



BLAKENEY BRIDGE REPORT #PW-26-2022

Public Works Committee
October 26, 2022

Sean Derouin, Public Works Manager

BACKGROUND

- Keystone Bridge Management services prepared a memo to PW in March 2022 regarding the deteriorating condition of the Blakeney Bridge detailing the risk and remaining service life with recommendations to move forward (Appendix A).
- Report Pw-12-2022 (Appendix B) was presented to the PW Committee in April to renew the dialogue regarding the future of the Blakeney bridge with options.
- The following motion PW-2022-30 was passed:
That Council authorize the enhanced inspection and load posting review in 2022 of the Blakeney Bridge; and

That the County proceed with an RFP to complete an Environmental Assessment, with the project date to take place in 2023
- *Note: it was decided not to pursue a transportation needs study to investigate the need for the crossing as Council would not support closing the bridge.*

DISCUSSION

- Keystone Bridge Management was able to complete the enhanced inspection this past September during low water flow and the Engineer was able to undertake an unconstrained inspection on the underside of the bridge using waders and a ladder. The draft report is included as Appendix C.
- Present Condition of the Bridge:
 - Substructure concrete is in poor condition and continues to disintegrate and erode from hydraulic scour forces. Concrete repairs completed in 2000 have started to de-bond and fail.
 - Structural steel, which is all original, is in fair condition except for the girder ends due to leaking expansion joints. There is significant web thinning and section loss at the girder ends with numerous perforations.
 - The concrete deck which was replaced in 1975 has widespread delamination on over 50% of the area and there is a strong possibility of a deck punching failure occurring in the near future.

DISCUSSION

- **Report Recommendation**

- Due to the rapidly deteriorating deck surface and the severe stringer and girder end corrosion that has been recently observed, the report recommends:
 - Reducing the load posting to 5 tonnes.
 - Replacing the bridge as soon as possible.

- **Bridge Replacement:**

- It is recommended to replace the 3 bridges “Like-for-Like”, with a single lane modular panel bridges on 3 new sets of abutments, eliminating 2 piers in the water, at an estimated cost of \$2.5M.
- Schedule A+ Municipal EA.

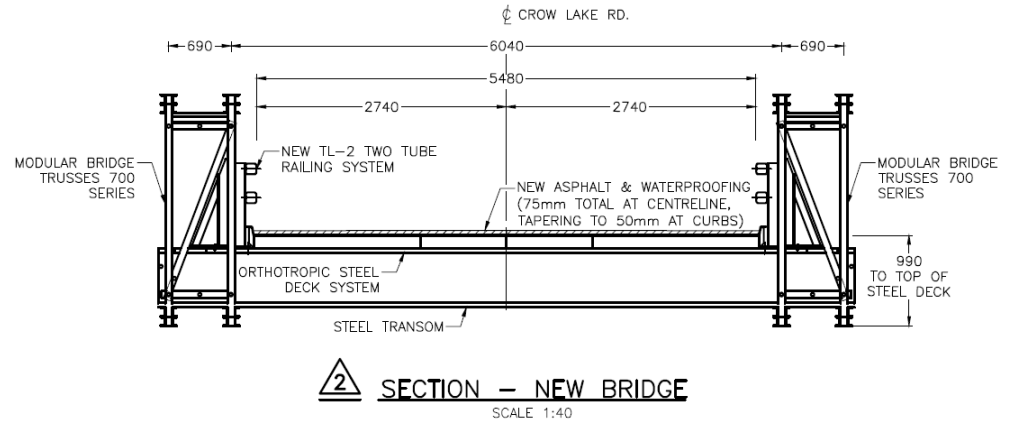
Reconstruction or alteration of a structure or the grading adjacent to it when the structure is over 40 years old which, after appropriate evaluation, is found not to have cultural heritage value or, where there is cultural heritage value, the cultural heritage features are protected or replicated to the satisfaction of MHSTCI. Determination of cultural heritage value will be in accordance with a screening checklist developed with the Ministry of Tourism and Culture (MHSTCI) and posted on the MEA website.

- A Heritage Impact Assessment (HIA) will be required to determine if there is cultural heritage value and is underway.

DISCUSSION

- **Example Bridge:**

- Bolingbroke Bridge on Crow Lake Rd. in Tay Valley, completed in 2021
- ACROW Panel Bridge



DISCUSSION

- **Warrant for a Single Lane Bridge**

Current AADT ~400, with a seasonal ADT of ~700 as a result of tourism and recreation.

- MTO Structural Manual for Design of Bridges on Low Volume Roads

- If the speed limit is reduced to 40 kph, then a single lane bridge with a minimum width of 4m is warranted. Notes 2,3,4,&6 apply.

- **Note 2:** Traffic Signals would mitigate the poor sightlines at ends of the bridge.

- **Note 3:** Consultation with local officials should be undertaken in an attempt to accommodate wider vehicles such as farm equipment.

- **Note 4:** new single-lane bridges should not be wider than 4.9m to avoid confusion with a two-lane bridge.

- **Note 6:** Since the seasonal ADT is significantly >400, then additional traffic measures are recommended, which include traffic signals.

STRUCTURAL MANUAL				
2011 04 01	APPENDIX A GUIDELINES FOR THE DESIGN OF BRIDGES ON LOW VOLUME ROADS			PAGE E1-12
TABLE 1: MINIMUM LANE, SHOULDER AND BRIDGE WIDTHS.				
AADT	OPERATING SPEED (km/hr)	MIN. LANE WIDTH (m)	MIN. SHOULDER WIDTH (m)	MIN. BRIDGE WIDTH (m) ^{1,4}
0 - 200	< 70	3.0	0.5	4.0 ^{2,3,4}
	≥ 70	3.0	0.5	7.0
200 – 400 ⁵	< 50	3.0	0.5	4.0 ^{2,3,4,6}
	≥ 50 and < 70	3.0	0.5	7.0
	≥ 70	3.25	1.0	8.5
1 - Width measured between the inside face of the barriers, guiderails, or curbs. 2 - Horizontal and vertical sight distances shall be provided to allow approaching motorists to observe an opposing vehicle on a single lane bridge or its far approach. If there are sight distance issues, a single lane bridge should not be used. 3 - Farm or other special vehicles may require larger widths. Consultation shall be made with local officials. It may also be acceptable to have a lower barrier to accommodate these farm or other special vehicles. 4 - New single lane bridges wider than 4.9 m should be avoided as they may give the appearance of a two-lane bridge. 5 - Range also applies to existing roadways with AADT >400, where operational issues have been minimal and Approval for use of these guidelines has been obtained. 6 - For AADT > 400, or for locations where the Seasonal Average Daily Traffic is significantly >400, consideration should be given to using additional traffic control measures at the bridge for single lane structures (i.e. traffic signals, yield sign for one direction, etc.).				

DISCUSSION

- **Pedestrian Access:**

- There is no strong warrant for a separated pedestrian crossing.
- With the speed limit lowered to 40 kph, traffic signals at each end of the bridge, and good sightlines across the bridge, pedestrians can be safely accommodated on the bridge with demarcating a walkway by painting a white edge line.

- **Farm Equipment:**

- At a minimum, the bridge would not be reduced to less than the existing 4.9m width.
- The MTO structural manual does not recommend a width greater than 4.9m due to the appearance of a two-lane bridge.
 - This may be mitigated with the use of signals preventing oncoming vehicles.
- In general, the wider the bridge, the deeper the superstructure will be required to carry the load, and the more money it will cost.
- The County will consult with the public and will propose a final design width to County Council at a later date for approval.

DISCUSSION

- **5 Arches Bridge Rehabilitation planned for 2023**
 - It is recommended to defer this rehabilitation to 2024 to support the replacement of Blakeney Bridge in 2023.
 - WSP is currently working on the rehabilitation alternatives report for the 5-arches bridge and has confirmed there would be no significant risk by deferring the project to 2024, email correspondence is included as Appendix D.
 - Replacing the Blakeney Bridge prior to working on the 5-Arches Bridge would alleviate the potential for an overload trespass on the restricted 5-tonne Blakeney bridge during a road closure on the 5-arches bridge that may be required for the rehabilitation.

DISCUSSION

- **Timelines**

- Approval for reducing the load limit to 5 tonnes is critical to ensure public safety.
- Approval to proceed with the replacement design RFP is required as soon as possible in order to start the procurement process.
 - A decision on the single lane vs two lane replacement bridge will be required prior to advertising the design RFP.
- If the replacement were to take place next year, the Construction Contract would need to be awarded by the end of May to allow for fabrication of the new bridge.
 - The detailed design and tender documentation would need to be completed by early April.
 - The designer will be required to investigate cost saving options such as pre-purchasing the bridge from the manufacture.

DISCUSSION

- **Consultation with MM Public Works Department**
 - Mississippi Mills preference is to install a two-lane structure. However, in the interest of public safety, a rapid replacement of the existing structure with a single lane bridge with traffic lights on either end is a reasonable approach, provided adequate consideration is given to the agricultural community and pedestrian safety.
- MM has concerns with maintenance on the 5-tonne load restricted bridge, specifically with plows crossing the bridge.
- The reduced load limit will also have impact on waste collection, bussing, and emergency services.
- Further discussions with MM PW have been scheduled to help mitigate these issues.

ANALYSIS & OPTIONS

1. Reduce Load Posting to 5 tonnes.
2. Advertise an RFP for the design of the replacement bridge.

OR

1. Defer item to next Public Works Committee

A report will be brought to the next public works meeting to discuss the timing of the bridge replacement.

FINANCIAL IMPACT

- Current proposed bridge capital budget for 2023= \$1M
- 1. Replace Bridge “Like-for-Like” ~ \$2.5M (+Engineering)
 - The \$1.5M to \$2M deficiency would require allocation from reserves.
- 2. Replace Bridge with a 2-lane conventional Bridge= ~\$5-\$8M

PW is currently researching available grants for this project.

ATTACHMENTS

- Appendix A- Blakeney Bridge Condition Report March 2022
- Appendix B- Council Report PW-12-2022 Blakeney Bridge
- Appendix C- Blakeney Bridge Draft Enhanced Inspection Report Sept 2022
- Appendix D- Email Correspondence Regarding 5-Arches Bridge Deferral to 2024

RECOMMENDED MOTION

That Council authorizes the necessary amendment to Bylaw 2022-34, A Bylaw to consolidate the bylaws that regulate traffic on roads under the jurisdiction of the County of Lanark, to further reduce the load posting from 12 tonnes to 5 tonnes; and

That the County proceed with an RFP to complete the detailed design of the replacement bridge; and

That Council direct staff to proceed with replacing Blakeney Bridge with a “Like-for-Like”, single lane modular bridge; and

That Council discuss the budget prioritization of bridge projects at the next meeting of the Public Works Committee.

March 23,2022

Memo to Lanark County Regarding the Blakeney Bridge

Introduction

The Blakeney Bridge comprises three individual single-lane bridges and connecting causeway that crosses the Mississippi River downstream of Almonte. The bridge has a two-span 26.8 m westerly component, a two-span 26.5 m middle section, and a single 13.1 m easterly span. The bridge was constructed in 1912. Records do not indicate if there was an earlier bridge that preceded the present bridge.

The bridge received a deck replacement in 1975. The deck has a minimum thickness of 150 mm and is not waterproofed or paved. The curb-to-curb width of the deck is 4.58 m. A follow-up rehabilitation took place in 2000. The rehabilitation included deck repairs, girder repairs, a new railing system, and substructure repairs and partial substructure renewal. Upon completion of the 2000 rehabilitation, the bridge was load posted at a single-truck limit of 12 tonnes.

A corrosion perforated main girder on the west bridge was repaired in 2020.

Traffic counts are modest, and the bridge operates well as a single-lane structure.

The bridge is now 110 years old. This memo report examines the present condition of the bridge and options for maintaining the crossing.

Present Condition of Bridge

Deck

The exposed concrete deck of all three bridges has frequent delamination and spalling over more than 15% of the combined surface. Repairs completed in 2000 have since partly delaminated. The deck is chloride contaminated. The deck is at the end of its service life and is not considered repairable.

Railings

The bridge railings installed in 2000 remain in good condition.

Structural Steel

The structural steel of the bridge consists of external main girders, transverse floor beams framing into the main girders, and four lines of longitudinal stringers that support the interior bridge deck. The steel is in mixed condition. The stringers and main girders are in the poorest condition where they have been exposed to leaking expansion joints. There is a notable perforation of the north main girder of the west bridge at the west abutment. This has been strengthened with an added web stiffener. However, this perforation is an indication of what is in store for the other girder ends with similar chloride exposure. Two of the four stringers of the middle bridge at the west abutment are severely corroded and have suspected perforation. Loss of paint is most evident where girders and stringers are close to abutment expansion joints. The structural steel condition and member sizing is the limiting consideration for the load capacity of the bridge. Given its condition and lack of capacity, it is not considered salvageable or a candidate for strengthening.

Sub Structure

The sub structure consists of six abutments and two piers all lightly reinforced and founded on the exposed bedrock river bottom, together with wing walls. Most of the substructure is original to 1912, with patching repairs prominent. The original concrete exhibits severe scaling and disintegration, cold joints, undercutting, and various erosion features. The average strength of the abutment concrete ranges between 12.4 MPa and 27.1 MPa based on 2018 coring results. Modern concrete is specified to have a 35 MPa strength. The wing walls are generally in better condition and many of them were replaced or rehabilitated in 2000. The substructure is barely adequate for the present bridge load posting. The substructure is vulnerable to a catastrophic flood event. The substructure is at the end of its service life and the only viable option is to replace it completely if it is desired to retain the crossing.

Bridge Opening and Clearance

There is no indication that the bridge opening is inadequate. However, hydraulic modelling should be undertaken to test this assumption. The clearance above the design flood is required to be at least 30 cm. It is uncertain whether this design clearance is achieved with the present bridge. This too requires analysis. The two piers are vulnerable to debris in the river snagging on them. In a worst-case scenario, debris snagging on the piers could partly destroy the bridge. There is some undercutting of the substructure foundations evident

Road Network Considerations

The closest settlement to Blakeney is Almonte, and it is essentially equidistant at about 8 km following either CR 29 or CR 17. The second closest settlement is Pakenham, and it is again roughly equidistant at just over 13 km via CR 29 or CR 17. The bridge does offer slightly improved connectivity to Hwy 417 on Panmure Road. For sight seeing traffic, the bridge is an attractive alternative for visitors to the Blakeney Rapids. Closing the bridge for renewal or permanently will not result in significant hardship for most of the present bridge users.

The absolute need for the bridge is open for discussion and should be studied as part of determining the future of the Blakeney Bridge crossing.

Risk and Remaining Service Life

The bridge has exhausted its normal service life. It is effectively on life support and relies on strategic repairs to maintain its open status. As the bridge continues to deteriorate the risk of an adverse event will increase. The following risk scenarios may develop should the bridge be maintained open:

1. A deck punching failure may develop. The concrete deck is significantly deteriorated, and a heavy wheel load could result in a localized failure of the deck. This could result in minor damage to the vehicle but would necessitate closure of the bridge pending repair. The steel stringers of the superstructure are well positioned close to the live load wheel tracks, and for the Blakeney Bridge an actual failure is only a very remote possibility.
2. A girder or stringer end may crush. Several of the girder ends and stringer ends exhibit significant corrosion with major section loss and possible perforation. Although repairs have been undertaken in 2000, and 2020, it is possible that continued deterioration could result in a girder or stringer end failing in shear, and thereby crushing. The failure would show as a

depression of the deck surface adjacent an abutment. It would necessitate closure of the bridge to repair.

3. Load trespass. Although the bridge is posted at 12 tonnes, there is nothing physically preventing a 40-tonne load from attempting to cross the bridge. An over-load such as this would very likely result in severe unrecoverable damage to the bridge. Some municipalities place portals before load-restricted bridges to discourage truck traffic. This was done for example at Lanark's Andrewsville Bridge.
4. Catastrophic flooding has already been noted as a vulnerability concern. A replacement bridge would likely avoid piers in the river channel and would improve the hydraulic performance of the crossing.
5. Missed defects. The Blakeney Bridge is difficult to inspect fully. About half of the bridge is inaccessible during an ordinary biennial inspection due to strong currents and depth of water. Thus, the overall condition is inferred from the areas that are inspectable. It is entirely possible that a critical defect can go undetected for many years.

Remaining Life

It is entirely possible to keep the bridge open to light traffic for certainly three and possibly six years. It may be prudent to further reduce the load posting to five tonnes. It must be understood however, that the County must accept the escalating risk associated with keeping the bridge open.

Recommendations

Need Study

A transportation study is strongly recommended to assess the continuing need for the Blakeney Bridge. Traffic counts, and origin-destination surveys are suggested.

Bridgemaster Inspection

A Bridgemaster type inspection was previously completed in 2017. A follow-up very thorough inspection from the bucket of an articulated arm under bridge inspection device is advised. A full day inspection should be budgeted, and the bridge will need to be closed to traffic. A trailer mounted arm will most likely be required as a truck mounted arm would exceed the load capacity of the bridge.

Cultural Heritage Assessment

Owing to the age of the bridge, any closure or demolition of the bridge will be subject to Provincial Heritage regulations. A Cultural Heritage Assessment should be initiated to help frame any deliberations for the future of the crossing. This activity should be part of a comprehensive EA assessment which will be required for any contemplated significant changes for the bridge.

Load Posting Revision

Following a detailed arm's length inspection, the current load posting on the bridge should be reviewed. There has been ongoing deterioration since the 2000 rehabilitation when the 12-tonne load posting was imposed. The lowest practical load posting is five tonnes.

Benign Neglect

The option of doing nothing to the bridge requires consideration. The bridge would of course require ongoing regular maintenance such as snow ploughing and sweeping, and regular inspection. If a policy of benign neglect is adopted, it must be together with a plan for a firm closure of the bridge.

It is conceivable to reduce the load posting to five tonnes and plan on closing the bridge by not later than December 2026.

Economical Replacement

The most economical replacement for the bridge would be a series of single lane modular trusses such as the ACROW panel bridge constructed at Bolingbroke. Three 27 m spans could be installed for approximately \$2,000,000. Conventional bridging solutions will cost more than \$3,000,000.

Closing

This extended memo is intended to promote renewed dialogue regarding the disposition of the Blakeney Bridge. Clearly the necessity of keeping a bridge in perpetuity at the Blakeney rapids is uncertain. However, the continued viability of the current bridge is certain. The current bridge will have to be closed soon. The timing of closure is a balancing act of risk tolerance and public convenience. It is clearly time for Lanark County to gather the evidence and decide regarding the continued operation of this crossing of the Mississippi.

Harold Kleywegt, P.Eng.
Managing Director
Keystone Bridge Management Corp.



Image 1 Upstream view of Blakeney Bridge



Image 2 Perforated main girder north side of west span at west abutment, with strengthening added



Image 3 Severely corroded stringer end on middle bridge, west end



Image 4 Severely deteriorated substructure concrete with prominent patch



Image 5 Typical deck with concrete patches, cold patches, cracking, and delamination



Image 6 Typical deck end and open expansion joint that admits chlorides to girder ends



Image 7 Typical steel floor system with exterior main girders, transverse floor beams, and longitudinal internal stringers



Image 8 Severe disintegration of 1912 concrete and undercutting of foundation at bedrock surface



BLAKENEY BRIDGE REPORT #PW-12-2022

Public Works Committee
April 27, 2022

Sean Derouin, Public Works Manager

BACKGROUND

- Blakeney Bridge spans the Mississippi River, 8km downstream of Almonte and 11 km upstream of Pakenham.
- Bridge is located on Blakeney Road (Twp. Road), just west of the hamlet of Blakeney, east of County Road 29.
- Constructed in 1912, the crossing is composed of three (3) individual structures, one a single span, while the other two have supporting piers in the river as follows:
 - West Bridge: 26.8m 2-span bridge
 - Middle Bridge: 26.5m 2-span bridge
 - East Bridge: single 13.1m span bridge
- The bridge provides for 300 cars per day on average.
- The structures are deficient in load carry capacity, with a 12-tonne load limit imposed, and substandard in width, with a single 4.9m lane.



BACKGROUND

- Blakeney Bridge is considered a boundary bridge as it is not located on a County Road.
- It is unknown when the Bridge became a County responsibility, but existing records indicate the bridge has been a County bridge dating back to at least the 1940's.
- Historically, boundary bridges were transferred to the upper tiers in order to gain eligibility for provincial supplementary funding administered by the Ministry of Transportation known as the Boundary Bridge Fund that was available to Counties for rehabilitating or reconstructing Boundary Bridges.
- In 1995, the County of Lanark completed an Environmental Assessment, Alternatives Report, and a draft design for a replacement two-lane bridge after receiving funding from the Boundary Bridge Fund.
 - The application to MTO included concerns regarding the bridge's concrete deterioration, bridge width, and structural adequacy.
- In 1996, all supplementary funding programs previously administered by the MTO had been discontinued with the passing of Bill 26, and the Boundary Bridge Fund was assimilated into block grants, therefore the County of Lanark never received the necessary funding to proceed with the bridge replacement.

BACKGROUND

- Blakeney Bridge Rehabilitation History:
 - 1975: exposed concrete deck replacement
 - 1993: emergency abutment repairs
 - 2000: deck and girder repairs; substructure repairs; new railings-> designed to provide service life extension of 20-25 years.
 - 2007: emergency repairs to the abutments completed
 - 2020: corrosion perforated girder repaired
- An enhanced bridge master inspection was completed in 2017 (Appendix A) with a follow up structural design report in 2019 (Appendix B) recommending replacement of the bridge and three abutments.
- The 2021 regular biannual inspection noted stringers requiring strengthening and large-scale delamination of the concrete deck (Appendix C).

DISCUSSION

- An updated report on Blakeney Bridge was prepared by Keystone Bridge Management services this past month (Appendix D) which highlighted the condition of the bridge and recommended further studies/ investigations.

Risk and Remaining Service Life

- From the 2022 report, the following risk scenarios may occur if the bridge is not rehabilitated or replaced in the next 3 to 6 years:
 - Deck punching failure causing vehicle damage and resulting in closure of the bridge
 - Girder or Stringer end crushing resulting in a depression of the deck surface and subsequent closure of the bridge
 - Load Trespass resulting in severe/ catastrophic damage to the bridge
 - Flooding event damaging piers and abutment foundations in the water course
 - Missed critical defects due to accessibility constraints during inspection.
- The report recommends reducing the load posting to 5-tonnes and closing the bridge no later than 2026 if significant capital investments are not made.

DISCUSSION

- The 2022 report also recommended the following studies/ investigations to be completed.
 - Transportation Study to investigate the need for the bridge crossing
 - Follow up enhanced bridge master inspection
 - Environmental Assessment (EA) which includes a Cultural Heritage Assessment (CHER) and a Heritage Impact Assessment (HIA), which would be required for any contemplated significant changes to the bridge
 - Load Posting Review



CONCLUSION

- Most of the substructure consists of materials from original construction, at over 100 years old, the bridge has exhausted its normal service life and would be required to close in the next three to possibly six years if the County does not invest in it.
- Blakeney Bridge is a low volume, single lane, load posted bridge, not located on a County Road, therefore the PW department would like endorsement from County Council on the direction to take regarding the future of the bridge, since significant capital investments are required to maintain its service, such as:
 - Major Rehabilitation= >\$1M, extending the service life for 15-20 years.
 - Structure Replacement= \$2-3M, extending the service life for 75 years.



ANALYSIS & OPTIONS

1. Advertise a Request for Proposal (RFP) for a Municipal Class Environmental Assessment (EA) report to assess alternative options for Blakeney Bridge which would include a CHER, HIA and a Transportation Needs Study to determine the need for the bridge crossing and recommend the preferred option such as:
 - I. Close Bridge
 - II. Convert to pedestrian only bridge
 - III. Rehabilitate Bridge
 - IV. Replace Bridge
 - V. Do nothing.
2. Review existing load posting and reduce if required.
3. Complete an enhanced bridge master inspection to update the existing condition of the bridge.
4. Move forward with bridge replacement in the next 3 years (still require a CHER & HIA)
5. Close bridge to traffic by 2026, pending results of yearly inspections.
6. Any combination of the above.

FINANCIAL IMPACT

1. EA + Transportation Study~ \$50-\$60K
2. Load Posting Review ~\$5-\$10K
3. Enhanced Bridge Inspection ~\$5-\$10K
4. Move forward with bridge replacement in the next 3 years (still require a CHER & HIA) ~\$30-\$40
5. Close bridge to traffic by 2026, pending results of yearly inspections. ~\$2K for signage and public notice
6. Any combination of the above.

RECOMMENDATIONS

- PW recommends completing an enhanced inspection and load posting review in 2022, which can be accommodate within our existing engineering budget.
- PW also recommends proceeding with an RFP to complete an Environmental Assessment + a Transportation needs study, tendering in 2022 and beginning the assignment in 2023.

FURTHER DISCUSSION

- The Municipal Act of 1980 stated that “The Council of a County has jurisdiction over every bridge crossing a river, stream, pond, or lake forming a boundary line between local municipalities, other than a city or separated town”.
- In 1998, The County amalgamated into 6 townships and 3 towns.
- Blakeney Bridge is no longer considered a boundary bridge, along with Bow Lake Road Bridge (Lanark Highlands), and three structural culverts located on the Upper Scotch Line (Tay Valley).
- The only remaining inter-municipal boundary bridge is Glen Isle, which is on the boundary between Mississippi Mills and Beckwith.
- Since boundary bridge funding is no longer available, there is no advantage to the County to manage these structures as they are primarily local use bridges.
- Further discussion should take place regarding future jurisdiction of these boundary bridges.

FURTHER DISCUSSION

- Removing the bridge from the County jurisdiction does not immediately remove future liability
- County still needs to demonstrate due diligence on repair and maintenance

ATTACHMENTS

- Appendix A- Blakeney Bridge 2017 Enhanced Inspection
- Appendix B- Blakeney Bridge 2019 SDR Report
- Appendix C- Blakeney Bridge 2021 Bi-Annual Inspection
- Appendix D- Blakeney Bridge 2022 Condition Report

RECOMMENDED MOTION

That Council authorize the enhanced inspection and load posting review in 2022 of the Blakeney Bridge; and

That the County proceed with an RFP to complete an Environmental Assessment and a Transportation needs study, with the project date to take place in 2023; and

That Council direct staff to proceed with investigating options to vest the Blakeney Bridge from the County jurisdiction and bring forward information to Council concerning the same at a future meeting.



BLAKENEY BRIDGE ENHANCED INSPECTION REPORT

Lanark County – October 2022



Keystone Bridge Management Corp.

Your Bridge Asset Management Specialist

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DRAFT



Introduction

Keystone Bridge Management Corp. was retained by Lanark County to provide an enhanced inspection of the Blakeney Bridge. The bridge crosses the Mississippi River between Almonte and Pakenham. An enhanced inspection permits unconstrained up-close inspection of the entire bridge. Keystone provided a conventional OSIM type inspection of the bridge previously in 2017, 2019, and 2021. A previous enhanced inspection was completed by others in 2017.

Inspection was completed over the course of two days. The underside of the bridge was viewed on September 15, 2022. The inspection party consisted of engineering student Nicole Balles and the writer. Access to the underside was obtained by wading and ladders. Over 150 photographs were taken to thoroughly document the substructure, structural steel, and other bridge features. Fifty-four of the images are provided in an appendix to the report.

The field work was completed on September 29th with Steve Reid, C.E.T., and Nicole Balles assisting. The deck surface was chain dragged, hammer sounded and mapped. Traffic was estimated at up to 50 vehicles per hour and this limited the precision of the survey. A drawing indicating the deck condition is included at the end of the report. Four images of the condition survey are included.

History

The bridge is three single-lane bridges interconnected with a causeway built on two islands in the river. There is a two-span west bridge, a two-span middle bridge, and a single span east bridge. The five spans have essentially identical steel framing and are each nominally 13 m long. The bridge was constructed in 1912. All the structural steel and most of the principal substructure concrete is original.

The bridge deck was replaced circa 1975 with an exposed concrete deck cast on corrugated steel deck pans. The non-composite replacement deck had an intended minimum thickness of 150 mm at the curbs and 195 mm at the crown. A further rehabilitation took place in 2000 to upgrade the bridge railing system, repair deteriorated structural steel, repair the abutments and piers, improve substructure appurtenances such as wing walls and retaining walls, and deck repairs to the west bridge.

The abutment concrete was tested for strength in 2018. The strength ranged from 15.0 to 27.9 MPa. The lowest strength was about half of that required for modern concrete. The pier concrete was not tested. The poorest concrete was in the east bridge.

Significant perforation of the NW bearing area of the north girder on the west bridge was observed in 2019. This was repaired the same year.

Present Condition of Bridge

The present condition of the bridge is documented with images and two drawings appended to the report. The images and drawings are referenced in the following sections.

Substructure – Abutments and Piers

The substructure concrete is in mostly poor to fair condition. The worst concrete is associated with the east bridge. The east abutment of the east bridge has areas of the exposed face where up to 100 mm of section loss is present. See Image 8. The west abutment of the east bridge is undercut from cavitation



to a depth of 1200 mm in two locations. See Images 13 & 14. The concrete is slowly disintegrating and possibly eroding from hydraulic scour forces. Repair concrete placed in 2000 has debonded and failed in some areas but is largely still in place on the west and middle bridges.

The concrete plinth that supports the stringers at the west abutment of the west bridge (Image 50) and west abutment of the middle bridge is badly fractured and breaking up.

A concrete collar presumably placed in 2000 to protect the base of the west bridge pier has partly broken away on the upstream east side. (Image 46).

Structural Steel – Girders, Floor Beams & Stringers

The structural steel framing consists of two exterior 660 mm deep longitudinal girders interconnected by two-460 mm deep transverse floor beams per span. Four lines of 250 mm deep longitudinal stringers spaced at 905 mm directly support the bridge deck between the main girders. Image 9 is representative.

The structural steel is in remarkably good condition for the most part. Unfortunately, the girder and stringer ends at the abutments have suffered from years of salt exposure from leaking expansion joints. This has been exacerbated by moist sandy debris collecting around the girder and stringer bearings. The resulting chloride saturated environment has resulted in severe localized corrosion of the stringer and girder terminations. Repairs to the steel member ends were made in 2000. Despite the repairs significant damage has taken place since. It is suspected some damage may have been overlooked previously.

All the stringer ends, and girder ends at the west abutment of the middle bridge are seriously corrosion damaged with web thinning and perforation. Three consecutive stringer ends are severely perforated, and the deck support is very compromised at this location. See images 31, 32, & 33.

Similarly, all the stringer ends and girder ends at the west abutment of the west bridge are seriously corrosion damaged with web thinning and perforation. One stringer end is fully perforated (Image 51), and the north girder end is significantly perforated to the point that it received emergency repairs in 2019.

The east bridge has significant web thinning and section loss at both abutments. There is minor perforation of the north girder at the east abutment.

A drawing showing the most concerning areas of corrosion is provided at the end of this report.

Deck

All three bridges have widespread delamination that is now exceeding 50% of the total deck surface. Note that in 2019 only the west bridge was noted to have significant delamination. In 2021 substantial delamination was recorded for the east bridge as well.

The west bridge deck was repaired in 2000. These repairs are now failing and are delaminated and spalled with asphalt repair materials.

The most concerning area of deck is a very prominent pothole type feature central to the middle bridge. This is shown in Image 20. The deck has failed completely or is very near to failing completely at this



location. The steel deck pans on the deck soffit obscure the underside of this feature. There is a strong possibility of the deck experiencing a punching failure at this location.

A drawing indicating the condition of the three decks is appended at the end of the report. Please note that the outlines of deterioration are approximate. Four images of the survey are appended.

At this juncture the deck is not salvageable and barely serviceable. The deck lacks interior edge support at the west abutment of the middle bridge and is in danger of local failure at this location.

Safety Appliances

The three beam railing system on the bridges and between the bridges remains in good condition. The small deck curbs have large sections of spalling, especially on the west bridge.

Channel

The river channel was unobstructed. A hydraulic jump is present under most of the bridge.

Outlook

Keystone Bridge Management Corp. has been actively participating in the management of this bridge since 2017. Deterioration of the deck surface has progressed very rapidly in the intervening years. Previously unreported severe stringer and girder end corrosion has since come to light. Continued slow relentless weathering, erosion and hydraulic cavitation of the substructure is continuing to further weaken and compromise the support provided by the abutments and piers.

Although Keystone is on record for suggesting as recently as 2019 that with suitable repairs the life of the present bridge could be extended by another 20 years, the observations from the present enhanced inspection have irrevocably reversed this optimism. The bridge is clearly at the end of its useful life and the only prudent course of action is to either close or replace it.

Risks

There is a very strong possibility that a localized deck failure may occur. This will result in a large pothole or local depression in the deck surface that would be alarming but not likely dangerous to the public. However, it would result in the need to close the bridge pending repair. Vehicle damage may occur.

Although the bridge has a load posting of 12 tonnes single truck, that is not a guarantee that a heavier load will attempt crossing. There are numerous examples of load trespass elsewhere. There is a strong likelihood that a load perhaps double to triple the posted limit will try to cross the bridge. Such loading would very likely fail the deck in the manner described in the preceding paragraph.

The impacts of climate change are resulting in more frequent and higher magnitude flood events. The Blakeney Bridge may well be vulnerable to an extraordinary flood event. It is certainly more vulnerable due to the weakened and undercut condition of the piers and abutments. Drift type debris hanging up on the piers is a concern. Ice jamming may be an issue.



Recommendations

The existing 12 tonne load posting has been in place presumably since the 2000 rehabilitation. Appreciable deterioration of the deck and structural steel has occurred since. Thus, it is recommended to further reduce the load capacity of the bridge. A structural evaluation should be initiated but in the absence of such an evaluation, a 5-tonne load limit should be imposed immediately. A 5-tonne load limit is the practical minimum load posting for a bridge, after which it should be closed.

With only light vehicle traffic, the possibility of a local deck failure will be forestalled. But not indefinitely. The bridge should be taken out of service as soon as possible to facilitate the construction of a replacement.

Replacement Planning

The followings actions should be initiated to facilitate a replacement bridge:

1. A comprehensive topographic and bathymetric survey of the bridge site should be commissioned. The survey should extend about 60 m beyond the bridge and 20 m upstream and downstream.
2. A hydrotechnical assessment of the river crossing is required to verify the adequacy of the present bridge opening and confirm the required clearance above design high water level.
3. The road alignment should be reviewed to check for improvement opportunities to the approach curvature and sight lines.
4. Pre-consultation with approval agencies and the public should be initiated.

Replacement Options

Should the planning support a replacement in kind new bridge solution on the present alignment, an economical choice that can be quickly implemented is a modular bridge such as the ACROW panel bridge constructed at Bolingbroke. It is suggested a budget of \$1.8M to \$2.5M will be sufficient to construct the required three new bridges on new abutments, with the presumption the piers will be eliminated.

A more conventional steel or prestressed girder type bridge will cost of the order of \$5M.

If the two intermediate island causeway sections are eliminated to improve the channel such that a single multi span bridge results, the cost could soar to \$10M.

Access considerations for reconstructing the middle bridge will have a major bearing on the replacement cost. It may make sense to replace the middle bridge by relying on the east and west bridges for access. This approach would extend the schedule but could offer large savings.



Closing

Keystone Bridge Management Corp. is pleased to report on the enhanced inspection of the Blakeney Bridge crossing of the Mississippi River in Lanark County. Should there be any lingering concerns or additional information required with respect to this assignment, then Keystone will be happy to respond.

We trust the services rendered are complete. It is Keystone's sincerest desire that the recommendations stemming from this work will be of lasting benefit to Lanark County.

Harold Kleywegt, P.Eng.
Managing Director
Keystone Bridge Management Corp.

APPENDICES

- Images
- Steel Framework Plan Drawing
- Deck Condition Drawing





Image 1. South elevation of east bridge



Image 2. East approach of east bridge





Image 3. Typ. railing system on east bridge



Image 4. South guide rail on east bridge





Image 5. North upstream channel of east bridge



Image 6. South downstream channel of east bridge





Image 7. East abutment of east bridge



Image 8. East abutment disintegration and spalling of east bridge to 100 mm depth





Image 9. Structural steel & soffit of east bridge facing east



Image 3. Typ. condition of stringer east end of east bridge





Image 11. Web thinning of south girder east end of east bridge



Image 12. Web patch on 3rd stringer from south on east abutment of east bridge





Image 13. West abutment of east bridge



Image 14. West abutment 1.2 m deep cavitation undercut, east bridge





Image 4. Typ. condition of stringer west end of east bridge



Image 16. Typ. abutment bearing of girders of east bridge





Image 17. South elevation of middle bridge



Image 18. East approach of middle bridge





Image 19. Typ. guide rail on middle bridge



Image 5. Concerning pothole cracks with asphalt patch on deck of middle bridge





Image 6. South upstream channel of middle bridge



Image 7. North downstream channel of middle bridge





Image 8. East abutment of middle bridge



Image 9. Soffit & steel floor system of east span of middle bridge facing east





Image 10. East face of pier of middle bridge



Image 11. Pier bearing of south girders of middle bridge





Image 12. Soffit & floor system of west span of middle bridge facing east



Image 28. West abutment of middle bridge





Image 29. General condition of stringer ends of middle bridge at west abutment



Image 30. Web thinning of south girder end of middle bridge west abutment





Image 13. Perforation of 1st stringer from south of middle bridge west abutment



Image 14. Perforation of 2nd stringer from south of middle bridge west abutment





Image 15. Perforation of 3rd stringer from south of middle bridge west abutment



Image 16. Soffit & floor system of west span of middle bridge facing east





Image 17. South elevation of west bridge



Image 18. North elevation of west bridge





Image 19. West approach of west bridge



Image 38. Typ. guide rail on west bridge and asphalt condition





Image 39. Disintegration of south curb of west bridge



Image 20. South upstream channel of west bridge





Image 21. Soffit & floor system of east span of west bridge facing west



Image 22. Typ. condition of stringer east end of west bridge





Image 43. Web thinning of north girder end on east abutment of west bridge



Image 23. Exterior face south girder on east abutment of west bridge





Image 24. East face of pier of west bridge



Image 46. Fractured pier collar of west bridge pier east side





Image 47. Condition of girder ends on pier of west bridge



Image 48. Typ. stringer ends on pier of west bridge





Image 49. Soffit of west span of west bridge facing east



Image 25. Disintegration of ballast wall above west abutment of west bridge





Image 26. West end of Stringer 2 with debris and perforation on west bridge



Image 52. Perforation of north girder end on west abutment of west bridge





Image 53. General western bearing area of northern 2 stringers of west bridge



Image 27. Disintegration of west bearing seat of west bridge at Stringer 3





Image 28. West end of west bridge deck condition survey



Image 29. East end of west bridge deck condition survey





Image 30. Middle to east end of middle bridge deck condition survey



Image 31. East bridge deck condition survey



From: [Williams, Craig](#)
To: [Sean Derouin](#)
Cc: [Huctwith, Andrew](#)
Subject: RE: 5 Arches
Date: October 14, 2022 2:57:56 PM
Attachments: [image001.png](#)

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good Afternoon Sean,

While it is never ideal to defer work that has the potential to continue to deteriorate, the existing structure may not change significantly. It is likely that there will not be significant changes if the rehabilitation project is delayed by only one year. For the most part the inspection results again should be representative with just progression of the deterioration and increased quantities. Signs of change particularly on the pier nosings should be monitored.

Based on the results of the deck condition survey, the investigation found the deck slab to be in good condition with half-cell readings below the threshold (for recommending removal) established in the MTO Structural Rehabilitation Manual, as well as for the chloride content. The rehab manual suggests that condition surveys should be updated if they are more than 4 years old and at the time of construction (2024) where we would still be within the suggested period. Based on the Stone Masonry Inspection Report and Inspection completed in 2021, it may be prudent to complete a visual inspection after the spring melt occurs of the piers, their concrete jackets, and the south facing joints on the pier nosings as the open joints currently have organics growing from them and are allowing water into the piers. The joints have likely been missing for a number of years since the most recent re-pointing was completed in 2011 and are a regular and reoccurring maintenance item. The jackets on the north side of the piers (downstream) should be monitored and be part of the focus of the visual inspection as they do appear to be experiencing some loss since the previous visual inspection completed in 2019. Although the project, may be deferred for a year, the short term preservation strategy and vulnerabilities described in the masonry report will need to be addressed in the near future and should not be allowed to extend past the anticipated 2024 construction date.

I will endeavor to provide for you the SDR and associated deliverables as soon as practically possible so you may review and provide feedback in advance of submitting/presenting to council.

If you have any further questions please do not hesitate to call.

Thank you sir.



Craig Williams, P. Eng.
Project Engineer
Transportation Ontario

T+ 1 613-856-0382

WSP Canada
1224 Gardiners Road, Suite 201
Kingston, Ontario
K7P 0G2

wsp.com

From: Sean Derouin <SDerouin@lanarkcounty.ca>

Sent: Thursday, October 13, 2022 2:17 PM

To: Williams, Craig <craig.williams@wsp.com>

Subject: 5 Arches

Hey Craig,

Turns out we have a bridge that needs to be replaced next year, so we will be recommending to Council to defer 5 arches to 2024.

Council will want to make sure we can defer 5-arches without issue. Can you confirm that deferring the rehab for 1-year would not increase risk of deterioration and that the current inspections and investigations will still be relevant?

We would still like to move forward with presenting the SDR results to Council in November so they can make the final say on the rehab alternative we choose.

Let me know what you think.

Thanks,

Sean

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-LAEmHhHzdJzBITWfa4Hgs7pbKl



**MINUTES
NINTH MEETING OF 2022
PUBLIC WORKS
COMMITTEE OF THE WHOLE**

The Public Works Committee of the Whole met in regular session on Wednesday, October 26, 2022 immediately following County Council.

Members Present: Chair S. Fournier, Warden J. Fenik and Councillors P. McLaren, C. Lowry, R. Minnille, B. Dobson, K. Van Der Meer, J. Fenik, E. McPherson, B. Campbell,, B. Crampton, R. Kidd, S. Mousseau, D. Black, S. Redmond, and R. Scissons.

Staff/Others Present: K. Greaves, CAO
J. Ralph, County Clerk
M. Beson, Deputy Clerk
T. McCann, Director of Public Works
S. Derouin, Public Works Manager
J. Stewart, County Planner

Regrets: Councillor J. Hall

PUBLIC WORKS

Chair: Councillor S. Fournier

1. CALL TO ORDER (Reminder please silence all electronic devices)

The meeting was called to order at 5:28 p.m.
A quorum was present.

2. DISCLOSURE OF PECUNIARY INTEREST

None at this time.

3. APPROVAL OF MINUTES

September 28, 2022

MOTION #PW-2022-66

MOVED BY: K. Van Der Meer **SECONDED BY:** E. McPherson

THAT, the minutes of the Public Works Committee meeting held on September 28, 2022 be approved as circulated.

ADOPTED

4. ADDITIONS AND APPROVAL OF AGENDA

October 26, 2022

MOTION #PW-2022-67

MOVED BY: B. Campbell **SECONDED BY:** S. Redmond

THAT, the agenda be approved as presented.

ADOPTED

5. DELEGATIONS (10 MINUTES)

6. QUESTIONS OF THE DELEGATION FROM COUNCIL

7. PRESENTATIONS

8. COMMUNICATIONS

9. CONSENT REPORTS

10. DISCUSSION REPORTS

- i) PW-26-2022 Blakeney Bridge
Sean Derouin, Public Works Manager

Councillor Lowry put forward a motion for the Blakeney Bridge report.

Council discussed the item. Council directed staff to bring forward a report to the next Council meeting related to the remedial work.

MOTION #PW-2022-68

MOVED BY: C. Lowry **SECONDED BY:** R. Minnille

THAT, Council authorizes the necessary amendment to Bylaw 2022-34, A Bylaw to consolidate the bylaws that regulate traffic on roads under the jurisdiction of the County of Lanark, to further reduce the load posting from 12 tonnes to 5 tonnes; and

AND THAT Council direct staff to hold a Public Information Centre with residents prior to the issuance of a design RFP for the Blakeney Bridge; and

AND THAT Council direct staff to proceed with remedial work in effort to reinstate current load restrictions in the interim.

ADOPTED

- 11. VERBAL REPORTS**
- 12. DEFERRED REPORTS**
- 13. CONFIDENTIAL REPORTS**
- 14. NEW/OTHER BUSINESS**
- 15. ADJOURNMENT**

The Committee adjourned at 6:04 p.m. on motion by Councillors B. Crampton, S. Redmond.

Jasmin Ralph, Clerk

A handwritten signature in black ink, appearing to read 'Kurt Greaves', with a long horizontal line extending to the right.

Kurt Greaves, CAO