Structural Assessment Report and Design

William Parkway Improvements Municipal Class EA

Torbram Road Over Mimico Creek Culvert Structural Assessment Report

Submitted to:
City of Brampton, Ontario

PROJECT 478286

Prepared by:

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August 2024

William Parkway Improvements Municipal Class EA

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TABLE OF CONTENTS

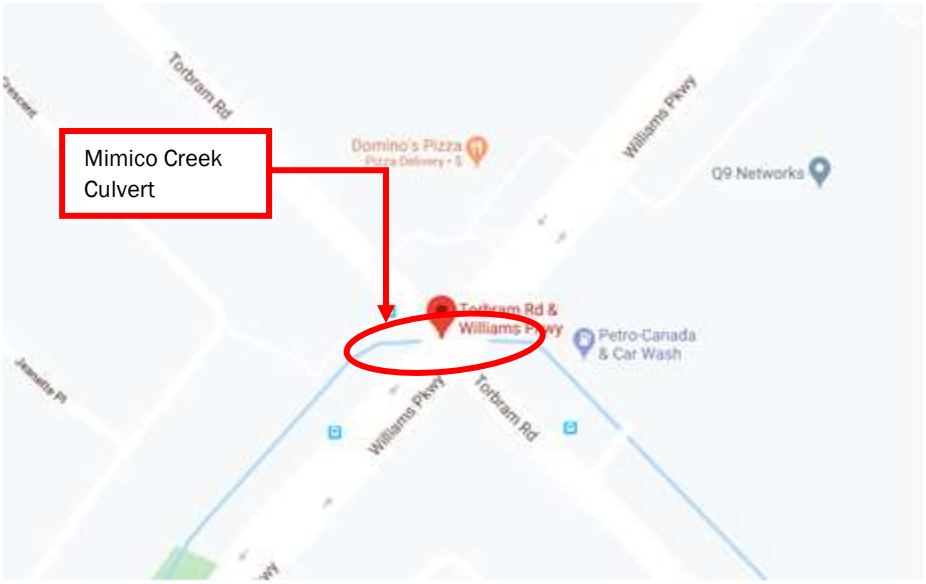
APPENDICES

1. Introduction

As part of the assignment, the City of Brampton is undertaking a Municipal Class Environmental Assessment (MCEA) study for improvements to Williams Parkway, which includes the culvert located at Williams Parkway and Torbram Road. This culvert was assessed as part of the Torbram Road Municipal Class Environmental Assessment and the findings and design recommendations were documented in the Torbram Road EA Preliminary Structural Design Report (August 2020). This Williams Parkway MCEA structural report provides a summary of the findings of the Torbram Road MCEA including the site inspection conducted and replacement recommendations at the Torbram Road Over Mimico Creek Culvert.

2. Location

The existing structure is located at the Torbram Road and Williams Parkway intersection, at the eastern limits of the MCEA study area, in the City of Brampton, Ontario as shown in the Key Plan below.



Key Plan

3. Available Information

The following reference documents were made available and used to populate this report:

- Torbram Road EA from Bovaird Drive to Queen Street East Preliminary Structural Design Report, August 2020
- Stormwater Management and Hydraulic Analysis, November 2019
- Existing general arrangement (GA) of the bridge over Mimico Creek showing the size of existing CSP culvert, May 1989
- Biennial Culvert Inspection Report, August 2010
- Geotechnical Investigation Proposed Road Reconstruction – Torbram Road Queen Street East to Bovaird Drive by Soil-Mat, October 2017

4. Existing Structure

4.1 Structure

The existing structure is a corrugated steel pipe (CSP) culvert. The structure has west-east orientation located under the intersection of Torbram Road and Williams Parkway. The culvert currently carries 4 lanes of vehicular through traffic for Torbram Road and 4 lanes of vehicular though traffic for Williams Parkway, plus associated turn lanes and sidewalk crossings. The culvert was constructed in 1980, as per the Biennial Culvert Inspection Report.

Photographs of the existing structure are presented in **Appendix C.**

4.2 Maintenance and Repair History

The maintenance and repair history are unknown.

4.3 Condition of Structure

As part of the Torbram Road MCEA, Parsons conducted a visual site inspection of the culvert on April 16, 2020, to assess the existing condition of the culvert, wing walls, culvert railing and slope protection.

The following is a summary of the inspection findings.

End Wall:

The end wall of culvert was found to be in excellent to good condition. Inlet end wall of the culvert shows the sign of medium deterioration.

Barrel:

The CSP barrel of culvert was found to be in poor condition. The barrel deteriorated progressively as a result of corrosion. Most of the joints and bolts are in poor condition. The bottom side shows medium corrosion and sever to very sever isolated areas.

Barrier:

Excellent condition with no or little sign of deterioration. Since barrier is the part of culvert, it will also be replaced.

Railing System:

The railing system was in good condition.

Embankment:

Both North and South embankments do not show any sign of erosion. The embankments are in excellent condition.

Slope Protection:

The slope protection of North and South embankments do not show any sign of deterioration. There is a medium crack on the North-West slope protection of the culvert. Generally, slope protections are in excellent condition.

5. Design Options

The culvert was visually inspected in April 2020. As per visual inspection, it is concluded that the culvert CSP barrel shows the sign of severe deterioration caused by corrosion and cannot be readily rehabilitated without excavation of the roadway or reduction to the hydraulic capacity. It is also noted that the culvert has surpassed approximately 40 years of the service life which is typical for these types of structures. Accordingly, rehabilitation or strengthening of the culvert is

not recommended and not discussed further in this report. Therefore, the culvert will be fully replaced in its entirety by a new culvert.

Different options have been studied for the replacement of Torbram Road Over Mimico Creek culvert while conducting the Stormwater Management and Hydraulic Analysis studies. The proposed options outlined in the Stormwater Management and Hydraulic Analysis report are based on the study report titled "Stormwater Management and Hydraulic Analysis - Torbram Road from Bovaird Drive to Queen Street East (November 2019)" prepared and submitted by Parsons for the Torbram Road MCEA Study.

- Twin culverts of dry and wet cells (3.6 m x 2.4 m & 3.0 m x 2.1 m) (similar to Williams Parkway ESR)
- Twin culverts of dry and wet cells (3.6 m x 2.4 m & 3.0 m x 2.1 m) with channel widening
- Twin culverts of dry and wet cells (3.6 m x 2.4 m & 3.0 m x 2.1 m) with raised road
- Twin culverts (3.6 m x 2.4 m & 3.0 m x 2.4 m) with widened channel
- Bridge opening (6.6 x 2.4) with widened channel
- Single culvert (6.6 m x 2.4 m) with widened channel

Based on the results of hydraulic analysis, twin culverts of dry and wet cells with raised road, twin culverts with widened channel, bridge opening with widened channel can satisfy the hydraulic requirements. The preferred/feasible options are as follows:

- Twin culverts (3.6 m x 2.4 m & 3.0 m x 2.4 m) with widened channel

Twin culverts (3.6 m x 2.4 m & 3.0 m x 2.4 m) with widened channel

The proposed option is replacing the existing CSP culvert with two individual single cell precast culverts placed side by side, or a cast-in-place double cell culvert. The twin cell culverts have the invert elevations 208.30 at the upstream and 207.87 at the downstream end. The sizes (span x rise) of culverts are 3600 mm x 2400 mm and 3000 mm x 2400 mm. A temporary flow passage would need to be constructed in order to facilitate the steam water flow and is discussed in further detail below.

A preliminary general arrangement drawing of closed box twin culvert with widened channel is included in **Appendix A**.

Construction costs for both open footings and closed footings were undertaken for comparison purposes. It was found that closed box culvert is likely to have a reduced cost on account of shallower footings and a reduced area of excavation required. Further review of open and closed footings will need to be undertaken during the detailed design. The cost estimate from the Torbram Road MCEA was reviewed and updated. The estimated cost for this option is $4,701,515 (closed box). The preliminary cost estimate for the culvert replacement is included in **Appendix B.**

6. Foundations

Based on the preliminary geotechnical investigation report that was prepared as part of the Torbram EA study that was carried out by Soil Mat Engineers and Consultants Ltd. in 2017, it is understood that the culvert can be founded on the native clayey silt/sandy silt soils. The estimated geotechnical capacity at serviceability limit state (SLS) and ultimate limit state (ULS) is 200 KPa and 300 KPa respectively. Where fill or soft material is encountered, it will be necessary to remove unsuitable material and replace with an engineered fill material. The estimated geotechnical capacity at serviceability limit state (SLS) and ultimate limit state (ULS) for engineer fill is anticipated to be 150 KPa and 225 KPa respectively.

Based on the above bearing capacities, it would be feasible to utilize either open or closed footings; however, if engineered fill is required, open footings may not result in a reduced footing size compared to the closed box. The type of footing will be dependent on several factors including the scour resistance of the foundation, culvert span, and the

geotechnical bearing capacities. A further geotechnical investigation needs to be carried out during the detailed design stage to determine foundation requirements and the suitability of open footings.

7. Temporary Flow Passage and Dewatering

To facilitate the replacement of the culvert, it will be necessary to construct a Temporary Flow Passage System and dewater the construction area. It is understood that the culvert exhibits a reasonable amount of flow, even during the summer months and thus an active dewatering solution will be required. It is anticipated to be feasible to divert the flow around the proposed excavation by means of pumping and utilizing the portions of the existing and new culvert to convey the flow outside the limits of construction. Further review of dewatering options will need to be undertaken during the detailed design phase.

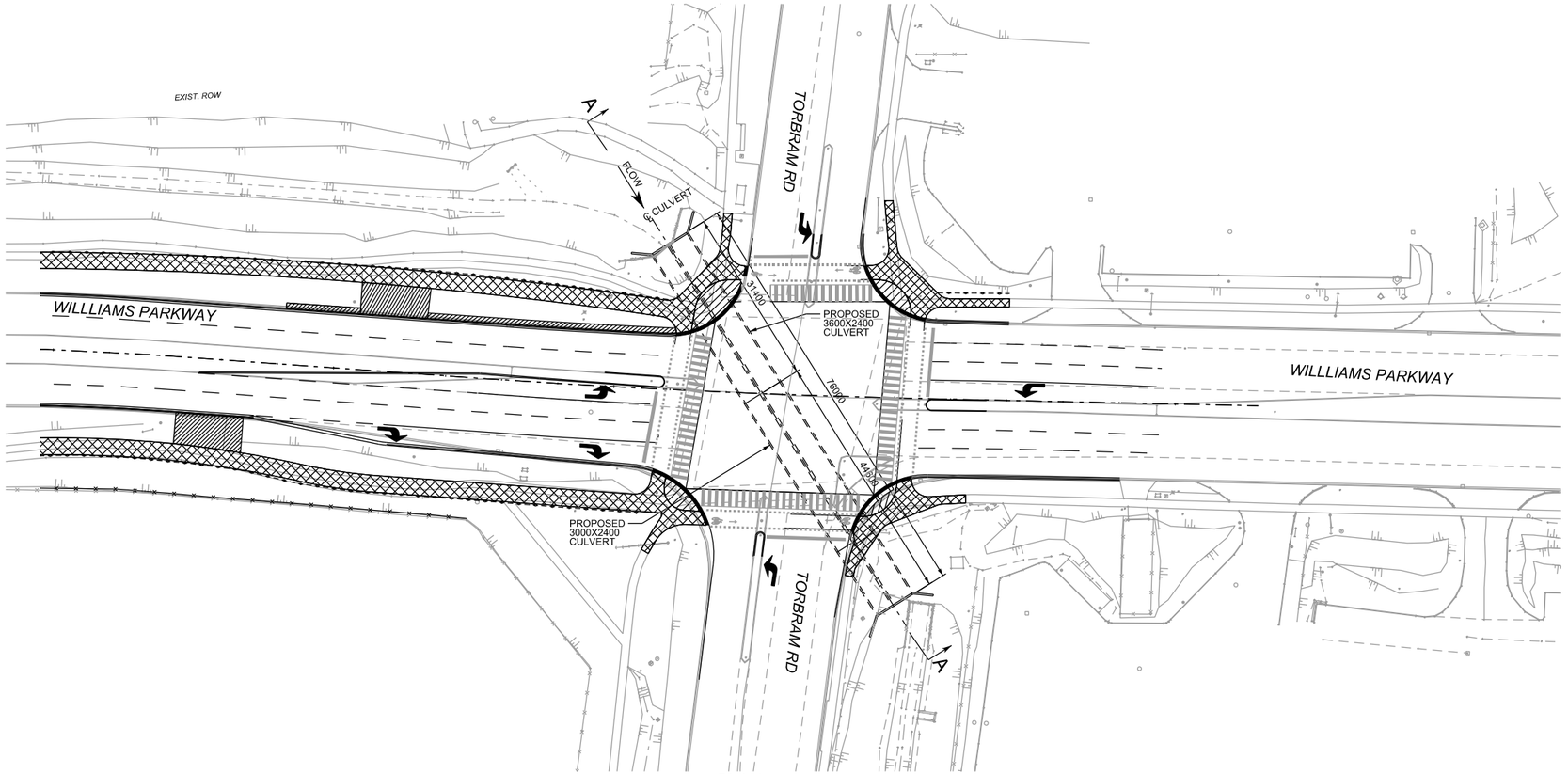
8. Summary and Recommendations

The visual inspection of the Torbram Road Over Mimico Creek Culvert indicates that the existing corrugated steel pipe culvert is in poor condition. Therefore, the full replacement of the culvert with the end walls, barrier and railing system is warranted.

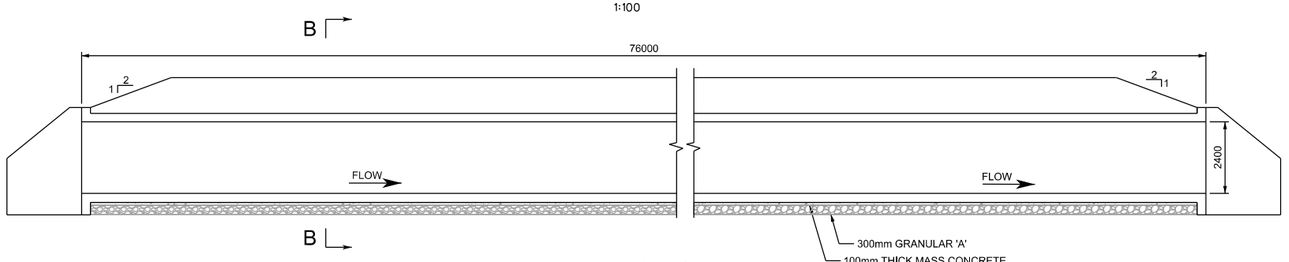
To reduce the construction duration and to minimize the traffic disruption to the Torbram Road and Williams Parkway intersection, utilizing precast components would be advantageous and should be reviewed further during detailed design.

The General Arrangement is provided in Appendix A and construction cost estimate is provided in Appendix B. The photos for existing structure are attached in Appendix C.

APPENDIX A – GENERAL ARRANGEMENT DRAWING



PLAN
1:100



SECTION A–A
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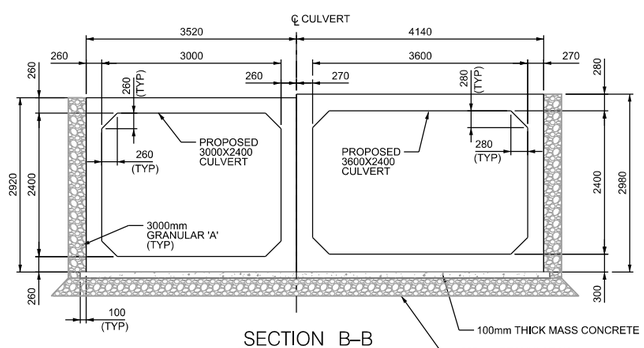


SECTION B–B
1:10

GENERAL NOTES:

1. CLASS OF CONCRETE:

PRECAST CONCRETE	35	MPa
MASS CONCRETE	20	MPa
REMAINDER	30	MPa

UNLESS OTHERWISE NOTED

2. CLEAR COVER TO REINFORCING STEEL:

CULVERT TOP SURFACE	50 ±	10
CULVERT INSIDE WALLS	50 ±	10
REMAINDER	45 ±	10

UNLESS OTHERWISE NOTED

3. REINFORCING STEEL:

REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.

UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BARS SHALL BE CLASS B.

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

CONSTRUCTION NOTES:

1. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, DETAILS AND ELEVATIONS OF THE EXISTING STRUCTURE THAT ARE RELEVANT TO THE WORK SHOWN ON THE DRAWINGS PRIOR TO COMMENCEMENT OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE CONTRACT ADMINISTRATOR AND THE PROPOSED ADJUSTMENT OF THE WORK REQUIRED TO MATCH THE EXISTING STRUCTURE SHALL BE SUBMITTED FOR APPROVAL.
2. THE LOCATION OF EXISTING UTILITIES IS APPROXIMATE. THE CONTRACTOR SHALL PROTECT THE UTILITIES FROM DAMAGE DURING WORK OPERATIONS.
3. DEBRIS FROM STRUCTURE REMOVALS SHALL BE PREVENTED FROM ENTERING THE WATERCOURSE.
4. BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH CONCRETE WALLS KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500 MM.
5. PROTECTION SYSTEMS SHALL BE DESIGNED FOR PERFORMANCE LEVEL 2.
6. THE CONTRACTOR SHALL ISOLATE WORK AREAS FROM THE WATERCOURSE FLOW FOR CULVERT REPLACEMENT AS REQUIRED TO COMPLETE ALL WORK IN THE DRY.

ABBREVIATION:

W.P.	WORKING POINT
EL.	ELEVATION
STA	STATION

LEGEND:

MASS CONCRETE

GRANULAR 'A'

NEW CONCRETE

NO.	BY	DATE	REVISIONS	CHECKED

BRAMPTON Flower City
brampton.ca
Public Works & Engineering
Capital Works

PARSONS

PROJECT DWG. NO.

WILLIAMS PKWY AND TORBRAM RD

PROPOSED CULVERTS

GENERAL ARRANGEMENT

SURVEYED BY:		DATE: JULY 2024		FILE NO.	XX-XXX-XXX
DRAWN BY:	F. PANG	CHECKED BY:	R. GABR	DRAWING NO.	SHEET NO.
DESIGNED BY:	W. GAN	CHECKED BY:	C. KHO		
SCALE:	AS NOTED	DATE:	JULY 2024		

LAST UPDATED: 21 SEP 16 - PMZ

APPENDIX B – COST ESTIMATE

TWIN CELL CLOSED BOX CULVERTS						
ITEM	ITEM CODE	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
1	0314-0071	Granular Backfill	t	736	$ 75	$ 55,200
2	0539-0040	Protection System	LS	1	$ 150,000	$ 150,000
3	0902-0010	Earth Excavation for Structure	m^3	4,637	$ 50	$ 231,850
4	0902-0030	Dewatering Structure Excavations	LS	1	$ 150,000	$ 150,000
5	0904-0015	Concrete in Culverts	m^3	543	$ 4,500	$ 2,443,500
6	0904-0035	Mass Concrete	m^3	60	$ 1,800	$ 108,000
7	0905-0010	Reinforcing Steel Bar	t	82	$ 5,000	$ 410,000
8	0905-0030	Mechanical Connectors	ea	272	$ 250	$ 68,000

Sub-Total	$	3,616,550
30% Contingency	$	1,084,965
TOTAL	**$**	**4,701,515**

TWIN CELL OPEN FOOTING CULVERT						
ITEM	ITEM CODE	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
1	0314-0071	Granular Backfill	t	740	$ 75	$ 55,500
2	0539-0040	Protection System	LS	1	$ 150,000	$ 150,000
3	0902-0010	Earth Excavation for Structure	m3	6150	$ 50	$ 307,500
4	0902-0030	Dewatering Structure Excavations	LS	1	$ 150,000	$ 150,000
5	0904-0015	Concrete in Culverts	m3	628	$ 4,500	$ 2,826,000
6	0904-0035	Mass Concrete	m3	31	$ 1,800	$ 55,800
7	0905-0010	Reinforcing Steel Bar	t	95	$ 5,000	$ 475,000
8	0905-0030	Mechanical Connectors	ea	204	$ 250	$ 51,000

Sub-Total	$	4,070,800
30% Contingency	$	1,221,240
TOTAL	**$**	**5,292,040**

APPENDIX C – EXISTING STRUCTURE PHOTOGRAPHS

PHOTOGRAPH 1 OUTLET END WALLS

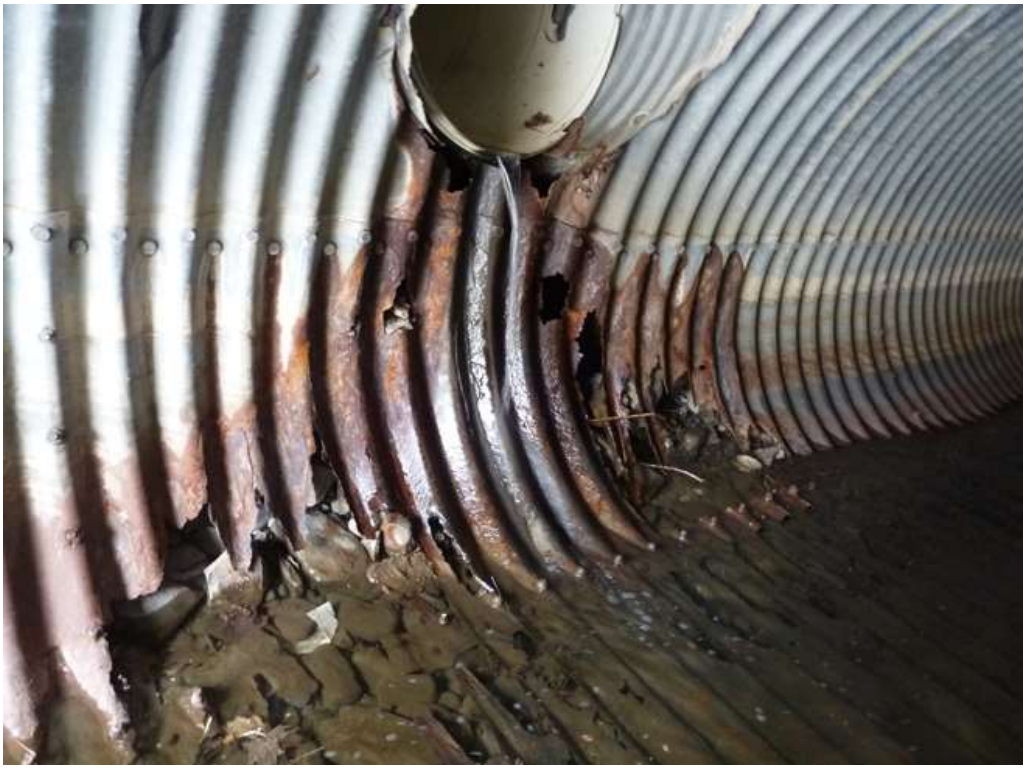
PHOTOGRAPH 2 OUTLET END WALL - SOUTH

PHOTOGRAPH 3 OUT END WALL – NORTH

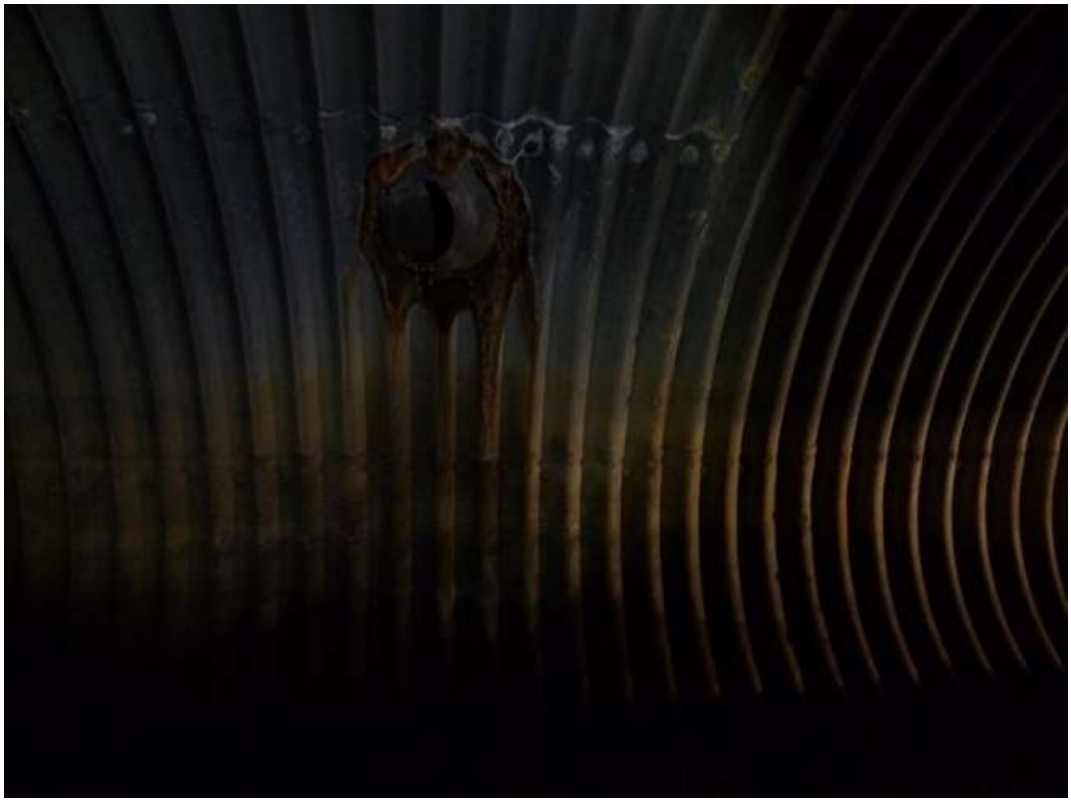
PHOTOGRAPH 4 INLET END WALL

PHOTOGRAPH 4 INLET END WALL – SOUTH

PHOTOGRAPH 6 INLET END WALL - NORTH



PHOTOGRAPH 7 CULVERT BARREL - DETERIORATED



PHOTOGRAPH 8 CULVERT BARREL - RUSTED

PHOTOGRAPH 9 CULVERT BARREL – RUSTED JOINTS

PHOTOGRAPH 10 RUSTED BOLTS