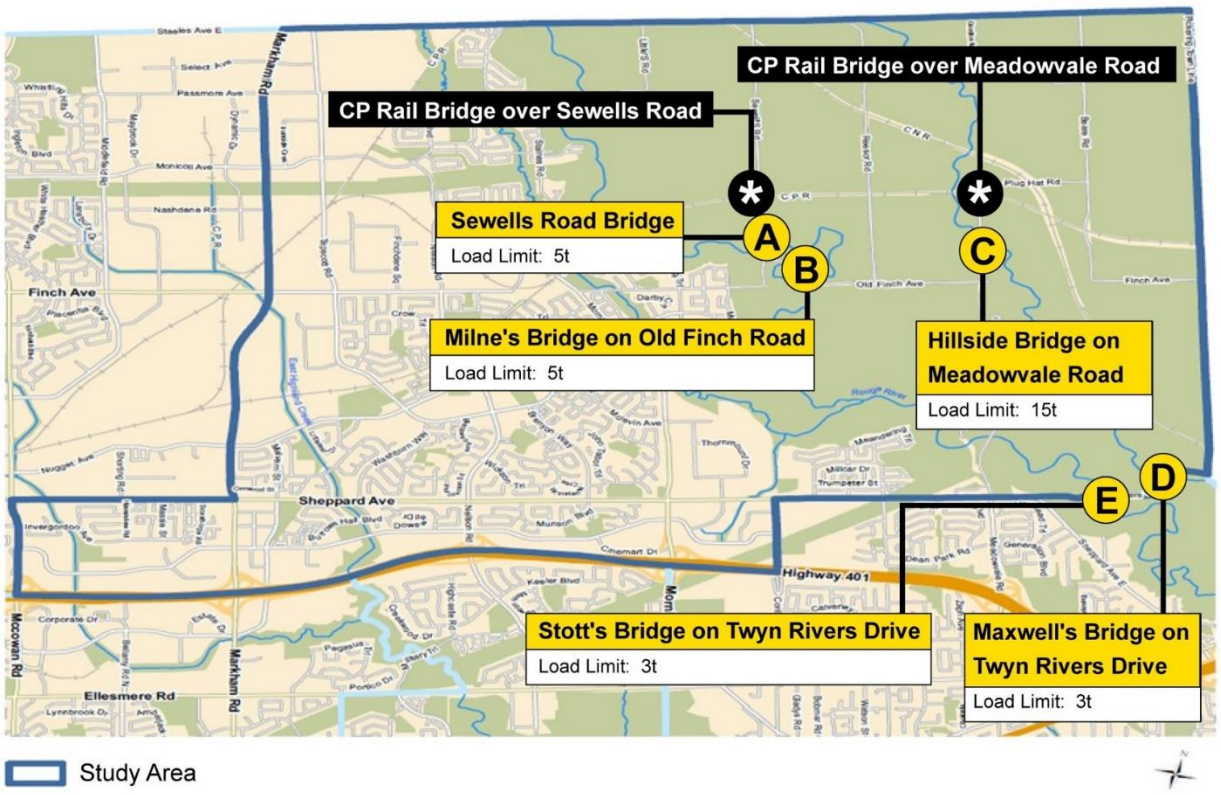



**Figure 1: Site location**

# 2.0 Available Information

## 2.1 Drawings

The following historical drawings are available for reference:

- Drawings 802-5002-S-5 to 802-5002-S-12, "Structural Rehabilitation of the Maxwell's Bridge", Totten Sims Hubicki Associates, 1997.
- Drawing S-5002-13, "Plan/Profile", 1990.
- Drawings 802-5002-S-14 to 802-5002-S-16, "Twyn Rivers Drive over Little Rouge River, Bridge Repairs", Associated Engineering, 2013.

## 2.2 Reports

The following documents are available for reference:

- City of Toronto, Bridge Inspection Form, Structure No. 802, Structure Name: Twyn Rivers Drive over Little Rouge River, 2021.
- Multiple bridge Inspection and rehabilitation in North-East Scarborough, Twyn Rivers Drive Bridge over Little Rouge River (Bridge No. 802), Associated Engineering, 2013.
- Corporation of the City of Scarborough By-Law Number 25152 to designate the Maxwell's Bridge Concession III, Part Lot 2 now designated as Part 1 on Plan 64R-15231 as being of historical and architectural value, 1997.
- "Rouge Park Bridges TMP: Traffic Analysis Memo", Dillon Consulting, April 2021.
- Transportation Assessment Memo, Rouge Park Bridges TMP, Dillon Consulting, May 2021.
- "Hydraulic Report - Rouge Park Bridges Transportation Master Plan", Dillon Consulting, November 2020.
- "Desktop Study Geotechnical and Hydrogeological Assessment. Rouge Park Bridges Transportation Master Plan EA, Toronto, Ontario", Thurber Engineering Ltd, November 2020.

## 2.3 Relevant Design Guidelines

References for the assessment of feasible alternative solutions for retention, rehabilitation or replacement of the bridge structures included, but was not limited to the following:

- MTO Structural Planning Guideline
- MTO Structural Manual
- Canadian Highway Bridge Design Code (CHBDC)
- MTO Structural Financial Manual
- MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads
- MTO Roadside Safety Manual
- City of Toronto - Road Engineering Design Guidelines
- Accessibility for Ontarions with Disabilities Act (AODA)

# 3.0 Existing Site Conditions

## 3.1 Roadway Features and Geometry

Twyn Rivers Drive has a two-lane rural cross-section with no paved shoulder, bike lanes or sidewalks. The road is posted with “no trucks” signage at entry points. It is classified as collector with a posted speed of 50 km/h, except near the bridges, where the posted speed is 40 km/h. The roadway profile features a slight sag curve (Minimum K=3.2) at the bridge. See **Appendix A** for the General Arrangement drawing of the bridge.

Within the structure limits the existing horizontal alignment is straight, but approaches have horizontal curves limiting the sight lines. The bridge accommodates two 3.05 m wide lanes (one lane in each direction). The bridge has no skew angle and has a 2% crown on the deck.

Twyn Rivers Drive is identified as an evacuation route in the event of a Pickering nuclear station evacuation event. Its effectiveness for use as an evacuation route is hampered by the low load limits at Maxwell’s Bridge and Stotts Bridge, the single-lane width of Stotts Bridge and the extremely steep roadway grade climbing to the west (posted signs indicate 30% grade).

There are two trails that cross Twyn Rivers Drive around the structure.

The RNUP *Orchard Trail* crosses the road approximately 26 m north of the bridge. Wood fencing has been installed to slow pedestrian traffic at the roadway intersection. Guide rails have been interrupted to allow hikers to cross the road, resulting in nonstandard termination of guide rail system at the bridge. Due to a sharp curve in Twyn Rivers Drive to the north, and an S-curve in the road to the south, the sight distance to the trail crossing for vehicles approaching is limited.

The RNUP *Vista-Mast Trail* was realigned in 2023 and a new section of trail with a dedicated pedestrian bridge across the Little Rouge Creek was added and sections of the trail that formerly crossed Twyn Rivers Drive near the bridge have been officially closed.

Approximately 400 m east of the bridge along Twyn Rivers Drive there is a parking lot for hikers, on property owned by RNUP.

## 3.2 Traffic

A Traffic Analysis Memo was prepared as part of the Rouge Park Bridges TMP, which provided an analysis and overview of the existing and future traffic conditions within the RNUP. The reported 2021 Annual Average Daily Traffic (AADT) at the structure is 8,000 vehicles per day and the forecasted 2041 AADT is 11,300 vehicles per day. The road is posted with “no trucks” signage at entry points.

## 3.3 Roadside Safety

There is guide rail approaching the bridge and anchored into the end walls in all four quadrants of the structure. The guide rail is in good condition. A detailed road safety audit was not completed.

The RNUP Vista-Mast Trail was realigned in 2023 and the portion of the trail that crossed Twyn Rivers Drive at the bridge site was officially closed eliminating roadside safety concerns due to poor site lines. However, it is recommended that guide rail repairs be completed to remove the gaps formerly provided for trail entrancesl.

## 3.4 Property

The bridge is located on City property, within an approximate 20 metre right-of-way. Beyond the 20 m right-of-way limit most of the property is owned by Parks Canada. Additional property owners exist within the boundaries of the park and the extents of these should be determined in preliminary design.

## 3.5 Utilities

Overhead utility lines run parallel to Twyn River Drive at the structure along the east side.

## 3.6 Water and Sewer

Water and sewer information was not available at this time.

## 3.7 Posted Signage

The following posted signage was observed at the bridge:

- The bridge has a load posting sign of a maximum load limit of 3 tonnes, at both approaches.
- On Twyn Rivers Drive a regulatory Heavy Vehicle Prohibition sign is posted at entry points.
- Along Twyn Rivers Drive warning signs about curves and pedestrian crossing are posted.

## 3.8 Survey

Existing topographic survey information was obtained from the City. Hydraulic models for the Little Rouge River at the location of the bridge were provided by the Toronto and Region Conservation Authority.

# 4.0 Existing Bridge

Maxwell's Bridge, constructed in 1927, is a 19.0 m single-span concrete bowstring half-through arch bridge with a concrete deck slab and an asphalt wearing surface carrying Twyn Rivers Drive Road over the Little Rouge River. The curb to curb width of 6.1 m accommodates two lanes of traffic. The bridge has a load posting of 3 tonnes.

A General Arrangement drawing is provided in **Appendix A**, and site photographs are included in **Appendix B**.

## 4.1 Superstructure

The superstructure is comprised of a bowstring half-through arch on both sides, with longitudinal bottom chords along the length of the bridge and six vertical hangers with varying height along the arch.

The bridge has a single span of nominal length of 19.0 m and a total bridge length of 28.6 m. The structure is 7.52 m wide with a clear width of 6.10 m between curbs.

The concrete structure also serves as the railing on either side with two end walls at each quadrant and two concrete railings along the length of the bridge with 710 mm wide concrete curbs. The bridge has a 248 mm thick concrete deck with a 90 mm asphalt and waterproofing system. The bridge has eight transverse concrete floor beams.

The superstructure extends over the ballast wall and transitions to the roadway asphalt.

## 4.2 Substructure

The substructure is constructed of conventional closed concrete U-shaped abutments, founded on spread footings. There is no approach slab.

## 4.3 Maintenance and Repair History

Since the original bridge construction, the Maxwell Bridge was rehabilitated in 1997 and 2013. The following work was completed:

- Deck replacement and new asphalt and waterproofing system (1997); and
- Concrete patch repair or envelopment of the arch, verticals, floor beams, bottom chord, abutments, wingwalls, and new asphalt and waterproofing system (1997, 2013).

See **Appendix A** for the Rehabilitation General Arrangement drawings.

## 4.4 Condition of Structure

The condition of the structure was determined from a review of available documentation, visual site walk-through surveys of the structure in November 2019 and October 2020, and interviews with City staff.

The 2021 biennial bridge inspection assigned a Bridge Condition Index (BCI) of 71.6, which relates to a bridge considered in good condition. It should be noted that these inspections are intended to identify repairs required in the next two years and do not address functional obsolescence or long-term considerations.

The structural inspection and evaluation completed in 2013 confirmed the 3 tonne load posting. The report recommended concrete patching, and replacement of asphalt and waterproofing, which was implemented under Contract 12SE-10S.

The existing barrier system is not a crash-tested approved system in accordance with CAN/CSA-S6-19 and the concrete rails pass through the vertical hangers that carry structure loads to the concrete arches which is the main load carrying components on the structure. This configuration results in the structures main load carrying components being vulnerable to vehicle collision loads.

The abutments were in generally good condition.

In general, despite its age, the bridge has been maintained in good condition.

# 5.0 Heritage Evaluation

In 1997, the City of Scarborough designated Maxwell's Bridge as being of historical and architectural value or interest under *The Ontario Heritage Act, R.S.O. 1990, Chapter O.18.*

The reasons for designation were given in Schedule B to By-Law Number 25152, as follows:

> "The Maxwell's Bridge is recommended for designation for historical and structural reasons. The bridge, built in 1927, is reinforced concrete, bowstring arch ''through'' structure, of a type pioneered in Canada by Frank Barber C.E. in the early 1900's. The bridge name was once associated with Maxwell's Mill which was located just north of the bridge structure. It was built to replace earlier access roads to the saw and grist mills and a woollen factory on the Rouge. Few of these bridge types remain in Ontario and the Maxwell's Bridge was one of the last of this type to be constructed in the province."

Heritage conservation is an important consideration in the assessment of bridge alternative solutions, and in the overall evaluation of alternative solutions in the TMP, which are addressed in the "Cultural Heritage Resource Assessment Report" and a "Scoped Heritage Impact Assessment Report" by ASI, to assess the recommended alternative solutions from a heritage perspective.

## 5.1 Heritage Guideline Options

The "Ontario Heritage Bridge Guidelines" (Ontario Ministry of Transportation, 2008) has been used as a supplementary reference to the primary heritage guide used by the City, "Conservation of Historic Places in Canada" (Parks Canada, 2010). The former guide articulates a series of heritage treatment options to be considered in rank order (from most desirable to least) as follows:

1. Retention of existing bridge with no major modifications;
2. Retention with restoration of missing or deteriorated elements;
3. Retention of bridge with sympathetic modification;
4. Retention of bridge with sympathetically designed new structure nearby;
5. Retention of bridge adapted for alternative use;
6. Retention of bridge as heritage monument for viewing purposes;
7. Relocation of bridge – applicable for smaller, lighter structures; and
8. Bridge removal and replacement with sympathetically designed structure.

Reference will be made to these options in the remainder of this report.

# 6.0 Identification of Alternative Solutions

### Need for a Crossing

At the onset of the project, the need for a bridge crossing at the site was evaluated based on traffic needs, detour route availability, and other factors. It was concluded that the crossing could not be closed and decommissioned permanently. Therefore, **all alternative solutions to be considered require a bridge crossing to be in service for the next 20 years**, representing the study period for the TMP.

Three Alternative Solutions for the bridge crossing have been identified:

- Alternative 1: Retain Bridge
- Alternative 2: Rehabilitate Bridge
- Alternative 3: Replace Bridge

Each alternative is described below, for clarity.

## 6.1 Alternative 1: Retain Bridge

Retention of the existing bridge means keeping the bridge in its existing configuration with minimal changes, if any. It may include maintenance repairs, or improvements to roadway approaches, sight lines, signage or other ancillary features. However, functional improvements that change the cross-section of the bridge, or strengthening that substantially alters the form and appearance of the structure are not considered in this alternative.

This alternative involves continued operation of the bridge with minimal modifications at the start and no planned repairs in the next 20 years. Normal maintenance and inspections are anticipated. No improvement to functional adequacy would be achieved. Roadside safety would typically not be improved.

This alternative would only be feasible if the level of risk, safety and reliability of continued operations is deemed acceptable.

## 6.2 Alternative 2: Rehabilitate Bridge

Rehabilitation means strengthening and altering the existing bridge to address deficiencies, and the process may allow improvements to its functional adequacy. This may include adding structural components to supplement the existing ones, replacing components of the structure or other similar improvements. However, significant alterations in form and appearance may occur.

Rehabilitation is defined in the Canadian Highway Bridge Design Code (CHBDC) as a modification, alteration, or improvement of the condition of a structure or bridge subsystem that is designed to correct deficiencies in order to achieve a particular design life and live load level. Functional adequacy

may be viewed as encompassing not only design life and live load levels, but also operational risk, maintenance requirements, geometric constraints, and other factors.

A minor rehabilitation may focus solely on correcting deficiencies without any improvement in functional adequacy. However, corrective actions that require more extensive modifications are considered major rehabilitations.

Major rehabilitations provide the opportunity (and often the obligation) to achieve an acceptable level of functional adequacy. For example, the CHBDC indicates that consideration shall be given to closing bridges that would be posted for a load limit below 7 tonnes. For older bridges, it is often not feasible to strengthen bridges to load levels comparable to a new bridge, thus lower load levels would be targeted. Table 15.1 of the CHBDC provides guidance on target load levels for bridges to be rehabilitated for restricted normal traffic. In this case, bridges carrying emergency vehicles, single unit trucks, school buses and maintenance vehicles should be capable of supporting a CL3-ONT design live load, which relates to a posted load limit of 25 tonnes. (For comparison, a bridge that can support unrestricted normal traffic would be comparable at 63 tonnes.)

Rehabilitation typically extends the service life of a bridge for 25 to 35 years, which would correlate to no planned repairs during the 20-year planning horizon for this study. Normal maintenance and inspections are anticipated. Roadside safety (e.g. barriers) could be improved in some cases, but it may not be possible to achieve the level of performance possible with new construction.

The benefits of rehabilitation should be evaluated against associated costs, risks and consequences.

Risks may include increasing loads to the substructure (e.g., abutments) beyond acceptable levels, the potential to uncover problems during construction that are much worse than could be known at the beginning, hazards to worker or public safety during the rehabilitation, and other issues.

Consequences include potential impacts to the heritage value and aesthetic appearance of the bridge, and these should be minimized or avoided where feasible. Rehabilitation may involve adding structural components to supplement the existing ones, replacing components of the structure or other significant modifications. Such significant alterations in form, proportion, massing, or materials may be so extensive that the heritage value cannot be appropriately preserved, in which case rehabilitation would not be recommended.

Widening of this bridge through a major rehabilitation would require such an extensive dismantling and replacement of the original structure and abutments that it is not considered feasible.

## 6.3 Alternative 3: Replace Bridge

Replacement of the existing bridge means complete removal of the existing bridge, and replacement with a new structure. This allows the greatest improvement in the functional adequacy of the bridge such as load-carrying capacity, width, and service life. For replacement of heritage bridges, it must be demonstrated that the other alternative solutions are not suitable before replacement is considered.

Replacement would remove constraints such as load limits, span limits, bridge clearance for hydraulics, bridge width, number of lanes, shoulder widths, roadside safety barriers, bicycle lanes, and pedestrian accommodation. It also provides the opportunity to use new materials and structure forms to improve durability. Typically, the design life for a new bridge designed according to the CHBDC is 75 years. Minimal maintenance would be required for the first 20 years after construction.

Replacement would involve removal of the existing bridge span and its abutments, affecting the heritage characteristics of the bridge and its surrounding area. However, the existing bridge superstructure could be removed carefully and adapted for alternate use away from its current location, potentially elsewhere in the RNUP or in the City, providing a degree of heritage conservation.

In many cases the original bridge could be adapted for a new use such as a pedestrian crossing, cycle path or scenic viewing, or retained as a heritage monument for viewing purposes only. The bridge could be relocated to a new site for these purposes.

Retention of the existing bridge on the current site is not considered feasible at this site, due to limitations in right-of-way and span limitations to achieve appropriate hydraulic clearance.

The Ontario Heritage Bridge Guidelines (MTO, 2008) recommends the heritage impact of a bridge replacement could be mitigated using sympathetic design which means making the new structure physically and visually compatible with the heritage attributes of the original. It would be compatible in terms of the massing, size, scale, and architectural features to protect the cultural heritage value of the bridge and its environment.

A commemorative monument, plaque or sign could be erected at the site to recognize the history of the original bridge.

A heritage bridge often has contextual value attached to its cultural heritage value, requiring the scenic characteristics of the river crossing, the roadway alignment, and natural setting be taken into account for any replacement structure that may be considered.

# 7.0 Evaluation of Alternative Solutions

As part of the broader Transportation Master Plan, alternative solutions are being evaluated against the following six factors:

- Bridge Condition and Function;
- Transportation;
- Heritage and Archaeology;
- Natural Environment & Hydraulics;
- Public Uses in Rouge National Urban Park; and
- Implementation.

This report focuses on the 'Bridge Condition and Function' for each alternative, and the review has been supported by other technical and professional studies. The evaluation of alternative solutions is described in the following sections.

## 7.1 Alternative 1: Retain Bridge

Alternative 1 is a 'holding strategy' where the existing bridge is retained and maintenance repairs are completed for the remainder of the service life until a major rehabilitation is completed or the structure is replaced.

Repairs would be focused on maintaining the structure in a safe operating condition, but would not include strengthening to address the current 3 tonne load posting. Based on a review of previous inspection and engineering reports, the scope of work is expected to be limited to concrete patch repairs to address areas of medium to severe deterioration (delaminations, spalls, scaling, etc.).

The existing asphalt wearing surface and waterproofing system were replaced in 2013 and the asphalt is reported to be generally in good condition in the 2021 City of Toronto Bridge Inspection Form. Replacement of the wearing surface has not been included in the scope of the proposed repairs, but may be required during the 20 year study period. The waterproofing system should be replaced at the same time.

A regular monitoring and maintenance program would be required for the remainder of the service life to address ongoing deterioration at critical locations.

Alternative 1 provides the lowest capital cost alternative and addresses the ongoing deterioration at the site. The reported condition of the structure appears to support retaining it, with minimal alternations to conserve the cultural heritage value.

Truck traffic would continue to be required to use an alternate route which limits nearby residents' access to fire and other emergency services as well as access for other service vehicles and deliveries such as home heating oil. The Twyn Rivers Drive evacuation route would continue to require a "no trucks" restriction.

The existing soffit elevation would be maintained, which currently does not meet current standards for clearance above the design storm water elevation.

## 7.2 Alternative 2: Rehabilitate Bridge

Alternative 2 includes a major rehabilitation with the intent to improve structural performance and extend the service life of the bridge significantly.

The current 3 tonne load posting was confirmed in 2013 by Associated Engineering; however, the evaluation was based on assumed reinforcing details, since the original reinforcing drawings from 1927 are not available. The ability to strengthen the structure would remain dependant on these assumptions.

Encapsulation of the chords and floor beams with additional reinforcement may be feasible, but properly developing and anchoring the new reinforcing would be challenging at the intersections of different elements. The vertical members would be particularly challenging to strengthen using encapsulation, since new reinforcement on the sides of the verticals would need to be fully developed at the intersections with the chord members. External strengthening systems, such as high-strength steel bars or cables may be required to supplement the existing verticals.

Given the unknown capacity of the existing reinforcing and the difficulties in strengthening certain locations, it is unlikely that the bridge can be sufficiently strengthened to permit truck traffic. Therefore, rehabilitation work would focus on modest strengthening of the structure and extending the service life. Based on a review of previous inspection and engineering reports, the scope of work is expected to include:

- Encapsulation of the top and bottom chords and floorbeams, as required;
- Installation of external high-strength bars at the verticals; and,
- Localized concrete patch repairs to the floorbeams, deck, curbs, barriers, and abutments.

Similar to Alternative 1, replacement of the asphalt wearing surface and waterproofing system has not been included in the scope of the proposed rehabilitation, but may be required during the 20 year study period.

A regular monitoring and maintenance program would be required for the remainder of the service life.

Alternative 2 is a high cost alternative for extending the service life beyond Alternative 1. The bridge would remain load posted with no functional improvements in terms of allowing truck traffic.

The original reinforcing details are unknown, so strengthening is expected to include encapsulation of existing members and external strengthening systems to supplement the existing verticals. These measures would alter the original form and result in significant loss of heritage value. The load carrying capacity would be improved, but it is not expected to be feasible to strengthen the structure to meet current standards.

Truck traffic would continue to use an alternate route, which limits nearby resident's access to fire and other emergency services as well as access for service vehicles and deliveries such as home heating oil. The Twyn Rivers Drive evacuation route would continue to require a "no trucks" restriction.

Similar to Alternative 1, this alternative maintains the existing hydraulic opening, which currently does not provide minimum clearance above the design storm water elevation.

## 7.3 Alternative 3: Replace Bridge

Alternative 3 includes complete replacement of the structure. The new bridge would meet current standards which are calibrated for a 75 year design life. Minimal maintenance would be required for the first 20 years after construction.

Alternative 3, complete replacement, provides the most improvements to the safety and overall function of the structure, but also represents the highest initial cost. However, based on the reported condition replacement may not be warranted at this time.

The replacement structure would be designed in accordance with current standards and would provide full access for truck traffic, including emergency vehicles and large service trucks.

The two lane configuration would be widened to reduce collision risks and improves access for recreational users.

The hydraulic opening would provide increased conveyance and the span would include an allowance for spanning the meander belt or erosion limits of the river.

Minimal maintenance is expected to be required for the first 20 years. Modern structural configurations and materials would be used, resulting in a more durable structure with lower future maintenance requirements.

## 7.4 Recommended Alternative

Retaining the existing structure (Alternative 1) is recommended at this site. Rehabilitation (Alternative 2) to permit truck traffic is not expected to be feasible and even modest strengthening would significantly alter the original form and appearance of the structure and impact the cultural heritage value. Replacement (Alternative 3) does not appear to be warranted at this time, based on the reported condition.

This Functional Design Report is focused on bridge engineering, with reference to roadway geometrics and other factors as appropriate. The evaluation of alternative solutions, from this perspective, is summarized in **Table 1**. A more comprehensive multi-factor evaluation of alternative solutions is included in the TMP report.

**Table 1 – Evaluation of Alternative Solutions**

| Criteria | Alternative 1: Retain | Alternative 2: Rehabilitate | Alternative 3: Replace |
|---|---|---|---|
| **Bridge Condition and Function** | Bridge has remaining service life. Bridge would remain with load posting. | Repairs to address deterioration. Bridge would remain with load posting | New two lane bridge would meet current standards |
| **Heritage** | Cultural heritage value would be maintained | Rehabilitation would significantly alter the original form and impact the cultural heritage | Sympathetic design would be recommended. |
| **Implementation** | Low complexity due to limited scope. Continued risk associated with unknown existing reinforcing details. | High complexity due unknown existing reinforcing details. Not feasible to strengthen to current standards. | Low complexity due to new sympathetic bridge design. |

For the purposes of this report, a precast concrete or steel tied arch bridge could be considered as the replacement structure type, to provide a sympathetic design, given the uncertainty of other heritage mitigations.

## 7.5 Heritage Conservation Options Review

Heritage conservation options are based on the 'Conservation of Historic Places in Canada;' (Parks Canada, 2010) which provides principles for infrastructure conservation and references the Ontario Heritage Bridge Guidelines (MTO, 2008) for the specific case of bridges. This provides a rank-order approach to heritage bridge conservation options, ranging from least to most heritage impact. The rank-order approach requires each option to be evaluated and found to be non-viable before the subsequent option is considered. The rank-order options that were considered are listed in **Table 2** below.

**Table 2: Heritage Options Review**

| Conservation Option | Evaluation Summary |
|---|---|
| 1. Retain existing bridge with no major modifications | Viable for look-ahead period based on condition, and two lane width, recognizing it is on a "no trucks" route, it has had proven performance to date, and recognizing that the nearby Stotts Bridge (Site E) has been identified for replacement which will allow fire and emergency access to the west of the Maxwell's Bridge.<br><br>Ongoing maintenance and monitoring is recommended. |
| **Recommendation:** | **Retain existing bridge (option #1)** |

Heritage conservation is an important consideration in the assessment of bridge alternative solutions, and in the overall evaluation of alternative solutions in the TMP, which will be addressed in the "Cultural Heritage Resource Assessment Report" and a "Heritage Impact Assessment Report" by ASI, to assess the recommended alternative solutions from a heritage perspective.

# 8.0 Functional Design (Recommended Alternative)

The recommended alternative has been advanced to an approximate 10% design. Future preliminary and detailed engineering studies will be required to refine the design.

## 8.1 Recommended Repairs

Specific locations requiring concrete repair will be confirmed during future design phases of this project. The 2021 Bridge Inspection Form lists minor spalls on the curbs, barriers, and abutments and areas of delamination on the verticals. These locations and any additional areas of medium to severe concrete deterioration will be addressed with partial-depth concrete removals and new patch repairs.

A preliminary general arrangement drawing of the recommended alternative is provided in **Appendix C**.

## 8.2 Pedestrian and Bikeway Facilities

Twyn Rivers Road is not currently a designated route with signage for cyclists and cyclists who travel the route are required to share the road with vehicular traffic.

There are ongoing projects planned in the vicinity of Maxwell's Bridge, including installation of a nearby pedestrian structure over the Little Rouge River, to improve pedestrian safety. No additional allowance has been provided for pedestrian or trail facilities in the TMP.

## 8.3 Stotts Bridge on Twyn Rivers Drive (No. 803)

Under current load restrictions, truck traffic cannot cross Stotts Bridge or Maxwell's Bridge which restricts access to Twyn River Drive between the two structures. It is expected that a temporary bridge will be required for equipment access to construct the proposed replacement structure at the Stotts Bridge site.

The limited scope of work recommended at Maxwell's Bridge is not expected to require large equipment, but it may be prudent to schedule the work at this site after Stotts Bridge has been replaced, to ensure equipment access is not impeded by the load restrictions.

# 9.0 Other Considerations

## 9.1 Hydraulics and Hydrology

A Hydraulics Report was provided under separate cover. The key hydraulic design criteria for Hillside Bridge are summarized as follows:

High water level based on 1:50 year design flow is estimated to be 87.33 m. Existing freeboard and clearance are estimated to be 1.85 m and 1.10 m, respectively. These are both above the minimum freeboard and clearance requirement of 1.0 m.

## 9.2 Navigability

The Little Rouge River is not included on the List of Scheduled Waters under the *Canadian Navigable Waters Act*.

## 9.3 Access to Site

The site is readily accessible from Twyn Rivers Drive. Once Stotts Bridge is replaced, access to both ends of Maxwell Bridge will be possible.

## 9.4 Environmental Considerations

This Transportation Master Plan is being completed in accordance with the Municipal Class Environmental Assessment process, using Approach #2, where the level of investigation, consultation and documentation shall fulfil the requirements for Schedule B projects, as a minimum. This includes completion of Phase 1 (problem/opportunity definition) and Phase 2 (evaluation and selection of a recommended solution) of the Class EA process.

Identification of environmental factors (e.g., natural habitat, archaeology, cultural heritage, hydrology and hydraulic conveyance, fluvial geomorphology, geotechnical and foundation conditions, traffic, etc.) will need to be completed as part of the Preliminary Design for the recommended alternative following completion of the Rouge Park Bridges TMP.

## 9.5 Hazardous Materials

No hazardous materials have been identified on the bridge.

## 9.6 Future Study Requirements

Additional studies that should be undertaken as part of preliminary design of the recommended alternative include, but are not limited to:

- Detailed Structure Inspection - to determine/confirm extent of required repairs and facilitate development of maintenance plan to ensure the service life of the structure is extended for 20 years.

# *10.0* Closure

The foregoing summarizes the structural existing conditions at **Maxwell's Bridge on Twyn Rivers Drive (No. 802)**. Alternative Solutions for retaining, rehabilitating, and replacing the structure are presented and assessed and a recommended solution is recommended for this bridge project site, one of five bridge project sites considered under the Rouge Park Bridges Transportation Master Plan.

**DILLON CONSULTING LIMITED**

Reviewed by:


Janette McCann, M. Eng, P.Eng.
*Associate, Structural Engineer*

Reviewed by:

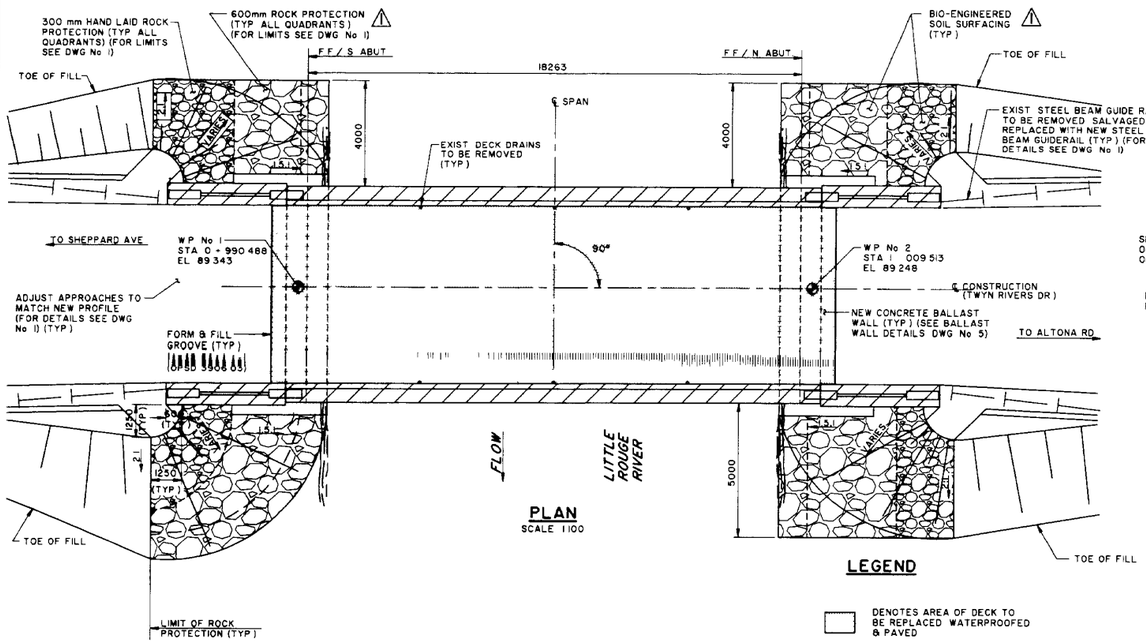

Chris Haines, P.Eng.
*Project Manager, Structural Engineer*

# Appendix A

## *Drawing of Existing Bridge*

CITY OF SCARBOROUGH

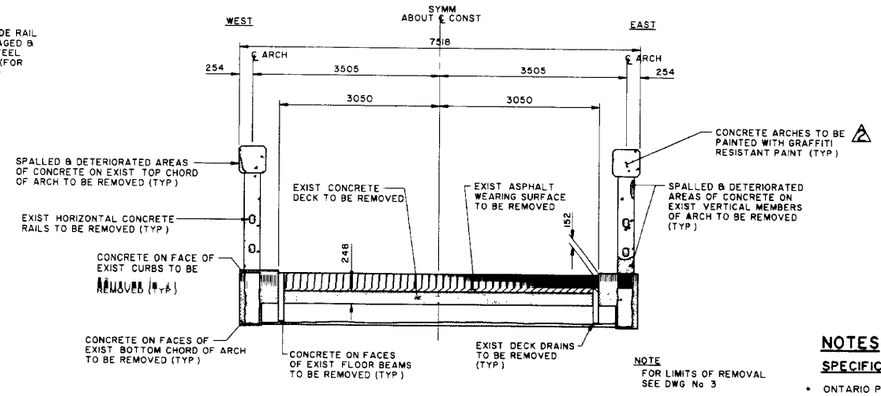
CONSTRUCTION NORTH




## PLAN
SCALE 1100

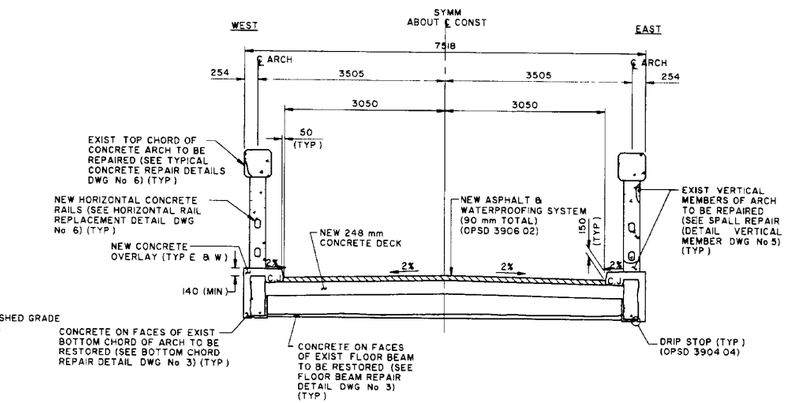
## LEGEND

- DENOTES AREA OF DECK TO BE REPLACED WATERPROOFED & PAVED
- DENOTES AREA OF CURBS TO BE OVERLAID
- W L DENOTES WATERLINE
- S/B DENOTES STREAMBED
- O G DENOTES ORIGINAL GROUND
- W P DENOTES WORKING POINT
- T/A DENOTES TOP OF ASPHALT
- F F DENOTES FRONT FACE

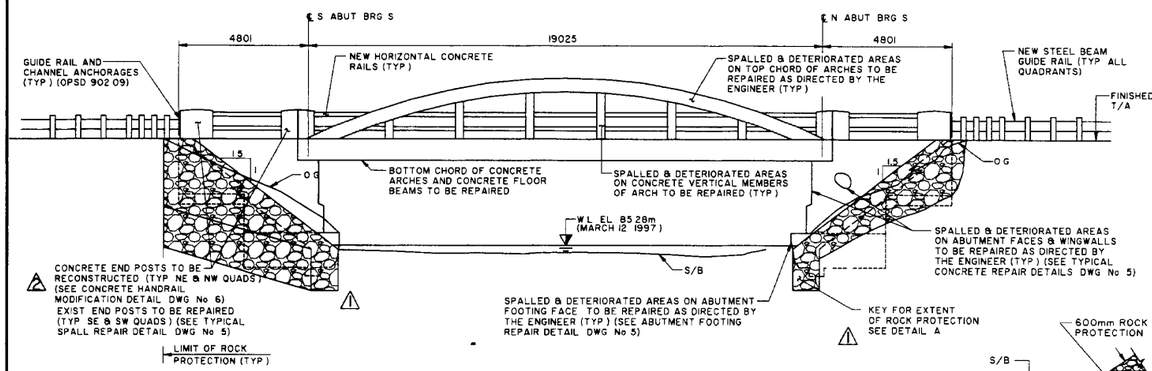



NOTE
FOR LIMITS OF REMOVAL SEE DWG No 3

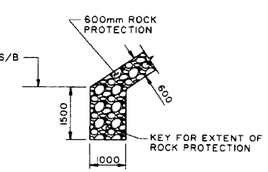
## EXISTING DECK SECTION
SCALE 1:50




## NEW DECK SECTION
SCALE 1:50




## ELEVATION
SCALE 1:100




## DETAIL 'A'
SCALE 1:75

## NOTES

### SPECIFICATIONS

- ONTARIO PROVINCIAL STANDARD SPECIFICATIONS DIVISION 9
- ONTARIO HIGHWAY BRIDGE DESIGN CODE 1991

LIVE LOAD O H B D C - 91 + 90mm ASPHALT & WATERPROOFING SYSTEM (EXCEPT RAILING SYSTEM) L1=15 TONNES L2=27 TONNES L3=37 TONNES

### CONCRETE

- ALL CONCRETE 30 MPa
- MAXIMUM AGGREGATE SIZE 13.2mm REPAIRS, 19mm ALL OTHER CONCRETE
- ALL CONCRETE REPAIR MATERIALS SHALL BE APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS

ALL EXPOSED CONCRETE EDGES TO HAVE 20mm CHAMFER UNLESS OTHERWISE NOTED

### CLEAR COVER TO REINFORCEMENT

| | |
|---|---|
| DECK | 70 ± 20 mm (TOP)<br>40 ± 10 mm (BOTTOM) |
| FLOOR BEAMS | 40 ± 10 mm |
| REMAINDER (EXCEPT AS NOTED) | 70 ± 20 mm |

### REINFORCING STEEL

ALL REINFORCING STEEL SHALL BE IN ACCORDANCE WITH C S A G30 18M 1992 GRADE 400 UNLESS OTHERWISE NOTED

REINFORCING STEEL SHALL BE FIELD CUT AS DIRECTED BY THE ENGINEER AND AS A NON PAY ITEM

REINFORCING BARS WITH PREFIX C DENOTE COATED BARS

FOR CONSTRUCTION SEQUENCE SEE DWG No 3

### NOTES TO CONTRACTOR

CONTRACTOR TO CHECK ALL RELEVANT STRUCTURE DIMENSIONS AND ELEVATIONS SHOWN ON THE DRAWINGS AND ADJUST DIMENSIONS AND ELEVATIONS AS REQUIRED TO MATCH EXISTING STRUCTURE AND AS APPROVED BY THE ENGINEER

- ANY DAMAGE DONE TO THE EXISTING STRUCTURE DURING REMOVALS OR RECONSTRUCTION SHALL BE REPAIRED BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER AND AT NO COST TO THE OWNER

### REFERENCE DRAWINGS

- DETAILS OF THE EXISTING STRUCTURE HAVE BEEN DERIVED FROM DRAWINGS OF MAXWELL'S BRIDGE BY THE TOWNSHIP OF SCARBOROUGH ENGINEERING DEPARTMENT DATED AUG 8 1927

| APPROVALS | | | | | AS CONSTRUCTED | |
|---|---|---|---|---|---|---|
| SOURCE NAME | DATE SENT | DATE RECEIVED | APPROVAL TYPE | APPROVAL NUMBER | CONTRACT TYPE | BRIDGE REHAB |
| MTRCA | APR 25/97 | JUNE 18/97 | PERMIT | 078/97/SCAR | FILE NO | 8354 |
| MNR | APR 25/97 | JULY 29/97 | PERMIT | YS-66-97/98 | CONTRACT NO | 8534 |
| | | | | | CONTRACTOR | McPHERSON-ANDREWS CONTRACTING LTD |
| | | | | | STARTED | JULY 14 1997 |
| | | | | | COMPLETED | MAY 29 1998 |
| | | | | | LAYOUT BY | N/A |
| | | | | | PROJ ENG | B WOLF |
| | | | | | INSPECTOR | R GUPTA BHAYA |
| | | | | | FINAL SURVEY BY | N/A |
| | | | | | FINALIZED BY | CONSULTANT |
| | | | | | DATE | JUNE 1998 |
| | | | | | REVIEWED BY | B WOLF |
| | | | | | DATE | JUNE 1998 |
| | | | | | CONSULTANT | TOTTEN SIMS HUBICKI ASSOC |

| NO | DATE | REVISIONS | BY | CHECKED |
|---|---|---|---|---|
| 2 | JAN 98 | AS CONSTRUCTED | DMG | DLB |
| 1 | JUNE 97 | REVISED PER MTRCA COMMENTS | DMG | DLB |

C. T. SPENCER — LICENCED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

D. L. BAXTER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

SEAL

CITY OF SCARBOROUGH
WORKS AND ENVIRONMENT DEPARTMENT

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS

5002-S-5

# STRUCTURAL REHABILITATION OF THE MAXWELL'S BRIDGE
ON TWYN RIVERS DRIVE
CITY OF SCARBOROUGH
LITTLE ROUGE RIVER

## GENERAL ARRANGEMENT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DESIGN | CTS | DRAWN | DMG | CHECK | DLB | PROJECT | 42-18696-03 |
| SCALES | AS NOTED | | | ACAD FILE NAME | MAX_GA | DRAWING NUMBER | 2 |
| DATE | MAY 1997 | | | | | | |

2363F

C:\MAX\MAX_GA 06/24/98 11:21

# Appendix B

## *Site Photographs*


Bridge, Looking North

East Face of Bridge

West Face of Bridge

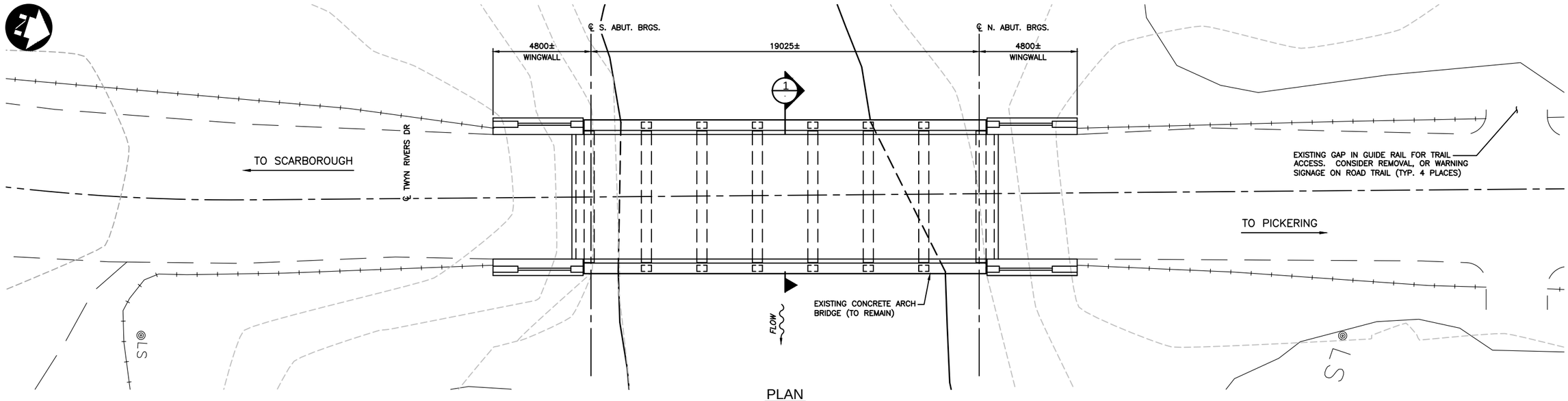
North Abutment

Orchard Trail West Connection

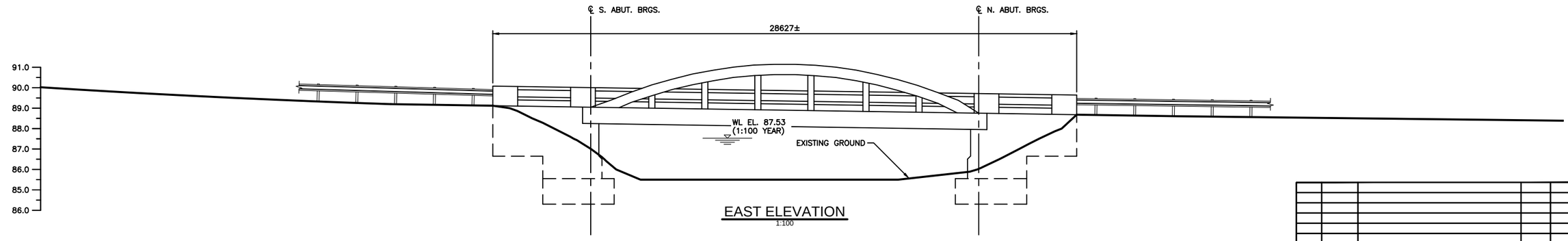

Mast Trail East Connection

# Appendix C

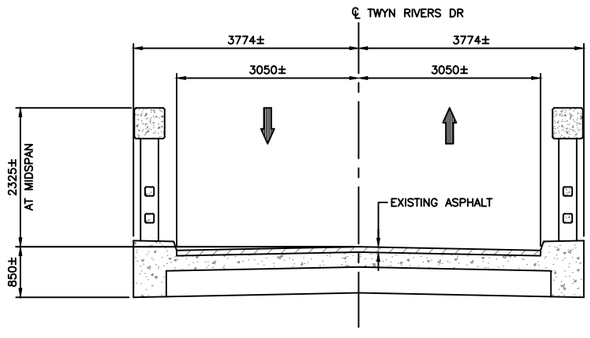
## *General Arrangement Drawing for the Recommended Alternative*




PLAN
1:100




EAST ELEVATION
1:100




1 SECTION
1:50

**PRELIMINARY**

| No. | DATE | REVISIONS | INITIAL | SIGNED |
|---|---|---|---|---|
| | | | | |

DILLON CONSULTING
235 Yorkland Blvd., Suite 800, Toronto, ON M2J 4Y8
Phone: (416) 229-4646 Fax (416) 229-4692

APPROVED _____

SIGNATURE _____
NAME (PRINT) _____
DATE _____

# ROUGE PARK BRIDGES TRANSPORATION MASTER PLAN

MAXWELL BRDIGE (No. 802) ON TWYN RIVERS DRIVE OVER LITTLE ROUGE RIVER

| | | | | | | |
|---|---|---|---|---|---|---|
| DESIGN | --- | DRAWN | SJM | CHECKED | --- | JOB No. 19-1924 |
| SCALE: | AS NOTED | | | | DWG: | |
| DATE: | DECEMBER 2023 | | | | SHEET | OF |