Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

McCormick Rankin

Walpole Island Swing Bridge

Comprehensive Detailed Inspection and Alternative Assessment Report

PWGSC Project No. R.051213.001

MRC McCORMICK RANKIN
A member of MMM GROUP

July 2012

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EXECUTIVE SUMMARY

McCormick Rankin (MRC), a member of MMM Group, was retained by Public Works and Government Services Canada (PWGSC) to undertake a detailed inspection of all structural components, a condition inspection of the mechanical and electrical components, and a designated substance survey (DSS) of the Walpole Island Swing Bridge near Wallaceburg, Ontario.

The mechanical and electrical inspection was completed on December 12th, 2011 by Ameresco Consulting Incorporated.

The structural inspection was complete in two (2) phases. From December 13th to December 15th, 2011 the condition of the substructure and underside of the superstructure was assessed by Mr. Agostino Monteleone, P.Eng., and Mr. Kyle Yusek, E.I.T. of MRC. A detailed deck condition survey of the structure was performed from April 30th to May 1st, 2012 by Mr. Agostino Monteleone, P. Eng., Mr. Kyle Yusek, E.I.T., and Mr. Matthew Thomson, E.I.T. of MRC. To assess the condition of the submerged portions of the piers and dolphins, an underwater inspection was completed by ASI Group Ltd. under the direction of Mr. Agostino Monteleone, P.Eng., on May 1, 2012. All field supervision and project management was directed by Mr. Goby Jeyagoby, P. Eng. of MRC.

A designated source material investigation to identify and characterize building materials that may contain hazardous substances was completed on May 1st, 2012 by Ms. Annette Blazeiko and Ms. Carrie Stephenson of Ecoplans, a Member of MMM Group.

The structural inspection was completed following the processes and procedures in the PWGSC Bridge Inspection Manual 2010 (BIM). Observations during the inspection were noted on the standard BIM inspection forms and have been provided in Appendix A.

Overall, the structure was found to be in fair-to-good condition, with some localized areas observed to be in poor-to-fair condition. The mechanical and electrical components of the structure were found to be in good condition. The designated source material investigation did not identify any hazardous materials and the building materials were observed to be in good condition.

The structural inspection of the bridge reveals a number of items requiring attention, including:

- Bearing seats and ballast walls: delamination and spalling at west abutment;
- Piers: areas of cracking, delamination, and spalling particularly on bearing pedestals at rest piers; concrete erosion at waterline;
- Bearings: localized coating breakdown and corrosion noted;
- Embankments: three (3) small gullies caused by disintegrated splash pads;
- Abutments: clogged drains which are corroded at the outlets;

- Soffit: exterior soffit exhibits localized delamination, spalling and exposed corroded reinforcing steel;
- Orthotropic steel deck: small areas of localized coating failure and corrosion noted; two (2) potential cracks locations were identified (limited access);
- Deck drains: outlets are corroded, drain pipes do not extend far enough below steel deck troughs or bottom flanges of girders;
- Concrete bridge deck on approach spans: approximately 11% of the reinforcing steel in the concrete deck has a greater than 90% probability of active corrosion;
- Maintenance platform: Substandard railing height; and
- Railing system: Substandard connections to the approach SBGR at all four (4) corners.

Below summarizes the structural recommendations for the Walpole Island Swing Bridge based on priority codes:

<u>Priority Code M – Routine annual maintenance</u>

1. Girders: Clean bird nests and droppings.
2. Joints: Clean debris from joint seals at abutments and shore piers.
3. Slope: Construct/maintain spillways beneath deck drains.
4. Railings: Tighten/replace lose connection bolts.
5. Utilities: Tighten/replace lose connection bolts.

<u>Priority Code S – Further studies/investigations required prior to initiating repair programme</u>

1. Swing span deck: Further investigation through non-destructive testing such as Liquid Penetrant (LP) testing of the potential crack at the bottom of the third longitudinal trough from the north girder in span 4 at second cross beam from the pivot pier.
2. Girders: Further investigation through non-destructive testing such as Liquid Penetrant (LP) testing of the potential crack at the weld connecting girder 2 to the sixth transverse cross beam from the east in span 4.

<u>Priority Code B – Repair/replace in less than 3 years</u>

1. Piers Replace/repair bearing pedestals and seats. Install new railings on maintenance platforms and repair/replace ladders at rest and pivot piers.
2. Coatings: Localized (zone) coating on steel surfaces (including bearings) prior to further deterioration, as required.
3. Signage: Replace missing and damaged signs.
4. Railings Repair impact/abrasion damage.

<u>Priority Code C – Repair/replace in less than 5 years</u>

1. Abutments: Patch repair deteriorated concrete on west abutment bearing seat and ballast wall.

2. Deck Soffit: Patch repair deteriorated concrete on soffit.
3. Deck (Asphalt Surface): Replace asphalt wearing surface as it is nearing the end of its service life.
4. Deck (Concrete Surface): Remove and replace existing concrete overlay
5. Deck drains: Repair/replace splash pads on embankments, recoat drain pipes, and extend drain pipes.
6. Curbs: Patch repair spalled areas on curb.
7. Embankments: Place fills in gullies and over exposed footing.
8. Piers: Repair spalled and delaminated areas.
9. Bearings: Replace bearings.
10. Joints Repair/replace damaged and corrosive areas.

Overall, based on the structural inspection, the current rating and the current functional rating is 4-5. These ratings do not apply to the mechanical and electrical components.

The mechanical inspection reveals various components requiring minor maintenance such as grease removal and lubrication. The swing motor brakes were noted with severe grease and oil contamination, which is affecting the ability to slow the span. A safety concern noted was a lack of guarding for all machinery, as per Section 13.8.2 of the Canadian Highway Bridge Design Code (CHBDC).

The electrical inspection highlights potential safety concerns at the ready access to the motor control cabinet inside the operating pulpit. This cabinet is an open architecture design that has lethal voltage at exposed connections. Currently this cabinet is used as storage for some keys, which should be immediately removed. Secondly, access to this cabinet should be restricted to authorized, trained personnel wearing appropriate protection. Another safety concern noted was the location of the emergency generator in the operating pulpit, which represents a considerable noise and emission hazard. Operationally, the main electrical service is in poor condition. The traffic control gates and traffic lights were also noted to be in poor condition.

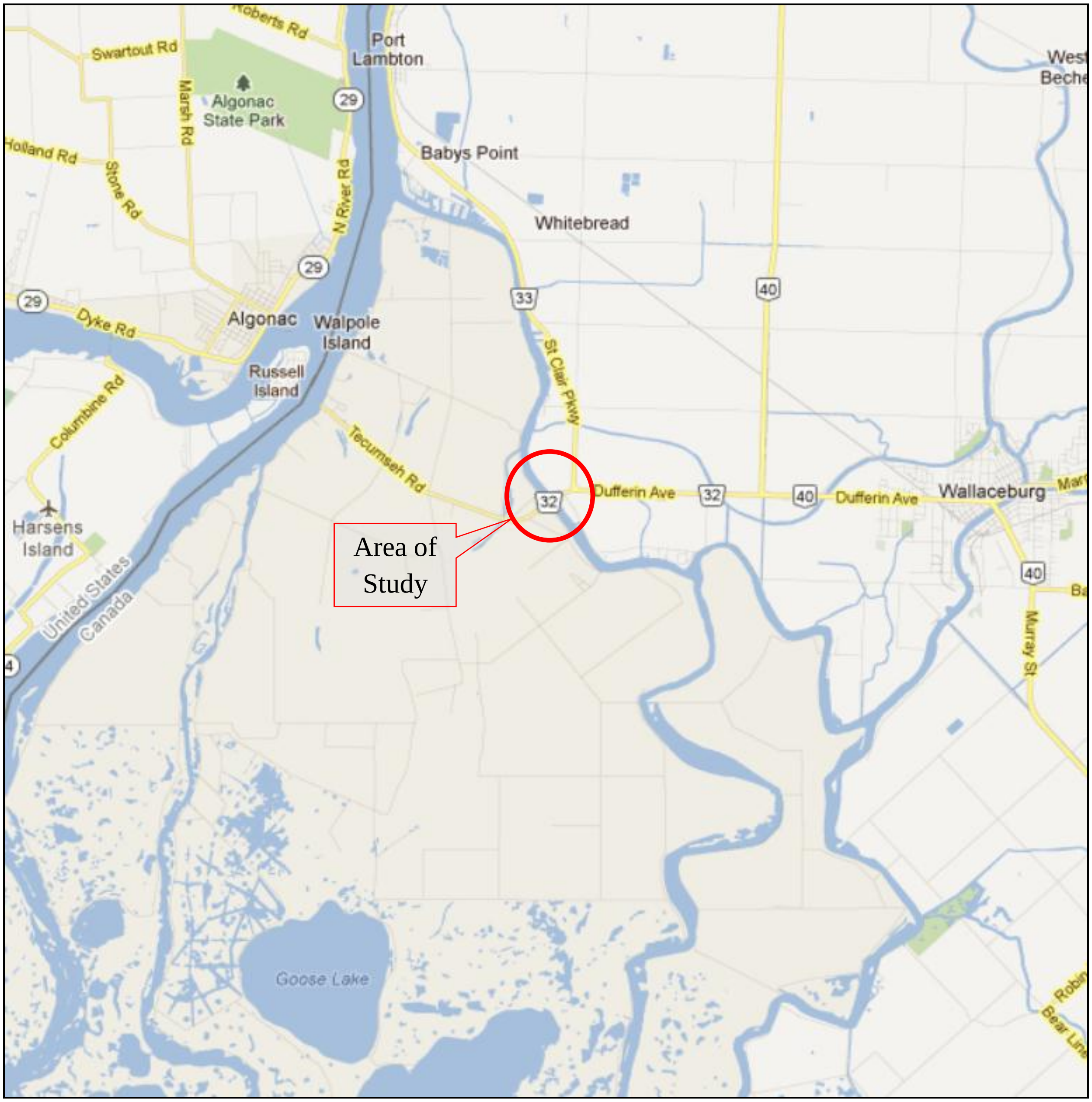
Below summarizes the mechanical and electrical recommendations for the structure:

- General mechanical maintenance items such as cleaning and lubrication of various elements;
- Review the guarding of all machinery, as per Section 13.8.2 of the CHBDC, and install suitable guards as necessary;
- Replace the brake shoes and drums of the span swing drive;
- Clean out the drain holes on the center pier of bird guano;
- Open up the east side wedge drive coupling and perform an inspection. If damaged due to lack of lubrication, replace the complete coupling. If the coupling is considered to be in serviceable condition, apply proper lubrication as required;
- Wedge electrical motor bearing lubrication and sealing;

- Replacement of oil seals on span drive gearbox;
- Check submarine cable by meggering;
- Replace main electrical service;
- Replace the emergency generator with an externally mounted unit inside a weatherproof sound attenuated enclosure;
- Replace the existing aging traffic gates;
- Miscellaneous conduit repairs, install missing cover plates;
- Protection of conduits at the base of the control tower; and
- Replace traffic lights with code compliant fixtures.

MRC considers three (3) structural rehabilitation options. Based on the findings of the inspection, MRC recommends Option 2, "Minimum Rehabilitation with Deck Overlay", as the most suitable solution to extend the service life of the structure by approximately 30 years, at which time major rehabilitation will be required. The estimated capital cost of Option 2 is $2.0M, which includes mechanical and electrical recommendations, contingencies, and engineering and construction administration fees. MRC also recommends that consideration be given to lower the existing road profile of the road under span 1 in order to address the substandard headroom (3.3 m posted). A 25-year management plan is presented based on the recommended repair program.

KEY PLAN



Walpole Island Swing Bridge
Wallaceburg, Ontario

KEY PLAN
Scale: Not to scale

1. INTRODUCTION

McCormick Rankin (MRC), a member of MMM Group was retained by Public Works and Government Services Canada (PWGSC) to undertake a detailed inspection of the structural components, a condition inspection of the mechanical and electrical components, and a designated substance survey (DSS) of the Walpole Island Swing Bridge near Wallaceburg, Ontario. The structural inspection includes a close up visual inspection of all accessible components, a detailed deck condition survey, and an underwater inspection.

MRC commissioned Ameresco Consulting Incorporated to perform the mechanical and electrical inspection and condition assessment; ASI Group Ltd to perform an underwater inspection to assess the condition of the submerged portions of the piers and dolphins; and Ecoplans, a Member of MMM Group, to carry out the designated source material investigation;

The inspection was completed in two (2) phases. The first (1st) phase encompasses a structural inspection (substructure and underside of the superstructure), and mechanical and electrical inspections that were completed from December 13th to December 15th, 2011. The second (2nd) phase comprises of a structural inspection (detailed deck condition survey and underwater inspection), and designated source material investigation that were completed from April 30th to May 1st, 2012.

This report summarizes the results of the inspections and provides recommendations for rehabilitation/renewal, which are supported by detailed financial analyses and cost estimates.

The Summary of Significant Findings and Recommendations for Repairs are presented in Sections 4 and 5, respectively. A 25-year management plan for the structure, based on the recommended repair strategy, is presented in Sections 6. Observations from the inspection are provided on standard inspection forms in Appendix A. Throughout this report, reference is made to representative photographs of the existing conditions, which have been included in Appendix B.

Further additional Engineering Studies or Surveys (Destructive and Non-Destructive Testing) have been recommended where MRC has deemed such works appropriate.

2. INSPECTION METHODOLOGY FOR STRUCTURAL WORK

Preliminary site reconnaissance was completed on October 4th, 2011 by Mr. Matt Thomson, E.I.T. (MRC).

The mechanical and electrical inspection and condition assessment was completed on December 12th, 2011 by Ameresco Consulting Incorporated.

Two (2) phases were required to perform the structural inspection. From December 13th to December 15th, 2011 the condition of the substructure and underside of the structure was assessed by Mr. Agostino Monteleone, P.Eng., and Mr. Kyle Yusek, E.I.T. of MRC. A detailed deck condition survey of the structure was then performed from April 30th to May 1st, 2012 by Mr. Agostino Monteleone, P. Eng., Mr. Kyle Yusek, E.I.T., and Mr. Matthew Thomson, E.I.T. of MRC. To assess the condition of the submerged portions of the piers and dolphins, an underwater inspection was completed by ASI Group Ltd. under the direction of Mr. Agostino Monteleone, P.Eng., on May 1, 2012. All field supervision and project management was directed by Mr. Goby Jeyagoby, P. Eng. of MRC

A designated source material investigation to identify and characterize building materials that may contain hazardous substances was completed on May 1st, 2012 by Ms. Annette Blazeiko and Ms. Carrie Stephenson of Ecoplans.

The inspection was performed in accordance with the PWGSC Bridge Inspection Manual, 2010 (BIM). Inspection results and material and performance condition ratings (MCR, PCR) were documented for each component using the forms provided in Appendix B of the BIM.

2.1 Condition Ratings

A numerical rating was assigned to each component of the structure based upon the severity of its observed material defects and its ability to perform its function. The numeric scale ranges from 1 to 6, where 1 = very severe defects, and 6 = new condition. The principles and general application of the rating system were in accordance with Section 2 of Part 2 of the BIM. Figure 2.2 of the BIM is included below as a reference guide for the condition rating of components. Tables detailing specific material and performance related defects for the components are found in Appendix A of the BIM.

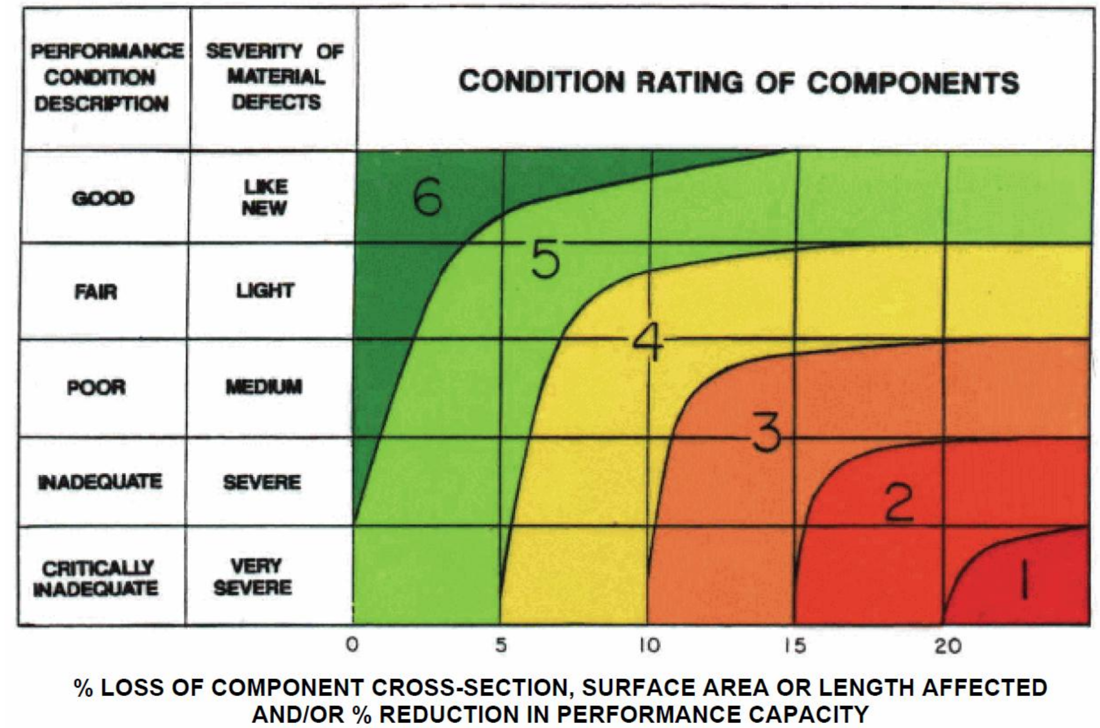


Figure 2.2 Condition Rating of Components

2.2 Priority Codes

In accordance with Section 2.3 of Part 2 of the BIM, each component was assigned a priority code indicative of the urgency and nature of recommended repairs as well as the need to further inspection. The priority code assigned to each component is one of the following in Table 1:

Table 1 - Priority Codes

Code	Description
U	Urgent requires immediate attention and remedial measure to ensure public safety
M	Required work to be done as part of routine annual maintenance.
S	Further study/investigations/surveys required prior to initiating repair programme.
A	Repair and/or replacement to be done in less than 1 year.
B	Repair and/or replacement to be done in less than 3 years.
C	Repair and/or replacement to be done in less than 5 years.
D	Condition to be re-assessed at the next inspection.

2.3 Access for Inspection

Detailed (close up) inspection of the soffit, girders, fascia, and piers was accessed using the Hydra-Platform Lift, provided by Facca Incorporated. The basic functions of the unit provided included being lowered over the side of the bridge deck, a telescoping platform with a maximum length of 9.75m (32ft), and ability to rotate up to 180° below the deck.

Traffic control was provided by Facca Incorporated at all times during inspection.

The existing maintenance platforms on the rest piers and pivot pier were used to gain access to the bearings as well as mechanical components. These platforms were accessed via manholes located on the south sidewalk.

A four-man crew of ASI Group Ltd., equipped with a surface-supplied diving system and two-way voice communications performed a close-up visual inspection of the entire submerged surface of the west rest pier, pivot pier, east rest pier, east shore pier and dolphins. All diving operations were carried out in accordance with the Ontario Ministry of Labour Diving Regulation O.Reg. 629/64 as amended to O.Reg.155/04. A floating vessel (motorized boat) was used to provide dive support and the minimize impact on navigation traffic. Two (2) divers were used. A video camera, mounted to the top of the diver's helmet, relayed images via a closed circuit arrangement, to a monitor on the vessel.

3. DESCRIPTION AND HISTORY OF THE STRUCTURE

3.1 Bridge Description

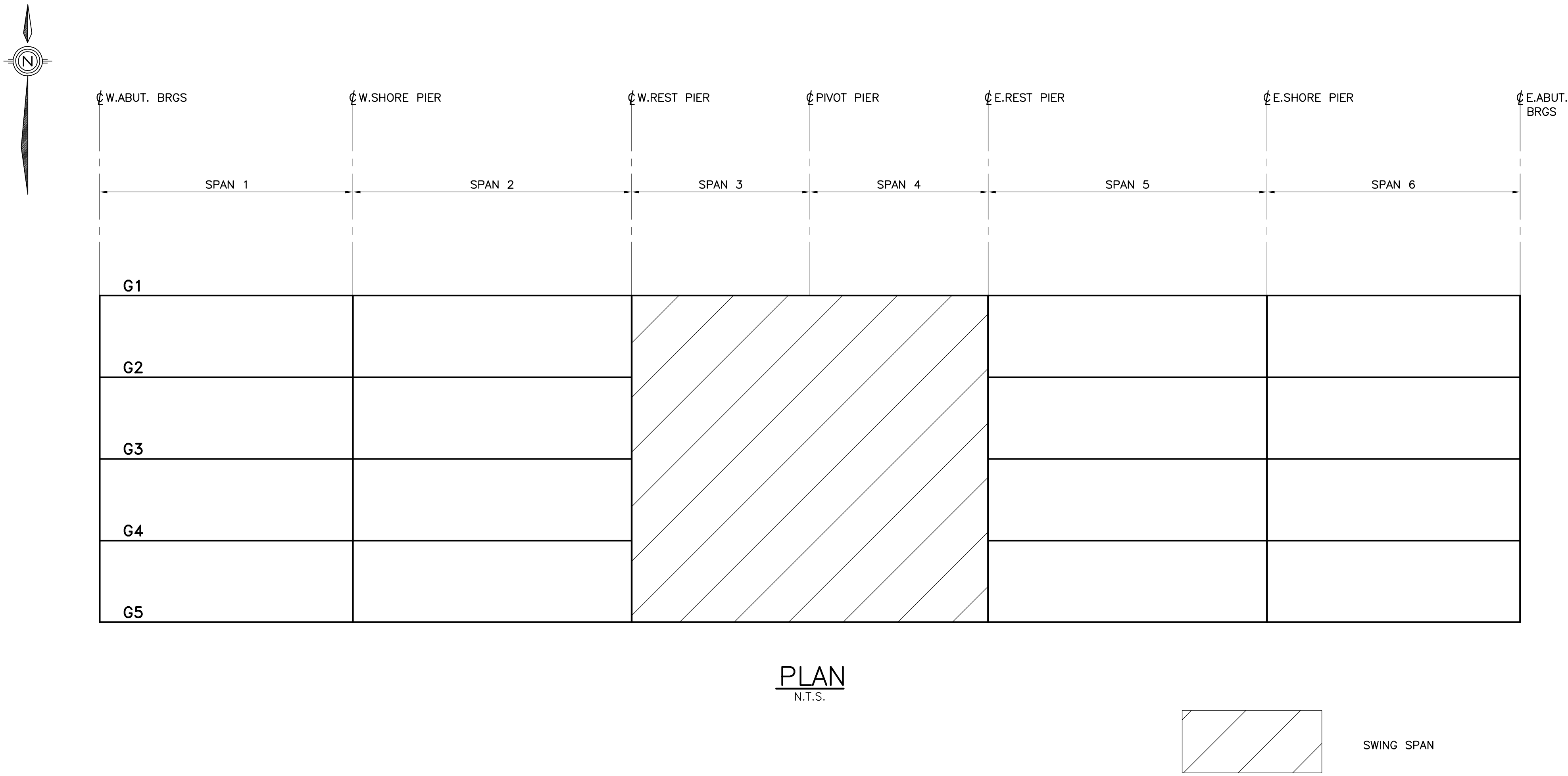
Located west of Wallaceburg, Ontario on the eastern boundary of the Walpole Island First Nation, the Walpole Island Swing Bridge connects Dufferin Avenue on the mainland to Tecumseh Road on the island. Constructed in 1968, the bridge carries two (2) lanes of traffic and two (2) sidewalks with aluminum railings over the Chenal Ecarte (Snye) River, a navigable waterway linking Lake Huron to Lake St. Clair. The structure also passes over Bridge Road, which runs parallel to the river along the west bank.

The bridge has an overall width of 11.887m (39ft), a roadway width of 8.534m (28ft), and an overall length of 156.058m (512ft). The bridge comprises a 66.446m (218ft) main swing span with four (4) fixed approach spans; two (2) at each end of the main swing span. The length of the approach spans adjacent to the abutments are 19.812m (65ft) and the length of the approach spans adjacent to the main swing span are 20.117m (66ft). Each approach span is comprised of an exposed latex modified concrete overlay on a concrete deck supported on five (5) steel girders and the main swing span is comprised of an asphalt wearing surface on a steel orthotropic deck that is supported by two (2) steel girders. The main swing span is capable of rotating clockwise 90° from a “closed” position to an “open” position about a centre pier.

The substructure consists of two (2) concrete abutments and five (5) concrete piers, all founded on steel piles. The first sets of piers beyond each abutment, supporting both spans, are referred to as “shore piers”. The second sets of piers beyond the abutment, supporting an approach span and the swing span, are referred to as “rest piers”. The centre pier supporting only the swing span is referred to as a “pivot pier”.

There are expansion joints in the deck present over the abutments, shore piers, and rest piers. Details describing the mechanical and electrical systems for the swing span are found in the report *Mechanical and Electrical Inspection and Condition Assessment of Walpole Island Swing Bridge* (April 2012) in Appendix D.

For the purpose of this report, the bridge is considered to be oriented in the west-east direction. The spans have been numbered from west (span 1) increasing to the east (span 6), as shown in Figure 1. For clarity and simplification, the main swing span has been divided into two (2) spans on either side of the pivot pier, thus resulting in a total of six (6) spans. The girders and bearings have been numbered from north increasing to the south and are distinguished according to the appropriate span.



PLAN
N.T.S.

McCORMICK RANKIN CORPORATION
A member of MMM GROUP

WALPOLE ISLAND SWING BRIDGE
BRIDGE ELEMENT NAMING SCHEME

DATE: APRIL 2012
DRAWING:
FIGURE 1

CAD FILE LOCATION AND NAME: S:\2011\32\3211121\SK-1.dwg   MODIFIED: 4/3/2012 11:39:24 AM BY: AWADC   DATE PLOTTED: 5/31/2012 4:42:08 PM BY: AWADC

3.2 Repair History

In 1981 work was performed on the bridge. This included overlaying the existing approach spans with a 38mm (1-½”) latex modified concrete overlay, building up all deck joints and the asphalt wearing surface on the main swing span to suit the new overlay, and repairing damaged areas of the curb face.

In 1994, a full replacement of the submarine cables required for bridge operation was completed.

In 2000, various structural and concrete repairs were completed.

In 2003, the entire structure was cleaned and recoated.

4. SUMMARY OF SIGNIFICANT FINDINGS (STRUCTURAL)

The material and performance condition rating comprises a numerical system in which a number from 1 to 6 (1 = very severe defects, 6 = new condition) is assigned to each component of the structure based upon the severity of the observed material defects or the ability of a component to perform its function within the structure. In addition to the condition rating, each defect is given a priority code indicative of the urgency and nature of the required repairs or need for more detailed inspection. This section of the report summarizes the condition ratings and priority codes for the various components of the Walpole Island Swing Bridge.

4.1 Waterways

The Chenal Ecarte (Snye) River is a straight navigable waterway with no defects noted. There are eight (8) protective dolphins in the waterway, four (4) upstream and four (4) downstream from the structure to help guide vessels. (See photographs 38, 39, and 138)

Underwater Inspection

A close-up visual inspection was completed of the entire submerged surface of the dolphins.

The dolphins were found to be in good condition, with large portions of its submerged sections covered with zebra mussels and algae. The dolphin north of the west rest pier had only one (1) band of wire above water, whereas all other dolphins had two (2) bands of wire. The dolphin north of the pivot pier was found to be leaning towards the pier, but its submerged section was found to be in good condition. The dolphin directly south of the pivot pier had a wide split that terminated at the waterline.

Further details of the underwater inspection can be found in the report *Walpole Island Bridge Inspection, Underwater Inspection* (ASI Group Ltd, May 2012) which has been included in Appendix J. A copy of the complete inspection video including voice recordings is also found in Appendix J.

The condition rating of the waterway is 5 and its priority code is D.

4.2 Embankments and Slope Protection

Embankments

Three (3) small gullies have formed below the northeast, northwest, and southwest corner deck drains on the front faces of the east and west embankments due to disintegrating splash pads. Additionally, the top 250 mm of the west abutment footing is exposed.

Both embankments generally appear to be stable with no evidence of settlement or loss of material from underneath of the foundations. (See photographs 40 and 43).

The condition rating of the embankments is 4 and their priority code is C due to the loss of embankment material on the front faces of the slopes.

Slope Protection

There is rock fill protecting the east abutment front face with approximately 10% loss of material near the centre. There is granular fill protecting the west abutment front face with two areas of erosion and approximately 5% loss of material, resulting from the poor performance of disintegrating asphalt splash pads below the deck drains. The northwest and southwest corner slopes are protected by grass, and the northeast and southeast slopes are protected by natural vegetation. All four (4) corner slopes are in good condition. (See photographs 40, 43, 47, and 48).

The condition rating of the slope protection is 4 and its priority code is M due to areas of erosion.

4.3 Substructure Components

Abutments

The east abutment is generally in good condition, however all four (4) drain pipes on the front face are plugged and corroded at the outlets. The west abutment was found to be in fair-to-good condition with eight (8) equally spaced full height medium vertical cracks and light honeycombing along the base. Similar to the east abutment, all four (4) drain pipes are plugged and corroded at the outlets. In addition, there are areas of delamination, spalling, and exposed corroded reinforcing steel bars on the south end of the bearing seat as well as the south end of the ballast wall. (See photographs 40-46, 49, and 50).

The condition rating of both abutments is 4 and their priority code is C, based on the delamination and spalling of the west abutment as well as the condition of the wall drains.

Piers

The east shore pier is generally in good condition having a medium crack with efflorescence staining near the north end of the bearing seat, concrete erosion on the north face at the waterline, and two (2) medium vertical cracks on the west face extending from waterline to approximately two thirds (2/3) of the height of the pier (See photographs 51-53).

The east rest pier is in fair-to-good condition. There is some spalling with exposed corroded reinforcing steel present on north face near the top of the pier. On the top of the pier, delaminated concrete was noted along the bottom of the maintenance access channel with a wide crack along the south wall of the maintenance access channel. East bearing pedestals 3, 4, and 5 (span 2) exhibit areas of delamination with wide cracks on all faces. The maintenance platform was noted to have a substandard railing height and localized medium corrosion along the railing and at the base of the ladder (See photographs 54-59).

The pivot pier is in good condition with localized areas of rust staining on the west face and a narrow to medium crack extending from the waterline up to approximately two thirds of the height of the east face (See photograph 60).

The west rest pier is in fair-to-good condition with random narrow cracking and three (3) areas of delamination on the east face, and concrete erosion on the south face at the waterline. West bearing pedestals 1 and 3 (span 5) exhibit severe spalling with up to 15% loss of bearing seat area, wide cracks, and exposed corroded reinforcing steel bars. The spalled concrete on the west pedestal 3 appears to be previous patch work that has failed. West bearing pedestals 4 and 5 (span 5) have some spalling, delamination, and wide cracks. Similar to the east rest pier, the maintenance platform has a substandard railing height and localized medium corrosion along the railing and at the base of the ladder (See photographs 61-70).

The maintenance platforms around the piers were noted to have substandard railing height at the rest and pivot piers.

Underwater Inspection

A close-up visual inspection was completed of the entire submerged surface of the west rest pier, pivot pier, east rest pier and east shore pier.

The west shore pier is generally in good condition, with the top 150 mm of its footing exposed on east side (See photographs 71 and 72).

Generally, the piers were found to be in good condition with localized scaling and minor spalls noted on some piers at the water line. No scour, erosion or exposed reinforcing steel was noted along the piers.

The sheet pile adjacent to the piers was found to be in good condition. All the piers were found to have large portions of its submerged sections covered with zebra mussels and algae.

Further details of the underwater inspection can be found in the report *Walpole Island Bridge Inspection, Underwater Inspection* (ASI Group Ltd, May 2012) which has been included in Appendix J. A copy of the complete inspection video including voice recordings is also found in Appendix J.

The overall condition rating of the piers is 3 and their priority code is B and C due to the condition of the bearing seats/pedestals, and the spalling and delamination present elsewhere, respectively.

4.4 Bearings

The bearings on both abutments were noted with some localized corrosion and coating failure (See photographs 73 and 81).

The east and west shore piers bearings have some areas of localized fretting corrosion and rusting on most bearings (See photographs 74 and 80).

At the east rest pier there is coating failure and rust staining on all bearings. All span 2 bearings have fretting corrosion and rust jacking. East bearing 4 (span 2) has severe fretting corrosion possibly restricting movement. The span 3 bearings exhibit corrosion on both base plates and some nuts (See photographs 75 and 76).

Similar to the east rest pier, the west rest pier span 4 bearings exhibit corrosion on both base plates. The span 5 west bearings exhibit some fretting corrosion and some rust jacking (See photographs 78 and 79).

The condition rating of the bearings is 4 and their priority code is C.

4.5 Joints

The expansion joints at the abutments and the shore piers are generally in fair condition with debris accumulation on the seals near the centres. The east abutment seal has settled near the centre (See photographs 31, 32, 36, and 37).

The joints at the rest piers do not have seals, due to the nature of the main swing span. Some corrosion was noted on the underside of the steel armouring (See photographs 33-35, 148, and 149).

Abrasion damage was noted on the armouring angles over the east rest pier (See photograph 147).

The condition rating of the joints is 4 and their priority code is C and M.

4.6 Superstructure Components

Steel Girders, Diaphragms, and Cross Bracings

Many areas of localized coating failure and corrosion were noted on the girder webs, bottom girder flanges, and lower cross bracing and diaphragm members. Sizes ranged from 400 mm x 750 mm to smaller areas of flaking (See photographs 92-97, 100-103, 111, 113-115, 118-121, and 129).

Many bird nests and guano (droppings) were noted throughout the interior girders which are recommended to be cleaned as part of routine maintenance (See photographs 96 and 97).

Impact damage and abrasion marks were noted on the bottom flanges of girders 1, 3, 4 and 5 of span 1 (See photographs 122-126). Furthermore on this span, deformation of the stiffener on girder 5 near the connection to east diaphragm was noted (See photographs 127 and 128). This deformation does not impact the structural integrity of the girders to carry applied loads. No immediate remedial action is required.

A potential crack was observed in the weld connection of the second (2nd) girder to the fifth (5th) transverse crossbeam from the east, of span 4. Due to limited accessibility, further investigation through the use of non-destructive testing such as Liquid Penetrant (LP) testing is recommended to verify the existence of the crack (See photograph 115).

The condition rating of the steel girders, diaphragms, and cross bracing is 5 and its priority codes are M and S due to the need for cleaning and additional investigations of the potential cracks, respectively.

4.7 Deck Components

Comments pertaining to the concrete and asphalt wearing surfaces, approaches, curbs and sidewalks are found in Section 4.13.

Concrete Deck Soffit (Spans 1, 2, 5, 6)

The interior soffit of spans 1, 2, 5 and 6 are generally in good condition with localized areas of delamination, spalling, and previously patched areas particularly near the girder haunches. Sizes of these areas are typically 150 mm x 100 mm or less, with two (2) areas that are larger.

The exterior soffits of these spans are in fair-to-good condition with approximately 5-10% of the area being delaminated or spalled with some exposed corroded reinforcing steel bars (See photographs 82-91). Sizes of these areas are typically 300 mm x 300 mm. There is evidence of patching throughout the exterior soffits as well.

The condition rating of the concrete deck soffit is 5 and its priority codes are C.

Orthotropic Deck (Spans 3, 4)

The soffit of the orthotropic steel deck of spans 3 and 4 have some small areas of corrosion on the longitudinal troughs near the deck drains and a deformed deck plate on the north side of the deck of span 3 (See photographs 104-110, 112, 116, and 117). There are also some areas of corrosion on the side plates below the sidewalk.

A potential crack on span 4 near a weld connecting the second (2^{nd}) cross beam from the pivot pier to the third (3^{rd}) trough from girder 1 was noted. Due to limited accessibility, further investigation with the use of non-destructive testing such as Liquid Penetrant (LP) testing is recommended to verify the existence of the crack (See photographs 98 and 99).

Light corrosion was noted throughout the length of the maintenance access tram rail.

The condition rating of the deck soffit is 5 and its priority codes are C, S.

Deck Drains

The deck drains are in fair-to-good condition. There is corrosion and some section loss on the outlets of the majority of drain pipes. Additionally, the drain pipes on spans 3 and 4 do not extend below the longitudinal troughs which is resulting in localized areas of corrosion forming on the troughs (See photographs 130 and 131). As per Clause 9.2.1 of the MTO Structural Manual, pipes should project 400 mm below the bottom flange of adjacent girders to prevent splash (provided adequate minimum vertical clearance requirement is still met).

The northeast, northwest, and southwest asphalt splash pads are disintegrating leading to the loss of embankment material, forming gullies (See photographs 40 and 43).

The condition rating of the deck drains is 4 and their priority code is C.

4.8 Traffic Railing System

The railing on the north and south side of the structure is an aluminum four (4) rail and post system 1330 mm in height from the top of the sidewalk. The railing currently does not conform to current standards and a discussion on this topic is included below.

There is a section approximately 3 m in length of abrasion damage on the south railing over the west rest pier. Impact damage was also noted on the south railing, just east of the pivot pier. Abrasion damage was noted on the north railing near the west abutment.

A loose anchor bolt on a post near the northeast corner of the structure was noted (See photograph 30). An anchor bolt is missing at the south railing post base near the east abutment (See Photograph 140).

As previously mentioned there are substandard connections to the approach SBGR at all four (4) corners (See photographs 12 and 13).

The condition rating of the railing is 4 and the priority code is B, M.

Sub-standard Railing

The existing railing on the north and south side of the bridge is sub-standard.

In Ontario, prior to introduction of the third (3rd) edition of Ontario Highway Bridge Design code (OHBDC) in 1993, bridge railings were designed to a static load given in the 1979 and 1983 editions of the OHBDC. With the introduction of third (3rd) edition of OHBDC bridge railing were required to conform to crash tested railing standards based on appropriate performance levels (PL1, PL2 & PL3) determined by site exposure index. These requirements were further strengthened by the implementation of Canadian Bridge Design Code (CHBDC) in 2000. CHBDC redefined the loadings for the design of railing anchorages and the deck cantilever.

The existing railing appears to be installed during the original construction in the late 1960. Original construction date of the railing predates the introduction of OHBDC in 1979 or CHBDC in 2000. Therefore, the existing railing does not comply with the either OHBDC or CHBDC requirements.

The MTO memo dated November 24, 2004 recommends railings that do not conform to any past (OHBDC) or present (CHBDC) crash tested standards shall be upgraded or replaced to meet the current standards at the same time when the deck is programmed for rehabilitation. Deck rehabilitation works includes patching or overlay, waterproofing and paving.

Despite the above recommendation by MTO, the following factors/issues should be taken in to account when determining the course of action:

- The existing railing was installed in 1968 were commonly used in that era of construction, especially for swing bridges. There are numerous bridges with similar railings that still remain is service in the province of Ontario and in North America;
- The existing railing on the bridge has performed satisfactorily to date, with minimal incidents, over the last four (4) decades. Only minor collision damages were noted at a couple of locations;

- It is possible to replace the railing, which meets current standard requirements, for the approach spans. The potential for replacing the railing over the swing spans will be investigated and confirmed during the next phase of design. However, we note that it may not be fully compliant with the currents standards;
- The existing sidewalks on both sides of the bridge effectively act as curb barrier (approximately 170 mm depth) to contain/re-direct the vehicle heading for an impact with the railings; and
- During our field investigations we observed a low volume of traffic crossing the bridge. This needs to be confirmed as part of the next phase of the work. It should be noted that present design code requirements have been developed for bridges with high traffic volumes. For bridges with low traffic volumes, these requirements are too stringent and consideration could be given to verify whether railings conforming to Low Volume Road Guidelines would apply. These design guidelines apply for bridges on roads with an average annual daily traffic (AADT), in both directions, of 400 or less.

Given the above considerations, it may not be justifiable to replace the railings on the bridge at this time.

4.9 Structural Steel Coatings

Many small localized areas of coating failure were noted throughout the structural steel. Coating failure accounted for less than 5% of the total surface areas of the structural steel. The girders were found to have areas of localized flaking and peeling predominately on the lower halves of webs and the top of the bottom flanges. The cross bracings at the piers and abutments have evidence of coating failure on the underside of most bottom members. The orthotropic deck has localized flaking and peeling of the coating at various areas on the bottom of deck as well as corrosion present in the vicinity of deck drains. The deck drains themselves have coating failure at outlets (See photographs 92-131).

The condition rating of the coatings is 5 and its priority code is B.

4.10 Signage

There are no hazard markers present at the four (4) corners of the bridge.

There should be two (2) “Danger - Do Not Anchor” signs present above the pivot pier on both the north and south sides. The sign on the south side is illegible, partially covered with black paint (See photograph 134). The sign at the north side near the pivot pier is missing; only the support brackets are attached to the railing (See photograph 146). The replacement of both the north and south facing signs is recommended.

There are two (2) low clearance signs on the exterior of the north and south span 1 girders which have been subjected to some vandalism although they are still legible (See photograph 132).

There is an advance low clearance sign north of the structure in fair condition with some discolouration (See photograph 133).

The condition rating of the signage is 4 and its priority code is B.

4.11 Utilities

There are five (5) light poles mounted on the north side of the structure which are in good condition (See photographs 2 and 3). It was also noted there are utility wires along the north side of each approach leading to the submarine cables running parallel to the structure.

A utility box was noted at the base of the southeast embankment. There are four (4) traffic control arms present; two (2) on each approach to stop traffic when the bridge is open (See photographs 135-137).

The condition rating of the utilities is 5 and its priority code is M.

4.12 Detailed Deck Condition Survey

General

The bridge deck condition survey was conducted in accordance with Appendix D of BIM. For the purpose of this report, the structure is assumed to run in the west-to-east direction and spans are numbered from 1 to 6. For example, “span 1” is the west most approach span. Drawing 1, in Appendix H, illustrates the general arrangement of the structure and labelling referenced throughout this report.

A total of six (6) sawn asphalt samples were extracted from the asphalt-riding surface over the orthotropic deck, and 14 concrete core samples were retrieved from the concrete deck. The sawn asphalt samples and core samples were subject to several qualitative and quantitative observations. These observations for the asphalt samples included the bond of the asphalt to the waterproofing, as well as the bond of the waterproofing to the deck. The concrete deck was inspected for any signs of deterioration such as delaminations, scaling, and cracks. A concrete cover survey was performed and asphalt thickness measurements were taken at the sawn sample locations.

The concrete curbs, sidewalks and approach slabs were also inspected.

All data compiled from the condition survey such as the deck condition survey forms, concrete core logs and photos, asphalt sawn sample log and photos, deck condition survey drawings, and concrete core laboratory testing results are found in Appendices E, F, G, H, and I, respectively, and are referenced throughout this report.

Orthotropic Deck (Bituminous Surface)

The orthotropic steel deck with asphalt wearing surface on spans 3 and 4 is generally in fair-to-good condition with medium and wide longitudinal, transverse, and random cracking. Longitudinal cracks were commonly found in the centre of the lanes between the wheel paths and along the edges of the wheel paths toward the curbs (See photographs 17-18). Transverse cracking was noted along the east and west rest piers. On the deck top there are a few sealed longitudinal cracks in the asphalt (See photographs 15-19).

The asphalt thickness at the location of the sawn asphalt samples ranged from 55 mm to 63 mm and averaged 61 mm. It appears as if some type of adhesive/bond coat was applied to the deck before placing the asphalt.

Figure 2 illustrates the composition of two (2) commonly found asphalt compositions found on orthotropic steel decks. The Contract Documents provided to MRC do not include details regarding the composition of the existing asphalt wearing surface over the orthotropic steel deck. Based on our field observations and measurements, it appears that mastic asphalt was likely laid on the structure, as shown in Figure 2a.

Overall, the bond of the asphalt to the steel deck was noted to be in fair-to-good condition. In five (5) out of the six (6) sawn sample locations, the bond of the asphalt to the steel deck was noted to be in good condition. One (1) of the samples was poorly bonded to the steel deck. The overlying asphalt transition at the rest piers (performed during 1981 rehabilitation) was found to be well bonded to the underlying existing asphalt.

No cracks or corrosion of the steel was noted on the orthotropic steel deck at the sample locations.

Locations of the sawn asphalt samples are shown in Drawings 2-5 of Appendix H.

The material condition rating of the asphalt wearing surface is 4, the performance condition rating is 5, and the priority code is C.

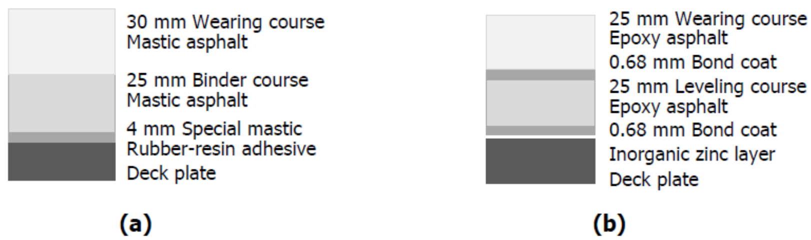


Figure 2 – Typical Component Layers: (a) Mastic Asphalt; and (b) Epoxy Asphalt.

Concrete Deck

Spans 1, 2, 5 and 6 consist of a reinforced concrete slab that has been resurfaced with latex modified concrete overlay and a concrete wearing surface. The concrete deck is generally in fair condition, with medium and wide longitudinal and transverse cracks. Previously repaired concrete areas were noted (See photographs 13, 14, and 19-23).

A concrete cover survey was performed using a 2.5 m x 3.0 m grid (transverse x longitudinal) grid. The readings from the survey ranged from 44 mm to 106 mm, with an average of 74 mm.

Examination of the 14 cores recovered from the bridge generally reveals that the original base concrete is of a light grey colour and more porous than the darker overlay material. The overlay was present on all cores and ranged in thickness from 45 mm to 100 mm. It was well bonded to the deck at all cores.

At all core locations, the concrete deck and overlay generally appeared to be in good condition. Six (6) of the 14 cores were noted to have numerous air voids throughout the sample.

Deck reinforcing steel was intercepted in four (4) out of the 14 cores. The reinforcing steel was generally found to be in good condition with some light corrosion of the reinforcing steel noted at Core 1.

Locations of core samples are included in Drawings 2-5 of Appendix H.

The condition rating of the deck is 4 and their priority code is C.

Curbs and Sidewalks

The curbs and sidewalks are generally in good condition with localized concrete spalling, medium transverse cracks and previous patchwork noted.

Spalled concrete with exposed corroded reinforcing steel was noted in two (2) locations: one (1) at the east end of the north sidewalk in span 2 (See Photograph 143), and another one (1) at the east end of the south sidewalk in span 1 (See Photograph 144).

The condition rating of the curbs and sidewalks is 5 and their priority code is C.

Approaches

New approach slabs were constructed in 1981. Both the east and the west approach asphalt wearing surfaces are generally in good condition with one (1) medium transverse crack on the east approach. Substandard end treatments and connections to the bridge were noted on the steel beam guiderail (SBGR) (See photographs 6-12).

The condition rating of the approaches is 5 and their priority code is D.

Core Testing

Physical testing of the concrete cores recovered from the bridge deck was conducted by Golder Associates Ltd. certified Material Laboratory in Whitby, Ontario. Testing includes the determination of chloride-ion content, hardened air-void system analysis, and compressive strength testing. The test reports are included in Appendix J and are summarized within the core sample logs in Appendix F.

Chloride-Ion Content

The chloride ion content of the deck was determined by testing three (3) core samples for acid soluble chloride ion content. The chloride content profile was measured from successive 10 mm thick slices to a depth of 90 mm. Testing procedures and review of the cores were in accordance with Cores for Total Soluble Chloride Ion Content, (MTO LS-417), and the *MTO Structure Rehabilitation Manual*.

The *Structure Rehabilitation Manual* states that a chloride content of 0.200% or greater by mass of cement is necessary to react with embedded steel and permit corrosion. For a typical cement factor of 300 kg/m^3 this corresponds to a chloride content of 0.025% by mass of concrete. In determining the chloride content profile, it is necessary to establish a background chloride content value. The value is taken as the lowest measured reading from all the cores to set a benchmark. This value represents the chloride content which may have already been in place at the time of construction, and does not contribute to the corrosion. The actual chloride content reading is subtracted by the background value to obtain a corrected measurement. For the Walpole Island Swing Bridge, two (2) backgrounds were established, one for the overlay and one for the original concrete below. The background chloride ion content for the overlay was 0.025% and was found in the 20-30 mm horizon depth of Core 3 for the overlay. The original concrete was found to have a background chloride ion content of 0.022 % and was found in the 60-70 mm horizon depth of Core 2.

Table 2 summarizes the chloride-ion content test at the depths in which the chloride-ion content provides an ideal environment for corrosive activity. Cover meter readings taken at concrete core samples are also listed in Table 2. The table below shows that the chloride ion content at the level of the reinforcing steel bars may be sufficient to cause corrosion of the reinforcing steel at one (1) of the three (3) locations tested (Core 3). Light corrosion was noted at one (1) of the cores where reinforcing steel had been exposed.

Table 2 – Chloride Ion Content Testing Summary

Core Sample Tested for Chloride Ion Content	Depth at Which Chloride Ion Content of 0.025 % is Exceeded*	Approximate Depth of Concrete Cover (mm)
Core 2	0 – 30 mm	58
Core 3	0 – 10, 60-70 mm	70
Core 13	-	70

** A chloride content of 0.025 % by mass of concrete is the minimum required to permit corrosion of embedded reinforcing steel.*

Hardened Air Void System Analysis

The *MTO Structure Rehabilitation Manual* classifies concrete as properly entrained with air if the following parameters are met:

- Air content > 3 %;
- Spacing factor < 0.20 mm; and,
- Specific surface > 24 mm^2/mm^3

Cores 4 and 10 were tested for hardened air void system parameters and the findings are summarized in Table 3.

Table 3 – Hardened Air Void System Analysis

Parameter	Core 4	Core 10	Remarks
Air Content	4.4 %	6.8 %	OK - Both cores > 3%
Spacing Factor	0.242 mm	0.314 mm	Does not meet requirements - Both cores > 0.20 mm
Specific Surface	21.03 mm^2/mm^3	13.35 mm^2/mm^3	Does not meet requirements - Both cores < 24.20 mm^2/mm^3

Based on the laboratory results, spacing factor and specific surface requirements for both core samples are not satisfied. These two (2) requirements are important in contributing to the effectiveness of air entrainment since the deck is frequently subjected to cycles of freezing and thawing in the presence of moisture or de-icing materials.

Compressive Strength Testing

Cores 8 and 11 were tested for compressive strength and were reported to have corrected compressive strengths of 57.6 and 45.2 MPa, respectively. The original Contract Drawings indicates a compressive strength of 27.5 MPa (4000 psi) for the bridge deck.

Corrosion Potential Survey

The corrosion potential readings are grouped into three ranges as follows:

- ***Low Range:*** If potentials over an area are numerically less than - 0.200 V, there is a greater than 90% probability that no reinforcing steel corrosion is occurring in that area at the time of measurement;
- ***Mid Range:*** If potentials over an area are within the range of - 0.200 V to - 0.350 V, corrosion activity of the reinforcing steel in that area is uncertain; and
- ***High Range:*** If potentials over an area are numerically greater than - 0.350 V, there is a greater than 90% probability that reinforcing steel corrosion is occurring in that area at the time of measurement.

The corrosion potential readings are presented in Appendix H and a summary of the findings are presented in Table 4. The findings suggest that approximately 11% of the reinforcing steel in the concrete deck has a greater than 90% probability of corrosion at the time of measurement. Roughly 31% of the bridge deck was reported to be in the uncertain corrosion activity range. The survey also reveals that approximately 58% of the concrete deck has a greater than 90% probability that the reinforcing steel is not undergoing corrosion is occurring at the time of measurement.

Table 4 - Corrosion Potential Reading Summary

Corrosion Potential (V)	% of Surveyed Deck Area
0 to -0.199	58
-0.200 to -0.350	31
Less than -0.350	11

The corrosion potential readings at Cores 2, 3, and 13 are within the low-medium corrosion potential range as well. However, as shown in Table 2, the chloride ion content of 0.025% is exceeded at the level of reinforcing steel for Core 3. This finding indicates that although low corrosion potentials were noted at Core 3 (-0.05V), conditions are suitable for corrosion to occur.

Corrosion potential results are shown in Drawings 6 and 7 of Appendix H. Contours are used to identify areas of low-, mid-, and high-range areas of corrosion potential.

4.14 Designated Substance Survey

The purpose of the designated substance survey was to identify and characterize materials that may contain hazardous substances; document the location, type, and current conditions of hazardous materials; and to assess the need for environmental management of these materials during future renovation work.

Based on the results of the investigation, hazardous materials were not identified in accessible areas of the Site. In general, materials were observed to be in good condition at the Walpole Island Swing Bridge. There was the potential for mercury, silica, and PCBs contained within materials. If future renovation activities should expose or affect the integrity of these building materials, confirmatory sampling should be conducted to identify management options.

Further details of the inspection can be found in the report *Designated Substance Survey* (Ecoplans, May 2012) which has been included in Appendix K. Condition ratings and priority codes are not applicable to these components.

4.15 Mechanical and Electrical Inspection

For a more detailed description of the mechanical and electrical components, refer to the report *Mechanical and Electrical Inspection and Condition Assessment of Walpole Island Swing Bridge* (Ameresco Consulting Incorporated, April 2012) which has been included in Appendix D. Condition ratings and priority codes are not applicable to these components, as stated in the introduction of the BIM.

<u>Mechanical</u>

The east and west rest pier wedge systems are in good condition, with only the wedge link mechanism and gear selector requiring some lubrication. The wedge drive gearbox is in good operation with a lack of lubrication noted on the bevel gears, mitre boxes, and chain transmission as well as a pushed out seal on the electrical motor. The centre span drive gearbox operated well but with signs of oil leakage. The centre span swing brakes are in poor condition, having been contaminated by leaking oil which is affecting the operators' ability to slow the span. The pivot bearing works well and is in good condition. A lack of lubrication was noted on the circular rack, pinion, and balance wheels on the pivot pier.

Electrical

Overall, the electrical components are in good condition. It was noted that the emergency generator should be relocated outside of the operating pulpit. All elements of the motor control centre are in very good condition; however, access to this enclosure should be restricted due to dangerous exposed electrical connections. The traffic lights used at either end of the bridge are in good condition, but do not meet current standards. The traffic gates are in poor condition with corrosion present on the housing. This is evidence that the arms have broken free and poor wiring exists.

4.16 Overall Ratings

Overall, based on the structural comprehensive detailed inspection, the current structural rating given and the current functional rating are both 4-5. These ratings do not apply to the mechanical and electrical components.

5. RECOMMENDATIONS FOR REPAIRS

Overall, the condition of the bridge structurally, mechanically, and electrically is fair-to-good. A recommended repair program and cost estimate has been developed to address the issues observed in the comprehensive detailed structural inspection, and the mechanical and electrical inspections. The cost estimates are in 2012 dollars with the assumption that all recommendations are incorporated into a single rehabilitation contract. Cost estimates do not take into account the costs associated with routine maintenance, such as light bulbs, signage, guiderails, deck sweeping, joint cleaning, and so on. Recommendations for the mechanical and electrical components are made in reference to the report *Mechanical and Electrical Inspection and Condition Assessment of Walpole Island Swing Bridge* (Ameresco Consulting Incorporated, April 2012) found in Appendix D.

The MTO Structural Rehabilitation Manual, dated April 2007, was used to as a guideline to interpret the information collected from the inspection, and select the most appropriate strategy to be used rehabilitation of the Walpole Island Swing Bridge.

A life cycle cost analysis (LCCA) of the rehabilitation alternatives was performed and results are discussed in this section. The financial analysis helps establish the most cost effective rehabilitation option over the next 50 years. As some repair/rehabilitation methods have different remaining service lives, the financial analysis considers options to allow components to deteriorate to the point where replacement is required.

The following recommendations are presented based on the findings of the structural inspection. Three (3) structural options are considered:

- Option 1 – Minimum Rehabilitation;
- Option 2 – Minimum Rehabilitation with Deck Overlay; and
- Option 3 – Major Rehabilitation.

<u>Option 1 – Minimum Rehabilitation</u>

This alternative is based on undertaking minor repairs that would postpone major capital expenditure for an estimated 15 years at which time the structure will require major rehabilitation, including the entire replacement of the concrete deck in the approach spans.

Minor rehabilitation of the existing structure, which MRC recommends be carried out within the next two (2) years, includes the followings:

- Seal all surface cracks on the approach (concrete) deck spans;

- Remove and replace the existing asphalt over the swings spans and waterproof the steel deck. The existing asphalt was placed in 1968 and the ends of the swing span were overlaid during the rehabilitation in 1981. The asphalt over the swing spans is nearing the end of its service life and therefore, should be replaced;
- Replace all spalled/deteriorated bearing pedestals;
- Remove and replace existing bearings;
- Zone (localized) cleaning and coating of failed structural steel coating;
- Repair impact damage to girder flanges and webs stiffener on span 1 by heat straightening the damaged steel;
- Repair all spalled/delaminated concrete on the deck soffit, fascia, abutments, piers, bearing pedestals, and sidewalk;
- Replace/extend the current deck drains to project 400 mm below the bottom flange of adjacent girders to prevent splash (provided adequate minimum vertical clearance requirement is still met);
- Replace the current sub-standard SBGR-to-approach connection detail to meet current specifications;
- Replace the current sub-standard railing on the maintenance access platforms at the rest and pivot piers to meet current specifications according to the Occupational Health and Safety Act and Regulations for Construction Projects (OHSA) including a minimum height of 900 mm;
- Backfill the gullies at the embankments and cover the exposed west abutment footing;
- Clean/remove debris and guano (bird dropping) buildup;
- Replace the "Danger – Do Not Anchor" signs on the north and south side of the pivot pier;
- Replace the two (2) low clearance signs on the exterior of the north and south span 1 girders;
- Replace expansion joint seals. The typical service life of expansion joint seals ranges between 5-15 years. The existing seals were installed in the 1990s and will require replacement to maintain long-term performance and durability of the bearings and substructure;
- Tighten/replace all loose anchor bolts on rail posts; and
- Repair the impact damage on the south traffic railing over the west rest pier.

The estimated cost for the structural rehabilitation noted above can be found below under "Summary of Capital Costs" in Table 5 and the results of the LCCA can be found below under "Life Cycle Cost Analysis Comparison" in Table 8. Preliminary General Arrangement Drawings of the abovementioned structural rehabilitation can be found in Appendix M.

Option 2 – Minimum Rehabilitation with Deck Overlay

This alternative involves scarifying the top 50 mm of existing concrete deck, which includes the removal of existing overlay and the upper portion of the existing deck, and placing a new layer of latex modified concrete on the existing bridge decks of the approach spans, in addition to the points listed within "Option 1 – Minimum Rehabilitation". The concrete overlay will not add additional dead load to the structure. MRC recommends this alternative be carried out within the next two (2) years.

A concrete overlay is considered as the following were revealed during our inspection of the concrete bridge deck:

- Approximately 11% of the reinforcing steel in the concrete deck has a greater than 90% probability of corrosion and patching of a large areas is not economical;
- One (1) of the three (3) cores tested has reached the threshold value for the chloride content at the level of the reinforcing steel;
- Approximately 16 m^2 of the concrete deck has undergone previous repairs. These areas were found to have higher corrosion potential readings that the 'non-repaired' portions of the deck and are likely to facilitate future chloride penetration to the reinforcing steel through the cold joints around the repaired areas. The elimination of the cold joints enhances the long-term performance and, durability of the bridge deck, and minimizes future rehabilitation and maintenance; and
- Various medium and wide cracks were noted on the concrete deck. A concrete overlay bridges existing cracks and impedes chloride penetration to lower levels.

Concrete overlays provide additional cover to the reinforcing steel and are well suited to lower the rate of corrosion due to the increased concrete cover and possible upward migration of chloride from the original concrete into the overlay.

Since the chloride content at the reinforcing steel level was not found to be very high (i.e. less than two (2) times threshold value; < 0.05%), this method seems appropriate as the original concrete in the deck does not warrant the removal of chloride contaminated concrete. Overlaying the superstructure bridges the existing medium and wide cracks found on the deck surface, and should extend the service life of the deck by approximately 25-30 years, at which time major rehabilitation would be required. Given that the deck is likely to be replaced in 25-30 years, conversion to semi-integral abutments is not recommended at this time due to the significant additional capital cost (approximately $125,000). However, approximately $30,000 - $40,000 will be required in 15 years for the replacement of the expansion joints.

The estimated cost for the structural rehabilitation noted above can be found below under "Summary of Capital Costs" in Table 6 and the results of the LCCA can be found below under "Life Cycle Cost Analysis Comparison" in Table 8. Preliminary General Arrangement Drawings of the abovementioned structural rehabilitation can be found in Appendix N.

Option 3 – Major Rehabilitation

Major rehabilitation of the existing structure, which MRC recommends be carried out in the next five (5) to ten (10) years, includes the followings in addition to the points listed in "Option 1 – Minimum Rehabilitation":

- Complete replacement of the concrete deck at all approach spans. The existing concrete deck at the approach spans is nearing the end of its service life and without intervention will likely require replacement in the near future. Typical service life of a concrete deck is in the region of 40-45 years;
- Convert the existing abutments to semi-integral abutments to enhance the performance and durability of the structure. The existing expansion joints are leaking, causing deterioration of the substructure components. The expansion joints could simply be replaced; however they would continue to permit leakage onto the substructure and be susceptible to premature failure, requiring additional maintenance/repairs over the life-span of the structure. Conversion to a semi-integral abutment arrangement is recommended to extend the service life of the substructure components and reduce the future maintenance costs associate with expansion joints;
- Consideration should be given during the rehabilitation design to eliminate the expansion joints over the piers by providing continuity. The leakage through expansion joints causes premature deterioration of the girder ends, as well as the substructure. In order to avoid this deterioration and to minimize long-term maintenance repairs, it would be desirable to eliminate the expansion joints over the piers by making the superstructure continuous over the land piers of the approach spans; and
- Consideration should be given to improve the sub-standard vertical clearance under span 1. This could be achieved by lowering the road profile, which will minimize the potential for future impact damage to the girder flanges.

The estimated cost for the structural rehabilitation noted above can be found below under "Summary of Capital Costs" in Table 7 and the results of the LCCA can be found below under "Life Cycle Cost Analysis Comparison" in Table 8. Preliminary General Arrangement Drawings of the abovementioned structural rehabilitation can be found in Appendix O.

Summary of Capital Costs

Cost estimates for the proposed works are calculated based on estimated unit cost prices and estimated quantities. The following shall be considered when reviewing the estimates:

- Estimates are based on the current level of evaluation and design completed by MRC and Ameresco Consulting Inc. to date;
- Estimated construction costs account for traffic control costs;
- Allowances for contingencies (15%) and engineering and construction administration (15%) are included in the estimates;
- Estimates do not account for any unforeseen conditions;
- Estimates are rounded to the nearest $1000;
- Costs associated with lowering of the road under span 1 (option 3) are not considered; and
- Prices are based on current 2012 dollars.

Appendix C contains details of the cost estimates for the two (2) proposed structural rehabilitation options. Appendix D contains details of the cost estimate for the mechanical and electrical components.

Table 5 - Summary of Estimated Capital Costs for Minimum Structural, Mechanical and Electrical Rehabilitation (Option 1)

Discipline	Estimated Construction Cost	Contingency (15%)	Subtotal Capital Cost	Engineering & CA* (15%)	Total Capital Cost
Structural	$ 950,000	$ 143,000	$ 1,093,000	$ 164,000	$ 1,257,000
Mechanical	$ 45,000	$ 7,000	$ 52,000	$ 8,000	$ 60,000
Electrical	$ 370,000	$ 56,000	$ 426,000	$ 64,000	$ 490,000

***CA – denotes contract administration** **TOTAL $ 1,807,000**

Table 6 - Summary of Estimated Capital Costs for Minimum Structural, Mechanical and Electrical Rehabilitation (Option 2)

Discipline	Estimated Construction Cost	Contingency (15%)	Subtotal Capital Cost	Engineering & CA* (15%)	Total Capital Cost
Structural	$ 1,080,000	$ 162,000	$ 1,242,000	$ 186,000	$ 1,428,000
Mechanical	$ 45,000	$ 7,000	$ 52,000	$ 8,000	$ 60,000
Electrical	$ 370,000	$ 56,000	$ 426,000	$ 64,000	$ 490,000

***CA – denotes contract administration** **TOTAL $ 1,978,000**

Table 7 - Summary of Estimated Capital Costs for Minimum Structural, Mechanical and Electrical Rehabilitation (Option 3)					
Discipline	**Estimated Construction Cost**	**Contingency (15%)**	**Subtotal Capital Cost**	**Engineering & CA* (15%)**	**Total Capital Cost**
Structural	$ 2,172,000	$ 326,000	$ 2,498,000	$ 375,000	$ 2,873,000
Mechanical	$ 45,000	$ 7,000	$ 52,000	$ 8,000	$ 60,000
Electrical	$ 370,000	$ 56,000	$ 426,000	$ 64,000	$ 490,000

***CA – denotes contract administration** **TOTAL** **$ 3,423,000**

Life Cycle Cost Analysis Comparison

The objective of this analysis was to identify the most economical of the renewal options for the Walpole Island Swing Bridge. Details of the life cycle cost analysis can be found in Appendix C. The following definitions, comments and assumptions should be noted when reviewing the analysis for the structure:

Effective Discount Rate

The discount rate is a percentage by which the value of a future cash flow is reduced for each time period the cash flow components diverge from the present. The selected rate can have a profound effect on the current value of future expenditures as a low rate will increase the current value of future spending, while a higher rate will lower its value.

For this study, a real discount rate of 0.859% was used based on our previous work recently undertaken for PWGSC. A life-cycle financial analysis over a 25 and 50-year planning horizon was conducted to determine the total net present value (NPV) of the cost for each evaluated option. The result of the analysis is presented below in present value terms using the discount rate of 0.859%. Costs are detailed in Appendix C.

Residual Values

Assessment of residual life is a difficult task and there are no specific methods to assess this. A thorough knowledge of the performance of the past rehabilitations and engineering judgement are utilized to assess the useful residual life. The existing bridge were built in 1968 and provided maintenance works are completed as required, it should last for another 50 years or longer.

Due to timing differences between the capital expenditures in the options developed and differential useful lives between the rehabilitation and full replacement solutions, residual values need to be determined and added at the end of the 25 or 50 year analysis periods. This ensures that the evaluation of the options is not skewed by large capital expenditures late in the time period of the analysis.

It was assumed that the design life of a new bridge is 75 years. Design life of other components such as concrete deck overlay, asphalt wearing surface and so on, are in accordance with clause C2.3.1 of CHBDC Commentary.

Residual values have been calculated by applying straight line depreciation to construction costs (including mobilization/demobilisation and traffic control, but excluding contingency, engineering & construction administration fees, and HST).

Sensitivity Analysis

A sensitivity analysis was undertaken to determine how changes in the discount rate impact the net present values for each option in the analysis. Two (2) scenarios are considered; scenario 1 and scenario 2 consider discount rates 1% and 2% higher than the base rate, respectively. Potential impacts identified through the sensitivity analysis are illustrated below.

Table 8 - Summary of Estimated Capital Cost and Life Cycle Cost Analysis Comparison of Renewal Options

Option	Capital Cost	Base Case				Sensitivity Analysis			
		Discounted		Undiscounted		Scenario (1)		Scenario (2)	
		Nominal Discount Rate				Nominal Discount Rate			
		3.683%		0%		4.683%		5.683%	
		25 y	50 y	25 y	50 y	25 y	50 y	25 y	50 y
1	$ 0.95	$ 2.08	$ 3.96	$ 2.16	$ 4.55	$ 1.99	$ 3.41	$ 1.90	$ 2.97
2	$ 1.08	$ 1.62	$ 3.53	$ 1.67	$ 4.09	$ 1.56	$ 3.03	$ 1.50	$ 2.62
3	$ 2.17	$ 2.46	$ 4.35	$ 2.46	$ 4.91	$ 2.44	$ 3.86	$ 2.42	$ 3.49

Note: All costs are in million dollars. Inflation = 2.8%.

Structural Recommendations

Based on the findings of the inspection and consideration of the LCCA, Option 2, "Minimum Rehabilitation with Deck Overlay", is recommended. This alternative extends the service life of the structure by approximately 30 years or so, at which time major rehabilitation will be required. Despite that Option 1 provides an approximately 10% lower capital cost, Option 2 provides more favourable LCCA results over a 50 year period.

Chlorides are a primary contributing cause of reinforcing steel corrosion. A concrete overlay provides additional cover to the reinforcing steel that will increase the number of years for the chlorides to diffuse down to the level of reinforcing steel and initiate corrosion. The elimination of the cold joint around previously repaired areas on the concrete deck enhances the long-term performance and durability of the bridge deck, and minimizes future rehabilitation and maintenance. Therefore, a new overlay should ensure that the reinforcing steel in the deck likely remains in fair-to-good condition until a second generation rehabilitation (i.e. major rehabilitation) is required.

It should be noted that this proposed alternative does not eliminate the existing expansion joints, which currently permits leakage onto the girder ends and substructure. Leakage through the joints will require additional maintenance/repairs over the life-span of the structure. Accurately depicting an engineering estimate for future maintenance/repairs of the substructure over the next 50 years is a challenging task based on the variety of factors influencing the work. Based on our engineering judgement, \$100,000/rehabilitation was assumed to repair the substructures in Options 1 and 2, while \$50,000/rehabilitation was allocated to repair the substructure in Option 3, as part of the LCCA.

Furthermore, it is recommended that consideration is given to lower the existing road profile of the road under span 1 in order to address the existing headroom (3.2 m posted). The capital cost estimate or LCCA do not include the costs associated with lowering of the road as the scope of work is to be confirmed by PWGSC.

In the event that lowering the profile of the road under span 1 is not considered desirable, consideration should be given to protect the structure by installing a crash protection ‘portal’ just north and south of the structure. The portal is intended to minimize impact to the bridge superstructure. The abovementioned estimated costs do not include price of the installing the portal.

Mechanical Recommendations

To ensure a continued operable condition, the following are mechanical recommendations for this bridge. The brake shoes and drums of the span swing drive should be replaced. Excessive grease should be removed from the wedges and centre pivot bearing, in addition to lubricating all other equipment as needed. The east side wedge drive coupling should be lubricated or replaced if damaged due to lack of lubrication. The wedge electrical drive motor bearings should be lubricated and sealed. Proper safety guards should be installed over the drive mechanisms of the bridge. Finally, all oil seals on the span drive gearbox should be replaced.

Electrical Recommendations

The following are the electrical recommendations for this bridge. The main electrical service components should be replaced. If it is to be placed in the same location, it should be housed inside a stainless steel enclosure with a minimum environmental rating of NEMA 4X. Owing to its age, lack of code compliance, and other health and safety concerns the emergency generator should be replaced by a packaged unit located outside of the tower. The motor control cabinet inside the operating pulpit is of vintage open architecture style, with lethal voltage existing at most of the exposed connections. Storage of keys should be removed from this cabinet, which should then be subsequently locked out only to be accessed by authorized and trained personnel wearing appropriate protection. Submarine cables should be checked annually for insulation integrity to track any degradation. The traffic control gates should be replaced with new units. Additionally, the traffic control lights should be replaced with proper, code compliant (red, amber, green) LED fixtures. There are missing junction box covers on the north face of the bridge, at the base of a lamp standard near the northwest corner of the bridge, and adjacent to the control tower entrance which should be replaced, regardless of whether they contain unused wiring or not. The conduits at the base of the control tower should be mechanically protected from vehicles in compliance with the 2009 ESA code. Furthermore, conduit repairs should be performed at the base of the southwest traffic light, inside the west expansion gap, and on the conduit running along the south side of the east approach. Finally, it is recommended that many of the lights on the bridge could be replaced by LED lamps, which would alleviate some of the maintenance issues surrounding lamp replacements.

6. 25 YEAR MANAGEMENT PLAN

A 25-year management plan for the Walpole Island Swing Bridge is presented in Table 9. The management plan has been developed based on the recommended repair program (Option 2 - Minimum Rehabilitation with Deck Overlay) and includes contingencies for construction (15%) and allowances for engineering and construction administration (15%). The proposed management plan calls for an outlay of funds in 2013 ($1,978,000).

If insufficient funds are available to PWGSC to proceed with the work in 2013, consideration could be given to deferring some of the work to 2014 and/or 2015.

Years 2014-2038 (inclusive) only account for contingencies for construction (15%); allowances for engineering and construction administration are not included.

Recoating of structural steel, replacement of expansion joint seals, and maintenance/repairs to the substructure has been assumed in the life cycle cost analysis in the 15^{th} year from the time of the proposed rehabilitation.

Engineering estimates do not include lowering the existing road profile under span 1 or routine maintenance costs such as maintenance of light fixtures and bulbs, signage, guiderails, anti-graffiti repairs, deck sweeping, clean-out of expansion joints, and similar maintenance items.

Description	Table 9 - 25 Year Management Plan for Walpole Island Swing Bridge (Costs in 2012 Dollars x 10^3; Construction Administration and Engineering fees are included only for year 2013)																								
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
Minimum Rehabilitation with Deck Overlay	1978																									
Remove and Replace Expansion Joint Seals																13										
Cleaning and Coating Structural Steel (all)																895										
Substructure Maintenance/Repairs																115										
Mechanical Maintenance		2.5	2.5	2.5	2.5	2.5	2.5	2.5	5	2.5	2.5	2.5	2.5	13	2.5	2.5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	67
Electrical Maintenance		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
General Structural Inspection		15				15				15				15				15				15				15
Comprehensive Inspection				60				60				60				60				60				60		
Underwater Inspection				20				20				20				20				20				20		
YEARLY COST	**1978**	**21**	**6**	**86**	**6**	**21**	**6**	**86**	**8.5**	**21**	**6**	**86**	**6**	**31.5**	**6**	**1109**	**8.5**	**21**	**6**	**86**	**6**	**21**	**6**	**86**	**6**	**85.5**

*** Note: Deck replacement will occur in year 2047.

Report Prepared By:

LICENSED PROFESSIONAL ENGINEER
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JULY 31/12
PROVINCE OF ONTARIO

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Project Engineer
Bridge Engineering

Report Reviewed and Approved By:

LICENSED PROFESSIONAL ENGINEER
S. JEYAGOBY
July 31, 2012
PROVINCE OF ONTARIO

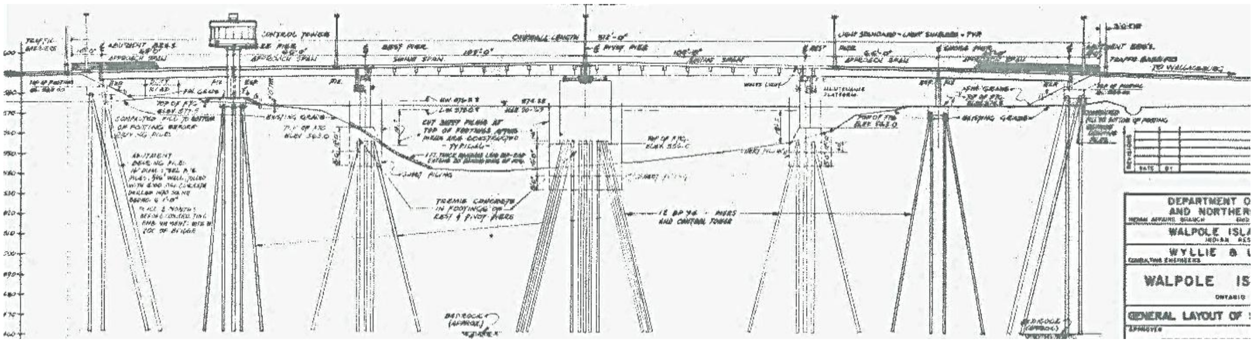
Goby Jeyagoby, P.Eng.
Senior Project Manager, Associate
Bridge Engineering

APPENDIX A

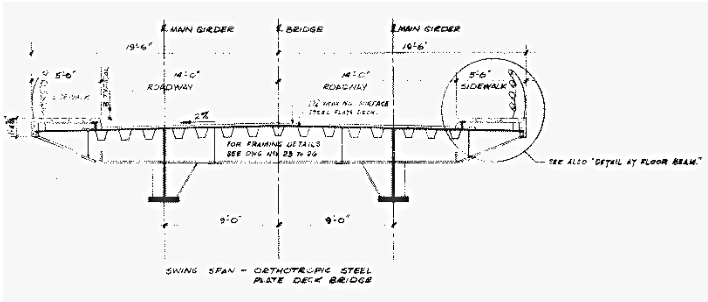
FIELD OBSERVATION RECORD FORMS (STRUCTURAL)

NAME: WALPOLE ISLAND SWING BRIDGE
LOCATION: WALPOLE ISLAND (DUFFERIN AVENUE/TECUMSEH ROAD)
YEAR CONSTRUCTED: 1968

SOUTH ELEVATION



SOUTH ELEVATION



SWING SPAN CROSS SECTION

NOTES:

1. Concrete abutments on spread footings.
2. Two concrete shore piers, two concrete rest piers, and one concrete pivot pier.
3. Concrete deck on five steel girders for two east and two west spans. Steel orthotropic deck on the two swing spans.

NAME: **WALPOLE ISLAND SWING BRIDGE**
LOCATION: **WALPOLE ISLAND (DUFFERIN AVENUE/TECUMSEH ROAD)**
YEAR CONSTRUCTED: **1968**
TYPE OF INSPECTION **Comprehensive Detailed Inspection**

Original Design:	Wyllie and Ufnal Limited		
Drawings Available:	Yes		
Previous Inspection Report Date:	Unavailable		
Author:	Unavailable		
Inspection Date:	December 13 - 15, 2011 & April 30 – May 1, 2012		
Inspector:	Agostino Monteleone, P. Eng. (MRC), Kyle Yusek, E.I.T. (MRC), Matthew Thomson, E.I.T (MRC)		
Temperature:	5°C (Dec 13), 3°C (Dec 14), 6°C (Dec 15) 7°C (April 30), 5°C (May 1)		
Weather:	Overcast (Dec 13), Rain (Dec 14), Rain (Dec 15) Rain (April 30), Overcast (May 1)		
Access Equipment:	Hydra-Platform, Motorized Boat (underwater inspection)		
Previous Overall Rating, Structural:	Unavailable	Current Overall Rating, Structural:	5
Previous Overall Rating, Functional:	Unavailable	Current Overall Rating, Functional:	5

Component Classification
Primary (P)
Secondary (S)
Auxiliary (A)

Condition Rating
A material and performance condition rating of 1 to 6 (1 = very severe defects, 6 = new condition). Figure 2.2 of the BIM is included on the following page as a reference for the condition rating of components.

Priority Codes
U - Urgent requires immediate attention and remedial measures to ensure public safety.
M - Required work to be done as part of routine annual maintenance.
S - Further study/investigations/surveys required prior to initiating repair programme.
A - Repair and/or replacement to be done in less than 1 year.
B - Repair and/or replacement to be done in less than 3 years.
C - Repairs and/or replacement to be done in less than 5 years.
D - Condition to be re-assessed at the next inspection.

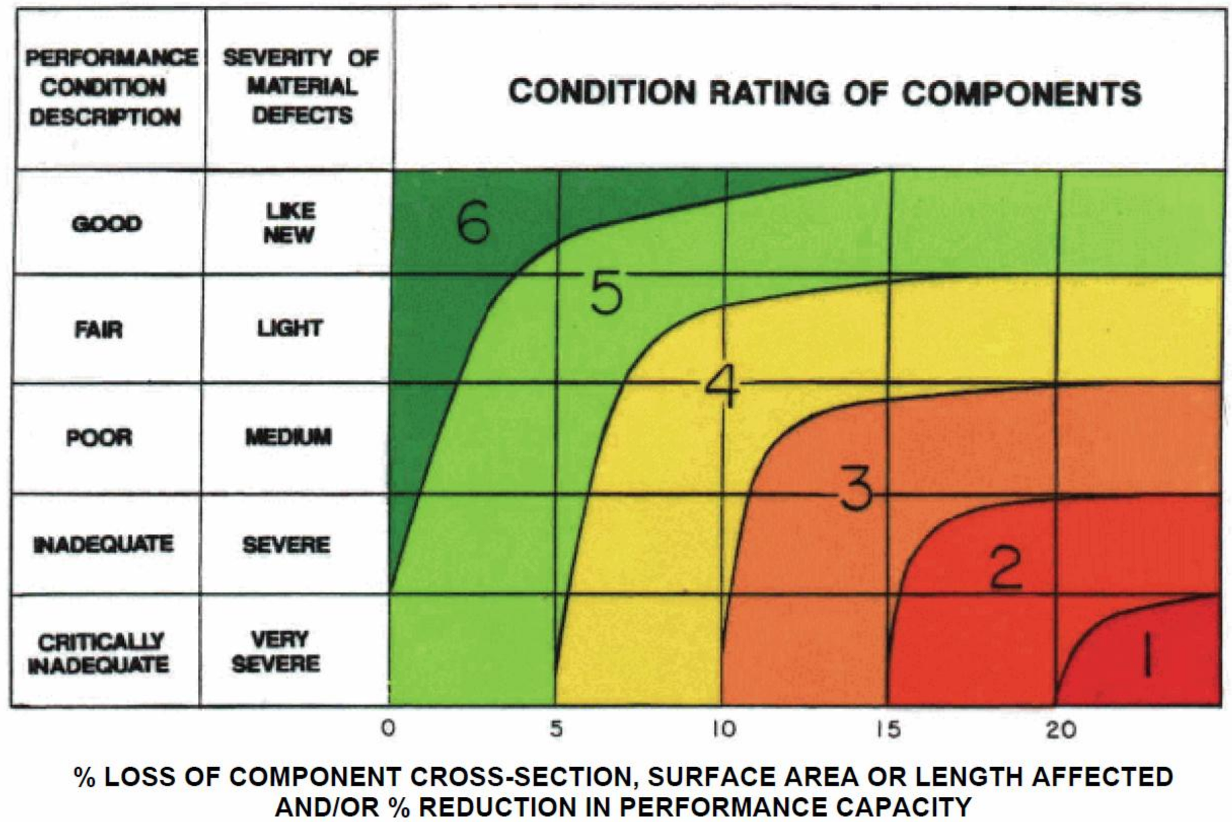


Figure 2.2 Condition Rating of Components

NAME:	**WALPOLE ISLAND SWING BRIDGE**
LOCATION:	**WALPOLE ISLAND (DUFFERIN AVENUE/TECUMSEH ROAD)**
YEAR CONSTRUCTED:	**1968**
TYPE OF INSPECTION	**Comprehensive Detailed Inspection**

ELEMENT	**OBSERVATION**	**CONDITION RATING**	**PRIORITY CODE**
WATERWAY: (P)	Straight navigable waterway with no significant defects noted. There are eight protective dolphins in the waterway, four upstream and four downstream from the structure that were generally found to be in good condition. Large portions of submerged sections covered with zebra mussels and algae. Dolphin north of west rest pier had only one (1) band of wire above water. Dolphin north of pivot pier found to be leaning towards pier. Dolphin south of pivot pier had a wide spit that terminates at waterline. (See photographs 38, 39, 138)	5	D
EMBANKMENTS: (P, S)	Three small gullies have eroded below the northeast, northwest, and southwest corner deck drains. The top 250mm of the west abutment footing is exposed. Both embankments generally appear to be stable. (See photographs 40, 43)	4	C
SLOPE PROTECTION: (A)	There is rock fill protecting the east abutment front face with approximately 10% loss of material near the centre. Granular fill is protecting the west abutment front face with two areas of erosion and approximately 5% loss of material. All four corner slopes are protected by vegetation in good condition. Four asphalt spillways on the embankments are disintegrating. (See photographs 40, 43, 47, 48)	4	M
ABUTMENTS: (P)	East abutment: Four drain pipes on the front face are plugged and corroded at outlets. West abutment: Eight vertical medium cracks equally spaced along the front face. Light honeycombing along width of the base. Delamination and spalling on the southwest corner of the bearing seat with exposed corroded reinforcing steel bars. Delamination and spalling at the south end of the ballast wall with exposed corroded reinforcing steel. Four drain pipes on the front face are plugged and corroded at outlets. The top 200mm of the footing is exposed. (See photographs 40-46, 49, 50).	4	C

NAME: WALPOLE ISLAND SWING BRIDGE
LOCATION: WALPOLE ISLAND (DUFFERIN AVENUE/TECUMSEH ROAD)
YEAR CONSTRUCTED: 1968
TYPE OF INSPECTION Comprehensive Detailed Inspection

ELEMENT	OBSERVATION	CONDITION RATING	PRIORITY CODE
PIERS: (P)	East Shore Pier: Medium crack with efflorescence near the north end of the bearing seat. Concrete erosion on the north face at the waterline. Two medium vertical cracks on the west face extending from waterline to 2/3 height. (See photographs 51-53). East Rest Pier: There is some spalling with exposed corroded rebar present on north face near the top of the pier. Delamination noted in access channel on top of pier. Wide crack along south wall of access channel on top of pier. Span 2 bearing 3, 4, 5 pedestals exhibit delamination and wide cracks. The maintenance platform has substandard railing height and localized medium corrosion along the railing and at the base of the ladder. (See photographs 54-59). Pivot Pier: Localized rust staining on the west face. Narrow to medium crack extending from waterline to 2/3 height on east face. (See photograph 60). West Rest Pier: Random narrow cracking on east face. Three areas of delamination on east face. Concrete erosion on south face at waterline. Span 5 bearing 1 and 3 pedestals have severe spalling, 15% loss of bearing seat area, and wide cracks. Span 5 bearing 4 and 5 pedestals have spalling, delamination, and wide cracks. The maintenance platform has substandard railing height and localized medium corrosion along the railing and at the base of the ladder. (See photographs 61-70) West Shore Pier: Good condition, with top 150mm of footing exposed on east side. (See photographs 71, 72).	3	B, C
BEARINGS: (S)	Abutments: Some localized rusting and coating failure. (See photographs 73, 81). East and West Shore Piers: Some areas of localized fretting corrosion and rusting on most bearings. (See photographs 74, 80). East Rest Pier: Coating failure and rust staining on all bearings. Span 2 all bearings have fretting corrosion and some rust jacking. Span 2 bearing 4 has severe fretting corrosion possibly restricting movement. Span 3 bearings exhibit corrosion on base plates and nuts. (See photographs 75, 76). West Rest Pier: Span 4 bearings exhibit corrosion on both base plates. All span 5 bearings exhibit some fretting corrosion and some rust jacking. (See photographs 78, 79).	4	C

NAME: WALPOLE ISLAND SWING BRIDGE
LOCATION: WALPOLE ISLAND (DUFFERIN AVENUE/TECUMSEH ROAD)
YEAR CONSTRUCTED: 1968
TYPE OF INSPECTION Comprehensive Detailed Inspection

ELEMENT	OBSERVATION	CONDITION RATING	PRIORITY CODE
JOINTS: (S)	The expansion joints at the abutments and the shore piers noted some debris accumulation on the seals near the centres. The east abutment seal has settled near the centre (See photographs 31, 32, 36, and 37). The joints at the rest piers do not have seals, due to the nature of the main swing span. Some rusting was noted on the underside of the steel armouring (See photographs 33-35, 148, and 149). Abrasion damage was noted on the armouring angles over the east rest pier (See photograph 147).	4	C, M
GIRDERS: (P)	Many small areas of localized light rusting, particularly near the bottoms of the webs and the tops of the bottom flanges. (See photographs 92-97, 100-103, 111, 113-115, 118-121, 129). Many bird nests throughout which should be cleaned. (See photographs 96, 97). Impact damage and abrasion marks on the bottom flanges of span 1 girders 1, 3, 4, 5. (See photographs 122-126). There is some deformation of the stiffener on span 1 girder 5 near the connection to the east diaphragm. (See photographs 127, 128). There is a possible crack in the weld connecting girder 2 to the fifth transverse cross beam from the east in span 3 requiring further investigation through the use of non-destructive testing (See photograph 115).	5	M, S
COATINGS: (A)	Many small areas of coating failure throughout; Girders - localized flaking and peeling on lower halves of webs, top of bottom flanges, less than 5%. Bracing - coating failure on the underside of most bottom members. Orthotropic deck - localized flaking and peeling on bottom of deck, and rusting present in the vicinity of deck drains, less than 5%. Deck drains - coating failure at outlets. (See photographs 92-131).	5	B

NAME: WALPOLE ISLAND SWING BRIDGE
LOCATION: WALPOLE ISLAND (DUFFERIN AVENUE/TECUMSEH ROAD)
YEAR CONSTRUCTED: 1968
TYPE OF INSPECTION Comprehensive Detailed Inspection

ELEMENT	OBSERVATION	CONDITION RATING	PRIORITY CODE
DECK SOFFIT: (P)	There is an exposed latex modified concrete overlay on the original concrete deck on spans 1, 2, 5, 6. On the interior soffit there are some small spalls and previously patched areas. On the exterior soffits there are many areas of delamination and spalling, some with exposed corroded reinforcing steel bars. Approximately 5-10% of the soffit is delaminated or spalled (See photographs 82-91). There is an orthotropic steel deck with asphalt wearing surface on spans 3, 4. On the soffit there are some small areas of rusting on the longitudinal troughs near the deck drains and a deformed side plate on the north side of the deck of span 4. (See photographs 104-110, 112, 116, 117). There is a potential crack near a weld on span 4 that will require further investigation due to limited access. (See photographs 98, 99).	5	C, S.
DECK (CONCRETE SURAFCE): (P)	There is an exposed latex modified concrete overlay on the original concrete deck on spans 1, 2, 5, 6. On these spans, medium and wide cracks and previously patched areas are noted. (See photographs 13, 14, 19-23). The deck condition survey revealed that 11% of the deck has a greater than 90% probability of corrosive activity.	4	C
DECK (ASPHALT SURAFCE): (P)	There is an orthotropic steel deck with asphalt wearing surface on spans 3, 4. On the deck top there are sealed longitudinal cracks in the asphalt. (See photographs 15-19). One (1) of the six (6) asphalt sawn samples extracted deck was poorly bonded to the steel deck. Asphalt was generally in good condition with medium and wide cracks noted.	5	C
DECK DRAINS: (A)	There is corrosion with some section loss on the outlets of the majority of drain pipes. The drain pipes on spans 3, 4 do not extend below the longitudinal troughs resulting in areas of rust forming on the troughs. (See photographs 130, 131). The northeast, northwest, and southwest asphalt splash pads are disintegrating, forming gullies in the embankments. (See photographs 40, 43).	4	C
CURBS AND SIDEWALKS: (P, S)	Generally sound. There are some patched areas. There is a spall on the north curb near the joint over the west rest pier. There are a few localized areas of rust staining. (See photographs 24, 25, 143, 144).	5	C

NAME: WALPOLE ISLAND SWING BRIDGE
LOCATION: WALPOLE ISLAND (DUFFERIN AVENUE/TECUMSEH ROAD)
YEAR CONSTRUCTED: 1968
TYPE OF INSPECTION Comprehensive Detailed Inspection

ELEMENT	OBSERVATION	CONDITION RATING	PRIORITY CODE
RAILINGS: (S)	Barrier railings are an aluminum four-rail and post system. Height = 1330mm. There is a 3 m length of impact on the south railing over the west rest pier. There is a loose anchor bolt on a post near the northeast corner of the structure. (See photographs 26-30). There are substandard connections to the approach SBGR. (See photograph 12, 13). A loose bolt was note at the base of the north and south railing post (See Photographs 141 and 140, respectively).	4	B, M
APPROACHES: (S)	Good sight distance. Asphalt wearing surface generally in good condition. There is one medium transverse crack on the east approach. There are substandard end treatments on the SBGR. (See photographs 6-12). The approach slabs were constructed in 1981.	5	D
UTILITIES: (A)	There are five light poles mounted on the north side of the structure. (See photographs 2, 3). Nearby, there are utility wires along the north side of the approaches, and a submarine cable parallel to the north side of the structure. There is a utility box at the base of the southeast embankment. There are traffic control arms present on both approaches. (See photographs 135-137).	5	M
SIGNAGE: (A)	There are no hazard markers present. There is a "Do Not Anchor" sign present above the pivot pier on both the north and south sides. (See photograph 134). There are two low clearance signs on the exterior of the north and south span 1 girders which have been subjected to some vandalism. (See photograph 132). There is an advance low clearance sign north of the structure. (See photograph 133). A sign at the north end near the pivot pier is missing; only the support brackets are attached the railing (See photograph 146). A new sign is required to reinstate the missing sign at the north end.	4	B

NOTE: P = Primary S = Secondary A = Auxiliary

RECOMMENDATIONS

NAME: WALPOLE ISLAND SWING BRIDGE
LOCATION: WALPOLE ISLAND (DUFFERIN AVENUE/TECUMSEH ROAD)
YEAR CONSTRUCTED: 1968
TYPE OF INSPECTION Comprehensive Detailed Inspection

Priority Code M – Required work to be done as part of routine annual maintenance

1. Girders: Clean bird nests and droppings.
2. Deck joints: Clean debris from joint seals at abutments and shore piers.
3. Slope protection: Construct/maintain spillways beneath deck drains.
4. Railings: Tighten/replace lose connection bolts.
5. Utilities: Tighten/replace lose connection bolts.

Priority Code S – Further studies/investigations required prior to initiating repair programme

1. Orthotropic Deck: Further investigation through non-destructive testing such as Liquid Penetrant (LP) testing of the potential crack at the bottom of the third longitudinal trough from the north girder in span 3 at second cross beam from the pivot pier.
2. Girders: Further investigation through non-destructive testing such as Liquid Penetrant (LP) testing of the potential crack at the weld connecting girder 2 to the sixth transverse cross beam from the east in span 4.

Priority Code B – Repair/replace in less than 3 years

1. Piers: Replace/repair bearing pedestals and seats. Install new railings on maintenance platforms and repair/replace ladders at rest and pivot piers.
2. Coatings: Localized (zone) coating on steel surfaces (including joint armouring and bearings) prior to further deterioration, as required.
3. Signage: Replace missing and damaged signs.
4. Railings Repair impact/abrasion damage.

Priority Code C – Repair/replace in less than 5 years

1. Abutments: Patch repair deteriorated concrete on west abutment bearing seat and ballast wall.
2. Deck Soffit: Patch repair deteriorated concrete on soffits.
3. Deck (Asphalt Surface): Replace asphalt wearing surface as it is nearing the end of its service life.
4. Deck (Concrete Surface): Remove and replace existing concrete overlay.
5. Deck drains: Repair/replace splash pads on embankments, recoat drain pipes, and extend drain pipes.
6. Curbs: Patch repair spalled areas as on curb.
7. Embankments: Place fill in gullies and over exposed footing.
8. Piers: Repair spalled and delaminated areas.
9. Bearings: Replace bearings.
10. Joints: Repair/replace damaged and corrosive areas.

Element	Previous MCR[1]	Previous PCR[2]	New MCR[1]	New PCR[2]	Comments
Primary Components					
Streams	N/A	N/A	5	5	No observed defects.
Embankments supporting foundations	N/A	N/A	4	5	Appears stable. Some loss of material on west embankment.
Foundations	N/A	N/A	5	5	No observed defects.
Abutment Walls	N/A	N/A	4	5	Cracks, delamination, spalling, plugged drains on abutments
Piers	N/A	N/A	3	4	5-10% loss of bearing seat area at two locations. Wide cracks, spalling, delamination on bearing pedestals
Beams, Girders	N/A	N/A	5	5	Some areas of coating failure and rusting
Floor Beams	N/A	N/A	5	5	Some areas of coating failure and rusting on cross beams on swing spans
Connections of primary components	N/A	N/A	5	5	No observed defects.
Decks	N/A	N/A	4	5	Delamination, spalling particularly on exterior soffits of spans 1, 2, 5, 6. Some rusting and coating failure on spans 3, 4
Wearing Surface	N/A	N/A	4	5	Medium and wide cracks noted. 11% of concrete deck likely undergoing corrosive activity.
Sidewalks accessible to traffic	N/A	N/A	5	5	No observed defects.
Structure steel coatings on primary components	N/A	N/A	5	5	Visible metal, rust, flaking, less than 5%.
Secondary Components					
Embankments not supporting foundations	N/A	N/A	5	5	Embankments at all four corners in good condition
Ballast Walls	N/A	N/A	4	5	Delamination and spalling on south end west ballast wall
Wingwalls	N/A	N/A	5	5	No observed defects
Bearing Seats	N/A	N/A	3	4	Wide cracks and delamination on most bearing pedestals on rest piers. Two locations of significant

[1] Material Condition Rating
[2] Performance Condition Rating

Element	Previous MCR[1]	Previous PCR[2]	New MCR[1]	New PCR[2]	Comments
					loss of bearing seat on west rest pier pedestals.
Joints	N/A	N/A	4	5	Some debris accumulation on seals and seal settlement. Some rusting of armouring at rest piers
Non-Load Bearing Diaphragms	N/A	N/A	5	5	Rust on the underside of bottom flanges of most diaphragms
Bracings	N/A	N/A	5	5	Rust on the underside of bottom flanges of most bracing at the piers
Connections of secondary components	N/A	N/A	5	5	No observed defects.
Curbs	N/A	N/A	5	5	Localized spalls noted.
Approaches	N/A	N/A	5	1	Steel beam guide rail connection to structure and end treatments are substandard
Approach Slabs	N/A	N/A	5	5	Medium transverse crack on east approach noted.
Railings	N/A	N/A	4	4	Minor impact damage and abrasion on south railing over bridge noted. Substandard railings at rest and pivot piers.
Structural Steel Coatings on Secondary Components	N/A	N/A	5	5	Visible metal, rust, flaking in many small areas including on bearings
Bearings	N/A	N/A	4	4	Localized fretting corrosion and coating failure.
Auxiliary Components					
Slope Protection	N/A	N/A	4	4	Loss of slope protection with minor erosion.
Deck Drains and Drainage Systems	N/A	N/A	4	4	Corrosion and some section loss at outlets of most drain pipes. Splash pads on embankments are deteriorating and forming gullies
Signs	N/A	N/A	4	4	No hazard markers present. Some vandalism to low clearance signs, although still legible. One (1) “Danger – Do Not Anchor” sign is illegible. One (1) sign is missing near pivot pier.

Element	Previous MCR[1]	Previous PCR[2]	New MCR[1]	New PCR[2]	Comments
Utilities	N/A	N/A	5	5	Five light poles on structure in good condition.

[1] Material Condition Rating
[2] Performance Condition Rating

APPENDIX B

SITE PHOTOGRAPHS (STRUCTURAL)

Photograph 1 - North elevation showing spans 2, 3, 4, 5 and 6 from the west

Photograph 2 - South elevation showing spans 2, 3, 4, 5 and 6 from the west

Photograph 3 - South elevation of span 1

Photograph 4 - South elevation of the control tower

Photograph 5 - North elevation of the control tower

Photograph 6 - East approach looking east

Photograph 7 - East approach looking west

Photograph 8 - West approach looking east

Photograph 9 - West approach looking west

Photograph 10 - Looking east from west approach slab

Photograph 11 - East approach slab wearing surface, note transverse crack

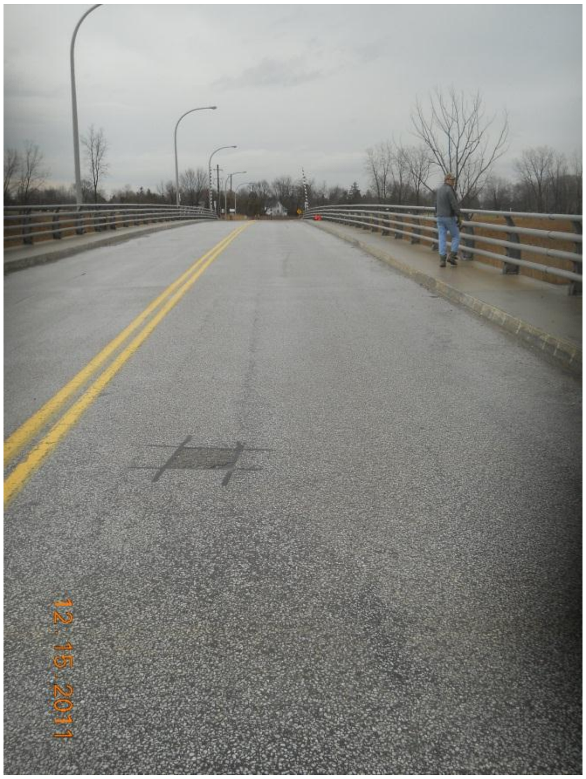
Photograph 12 - West approach slab wearing surface

Photograph 13 - Span 6 wearing surface looking east

Photograph 14 - Span 5 wearing surface looking west

Photograph 15 - Span 4 asphalt wearing surface looking east, eastbound lane

Photograph 16 - Span 4 asphalt wearing surface looking east, westbound lane, note patch



Photograph 17 - Span 3 asphalt wearing surface looking east, eastbound lane, note patch

Photograph 18 - Span 3 asphalt wearing surface looking east, westbound lane, note sealed crack

Photograph 19 - Span 2 wearing surface looking east

Photograph 20 - Span 1 wearing surface looking east

Photograph 21 - Typical span 1, 2, 5, 6 wearing surface

Photograph 22 - Span 2, note core hole and cracking

Photograph 23 - Span 1 concrete patches

Photograph 24 - North sidewalk looking west, typical condition

Photograph 25 - Spall on north curb at west rest pier

Photograph 26 - North railing looking west

Photograph 27 - South railing looking west

Photograph 28 - South railing, note impact damage above west rest pier

Photograph 29 - Typical railing and lamp post anchorages

Photograph 30 - Note loose bolt on railing post at northeast corner

Photograph 31 - West abutment expansion joint looking north, note some debris accumulation

Photograph 32 - West shore pier expansion joint looking north, note some debris accumulation

Photograph 33 - West rest pier joint looking north

Photograph 34 - East rest pier joint looking north

Photograph 35 - East rest pier underside of joint looking up from centre, note corrosion

Photograph 36 - East shore pier expansion joint looking north, note some debris accumulation

Photograph 37 - East abutment expansion joint looking north, note some debris accumulation

Photograph 38 - Looking north (upstream), note two of four protective dolphins. Note that the right dolphin is leaning towards structure.

Photograph 39 - Looking south (downstream), note three of four protective dolphins

Photograph 40 - East abutment

Photograph 41 - Northeast wingwall

Photograph 42 - Southeast wingwall

Photograph 43 - West abutment, note gullies and exposed concrete footing

Photograph 44 - Typical west abutment drain, note debris clogging drain

Photograph 45 - Northwest wingwall

Photograph 46 - Southwest wingwall

Photograph 47 - Northwest embankment

Photograph 48 - Southwest embankment

Photograph 49 - South end of west abutment, note spalling and delamination

Photograph 50 - South end of west abutment bearing seat, note spalling and delamination

Photograph 51 - West face of east shore pier, note vertical crack near centre

Photograph 52 - North end of bearing seat of east shore pier, note cracking and efflorescence

Photograph 53 - North end of east shore pier, note light concrete erosion at waterline

Photograph 54 - East face of east rest pier

Photograph 55 - Top of east rest pier looking north with swing span in open position

Photograph 56 - North face of east rest pier, note exposed corroded reinforcing steel bars

Photograph 57 - Top of east rest pier, note delamination

Photograph 58 - Top of east rest pier, note crack

Photograph 59 - Span 5 girder 3 bearing pedestal, note delamination

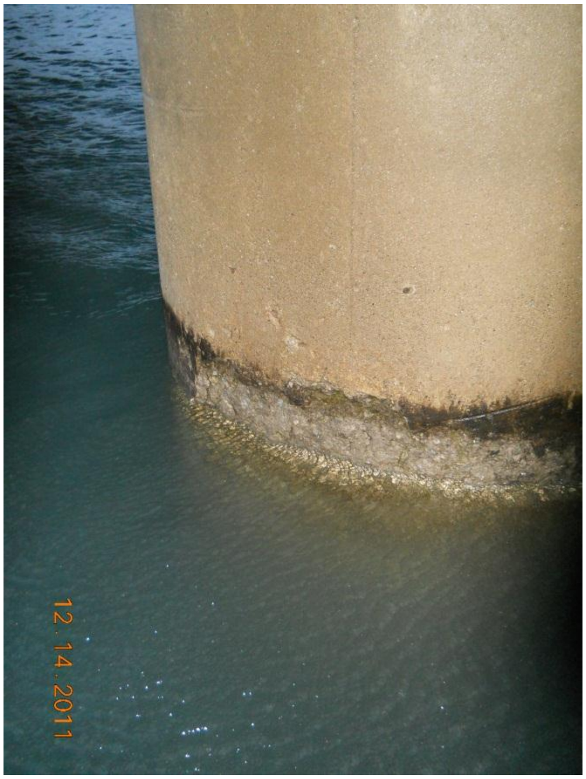
Photograph 60 - East face of pivot pier

Photograph 61 - East face of west rest pier, note random cracking

Photograph 62 - Top of west rest pier looking south with swing span in open position

Photograph 63 - North end of east face of west rest pier, note delamination

Photograph 64 - South end of east face of west rest pier, note delamination



Photograph 65 - South face of west rest pier, note concrete erosion at waterline

Photograph 66 - Top of west rest pier, note cracking and delamination

Photograph 67 - West rest pier, span 2 girder 1 bearing pedestal, note spalling and delamination

Photograph 68 - West rest pier, third bearing pedestal from north, note spalling

Photograph 69 - West rest pier, fourth bearing pedestal from north, note delamination and cracks

Photograph 70 - West rest pier, fifth bearing pedestal from north, note delamination and cracks

Photograph 71 - East face of west shore pier, note exposed footing

Photograph 72 - West face of west shore pier

Photograph 73 - East abutment bearing, fifth from north end, typical to others

Photograph 74 - Span 6 east shore pier bearings, first from north end, typical to others

Photograph 75 - Span 5 east rest pier bearing, second from north, typical to others

Photograph 76 - Span 4 east rest pier, south bearing, typical to other

Photograph 77 - Pivot pier, south live load relief bearing

Photograph 78 - Span 3 west rest pier, south bearing, typical to other

Photograph 79 - Span 2 west rest pier bearing, first from north, typical to others

Photograph 80 - Span 2 west shore pier bearing second from north end, note coating failure on bracing, typical to others

Photograph 81 - West abutment bearing second from north end, note typical coating breakdown

Photograph 82 - Soffit and girder 4, span 1 looking east

Photograph 83 - Soffit, span 6 south exterior, note delamination and exposed reinforcement

Photograph 84 - Soffit, span 5 looking west, typical condition

Photograph 85 - Fascia, span 4 north side, note delamination and cracking

Photograph 86 - Soffit, span 2, typical condition

Photograph 87 - Soffit, span 2 south exterior, note delamination and previous patching

Photograph 88 - Soffit, span 1, typical condition

Photograph 89 - Soffit, span 1, note spall near haunch at girder 4

Photograph 90 - Soffit, span 1 south exterior, note delamination and spalling

Photograph 91 - Soffit, span 1 south exterior, note delamination and exposed reinforcing steel

Photograph 92 - Bracing, east shore pier, note coating failure on bottom of bottom flange - typical of most bracing

Photograph 93 - Span 5, north exterior soffit and girder 1, note coating failure on bottom of web

Photograph 94 - Soffit and girder 1, span 5 looking west, note coating failure on bottom of web

Photograph 95 - Soffit and girders 4, 5, span 5 looking west

Photograph 96 - Diaphragm, span 4 near pivot pier, note localized areas of rusting

Photograph 97 - Transverse splice, span 4, typical

Photograph 98 - Longitudinal trough, span 4, third trough south of girder 1 east of transverse splice, note potential crack near weld

Photograph 99 - Longitudinal trough, span 4, third trough south of girder 1 east of transverse splice, note potential crack near weld

Photograph 100 - Span 4, girder 2 looking east, typical condition

Photograph 101 - Span 4, girder 1 looking east, typical condition

Photograph 102 - Span 4, typical connection of exterior cross beams

Photograph 103 - Span 4, exterior end of cross beam, typical condition

Photograph 104 - Span 4, coating failure and rusting on north side of north exterior longitudinal trough

Photograph 105 - Span 4, north exterior soffit looking west

Photograph 106 - Soffit, span 4 looking west

Photograph 107 - Soffit, span 4, typical steel orthotropic deck

Photograph 108 - Span 3, note coating failure on machinery beam

Photograph 109 - Soffit, span 3, note coating failure on bottom of troughs

Photograph 110 - Span 3, note rusting on bottom of rest pier wedge driveshaft

Photograph 111 - Span 3, south exterior soffit looking east

Photograph 112 - Soffit, span 3, typical condition

Photograph 113- Span 3, girder 1 looking west

Photograph 114 - Span 3, girder 2 looking west

Photograph 115 - Span 3, girder 2 at fifth cross beam from pivot pier, note potential crack in vertical weld (limited access during inspection prevented confirmation of crack)

Photograph 116 - Span 3, note coating failure on cross beam web

Photograph 117 - Span 3, note deformation in south exterior deck plate

Photograph 118 - Span 2, girder 3, note coating failure on web

Photograph 119 - Bracing, west shore pier, note coating failure on bottom member

Photograph 120 - Bracing, west shore pier, note coating failure on bottom member

Photograph 121 - Diaphragm, span 1 looking west, typical condition

Photograph 122 - Span 1 girders looking south, note impact damage

Photograph 123 - Span 1, girder 1, note impact damage

Photograph 124 - Span 1, girder 4, note impact damage

Photograph 125 - Span 1, girder 4, note impact damage

Photograph 126 - Span 1, girder 5, note impact damage

Photograph 127 - Span 1, diaphragm 2 connection to girder 5, note deformation of stiffener

Photograph 128 - Span 1, diaphragm 2, note rusting on bottom of member

Photograph 129 - Span 1, girder 5 exterior, note coating failure

Photograph 130 - Deck drain, typical for spans 1, 2, 5, 6, note corrosion at bottom. Deck drain does not extend far enough beyond girder bottom flange.

Photograph 131- Deck drain, typical for spans 3, 4, note drain does not extend below trough

Photograph 132 - Low clearance sign, south side of span 1, north side similar

Photograph 133 - Advance low clearance sign, north side of span 1

Photograph 134 - Danger sign over pivot pier north side. Typical on south side

Photograph 135 - Note utilities at the northeast corner

Photograph 136 - Note utilities at the northwest corner

Photograph 137 - Note utility box at southwest corner

Photograph 138 - Downstream protective dolphins

Photograph 139 – Typical guide rail at structure, note lack of connection between the guide rail and bridge barrier

Photograph 140 – South railing post, second from east abutment - Note missing bolt at base.

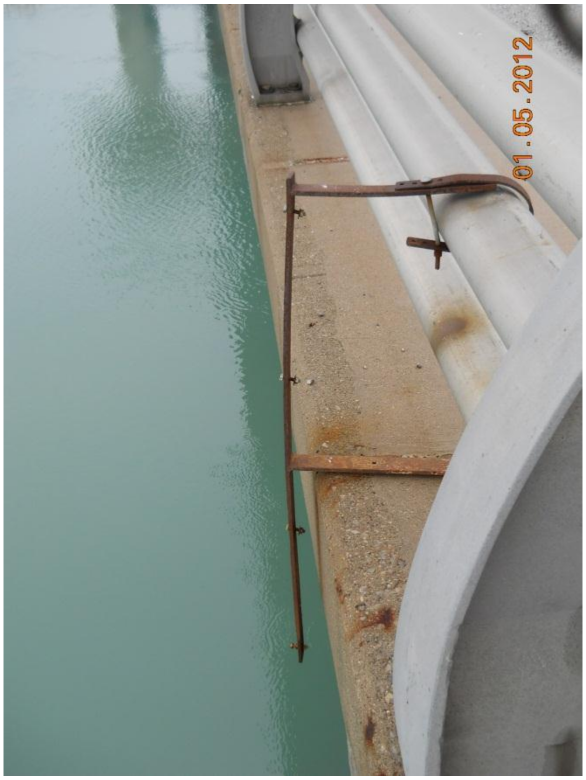
Photograph 141- North railing post, first from east abutment - Note loose bolt at base

Photograph 142 - Northwest approach SBGR - Note deformation near mid length.

Photograph 143 - North sidewalk, east end of span 2 - Note spall with exposed corroded reinforcing steel bar.

Photograph 144 - South sidewalk, east end of span 1 - Note spall with exposed corroded reinforcing steel bar.

Photograph 145 - North sidewalk near west end of span 1 - Note spall



Photograph 146 - Sign support bracket, south face of span 4 - Note missing sign.

Photograph 147 - Joint over east rest pier - Note abrasion damage to armouring angles.

Photograph 148 - Joint over east rest pier looking south - Note corrosion of armouring angles.

Photograph 149 - Joint over west rest pier looking south - Note corrosion of armouring angles.

APPENDIX C

DETAILED COST ESTIMATES AND LIFE CYCLE COST ANALYSES (STRUCTURAL)

Walpole Island Swing Bridge
Option 1 Minimum Rehabiliation

No.	ITEM	UNIT	QTY	UNIT COST	TOTAL COST
Option 1 - Minimum Rehabilitation					
1	Mobilization and Demobilization	LS	1	$100,000	$100,000
2	Access platform for various repairs	LS	1	$50,000	$50,000
3	Backfill gullies at embankments	m3	100	$25	$2,500
4	Remove & replace maintenance access platform railing	m	77	$200	$15,300
5	Concrete Removal - Partial Depth - Type B	m3	2	$6,000	$12,000
6	Concrete Removal - Partial Depth - Type C	m3	10	$3,500	$33,250
7	Extend deck drains	Ea	40	$250	$10,000
8	Remove and replace expansion joint seals	m	50	$220	$11,000
9	Concrete Patches - Form & Pump	m3	13	$7,000	$88,550
10	Concrete Patches - Prop Products	m3	0.3	$10,000	$3,000
11	Jack structure for bearing removal	LS	1.0	$100,000	$100,000
12	Remove existing bearing pedestals	m3	10	$1,500	$15,000
13	Remove existing bearings	Ea	40	$500	$20,000
14	New Bearings	Ea	44	$500	$22,000
15	Concrete bearing pedestals	m3	1.5	$2,500	$3,750
16	Crack repair - epoxy injection	m	35	$250	$8,750
17	Clean debris and guano buildup	LS	1	$5,000	$5,000
18	Localized (zone) cleaning and coating structural steel	m2	500	$400	$200,000
19	Remove asphalt wearing surface over steel deck	m2	575	$25	$14,375
20	Place asphalt wearing surface	m2	575	$225	$129,375
21	SBGR-to-approach connection	Ea	4	$2,500	$10,000
22	Repair impact damage (span 1)	LS	1	$15,000	$15,000
23	Replace signs	Ea	3	$400	$1,200
24	Repair impact damage on south barrier wall	m	3	$1,000	$3,000
SUBTOTAL					**$873,050**
20% Traffic Control or max $75,000					**$75,000**
SUBTOTAL CAPITAL COSTS (Excluding Contingencies)					**$948,050**

Definitions

Concrete Removal - Partial Depth - Type B: Typically applies to removals from the deck soffit and fascia of bridge decks; soffit of the top slab of culverts and tunnels; girders; diaphragms; outside face of concrete barrier walls and parapet walls.

Concrete Removal - Partial Depth - Type C: Typically applies to removals from abutments and wingwalls; pier columns and caps; bearing seat; retaining walls; vertical walls of culverts and tunnels. Type C also refers to concrete removals other than the ones specified for Type A or B.

Walpole Island Swing Bridge
Option 2 Minimum Rehabiliation with Deck Overlay

No.	ITEM	UNIT	QTY	UNIT COST	TOTAL COST
Option 2 - Overlay Rehabilitation					
1	Mobilization and Demobilization	LS	1	$100,000	$100,000
2	Access platform for various repairs	LS	1	$50,000	$50,000
3	Backfill gullies at embankments	m3	100	$25	$2,500
4	Remove & replace maintenance access platform railing	m	77	$200	$15,300
5	Concrete Removal - Partial Depth - Type B	m3	2	$6,000	$12,000
6	Concrete Removal - Partial Depth - Type C	m3	10	$3,500	$33,250
7	Extend deck drains	Ea	40	$250	$10,000
8	Remove and replace expansion joint seals	m	50	$220	$11,000
9	Concrete Patches - Form & Pump	m3	13	$7,000	$88,550
10	Concrete Patches - Prop Products	m3	0.3	$10,000	$3,000
11	Jack structure for bearing removal	LS	1.0	$100,000	$100,000
12	Remove existing bearing pedestals	m3	10	$1,500	$15,000
13	Remove existing bearings	Ea	40	$500	$20,000
14	Scarify existing concrete overlay	m2	685	$40	$27,400
15	Latex modified concrete overlay	m3	35	$1,800	$63,000
16	Concrete overlay (curing and finishing)	m2	685	$25	$17,125
17	New Bearings	Ea	44	$500	$22,000
18	Concrete bearing pedestals	m3	1.5	$2,500	$3,750
19	Crack repair - epoxy injection	m	35	$250	$8,750
20	Clean debris and guano buildup	LS	1	$5,000	$5,000
21	Localized (zone) cleaning and coating structural steel	m2	500	$400	$200,000
22	Remove asphalt wearing surface over steel deck	m2	575	$25	$14,375
23	Place asphalt wearing surface	m2	575	$225	$129,375
24	SBGR-to-approach connection	Ea	4	$2,500	$10,000
25	Repair impact damage (span 1)	LS	1	$15,000	$15,000
26	Replace signs	Ea	3	$400	$1,200
27	Repair impact damage on south barrier wall	m	3	$1,000	$3,000
SUBTOTAL					**$980,575**
20% Traffic Control or max $100,000					**$100,000**
SUBTOTAL CAPITAL COSTS (Excluding Contingencies)					**$1,080,575**

Definitions

Concrete Removal - Partial Depth - Type B: Typically applies to removals from the deck soffit and fascia of bridge decks; soffit of the top slab of culverts and tunnels; girders; diaphragms; outside face of concrete barrier walls and parapet walls.

Concrete Removal - Partial Depth - Type C: Typically applies to removals from abutments and wingwalls; pier columns and caps; bearing seat; retaining walls; vertical walls of culverts and tunnels. Type C also refers to concrete removals other than the ones specified for Type A or B.

Walpole Island Swing Bridge
Option 3 Major Rehabiliation

No.	ITEM	UNIT	QTY	UNIT COST	TOTAL COST
Option 3 - Major Rehabilitation					
1	Mobilization and Demobilization	LS	1	$100,000	$100,000
2	Access platform for various repairs	LS	1	$50,000	$50,000
3	Excavation for structure	m3	200	$50	$10,000
4	Granular A backfill for structure	m3	200	$50	$10,000
5	Backfill gullies at embankments	m3	100	$25	$2,500
6	Remove & replace maintenance access platform railing	m	76.5	$200	$15,300
7	Remove existing concrete deck	m3	185	$1,300	$240,500
8	Crack repair - epoxy injection	m3	40	$800	$32,000
9	Jack structure for bearing removal	LS	1	$100,000	$100,000
10	Remove existing sidewalk	m3	110	$800	$88,000
11	Remove existing asphalt	m2	575	$25	$14,375
12	Remove existing bearing pedestals	m3	10	$1,500	$15,000
13	Remove existing bearings	Ea	40	$500	$20,000
14	Remove existing abutment ballast wall (retain rebar)	m3	15	$1,500	$22,500
15	Remove, salvage and reinstall existing railing	m	320	$60	$19,200
16	Repair impact damage (span 1)	LS	1	$15,000	$15,000
17	Repair impact damage on south barrier wall	m	3	$1,000	$3,000
18	Crack repair - epoxy injection	m	35	$150	$5,250
19	Concrete Removal - Partial Depth - Type C	m3	9.5	$3,500	$33,250
20	Extend deck drains	Ea	40	$250	$10,000
21	Clean debris and guano buildup	LS	1	$5,000	$5,000
22	Localized (zone) cleaning and coating structural steel	m2	500	$400	$200,000
23	New Bearings	Ea	44	$500	$22,000
24	Place asphalt wearing surface	m2	575	$225	$129,375
25	Concrete in deck	m3	220	$2,000	$440,000
26	Concrete in sidewalk	m3	110	$1,500	$165,000
27	Concrete in approach slabs	m3	40	$2,000	$80,000
28	Concrete bearing pedestals	m3	1.5	$2,500	$3,750
29	Concrete in ballast wall (semi-integral abutment)	m3	18	$1,500	$27,000
30	Concrete Patches - Form & Pump	m3	9	$7,000	$63,000
31	Concrete Patches - Prop Products	m3	0.3	$10,000	$3,000
32	Dowels (bearing pedestals)	Ea	120	$50	$6,000
33	Steel girder rehab detail over shore pier (continuous)	LS	1	$30,000	$30,000
34	Reinforcing steel	t	8.1	$1,600	$12,960
35	Coated reinforcing steel	t	5.6	$3,200	$17,920
36	SBGR-to-approach connection	Ea	4	$2,500	$10,000
37	Replace signs	Ea	3	$400	$1,200
SUBTOTAL					**$2,022,080**
20% Traffic Control or max $150,000					**$150,000**
SUBTOTAL CAPITAL COSTS (Excluding Contingencies)					**$2,172,080**

Definitions

Concrete Removal - Partial Depth - Type B: Typically applies to removals from the deck soffit and fascia of bridge decks; soffit of the top slab of culverts and tunnels; girders; diaphragms; outside face of concrete barrier walls and parapet walls.

Concrete Removal - Partial Depth - Type C: Typically applies to removals from abutments and wingwalls; pier columns and caps; bearing seat; retaining walls; vertical walls of culverts and tunnels. Type C also refers to concrete removals other than the ones specified for Type A or B.

Walpole Island Swing Bridge LCCA - Alternative 1 (Minimum Rehabiliation)

		Costs (in 2012 dollars)
Year	**Cost Description**	**Costs (in 2012 dollars)**
1	Minimum Rehabiliation	$ 950,000
15	Replace concrete deck Semi-integral abutment converstion Expansion joint replacement Expansion joint seal replacement Structural steel coating (all) Misc substructure rehabiliation	$ 2,140,000
30	Expansion joint and seal Asphalt replacement Structural steel coating (all)	$ 1,225,000
45	Concrete overlay Bearing replacement Expansion joint and seal replacement Structural steel coating (all) Misc substructure rehabiliation	$ 1,150,000
25	Residual Value	$ 930,000
50	Residual Value	$ 915,000

Walpole Island Swing Bridge LCCA - Alternative 1
(Minimum Rehabiliation)

	Year																	
Cost Description	**1**	**2**	**3**	**4**	**5**	**15**	**#**	**20**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**40**	**45**	**50**
YEAR 1	$ 950,000																	
YEAR 15						$ 2,140,000												
YEAR 30														$ 1,225,000				
YEAR 45																	$ 1,150,000	
Residual value (25 yrs.)									$ (930,000)									
Residual value (50 yrs.)																		$ (915,000)
Total (25 yrs.)	**$ 950,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 2,140,000**		**$ -**	**$ (930,000)**									
Total (50 yrs.)	**$ 950,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 2,140,000**		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,225,000**	**$ -**	**$ -**	**$ 1,150,000**	**$ (915,000)**

NPV (25 yrs.): **-$2,082,995**
NPV (50 yrs.): **-$3,958,008**

Walpole Island Swing Bridge LCCA - Alternative 1 (Minimum Rehabiliation)

Inflation Rate: 2.800%
Real Discount Rate (Base Case): 0.859%
Real Discount Rate (Scenario 1): 1.832%
Real Discount Rate (Scenario 2): 2.804%

NPV SUMMARY (BASE CASE)					SENSITIVITY ANALYSIS (Change in Discount Rate)			
OPTION DESCRIPTION	Base Case				Scenario (1)		Scenario (2)	
	Discounted Costs		Undiscounted Costs		25 yrs	50 yrs	25 yrs	50 yrs
Costs (in 2012 dollars)	$ (2,082,995)	$ (3,958,008)	$ (2,160,000)	$ (4,550,000)	$ (1,991,119)	$ (3,412,378)	$ (1,898,173)	$ (2,973,401)

Walpole Island Swing Bridge LCCA - Alternative 2 (Minimum Rehabiliation with Deck Overlay)

Year	Cost Description	Costs (in 2012 dollars)
1	Minimum Rehabilitation Concrete Overlay	$ 1,080,000
15	Replace concrete deck Semi-integral abutment converstion Expansion joint replacement Expansion joint seal replacement Structural steel coating (all) Misc substructure rehabiliation	$ 900,000
30	Expansion joint and seal Asphalt replacement Structural steel coating (all)	$ 2,230,000
45	Concrete overlay Bearing replacement Expansion joint and seal replacement Structural steel coating (all) Misc substructure rehabiliation	$ 935,000
25	Residual Value	$ 310,000
50	Residual Value	$ 1,060,000

Walpole Island Swing Bridge LCCA - Alternative 2
(Minimum Rehabiliation with Deck Overlay)

	Year																	
Cost Description	1	2	3	4	5	15	#	20	25	26	27	28	29	30	31	40	45	50
YEAR 1	$ 1,080,000																	
YEAR 15						$ 900,000												
YEAR 30														$ 2,230,000				
YEAR 45																	$ 935,000	
Residual value (25 yrs.)									$ (310,000)									
Residual value (50 yrs.)																		$ (1,060,000)
Total (25 yrs.)	**$ 1,080,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 900,000**		**$ -**	**$ (310,000)**									
Total (50 yrs.)	**$ 1,080,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 900,000**		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 2,230,000**	**$ -**	**$ -**	**$ 935,000**	**$ (1,060,000)**

NPV (25 yrs.): **-$1,616,766**
NPV (50 yrs.): **-$3,532,898**

Walpole Island Swing Bridge LCCA - Alternative 2 (Minimum Rehabiliation with Deck Overlay)

Inflation Rate: 2.800%
Real Discount Rate (Base Case): 0.859%
Real Discount Rate (Scenario 1): 1.832%
Real Discount Rate (Scenario 2): 2.804%

NPV SUMMARY (BASE CASE)					SENSITIVITY ANALYSIS (Change in Discount Rate)			
OPTION DESCRIPTION	Base Case				Scenario (1)		Scenario (2)	
	Discounted Costs		Undiscounted Costs		25 yrs	50 yrs	25 yrs	50 yrs
Costs (in 2012 dollars)	$ (1,616,766)	$ (3,532,898)	$ (1,670,000)	$ (4,085,000)	$ (1,558,088)	$ (3,025,101)	$ (1,501,970)	$ (2,620,967)

Walpole Island Swing Bridge LCCA - Alternative 3 (Major Rehabiliation)

Costs (in 2012 dollars)

Year	Cost Description	Costs (in 2012 dollars)
1	Major Rehabiliation	$ 2,170,000
15	Structural steel coating Replace expansion joint seal (piers) Misc substructure rehabiliation	$ 985,000
30	Concrete overlay Expansion joint replacement (piers) Bearing replacement (piers) Structural steel coating Asphalt replacement Misc substructure rehabiliation	$ 1,335,000
45	Structral steel coating Expansion joint seal replacement (piers) Misc substructure rehabiliation	$ 1,085,000
25	Residual Value	$ 700,000
50	Residual Value	$ 670,000

Walpole Island Swing Bridge LCCA - Alternative 3
(Major Rehabiliation)

Cost Description	Year 1	2	3	4	5	15	20	25	26	27	28	29	30	31	40	45	50
YEAR 1	$ 2,170,000																
YEAR 15						$ 985,000											
YEAR 30													$ 1,335,000				
YEAR 45																$ 1,085,000	
Residual value (25 yrs.)								$ (700,000)									
Residual value (50 yrs.)																	$ (670,000)
Total (25 yrs.)	**$ 2,170,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 985,000**	**$ -**	**$ (700,000)**									
Total (50 yrs.)	**$ 2,170,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 985,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,335,000**	**$ -**	**$ -**	**$ 1,085,000**	**$ (670,000)**

NPV (25 yrs.): -$2,455,263
NPV (50 yrs.): -$4,352,307

Walpole Island Swing Bridge LCCA - Alternative 3 (Major Rehabiliation)

Inflation Rate: 2.800%
Real Discount Rate (Base Case): 0.859%
Real Discount Rate (Scenario 1): 1.832%
Real Discount Rate (Scenario 2): 2.804%

NPV SUMMARY (BASE CASE)					SENSITIVITY ANALYSIS (Change in Discount Rate)			
OPTION DESCRIPTION	Base Case				Scenario (1)		Scenario (2)	
	Discounted Costs		Undiscounted Costs		25 yrs	50 yrs	25 yrs	50 yrs
Costs (in 2012 dollars)	$ (2,455,263)	$ (4,352,307)	$ (2,455,000)	$ (4,905,000)	$ (2,442,134)	$ (3,864,680)	$ (2,419,139)	$ (3,488,045)

APPENDIX D

MECHANICAL AND ELECTRICAL INSPECTION REPORT

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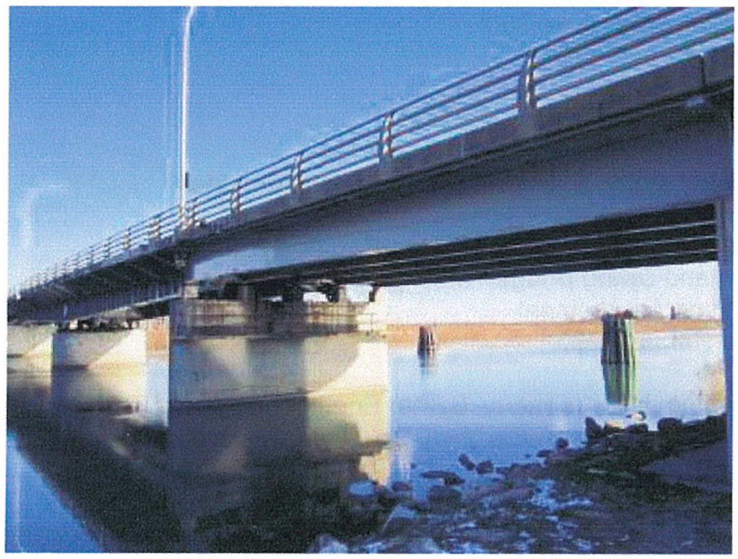
MECHANICAL AND ELECTRICAL INSPECTION AND CONDITION ASSESSMENT OF WALPOLE ISLAND SWING BRIDGE



WALPOLE ISLAND FIRST NATION PUBLIC WORKS
GD. STN. MAIN, WALLACEBURG, ONTARIO N8A 4L4

Submitted By:
Ameresco Consulting Inc.

July 2012

Reference No.: 211286

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July 9, 2012

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Mississauga, Ontario
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Attn: Mr. Goby Jeyagoby, P. Eng. – Senior Project Manager

Re: Walpole Island Swing Bridge - Mechanical and Electrical Inspection
And Condition Assessment
Ameresco Ref.: 211286

Ameresco Consulting Inc. (formerly Byrne Engineering Inc.) is pleased to submit for your information, our Final Report on the Walpole Island Swing Bridge – Mechanical and Electrical Inspection and Assessment.

If you have any questions on the following, please do not hesitate to contact the undersigned at extension 277.

LICENSED PROFESSIONAL ENGINEER
July 9/12
D. J. Crosthwaite
PROVINCE OF ONTARIO

Yours truly,

Daniel Crosthwaite P. Eng., MBA, PMP
Vice President Engineering

PS:jb

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Section 1 – Executive Summary

Ameresco Consulting Inc. (formerly Byrne Engineering Inc.) has conducted an investigation to examine the current condition of the mechanical and electrical elements of the Walpole Island Swing Bridge. The following report presents the findings of the inspection, recommended repairs and the associated estimate of engineering and construction costs.

The inspection was performed by Ameresco Consulting personnel on December 12, 2011 and included identifying areas of mechanical and electrical concern. These areas are documented in photographs attached in Appendix 1.

The mechanical inspection of the bridge has revealed a number of items requiring attention. Minor maintenance items such as lubrication of elements and removal of excess grease were noted. Major concerns were severe oil and grease contamination at the swing motor brakes, severe corrosion of the East and West Pier maintenance access platforms and the lack of lubrication point for wedge operating levers mechanism. A safety concern is the guarding of all machinery, which is to comply with Section 13.8.2 of the Canadian Highway Bridge Design Code.

Generally, the bridge is in very good condition electrically, particularly when the age of the bridge is considered. It appears preventative measures have been taken over the years to maintain the electrical system in good working order. The major electrical components have been built with a considerable level of redundancy. The major operating components, namely the wedge and rotate electrical systems, have 100% redundancy. There are duplicate motors and control components for both. There is even a redundant control transformer in the event of a failure.

The most prominent electrical safety concern is the ready access to the motor control cabinet inside the operating pulpit. It houses the protective devices, such as breakers, overloads and fuses. Modern control panels are generally built to be 'touch safe', making it difficult to inadvertently touch the live components within. In this case, the control cabinet is a vintage open architecture design which is comprised of exposed terminations. The voltage level at many of these exposed connections is lethal and as a result, access to this cabinet should be restricted to trained, authorized personnel, wearing appropriate protection. It was even noted that the inside of this cabinet is used for the storage of keys. These should be removed and stored elsewhere and a lock should be placed on the door of this cabinet to prevent cavalier access.

Concerns were expressed regarding the current location of the emergency generator. It is located inside the operating pulpit and represents a considerable noise and emission hazard to operating personnel; present day codes would not permit this. This, along with the age of the generator, warrants consideration for replacement. The new unit could be purchased as a packaged unit inside of a weatherproof, sound attenuated enclosure and could be located near the base of the control tower.

Operationally, the most prominent electrical concerns are the condition of the main electrical service and the condition of the traffic gates. In addition to replacement of the traffic gates, we have also recommended replacement of the traffic lights to a code compliant regular (red, amber, green) style fixture.

Mechanical and electrical repairs to the bridge components will be required to ensure safe operation of the movable structure. Full details of the recommendations are given in the body of this report, as well as the costs associated with the recommended mechanical and structural remediation. A detailed breakdown is located in Appendix 2.

The estimated total cost is $411,000.00 which includes the following items:

- General mechanical maintenance items such as cleaning and lubrication of various elements
- Replace the East and West Pier maintenance access platforms and supports
- Review the guarding of all machinery, as per Section 13.8.2 of the Canadian Highway Bridge Design Code, and install suitable guards as necessary
- Replace the brake shoes and drums of the Span Swing Drive
- Clean out the drain holes on the center pier of bird guano
- Open up the East Side wedge drive coupling and perform an inspection. If damaged due to lack of lubrication, replace the complete coupling. If the coupling is considered to be in serviceable condition, apply proper lubrication as required
- Corrosion removal and repainting of wedge bases
- Wedge electrical motor bearing lubrication and sealing
- Replacement of oil seals on span drive gearbox
- Check submarine cable by meggering
- Replace main electrical service
- Replace the emergency generator with an externally mounted unit inside a weatherproof sound attenuated enclosure
- Replace the existing aging traffic gates
- Miscellaneous conduit repairs, install missing cover plates
- Protection of conduits at the base of the control tower
- Replace traffic lights with code compliant fixtures

We conclude that the Walpole Island Swing Bridge is in good operable condition. However, mechanical and electrical repairs are required to extend the life and serviceability of the structure. Details of the recommendations are outlined in the report.

Section 2 – Introduction

2.1 Report Purpose

The report begins with a Bridge Description Section covering the physical description of the bridge components: overall design, mechanical, electrical power and control and bridge operations.

The Bridge Mechanical and Electrical Inspection Section presents the inspections that were carried out, problems that were found with the components, as well as indicating where further investigation is required. This is followed by the Assessment of Findings Section.

The report concludes with a Conclusions and Recommendations Section regarding the current state of the bridge and recommended next steps.

Throughout the report, reference is made to Photographs. Photographs from the inspection (1 through 44) are in Appendix 1. A summary of the estimated costs for work recommended is included in Appendix 2.

The Walpole Island Swing Bridge is a three section structure over the Channel Ecarte, a navigable waterway that links Lake Huron to Lake St. Clair. The bridge connects the mainland on the East end to the West side of Walpole Island and allows pleasure and commercial watercraft access to the waterway.

The bridge consists of three spans. The centre movable span is constructed of a steel support structure with a steel orthotropic deck and rotates about a center pivot pier. In the closed position the movable span rests on the East and West rest piers. The center section joins two fixed approach spans at the East and West ends of the bridge which are constructed of a steel support system with a concrete deck. The bridge was originally constructed in 1968 / 1969 and is therefore 43 years old.

The inspections were conducted to examine the bridges current condition of the mechanical and electrical components, as well as to identify any areas of concern that may require immediate attention, or that should be scheduled for repair or replacement in the foreseeable future.

The purpose of this report is to present the current condition of the bridges mechanical and electrical elements, as examined during the inspection conducted by Ameresco Consulting personnel. Recommended repairs and rehabilitation measures have also been determined and are outlined in the report. The report also presents the associated engineering and construction cost estimates.

Section 3 – Bridge Description

3.1 General

The bridge consists of a 218'-0" long main swing span and two fixed approach spans. The main swing span is constructed of two steel plate girders, transverse steel girders and frames, concrete sidewalks, and a steel orthotropic deck with an asphalt driving surface. Balance of the swing span in the open position is maintained by the structural and mechanical systems being virtually symmetrical about the center pivot. The fixed approach spans consist of a concrete deck and sidewalks supported by five steel plate girders and transverse steel diaphragms.

The center section of the bridge rotates about a center pivot pier. The ends of the movable span mate with the two fixed approach spans at the East and West rest piers. The fixed spans are supported at the rest piers, shore piers and abutments.

In the closed position, the swing span is supported on four end wedges at the rest piers and two live load bearings at the pivot pier. In opening the swing span, the wedges are withdrawn so that the dead load of the span is carried by the center pivot. Eight balance wheels resist the unbalanced dead load and any wind, snow or ice loads. The swing span is opened by driving two bull pinions attached to the bridge structure on a circular gear track fixed to the pivot pier. Power for the opening operation is provided by one of two 10 HP motors, which are connected to the bull pinions through a suitable gear reduction unit.

Operator control of the bridge is provided in a control room at the top level of a control tower, located on the West shore at the South side of the fixed approach span. Interlocking is provided with a road signaling system and traffic gates to eliminate improper sequencing. Bypass switches, which require breaking a seal before operation, are provided for each of the interlocks; with each interlock having an indicating light for condition monitoring.

Entry to the center and rest piers is by way of manholes in the South sidewalk. The bridge is regularly opened and operates year round.

3.2 Mechanical Components

All mechanical systems associated with the operation of the bridge are located on the swing span structure. Two wedge drive motors, gearbox and associated brakes are located at the center pivot pier. Wedge drive mechanisms are located at the West and East ends of the swing span. These mechanisms are operated by means of drive shafts extending from the central pier gearbox.

3.2.2 Wedge Blocks and Drive

When engaged, wedge blocks located at the rest piers raise the span to mate with the fixed approach spans (**PHOTOGRAPHS 1, 2, 5 and 12**). Centering devices form part of the wedge mechanisms and cause the bridge to be positively centered when the wedges are driven. When the wedges are withdrawn, the swing span structure drops approximately 4 inches so that the load is carried on the pivot bearing at the center pivot pier. The wedges are driven through shafts from the central pier where the motors and the gearbox are located.

Wedge driving motors are 10 hp. 550 volts, 60 cycle, 690 R.P.M. Squirrel cage units with Stearns disk brakes mounted at the non—drive ends. The brake rating is 25 ft. lb. The wedge drive gear reducer is a double reduction, helical gear unit with a ratio of 38.57 to 1 and has double shaft extensions on the output and input sides. Output extensions connect through split clamp couplings to the longitudinal shafts leading to each end of the bridge.

3.2.2 Wedge Drive Mechanism

Input extensions connect through gear type flexible couplings to the wedge drive motors (**PHOTOGRAPH 24**). Speed reduction for the end wedge operating mechanism is achieved by two pairs of bevel gears (**PHOTOGRAPHS 4, 8**), one pair of spur gears and a pinion gear. The last gear (**PHOTOGRAPH 7**) is connected directly to wedge struts which transmit motion directly to the wedges. The wedge struts also serve to lock the wedge in the fully driven position.

The centering device at the West end of the swing span brings the span, when closing, into accurate alignment with the pier members. Actuation of the device is combined with the end wedge drive. The centering operation occurs during the early part of the end wedge driving cycle. Limit switches are provided to control bridge swing, wedge drive and centering.

Power supply for the bridge machinery, control light and signal circuits are contained in a flexible looping cable between the pivot pier and the bridge machinery (**PHOTOGRAPH 18**). The looping cable is suspended on trolleys which roll in a circular track under the bridge about the center pivot. The looping cable assembly consists of 11 multi conductor cables.

3.2.3 Swing Circular Rack and Drives

The center pivot is the main bearing supporting the swing span during the rotation (**PHOTOGRAPH 18**). It consists of a bronze lens which floats freely between two hardened steel disks. This allows for rotation about a vertical axis as well as a slight rocking motion. The bearing is lubricated by an oil bath, and a closure ring excludes the entry of dirt and moisture. Eight balance wheels limit the out—of—balance motion by bearing against a cast steel circular track which is anchored to the pivot pier (**PHOTOGRAPH 13, 26**).

Two drive motors, a gearbox and associated brakes are also located at the center of the swing span (**PHOTOGRAPH 36**). Two bull pinions are driven via a bevel gear set from the gearbox (**PHOTOGRAPH 22, 31**). These pinions engage a circular rack attached to the pivot pier to cause a bridge slewing motion. When the wedges are withdrawn, the load is transferred to the pivot pier bearing, and the balance wheels running on a circular track adjacent to the swing rack are used to support out-of-balance forces.

The main driving motors are 10 HP wound rotor units operating on 550 volts, 3 phase 60 cycle power. The full load speed is 690 R.P.M. Two thruster brakes operating on the electro—hydraulic principle, are mounted on the motor drive shaft (**PHOTOGRAPH 29, 36**). Braking force is produced by a centrifugal pump actuated by an electric motor supplied from a 550 volts 3 phase circuit. Each brake has a thrust rating of 50 lbs. at 2 inch stroke. Operating on a 6 inch brake wheel, the brake can produce a maximum braking torque of 50 ft. lb. with a spring setting of 3 inches between spring collars. Power OFF automatically sets the brake ON. Speed of the setting is governed by an adjustable time delay. An interlock switch is provided, operating in the fully released position of the brake. Manual release is also provided, permitting ON or OFF setting without resorting to electric drive or control. The coupling device between motors and the gear reducer input shaft is a combination type, combining brake wheel and flexible coupling.

The main gear reducer unit is a triple reduction helical gear type with a differential built into the slow gear unit. Its reduction ratio is 54.359 to 1. The unit has a double shaft extension on the input side which is coupled to the driving motors by a brake wheel coupling. The double output shaft is connected to the bevel gear train through a split clamp coupling. An equalizer unit ensures that exactly the same torque is applied to each of the two driving bull pinions.

Two end bevel drive and bull pinion units of 3.69 to 1 ratio are placed diametrically opposite each other at each end of the main drive shaft. These serve to change the drive direction from horizontal to vertical (**PHOTOGRAPHS 20, 28**).

Each bevel gear is keyed to the upper end of a vertical shaft, each of which has a bull pinion mounted on the lower end (**PHOTOGRAPH 21, 22**). These pinions mesh with the circular track (**PHOTOGRAPH 31**).

3.3 Electrical Power and Control Systems

Power is supplied by way of a 100 amp 600 volt service at a terminal pole on the West shore of the North side of the bridge. Normal power is supplemented by a 60 KW standby diesel generator, located in the control room. The control room houses all power and motor controls. A control desk provides for operator control of the bridge.

Power and control wiring from the control tower runs to the West shore lighting and traffic control equipment. Submarine cables carry power and control from the control tower to the pivot pier. Another submarine cable is then routed from the pivot pier to the East rest pier and shore.

Electrical control equipment is comprised of vintage relay control with drum controllers, controlling wound rotor motors for speed control of the movable span. Redundancy is built into the bridge by way of redundant wedge and span rotate motors, and their control components.

3.3.1 Roadway Traffic Signals and Gates

Traffic control is provided by flashing stoplights and motor operated barriers on both sides of the roadway at the West and East approach roads.

Section 4 - Bridge Mechanical and Electrical Inspection

4.1 General

The site visit to carry out a general review of the mechanical and electrical systems was conducted on December 12th between 1:00 pm and 5:30 pm by P. Scurtu, P. Eng. and T. Colbert, C.E.T. in the presence of Goby Jeyagoby, P.Eng. from McCormick Rankin Corporation and A. Campeau, Project Engineer from Aboriginal Affairs and Northern Development Canada. Discussions were held regarding operation of the bridge and the mechanical and electrical maintenance that has been previously performed. The weather was clear and 4°C.

The manhole covers situated at the center pier and end piers were removed to allow inspection of the mechanisms. A complete swing opening of the bridge was undertaken using the central pier drive.

4.2 Mechanical

4.2.1 Review of Operation and Maintenance History

Various inspections have been conducted on the bridge over the years. Rehabilitation projects have occurred at frequent intervals to maintain the bridge in good operable condition. A full replacement of the submarine cables was completed in the early 1990s and various structural concrete repairs were conducted throughout the late 1990s. The entire structure was thoroughly cleaned and painted in 2003.

The operator reports that during the winter months he encounters occasional difficulty pulling the support wedges.

4.2.2. Rest Piers Wedge System

The East and West wedge systems appear to be in good condition, and were fully engaged, well lubricated and operated with a smooth, continuous motion with no indication of any binding or excessive play in any of the linkages or drive shafts (**PHOTOGRAPHS 1, 2, 5 and 12**). Nevertheless, the wedge strike platforms have their support bases corroded. The wedge link mechanism and gear sector at both rest piers shows a lack of lubrication and corrosion (**PHOTOGRAPHS 3, 6, 7, 9 and 10**).

4.2.3 Wedge Drive and Gearbox

The wedge drive gearbox (**PHOTOGRAPH 24**) appeared to operate quite freely with no signs of excessive wear or misalignment. Lubrication levels were maintained and there was no evidence of any leakage. Drive shafts operated smoothly with no indication of twisting or misalignment. All couplings and gears worked well and showed no excessive backlash. Nevertheless, the bevel gears and the miter gear boxes (**PHOTOGRAPHS 4, 8**) show lack of lubrication and corrosion. The chain transmission and the chain coupling of the position controller from the center pier show a lack of lubrication and corrosion (**PHOTOGRAPHS 17, 23**), also, one of the electrical motor shaft bearing seals is pushed out of its housing (**PHOTOGRAPH 25**). Therefore, the bearing is dust contaminated and should be replaced before it breaks and stops the motor functioning.

4.2.4 Center Pier Span Drive and Gearbox

The span drive gearbox of the center pier operated well, but showed signs of leakage from both of the input shafts (**PHOTOGRAPH 33**). Therefore, the oil seals on these shafts require replacement. The bevel gears (**PHOTOGRAPHS 20, 28**) show lack of lubrication and corrosion and were a little noisy during operation. Also, the spur gears of the swing drive show a lack of lubrication and corrosion (**PHOTOGRAPH 19**). The drive position controller chain transmission is showing a lack of lubrication and corrosion (**PHOTOGRAPH 23**). The draining holes are filled with bird guano.

4.2.5 Center Pier Span Swing Brakes

The span brakes are in poor condition as a result of oil leaking from the gearbox input shaft seals (**PHOTOGRAPH 29**). The brake shoes and brake hubs need to be replaced soon as they are affecting the operator's ability to slow the span and the ends of its travel.

4.2.6 Center Pier Pivot Bearing

The pivot bearing at the center of the span works well and is certainly well lubricated (**PHOTOGRAPH 18**). The excessive lubrication may result in oil or grease finding its way into the watercourse with all the associated environmental problems.

4.2.7 Rest Piers Centering Devices

The centering devices, as part of the wedge drive system, work well and locate the bridge as required with a smooth and free action (**PHOTOGRAPHS 2, 12**).

4.2.8 Rest Piers Wedge Access Platforms

The maintenance access platforms on the East and West piers are in very bad condition and are corroded to such an extent that they cannot safely be used. It is important for maintenance access that they are replaced as soon as possible (**PHOTOGRAPH 32**).

4.2.9 Safety Guards

The safety guards over the chain couplings and the long transmission shafts (**PHOTOGRAPH 17**) of the various drive systems do not meet the requirements of Section 13.8.2 of the Canadian Highway Bridge Design Code or the Ontario Occupational Health and Safety Act. A proper study should be carried out and new guards designed and installed.

4.2.10 Center Pier Swing Circular Rack, Pinion and Balance Wheels

The rack gear and the bull spur pinion show a lack of lubrication and corrosion (**PHOTOGRAPHS 13, 14, 21, 22**). The balance wheel shafts are lacking lubrication as well, and if not appropriately lubricated their bearing will wear and fail (**PHOTOGRAPH 15**). The center pier live relief wedges are well maintained and lubricated.

4.3 Electrical

The referenced Electrical Photographs can be found in Appendix 1.

The operator and maintenance supervisor indicated that the bridge is generally reliable in operation, with the most troublesome components being the traffic gates. The highest maintenance item is the replacement of the navigation, obstruction and clearance lights around the bridge. The operator and maintenance supervisor also expressed concern regarding the noise and emissions from the emergency generator, given its location inside the operating pulpit

4.3.1 Main Service Equipment

The main electrical service is in poor condition and should be replaced. If the new service is to be placed in the same location, it is recommended to house the equipment inside a stainless steel enclosure with a minimum environmental rating of NEMA 4X (**PHOTOGRAPH 34**).

4.3.2 Emergency Generator

The emergency generator is poorly located inside the operating pulpit. When running it represents a health concern to operating personnel by way of noise and emissions. It has logged 900 hours of run time and is regularly exercised. Reportedly, it has never undergone any major service since it was first installed (**PHOTOGRAPH 35**). Canadian Standards Association (CSA) C282 statement 6.2 calls for emergency generators to be located in separate buildings or separated from the remainder of building by fire separation. The same code suggests that emergency generators should be located within one storey of grade.

4.3.3 Control Tower

There is a 30 KVA distribution transformer inside the control tower at the operator's level which is noisy. The transformer may have loose laminations; however the operator and maintenance supervisor explained that it has always been this way. Pricing for replacing this has been included for consideration.

The electrical MCC cabinet in the operator's pulpit is in good condition but it represents a considerable safety concern due to its accessibility. It contains a key rack inside the door and is used for the storage of keys (**PHOTOGRAPH 36**).

Inside the washroom in the operator's area, there is an opening in a junction box immediately beneath the sink (**PHOTOGRAPH 37).**

4.3.4 Submarine Cables

The submarine cables appear to be in good condition and no issues have been reported. However, it is good practice to megger test them annually to ensure the integrity of insulation (**PHOTOGRAPH 38**).

4.3.5 Traffic Control Equipment

It was reported that the traffic gates are the single most troublesome component in the bridge operation. Three of the four gates showed evidence of the gate arms having been welded back together. The gates themselves appear old and are showing signs of corrosion. The wiring to many of the gate arm lights and some of the wiring inside the gate cabinets is in need of repair (**PHOTOGRAPH 39**).

The traffic signal lights are in fair condition, and are not compliant with present day codes. The Canadian Highway Bridge Design Code CAN/CSA-S6-00 13.5.6 refers to the Canadian Manual of Uniform Traffic Control Devices. Statement B 6.05 'Moveable Span Bridge Signals' in this manual, addresses the type and control of the traffic light signals. The traffic lights should be a standard three light (Red, Amber, and Green) arrangement (**PHOTOGRAPH 40**).

4.3.6 Electrical Enclosures and Miscellaneous Wiring

There are a few locations where there are missing box covers (**PHOTOGRAPH 42**):

- On the North face of the bridge
- The base of a lamp standard on the North West corner of the bridge
- Adjacent to the control tower entrance

At the base of the control tower there are a couple of conduits which are vulnerable to damage from vehicles parking in the area (**PHOTOGRAPH 43**).

There are a few locations where conduit repairs are required (**PHOTOGRAPH 44**):

- The base of the South West traffic light
- Inside the West expansion gap
- The conduit running along the South side of the East approach is in need of additional mounting straps

Section 5 - Assessment of Findings

Cost estimates quoted within this section are reiterated in the Table within Appendix 2. Estimates are contingent upon factors over which we have no control and are not guaranteed as to accuracy. Exact costs will be determined only upon completion of any engineering work and when tenders have been received.

5.1 Mechanical

This bridge is 43 years of age. The mechanisms and mechanical parts are in good condition but there are certain places mentioned below, where the level of maintenance is poor.

5.1.1 Rest Piers Wedge System

The East and West wedge systems appear to be in good condition and operated with a smooth, continuous motion, with no indication of any binding or excessive play in any of the linkages or drive shafts. The main problem is the lack of lubrication in the places mentioned in the previous chapter; a lubrication schedule should be instated and its application enforced. The wedge bases should be cleaned of corrosion and repainted. Allow design time of 24 hours as well as construction time of 24 hours.

5.1.2 Wedge Drive and Gearbox

The wedge drive gearbox appeared to operate quite freely with no signs of excessive wear or misalignment. Lubrication levels were maintained and there was no evidence of any leakage. Drive shafts operated smoothly with no indication of twisting or misalignment. All couplings and gears worked well and showed no excessive backlash. Meanwhile, there is lack of lubrication of all the external parts between the center pier and the rest piers, therefore measures should be taken to instate and enforce a lubrication schedule. On the electrical motor there is a bearing with a pushed out seal which should be addressed either by replacing the seal and lubricating the existent bearing if it is still well lubricated, or completely replacing the bearing if it is dry. Allow repair time of 8 to 24 hours depending on the bearing situation.

5.1.3 Center Pier Span Drive and Gearbox

The span drive gearbox operated well but showed signs of leakage from both of the input shafts. The oil seals on these shafts require replacement. The bevel gears and the spur gears of the transmission are completely dry and require greasing immediately, as indicated in the previous chapter. As well, the draining holes need to be unclogged.

5.1.4 Center Pier Span Swing Brakes

The span swing brakes are in poor condition as a result of contamination by oil leaking from the gearbox input shaft seals. The brake shoes and brake hubs need to be replaced soon as they are affecting the operator's ability to slow the span and the ends of its travel. Allow repair time of 24 hours.

5.1.5 Center Pier Pivot Bearing

The pivot bearing at the center of the span works well and is certainly well lubricated. The excessive lubrication may result in oil or grease finding its way into the watercourse. Containing and removing the excess of lubricant should be done periodically.

5.1.6 Rest Pier Centering Devices

The centering devices, as part of the wedge drive system, work well and locate the bridge as required with a smooth and free action.

5.1.7 Rest Piers Wedge Access Platforms

The maintenance access platforms on the East and West piers should be replaced as a result of their advanced corrosion. Allow design time of 8 hours and construction time of 24 hours.

5.1.8 Safety Guards

As mentioned in the previous chapter, a safety study should be done and the unprotected mechanical moving parts should be covered with protective safety guards. Allow design time of 8 hours and construction time of 24 hours.

5.1.9 Center Pier Swing Circular Rack, Pinion and Balance Wheels

A lubrication schedule should be instated and enforced for the circular rack, pinion and balance wheels as there is a lack of lubrication and corrosion.

5.2 Electrical

5.2.1 General

As previously mentioned, the general condition of the electrical components is good, particularly when one considers the age of the equipment. It should be noted that many of the control components are obsolete and would likely be difficult, if not impossible, to obtain (**PHOTOGRAPH 41**). Given that these components are well maintained and that the most critical items are backed up by redundant systems, it is generally felt that a control system upgrade can be deferred until the primary control system becomes troublesome or begins to exhibit signs of fatigue.

5.2.2 Emergency Generator

The emergency generator is old and poorly located inside the operating pulpit, presenting a health hazard to the bridge operator and making it difficult to refuel and maintain. Relocating this unit outside the control tower would alleviate these issues as well as permit the installation of a larger fuel supply, to permit a longer run time.

5.2.3 Motor Control Center

The contactors, relays, breakers and fuses within this control center all appear in very good condition; however, the open architecture style is dangerous due to the exposed electrical connections. There is an area on the inside door of this enclosure which is being utilized for key storage. Access to this control center should be restricted.

5.2.4 Traffic Control

The traffic lights are an older style system consisting simply of flashing red lights. Present day code calls for a regular intersection 'three light' system consisting of green, amber and red lights.

The traffic barriers are showing signs of age and appear poorly maintained. The housings are corroding and three of the four gate arms show evidence of having been broken free in the past. Wiring inside the gates and around some of the gate arms is in poor condition.

Section 6 – Conclusions and Recommendations

We recommend that a number of elements undergo maintenance, replacement, rehabilitation or repair as outlined below:

Item Number	Estimated Cost	Description
1	$ 10,000	Replace the brake shoes and drums of the Span Swing Drive.
2	$ 3,000	Remove excessive grease from the wedges and centre pivot bearing. Lubricate all other equipment as required.
3	$ 500	Clean out the drain holes of bird guano on the center pier.
4	$ 6,000	Open up the East Side wedge drive coupling and inspect it. If damaged due to lack of lubrication, replace the complete coupling. If the coupling is considered to still be in serviceable condition, apply proper lubrication as required.
5	$ 11,000	Fabricate and install proper safety guards over the drive mechanisms of the bridge.
6	$ 3,000	Corrosion removal and repainting of wedge bases.
7	$ 1,000	Wedge electrical motor bearing lubrication and sealing.
8	$ 2,000	Replacement of oil seals on the span drive gearbox.
9	$ 7,000	Rest Piers Wedge Access Platforms
TOTAL	**$43,500.00**	

Main Electrical Service

The main electrical service components should be replaced. If it is to be placed in the same location it should be housed inside a stainless steel enclosure with a minimum environmental rating of NEMA 4X (**PHOTOGRAPH 34**).

Emergency Generator

Normally a generator set of this age would be recommended for a complete overhaul, including the engine and alternator, to ensure continued reliability. Given the age of the unit, the lack of code compliance and the safety and health concerns, it is strongly advised to replace the unit with a packaged system located outside, near the base of the tower, housed inside a weatherproof, sound attenuated enclosure (**PHOTOGRAPH 35**).

Control Tower

Due to the open architecture style of the interior components, lethal voltage exists at most of the exposed connections inside (600 VAC). The keys should be removed from this cabinet and stored elsewhere. This motor control cabinet should then be locked closed and only be accessed by authorized, trained personnel wearing appropriate protection (**PHOTOGRAPH 36**).

The opening in the junction box immediately below the right side of the sink in the washroom should be plugged (**PHOTOGRAPH 37**).

Submarine Cables

To keep track of any degradation of submarine cable insulation, it is recommended that all submarine cables be checked annually for insulation integrity with an insulation tester (megger).

Traffic Control Equipment

Given the history of traffic gate problems and the degrading condition of much of the equipment on the traffic gates; it is strongly advised to replace the traffic gates with new units. New units would come equipped with maintenance free LED gate arm lights and would also be equipped with shear pins on the gate arms which permit the gate arm to swing away in the event of accidental vehicle contact.

It is also recommended to replace the traffic lights with proper, code compliant (red, amber, green) traffic light fixtures. These can also be equipped with LED lights to reduce maintenance.

Electrical Enclosures and Miscellaneous Wiring

It is suspected that although some of these locations may contain unused wiring, it is still recommended that junction box covers are installed where ever they are missing (**PHOTOGRAPH 42**):

- On the North face of the bridge
- At the base of a lamp standard on the North West corner of the bridge
- Adjacent to the control tower entrance

The electrical conduits at the base of the control tower should be mechanically protected from accidental injury from vehicles parking nearby (**PHOTOGRAPH 43**). See the following paragraph taken from the 2009 ESA code:

12-932 Protection for raceways in lanes:

If subject to mechanical injury and unless otherwise protected, steel guards of not less than No. 10 MSG, adequately secured, shall be installed to protect raceways less than 2m above grade in lanes and driveways.

Conduit repairs should be performed in the following locations (**PHOTOGRAPH 44**):

- At the base of the South West traffic light
- Inside the West expansion gap
- The conduit running along the South side of the East approach needs additional mounting straps

Miscellaneous

To alleviate some of the maintenance issues surrounding lamp replacements, many of the lights could be replaced with LED lamps. These tend to be considerably more expensive and in some cases, it may require replacement of the fixture. However, once they are changed they will provide many years of trouble free use.

Cost estimates are generally based on one of the three methods:

- Quotations from suppliers
- Extrapolation of cost or quotes for previous work
- Direct estimation by the consulting engineer

While every effort has been made to establish the appropriate costs, it must be recognized that the figures represent an estimate. The actual costs may vary even with standard types of construction. For non-standard work, such as bridge rehabilitation work, the variation may be greater.

The estimates are therefore subject to change and are contingent upon factors over which we have no control. The estimates are not guaranteed as to accuracy. Exact costs will be determined only when tenders have been received for the project.

Estimates are budgetary, and do not constitute an offer to perform the work. There is no allowance for taxes, inflation, or material and labour market conditions.

See Appendix 2 for a breakdown of budget cost estimates. All estimates are budgetary (+/- 25%), exclude taxes, and may vary due to final scope variations, market conditions, and other unknown factors.

APPENDIX 1

PHOTOGRAPHS
DECEMBER 12, 2011
(1 THROUGH 44)

PHOTOGRAPH 1: SPAN WEDGE WITH CORRODED BASE PLATE ON THE SOUTH SIDE OF THE WEST REST PIER

PHOTOGRAPH 2: SPAN WEDGE WITH CORRODED BASE PLATE ON THE NORTH SIDE OF THE WEST REST PIER

PHOTOGRAPH 3: WEDGE MECHANISM ON THE WEST REST PIER SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 4: WEDGE DRIVE SHAFT AND BEVEL GEARS ON THE WEST REST PIER SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 5: SPAN WEDGE WITH CORRODED BASE PLATE
ON THE SOUTH SIDE OF THE EAST REST PIER

PHOTOGRAPH 6: WEDGE MECHANISM ON THE EAST REST PIER, SOUTH
SIDE SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 7: WEDGE MECHANISM GEAR SECTOR ON THE REST PIER SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 8: WEDGE DRIVE SHAFT AND BEVEL GEARS ON THE EAST REST PIER SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 9: WEDGE MECHANISM ON THE EAST REST PIER, NORTH SIDE SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 10: SLEEVE BEARINGS SHOWING LACK OF LUBRICATION

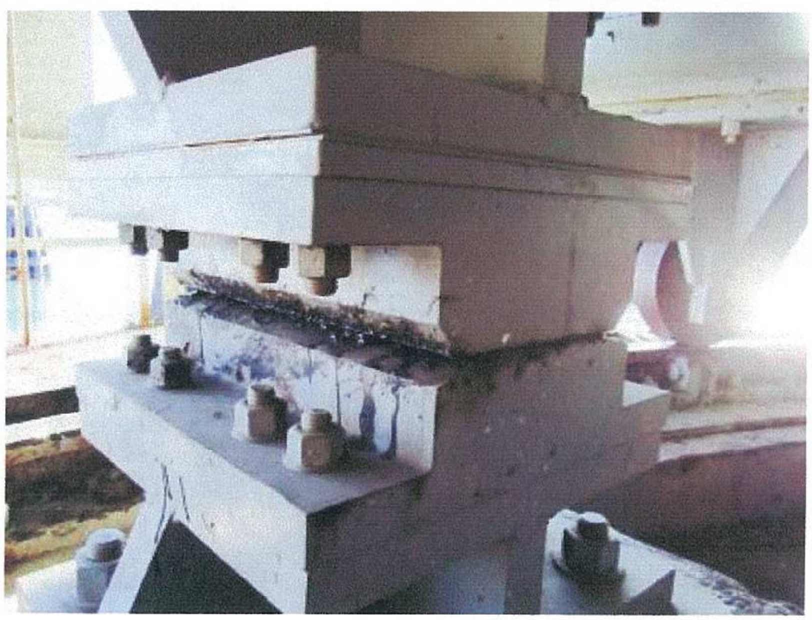
PHOTOGRAPH 11: INSPECTION CRADLE AND TRACK SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 12: SPAN WEDGE WITH CORRODED BASE PLATE ON THE NORTH SIDE OF THE EAST REST PIER

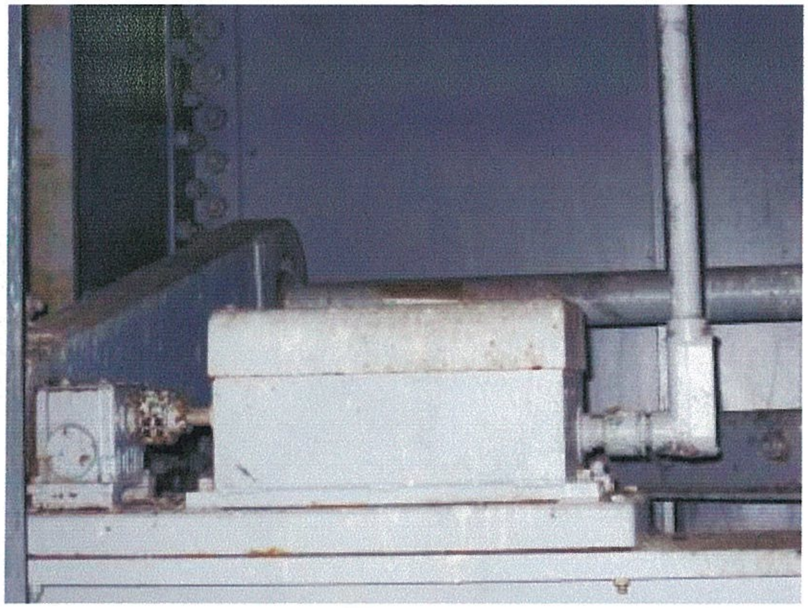
PHOTOGRAPH 13: CENTRE PIER BALANCE WHEELS ON TRACK WITH SPUR GEAR

PHOTOGRAPH 14: SOUTH SIDE CENTRE PIER LIVE LOAD RELIEF WEDGE AND CIRCULAR RACK

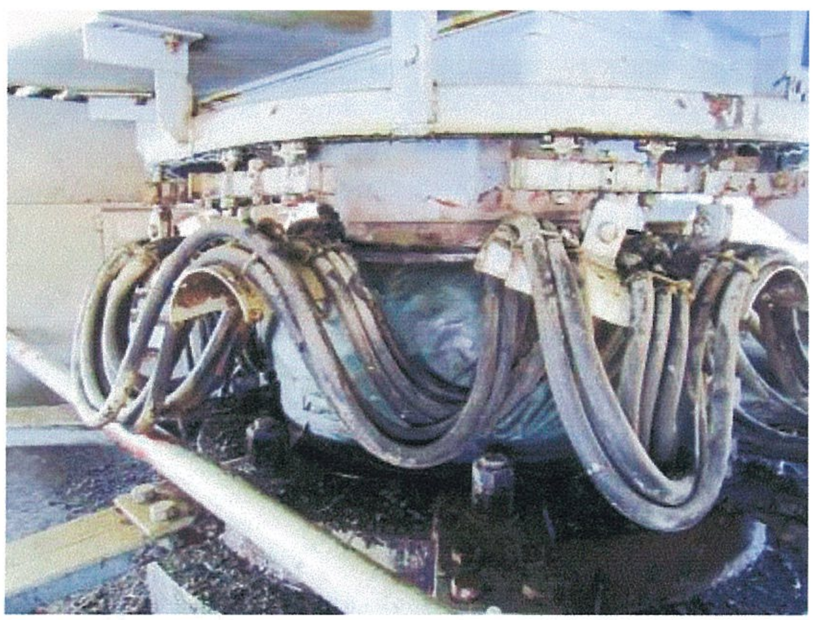
PHOTOGRAPH 15: CENTRE PIER BALANCE WHEELS ON TRACK WITH SPUR GEAR SHOWING LACK OF LUBRICATION



PHOTOGRAPH 16: SOUTH SIDE CENTRE PIER LIVE LOAD RELIEF WEDGE



PHOTOGRAPH 17: CENTRE PIER WEDGE POSITION CONTROLLER TRANSMISSION



PHOTOGRAPH 18: BRIDGE DEAD LOAD BEARING PIVOT ON CENTRE PIER

PHOTOGRAPH 19: CENTRE PIER SWING DRIVE SPUR GEARS SHOWING LACK OF LUBRICATION AND CORROSION

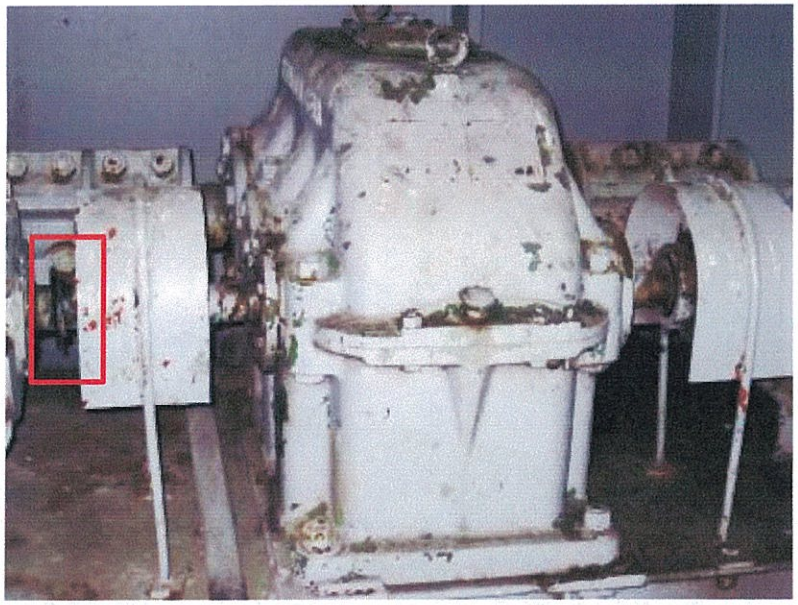
PHOTOGRAPH 20: CENTRE PIER EAST SIDE SWING DRIVE BEVEL GEARS SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 21: CENTRE PIER EAST SIDE SWING DRIVE GEAR SHOWING LACK OF LUBRICATION AND CORROSION

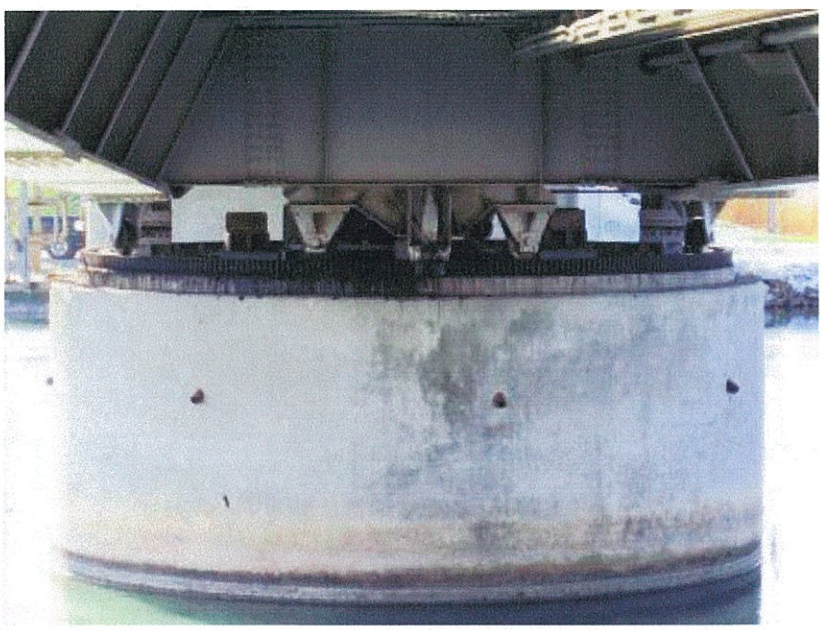
PHOTOGRAPH 22: CENTRE PIER EAST SIDE SWING DRIVE FINAL GEAR SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 23: CENTRE PIER SWING DRIVE POSITION CONTROLLER TRASMISSION SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 24: CENTRE PIER WEDGES DRIVE MOTORS AND REDUCER



PHOTOGRAPH 25: SEAL PUSHED OUT OF ITS HOUSING AT THE CENTRE PIER WEDGE DRIVE MOTOR



PHOTOGRAPH 26: CENTRE PIER SWING DRIVE SPUR GEAR ON CIRCULAR RACK AND BALANCING WHEELS

PHOTOGRAPH 27: NORTH SIDE CENTRE PIER LIVE LOAD RELIEF WEDGE

PHOTOGRAPH 28: CENTRE PIER WEST SIDE SWING DRIVE BEVEL GEARS SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 29: EAST SIDE SWING DRIVE BRAKE HUB SHOWING CONTAMINATION WITH LUBRICANT

PHOTOGRAPH 30: CENTRE PIER WEST SIDE SWING DRIVE GEAR SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 31: CENTRE PIER EAST SIDE SWING DRIVE FINAL GEAR AND CIRCULAR RACK SHOWING LACK OF LUBRICATION AND CORROSION

PHOTOGRAPH 32: WEST REST PIER MAINTENANCE PLATFORM SHOWING CORROSION

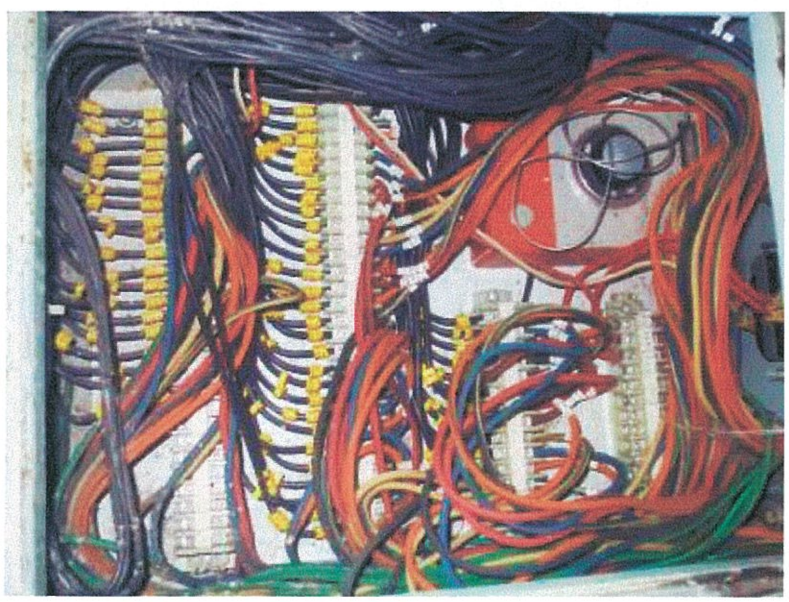
PHOTOGRAPH 33: CENTER PIER SWING DRIVE MOTORS AND REDUCER

PHOTOGRAPH 34: ELECTRICAL SERVICE

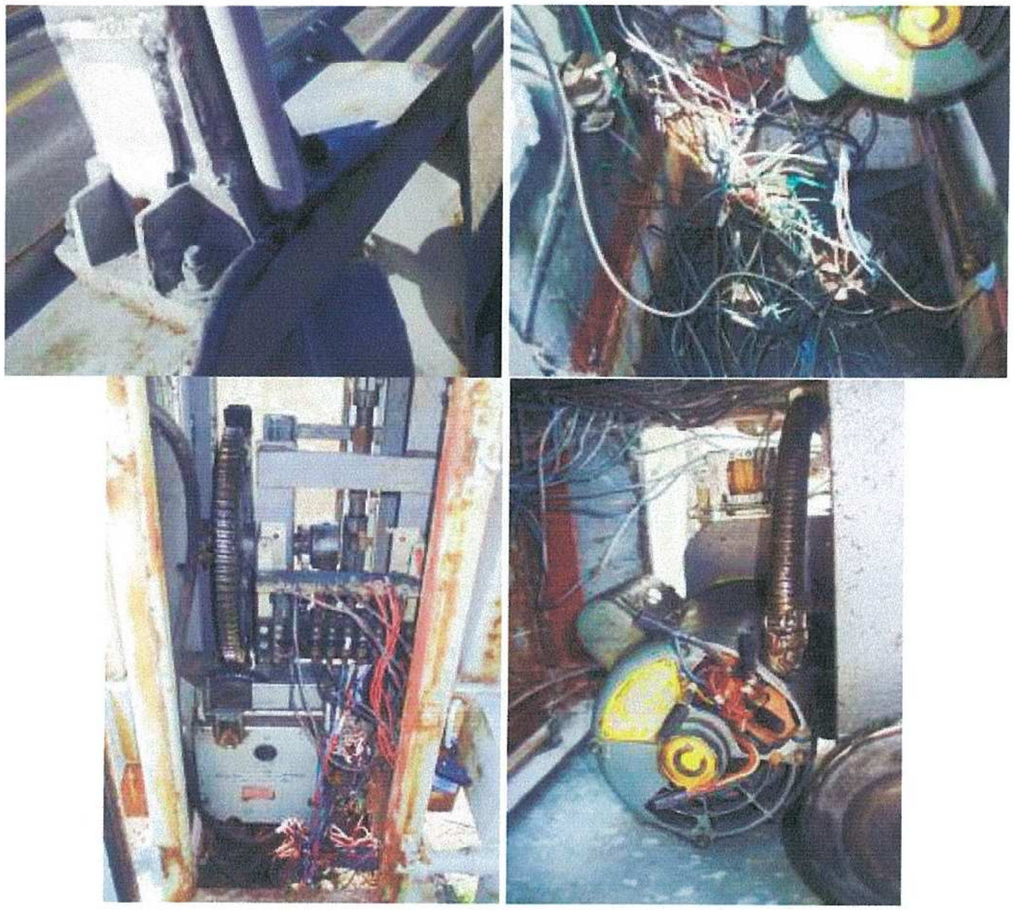
PHOTOGRAPH 35: EMERGENCY GENERATOR

PHOTOGRAPH 36: MOTOR CONTROL CENTER

PHOTOGRAPH 37: JUNCTION BOX OPENING



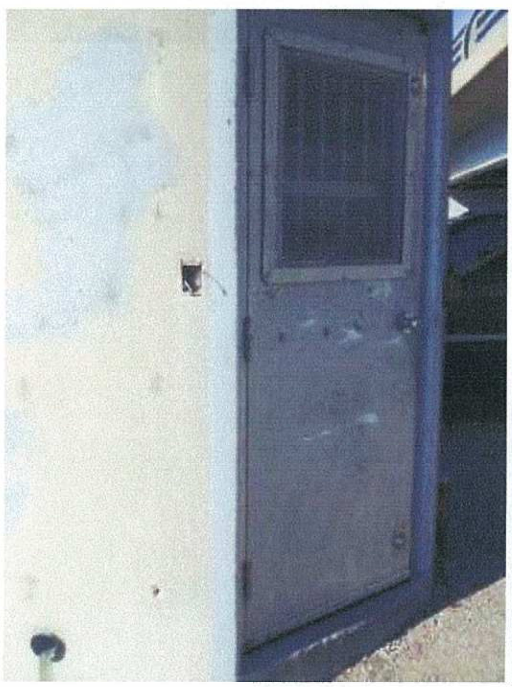
PHOTOGRAPH 38: SUBMARINE CABLE JUNCTION BOX

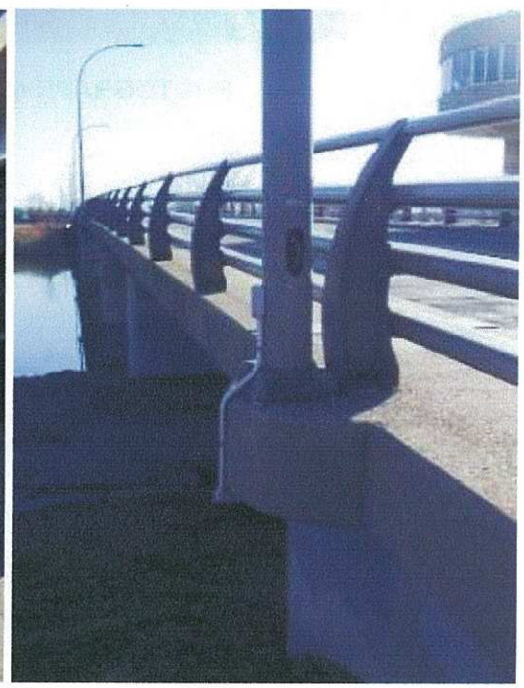


PHOTOGRAPH 39: TRAFFIC GATES

PHOTOGRAPH 40: TRAFFIC LIGHTS

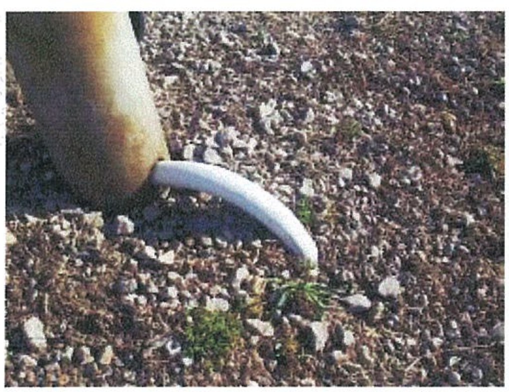
PHOTOGRAPH 41: SPAN ROTATE DRUM CONTROLLER

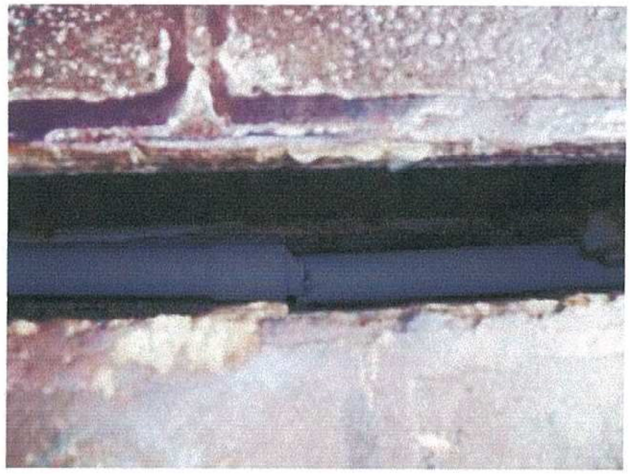




PHOTOGRAPH 42: JUNCTION BOX COVERS

PHOTOGRAPH 43: UNPROTECTED CONDUITS





PHOTOGRAPH 44: CONDUIT REPAIRS

APPENDIX 2

ESTIMATED COSTS AND TIME FOR RECOMMENDED WORK

MECHANICAL COSTS

ITEM	AMOUNT
REPLACE THE BRAKE SHOES AND DRUMS OF THE SPAN SWING DRIVE.	$ 10,000
REMOVE EXCESSIVE GREASE FROM THE WEDGES AND CENTRE PIVOT BEARING. LUBRICATE ALL OTHER EQUIPMENT AS REQUIRED.	$ 3,000
CLEAN OUT THE DRAIN HOLES ON THE CENTER PIER OF BIRD GUANO.	$ 500
OPEN UP THE EAST SIDE WEDGE DRIVE COUPLING AND INSPECT IT. IF DAMAGED DUE TO LACK OF LUBRICATION, REPLACE THE COMPLETE COUPLING. IF THE COUPLING IS CONSIDERED TO STILL BE IN SERVICEABLE CONDITION, APPLY PROPER LUBRICATION AS REQUIRED.	$ 6,000
FABRICATE AND INSTALL PROPER SAFETY GUARDS OVER THE DRIVE MECHANISMS OF THE BRIDGE.	$ 11,000
WEDGE BASES CORROSION REMOVAL AND REPAINTING.	$ 3,000
WEDGE ELECTRICAL MOTOR BEARING LUBRICATION AND SEALING.	$ 1,000
REPLACEMENT OIL SEALS ON SPAN DRIVE GEARBOX.	$ 2,000
REST PIERS WEDGE ACCESS PLATFORMS	$ 7,000
TOTAL:	$ 43,500
NOTES:	
Estimate is based on a rough preliminary design concept.	
It is assumed that there will be minimal mechanical or structural modifications.	
Construction management is not included in this estimate	
Regular project meetings and site visits are not included in this estimate	
Remediation of designated substances (if any) are not included	

ELECTRICAL COSTS

ITEM	EQUIP. COST	CONST. COST	TOTAL UNIT COST
ELECTRICAL SERVICE			$ 12,000
REMOVAL OF OLD GENERATOR & TRANSFER SWITCH			$ 7,500
EMERGENCY GENERATOR (including transfer switch)	$ 80,000	$ 75,000	$ 155,000
TRAFFIC BARRIERS	$ 82,000	$ 40,000	$ 122,000
NAVIGATION / OBSTRUCTION LIGHTS	$ 10,000	$ 7,000	$ 17,000
MISC. REPAIRS (conduits, covers, protection)		$ 10,000	$ 10,000
TRAFFIC LIGHTS	$ 24,000	$ 18,000	$ 42,000
TOTAL:			**$365,500**
OPTIONAL ITEMS:			
30 KVA DISTRIBUTION TRANSFORMER	$ 1,000	$ 1,000	$ 2,000
TOTAL (for options):			**$ 2,000**
GRAND TOTAL (including options):			**$ 367,500**
NOTES:			
This estimate is based on a rough preliminary design concept only			
It is assumed that there will be minimal mechanical or structural modifications required			
Construction management is not included			
Regular project meetings and site visits are not included			
Remediation of designated substances (if any) are not included			

SCHEDULING

TASK	DELIVERY	ENG	INSTALLATION	TOTAL
Electrical Service	1 week	0.5 weeks	0.5 weeks	2 weeks
Emergency Generator	16 weeks	3 weeks	2 weeks	***21 weeks**
Traffic Barriers	8 weeks	1 week	2 weeks	11 weeks
Navigation / Obstruction lights				1 week
Misc. conduit repairs				1 week
NOTES:				
Time estimates based on past experience.				
*Depending on manpower applied, most tasks can be done concurrently, making the				
emergency generator task the critical path at 21 weeks,				

APPENDIX E

DECK CONDITION SURVERY FORMS (STRUCTURAL)

DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE

OSIM Identifier **Deck**

1. Dimensions and Area of Survey

Width between E abutment curbs 8.534 m Width between W abutment curbs 8.534 m

Length between abutment joints 66.446 m Area of deck riding surface 567.077 m²

2. Asphalt Surface Cracks

Orientation	Unsealed	Sealed	
Transverse	12	0	**m**
Longitudinal	45	21	**m**
Diagonal	0	0	**m**

Remarks

Medium and wide asphalt cracks recorded only.

3. Asphalt Condition and Depth

Condition *	Thickness (mm)		
	Min	**Max**	**Avg.**
F-G	55	63	61

* G - Good F - Fair P - Poor V- Variable Good to Poor

4. Waterproofing

Type	Condition	Conc. Bond	Thickness (mm)		
			Min.	**Max.**	**Avg.**
Unknown	N/A	N/A	N/A	N/A	N/A

Note:
No waterproofing member recovered.

* G - Good F - Fair P - Poor V- Variable Good to Poor

DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE

OSIM Identifier **Deck**

5. Concrete Cover – Cores and Sawn Samples

Minimum	Maximum	Average	
N/A	N/A	N/A	**mm**

Note: Concrete cores were not removed due to the steel orthotropic deck.

6. Corrosion Activity

Minimum	Maximum	Average	
N/A	N/A	N/A	**V**

Note: Corrosion potentials were not measured due to the steel orthotropic deck.

0 to -0. 20	-0. 20 to -0. 35	-0. 35 to -0.45	<-0. 45	**V**
N/A	N/A	N/A	N/A	**m²**
N/A	N/A	N/A	N/A	**%**

7. Defective Cores and Sawn Samples

Corrosion Activity (Volts)	Cores and Sawn Samples						
	Total in Each Area	Delaminated, Spalled, Severe			Medium Scaling*		
		No.	m^2	%	No.	m^2	%
0 to –0.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-0.20 to –0.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-0.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A

* The percent calculation should be of the entire deck area investigated. The values obtained should be used with caution as large errors may occur when a small number of samples are used for the calculation or when the samples are not randomly distributed over the entire deck area.

DETAILED CONDITION SURVEY SUMMARY SHEET
ASPHALT COVERED DECK
DECK RIDING SURFACE

OSIM Identifier **Deck**

8. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (volts)		**0 to -. 20**	**-. 20 to -. 35**	**<-. 35**
Chloride Content *	0-10 mm	N/A	N/A	N/A
	20-30 mm	N/A	N/A	N/A
	40-50 mm	N/A	N/A	N/A
	60-70 mm	N/A	N/A	N/A
	80-90 mm	N/A	N/A	N/A
	100-110 mm	N/A	N/A	N/A
	120-130 mm	N/A	N/A	N/A
	140-150 mm	N/A	N/A	N/A

***** Average chloride content as % chloride by weight of concrete after deducting background chlorides for all cores taken in each range of corrosion potential.

9. Chloride Content at Level of Rebar

Core No.	N/A
Chloride Content *	N/A
Corrosion Potential (V)	N/A

10. AC Resistance Test Data of Epoxy Coated Rebar

Measured AC Resistance between Connection # 1 and # 2						Calculated AC Resistance*
Connection #1	Connection # 2					
	G1	G2	G3	G4	G5	
G1	N/A	-	-	-	-	-
G2	-	N/A	-	-	-	-
G3	-	-	N/A	-	-	-
G4	-	-	-	N/A	-	-
G5	-	-	-	-	N/A	-

12. Concrete Air Entrainment

Concrete Air Entrained? Yes N/A No N/A Marginal N/A

13. Compressive Strength

Average Compressive Strength N/A MPa

DETAILED CONDITION SURVEY SUMMARY SHEET

EXPOSED CONCRETE COMPONENTS (Exposed Deck, Deck Soffit, Curbs, Medians, Sidewalks, Barrier/Parapet Walls etc.): Use separate form for each component

Component Type And Location: FIXED DECK SPANS East and west of swing span

OSIM Identifier **EXPOSED DECK**

1. Dimensions and Area

Width 8.534 m

Length 80.512 m

Height 0.229 m

Total Area Surveyed 687.089 m²

2. Cracks (medium and wide)

Remarks

Type		Trans.	Long.	Other	Total
Medium Width	Clean	20	6	1	
	Stained	0	0	0	27 m
Wide Width	Clean	21	0	0	
	Stained	0	0	0	21 m

3. Alkali Aggregate Reaction

Area of component with severe to very severe aggregate reaction

0 m²

4. Concrete Cover

Minimum	Maximum	Average	
44	106	74	mm

0-20 mm	0	40 - 60mm	96.192	m²
	0		14	%
20 -40 mm	0	Over 60 mm	590.897	m²
	0		86	%

DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Component Type and Location: FIXED DECK SPANS

5. Corrosion Activity

Minimum	Maximum	Average	
-0.026	-0.530	-0.194	**V**

0 to -. 20	-. 20 to -. 35	-. 35 to -. 45	<-. 45	**V**
395	211	59	15	**m²**
58	31	9	2	**%**

6. Delamination and Spalls

Defect Type	Delaminations	Spalls	Patches
Area (m^2)	0	0.5	50
Total Delaminations and Spalls		**Total Delaminations and Spalls in Areas < -0.35**	
0.5 **m^2**	0.1 **%**	0 **m^2**	0 **%**

7. Scaling

Light	Medium	Severe to Very Severe	
0	0	0	**m^2**
0	0	0	**%**

8. Honeycombing

Total Area 0 m²

DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Component Type and Location: FIXED DECK SPANS

9. Adjusted Chloride Content Profile

Corrosion Activity at Core Location (volts)		**0 to -. 20**	**-. 20 to -. 35**	**<-. 35**
Chloride Content *	0-10 mm	0.120	-	0.092
	20-30 mm	0.004	-	0.063
	40-50 mm	0.002	-	-
	60-70 mm	0.011	-	-
	80-90 mm	0.007	-	-
	100-110 mm	-	-	-

***** Average chloride content as % chloride by weight of concrete after deducting background chlorides for all cores taken in each range of corrosion potential.

10. Chloride Content at Level of Rebar

Core No.	C2	C3	C13
Chloride Content *	-	0.025	0.001

* Chloride content as % chloride by weight of concrete after deducting background chlorides

11. AC Resistance Test Data of Epoxy Coated Rebar

Measured AC Resistance between Connection # 1 and # 2						Calculated AC Resistance*
Connection #1	Connection # 2					
	G1	G2	G3	G4	G5	
G1	N/A					
G2		N/A				
G3			N/A			
G4				N/A		
G5					N/A	

* See Appendix 1E for calculating AC resistance contributed by individual rebar.

DETAILED CONDITION SURVEY SUMMARY SHEET
EXPOSED CONCRETE COMPONENTS

Component Type and Location: **FIXED DECK SPANS**

12. IR Drop and True Half Cell Potential Measurements of Epoxy Coated Rebar

IR Drop between Connection # 1 and # 2						True Half Cell Potential*
Connection #1 (Positive)	Connection # 2					
	G1	G2	G3	G4	G5	
G1	N/A					
G2		N/A				
G3			N/A			
G4				N/A		
G5					N/A	

* Half-cell reading taken on the same rebar with the ground connection.

13. Concrete Air Entrainment

Concrete Air Entrained? Yes ______ No ______ Marginal ✓

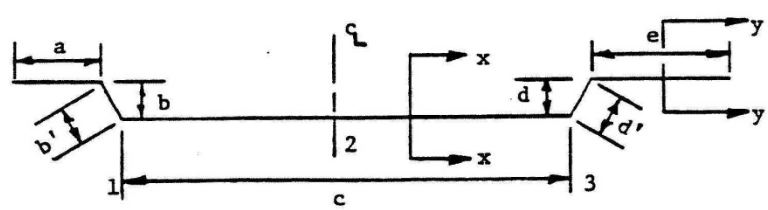
14. Compressive Strength

Average Compressive Strength 51.4 MPa

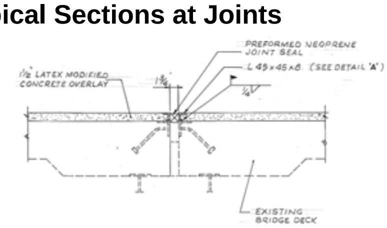
DETAILED CONDITION SURVEY SUMMARY SHEET
EXPANSION JOINTS

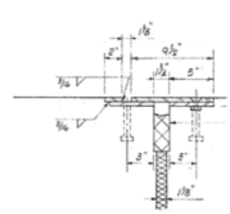
Dimensions	Abutments				Intermediate			
	Joint 1		Joint 2		Joint 3		Joint 4	
	N	E	S	W	E Shore Pier		W Shore Pier	
a (mm)	-	1600	-	1600	1600		1600	
b (mm)	-	170	-	170	170		170	
b’ (mm)	-	180	-	180	180		180	
c (mm)	-	8680	-	8690	8650		8660	
d (mm)	-	170	-	170	170		160	
d’ (mm)	-	180	-	180	180		170	
e (mm)	-	1600	-	1600	1600		1600	
Depth of Asphalt @ Deck Side					N/E	S/W	N/E	S/W
1 (mm)	-		-		-	-	-	-
2 (mm)	-		-		-	-	-	-
3 (mm)	-		-		-	-	-	-
Width: Top of Ballast Wall and End Dams								
	E	W	E	W	E	W	E	W
1 (mm)	330	490	470	310	480	460	490	480
2 (mm)	330	490	470	310	480	460	490	480
3 (mm)	330	490	470	310	480	460	490	480
Gap Dimensions								
1 (mm)	65		58		56		63	
2 (mm)	60		61		60		63	
3 (mm)	63		67		60		63	
Miscellaneous Joint Details								
Skew Angle	0°		0°		0°		0°	
Exp.	Yes		Yes		Yes		Yes	
Fixed	No		No		No		No	
Type	Strip Seal		Strip Seal		Strip Seal		Strip Seal	
Leaking	Yes		Yes		Yes		Yes	
Angle Size	L45 x 45 x 8		L45 x 45 x 8		L45 x 45 x 8		L45 x 45 x 8	
Temp. (°C)	Deck		10°C		Ambient		13°C	

W | Joint Dimensions | E



Typical Sections at Joints





X-X	Y-Y

Remarks

DETAILED CONDITION SURVEY SUMMARY SHEET
EXPANSION JOINTS

Remarks

Dimensions					Intermediate	
					Joint 5	Joint 6
					E Rest Pier	W Rest Pier
a (mm)					1600	1600
b (mm)					200	200
b' (mm)					210	210
c (mm)					8690	8690
d (mm)					200	200
d' (mm)					210	210
e (mm)					1600	1600

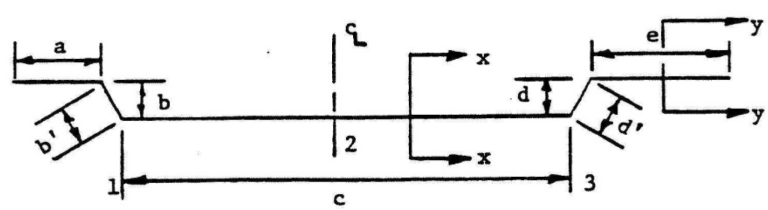
Depth of Asphalt @ Deck Side			N/E	S/W	N/E	S/W
1 (mm)			-	-	-	-
2 (mm)			-	-	-	-
3 (mm)			-	-	-	-

Width: Top of Ballast Wall and End Dams								
					N/E	S/W	N/E	S/W
1 (mm)					-	-	-	-
2 (mm)					-	-	-	-
3 (mm)					-	-	-	-

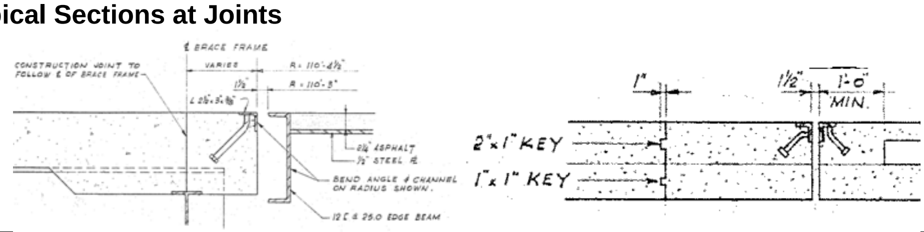
Gap Dimensions				
1 (mm)			54	45
2 (mm)			40	35
3 (mm)			50	50

Miscellaneous Joint Details				
Skew Angle			0°	0°
Exp.			Yes	Yes
Fixed			No	No
Type			Open Joint	Open Joint
Leaking			Yes	Yes
Angle Size			L45 x 45 x 8	L45 x 45 x 8

W **Joint Dimensions** **E**



Typical Sections at Joints



X-X	Y-Y

DRAINAGE

	Number	Type	Length	Angle
Deck Drains	20	Round Metal Pipe (100mm)	150 mm	0°
	10	Round Metal Pipe (150mm)	1000 mm	0° (45° at four corners)

Catch Basins	Yes	NE, NW	SE, SW
	No	-	-

* Identify location of catch basins as N/E, N/W, S/E etc. using the same direction of north as shown on the drawings.

Drainage Tubes	No	**Void Drains**	No

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Span 1 Eastbound Lane

1. **Delaminations:**
   a. Weight of Chain: 0.5 kN/m
   b. Other equipment: None

2. **Concrete Cover**
   a. Covermeter Make and Model: Elcometer Protovale 331, Model T
   b. Battery Check:
      i. Reading at Start of Test: OK
      ii. Reading at End of Test: OK
   c. Concrete Cover Check:
      i. Location of Check: Concrete block with reinforcing steel
      ii. Actual Depth and Rebar Diameter: Cover: 75mm; Size: 15M
      iii. Reading Before Test: 75mm
      iv. Readings Each 30 Minutes During Test: 75mm
      v. Readings End of Test: 75mm

3. **Corrosion Activity:**
   a. Half Cell Make / Model: Cupric Sulfate / MCM RE-5
   b. Multimeter Make / Model: Radio Shack CAT NO. 22-813
   c. Length / Gauge of Lead Wires: 120m / #16
   d. Deck Temperature:
      i. Start of Test: 7°C End of Test: 10°C
   e. Ambient Temperature:
      i. Start of Test: 10°C End of Test: 12°C
   f. Battery Check: OK
   g. Ground Check:
      i. Method of Connection: Compression Clamp
      ii. Ground Location: D97 Check Location: D86
      iii. Lead Resistance: 1.2Ω Voltage Drop: 0.04mV
      iv. Resistance: 2.2Ω Resistance Reversed: 2.2Ω

4. Grid Point Potential Readings Check

Location	Initial Reading (V)	Check Reading (V)	Check Reading (V) - Concrete Overlay
F87	-0.218	-0.213	-0.219
E88	-0.110	-0.118	-0.119
D87	-0.080	-0.088	-0.087
F90	-0.160	-0.170	-0.172
D92	-0.156	-0.164	-0.163

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Span 1 Westbound Lane

1. Delaminations:

a. Weight of Chain: 0.5 kN/m
b. Other equipment: None

2. Concrete Cover

a. Covermeter Make and Model: Elcometer Protovale 331, Model T
b. Battery Check:
   i. Reading at Start of Test: OK
   ii. Reading at End of Test: OK
c. Concrete Cover Check:
   i. Location of Check: Concrete block with reinforcing steel
   ii. Actual Depth and Rebar Diameter: Cover: 75mm; Size: 15M
   iii. Reading Before Test: 75mm
   iv. Readings Each 30 Minutes During Test: 75mm
   v. Readings End of Test: 75mm

3. Corrosion Activity:

a. Half Cell Make / Model: Cupric Sulfate / MCM RE-5
b. Multimeter Make / Model: Radio Shack CAT NO. 22-813
c. Length / Gauge of Lead Wires: 120m / #16
d. Deck Temperature:
   i. Start of Test: 3°C   End of Test: 5°C
e. Ambient Temperature:
   i. Start of Test: 5°C   End of Test: 8°C
f. Battery Check: OK
g. Ground Check:
   i. Method of Connection: Compression Clamp
   ii. Ground Location: A98   Check Location: C86
   iii. Lead Resistance: 1.2Ω   Voltage Drop: 0.04mV
   iv. Resistance: 2.1Ω   Resistance Reversed: 2.1Ω

4. Grid Point Potential Readings Check

Location	Initial Reading (V)	Check Reading (V)	Check Reading (V) - Concrete Overlay
A86	-0.182	-0.187	-0.186
B87	-0.087	-0.092	-0.094
C87	-0.138	-0.141	-0.143
B91	-0.115	-0.106	-0.105
A93	-0.191	-0.184	-0.182

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Span 2 Eastbound Lane

1. **Delaminations:**
   a. Weight of Chain: 0.5 kN/m
   b. Other equipment: None

2. **Concrete Cover**
   a. Covermeter Make and Model: Elcometer Protovale 331, Model T
   b. Battery Check:
      i. Reading at Start of Test: OK
      ii. Reading at End of Test: OK
   c. Concrete Cover Check:
      i. Location of Check: Concrete block with reinforcing steel
      ii. Actual Depth and Rebar Diameter: Cover: 75mm; Size: 15M
      iii. Reading Before Test: 75mm
      iv. Readings Each 30 Minutes During Test: 75mm
      v. Readings End of Test: 75mm

3. **Corrosion Activity:**
   a. Half Cell Make / Model: Cupric Sulfate / MCM RE-5
   b. Multimeter Make / Model: Radio Shack CAT NO. 22-813
   c. Length / Gauge of Lead Wires: 120m / #16
   d. Deck Temperature:
      i. Start of Test: 10°C End of Test: 12°C
   e. Ambient Temperature:
      i. Start of Test: 12°C End of Test: 14°C
   f. Battery Check: OK
   g. Ground Check:
      i. Method of Connection: Compression Clamp
      ii. Ground Location: F73 Check Location: D84
      iii. Lead Resistance: 1.2Ω Voltage Drop: 0.04mV
      iv. Resistance: 2.4Ω Resistance Reversed: 2.4Ω

4. Grid Point Potential Readings Check

Location	Initial Reading (V)	Check Reading (V)	Check Reading (V) - Concrete Overlay
F85	-0.374	-0.364	-0.364
E83	-0.297	-0.299	-0.293
E82	-0.190	-0.179	-0.180
D75	-0.241	-0.240	-0.246
F78	-0.266	-0.270	-0.271

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Span 2 Westbound Lane

1. **Delaminations:**
   a. Weight of Chain: 0.5 kN/m
   b. Other equipment: None

2. **Concrete Cover**
   a. Covermeter Make and Model: Elcometer Protovale 331, Model T
   b. Battery Check:
      i. Reading at Start of Test: OK
      ii. Reading at End of Test: OK
   c. Concrete Cover Check:
      i. Location of Check: Concrete block with reinforcing steel
      ii. Actual Depth and Rebar Diameter: Cover: 75mm; Size: 15M
      iii. Reading Before Test: 75mm
      iv. Readings Each 30 Minutes During Test: 75mm
      v. Readings End of Test: 75mm

3. **Corrosion Activity:**
   a. Half Cell Make / Model: Cupric Sulfate / MCM RE-5
   b. Multimeter Make / Model: Radio Shack CAT NO. 22-813
   c. Length / Gauge of Lead Wires: 120m / #16
   d. Deck Temperature:
      i. Start of Test: 5°C End of Test: 8°C
   e. Ambient Temperature:
      i. Start of Test: 8°C End of Test: 11°C
   f. Battery Check: OK
   g. Ground Check:
      i. Method of Connection: Compression Clamp
      ii. Ground Location: C84 Check Location: B72
      iii. Lead Resistance: 1.2Ω Voltage Drop: 0.04mV
      iv. Resistance: 2.7Ω Resistance Reversed: 2.7Ω

4. Grid Point Potential Readings Check

Location	Initial Reading (V)	Check Reading (V)	Check Reading (V) - Concrete Overlay
C73	-0.223	-0.222	-0.231
C72	-0.255	-0.258	-0.264
B75	-0.366	-0.357	-0.356
B83	-0.109	-0.109	-0.108
C78	-0.464	-0.460	-0.455

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Span 5 Eastbound Lane

1. **Delaminations:**
    a. Weight of Chain: 0.5 kN/m
    b. Other equipment: None

2. **Concrete Cover**
    a. Covermeter Make and Model: Elcometer Protovale 331, Model T
    b. Battery Check:
        i. Reading at Start of Test: OK
        ii. Reading at End of Test: OK
    c. Concrete Cover Check:
        i. Location of Check: Concrete block with reinforcing steel
        ii. Actual Depth and Rebar Diameter: Cover: 75mm; Size: 15M
        iii. Reading Before Test: 75mm
        iv. Readings Each 30 Minutes During Test: 75mm
        v. Readings End of Test: 75mm

3. **Corrosion Activity:**
    a. Half Cell Make / Model: Cupric Sulfate / MCM RE-5
    b. Multimeter Make / Model: Radio Shack CAT NO. 22-813
    c. Length / Gauge of Lead Wires: 120m / #16
    d. Deck Temperature:
        i. Start of Test: 12°C   End of Test: 12°C
    e. Ambient Temperature:
        i. Start of Test: 14°C   End of Test: 15°C
    f. Battery Check: OK
    g. Ground Check:
        i. Method of Connection: Compression Clamp
        ii. Ground Location: D15   Check Location: F26
        iii. Lead Resistance: 1.2Ω   Voltage Drop: 0.04mV
        iv. Resistance: 2.7Ω   Resistance Reversed: 2.7Ω

4. Grid Point Potential Readings Check

Location	Initial Reading (V)	Check Reading (V)	Check Reading (V) - Concrete Overlay
E25	-0.190	-0.187	-0.185
F24	-0.245	-0.236	-0.239
F26	-0.246	-0.248	-0.242
D23	-0.260	-0.261	-0.259
D18	-0.206	-0.212	-0.209

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Span 5 Westbound Lane

1. **Delaminations:**
   a. Weight of Chain: 0.5 kN/m
   b. Other equipment: None

2. **Concrete Cover**
   a. Covermeter Make and Model: Elcometer Protovale 331, Model T
   b. Battery Check:
      i. Reading at Start of Test: OK
      ii. Reading at End of Test: OK
   c. Concrete Cover Check:
      i. Location of Check: Concrete block with reinforcing steel
      ii. Actual Depth and Rebar Diameter: Cover: 75mm; Size: 15M
      iii. Reading Before Test: 75mm
      iv. Readings Each 30 Minutes During Test: 75mm
      v. Readings End of Test: 75mm

3. **Corrosion Activity:**
   a. Half Cell Make / Model: Cupric Sulfate / MCM RE-5
   b. Multimeter Make / Model: Radio Shack CAT NO. 22-813
   c. Length / Gauge of Lead Wires: 120m / #16
   d. Deck Temperature:
      i. Start of Test: 8°C   End of Test: 8°C
   e. Ambient Temperature:
      i. Start of Test: 11°C   End of Test: 11°C
   f. Battery Check: OK
   g. Ground Check:
      i. Method of Connection: Compression Clamp
      ii. Ground Location: C26   Check Location: A15
      iii. Lead Resistance: 1.2Ω   Voltage Drop: 0.04mV
      iv. Resistance: 2.4Ω   Resistance Reversed: 2.4Ω

4. Grid Point Potential Readings Check

Location	Initial Reading (V)	Check Reading (V)	Check Reading (V) - Concrete Overlay
B16	-0.120	-0.124	-0.125
A18	-0.099	-0.100	-0.099
B21	-0.073	-0.079	-0.078
A23	-0.340	-0.348	-0.350
C25	-0.221	-0.214	-0.212

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Span 6 Eastbound Lane

1. **Delaminations:**
   a. Weight of Chain: 0.5 kN/m
   b. Other equipment: None

2. **Concrete Cover**
   a. Covermeter Make and Model: Elcometer Protovale 331, Model T
   b. Battery Check:
      i. Reading at Start of Test: OK
      ii. Reading at End of Test: OK
   c. Concrete Cover Check:
      i. Location of Check: Concrete block with reinforcing steel
      ii. Actual Depth and Rebar Diameter: Cover: 75mm; Size: 15M
      iii. Reading Before Test: 75mm
      iv. Readings Each 30 Minutes During Test: 75mm
      v. Readings End of Test: 75mm

3. **Corrosion Activity:**
   a. Half Cell Make / Model: Cupric Sulfate / MCM RE-5
   b. Multimeter Make / Model: Radio Shack CAT NO. 22-813
   c. Length / Gauge of Lead Wires: 120m / #16
   d. Deck Temperature:
      i. Start of Test: 12C   End of Test: 13°C
   e. Ambient Temperature:
      i. Start of Test: 15°C   End of Test: 15°C
   f. Battery Check: OK
   g. Ground Check:
      i. Method of Connection: Compression Clamp
      ii. Ground Location: F2   Check Location: D13
      iii. Lead Resistance: 1.2Ω   Voltage Drop: 0.21mV
      iv. Resistance: 2.2Ω   Resistance Reversed: 2.2Ω

4. Grid Point Potential Readings Check

Location	Initial Reading (V)	Check Reading (V)	Check Reading (V) - Concrete Overlay
F8	-0.144	-0.142	-0.140
E3	-0.096	-0.093	-0.095
F11	-0.130	-0.128	-0.126
D5	-0.118	-0.121	-0.120
F13	-0.116	-0.112	-0.115

SURVEY EQUIPMENT AND CALIBRATION PROCEDURES

Component Type: Span 6 Westbound Lane

1. Delaminations:

a. Weight of Chain: 0.5 kN/m
b. Other equipment: None

2. Concrete Cover

a. Covermeter Make and Model: Elcometer Protovale 331, Model T
b. Battery Check:
   i. Reading at Start of Test: OK
   ii. Reading at End of Test: OK
c. Concrete Cover Check:
   i. Location of Check: Concrete block with reinforcing steel
   ii. Actual Depth and Rebar Diameter: Cover: 75mm; Size: 15M
   iii. Reading Before Test: 75mm
   iv. Readings Each 30 Minutes During Test: 75mm
   v. Readings End of Test: 75mm

3. Corrosion Activity:

a. Half Cell Make / Model: Cupric Sulfate / MCM RE-5
b. Multimeter Make / Model: Radio Shack CAT NO. 22-813
c. Length / Gauge of Lead Wires: 120m / #16
d. Deck Temperature:
   i. Start of Test: 8°C End of Test: 9°C
e. Ambient Temperature:
   i. Start of Test: 12°C End of Test: 13°C
f. Battery Check: OK
g. Ground Check:
   i. Method of Connection: Compression Clamp
   ii. Ground Location: A1 Check Location: C14
   iii. Lead Resistance: 1.2Ω Voltage Drop: 0.04mV
   iv. Resistance: 2.1Ω Resistance Reversed: 2.1Ω

4. Grid Point Potential Readings Check

Location	Initial Reading (V)	Check Reading (V)	Check Reading (V) - Concrete Overlay
C10	-0.016	-0.024	-0.021
B8	-0.041	-0.035	-0.037
A6	-0.196	-0.184	-0.186
B5	-0.069	-0.071	-0.071
B2	-0.063	-0.070	-0.073

APPENDIX F

CONCRETE CORE LOG AND PHOTOS (STRUCTURAL)

CORE LOG FOR EXPOSED CONCRETE

Walpole Island Swing Bridge

Core Number		C1		C2		C3	
Location		D4		D8		E13	
Diameter (mm)		100		100		100	
Length (mm)		130		130		190	
Full Depth (Y/N)		N		N		N	
Defects in Concrete[1]		N		N		N	
Condition of Rebar[2, 3]		LR		G		N/A	
Corrosion Potential (Closest grid point, V)		-0.300		-0.407		-0.050	
Compressive Strength (MPa)		-		-		-	
Chloride Content (% by weight of concrete)		**Total**	**Corrected**	**Total**	**Corrected**	**Total**	**Corrected**
	0-10mm	-	-	0.112	0.090	0.249	0.227
	20-30mm	-	-	0.085	0.063	0.025	0.003
	40-50mm	-	-	0.023	0	0.029	0.004
	60-70mm	-	-	0.022	0	0.046	0.025
	80-90mm	-	-	0.023	0	0.038	0.013
Air Voids	**Air Content (%)**	-		-		-	
	Spec. Surf (mm^2/mm^3)	-		-		-	
	Spacing Factor (mm)	-		-		-	
Testing Laboratory		-		Golder Assoc. Ltd		Golder Assoc. Ltd.	
Remarks		50mm latex modified concrete overlay with good bond to deck. 20M bar with 70mm cover.		110mm latex modified concrete overlay with good bond to deck. 15M bar with 72mm cover.		60mm latex modified concrete overlay with good bond to deck.	

1. Defects: C = Cracked, D = Delamination, R=Rough, Sc = Scaling, S = Spalling, N =None
2. Condition: G = Good, F = Fair, P = Poor
3. Condition of Rebar: LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG FOR EXPOSED CONCRETE

Walpole Island Swing Bridge

Core Number		C4		C5		C6	
Location		F15		D21		Grid 75 @ South Sidewalk	
Diameter (mm)		100		100		100	
Length (mm)		240		95		170	
Full Depth (Y/N)		Y		N		N	
Defects in Concrete[1]		Air voids noted		N		Air voids noted	
Condition of Rebar[2, 3]		G		N/A		N/A	
Corrosion Potential (Closest grid point, V)		-0.109		-0.445		-0.325	
Compressive Strength (MPa)		-		-		-	
Chloride Content (% by weight of concrete)		**Total**	**Corrected**	**Total**	**Corrected**	**Total**	**Corrected**
	0-10mm	-	-	-	-	0.431	0.359
	20-30mm	-	-	-	-	0.191	0.119
	40-50mm	-	-	-	-	0.098	0.026
	60-70mm	-	-	-	-	0.120	0.048
	80-90mm	-	-	-	-	0.072	0
Air Voids	**Air Content (%)**			-		-	
	Spec. Surf (mm^2/mm^3)			-		-	
	Spacing Factor (mm)			-		-	
Testing Laboratory		Golder Assoc. Ltd.		-		Golder Assoc. Ltd	
Remarks		45mm latex modified concrete overlay with good bond to deck. 195mm concrete deck. 15M bar with 108mm cover. 15M bar with 180mm cover.		Core removed from area of interface between original overlay and patching. Core split during coring operation. Latex modified overlay present throughout core.		Core removed from south sidewalk. Core was not long enough to inspect the bond between the deck pour and the sidewalk pour.	

1. Defects: C = Cracked, D = Delamination, R=Rough, Sc = Scaling, S = Spalling, N =None
2. Condition: G = Good, F = Fair, P = Poor
3. Condition of Rebar: LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG FOR EXPOSED CONCRETE

Walpole Island Swing Bridge

Core Number		C7		C8		C9	
Location		D77		D90		F98	
Diameter (mm)		100		100		100	
Length (mm)		150		190		200	
Full Depth (Y/N)		N		N		N	
Defects in Concrete[1]		Air voids noted		N		N	
Condition of Rebar[2, 3]		G		N/A		N/A	
Corrosion Potential (Closest grid point, V)		-0.274		-0.417		-0.270	
Compressive Strength (MPa)		-				-	
Chloride Content (% by weight of concrete)		**Total**	**Corrected**	**Total**	**Corrected**	**Total**	**Corrected**
	0-10mm	-	-	-	-	-	-
	20-30mm	-	-	-	-	-	-
	40-50mm	-	-	-	-	-	-
	60-70mm	-	-	-	-	-	-
	80-90mm	-	-	-	-	-	-
Air Voids	**Air Content (%)**	-		-		-	
	Spec. Surf (mm^2/mm^3)	-		-		-	
	Spacing Factor (mm)	-		-		-	
Testing Laboratory		-		Golder Assoc. Ltd.		-	
Remarks		50mm latex modified concrete overlay with good bond to deck. 20M bar with 95mm cover.		Core taken at location of deck patch. 100mm latex modified concrete overlay with good bond to deck.		-	

1. Defects: C = Cracked, D = Delamination, R=Rough, Sc = Scaling, S = Spalling, N =None
2. Condition: G = Good, F = Fair, P = Poor
3. Condition of Rebar: LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG FOR EXPOSED CONCRETE

Walpole Island Swing Bridge

Core Number		C10		C11		C12	
Location		B5		C15		Gridline 15 @ North Sidewalk	
Diameter (mm)		100		100		100	
Length (mm)		120		225		225	
Full Depth (Y/N)		N		Y		N	
Defects in Concrete[1]		Air voids noted		Air voids noted		Air voids noted	
Condition of Rebar[2, 3]		N/A		N/A		N/A	
Corrosion Potential (Closest grid point, V)		-0.069		-0.074		-0.230	
Compressive Strength (MPa)		-				-	
Chloride Content (% by weight of concrete)		Total	Corrected	Total	Corrected	Total	Corrected
	0-10mm	-	-	-	-	-	-
	20-30mm	-	-	-	-	-	-
	40-50mm	-	-	-	-	-	-
	60-70mm	-	-	-	-	-	-
	80-90mm	-	-	-	-	-	-
Air Voids	Air Content (%)			-		-	
	Spec. Surf (mm^2/mm^3)			-		-	
	Spacing Factor (mm)			-		-	
Testing Laboratory		Golder Assoc. Ltd.		-		-	
Remarks		45mm latex modified concrete overlay with good bond to deck.		45mm latex modified concrete overlay with good bond to deck.		Core taken through sidewalk. 205mm concrete sidewalk with good bond to deck.	

1. Defects: C = Cracked, D = Delamination, R=Rough, Sc = Scaling, S = Spalling, N =None
2. Condition: G = Good, F = Fair, P = Poor
3. Condition of Rebar: LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

CORE LOG FOR EXPOSED CONCRETE

Walpole Island Swing Bridge

		C13		C14	
Core Number		C13		C14	
Location		C93		Gridline 77 @ South Sidewalk	
Diameter (mm)		100		100	
Length (mm)		215		280	
Full Depth (Y/N)		Y		N	
Defects in Concrete[1]		C		C	
Condition of Rebar[2, 3]		N/A		N/A	
Corrosion Potential (Closest grid point, V)		-0.092		-0.266	
Compressive Strength (MPa)		-		-	
Chloride Content (% by weight of concrete)		**Total**	**Corrected**	**Total**	**Corrected**
	0-10mm	0.034	0.012	-	-
	20-30mm	0.026	0.004	-	-
	40-50mm	0.025	0	-	-
	60-70mm	0.026	0.001	-	-
	80-90mm	0.025	0	-	-
Air Voids	**Air Content (%)**	-		-	
	Spec. Surf (mm^2/mm^3)	-		-	
	Spacing Factor (mm)	-		-	
Testing Laboratory		Golder Assoc. Ltd.		-	
Remarks		45mm latex modified concrete overlay with good bond to deck. 170mm deck. Narrow horizontal crack along overlay/deck interface. Narrow vertical crack extending 125mm from bottom up.		Core taken from sidewalk. Core broke during coring operation. 240mm sidewalk with good bond to deck. Narrow horizontal crack along sidewalk/deck interface.	

1. Defects: C = Cracked, D = Delamination, R=Rough, Sc = Scaling, S = Spalling, N =None
2. Condition: G = Good, F = Fair, P = Poor
3. Condition of Rebar: LR = Light Rust, SR = Severe Rust, N/A = No rebar exposed

Core C1 - Note light surface rusting on reinforcing steel bar

Core C2

Core C3

Core C4 – Note air voids

Core C5 - Note split due to coring operation

Core C6 - Note core removed from sidewalk; air voids noted

Core C7 - Note air voids noted

Core C8 - Note core removed from area of deck patching

Core C10 - Note air voids noted

Core C11 - Note air voids noted

Core C12 - Note core removed from sidewalk, note air voids

Core C13 - Note narrow horizontal crack at overlay/deck interface

Core C14 - Note, core split during coring operation. Note narrow horizontal crack along sidewalk/deck interface below split

APPENDIX G

ASPHALT SAWN SAMPLE LOG AND PHOTOS (STRUCTURAL)

SAWN ASPHALT SAMPLE LOG

Walpole Island Swing Bridge

Sample Number	S1	S2	S3
Location	D71	D63	F48
Size (mm x mm)	300 x 300	300 x 300	300 x 300
Thickness of Asphalt (mm)	60	62	55
Thickness of Asphalt at Nearest Grid Point (mm)	N/A	N/A	N/A
Condition of Asphalt[1]	G	G	G
Waterproofing (W/P) Type	Unknown	Unknown	Unknown
W/P Thickness (mm)	0	0	0
Condition of W/P[1]	N/A	N/A	N/A
Bond of W/P to Asphalt	G	G	P
Bond of W/P to Steel	G	G	P
Concrete Cover to Reinforcing Steel (mm)	N/A	N/A	N/A
Defects in Steel Surface	N	N	N
Corrosion Potential at Nearest Grid Point	N/A	N/A	N/A
Remarks	No cracks noted in steel deck. No corrosion noted on steel deck. Good bond between asphalt and deck.	No cracks noted in steel deck. No corrosion noted on steel deck. Good bond between asphalt and deck.	No cracks noted in steel deck. No corrosion noted on steel deck. Poor bond between asphalt and deck.

1. Condition: G = Good, F = Fair, P = Poor
2. Defects: C = Cracked, D = Delamination, R=Rough, Sc = Scaling, S = Spalling, N =None

SAWN ASPHALT SAMPLE LOG

Walpole Island Swing Bridge

Sample Number	S4	S5	S6
Location	D36	F29	A49
Size (mm x mm)	340 x 280	320 x 270	220 x 310
Thickness of Asphalt (mm)	63	62	62
Thickness of Asphalt at Nearest Grid Point (mm)	N/A	N/A	N/A
Condition of Asphalt[1]	G	F - G	G
Waterproofing (W/P) Type	Unknown	Unknown	Unknown
W/P Thickness (mm)	0	0	0
Condition of W/P[1]	N/A	N/A	N/A
Bond of W/P to Asphalt	G	G	G
Bond of W/P to Steel	G	G	G
Concrete Cover to Reinforcing Steel (mm)	N/A	N/A	N/A
Defects in Steel Surface	N	N	N
Corrosion Potential at Nearest Grid Point	N/A	N/A	N/A
Remarks	No cracks noted in steel deck. No corrosion noted on steel deck. Good bond between asphalt and deck.	No cracks noted in steel deck. No corrosion noted on steel deck. Good bond between asphalt and deck.	No cracks noted in steel deck. No corrosion noted on steel deck. Good bond between asphalt and deck.

1. Condition: G = Good, F = Fair, P = Poor
2. Defects: C = Cracked, D = Delamination, R=Rough, Sc = Scaling, S = Spalling, N =None

Sawn Sample S1

Sawn Sample S2

Sawn Sample S3

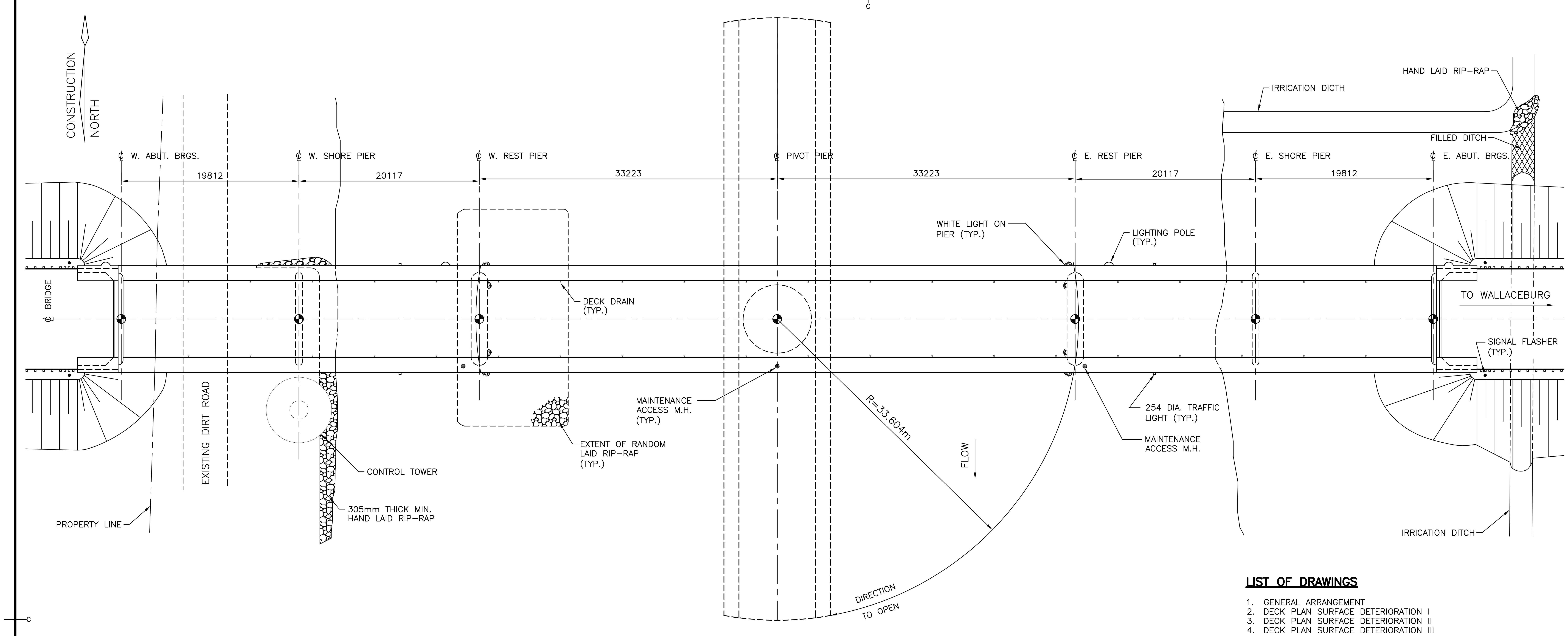
Sawn Sample S4

Sawn Sample S5

Sawn Sample S6

APPENDIX H

DECK CONDITION SURVERY DRAWINGS (STRUCTURAL)



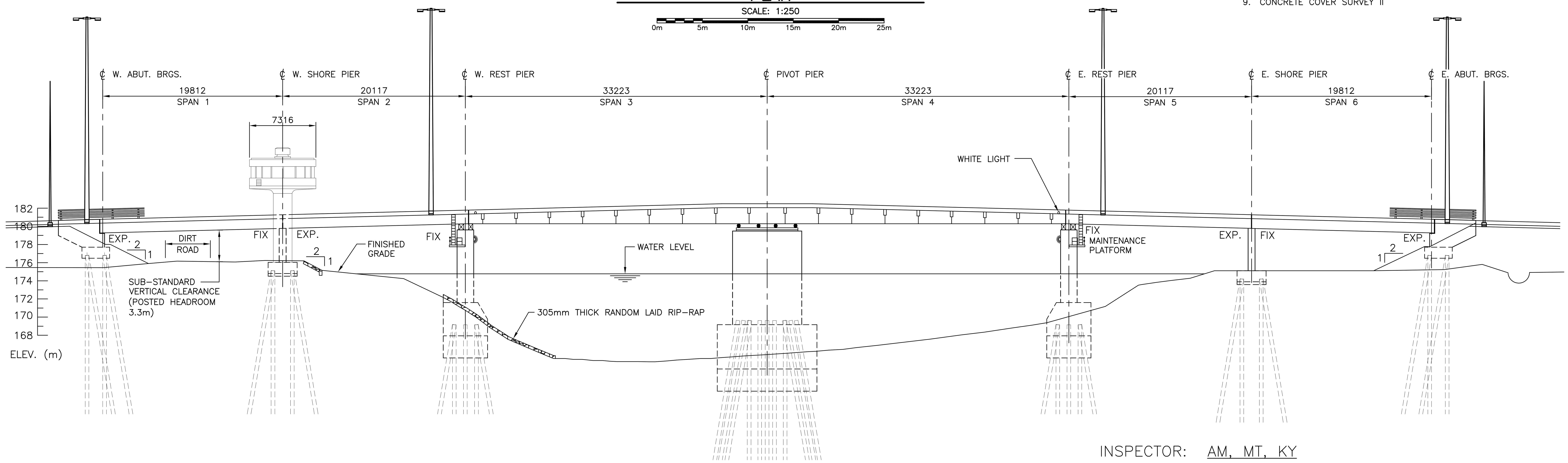
PLAN

SCALE: 1:250

0m 5m 10m 15m 20m 25m

LIST OF DRAWINGS

1. GENERAL ARRANGEMENT
2. DECK PLAN SURFACE DETERIORATION I
3. DECK PLAN SURFACE DETERIORATION II
4. DECK PLAN SURFACE DETERIORATION III
5. DECK PLAN SURFACE DETERIORATION IV
6. CORROSION POTENTIALS I
7. CORROSION POTENTIALS II
8. CONCRETE COVER SURVEY I
9. CONCRETE COVER SURVEY II



INSPECTOR: AM, MT, KY

DATE APRIL 30, MAY 1 2012

ELEVATION

SCALE: 1:250

0m 5m 10m 15m 20m 25m

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WALPOLE ISLAND SWING BRIDGE CONDITION SURVEY

drawing / dessin

WALPOLE ISLAND BRIDGE GENERAL ARRANGMENT

designed / conçu: A. MONTELEONE
date: MAY 2012

drawn / dessiné: M. YANG
date: MAY 2012

approved / approuvé: G. JEYAQOBY
date: MAY 2012

Tender / Soumission

PWGSC Project Manager / Administrateur de projets TPSGC

project number / no. du projet: R.051213.001

drawing no. / no. du dessin: 1

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DATE PLOTTED: 6/1/2012 10:17:23 AM BY: XING ZHAO

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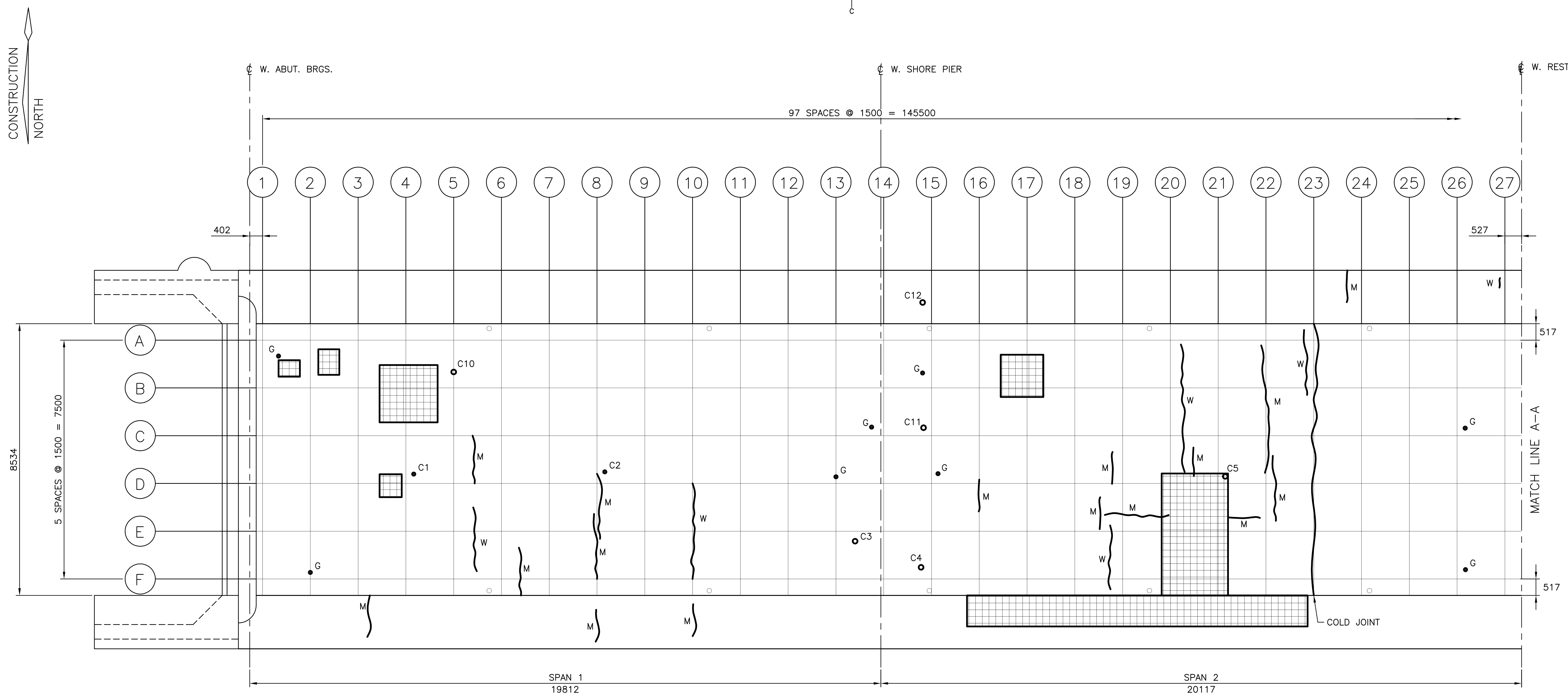

PLAN

SCALE/ÉCHELLE: 1:75

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

LEGEND:

M	MEDIUM CRACK
W	WIDE CRACK
▦	PREVIOUSLY REPAIRED/PATCHED CONCRETE
■	ASPHALT SAWN SAMPLE
G	GROUND CHECK
C	CONCRETE CORE

NOTE: DIMENSIONS ON SURFACE DEFECTS ARE APPROXIMATE ONLY

INSPECTOR: AM, MT, KY

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WALPOLE ISLAND SWING BRIDGE CONDITION SURVEY

drawing / dessin

DECK PLAN
SURFACE DETERIORATION I

designed	A. MONTELEONE	conçu
date	MAY 2012	
drawn	Z. PAN	dessiné
date	MAY 2012	
approved	G. JEYAQOBY	approuvé
date	MAY 2012	
Tender		Soumission
PWGSC Project Manager		Administrateur de projets TPSGC
project number	R.051213.001	no. du projet
drawing no.	2	no. du dessin

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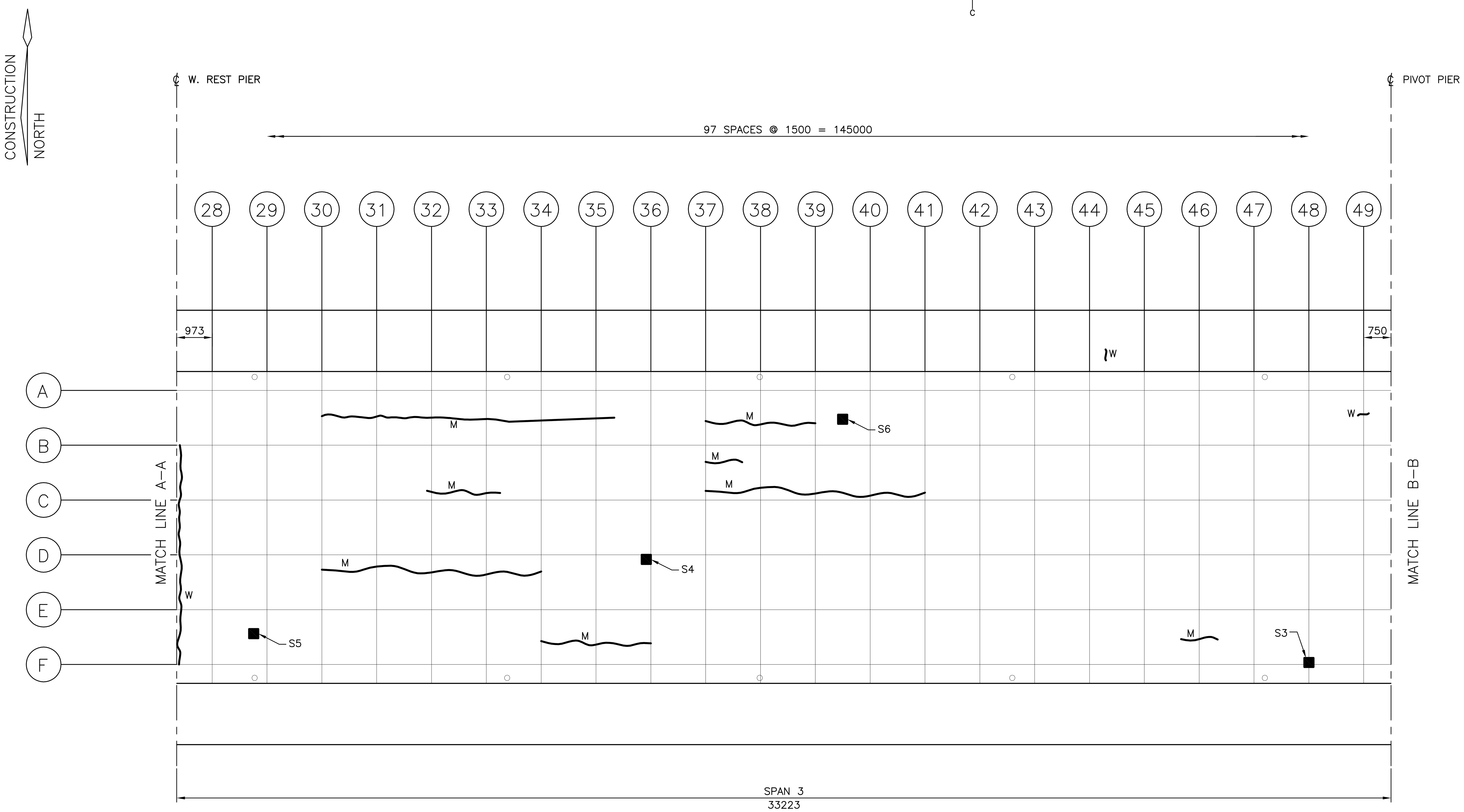

PLAN

SCALE/ÉCHELLE: 1:75

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

LEGEND:

M	MEDIUM CRACK
W	WIDE CRACK
	PREVIOUSLY REPAIRED/PATCHED CONCRETE
■	ASPHALT SAWN SAMPLE
G	GROUND CHECK
C	CONCRETE CORE

NOTE: DIMENSIONS ON SURFACE DEFECTS ARE APPROXIMATE ONLY

INSPECTOR: AM, MT, KY

DATE APRIL 30, MAY 1 2012

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WALPOLE ISLAND SWING BRIDGE CONDITION SURVEY

drawing / dessin

DECK PLAN
SURFACE DETERIORATION II

designed / conçu: A. MONTELEONE
date: MAY 2012
drawn / dessiné: Z. PAN
date: MAY 2012
approved / approuvé: G. JEYAQOBY
date: MAY 2012
Tender / Soumission
PWGSC Project Manager / Administrateur de projets TPSGC
project number / no. du projet: R.051213.001
drawing no. / no. du dessin: 3

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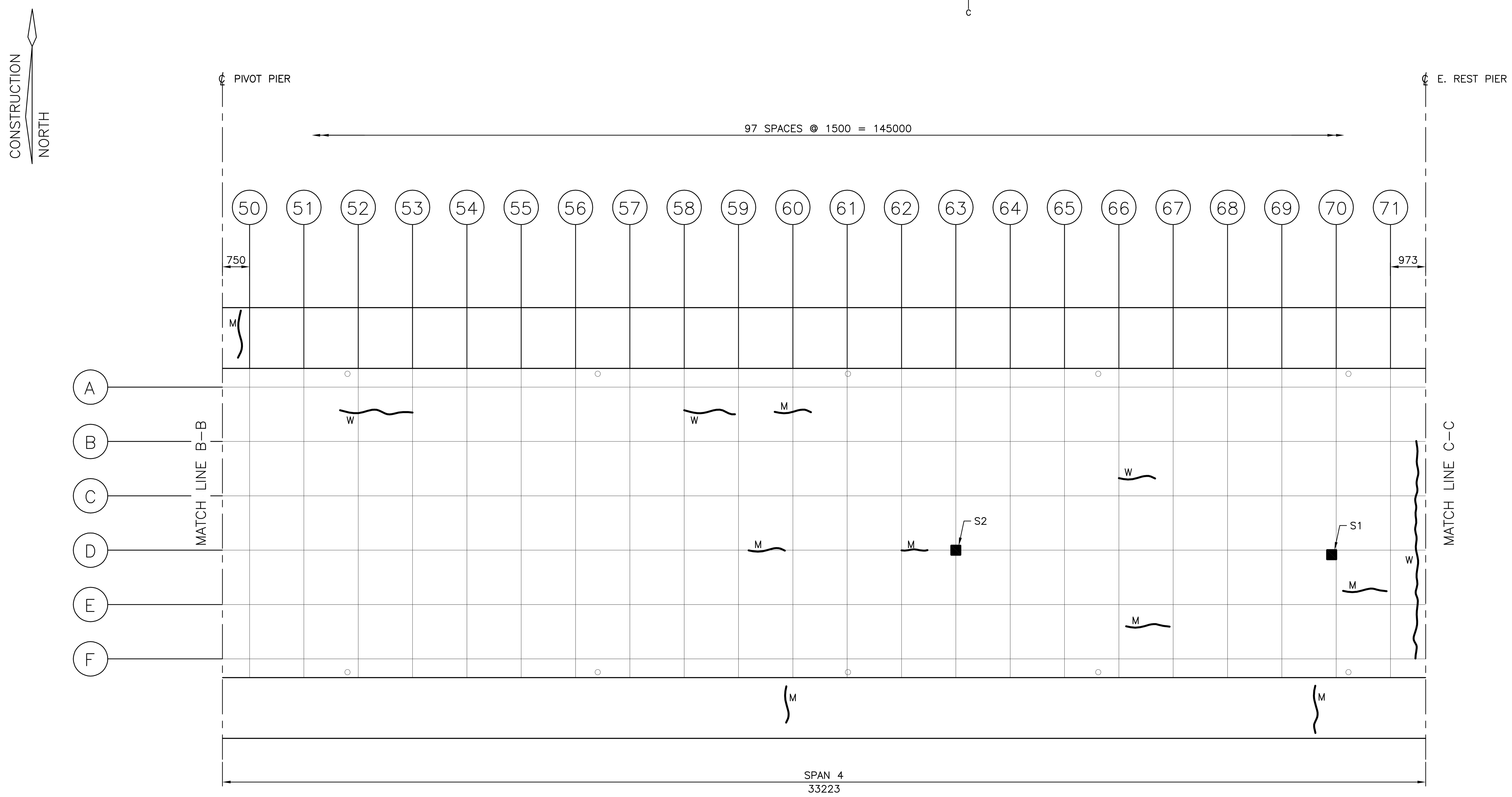

PLAN

SCALE/ÉCHELLE: 1:75

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

LEGEND:

M	MEDIUM CRACK
W	WIDE CRACK
	PREVIOUSLY REPAIRED/PATCHED CONCRETE
■	ASPHALT SAWN SAMPLE
G	GROUND CHECK
C	CONCRETE CORE

NOTE: DIMENSIONS ON SURFACE DEFECTS ARE APPROXIMATE ONLY

INSPECTOR: AM, MT, KY

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revisions 0	date
project / projet	WALPOLE ISLAND SWING BRIDGE CONDITION SURVEY
drawing / dessin	DECK PLAN SURFACE DETERIORATION III
designed / conçu	A. MONTELEONE
date	MAY 2012
drawn / dessiné	Z. PAN
date	MAY 2012
approved / approuvé	G. JEYAQOBY
date	MAY 2012
Tender	Soumission
PWGSC Project Manager	Administrateur de projets TPSGC
project number / no. du projet	R.051213.001
drawing no. / no. du dessin	4

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DATE PLOTTED: 6/1/2012 10:17:37 AM BY: XING ZHAO

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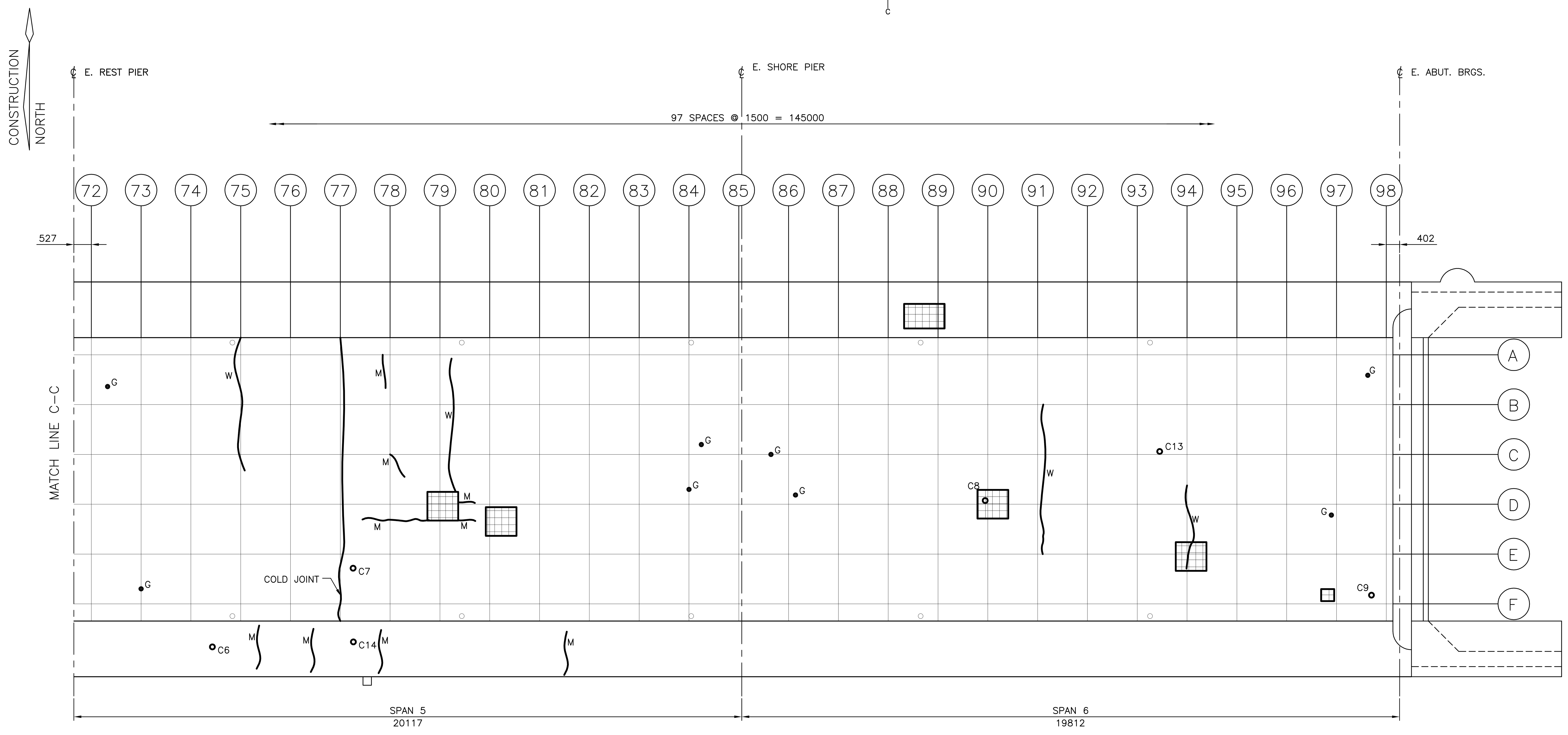

PLAN

SCALE/ÉCHELLE: 1:75

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

LEGEND:

M	MEDIUM CRACK
W	WIDE CRACK
	PREVIOUSLY REPAIRED/PATCHED CONCRETE
■	ASPHALT SAWN SAMPLE
G	GROUND CHECK
C	CONCRETE CORE

NOTE: DIMENSIONS ON SURFACE DEFECTS ARE APPROXIMATE ONLY

INSPECTOR: AM, MT, KY

DATE APRIL 30, MAY 1 2012

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WALPOLE ISLAND SWING BRIDGE CONDITION SURVEY

drawing | dessin

DECK PLAN

SURFACE DETERIORATION IV

designed A. MONTELEONE conçu
date MAY 2012
drawn Z. PAN dessiné
date MAY 2012
approved G. JEYAQOBY approuvé
date MAY 2012
Tender Soumission
PWGSC Project Manager Administrateur de projets TPSGC
project number no. du projet
R.051213.001
drawing no. no. du dessin
5

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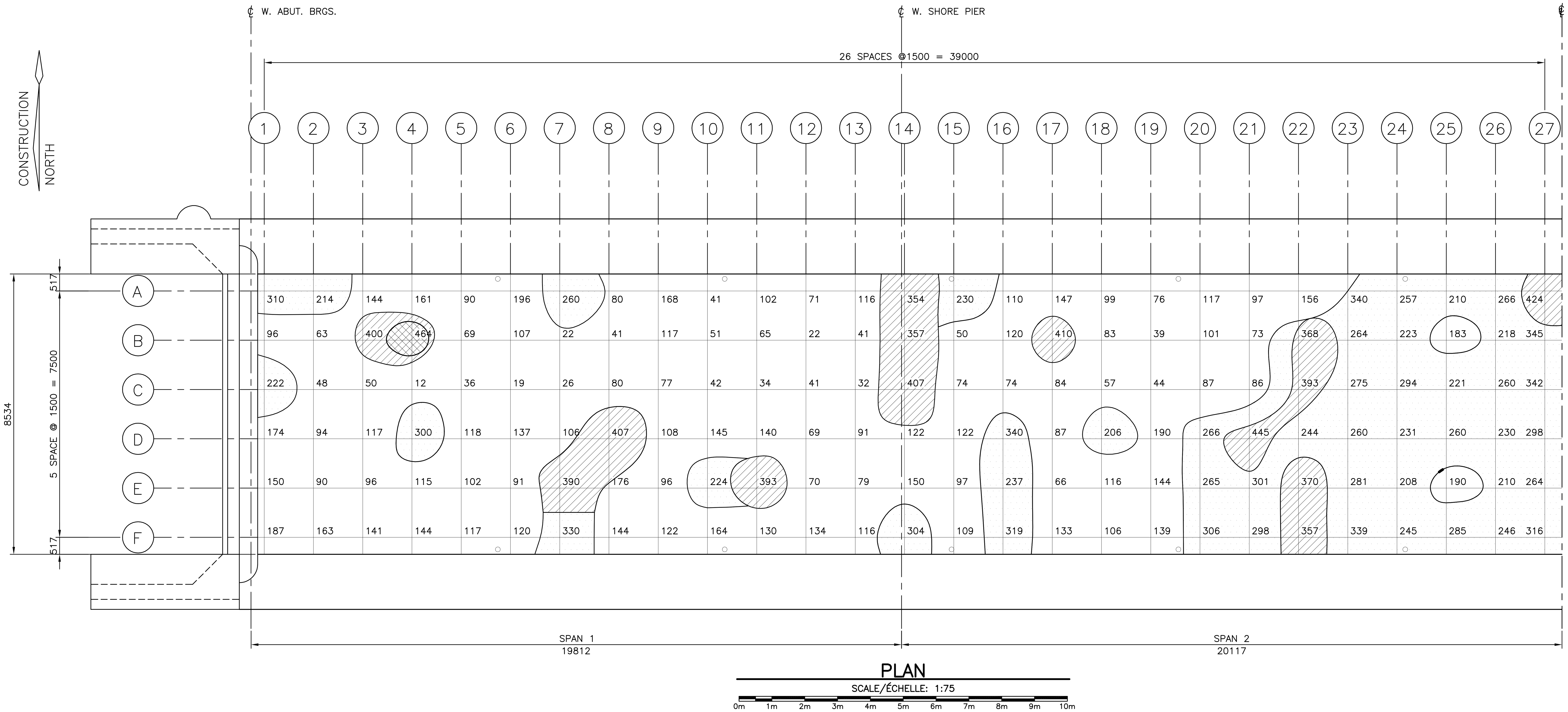

LEGEND:

- 0 TO −199 mV
- −200 TO −350 mV
- −350 TO −450 mV
- MORE NEGATIVE THAN −450 mV
- 175 HALF CELL POTENTIAL (NEGATIVE VOLTS x10^{-3})

INSPECTOR: AM, MT, KY

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WALPOLE ISLAND SWING BRIDGE CONDITION SURVEY

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CORROSION POTENTIALS I

designed	A. MONTELEONE	conçu
date	MAY 2012	
drawn	Z. PAN	dessiné
date	MAY 2012	
approved	G. JEYAQOBY	approuvé
date	MAY 2012	
Tender		Soumission
PWGSC Project Manager		Administrateur de projets TPSGC
project number	R.051213.001	no. du projet
drawing no.	6	no. du dessin

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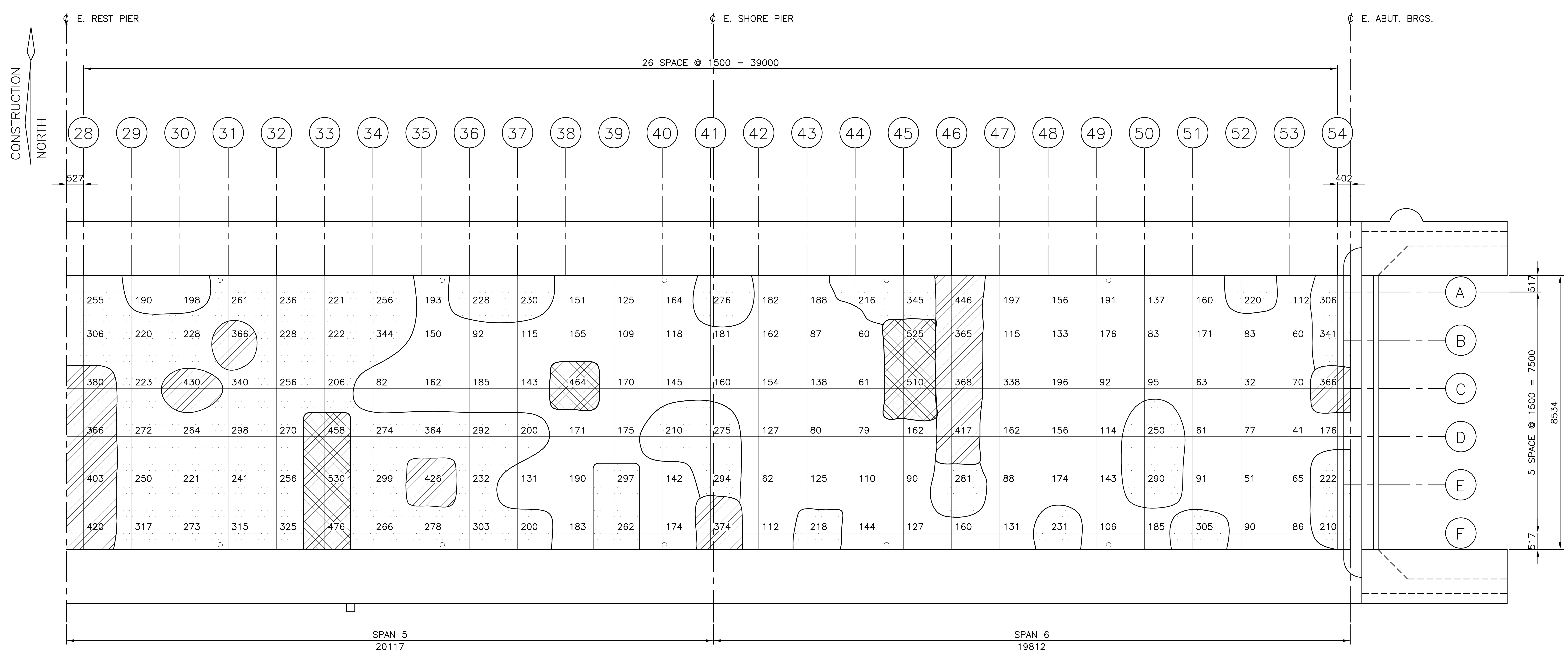

PLAN

SCALE/ÉCHELLE: 1:75

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

LEGEND:

- 0 TO −199 mV
- −200 TO −350 mV
- −350 TO −450 mV
- MORE NEGATIVE THAN −450 mV
- 175 HALF CELL POTENTIAL (NEGATIVE VOLTS x10^{-3})

INSPECTOR: AM, MT, KY

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WALPOLE ISLAND SWING BRIDGE CONDITION SURVEY

drawing / dessin

CORROSION POTENTIALS II

designed	A. MONTELEONE	conçu
date	MAY 2012	
drawn	Z. PAN	dessiné
date	MAY 2012	
approved	G. JEYAQOBY	approuvé
date	MAY 2012	
Tender		Soumission
PWGSC Project Manager		Administrateur de projets TPSGC
project number	R.051213.001	no. du projet
drawing no.	7	no. du dessin

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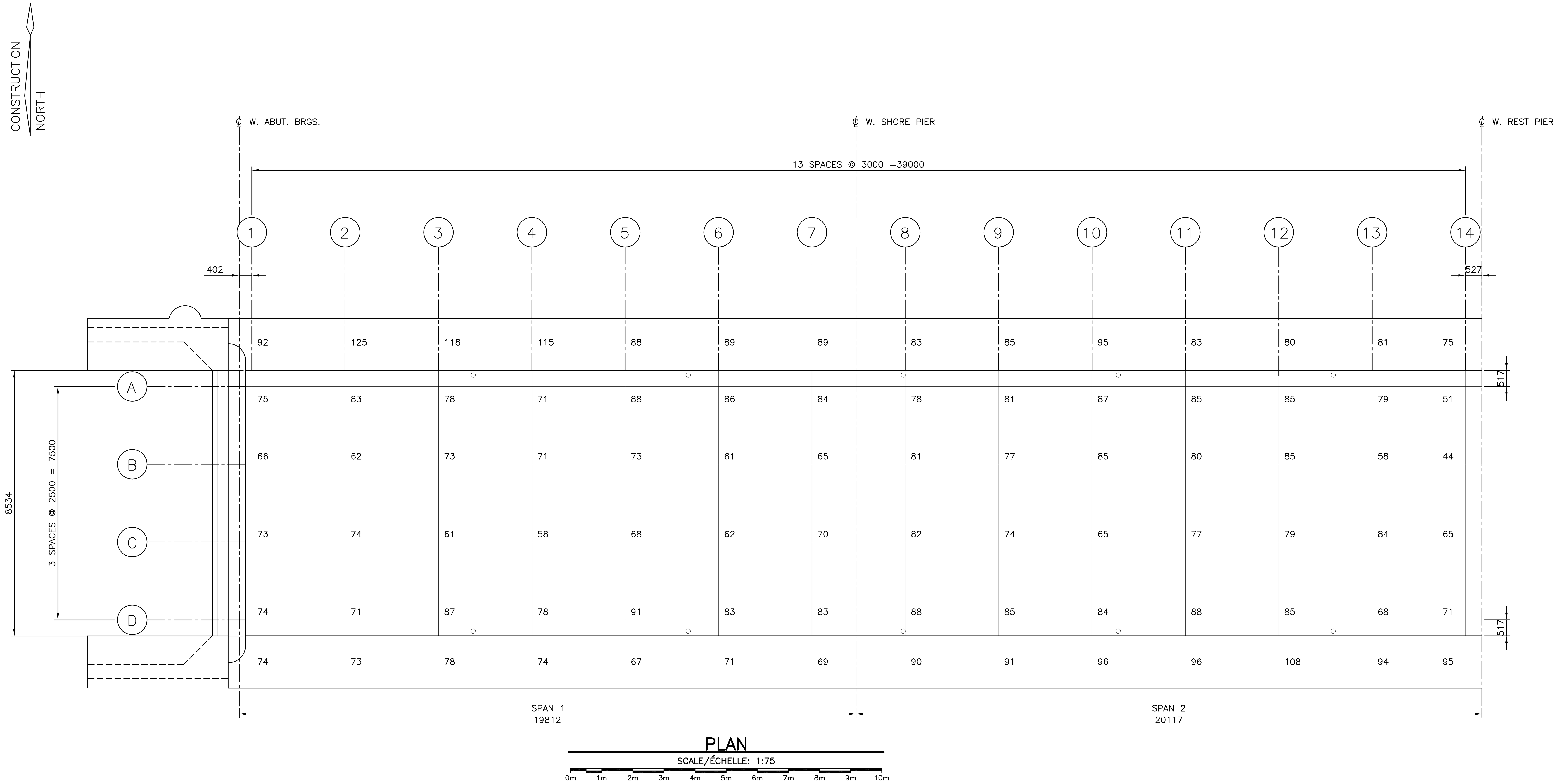

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	92	125	118	115	88	89	89	83	85	95	83	80	81	75
A	75	83	78	71	88	86	84	78	81	87	85	85	79	51
B	66	62	73	71	73	61	65	81	77	85	80	85	58	44
C	73	74	61	58	68	62	70	82	74	65	77	79	84	65
D	74	71	87	78	91	83	83	88	85	84	88	85	68	71
	74	73	78	74	67	71	69	90	91	96	96	108	94	95

INSPECTOR: AM, MT, KY

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project / projet
WALPOLE ISLAND
SWING BRIDGE
CONDITION SURVEY

drawing / dessin
CONCRETE COVER
SURVEY I

designed / conçu A. MONTELEONE
date MAY 2012
drawn / dessiné Z. PAN
date MAY 2012
approved / approuvé G. JEYAQOBY
date MAY 2012
Tender / Soumission
PWGSC Project Manager / Administrateur de projets TPSGC
project number / no. du projet
R.051213.001
drawing no. / no. du dessin
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PWGSC A1 (2004)

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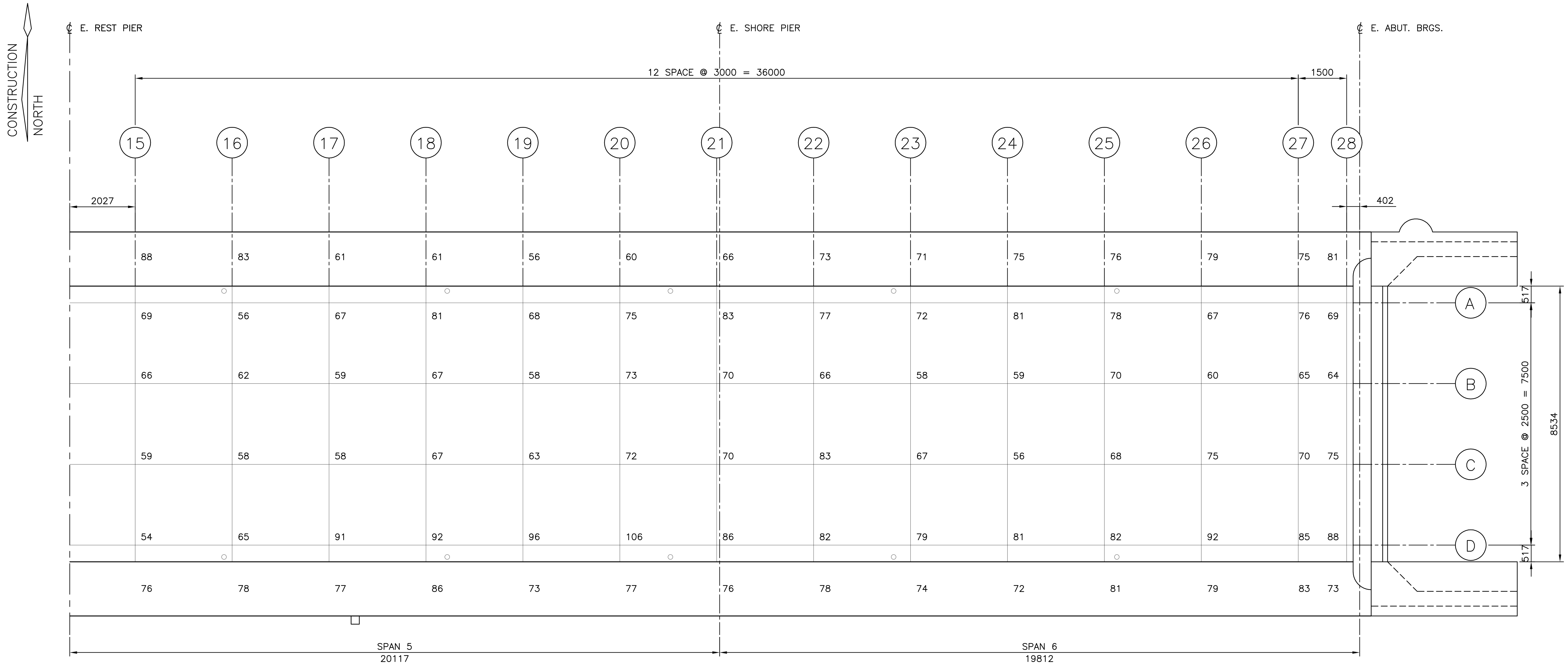

PLAN

SCALE/ÉCHELLE: 1:75

0m 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m

INSPECTOR: AM, MT, KY

DATE APRIL 30, MAY 1 2012

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WALPOLE ISLAND SWING BRIDGE CONDITION SURVEY

drawing / dessin

CONCRETE COVER SURVEY II

designed / conçu: A. MONTELEONE
date: MAY 2012
drawn / dessiné: Z. PAN
date: MAY 2012
approved / approuvé: G. JEYAQOBY
date: MAY 2012
Tender / Soumission
PWGSC Project Manager / Administrateur de projets TPSGC
project number / no. du projet: R.051213.001
drawing no. / no. du dessin: 9

APPENDIX I

CONCRETE CORE LABORATORY TESTING RESULTS (STRUCTURAL)

MICROSCOPICAL DETERMINATION OF AIR VOID SYSTEM PARAMETERS IN HARDENED CONCRETE

(MTO LS-432)

Golder Associates

May 11, 2012

Golder Project Number: 12-1183-0052-1000

McCormick Rankin
2655 North Sheridan Way
Mississauga, ON L5K 2P8

Attention: Mr. Agostino Monteleone, P.Eng.

Project:	Walpole Island Swing Bridge
File No.	3211121.300

Date Received: May 07, 2012 **Date Tested:** May 12, 2012
Tested By: J. Taylor

Method Used:	**Modified Point Count (Procedure B)**	
Sample ID #	C4	C10
Golder Lab Number	C-12-0378	C-12-0380
Length of traverse, mm	2577.5	2577.5
Total number of stops	1353	1353
Total area tested, cm^2	132.8	85.9
Paste content, %	27.27	28.53
Paste to air ratio, %	6.15	4.20
Void frequency, per mm	0.233	0.227
Average chord length, mm	0.190	0.300
Specific surface, mm^2/mm^3	21.03	13.35
Spacing factor, mm	**0.242**	**0.314**
Air content, %	**4.4**	**6.8**
Remarks:		

Reviewed by: ______________________
Jeremy Rose, Laboratory Manager

CCIL

Notice: The test data given herein pertains to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

OBTAINING AND TESTING DRILLED CORES FOR COMPRESSIVE STRENGTH TEST
(CSA A23.2-14C)

May 11, 2012

Golder Project Number: 12-1183-0052-1000

McCormick Rankin
2655 North Sheridan Way
Mississauga, ON L5K 2P8

Attention: Mr. Agostino Monteleone, P.Eng.

Project:	Walpole Island Swing Bridge
File No.	3211121.300

Date Received: May 07, 2011
Date Tested: May 11, 2011 **Tested By:** J. Taylor

Core Number:	**C8**	**C11**
Golder Lab Number:	C-12-0379	C-12-0381
Moisture Condition at Time of Test	Wet	Wet
Capping Material	Grinder	Grinder
Average Diameter, (mm)	98.5	98.5
Average Length (mm)	148.7	169.3
Density, (Mg/m^3)	2.331	2.324
Load, (kN)	456.37	351.55
Compressive Strength, (MPa)	59.9	46.2
Corrected Compressive Strength, (MPa)	**57.6**	**45.2**
Remarks:		

Reviewed by: ____________________
Jeremy Rose, Laboratory Manager

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

ACID SOLUBLE CHLORIDE ION CONTENT IN CONCRETE
(MTO LS-417)

Golder Associates

May 11, 2012

Golder Project Number: 12-1183-0052-1000

McCormick Rankin
2655 North Sheridan Way
Mississauga, ON L5K 2P8

Attention: Mr. Agostino Monteleone, P.Eng.

Project:	Walpole Island Swing Bridge
File No.	3211121.300

Date Received: May 07, 2011
Date Tested: May 11, 2011 **Tested By:** R. McVey

Core Number:	**C3**	**C13**
Golder Lab No.:	C-12-0377	C-12-0382
Horizon Depth	**Acid Soluble Chloride Ion Content (% Cl by Weight of Concrete)**	
0 – 10 mm	0.249	0.034
20 – 30 mm	0.025	0.026
40 – 50 mm	0.029	0.025
60 – 70 mm	0.046	0.026
80 – 90 mm	0.038	0.025
Remarks:		

Reviewed by: ______________________
Jeremy Rose, Laboratory Manager

CCIL

Notice: The test data given herein pertain to the samples provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Golder Associates

ACID SOLUBLE CHLORIDE ION CONTENT IN CONCRETE
(MTO LS-417)

May 29, 2012

Golder Project Number: 12-1183-0052-1000

McCormick Rankin
2655 North Sheridan Way
Mississauga, ON L5K 2P8

Attention: Mr. Agostino Monteleone, P.Eng.

Project:	Walpole Island Swing Bridge
File No.	3211121.300

Date Received: May 25, 2012
Date Tested: May 29, 2012 **Tested By:** R. Hobson

Core Number:	**C2**	**C6**
Golder Lab No.:	C-12-0449	C-12-0450
Horizon Depth	**Acid Soluble Chloride Ion Content (% Cl by Weight of Concrete)**	
0 – 10 mm	0.112	0.431
20 – 30 mm	0.085	0.191
40 – 50 mm	0.023	0.098
60 – 70 mm	0.022	0.120
80 – 90 mm	0.023	0.072
Remarks:		

Reviewed by: ______________________
Jeremy Rose, Laboratory Manager

CCIL

APPENDIX J

UNDERWATER INSPECTION REPORT

FINAL REPORT

Submitted to

McCormick Rankin, a Member of MMM Group

May 23, 2012

Walpole Island Bridge Inspection

Underwater Inspection Completed: May 1, 2012

Prepared by:
Hoi Leung, Operations Manager

ASI Group Project DH11-097

ASI Group

PO Box 2205, 250 Martindale Road, St. Catharines, Ontario, L2R 7R8, Canada
Tel: 905-641-0941 Fax: 905-641-1825 www.asi-group.com

Table of Contents

List of Appendices

FINAL REPORT

McCormick Rankin, a Member of MMM Group
Walpole Island Bridge Inspection

Inspection Completed: May 1, 2012

Prepared by: Hoi Leung, Operations Manager

1.0 CONSTRUCTION INFORMATION

Walpole Island Bridge is located in Lambton County west of Wallaceburg. It has an east / west orientation. The feature carried is RR 32 (Tecumseh Road) and the feature crossed is the Snye River. The water flows in a southerly direction.

The bridge is a six span structure with five piers. The West Rest Pier, Pivot Pier and East Rest Pier were inspected completely. The West Shore Pier was dry and only the west side of East Shore Pier was inspected.

Figure 1: North Elevation

2.0 BACKGROUND INFORMATION

Reference drawings provided by McCormick Rankin can be found in Appendix 1 and are as follows:

Drawing Title	**Drawing / File No.**
General Arrangement	unknown
Electrical Details	unknown

3.0 GENERAL INFORMATION

For the purposes of this inspection, the bridge will be described using the cardinal coordinate system and not the flow of the river. Flow of the river is from north to south and was minimal at the time of the inspection.

4.0 SCOPE OF WORK

Inspection requirements involved an underwater inspection of the piers and dolphins (i.e., substructure). Only the primary components associated with the aforementioned sections will be considered.

The report shall include:

- Atmospheric and hydraulic conditions
- Descriptions and photographs of all anomalies or damages
- Descriptions and measurements of all damaged areas
- General riverbed observations

DVD documentation is provided, contingent on water clarity at the time of inspection.

5.0 RESULTS

5.1 Information Gathered

The following information was gathered during the inspection process:

- Digital photographs obtained during the surface inspection.
- General layout drawings provided by McCormick Rankin.

5.2 Findings

5.2.1 Method of Evaluation

Based on the Bridge Inspection Manual (BIM) dated December 2010, the materials defects chart was used to identify the conditions found. Severity levels, wherever possible, were established.

Concrete conditions identified are:

- Scaling
- Disintegration
- Erosion
- Delamination
- Spalling
- Cracking
- Surface Defects

All dimensions are expressed in millimetres.

5.2.2 West Rest Pier

The West Rest Pier was in good condition at the time of the inspection.

Figure 2: West Rest Pier, East Face

The benchmark was 4200mm, measured from the top of the West Rest Pier at the north nose to the water line. Average depth soundings on the west face were 3952mm and 5587mm on the east face. There was a significant slope from the west to the east face but there were no localized areas of scour or undermining. The bottom was composed of silt and timber debris.

The footing was 3400mm below the water line. It was 1600mm wide measured from the face of the pier to the edge. Steel sheet pile surrounding the footing was exposed on the west side 600mm above the mud line and 2300mm on the east side. The sheet pile was in good condition at the time of the inspection.

There were minor spalls at the water line at both the north and south nose. The dimensions were 300mm in diameter and 30mm deep. No rebar was exposed. The remaining concrete surfaces were in good condition with no cracks. Marine growth in the form of mussels covered 40% of all surfaces.

Figure 3: West Rest Pier, North Nose showing Spall at Water Line

5.2.3 Pivot Pier

The Pivot Pier was in good condition at the time of the inspection.

Figure 4: Pivot Pier, South Face

Figure 5: Pivot Pier, North Face

The benchmark was 3900mm, measured from the top of the Pivot Pier to the water line at the centre line of the south face. Average depth soundings were 11,216mm. There were no localized areas of scour or undermining. The bottom was composed of silt and timber debris.

The footing was 6000mm below the water line. It was 2000mm wide measured from the face of the pier to the edge. Steel sheet pile surrounding the footing was exposed on an average of 5700mm above the mudline. The sheet pile was in good condition at the time of the inspection. The concrete surfaces were in good condition with 100% coverage of mussel and marine growth. There was scaling of 10mm in a horizontal band at the water line.

5.2.4 East Rest Pier

The East Rest Pier was in good condition at the time of inspection.

Figure 6: East Rest Pier, West Face

Average depth soundings on the west face were 8983mm and 6105mm on the east face. There was a significant slope from the east face down to the west face but there were no localized areas of scour or undermining. The bottom was composed of silt and timber debris.

The footing was 3600mm below the water line. It was 700mm wide on the west face and 1600mm wide on the east face. Steel sheet pile surrounding the footing was exposed on the west side 5600mm above the mud line and 3300mm on the east side. The sheet pile was in good condition at the time of the inspection.

There were minor spalls at the water line at both the north and south nose. The dimensions were 500mm in diameter and 30mm deep. No rebar was exposed. The remaining concrete surfaces were in good condition with no cracks. Marine growth in the form of mussels covered 40% of all surfaces.

Note: As per drawings, a submarine cable extends from the West Rest Pier to the East Rest Pier via the Pivot Pier. This cable was not visible during the time of inspection (drawings show it is buried).

5.2.5 East Shore Pier

The East Shore Pier was in good condition at the time of inspection. Only the west side was inspected.

Figure 7: East Shore Pier, West Face

The average depth sounding was 438mm. There was no localized scour or undermining.

The concrete was in good condition with no cracks or spalls. The footing was 50mm below water surface and 1400mm wide. It was exposed 350mm above the mudline on average. There was no steel sheet pile exposed. River bottom was light silt and mud.

5.2.6 Dolphins

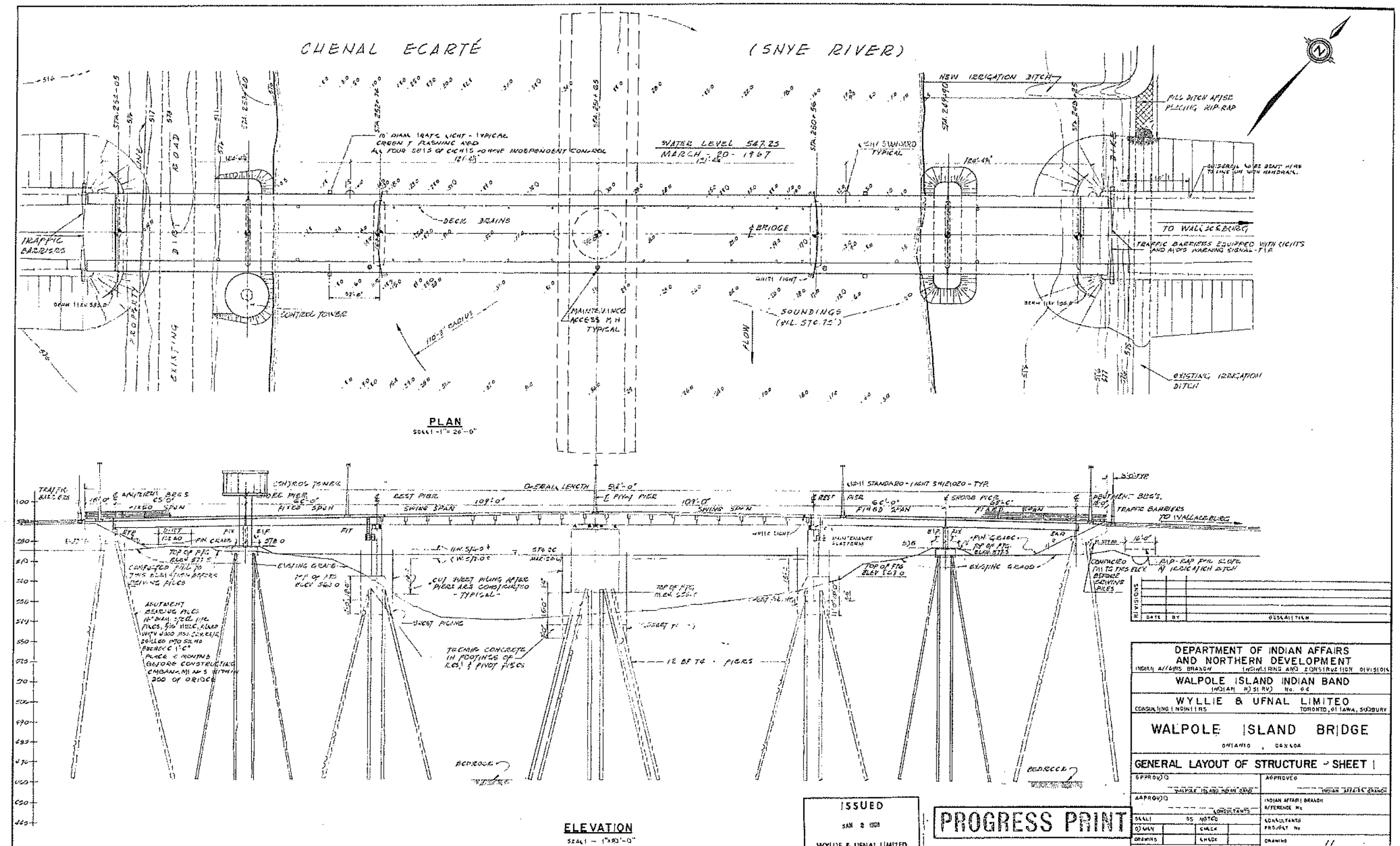
Dolphins north and south of the bridge were inspected. The dolphin north of the West Rest Pier had only one band of wire above water. All other dolphins had two bands above water. The dolphin north of the Pivot Pier was leaning toward the pier. The remaining dolphin north of the bridge was in good condition. The northernmost dolphin was not inspected.

The dolphin directly south of the Pivot Pier had a split that terminated at the waterline. The remaining dolphins were in good condition. The southernmost dolphin was not inspected.

Figure 8: North Dolphin showing lean toward the bridge. Dolphin in the background shows only one band at the top and missing band above the waterline

APPENDIX 1:

Drawings



CHENAL ECARTÉ
(SNYE RIVER)
NEW IRRIGATION DITCH
WATER LEVEL 547.25
MARCH - 20 - 1967
DECK DRAINS
CONTROL TOWER
TRAFFIC BARRIERS
TO WALLACEBURG
SOUNDINGS
FLOW
EXISTING IRRIGATION DITCH
PLAN
ELEVATION
EXISTING GRADE
12 OF 14 - PIERS
BEDROCK
ISSUED
WYLLIE & UFNAL LIMITED
PROGRESS PRINT
REVISIONS
DATE
BY
DESCRIPTION
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT
INDIAN AFFAIRS BRANCH
ENGINEERING AND CONSTRUCTION DIVISION
WALPOLE ISLAND INDIAN BAND
WYLLIE & UFNAL LIMITED
CONSULTING ENGINEERS
TORONTO, OTTAWA, SUDBURY
WALPOLE ISLAND BRIDGE
ONTARIO, CANADA
GENERAL LAYOUT OF STRUCTURE - SHEET 1
APPROVED
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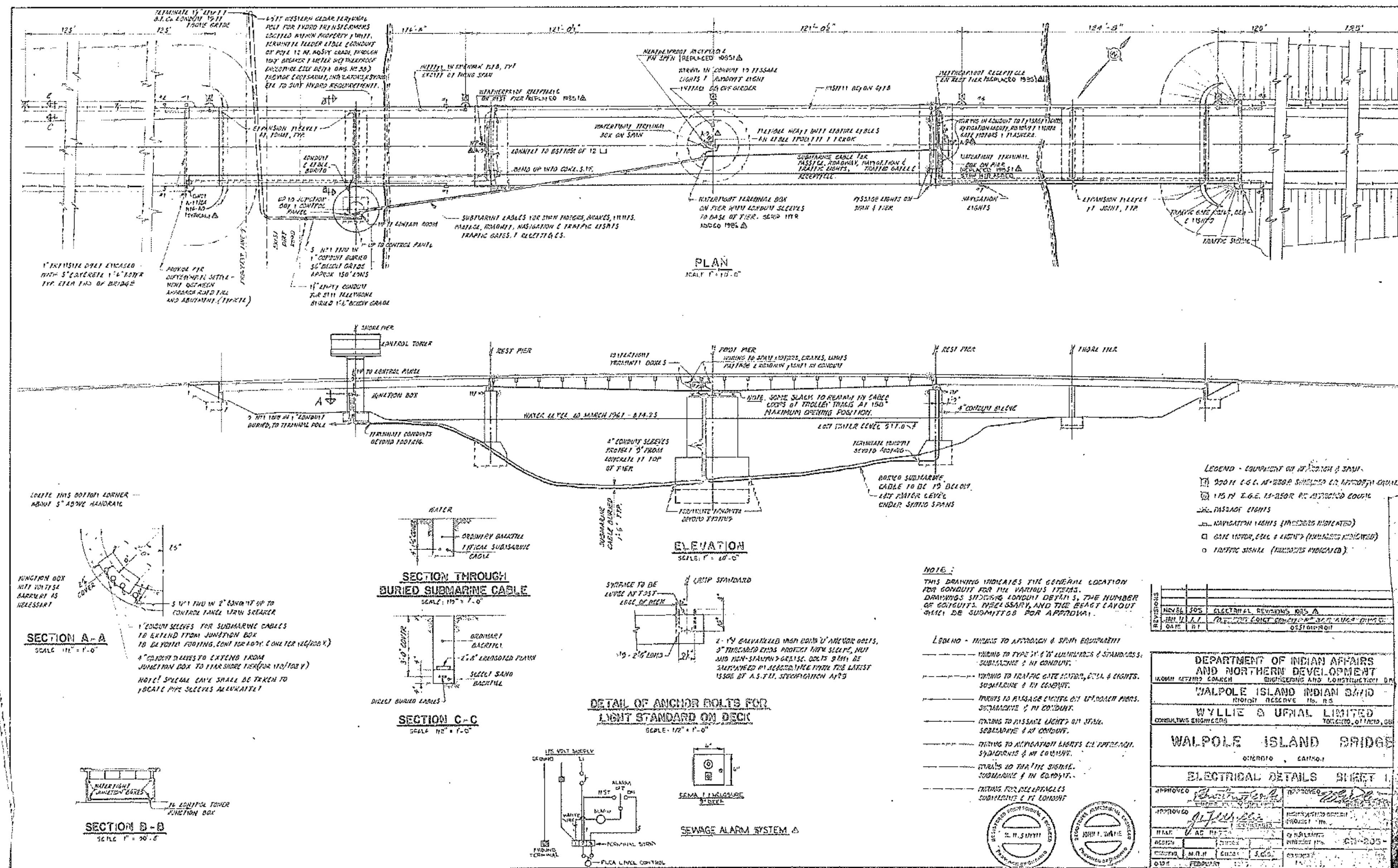
INDIAN AFFAIRS BRANCH
CONSULTANTS
INDIAN AFFAIRS BRANCH
REFERENCE No
SCALE
AS NOTED
CHECK
CONSULTANTS
PROJECT No
DRAWING
DATE
1961.
DRAWING No
11


PLAN
ELEVATION
SECTION THROUGH BURIED SUBMARINE CABLE
SECTION A-A
SECTION C-C
SECTION B-B
DETAIL OF ANCHOR BOLTS FOR LIGHT STANDARD ON DECK
SEWAGE ALARM SYSTEM
NOTE :
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT
ENGINEERING AND CONSTRUCTION
WALPOLE ISLAND INDIAN BAND
WYLLIE & UFNAL LIMITED
CONSULTING ENGINEERS
WALPOLE ISLAND BRIDGE
ELECTRICAL DETAILS SHEET 1
ELECTRICAL REVISIONS 1985
APPROVED
DESIGN
DRAWN
DATE FEBRUARY

APPENDIX 2:

Inspection Video (DVD)

APPENDIX K

DESIGNATED SUBSTANCE SURVEY REPORT

DESIGNATED SUBSTANCE SURVEY

Walpole Island Swing Bridge Rehabilitation

Public Works and Government Services Canada

Project #: R.0512113.001

FINAL REPORT

MAY 2012

PREPARED BY:

ecoplans Limited
A member of MMM GROUP

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PROJECT NO. 3211121.000.

EXECUTIVE SUMMARY

Ecoplans (Ecoplans) was retained by McCormick Rankin to complete a designated substance survey (DSS) of the Walpole Island Swing Bridge, in Walpole Island, Ontario (the "Subject Property"). The Subject Property includes a swing bridge spanning the Chenal Ecart (Snye) River and the accompanying control tower. The bridge connects Tecumseh Road on Walpole Island to Dufferin Avenue.

The purpose of the Designated Substance Survey (DSS) was to identify and characterize building materials that may contain hazardous substances; document the location, type, and current conditions of hazardous building materials; and to assess the need for environmental management of these materials during future renovation work.

Based on the results of this investigation, hazardous building materials have not been identified in accessible areas of the Site. In general, building materials were observed to be in good condition at the Subject Property. The following summarizes the findings and recommendations of the DSS:

Lead: Laboratory results from five representative paint samples collected from areas along walls or railings where localized flaking was observed indicated that elevated levels of lead was not detected in these samples. The majority of painted surfaces observed in the building were observed to be in good condition with some minor localized areas of peeling or flaking. In addition, given the age of the building, any painted surfaces not samples would likely not contain elevated levels of lead. Standard dust control techniques are considered to be appropriate to protect on-site workers during future renovation or demolition processes that may involve disturbing painted surfaces.

Asbestos: Based on the results of the DSS, ACM is not suspected to be present in sampled building materials or other accessible materials observed at the Subject Property. It is possible that inaccessible materials not assessed at the time of this survey (e.g., roofing materials, materials behind enclosed walls, etc.) may contain asbestos. If material conditions are suspect at the time of exposure, confirmatory sampling should be conducted to identify management options.

Mercury: Fluorescent light tubes, metal halide lights and thermostats were observed in the control tower. These materials may contain mercury. The continued use of these systems does not present a hazard to site occupants and the environment. If future renovation activities require the replacement of these light tubes and thermostats, it is recommended that a qualified contractor remove and dispose/recycle the light tubes and thermostats in accordance with regulatory requirements.

Silica: Materials used for the construction of the building, such as mortar, concrete, block and brick are likely to contain silica. As this material was observed to be in good condition at the time of the DSS survey, the possible presence of silica in these materials does not present a

hazard to site occupants and the environment. If future renovation activities may affect the integrity of these materials, standard demolition dust control measures should be implemented where practical to ensure airborne dusts are controlled.

ODS: Based on the results of this survey, ODS are not suspected to be present at the subject property.

PCBs: Based on the results of the survey, there is the potential for PCBs to be present in the light fixture ballasts identified at the Subject Property. It is recommended that during any building renovations that all light fixture ballast be checked for the presence of PCBs.

Other Designated Substances: Ecoplans did not identify the presence of the other following designated substances; Acrylonitrile, Arsenic, Benzene, Coke oven emissions, Ethylene oxide, Isocyanates, and Vinyl chloride.

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1.0 BACKGROUND

Ecoplans (Ecoplans) was retained by McCormick Rankin (MRC) to complete a Designated Substance Survey (DSS) of the Walpole Island Swing Bridge, in Walpole Island, Ontario (the "Subject Property").

The Subject Property includes a swing bridge spanning the Chenal Ecart (Snye) River and the accompanying control tower. The bridge connects Tecumseh Road on Walpole Island to Dufferin Avenue (Figure 1). Repairs and maintenance include in 1981, a concrete overlay and new slabs, operation cables were replaced in 1994 and in 2003 the entire structure was cleaned and recoated.

The purpose of the Designated Substance Survey (DSS) was to identify and characterize building materials that may contain hazardous substances; document the location, type, and current conditions of hazardous building materials; and to assess the need for environmental management of these materials during future renovation work.

1.1 Site Structure Description

The Subject Property is located at NAD 83, Zone 17 UTM co-ordinates 378967E, 4716615N. The Walpole Island Swing Bridge was constructed in 1968 and spans 156 metres across. The bridge consists of a main swing span and two fixed approach spans. The main swing span is constructed of steel plate girders, concrete sidewalks, and a steel orthotropic deck with asphalt surface and rotates upon the centre pivot pier.

The control room structure consists of a concrete slab-on-grade two-storey tower with no basement and is located on the west shore at the south side of the fixed approach span.

Power for the bridge control is supplied via submarine cables from the control tower to the centre pivot pier.

1.2 Limitations

The DSS was completed by observing areas of the building structure that were deemed safe for access. The DSS report reflects the observations and results of analysis completed on specific structures and finishes of the building.

1.3 Scope of Work

Eleven designated substances are regulated under the Occupational Health and Safety Act:

Acrylonitrile, Arsenic, Asbestos, Benzene, Coke oven emissions, Ethylene oxide, Isocyanates, Lead, Mercury, Silica, and Vinyl chloride.

In addition, other potentially hazardous materials such as polychlorinated biphenyls (PCBs) and ozone depleting substances (ODS) are commonly found in buildings. This assessment considers these substances as well.

The DSS considered the age of the facility and typical manufacturing processes for building materials in the assessment of potentially hazardous substances. The scope of work included the following:

- Visually assess building materials for the possible presence of designated substances and hazardous materials;
- Recover non-destructive and representative samples of building materials and submit for laboratory analysis. Samples of building materials suspected of containing hazardous materials were recovered, placed into re-sealable plastic bags and labelled with a unique sample identification number. Samples were submitted to Maxxam Analytics (Maxxam) located in Mississauga, Ontario for analytical testing of lead.
- Prepare a summary report indicating the findings of the DSS.

1.4 Quality Assurance and Quality Control

Samples of building materials were submitted for laboratory analysis. Quality assurance and quality control of the samples were maintained in a number of ways:

- Samples were given unique identifiers as they were collected, identifying the project number, date and sample location. The sample numbers were recorded in field notes for each location.
- A chain-of-custody (COC) form was filled out prior to submitting the samples to the laboratory. The COC documented sample movement from collection to receipt at the laboratory and provided sample identification, requested analysis, and conditions of samples upon arrival at the laboratory (e.g. container status).
- Maxxam is accredited with the Canadian Association for Laboratory Accreditation (CALA) for the analysis of lead. EMSL and Pinchin are accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for the analysis of asbestos. Copies of the quality assurance reports and analytical methods are included with the Certificates of Analysis in Appendix A.

2.0 SITE VISIT

Ecoplans conducted site visits of the Subject Property on October 4, 2011 and April 30, 2012. The purpose of the site visits was to determine the location, quantity, and current conditions of hazardous materials present within the Subject Property. Mr. Agostino Monteleone and Mr. Mathew Thompson of MRC provided access to detailed drawings of the bridge structure for the purpose of this survey. The Bridge Operator had previously escorted Ecoplans field staff around the premises during the initial site visit that Ecoplans completed in October 2011 which identified possible locations and types of hazardous materials to be further assessed during the DSS. Photographs of the site inspection are included at the end of the report.

2.1 Lead

Lead can be present in a variety of materials including paint, plumbing and solder. Lead was used as a white pigment in paint until the mid-1950s, in concentrations as high as 50% by weight. As such, buildings built before the mid-1950s are likely to contain lead based paint (LBP). Smaller amounts of lead may also be found in buildings constructed up to 1980.

Under the Canadian Hazardous Products Act (1986, Updated 2005) paint containing lead in excess of 0.06% (600 mg/kg) is controlled in Canada. This definition does not evaluate existing painted surfaces in the work place. In absence of Canadian regulations, the U.S. Housing and Urban Development (HUD) guideline was consulted to provide a criterion used in the evaluation of building paint. HUD defines any paint containing over 0.5% (5,000 mg/kg) or 1.0 mg/cm2 of lead to be LBP.

The presence of lead does not affect the management of building materials for recycling, however, control measures may be required to minimize the generation of airborne lead dust, particularly for activities that may generate excessive dust, such as sanding or grinding.

2.1.1 Lead Assessment Results

A total of five samples were collected and submitted for the analysis of lead in the paint. Three samples were collected from the control tower (tower blue, tower grey and tower red). The control tower walls were painted blue (Photograph 1) and the railing samples were layered with the grey paint overlying the red (Photograph 2).

Two samples were collected from the bridge on the west pier (girder grey and railing grey). The paint was observed to be in generally good condition with some minor areas of localized cracking and peeling (Photograph 3 and 4).

Table 1: Lead Analytical Results Summary

Sample ID	Sample Description	Sample Location	Lead Content	Lead Impacted
Tower Blue (Photograph 1)	Paint	Tower wall	530 mg/kg	No
Tower Grey (Photograph 2)	Second Coat of Paint	Tower railing	580 mg/kg	No
Tower Red (Photograph 2)	Base Coat of Paint	Tower railing	2400 mg/kg	No
Girder Grey (Photograph 3)	Grey Paint	Centre Girder on west pier	130 mg/kg	No
Railing Grey (Photograph 4)	Grey Paint	West pier railing	62 mg/kg	No

Based on the survey results, elevated levels of lead (i.e. above the 5,000 mg/kg US HUD Guideline) were not identified in the painted building materials at the Subject Property. In addition, given the age of the building, any painted surfaces not samples would likely not contain elevated levels of lead.

In general, standard dust control practices for activities associated with building renovation are sufficient to control dust from exposed painted surfaces with less than 5,000 mg/kg lead. At higher concentrations, abatement, worker protection or enhanced dust control measures may be required. Based on this survey and historical reports, standard dust control measures are likely sufficient where dismantling of painted surfaces is conducted. Should painted surfaces be grounded, sanded or otherwise abraded, the effects of any works on the underlying substrates of paint should be considered in the development of dust control measures.

2.2 Asbestos

Asbestos is a commercial term given to six naturally occurring minerals that are incombustible and separable into fibres. The fibres are strong, durable and resistant to heat and fire and are long, thin and flexible enabling them to be woven into cloth. These qualities have resulted in the wide use of asbestos in commercial, industrial, automotive and building materials. Common asbestos containing materials (ACMs) include pipe-covering, insulating cement, insulating block, refractory and boiler insulation materials, transite board, fireproofing spray, joint compound, vinyl floor tile, ceiling tile, mastics, roofing products, and duct insulation for HVAC applications. Although the common construction use of friable (hand pressure crumbles the material easily) ACM generally ceased voluntarily in the mid-1970s, it was not until the mid to late 1980s that ACM use was banned through legislation.

Under Occupational Health and Safety regulations in effect in Ontario, material containing 0.5% by dry weight or more of asbestos fibres is considered ACM. Ecoplans staff inspected the Subject Property for the presence of friable and non-friable ACM.

2.2.1 Inspection

No materials were observed that warranted confirmatory sampling for potential asbestos-containing material. Walls, flooring, and ceilings in the Control Tower are comprised of exposed concrete and steel stairs and were in good condition. Fibreglass pipe wrap insulation was observed and had been painted.

2.2.2 Asbestos Assessment Results

As noted above no building material samples were sampled for ACMs.

2.2.3 Additional Sampling Requirements

In the event that future bridge renovations occur, materials that become exposed that support the suspicion of asbestos should be sampled. Based on the results of the analysis of other suspect materials and the date of building construction, asbestos is unlikely to be present in these materials.

If encountered, non-friable suspect materials can be removed prior to renovation according to Type 1 abatement procedures. Friable suspect materials should be removed prior to renovation according to Type 2 (provided quantity and type of material is suitable) or Type 3 abatement procedures.

2.3 Mercury

Mercury is a naturally occurring metal that is found in air, water and soil. Elemental or metallic mercury is the most common industrial form of mercury. Mercury is a toxic element that is controlled as a designated substance in Ontario. Mercury containing equipment (MCE) commonly found in the workplace includes: mercury vapour lamps of high intensity discharge lamps, fluorescent light tubes, thermostats and electrical switches.

Interior fluorescent lights and thermostats were observed during the DSS and are suspected of containing mercury. These materials will require management during building renovations to avoid the release of mercury to the environment.

2.4 Silica

Silica is a naturally occurring mineral and can be present in materials used for building construction, such as mortar, concrete, block and brick. Silica is a designated substance and dust generated through the handling of materials containing silica must be controlled. The building is comprised primarily of concrete construction; therefore, standard dust control measures should be implemented where practical to ensure airborne dusts are controlled.

2.5 Polychlorinated Biphenyls

PCBs were first manufactured in 1929 and used until the late 1970s in dielectric fluid in transformers, motor capacitors and lighting ballasts. In the late 1970s, the use of PCBs was banned and replacement of PCB-containing equipment was phased in over the following decades. Ballast manufacturers stopped using PCBs in their products by 1980.

A detailed inspection of florescent light ballasts could not be completed due to safety limitations. However, because the building was constructed a decade prior the ban of PCBs, it is likely that PCBs are present in any ballasts installed at the Subject Property and if present the ballasts must be managed in accordance with the EPA Ontario Regulation 362/90 (as amended In 2011).

2.6 Ozone Depleting Substances

Ozone depleting substances (ODS) generally contain chlorine, fluorine, bromine, carbon, and hydrogen in varying proportions and are often described by the general term halocarbons. Chlorofluorocarbons (CFCs), carbon tetrachloride, and methyl chloroform are important human-produced ozone-depleting gases that have been used in many applications including refrigeration, air conditioning, foam blowing, cleaning of electronic components, and as solvents. Another important group of human-produced halocarbons is the halons, which contain carbon, bromine, fluorine, and (in some cases) chlorine and have been mainly used as fire extinguishers.

The manufacture and use of ODS and CFCs in industry has been severely curtailed following the Montreal Protocol (1988). In Canada, CEPA, 1999 and the Ozone-Depleting Substances Regulation, 1998 (SOR/99-7) regulates the manufacturing, use and restrictions of ODS and CFCs.

ODS are not suspected to be present at the subject property.

2.7 Other Designated Substances

Ecoplans did not identify the presence of the other following designated substances; Acrylonitrile, Arsenic, Benzene, Coke oven emissions, Ethylene oxide, Isocyanates, and Vinyl chloride.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this investigation, hazardous building materials have not been identified in accessible areas of the Site. In general, building materials were observed to be in good condition at the Subject Property. The following summarizes the findings and recommendations of the DSS:

Lead: Laboratory results from five representative paint samples collected from areas along walls or railings where localized flaking was observed indicated that elevated levels of lead was not detected in these samples. The majority of painted surfaces observed in the building were observed to be in good condition with some minor localized areas of peeling or flaking. In addition, given the age of the building, any painted surfaces not samples would likely not contain elevated levels of lead. Standard dust control techniques are considered to be appropriate to protect on-site workers during future renovation or demolition processes that may involve disturbing painted surfaces.

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Mercury: Fluorescent light tubes, metal halide lights and thermostats were observed in the control tower. These materials may contain mercury. The continued use of these systems does not present a hazard to site occupants and the environment. If future renovation activities require the replacement of these light tubes and thermostats, it is recommended that a qualified contractor remove and dispose/recycle the light tubes and thermostats in accordance with regulatory requirements.

Silica: Materials used for the construction of the building, such as mortar, concrete, block and brick are likely to contain silica. As this material was observed to be in good condition at the time of the DSS survey, the possible presence of silica in these materials does not present a hazard to site occupants and the environment. If future renovation activities affect the integrity of these materials, standard demolition dust control measures should be implemented where practical to ensure airborne dusts are controlled.

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Other Designated Substances: Ecoplans did not identify the presence of the other following designated substances; Acrylonitrile, Arsenic, Benzene, Coke oven emissions, Ethylene oxide, Isocyanates, and Vinyl chloride.

Yours truly,

ECOPLANS, a member of MMM Group

Reviewed by:

Annette Blazeiko, B.A.Sc,
Environmental Scientist

Derek A. Stewart, M.Sc., P.Geo
Senior Hydrogeologist

4.0 CLOSURE AND LIMITATIONS

This report has been prepared for use by MRC in accordance with generally accepted environmental investigation practices at the time of the assessment. We understand that the report may be provided to potential renovation contractors, for the purpose of identifying potential hazardous materials in the building. Therefore we extend the use of the report to these parties, for the stated purpose. Any use of the report by any other party without the written consent of MMM Group Limited is the sole responsibility of such party. MMM Group Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The observations and investigations (hereinafter referred to as the "work") upon which this report are based were carried out in accordance with the terms and conditions of the contract pursuant to which the work was commissioned. The conclusions presented in the report are based solely upon the scope of services described in the contract and governed by the time and budgetary constraints imposed by the contract.

The principles, procedures and standards applied in conducting hazardous materials or designated substances surveys are neither regulated nor universally the same. The work has been carried out in accordance with generally accepted environmental study and/or professional practice, industry standards and applicable environmental regulations. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our original contract and included in this report.

The conclusions of the designated substances survey are based upon conditions observed at the time of the site visit. No assurance is made regarding changes in conditions subsequent to the investigation.

The conclusions of the designated substances survey regarding the current environmental conditions on the subject site are based on the investigations conducted during the work and information from other sources as may be indicated in the report. The accuracy of information from other sources as it may have been considered was not verified, nor was it determined that the information considered represented all such information that exists and pertains to the subject site. The conclusions made are based on reasonable and professional interpretation of the information considered. If additional information concerning environmental conditions of relevance to this report is obtained during future work at the subject property, MMM Group Limited should be notified in order that we may determine if modifications to the conclusions presented in this report are necessary.

This designated substances survey report must be read as a whole and sections taken out of such context may be misleading. When discrepancies occur between the preliminary (draft) and final versions of the report, the final version of the report shall take precedence.

MMM Group Limited's liability with respect to the work is limited to re-performing, without cost, any part of the work that is unacceptable solely as a result of failure to comply with industry standards. MMM Group Limited's maximum liability is limited to the amount of its remuneration under the original contract, provided that notice of claim is made within one year of the date of delivery of the report.

5.0 QUALIFICATIONS OF THE ENVIRONMENTAL CONSULTANT

Ecoplans Limited, established in 1970, provides consulting services in the biological and physical sciences, environmental planning, landscape architecture, environmental impact assessment, and environmental site assessment and remediation. Ecoplans' staff includes specialists in all facets of the environmental field. The Environmental Site Assessment and Remediation Division of Ecoplans Limited specializes in Phase I, II and III Environmental Site Assessments, electromagnetic surveys, aboveground and underground storage tank removals/assessments, groundwater investigations and site remediation/restoration. Ecoplans has completed numerous Phase I and Phase II Environmental Site Assessments for both the public and private sector. Some of their clients include the Ministry of Transportation, GO Transit, Ontario Realty Corporation, Regional Municipality of Peel, Greater Toronto Airports Authority, Medallion Properties Inc., and Marshall-Barwick Inc.

Mr. Derek Stewart, M.Sc., P.Geo, is a Senior Hydrogeologist with Ecoplans' Environmental Site Assessment & Remediation Division. Mr. Stewart has over 21 years of experience carrying out site assessments and remediation projects working for a number of environmental consulting firms. He has been with Ecoplans since 1996. At the project level, Mr. Stewart provides technical and editorial support to his staff and peer reviews all draft and final reports prior to being sent to the client.

Ms. Annette Blazeiko, B.A.Sc, is an Environmental Scientist working with Ecoplans' Environmental Site Assessment & Remediation Division. Ms. Blazeiko has an academic background in Environmental Sciences, and Environmental Management and Assessment. She has over 5 years of experience in the field and has completed numerous Phase I and II Environmental Site Assessments including hazardous materials surveys at various types of properties. She is familiar with building operations and abatement protocols that are associated with hazardous materials.

6.0 REFERENCES

Environmental Protection Act, Ontario Regulation 362/90 – Waste Management – PCBs (as amended by O.Reg. 232/11). E-Laws, Service Ontario.

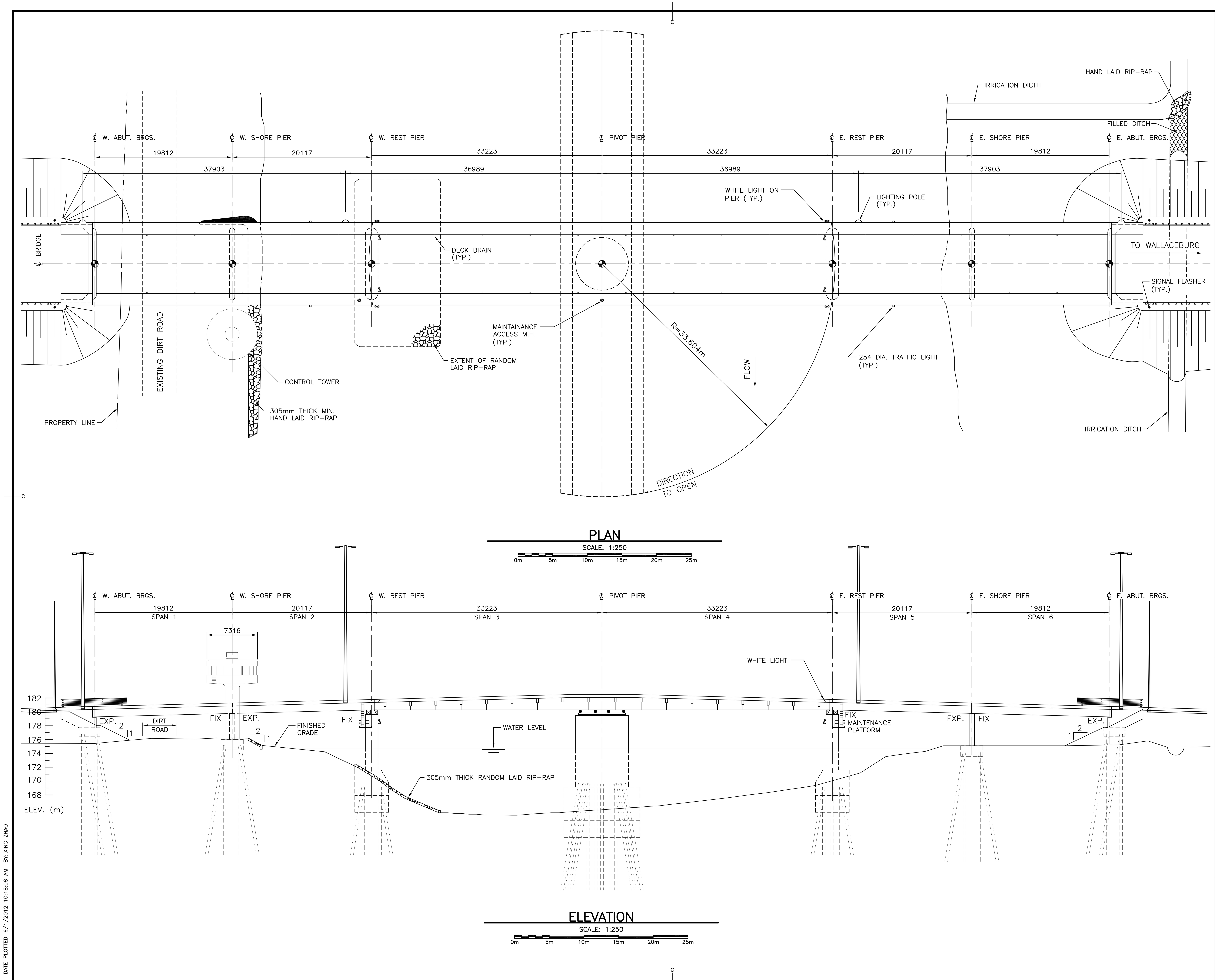
Hazardous Products Act, RSC 1985, c.H-3, Controlled Products Regulations SOR/88-66. Department of Justice, Canada.

Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2 (revised) by Environment Canada, dated August 1991.

Occupational Health & Safety Act, Ontario Regulation 278/05 Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations (as amended by O. Reg. 479/10). e-Laws, Service Ontario.

APPENDIX L

EXISTING GENERAL ARRANGEMENT DRAWING (STRUCTURAL)



Public Works and Government Services Canada | Travaux Publics et Services gouvernementaux Canada

MRC McCORMICK RANKIN A member of MMM GROUP

0		
revisions		date

project / projet

REHABILITATION WALPOLE ISLAND SWING BRIDGE

drawing / dessin

WALPOLE ISLAND BRIDGE GENERAL ARRANGMENT I

designed G. JEYAQOBY conçu

date

drawn M. YANG dessiné

date

approved approuvé

date

Tender Soumission

PWGSC Project Manager Administrateur de projets TPSGC

project number no. du projet

R.051213.001

drawing no. no. du dessin

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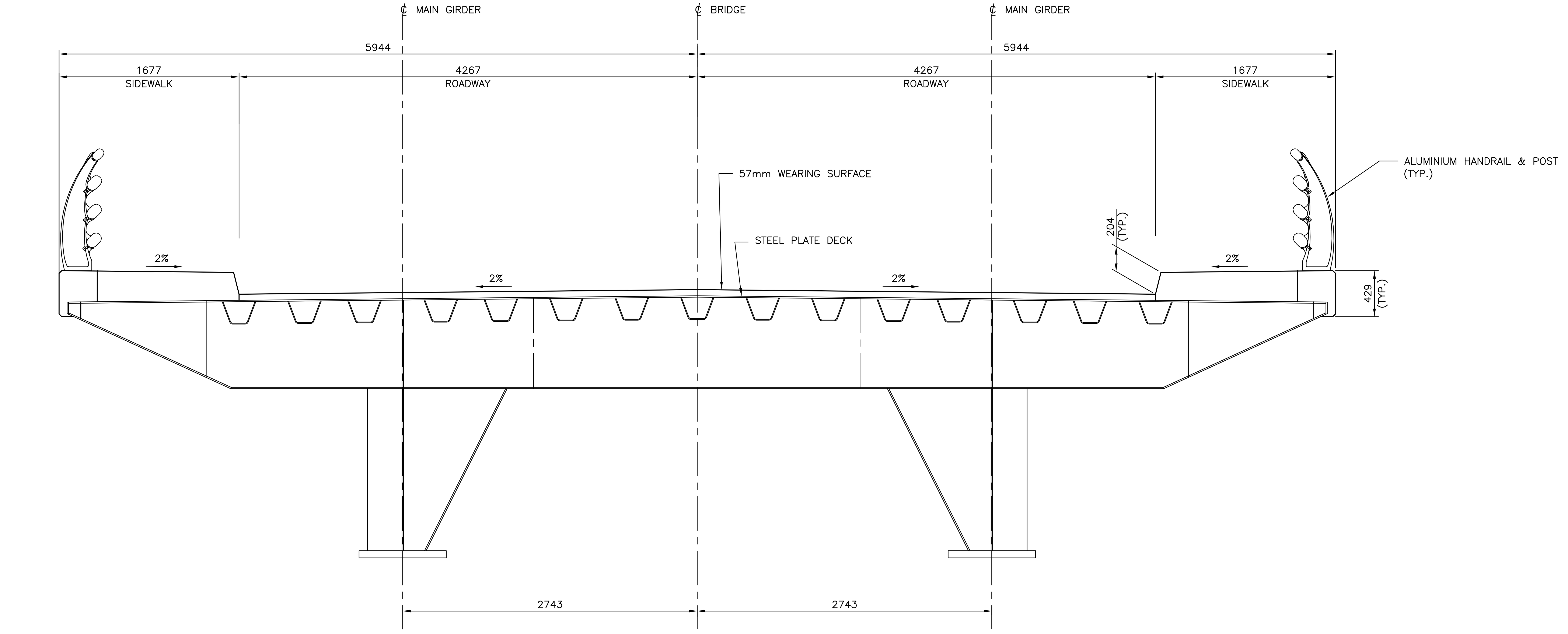

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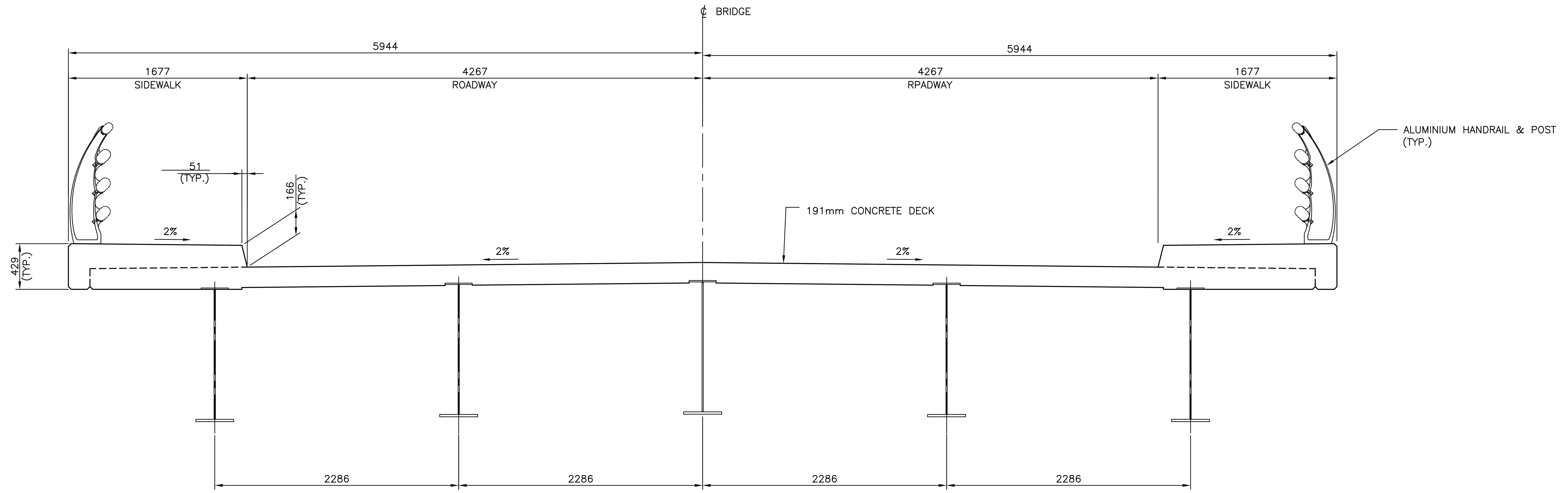

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revisions		date
0		

project / projet

REHABILITATION WALPOLE ISLAND SWING BRIDGE

drawing / dessin

WALPOLE ISLAND BRIDGE
GENERAL ARRANGMENT II

designed G. JEYAQOBY conçu
date
drawn M. YANG dessiné
date
approved approuvé
date
Tender Soumission
PWGSC Project Manager Administrateur de projets TPSGC
project number no. du projet
R.051213.002
drawing no. no. du dessin
2

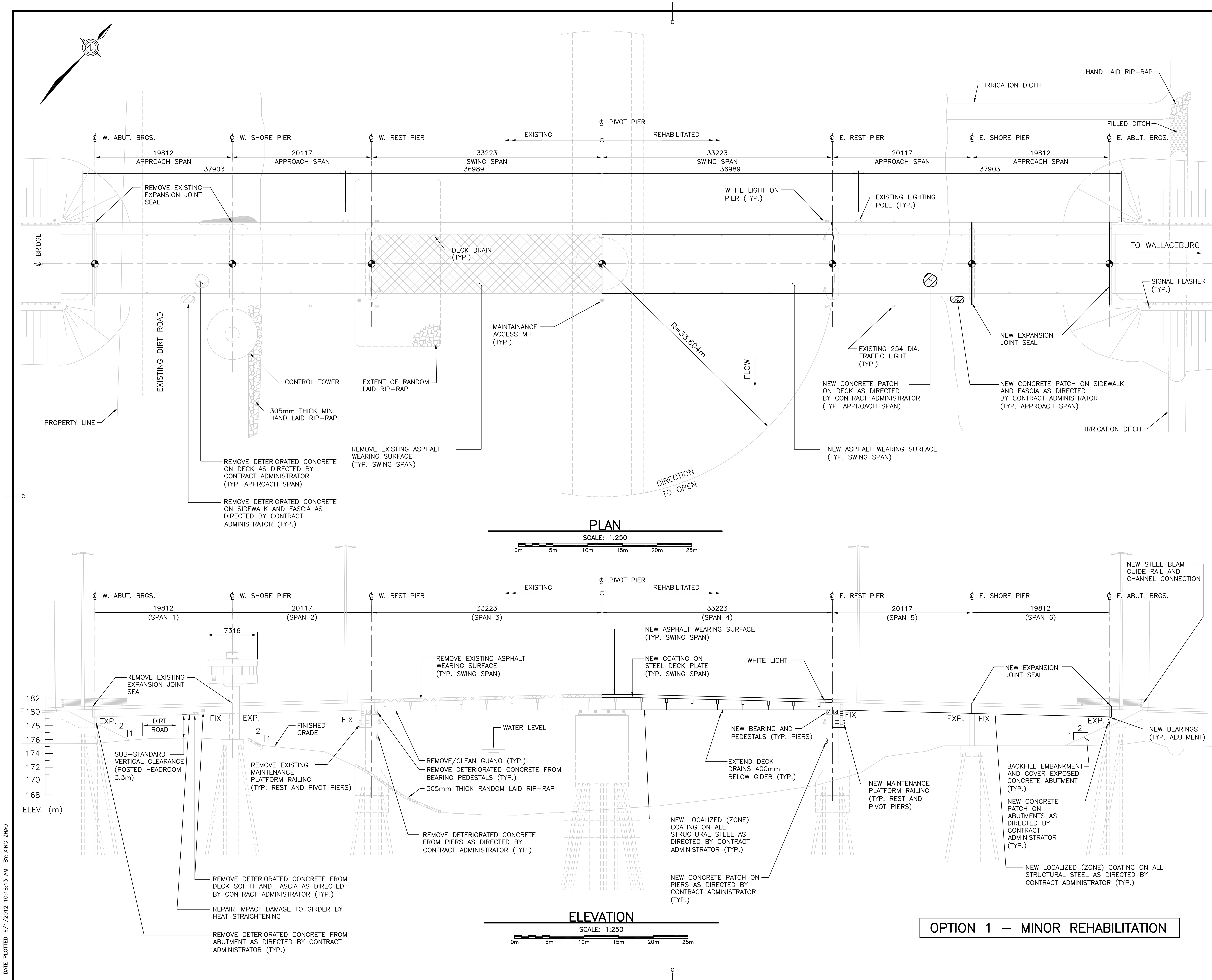
PWGSC A1 (2004)

E-DRM/GDD-E:

APPENDIX M

PRELIMINARY GENERAL ARRANGEMENT DRAWING

OPTION 1 PROPOSED REHABILITATION (STRUCTURAL)



OPTION 1 – MINOR REHABILITATION

Public Works and Government Services Canada | Travaux Publics et Services gouvernementaux Canada

MRC McCORMICK RANKIN
A member of MMM GROUP

0
revisions | date

project | projet

REHABILITATION OF WALPOLE ISLAND SWING BRIDGE

drawing | dessin

WALPOLE ISLAND BRIDGE
GENERAL ARRANGMENT I
OPTION 1
PROPOSED REHABILITATION

designed A. MONTELEONE | conçu
date
drawn M. YANG | dessiné
date
approved G. JEYAQOBY | approuvé
date
Tender | Soumission
PWGSC Project Manager | Administrateur de projets TPSGC
project number | no. du projet
R.051213.001
drawing no. | no. du dessin
1

E-DRM/GDD-E:

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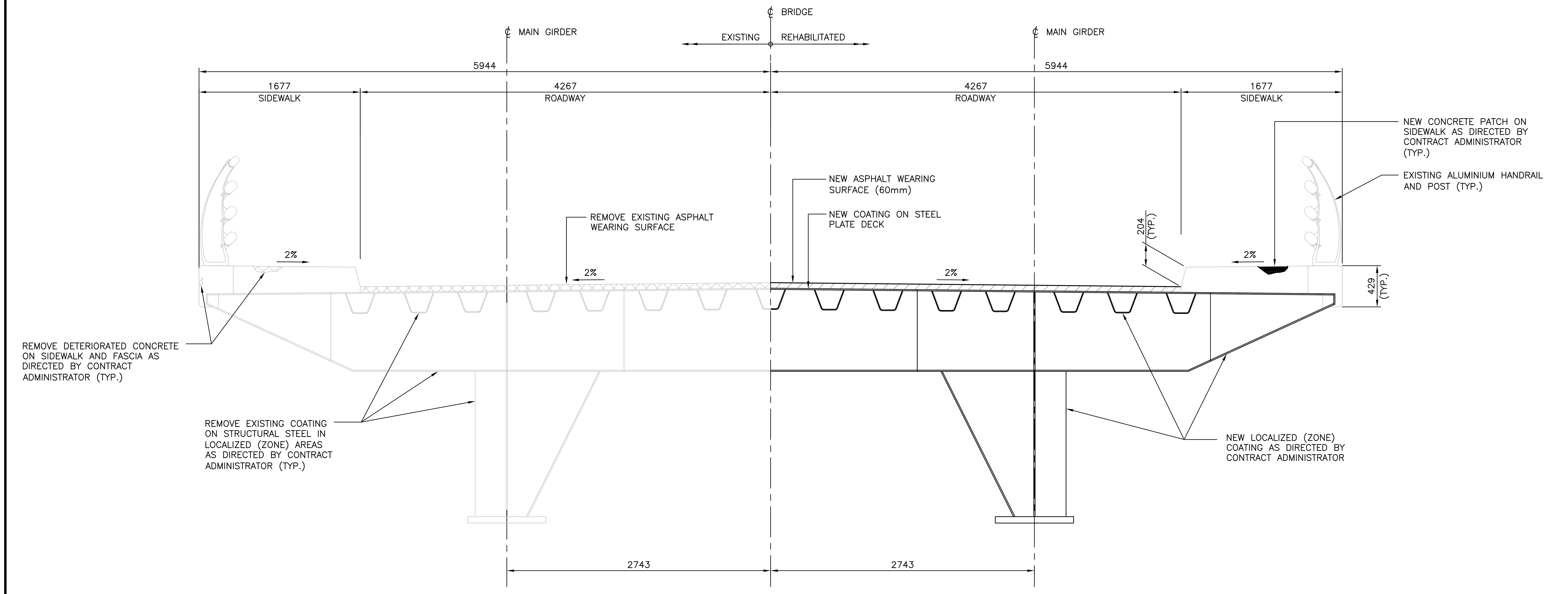
MODIFIED: 6/1/2012 9:41:30 AM BY: ZHAOX
DATE PLOTTED: 6/1/2012 10:18:13 AM BY: XING ZHAO

PWGSC A1 (2004)

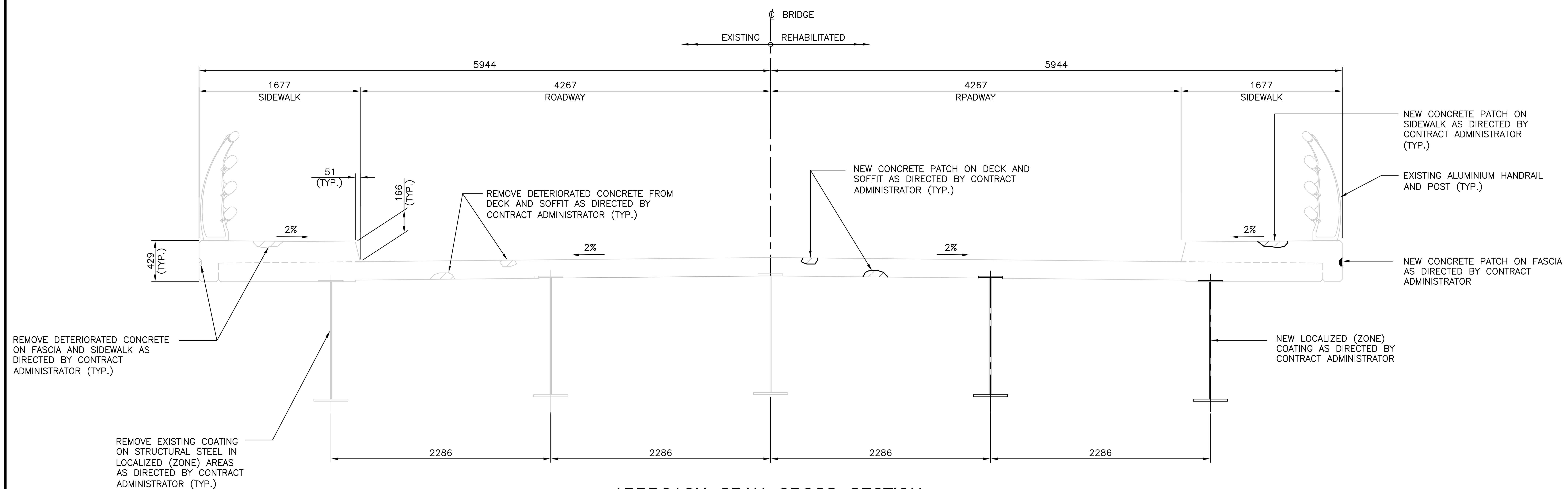
0 10 20mm 40 60 80 100 120 140 160 180 200mm



SWING SPAN CROSS SECTION

SCALE: 1:25

0mm 500mm 1000mm 1500mm 2000mm 2500mm



APPROACH SPAN CROSS SECTION

SCALE: 1:25

0mm 500mm 1000mm 1500mm 2000mm 2500mm

OPTION 1 – MINOR REHABILITATION

Public Works and Government Services Canada | Travaux Publics et Services gouvernementaux Canada

McCORMICK RANKIN
A member of MMM GROUP

0	
revisions	date
project / projet	REHABILITATION OF WALPOLE ISLAND SWING BRIDGE
drawing / dessin	WALPOLE ISLAND BRIDGE GENERAL ARRANGMENT II OPTION 1 PROPOSED REHABILITATION
designed / conçu	A. MONTELEONE
date	
drawn / dessiné	M. YANG
date	
approved / approuvé	G. JEYAQOBY
date	
Tender / Soumission	
PWGSC Project Manager / Administrateur de projets TPSGC	
project number / no. du projet	R.051213.002
drawing no. / no. du dessin	2

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DATE PLOTTED: 6/1/2012 10:18:29 AM BY: XING ZHAO

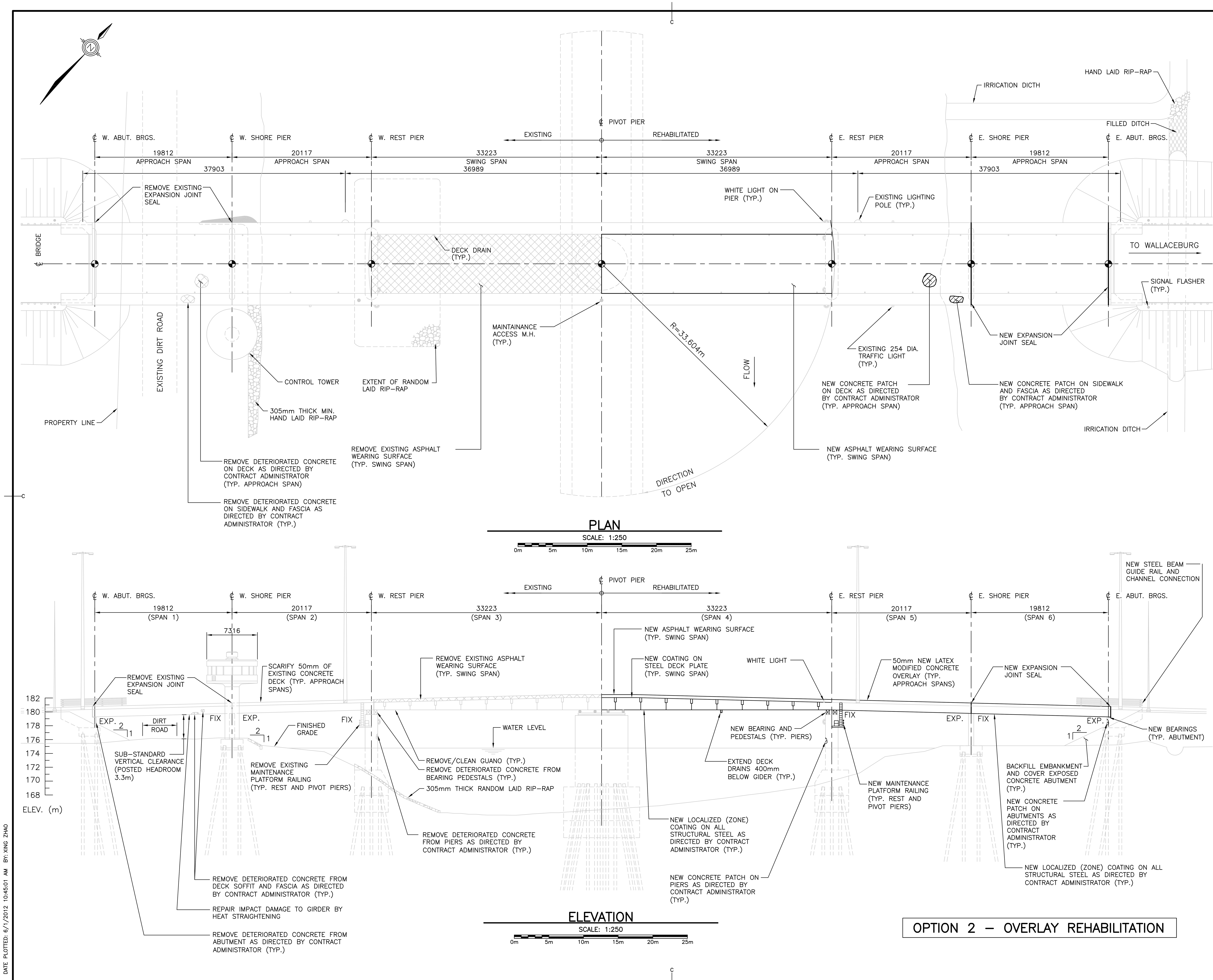
PWGSC A1 (2004)

E-DRM/GDD-E:

APPENDIX N

PRELIMINARY GENERAL ARRANGEMENT DRAWING

OPTION 2 PROPOSED REHABILITATION (STRUCTURAL)



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revisions	date
0	

project / projet

REHABILITATION OF WALPOLE ISLAND SWING BRIDGE

drawing / dessin

WALPOLE ISLAND BRIDGE GENERAL ARRANGMENT I 2 PROPOSED REHABILITATION

designed / conçu: A. MONTELEONE
date

drawn / dessiné: M. YANG
date

approved / approuvé: G. JEYAQOBY
date

Tender / Soumission

PWGSC Project Manager / Administrateur de projets TPSGC

project number / no. du projet: R.051213.001

drawing no. / no. du dessin: 1

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PWGSC A1 (2004)

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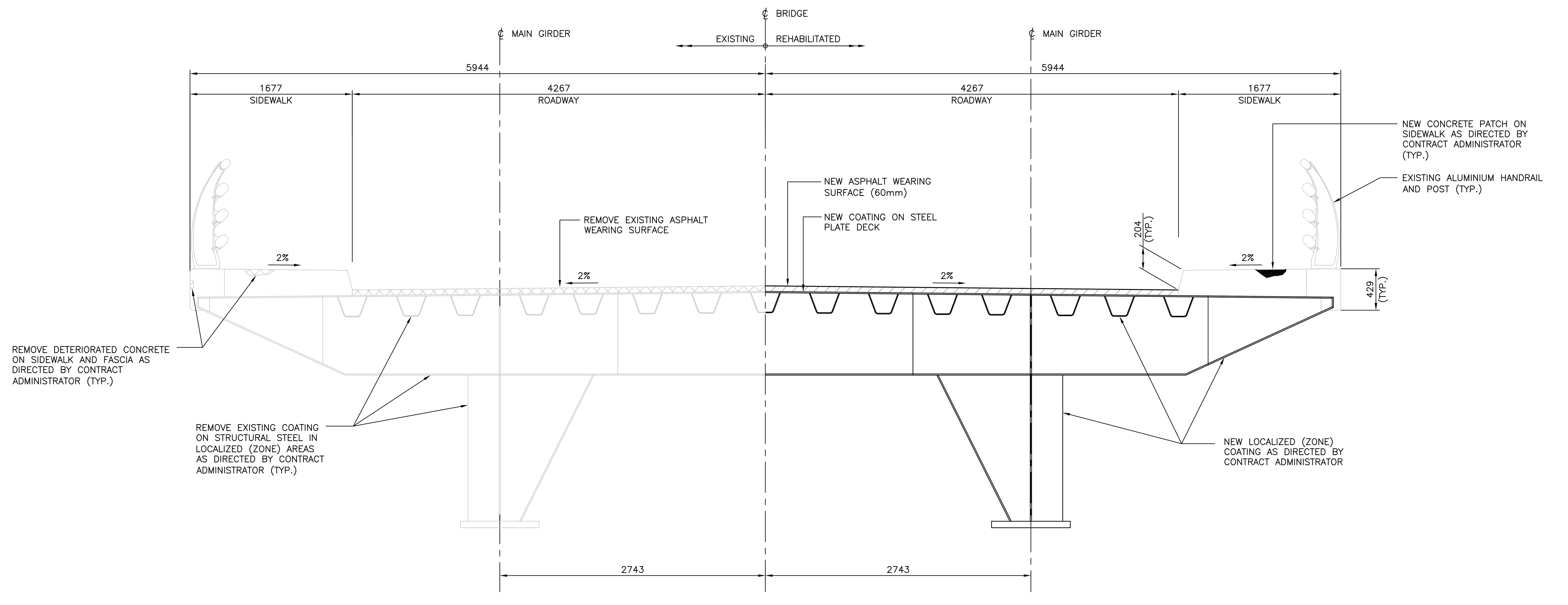

SWING SPAN CROSS SECTION

SCALE: 1:25

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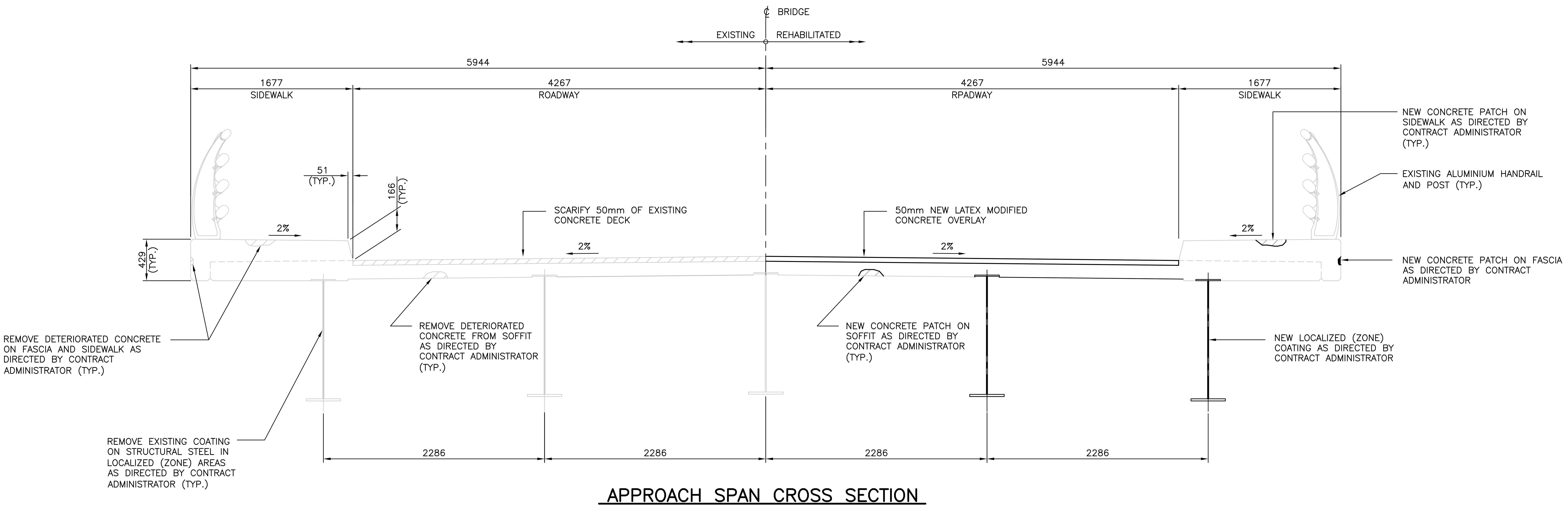

APPROACH SPAN CROSS SECTION

SCALE: 1:25

0mm 500mm 1000mm 1500mm 2000mm 2500mm

OPTION 2 – OVERLAY REHABILITATION

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project | projet

REHABILITATION OF WALPOLE ISLAND SWING BRIDGE

drawing | dessin

WALPOLE ISLAND BRIDGE GENERAL ARRANGMENT II OPTION 2 PROPOSED REHABILITATION

designed A. MONTELEONE conçu

date

drawn M. YANG dessiné

date

approved G. JEYAQOBY approuvé

date

Tender | Soumission

PWGSC Project Manager | Administrateur de projets TPSGC

project number | no. du projet

R.051213.002

drawing no. | no. du dessin

2

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DATE PLOTTED: 6/1/2012 10:18:34 AM BY: XING ZHAO

PWGSC A1 (2004)

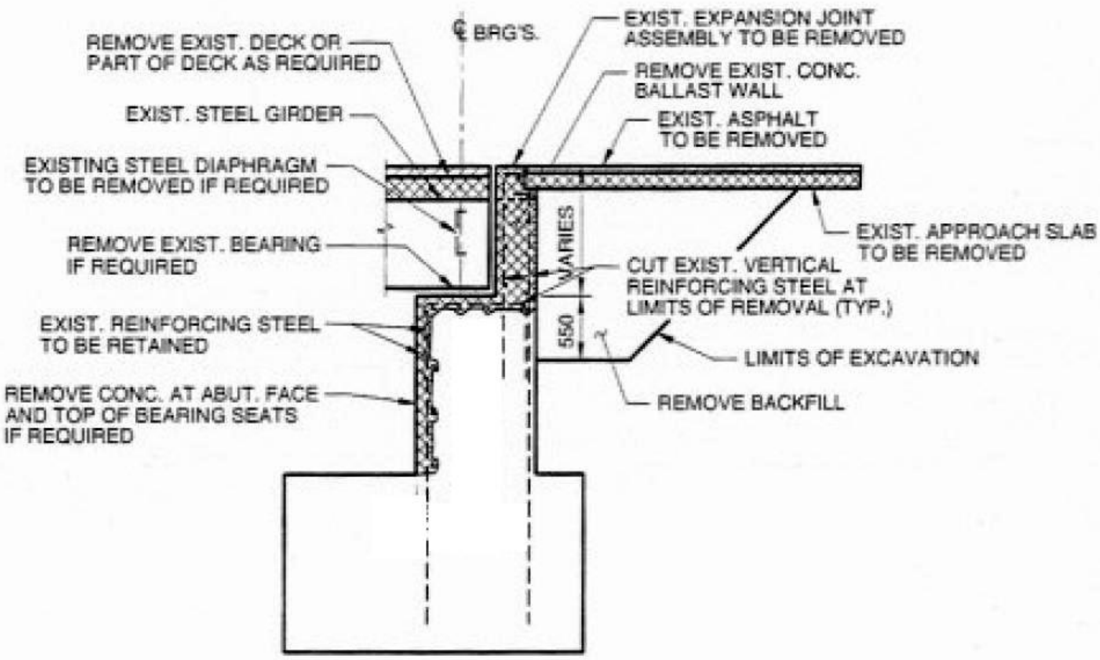
E–DRM/GDD–E:

APPENDIX O

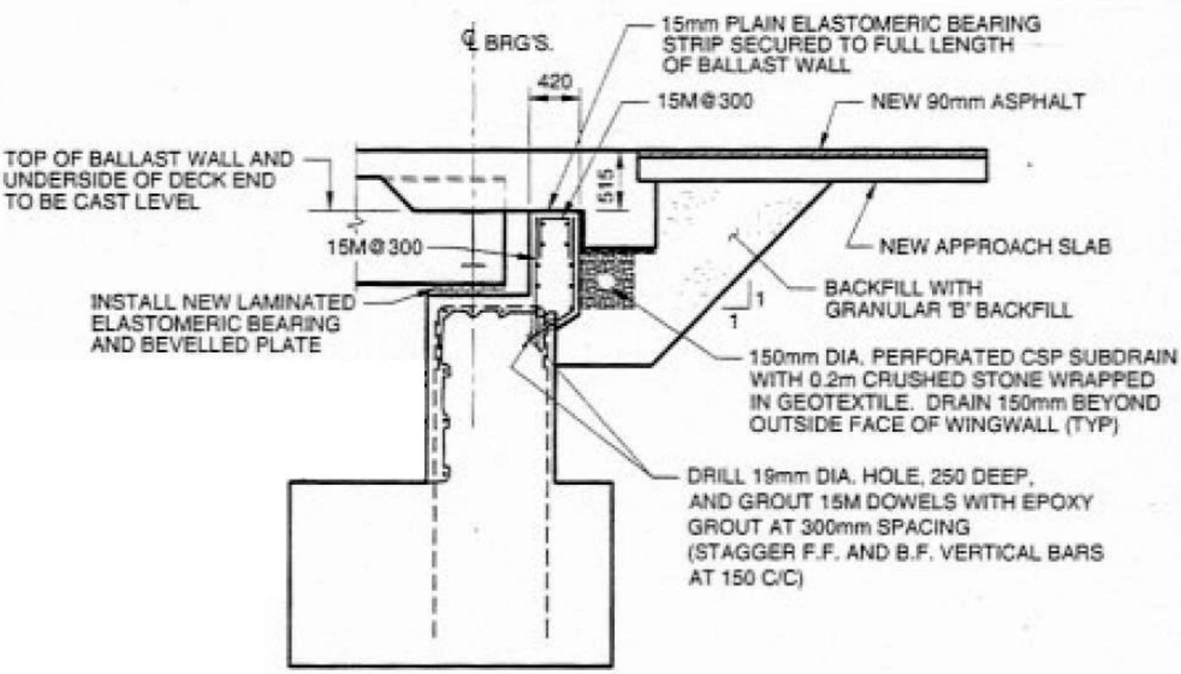
PRELIMINARY GENERAL ARRANGEMENT DRAWING

OPTION 3 PROPOSED REHABILITATION (STRUCTURAL)

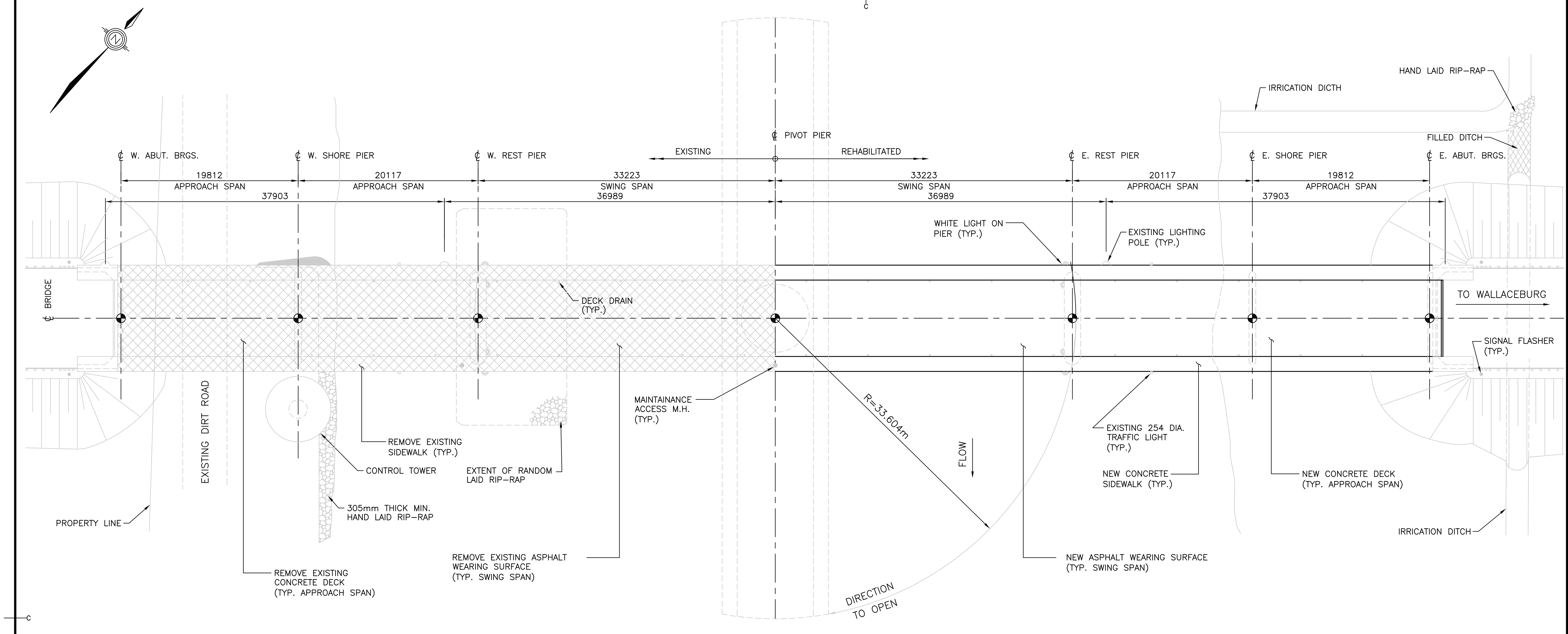
SEMI-INTEGRAL CONNECTION DETAILS



REMOVAL DETAIL



REHABILITATED DETAIL



PLAN
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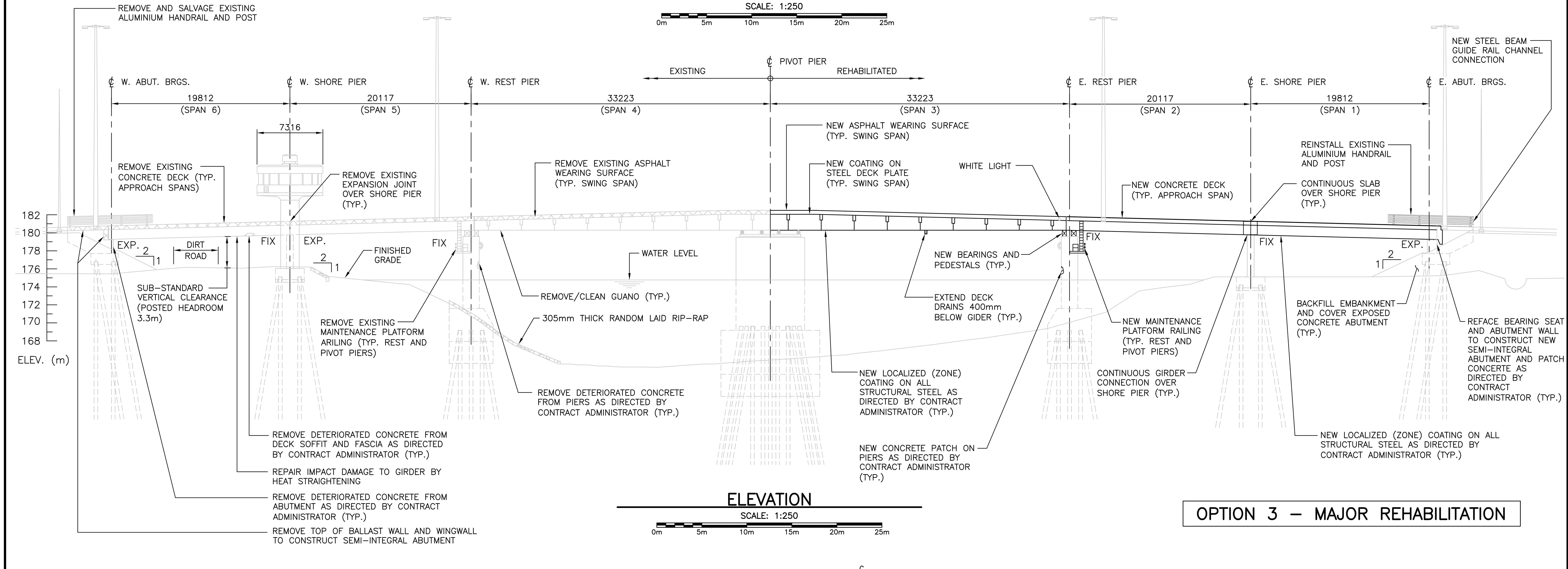

ELEVATION
SCALE: 1:250
0m 5m 10m 15m 20m 25m

OPTION 3 – MAJOR REHABILITATION

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McCORMICK RANKIN
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revisions 0	date
project	projet
REHABILITATION OF WALPOLE ISLAND SWING BRIDGE	
drawing	dessin
WALPOLE ISLAND BRIDGE GENERAL ARRANGMENT I OPTION 3 PROPOSED REHABILITATION	
designed A. MONTELEONE	conçu
date	
drawn M. YANG	dessiné
date	
approved G. JEYAQOBY	approuvé
date	
Tender	Soumission
PWGSC Project Manager	Administrateur de projets TPSGC
project number R.051213.001	no. du projet
drawing no. 1	no. du dessin

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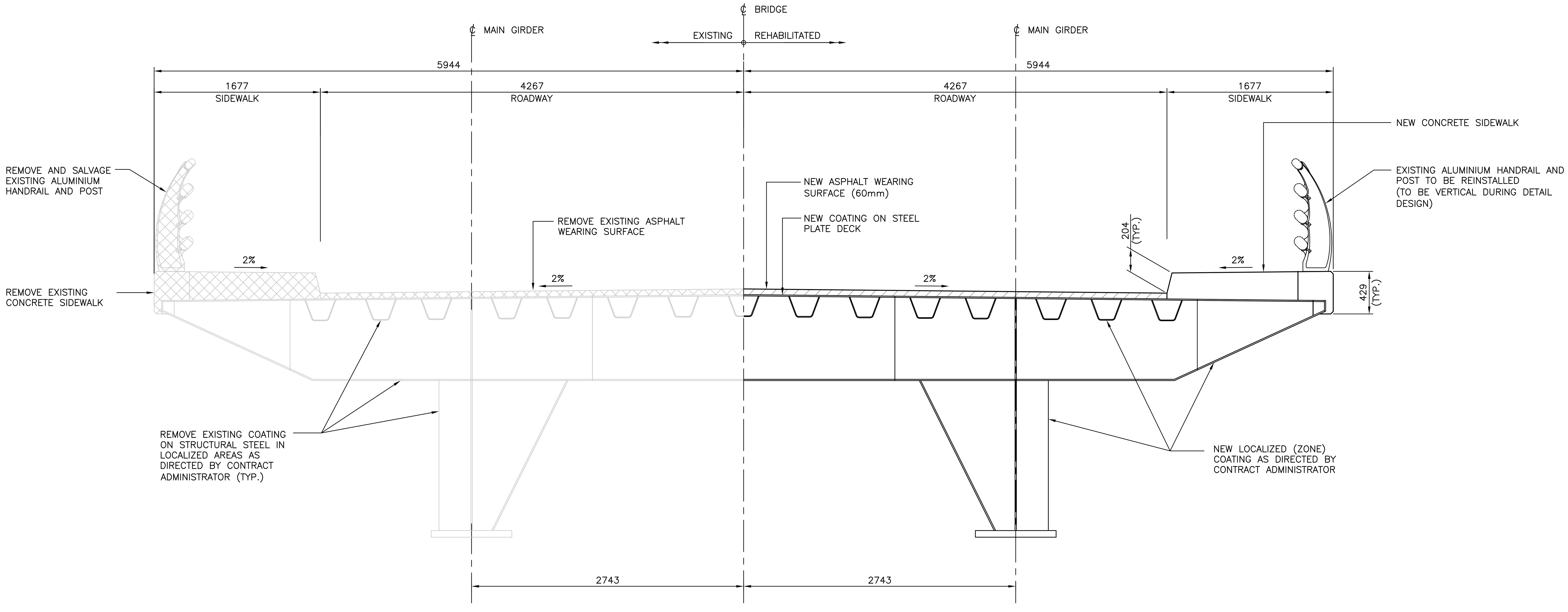
DATE PLOTTED: 6/1/2012 10:18:18 AM BY: XING ZHAO

PWGSC A1 (2004)

E-DRM/GDD-E:



SWING SPAN CROSS SECTION

SCALE: 1:25

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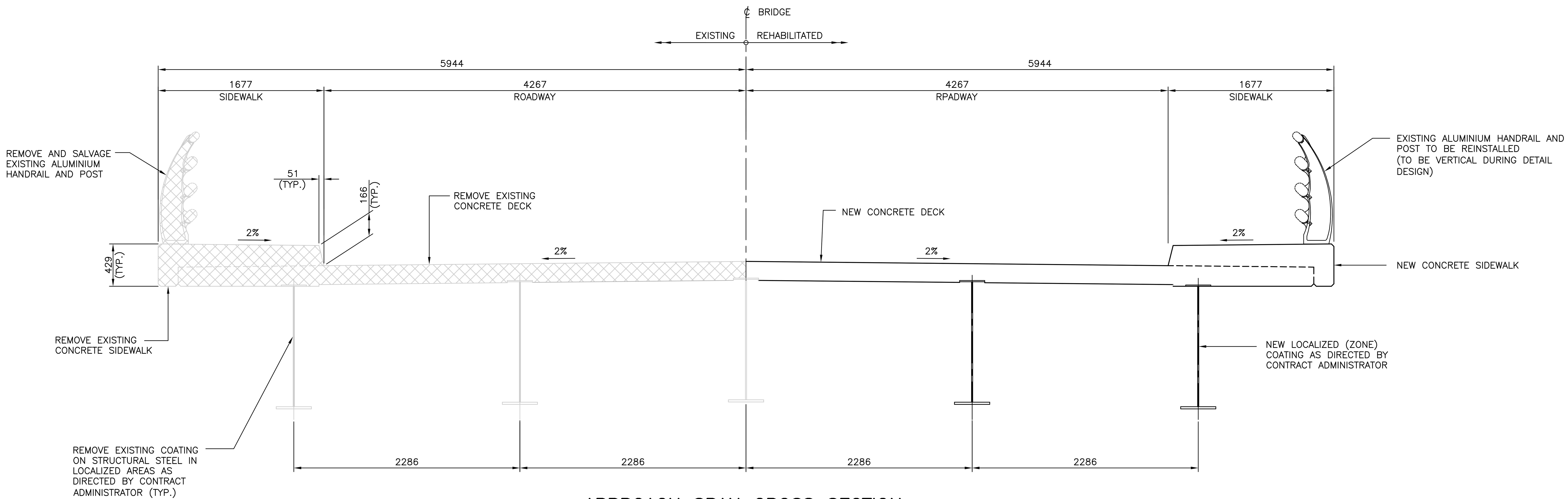

APPROACH SPAN CROSS SECTION

SCALE: 1:25

0mm 500mm 1000mm 1500mm 2000mm 2500mm

OPTION 3 – MAJOR REHABILITATION

Public Works and Government Services Canada / Travaux Publics et Services gouvernementaux Canada

McCORMICK RANKIN
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revisions		date
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project / projet

REHABILITATION OF WALPOLE ISLAND SWING BRIDGE

drawing / dessin

WALPOLE ISLAND BRIDGE
GENERAL ARRANGMENT II
OPTION 3
PROPOSED REHABILITATION

designed A. MONTELEONE conçu
date
drawn M. YANG dessiné
date
approved G. JEYAQOBY approuvé
date
Tender Soumission
PWGSC Project Manager Administrateur de projets TPSGC
project number no. du projet
R.051213.002
drawing no. no. du dessin
2

E–DRM/GDD–E:

PWGSC A1 (2004)

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DATE PLOTTED: 6/1/2012 10:18:39 AM BY: XING ZHAO