Tillsonburg	**Report Title**	Kinsmen Pedestrian Bridge Enhanced Inspection
	Report No.	OPS 19-44
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	Meeting Type	Council Meeting
	Council Date	October 28, 2019
	Attachments	• Kinsmen Pedestrian Bridge Evaluation Report

RECOMMENDATION

THAT Council receive Report OPS 19-44 Kinsmen Pedestrian Bridge Enhanced Inspection;

AND THAT G. Douglas Vallee Limited continued to be retained to complete the Municipal Class Environmental Assessment;

AND FURTHER THAT the associated engineering costs in the amount of $12,100 be funded by the remaining project budget.

BACKGROUND

The Kinsmen Pedestrian Bridge is located on Veterans Memorial Walkway, 170m west of Rolph St. The structure is an old railway girder bridge constructed in approximately 1910 subsequently converted to a pedestrian bridge approximately 20 (+/-) years ago, with 9 spans and has total length of 107.5m.

Through Report OPS 19-14 G. Douglas Vallee Limited was retained by the Town to complete an Enhanced OSIM Inspection of the Kinsmen Pedestrian Bridge including a load limit analysis and evaluation of rehabilitation options.

SUMMARY

Enhanced OSIM Inspection

On June 18, 20 and 21, 2019 each element of the bridge was thoroughly inspected, including inaccessible elements through the use of a drone-mounted camera and certified rope access technicians. Steel sections were cleaned with a wire-brush and caliper measured to determine corrosion section loss, wood ties were tapped with a hammer to test for soundness and concrete areas were tested for soundness with the use of a hammer and Delam 2000 tool.

Results of the Enhanced OSIM Inspection are summarized below:

Concrete Abutments

There are no records that indicate the abutments or piers have undergone any rehabilitation work since originally constructed. Minor cracking and delamination of the abutment walls was noted. Deterioration of the mortar was also evident with an average of approximately 30% mortar loss in the joints. Approximately 60% of the abutments are in good condition, 30% are in fair condition and 10% in poor condition.

Maintenance to repair mortar joints of the abutments is recommended to be completed within 2 years.

Piers

The majority of the piers have mortar loss ranging from 15% - 50%. Overall the pier condition is approximately 63% good condition, 31% fair condition, and 6% poor condition. Maintenance to reinstate the mortar joints of the pier base walls is recommended to be completed within 2 years.

The pier caps are concrete block pedestals located at the foot of each steel column at the top of the block piers. Three (3) pier caps were noted to have large cracks that spanned in the east-west direction. The steel strapping around the pier caps have moderate to severe corrosion with one pier cap missing the steel strapping. The pier caps are summarized as 56% good condition, 25% fair condition and 19% poor condition. It is recommended that the concrete pier caps be rehabilitated in 1-5 years with the missing steel strap replaced as soon as possible.

Steel Columns

The columns are comprised of two (2) steel channels, one (1) steel plate on the exterior side, and steel braces on the interior. The columns were observed to have a wide range of light to severe corrosion, flacking and delamination. The steel braces on the interior side were noted to be severely corroded with localized areas of failed sections. The columns were found to be 69% fair condition and 31% poor condition. The columns are recommended to be rehabilitated in 1-5 years.

Bearing Seats and Pads

There are two (2) bearings at each abutment and two at each pier. In 2010 the timber bearing seats at each abutment were replaced. The bearing at each of the piers are steel plates with light to severe corrosion. Overall the bearings are 95% fair condition and 5% poor condition with rehabilitation recommended in 1-5 years.

Deck Girders and Diaphragms

The deck girders are arranged in two rows along the length of the bridge, with diaphragm cross-braces throughout to maintain alignment and stability. These girders are the main structural components that carry the deck load to the piers and abutments. Light to severe corrosion, flaking of delaminated steel and heavily deteriorated rivet connections are evident throughout the girders. Overall the girders were observed to be in 80% fair condition and 20% poor condition. The girders are recommended to be rehabilitated in 1-5 years.

The diaphragm cross-braces are generally in fair to poor condition with severe corrosion and flaking of delaminated steel causing section loss. The diaphragms are recommended to be replaced in 1-5 years.

Wood Deck Ties

The wood deck ties were rehabilitated in 2010 and display no significant signs of deterioration. Overall the wood deck ties are 80% good condition and 20% fair condition. There is no recommended work for the wood deck ties.

Bridge Barrier

The current barrier is a steel chain-link fence with medium corrosion of the chain-link and anchor plates. A loose wire was also noted at the bottom of the fence that requires maintenance. Overall the chain-link fence barrier is in fair condition.

Deck Wearing Surface
The existing wearing surface is comprised of longitudinal wood planks attached directly to the wood deck ties beneath without any air gap. The deck wearing surface was observed to be in 75% good condition, 24% fair condition and 1% poor condition. Maintenance to remove and replace wood deck planks will be an ongoing task.

The construction method of attaching the longitudinal wood planks directly to the wood deck ties without an air gap will cause premature deterioration of the wood deck ties. The deck surface has also been identified as a safety concern due to slippery conditions in cold or wet weather. Alternative deck surface options should be explored as part of future rehabilitation work.

Based on the results of the Enhanced OSIM Inspection a major rehabilitation of the Kinsmen Pedestrian Bridge should be planned to occur in less than five (5) years due to the current condition of major structural elements. Delaying the rehabilitation work beyond this timeframe may incur a level of deterioration that is no longer feasible to repair such that the bridge will need to be closed and/or replacement will need to be considered within 10 years.

Load Limit Analysis
A load limit analysis identifies the load carrying capacity of the bridge based on the calculation methods prescribed in the Canadian Highway Bridge Design Code (CHBDC). The evaluation process applies factored Ultimate Limit State (ULS) load combinations and compares the factored load applied to the bridge against the calculated factored strength or resistance of the bridge to determine a structural factor of safety. The factored load combinations are applied to the structure elements following the load path of the structure in a top-down manner. The load path is the route in which an applied factored load or force travels through a structure until it meets the ground. In the case of the Kinsmen Pedestrian Bridge the load path follows the structure elements listed below:

- Chain link fence barrier
- Wood deck ties
- Steel girders
    - Typical girders
    - Centre-span girders
- Steel columns
- Concrete foundations, piers and abutments

These elements of the structure were subjected to two (2) ULS load combinations:

- Combination 1: Dead Loading + Pedestrian Live Loading
- Combination 2: Dead Loading + Snow Loading + Sidewalk Snow Clearing Machine

It should be noted that the probability of the maximum pedestrian live load and the maximum snow load occurring simultaneously is negligible.

Based on the results of the Enhanced OSIM Inspection the section loss of each structural member was quantified and used in the evaluation to determine the structures current factored

resistance/strength. The ratio of the structures factored resistance over the factored load yields the structural factor of safety of each element.

The analysis revealed that the current state of the main structural components of the bridge are adequate to support pedestrian loading, but that the wood deck ties are inadequate to support a sidewalk snow clearing machine. The analysis also found that the chain link fence barrier is not adequate to support lateral loads from pedestrians, cyclists, or a sidewalk snow clearing machine.

The load limit analysis recommends that the chain link fence barrier by monitored on a more regular basis and be replaced with a more suitable barrier in conjunction with bridge rehabilitation work within the next five (5) years. In order to maintain the structural integrity of the main load-carrying members a major rehabilitation of structural steel throughout the bridge is required within the next five (5) years.

The load limit analysis also identified a serviceability issue associated with the longitudinal wood deck planks being slippery during cold and wet weather conditions and recommended that deck also be replaced with a non-slip surface as part of the rehabilitation work.

Options Evaluation

Based on the current structure condition established by the enhanced inspection and the load limit analysis completed in accordance with the CHBDC it has been determined that the Kinsmen Pedestrian Bridge requires major repair and rehabilitation work to meet current standards and to extend its useful life.

While the bridge is not listed as a protected structure under the Ontario Heritage Act, if a Cultural Heritage Evaluation Report was completed it would likely score high enough to be eligible for designation. The Kinsmen Pedestrian Bridge not only has the potential of an attractive cultural heritage piece, but it also provides an important link to the downtown core for residents west of the Stoney Creek Valley. With this in mind four options were evaluated:

- Do nothing;
- Close the bridge;
- Repair the bridge; and
- Replace the bridge.

Do Nothing

To ‘do nothing’ does not address the advance state of structure deterioration, compliance with CHBDC standards, or deck serviceability issues. Neglecting to complete the necessary rehabilitation work will likely result in bridge closure within 10 years. The bridge will continue to deteriorate and will progress beyond the point for a cost effective rehabilitation.

To ‘do nothing’ will not incur any short term construction costs, but will require another Enhanced OSIM Inspection by 2025 in accordance with O.Reg. 104/97 - Standards for Bridges at an estimated cost of **$80,000.**

Close Bridge

Closing the bridge would address the deck serviceability issue, but would create a new problem of pedestrian access across Stoney Creek Valley. The benefit of this option is the low cost and protection of public safety, but the bridge would still require regular inspections until demolished. At this time the bridge does not require closure, however if 'Do Nothing' is selected closing the bridge would be the first stage in the process with demolition thereafter. This option would require modest work in order to close the bridge to pedestrian traffic and subsequently require consideration of the eventual decision to demolish or replace the structure. A high level estimated cost of each stage is provided below:

Stage 1 (Closure) - $18,750
Stage 2 (Demolition) - $300,000
Total - $318,750

Repair Bridge

Two (2) deck rehabilitation options were considered, one is a wood deck repair option while the other is an option that considers the removal and replacement of the wood deck ties and planks with a new steel grate system. Both options require a new pedestrian barrier and rehabilitation of the supporting structural steel and concrete components. Each option can be completed at one time or in two stages to ease the financial burden. However there are two extremely important items to note: (1) that phasing the work will result in an overall higher cost upon completion, and (2) deck replacement should not be considered if the rehabilitation of the supporting structure is delayed more than a few years or neglected entirely. Without the rehabilitation of the supporting structure, the bridge will require closure regardless of the deck condition on top.

Repair Option – Wood Deck Replacement

This option would replace the existing wood deck planks with a new wood deck system that is less prone to slippery conditions in wet or cold weather and would allow for air flow between the wood deck ties and new wood deck system to increase the lifespan of the wood.

Advantages	Disadvantages
• Requires minimal work to rehabilitate the deck • Least costly repair • Bridge remains open • Lifespan of deck increased by 30 years (+/- 10yr) until next major deck rehab. • Lifespan of overall structure increased by 50 years • Aesthetics are improved with new attractive and effective barrier • Integrity of heritage value is protected with sympathetic modifications	• Even though a least costly rehabilitation option, it is still an expensive project • The wood deck will still require maintenance and repairs on a 10 year cycle • Snow removal must still be done by hand • Slippery deck conditions would be improved, but not eliminated in wet or cold weather
Stage 1 (Steel Deck) - $400,000 Stage 2 (Structure Rehab) - $2,500,000 **Total - $2,900,000**	

Repair Option – Steel Deck Replacement

This option would remove the wood deck ties and planks and install a new open grate deck system similar to that on the Hawkins Pedestrian Bridge. The grated deck system would significantly reduce slippery conditions in cold or wet weather and eliminate the need for snow removal maintenance.

Advantages	Disadvantages
• Bridge remains open • Lifespan of deck increased by 40 years (+/- 10 yrs) until next major deck rehab. • Lifespan of overall structure increased by 50 years • Aesthetics are improved with new attractive and effective barrier • Steel grate deck system significantly improves slip resistance • Steel grate deck system more durable • Steel grate deck system requires less maintenance and repair • Steel grate deck system eliminates need for snow removal maintenance • Integrity of heritage value is protected with sympathetic modifications	• More expensive rehabilitation option • Some pedestrians may feel uncomfortable seeing through the steel grate deck • Removal of wood deck ties will have an aesthetic effect on the former railway bridge
Stage 1 (Steel Deck) - $675,000 Stage 2 (Structure Rehab) - $2,500,000 **Total - $3,175,000**	

Replace Bridge

Three (3) bridge replacement options were considered:

- a ‘Like-for-Like” railway bridge replacement,
- a modern High Elevation pedestrian bridge, and
- a ‘Valley Path’ replacement that incorporates a smaller pedestrian bridge along a path on the valley floor.

Replace Option – ‘Like-for-Like’

This option would require full removal of the existing structure and replacement with a structure designed to resemble the existing bridge retaining the aesthetic appeal of a former railway bridge that meets current code requirements. The bridge deck would be at the same elevation as the current bridge so the existing pedestrian path would not be impacted.

Advantages	Disadvantages

• Keeps pedestrian path at the same elevation • Bridge can be designed to carry vehicles for maintenance purposes • Lifespan significantly increased to 80 yr • Aesthetics can be designed to mimic existing railway bridge.	• Most expensive option • Heritage value of the existing railway bridge would be lost.
Stage 1 (Demolition) - $300,000 Stage 2 (Construction) - $4,075,000 **Total - $4,375,000**	

Replace Option – High Elevation Bridge
This option would require full removal of the existing structure and replacement with a modern pedestrian bridge that meets current code requirements. The bridge deck would be at the same elevation as the current bridge so the existing pedestrian path would not be impacted.

Advantages	Disadvantages
• Keeps pedestrian path at the same elevation • Bridge can be designed to carry vehicles for maintenance purposes • Lifespan significantly increased to 80 yr • Aesthetics can be designed to suit desired look	• Not the least expensive option, but not the most expensive either • Heritage value of the existing railway bridge would be lost.
Stage 1 (Demolition) - $300,000 Stage 2 (Construction) - $1,950,000 **Total - $2,250,000**	

Replace Option – 'Valley Path'
This option would require at least partial removal of the existing structure. A new valley path would be constructed with a more modest pedestrian bridge constructed over the waterway on the valley floor. The path would continue to the existing embankments where a series of switchback sections would be constructed up the embankments.

Advantages	Disadvantages
• Pedestrian link is maintained • Lowest cost replacement option • Bridge can be designed to carry vehicles for maintenance purposes • Lifespan significantly increased to 60 yr • Aesthetics can be designed to suit desired look	• The valley path would be difficult for individuals with mobility issues to traverse the switchback paths on the embankments • Heritage value of the existing railway bridge would be diminished
Stage 1 (Demolition) - $300,000 Stage 2 (Construction) - $950,000 **Total - $1,250,000**	

Each of the options were evaluated using a set of weighted criteria to provide a consistent systematic process to identify the most desirable solution. The criteria used are identified below and summarized in the following chart:

Accessibility & Functionality: /20
How accessible is the option being considered? Does it present additional challenges or does it remove barriers to the path of travel? Lower challenges and barriers to the path of travel result in better functionality and a higher score.

Aesthetics & Heritage: /15
Does the option have aesthetic appeal? Is the visual appearance sympathetic to the heritage value of the existing structure? Better visual appeal and lower impacts to heritage aesthetics result in a higher score.

Durability & Lifespan: /20
Does the option have durable materials that do not require periodic repair and replacement? Assuming that needed repairs and maintenance is carried out, does the option have a short, medium, or long term life expectancy? More durable options that require less maintenance and have a long lifespan result in a higher score.

Safety & Liability: /15
It is assumed that regulatory requirements (ie CHBDC, etc.) will be met, but are there hazards that may pose a liability to the Town? Lower risks result in a higher score.

Construction Cost: /30
How does the cost of construction compare to the other considered options? Lower costs result in a higher score.

TOTAL: /100
The sum of all evaluation categories represents a total score out of 100 points. The highest score being the more desirable option using the weighted criteria considered.

OPTIONS	CRITERIA								
	Accessibility & Functionality /20	Aesthetics & Heritage /15	Durability & Lifespan /20	Safety & Liability /15	Comparative Cost /30	Estimated Lifespan (years)	Cost Estimate (Class D) $ (k)	Value per year (cost / lifespan in years) $ (k)	OVERALL RATING /100
Do Nothing						10	$80	$8	46
Close Bridge						10	$320	$32	49
Rehabilitation – Wood Deck						50	$2,900	$58	54
Rehabilitation – Steel Deck						50	$3,180	$64	73
Replace 'Like-for-Like'						80	$4,375	$55	66
Replace 'High Elev Pedestrian'						80	$2,250	$28	78
Replace 'Valley Path'						60	$1,250	$21	71

Most Desirable — Least Desirable

The evaluation chart above indicates:

- **Most preferred** - High Elevation Pedestrian Replacement, Steel Deck Rehabilitation
- **Less preferred** - Valley Path Replacement, Like-for-Like Replacement, Wood Deck Rehabilitation
- **Least preferred** - Close the Bridge, Do Nothing

It should be noted that if no work is undertaken within five (5) years, the rehabilitation options would no longer be feasible.

Next Steps

The Kinsmen Pedestrian Bridge is at a critical decision point. To 'Do Nothing' will limit the feasibility of available options; as each year passes the cost and viability of rehabilitation options diminishes.

The identified preferred solution is a replacement with a High Elevation Pedestrian Bridge followed by a Steel Deck Rehabilitation. Regardless of which preferred solution is selected the project will require a Municipal Class Environmental Assessment (Municipal Class EA). Given the importance of this structure in terms of history and pedestrian linkage to the downtown staff are recommending that G. Douglas Vallee Limited continued to be retained to complete the Class EA including public consultation with results brought back to Council for confirmation of the preferred solution for the Kinsmen Pedestrian Bridge.

CONSULTATION/COMMUNICATION

In accordance with the Town Public Engagement Policy *Strategy 3 – Involve, Consult, Collaborate* and as part of the Municipal Class EA process a 30 day public comment period and public information center will be conducted to present the results of the above identified alternative solutions and solicit public feedback.

FINANCIAL IMPACT/FUNDING SOURCE

The attached Kinsmen Pedestrian Bridge Evaluation Report, in particular the Options Evaluation Section are reflective of the options that would be considered as part of a Municipal Class EA process i.e. a majority of the work required for a Municipal Class EA Schedule 'B' project has already been completed with the exception of preparing a formal project file, completing an inventory and identifying the impact of the alternative solutions on the natural, social, and economic environment and consultation with review agencies (i.e. LPRCA) and the public to solicit comment and feedback. Based on the consultants quote approximately $12,100 is need to complete the remaining aspects of a Municipal Class EA Schedule 'B' for the Kinsmen Pedestrian Bridge.

Further to Report OPS 19-14 approximately $12,300 of the Kinsmen Pedestrian Bridge Enhanced OSIM Inspection budget remains unspent. Staff are requesting that the remaining project funds be used to complete the Municipal Class EA Schedule 'B' for the Kinsmen Pedestrian Bridge.

COMMUNITY STRATEGIC PLAN

The completion of a Municipal Class EA for the Kinsmen Pedestrian Bridge supports Objective 1 – Excellence in Local Government of the Community Strategic Plan by demonstrating communication and collaboration and supports Objective 2 – Economic Sustainability of the Community Strategic Plan through timely planning and renewal of infrastructure assets to reach their full potential service life.

Report Approval Details

Document Title:	OPS 19-44 Kinsmen Pedestrain Bridge Enhanced OSIM Inspection.docx
Attachments:	- OPS 19-44 Attachment 1 - Kinsmen Pedestrian Bridge Evaluation Report.pdf
Final Approval Date:	Oct 22, 2019

This report and all of its attachments were approved and signed as outlined below:

Dave Rushton - Oct 22, 2019 - 9:31 AM

Ron Shaw - Oct 22, 2019 - 10:03 AM

Donna Wilson - Oct 22, 2019 - 3:11 PM