

Submission for
**Canadian Consulting
Engineering Awards 2022**



TOWNSHIP OF
EAST GARAFRAXA



BURNSIDE



Bridge No. 7 Rehabilitation
Township of East Garafraxa

Transportation Category



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Bridge No. 7 Rehabilitation**

April 13, 2022

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Introduction

R.J. Burnside & Associates Limited (Burnside) and the Township of East Garafraxa (Township) are pleased to present the Rehabilitation of Bridge No. 7 to the Association of Consulting Engineering Companies' (ACEC) for consideration for a 2022 Canadian Consulting Engineering Award in the Transportation Category.



Image 1: Aerial View of Rehabilitated Bridge

Project Summary

The Township objectives for this important bridge rehabilitation project were to preserve the bridge's heritage and aesthetic, improve load capacity, and maximize durability. Burnside was retained to achieve these objectives and provided full project planning, design, and construction oversight services for the scope of work. At all points along the project, Burnside ensured that modern day practices, materials, and technology were employed to preserve an important link with the Township's past and maintain it for the future.



Image 2: Grand River View of Existing Bridge

Innovation

The Grand River is designated as a Canadian Heritage River, in recognition of the natural and human heritage that connects its history to the present and informs its future as a public resource. Along with its natural environment, tourism, and access to recreation activities, the historic and cultural heritage features found along the river are part of what qualified this designation. There are many concrete bowstring arches along the watercourse, and each tells its own story.



Image 3: Road View of Existing Bridge

The East Garafraxa Bridge No.7 sets itself apart as unique and it is the only skewed, off-set twin concrete bowstring arch bridge along the river. Its unique character, style, and aesthetic are a testament to the early settlement of the area and the balance of form and function that was once commonplace in Ontario bridge construction. The Township committed to preserving its heritage by rehabilitating this unique structure rather than replacing it.



Image 4: Rehabilitation Access Challenges

Burnside evaluated the existing structure, replaced the concrete deck, strengthened the floor beams and re-established the barriers, arches, and upper portions of its abutments and central pier. Using a composite timber/concrete deck allowed Burnside to reduce dead load on the bridge, which increased live load capacity. Implementing new advances in lightweight waterproofing and water-

resistant coating technologies, Burnside was able to further reduce dead load, protect repaired components, increase the durability of the repairs, and refresh its overall appearance.

Drawings of the original bridge were available during the design for evaluation and planning purposes; however, during construction, concrete removals identified drawing deviations in reinforcing size and location. In response to this, scanning technology was employed to confirm the location of shear stirrups in the floor beams without removing concrete.



Image 5: Removal of Existing Deck

Using sophisticated analysis and design tools along with Burnside's structural expertise, modifications were made to the design to suit actual field conditions without delaying the project or significantly increasing costs. The ability to adapt and modify the design on the fly was both challenging and rewarding, and ensured the Township received the maximum benefit for the funds expended.

The most successful aspect of the project was the preservation of a unique cultural heritage feature at a time when most structures of this vintage are being removed out of convenience. This project offered the opportunity to implement a unique rehabilitation of a truly unique structure, to ensure that a key piece of the Township's cultural heritage was preserved for the future.

Complexity

Due to age, the bridge abutments had rotated nominally inward towards the river over time, which reduced the ability of the structure to expand and contract as originally intended. It was difficult to determine the exact amount of rotation that had occurred and there was a concern that the bottom exterior chords and deck – typically in tension – may be subject to compression loading. To remedy this issue, a detailed deck panel removal sequence was developed in conjunction with the Contractor, given that the deck panels were going to be removed to be replaced and there were repairs required on the exterior and soffit of the bottom chords. Similarly, the work to repair the exterior chords, which included removing concrete, required a staging plan to ensure that the potential for structure instability was eliminated. To further ensure stability, temporary struts were placed in areas where the deck was removed to preclude potential buckling of the bottom chords while concrete was removed.

The original design drawings were available for evaluation, but scans of the existing floor beams identified a lack of sufficient shear reinforcement to allow for a load increase. A methodology to cap the floor beams and make them composite with the new deck was developed to maximize the capacity of the floor beams.

Additionally, the top of the bridge pier between the two spans had experienced significant concrete deterioration over time. Full depth removal was not practical, and an epoxy grout encapsulation method was developed to recapture lost strength.



Image 6: Temporary Deck Struts Installed for Buckling Prevention

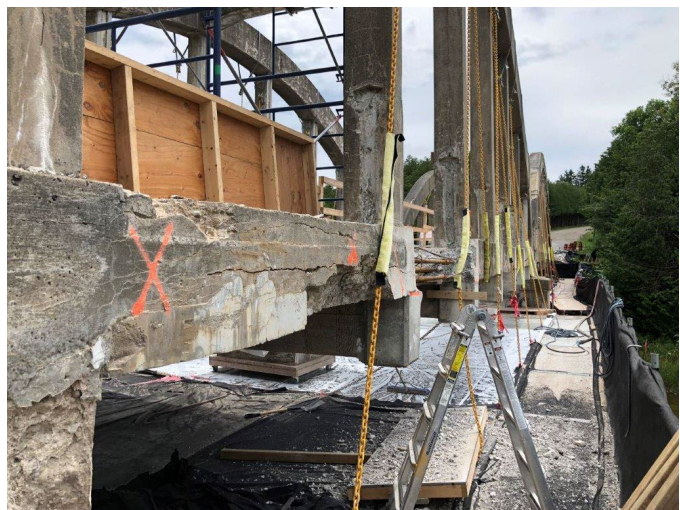


Image 7: Tension Chord Removals

Social and / or Economic Benefits

East Garafraxa 12th Line is a low volume road serving mostly rural agricultural and residential properties. Bridge No. 7 is situated in the Grand River Valley that is well defined in the area.

It was determined that the cost to replace the bridge and road approaches was significant and not within the budget available to the Township. Furthermore, due to the unique nature of the structure, the Township desired to preserve the bridge and its cultural heritage, which has become a local focal point as part of the designation of the Grand River as a Canadian Heritage River. Without rehabilitation or repair, the bridge would soon become deficient from a load capacity perspective and would impact school buses, snow removal equipment, and fire, ambulance and police services.

The goals of the rehabilitation included preserving the heritage and aesthetic of the bridge, enhancing the durability of the bridge, and strengthening it to the maximum practical limit in order to extend its useful service life. The social benefits of the project include the preservation of local heritage, the demonstration of the Township's desire to maintain its connection to its historic roots, and to ensure a local landmark remains in place for the foreseeable future. The improved load limit ensures access to emergency services and reduces travel time for residents accessing Dufferin Road 109 and points east and west. A closed bridge would add approximately 8 to 10 km for some residents, or 20 to 25 additional minutes for a round trip.



Image 8: Installation of Concrete Composite Deck

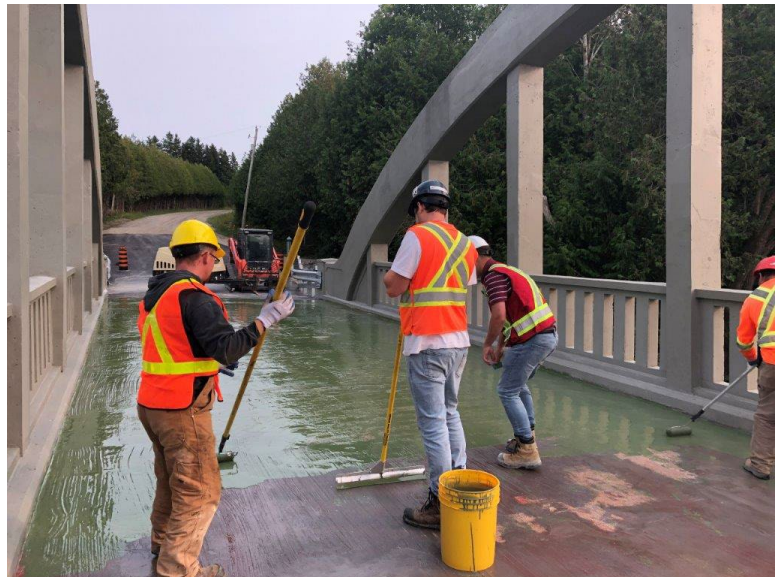


Image 9: Installation of Lightweight Waterproofing

Environmental Benefits

From an environmental perspective, the primary resource addressed through this project relates to the cultural heritage environment. The number of concrete bowstring arch bridges in Ontario is declining each year; once common, they are no longer constructed, replaced by more modern, cost effective and more easily constructed structure types. The loss of this heritage is irreplaceable and particularly so at East Garafraxa Bridge No.7, as it is one of the few – if not the only - skewed offset twin bowstring arches in Ontario. The Township's desire to preserve this structure demonstrated their commitment to their rural heritage and natural beauty.

A new bridge at this location would have required a larger, two span structure, with precast concrete or steel girders on a central pier and concrete abutments. A new pier would have to be built within the watercourse or the floodplain, impacting the habitat of the endangered Redside Dace in the nearby Irving Creek tributary. Improvements to the approach roads that would be required for a new bridge would require the removal of trees, thus impacting potential bird and bat habitat.

From a sustainability perspective, the bridge has effectively been recycled, refurbished to serve its intended purpose for a longer service life than that for which it was originally designed. A new replacement bridge would require many resources to construct, to fabricate the steel for girders, or produce cement for the concrete components. Instead, the rehabilitation of the bridge used far less resources, thus reducing the project's environmental footprint.



Image 10: Grand River View of Rehabilitated Bridge

Meeting Client's Needs

The Township was on record as having a desire to preserve its cultural environment and connection to its historic roots through the preservation of Bridge No. 7, and commitments had been made in this regard when the Grand River was being designated as a Canadian Heritage River. The Township is very aware and supportive of the tourism and economic benefits that come with its location and natural surroundings.

As part of its biennial bridge inspection program, Bridge No. 7 had been identified as needing replacement or significant rehabilitation. The costs for a replacement bridge were significant and difficult to justify for a low volume road, and replacement was not in keeping with the Township's stated desire to preserve this unique structure.

Burnside was engaged to assist the Township in considering their alternatives for the bridge, which included confirming the estimated costs for replacement and providing several rehabilitation options. The proposed options offered a range of possibilities from low cost with short service life to a major investment with a longer service life. The Township elected to proceed with an option that would result in the longest possible extended service life, lowest maintenance, and highest durability. In addition, the rehabilitation would increase the load carrying capacity of the bridge to the maximum practical limit.

Burnside assisted the Township with a successful funding application that allowed the Township to fulfill all of their commitments with maximum benefits to the local residents and the broader community.

Closing

On behalf of the Township and the entire project team, we thank the ACEC for its consideration of the Rehabilitation of Bridge No. 7 project for a 2022 Canadian Consulting Engineering Award in the Transportation Category. We trust that we have demonstrated how this important heritage transportation infrastructure project meets each of the five selection criteria, resulting in a strong project candidate for this award.

Mark Hallman, P.Eng., LEED AP, WELL AP (Proposal Manager, 226-486-1561, Mark.Hallman@rjburnside.com) and Chris Knechtel, P.Eng. (Engineering Manager, 519-938-3012, Chris.Knechtel@rjburnside.com) can be reached at the ACEC's convenience, should you have any questions or comments on our submission.

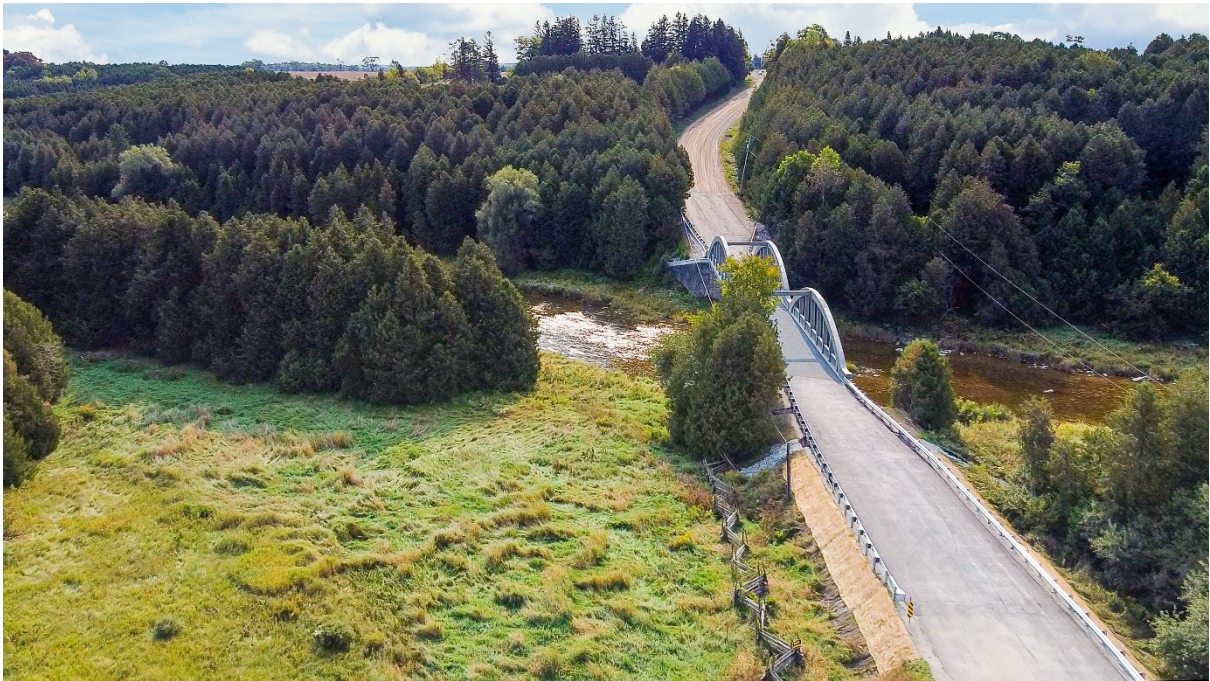


Image 11: Aerial View of Completed Bridge

Appendix A

Consent Forms





2022 Canadian Consulting Engineering Awards Project Owner Form

I am authorized, on behalf of (INSERT ORGANIZATION NAME) Township of East Garafraxa,
to confirm and consent to the following relating to (INSERT PROJECT NAME) Bridge No. 7 Rehabilitation,
being submitted to the 2022 Canadian Consulting Engineering Awards by (INSERT SUBMITTING FIRM'S NAME)
R.J. Burnside & Associates Limited;

- The project was completed to our satisfaction;
- The submitting firm(s) performed duties as described in their submission;
- We are not, and do not expect to be, in litigation with the submitting firm(s) regarding the project being submitted

I also acknowledge and agree to the following:

- Submitted projects will be evaluated by a panel of jurors who are engineering experts and/or have expertise relevant to the judging criteria;
- The decision of the panel will be accepted as final;
- The submitting firm(s) whose projects are selected for an award by the jury will be notified in Q2 of 2022
- Winning projects will be announced publicly in Q4 during an awards gala hosted by the Association of Consulting Engineering Companies – Canada (ACEC)
- Videos and descriptions of the winning projects will be produced for the awards gala by ACEC and will be available to the submitting firms, owners and clients upon request following the gala.
- Following the awards gala, winning projects will be publicized through, but not limited to, the following:
 - o *Canadian Consulting Engineer* magazine and website
 - o ACEC publications and website
 - o ACEC #20DaysofExcellence social media campaign
 - o Press releases issued by ACEC
- Submitting firms may also publicize the winning projects
- The entire project entry will be archived on the *Canadian Consulting Engineer* website, whether it was selected as a winning project or not.

Name: Susan Stone, A.M.C.T.

Position: CAO/Clerk

Company: Township of East Garafraxa

Address: 065371 Dufferin County Road 3, Unit 2

City: East Garafraxa Province: ON Postal Code: L9W 7J8

Tel. 226-259-9400 E-mail: sstone@eastgarafraxa.ca

Signature:  Date: April 7, 2022

2022 Canadian Consulting Engineering Awards Consent Form

For a project entry to the 2022 Canadian Consulting Engineering Awards to be considered complete, the following documents must be included with the submission:

- This form, completed and signed by an individual on behalf of the entering consulting engineering firm(s).
- A completed and signed project owner consent form.
- A completed and signed client consent form (if not the same as the project owner).

TO BE COMPLETED BY AN INDIVIDUAL SIGNING ON BEHALF OF THE ENTERING COMPANY (COMPANIES).

I (We) confirm that this entry complies with the contest rules and that the information submitted is accurate.

I (We) also agree to accept as final the decision of the panel of jurors.

I (We) consent to having the entire project entry archived on the *Canadian Consulting Engineer* website, whether it is selected as a winning project or not.

Name: Chris Knechtel, P.Eng. _____

Position: Engineering Manager _____


Company: R.J. Burnside & Associates Limited _____

Address: 15 Townline _____

City: Orangeville _____ Province: Ontario _____

Postal Code: L9W 3R4 _____ Tel.: 519-938-3012 _____

E-mail: Chris.Knechtel@rjburnside.com _____

Signed  _____

Date April 11, 2022 _____

