October 6, 2020
Our File: 216137-1

Via Email: gfurtney@brockton.ca

Municipality of Brockton
100 Scott Street, Box 68
Walkerton, ON N0G 2V0

Attention: Mr. Gregory Furtney

Re: Bridge Closure Recommendation
Greenock Bridge Structure. No. 6
Municipality of Brockton

Dear Gregory,

As requested, GM BluePlan Engineering Limited (GMBP) has recently completed a load evaluation for the Greenock Structure No. 006 located on Concession Road 8 over the Teeswater River. The purpose of the load evaluation was to quantify the deficiencies and deterioration of key structural members of the bridge and determine the adequacy of the current load posting. Our initial review of the structure in 2020 was completed as part of the biennial bridge inspections for the two former townships, Brant and Greenock, which currently form part of the Municipality of Brockton (Municipality). The inspections involved attending each Municipality owned bridge and culvert and assessing the current condition of the structure. As part of the inspection report, we recommended that the load posting for Greenock Bridge Structure No. 006 be evaluated prior to the end of 2020. This letter has been provided to the Municipality to summarize the results included in the load evaluation report and is intended to provide an executive summary of our findings and recommendations. For a more detailed overview, please refer to our load evaluation report.

Based on our onsite review, the bridge is currently in poor condition due to several structural elements being identified as critically deficient (see attached photo report). The cross beams which support the deck top and stringers are in fair to poor condition with localized areas exhibiting 50% section loss. The section loss in the flanges and perforations in the web of the cross beams significantly reduces the load carrying capacity and lateral stability of the steel members. The east bearing connections which transfer the applied loads from the steel truss structure to the concrete substructure of the bridge are in poor condition with severe corrosion and section loss. Each end of the top and bottom chord is connected to the bridge substructure with a single steel pin. The gusset plates anchoring the east pin connections to the top of the abutment wall are in poor condition with approximately 30% to 50% section loss. The east ends of the top and bottom chord are also in poor condition with severe corrosion and section loss. The exterior component of the southeast bottom chord is exhibiting approximately 80% section loss.

The bridge substructure is in fair to poor condition with significant spalling, wide vertical cracks and evidence of water penetration through the back of the abutment. Cracking on the bearing seat adjacent to the truss connections could indicate that the substructure is being over stressed by the truss. The bearing plates at each truss connection appear to be touching the front face of the ballast wall. A vertical crack on the ballast wall has also been noted at each truss connection which could indicate that the truss is applying pressure to the ballast wall. Please refer to the 2020 Load Evaluation Report for full details regarding the condition of the structure.

Currently, Greenock Structure No. 006 has a triple load posting of 7, 12 and 19 tonnes. The last load evaluation completed on the bridge was in 2016 which determined that the triple load posting should be revised to 6, 12 and 19 tonnes (not completed). It should be noted that there are a few key differences between the 2016 and 2020 load evaluation which have been outlined below:

1. Significant effort was made in 2020 to clean the tops of the abutments off which are typically covered in gravel and vegetation. In addition, several steel elements were cleaned with a wire brush to remove loose corrosion.

2. Due to the low water level at the time of our 2020 review, GMBP was able to inspect a large portion of the underside of the bridge with a ladder, allowing for a more detailed review of the stringers and cross beams (not always possible if water levels are high).

3. Our 2020 analysis has considered MTO Technical Report Document No. SRR-88-04 – Bridge Testing – A Surprise Every Time (1988). This document provides recommendations for evaluating pin-connected steel truss bridges (i.e. Greenock Structure No. 006) with double member tension chords (bottom chords). The report identifies an uneven loading pattern common to this type of truss which was not considered in our 2016 load evaluation as the existence of the MTO document was unknown.

4. Although the last evaluation was only 4 years ago, the structure has continued to deteriorate at a significant rate.

The load evaluation was carried out in accordance with CSA S6-19, Canadian Highway Bridge Design Code (CHBDC) and CSA S16-14, Structural Steel Design Standard. Based on the results of the load evaluation, the bridge currently has three elements deemed critically deficient which are unable to support the Ontario truck loading included in the three evaluation levels set by CHBDC. These members have been identified as the steel cross beams below the deck, the east ends of the bottom chord and the east bearing connection gusset plates. Since the bridge is located on a rural roadway with a low traffic count, we have also consider implementing a single load posting outside the limits of the bridge code (3 tonnes or less). Considering that a majority of vehicles utilizing the bridge would weigh more than this load limit (especially winter maintenance vehicles), we recommend that the structure be closed to all vehicle loading.

The Municipality has requested that we also consider the possibility of leaving the bridge open for pedestrian traffic only. The bridge code requires that a live load of 3.80 KPa be considered for the subject bridge if it is utilized as a pedestrian bridge. Based on our analysis, the current condition of the bridge has capacity to support approximately 0.90 KPa (less than 25% of the bridge code requirements). It should also be noted that the existing barrier system on the bridge does not meet the code requirements for pedestrian traffic. Therefore, we recommend that the bridge structure also be closed to all pedestrian loading.

Based on the current condition of the structure and the results of the load evaluation, we recommend that the Municipality take the following steps:

- Close the structure to all vehicle and pedestrian traffic prior to the beginning of Winter 2020. Barricades should be installed at each end of the bridge along with signage indicating the closure.

- The Municipality should begin budgeting for the permanent removal or replacement of the structure within 1-5 years. It is our opinion that attempting to perform any repairs to the existing structure at this point would only provide a minimal extension in the service life of the bridge at a significant cost to the Municipality (see below).

- Initiate a Municipal Class Environmental Assessment (MCEA) on the structure to determine the impacts to the surrounding environment, including local agricultural and residential communities, if the structure is permanently removed or replaced.

- Increase the frequency of inspections for the structure to every 6 months to monitor the deterioration of the deficient members until a decision regarding the future of the structure can be determined by the Municipality. If the bridge is closed and winter maintenance is not completed on bridge, significant snow loading could accumulate. Increasing the frequency of the bridge inspections will allow the Municipality to monitor the bridge more closely and if required, implement temporary repairs if an element on the bridge appears to be failing.

It should be noted that repairs to the existing structure could be completed if the Municipality wishes to keep the structure opened. Based on our review, we anticipate that the following repairs would need to be completed to keep the bridge open beyond 2020:

- Replacement of the NE, SE and SW bearing connections.
- Replacement of the NE and SE bottom chords.
- Replacement of 3 to 4 cross beams.
- Concrete repairs to the east bearing seat and abutment wall.

These repairs would require significant temporary shoring to support the truss as components are removed and replaced. We estimate that the total rehabilitation cost for these repairs would be in range of **$150,000 to $200,000 (excluding HST).** It should be noted that this opinion of cost has been prepared with limited design details and is based on probable conditions affecting the project. Factors such as contractor availability, schedule of work and COVID-19 restrictions can have a significant affect on the cost of these repairs, especially if this work is expected to be completed before the end of 2020 and deemed as emergency work. If the above repairs are completed, we expect that the structure could remain open for an additional 5 to 10 years at the most. Due to the condition of the substructure and the remaining steel truss members, we would still recommend that the bridge be posted with a single load posting even if the repairs are completed. The load posting would be determined when the detail design of the repairs are completed. It should also be noted that additional repairs to the bridge structure could still be required in the future.

Should you have any questions about the load evaluation results, or if you require input on rehabilitation or replacement options, please feel free to contact the undersigned.

Yours truly,

GM BLUEPLAN ENGINEERING LIMITED
Per:

Jesse Borges, P.Eng.
JB/mr

cc: Municipality: John Strader - jstrader@brockton.ca
GMBP: Brent Willis, P.Eng. – brent.willis@gmblueplan.ca
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Photo 1 - View of structure from west (May 1, 2020).

Photo 2 - View of south truss (May 1, 2020)

Photo 3 - View of soffit looking east (May 1, 2020).

Photo 4 - View of southeast bearing connection (September 22, 2020).

Photo 5 - Severe corrosion and section loss at southeast bearing connection (September 22, 2020).

Photo 6 - Approximately 75% section loss at east end of south bottom chord (September 22, 2020).

Photo 7– Severe corrosion and section loss of gusset plate at southeast bearing connection (September 22, 2020).

Photo 8 - View of northeast bearing connection (September 22, 2020).

Photo 9- Severe corrosion and section loss at northeast bearing connection (September 22, 2020).

Photo 10 - Severe corrosion and section loss of gusset plate at northeast bearing connection (September 22, 2020).

Photo 11 - Severe corrosion, section loss and perforations at east cross beam (September 22, 2020).

Photo 12 - Approximately 80% section loss at top flange of cross beam (September 22, 2020).

Photo 13 - Approximately 50% section loss at bottom flange of cross beam (September 22, 2020).

Photo 14 - Large perforation (350mm x 50mm) at north end of cross beam near mid span (September 22, 2020).

Photo 15 - Approximately 30% section loss throughout stringer supports (September 22, 2020).

Photo 16 - Significant concrete deterioration and spalling noted adjacent to northeast bearing connection (September 22, 2020).