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File No. BR1104

May 21, 2014

Mike Berkvens, C.E.T., Development Manager
City of Sarnia
255 Christina Street North, P.O. Box 3018
Sarnia, ON N7T 7N2

Dear Sir

RE: Cull Drain Truss Bridge (000310) on Old Lakeshore Road

On September 24, 2013 BMROSS reviewed the Cull Drain Bridge for the purpose of providing repair options for the structure. By way of this letter-report, we wish to make our observations, and recommendations, provide a work plan, and a budget. A site location map is provided in Appendix 'A'.

OBSERVATIONS

The bridge was closed at the time of the review and barricaded with two lines of fencing from vehicle and pedestrian access. The width between the curbs is 4.72 m. Since the curb to curb width is less than 6.0 m the structure is a single lane bridge.

The bridge is a riveted steel half-through truss with a clear span of 28.7 m and a bearing span of 30.5 m +/-. The truss is supported by back-battered mass concrete abutments. Site photographs are provided in Appendix 'B'.

Deck

The concrete deck is estimated to be 160 mm to 170 mm thick with an outside to outside width of 5.0 m. The deck is in poor condition and has failed at the most easterly bay of the structure due to a lack of support from the disintegrated deck stringers below. The bottom mat of reinforcing steel is exposed at many locations due to a lack of concrete cover under the steel. The top of the deck is hidden below asphalt and gravel with an average estimated thickness of 100 mm and could not be observed.

Deck Stringers

The longitudinal stringers consist of 2 - 177 mm deep exterior C-channels, and 5 – 200 mm deep interior W- beams at 820 mm c/c in each of the seven bays. The stringers rest on top of cross beams. All of the stringers in the easterly two bays of the bridge and the most westerly bay are in poor condition, and are displaying significant corrosion. The stringers in the most easterly bay have disintegrated to a point where they provide no support for the deck above. The ends of 1 to 2 stringers are in poor condition in each of the remaining bays. In addition, there is very little bearing length for the stringers at the interior cross beams.

Deck Cross Beams

There are 6 – 455 mm deep interior cross beams (W-sections) and 1-455 mm deep cross beam (W-section) resting on each abutment bearing seat. The interior cross beams appear to be in fair condition. Pack rust was observed on the bottom flange of the cross beams resting on the abutment bearing seats.

Steel Truss

Diagonal and Vertical Elements

The diagonal and vertical elements consist of 2 angle irons back to back. The diagonal and vertical elements appear to be in fair condition and alignment.

Top Chord

The top chord consists of 2 – C-channels back to back connected to a top plate with rivets. The C-channel components appear to be predominately in fair condition. However, pack rust is forming between the C-channels and the top plate which could cause the connecting rivets to fail in tension in the 5 to 10 year period. The C-channels are in poor condition at the locations of the bearing seats.

Bottom Chord

The bottom chord consists of 2 angle irons back to back in the outside bays and 4 angle irons back to back in the interior bays. The angle irons are completely disconnected from the truss at all 4 bearing locations. Also the bottom leg of the bottom chords are perforated at a number of locations along the length of the truss at various gusset locations.

Gusset Plates

The gusset plates consist of 10 mm thick steel plate and appear to generally be in fair condition. One location on each truss was noted where it is possible that the bottom chord is hiding localized deterioration / corrosion occurring on the inside face of the gusset plates.

Horizontal Cross Bracing

Cross bracing is provided in each of the seven bays.

Railings

The steel railings are of a lattice style panel. The top of the railing panel is 0.85 m above the curb which is less than code requirements (1.07 m above the deck). The openings between slats may not meet dimensional requirements of current codes. The opening between the edge of the deck and the railings could allow a small child to slip through. The railings are damaged at a number of locations, and one section has been replaced with wood planks.

Abutments

The two abutments appear to be mass concrete. The lower 0.6 m of the west abutment and the outside edges of both abutments are delaminated. Some narrow cracks can be observed on the west abutment at the bearing seat locations. Delaminations, cracks and spalling can be observed at the bearing seats of the east abutment. The remainder of the abutments sounded to be in fair condition when struck with a hammer.

0.6 m to 0.9 m of the west footing is exposed and 0.4 m of the north footing is exposed.

Wingwalls

The four wingwalls appear to be mass concrete and there does not appear to be a positive connection between the abutments and the wingwalls. It is possible that they were designed as gravity structures.

Cold joints can be observed in the southeast and southwest wingwalls. However, they appear to be in relatively fair condition. Also, a stone retaining wall on the south side of the structure reduces the exposed surface area of the south wingwalls compared to the north wingwalls.

The northeast wingwall is cracked across its full width in a number of locations and has failed. The northwest wingwall is cracked and delaminated. Mass concrete blocks are used as front fill at both of the wingwalls on the north side of the structure.

Coatings

A review by ERS Inspection Ltd. (SSPC Certified Protective Coating Specialist) (Appendix 'C') indicated that there is evidence that the original truss structure was coated with a lead primer. Most of the primer has worn away. Fortunately, older steel has enough impurities that it is slow to corrode in normal atmospheric conditions. This is why a number of the truss components are in fair condition.

SUMMARY OF OBSERVATIONS

Many of the truss components are in satisfactory condition. Some critical truss components are in poor condition and it is appropriate that the bridge remain closed from vehicular and pedestrian traffic.

RECOMMENDATIONS FOR USE

After a significant repair program is completed, the bridge could be capable of supporting the pedestrian live load as specified in the Bridge Code. If the structural analysis proves that the strength of the repaired bridge is adequate, then you may be able to allow maintenance traffic. However, it is unlikely that a load posting of more than 5 tonnes can be achieved.

ENVIRONMENTAL ASSESSMENT IMPLICATIONS

Sympathetic repairs to the structure, which would not alter the basic structural system, would be classified as a Schedule A+. This requires some form of public notification but no formal Class EA process. A letter to adjacent property owners advising of the intended work program would suffice to satisfy the notification requirements.

If the City wishes to proceed with a Heritage Assessment and an Environmental Assessment, an additional allowance of $25,000 + HST for a Heritage Assessment and an Environmental Assessment should be included. This assumes that no studies (Biology, Archaeology, etc.) are required, but allows for one public meeting if desired by the City. It is assumed the City will pay for permit and notice fees.

RECOMMENDATIONS FOR REPAIR

It is our opinion that the bridge could be repaired to a state where it is safe for pedestrian use or even a load limited maintenance vehicle use. The repair program would be comprehensive and it may not be more effective than replacing the trusses with a prefabricated bridge.

The comprehensive repair program would involve complete removal of the deck and deck stringers in a staged manner to maintain stability. Defective truss components would be replaced and the concrete deck could be replaced. The concrete of the south wingwalls could be refaced with new concrete but re-facing is not an option for the abutments as this would restrict the hydraulic opening of the bridge.

The main abutment faces would have to be patch repaired in stages to maintain stability. Stability of the abutments should be improved by restoring front fill erosion protection. Backfill pressure could be reduced with the use of a drain and granular backfill for part of the abutment height. The northwest wingwall could be repaired similar to the wingwalls on the south side of the bridge. The northeast wingwalls should be completely replaced.

Re-coating structural steel is very expensive with the environmental constraints of the river. For this reason we recommend that all new components be hot-dip galvanized. The zinc coating provides better protection than paint at a marginal increase in cost. The galvanizing also avoids the requirement for maintenance painting in the future.

A repair program should consider all defective components together and the order of operations will be critical to avoid causing instability to the structure. The following is a list of work recommended to be done with an opinion of the probable cost of each item. An elevation view of the bridge along with a deck section is provided in Appendix 'D'. The order of the list is not intended to be an order of operations that should be completed at the time of detailed design.

1. Mobilization, demobilization	$ 18,000
2. Traffic control (road closed)	$ 2,000
3. Remove deck concrete	$ 21,000
4. Excavate, drain, backfill ballast walls	$ 10,000
5. Excavate, drain, backfill northeast wingwall	$ 12,000
6. Dewater and silt control	$ 10,000
7. New concrete deck	$ 50,000
8. Abutment patch repairs 4.5 m^3 @ $5,000	$ 22,500
9. South wingwall removals 1.5 m^3 @ $3,000	$ 4,500
10. Re-face south wingwalls 4.5 m^3 @ $2,700	$ 12,150
11. Northwest wingwall removals 2.5 m^3 @ $3,000	$ 7,500
12. Northwest wingwall repairs 2.5 m^3 @ $2,700	$ 6,750
13. Northeast wingwall removals	$ 10,000
14. New gabion baskets for northeast wingwall	$ 12,000
15. Rip rap erosion protection for footings	$ 12,000
16. Replace stringers 49 @ $1,500	$ 73,500
17. Replace bottom chords	$ 20,000
18. Replace horizontal gusset plates and bracing	$ 15,000
19. Reinforce gusset side plates 4 @ $3,000	$ 12,000
20. Reinforce top chord at bearing seats	$ 10,000
21. Temporary support for bearing replacement	$ 20,000
22. Replace bearings	$ 10,000
23. Restoration of surfaces	$ 5,000
24. Bonding and insurance	$ 6,500
25. Contingency allowance (15%)	$ 57,000
26. Allowance to repair railings	$ 10,000
27. Allowance to replace ballast walls 6.0 m^3 @ $1,800	$ 10,800
28. Allowance to replace breast walls 2.5 m^3 @ $1,800	$ 4,500
Subtotal by Construction	$ 464,700
Design, Contract Administration	$ 81,000
Allowance for Species at Risk Habitat Assessment	$ 7,000
Total Probable Cost	$ 552,700 + HST

The above budget does not include sundry costs by the City. These may be for items such as advertising (e.g. tender), work permits, etc. The above budget does not include any allowance for fencing or path surface material on the approaches to the bridge.

The budget should be considered preliminary based on the forecast repairs. A revision to this budget should be made at the time of detailed design. A 15% Contingency Allowance was included along with various allowances to account for unknowns.

DECK OPTIONS

Once the design phase is underway, options for the deck structure could be considered. The above noted budget assumes a concrete deck. However, a wood deck may be a less expensive option and provide savings in the range of $10,000 to $15,000 + HST.

ADDITIONAL REPAIRS

As noted above, the top plate of the chord will likely need to be replaced in the five to ten year period. The anticipated construction cost to replace the top plate is noted below.

- Replace top plate of top chord $ 80,000 + HST

It is understood that the City would benefit from a cost to strip and re-coat the Structure. Appendix 'C' includes a letter from ERS Inspection Services Ltd. which discusses anticipated costs to strip and recoat the structure.

- Strip and re-coat the structural steel members $400,000 +HST

SERVICE LIFE

Old truss bridges like this are chronic maintenance concerns and we are unable to provide a life cycle cost analysis. The concrete abutments may develop deep spalls or cracks. Corrosion cells develop that concentrate rust in one critical area of truss members. Deck stringers are a constant maintenance issue with truss bridges. However, by having them hot-dip galvanized, these elements should have a good head start on durability. The service life of any components will be highly dependent on the use of the bridge. Use by vehicles will accelerate corrosion, cause impact damage and abrasion.

It is probable that repairs will be required to some of the original steel members in 15 years. The abutments will also likely require patch repairs at that time.

TIMELINES

As noted above, we are of the opinion, that since the repairs are likely to maintain the original appearance of the bridge, a Heritage Assessment and an Environmental Assessment are not required. Based on this, we anticipate the following time line for any year:

Notice to Proceed to Design	Mid January
Preliminary Design and Updated Budget	Early March
Tendering	Mid May
Accept Tender	Mid June
Complete Construction	Mid November

If the City wishes to proceed with a Heritage Assessment and an Environmental Assessment, the above noted time line may be feasible, but it would be prudent to assume the design and EA could be completed in year 1 and construction could be completed the following year (for a 2 year project).

CONCLUSIONS

In our opinion the bridge can be practically rehabilitated to provide another 20 or 30 years of service with continued maintenance. A comprehensive rehabilitation program has been proposed with an overall budget of about $552,700 + HST. An additional $80,000 + HST will be required in the 5 to 10 year period to repair the top chord. It is likely impractical to expect this bridge to carry more than a 5 tonne live load. We typically do not recommend re-coating older truss structures. The City should budget an additional $400,000 + HST to strip and re-coat the steel members if they feel it is of benefit.

Please do not hesitate to contact us if you have questions about this report or if you wish to proceed with tendering the rehabilitation work.

Yours very truly

B. M. ROSS AND ASSOCIATES LIMITED

Per _____
R. J. Munn, P. Eng.

Per _____
A. I. Ross, P. Eng.

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APPENDIX 'A'

SITE LOCATION MAP


KEY PLAN
N
BRIDGE LOCATION
OLD LAKESHORE ROAD
HURON SHORES DRIVE
JAMIESON LANE
LAMBERT ROAD
LEWIS ROAD
OLD LAKESHORE ROAD
LAKESHORE ROAD
7
CULL DRAIN
BLACKWELL ROAD
TELFER ROAD
BRIGDEN ROAD

APPENDIX 'B'

PHOTOGRAPHS

South Elevation

Facing East

Deck Failure – East Bay

Bearing Seat at Northwest Corner of Bridge

Northeast Wingwall

APPENDIX 'C'

COATING REVIEW BY
ERS INSPECTION SERVICES LTD.

ERS
a
INSPECTION LIMITED

669 Osgoode Drive, Unit 42
London, Ontario N6E 2C7
Tel: (519) 686-5588
Fax: (519) 649-5385

Customer: **B M Ross**

Date: **November 1/13**

Location: **Sarnia Cull Drain Bridge**

P.O.#

JOB #

Inspector: **Earle Stainton**

Remarks:

This is a very old bridge that is in disrepair and the deck has been condemned because it is not safe to walk on.

PURPOSE:

The writer was requested to do a limited inspection of the bridge. The City is asking what would be the feasibility of coating this structure and what would it cost.

METHOD:

The inspection was visual there is not enough paint left of the bridge to get any readings on. There is evidence of lead primer which adds cost to the coating part of the project.

OBSERVATIONS:

The upper truss is in very poor shape and needs to have a lot of work done on it.

RESULTS:

There is a lot of remedial work to do on this truss to save it.

CONCLUSION:

The bridge if over water so it has to be scaffolded and totally enclosed with negative air pressure inside to eliminate the abrasive from getting to the water. The most common way to do this is to hang scaffold from the underside of the bridge. Even if it is repaired underneath this may be a problem because of the weight of the scaffold. The cost of enclosing the structure to abrasive blast it anticipated to be in the $ 200,000 range and the cost of the coating work is anticipated to be in the $ 200,000 range.

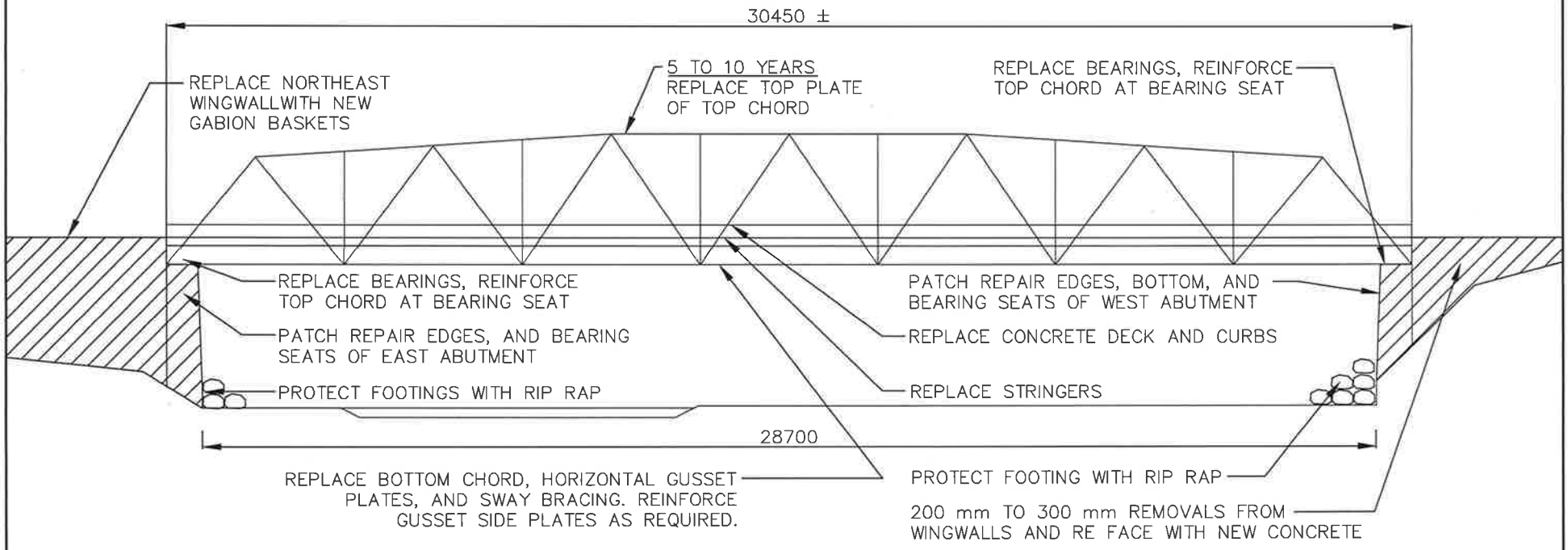
RECOMMENDATIONS:

I would highly recommend building a new structure that looks similar. The parts can be coated in a plant and bolted together on site. I am quite sure that this would cost a lot less and give everyone more value for the money spent.

ERS Inspection Limited

APPENDIX 'D'

PRELIMINARY DRAWINGS



NORTH ELEVATION

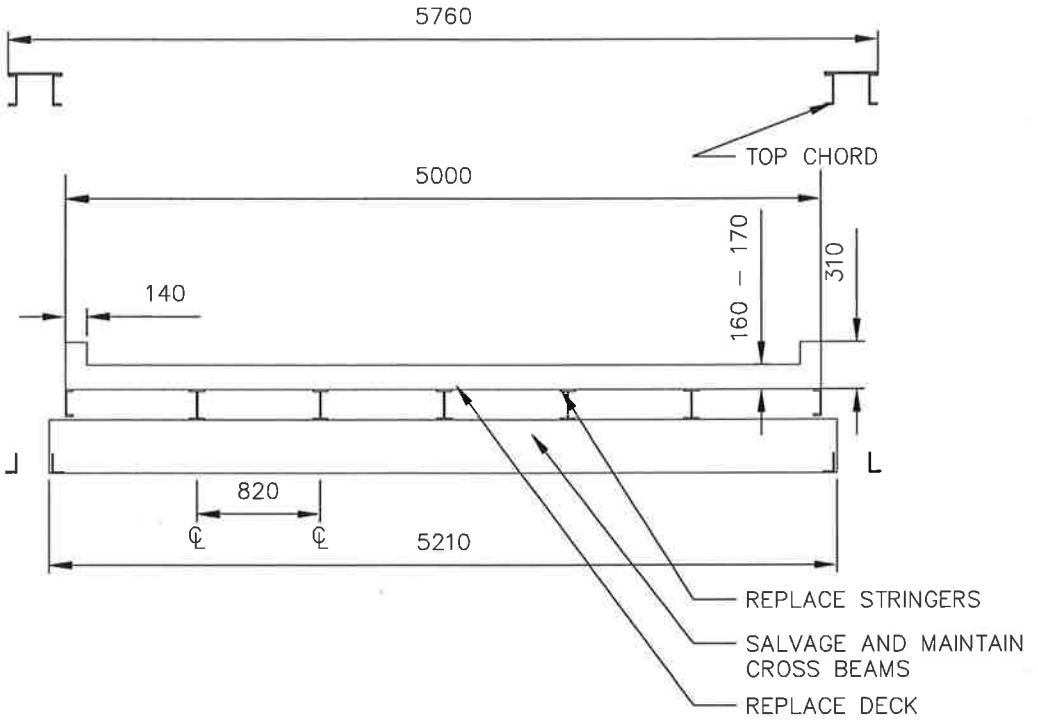
BMROSS engineering better communities

City of Sarnia

PRELIMINARY REVIEW

Cull Drain
(Old Lakeshore Road)

DATE No. Nov., 2013	PROJECT No. BR1104
SCALE 1:150	DRAWING No. 1 of 2



DECK SECTION

BMROSS engineering better communities	**City of Sarnia** **PRELIMINARY REVIEW** **Culi Drain (Old Lakeshore Road)**	**DATE No.** Nov., 2013	**PROJECT No.** BR1104
		SCALE 1:50	**DRAWING No.** 2 of 2