Prepared By:

GM BluePlan ENGINEERING

Municipality of Brockton

2018 – Greenock Structure No. 0013 OSIM

Our File: 216137

June 2019

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BRIDGE REVIEW REPORT

Structure No.:	0013
MTO Site No.:	N/A
Location:	Lot 23A, Concession 8, Greenock Survey
Date of Review:	May 31, 2019
Inspector:	Jesse Borges, B. Eng., EIT
Estimated Safe Loading:	No posting required.

Structure Description:

Structure: Cast-in-place concrete arch culvert **Year Constructed:** unknown

No. Spans: 1 **Width:** ±16.5m **Length:** ±6.5m

Approaches: Asphalt

Wearing Surface: Asphalt

BCI: 22

Remarks:

- Asphalt wearing surface is in fair to poor condition with longitudinal and transverse cracks. Asphalt at north has been patched.
- There is a steel beam guiderail on the structure and off the approaches.
- Several guiderail posts and bearing blocks are damaged in the southwest and northeast approaches.
- The southeast retaining wall is not part of the structure but does have severe deterioration and water leaking. Failure of the following wall could cause problems for the culvert.
- There is no headwall on either side of the culvert. It appears that part of the ground behind the southwest corner has slumped in and the grade is eroding due to water runoff on the steep slope.
- There is a large stone wingwall in the southwest corner. There is no mortar between the stones.
- There is no drip edge cast into the soffit.
- There is a medium horizontal crack along the width of the structure at each construction joint. There is also light honeycombing along the length of the construction joints.
- There are numerous hairline to medium longitudinal and transverse cracks throughout the structure with efflorescence indicating water is leaking through the entire structure.
- There is some spalling at the south soffit and the northwest wall exposing reinforcing steel.
- South embankment is failing, causing the guiderail to be pulled down and away from the roadway.
- The large vegetation growing beside and on top of the barrel will allow roots to damage the structure.

Conclusions:

Generally, the structure appears in fair to poor condition. There is excessive cracking throughout the structure covered with efflorescence indicating water is leaking through the structure. However, the structure does appear to be stable. Waterproofing the top of the arch and refacing the interior surface of the barrel may extend the life span of the structure. However, performing major repairs to the structure would only delay the structures replacement and would not be financially beneficial to the Municipality. The structure has been recommended for replacement since 2010 when it was introduced into the Brockton Review Program indicating construction by 2020. An intrusive investigation in 2012 exposed a portion of the exterior surface of the barrel which exhibited sound concrete in fair condition.

The rate of deterioration from 2010 to 2019 has been slower than expected allowing the Municipality to delay the replacement of the structure. The Municipality should prepare for replacement of this structure within 1 -5 years.

Recommendations:

1. Continue to monitor condition of soffit with reviews every two years.
2. Budget for replacement in 1 to 5 years.

GM BLUEPLAN ENGINEERING LIMITED
Per:

Jesse Borges, B.Eng., E.I.T.

Inventory Data:

Structure Name	Greenock Bridge Structure No. 0013		
Main Hwy/Road #		On X Under □	Crossing Type: Navig. Water □ Non-Navig. Water X; Rail □ Road □ Ped. □ Other □
Road Name	Chepstow Road/Concession Road 6		
Structure Location	0.1Km East of Side Road 5		
Latitude	44.15426	Longitude	-81.27508
Owner(s)	Municipality of Brockton	Heritage Designation:	Not Cons. X Cons./not App. □ List/not Desig. □ Desig./not List □ Desig. & List □
MTO Region *	South Western	Road Class:	Freeway □ Arterial □ Collector □ Local X
MTO District *	Owen Sound	Posted Speed	50 Km/hr; No. of Lanes: 2
Old County *	Greenock	AADT	% Trucks
Geographic Twp. *	Brockton	Special Routes:	Transit □ Truck □ School □ Bicycle □
Structure Type *	Arch Culvert	Detour Length Around Bridge	(km)
Total Deck Length	9.60 (m)	Fill on Structure	+1.0 (m)
Overall Str. Width	22.20 (m)	Skew Angle	20 (Degrees)
Total Deck Area	213.20 (sq.m)	Direction of Structure	N-S
Roadway Width	6.90 (m)	No. of Spans	1 (m)
Span Lengths	8.60m		(m)

Historical Data:

Year Built	Unknown	Year of Last Major Rehab.	
Last OSIM Inspection	Unknown	Last Evaluation	
Last Enhanced OSIM Inspection		Current Load Limit	/ / (tonnes)
Enhanced Access Equipment (ladder, boat, lift, etc.)		Load Limit By-Law #	
Last Underwater Inspection		By-Law Expiry Date	
Last Condition Survey	2012	Min. Vertical Clearance	(m)

Rehab. History: (Date/description)

An intrusive investigation completed in 2012 exposed a portion of the exterior soffit surface of the barrel which exhibited sound concrete in fair condition.

Field Inspection Information:			
Date of Inspection:	May 31, 2019	Type of Inspection:	X OSIM Enhanced OSIM
Inspector:	Jesse Borges, B.Eng., EIT		
Others in Party:	Trever O'Brien, P.Eng.		
Access Equipment Used:	Camera, Measuring Tape and Hammer		
Weather:	Sunny		
Temperature:	+16 °C		

Additional Investigations Required:	Priority			Estimated Cost
	None	Normal	Urgent	
Material Condition Survey				
Detailed Deck Condition Survey:	X			
Non-destructive Delam. Survey of Asphalt-Covered Deck:	X			
Concrete Substructure Condition Survey:	X			
Detailed Coating Condition Survey:	X			
Detailed Timber Investigation	X			
Post-Tensioned Strand Investigation	X			
Underwater Investigation:	X			
Fatigue Investigation:	X			
Seismic Investigation:	X			
Structure Evaluation:	X			
Monitoring (deformations, settlements, movements, crack widths)	X			
Load Posting – Estimated Load			Total Cost	
Investigation Notes:				

Overall Structure Notes:	Replacement in 1-5 Years.
Overall Comments:	Generally, the structure appears to be in fair to poor condition. The barrel of the structure has active signs of water seepage through the concrete arch with efflorescence and corrosion staining. Spalls were noted throughout the barrel with exposed reinforcing exhibiting severe section loss. The steep embankments at the four quadrants of the structure are showing signs of erosion. Erosion of the embankments and over the culvert have caused the steel beam guiderail to rotate away from the roadway. We recommend that the structure be replaced in 1-5 years.
Date of Next Inspection:	May 31, 2021

Suspected Performance Deficiencies

01 Load carrying capacity
02 Excessive deformations (deflections & rotations)
03 Continuing settlement
04 Continuing movements
05 Seized bearings
06 Bearing not uniformly loaded/unstable
07 Jammed expansion joint
08 Pedestrian/vehicular hazard
09 Rough riding surface
10 Surface ponding
11 Deck drainage
12 Slippery surfaces
13 Flooding/channel blockage
14 Undermining of foundation
15 Unstable embankments
16 Other

Maintenance Needs

01 Lift and Swing Bridge Maintenance
02 Bridge Cleaning
03 Bridge Handrail Maintenance
04 Painting Steel Bridge Structures
05 Bridge Deck Joint Repair
06 Bridge Bearing Maintenance
07 Repair to Structural Steel
08 Repair of Bridge Concrete
09 Repair of Bridge Timber
10 Bailey bridges - Maintenance
11 Animal/Pest Control
12 Bridge Surface Repair
13 Erosion Control at Bridges
14 Concrete Sealing
15 Rout and Seal
16 Bridge Deck Drainage
17 Scaling (Loose Concrete or ACR Steel)
18 Other

Element Data

Element Group:*	Culvert	Length:	22.20m
Element Name: *	Barrel	Width:	8.60m
Location:		Height:	4.40m
Material: *	Cast-In-Place Concrete	Count:	1
Element Type: *	Arch	Total Quantity:	305.0
Environment:	Benign / **Moderate** / Severe	Limited Inspection ☐	
Protection System: *			

Condition Data:	Units	Exc.	Good	Fair	Poor*	Perform. Deficiencies
	m² / m / each / % / all			183.0	122.0	

Comments: Concrete barrel exhibiting significant signs of water penetration with efflorescence deposits. Concrete spalls noted with exposed corroded reinforcing. Active water leakage noted at construction joints. Vertical and horizontal narrow to medium cracks noted with efflorescence.

Recommended Work: ☐ Rehab **X** Replace	Maintenance Needs:
☐ Urgent **X** 1-5 years ☐ 6-10 years ☐ None	☐ Urgent ☐ 1 year ☐ 2 year
Replace culvert structure.	

Element Group:*	Deck	Length:	21.60m
Element Name: *	Wearing Surface	Width:	6.90m
Location:		Height:	
Material: *	Asphalt	Count:	1
Element Type: *		Total Quantity:	149.10
Environment:	Benign / Moderate / **Severe**	Limited Inspection ☐	
Protection System: *			

Condition Data:	Units	Exc.	Good	Fair	Poor*	Perform. Deficiencies
	m² / m / each / % / all		59.10	45	45	

Comments: Transverse cracks noted over structure. Rutting and map cracking noted at edge of roadway over structure. Asphalt patch noted from previous investigation.

Recommended Work: ☐ Rehab **X** Replace	Maintenance Needs: 15
☐ Urgent **X** 1-5 years ☐ 6-10 years ☐ None	☐ Urgent **X** 1 year ☐ 2 year
Replace asphalt wearing surface.	Rout and seal asphalt.

Element Group:*	Retaining Wall	Length:	4.30m
Element Name: *		Width:	0.30m
Location:	Southeast Quadrant	Height:	2.30m
Material: *	Mass Concrete	Count:	1
Element Type: *		Total Quantity:	9.89
Environment:	Benign / **Moderate** / Severe	Limited Inspection ☐	
Protection System: *			

Condition Data:	Units	Exc.	Good	Fair	Poor*	Perform. Deficiencies
	m² / m / each / % / all			2.0	7.89	

Comments: Retaining wall is in poor condition with severe concrete deterioration, scouring and spalling.

Recommended Work: ☐ Rehab **X** Replace	Maintenance Needs:
☐ Urgent **X** 1-5 years ☐ 6-10 years ☐ None	☐ Urgent ☐ 1 year ☐ 2 year
Replace retaining wall.	

* A quantity must be estimated using the appropriate unit (e.g. m^2). Percent should not be used

Element Data

Element Group:*	Barrier	Length:	95.0m
Element Name: *	Barriers/Parapet Walls	Width:	
Location:		Height:	
Material: *	Steel	Count:	1.0
Element Type: *	Steel Flex Beam on Wood Posts	Total Quantity:	95.0
Environment:	Benign / Moderate / **Severe**	Limited Inspection ☐	
Protection System: *	Hot Dip Galvanizing		

Condition Data:	Units	Exc.	Good	Fair	Poor*	Perform. Deficiencies
	m^2 / **m** / each / % / all			31.0	64.0	**02**

Comments: North and south guiderail have rotated outward away from roadway due to possible erosion issues on embankment. All wood posts are exhibiting signs of rot and deterioration. Localized guiderail damage at southwest, northwest and northeast due to vehicle impact.

Recommended Work: ☐ Rehab **X** Replace ☐ Urgent **X** 1-5 years ☐ 6-10 years ☐ None Replace guiderail system.	Maintenance Needs: ☐ Urgent ☐ 1 year ☐ 2 year

Element Group:*	Foundations	Length:	
Element Name: *	Foundation (Below Ground Level)	Width:	
Location:		Height:	
Material: *	Cast-in-Place Concrete	Count:	1
Element Type: *	Spread Footing	Total Quantity:	1
Environment:	**Benign** / Moderate / Severe	Limited Inspection **X**	
Protection System: *			

Condition Data:	Units	Exc.	Good	Fair	Poor*	Perform. Deficiencies
	m^2 / m / each / % / all	N/A	N/A	N/A	N/A	

Comments: Limited inspection due to water and granular elevation. Footing at southwest corner exposed. Concrete curb poured in past to stop granular scouring at southwest corner. Based on overall condition of structure, foundation appears to be performing.

Recommended Work: ☐ Rehab **X** Replace ☐ Urgent **X** 1-5 years ☐ 6-10 years ☐ None Replace foundation with culvert.	Maintenance Needs: ☐ Urgent ☐ 1 year ☐ 2 year

Element Group:*	Embankments and Streams	Length:	
Element Name: *	Embankments	Width:	
Location:	Each Quadrant	Height:	
Material: *	Earth	Count:	4
Element Type: *		Total Quantity:	4
Environment:	Benign / Moderate / Severe	Limited Inspection ☐	
Protection System: *			

Condition Data:	Units	Exc.	Good	Fair	Poor*	Perform. Deficiencies
	m^2 / m / **each** / % / all		3	1		

Comments: Embankments appear to be in good to fair condition. Holes in southwest embankment noted due to erosion and water infiltration. All embankments appear to be overly steep but stable. Large trees and heavy vegetation growing on both sides of roadway over structure.

Recommended Work: **X** Rehab ☐ Replace ☐ Urgent **X** 1-5 years ☐ 6-10 years ☐ None Remove large vegetation and stabilize embankments.	Maintenance Needs: ☐ Urgent ☐ 1 year ☐ 2 year

* A quantity must be estimated using the appropriate unit (e.g. m^2). Percent should not be used

Element Data

Element Group:*	Embankments and Streams	Length:	
Element Name: *	Streams and Waterways	Width:	
Location:		Height:	
Material: *		Count:	
Element Type: *		Total Quantity:	
Environment:	Benign / Moderate / Severe	Limited Inspection ☐	
Protection System: *			Perform. Deficiencies

Condition Data:	Units	Exc.	Good	Fair	Poor*	
	m^2 / m / each / % / **all**		1			

Comments: Watercourse is clear of debris and appears to be flowing without any obstructions. Turbulence at southwest corner of structure has scoured culvert foundations in past. Water depth during inspection varied with south end of structure at 0.9m and north end of structure at 0.2m.

Recommended Work:	Maintenance Needs:
X Rehab ☐ Replace	
☐ Urgent **X** 1-5 years ☐ 6-10 years ☐ None	☐ Urgent ☐ 1 year ☐ 2 year
Install scour protection in watercourse after culvert replacement.	

* A quantity must be estimated using the appropriate unit (e.g. m^2). Percent should not be used.

Repair and Rehabilitation Required:		Priority				Estimated Structural Cost
Element[1]	Repair and Rehabilitation Required[2]	6 to 10 years	1 to 5 years	Within 1 year	Urgent	
Culvert	Replacement		X			$500,000
Asphalt	Replacement		X			$25,000
Sidewalk/Curb	Replacement		X			$15,000
Barrier	Replacement		X			$25,000
Foundations	Replacement		X			$350,000
Retaining Wall	Replacement		X			$10,000
Stream/Waterway	Rehabilitation		X			$10,000
Other	Structure Demolition		X			$120,000
Estimated Rehabilitated or Replacement Structure Dimensions[3]				Total Structural Cost		**$1,055,000**
Total Deck Length (m)		Overall Str. Width (m)				

1 - Indicate specific costs for structure replacement OR for rehabilitation under the given headings.
2 - Give a very brief description of the rehabilitation work required.
3 - Estimated structure dimensions after completion of the proposed work – if it is expected to change.

Associated Work[4]:	Comments	Estimated Associated Work Cost
Approaches[5]		
Detours		
Traffic Control		$20,000
Utilities		
Other (Dewatering)		$50,000
Environmental Assessment		$100,000
Engineering	Engineering Design and Contract Administration (15%)	$170,000
Contingency	(15%)	$170,000
	Total Associated Work Cost	**$510,000**

Total Construction Cost	**$1,565,0000**

4 - Includes other construction costs associated with the structure. Engineering fees for reports, environmental studies, designs, project management and contingencies are not included as associated work and should be specified on the Building Canada Fund – Communities Component (BCF-CC) Bridge Technical Schedule.
5 - Approach cost is for work (fill, pavement, guide rail, etc.) immediately adjacent to the structure to adjust for minor changes in horizontal or vertical alignment and for barrier end treatments at the structure. For BFC-CC applications, approaches longer than 30m (per end) require a separate Local Road Infrastructure Technical Schedule to be completed for that portion of road.

Justification:

The structure is nearing the end of its useful life cycle. The structure is exhibiting overall deterioration with active water seepage. We recommend the structure be replaced in 1-5 years.

Photo 1 - View of south elevation.

Photo 2 - View of roadway looking west.

Photo 3 - View of north elevation.

Photo 4 - Typical transverse crack in asphalt.

Photo 5 - Settlement and cracking of asphalt along southern edge of wearing surface.

Photo 6 - Outward rotation of south steel beam guiderail.

Photo 7 - View of typical rotted post.

Photo 8 - Deteriorated retaining wall at southeast.

Photo 9 - View of typical soffit condition.

Photo 10 - Evidence of water seepage through original construction joints.

Photo 11 - Barrel wall with exposed reinforcing.

Photo 12 - Active water seepage through barrel wall.

Photo 13 - Exposed reinforcing with severe section loss.

Photo 14 - Top of foundation exposed at southwest.

Photo 15 - Large vegetation (tree) growing on top of culvert.

Photo 16 - Voids at southwest embankment due to erosion.

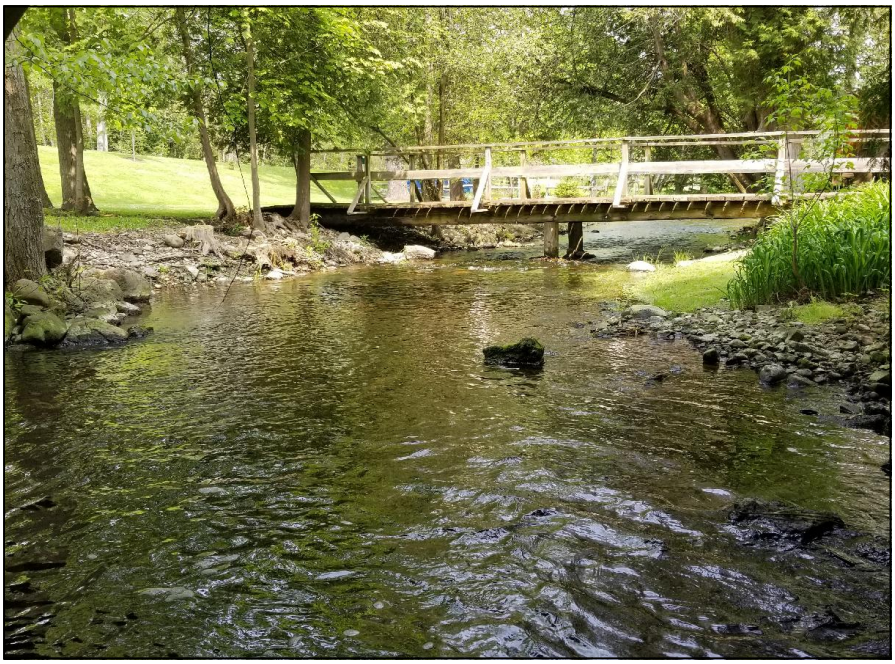

Photo 17 - View of watercourse looking north.

Photo 18 - View of watercourse looking south.