Corporation of the City of Cambridge

Cambridge Municipal Heritage Advisory Committee Meeting Agenda

Meeting Number: 05-24

Date: May 16, 2024, at 7 p.m.

Location: Hybrid Meeting at City Hall and via Zoom

To increase delegate accessibility, this meeting will be livestreamed virtually. If you wish to appear as a delegate, you may register to appear as a delegation by visiting: https://forms.cambridge.ca/Delegation-Request-Form.

Members of the public wishing to speak at the Municipal Heritage Advisory Committee may complete the Delegation Request Form no later than 12:00 noon on the day prior to the meeting.

Please be advised that only one person can delegate at a time and additional people cannot be invited to join due to technical limitations. All written delegation submissions will form part of the public record.

This meeting will be livestreamed on the City of Cambridge’s YouTube page, which can be accessed via the following link: https://www.youtube.com/@CityOfCambridgeOn/streams.

Meeting Called to Order

Roll Call

Disclosure of Interest

Approval of Minutes

THAT the Minutes of the April 4, 2024, Special meeting of the Municipal Heritage Advisory Committee be considered for errors and omissions and be adopted. PP 001

THAT the Minutes of the April 18, 2024, meeting of the Municipal Heritage Advisory Committee be considered for errors and omissions and be adopted. PP 004
Presentations:

Scott MacDonald, Project Engineer, will give a presentation on report 24-014(MHAC) Black Bridge Road Bridge Heritage Permit Application

Delegations:

Agenda Items:

1. 24-014(MHAC) Black Bridge Road Bridge Permit Application, Bridge Alterations

THAT Report 24-014 (MHAC) Black Bridge Road Bridge Heritage Permit Application, Bridge Alterations be received;

AND FURTHER THAT the Municipal Heritage Advisory Committee recommend that Council approve the Heritage Permit application for the proposed repairs and alterations for the conversion of the Black Bridge Road Bridge from a vehicular bridge to a pedestrian bridge as outlined in Report 24-014 (MHAC), with the list of alterations detailed in Appendix C, subject to the following conditions:

1) Following Council approval, any minor changes to the plans and elevations shall be submitted to the satisfaction of the Chief Planner or designate, prior to an application for a building permit and/or the commencement of any alterations; and

2) That the implementation of alterations, in accordance with this approval, shall be completed no later than two (2) years following Council approval. If the alterations are not completed by such a time, then this approval expires as of that date and no alterations shall be undertaken without a new approval issued by the City of Cambridge.

2. 24-013 (MHAC) 171 Guelph Avenue (Forbes Estate) Heritage Conservation Easement Agreement

THAT Report 24-013 (MHAC) 171 Guelph Avenue (Forbes Estate) Heritage Conservation Easement Agreement be received;

AND FURTHER THAT the Municipal Heritage Advisory Committee recommend that Council approve the draft heritage conservation easement agreement, attached as Appendix A to this report.
3. 24-015(MHAC) Request for Funding from the Designated Heritage Property Grant Program – 27 Carolinian Lane

THAT Report 24-015(MHAC) – Request for Funding from the Designated Heritage Property Grant Program – 27 Carolinian Lane - be received;

AND THAT the Municipal Heritage Advisory Committee recommend that the application for funding from the 2024 Operating Budget be approved by the Deputy City Manager of Community Development for the designated property municipally known as 27 Carolinian Lane to a maximum of $5,000 for the repair of two original wood windows and the replication of matching wood storm windows on the front façade of the dwelling as described in Report 24-015(MHAC);

AND THAT the work must be completed by November 1, 2024;

AND FURTHER THAT the grant is conditional on the inspection of the completed work to the satisfaction of heritage planning staff.

4. 24-016 (MHAC) Request for Funding from the Designated Heritage Property Grant Program - 360 Clyde Road

THAT Report 24-016(MHAC) – Request for Funding from the Designated Heritage Property Grant Program – 360 Clyde Road - be received;

AND THAT the Municipal Heritage Advisory Committee recommend that the application for funding from the 2024 Operating Budget be approved by the Deputy City Manager of Community Development for the designated property municipally known as 360 Clyde Road to a maximum of $5,000 for the repair of two limestone and granite chimneys on the dwelling as described in Report 24-016(MHAC).

AND THAT the work must be completed by November 1, 2024;

AND FURTHER THAT the grant is conditional on the inspection of the completed work to the satisfaction of heritage planning staff.

5. 24-017 (MHAC) Request for a Sign Permit for 62 Dickson Street

THAT Report 24-017(MHAC) - Request for a Sign Permit for 62 Dickson Street – be received;

AND FURTHER THAT the Municipal Heritage Advisory Committee (MHAC) approve the request for a sign permit for the property known as the Cambridge Centre for the Arts, located at 62 Dickson Street, for an outdoor public art gallery display.
Other Business
   a) Chair’s Comments
   b) Council Report/Comments
   c) Staff/Senior Planner – Heritage Comments

Next Meeting:

Date & Time: June 20, 2024, at 7 p.m.
Hybrid at City Hall and via Zoom

Close of Meeting

THAT the MHAC meeting does now adjourn at _____p.m.

Distribution:

Christina Thomson, Sue Brown, Nelson Cecilia, Michelle Goodridge, Councillor Corey Kimpson, Kimberly Livingstone, Rosemary Minella, Mark Melo, Megan Oldfield, Nancy Woodman.
Committee Members in Attendance: Nelson Cecilia, Michelle Goodridge (7:19 p.m.), Kimberly Livingstone (7:26 p.m.), Rosemary Minella, Megan Oldfield, Nancy Woodman and Susan Brown in the role of Chair.

Regrets: Councillor Corey Kimpson

Staff in Attendance: Laura Waldie, Senior Planner – Heritage, Jeremy Parsons, Senior Planner – Heritage, Karin Stieg-Drobig, Recording Secretary and Maria Barrantes Barreto, Council Committee Services Coordinator.

Meeting Called to Order

The special meeting of the Municipal Heritage Advisory Committee was held virtually via Microsoft Zoom and live streamed to the City of Cambridge YouTube channel. Kimberly Livingstone, MHAC Chairperson, welcomed everyone present, and she advised those present that, in its advisory role, MHAC makes recommendations that then go to Council for a decision. The meeting was called to order at 7:12 p.m. and the meeting adjourned at 7:42 p.m.

Declarations of Interest - NIL

Reports:

1. Memo 23-009 (MHAC) HIA for 82-88 Beverly Street

Laura Waldie, Senior Planner-Heritage provided a brief overview of the project by reviewing the background of the proposed townhouse project, and advising the Committee that the parcel proposed for the residential units will be severed from the existing school. It was also noted that staff are working with the owner on the listed heritage property’s designation.

Moved By: Nelson Cecilia
Seconded By Rosemary Minella
THAT Report 24-009 (MHAC) – Heritage Impact Assessment for Redevelopment of 82-88 Beverly Street be received;

AND THAT the Municipal Heritage Advisory Committee receives the Heritage Impact Assessment prepared by MHBC Planning dated May 2023;

AND THAT the Municipal Heritage Advisory Committee recommends that protective fencing be put up along the north side of the school along the driveway access and along the rear of 119 Wellington Street to protect those properties during the construction phase of the proposed townhouse development;

AND FURTHER THAT the Municipal Heritage Advisory Committee recommends the submission of a vibration study for both the school at 82 Beverly Street and 119 Wellington Street, to the satisfaction of the Chief Planner, prior to construction should Council approve the development application.

CARRIED

2. 24-010 (MHAC) 84 Chalmers Street North, Heritage Impact Assessment

Jeremy Parsons, Senior Planner - Heritage provided a brief overview of the project through a review of the background noting its location next to a listed heritage property at 78 Chalmers Street North. The proposal is to demolish the existing dwelling and replace it with two semi-detached dwellings. He further noted that a large tree located at the front of the property will be retained and a vegetative buffer will be used to ensure visual separation between the new, modern building and the listed heritage property next door.

The Committee discussed the tree to be retained, noting the development application currently listed online shows it being removed. Jeremy advised that while that was the initial proposal, the owner has since committed to saving the tree as is reflected in the most current drawings. The Committee also discussed whether the large tree in the front yard could be retained and whether permeable pavers could be used to protect the tree roots from vehicular tire impacts. Lastly, the proposed landscaping between the lot lines was discussed given the proposed distance from one building to the other.

Moved By: Nelson Cecilia
Seconded By Nancy Woodman
THAT Report 24-010 (MHAC) 84 Chalmers Street North, Heritage Impact Assessment (HIA) be received;

AND FURTHER THAT the Municipal Heritage Advisory Committee support the contents and conclusions of the scoped HIA.

CARRIED

Next Meeting

Date & Time: April 18, 2024, 7:00 p.m.
Location: Hybrid, City Hall and via Zoom

Close of Meeting

Moved by: Nancy Woodman
Seconded by: Kimberly Livingstone

THAT the Municipal Heritage Advisory Committee meeting does now adjourn at 7:42 p.m.

CARRIED

Susan Brown  Karin Stieg-Drobig
MHAC Vice-Chairperson Recording Secretary
Committee Members in Attendance: Nelson Cecilia, Michelle Goodridge, Susan Brown, Rosemary Minella, Megan Oldfield, Nancy Woodman, Councillor Corey Kimpson, and Kimberly Livingstone in the role of Chair.

Regrets: None

Staff in Attendance: Laura Waldie, Senior Planner – Heritage, Jeremy Parsons, Senior Planner – Heritage, Karin Stieg-Drobig, Recording Secretary and Maria Barrantes Barreto, Council Committee Services Coordinator.

Meeting Called to Order:

The special meeting of the Municipal Heritage Advisory Committee was held virtually via Microsoft Zoom and live streamed to the City of Cambridge YouTube channel. Kimberly Livingstone, MHAC Chairperson, welcomed everyone present, and she advised those present that, in its advisory role, MHAC makes recommendations that then go to Council for a decision. The meeting was called to order at 7:16 p.m. and the meeting adjourned at 8:15 p.m.

Declarations of Interest: NIL

Approval of Minutes:

THAT the Minutes of the March 21, 2024 and April 4, 2024 meeting of the Municipal Heritage Advisory Committee be considered for errors and omissions and be adopted.

Moved By: Susan Brown
Seconded By: Rosemary Minella

Presentations:

1. Jenna Brown-Jowett, Director of Corporate Strategy, gave a presentation regarding the City of Cambridge Strategic Plan.
2. Slobodanka Lekic, Manager of Building Design & Construction gave an introduction to the consulting team from George Robb Architects.

Don Scott, Principal Architect at George Robb Architects gave an overview of the work scheduled for the City-owned heritage buildings Landreth Cottage and Cambridge Arts Theatre.

Reports:

1. **Report 24-011 (MHAC) Updated Heritage Impact Assessment (HIA) Terms of Reference**

Laura Waldie, Senior Planner-Heritage provided an overview of the report and the HIA Terms of Reference, noting that previous terms of reference in place at the City of Cambridge were not sufficiently detailed, did not meet industry standards, and did not cover salvage plans or conservation plans. Further, she shared that previous terms of reference were not in line with other municipalities across Waterloo Region. Laura Waldie outlined the benefits of having new HIA Terms of Reference in place.

Nancy Woodman posed questions as to how the new HIA Terms of Reference would change the process and when HIAs are required. Laura Waldie indicated that the process would not change, however the contents of reports would be more substantial. She also shared that HIAs are required at the discretion of staff, guided by the policies of the Official Plan. Michelle Goodbridge posed a question on how the City of Cambridge compares to other nearby municipalities with regards to HIA content requirements. Nancy Woodman also posed a question whether or not submitted HIAs will continue to come to MHAC. Laura Waldie responded that all HIAs come to MHAC for review. Kimberly Livingston asked how HIAs are deemed complete by the City. Laura Waldie clarified that staff receive drafts and finalized copies of reports. She also outlined the process for HIA reviews and salvage plans and mechanisms to ensure conditions are adhered to.

Moved By: Nelson Cecilia
Seconded By Susan Brown

**THAT Report 24-011 (MHAC) Updated Heritage Impact Assessment (HIA) Terms of Reference - be received;**
AND FURTHER THAT the Municipal Heritage Advisory Committee recommends that Council approve the updated HIA Terms of Reference, which also includes terms of references for a conservation plan and documentation and salvage plan.

CARRIED

2. Report 24-012 (MHAC) Hespeler Heritage Conservation District Study Report

Presentation:

Emily Guy, Research & Policy Lead of TRACE architectures Inc gave a presentation on the Hespeler Heritage Conservation District (HCD) Study including a full overview of Study including the process, evaluation results, public consultation data, and recommended boundaries.

Questions were posed by Susan Brown regarding the number of properties evaluated that meet two of nine criteria under Ontario Regulation 9/06, the common criteria that they are meeting, and how many are listed. Emily Guy indicated that 175 properties meet this threshold, however, the exact numbers may change. Jeremy Parsons also indicated that there are 67 listed properties. Michelle Goodbridge asked about properties that are located outside of the boundaries and 1691 Franklin Boulevard specifically. Mark Brandt indicated that properties located just outside of the District that are determined to have value will be recommended to the City for consideration for future Part IV designations. Susan Brown also asked about properties within plans of condominiums. Michelle Goodbridge also commented that the Study was well done and the community was involved in the process.

Moved By: Susan Brown
Seconded By Nelson Cecilia

THAT Report 24-0012 (MHAC) Hespeler Heritage Conservation District Study Report be received;

AND THAT the Municipal Heritage Advisory Committee (MHAC) accepts the Hespeler Heritage Conservation District (HCD) Study Report, its recommendations, and its conclusions outlined within Appendix B;

AND THAT the MHAC recommend that Council endorse the recommended HCD boundaries, as outlined within Appendix A;
AND FURTHER THAT the MHAC recommend that Council approve the recommendations and conclusions of the HCD Study Report and approve the preparation of a Hespeler HCD Plan and Guidelines in accordance with Section 41 of the Ontario Heritage Act.

CARRIED

3. Report 24-007 (MHAC) Delegated Authority By-law for Heritage Permits

Jeremy Parsons, Senior Planner-Heritage provided an overview of the report and the proposal for a delegated authority by-law for heritage permits. He shared that staff are proposing a by-law for minor heritage permits only, excluding major work and permit refusals. All heritage permits would still come before MHAC and Council would retain the ability to pull any items from the delegated authority stream as needed. He noted the benefits for the City of Cambridge including improve approval times, improved customer service, and ability of staff to focus on other priorities.

Michelle Goodridge posed a question on what would happen if MHAC made an amendment to staff’s recommendations, or if they had comments. Jeremy Parsons indicated that in any cases where staff and MHAC disagree, the heritage permit application would not be eligible for delegated authority. Laura Waldie provided an example that if someone wanted to construct an accessibility ramp into their home and MHAC wanted some materials changed. We would take that to the owner and if they did not agree with the materials change, then the permit would likely not be issued until we sent the refusal to Council for a decision. Also any suggestions that were not included in an amendment to the recommendations, would be recommendations from MHAC under its advisory role. Councillor Kimpson asked about the timing of heritage permit approvals and the trigger to bring the permits to Council. Jeremy Parsons indicated that staff are of the opinion that MHAC would be the best forum in which Council could pull applications from the delegated authority approval stream. Michelle Goodridge also requested that in the report going to Council that more clarity could be provided in cases where MHAC requests a change to report recommendations but still supports approval.

Moved By: Nelson Cecilia
Seconded By Nancy Woodman

THAT Report 24-07 (MHAC) Delegated Authority By-law for Heritage Permits be received;
AND THAT the Municipal Heritage Advisory Committee (MHAC) recommend that Council approve the proposed power to consent to certain alterations to properties designated under the Ontario Heritage Act to the Chief Planner, subject to consultation with MHAC;

AND FURTHER THAT the Draft By-law, attached as Appendix A to Report 24-007 (MHAC), be supported by MHAC.

CARRIED

Other Business

Councillor Kimpson shared that Council has approved the 50th celebration public art project, it will be a sculpture of the historic Sheave Tower that will be located at the Fountain Street soccer fields.

Next Meeting

Date & Time: May 16, 2024, 7:00 p.m.
Location: Hybrid, City Hall and via Zoom

Close of Meeting

Moved by: Meg Oldfield
Seconded by: Michelle Goodridge

THAT the Municipal Heritage Advisory Committee meeting does now adjourn at 8:15 p.m.

CARRIED

Kimberly Livingstone    Jeremy Parsons and Laura Waldie
MHAC Chairperson     Senior Heritage Planners
Heritage Permit Application, Black Bridge Road Bridge
MHAC Meeting – May 16, 2024
Introduction

Purpose:
Provide information and an opportunity to answer questions in support of the Heritage Permit Application for alterations to the Black Bridge Road Bridge

Project:
The alterations to the Black Bridge Road Bridge are being completed as part of the City’s Black Bridge Rd and Townline Rd Improvement project

Project Team:
• Scott MacDonald, Project Manager, City of Cambridge
• Heidy Schopf, Cultural Heritage Team Lead, WSP
• Matthew Galloway, Associate Bridge Engineer, WSP
Background

- Black Bridge was constructed in 1916. It is a single-lane pin-jointed steel truss bridge that carries Black Bridge Road over the Speed River
- Black Bridge is designated under Part IV of the Ontario Heritage Act and is a key component of the Black Bridge Road Bridge Cultural Heritage Landscape
- A Class Environmental Assessment (Class EA) was undertaken to determine the future plan for the existing heritage Black Bridge and improvements to Black Bridge Road and Townline Road; Class EA completed in 2017
- The preferred alternative from the Class EA included reusing the heritage bridge as part of a multi-use trail (MUT) system
- The studies and design work required to reuse the heritage bridge as an MUT has now been completed
A Strategic Conservation Plan (SCP) was completed by WSP for the heritage bridge to manage the proposed changes to Black Bridge, as well as future maintenance and repairs.

The purpose of the SCP is to ensure that the significance and heritage attributes of Black Bridge are conserved over the short, medium, and long term.

The SCP presents an Action Plan to conserve Black Bridge which is consistent with a primary heritage conservation strategy of rehabilitation, with a secondary strategy of preservation of this site.

Conservation goals: conserve the four key views, conserve the heritage attributes of the bridge, conserve the steel truss materials.

The SCP was presented to MHAC in April 2022.
Heritage Attributes

- Alignment
- Material (Steel)
- Views
- Steel truss construction with riveted joints
- Concrete abutments
- Single Span

Plate 1: Heritage attributes of Black Bridge (steel truss construction with riveted joints and abutments highlighted in blue)
• Along with the SCP a Structural Condition Survey was completed
• Black Bridge has sufficient capacity for it's planned use
• Minor repairs are recommended: concrete patch repairs, sealing of cracks, cleaning and coating of areas of the steelwork
• For wind loading key stiffening of connections or an additional truss may be needed
• Modifications to convert to a MUT includes: replacing concrete curbs, install new cycle height railing, install cover plates over expansion joints, remove existing guide rails and signage
• Other repairs needed to address damage by collisions

City of Cambridge
Proposed Repairs/Alterations

• As part of the Black Bridge Road and Townline Road project the alterations and repairs to the heritage bridge will be completed
• Repairs to address collision damage, steel sections requiring replacement will be in a “like for like” manner
• Minor rehabilitation to strengthen bridge members and address structural defects
• Modifications to convert bridge to MUT:
  o New concrete footings to support new railing
  o Install new cycle height railings
  o Install cover plates over expansion joints
  o Remove guide rails and vehicular signage
Next Steps

• Finalize contract drawings and tender package
• Get final approvals and permits
• Tender the construction project
• Construction
  ➢ Phase 1 – New Bridge and Approaches (2024-2025)
  ➢ Phase 2 – Black Bridge Road and Heritage Bridge
    Repairs/Alterations (2025)
  ➢ Phase 3 – Townline Road Improvements (2026)
Thank You!

Questions?
To: Municipal Heritage Advisory Committee
Meeting Date: 5/16/2024
Report Title: 24-014 (MHAC) Black Bridge Road Bridge Heritage Permit Application, Bridge Alterations
Report Author: Jeremy Parsons, Senior Planner-Heritage
Department Approval: Joan Jylanne, Manager of Policy Planning
Department: Community Development
Division: Policy Planning
Report No.: 24-014 (MHAC)
File No.: LAC.8.105
Ward: Ward 1, Ward 2

RECOMMENDATION(S):

THAT Report 24-014 (MHAC) Black Bridge Road Bridge Heritage Permit Application, Bridge Alterations be received;

AND FURTHER THAT the Municipal Heritage Advisory Committee recommend that Council approve the Heritage Permit application for the proposed repairs and alterations for the conversion of the Black Bridge Road Bridge from a vehicular bridge to a pedestrian bridge as outlined in Report 24-014 (MHAC), with the list of alterations detailed in Appendix C, subject to the following conditions:

1) Following Council approval, any minor changes to the plans and elevations shall be submitted to the satisfaction of the Chief Planner or designate, prior to an application for a building permit and/or the commencement of any alterations; and

2) That the implementation of alterations, in accordance with this approval, shall be completed no later than two (2) years following Council approval. If the alterations are not completed by such a time, then this approval expires as of that date and no alterations shall be undertaken without a new approval issued by the City of Cambridge.

EXECUTIVE SUMMARY:

Purpose

This report has been prepared to consult with the Municipal Heritage Advisory Committee (MHAC) on a Heritage Permit application in support of the proposed
alterations required to repair the designated bridge and convert it from vehicular to pedestrian use.

**Key Findings**

- The Black Bridge Road Bridge is a single-lane Pratt steel truss bridge constructed in 1916 to cross over the Speed River.
- The property was designated under Part IV of the Ontario Heritage Act in 2003 and is located within the Black Bridge Cultural Heritage Landscape.
- In 2016 and 2021 the bridge was damaged by vehicular traffic. In 2021, a structural condition assessment identified that the bridge is receiving excessive traffic for a small, single-lane bridge.
- A Cultural Heritage Impact Assessment (2017) and Strategic Conservation Plan (2022) both identified that the structure should be converted to pedestrian use.
- The alterations proposed include removing vehicular signage, replacing concrete curbs, installing new cycle height railings, installing cover plates over bridge expansion joints, and removing steel beam guide rails.

**Financial Implications**

The Black Bridge Road and Bridge Reconstruction project (A/00492-40) has an overall approved budget of $20.6 million and is funded through the Capital Budget. The alterations to the heritage bridge comprise approximately $600,000. Approximately $60,000 has been allocated to supporting studies, plans, and design. No funds have yet been spent on the bridge alterations.

**STRATEGIC ALIGNMENT:**

☐ Strategic Action; or
☒ Core Service

**Objective(s):** Not Applicable

**Strategic Action:** Not Applicable

**Program:** Community Development

**Core Service:** Heritage Conservation

**BACKGROUND:**

The Black Bridge Road Bridge is located on Black Bridge Road, crossing the Speed River, between Townline Road to the east and the Canadian National Railway line to the west (Figure 1). The pin-jointed Pratt-style steel truss bridge was constructed in 1916 to replace an earlier wooden bridge at the same location.
The property is located within the Black Bridge Cultural Heritage Landscape (CHL) (Figure 2), formalized through Official Plan Amendment No. 15 and subject to the policies of Section 9 of the Official Plan. The bridge is identified as a key Character Defining Attribute of the Black Bridge CHL. Section 9.2.3 of the Official Plan outlines that a Cultural Heritage Impact Assessment (CHIA) is required for development proposals or other alterations that may impact the Character Defining Attributes of the CHL.

![Aerial image of the vicinity of subject property with the bridge indicated by a red arrow](City of Cambridge, 2024)

Figure 1: Aerial image of the vicinity of subject property with the bridge indicated by a red arrow (City of Cambridge, 2024)
In 2003, the bridge was designated under Part IV of the Ontario Heritage Act through Designation By-law No. 16-03 (attached as Appendix A).

In 2010, a Municipal Class Environmental Assessment (EA) was initiated for the Black Bridge Road and Townline Road Study Area wherein it was identified that the bridge did not meet capacity and safety requirements for continued vehicular traffic in its current condition. The EA also recommended a road realignment that would result in the retention of the bridge in-situ while discontinuing vehicular use of the bridge.

In 2016, the bridge was damaged by vehicular traffic twice. As such, the bridge underwent emergency repairs, as outlined in Report 08-2016 (MHAC). In 2016, the
bridge was included within the Black Bridge Cultural Heritage Landscape, approved by Council through Official Plan Amendment No. 15, and integrated within the Official Plan.

In 2017, a CHIA was submitted that identified alternatives for the heritage bridge and focused on its functional replacement. The CHIA was brought before MHAC in 2020 through Report 20-036 (MHAC).

In 2021, a transport truck struck the bridge while travelling east along Black Bridge Road. The collision caused structural damage to the steel truss superstructure on the west elevation. Subsequently, in 2021, a Condition Survey Report of the bridge was completed by a team of structural engineers. The report, which was later updated in 2023, identified that the bridge was receiving excessive traffic for a small, single-lane bridge (attached as Appendix E).

In 2022, a Strategic Conservation Plan (SCP) was completed for the bridge, in accordance with SCP Terms of Reference. The SCP identified an action plan for the bridge including the timing and scope of repairs and other alterations. The SCP was brought before MHAC in 2022 through Report 22-011 (MHAC).

On April 9, 2024, a Heritage Permit application (Appendix B) was submitted to Heritage Planning along with a letter outlining proposed alterations (Appendix C), a set of bridge drawings (Appendix D), and the Condition Survey Report (Appendix E).

The work on the bridge is expected to be completed in 2025.

EXISTING POLICY / BY-LAW(S):
Ontario Heritage Act (R.S.O. 1990, c. O.18)

Alteration of property

33 (1) No owner of property designated under section 29 shall alter the property or permit the alteration of the property if the alteration is likely to affect the property’s heritage attributes, as set out in the description of the property’s heritage attributes in the by-law that was required to be registered under clause 29 (12) (b) or subsection 29 (19), as the case may be, unless the owner applies to the council of the municipality in which the property is situate and receives consent in writing to the alteration. 2019, c. 9, Sched. 11, s. 11.

Application

(2) An application under subsection (1) shall be accompanied by the prescribed information and material. 2019, c. 9, Sched. 11, s. 11.

Other information
(3) A council may require that an applicant provide any other information or material that the council considers it may need. 2019, c. 9, Sched. 11, s. 11.

Notice of complete application

(4) The council shall, upon receiving all information and material required under subsections (2) and (3), if any, serve a notice on the applicant informing the applicant that the application is complete. 2019, c. 9, Sched. 11, s. 11.

Notification re completeness of application

(5) The council may, at any time, notify the applicant of the information and material required under subsection (2) or (3) that has been provided, if any, and any information and material under those subsections that has not been provided. 2019, c. 9, Sched. 11, s. 11.

Decision of council

(6) The council, after consultation with its municipal heritage committee, if one is established, and within the time period determined under subsection (7),

(a) shall,

(i) consent to the application,

(ii) consent to the application on terms and conditions, or

(iii) refuse the application; and

(b) shall serve notice of its decision on the owner of the property and on the Trust. 2019, c. 9, Sched. 11, s. 11.

Same

(7) For the purposes of subsection (6), the time period is determined as follows:

1. Unless paragraph 2 applies, the period is 90 days after a notice under subsection (4) is served on the applicant or such longer period after the notice is served as is agreed upon by the owner and the council.

2. If a notice under subsection (4) or (5) is not served on the applicant within 60 days after the day the application commenced, as determined in accordance with the regulations, the period is 90 days after the end of that 60-day period or such longer period after the end of the 60-day period as is agreed upon by the owner and the council. 2019, c. 9, Sched. 11, s. 11.

Deemed consent
(8) If the council fails to notify the owner under clause (6) (b) within the time period determined under subsection (7), the council shall be deemed to have consented to the application. 2019, c. 9, Sched. 11, s. 11.

9. **BLACK BRIDGE CULTURAL HERITAGE LANDSCAPE SITE SPECIFIC POLICY AREA**

1. **Preamble:**

The Black Bridge CHL is an area of cultural heritage significance in which the modifications resulting from human activities can be identified and are valued by the community. The Black Bridge CHL possesses cultural associations, as well as groupings of individual heritage features, such as the built structures, open spaces, archaeological sites and natural elements that together comprise a significant heritage form, distinctive from that of its constituent elements or parts. The CHL should be conserved in such a way that the area’s heritage values, attributes and integrity are retained, and the awareness, appreciation and enjoyment of the Black Bridge CHL should be promoted.

1.1 The following heritage themes provide a foundation for the Black Bridge Cultural Heritage Landscape:

   a. Settlement: Aboriginal and Early European;
   b. Community Development: Grist Mills and Saw Mills;
   c. Transportation: Road, River and Rail; and
   d. The Rivers and the Land.

1.2 The following are the key Character Defining Attributes of the Black Bridge CHL, as identified through the Black Bridge CHL Technical Study (January 2016):

   a. The Mill, 4860 Townline Road, City of Cambridge;
   b. The Mill Races, located in City of Cambridge and Township of Puslinch;
   c. The Irish Creek Pond and Dam, Township of Puslinch;
   d. The Speed River Dam, Township of Puslinch;
   e. The Mill Manager’s House, 4880 Townline Road, City of Cambridge;
   f. The Mill Boarding House, 4790 Townline Road, City of Cambridge;
g. The Black Bridge, Black Bridge Road at the Speed River, City of Cambridge;

h. 537 River Road, City of Cambridge;

i. The Roszell Farm, 6542 Roszell Road, Township of Puslinch;

j. Crossroads Memorial Church and Brethren in Christ Cemetery, 4614 Wellington Road, Township of Puslinch;

k. The Speed River, and the Irish Creek their valleys and floodplains, City of Cambridge and Township of Puslinch;

l. Views of the Speed River valley, from Black Bridge Road, views of the Black Bridge along the road and across the valley, and views along Townline Road from Black Bridge Road to the hill top near River Road, City of Cambridge and Township of Puslinch; and

m. Views and viewsheds associated with these Character Defining Attributes, City of Cambridge and Township of Puslinch.

2. Policies: In addition to the policies and permitted uses in this Plan, the lands designated as the Black Bridge Cultural Heritage Landscape (Black Bridge CHL) as identified on Schedule ‘A’, Figure 67 of this Plan, are subject to the following policies:

2.1 Conservation

The Black Bridge Cultural Heritage Landscape shall be conserved.

2.2 Education and Awareness

The community is encouraged to promote continued education, awareness and interpretation of the Black Bridge CHL, as detailed in the Management Strategy contained within the Black Bridge CHL Technical Study, and through undertakings such as a coordinated signage program for the area that interprets the themes and significant features, walking or cycling tours, interpretive brochures, and digital media, as appropriate.

2.3 Cultural Heritage Impact Assessment (CHIA)

A Cultural Heritage Impact Assessment shall be required for a development proposal on all properties within, or directly adjacent to, the Black Bridge CHL in order to ensure that development is context sensitive and mitigates impacts to Character Defining Attributes.

The Cultural Heritage Impact Assessment shall be undertaken in accordance with the requirements under Section 4.10 of this Plan.
Where a Cultural Heritage Impact Assessment has been undertaken in respect to a development proposal and where the development proposal has been reviewed by the Municipal Heritage Advisory Committee and approved by Council, a further Cultural Heritage Impact Assessment will not be required.

2.4 Infrastructure

“Infrastructure” development, upgrades and/or improvements shall be planned and designed in such a way as to minimize impacts and be sympathetic to the Black Bridge CHL’s Character Defining Attributes and to the broader context of the area.

2.5 Property Listing and Designation

Character Defining Attributes of the Black Bridge CHL located within the City of Cambridge shall be listed in the Municipal Register and property owners shall be encouraged to seek designation under the Part IV of the Ontario Heritage Act.

2.6 Amendments to Black Bridge CHL

The Black Bridge CHL policies, Character Defining Attributes and/or boundary may need to be amended from time to time. Amendments shall be prepared by the City of Cambridge’s Planner – Heritage and brought forward to MHAC for review. MHAC shall provide a recommendation in regards to the amendment for consideration and approval by Council. All amendments will be pursuant to the Planning Act.

ANALYSIS:

The proposed alterations to the Black Bridge Road Bridge include the following:

Repairs to address 2021 collision damage:

- Install a temporary lateral bracing system to laterally support the bridge during the removal and replacement of the bottom lateral brace at the west end of the bridge;
- Heat straighten all lateral frame members designated to remain that have deformed as a result of the collision, including gusset plates;
- Remove and replace diagonal cross bracing and vertical brace at right lateral truss frame including replacing all riveted connections with new bolted connections;
- Remove and replace bottom lateral brace including all gusset plates and all riveted connections to bottom lateral brace with new gusset plates and bolted connections;
- Remove and replace knee braces including gusset plates connected to main vertical truss members and bolted connections;
• Heat straighten main vertical truss member at deformed section near knee brace connection; and,

• Repair steel sections where there is weathering steel, matching the existing steel section properties, to repair damaged sections in a “like for like” manner.

Repairs to rehabilitate, strengthen bridge members, and address structural deficits:

• Weld strengthening plates to outer side faces of the end diagonal truss members;
• Replace rivets with high strength bolts in the area of the end diagonal trusses between the bottom of the lateral brace and the knee brace;
• Add an additional angle to the back of the existing angle that forms the central vertical member of each lateral truss;
• Remove deteriorated concrete from abutments and wingwalls and deck;
• Patch repair abutments and wingwalls, and deck;
• Remove deteriorated concrete from concrete railings on approaches;
• Patch repair concrete railings on approaches;
• Seal cracks wider than 0.5mm in deck, deck soffit, abutment and wingwalls, by injecting with colour matching epoxy;
• Abrasive blast clean deck surface and apply migratory corrosion inhibitor, comprising a silane sealer and an organic corrosion inhibitor;
• Locally power tool clean corroded areas of structural steelwork and coat areas with a 3 coat (epoxy zinc/epoxy/polyurethane) system, compatible with the existing coating and with a topcoat to match the colour of the existing coating; and,
• Place riprap on embankments for erosion protection.

Alterations to convert to a multi-use trail:

• Construct new concrete footings on approaches, extending to ends of wingwalls, to support new cycle height railings;
• Install new cycle height railings on existing bridge curbs and new approach footings;
• Install cover plate over expansion joint at each end of bridge. Cover plate prevents edges of joint from becoming trip hazard to pedestrians and cyclists;
• Remove steel beam guide rails on approaches; and,
• Remove vehicular signage at each end of bridge.
As identified within Designation By-law No. 16-03, the single-lane pin-jointed steel truss bridge, in its entirety, is a protected heritage attribute. As such, alterations proposed to the bridge require a Heritage Permit under Section 33 of the Ontario Heritage Act.

The proposed alterations represent, in part, necessary maintenance work designed to repair and rehabilitate the 1916 bridge structure and extend its lifespan for continued use. The proposed alterations also seek to successfully convert the structure from vehicular to pedestrian use. These changes include installing new cycle height railings and cover plates over joints to ensure safe use by both pedestrians and cyclists. The proposed alterations are guided by the Strategic Conservation Plan (2022), which was undertaken to manage the change planned to the bridge including ensuring that the cultural heritage value of the bridge is retained through its conversion to a pedestrian structure.

Heritage Planning staff support the proposed alterations and the Heritage Permit application, as submitted. The proposal seeks to extend the life of the original structure, ensuring that the bridge is safe and accessible for future generations. The proposal also seeks to enable greater use and appreciation of the heritage resource by removing vehicular traffic and allowing better access by pedestrians and cyclists.

**FINANCIAL IMPACT:**

The Black Bridge Road and Bridge Reconstruction project (A/00492-40) has an overall approved budget of $20.6 million and is funded through the Capital Budget. The alterations to the heritage bridge comprise approximately $600,000. Approximately $60,000 has been allocated to supporting studies, plans, and design. No funds have yet been spent on the bridge alterations.

**PUBLIC VALUE:**

**Transparency:**

To ensure transparency, MHAC meeting agendas are posted on the City’s website.

**PUBLIC INPUT:**

Meetings of the MHAC are open to the public via the City’s YouTube channel.

**INTERNAL / EXTERNAL CONSULTATION:**

Heritage planning staff have liaised with staff from Engineering and Transportation Services in the writing of this report.
CONCLUSION:

For the reasons outlined in this report, Heritage Planning staff recommend that MHAC recommend Council approve the Heritage Permit application for alterations proposed to repair the Black Bridge Road Bridge and to convert it from vehicular to pedestrian use, subject to the conditions outlined in this report.

REPORT IMPACTS:

Agreement: No
By-law: No
Budget Amendment: No
Policy: No

APPROVALS:

This report has been reviewed and approved for inclusion in the agenda by the respective Departmental Manager.

ATTACHMENTS:

1. 24-014 (MHAC) Appendix A: Designation By-law No. 16-03
2. 24-014 (MHAC) Appendix B: Heritage Permit Application
3. 24-014 (MHAC) Appendix C: List of Proposed Alterations Prepared by WSP
4. 24-014 (MHAC) Appendix D: Heritage Bridge Drawings Prepared by WSP
5. 24-014 (MHAC) Appendix E: Condition Survey Report Prepared by WSP
This document was retrieved from the Ontario Heritage Act e-Register, which is accessible through the website of the Ontario Heritage Trust at www.heritagetrust.on.ca.

Ce document est tiré du registre électronique, tenu aux fins de la *Loi sur le patrimoine de l’Ontario*, accessible à partir du site Web de la Fiducie du patrimoine ontarien sur www.heritagetrust.on.ca.
January 23, 2003

Ms. Rita Calderone
Ministry of Tourism, Culture and Recreation
400 University Avenue
4th floor
Toronto, ON M7A 2R9

Dear Ms. Calderone:

Re: By-law Designating City of Cambridge Property under Part IV of the Ontario Heritage Act

In accordance with the Ontario Heritage Act, I am sending the attached City of Cambridge By-law 16-03 designating the Black Bridge Road Bridge under Part IV of the Ontario Heritage Act R.S.O. 1990.

Should there be any questions or concerns, please me at (519) 740-4650, extension 4580.

Yours truly,

Valerie Spring, B.A., M.A.,
L.A.C.A.C. Co-ordinator

VS/jb

Attach.
BY-LAW NO. 16-03
OF THE
CORPORATION OF THE CITY OF CAMBRIDGE

Being a by-law of the Corporation of the City of Cambridge to designate the structure known as the Black Bridge Road Bridge, Cambridge, Ontario as a property of cultural heritage value or interest.

WHEREAS the Ontario Heritage Act, R.S.O. 1990, Chapter 0.18 authorizes the Council of a municipality to enact by-laws to designate real property including the structure thereon, to be of cultural heritage value or interest;

AND WHEREAS Notice of Intention to Designate the Black Bridge Road Bridge, Cambridge, Ontario has been duly published and served;

NOW THEREFORE, THE MUNICIPAL COUNCIL OF THE CORPORATION OF THE CITY OF CAMBRIDGE ENACTS AS FOLLOWS:

1. THAT there is designated as being of cultural heritage value or interest the structure, more particularly described in Schedule “A” attached hereto, known as the Black Bridge Road Bridge, Cambridge, Ontario. The reasons for designation, including a description of the heritage attributes of the property, are as set out in Schedule “B” attached hereto.

2. THAT the City of Cambridge is hereby authorized to cause a copy of this by-law to be served upon the owner of the said property and upon the Ontario Heritage Foundation and to cause notice of this by-law to be published in a newspaper having general circulation in the City of Cambridge.

READ A FIRST, SECOND AND THIRD TIME
ENACTED AND PASSED, THIS 20TH DAY OF JANUARY, A.D., 2003

MAYOR

CLERK
SCHEDULE "A"
TO BY-LAW NO. 16-03
OF THE
CORPORATION OF THE CITY OF CAMBRIDGE

ALL AND SINGULAR that certain parcel or tract of land and structure, situate, lying and being in the City of Cambridge, in the Regional Municipality of Waterloo, and being composed of Concession 4 Beasley’s Lower Block Part Lot 13 on Black Bridge Road Bridge and known as the Black Bridge Road Bridge.
SCHEDULE "B"
TO BY-LAW NO. 16-03
OF THE
CORPORATION OF THE CITY OF CAMBRIDGE

This property is recommended for designation because of its cultural heritage value and interest. The current Black Bridge Road Bridge was constructed in 1916 but there is evidence of a wooden bridge structure on this site from as early as 1910. The Waterloo Township Minutes of July 1916 indicate that the Hamilton Bridge Works Company was awarded the contract to build a "steel superstructure at a bridge at Cole's Mill, near Hespeler" for $5575.00.

Historically, the Black Bridge Road was the Block Line that divided Wilson's Upper Block and Wilson's Lower Block and was a point of reference on early maps dating back to 1805.

The Black Bridge Road Bridge is a single-lane pin-jointed steel truss bridge and is typical of the bridges built in that era. It has undergone extensive repair work beginning in 1931 when the wooden deck was replaced, and most recently in 1996. Despite these repairs, the bridge has retained its original form and is the only steel bridge of its kind in Cambridge.

The heritage attribute of this property is the single-lane pin-jointed steel truss bridge in its entirety.

REASONS FOR DESIGNATION

The property was evaluated in terms of the criteria for designation in accordance to the Heritage Policies within the City of Cambridge Official Plan:

Heritage Value or Interest

a) it dates from an early period in the development of the City's communities

Architectural Value or Interest

a) it is a good, representative example of a method of construction now rarely used;
b) it is a good, representative example of its architectural style of period of building;
c) it terminates a view or otherwise makes an important contribution to the urban composition or streetscape of which it forms a part.

Further information about this property can be found in the L.A.C.A.C. building file.
DATED: JANUARY 20TH. A.D. 2003

BY-LAW NO. 16 - 03

OF THE

CORPORATION OF THE CITY OF CAMBRIDGE

Being a By-law of the Corporation of the City of Cambridge to designate the structure known as the Black Bridge Road Bridge, Cambridge, Ontario as a property of cultural heritage value or interest.


JAMES ANDERSON
CITY CLERK
CITY CLERK
Heritage Permit Application Form

The following application form is pursuant to the Ontario Heritage Act, R.S.O 1990, Sections 33, 34, and 42. The City of Cambridge will issue a Notice of Receipt within the receipt of a complete application, including all required supporting documentation. Please attach to this form any photographs, plans, drawings, studies, etc, required to fully describe and support the proposed alterations.

**Part A – Heritage property information**

<table>
<thead>
<tr>
<th>Address</th>
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<tr>
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**Part B – Applicant information**

<table>
<thead>
<tr>
<th>Property Owner</th>
<th>Mail Code:</th>
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<tr>
<td>Scott MacDonald on behalf of City of Cambridge</td>
<td>N 1 R 5 W 8</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>50 Dickson Street</td>
<td>N 1 R 5 W 8</td>
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<tr>
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**Part C – Agent information (if applicable)**

<table>
<thead>
<tr>
<th>Agent</th>
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<tr>
<td>WSP Canada Limited</td>
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4 of 6
Part D – Scope of work:

A. Select which types(s) of work apply in the boxes below:

- Alteration (including landscape alterations and signage)  
- Demolition (partial or full)  
- New Construction or Addition  
- Relocation

B. Clearly describe all the changes you are undertaking to the property and which heritage features will be impacted. Attach additional pages if needed.

Black Bridge has been subject to a Heritage Impact Assessment (HIA) (MHBC 2017) and Strategic Conservation Plan (SCP) (Wood 2022), which both identified that the structure should be converted from a vehicular crossing to a pedestrian bridge. A structural condition survey of the bridge completed by Wood in 2021 found that Black Bridge is currently receiving excessive traffic for a single lane load posted bridge and concluded that conversion to a pedestrian bridge is required. In addition, On November 4, 2021, an 18-wheeler transport truck struck Black Bridge while travelling east along Black Bridge Road. The collision caused structural damage to the steel truss superstructure on the west elevation, considered to be a heritage attribute. Consultation with the City of Cambridge determined that Black Bridge was damaged by vehicular traffic twice in 2016, which also resulted in damages to the portals. The collisions and resulting damages to heritage attributes highlight the need to convert Black Bridge to a pedestrian bridge since continued vehicular traffic will threaten the long-term viability of this structure.

A list of the proposed alterations to convert the structure from a vehicular bridge to a pedestrian bridge is appended to this form.

Part E – List of supporting documentation:

Check all that apply:

- Photographs (existing and historical)  
- Plans, Drawings, and Sample Materials  
- Historical Documentation  
- Contractor Quotes  
- Heritage Impact Assessment or Conservation Plan  
- Documentation for Building Code or Planning Act applications (Pre-Consultation, Site Plan, Minor Variance, Consent, Zoning By-law Amendment, Official Plan Amendment, etc)
Part F – Declaration

Check the appropriate statement:

☐ I, the Applicant, am the sole owner of the property for which this application is made.

☑ I, the Applicant, am one of the owners of this property and have received express authorization from all other property owners to make this application for alteration.

Name: Scott MacDonalld  Date: 2024-06-09
Signature: X

Part G - For office use only

Received by:  Date:
Reviewed by:  Date:

☐ Approved
☐ Not approved
☐ Approved with the following terms and/or conditions:

Part H – Authorization and Appointment of an Agent

I, ___________________________, being the registered owner of property legally described as:

Civic Address: ___________________________
Legal Description: ___________________________

I hereby give authorization for ___________________________ to act as my agent in the matter of ___________________________.

It is understood that until the City of Cambridge is advised otherwise, the City shall deal exclusively with the above-noted person with respect to the matter noted above.

Name: ___________________________  Date: _____________
Signature: X
February 7, 2024

City of Cambridge
50 Dickson Street
Cambridge, ON, N1R 5W8

Attention: Laura Waldie, Senior Planner Heritage

Dear Laura,

Subject: Heritage Permit Application Form for Black Bridge Road Bridge, City of Cambridge, Ontario

Dear Laura,

The following text was prepared for the Strategic Conservation Plan (SCP) for the Black Bridge Road Bridge (Black Bridge) by Wood PLC (now WSP Canada Limited) (WSP) in 2022. The text details the proposed changes to Black Bridge to convert the structure from a vehicular bridge to a pedestrian bridge and integrate the bridge with the proposed multi-use trail (MUT). Please consider this list of proposed alterations to support the Heritage Application Form to complete the alterations to Black Bridge.

BLACK BRIDGE FUTURE PLANS AND NEEDS

The Heritage Impact Assessment (HIA) prepared by MHBC in 2017 determined that retention of Black Bridge in situ and rehabilitation of the bridge to serve as a pedestrian bridge was the preferred alternative for Municipal Class Environmental Assessment for Black Bridge Road and Townline Road (MHBC 2017). The Structural Condition Survey completed by Wood (now WSP) in 2023 included a detailed evaluation of the structural capacity of the existing heritage truss bridge (WSP 2023). The Structural Condition Survey found that under some design load combinations, stresses in the end diagonal truss members, and the central vertical members of the lateral trusses, exceed capacity. Also, it is noted that the design live loading under pedestrians is actually higher than the existing posted vehicle loading, and the stresses will become worse in the new configuration. Therefore, strengthening of the end diagonal members is required in order to achieve code compliance when converting the bridge from a vehicular crossing to a pedestrian bridge. These findings support MHBC’s conclusion that conversion of Black Bridge to be part of a Multi-Use Trail is the preferred alternative to conserve Black Bridge.

On November 4, 2021, an 18-wheeler transport truck struck Black Bridge while travelling east along Black Bridge Road. The collision caused structural damage to the steel truss superstructure on the west elevation, considered to be a heritage attribute. Consultation with the City of Cambridge determined that Black Bridge was damaged by vehicular traffic twice in 2016, which also resulted in damages to the portals. The collisions and resulting damages to heritage attributes highlight the need to convert Black Bridge to a pedestrian bridge since continued vehicular traffic will threaten the long-term viability of this structure.
PROPOSED REPAIRS

REPAIRS TO ADDRESS COLLISION DAMAGE

The following repairs were designed by WSP and carried out by Marbridge Construction Ltd in April 2022 to address damage caused by the collision on November 4, 2021:

• Install a temporary lateral bracing system to laterally support the bridge during the removal and replacement of the bottom lateral brace at the west end of the bridge;
• Heat straighten all lateral frame members designated to remain that have deformed as a result of the collision, including gusset plates;
• Remove and replace diagonal cross bracing and vertical brace at right lateral truss frame including replacing all riveted connections with new bolted connections;
• Remove and replace bottom lateral brace including all gusset plates and all riveted connections to bottom lateral brace with new gusset plates and bolted connections;
• Remove and replace knee braces including gusset plates connected to main vertical truss members and bolted connections;
• Heat straighten main vertical truss member at deformed section near knee brace connection; and,
• Steel sections were weathering steel, matching the existing steel section properties to repair damaged sections in a “like for like” manner.

MINOR REHABILITATION TO STRENGTHEN BRIDGE MEMBERS

WSP recommends to strengthen certain members of the bridge in order that all bridge members satisfy the requirements of the Canadian Highway Bridge Design Code. The following work should be carried out:

• Weld strengthening plates to outer side faces of the end diagonal truss members
• Replace rivets with high strength bolts in the area of the end diagonal trusses between the bottom of the lateral brace and the knee brace
• Add an additional angle to the back of the existing angle that forms the central vertical member of each lateral truss.

MINOR REHABILITATION TO ADDRESS STRUCTURAL DEFECTS

WSP’s Condition Survey Report recommended the following minor rehabilitations to address current structural defects of Black Bridge:

— Remove deteriorated concrete from abutments and wingwalls and deck;
— Patch repair abutments and wingwalls and deck;
— Remove deteriorated concrete from concrete railings on approaches;
— Patch repair concrete railings on approaches;
— Seal cracks wider than 0.5mm in deck, deck soffit, abutment and wingwalls, by injecting with colour matching epoxy;
— Abrasive blast clean deck surface and apply migratory corrosion inhibitor, comprising a silane sealer and an organic corrosion inhibitor;
— Locally power tool clean corroded areas of structural steelwork and coat areas with a 3 coat (epoxy zinc/epoxy/polyurethane) system, compatible with the existing coating and with a top coat to match the colour of the existing coating; and
— Place riprap on embankments for erosion protection.

PROPOSED MODIFICATIONS TO CONVERT BRIDGE TO MULTI-USE TRAIL

WSP’s Condition Survey Report included a list of modifications required to convert Black Bridge to a multi-use trail. Proposed modifications include:

— Construct new concrete footings on approaches, extending to ends of wingwalls, to support new cycle height railings;
— Install new cycle height railings on existing bridge curbs and new approach footings;
— Install cover plate over expansion joint at each end of bridge. Cover plate prevents edges of joint from becoming trip hazard to pedestrians and cyclists;
— Remove steel beam guide rails on approaches; and,
— Remove vehicular signage at each end of bridge.

CONCLUSION

Please do not hesitate to contact the undersigned should you have any questions regarding the proposed alterations to Black Bridge and accompanying Heritage Permit Application.

Yours sincerely,

Heidy Schopf, MES, CAHP
Cultural Heritage Team Lead
Email: heidy.schopf@wsp.com
Phone: 416-514-0145

Matthew Galloway, M.Eng., MICE, MIStructE, P.Eng.
Associate Bridge Engineer
Email: matthew.galloway@wsp.com
Phone: 905-220-6718
PERMIT SUBMISSION

END PORTAL FRAME - REHABILITATION DETAILS

SINGLE VERTICAL ANGLE IN REQUIRED

LEVEL HANG 4 REQUIRED

48
THE CITY OF CAMBRIDGE
BLACK BRIDGE ROAD BRIDGE
CONDITION SURVEY REPORT

DECEMBER 21, 2023

CONFIDENTIAL
BLACK BRIDGE ROAD BRIDGE

THE CITY OF CAMBRIDGE

CONDITION SURVEY REPORT
CONFIDENTIAL

PROJECT NO.: IM21106003
DATE: DECEMBER 21, 2023

WSP
3450 HARVESTER ROAD, SUITE 100
BURLINGTON, ON L7N 3W5
T: +1 (905) 335-2353
WSP.COM
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1 INTRODUCTION

WSP E&I Canada Limited (Formerly Wood Environment & Infrastructure Solutions) was retained by the City of Cambridge to complete the detailed design of a new bridge structure crossing the Speed River, a new alignment for Black Bridge Road, improvements to Townline Road, a new crossing of Irish Creek, and the reuse of the existing heritage truss bridge as part of a Multi-use Trail (MUT). As part of the scope of work detailed in the Agreement, an evaluation of the structural capacity of the existing heritage truss bridge to carry Multi-Use Trail loading has been carried out.

WSP has carried out a visual inspection, as well as a structural evaluation and analysis of the capacity of the existing structure. While recommendation for bridge rehabilitation was not explicitly included in the scope, WSP’s observations of structural defects and recommendations for necessary repairs have also been included in this report for consideration.

The purpose of this report is to present the findings of the evaluation of the remaining capacity of the bridge members and to recommend appropriate remedial action(s) to maintain its service until future rehabilitation and/or replacement occurs. The evaluation has been carried out in accordance with the Canadian Highway Bridge Design Code (CHBDC/CSA S6-19) and the MTO Guidelines for the Design of Pedestrian and Bicycle Bridges (Bridge Office Memo, 2007).

2 EXISTING STRUCTURE

The existing structure is a 35.7m long, single span Pratt type truss bridge constructed in 1916, crossing the Speed River. The span is supported by two concrete abutments, with rocker bearings at the east abutment and fixed bearings at the west abutment. The bridge consists of a single lane roadway, the total bridge width is 4.8m and deck width is 4.24m. The bridge was designed as a 152mm thick concrete deck supported by S250X38 longitudinal stringers and W460X97 transverse floor beams. There are existing L65X65X8 cross-bracings between the transverse floor beams, that were installed as part of a rehabilitation in 1995. The bridge has been substantially rehabilitated during its 100-year history. It is currently receiving excessive traffic for a single lane load posted bridge.

3 PAST REHABILITATION WORK

A major rehabilitation of the structure was completed in 1995. The work consisted of a concrete deck replacement, installation of new floor beams, rehabilitation of existing bearings, substructure rehabilitation, and steel recoating.

The end transverse trusses have been damaged multiple times by over-height trucks. Various transverse truss members have been repaired or replaced during minor rehabilitations in 2016 and 2022.

4 EXISTING CONDITIONS

4.1 CONCRETE DECK AND CURBS

The deck and curbs were found to be generally in good condition, with some hairline cracks and small concrete spalls observed. The sealant in front of the construction joint between deck and curb was observed to be loose in places. Ponding of water on the deck adjacent to the curb was observed at various locations.
4.2 DECK SOFFIT

The deck soffit was found to be generally in good condition. Hairline and narrow cracks with efflorescence deposits were observed on the soffit, mostly in line with the deck drains.

4.3 DECK DRAINS

The deck drains were found to be generally in good condition. Some corrosion was noted at the top of the drains where they are embedded into the deck.

4.4 STEEL TRUSSES

The steel trusses were found generally to be in good condition. Some minor section loss to steel members and rivets was noted near the base of the truss members. The areas of section loss have been coated over, indicating no new corrosion since the last time they were coated. The coating on the steel is just on the bottom of the truss members and has a brown top coat, and was found to be in good condition.

4.5 HAND RAILING ON BRIDGE

The steel handrail on the bridge consists of three horizontal rails connected back to the vertical and diagonal truss members. The handrail was found to be in fair condition. The ends of the rails are bent in places, one connection plate has become disconnected and the coating on the steel is showing deterioration.

4.6 STEEL FLOOR BEAMS, STRINGERS, AND BOTTOM BRACING

The steel floor beams, stringers, and bottom bracing were found generally to be in good condition. Small areas of corrosion were noted, mainly at the connections between the diagonal bracing and the floor beams. The coating on the steel has a grey top coat, and a white powdery deposit was observed on many of the members. This deposit may be zinc hydroxide, indicating a zinc-based coating, and the deposit would indicate some breakdown of the coating system.

4.7 EXPANSION JOINTS

The expansion joints are strip seal joints with asphaltic concrete dams. The expansion joints were found to be in good condition, but are filled with debris. No leakage was observed on the abutments below the joints.

4.8 BEARINGS

The bearings were found to be in good condition.

4.9 APPROACHES

The asphalt approaches were found to be in fair condition, with some transverse and longitudinal cracks and settlement at the edges of the asphalt pavement.
4.10 ABUTMENT WALLS AND WINGWALLS

The abutments and wingwalls are generally in fair condition. Cracks and spalls in the concrete were noted, mostly near the waterline and at locations where the subdrains from the embankments outlet. Cracks in the concrete were also noted along the lines of the anchor plates to the threadbars that tie the two wingwalls together.

4.11 CONCRETE RAILINGS ON APPROACHES AND STEEL BEAM GUIDE RAIL

There is a concrete two-beam railing on the northeast, northwest and southwest corners of the bridge. The concrete railing was found to be in fair condition with a spall observed on the northwest railing.

There is a short length of steel beam guiderail (SBGR) with timber posts on all four corners of the bridge. The SBGRs were found to be generally in good condition.

4.12 EMBANKMENTS, STREAMS, AND WATERWAYS

The bridge embankments at all four quadrants were found to be in fair condition. The embankments are set back from the abutments, indicating the bridge creates an obstruction to the flow of the river. There is minor erosion and loss of vegetation, especially on the east embankment.

The stream and waterway were found to be generally in good condition.

5 STRUCTURAL EVALUATION

A structural evaluation of the existing truss span was carried out in accordance with Clauses 14, 5 and 10 of the Canadian Highway Bridge Design Code (CHBDC/CSA S6-19).

For the purpose of the structural analysis of the bridge, the truss members were identified as shown in Figure 1.

![Figure 1: Truss Member Labelling Convention](image)

5.1 ANALYSIS SOFTWARE AND MODELLING OVERVIEW

Structural analysis of the truss span subjected to pedestrian loading was conducted to determine load effects acting on the truss members. 2D and 3D truss models were created using the structural analysis software “MIDAS Civil” for this purpose.
For the 2D model, pedestrian live loads, floor beam and stringer dead loads, wind loads, and snow loads were assigned to the model as concentrated loads on bottom chord nodes, representing the points where the truss connected to the transverse floor beams. In the 3D model, the loads were applied as distributed loads on the floor beams. The loads were computed using tributary areas of the floor beams and trusses. Section details and properties were modelled using approximations from available sections within MIDAS Civil, that closely resemble section details in real life. As such, the self-weight of the truss members was accounted for automatically by the program, using the volume and density of each element. The 3D model also had lateral loads applied to account for wind loads, and lateral compression effects on the top chord.

The following assumptions were made for evaluation and analysis:

- Batten plates and/or lacing were neglected when considering section properties, however it is assumed that their connections were sufficient to allow double channels or angles, connected by the battens or lacing, to act as a single member.
- No section loss was accounted for in the MIDAS model of the truss or for calculating self-weight loads. However, conservatively, a uniform section loss of 10% was assumed for all truss members within the splash zone when calculating their member capacities.

5.2 DESIGN LOADS & LOAD CASES

For the purpose of evaluation and analysis, the following material properties for truss steel were used:

- $F_y = 248$ MPa – samples of the steel were tested in a lab and confirmed to be minimum 36 ksi grade steel
- $F_u = 420$ MPa – as per CHBDC Cl. 14.7.4.2, Table 14.1
- \( E_s = 200,000 \text{ MPa} \)
- \( \gamma = 77 \text{ kN/m}^3 \)
- \( G_s = 77,000 \text{ MPa} \)

The load combinations and design loadings shown in Tables 1 and 2 respectively, were used in the analysis in accordance with Section 3 of CHBDC and the MTO guidelines for the Design of Pedestrian and Bicycle Bridges (Bridge Office Memo, Oct. 29, 2007).

**Table 1: Load Factors and Combinations**

<table>
<thead>
<tr>
<th>Load Combination</th>
<th>DL-D1</th>
<th>DL-D2</th>
<th>LL</th>
<th>SL</th>
<th>WL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS1</td>
<td>1.0</td>
<td>1.0</td>
<td>0.9</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>ULS1</td>
<td>1.1</td>
<td>1.2</td>
<td>1.7</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>ULS2</td>
<td>1.1</td>
<td>1.2</td>
<td>1.6</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>ULS3</td>
<td>1.1</td>
<td>1.2</td>
<td>1.4</td>
<td>0.5</td>
<td>0.45</td>
</tr>
<tr>
<td>ULS4</td>
<td>1.1</td>
<td>1.2</td>
<td>0.0</td>
<td>0.0</td>
<td>1.4</td>
</tr>
<tr>
<td>DL</td>
<td>1.1</td>
<td>1.2</td>
<td>0.0</td>
<td>1.5</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Table 2: Load Summary Table**

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Deck Int.</td>
<td>DL - D2</td>
</tr>
<tr>
<td>Concrete Deck End</td>
<td>DL - D2</td>
</tr>
<tr>
<td>Steel SW Interior</td>
<td>DL - D1</td>
</tr>
<tr>
<td>Steel SW Ends</td>
<td>DL - D1</td>
</tr>
<tr>
<td>Ped Loading Int.</td>
<td>LL</td>
</tr>
<tr>
<td>Ped. Loading End</td>
<td>LL</td>
</tr>
<tr>
<td>Snow Load Interior</td>
<td>SL</td>
</tr>
<tr>
<td>Snow Load Ends</td>
<td>SL</td>
</tr>
<tr>
<td>Wind Load</td>
<td>WL</td>
</tr>
<tr>
<td>Railing Load</td>
<td>SL-D1</td>
</tr>
<tr>
<td>Additional Lateral Load due to Compressive Load</td>
<td>DL/LL/SL/WL</td>
</tr>
</tbody>
</table>

It has been identified that the reactions from worst case maintenance vehicle are less than that from pedestrian live load, therefore the latter governs, and maintenance vehicle loads have been neglected for global effects. The load effects obtained from analysis were compared against member capacities, the following member capacities were calculated for the truss span:

- Tension capacity of tension members
- Compressive capacity of compression members
- Combined compressive load and moment for members which experience substantial moment i.e. end diagonals

### 5.3 ULTIMATE LIMIT STATE – TENSION MEMBERS

This assessment was conducted to evaluate the carrying capacity of tension members of the truss span in current condition under MUP bridge loading. A detailed analysis procedure was carried out for
each tensile load carrying member under ultimate limit state (ULS) conditions, in accordance with Cl. 10.5 and 10.8 of CSA S6-19. The following tensile capacity checks were conducted, and are detailed in the calculation sheet in Appendix B:

- Tensile capacity of gross section as per Cl. 10.5.7
- Tensile capacity of net section as per Cl. 10.8.1.3.1
- Bolt/rivet bearing capacity as per Cl. 14.7.4.6 and Cl. 10.18.2.3.3(a)
- Bolt/rivet shear capacity as per Cl. 14.14.1.4.2b and Cl. 10.5.7

The governing tensile capacity is taken as the minimum of the checks above. Table 3 below contains a summary of the capacity vs demand for tension members. The greater of the demands found between the 2D and 3D models was used to calculate the capacity/demand ratio.

<table>
<thead>
<tr>
<th>Truss Member</th>
<th>Number</th>
<th>Governing Case</th>
<th>Demand (kN)</th>
<th>Capacity (kN)</th>
<th>C/D</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom Chord - Ends</td>
<td>1, 2, 6, 7</td>
<td>ULS2</td>
<td>357</td>
<td>792</td>
<td>2.22 OK</td>
<td></td>
</tr>
<tr>
<td>Bottom Chord - Interior</td>
<td>3, 4, 5</td>
<td>ULS2</td>
<td>703</td>
<td>824</td>
<td>1.17 OK</td>
<td></td>
</tr>
<tr>
<td>End Verticals</td>
<td>14, 25</td>
<td>ULS2</td>
<td>147</td>
<td>321</td>
<td>2.18 OK</td>
<td></td>
</tr>
<tr>
<td>1st Interior Diagonal</td>
<td>15, 24</td>
<td>ULS3</td>
<td>421</td>
<td>589</td>
<td>1.40 OK</td>
<td></td>
</tr>
<tr>
<td>2nd Interior Diagonal</td>
<td>17, 22</td>
<td>ULS3</td>
<td>200</td>
<td>342</td>
<td>1.71 OK</td>
<td></td>
</tr>
<tr>
<td>Middle Interior Diagonal</td>
<td>19, 20</td>
<td>ULS2</td>
<td>16</td>
<td>259</td>
<td>17.47 OK</td>
<td></td>
</tr>
</tbody>
</table>

As presented in Table 3, all tension members possess adequate tensile capacity, with capacity over demand ratio C/D ≥ 1.0. Therefore, as per CSA S6-19, all truss tension members have sufficient tension capacity under the proposed pedestrian loading, and no remedial action is necessary at this time.

### 5.4 ULTIMATE LIMIT STATE – COMPRESSION MEMBERS

The carrying capacity of compression members under present conditions was computed in accordance with the requirements of Cl. 10.9 under ultimate limit states (ULS). The evaluation methodology for compression members is as follows:

- Section properties of compression members were calculated
- Section classification was calculated to determine required checks as per Cl. 10.9.2
- Flexural buckling capacity was computed in accordance with Cl. 10.9.3
- Flexural torsional buckling capacity was determined as per Cl. 10.9.3.2 for sections singly symmetric about the Y-axis. The CISC Torsional Section Properties Manual (CISC, 2002) was used to calculate torsional section properties required to determine Euler Buckling stresses induced by torsional effects.
- The governing compressive capacity was taken as the smallest of flexural buckling and flexural torsional buckling capacities.
- For flexural torsional buckling it was assumed that members behave like closed sections, due to the presence of the batten plates and lattice bars connecting together the angle sections and resulting in what is effectively a closed shape.

Table 4 below contains a summary of the capacity vs demand for the truss compression members. The greater of the demands found between the 2D and 3D models was used to calculate the capacity/demand ratio.
Table 4: Evaluation of Compression Members (Axial Effects Only)

<table>
<thead>
<tr>
<th>Truss Member</th>
<th>Number</th>
<th>Governing Case</th>
<th>Demand (kN)</th>
<th>Capacity (kN)</th>
<th>C/D</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Chord</td>
<td>8,9,10,11,12</td>
<td>ULS2</td>
<td>720</td>
<td>1132</td>
<td>1.78</td>
<td>OK</td>
</tr>
<tr>
<td>End Diagonals</td>
<td>13,26</td>
<td>ULS2</td>
<td>631</td>
<td>1009</td>
<td>1.54</td>
<td>OK</td>
</tr>
<tr>
<td>Interior Verticals</td>
<td>16,18,21,23</td>
<td>ULS3</td>
<td>176</td>
<td>487</td>
<td>2.77</td>
<td>OK</td>
</tr>
</tbody>
</table>

As per the results in Table 4, all compression members have sufficient compressive capacity, with capacity over demand ratio C/D ≥ 1.0 as per CSA S6-19 when considered only for compressive effects.

The end diagonal however has significant combined effects of compression and bending moment due to the lateral loads applied to the bridge and connected to the end diagonal through the end transverse truss. The end diagonal truss members were evaluated for the combined effects as per CSA S6-19 clause 10.9.4.1 (see below):

\[
\frac{C_f}{C_r} + \frac{U_1 M_{fX}}{M_{rx}} + \frac{U_1 M_{fY}}{M_{ry}} \leq 1.0
\]

Figure 4: S6-19 Clause 10.9.4.1 for Combined Load Effects

The table below summarizes the results of the evaluation of the end diagonal due to combined axial and bending load effects:

Table 5: End Diagonal for Combined Axial Compression & Bending

<table>
<thead>
<tr>
<th>Location in End Transverse Truss</th>
<th>Governing Case</th>
<th>(\frac{C_f}{C_r} + \frac{U_1 M_{fX}}{M_{rx}} + \frac{U_1 M_{fY}}{M_{ry}})</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>At Knee Brace</td>
<td>ULS4</td>
<td>1.49</td>
<td>NOT OK</td>
</tr>
<tr>
<td>Between bearing &amp; knee brace</td>
<td>ULS4</td>
<td>1.17</td>
<td>NOT OK</td>
</tr>
<tr>
<td>At bearing</td>
<td>ULS4</td>
<td>0.93</td>
<td>OK</td>
</tr>
</tbody>
</table>

Based on existing conditions, the end diagonal does not meet this requirement with a combined demand/capacity ratio of 1.49 at the worst location for the ULS4 load case, which exceeds the max 1.0 requirement. Therefore, strengthening of the end diagonal is required to accommodate the proposed design loading.

The strengthening works will include the welding of a plate along the channel web on each side of the section for the full length from top of bearing gusset plate to bottom of top chord gusset plate. Rivets in the top chord cover plate between the new brace and bottom angle of the transverse truss will also be replaced with ASTM A325 M20 bolts to allow for adequate shear transfer.

5.5 ULTIMATE LIMIT STATE – END TRANSVERSE TRUSS

The capacity of the end transverse truss members was evaluated against the load effects found in the 3D model. The table below summarizes the results:

Table 6: Evaluation of End Transverse Truss Members

<table>
<thead>
<tr>
<th>Truss Member</th>
<th>Governing Case</th>
<th>Demand (kN)</th>
<th>Capacity (kN)</th>
<th>C/D</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee Brace</td>
<td>ULS4</td>
<td>189</td>
<td>292</td>
<td>1.55</td>
<td>OK</td>
</tr>
</tbody>
</table>
Based on the results above, strengthening of the existing vertical single angle is required to accommodate the proposed design loading. Since the vertical single angle in the west portal frame was replaced with a new higher grade steel angle in 2022, only the east portal frame vertical angle requires strengthening. This will be done by adding an additional single vertical angle at the back face of existing.

5.6 FATIGUE LIMIT STATE

Crack initiation will generally occur at points of high stress concentration in welds and mechanical fasteners caused by the presence of a combination of external discontinuities, such as changes in geometry (deformations), and internal discontinuities such as porosities, slag inclusions, cold laps and similar defects. Crack propagation can prevail due to the application of cyclic loading, this phenomenon is a characteristic of fatigue damage. Structural fatigue could produce unstable cracks, which can impact the serviceability of a member and cause failure. Whether cracks will propagate depends on the applied stress range, the number of stress cycles and the class of the detail. There are two types of fatigue: 1) load induced fatigue primarily caused by principal stresses normally considered in design, and 2) distortion induced fatigue caused by secondary stresses due to end restraints and out-of-plane movements caused by forces induced in connected components such as diaphragms, bracing, etc.

It has been identified that the bottom chord truss members and the diagonal tension members are the main members that could have sustained fatigue damage throughout the life cycle of the bridge. This is the case since the aforementioned truss members are subjected to tension, which is the primary cause of concern in fatigue, as a small crack could propagate due to tensile stresses. For load induced fatigue, the fatigue prone details at this structure were identified and classified into the corresponding fatigue detail categories, in accordance with Cl. 10.17, Table 10.7 of CSA S6-19. The fatigue prone details identified at the Black Bridge Road Bridge are listed in Table 5.

Table 7: Fatigue Prone Details

<table>
<thead>
<tr>
<th>Fatigue Detail</th>
<th>Description</th>
<th>Fatigue Category</th>
<th>Member</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Truss bottom chord and diagonal members at gusset plates fastened by rivets</td>
<td>D</td>
<td>2, 3, 4, 5, 6, 15, 17, 19, 20, 22, 24</td>
</tr>
<tr>
<td>2</td>
<td>Truss bottom chord at gusset plates fastened by bolts</td>
<td>B</td>
<td>1, 7</td>
</tr>
</tbody>
</table>

5.6.1 FATIGUE CAPACITY CHECK

When members are subjected to high load induced stress ranges, it indicates that fatigue prone details could have accumulated enough fatigue damage to result in unstable cracks. The intent of evaluating a detail for fatigue is to minimize the probability of fatigue damage or eventual fatigue failure. Details that prove to have capacity against fatigue damage are called “fail-safe”. Given that many bridges were designed before fatigue became a major concern, many structures can’t be deemed “fail-safe”. To confirm safety of fatigue prone details of Black Bridge Road Bridge truss...
members, the demand stress range ($f_{sr}$) for every detail is checked against an “allowable” fatigue stress range ($F_{sr}$) computed as per Cl. 10.17.2.3.1 of CSA S6-19 and based on 200,000 stress cycle as per the recommendations of the MTO Guidelines for Design of Pedestrian and Bicycle Bridges (Bridge Office Memo, 2007). Table 6 below summarizes the fatigue capacity check conducted and the detailed fatigue calculations are available in Appendix B.

Table 8: Fatigue Capacity of Critical Details Under Pedestrian Loading

<table>
<thead>
<tr>
<th>Member</th>
<th>Fatigue Category</th>
<th>$F_{max}$</th>
<th>$F_{min}$</th>
<th>$F_{range}$</th>
<th>$A_g$</th>
<th>$A_{net}$</th>
<th>$f_{sr}$</th>
<th>$F_{sr}$</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,6 &amp; 7</td>
<td>B</td>
<td>116</td>
<td>0</td>
<td>116</td>
<td>3205</td>
<td>2749</td>
<td>42</td>
<td>270</td>
<td>OK</td>
</tr>
<tr>
<td>3, 4 &amp; 5</td>
<td>D</td>
<td>228</td>
<td>0</td>
<td>228</td>
<td>3980</td>
<td>2903</td>
<td>79</td>
<td>153</td>
<td>OK</td>
</tr>
<tr>
<td>14 &amp; 25</td>
<td>D</td>
<td>51</td>
<td>0</td>
<td>51</td>
<td>1885</td>
<td>1288</td>
<td>39</td>
<td>153</td>
<td>OK</td>
</tr>
<tr>
<td>15 &amp; 24</td>
<td>D</td>
<td>156</td>
<td>0</td>
<td>156</td>
<td>2969</td>
<td>2073</td>
<td>75</td>
<td>153</td>
<td>OK</td>
</tr>
<tr>
<td>17 &amp; 22</td>
<td>D</td>
<td>74</td>
<td>0</td>
<td>74</td>
<td>1689</td>
<td>1205</td>
<td>61</td>
<td>153</td>
<td>OK</td>
</tr>
<tr>
<td>19 &amp; 20</td>
<td>D</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>1397</td>
<td>913</td>
<td>5</td>
<td>153</td>
<td>OK</td>
</tr>
</tbody>
</table>

The findings indicate that all fatigue prone details possess adequate fatigue capacity under the proposed pedestrian loading. This implies that under pedestrian loading, the bridge has not reached the end of its fatigue life and it is unlikely that the fatigue prone details have sustained critical fatigue damage.

5.7 REMAINING FATIGUE LIFE CHECK

The longevity of the “fail-safe” assumption in fatigue prone details must be determined to estimate when a bridge might reach the end of its fatigue life. If a structure is deemed adequate in resisting fatigue stresses, throughout its life this capacity will eventually degrade, and it is essential to understand when it will lose its fatigue capacity. This is called remaining fatigue life evaluation, which can be expressed in terms of number of cycles, time until failure or inspection frequency. A screening tool has been established in Cl. 10.17.2.3.1, to determine whether a detail possesses an infinite remaining fatigue life, by comparing the load induced fatigue stress range ($f_{sr}$) with the threshold fatigue stress range ($F_{srt}$). If the load induced stress range is less than the fatigue threshold then the detail is of infinite fatigue life, and it is unlikely throughout the remaining life of the bridge that unstable cracks are produced, or fatigue failure is resulted at fatigue prone details. Table 7 below summarizes the findings of this check.

Table 9: Remaining Fatigue Life Check Under Pedestrian Loading

<table>
<thead>
<tr>
<th>Member</th>
<th>Fatigue Category</th>
<th>$f_{sr}$</th>
<th>$F_{srt}$</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,6 &amp; 7</td>
<td>B</td>
<td>42</td>
<td>110</td>
<td>Infinite Fatigue Life</td>
</tr>
<tr>
<td>3, 4 &amp; 5</td>
<td>D</td>
<td>79</td>
<td>48</td>
<td>Not Infinite Fatigue Life</td>
</tr>
<tr>
<td>14 &amp; 25</td>
<td>D</td>
<td>39</td>
<td>48</td>
<td>Infinite Fatigue Life</td>
</tr>
<tr>
<td>15 &amp; 24</td>
<td>D</td>
<td>75</td>
<td>48</td>
<td>Not Infinite Fatigue Life</td>
</tr>
<tr>
<td>17 &amp; 22</td>
<td>D</td>
<td>61</td>
<td>48</td>
<td>Not Infinite Fatigue Life</td>
</tr>
<tr>
<td>19 &amp; 20</td>
<td>D</td>
<td>5</td>
<td>48</td>
<td>Infinite Fatigue Life</td>
</tr>
</tbody>
</table>

As stipulated in the table above, bottom chord members 3,4,5 and diagonals 15,24,17,22 do not pass this check, therefore, they do not have an infinite remaining fatigue life, further analysis is required to estimate the remaining fatigue life of these members and to confirm that the bridge has not reached the end of its fatigue life.

The remaining fatigue life of the aforementioned members has been estimated using the AASTHO Manual for Bridge Evaluation (AASHTO MBE, 2008) Article 7.2. The following parameters and assumptions were used for the computation of the remaining fatigue life:
• Minimum life constant, \( R_R = 1.0 \) as per Table 7.2.5.2.1
• Fatigue life constant for CAT D, \( A = 2.20 \times 10^9 \) Ksi as per Table 6.6.1.2
• Assumed growth rate, \( g = 2\% \)
• Assumed stress cycles per truck, \( n = 1 \)
• Age of bridge, \( a = 107 \) years
• ADTT assumption to represent truck usage throughout bridge life, \( \text{ADTT} = 100 \) (AADT is 2000, assuming 5% of traffic is trucks, \( \text{ADTT} = 100 \))

Table 8 below summarizes the findings of this assessment, please refer to the calculation sheet in Appendix B for the detailed evaluation steps.

### Table 10: Estimation of Remaining Fatigue Life (Vehicular Loading)

<table>
<thead>
<tr>
<th>Member</th>
<th>Fatigue Category</th>
<th>( f_{cr} )</th>
<th>( Y_{rem} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 4 &amp; 5</td>
<td>D</td>
<td>11</td>
<td>103 Years</td>
</tr>
<tr>
<td>15 &amp; 24</td>
<td>D</td>
<td>6</td>
<td>202 Years</td>
</tr>
<tr>
<td>17 &amp; 22</td>
<td>D</td>
<td>11</td>
<td>109 Years</td>
</tr>
</tbody>
</table>

Based on the assessment above, the remaining fatigue life of the Black Bridge Road Bridge is approximately 103 years, based on the worst-case member and assuming that vehicular loading continues. This estimate is based on approximations of historical truck loading, accurate information regarding historical loading and stress histograms, which is needed for a detailed fatigue assessment is not available at the time of this evaluation.

Since the bridge will be closed to vehicular traffic in 2024, loading will not continue at the rate of 100 trucks/day. Based on the MTO guidelines to assume 200,000 fatigue cycles for the lifespan of the bridge, and assuming a typical 100 year design life, we can anticipate a similar fatigue life once the bridge loading is changed from vehicular traffic to a multi-use path bridge. We anticipate that the fatigue life will outlive the remaining service life of the bridge.

### 5.8 SERVICEABILITY LIMIT STATE

#### 5.8.1 DEFLECTION

As per the Bridge Office Guidelines for the Design of Pedestrian and Bicycle Bridges (Bridge Office Memo, Oct. 29, 2007), the following deflection limits shall be satisfied for a truss bridge:

• The maximum deflection, at the Serviceability Limit State, due to the pedestrian live load does not exceed 1/600 of the span.

• The horizontal deflection, due to lateral wind load and using a service load factor of 1.0, shall not exceed 1/600 of the length of the span.

<table>
<thead>
<tr>
<th>Load Case</th>
<th>Max. Deflection</th>
<th>Span/600</th>
<th>Deflection Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS 1</td>
<td>27</td>
<td>58.25</td>
<td>OK</td>
</tr>
<tr>
<td>Ped. LL only</td>
<td>8</td>
<td>58.25</td>
<td>OK</td>
</tr>
<tr>
<td>Ped. LL + Vert W.L.</td>
<td>9</td>
<td>58.25</td>
<td>OK</td>
</tr>
</tbody>
</table>

The horizontal deflections were also calculated with the 3D truss.
Table 12: Horizontal Deflection of Truss

<table>
<thead>
<tr>
<th>Load Case</th>
<th>Max. Deflection</th>
<th>Span/600</th>
<th>Deflection Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS 1</td>
<td>5</td>
<td>58.25</td>
<td>OK</td>
</tr>
<tr>
<td>Ped. LL only</td>
<td>1</td>
<td>58.25</td>
<td>OK</td>
</tr>
<tr>
<td>Ped. LL + W.L.</td>
<td>2</td>
<td>58.25</td>
<td>OK</td>
</tr>
</tbody>
</table>

5.9 CONCLUSION OF STRUCTURAL EVALUATION

A structural evaluation of the existing truss spans was carried out in accordance with Clauses 14, 5 and 10 of the Canadian Highway Bridge Design Code (CHBDC/CSA S6-19). In order to carry out the evaluation, 2D and 3D truss models were created using the structural analysis software "MIDAS Civil".

Using these models, design checks were carried out at Ultimate Limit State (ULS), Fatigue Limit State (FLS) and Serviceability Limit State (SLS).

Generally the structural evaluation found the existing bridge to have sufficient capacity to support pedestrian traffic and maintenance vehicles, in accordance with the requirements of the Canadian Highway Bridge Design Code (CHBDC). Strengthening of the end vertical diagonal members, and the vertical single angle in the end transverse truss is required to accommodate the proposed loading.

6 PROPOSED REHABILITATION WORK

6.1 STRUCTURAL REHABILITATION

Based on the results of the visual inspection, and structural evaluation, the following minor rehabilitation is recommended to repair the current structural defects and to strengthen the truss:

- Remove deteriorated concrete from abutments and wingwalls and deck;
- Patch repair abutments and wingwalls and deck;
- Remove deteriorated concrete from concrete railings on approaches;
- Patch repair concrete railings on approaches;
- Seal cracks wider than 0.5mm in deck, deck soffit, abutment and wingwalls, by injecting with epoxy;
- Abrasive blast clean deck surface and apply migratory corrosion inhibitor, comprising a silane sealer and an organic corrosion inhibitor;
- Locally power tool clean corroded areas of structural steel on underside of deck and coat areas with a two coats of a zinc rich primer;
- Replace existing expansion joints with new Wabo Transflex joint;
- Strengthen end diagonal by welding an additional plate to each web of the member. Replace rivets on end diagonal cover plate between knee brace and transverse truss with high strength bolts;
- Add additional single vertical angles to the east end transverse truss; and,
- Place riprap on embankments for erosion protection.
6.2 MODIFICATIONS TO CONVERT BRIDGE TO MULTI-USE TRAIL

The structure is to be converted from a vehicular bridge to a bridge for a multi-use trail. The following modifications to the bridge are proposed in order to facilitate this change:

- Construct new concrete footings on approaches, extending to ends of wingwalls, to support new cycle height railings;
- Install new cycle height railings on existing bridge curbs and new approach footings;
- Remove steel beam guide rails on approaches; and
- Remove vehicular signage at each end of bridge.

For details of the proposed cycle height railings for the bridge, please refer to ‘Architectural Report – Railing Options’ by WSP (formerly Wood).

7 SUMMARY

WSP has carried out a visual inspection and a structural evaluation of the existing structure. The structural evaluation found the existing bridge to mostly have sufficient capacity to support pedestrian traffic and maintenance vehicles, in accordance with the requirements of the Canadian Highway Bridge Design Code (CHBDC). There are two areas of the bridge where localized strengthening repairs will be required, and these are the end diagonals of the main vertical trusses, and the intermediate vertical members of the end lateral trusses which connect to the knee braces. WSP also recommends a minor rehabilitation to the bridge to address defects that were observed. These include patch repairs to abutments, wingwalls and concrete railings, sealing of cracks with epoxy, and cleaning and coating areas of corrosion on the steelwork.

In order to convert the structure from a vehicular bridge to a multi-use trail, WSP proposes modifications that include replacing the concrete curbs, installing a new cycle height railing on the bridge and approaches, and removing the existing steel beam guide rails and signage.
8 CLOSURE

We trust that this report is adequate for your purposes. If you have any questions or concerns, please feel free to contact the undersigned at your convenience.

Sincerely,

WSP E&I Canada Limited

Bridge Engineer

Associate Bridge Engineer
Asphalt wearing surface on approach – note longitudinal and transverse cracks

North bridge elevation – note spall in concrete railing on approach
South bridge elevation – note leaching at joint between curb and deck

Bridge deck – note ponding
Bridge deck – note spall

Expansion joint – note that joint is filled with debris
Steel truss member – note some section loss

Steel truss member – note pitting of steel angle and rivet
Railing on bridge – note deterioration of coating

Bridge railing – note damage to ends of rails
Bridge soffit – note crack with efflorescence and corrosion of top of deck drain

Bottom bracing members and stringers – note white sediment deposit on coating
Floor beams and bottom bracing – note corrosion on gusset plate

East abutment – note spall at waterline
Northwest wingwall – note crack between anchor heads of tie-rods

Northwest corner of abutment – note spall near to outlet of subdrain
1. DESIGN INPUT

Calcs Prepared by:  Nathan Kranendonk / Sam Alhasan
Calcs Reviewed by:  Matthew Galloway

1.1 Bridge Data

<table>
<thead>
<tr>
<th>Bridge Name</th>
<th>Blackbridge Rd. Truss Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span Length</td>
<td>34950 mm</td>
</tr>
<tr>
<td>Deck Width</td>
<td>4300 mm</td>
</tr>
<tr>
<td>Inside Deck Width</td>
<td>3900 mm</td>
</tr>
<tr>
<td>Deck Thick. - Final</td>
<td>180 mm</td>
</tr>
<tr>
<td>Deck Thick. - Ex.</td>
<td>180 mm</td>
</tr>
<tr>
<td>Truss CL to CL</td>
<td>4774 mm</td>
</tr>
<tr>
<td>Ext. Stringers CL to CL</td>
<td>4012 mm</td>
</tr>
<tr>
<td>Skew</td>
<td>0 degrees</td>
</tr>
<tr>
<td>Number of Trusses</td>
<td>2</td>
</tr>
<tr>
<td>Floor Beam Spacing</td>
<td>4993 mm ave.</td>
</tr>
</tbody>
</table>

1.2 Material Properties

<table>
<thead>
<tr>
<th>Material Type</th>
<th>F_y</th>
<th>Fu</th>
<th>Es</th>
<th>γ</th>
<th>Gs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truss Steel</td>
<td>248</td>
<td>420</td>
<td>200000</td>
<td>77</td>
<td>77000</td>
</tr>
<tr>
<td>New Structural Steel</td>
<td>350</td>
<td>450</td>
<td>200000</td>
<td>77</td>
<td>77000</td>
</tr>
</tbody>
</table>

Assuming minimum 36 ksi steel
Tested capacity was 45.4 ksi
Black Bridge Rd. Truss Bridge
Section A - Design Input

<table>
<thead>
<tr>
<th>Gs</th>
<th>77000 MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Deck</td>
<td>f’c</td>
</tr>
<tr>
<td>γc</td>
<td>24 kN/m3</td>
</tr>
</tbody>
</table>

1.3 Evaluation Approach

- The truss was modelled in Midas in both a 2D and 3D model. All section properties were based off measured or assumed dimensions (see B-Section Capacity).
- Batten plates and/or lacing was neglected when considering section properties, it is assumed that they allowed tied channels or angles to act as a single member. DL factor was increased to allow for some additional load.
- For ex. members within splash zone, a uniform section loss of 10% has been assumed.

1.4 Truss Member Labelling Convention

1.4 Section Geometry

**Truss Bottom Chord (Outside)**
Member Nos. 1, 2, 6, 7
2-angles - c/w lacing

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>102</td>
<td>0</td>
<td>102 mm</td>
</tr>
<tr>
<td>w</td>
<td>9.5</td>
<td>0</td>
<td>9.5 mm</td>
</tr>
<tr>
<td>b</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
<tr>
<td>t</td>
<td>9.5</td>
<td>0</td>
<td>9.5 mm</td>
</tr>
<tr>
<td>c</td>
<td>50.8</td>
<td>0</td>
<td>50.8 mm</td>
</tr>
<tr>
<td>Area</td>
<td>3205.3 mm²</td>
<td>3205.3 mm²</td>
<td></td>
</tr>
</tbody>
</table>

**Truss Bottom Chord (Interior)**
Member Nos. 3, 4, 5
2-angles - c/w battens (ignore)

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>152.4</td>
<td>0</td>
<td>152.4 mm</td>
</tr>
<tr>
<td>w</td>
<td>9.5</td>
<td>0.1</td>
<td>8.55 mm</td>
</tr>
</tbody>
</table>
Black Bridge Rd. Truss Bridge
Section A - Design Input

<table>
<thead>
<tr>
<th>d/w</th>
<th>d/w</th>
</tr>
</thead>
<tbody>
<tr>
<td>b/t</td>
<td>b/t</td>
</tr>
</tbody>
</table>

| b  | 88.9 | 0   | 88.9 mm |
| t  | 9.5  | 0.1 | 8.55 mm |
| c  | 25.4 | 0   | 25.4 mm |

Area 4404.2 3980.025 mm²

Truss End Vertical
Member Nos. 14, 25
2-angles - c/w lacing

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
<tr>
<td>w</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>b</td>
<td>63.5</td>
<td>0</td>
<td>63.5 mm</td>
</tr>
<tr>
<td>t</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>c</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
</tbody>
</table>

Area 2082.44 1885.43 mm²

Truss 1st Internal Diagonals
Member Nos. 15, 24
2-angles - c/w battens

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>127</td>
<td>0</td>
<td>127 mm</td>
</tr>
<tr>
<td>w</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>b</td>
<td>88.9</td>
<td>0</td>
<td>88.9 mm</td>
</tr>
<tr>
<td>t</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>c</td>
<td>25.4</td>
<td>0</td>
<td>25.4 mm</td>
</tr>
</tbody>
</table>

Area 3286.4 2968.994 mm²

Truss 2nd Internal Diagonals
Member Nos. 17, 22
2-angles - c/w battens

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
<tr>
<td>w</td>
<td>6.4</td>
<td>0.1</td>
<td>5.76 mm</td>
</tr>
<tr>
<td>b</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
<tr>
<td>t</td>
<td>6.4</td>
<td>0.1</td>
<td>5.76 mm</td>
</tr>
<tr>
<td>c</td>
<td>50.8</td>
<td>0</td>
<td>50.8 mm</td>
</tr>
</tbody>
</table>

Area 1868.8 1689.293 mm²

Truss Middle Internal Cross Diagonals
Member Nos. 19, 20
2-angles - c/w battens

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>63.5</td>
<td>0</td>
<td>63.5 mm</td>
</tr>
<tr>
<td>w</td>
<td>6.4</td>
<td>0.1</td>
<td>5.76 mm</td>
</tr>
<tr>
<td>b</td>
<td>63.5</td>
<td>0</td>
<td>63.5 mm</td>
</tr>
<tr>
<td>t</td>
<td>6.4</td>
<td>0.1</td>
<td>5.76 mm</td>
</tr>
<tr>
<td>c</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
</tbody>
</table>
### Black Bridge Rd. Truss Bridge
### Section A - Design Input

| Area | 1543.68 | 1396.685 mm² |

#### Truss Top Chord
Member Nos. 8, 9, 10, 11, 12
2-channels - c/w lacing bottom and cover plate top

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b_t$</td>
<td>355.6</td>
<td>0</td>
<td>355.6 mm</td>
</tr>
<tr>
<td>$t_t$</td>
<td>7.9</td>
<td>0</td>
<td>7.9 mm</td>
</tr>
<tr>
<td>$b_c$</td>
<td>57.2</td>
<td>0</td>
<td>57.2 mm</td>
</tr>
<tr>
<td>$t_c$</td>
<td>9.5</td>
<td>0</td>
<td>9.5 mm</td>
</tr>
<tr>
<td>$s$</td>
<td>222.2</td>
<td>0</td>
<td>222.2 mm</td>
</tr>
<tr>
<td>$d_c$</td>
<td>203.2</td>
<td>0</td>
<td>203.2 mm</td>
</tr>
<tr>
<td>$w_c$</td>
<td>6.4</td>
<td>0</td>
<td>6.4 mm</td>
</tr>
<tr>
<td>$h_c$</td>
<td>184.2</td>
<td>0</td>
<td>184.2 mm</td>
</tr>
<tr>
<td>$b_b$</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>$t_b$</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
</tbody>
</table>

| Area    | 7340.6   | 7340.6 mm² |

#### Truss End Diagonals
Member Nos. 13, 26
2-channels - c/w lacing bottom and cover plate top

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b_t$</td>
<td>355.6</td>
<td>0</td>
<td>355.6 mm</td>
</tr>
<tr>
<td>$t_t$</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>$b_c$</td>
<td>60.3</td>
<td>0</td>
<td>60.3 mm</td>
</tr>
<tr>
<td>$t_c$</td>
<td>9.5</td>
<td>0.1</td>
<td>8.55 mm</td>
</tr>
<tr>
<td>$s$</td>
<td>222.2</td>
<td>0</td>
<td>222.2 mm</td>
</tr>
<tr>
<td>$d_c$</td>
<td>203.2</td>
<td>0</td>
<td>203.2 mm</td>
</tr>
<tr>
<td>$w_c$</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>$h_c$</td>
<td>184.2</td>
<td>0</td>
<td>184.2 mm</td>
</tr>
<tr>
<td>$b_b$</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>$t_b$</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
</tbody>
</table>

| Area    | 8011     | 7209.9 mm² |

#### Truss Inner Verticals
Member Nos. 16, 18, 21, 23
2-channels - c/w lacing both sides

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b_t$</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>$t_t$</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>$b_c$</td>
<td>60.3</td>
<td>0</td>
<td>60.3 mm</td>
</tr>
<tr>
<td>$t_c$</td>
<td>9.5</td>
<td>0.1</td>
<td>8.55 mm</td>
</tr>
</tbody>
</table>
## Black Bridge Rd. Truss Bridge
### Section A - Design Input

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( s )</td>
<td>82.6 mm</td>
<td>0 mm</td>
<td>82.6 mm</td>
<td>0 mm</td>
</tr>
<tr>
<td>( d_c )</td>
<td>203.2 mm</td>
<td>0 mm</td>
<td>203.2 mm</td>
<td>0 mm</td>
</tr>
<tr>
<td>( w_c )</td>
<td>7.9 mm</td>
<td>0.1 mm</td>
<td>7.11 mm</td>
<td>0.1 mm</td>
</tr>
<tr>
<td>( h_c )</td>
<td>184.2 mm</td>
<td>0 mm</td>
<td>184.2 mm</td>
<td>0 mm</td>
</tr>
<tr>
<td>( b_b )</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
</tr>
<tr>
<td>( t_b )</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
</tr>
</tbody>
</table>

| Area      | 5201.76 mm² | 4681.584 mm² |

### Floor Beams

#### Interior
- Geometry:
  - \( d \): 466 mm
  - \( b \): 193 mm
  - \( t \): 19 mm
  - \( w \): 11.4 mm

| TOTAL Area | 12300 mm² |

#### Ends
- Geometry:
  - \( d \): 347 mm
  - \( b \): 203 mm
  - \( t \): 13.5 mm
  - \( w \): 7.7 mm

| TOTAL Area | 8130 mm² |

### Stringers
- Geometry:
  - \( d \): 254 mm
  - \( b \): 118 mm
  - \( t \): 12.5 mm
  - \( w \): 7.9 mm

| TOTAL Area | 4810 mm² |
2.1 TENSION MEMBERS

2.1.1 Truss Bottom Chord (Outside)

Member Nos. 1, 2, 6, 7
2-angles - c/w lacing

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>102</td>
<td>0</td>
<td>102 mm</td>
</tr>
<tr>
<td>h</td>
<td>92.5</td>
<td>0</td>
<td>92.5 mm</td>
</tr>
<tr>
<td>w</td>
<td>9.5</td>
<td>0</td>
<td>9.5 mm</td>
</tr>
<tr>
<td>b</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
<tr>
<td>t</td>
<td>9.5</td>
<td>0</td>
<td>9.5 mm</td>
</tr>
<tr>
<td>c</td>
<td>50.8</td>
<td>0</td>
<td>50.8 mm</td>
</tr>
</tbody>
</table>

Area: 3205.3 mm²

a). Section Properties

About Major-Axis (X in capacity calcs, Y in Midas) \( Y_{bot} = 28 \) mm

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>( Y_{bot} ) (mm)</th>
<th>( A^*Y_{bot} ) (mm³)</th>
<th>( A^*(Y_{bot}-Y_{bot})^2 ) (mm⁶)</th>
<th>( I_o ) (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>1758</td>
<td>56</td>
<td>97981</td>
<td>1402109</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>1448</td>
<td>5</td>
<td>6877</td>
<td>749649</td>
</tr>
<tr>
<td>Sum</td>
<td>3205</td>
<td></td>
<td>2151758</td>
<td></td>
</tr>
</tbody>
</table>

\[ I = 3.42E+06 \text{ mm}^4 \]
\[ r = 33 \text{ mm}^3 \]
\[ As = 1206.5 \text{ mm}^2 \]

About Minor-Axis (Y in capacity calcs, Z in Midas) \( X_{left} = 102 \) mm

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>( X_{CL} ) (mm)</th>
<th>( A^*X_{CL} ) (mm³)</th>
<th>( A^*X_{CL}^2 ) (mm⁶)</th>
<th>( I_o ) (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>1758</td>
<td>97</td>
<td>170214</td>
<td>16485214</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>1448</td>
<td>64</td>
<td>91935</td>
<td>5837892</td>
</tr>
<tr>
<td>Sum</td>
<td>3205</td>
<td></td>
<td>22323105</td>
<td></td>
</tr>
</tbody>
</table>

\[ I = 2.30E+07 \text{ mm}^4 \]
\[ r = 85 \text{ mm}^3 \]
\[ As = 1465 \text{ mm}^2 \]

Torsional Resistance

\[ \text{sum of } bt^3/3 \text{ for section} \]
\[ I_{xx} = 9.64E+04 \text{ mm}^4 \]

Summary Table for Midas Section Properties*

| \( I_{yy} \) | 3.42E+06 mm⁴ | Area | 3205 mm² |
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th>Izz</th>
<th>2.30E+07 mm⁴</th>
<th>Asy</th>
<th>1206.5 mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxx</td>
<td>9.64E+04 mm⁴</td>
<td>Asz</td>
<td>1465 mm²</td>
</tr>
</tbody>
</table>

a) Gross Section

<table>
<thead>
<tr>
<th>Ag</th>
<th>3205.3 mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>φs</td>
<td>0.95</td>
</tr>
<tr>
<td>Fy</td>
<td>350 Mpa</td>
</tr>
<tr>
<td>Tr</td>
<td>1065.76 kN</td>
</tr>
</tbody>
</table>

*these members were replaced after 2003

b) Net Tension

<table>
<thead>
<tr>
<th>d</th>
<th>24 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>An</td>
<td>2749.3 mm²</td>
</tr>
<tr>
<td>φu</td>
<td>0.80</td>
</tr>
<tr>
<td>Ane</td>
<td>2199.44 mm²</td>
</tr>
<tr>
<td>Fu</td>
<td>450 Mpa</td>
</tr>
<tr>
<td>Tr</td>
<td>791.80 kN</td>
</tr>
</tbody>
</table>

*c* assume 22M bolts + 2mm

<table>
<thead>
<tr>
<th>φbr</th>
<th>0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>12 bolts</td>
</tr>
<tr>
<td>t</td>
<td>9.5</td>
</tr>
<tr>
<td>d</td>
<td>24 mm</td>
</tr>
<tr>
<td>Fu</td>
<td>450 Mpa</td>
</tr>
<tr>
<td>Br</td>
<td>2954.88 kN</td>
</tr>
</tbody>
</table>

*at bearing side

*c* assume M22 bolts put back

New structural steel

c) bolts in bearing

*d* this connection is bolted as it was recently replaced

d) Bolts in shear

<table>
<thead>
<tr>
<th>φb</th>
<th>0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>12 bolts</td>
</tr>
<tr>
<td>m</td>
<td>1 faces</td>
</tr>
<tr>
<td>Ab</td>
<td>380 mm²</td>
</tr>
<tr>
<td>Fu</td>
<td>825 MPa</td>
</tr>
<tr>
<td>Vr</td>
<td>1805.76 kN</td>
</tr>
</tbody>
</table>

*at bearing side

e) Governing Capacity

| Tr        | 791.80 kN   |

2.1.2 Truss Bottom Chord (Interior)

Member Nos. 3, 4, 5
2-angles - c/w battens (ignore)

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
</table>

851
### Section B - Section Capacity

<table>
<thead>
<tr>
<th>d</th>
<th>152.4</th>
<th>0</th>
<th>152.4 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>h</td>
<td>142.9</td>
<td>0</td>
<td>142.9 mm</td>
</tr>
<tr>
<td>w</td>
<td>9.5</td>
<td>0.1</td>
<td>8.55 mm</td>
</tr>
<tr>
<td>b</td>
<td>88.9</td>
<td>0</td>
<td>88.9 mm</td>
</tr>
<tr>
<td>t</td>
<td>9.5</td>
<td>0.1</td>
<td>8.55 mm</td>
</tr>
<tr>
<td>c</td>
<td>25.4</td>
<td>0</td>
<td>25.4 mm</td>
</tr>
</tbody>
</table>

**Area**

|          | 4404.2 | 3963.78 mm² |

### a). Section Properties

#### About Major-Axis (X in capacity calcs, Y in Midas)

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>(Y_{\text{bot}}) (mm)</th>
<th>(A^{*}Y_{\text{bot}}) (mm³)</th>
<th>(A^{*}(Y_{\text{bot}}-y_{\text{bot}})^{2}) (mm⁴)</th>
<th>(I_{o}) (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>2444</td>
<td>80</td>
<td>195487</td>
<td>2877035</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>1520</td>
<td>4</td>
<td>6499</td>
<td>2607059</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>3964</td>
<td></td>
<td>5484093</td>
<td>4167520</td>
</tr>
</tbody>
</table>

\[ I = 9.65 \times 10^6 \text{ mm}^4 \]

\[ r = 49 \text{ mm}^3 \]

\[ As = 1407.5833 \text{ mm}^2 \]

#### About Minor-Axis (Y in capacity calcs, Z in Midas)

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>(X_{\text{CL}}) (mm)</th>
<th>(A^{*}X_{\text{CL}}) (mm³)</th>
<th>(A^{*}X_{\text{CL}}^{2}) (mm⁴)</th>
<th>(I_{o}) (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>2444</td>
<td>97</td>
<td>237822</td>
<td>23146065</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>1520</td>
<td>57</td>
<td>86879</td>
<td>4965127</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>3964</td>
<td></td>
<td>2811192</td>
<td>1016084</td>
</tr>
</tbody>
</table>

\[ I = 2.91 \times 10^7 \text{ mm}^4 \]

\[ r = 86 \text{ mm}^3 \]

\[ As = 2036 \text{ mm}^2 \]

#### Torsional Resistance

\[ \text{sum of bt}^3/3 \text{ for section} \]

\[ I_{xx} = 9.66 \times 10^4 \text{ mm}^4 \]

### Summary Table for Midas Section Properties*

| \(I_{yy}\) | 9.65 \times 10^6 \text{ mm}^4 | **Area** | 3964 \text{ mm}² |
| \(I_{zz}\) | 2.91 \times 10^7 \text{ mm}^4 | **Asy** | 1407.5833 \text{ mm}² |
| \(I_{xx}\) | 9.66 \times 10^4 \text{ mm}^4 | **Asz** | 2036 \text{ mm}² |

### a) Gross Section

| \(A_g\) | 3963.78 \text{ mm}² |
| \(\phi_s\) | 0.95 |

---

*Values obtained via Midas software for structural analysis.*

---

**Angle Vert Leg**

\[ 23146065 \times 14886 \]

\[ 2811192 \times 1016084 \]

**Angle Horiz. Leg**

\[ 4965127 \times 1001198 \]

**Sum**

\[ 2811192 \times 1016084 \]

---

**10.5.7**

---

861
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

Table 14.1

<table>
<thead>
<tr>
<th>Fy</th>
<th>248 Mpa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tr</td>
<td>933.87 kN</td>
</tr>
</tbody>
</table>

10.8.2

b) Net Tension

<table>
<thead>
<tr>
<th>d</th>
<th>21 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>An</td>
<td>2886.48 mm²</td>
</tr>
<tr>
<td>φu</td>
<td>0.80</td>
</tr>
<tr>
<td>Ane</td>
<td>2453.508 mm²</td>
</tr>
<tr>
<td>Fu</td>
<td>420 Mpa</td>
</tr>
<tr>
<td>Tr</td>
<td>824.38 kN</td>
</tr>
</tbody>
</table>

10.8.1.3.1 10.5.7 10.8.1.3.2.2 10.8.2

c) Rivets in bearing

<table>
<thead>
<tr>
<th>φmc</th>
<th>0.67</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>8.55</td>
</tr>
<tr>
<td>d</td>
<td>21 mm</td>
</tr>
<tr>
<td>n</td>
<td>19 rivets</td>
</tr>
<tr>
<td>e</td>
<td>35 mm</td>
</tr>
<tr>
<td>Fu</td>
<td>320 Mpa</td>
</tr>
<tr>
<td>Br</td>
<td>1219.025 kN</td>
</tr>
</tbody>
</table>

14.14.1.4.2 a 14.7.4.6

d) Rivets in shear

<table>
<thead>
<tr>
<th>φr</th>
<th>0.67</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>19 rivets</td>
</tr>
<tr>
<td>m</td>
<td>1</td>
</tr>
<tr>
<td>Ar</td>
<td>285 mm²</td>
</tr>
<tr>
<td>Fu</td>
<td>320 Mpa</td>
</tr>
<tr>
<td>Vr</td>
<td>870.732 kN</td>
</tr>
</tbody>
</table>

14.14.1.4.2 b

e) Governing Capacity

| Tr  | 824.38 kN |

2.1.3 Truss End Vertical

Member Nos. 14, 25
2-angles - c/w lacing

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
<tr>
<td>h</td>
<td>68.3</td>
<td>0</td>
<td>68.3 mm</td>
</tr>
<tr>
<td>w</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>b</td>
<td>63.5</td>
<td>0</td>
<td>63.5 mm</td>
</tr>
<tr>
<td>t</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>c</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
</tbody>
</table>

Area          | 2082.44   | 1874.196  mm² |
a). Section Properties

**About Major-Axis (X in capacity calcs, Y in Midas)**

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>$Y_{bot}$ (mm)</th>
<th>$A\times Y_{bot}$ (mm³)</th>
<th>$A\times (Y_{bot} - Y_{bot})^2$ (mm⁴)</th>
<th>$I_o$ (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>971</td>
<td>41</td>
<td>40073</td>
<td>463701</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>903</td>
<td>4</td>
<td>3210</td>
<td>226979</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>1874</strong></td>
<td></td>
<td></td>
<td><strong>690680</strong></td>
</tr>
</tbody>
</table>

\[
I = 1.07E+06 \text{ mm}^4
\]

\[
r = 24 \text{ mm}^3
\]

\[
As = 836.08333 \text{ mm}^2
\]

**About Minor-Axis (Y in capacity calcs, Z in Midas)**

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>$X_{CL}$ (mm)</th>
<th>$A\times X_{CL}$ (mm³)</th>
<th>$A\times X_{CL}^2$ (mm⁴)</th>
<th>$I_o$ (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>971</td>
<td>98</td>
<td>95224</td>
<td>9336223</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>903</td>
<td>70</td>
<td>63072</td>
<td>4405611</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>1874</strong></td>
<td></td>
<td></td>
<td><strong>13741834</strong></td>
</tr>
</tbody>
</table>

\[
I = 1.40E+07 \text{ mm}^4
\]

\[
r = 87 \text{ mm}^3
\]

\[
As = 809 \text{ mm}^2
\]

**Torsional Resistance**

\[
\text{sum of } bt^3/3 \text{ for section } I_{xx} = 3.16E+04 \text{ mm}^4
\]

**Summary Table for Midas Section Properties**

<table>
<thead>
<tr>
<th>$I_{yy}$ (mm⁴)</th>
<th>Area (mm²)</th>
<th>$I_{zz}$ (mm⁴)</th>
<th>$I_{xx}$ (mm⁴)</th>
<th>Area (mm²)</th>
<th>$I_{xx}$ (mm⁴)</th>
<th>$I_{xx}$ (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.07E+06$</td>
<td>1874</td>
<td>$1.40E+07$</td>
<td>836.08333</td>
<td>mm²</td>
<td>$3.16E+04$</td>
<td>809</td>
</tr>
</tbody>
</table>

**a) Gross Section**

| $A_g$ | 1874.196 mm² |
| $\phi_s$ | 0.95 |
| $F_{y}$ | 248 Mpa |
| $T_r$ | 441.56 kN |

**b) Net Tension**

| $d$ | 21 mm |
| $A_n$ | 1276.956 mm² |
| $\phi_u$ | 0.80 |
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th>Ane</th>
<th>1085.413 mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fu</td>
<td>420 Mpa</td>
</tr>
<tr>
<td>Tr</td>
<td>364.70 kN</td>
</tr>
</tbody>
</table>

10.8.1.3.2.2
10.8.2

14.14.1.4.2 a

14.7.4.6
14.14.1.4.2 b

14.14.1.4.2

2.1.4 Truss 1st Internal Diagonals

Member Nos. 15, 24
2-angles - c/w battens

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>127</td>
<td>0</td>
<td>127 mm</td>
</tr>
<tr>
<td>h</td>
<td>119.1</td>
<td>0</td>
<td>119.1 mm</td>
</tr>
<tr>
<td>w</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>b</td>
<td>88.9</td>
<td>0</td>
<td>88.9 mm</td>
</tr>
<tr>
<td>t</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>c</td>
<td>25.4</td>
<td>0</td>
<td>25.4 mm</td>
</tr>
</tbody>
</table>

Area 3286.4 2957.76 mm²

a). Section Properties

About Major-Axis (X in capacity calcs, Y in Midas)

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>Yb (mm)</th>
<th>A*Yb (mm³)</th>
<th>A*(Yb-Yb)² (mm⁴)</th>
<th>I (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>1694</td>
<td>67</td>
<td>112896</td>
<td>1632015</td>
</tr>
</tbody>
</table>
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th>Angle Horiz. Leg</th>
<th>1264</th>
<th>4</th>
<th>4494</th>
<th>1299561</th>
<th>5325</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum</td>
<td>2958</td>
<td></td>
<td></td>
<td>2931576</td>
<td>2007277</td>
</tr>
</tbody>
</table>

\[
I = 4.94\times10^6 \text{ mm}^4 \\
r = 41 \text{ mm}^3 \\
As = 1170.5167 \text{ mm}^2 \\
\]

About Minor-Axis (Y in capacity calcs, Z in Midas) \( X_{\text{left}} = 102 \text{ mm} \)

<table>
<thead>
<tr>
<th>Area ((\text{mm}^2))</th>
<th>(X_{\text{CL}}) ((\text{mm}))</th>
<th>(A*X_{\text{CL}}) ((\text{mm}^3))</th>
<th>(A*X_{\text{CL}}^2) ((\text{mm}^4))</th>
<th>(I_o) ((\text{mm}^4))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>1694</td>
<td>98</td>
<td>166049</td>
<td>16280295</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>1264</td>
<td>57</td>
<td>72247</td>
<td>4128895</td>
</tr>
<tr>
<td>Sum</td>
<td>2958</td>
<td></td>
<td></td>
<td>20409189</td>
</tr>
</tbody>
</table>

\[
I = 2.12\times10^7 \text{ mm}^4 \\
r = 85 \text{ mm}^3 \\
As = 1411 \text{ mm}^2 \\
\]

Torsional Resistance

\[
\text{sum of }bt^3/3 \text{ for section} \\
I_{xx} = 4.98\times10^4 \text{ mm}^4 \\
\]

Summary Table for Midas Section Properties*

<table>
<thead>
<tr>
<th>(I_{yy})</th>
<th>(4.94\times10^6 \text{ mm}^4)</th>
<th>(I_{zz})</th>
<th>(2.12\times10^7 \text{ mm}^4)</th>
<th>(A_{\text{yy}})</th>
<th>(2958 \text{ mm}^2)</th>
<th>(A_{\text{zz}})</th>
<th>(1170.5167 \text{ mm}^2)</th>
</tr>
</thead>
</table>

a) Gross Section

\[
\begin{align*}
Ag & = 2957.76 \text{ mm}^2 \\
\phi_s & = 0.95 \\
F_y & = 248 \text{ Mpa} \\
T_r & = 696.85 \text{ kN} \\
\end{align*}
\]

b) Net Tension

\[
\begin{align*}
d & = 21 \text{ mm} \\
An & = 2061.9 \text{ mm}^2 \\
\phi_u & = 0.80 \\
A_{ne} & = 1752.615 \text{ mm}^2 \\
F_u & = 420 \text{ Mpa} \\
T_r & = 588.88 \text{ kN} \\
\end{align*}
\]

c) Rivets in bearing

\[
\begin{align*}
\phi_{mc} & = 0.67 \\
\end{align*}
\]
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th>t</th>
<th>7.11</th>
</tr>
</thead>
<tbody>
<tr>
<td>d mm</td>
<td>21</td>
</tr>
<tr>
<td>n</td>
<td>14 rivets</td>
</tr>
<tr>
<td>e mm</td>
<td>35</td>
</tr>
<tr>
<td>Fu Mpa</td>
<td>320</td>
</tr>
<tr>
<td>Br kN</td>
<td>746.9482</td>
</tr>
</tbody>
</table>

14.7.4.6

| d | 14 rivets |
| m | 1 |
| Ar mm² | 285 |
| Fu Mpa | 320 |
| Vr kN | 641.592 |

14.14.1.4.2b
d) Rivets in shear

\[
\phi_r = 0.67
\]

<table>
<thead>
<tr>
<th>( n ) rivets</th>
<th>14</th>
</tr>
</thead>
</table>

*3/4" rivets assumed

Tr 588.88 kN

e) Governing Capacity

2.1.5 Truss 2nd Internal Diagonals

Member Nos. 17, 22
2-angles - c/w battens

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
<tr>
<td>h</td>
<td>69.8</td>
<td>0</td>
<td>69.8 mm</td>
</tr>
<tr>
<td>w</td>
<td>6.4</td>
<td>0.1</td>
<td>5.76 mm</td>
</tr>
<tr>
<td>b</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
<tr>
<td>t</td>
<td>6.4</td>
<td>0.1</td>
<td>5.76 mm</td>
</tr>
<tr>
<td>c</td>
<td>50.8</td>
<td>0</td>
<td>50.8 mm</td>
</tr>
</tbody>
</table>

Area 1868.8 1681.92 mm²

a) Section Properties

About Major-Axis (X in capacity calcs, Y in Midas)

\[ Y_{bot} = \frac{18 \text{ mm}}{2} \]

<table>
<thead>
<tr>
<th>Angle Vert Leg</th>
<th>Area (mm²)</th>
<th>( y_{bot} ) (mm)</th>
<th>( A*Y_{bot} ) (mm³)</th>
<th>( A*(Y_{bot} - Y_{bot})^2 ) (mm⁴)</th>
<th>( I_o ) (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Horiz. Leg</td>
<td>878</td>
<td>3</td>
<td>2528</td>
<td>205710</td>
<td>2427</td>
</tr>
<tr>
<td>Sum</td>
<td>1682</td>
<td></td>
<td></td>
<td>611764</td>
<td>328932</td>
</tr>
</tbody>
</table>

\[
I = 9.41E+05 \text{ mm}^4
\]

\[
r = 24 \text{ mm}^3
\]

\[
As = 812.8 \text{ mm}^2
\]
Black Bridge Rd. Truss Bridge  
Section B - Section Capacity

**About Minor-Axis (Y in capacity calcs, Z in Midas)**  
\[ X_{\text{left}} = 102 \text{ mm} \]

<table>
<thead>
<tr>
<th>Area</th>
<th>(X_{\text{CL}})</th>
<th>(A*X_{\text{CL}})</th>
<th>(A*X_{\text{CL}}^2)</th>
<th>(I_o)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>804</td>
<td>99</td>
<td>79380</td>
<td>7836429</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>878</td>
<td>64</td>
<td>55742</td>
<td>3539606</td>
</tr>
<tr>
<td>Sum</td>
<td>1682</td>
<td></td>
<td></td>
<td>11376035</td>
</tr>
</tbody>
</table>

\[ I = 1.18 \times 10^7 \text{ mm}^4 \]
\[ r = 84 \text{ mm}^3 \]
\[ As = 670 \text{ mm}^2 \]

**Torsional Resistance**

\[ \text{sum of } b t^3/3 \text{ for section} \]
\[ I_{xx} = 1.86 \times 10^4 \text{ mm}^4 \]

**Summary Table for Midas Section Properties***

| \(I_{yy}\) | \(9.41 \times 10^5 \text{ mm}^4\) | Area  | 1682 mm² |
| \(I_{zz}\) | \(1.18 \times 10^7 \text{ mm}^4\) | Asy   | 812.8 mm² |
| \(I_{xx}\) | \(1.86 \times 10^4 \text{ mm}^4\) | Asz   | 670 mm² |

a) **Gross Section**

| \(A_g\) | 1681.92 mm² |
| \(\phi_s\) | 0.95 |
| \(F_y\) | 248 Mpa |
| \(T_r\) | 396.26 kN |

b) **Net Tension**

| \(d\) | 21 mm |
| \(A_n\) | 1198.08 mm² |
| \(\phi_u\) | 0.80 |
| \(A_{ne}\) | 1018.368 mm² |
| \(F_u\) | 420 Mpa |
| \(T_r\) | 342.17 kN |

c) **Rivets in bearing**

| \(\phi_{mc}\) | 0.67 |
| \(t\) | 5.76 |
| \(d\) | 21 mm |
| \(n\) | 8 rivets |
| \(e\) | 35 mm |
| \(F_u\) | 320 Mpa |
| \(B_r\) | 345.7843 kN |

\(< 622.41178 \text{ kN}\)
d) Rivets in shear

<table>
<thead>
<tr>
<th>( \phi_r )</th>
<th>0.67</th>
</tr>
</thead>
<tbody>
<tr>
<td>( n )</td>
<td>8 rivets</td>
</tr>
<tr>
<td>( m )</td>
<td>1</td>
</tr>
<tr>
<td>( A_r )</td>
<td>285 mm²</td>
</tr>
<tr>
<td>( F_u )</td>
<td>320 Mpa</td>
</tr>
<tr>
<td>( V_r )</td>
<td>366.624 kN</td>
</tr>
</tbody>
</table>

*3/4" rivets assumed

\( \phi_r \) is the rivet efficiency factor.

e) Governing Capacity

\[ T_r = 342.17 \text{ kN} \]

2.1.6 Truss Middle Internal Cross Diagonals

Member Nos. 19, 20
2-angles - c/w battens

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d )</td>
<td>63.5</td>
<td>0</td>
<td>63.5 mm</td>
</tr>
<tr>
<td>( h )</td>
<td>57.1</td>
<td>0</td>
<td>57.1 mm</td>
</tr>
<tr>
<td>( w )</td>
<td>6.4</td>
<td>0.1</td>
<td>5.76 mm</td>
</tr>
<tr>
<td>( b )</td>
<td>63.5</td>
<td>0</td>
<td>63.5 mm</td>
</tr>
<tr>
<td>( t )</td>
<td>6.4</td>
<td>0.1</td>
<td>5.76 mm</td>
</tr>
<tr>
<td>( c )</td>
<td>76.2</td>
<td>0</td>
<td>76.2 mm</td>
</tr>
</tbody>
</table>

Area

|   | 1543.68 | 1389.312 mm² |

a). Section Properties

About Major-Axis (X in capacity calcs, Y in Midas)

\[ Y_{bot} = 15 \text{ mm} \]

<table>
<thead>
<tr>
<th></th>
<th>Area (mm²)</th>
<th>( Y_{bot} ) (mm)</th>
<th>( A*Y_{bot} ) (mm³)</th>
<th>( A*(Y_{bot}^{2}) ) (mm⁶)</th>
<th>( I_o ) (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>658</td>
<td>34</td>
<td>22569</td>
<td>244415</td>
<td>178723</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>732</td>
<td>3</td>
<td>2107</td>
<td>108058</td>
<td>2023</td>
</tr>
<tr>
<td>Sum</td>
<td>1389</td>
<td></td>
<td>352473</td>
<td>180745</td>
<td></td>
</tr>
</tbody>
</table>

\[ I = 5.33E+05 \text{ mm}^⁴ \]

\[ r = 20 \text{ mm}^3 \]

\[ A_s = 677.33333 \text{ mm}^² \]

About Minor-Axis (Y in capacity calcs, Z in Midas)

\[ \chi_{left} = 102 \text{ mm} \]

<table>
<thead>
<tr>
<th></th>
<th>Area (mm²)</th>
<th>( \chi_{CL} ) (mm)</th>
<th>( A*\chi_{CL} ) (mm³)</th>
<th>( A*\chi_{CL}^{2} ) (mm⁶)</th>
<th>( I_o ) (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Vert Leg</td>
<td>658</td>
<td>99</td>
<td>64937</td>
<td>6410603</td>
<td>1819</td>
</tr>
<tr>
<td>Angle Horiz. Leg</td>
<td>732</td>
<td>70</td>
<td>51097</td>
<td>3569103</td>
<td>245806</td>
</tr>
<tr>
<td>Sum</td>
<td>1389</td>
<td></td>
<td>9979706</td>
<td>247625</td>
<td></td>
</tr>
</tbody>
</table>
Black Bridge Rd. Truss Bridge  
Section B - Section Capacity

\[ I = 1.02 \times 10^7 \text{ mm}^4 \]
\[ r = 86 \text{ mm}^3 \]
\[ As = 548 \text{ mm}^2 \]

Torsional Resistance

\[ \text{sum of } bt^3/3 \text{ for section } I_{xx} = 1.54 \times 10^4 \text{ mm}^4 \]

**Summary Table for Midas Section Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_{yy} )</td>
<td>5.33 \times 10^5 \text{ mm}^4</td>
</tr>
<tr>
<td>Area</td>
<td>1389 \text{ mm}^2</td>
</tr>
<tr>
<td>( I_{zz} )</td>
<td>1.02 \times 10^7 \text{ mm}^4</td>
</tr>
<tr>
<td>( AS_y )</td>
<td>677.33 \text{ mm}^2</td>
</tr>
<tr>
<td>( I_{xx} )</td>
<td>1.54 \times 10^4 \text{ mm}^4</td>
</tr>
<tr>
<td>( AS_z )</td>
<td>548 \text{ mm}^2</td>
</tr>
</tbody>
</table>

a) Gross Section

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A_g )</td>
<td>1389.31 \text{ mm}^2</td>
</tr>
<tr>
<td>( \phi_s )</td>
<td>0.95</td>
</tr>
<tr>
<td>( F_y )</td>
<td>248 \text{ Mpa}</td>
</tr>
<tr>
<td>( T_r )</td>
<td>327.32 \text{ kN}</td>
</tr>
</tbody>
</table>

b) Net Tension

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d )</td>
<td>21 \text{ mm}</td>
</tr>
<tr>
<td>( A_n )</td>
<td>905.47 \text{ mm}^2</td>
</tr>
<tr>
<td>( \phi_u )</td>
<td>0.80</td>
</tr>
<tr>
<td>( A_{ne} )</td>
<td>769.65 \text{ mm}^2</td>
</tr>
<tr>
<td>( F_u )</td>
<td>420 \text{ Mpa}</td>
</tr>
<tr>
<td>( T_r )</td>
<td>258.60 \text{ kN}</td>
</tr>
</tbody>
</table>

c) Rivets in bearing

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \phi_{mc} )</td>
<td>0.67</td>
</tr>
<tr>
<td>( t )</td>
<td>5.76</td>
</tr>
<tr>
<td>( d )</td>
<td>21 \text{ mm}</td>
</tr>
<tr>
<td>( n )</td>
<td>6 rivets</td>
</tr>
<tr>
<td>( e )</td>
<td>35 \text{ mm}</td>
</tr>
<tr>
<td>( F_u )</td>
<td>320 \text{ Mpa}</td>
</tr>
<tr>
<td>( B_r )</td>
<td>259.34 \text{ kN}</td>
</tr>
</tbody>
</table>

d) Rivets in shear

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \phi_r )</td>
<td>0.67</td>
</tr>
<tr>
<td>( n )</td>
<td>6 rivets</td>
</tr>
<tr>
<td>( m )</td>
<td>1</td>
</tr>
<tr>
<td>( A_r )</td>
<td>285 \text{ mm}^2</td>
</tr>
<tr>
<td>( F_u )</td>
<td>320 \text{ Mpa}</td>
</tr>
<tr>
<td>( V_r )</td>
<td>274.97 \text{ kN}</td>
</tr>
</tbody>
</table>
e) Governing Capacity

\[ T_r = 258.60 \text{ kN} \]

2.2 Compression Members

2.2.1 Top Chord

Member Nos. 8, 9, 10, 11, 12
2-channels - c/w lacing bottom and cover plate top

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>( b_t )</td>
<td>355.6</td>
<td>0</td>
<td>355.6 mm</td>
</tr>
<tr>
<td>( t_t )</td>
<td>7.9</td>
<td>0</td>
<td>7.9 mm</td>
</tr>
<tr>
<td>( b_c )</td>
<td>57.2</td>
<td>0</td>
<td>57.2 mm</td>
</tr>
<tr>
<td>( t_c )</td>
<td>9.5</td>
<td>0</td>
<td>9.5 mm</td>
</tr>
<tr>
<td>( s )</td>
<td>222.2</td>
<td>0</td>
<td>222.2 mm</td>
</tr>
<tr>
<td>( d_c )</td>
<td>203.2</td>
<td>0</td>
<td>203.2 mm</td>
</tr>
<tr>
<td>( w_c )</td>
<td>6.4</td>
<td>0</td>
<td>6.4 mm</td>
</tr>
<tr>
<td>( h_c )</td>
<td>184.2</td>
<td>0</td>
<td>184.2 mm</td>
</tr>
<tr>
<td>( b_b )</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>( t_b )</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>Area</td>
<td>7340.6</td>
<td></td>
<td>7340.6 mm²</td>
</tr>
</tbody>
</table>

a). Section Properties

\[ L = 5004 \text{ mm} \]

\[ Y_{bot} = 142 \text{ mm} \]

\[ l = 4.64 \times 10^7 \text{ mm}^4 \]

\[ r = 80 \text{ mm}^3 \]

\[ A_s = 4152.3667 \text{ mm}^3 \]

\[ X_{left} = 178 \text{ mm} \]

<table>
<thead>
<tr>
<th></th>
<th>Area (mm²)</th>
<th>( X_{cl} ) (mm)</th>
<th>A*( X_{cl} ) (mm³)</th>
<th>A*( X_{cl}^2 ) (mm⁴)</th>
<th>I₀ (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover Plate</td>
<td>2809</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>29602685</td>
</tr>
<tr>
<td>Channel Top Flange</td>
<td>1087</td>
<td>140</td>
<td>151826</td>
<td>21210087</td>
<td>296320</td>
</tr>
<tr>
<td>Channel Web</td>
<td>2358</td>
<td>114</td>
<td>269492</td>
<td>30802932</td>
<td>8048</td>
</tr>
<tr>
<td>Sum</td>
<td>7341</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th>Channel Bottom Flange</th>
<th>1087</th>
<th>140</th>
<th>151826</th>
<th>21210087</th>
<th>296320</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum</td>
<td>7341</td>
<td></td>
<td>73223105</td>
<td>30203372</td>
<td></td>
</tr>
</tbody>
</table>

\[ I = 1.03 \times 10^8 \text{ mm}^4 \]
\[ r = 119 \text{ mm}^3 \]
\[ A_s = 1965 \text{ mm}^2 \]

Torsional Resistance

\[ \text{sum of } bt^3/3 \text{ for section} \]
\[ I_{xx} = 1.01 \times 10^5 \text{ mm}^4 \]

Summary Table for Midas Section Properties*

<table>
<thead>
<tr>
<th>I_{yy}</th>
<th>4.64 \times 10^7 \text{ mm}^4</th>
<th>Area</th>
<th>7341 \text{ mm}^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_{zz}</td>
<td>1.03 \times 10^8 \text{ mm}^4</td>
<td>A_{yy}</td>
<td>4152.3667 \text{ mm}^2</td>
</tr>
<tr>
<td>I_{xx}</td>
<td>1.01 \times 10^5 \text{ mm}^4</td>
<td>A_{zz}</td>
<td>1965 \text{ mm}^2</td>
</tr>
</tbody>
</table>

*note sign convention differs from what is used for calcs below

b). Section Classification

i). Cover Plate (Flanges of rectangular hollow structural shapes)
\[ b_e/t = 26.51 < 420/\text{sqrt(Fy)} \] Class 1

ii). Channel Web (Web in axial compression)
\[ h/w = 28.78 < 670/\text{sqrt(Fy)} \] Class 1

c). Check Flexural Buckling

i). Slenderness Ratio
\[ k = 1.0 \]
\[ L = 5004 \text{ mm} \] Member Length
\[ \phi_s = 0.90 \]
\[ k_x L_x/r_x = 63 < 120 \text{ OK} \] Major Axis Buckling Controls
\[ k_y L_y/r_y = 42 < 120 \text{ OK} \]

\[ \lambda_x = \frac{kL}{r_x} \sqrt{\frac{F_y}{E_s}} \]
\[ n = 1.34 \]
\[ C_r = \phi_s A_F Y (1 + \lambda_n^{2n})^{-1/2} \text{ kN} \]

Governs

d). Check Flexural Torsional Buckling

Analysis for sections singly symmetric about vert-axis only, closed section is assumed
\[ R_0 = 2t \]
\[ R_i = t \]
\[ R_c = \frac{R_0 + R_i}{2} = 1.5t \]
\[ A_p = (d - t)(b - t) - R_c^2 (4 - \pi) \text{ mm}^2 \]
\[ p = 2[(d - t)(b - t)] - 2R_c(4 - \pi) \text{ mm}^3 \]

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Black Bridge Rd. Truss Bridge
Section B - Section Capacity

\[ J = \frac{4A_s^2t}{\rho} \]

\[ C_w = 0 \quad \text{Assume Closed Section} \]
\[ Y_o = 0 \quad \text{Assume Closed Section} \]
\[ H = 1.0 \]

\[ H = 1 - \frac{Y_o^2}{r_0^2} \text{ for sections singly symmetric about the y-axis} \]

\[ F_{ey} = \frac{\pi^2E_s}{(k_\phi / r_y)^2} \quad F_{ey} = 1110.6963 \text{ MPa} \]
\[ r_o^2 = \frac{Y_o^2}{k_\phi} + r_e^2 + r_y^2 \quad r_o^2 = 20411.40 \text{ mm}^2 \]
\[ F_{ez} = \frac{\pi^2E_sC_w}{(k_\phi)^2 + G_d} / A_r^2 \quad F_{ez} = 30682.51 \text{ MPa} \]
\[ F_{ex} = \frac{\pi^2E_s}{(k_\phi l / r_x)^2} \quad F_{ex} = 498.35 \text{ MPa} \]
\[ F_e = \frac{F_{ey} + F_{ez}}{2H} \left[ 1 - \sqrt{1 - \frac{4F_{ey}F_{ez}H}{(F_{ey} + F_{ez})^2}} \right] \quad F_e = 1110.70 \text{ MPa} \]
\[ \lambda_e = \sqrt{F_y / F_e} \quad \lambda_e = 0.4725 \]
\[ C_r = \phi_A F_y (1 + \lambda_2)^{-1/\eta} \quad C_r = 1491.550 \text{ kN} \]

e). Select Governing Compressive Capacity

\[ C_r = 1279.703 \text{ kN} \quad \text{Flexural Buckling Capacity in the Strong Axis Governs} \]

f). Check Shear Capacity of Rivets

\[ V = 9.21 \text{ kN} \quad \text{Vertical Shear} \]
\[ Q = 183039.19 \text{ mm}^3 \quad \text{First moment of area} \]
\[ I_s = 4.64E+07 \text{ mm}^4 \quad \text{Moment of inertia of built-up section} \]
\[ q = \frac{V*Q}{I_s} \quad q = 36.34 \text{ N/mm} \quad \text{Shear Flow} \]
\[ S = 385 \text{ mm} \quad \text{Approximate spacing per rivet} \]
\[ n = 26 \quad \text{Approximate number of rivets} \]
\[ d = 19.05 \text{ mm} \quad 3/4" \text{ rivet diameter} \]
\[ V_t = q*S \quad V_t = 13.98 \text{ kN} \quad \text{Shear force per rivet} \]

i) Rivets in bearing

Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th>φmc</th>
<th>0.67</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>7.9</td>
</tr>
<tr>
<td>d</td>
<td>21.05 mm</td>
</tr>
<tr>
<td>n</td>
<td>1 rivets</td>
</tr>
<tr>
<td>e</td>
<td>35 mm</td>
</tr>
<tr>
<td>Fu</td>
<td>320 Mpa</td>
</tr>
<tr>
<td>Br</td>
<td>59.28 kN</td>
</tr>
</tbody>
</table>

ii) Rivets in shear

<table>
<thead>
<tr>
<th>φr</th>
<th>0.67</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>1 rivets</td>
</tr>
<tr>
<td>m</td>
<td>1</td>
</tr>
<tr>
<td>Ar</td>
<td>285 mm2</td>
</tr>
<tr>
<td>Fu</td>
<td>320 Mpa</td>
</tr>
<tr>
<td>Vr</td>
<td>45.83 kN</td>
</tr>
</tbody>
</table>

2.2.2 End Diagonals - Existing Section

Member Nos. 13, 26
2-channels - c/w lacing bottom and cover plate top

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>b_t</td>
<td>355.6</td>
<td>0</td>
<td>355.6 mm</td>
</tr>
<tr>
<td>t_t</td>
<td>7.9</td>
<td>0</td>
<td>7.9 mm</td>
</tr>
<tr>
<td>b_c</td>
<td>60.3</td>
<td>0</td>
<td>60.3 mm</td>
</tr>
<tr>
<td>t_c</td>
<td>9.5</td>
<td>0</td>
<td>9.5 mm</td>
</tr>
<tr>
<td>s</td>
<td>222.2</td>
<td>0</td>
<td>222.2 mm</td>
</tr>
<tr>
<td>d_c</td>
<td>203.2</td>
<td>0</td>
<td>203.2 mm</td>
</tr>
<tr>
<td>w_c</td>
<td>7.9</td>
<td>0</td>
<td>7.9 mm</td>
</tr>
<tr>
<td>h_c</td>
<td>184.2</td>
<td>0</td>
<td>184.2 mm</td>
</tr>
<tr>
<td>b_b</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>t_b</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
</tbody>
</table>

Area 8011 8011 mm²

a). Section Properties

Le 4839
L = 8260 mm

Member Length

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>y_{bot} (mm)</th>
<th>A*y_{bot} (mm³)</th>
<th>A*(y_{bot}^2-y_{bot}) (mm⁴)</th>
<th>I_{y} (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover Plate</td>
<td>2809</td>
<td>207</td>
<td>581934</td>
<td>13195701</td>
</tr>
</tbody>
</table>
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th></th>
<th>1146</th>
<th>198</th>
<th>227364</th>
<th>4102070</th>
<th>8617</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Top Flange</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel Web</td>
<td>2910</td>
<td>102</td>
<td>295693</td>
<td>3987194</td>
<td>8228956</td>
</tr>
<tr>
<td>Channel Bottom Flange</td>
<td>1146</td>
<td>5</td>
<td>5442</td>
<td>20530304</td>
<td>8617</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>8011</td>
<td></td>
<td></td>
<td>41815269</td>
<td>8260799</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
5.01\times10^7 & \quad \text{l} = 5.01\times10^7 \text{ mm}^4 \\
5 & \quad r = 79 \text{ mm}^3 \\
& \quad \text{As} = 4251 \text{ mm}^2 \\
\end{align*}
\]

About Minor-Axis (Z in Midas, Y in Capacity Calcs)

\[
X_{\text{left}} = 178 \text{ mm}
\]

<table>
<thead>
<tr>
<th></th>
<th>(X_{\text{CL}})</th>
<th>(A\times X_{\text{CL}})</th>
<th>(A\times X_{\text{CL}}^2)</th>
<th>(I_o)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover Plate</td>
<td>2809</td>
<td>0</td>
<td>0</td>
<td>29602685</td>
</tr>
<tr>
<td>Channel Top Flange</td>
<td>1146</td>
<td>141</td>
<td>161830</td>
<td>22858505</td>
</tr>
<tr>
<td>Channel Web</td>
<td>2910</td>
<td>115</td>
<td>334837</td>
<td>38522987</td>
</tr>
<tr>
<td>Channel Bottom Flange</td>
<td>1146</td>
<td>141</td>
<td>161830</td>
<td>22858505</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td>8011</td>
<td></td>
<td></td>
<td>84239998</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
1.15\times10^8 & \quad \text{l} = 1.15\times10^8 \text{ mm}^4 \\
& \quad r = 120 \text{ mm}^3 \\
& \quad \text{As} = 2425 \text{ mm}^2 \\
\end{align*}
\]

Torsional Resistance

\[
\text{sum of } b\times t^3/3 \text{ for section} \quad I_{xx} = 1.32\times10^5 \text{ mm}^4
\]

Summary Table for Midas Section Properties*

<table>
<thead>
<tr>
<th>(l_{yy})</th>
<th>(5.01\times10^7 \text{ mm}^4)</th>
<th>(\text{Area})</th>
<th>(8011 \text{ mm}^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(l_{zz})</td>
<td>(1.15\times10^8 \text{ mm}^4)</td>
<td>(\text{As})</td>
<td>(4250.5333 \text{ mm}^2)</td>
</tr>
<tr>
<td>(l_{xx})</td>
<td>(1.32\times10^5 \text{ mm}^4)</td>
<td>(\text{Asz})</td>
<td>(2425 \text{ mm}^2)</td>
</tr>
</tbody>
</table>

*note sign convention differs from what is used for calcs below

b). Section Classification

i). Top Plate (Flanges of Rect. Hollow Struct. Shapes)

\[
b_e/t = 21.73 < 420/\sqrt{\text{Fy}} \quad \text{Class 1}
\]

ii). Channel Web (Web in Axial Compression)

\[
h/w = 23.32 < 670/\sqrt{\text{Fy}} \quad \text{Class 1}
\]

c). Check Flexural Buckling

i). Slenderness Ratio

\[
k = 0.9
\]

\[
L_x = 8260 \text{ mm} \quad \text{Member Length}
\]

\[
L_y = 4839 \text{ mm}
\]
Black Bridge Rd. Truss Bridge  
Section B - Section Capacity

\[ \phi_s = 0.90 \]

\[ k_{L_x}/r_s = 94 < 120 \text{ OK Major (in-plane) Axis Buckling Controls} \]

\[ k_{L_y}/r_y = 36 < 120 \text{ OK} \]

\[ \frac{\lambda}{r} = \sqrt{\frac{F_y}{\pi^2 E_s}} \]

\[ \lambda_x = 1.0539 \]

\[ n = 1.34 \]

\[ C_r = \phi_s A_F y (1 + \lambda^{2n})^{-1/n} \]

\[ C_{rx} = 1009.527 \text{ kN} \quad \text{Governs *unbraced} \]

\[ C_{rx} = 1337 \text{ kN} \quad \text{*braced length of 4500mm} \]

d). Check Flexural Torsional Buckling

*Analysis for sections singly symmetric about Y-axis only, closed section is assumed*

\[ R_0 = 2t \]

\[ R_i = 7.9 \text{ mm} \quad \text{Inner corner radii} \]

\[ R_c = \frac{R_0 + R_i}{2} = 15.8 \text{ mm} \quad \text{Outer corner radii} \]

\[ A_p = 43425 \text{ mm}^2 \quad \text{Enclosed area} \]

\[ P = 815 \text{ mm} \quad \text{Mid-contour length} \]

\[ p = 7.31E+07 \text{ mm}^3 \quad \text{St.Venant Torsional Constant} \]

\[ J = \frac{4A_p^2 t}{p} \]

\[ C_W = 0 \quad \text{Assume Closed Section} \]

\[ Y_0 = 0 \quad \text{Assume Closed Section} \]

\[ H = 1.0 \]

\[ \frac{\pi^2 E_s}{(K_d/r_y)^2} \quad \text{F}_y = 510.7414 \text{ MPa} \]

\[ r_0^2 = \frac{y_o^2 + r_x^2 + r_y^2}{2} \quad r_0^2 = 20550.27 \text{ mm}^2 \]

\[ F_{ez} = \left[ \frac{\pi^2 E_s G_s}{(K_d/r_y)^2} + C_{Wz} \right] / A_r b^2 \quad F_{ez} = 34212.40 \text{ MPa} \]

\[ F_{ex} = \frac{\pi^2 E_s}{(K_d/r_x)^2} \quad F_{ex} = 223.27 \text{ MPa} \]

\[ F_e = \left[ \frac{F_{ey} + F_{ez}}{2H} \left[ 1 - \frac{4F_{ey}F_{ez}}{(r_{ey} + r_{ez})^2} \right] \right] \quad F_e = 510.74 \text{ MPa} \]

\[ \lambda_e = \sqrt{F_y/F_e} \quad \lambda_e = 0.6968 \]

\[ C_r = \phi_s A_F y (1 + \lambda^{2n})^{-1/n} \quad C_{re} = 1406.165 \text{ kN} \]

e). Select Governing Compressive Capacity

\[ C_r = 1009.527 \text{ kN} \quad \text{Buckling Capacity in the Major (In-Plane) Axis Governs} \]

f). Check Shear Capacity of Rivets
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

\[ V = 7.54 \text{ kN} \quad \text{Vertical Shear} \]
\[ Q = 192535.43 \text{ mm}^3 \quad \text{First moment of area} \]
\[ I_x = 5.01E+07 \text{ mm}^4 \quad \text{Moment of inertia of built-up section} \]

\[ q = \frac{VQ}{I} \]
\[ q = 28.98 \text{ N/mm} \quad \text{Shear Flow} \]
\[ S = 207 \text{ mm} \quad \text{Approximate spacing per rivet} \]
\[ n = 80 \quad \text{Approximate number of rivets} \]
\[ d = 19.05 \text{ mm} \quad \text{3/4" rivet diameter} \]

\[ V_f = qS \]
\[ V_f = 5.98 \text{ kN} \quad \text{Shear force per rivet} \]

\[ \phi = 0.67 \]
\[ t = 7.9 \]
\[ d = 21.05 \text{ mm} \quad *3/4"+2mm \]
\[ n = 1 \text{ rivets} \]
\[ e = 35 \text{ mm} \quad *\text{from Dillon report} \]
\[ F_u = 320 \text{ Mpa} \]
\[ B_r = 59.28 \text{ kN} \]

\[ \text{Cl.14.14.1.4.:} \]

\[ h) \quad \text{Rivets in shear} \]
\[ \phi = 0.67 \]
\[ n = 1 \text{ rivets} \]
\[ m = 1 \]
\[ A_r = 285 \text{ mm}^2 \quad *3/4" \text{ rivets assumed} \]
\[ F_u = 320 \text{ Mpa} \]
\[ V_r = 45.83 \text{ kN} \]

\[ \text{O.K.} \]

\[ \text{i) Minor Access Moment Capacity of End Diagonal} \]

\[ M_r = \phi_s Z_y F_y = \phi_s M_{py} \]

\[ \phi_s = 0.95 \quad 10702.9 \]
\[ Z_y = 9.08E+05 \text{ mm}^4 \]
\[ F_y = 248 \text{ Mpa} \]
\[ M_r = 213.981 \text{ kN-m} \]

\[ M_r = \phi_s S_y F_y = \phi_s M_{py} \]

\[ \phi_s = 0.95 \]
\[ I_y = 1.15E+08 \text{ mm}^4 \]
\[ y = 177.8 \text{ mm} \]
\[ S = 6.44E+05 \text{ mm}^3 \]
\[ F_y = 248 \text{ Mpa} \]
\[ M_r = 151.7912 \text{ kN-m} \]

\[ \text{As a Class 1 section} \]

\[ \text{As a Class 3 section} \]
i) Major Access Moment Capacity of End Diagonal

\[ M_r = \phi_s S_y F_y = \phi_s M_{yy} \]

As a Class 3 section

<table>
<thead>
<tr>
<th>( \phi_s )</th>
<th>0.95</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_y )</td>
<td>5.01E+07 mm4</td>
</tr>
<tr>
<td>( y )</td>
<td>139 mm</td>
</tr>
<tr>
<td>( S )</td>
<td>3.61E+05 mm3</td>
</tr>
<tr>
<td>( F_y )</td>
<td>248 Mpa</td>
</tr>
<tr>
<td>( M_r )</td>
<td>85.11379 kN-m</td>
</tr>
</tbody>
</table>

j) Combined Axial Compression & Flexure

a) cross-sectional strength

| \( C_r \) | 1788.055 kN |
| \( M_{ry} \) | 151.7912 kN-m |
| \( M_{rx} \) | 85.11379 kN-m |
| \( C_{ey} \) | 9.66E+03 kN |
| \( C_{ex} \) | 1.45E+03 kN |
| \( C_{ex} \) | 4.88E+03 kN |

b) Overall member strength

| \( C_r \) | 1009.527 kN |
| \( C_r \) | 1337.000 kN-m |
| \( M_{rx} \) | 85.11379 kN-m |
| \( M_{ry} \) | 151.7912 kN-m |
| \( C_{ey} \) | 9656.543 kN |
| \( C_{ex} \) | 1.45E+03 kN |

Note \( \omega_1 = 1 \), as there are multiple point loads applied between supports due to cross brace.

2.2.2c End Diagonals - Strengthened Channel Webs

Member Nos. 13, 26

2-channels - c/w lacing bottom and cover plate top

*critical point is at knee brace, therefore assume no section loss

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>( b_t )</td>
<td>355.6</td>
<td>0</td>
<td>355.6 mm</td>
</tr>
<tr>
<td>( t_t )</td>
<td>7.9</td>
<td>0</td>
<td>7.9 mm</td>
</tr>
<tr>
<td>( b_c )</td>
<td>60.3</td>
<td>0</td>
<td>60.3 mm</td>
</tr>
<tr>
<td>( t_c )</td>
<td>9.5</td>
<td>0</td>
<td>9.5 mm</td>
</tr>
<tr>
<td>( s )</td>
<td>222.2</td>
<td>0</td>
<td>222.2 mm</td>
</tr>
</tbody>
</table>
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th>( \overline{b}/t_b )</th>
</tr>
</thead>
</table>

| d_c | 203.2 | 0 | 203.2 mm |
| w_c | 7.9  | 0 | 7.9 mm   |
| h_c | 184.2 | 0 | 184.2 mm |
| plate_h | 100  | 0 | 100 mm   |
| plate_t | 19   | 0 | 19 mm    |
| b_b | 0     | 0 | 0 mm     |
| t_b | 0     | 0 | 0 mm     |
| Area | 8011  |   | 11811 mm² |

a). Section Properties

Le = 4839

| L = | 8260 mm |

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>( y_{bot} ) (mm)</th>
<th>( A*y_{bot} ) (mm³)</th>
<th>( A*(Y_{bot}-y_{bot})^2 ) (mm⁴)</th>
<th>( I_o ) (mm⁴)</th>
</tr>
</thead>
</table>

Cover Plate 2809 207 581934 13195701 14610
Channel Top Flange 1146 198 227364 4102070 8617
Channel Web 2910 102 295693 3987194 8228956
Channel Added Plates 3800 110 416100 45562950 3166667
Channel Bottom Flange 1146 5 5442 20530304 8617
Sum 11811 87378219 11427466

\( I = 9.88E+07 \) mm⁴

\( S = 9.88E+05 \) mm³

\( r = 91 \) mm

\( A_s = 4251 \) mm²

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>( x_{CL} ) (mm)</th>
<th>( A*x_{CL} ) (mm³)</th>
<th>( A*x_{CL}^2 ) (mm⁴)</th>
<th>( I_o ) (mm⁴)</th>
</tr>
</thead>
</table>

Cover Plate 2809 0 0 0 29602685
Channel Top Flange 1146 141 161830 22858505 347156
Channel Web 2910 115 334837 38529287 15136
Channel Added Plates 3800 129 488300 62746550 114317
Channel Bottom Flange 1146 141 161830 22858505 3166667
Sum 11811 146986548 33245960

\( I = 1.80E+08 \) mm⁴

\( r = 124 \) mm³

\( A_s = 5592 \) mm²

Torsional Resistance

\( \sum of bt^3/3 for section \) \( I_{xx} = 5.90E+05 \) mm⁴

Summary Table for Midas Section Properties

| \( I_{yy} \) | \( 9.88E+07 \) mm⁴ | Area     | 11811 mm² |

103
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th>lzz</th>
<th>1.80E+08 mm$^4$</th>
<th>Asy</th>
<th>4250.5333 mm$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxx</td>
<td>5.90E+05 mm$^4$</td>
<td>Asz</td>
<td>5592 mm$^2$</td>
</tr>
</tbody>
</table>

*note sign convention differs from what is used for calcs below

b). Section Classification

i). Top Plate (Flanges of Rect. Hollow Struct. Shapes)

\[
\frac{b_o}{t} = 21.73 < \frac{420}{\sqrt{F_y}} \quad \text{Class 1}
\]

ii). Channel Web (Web in Axial Compression)

\[
\frac{h}{w} = 23.32 < \frac{670}{\sqrt{F_y}} \quad \text{Class 1}
\]

b). Section Classification

i). Top Plate (Flanges of Rect. Hollow Struct. Shapes)

\[
\frac{b_o}{t} = 21.73 \quad \text{(Class 1)}
\]

ii). Channel Web (Web in Axial Compression)

\[
\frac{h}{w} = 23.32 \quad \text{(Class 1)}
\]

c). Check Flexural Buckling

i). Slenderness Ratio

\[
\lambda = \frac{KL}{r} \quad \sqrt{\frac{F_y}{\pi^2 E_s}}
\]

\[
\lambda_\text{u} = 0.9110
\]

\[
n = 1.34
\]

\[
C_r = \phi_s A F_y (1 + \lambda^{2n-1})^{1/n}
\]

\[
C_r = 1715.048 \text{ kN} \quad \text{Governs} \quad *\text{unbraced}
\]

\[
C_r = 1337 \text{ kN} \quad *\text{braced length of 4500mm}
\]

d). Check Flexural Torsional Buckling

Analysis for sections singly symmetric about Y-axis only, closed section is assumed

\[
R_0 = 2t
\]

\[
R_0 = 15.8 \text{ mm} \quad \text{Outer corner radii}
\]

\[
R_i = t
\]

\[
R_i = 7.9 \text{ mm} \quad \text{Inner corner radii}
\]

\[
R_c = \frac{R_0 + R_i}{2} = 1.5t
\]

\[
R_c = 11.85 \text{ mm} \quad \text{Mean corner radius}
\]

\[
A_p = (d-t)(b-t) - R_c^2 (4-\pi)
\]

\[
P = 815 \text{ mm} \quad \text{Mid-contour length}
\]

\[
p = 2[(d-t)+(b-t)] - 2R_c (4-\pi)
\]

\[
J = \frac{4A_p^2 t}{P}
\]

\[
C_w = 0 \quad \text{Assume Closed Section}
\]

\[
Y_0 = 0 \quad \text{Assume Closed Section}
\]

\[
H = 1.0
\]

\[
r_{ey} = \frac{\pi^2 E_s}{(k_{yL}/r_y)^2}
\]

\[
F_{ey} = 545.0434 \text{ MPa}
\]

\[
r_0^2 = r_{0y}^2 + r_{0y}^2 + r_{0z}^2
\]

\[
r_0^2 = 23625.28 \text{ mm}^2
\]

\[
F_{ez} = \frac{\pi^2 E_s C_w}{(k_{zL})^2} / A_0^2
\]

\[
F_{ez} = 20184.78 \text{ MPa}
\]
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

\[ F_{ex} = \frac{n^2E_s}{(K_xL/r_x)^2} \]

\[ F_e = \frac{F_{ex}}{\sqrt{1 - \left(\frac{4E_y/E_x}{(F_{ex}+F_{ex})} \right)^{2}}} \]

\[ F_e = 298.80 \text{ MPa} \]

\[ F_e = 545.04 \text{ MPa} \]

\[ \lambda_e = \sqrt{\frac{F_y}{F_e}} \]

\[ \lambda_e = 0.6745 \]

\[ C_r = \phi_r A_{F_y} (1 + \lambda_e^{2n})^{-1/n} \]

\[ C_r = 2109.429 \text{ kN} \]

e). Select Governing Compressive Capacity

\[ C_r = 1715.048 \text{ kN} \]

Flexural Buckling Capacity in the Major (In-Plane) Axis Governs

f). Check Shear Capacity of Rivets (DUE TO TRANSVERSE SHEAR)

\[ V = 97.10 \text{ kN} \]

Vertical Shear

\[ Q = 57398.58 \text{ mm}^3 \]

First moment of area

\[ I_x = 9.88E+07 \text{ mm}^4 \]

Moment of inertia of built-up section

\[ q = \frac{V*Q}{I} \]

\[ q = 563.50 \text{ N/mm} \]

Shear Flow

\[ S = 125 \text{ mm} \]

Approximate spacing per rivet

\[ n = 80 \]

Approximate number of rivets

\[ d = 19.05 \text{ mm} \]

3/4" rivet diameter

\[ V_f = q*S \]

\[ V_f = 70.44 \text{ kN} \]

Shear force per rivet

*does not pass in current condition. Rivets to be replaced with high strength bolts. Additional load is also present in rivets from compressive force (+/- 5 kN per rivet)

g) Rivets in bearing

| \( \phi_{mc} \) | 0.67 |
| \( t \) | 7.9 |
| \( d \) | 21.05 mm | *3/4"+2mm |
| \( n \) | 1 rivets |
| \( e \) | 35 mm | *from Dillon report |
| \( F_u \) | 320 Mpa | *rivets |
| \( B_r \) | 59.28 kN | > 70.44 NOT O.K. |

h) Rivets in shear

| \( \phi_r \) | 0.67 |
| \( n \) | 1 rivets |
| \( m \) | 1 |
| \( A_r \) | 285 mm2 | *3/4" rivets assumed |
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

<table>
<thead>
<tr>
<th>Fu</th>
<th>320 Mpa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vr</td>
<td>45.83 kN</td>
</tr>
</tbody>
</table>

i) Minor Access Moment Capacity of End Diagonal

\[ M_r = \phi_s Z_y F_y = \phi_s M_{py} \]

As a Class 1 Section

<table>
<thead>
<tr>
<th>( \phi_s )</th>
<th>0.95</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Z_y )</td>
<td>1.40E+06 mm4</td>
</tr>
<tr>
<td>( F_y )</td>
<td>248 Mpa</td>
</tr>
<tr>
<td>( M_r )</td>
<td>329.0245 kN-m</td>
</tr>
</tbody>
</table>

\[ M_r = \phi_s S_y F_y = \phi_s M_{py} \]

As a Class 3 section

<table>
<thead>
<tr>
<th>( \phi_s )</th>
<th>0.95</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_y )</td>
<td>1.80E+08 mm4</td>
</tr>
<tr>
<td>( y )</td>
<td>177.8 mm</td>
</tr>
<tr>
<td>( S )</td>
<td>1.01E+06 mm3</td>
</tr>
<tr>
<td>( F_y )</td>
<td>248 Mpa</td>
</tr>
<tr>
<td>( M_r )</td>
<td>238.8233 kN-m</td>
</tr>
</tbody>
</table>

i) Major Access Moment Capacity of End Diagonal

\[ M_r = \phi_s S_y F_y = \phi_s M_{py} \]

As a Class 3 section

<table>
<thead>
<tr>
<th>( \phi_s )</th>
<th>0.95</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_y )</td>
<td>9.88E+07 mm4</td>
</tr>
<tr>
<td>( y )</td>
<td>139 mm</td>
</tr>
<tr>
<td>( S )</td>
<td>7.13E+05 mm3</td>
</tr>
<tr>
<td>( F_y )</td>
<td>248 Mpa</td>
</tr>
<tr>
<td>( M_r )</td>
<td>167.939 kN-m</td>
</tr>
</tbody>
</table>

j) Combined Axial Compression & Flexure

10.9.4.1 a)

a) cross-sectional strength

\[ C_r = 2636.215 \text{ kN} \quad \lambda = 0 \]

\[ M_{ry} = 238.8233 \text{ kN-m} \quad \text{Class 3 Section} \]

\[ M_{rx} = 167.939 \text{ kN-m} \]

\[ C_{ey} = 1.25E+04 \text{ kN} \]

\[ C_{ex} = 2.86E+03 \text{ kN} \quad \text{*unbraced} \]

\[ C_{ex} = 1.19E+01 \text{ kN} \quad \text{*braced} \]

b) Overall member strength

\[ C_r = 1715.048 \text{ kN} \quad \text{*unbraced} \]

\[ C_r = 1337.000 \text{ kN-m} \quad \text{*braced length of 4.5m} \]

\[ M_{rx} = 167.939 \text{ kN-m} \]

\[ M_{ry} = 238.8233 \text{ kN-m} \quad \text{Class 3 Section} \]
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

Cey 1.25E+04 kN
Cex 2.86E+03

2.2.3 Inner Verticals

Truss Inner Verticals
Member Nos. 16, 18, 21, 23
2-channels - c/w lacing both sides

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Original</th>
<th>Sect Loss</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>b_t</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>t_t</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>b_c</td>
<td>60.3</td>
<td>0</td>
<td>60.3 mm</td>
</tr>
<tr>
<td>t_c</td>
<td>9.5</td>
<td>0.1</td>
<td>8.55 mm</td>
</tr>
<tr>
<td>s</td>
<td>82.6</td>
<td>0</td>
<td>82.6 mm</td>
</tr>
<tr>
<td>d_c</td>
<td>203.2</td>
<td>0</td>
<td>203.2 mm</td>
</tr>
<tr>
<td>w_c</td>
<td>7.9</td>
<td>0.1</td>
<td>7.11 mm</td>
</tr>
<tr>
<td>h_c</td>
<td>184.2</td>
<td>0</td>
<td>184.2 mm</td>
</tr>
<tr>
<td>b_b</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
<tr>
<td>t_b</td>
<td>0</td>
<td>0</td>
<td>0 mm</td>
</tr>
</tbody>
</table>

Area 5201.76 4681.584 mm²

a). Section Properties

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>y_bot (mm)</th>
<th>A*y_bot (mm³)</th>
<th>A*(y_bot-y_bot)² (mm^4)</th>
<th>I₀ (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover Plate</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Channel Top Flange</td>
<td>1031</td>
<td>197</td>
<td>203158</td>
<td>9577280</td>
</tr>
<tr>
<td>Channel Web</td>
<td>2619</td>
<td>101</td>
<td>263635</td>
<td>0</td>
</tr>
<tr>
<td>Channel Bottom Flange</td>
<td>1031</td>
<td>4</td>
<td>4408</td>
<td>9577280</td>
</tr>
<tr>
<td>Sum</td>
<td>4682</td>
<td>19154561</td>
<td>7418623</td>
<td></td>
</tr>
</tbody>
</table>

L = 6553 mm  Member Length
Y = 101 mm

I = 2.66E+07 mm⁴
r = 75 mm³
As = 1719 mm²

About Y-Axis

<table>
<thead>
<tr>
<th>Area (mm²)</th>
<th>X_CL (mm)</th>
<th>A*X_CL (mm³)</th>
<th>A*(X_CL)² (mm^4)</th>
<th>I₀ (mm⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover Plate</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Channel Top Flange</td>
<td>1031</td>
<td>71</td>
<td>73674</td>
<td>5264024</td>
</tr>
<tr>
<td>Channel Web</td>
<td>2619</td>
<td>45</td>
<td>117490</td>
<td>5270004</td>
</tr>
<tr>
<td>Channel Bottom Flange</td>
<td>1031</td>
<td>71</td>
<td>73674</td>
<td>5264024</td>
</tr>
<tr>
<td>Sum</td>
<td>4682</td>
<td>15798053</td>
<td>635915</td>
<td></td>
</tr>
</tbody>
</table>
Black Bridge Rd. Truss Bridge
Section B - Section Capacity

\[ I_y = 1.64 \times 10^7 \text{ mm}^4 \]
\[ r_y = 59 \text{ mm}^3 \]
\[ A_s = 2183 \text{ mm}^2 \]

Torsional Resistance

\[ \text{sum of } b t^3/3 \text{ for section } \]
\[ I_{xx} = 7.40 \times 10^4 \text{ mm}^4 \]

Summary Table for Midas Section Properties*

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ I_{yy} ]</td>
<td>[ 2.66 \times 10^7 \text{ mm}^4 ]</td>
</tr>
<tr>
<td>[ I_{zz} ]</td>
<td>[ 1.64 \times 10^7 \text{ mm}^4 ]</td>
</tr>
<tr>
<td>[ A_{sy} ]</td>
<td>[ 1718.55 \text{ mm}^2 ]</td>
</tr>
<tr>
<td>[ I_{xx} ]</td>
<td>[ 7.40 \times 10^4 \text{ mm}^4 ]</td>
</tr>
<tr>
<td>[ A_{sz} ]</td>
<td>[ 2183 \text{ mm}^2 ]</td>
</tr>
</tbody>
</table>

*note sign convention differs from what is used for calcs below

b). Section Classification

i). Channel Flange
\[ \frac{b}{t} = 7.05 < 145/\sqrt{F_y} \] Class 1

ii). Channel Web
\[ \frac{h}{w} = 25.91 < 670/\sqrt{F_y} \] Class 3

iii). Governing Class
Class 3

c). Check Flexural Buckling

i). Slenderness Ratio
\[ k = 1.0 \]
\[ L = 6553 \text{ mm} \] Member Length
\[ \phi_s = 0.90 \]
\[ k_s L_w/r_x = 87 < 120 \text{ OK} \]
\[ k_y L_y/r_y = 111 < 120 \text{ OK} \] Minor Axis Buckling Controls

\[ \lambda = \frac{kL}{r} \sqrt{\frac{F_y}{\pi^2 E_s}} \]
\[ \lambda_v = 1.2397 \]
\[ n = 1.34 \]
\[ C_r = \phi_s A F_y (1 + \lambda^{2/n})^{-1/n} \]
\[ C_r = 487.3671 \text{ kN} \] Governs

d). Check Flexural Torsional Buckling

Analysis for sections singly symmetric about Y-axis only

\[ R_0 = 2t \]
\[ R_0 = 14.22 \text{ mm} \] Outer corner radii

\[ R_i = t \]
\[ R_i = 7.11 \text{ mm} \] Inner corner radii

\[ R = \frac{R_0 + R_i}{2} = 1.5t \]
\[ R = 10.665 \text{ mm} \] Mean corner radius

\[ A_p = \frac{(d - t) (b - t) - R^2_c (4 - \pi)}{4} \]
\[ A_p = 15242 \text{ mm}^2 \] Enclosed area

\[ p = 2[(d - t) + (b - t)] - 2R_c (4 - \pi) = 539 \text{ mm} \] Mid-contour length

\[ J = \frac{4 A_p^2 t}{p} \]
\[ J = 1.23 \times 10^7 \text{ mm}^3 \] St. Venant Torsional Constant

\[ C_w = 0 \] Assume Closed Section

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ J ]</td>
<td>[ 1.23 \times 10^7 \text{ mm}^3 ]</td>
</tr>
<tr>
<td>[ Y_0 ]</td>
<td>[ 0 ]</td>
</tr>
</tbody>
</table>

108
Black Bridge Rd. Truss Bridge  
Section B - Section Capacity

\[ H = 1.0 \]

\[ F_{ey} = \frac{\pi^2 E_s}{(\kappa_f / r_f)^2} \]

\[ F_{ey} = 161.36116 \text{ MPa} \]

\[ r_0^2 = y_0^2 + r_r^2 \]

\[ r_0^2 = 9186.45 \text{ mm}^2 \]

\[ F_{ez} = \frac{\pi^2 E_s C_w}{(K_e)^2} + G_{yf} \]

\[ F_{ez} = 21943.93 \text{ MPa} \]

\[ F_{ex} = \frac{\pi^2 E_s}{(K_e L / r_e)^2} \]

\[ F_{ex} = 260.92 \text{ MPa} \]

\[ F_e = \frac{F_{ey} + F_{ez}}{2H} \left( 1 - \frac{3}{4} \frac{F_{ey} + F_{ez}}{F_e} \right) \]

\[ F_e = 161.36 \text{ MPa} \]

\[ \lambda_e = \sqrt{F_y / F_e} \]

\[ \lambda_e = 1.2397 \]

\[ C_r = \phi_m A F_y (1 + \lambda^{2n})^{-1/n} \]

\[ C_r = 487.3671 \text{ kN} \]

### e). Select Governing Compressive Capacity

\[ C_r = 487.367 \text{ kN} \]

**Flexural Buckling Capacity in the Strong Axis Governs**

**Flexural Torsional Buckling will not govern for this section since its doubly symmetric**

### f). Check Shear Capacity of Rivets

\[ V = 2.1 \text{ kN} \]

**Vertical Shear**

\[ Q = 100259.92 \text{ mm}^3 \]

**First moment of area**

\[ I_x = 2.87E+07 \text{ mm}^4 \]

**Moment of inertia of built-up section**

\[ q = V^*Q/I \]

\[ q = 7.33 \text{ N/mm} \]

**Shear Flow**

\[ S = 516 \text{ mm} \]

**Approximate spacing per rivet**

\[ n = 32 \]

**Approximate number of rivets**

\[ d = 19.05 \text{ mm} \]

**3/4" rivet diameter**

\[ V_l = q^*S \]

\[ V_l = 3.78 \text{ kN} \]

**Shear force per rivet**

### i) Rivets in bearing

<table>
<thead>
<tr>
<th>( \phi_{mc} )</th>
<th>0.67</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>6</td>
</tr>
<tr>
<td>d</td>
<td>21.05 mm *3/4&quot;+2mm</td>
</tr>
<tr>
<td>n</td>
<td>1 rivets</td>
</tr>
</tbody>
</table>
Black Bridge Rd. Truss Bridge  
Section B - Section Capacity

<table>
<thead>
<tr>
<th>e</th>
<th>35 mm</th>
<th>*from Dillon report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fu</td>
<td>320 Mpa</td>
<td>*rivets</td>
</tr>
<tr>
<td>Br</td>
<td>45.02 kN</td>
<td>&gt; 3.78 O.K.</td>
</tr>
</tbody>
</table>

ii) Rivets in shear

<table>
<thead>
<tr>
<th>( \phi_r )</th>
<th>0.67</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>1 rivets</td>
</tr>
<tr>
<td>m</td>
<td>1</td>
</tr>
<tr>
<td>Ar</td>
<td>285 mm²</td>
</tr>
<tr>
<td>Fu</td>
<td>320 Mpa</td>
</tr>
<tr>
<td>Vr</td>
<td>45.83 kN</td>
</tr>
</tbody>
</table>
3. DESIGN LOADS

3.1 Dead Loads

Concrete Deck & curb - Existing Condition

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>0.180</td>
</tr>
<tr>
<td>width</td>
<td>4.30</td>
</tr>
<tr>
<td>curb h</td>
<td>0.15</td>
</tr>
<tr>
<td>curb w</td>
<td>0.20</td>
</tr>
<tr>
<td>w</td>
<td>20.02</td>
</tr>
<tr>
<td>$P_{DL_INT}$</td>
<td>49.97</td>
</tr>
<tr>
<td>$P_{DL_END}$</td>
<td>24.98</td>
</tr>
</tbody>
</table>

*w_f_b_int* 24.91024 kN/m

*w_f_b_end* 12.45512 kN/m

Concrete Deck & curb - Final Condition (new curbs)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>0.180</td>
</tr>
<tr>
<td>width</td>
<td>4.30</td>
</tr>
<tr>
<td>inside w</td>
<td>3.80</td>
</tr>
<tr>
<td>curb h</td>
<td>0.18</td>
</tr>
<tr>
<td>curb w</td>
<td>0.25</td>
</tr>
<tr>
<td>w</td>
<td>20.74</td>
</tr>
<tr>
<td>$P_{DL_INT}$</td>
<td>51.77</td>
</tr>
<tr>
<td>$P_{DL_END}$</td>
<td>25.88</td>
</tr>
</tbody>
</table>

*w_f_b_int* 25.80629 kN/m

*w_f_b_end* 12.90315 kN/m

Floor Beam & Stringer S.W.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>end FB sw</td>
<td>0.63</td>
</tr>
<tr>
<td>int. FB sw</td>
<td>0.95</td>
</tr>
<tr>
<td>stringer sw</td>
<td>0.37</td>
</tr>
<tr>
<td>$P_{SW_INT}$</td>
<td>13.50</td>
</tr>
<tr>
<td>$P_{SW_END}$</td>
<td>6.027</td>
</tr>
</tbody>
</table>

*Railing S.W.*

Assume 1 kN/m line load along top chord on either end

3.2 Live Loads

LC1 - Original Design Loading Conditions (4tonne posted load)
Assume no heavy equipment

<table>
<thead>
<tr>
<th>posted load</th>
<th>4 tonne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>39.24 kN</td>
</tr>
<tr>
<td>Pressure</td>
<td>0.261104 kPa</td>
</tr>
<tr>
<td>SAY</td>
<td>0.5 kPa</td>
</tr>
<tr>
<td>P_PED_INT</td>
<td>4.745847 kN</td>
</tr>
<tr>
<td>P_PED_END</td>
<td>2.372923 kN</td>
</tr>
</tbody>
</table>

Pedestrian loading

<table>
<thead>
<tr>
<th>w_ped</th>
<th>3.84 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>34.95 m</td>
</tr>
<tr>
<td>P_PED_INT</td>
<td>36.40 kN</td>
</tr>
<tr>
<td>P_PED_END</td>
<td>18.20 kN</td>
</tr>
<tr>
<td>w_FB_int</td>
<td>18.61 kN/m</td>
</tr>
<tr>
<td>w_FB_end</td>
<td>9.31 kN/m</td>
</tr>
</tbody>
</table>

Reduced Loading (equivalent to parking garage)

<table>
<thead>
<tr>
<th>pressure</th>
<th>2.40 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>w_FB_int</td>
<td>11.65 kN/m</td>
</tr>
<tr>
<td>w_FB_end</td>
<td>5.82</td>
</tr>
</tbody>
</table>

Maintenance vehicle load

*Maintenance vehicle and pedestrian load are not applied simultaneously reactions from worst case maintenance vehicle are less than from pedestrian therefore pedestrian loads govern

3.3 Snow Load

<table>
<thead>
<tr>
<th>S</th>
<th>1.6 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (Int)</td>
<td>10.73 m²</td>
</tr>
</tbody>
</table>

*50 year return period

OBC Table 2

Climatic Data
### Black Bridge Rd. Truss Bridge
#### Section C - Design Loads

<table>
<thead>
<tr>
<th>Area (Ends)</th>
<th>5.37 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_{SL_INT} )</td>
<td>17.18 kN</td>
</tr>
<tr>
<td>( P_{SL_END} )</td>
<td>8.59 kN</td>
</tr>
<tr>
<td>( w_{FB_int} )</td>
<td>8.56 kN/m</td>
</tr>
<tr>
<td>( w_{FB_end} )</td>
<td>4.28 kN/m</td>
</tr>
</tbody>
</table>

#### 3.4 Wind Load

##### Vertical Wind Load

\[
F_v = q \cdot C_e \cdot C_g \cdot C_v
\]

3.10.2.3

<table>
<thead>
<tr>
<th>q</th>
<th>0.472 kPa</th>
<th><strong>50 year return period</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>C_e</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>C_g</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>C_v</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>F_v</td>
<td>1.18 kPa</td>
<td></td>
</tr>
<tr>
<td>Area (Int)</td>
<td>11.92 m²</td>
<td></td>
</tr>
<tr>
<td>Area (Ends)</td>
<td>5.96 m²</td>
<td></td>
</tr>
<tr>
<td>( P_{WV_INT} )</td>
<td>14.06 kN</td>
<td></td>
</tr>
<tr>
<td>( P_{WV_END} )</td>
<td>7.03 kN</td>
<td></td>
</tr>
<tr>
<td>( w_{FB_int} )</td>
<td>7.01 kN/m</td>
<td></td>
</tr>
<tr>
<td>( w_{FB_end} )</td>
<td>3.51 kN/m</td>
<td></td>
</tr>
</tbody>
</table>

##### Horizontal Wind Load

\[
F_h = q \cdot C_e \cdot C_g \cdot C_h
\]

*only included in 3 d model* 3.10.2.2

<table>
<thead>
<tr>
<th>q</th>
<th>0.472 kPa</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C_e</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>C_g</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>C_h</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>F_h</td>
<td>2.36 kPa</td>
<td><em>applied windward and leeward side</em> 3.10.2.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Member</th>
<th>d (front)</th>
<th>d (max)</th>
<th>w (kN/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.C. Outside</td>
<td>102</td>
<td>102</td>
<td>0.24072</td>
</tr>
<tr>
<td>B.C. Intermediate</td>
<td>152</td>
<td>152</td>
<td>0.35872</td>
</tr>
<tr>
<td>Stringer</td>
<td>254</td>
<td>254</td>
<td>0.59944</td>
</tr>
<tr>
<td>Conc. Deck</td>
<td>330</td>
<td>330</td>
<td>0.7788</td>
</tr>
<tr>
<td>Railing</td>
<td>150</td>
<td>150</td>
<td>0.354</td>
</tr>
<tr>
<td>End Vertical</td>
<td>76</td>
<td>114</td>
<td>0.26904</td>
</tr>
<tr>
<td>Int. Vertical</td>
<td>203</td>
<td>255.4</td>
<td>0.602744</td>
</tr>
<tr>
<td>Int. Diag. 1st</td>
<td>127</td>
<td>190.5</td>
<td>0.44958</td>
</tr>
<tr>
<td>Int. Diag 2nd.</td>
<td>76</td>
<td>114</td>
<td>0.26904</td>
</tr>
<tr>
<td>Int. Diag Middle</td>
<td>63</td>
<td>94.5</td>
<td>0.22302</td>
</tr>
<tr>
<td>Top Chord</td>
<td>203</td>
<td>203</td>
<td>0.47908</td>
</tr>
<tr>
<td>End Diagonal</td>
<td>203</td>
<td>203</td>
<td>0.47908</td>
</tr>
</tbody>
</table>

#### 3.5 Additional Lateral Load Due to Compressive Load
Assumed required bracing load is 0.5% of compressive load

### Compressive Load from 2D Model (kN) - LC1 Original Design Loading

<table>
<thead>
<tr>
<th>Member</th>
<th>Type</th>
<th>Conc. SW</th>
<th>Steel SW.</th>
<th>LL</th>
<th>Snow</th>
<th>Wind Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>13, 26</td>
<td>End Diag.</td>
<td>186.4</td>
<td>82</td>
<td>60.1</td>
<td>64.1</td>
<td>47.3</td>
</tr>
<tr>
<td>8, 12</td>
<td>End T.C.</td>
<td>188</td>
<td>83.3</td>
<td>60.6</td>
<td>64.6</td>
<td>47.7</td>
</tr>
<tr>
<td>9, 11</td>
<td>2nd T.C.</td>
<td>225.7</td>
<td>100.3</td>
<td>72.8</td>
<td>77.5</td>
<td>57.2</td>
</tr>
<tr>
<td>10</td>
<td>Mid T.C.</td>
<td>228.6</td>
<td>101.3</td>
<td>73.7</td>
<td>78.5</td>
<td>58</td>
</tr>
</tbody>
</table>

### Applied Lateral Loads (on each truss - kN) - LC1 Construction Loading

<table>
<thead>
<tr>
<th>Node</th>
<th>Type</th>
<th>Conc. SW</th>
<th>Steel SW.</th>
<th>LL</th>
<th>Snow</th>
<th>Wind Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>End</td>
<td>End Diag.</td>
<td>0.936</td>
<td>0.41325</td>
<td>0.30175</td>
<td>0.32175</td>
<td>0.2375</td>
</tr>
<tr>
<td>2nd</td>
<td>end T.C.</td>
<td>1.03425</td>
<td>0.459</td>
<td>0.3335</td>
<td>0.35525</td>
<td>0.26225</td>
</tr>
<tr>
<td>Middle</td>
<td>Middle T.C.</td>
<td>1.13575</td>
<td>0.504</td>
<td>0.36625</td>
<td>0.39</td>
<td>0.288</td>
</tr>
</tbody>
</table>

Assumed required bracing load is 0.5% of compressive load

### Compressive Load from 2D Model (kN) - LC2 Final Ped Bridge Loading

<table>
<thead>
<tr>
<th>Member</th>
<th>Type</th>
<th>Conc. SW</th>
<th>Steel SW.</th>
<th>LL</th>
<th>Snow</th>
<th>Wind Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>13, 26</td>
<td>End Diag.</td>
<td>210.6</td>
<td>82</td>
<td>153.5</td>
<td>64.1</td>
<td>53.2</td>
</tr>
<tr>
<td>8, 12</td>
<td>End T.C.</td>
<td>212.4</td>
<td>83.3</td>
<td>154.8</td>
<td>64.6</td>
<td>53.6</td>
</tr>
<tr>
<td>9, 11</td>
<td>2nd T.C.</td>
<td>255</td>
<td>100.3</td>
<td>185.9</td>
<td>77.5</td>
<td>64.4</td>
</tr>
<tr>
<td>10</td>
<td>Mid T.C.</td>
<td>258.2</td>
<td>101.3</td>
<td>188.2</td>
<td>78.5</td>
<td>65.2</td>
</tr>
</tbody>
</table>

### Applied Lateral Loads (on each truss - kN) - LC2 Final Ped Bridge Loading

<table>
<thead>
<tr>
<th>Node</th>
<th>Type</th>
<th>Conc. SW</th>
<th>Steel SW.</th>
<th>LL</th>
<th>Snow</th>
<th>Wind Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>End</td>
<td>End Diag.</td>
<td>1.0575</td>
<td>0.41325</td>
<td>0.77075</td>
<td>0.32175</td>
<td>0.267</td>
</tr>
<tr>
<td>2nd</td>
<td>end T.C.</td>
<td>1.1685</td>
<td>0.459</td>
<td>0.85175</td>
<td>0.35525</td>
<td>0.295</td>
</tr>
<tr>
<td>Middle</td>
<td>Middle T.C.</td>
<td>1.283</td>
<td>0.504</td>
<td>0.93525</td>
<td>0.39</td>
<td>0.324</td>
</tr>
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</table>

### 3.6 Vertical Load Summary Table

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>w Load (kN/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Deck Int.</td>
<td>DL-D2</td>
<td>25.81</td>
</tr>
<tr>
<td>Concrete Deck End</td>
<td>DL-D2</td>
<td>12.90</td>
</tr>
<tr>
<td>Steel SW</td>
<td>DL-D1</td>
<td>*calculated by Midas</td>
</tr>
<tr>
<td>Ped (LL) Int.</td>
<td>LL</td>
<td>18.61</td>
</tr>
<tr>
<td>Ped (LL) End.</td>
<td>LL</td>
<td>9.31</td>
</tr>
<tr>
<td>Snow Load Int.</td>
<td>Snow</td>
<td>8.56</td>
</tr>
<tr>
<td>Snow Load End.</td>
<td>Snow</td>
<td>4.28</td>
</tr>
<tr>
<td>Vert. Wind Load Int.</td>
<td>Wind</td>
<td>7.01</td>
</tr>
<tr>
<td>Vert. Wind Load End.</td>
<td>Wind</td>
<td>3.51</td>
</tr>
<tr>
<td>Railing Load</td>
<td>DL-D1</td>
<td>1.50</td>
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</table>

### 3.5 Load Factors & Combinations
# Black Bridge Rd. Truss Bridge
## Section C - Design Loads

<table>
<thead>
<tr>
<th>Load Combination</th>
<th>DL-D1</th>
<th>DL-D2</th>
<th>LL</th>
<th>SL</th>
<th>WL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLS1</td>
<td>1</td>
<td>1</td>
<td>0.9</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ULS1</td>
<td>1.1</td>
<td>1.2</td>
<td>1.7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ULS2</td>
<td>1.1</td>
<td>1.2</td>
<td>1.6</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>ULS3</td>
<td>1.1</td>
<td>1.2</td>
<td>1.4</td>
<td>0.5</td>
<td>0.45</td>
</tr>
<tr>
<td>ULS4</td>
<td>1.1</td>
<td>1.2</td>
<td>0</td>
<td>0</td>
<td>1.4</td>
</tr>
<tr>
<td>DL</td>
<td>1.1</td>
<td>1.2</td>
<td>0</td>
<td>1.5</td>
<td>0</td>
</tr>
</tbody>
</table>

*Snow load factors based on bridge office memo "guidelines for the design of pedestrian and bicycle bridges" Oct 2007*
## Black Bridge Rd. Truss Bridge
### Section D - Capacity vs. Demand

#### Capacity vs. Demand for LC2 Final Pedestrian Bridge Loading - 2D TRUSS

<table>
<thead>
<tr>
<th>Truss Member</th>
<th>No.</th>
<th>T/C</th>
<th>SLS1</th>
<th>ULS1</th>
<th>ULS2</th>
<th>ULS3</th>
<th>ULS4</th>
<th>DL (fact)</th>
<th>LL+WL</th>
<th>Capacity</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom Chord - Ends</td>
<td>1,2,6,7</td>
<td>T</td>
<td>288.9</td>
<td>345.6</td>
<td>357</td>
<td>354.9</td>
<td>248.5</td>
<td>262.6</td>
<td>116.2</td>
<td>791.80</td>
<td>OK</td>
</tr>
<tr>
<td>Bottom Chord - Interior</td>
<td>3,4,5</td>
<td>T</td>
<td>569.1</td>
<td>680.7</td>
<td>703.1</td>
<td>698.8</td>
<td>490</td>
<td>517.7</td>
<td>228</td>
<td>824.38</td>
<td>OK</td>
</tr>
<tr>
<td>End Vertical</td>
<td>14,25</td>
<td>T</td>
<td>118.1</td>
<td>142</td>
<td>147</td>
<td>146</td>
<td>99.8</td>
<td>105.9</td>
<td>50.5</td>
<td>320.80</td>
<td>OK</td>
</tr>
<tr>
<td>1st Interior Diagonal</td>
<td>15,24</td>
<td>T</td>
<td>317</td>
<td>379.1</td>
<td>391.5</td>
<td>389.1</td>
<td>273.3</td>
<td>288.6</td>
<td>126.5</td>
<td>588.88</td>
<td>OK</td>
</tr>
<tr>
<td>2nd Interior Diagonal</td>
<td>17,22</td>
<td>T</td>
<td>159.3</td>
<td>190.5</td>
<td>196.7</td>
<td>195.5</td>
<td>137.4</td>
<td>145.1</td>
<td>63.5</td>
<td>342.17</td>
<td>OK</td>
</tr>
<tr>
<td>Middle Interior Diagonal</td>
<td>19,20</td>
<td>T</td>
<td>11.9</td>
<td>14.8</td>
<td>13.9</td>
<td>13.8</td>
<td>10.2</td>
<td>10</td>
<td>4.9</td>
<td>258.60</td>
<td>OK</td>
</tr>
<tr>
<td>Top Chord</td>
<td>8,9,10,11,12</td>
<td>C</td>
<td>582.8</td>
<td>697.2</td>
<td>720.2</td>
<td>715.8</td>
<td>501.6</td>
<td>529.9</td>
<td>233.9</td>
<td>1279.70</td>
<td>OK</td>
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<tr>
<td>End Diagonals</td>
<td>13,26</td>
<td>C</td>
<td>477</td>
<td>570.5</td>
<td>589.2</td>
<td>585.6</td>
<td>410.9</td>
<td>434</td>
<td>190.8</td>
<td>1009.53</td>
<td>OK</td>
</tr>
<tr>
<td>Interior Verticals</td>
<td>16,18,21,23</td>
<td>C</td>
<td>133.7</td>
<td>159.2</td>
<td>164.1</td>
<td>163.2</td>
<td>117</td>
<td>123.1</td>
<td>50.5</td>
<td>487.37</td>
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</table>

<table>
<thead>
<tr>
<th>Truss Member</th>
<th>C/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom Chord - Ends</td>
<td>2.22</td>
</tr>
<tr>
<td>Bottom Chord - Interior</td>
<td>1.17</td>
</tr>
<tr>
<td>End Vertical</td>
<td>2.18</td>
</tr>
<tr>
<td>1st Interior Diagonal</td>
<td>1.50</td>
</tr>
<tr>
<td>2nd Interior Diagonal</td>
<td>1.74</td>
</tr>
<tr>
<td>Middle Interior Diagonal</td>
<td>17.47</td>
</tr>
<tr>
<td>Top Chord</td>
<td>1.78</td>
</tr>
<tr>
<td>End Diagonals</td>
<td>1.71</td>
</tr>
<tr>
<td>Interior Verticals</td>
<td>2.97</td>
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</tbody>
</table>

#### Capacity vs. Demand for LC2 Final Pedestrian Bridge Loading - 3D TRUSS

<table>
<thead>
<tr>
<th>Truss Member</th>
<th>No.</th>
<th>T/C</th>
<th>SLS1</th>
<th>ULS1</th>
<th>ULS2</th>
<th>ULS3</th>
<th>ULS4</th>
<th>DL (fact)</th>
<th>LL+WL</th>
<th>Capacity</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom Chord - Ends</td>
<td>1,2,6,7</td>
<td>T</td>
<td>0.9</td>
<td>1.2</td>
<td>1.2</td>
<td>1.3</td>
<td>1</td>
<td>0.9</td>
<td>0.5</td>
<td>791.80</td>
<td>OK</td>
</tr>
<tr>
<td>Bottom Chord - Interior</td>
<td>3,4,5</td>
<td>T</td>
<td>140.5</td>
<td>168.3</td>
<td>173.8</td>
<td>186</td>
<td>162.3</td>
<td>127.4</td>
<td>86.4</td>
<td>824.38</td>
<td>OK</td>
</tr>
<tr>
<td>End Vertical</td>
<td>14,25</td>
<td>T</td>
<td>111.6</td>
<td>135.3</td>
<td>139.9</td>
<td>139.3</td>
<td>95.9</td>
<td>100.1</td>
<td>49.1</td>
<td>320.80</td>
<td>OK</td>
</tr>
<tr>
<td>1st Interior Diagonal</td>
<td>15,24</td>
<td>T</td>
<td>335.7</td>
<td>402.4</td>
<td>415.4</td>
<td>421.6</td>
<td>315.8</td>
<td>303.8</td>
<td>155.7</td>
<td>588.88</td>
<td>OK</td>
</tr>
<tr>
<td>2nd Interior Diagonal</td>
<td>17,22</td>
<td>T</td>
<td>159.3</td>
<td>190.8</td>
<td>197</td>
<td>200.1</td>
<td>150.7</td>
<td>144.4</td>
<td>73.8</td>
<td>342.17</td>
<td>OK</td>
</tr>
<tr>
<td>Middle Interior Diagonal</td>
<td>19,20</td>
<td>T</td>
<td>11.1</td>
<td>13.2</td>
<td>13.5</td>
<td>13.4</td>
<td>9.8</td>
<td>10.4</td>
<td>3.9</td>
<td>258.60</td>
<td>OK</td>
</tr>
<tr>
<td>Top Chord</td>
<td>8,9,10,11,12</td>
<td>C</td>
<td>555.7</td>
<td>666.9</td>
<td>688.1</td>
<td>690.8</td>
<td>499.6</td>
<td>502.7</td>
<td>241.1</td>
<td>1279.70</td>
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</tr>
<tr>
<td>End Diagonals</td>
<td>13,26</td>
<td>C</td>
<td>510.3</td>
<td>610.8</td>
<td>630.8</td>
<td>656.8</td>
<td>531.2</td>
<td>462.5</td>
<td>272.7</td>
<td>1009.53</td>
<td>OK</td>
</tr>
</tbody>
</table>
# Black Bridge Rd. Truss Bridge

## Section D - Capacity vs. Demand

<table>
<thead>
<tr>
<th></th>
<th>C/D (3D)</th>
<th>C/D (2D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom Chord - Ends</td>
<td>609.08</td>
<td>2.22</td>
</tr>
<tr>
<td>Bottom Chord - Interior</td>
<td>4.43</td>
<td>1.17</td>
</tr>
<tr>
<td>End Vertical</td>
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<td>1.40</td>
<td>1.50</td>
</tr>
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<td>2nd Interior Diagonal</td>
<td>1.71</td>
<td>1.74</td>
</tr>
<tr>
<td>Middle Interior Diagonal</td>
<td>19.16</td>
<td>17.47</td>
</tr>
<tr>
<td>Top Chord</td>
<td>1.85</td>
<td>1.78</td>
</tr>
<tr>
<td>End Diagonals</td>
<td>1.54</td>
<td>1.71</td>
</tr>
<tr>
<td>Interior Verticals</td>
<td>2.77</td>
<td>2.97</td>
</tr>
</tbody>
</table>

### Loads in End Transverse Truss (C/T - kN) - Existing Conditions

<table>
<thead>
<tr>
<th>C/D</th>
<th>Wind</th>
<th>SLS1</th>
<th>ULS3</th>
<th>ULS4</th>
<th>All Lateral</th>
<th>Capacity</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5486452</td>
<td>Knee Brace</td>
<td>98.6</td>
<td>60.7</td>
<td>118</td>
<td>188.5</td>
<td>148.7</td>
<td>291.9196</td>
</tr>
<tr>
<td>0.9421079</td>
<td>Vert. Single Angle</td>
<td>76.5</td>
<td>46.7</td>
<td>91</td>
<td>145.7</td>
<td>115.3</td>
<td>137.2651</td>
</tr>
<tr>
<td>1.1849204</td>
<td>Horiz. Angle Top</td>
<td>29.7</td>
<td>45.8</td>
<td>68</td>
<td>75.7</td>
<td>48.7</td>
<td>89.69848</td>
</tr>
<tr>
<td>1.4801729</td>
<td>Horiz. Angle Bottom</td>
<td>31.5</td>
<td>23.3</td>
<td>41.4</td>
<td>60.6</td>
<td>47.7</td>
<td>89.69848</td>
</tr>
<tr>
<td>1.5578599</td>
<td>Diagonal Angle</td>
<td>40.7</td>
<td>25.8</td>
<td>49.4</td>
<td>78.1</td>
<td>51.3</td>
<td>121.6689</td>
</tr>
</tbody>
</table>

* Additional vertical single angle to be added to east end transverse truss

### Check combined axial and compressive loads in end diagonal as per CHBDC 10.9.4.1

**Existing Structure with no modifications (i.e. FB released, no brace) full proposed loading**

**At knee brace location**

a) cross sectional strength

- **Cr** 1788.055 kN
- **Mrx** 85.11379 kN-m - considered class 3 section for this check
- **Cey** 9656.543 kN
- **Cex** 1448.771 kN
- **Mry** 151.7912 kN-m - considered class 3 section for this check
b) overall member strength

**Cr** 1009.527 kN

**Mrx** 85.11379 kN-m - considered class 3 section for this check

**Cey** 9656.543 kN *used Le as distance from bearing to knee brace

**Cex** 1448.771 kN

**Mry** 151.7912 kN-m - considered class 3 section for this check

---

**Existing Structure with no modifications -
checked for section mid-height between bearing and knee brace**

**a) cross sectional strength**

**Cr** 1788.055 kN

**Cex** 1.45E+03

**Mrx** 85.11379 kN

**Mry** 151.7912 kN-m - considered class 3 section for this check

<table>
<thead>
<tr>
<th></th>
<th>Wind</th>
<th>SLS1</th>
<th>ULS1</th>
<th>ULS2</th>
<th>ULS3</th>
<th>ULS4</th>
</tr>
</thead>
<tbody>
<tr>
<td>End. Diag</td>
<td>Mz=Mfy (kN-m)</td>
<td>50.3</td>
<td>19.3</td>
<td>22.4</td>
<td>23.5</td>
<td>46.2</td>
</tr>
</tbody>
</table>

---

---
### Existing Structure with Plates welded to channel web (at knee brace)

#### a) Cross sectional strength

<table>
<thead>
<tr>
<th></th>
<th>Wind</th>
<th>SLS1</th>
<th>ULS1</th>
<th>ULS2</th>
<th>ULS3</th>
<th>ULS4</th>
</tr>
</thead>
<tbody>
<tr>
<td>End. Diag</td>
<td>My=Mfx (kN-m)</td>
<td>1.3</td>
<td>3.1</td>
<td>3.8</td>
<td>4</td>
<td>4.3</td>
</tr>
<tr>
<td>End. Diag</td>
<td>Fz (kN)</td>
<td>118.7</td>
<td>509.1</td>
<td>609.5</td>
<td>629.5</td>
<td>655.5</td>
</tr>
<tr>
<td>End. Diag</td>
<td>U1y**</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>End. Diag</td>
<td>U1x</td>
<td>1.089</td>
<td>1.542</td>
<td>1.726</td>
<td>1.768</td>
<td>1.826</td>
</tr>
<tr>
<td>End. Diag</td>
<td>D/C for combined</td>
<td>0.414</td>
<td>0.468</td>
<td>0.566</td>
<td>0.590</td>
<td>0.763</td>
</tr>
</tbody>
</table>

** in Minor access direction, frame is unbraced, therefore U1y is 1 (Cl. 10.9.4.1 (c) (iv))
Black Bridge Rd. Truss Bridge
Section D - Capacity vs. Demand

<table>
<thead>
<tr>
<th>End. Diag</th>
<th>U1y**</th>
<th>1.000</th>
<th>1.000</th>
<th>1.000</th>
<th>1.000</th>
<th>1.000</th>
<th>1.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>End. Diag</td>
<td>U1x</td>
<td>1.043</td>
<td>1.217</td>
<td>1.272</td>
<td>1.283</td>
<td>1.298</td>
<td>1.228</td>
</tr>
<tr>
<td>End. Diag</td>
<td>D/C for combined</td>
<td>0.375</td>
<td>0.362</td>
<td>0.427</td>
<td>0.444</td>
<td>0.601</td>
<td>0.807</td>
</tr>
</tbody>
</table>

** in Minor access direction, frame is unbraced, therefore U1y is 1 (Cl. 10.9.4.1 (c) (iv))

b) overall member strength

\[ Cr = 1715.048 \text{ kN} \]
\[ Mr_x = 167.939 \text{ kN-m} \]
\[ Cey = 1.25 \times 10^4 \text{ kN} \]
\[ *used \, Le \, as \, distance \, from \, bearing \, to \, knee \, brace \]
\[ Cex = 2.86 \times 10^3 \text{ kN} \]
\[ Mr_y = 238.8233 \text{ kN-m} \]

<table>
<thead>
<tr>
<th>End. Diag</th>
<th>Wind</th>
<th>SLS1</th>
<th>ULS1</th>
<th>ULS2</th>
<th>ULS3</th>
<th>ULS4</th>
</tr>
</thead>
<tbody>
<tr>
<td>End. Diag</td>
<td>Mz_max=Mfy (kN-m)</td>
<td>77.7</td>
<td>37.9</td>
<td>44</td>
<td>46.1</td>
<td>81.2</td>
</tr>
<tr>
<td>End. Diag</td>
<td>My=Mfx (kN-m)</td>
<td>0.7</td>
<td>1.4</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>End. Diag</td>
<td>Fz (kN)</td>
<td>118.7</td>
<td>510.3</td>
<td>610.8</td>
<td>630.8</td>
<td>656.8</td>
</tr>
<tr>
<td>End. Diag</td>
<td>U1y**</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>End. Diag</td>
<td>U1x</td>
<td>1.043</td>
<td>1.217</td>
<td>1.272</td>
<td>1.283</td>
<td>1.298</td>
</tr>
<tr>
<td>End. Diag</td>
<td>D/C for Max</td>
<td>0.3989</td>
<td>0.466385</td>
<td>0.551737</td>
<td>0.572294</td>
<td>0.73456</td>
</tr>
</tbody>
</table>

** in Minor access direction, frame is unbraced, therefore U1y is 1 (Cl. 10.9.4.1 (c) (iv))

Existing Structure with no modifications -
checked for section at end diagonal at bearing
a) cross sectional strength

\[ Cr = 1788.055 \text{ kN} \]
\[ C_{ex} = 1.45 \times 10^3 \text{ kN} \]
\[ Mr_{x} = 85.11379 \text{ kN} \]
\[ Mr_{y} = 151.7912 \text{ kN-m} \, - \, considered \, class \, 3 \, section \, for \, this \, check \]

<table>
<thead>
<tr>
<th>End. Diag</th>
<th>Wind</th>
<th>SLS1</th>
<th>ULS1</th>
<th>ULS2</th>
<th>ULS3</th>
<th>ULS4</th>
</tr>
</thead>
<tbody>
<tr>
<td>End. Diag</td>
<td>Mz_mid=Mfy (kN-m)</td>
<td>21.9</td>
<td>7</td>
<td>8.2</td>
<td>8.6</td>
<td>18.3</td>
</tr>
<tr>
<td>End. Diag</td>
<td>My=Mfx (kN-m)</td>
<td>1.8</td>
<td>7.7</td>
<td>9</td>
<td>9.2</td>
<td>9.8</td>
</tr>
<tr>
<td>End. Diag</td>
<td>Fz (kN)</td>
<td>118.7</td>
<td>510.3</td>
<td>610.8</td>
<td>630.8</td>
<td>656.8</td>
</tr>
<tr>
<td>End. Diag</td>
<td>U1y**</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>
**Black Bridge Rd. Truss Bridge**

**Section D - Capacity vs. Demand**

<table>
<thead>
<tr>
<th>End. Diag</th>
<th>U1x</th>
<th>1.089</th>
<th>1.544</th>
<th>1.729</th>
<th>1.771</th>
<th>1.829</th>
<th>1.579</th>
</tr>
</thead>
<tbody>
<tr>
<td>End. Diag</td>
<td>D/C for combined</td>
<td>0.234</td>
<td>0.471</td>
<td>0.578</td>
<td>0.601</td>
<td>0.699</td>
<td>0.705</td>
</tr>
</tbody>
</table>

** in Minor access direction, frame is unbraced, therefore U1y is 1 (Cl. 10.9.4.1 (c) (iv))

b) overall member strength

Cr   1009.527 kN
Ce,x 1.45E+03 kN
Mr_x 85.11379 kN-m
Mr_y 151.7912 kN-m - considered class 3 section for this check

<table>
<thead>
<tr>
<th>Wind Mz_mid=Mfy (kN-m)</th>
<th>SLS1</th>
<th>ULS1</th>
<th>ULS2</th>
<th>ULS3</th>
<th>ULS4</th>
</tr>
</thead>
<tbody>
<tr>
<td>End. Diag</td>
<td>21.9</td>
<td>7</td>
<td>8.2</td>
<td>8.6</td>
<td>18.3</td>
</tr>
<tr>
<td>End. Diag. My=Mfx (kN-m)</td>
<td>1.8</td>
<td>7.7</td>
<td>9</td>
<td>9.2</td>
<td>9.8</td>
</tr>
<tr>
<td>End. Diag Fz (kN)</td>
<td>118.7</td>
<td>510.3</td>
<td>610.8</td>
<td>630.8</td>
<td>656.8</td>
</tr>
<tr>
<td>End. Diag U1y**</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>End. Diag U1x</td>
<td>1.089</td>
<td>1.544</td>
<td>1.729</td>
<td>1.771</td>
<td>1.829</td>
</tr>
<tr>
<td>End. Diag D/C for Max</td>
<td>0.28489</td>
<td>0.69126</td>
<td>0.841873</td>
<td>0.872952</td>
<td>0.981791</td>
</tr>
</tbody>
</table>

** in Minor access direction, frame is unbraced, therefore U1y is 1 (Cl. 10.9.4.1 (c) (iv))
1.0 Identification of Fatigue Prone Details

<table>
<thead>
<tr>
<th>Detail</th>
<th>Description</th>
<th>Category</th>
<th>Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Truss bottom chords and diagonal members at gusset plates fastened by rivets</td>
<td>D</td>
<td>2,3,4,5,6,15,17,19,20,22 &amp; 24</td>
</tr>
<tr>
<td>2</td>
<td>Truss bottom chords at gusset plates fastened by high strength bolts</td>
<td>B</td>
<td>1 &amp; 7</td>
</tr>
</tbody>
</table>

2.0 Structural Fatigue Under Proposed Pedestrian Loading

2.1 General Requirements

\( F_{sr} \) is the fatigue stress range resistance of a member

\[
F_{sr} = (\gamma/N_c)^{(1/3)} \quad \text{if } F_{sr} \geq F_{srt}, \text{ else}
\]

\[
F_{sr} = (\gamma'/N_c)^{(1/5)} \quad \text{and } \geq F_{srt}/2
\]

0.52\( C_L f_{sr} \) \( < F_{sr} \) = stress due to Pedestrian live load + wind load @ FLS

\[
0.52 C_L \times f_{sr} = \text{stress due to Pedestrian live load + wind load @ FLS}
\]

0.52\( C_L \times f_{sr} = 1.0 \) Since pedestrian loading only is considered

2.2 \( F_{sr} \) Calculation

Fatigue analysis for truss members is performed at 4 locations. Each location falls under a detail category as outlined in Cl.10.7.2.3.2, Table 10.4 and Cl.10.17.2.5, Table 10.7.

The detail categories are as follows:
- Category B (mechanical connection)
- Category D (riveted connection)

\[
N_c = 365 \times Y \times N_d \times (ADTT_F) = 200000 \quad \text{Cycles as per recommendations of MTO}
\]

Memo for design of pedestrian bridges

<table>
<thead>
<tr>
<th>Detail</th>
<th>Category</th>
<th>( \gamma )</th>
<th>( F_{srt} ) (Mpa)</th>
<th>( \gamma' )</th>
<th>Life Cycle</th>
<th>( N_c )</th>
<th>( L_{span} ) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>B</td>
<td>7.21E+11</td>
<td>48</td>
<td>1.66E+15</td>
<td>75</td>
<td>200000</td>
<td>34950</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>3.93E+12</td>
<td>110</td>
<td>4.76E+16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Detail</th>
<th>Connections at Member Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>( F_{sr} ) = 153 MPa</td>
</tr>
<tr>
<td></td>
<td>( \geq F_{srt} = 48 ) MPa</td>
</tr>
<tr>
<td></td>
<td>Use ( F_{sr} = 153 ) MPa</td>
</tr>
<tr>
<td>B</td>
<td>( F_{sr} ) = 270 MPa</td>
</tr>
<tr>
<td></td>
<td>( \geq F_{srt} = 110 ) MPa</td>
</tr>
<tr>
<td></td>
<td>Use ( F_{sr} = 270 ) MPa</td>
</tr>
</tbody>
</table>

2.3 Load Induced Fatigue Stress Range

<table>
<thead>
<tr>
<th>Member</th>
<th>Fatigue Category</th>
<th>( f_{max} )</th>
<th>( f_{min} )</th>
<th>( F_{range} )</th>
<th>( A_g )</th>
<th>( A_{net} )</th>
<th>( f_{sr} )</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,6 &amp; 7</td>
<td>B</td>
<td>116</td>
<td>0</td>
<td>116.2</td>
<td>3205</td>
<td>2749</td>
<td>42</td>
<td>O.K.</td>
</tr>
<tr>
<td>3, 4 &amp; 5</td>
<td>D</td>
<td>228</td>
<td>0</td>
<td>228</td>
<td>3980</td>
<td>2903</td>
<td>79</td>
<td>O.K.</td>
</tr>
<tr>
<td>14 &amp; 25</td>
<td>D</td>
<td>51</td>
<td>0</td>
<td>50.5</td>
<td>1885</td>
<td>1288</td>
<td>39</td>
<td>O.K.</td>
</tr>
<tr>
<td>15 &amp; 24</td>
<td>D</td>
<td>156</td>
<td>0</td>
<td>155.7</td>
<td>2969</td>
<td>2073</td>
<td>75</td>
<td>O.K.</td>
</tr>
</tbody>
</table>
### 2.4 Infinite Fatigue Life Check

<table>
<thead>
<tr>
<th>Member Category</th>
<th>Fatigue</th>
<th>( f_{sr} )</th>
<th>( F_{srt} )</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 6 &amp; 7 B</td>
<td>42</td>
<td>110</td>
<td>-</td>
<td>( f_{sr} &lt; F_{srt} )</td>
</tr>
<tr>
<td>3, 4 &amp; 5 D</td>
<td>79</td>
<td>48</td>
<td>-</td>
<td>( f_{sr} &lt; F_{srt} )</td>
</tr>
<tr>
<td>14 &amp; 25 D</td>
<td>39</td>
<td>48</td>
<td>-</td>
<td>( f_{sr} &lt; F_{srt} )</td>
</tr>
<tr>
<td>15 &amp; 24 D</td>
<td>75</td>
<td>48</td>
<td>-</td>
<td>( f_{sr} &lt; F_{srt} )</td>
</tr>
<tr>
<td>17 &amp; 22 D</td>
<td>61</td>
<td>48</td>
<td>-</td>
<td>( f_{sr} &lt; F_{srt} )</td>
</tr>
</tbody>
</table>

### 2.5 Remaining Fatigue Life Estimation for Members with Finite Remaining Fatigue Life

\[
Y = \log \left[ \frac{R_g \ A}{365 \ n \ (ADTT)} \right]^{\frac{1}{\log(1+g)}} \ (1+g)^{(a-1)} + 1
\]

- \( R_g = 1.0 \) See table below
- \( A = 2.20E+09 \) Ksi Fatigue life constant for CAT D
- \( g = 0.02 \) 2% Growth rate assumed
- \( n = 1 \) stress cycles per truck
- \( a = 107 \) age of the bridge
- \( ADTT = 100 \) AADT = 2000

<table>
<thead>
<tr>
<th>Member Category</th>
<th>Fatigue</th>
<th>( f_{sr} )</th>
<th>( Y_{rem} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 4 &amp; 5 D</td>
<td>11</td>
<td>-</td>
<td>103 Years</td>
</tr>
<tr>
<td>15 &amp; 24 D</td>
<td>6</td>
<td>-</td>
<td>202 Years</td>
</tr>
<tr>
<td>17 &amp; 22 D</td>
<td>11</td>
<td>-</td>
<td>109 Years</td>
</tr>
</tbody>
</table>
### Tables from AASHTO MBE

<table>
<thead>
<tr>
<th>Detail Category (from Table 6.6.1.2.5-1 of the LRFD Specifications)</th>
<th>$R_R$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum Life</td>
</tr>
<tr>
<td>A</td>
<td>1.0</td>
</tr>
<tr>
<td>B</td>
<td>1.0</td>
</tr>
<tr>
<td>B'</td>
<td>1.0</td>
</tr>
<tr>
<td>C</td>
<td>1.0</td>
</tr>
<tr>
<td>C'</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td><strong>1.0</strong></td>
</tr>
<tr>
<td>E</td>
<td>1.0</td>
</tr>
<tr>
<td>E'</td>
<td>1.0</td>
</tr>
</tbody>
</table>

2.3 Base metal at the net section of all bolted connections in hot-dipped galvanized members (Huta and Valtinat, 2004); base metal at the appropriate section defined in Condition 2.1 or 2.2, as applicable, of high-strength bolted joints with precarved bolts installed in holes punched full size (Brown et al., 2007), and base metal at the net section of other mechanically fastened joints, except for eyebars and pin plates; e.g., joints using ASTM A327 bolts or non-preitensioned high strength bolts.

| D | $22 \times 10^6$ | 7 | In the net section originating at the side of the hole or through the gross section near the hole, as applicable |
To: Municipal Heritage Advisory Committee

Meeting Date: 5/16/2024

Report Title: 24-013 (MHAC) 171 Guelph Avenue (Forbes Estate) Heritage Conservation Easement Agreement

Report Author: Jeremy Parsons, Senior Planner-Heritage

Department Approval: Joan Jylanne, Manager of Policy Planning

Department: Community Development

Division: Policy Planning

Report No.: 24-013 (MHAC)

File No.: R01.01.155

Ward: Ward 1

RECOMMENDATION(S):

THAT Report 24-013 (MHAC) 171 Guelph Avenue (Forbes Estate) Heritage Conservation Easement Agreement be received;

AND FURTHER THAT the Municipal Heritage Advisory Committee recommend that Council approve the draft heritage conservation easement agreement, attached as Appendix A to this report.

EXECUTIVE SUMMARY:

Purpose

This report has been prepared to consult with the Municipal Heritage Advisory Committee (MHAC) on a draft heritage conservation easement agreement for the property located at 171 Guelph Avenue (Forbes Estate). The easement agreement is required to satisfy a condition of Plan of Subdivision 30T-18103.

Key Findings

- 171 Guelph Avenue was once a part of a large estate belonging to the Forbes family. The property contains the Forbes Estate House, a dwelling that was built in 1912 and designed by architecture firm Taylor and Taylor.
- In 2022, the Ontario Land Tribunal approved a Plan of Subdivision to divide the former 5.25-hectare estate into residential blocks. The subject property was registered as a 1.08-acre parcel in 2024.
The implementation of a heritage conservation easement agreement was a condition of the Plan of Subdivision to ensure the long-term conservation of the Forbes Estate House.

The heritage conservation easement agreement (attached as Appendix A) includes a Statement of Cultural Heritage Value and parameters related to the maintenance and long-term conservation of the Forbes Estate House.

Financial Implications

There are no direct costs with heritage conservation easement agreements. However, the costs of maintaining private property are solely borne by the property owner.

STRATEGIC ALIGNMENT:

☐ Strategic Action; or
☒ Core Service

Objective(s): Not Applicable

Strategic Action: Not Applicable

Program: Community Development

Core Service: Heritage Conservation

BACKGROUND:

The subject property is located at 171 Guelph Avenue, immediately north of Forbes Lane and northwest of the Speed River and Hespeler Mill Pond (Figure 1). The subject property is currently zoned R2 (residential) within the City’s Zoning By-law.

The subject property was previously part of a large estate lot belonging to the Forbes family. The subject property was subdivided from a larger 5.25-hectare property and includes the Forbes House, a large Classical Revival dwelling built in 1912, and a dry-stone wall fronting onto Guelph Avenue.

In 2018, a Draft Plan of Subdivision was submitted to the City of Cambridge by Polocorp Inc. A Cultural Heritage Impact Assessment (CHIA) was also submitted in 2018 by Archaeological Services Inc and later revised in 2020.

In 2022, Report 22-015-CD was brought before Council approving direction to designate the property under Part IV of the Ontario Heritage Act, relocate the stone tower, permit the demolition of secondary buildings, and permit the development of the original lands.

In 2022, the Ontario Land Tribunal approved a Plan of Subdivision for the former estate which divided the former Forbes Estate into sixteen (16) blocks that would be registered in two (2) phases. The Forbes Estate House lot comprised Phase 1 of the subdivision.
and was formally registered as its own residential lot in March of 2024 (Plan 58M716). The balance of the former estate, known as Phase 2, is set to be registered at a later date.

In order to ensure that the heritage attributes of the Forbes Estate House are maintained in accordance with the Conservation Plan (attached as Appendix B) and that costs of the works associated with urgent repairs to the Forbes Estate House are secured, the property owner will enter into a heritage conservation agreement with the City of Cambridge. A condition of Plan of Subdivision 30T-18103 states:

THAT the applicant agrees to enter into an agreement to undertake a Conservation Plan for the Forbes Estate House to the satisfaction of the City of Cambridge and that the recommendations of the accepted Conservation Plan be secured through a development agreement or heritage easement with the City of Cambridge, or other appropriate mechanism, to the satisfaction of the City of Cambridge.

In 2023, a Conservation Plan for the Forbes Estate House was completed by ERA Architects (attached as Appendix B).

Figure 1: Aerial photograph of the subject property at 171 Guelph Avenue with the Forbes Estate House indicated by a red pin (Google Maps, 2024).
EXISTING POLICY / BY-LAW(S):

Ontario Heritage Act (R.S.O. 1990, c. O.18)

Easements

37 (1) Despite subsection 36 (1), after consultation with its municipal heritage committee, if one is established, the council of a municipality may pass by-laws providing for the entering into of easements or covenants with owners of real property or interests in real property, for the conservation of property of cultural heritage value or interest. 2002, c. 18, Sched. F, s. 2 (19).

Idem

(2) Any easement or covenant entered into by a council of a municipality may be registered, against the real property affected, in the proper land registry office. R.S.O. 1990, c. O.18, s. 37 (2).

Idem

(3) Where an easement or covenant is registered against real property under subsection (2), such easement or covenant shall run with the real property and the council of the municipality may enforce such easement or covenant, whether positive or negative in nature, against the owner or any subsequent owners of the real property, and the council of the municipality may enforce such easement or covenant even where it owns no other land which would be accommodated or benefited by such easement or covenant. R.S.O. 1990, c. O.18, s. 37 (3).

Assignment

(4) Any easement or covenant entered into by the council of a municipality under subsection (2) may be assigned to any person and such easement or covenant shall continue to run with the real property and the assignee may enforce the easement or covenant as if it were the council of the municipality and it owned no other land which would be accommodated or benefited by such easement or covenant. R.S.O. 1990, c. O.18, s. 37 (4).

Conflict

(5) Where there is a conflict between an easement or covenant entered into by a council of a municipality under subsection (1) and section 33 or 34, the easement or covenant shall prevail. R.S.O. 1990, c. O.18, s. 37 (5).

Heritage Master Plan (2008)

Neighbourhood of Guelph Avenue
History

Hespeler’s “northern survey” is a residential neighbourhood developed primarily in the late 19th and early 20th centuries to house the prosperous middle class and, in several cases, the owners of the major local industries. Much of the land east of Guelph Avenue was owned by the Forbes family, owners of the largest mill in Hespeler.

Heritage Character

This area has a wide variety of housing ages and styles, from the mid-19th century to the mid-late 20th century, and a variety of materials, from limestone rubblestone, plaster, clapboard, and brick. It is characterized by large houses on large lots.

Character Defining Elements:

- neighbourhood boundary signified by the site and remnants of the original Hespeler estate house;
- early century estate style developments on the east side, with generous lots;
- some middle-class residential development on the west side; and
- wider street, mature tree canopy.

Cultural Assets:

- site of original Hespeler estate;
- estate houses of the early industrialists.

Conservation and Development Concerns and Opportunities

Any neighbourhood having large houses on large lots is vulnerable to subdivision and insensitive infill, as well as potential demolition of existing heritage buildings in order to increase the amount of buildable lands. Through traffic will also be an issue. Another potential threat to the area’s heritage character is inappropriate alterations. Conservation and enhancement of the streetscape and heritage buildings will help to counter this threat.

ANALYSIS:

Heritage conservation easements are binding legal agreements between property owners and municipalities that protect heritage features and stipulate conditions for alterations. Easements are registered on property titles and apply in perpetuity to any future owners. Easements are stronger and more comprehensive than Part IV designations, ensuring that heritage properties are adequately maintained and insured.
The proposed heritage conservation easement agreement for 171 Guelph Avenue (attached as Appendix A) intends to conserve the cultural heritage value of the Forbes Estate House as set out in the Statement of Cultural Heritage Value within the easement itself. The easement is also intended to secure the immediate repair work required for the conservation of the Forbes Estate House. The easement protects exterior heritage attributes of the dwelling as well as landscape features such as the winding driveway, front lawn vegetation, and the stone rubble wall which formed part of the estate boundary along Guelph Avenue.

The heritage conservation easement agreement outlines that the owner shall restore the Forbes Estate House in accordance with the maintenance recommendations outlined in Section 4 of the Conservation Plan. It is indicated that all reasonable efforts should be made to adhere to the general repair and restoration timeline outlined in the Conservation Plan.

Section 37 of the Ontario Heritage Act authorizes municipalities to enter into easements or covenants with owners for the conservation of properties of cultural heritage value or interest. Section 37 also requires that the Municipal Heritage Advisory Committee (MHAC) be consulted on all proposed easement agreements.

Heritage Planning staff are of the opinion that implementing an easement agreement for the Forbes Estate House will ensure that it is appropriately maintained and conserved long-term. The existing property owner has reviewed the proposed easement and is in support. The maintenance recommendations provided in Section 4 of the Conservation Plan include urgent repairs (0-6 months), short-term repairs (within 1-2 years), and long-term repairs and restoration (within 5 years). A Letter of Credit was secured by the City of Cambridge for short term repairs only. All other maintenance, repair, and restoration guidance are recommendations; however, they will be regulated through the City’s Heritage Permit process. All recommendations provided within the easement and the Conservation Plan are intended to improve the existing conditions of the dwelling and reduce the rate of deterioration for identified heritage attributes.

**FINANCIAL IMPACT:**
There are no direct costs with heritage conservation easement agreements. However, the costs of maintaining private property are solely borne by the property owner.

**PUBLIC VALUE:**

**Transparency:**
To ensure transparency, MHAC meeting agendas are posted on the City’s website.

**PUBLIC INPUT:**
Meetings of the MHAC are open to the public via the City’s YouTube channel.
INTERNAL / EXTERNAL CONSULTATION:
Heritage planning staff have liaised with the property owner and with staff from the Legal Services Division in crafting the heritage conservation easement agreement. The property owners are satisfied with the contents of the easement agreement.

CONCLUSION:
For the reasons outlined in this report, Heritage Planning staff recommend that MHAC recommend Council approve the draft heritage conservation easement agreement for the Forbes Estate House at 171 Guelph Avenue to ensure that the dwelling and landscape features are appropriately maintained and conserved.

REPORT IMPACTS:
Agreement: Yes
By-law: No
Budget Amendment: No
Policy: No

APPROVALS:
This report has been reviewed and approved for inclusion in the agenda by the respective Departmental Manager.

ATTACHMENTS:
1. 24-013 (MHAC) Appendix A: Draft Heritage Conservation Easement Agreement
2. 24-013 (MHAC) Appendix B: Conservation Plan
THIS HERITAGE EASEMENT AGREEMENT made this ___ day of ___ , 2024

BETWEEN:

THE CORPORATION OF THE CITY OF CAMBRIDGE

(hereinafter referred to as "the City")

-and-

Polocorp Inc.

(hereinafter referred to as the "Owner")

WHEREAS the Owner is the owner of lands and premises situated in the City of Cambridge, Regional Municipality of Waterloo, Province of Ontario, the parcel known municipally as 171 Guelph Avenue, being more particularly described in Schedule "A" to this Heritage Easement Agreement ("HEA") (hereinafter "the Lands");

AND WHEREAS there is a building located on the Lands known as “171 Guelph Avenue” (hereinafter “Forbes Estate House”) which is of cultural heritage value and which is to be protected through designation of the property under Part IV of the Ontario Heritage Act, R.S.O. 1990, c.O.18 once the “Work” under this HEA is completed;

AND WHEREAS one of the purposes of the Ontario Heritage Act is to support, encourage and facilitate the conservation, protection, and preservation of Ontario's cultural heritage resources such as the Forbes Estate House.

AND WHEREAS by subsection 37(1) of the Ontario Heritage Act, the City may enter into easements or covenants with owners of real property or persons having interests therein, for the conservation of property of cultural heritage value or interest;

AND WHEREAS by subsection 37(3) of the Ontario Heritage Act, such easements and covenants, when registered in the proper Land Registry Office against the real property affected by them shall run with the real property and may be enforced by the City or its assignee against the owners or any subsequent owners of the real property, even where the City owns no other land which would be accommodated or benefited by such covenants or easements;

AND WHEREAS the City and Owner desire, in this HEA, to conserve the elements of cultural heritage value of the Forbes Estate House as set out in the Statement of Cultural Heritage Value in Schedule “B” to this HEA and in the Conservation Plan dated January 6, 2023, on file at the City, and to secure the restoration and rehabilitation of
the Forbes Estate House in accordance with the Conservation Plan, attached in part below. The full Conservation Plan is on file at the City.

NOW THEREFORE THIS INDENTURE WITNESSETH that in consideration of the payment of the sum of TWO DOLLARS ($2.00) from each party to the other and for other good and valuable consideration, including the mutual covenants contained herein, the receipt and sufficiency of which is hereby acknowledged, the City and the Owner (collectively "the Parties") hereto covenant, agree and warrant as follows:

THEREFORE the parties agree as follows:

1.0 **RECITALS. SCHEDULES, AND REASONS FOR IDENTIFICATION**

1.1 The Recitals and Schedules shall form part of this HEA.

1.2 The Owner and the City agree that for the purposes of this HEA, the Statement of Cultural Heritage Value included as Schedule “B” sets out the reasons why the Forbes Estate House has been identified by the City as having cultural heritage value and will be the basis of any designation by-law for the property that may be brought forward in the future following this agreement.

1.3 Further, the Owner and the City agree for the purposes of this HEA, the original photographs included in the Conservation Plan show the state of the Forbes Estate House prior to the undertaking of the works outlined in Sections 2.3, 2.4 and 2.5 of this HEA and generally depict certain significant features of the appearance or the construction of the Forbes Estate House. The parties also agree that when determining the duties of the Owner under this HEA, the Conservation Plan shall be referred to.

1.4 Following the restoration of the Forbes Estate House in accordance with this HEA, the City shall be permitted to take replacement photographs to those mentioned in Section 1.3 above, identifying the same features as in the original photographs. The new photographs shall be kept on file with the City.

2.0 **DUTIES OF THE OWNER**

**Alterations**

2.1 The Owner shall not, without the prior written approval of the City, undertake or permit any alteration, demolition, repair, construction, remodelling, restoration, relocation or any other thing or act which would materially affect the heritage features of the Forbes Estate House as described in the Statement of Cultural Heritage Value and shown in photographs in the Conservation Plan.
2.2 Any application for the written permission of the City under Section 2.1 shall be submitted in the same form and considered by the City pursuant to the same process as an application for similar activities for individually designated properties under Part IV of the *Ontario Heritage Act* (heritage permit).

**Permitted Alterations**

2.3 The Owner shall restore the Forbes Estate House in accordance with the Conservation Plan.

2.4 The Owner shall restore and renovate the Forbes Estate House in accordance with the Conservation Plan’s maintenance recommendations outlined in Section 4. A timeline has been established for urgent repairs (Section 4.3), Short Term Repairs and Restoration (Section 4.4), and Long Term Repairs and Restoration (Section 4.5). All reasonable efforts should be made to adhere to general repair and restoration timeline outlined in Section 4 of the Conservation Plan.

2.5 If, prior to the commencement of the work contemplated in Sections 2.3, 2.4, 2.5 and 2.10, the Owner desires to make revisions to this proposed work, written permission must be obtained from the City in accordance with Section 2.2.

**Security and Breach of Owner’s Obligations**

2.6 Immediately upon execution of this HEA, the Owner will provide the City with security in the amount of $411,500 in order to secure the Owner’s obligations hereunder. The amount of $411,500 is based on an estimate of the full cost of work to be performed with respect to the Heritage Building, as outlined in Section 2.1, 2.4, 2.5 and 2.10 and in accordance with the Conservation Plan.

2.7 The Owner covenants and agrees:

   a) to provide to the City prior to execution of this Agreement by the City, an irrevocable and unconditional letter of credit from a financial institution acceptable to the City or other security (the “security”) deemed satisfactory at the sole discretion of the City in the amount set out in the Conservation Plan for the cost of all Works related to conservation of the Forbes estate and stone wall and compliance with all conditions in this Agreement;

   b) to file a letter of credit and to keep the said letter of credit in full force and effect and pay all premiums as the said letter(s) of credit becomes due or until such time as the City reduces or returns the letter of credit in
accordance with Clause 2.7c);

c) that the security held for the Works and Facilities referenced in Clause 2.7a) shall be fully released by the City once one hundred per cent (100%) of the total cost of the Works have been completed and paid by the Owner.

d) that pursuant to the Municipal Act, 2001, in the event the Owner fails to perform the Works required to be performed herein, such Works and Facilities may be performed and/or completed by the City at the Owner’s expense. Upon failure of the Owner to complete the Works within the said one (1) year period, or to undertake any other obligation of the Owner under this Agreement, the City may provide 30 days written notice to require remedy. If the deficiency or obligation is not performed within the notice period, the City and/or its authorized agents may enter in and upon the property of the Owner without providing notice to the Parties and perform and/or complete the Works at the Owner's expense. In the event that the City and/or its authorized agents perform or complete any or all of the Works, the City may draw on the aforementioned letter of credit or other satisfactory security approved by the City in such amount(s) as may be required to pay for the cost incurred by the City and/or its authorized agents to perform and/or complete the Works. In addition, or in the alternative, the City may add the full cost or any part of the cost incurred by the City or its authorized agents to perform or complete the Works to the tax roll of the Lands and collect the expense in like manner as municipal taxes;

e) that wherever in this Agreement a letter of credit is required to be filed with the City, the Owner may deposit with the City cash, certified cheque or bank draft in an amount equal to the letter of credit and such deposit shall be held by the City as security in accordance with this Agreement, provided that no interest shall be payable by the City on any such deposit; and;

f) that upon the transfer of ownership of the Lands, the City will not return any letter of credit required under this Agreement until the new owner files with the City a substitute letter of credit or such other security as may be permitted in the required amounts.

2.8 If the City is of the opinion, reasonably held, that the Owner has failed to perform any of its obligations set out in this HEA, in addition to any of its other legal or equitable remedies, the City may serve on the Owner a notice setting out particulars of the breach and of the City’s estimated maximum costs of remedying the breach. The Owner shall have ninety (90) days from receipt of such notice to remedy the breach or make arrangements satisfactory to the City for remedy of the breach, or the City may draw on the security to the amount of
the actual cost of remedying the breach and may enter upon the Lands to complete the Owner's obligations. Any expenses reasonably incurred by the City in completing the obligations of the Owner over and above the security provided shall be a debt owed by the Owner to the City and recoverable by the City by action in a court of law or may be added as an additional charge by the City on the Owner's Property Taxes and collected in a similar manner as municipal taxes.

**Insurance**

2.9 The Owner shall at all times keep the Forbes Estate House insured against all perils including fire, in an amount equal to no less than the replacement cost of the Forbes Estate House as if it had been properly relocated, is intact and is restored in accordance with the Conservation Plan and the requirements of this Agreement. The City shall be added to the insurance policy as a Loss Payee.

2.10 Upon execution of this HEA, the Owner shall deliver to the City a certified copy of the insurance policy, with limits and with a company that is acceptable to the City. At least three (3) weeks before the expiry of this policy, the Owner shall provide evidence of renewal of said policy satisfactory to the City.

2.11 If the Owner fails to insure the Forbes Estate House, as required in Section 2.11, or if any such insurance on the Forbes Estate House is cancelled or terminated, the City may obtain such insurance as the City deems necessary in an amount equal to the replacement cost as described in Section 2.11. Any sum paid in so doing shall forthwith be paid by the Owner to the City or, if not, shall be a debt due and owing to the City and recoverable from the Owner by action in a court of law or may be added as an additional charge by the City on the Owner's Property Taxes and collected in a similar manner as municipal taxes.

2.12 All proceeds receivable by the Owner under any insurance policy on the Forbes Estate House shall be applied to the replacement, rebuilding, restoration or repair of the Forbes Estate House to the fullest extent possible having regard to the Statement of Cultural Heritage Value in Schedule “B”, the Conservation Plan, the particular nature of the Forbes Estate House, and the cost of such work.

2.13 The Owner and any consultant/contractor on behalf of the Owner shall identify, hold harmless and defend the City and their respective directors, officers, council members, partners, agents and employees from and against all claims, demands, losses, costs (including all legal costs), damages, actions, suits or proceedings that arise directly or indirectly out of, or are attributable to, the Owner's performance of, or failure to perform contractual obligations,
condition of the work, the place of the work, a joining lands or highways used in connection with the performance of the work, including any act or omission of the owner or its agents, any sub consultant/contractor, employees, workers or other persons for whom the Owner and/or consultant/contractor is in law responsible. This indemnification shall include any legal costs incurred by the City of Cambridge on a substantial indemnity basis, including those incurred to defend any criminal or quasi-criminal prosecutions against the City resulting from the actions of the owner and/or the actions of any consultant or contractor performing work on the Owner’s behalf.

**Damage or Destruction**

2.14 The Owner shall notify the City of any damage or destruction to the Forbes Estate House within five (5) days of such damage or destruction being discovered.

2.15 In the event of damage or destruction of the Forbes Estate House the Owner shall, subject to prior approval from the City, replace, rebuild, restore or repair the Forbes Estate House in accordance with the Conservation Plan. The Owner shall submit all plans and specifications for such replacement, rebuilding, restoration or repair to the City for its written approval within ninety (90) days of the discovery of damage or destruction. Any approval will be made with reference to the Conservation Plan. The determination of the Senior Planner-Heritage shall be final. If the City fails to respond to a submission of plans and specifications within ninety (90) days of the receipt, approval shall be deemed to have been given.

2.16 The Owner agrees it shall carry out the work described in Section 2.15 on the Forbes Estate House but shall not cause such work to be commenced before receiving the written approval of the City of the plans and specifications for it. Any such work shall conform to the plans and specifications approved by the City and any terms and conditions as the City may stipulate acting reasonably. All work on the Forbes Estate House shall be commenced within thirty (30) days of the City's approval and shall be completed within nine (9) months of commencement of that work, or as soon as possible thereafter if factors beyond the Owner's control prevent completion within the nine (9) months.

2.17 If the Owner fails to submit plans and specifications pursuant to Section 2.15 which are acceptable to the City, the City may prepare its own set of plans and specifications. The Owner shall have sixty (60) days from receiving a copy of such plans and specifications to notify the City in writing that it intends to carry out the work in accordance with those plans and specifications, failing which the City may enter on the property, on thirty (30) days’ notice to the Owner, and proceed with the work. The cost of such work shall be up to the value of any insurance proceeds receivable by the Owner under any insurance policies and any additional amount that the City is
prepared to contribute to the cost of such work. Upon demand, the Owner shall reimburse the City for expenses incurred by the City. In the event that the insurance proceeds are insufficient to cover the reasonable costs of the work, any deficiency shall become a debt due to the City and may be collected from the Owner in any manner permitted by law, including adding the cost as an additional charge by the City on the Owner’s Property Taxes and collected in a similar manner as municipal taxes.

**Maintenance and Security of the Heritage Building**

2.18 The Owner shall be responsible for ensuring that the Forbes Estate House is maintained and secured in compliance with the *Fire Protection and Prevention Act, 1997*, S.O. 1997, c. 4, as amended or succeeded, and the Fire Code thereunder, as well as City by-laws having the intent of ensuring the property is not a fire hazard, is secured from unauthorized entry and is maintained in a good state of repair and complies with all applicable law.

**Emergencies**

2.19 Notwithstanding section 2.1, the Owner may undertake temporary measures in respect of the Forbes Estate House so long as they are:

- a) In keeping with the intent of this HEA;
- b) Consistent with the conservation of the Forbes Estate House and the Statement of Cultural Heritage Value in Schedule B;
- c) Reasonably necessary to deal with an emergency which puts the security or integrity of the Forbes Estate House at risk of damage;
- d) In compliance with the *Building Code Act, 1992*, S.O. 1992, c. 23, as amended or succeeded; and
- e) Undertaken in consultation with the City’s Heritage Planning Staff unless time does not permit consultation in case of emergency.

2.20 If time does not permit the Owner to consult with City’s Heritage Planning Staff before undertaking any temporary measures, the Owner shall notify the City of any measures taken within ten (10) days and must make arrangements with and satisfactory to the City for a permanent solution, where one is required by the Senior Planner-Heritage.
Notice to City of Divestment

2.21 The Owner shall immediately notify the City in the event that the Owner divests itself of the fee simple title to or of their possessory interest in the Lands.

3.0 WAIVER

3.1. The failure of the City at any time to require performance by the Owner of any obligation under this HEA shall in no way affect its right thereafter to enforce such obligation, nor shall the waiver by the City of the performance of any obligation be taken or be held to be a waiver of the performance of the same or any other obligation at any later time.

4.0 EXTENSION OF TIME

4.1 Time shall be of the essence of this HEA. Any time limits specified in this HEA may be extended with the consent in writing of both the Owner and the City, but no such extension of time shall operate as an extension of any other time limit, for which time shall remain of the essence.

5.0 INSPECTION OF THE HERITAGE BUILDING

5.1 The City or its representatives shall be permitted at all reasonable times to enter upon the Lands and inspect the Forbes Estate House upon prior written notice to the Owner of at least twenty-four (24) hours, or as otherwise permitted pursuant to the *Ontario Heritage Act*.

6.0 SEVERABILITY

6.1 The Owner and the City agree that all covenants, easements and restrictions contained in this HEA shall be severable, and that should any covenant, easement or restriction in this HEA be declared invalid or unenforceable, the remaining covenants, easements and restrictions shall not terminate thereby.

7.0 NOTICE

7.1. Any notices to be given under this HEA shall be in writing and be delivered by personal delivery, prepaid registered mail, or by email to the other party as follows:
THE OWNER
Polocorp Inc.
Address:
Telephone:
Email:

City Clerk
The Corporation of the City of Cambridge 50 Dickson Street
P.O. Box 669
Cambridge, ON N1R 5W8 Tel: (519) 740-4683
Fax: (855) 351-9223

And to:

Chief Planner, Community Development Department The Corporation of the City of Cambridge

50 Dickson Street
P.O. Box 669
Cambridge, ON N1R 5W8 Tel: (519) 623-1340
Fax: (519) 740-7729

7.2. Notice shall be deemed to have been received on the date of personal delivery or email transmission if such date is a business day and delivery is made prior to 4:00pm and otherwise on the fifth (5th) day after the date of mailing by prepaid registered mail.

7.3. The parties shall notify each other immediately, in writing or by email, of any changes of address from those set out above.

8.0 ENTIRETY

8.1 This written HEA embodies the entire agreement of the parties with regard to the matters dealt with herein, and no understandings or agreements, verbal or otherwise, exist between the parties except as herein expressly set out.

9.0 SUBSEQUENT INSTRUMENTS TO CONTAIN THESE PROVISIONS

9.1 Notice of these covenants shall be inserted by the Owner in any subsequent agreement affecting that portion of the Lands on which the Forbes Estate House is located or relocated and by which the Owner divests itself of the fee simple title to, or of their possessory interest in that portion of the Lands on which the Forbes Estate House is located or relocated.
10.0 INTERPRETATION

10.1 The headings in the body of this HEA form no part of the HEA but shall be deemed to be inserted for convenience of reference only.

10.2 This HEA shall be construed with all changes in number and gender as may be required by the context.

11.0 REGISTRATION

11.1 It is understood and agreed that this HEA shall be registered on title to the Lands in priority to all other interests in the Lands at the Owners’ expense and shall not be removed until the Owner has completed all obligations as set out herein to the satisfaction of the Senior Planner-Heritage.

12.0 ENUREMENT

12.1 It is intended that the covenants, easements, and restrictions set out in this HEA shall run with the Lands and shall enure to the benefit of and be binding upon the Owner and upon the City and their respective heirs, executors, administrators, successors and assigns, as the case may be.

12.2 In the event that the Owner transfers the Lands, upon the purchaser of the Lands providing their agreement by way of Unilateral Undertakings in favour of the City to assume the obligations of the Owner pursuant to this HEA, the Owner named herein shall be released from any further obligations and liability and such purchasers shall be deemed to be the parties originally named as the Owner.

13.0 POSTPONEMENTS

13.1 Prior to the registration of this HEA on title to the Lands, the Owner shall provide any postponements the City Solicitor considers necessary to ensure that this HEA shall have priority over any other interests in the Lands when registered. This shall be provided at no cost to the City.

IN WITNESS WHEREOF the parties have hereunto affixed their signatures attested to by their proper signing officers in that behalf:
OWNER: [INSERT]

Per:
Name:
Title:

Per:
Name:
Title:

I/We have authority to bind the Corporation.

City of Cambridge:

Per:
Name:
Title:

I/We have authority to bind the Corporation.
SCHEDULE “A”

Legal Description of the Lands

Schedule “A”

Block 1, Plan 58M-716, City of Cambridge, PIN 03758-1449(LT).
SCHEDULE “B”

STATEMENT OF CULTURAL HERITAGE VALUE

The property at 171 Guelph Avenue, City of Cambridge retains physical/design, historical/associative, and contextual value.

The property at 171 Guelph Avenue, known as the Forbes Estate, includes a fine example of a Classical Revival home with Beaux-Arts details. The Forbes House displays high degrees of craftsmanship and artistic merit throughout including its expressive front façade that incorporates ornate Ionic columns, wooden railings, and robust cornice. The building has a prominent porte-cochère that incorporates stone elements and includes Beaux-Arts details such as lead windows and exterior light fixtures. The Forbes House was designed by Taylor and Taylor, a Brantford based architecture firm that designed numerous important buildings in Brantford including the Market Building, Temple Building, Masonic Hall, and Brantford City Hall. The firm also designed buildings in Ingersoll, Woodstock, London, along with the St. Andrew’s Presbyterian Church in Hespeler. In addition to the Forbes House, the property formerly featured a stone tower used for agricultural purposes that will be relocated to Jacob’s Landing at the Hespeler Mill Pond.

The Forbes Estate’s location on the fringes of the Hespeler community adjacent to the Speed River is consistent with a historical approach to landscape and estate design that maintained that a rural setting and proximity to the natural environment were beneficial to health and wellness. The high degree of craftsmanship and artistic merit of the Forbes House, the Forbes Estate’s winding driveway and its articulation with a porte-cochère, extant rows of vegetation, remnant rubble stone wall, and the former orchard are consistent features of estate-like properties.

Historically, the property is associated with several prominent residents throughout its history, namely George Forbes, the first mayor of the Town of Hespeler, founder of the Dominion Woollens Textile Mill, and a prominent industrialist within the community. Forbes’ assemblage of the property has created the large estate-like property. Forbes’ son George Alexander Forbes also lived on the property and, like his father, was a prominent capitalist but was also known for his conservation work involving wood ducks. George Forbes’s brother-in-law, Zachariah Hall, also lived in the Forbes House. Hall was a local manufacturer and notable inventor of the two-piece hockey stick. Additionally, the property is associated with early agricultural development in Hespeler and may be associated with Hespeler’s original farm, associating the property with one of the community’s earliest settlers, an important business person within the Hespeler community, and the namesake for the town.

Contextually, the Forbes Estate has historically been a defining feature north of the Speed River with the property comprising much of the land east of Guelph Avenue. Today, the Forbes Estate is much smaller but retains a distinctive setting on Guelph Avenue. Though partially obscured, the Forbes House is the visually predominant feature of the property.
and is one of three buildings on contiguous properties on the east side of Guelph Avenue with historic influences and similar setbacks from the street. The east side of Guelph Avenue is tree-lined and contributes to the streetscape and exemplifies the private character of the Forbes Estate.

**Description of Heritage Attributes**

**Forbes House**

- The location of the Forbes House, set back from Guelph Avenue;
- The winding driveway leading to the Forbes House;
- The materials including buff brick and stone plinths, lintels, sills, ornamentation, and wood detailing;
- The front facade including the entrance with its stone lintel, wooden doors, and sidelights; incorporating Beaux-Arts details, the ornate ionic columns, wooden railings, porch, and balcony;
- The rare porte-cochere on the south elevation which is supported by four square brick piers sitting on stone plinths with base mouldings. The roof of the porte-cochere has a cornice with dentils and decorative brackets;
- The Beaux-Arts details including lead windows and exterior light fixtures; and
- The slate mansard roof with flared eaves, identical dormers, and robust cornice including dentils and brackets on all elevations.
- Three brick external chimneys on the south, north and east elevations;
- The symmetrical principal (west) façade, that features ornate ionic columns with a stone base, a first-floor porch, and second storey balcony that spans the width of the front elevation, containing robust wooden railings;
- The overhanging roof, which contains a significant cornice with dentils and evenly spaced brackets;
- A projecting portion of the building on the north elevation that contains two stone band courses and an external chimney with stepped stone inset.

**Other features**

- The rubble wall, which contributes to the estate boundary along Guelph Avenue;
- The rows of vegetation on the property demarcating the boundary along Guelph Avenue and the internal boundary between the Forbes House and the original George Forbes House that was demolished in 1949.
FORBES ESTATE

Conservation Plan

171 Guelph Avenue, Cambridge, ON
Issued: December 07, 2022
Revised: January 06, 2023
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Cover Image: Existing entrance to Forbes House (Polo Corp Inc., 2018)
This Conservation Plan was prepared for the preservation of the Forbes House, located at 171 Guelph Avenue, in the City of Cambridge. This Conservation Plan is for the exterior of the house only, but does include some recommendations for noteworthy interior heritage attributes as well.

The property consisting of the Forbes House is a 5.4 ha site within the former Town of Hespeler. The property contains several other buildings and landscape features including:

- 155 Guelph Avenue (c.1900 residential building).
- North Garage (late-nineteenth century coach house/garage which supported the Original George Forbes House that was demolished in 1949).
- Stone Building (mid-nineteenth century structure of unconfirmed function).
- South Garage (post-1950s outbuilding).
- Central Garage (post-1950s outbuilding).

A Draft Plan of Subdivision was submitted for the property in 2018, and the existing lot is to be severed with the Forbes House situated on a larger parcel that will include the perimeter stone wall. The remainder of the site will house the proposed development which involves the construction of a new residential subdivision of the Forbes Estate property. The three garages on the property are to be demolished. The northern tree line is to be maintained. The Stone Building will be relocated to Jacobs Landing Park, approximately 500m south of its original location. A separate conservation plan will be submitted to the City of Cambridge for this structure.

This report follows a Heritage Impact Assessment (HIA) originally issued by ASI in September 2018, and revised in February 2020.

The proposed preservation of the Forbes House will maintain the heritage value of the site by:

- Repairing, repointing and cleaning of localized areas.
- Surface prep, putty and repainting existing deteriorated windows and doors.
- Replacement of localized damaged windows to match existing.
- Minor restoration of the concrete steps beneath the porte-cochere on the south elevation.
- Localized repairs of the slate roof.
- Repairing and replacing deteriorated wood features such as soffits and balustrade.
- Providing a construction management and maintenance plan for noteworthy interior heritage attributes.
- Constructing a new three-car garage built from salvaged materials (if possible), or similar.
1.1 Scope of the Report

ERA Architects (“ERA”) has prepared this conservation plan on behalf of Polocorp Inc. and has developed the conservation approach with reference to the City of Cambridge’s Conservation Plan Requirements.

The purpose of this Conservation Plan is to identify and describe the scope of work required to conserve the heritage value and attributes listed. This Conservation Plan includes a description of the various heritage attributes observed on site, the recommended conservation work, construction management plan, maintenance plan, and detailed photographs to show the extent and location of this work.

This report should be read in conjunction with the approved HIA originally issued by ASI in September, 2018, and revised in February, 2020.

The proposal will preserve the building for continuing residential use. The work described in this Conservation Plan will be executed by a specialist subcontractor with a minimum of 5 years experience working with heritage structures. The work will be reviewed on site by ERA for general conformance with heritage guidelines and the conservation notes described in this report.
1.2 Site Location & Description

The Forbes House is located at 171 Guelph Ave, Cambridge, ON. The site is a 5.25 hectare property and contains several other buildings and landscape features. The property is the remnant of a 145-acre property formerly owned by the Forbes Family that included much of the triangular piece of land bordered by Guelph Avenue, Blackbridge Road, and the Speed River.

The Forbes House was constructed in 1912 and is listed on the City of Cambridge’s Heritage Register. The property also contains a Stone Building (mid-nineteenth century structure of unconfirmed function) and three garages.

1.3 Heritage Recognition

It is determined that the Forbes House and the Stone Building meet the criteria for designation under Part IV of the Ontario Heritage Act and meet the requirements under the City of Cambridge’s Criteria for Evaluating Heritage Properties.

1.4 Historic Overview

The existing Forbes House was designed by Brantford-based architects Taylor and Taylor and constructed in 1912. According to Lawrence Turner of the Company of Neighbours, the current house was built by George Forbes and was the home of his sister Margaret and her husband Zachariah Hall, who was a local manufacturer, notable inventor of the two-piece hockey stick, and a Conservative Party Member of Provincial Parliament from 1914 to 1919. This started a long chain of ownership within the Forbes family with the house passing to Forbes’ son George Alexander Forbes, and later to his grandson Ross Wilson in the 1980’s.

1.5 Summary of Exterior Heritage Attributes

The property at 171 Guelph Ave. has cultural heritage value as a well-crafted and excellent representative example of Classical Revival architecture from the early 1900’s. ERA prepared a list of the heritage attributes of the property at 171 Guelph Ave., which are as follows:

- The location of the Forbes House, set back from Guelph Avenue;
- The winding driveway leading to the Forbes House;
- The materials, with the buff brick cladding and stone plinths, lintels, sills, ornamentation and wood detailing;
- The slate mansard roof with flared eaves and identical dormers on each elevation;
- Three brick external chimneys on the south, north and east elevations;
- The symmetrical principal (west) façade, that features ornate ionic columns with a stone base, a first floor porch, and second storey balcony that spans the width of the front elevation, containing robust wooden railings;
- The main entry, which is elevated and protected by a porch with classical detailing, and sidelights on either side;
- Beaux-Arts style lead windows found throughout the house;
- The overhanging roof, which contains a significant cornice with dentils and evenly spaced brackets;
- A rare porte-cochere on the south elevation which is supported by four square brick piers sitting on stone plinths with base mouldings. The roof of the porte-cochere has a cornice with dentils and decorative brackets;
- A projecting portion of the building on the north elevation that contains two stone band courses and an external chimney with stepped stone inset.
1.6 Summary of Interior Heritage Attributes

The following is a list of interior heritage attributes identified by ERA Architects. Although these are not identified by the scope of the HIA, or the CP, ERA Architects strongly recommends that these elements be incorporated in any renovation:

- The entrance vestibule and hallway with the cornice mouldings, the baseboards, the paneled wainscoting, the door surrounds, the paneled wood doors and the ornate vision panels within the doors;
- The pocket doors separating the various rooms on the ground floors, with the door surrounds and the paneled doors with vision glass;
- The wooden staircase with the detailing on the stringers, hand rails, newel posts and spindles;
- The northwest and southwest rooms with the ornate plaster ceilings, cornice mouldings, the baseboards, the door and window surrounds, the interior wood shutters, and the fireplaces with decorative detailing.

2. FORBES HOUSE - EXISTING CONDITIONS

2.1 General

The investigations and recommendations in this report are based on a site visit conducted by ERA Architects on the 18th of October, 2022.

Photo documentation, observations from grade, and an interior assessment were done on site. A general survey of the exterior building envelope was first conducted prior to assessing interior conditions. Overall, the Forbes House is in good condition, with the exception of localized cracking, spalling and soiling of masonry units, failing windows and selective roof repairs.

The building components were graded using the following assessment terms:

- **Excellent**: Superior aging performance. Functioning as intended, no deterioration observed.
- **Good**: Normal Result. Functioning as intended; normal deterioration observed; no maintenance anticipated within the next five years.
- **Fair**: Functioning as intended; Normal deterioration and minor distress observed; maintenance will be required within the next three to five years to maintain functionality.
- **Poor**: Not functioning as intended; significant deterioration and distress observed; maintenance and some repair required within the next year to restore functionality.
- **Defective**: Not functioning as intended; significant deterioration and major distress observed; possible damage to support structure; may present a risk; must be dealt with immediately.
2.2 West Elevation (Front Entrance)

The front elevation is in good overall condition. This elevation features Ionic columns that frame the central entrance and stairs leading up to the porch. The stone columns are painted and are in good condition. The wood tongue and groove stained porch ceiling is also in good condition. The second storey balcony spans the width of the front elevation and contains wooden railings, which are in good condition. The deep overhanging eaves have prominent brackets and a wide cornice with dentil projections.

Localized cracking and spalling of stone units at the base of the house are visible at grade.

All exterior doors and sidelights are original and in good condition, with only minor repairs required to maple panels which can be seen peeling away.

The existing windows are wood framed and double hung with single glazing that is original to the home. Aluminum storm windows have been added and are not sympathetic to the original design. The windows are currently in fair condition with deteriorated sealants, peeling paint and damage to exterior wood frames. Wood storms have been removed, but are in storage and appear to be fair in condition.
2.3 North Elevation

This elevation has a projecting box bay to the west that contains two stone band courses and an external chimney with stepped stone offset. Previous brick repairs using mismatched bricks can be seen on the North elevation, as well as localized brick soiling. Mortar joint recession was noted from grade. Overall, the brick condition on the North elevation is good.

The basement windows located closer to grade are in poor condition, with deficient sealant along the outer edges, cracked putty around the window panes, and peeling paint. PVC venting is visible coming out through exiting basement window.

The soffit and fascia are noted as poor with wood rot and peeling paint. Water damage from faulty eaves trough at the roof edge was observed. Wood brackets appear fair, however a closer investigation is recommended to determine the condition of each unit.

Figure 14. North elevation with square bay window projection and stepped chimney. Vines have bonded to exterior masonry surface and causing damage (ERA, 2022).

Figure 15. Brick soiling and visible mortar loss on north chimney wall just under the soffit (ERA, 2022).

Figure 16. PVC pipe in existing basement window detracts visually. (ERA, 2015).

Figure 17. Failing sealant around window (ERA, 2022).

Figure 18. Failing mastic putty, surface coating and sealants (ERA, 2016).
2.4 East Elevation (Rear Elevation)

The rear elevation consists of a two-storey addition that has been altered from the original design to include side by side matching openings. The rear porch addition also includes a basement entrance.

Generally, the porch is in poor condition, with many of the wooden elements reduced to rot and peeling paint. The stairs and railings are unsafe and defective. Vertical tongue and groove wood cladding appears to be poor with missing wood trim, and deteriorated paint. The poured concrete foundation walls have been parged and cracking is visible in many locations. Door and window sills are also in poor condition, with cracked and spalled units.

Overall, the hard landscaping, grading and wood steps are in poor condition. The largest of the three chimneys contains three flues and is built into the rear brick wall. The chimney contains previous poor repairs towards the top half, and has excessive soiling from the roof-line to the concrete cap.
2.5 South Elevation

Soiling of brick and stone units can be observed on the south elevation, especially near gutter ends and downspouts. Excessive moisture has also damaged the wood window frames and stone sills that sit directly under the gutter. Soiled brick was also observed under the soffit on the second floor.

Sandstone foundation and window sills are in fair condition at grade with degraded surfaces from salt and moisture saturation damage. Biological green staining appears in areas where the gutters and downspouts have failed.

Cracking was observed on the concrete steps the lead to the entrance doors, and areas where parging was applied had mostly failed. Selective brick replacement and repointing is required at the brick wall supporting the porte-cochere. The masonry supporting and around the porte cochere columns, walls and entrance is noted as being in poor condition.

Figure 23. The south elevation Porte-cochere with sandstone base, buff brick columns and wood brackets and detailing is generally in fair condition with localized deterioration at grade.

Figure 24. Sandstone squared rubble and buff brick with efflorescence and spalling on exterior wall (ERA, 2022).

Figure 25. Previous brick replacement using mismatched bricks (ERA, 2022).

Figure 26. Similar soiling and salt damage on interior wall and columns. The cut stone at grade is spalling (ERA, 2022).

Figure 27. The stone steps are in poor condition with cracking and delamination (ERA, 2022).
2.6 Roof, Chimneys, & Dormers

The asphalt shingles and roof surface are poor and appear to be at the end of the expected life cycle. Asphalt shingles to be replaced with slate units that match in size, shape and colour (Vermont Green) and installed with pine battens laid horizontal. Ice and water shield, copper flashing and venting as required.

All dormers are in fair condition. New slate units to be applied to dormer cheeks and all copper flashing will require replacement during the process. Dormer soffits are in poor condition and will require replacement. Copper eaves and downspouts will require replacement during the roof restoration. All wood trim appears to be fair and should be replaced if needed.

All three of the multiple flue chimneys have been modified from the original design and appear to require repointing at the top on third of each unit. The brick and mortar on the chimneys is in fair condition and the concrete cap is expected to be fair as well. Further investigation from the roof surface is required to get an accurate condition. The copper cap flashing under the concrete cap looks to be in good condition and may require new sealants.
2.7 Interiors

The interior attributes of the Forbes house were observed to be in good condition.

1. Main Entrance Vestibule
The entrance vestibule was noted as good in condition with cornice mouldings, coffered ceiling, baseboards, raised wood panels, door surrounds, paneled wood doors and ornate vision panels within the doors.

2. Main Foyer
The main wooden staircase in the hall along with the balustrade is in good condition. Surface varnish on the stringers, hand rails, newel posts and spindles appears to be in good condition.

3. Rooms along the North Elevation
These rooms feature wooden pocket doors, ornate plaster ceilings, and a fireplace with decorative detailing which is in good condition.
4. Rooms along the East Elevation
These rooms make up the original rear porch which is now enclosed. The north-east room was used as a film set, and the original masonry walls have been painted. Doors and windows are in fair condition.

5. Southwest Room
Southwest room has wood shelving, and a painted coffered ceiling with a similar fireplace as the northwest room.

6. Landing Area and Balcony
A set of wooden steps leads up to the roof of the porte-cochere. The interior stairs are in good condition. Though accessible, the porte-cochere roof does not contain a railing and can not be used as a balcony.
7. Second & Third Floor

The wood staircases leading to the second and third floors are in good condition. Interior window panes, mullions and frames are in fair condition. Interior doors and decorative glazing are less detailed than the main floor, and are in good condition. Generally, the second and third floor represent similar conditions throughout.

8. Wine Cellar

The basement wine cellar is a unique room and appears to be in fair condition.
3 FORBES HOUSE - PROPOSED CONSERVATION SCOPE

3.1 Conservation Approach

In order to protect the heritage resource on the Site, the following conservation approach has been prepared to specifically address the cultural heritage value and the property’s heritage attributes outlined previously. The proposed scope of work provides for the repair and long-term management of the building.

3.2 Conservation Notes

PROTECTION
P100. PRESERVE STRUCTURAL INTEGRITY OF HERITAGE BUILDING. PROVIDE TEMPORARY BRACING AND SUPPORTS AS NECESSARY.

P101. PROTECT THE MATERIAL INTEGRITY OF THE HERITAGE WALLS DURING CONSTRUCTION. ALLOW SUFFICIENT WALL MOISTURE PROTECTION BY FLASHING OR OTHER PERMANENT CONSTRUCTION.

P102. PROTECT FINISH WORK AND ADJACENT MATERIAL FROM DAMAGE DURING CONSTRUCTION. ANY DAMAGE TO ADJACENT MATERIALS DURING WORK MUST BE REPAIRED.

MASONRY GENERAL
C100. SELECTIVELY REMOVE PARGING OFF REAR FOUNDATION WALL AND APPLY NEW PARGING TO MATCH EXISTING.

C101. PAINT STRIP IONIC COLUMNS, BASES AND CAPITALS. REPAIR ALL UNEVEN SURFACES AND SAND SMOOTH. PRIME AND PAINT 2 COATS WITH SILICATE DISPERSION PAINT (KEIM OR PERMATINT).

C102. REMOVE ALL REDUNDANT HARDWARE, OTHER MISCELLANEOUS & OBSOLETE ACCESSORIES. REMOVE ALL INSTANCES OF IVY GROWING ON THE WALLS.

C103. CLEAN MASONRY USING LOW-PRESSURIZED HOT WATER. FOR DIFFICULT STAINS THAT REMAIN, APPLY PROPRIETARY CLEANERS THAT ARE COMPATIBLE WITH HERITAGE MASONRY.

C104. REMOVE ALL PAINT COATINGS FROM MASONRY SURFACES.

C105. REPLACED BURNT, CRACKS & HEAVY SPALLING.

C106. PROVIDE CRACK REPAIRS TO DAMAGED STONE. FOR STEPS ON SOUTH ELEVATION, BUSH HAMMER USING PNEUMATIC TOOL TO ACHIEVE CONSISTENT APPEARANCE.

C107. PROVIDE POUltice APPLICATION ON AREAS WITH HEAVY SALT DAMAGE.

BRICK CONSERVATION
C108. USE SALVAGED BRICKS FOR BRICK REPLACEMENT. IF SALVAGED BRICKS ARE UNAVAILABLE, USE NEW BRICKS. INSTALLED BRICKS TO MATCH EXISTING & ADJACENT BRICK AREAS IN SIZE, COLOUR, AND TEXTURE.

C109. REPLACE BRICKS WITH CRACKS & HEAVY SPALLING.

C110. ALL BRICK AROUND OPENINGS AND ON THE FRONT FACADE TO BE REPLACED WITH EXISTING UNITS.

STONE CONSERVATION
C111. PROVIDE NEW STONE OR STONE SALVAGED FROM OTHER SITES. NEW OR SALVAGED STONE TO MATCH EXISTING & ADJACENT IN SIZE, COLOUR, TEXTURE AND PROFILE.

C112. PROVIDE CRACK REPAIRS ON STONE.

C113. PROVIDE DUTCHMAN REPAIRS TO DAMAGED STONE. FOR STEPS ON SOUTH ELEVATION, BUSH HAMMER USING PNEUMATIC TOOL TO ACHIEVE CONSISTENT APPEARANCE.

C114. PROVIDE POUltice APPLICATION ON AREAS WITH HEAVY SALT DAMAGE.
WINDOWS AND DOORS
C114. REMOVE PAINT ON WINDOW FRAMES AND REPLACE ALL CRACKED GLAZING. RESTORE MASTIC PUTTY. IF REPLACEMENT WINDOWS ARE REQUIRED ON EAST ELEVATION, MATCHING WOOD WINDOWS ARE REQUIRED AND APPROVAL REQUIRED.

WOOD CONSERVATION
C115. REMOVE ALL PAINT FROM ALL WOOD SURFACES. METHODS TO BE APPROVED BY CONSULTANT.
C116. DETERMINE QUANTITIES, LOCATIONS AND TYPES OF WOOD REPAIRS WITH HERITAGE CONSULTANT ON SITE. PROVIDE DETERMINATION ONCE PAINT REMOVAL IS COMPLETE.
C117. CONSERVE ALL EXTERIOR WOOD TRIM, INCLUDING WINDOW FRAMES.
C118. REPLACE IRREPARABLE OR MISSING WOOD PIECES ON STORM WINDOWS. MATCH PROFILE OF ORIGINAL.
C119. REPLACE IRREPARABLE OR MISSING WOOD PIECES ON ALTERED REAR PORCH TRIM AND CLADDING.
C120. PREPARE ALL WOOD SURFACES FOR PAINTING INDICATED.
C121. SCRAPE, SAND AND REMOVE ALL PAINT FROM FRONT PORCH FLOOR. PREP FOR DUST-FREE SURFACE. PRIME/PAINT WITH PORCH PAINT APPROVED BY CONSULTANT.
C122. REPLICATE BALUSTRADE ON TOP OF PORTE-COCHERE ROOF TO MATCH FRONT PORCH. ENSURE BALUSTRADE MEETS OBC RAILING CODE REQUIREMENTS.
C123. REMOVE ALL DETERIORATED OR MISSING SOFFIT AND FASCIA. PRIME AND PAINT ALL SURFACES.

ROOFING
C124. REMOVE ASPHALT SHINGLES AND ANY UNDERLAY. INSTALL MEMBRANE AND SLATE TO MATCH EXISTING UNITS IN SIZE, SHAPE AND COLOUR.
C125. PROVIDE NEW CHIMNEY, DORMER AND ROOF FLASHING WHERE REQUIRED.
C126. REPAIR EXISTING TROUGHS AND DOWNSPOUTS.
C127. PROVIDE NEW COPPER EAVESTROUGH (DORMERS & REAR EXTENSIONS).
C128. PROVIDE NEW TORCHED DOWN MEMBRANE FOR PORTE-COCHERE ROOF.
C129. PROVIDE NEW COPPER CHIMNEY CAP FLASHING.

FINISHES
C130. PAINT COLOURS TO BE SELECTED BY HERITAGE CONSULTANT BASED ON PAINT ANALYSIS.
C131. NEW SEALANTS AROUND ALL WINDOWS AND DOORS.
C132. SAND, PRIME, AND PAINT ALL EXTERIOR WOOD.

METAL CONSERVATION
C133. REINSTATE HISTORICAL PLAQUE AND ANY ORIGINAL HARDWARE.
C134. REPLACE MISSING IRON CRESTING TOP OF TRUNCATED ROOF PERIMETER. (SEE PG. 36, FIGURE 68).
MASONRY GENERAL
C101. PAINT STRIP ONIC COLUMNS, BASES AND CAPITALS. REPAIR ALL UNEVEN SURFACES AND SAND SMOOTH. PRIME AND PAINT 2 COATS WITH SILICATE DISPERSION PAINT (KEIM OR PERMATH).  
C103. CLEAN MASONRY USING LOW-PRESSURIZED HOT WATER. FOR DIFFICULT STAINS THAT REMAIN, APPLY PROPRIETARY CLEANERS THAT ARE COMPATIBLE WITH HERITAGE MASONRY.  
C104. REMOVE ALL PAINT COATINGS FROM MASONRY SURFACES.  
C105. REPOINT SELECTIVE LOCATIONS IN MASONRY. USE COMPATIBLE MORTAR. MATCH EXISTING AND ADJACENT IN COLOUR, TEXTURE, AND TOOLING.  
C108. ALL BRICK AROUND OPENINGS AND ON THE FRONT FACADE TO BE REPLACED WITH EXISTING UNITS.

STONE CONSERVATION
C109. PROVIDE NEW STONE OR STONE SALVAGED FROM OTHER SITES. NEW OR SALVAGED STONE TO MATCH EXISTING & ADJACENT IN SIZE, COLOUR, TEXTURE AND PROFILE.

WINDOWS AND DOORS
C114. REMOVE PAINT ON WINDOW FRAMES AND REPLACE ALL CRACKED GLAZING. RESTORE MASTIC PLUTTY. IF REPLACEMENT WINDOWS ARE REQUIRED ON EAST ELEVATION, MATCHING WOOD WINDOWS ARE REQUIRED AND APPROVAL REQUIRED.

WOOD CONSERVATION
C115. REMOVE ALL PAINT FROM ALL WOOD SURFACES. METHODS TO BE APPROVED BY CONSULTANT.  
C116. DETERMINE QUANTITIES, LOCATIONS AND TYPES OF WOOD REPAIRS WITH HERITAGE CONSULTANT ON SITE. PROVIDE DETERMINATION ONCE PAINT REMOVAL IS COMPLETE.  
C117. CONSERVE ALL EXTERIOR WOOD TRIM, INCLUDING WINDOW FRAMES.  
C118. REPLACE IRREPARABLE OR MISSING WOOD PIECES ON STORM WINDOWS. MATCH PROFILE OF ORIGINAL.  
C120. PREPARE ALL WOOD SURFACES FOR PAINTING INDICATED.  
C121. SCRAPE, SAND AND REMOVE ALL PAINT FROM FRONT PORCH FLOOR. PREP FOR DUST-FREE SURFACE. PRIME/PAINT WITH PORCH PAINT APPROVED BY CONSULTANT.  
C122. REPLICATE BALUSTRADE ON TOP OF PORCH TO MATCH FRONT PORCH. ENSURE BALUSTRADE MEETS OBC RAILING CODE REQUIREMENTS.  

ROOFING
C124. REMOVE ASPHALT SHINGLES AND ANY UNDERLAY. INSTALL MEMBRANE AND SLATE TO MATCH EXISTING UNITS IN SIZE, SHAPE AND COLOUR.
C125. PROVIDE NEW CHIMNEY, DORMER AND ROOF FLASHING WHERE REQUIRED.  
C126. REPAIR EXISTING TROUGHS AND DOWNSPOUTS.  
C127. PROVIDE NEW COPPER DOWNSPOUTS (DORMERS & REAR EXTENSIONS).

FINISHES
C130. PAINT COLOURS TO BE SELECTED BY HERITAGE CONSULTANT BASED ON PAINT ANALYSIS.  
C131. NEW SEALANTS AROUND ALL WINDOWS AND DOORS.  
C132. SAND, PRIME, AND PAINT ALL EXTERIOR WOOD.

METAL CONSERVATION
C133. REINSTATE HISTORICAL PLAQUE AND ANY ORIGINAL HARDWARE.
C134. REPLACE MISSING IRON CRESTING TOP OF TRUNCATED ROOF PERIMETER.
MASSONRY GENERAL
C102. REMOVE ALL REDUNDANT HARDWARE, OTHER MISCELLANEOUS & OBSOLETE ACCESSORIES. REMOVE ALL INSTANCES OF IVY GROWING ON THE WALLS.
C103. CLEAN MASONRY USING LOW-PRESSURIZED HOT WATER. FOR DIFFICULT STAINS THAT REMAIN, APPLY PROPRIETARY CLEANERS THAT ARE COMPATIBLE WITH HERITAGE MASONRY.
C104. REMOVE ALL PAINT COATINGS FROM MASONRY SURFACES.
C105. REPOINT SELECTIVE LOCATIONS IN MASONRY. USE COMPATIBLE MORTAR. MATCH EXISTING AND ADJACENT IN COLOUR, TEXTURE, AND TOOLING.

BRICK CONSERVATION
C107. REPLACE BRICKS WITH CRACKS & HEAVY SPALLING.

STONE CONSERVATION
C109. PROVIDE NEW STONE OR STONE SALVAGED FROM OTHER SITES. NEW OR SALVAGED STONE TO MATCH EXISTING & ADJACENT IN SIZE, COLOUR, TEXTURE AND PROFILE.

WINDOWS AND DOORS
C114. REMOVE PAINT ON WINDOW FRAMES AND REPLACE ALL CRACKED GLAZING. RESTORE MASTIC PUTTY. IF REPLACEMENT WINDOWS ARE REQUIRED ON EAST ELEVATION, MATCHING WOOD WINDOWS ARE REQUIRED AND APPROVAL REQUIRED.

WOOD CONSERVATION
C123. REMOVE ALL DETERIORATED OR MISSING SOFFIT AND FASCIA. PRIME AND PAINT ALL SURFACES.

FINISHES
C130. PAINT COLOURS TO BE SELECTED BY HERITAGE CONSULTANT BASED ON PAINT ANALYSIS.
C131. NEW SEALANTS AROUND ALL WINDOWS AND DOORS.
C132. SAND, PRIME, AND PAINT ALL EXTERIOR WOOD.

ROOFING
C124. REMOVE ASPHALT SHINGLES AND ANY UNDERLAY. INSTALL MEMBRANE AND SLATE TO MATCH EXISTING UNITS IN SIZE, SHAPE AND COLOUR.
C125. PROVIDE NEW CHIMNEY, DORMER AND ROOF FLASHING WHERE REQUIRED.
C126. REPAIR EXISTING TROUGHS AND DOWNSPOUTS.
C127. PROVIDE NEW COPPER DOWNSPOUTS (DORMERS & REAR EXTENSIONS).
C129. PROVIDE NEW COPPER CHIMNEY CAP FLASHING.
**Masonry General**

- C104. Remove all paint coatings from masonry surfaces.
- C105. Repoint selective locations in masonry. Use compatible mortar. Match existing and adjacent in colour, texture, and tooling.

**Brick Conservation**

- C107. Replace bricks with cracks & heavy spalling.

**Windows and Doors**

- C114. Remove paint on window frames and replace all cracked glazing. Restore mastic putty. If replacement windows are required on East elevation, matching wood windows are required and approval required.

**Wood Conservation**

- C115. Remove all paint from all wood surfaces. Methods to be approved by consultant.
- C118. Replace irreparable or missing wood pieces on storm windows. Match profile of original.
- C119. Replace irreparable or missing wood pieces on altered rear porch trim and cladding.
- C121. Scrape, sand, and remove all paint from front porch floor. Prep for dust-free surface. Prime/paint with porch paint approved by Consultant.

**Finishes**

- C130. Paint colours to be selected by Heritage Consultant based on paint analysis.
- C131. New sealants around all windows and doors.
- C132. Sand, prime, and paint all exterior wood.

**Roofing**

- C124. Remove asphalt shingles and any underlay. Install membrane and slate to match existing units in size, shape and colour.
- C125. Provide new chimney, dormer and roof flashing where required.
- C126. Repair existing troughs and downspouts.
- C127. Provide new copper downspouts (dormers & rear extensions).
- C129. Provide new copper chimney cap flashing.

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Figure 67: Rear Elevation (ERA, 2022).
MASONRY GENERAL
C103. Clean masonry using low-pressure hot water. For difficult stains that remain, apply proprietary cleaners that are compatible with heritage masonry.
C105. Repoint selective locations in masonry. Use compatible mortar. Match existing and adjacent in colour, texture, and tooling.
C106. Use salvaged bricks for brick replacement. If salvaged bricks are unavailable, use new bricks. Installed bricks to match existing & adjacent brick areas in size, colour, and texture.
C107. Replace bricks with cracks & heavy spalling.

STONE CONSERVATION
C109. Provide new stone or stone salvaged from other sites. New or salvaged stone to match existing & adjacent in size, colour, texture and profile.
C110. Remove heavy soiliong on stone. Stells & foundation.
C111. Provide crack repairs on stone.
C112. Provide Dutchman repairs to damaged stone. For steps on South elevation, Bush hammer using pneumatic tool to achieve consistent appearance.
C113. Provide poultice application on areas with heavy salt damage.

WINDOWS AND DOORS
C114. Remove paint on window frames and replace all cracked glazing. Restore mastic putty. If replacement windows are required on east elevation, matching wood windows are required and approval required.

WOOD CONSERVATION
C115. Remove all paint from all wood surfaces. Methods to be approved by consultant.
C117. Conserve all exterior wood trim, including window frames.
C118. Replace irreparable or missing wood pieces on storm windows. Match profile of original.
C120. Prepare all wood surfaces for painting. Indicated.
C121. Scraper, sand and remove all paint from front porch floor. Prep for dust-free surface. Prime/paint with porch paint approved by consultant.
C122. Replicate balustrade on top of porte-cochere roof to match front porch. Ensure balustrade meets OBC railing code requirements.
C123. Remove all deteriorated or missing soffit and fascia. Prime and paint all surfaces.

FINISHES
C130. Paint colours to be selected by heritage consultant based on paint analysis.
C131. New sealants around all windows and doors.
C132. Sand, prime, and paint all exterior wood.

Figure 68. South Elevation (ERA, 2022).
MASONRY GENERAL
C103. CLEAN MASONRY USING LOW-PRESSURIZED HOT WATER. FOR DIFFICULT STAINS THAT REMAIN, APPLY PROPRIETARY CLEANERS THAT ARE COMPATIBLE WITH HERITAGE MASONRY.
C105. REPOINT SELECTIVE LOCATIONS IN MASONRY. USE COMPATIBLE MORTAR. MATCH EXISTING AND ADJACENT IN COLOUR, TEXTURE, AND TOOGING.
C107. REPLACE BRICKS WITH CRACKS & HEAVY SPALLING.

STONE CONSERVATION
C109. PROVIDE NEW STONE OR STONE SALVAGED FROM OTHER SITES. NEW OR SALVAGED STONE TO MATCH EXISTING & ADJACENT IN SIZE, COLOUR, TEXTURE AND PROFILE.
C110. REMOVE HEAVY SOILING ON STONE STILLS & FOUNDATION.
C111. PROVIDE CRACK REPAIRS ON STONE.
C112. PROVIDE DUTCHMAN REPAIRS TO DAMAGED STONE.

WINDOWS AND DOORS
C114. REMOVE PAINT ON WINDOW FRAMES AND REPLACE ALL CRACKED GLAZING. RESTORE MASTIC PUTTY. IF REPLACEMENT WINDOWS ARE REQUIRED ON EAST ELEVATION, MATCHING WOOD WINDOWS ARE REQUIRED AND APPROVAL REQUIRED.

WOOD CONSERVATION
C115. REMOVE ALL PAINT FROM ALL WOOD SURFACES. METHODS TO BE APPROVED BY CONSULTANT.
C117. CONSERVE ALL EXTERIOR WOOD TRIM, INCLUDING WINDOW FRAMES.
C118. REPLACE IRREPARABLE OR MISSING WOOD PIECES ON STORM WINDOWS. MATCH PROFILE OF ORIGINAL.
C120. PREPARE ALL WOOD SURFACES FOR PAINTING INDICATED.
C121. SCRAPE, SAND AND REMOVE ALL PAINT FROM FRONT PORCH FLOOR. PREP FOR DUST-FREE SURFACE. PRIME/PAINT WITH PORCH PAINT APPROVED BY CONSULTANT.
C122. REPLICATE BALUSTRADE ON TOP OF PORTE-COCHERE ROOF TO MATCH FRONT PORCH. ENSURE BALUSTRADE MEETS OBC RAILING CODE REQUIREMENTS.
C123. REMOVE ALL DETERIORATED OR MISSING SOFFIT AND FASCIA. PRIME AND PAINT ALL SURFACES.

FINISHES
C130. PAINT COLOURS TO BE SELECTED BY HERITAGE CONSULTANT BASED ON PAINT ANALYSIS.
C131. NEW SEALANTS AROUND ALL WINDOWS AND DOORS.
C132. SAND, PRIME, AND PAINT ALL EXTERIOR WOOD.

ROOFING
C124. REMOVE ASPHALT SHINGLES AND ANY UNDERLAY. INSTALL MEMBRANE AND SLATE TO MATCH EXISTING UNITS IN SIZE, SHAPE AND COLOUR.
C125. PROVIDE NEW CHIMNEY, DORMER AND ROOF FLASHING WHERE REQUIRED.
C126. REPAIR EXISTING TROUGHS AND DOWNSPOUTS.
C127. PROVIDE NEW COPPER DOWNSPOUTS (DORMERS & REAR EXTENSIONS).
3.3 Proposed Heritage Landscape Plan and 3-Car Garage

The Forbes estate consists of various buildings linked by an internal driveway and surrounded by expansive vegetation and wooded areas. Access to the Forbes House is provided via a meandering driveway that passes beneath the porte-cochere and continues to the rear of the building, beyond the North Garage, and connects with Shaw Avenue East. The winding driveway will remain as is in the same configuration.

A row of vegetation along the west property line on Guelph Avenue marks the external boundary of the site. The property line is also signified with a low rubble wall that is approximately 18” high. Due to the proposed widening of Guelph Avenue, the portion of the existing stone wall that is to be retained will be required to be moved approximately 1m towards the Forbes House to allow for proposed road works and new sidewalk. This relocation will follow the same alignment as the current stone wall, and there will be no jogs in the wall. All sections will be moved back the same distance.

The north tree line demarcates the internal boundary of the severed lot. Refer to Figure 71.

A new three car garage is proposed to be constructed on the north east portion of the severed lot. This structure is to be built using sympathetic materials that complement the original design and are of a similar aesthetic to the Forbes House.

Figure 70. Existing garage to be demolished (ERA, 2022)

Figure 71. Proposed Site Plan showing severed lot (Polo Corp Inc., edited by ERA)
4 MAINTENANCE RECOMMENDATIONS

4.1 Introduction
As part of the program of work contained within this Conservation Plan, many improvements are proposed. The maintenance recommendations listed below are to be undertaken for the identified attributes within the time frames mentioned. It is important to note that the Letter of Credit is for urgent repairs only, and all other repairs listed are simply recommendations that will improve existing conditions and reduce the rate of deterioration for certain identified attributes. Refer to Cost Estimates in Section 8 of this report.

4.2 General Protection
- PRESERVE STRUCTURAL INTEGRITY OF HERITAGE BUILDING. PROVIDE TEMPORARY BRACING AND SUPPORTS AS NECESSARY.
- PROTECT THE MATERIAL INTEGRITY OF THE HERITAGE WALLS DURING CONSTRUCTION. ALLOW SUFFICIENT WALL MOISTURE PROTECTION BY FLASHING OR OTHER PERMANENT CONSTRUCTION.
- PROTECT FINISH WORK AND ADJACENT MATERIAL FROM DAMAGE DURING CONSTRUCTION. ANY DAMAGE TO ADJACENT MATERIALS DURING WORK MUST BE REPAIRED.

4.3 Urgent Repairs: 0 - 6 Months

WINDOWS AND DOORS
- REMOVE PAINT ON WINDOW FRAMES AND REPLACE ALL CRACKED GLAZING. RESTORE MASTIC PUTTY. IF REPLACEMENT WINDOWS ARE REQUIRED ON EAST ELEVATION, MATCHING WOOD WINDOWS ARE REQUIRED AND APPROVAL REQUIRED.
- REPLACE IRREPARABLE OR MISSING WOOD PIECES ON ALTERED REAR PORCH TRIM AND CLADDING.
- PROVIDE NEW TORCHED DOWN MEMBRANE FOR PORTE-COCHERE ROOF.
- REPLICATE BALUSTRADE AT TOP OF PORTE-COCHERE TO MATCH FRONT PORCH. ENSURE IT MEETS OBC RAILING CODE REQUIREMENTS.
- REMOVE ALL DETERIORATED OR MISSING SOFFIT AND FASCIA. PRIME AND PAINT SURFACES.
- REPAIR EXISTING TROUGHS AND DOWNSPOUTS.

ROOFING
- REMOVE ASPHALT SHINGLES AND ANY UNDERLAY INSTALL MEMBRANE AND SLATE TO MATCH EXISTING UNITS IN SIZE, SHAPE AND COLOUR.
- PROVIDE NEW CHIMNEY, DORMER AND ROOF FLASHING WHERE REQUIRED.
- PROVIDE NEW COPPER EAVESTROUGH (DORMERS & REAR EXTENSIONS).
- PROVIDE NEW COPPER CHIMNEY CAP FLASHING (DORMERS & REAR EXTENSIONS).

4.4 Short Term Repairs and Restoration: Within 1-2 years

MASONRY GENERAL
- SELECTIVELY REMOVE PARGING OFF REAR FOUNDATION WALL AND APPLY NEW PARGING TO MATCH EXISTING.
- CLEAN MASONRY USING LOW-PRESSURIZED HOT WATER. FOR DIFFICULT STAINS THAT REMAIN, APPLY PROPRIETARY CLEANERS THAT ARE COMPATIBLE WITH HERITAGE MASONRY.

- REPOINT SELECTIVE LOCATIONS IN MASONRY. USE COMPATIBLE MORTAR. MATCH EXISTING AND ADJACENT IN COLOUR, TEXTURE, AND TOOLING.

BRICK CONSERVATION
- REPLACE BRICKS WITH CRACKS & HEAVY SPALLING (ALLOW FOR 200 UNITS)

STONE CONSERVATION
- REMOVE HEAVY SOILING ON STONE STILLS & FOUNDATION.
- PROVIDE CRACK REPAIRS ON STONE.
- PROVIDE DUTCHMAN REPAIRS TO DAMAGED STONE (ALLOW FOR 5 sq. ft.)
- PROVIDE NEW STONE FOR PORTE-COCHERE ENTRANCE STEPS AND RISERS TO MATCH EXISTING.

WOOD CONSERVATION
- REMOVE ALL PAINTED FROM ALL WOOD SURFACES.
- DETERMINE QUANTITIES, LOCATIONS AND TYPES OF WOOD REPAIRS WITH HERITAGE CONSULTANT ON SITE. PROVIDE DETERMINATION ONCE PAINT REMOVAL IS COMPLETE.
- CONSERVE LENGTHS AND TYPES OF WOOD使用权 ON STILLS AND PARADES.
- REPLACE IRREPARABLE OR MISSING WOOD PIECES ON STORM WINDOWS. MATCH PROFILE OF ORIGINAL.
- PROVIDE NEW WOOD SURFACES FOR PAINTING APPROVED BY CONSULTANT.

FINISHES
- NEW SEALANTS AROUND ALL WINDOWS AND DOORS.
- SAND, PRIME, AND PAINT ALL EXTERIOR WOOD.

4.5 Long Term Repairs and Restoration: Within 5 years

MASONRY GENERAL
- PAINT STRIP IONIC COLUMNS, BASES AND CAPITALS. REPAIR ALL UNEVEN SURFACES AND SAND SMOOTH. PRIME AND PAINT 2 COATS WITH SILICATE DISPERSION PAINT (KEIM OR PERMATINT).
- REMOVE ALL REDUNDANT HARDWARE, OTHER MISCELLANEOUS & OBSOLETE ACCESSORIES.
- REMOVE ALL PAINT COATINGS FROM MASONRY SURFACES.

METAL CONSERVATION
- REINSTATE HISTORICAL PLAQUE AND ANY ORIGINAL HARDWARE.
- REPLACE MISSING IRON CRESTING TOP OF TRUNCATED ROOF PERIMETER.
4.6 Interior Recommendations

- REMOVE PREVIOUS PAINTED WOOD FROM FILM SHOOT. ALL BLUE PAINT FROM PORCH MASONRY, PAINT FROM FIREPLACE MANTELS AND SURROUNDS TO BE REMOVED. WOOD SHELVING AND CABINETS TO BE REMOVED.
- TRADITIONAL MOULDINGS AND FINISHES WERE REMOVED IN THE KITCHEN DURING FILMING. REINSTATE TO ORIGINAL CONDITION; MATCH ORIGINAL IN PROFILE AND STAIN TO MATCH. FLOORS AND CEILINGS TO MATCH OTHER ROOMS ON MAIN FLOOR.
- MISSING HARDWARE FROM DOORS AND WINDOWS TO BE REPLACED WITH SIMILAR.
- ALL SLIDING DOORS TO BE RESTORED TO ORIGINAL CONDITION. STRIP PAINT AND RESTORE SURFACES. REMOVE DOORS TO REPAIR AND LUBRICATE TRACKS BEFORE REINSTATING.

5 CONSTRUCTION MANAGEMENT PLAN

5.1 General

This CHMP provides the basis for the management of heritage issues and to minimise risk of impact during the first stage of development. The objectives and targets of heritage management and mitigation are outlined below.

5.2 Objectives and Targets

To correctly implement heritage management controls to ensure impacts are minimized during construction and to comply with contractual and legislative requirements. Avoid accidental impacts on heritage items through implementation of an unexpected heritage finds procedure.

5.3 Performance Indicators

No disturbance or damage to existing known heritage sites or items unknown or undocumented heritage sites are not knowingly destroyed, defaced or damaged.

5.4 Roles and Responsibilities

Relevant roles and responsibilities associated with this CHMP are identified below. All personnel are responsible for ensuring that heritage items are protected. It is important to note that failure to report a discovery and those responsible for the damage or destruction occasioned by unauthorized removal or alteration to a site.

Construction Manager:

Ensure that sufficient resources are allocated for the implementation of this CHMP. Ensure that the CEMP covers the management and mitigation measures presented in this CHMP. Ensure that the outcomes of the visual checks/ compliance and conformance construction monitoring/ incident reporting are systematically evaluated as part of ongoing management of construction activities. Ensure audits of construction site records/ monitoring records/ incident reports are undertaken on a monthly basis, findings are shared with relevant site personnel and corrective actions are implemented. Authorise all monitoring reports and any revisions to this CHMP.

Site Supervisor:

Understand and implement mitigation protocols as required in the CHMP and any other required measures during construction. Undertake relevant training to implement the requirements of this CHMP. All personnel are responsible for ensuring that the clearing limits are addressed and heritage items are protected. All site personnel to undertake toolbox talks in relation to the reporting process for unexpected finds.
Heritage Professional:
The heritage professional will be responsible for providing advice to minimise potential impacts to any historic heritage values that may be recorded during the construction activities.

5.5 Implementation

The Construction Management plan should be implemented for the duration of the construction on site. The following mitigation measures should be implemented prior and during construction:

• Baseline Documentation Report: All standing heritage buildings and structures shall be professionally documented through photos of elevations, floor plans, heritage building fabric, details and finishes and high resolution photographs. Photos shall be highest possible resolution in jpeg or tiff formats and must thoroughly document the building(s), context, landscape elements, trees and setting, all exterior elevations and interior spaces, detailing, finishes and characteristics.

Timeline to be implemented - prior to approval of severance / registration of Phase 1 development.

• Preventive Maintenance / Stabilization Plan: A plan that identifies and prioritizes critical, short-term building maintenance and stabilization requirements necessary to halt or delay deterioration or loss of building and heritage fabric.

The Owners shall assess and prepare an on-going building inspection and preventative maintenance program for the forbes house to ensure that routine property and building maintenance issues are identified and addressed regularly, effectively and promptly. The preparation and execution of a scheduled inspection, monitoring and maintenance checklist tailored to the each building or structure. Preventive maintenance shall be undertaken in accordance with recognized standards and practices in built heritage conservation.

Timeline to be implemented - duration of three months after commencement of registration of Phase 1 development; weather dependent.

• Security Plan: The Owner shall assess and outline all measures necessary to secure the buildings or structures. The new owner will be residing in the house during the proposed development and will provide measures to ensure security is implemented during construction.

• Letter of credit: Financial security

A portion of the securities submitted for the development application at the time of approval may be reserved for the protection of the resource. The City reserves the right to not release a portion of the securities until the conservation plan is satisfactorily implemented.

Timeline to be implemented - with registration of Phase 1 development.

6 CONSERVATION COST ESTIMATE

6.1 Disclaimer

A Letter of Credit to secure the dollar value of the conservation work identified in this Conservation Plan will be provided at an appropriate time under a separate cover letter.

* Please note, in preparing this estimate, the following limitations and exclusions apply:

This estimate excludes, taxes, allowances, contingencies, contractor fees, and any design fees by architectural or engineering consultants.

Costs were estimated using standard unit rates, mostly obtained from ERA’s historical cost data from previous projects. Where applicable, unit rates are adjusted for inflation only.

In the past, hyperinflation has occurred as a result of unexpected local or regional market factors, such as the number of projects being tendered at the same time, the likelihood that certain trades have limitations in their bids, uncertainties in the approval process, and time periods for tendering and construction.

There is no accounting for unpredictable costs associated with labour resource shortages, supply and demand cycles, or travel and per diem costs.

PROTECTION - REQUIRED FOR EVERY TIME FRAME LISTED BELOW

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COST</th>
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</thead>
<tbody>
<tr>
<td>PROTECTION</td>
<td></td>
</tr>
<tr>
<td>P100. Preserve structural integrity of heritage building. Provide temporary bracing and supports as necessary. Restore. $5,000.00</td>
<td></td>
</tr>
<tr>
<td>P101. Protect the material integrity of the heritage walls during construction. Allow sufficient wall moisture protection by flashing or other permanent construction. Restore. $5,000.00</td>
<td></td>
</tr>
<tr>
<td>P102. Protect finish work and adjacent material from damage during construction. Any damage to adjacent materials during work must be repaired. Restore. $5,000.00</td>
<td></td>
</tr>
<tr>
<td>URGENT REPAIRS: 0 - 1 YEAR</td>
<td></td>
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<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>WINDOWS AND DOORS</td>
<td></td>
</tr>
<tr>
<td>C114. Remove paint on window frames and replace all cracked glazing. Restore. (or replace with new matching units.)</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>Mastic putty. If replacement windows are required on east elevation, matching wood windows are required and approval required.</td>
<td>$36,000.00</td>
</tr>
<tr>
<td>C119. Replace irreparable or missing wood pieces on altered rear porch trim and cladding.</td>
<td>$20,000.00</td>
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(Continued)
### SHORT-TERM REPAIRS AND RESTORATION: WITHIN 1-2 YEARS (CONTINUED)

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WOOD CONSERVATION</strong></td>
<td></td>
</tr>
<tr>
<td>C115. REMOVE ALL PAINTED FROM ALL WOOD SURFACES.</td>
<td>-</td>
</tr>
<tr>
<td>C116. DETERMINE QUANTITIES, LOCATIONS AND TYPES OF WOOD REPAIRS WITH HERITAGE CONSULTANT ON SITE. PROVIDE DETERMINATION ONCE PAINT REMOVAL IS COMPLETE.</td>
<td>$40,000.00</td>
</tr>
<tr>
<td>C117. CONSERVE ALL EXTERIOR WOOD TRIM, INCLUDING WINDOW FRAMES.</td>
<td>-</td>
</tr>
<tr>
<td>C118. REPLACE IRREPARABLE OR MISSING WOOD PIECES ON STORM WINDOWS. MATCH PROFILE OF ORIGINAL.</td>
<td>-</td>
</tr>
<tr>
<td>C120. PREPARE ALL WOOD SURFACES FOR PAINTING INDICATED.</td>
<td>$15,000.00</td>
</tr>
<tr>
<td>C121. SCRAPE, SAND AND REMOVE ALL PAINT FROM FRONT PORCH FLOOR. PREP FOR DUST-FREE SURFACE. PRIME/PAINT WITH PORCH PAINTAPPROVED BY CONSULTANT.</td>
<td>$4,000.00</td>
</tr>
<tr>
<td><strong>FINISHES</strong></td>
<td></td>
</tr>
<tr>
<td>C129. NEW SEALANTS AROUND ALL WINDOWS AND DOORS.</td>
<td>$12,000.00</td>
</tr>
<tr>
<td>C130. SAND, PRIME, AND PAINT ALL EXTERIOR WOOD.</td>
<td>$20,000.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$241,000.00</td>
</tr>
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</table>

### URGENT REPAIRS: 0 - 1 YEAR (CONTINUED)

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>C122. REPLICATE BALUSTRADE ON TOP OF PORTE-COCHERE ROOF TO MATCH FRONT PORCH. ENSURE BALUSTRADE MEETS OBC RAILING CODE REQUIREMENTS.</td>
<td>$16,000.00</td>
</tr>
<tr>
<td>C123. REMOVE ALL DETERIORATED OR MISSING SOFFIT AND FACIA. PRIME AND PAINT SURFACES.</td>
<td>-</td>
</tr>
<tr>
<td>C126. REPAIR EXISTING TROUGHS AND DOWNSPOUTS.</td>
<td>$5,000.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$21,000.00</td>
</tr>
</tbody>
</table>

### SHORT-TERM REPAIRS AND RESTORATION: WITHIN 1-2 YEARS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MASONRY GENERAL</strong></td>
<td></td>
</tr>
<tr>
<td>C100. SELECTIVELY REMOVE PARGING OFF REAR FOUNDATION WALL AND APPLY NEW PARGING TO MATCH EXISTING.</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>C101. PAINT IONIC COLUMNS, BASES AND CAPITALS. REPAIR ALL UNEVEN SURFACES AND SAND SMOOTH. PRIME AND PAINT 2 COATS WITH SILICATE DISPERSION PAINT (KEIM OR PERMATINT).</td>
<td>$1000.00</td>
</tr>
<tr>
<td>C103. CLEAN MASONRY USING LOW-PRESSURIZED HOT WATER. FOR DIFFICULT STAINS THAT REMAIN, APPLY PROPRIETARY CLEANERS THAT ARE COMPATIBLE WITH HERITAGE MASONRY. USE COMPATIBLE MORTAR. MATCH EXISTING AND ADJACENT IN COLOUR, TEXTURE, AND TOOLING.</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>C104. REMOVE ALL PAINT COATINGS FROM MASONRY SURFACES.</td>
<td>-</td>
</tr>
<tr>
<td>C105. REPORT SELECTIVE LOCATIONS IN MASONRY USE COMPATIBLE MORTAR. MATCH EXISTING AND ADJACENT IN COLOUR, TEXTURE, AND TOOLING.</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$38,500.00</td>
</tr>
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### METAL CONSERVATION

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COST</th>
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</thead>
<tbody>
<tr>
<td>C131. REINSTALL HISTORICAL PLAQUE AND ANY ORIGINAL HARDWARE</td>
<td>$500.00</td>
</tr>
<tr>
<td>C132. REPLACE MISSING IRON CRESTING TO TOP OF TRUNCATED ROOF PERIMETER.</td>
<td>$20,000.00</td>
</tr>
</tbody>
</table>

### LONG-TERM REPAIRS AND RESTORATION: WITHIN 5 YEARS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MASONRY GENERAL</strong></td>
<td></td>
</tr>
<tr>
<td>C101. PAINT STRIP LIONIC COLUMNS, BASES AND CAPITALS. REPAIR ALL UNEVEN SURFACES AND SAND SMOOTH. PRIME AND PAINT 2 COATS WITH SILICATE DISPERSION PAINT (KEIM OR PERMATINT).</td>
<td>$12,000.00</td>
</tr>
<tr>
<td>C102. REMOVE ALL REDUNDANT HARDWARE, OTHER RECESSIONAL AND OBSOLETE ACCESSORIES. REMOVE ALL INSTANCES OF IVY GROWING ON THE WALLS.</td>
<td>$500.00</td>
</tr>
<tr>
<td>C103. REMOVE ALL PAINTED FROM ALL WOOD SURFACES.</td>
<td>-</td>
</tr>
<tr>
<td>C104. PREPARE ALL WOOD SURFACES FOR PAINTING INDICATED.</td>
<td>-</td>
</tr>
<tr>
<td>C105. REPORT SELECTIVE LOCATIONS IN MASONRY USE COMPATIBLE MORTAR. MATCH EXISTING AND ADJACENT IN COLOUR, TEXTURE, AND TOOLING.</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$97,000.00</td>
</tr>
</tbody>
</table>
7 DRY STONE WALL

7.1 Existing Condition

The existing dry-stone wall that fronts the Forbes property is in poor condition, however, the stone is in good condition. The existing wall is approximately 18” high and 24” wide. The wall is dry stacked, meaning it contains no mortar binding the stones together. The north section of this dry stone wall will be completely removed when the lot housing the Forbes House is severed. As part of the redevelopment of the Forbes Estate property, Guelph Avenue is slated to be widened and thus the portion of the existing stone wall that is to be retained will be required to be moved approximately 1m towards the Forbes House to allow for proposed road works.
7.2 Conservation

Dry stone walls in Canada are usually built with local stone, traditionally right from the ground nearby. By building without mortar, you are simplifying the needed tools, materials and supplies. Traditionally dry stone walls were constructed with undressed stone, and the varying styles reflect the best use of the stone available.

In order to protect the existing stone supply and surrounding landscape on the site, the following conservation approach has been prepared to specifically address the cultural heritage value and heritage attributes that contribute to the dry stone wall’s size, shape and style.

The current dry-stone wall that fronts the property has fallen, however, the stone is in good condition and represents wall stone that is typical in size and shape for a 10-15” wall with 1 lift of stone. The process of salvage, sorting and palleting the stone for the rebuild is fundamental to the success of this part of the conservation. Stones that are in good condition (to be determined by the dry stone wall contractor) from the north portion of the stone wall may also be utilized in order to reinstate the appropriate height of wall. Wall dimensions to be consistent with either side of the main driveway.

For details on salvaging the existing stones, excavating the new foundation of the wall, rebuilding the wall and specifications, refer to the Appendix section.

7.3 Cost Estimate

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COST</th>
</tr>
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<tbody>
<tr>
<td>DRY STONE WALL</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>PALETTE AND STORE STONE UNITS (EITHER ON SITE OR OFFSITE)</td>
<td>$60,000.00</td>
</tr>
<tr>
<td>REBUILD WALL TO ORIGINAL HEIGHT</td>
<td>$70,000.00</td>
</tr>
<tr>
<td>- EXCAVATION</td>
<td></td>
</tr>
<tr>
<td>- PREPARE BASE</td>
<td></td>
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<tr>
<td>- REBUILD WALL WITH COPING</td>
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</table>

Approx. 10-15”, varies in locations

Figure 77. Dry stone wall diagram of the Forbes Estate wall. A compacted footing with drainage, 1 lift of stone, and topped with “Coq-n-Hens” as seen in the example Figure 74 on pg. 42 (ERA, 2022).

Figure 78. Wall highlighted in red is additional stone that can be utilized for the rebuild. Review of existing condition of stone will determine the quantity for re-use (ERA, 2022).
This report provides a summary of the conservation approach relating to the proposed severed property, which includes the Forbes house, the dry-stone wall, and surrounding landscaping. The intention for each of these is outlined in the report.

While the Forbes house is currently in good condition, this report highlights some recommendations for prioritized repair to inform the long-term conservation of its historic attributes. Undertaking the conservation work outlined in this memo will protect its cultural heritage value and heritage attributes for future reuse. The information provide in this report will form the basis of the conservation drawings and specifications.

The strategy for the existing dry-stone wall is to salvage, store and reinstate the wall in its new location.

The general landscaping and vegetation surrounding the house and on the estate will not be altered, subject to the placement of the triple car garage and the exact location of the relocated dry stacked wall.

The Letter of Credit found in the Appendix section of this document is for protection and urgent repairs identified in the Conservation Plan. These repairs are mostly confined to the windows, rear porch, porte-cochere, soffit and fascia, and existing gutters and downspouts. It is important to note that the Letter of Credit is for urgent repairs only, and all other repairs listed are simply recommendations that will improve existing conditions and reduce the rate of deterioration for certain identified attributes.

Overall, the Forbes House is in good condition and its continuous maintenance and conservation is integral to the cultural heritage value of the property.

Figure 79. The main staircase in the Forbes House (ERA, 2022)
9.1 APPENDIX I - LETTER OF CREDIT
Dear Jeremy,

We would like to submit a cost estimate for the scope of work described in the conservation plan prepared by ERA Architects on Dec. 01, 2022. This reflects the base rates for the work, excluding HST, overhead, profits, and contingencies for a Letter of Credit (LC).

We recommend an LC in the amount of $112,000.00 to cover the conservation scope of work for the property at 171 Guelph Avenue.

<table>
<thead>
<tr>
<th>0-1 Year</th>
<th>PROTECTION</th>
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<tbody>
<tr>
<td></td>
<td>Shoring, Bracing, Hoarding</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td>Protection of exterior walls</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td>Protection of interior elements</td>
<td>$5,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0-1 Year</th>
<th>WINDOWS AND DOORS</th>
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<tbody>
<tr>
<td></td>
<td>New Windows</td>
<td>$36,000</td>
</tr>
<tr>
<td></td>
<td>Rear Porch repairs</td>
<td>$20,000</td>
</tr>
<tr>
<td></td>
<td>Porte Cochere Balustrade</td>
<td>$16,000</td>
</tr>
<tr>
<td></td>
<td>Soffit and Fascia Repairs</td>
<td>$20,000</td>
</tr>
<tr>
<td></td>
<td>Existing Gutters and Downspout Repairs</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>$112,000.00</strong></td>
</tr>
</tbody>
</table>

Please contact me if you have any questions.

Sincerely,

Andrew Pruss, Principal
ERA Architects Inc.
9.2  APPENDIX II - STATEMENT OF SIGNIFICANCE
To: SPECIAL COUNCIL
Meeting Date: 2/15/2022
Subject: 22-015-CD Request to Designate a Property of Cultural Heritage Value Under Part IV of the Ontario Heritage Act, Relocate the Stone Tower, and Permit Demolition of Secondary Buildings – 171 Guelph Avenue (Forbes Estate)
Submitted By: Lisa Prime MCIP RPP, Chief Planner
Prepared By: Abraham Plunkett-Latimer, Senior Planner - Heritage
Report No.: 22-015-CD
File No.: N/A
Wards Affected: Ward 1

RECOMMENDATION(S):

THAT Report 22-015-CD Request to Designate a Property of Cultural Heritage Value Under Part IV of the Ontario Heritage Act, Relocate the Stone Tower, and Permit Demolition of Secondary Buildings – 171 Guelph Avenue (Forbes Estate) be received;

AND THAT Council authorizes the Clerk publish a Notice of Intention to Designate the main house and its associated land as identified as Lot 8 in Figure 7 in this report on part of the property municipally known as 171 Guelph Avenue because of its cultural heritage significance, in accordance with Part IV of the Ontario Heritage Act;

AND THAT Council approves the request to relocate the Rubble Stone Wall at 171 Guelph Avenue to a line closer to the main house, according to the process described in Appendix C of this report, by a qualified stone mason with experience with historic dry stack stone construction at the developer’s cost;

AND THAT Council approves the request to relocate the Stone Tower at 171 Guelph Avenue to a City-owned site in Hespeler, according to the process described in Attachment 4 by a qualified stone mason using traditional mass masonry construction at the developer’s cost subject to detailed specifications for the cataloguing, storage, reconstruction methods, and mortar materials being submitted to City to the satisfaction of the chief planner as outlined in Report 22-015(CD);

AND THAT approval of the relocation of the stone tower be subject to the owner entering into a development agreement with the City of Cambridge to the satisfaction of...
the Chief Planner detailing the financial responsibilities of the owner and the City of Cambridge regarding the relocation and restoration of the stone tower as outlined in Report 22-015(CD).

AND THAT Council endorses Jacob’s Landing Park as the preferred location for the relocation of the stone tower subject to receiving the required approvals as outlined in Report 22-015(CD);

AND THAT after relocation of the Stone Tower a report be prepared for the Municipal Heritage Advisory Committee and Council’s recommending designation of the tower in the new location;

AND THAT Council approves the request to demolish all the other buildings and structures on the property at 171 Guelph Avenue under the condition that a salvage plan is provided for the demolition of the north garage and portions of the rubble stone wall that are to be demolished and that both structures are thoroughly documented with photographs and measured drawings prior to a demolition permit being granted.

AND FURTHER THAT Council directs staff to update the Heritage Properties Register listing for the remainder of the property at 171 Guelph Avenue after the designation for the main house on the property is registered on title.

EXECUTIVE SUMMARY:

Purpose

Council approval is requested to initiate the heritage designation of the main house at 171 Guelph Avenue, to permit the relocation of the stone tower and low stone wall, and approve the demolition of the other buildings and structures on the property.

This report provides an update to Report 21-120 which Council considered on July 13 2021. At that time Council deferred making a decision until further information was provided. This report is intended to provide the supplementary information that was requested and outline additional detail regarding the reasons for staff and the Municipal Heritage Advisory Committee’s recommendations that were previously considered by Council.

Key Findings

- The property located at 171 Guelph Avenue is listed on the City of Cambridge’s heritage register as a non-designated property of cultural heritage value or interest.
- The owner is proposing to redevelop the property as a residential subdivision requiring demolition or relocation of structures on the property.
• Council approval is required to permit the demolition or relocation of a structure on a property listed on the heritage register.
• The property has been evaluated and it has been determined to contain cultural heritage resources including the individual resources of the main house and the stone tower. The main house is proposed to be designated under the Ontario Heritage Act. The significance of the main house would be conserved by designating it on a 0.44-hectare (1.08-acre) lot and permitting the redevelopment of the rest of the property.
• The stone tower is proposed to be relocated to public lands and designated under the Ontario Heritage Act in its new location. The significance of the stone tower would be maintained if it were relocated.
• The other structures on the property have not been found to hold cultural heritage value or interest and are recommended to be demolished.
• The Municipal Heritage Advisory Committee recommended approval on August 20, 2020 and endorsed a tree management plan on December 17, 2020.
• A previous report regarding this property was considered by Council on July 13, 2021. Council requested that staff provide additional information before making a decision. Heritage staff have reviewed new information since the report was previously considered by Council. This new information does not substantially impact the report’s recommendations.

Financial Implications
• There is no fee for designating a property in Cambridge. The City will pay for publishing the Notice of Intention to Designate in the Cambridge Times in the corporate advertisement and for sending the notice to the owner. The City does provide and pay for the installation of a heritage landmark plaque if the owner desires one, at a cost of approximately $500.
• The owner is assuming all costs of the proposed work at the heritage property, including the relocation of the low rubble stone wall.
• The owner will also assume the costs of dismantling, documenting, storing, obtaining approvals, and reconstructing the Stone Tower at the destination location. The preliminary cost estimate of this work is $420,000 based on 2022 costing. In addition to this amount for the relocation of the Stone Tower, the owner will also project manage the adaptive re-use construction to repurpose the structure.
• At this preliminary stage, the stone tower is proposed to be adaptively reused as an observation tower with accessibility features. A preliminary estimate for the
cost to the City to adaptively reuse the tower as an observation tower, is approximately $350,000 based on 2022 costing.

- If Council approves the proposed relocation, detailed plans and costing would be prepared as next step for the tower’s re-use. A firm estimate for the required work would be determined and presented for Council’s consideration when plans for adaptive reuse are finalized. The adaptive re-use costs will be the responsibility of the City, with some shared costs between the developer and owner for items required by both parties (e.g. roof). This work would be funded as a future item through the capital budget process. The project would fall within the scope of the Core Areas Transformation Fund program, which may be considered for supplemental funding.

- If Council does not approve the adaptive reuse of the tower, the owner would be responsible for the cost of reconstructing the tower as-is. The City would be responsible for assisting with obtaining the required permits and preparing the new location for the tower at a cost of approximately $100,000 based on 2022 costing, to be funded as a future item through the capital budget process.

- Timing of the reconstruction work would be dependant on finalizing designs, securing funding, obtaining the required permits, and preparing the new site for the tower relocation. To facilitate the tower’s adaptive reuse, it is recommended that the work required to make the tower accessible be undertaken during reconstruction.

- Draft conditions of subdivision were recommended regarding the relocation of the stone tower and outlined in Report 21-037(CD). These conditions outline in more detail the financial responsibilities of the owner and City regarding the relocation of the tower. These conditions are included as Appendix E of this report. As a condition of approval for the relocation of the stone tower, the owner is requested to enter into a detailed agreement with the City accepting responsibility for the owner’s portion of the shared costs of relocating and restoring the tower in the new location.

STRATEGIC ALIGNMENT:

☑ Strategic Action; or
☐ Core Service

Objective(s): PLACEMAKING - Promote and create a wide range of destinations and activities that capitalize on the beauty of the rivers and heritage buildings

Strategic Action: Enhance opportunities to enjoy built and natural heritage
**Program:** Choose a Program

**Core Service:** Choose a Core Service

The proposed development would ensure the long-term conservation of the Forbes house in the Town of Hespeler and would maintain the character of Guelph Avenue by retaining approximately forty percent of the existing property’s frontage along with its mature trees and stone fence.

Relocating and adaptively reusing the stone tower on public property would create opportunities for the public to engage with, learn about, and celebrate the history of the Town of Hespeler and would provide an opportunity to positively contribute to placemaking.

**BACKGROUND:**

171 Guelph Avenue is a 5.4-hectare (13.3 acre) property containing a main house and accessory buildings. A low stone fence runs along the property line fronting onto Guelph Avenue and there are many mature trees on the property. It is accessed via a driveway fronting onto Guelph Avenue. The accessory buildings are accessed via internal lanes.

The property is listed on the City of Cambridge’s heritage register as a non-designated property of cultural heritage value or interest.

The property was previously the site of an agricultural complex owned by Jacob Hespeler, who was a key individual in the development of the Town of Hespeler, and was later the home of the Forbes family, who were prominent local industrialists and political figures. The property is the last remaining portion of a much larger estate that has over time been subdivided.

The property includes the Forbes House, a large masonry dwelling constructed in 1912. The Forbes House is bordered to the north by a line of trees that previously separated the current Forbes House from an earlier estate house on the same property that was demolished in 1949 Figure 3. It is accessed by a formal driveway from Guelph Avenue. The edge of the property is demarcated on Guelph Avenue by a low rubble stone wall Figure 4.

The property contains a number of outbuildings including a north garage, which was associated with the earlier residence on the property, and a stone tower associated with a nineteenth-century agricultural complex developed by Jacob Hespeler Figure 5 and Figure 6. The property also contains two garages dating to the second half of the twentieth century and an additional dwelling built in the Edwardian foursquare style at 155 Guelph Avenue.
Figure 1: Site Map Showing Location of Structures, Image Provided by ASI Heritage 2020. The “stone building” indicated in this image is referred to as the “stone tower” in this report.
Figure 2: Forbes House Front Elevation, 2020.

Figure 3: Trees demarcating boundary, August 13 2021.

Figure 4: Stone wall adjacent to Guelph Avenue, August 13, 2021.
Figure 5: North Garage, August 13 2021
In 2018 an application was received for Draft Plan of Subdivision Approval and a Zoning By-law Amendment to permit the redevelopment of the property. The proposal has evolved since 2018 in response to comments from municipal and regional staff and the public. The applicant is now proposing to construct a residential infill development consisting of 37 Single detached dwellings (7 freehold and 30 condominium), 12 townhouse units and up to 132 stacked townhouse units.

To permit the redevelopment of the property the Forbes house is proposed to be retained on a severed lot within the subdivision which will include a portion of the stone wall, the formal driveway, and line of trees demarcating the northern boundary of the yard. The stone tower is proposed to be relocated to City property. All other buildings and structures are proposed to be demolished.

A Cultural Heritage Impact Assessment (CHIA) prepared by ASI Heritage was provided to the City to evaluate the impacts of the proposed alteration to the property in September 2018. This CHIA was revised in February 2020 to address comments from City staff and an independent peer reviewer retained by the City. The CHIA is included
as Appendix A. The CHIA was deemed complete by City staff and the independent peer reviewer in 2020.

An earlier version of this report, 21-120(CD), was presented to Council on July 13, 2021 recommending designation of the Forbes house and relocation of the stone tower. This was presented in conjunction with report 21-037(CD) which was a report from Development Planning staff regarding the proposed draft plan of subdivision and zoning by-law amendment applications. Council deferred making a decision on both reports and requested that staff provide more information to address concerns that were raised at the July 13, 2021 Council Meeting.

Since July 13, 2021 heritage staff have received an additional source regarding the historical use of the stone tower entitled Hespeler New Hope – Canada West, written by Winfield Brewster and published in 1951. The relevant excerpt from this book is included as an attachment in Appendix B to this report. This document describes that the stone tower was previously used to house pigeons, poultry, and ducks prior to the 1950s.

Staff have also met with the developer and representatives from the Architectural Conservancy of Ontario Cambridge Branch. City staff contacted sources provided by the Architectural Conservancy of Ontario Cambridge Branch. This information included an opinion from a heritage building specialist who suggested that the stone tower’s physical characteristics were consistent with dovecotes he had previously encountered in his work. The additional information gained from this research was provided to ASI Heritage with a request for comments.

ASI Heritage has reviewed this additional information and has determined that the new information does not substantially change the recommendations of the February 2020 CHIA. The owner has also provided an additional memorandum prepared by Owen Scott regarding the additional research. Both memos are included as Appendix B.

The additional information gathered has been considered in formulating this report.

ANALYSIS:

Designation of the Forbes House and Relocation of Stone Wall:

The Forbes house has been found to hold cultural heritage value or interest because of its design value, its associative value, and its contextual value. The house was constructed in 1912 and is a rare and representative example of an estate-like Edwardian Classical Revival residence.

A number of landscape elements have also been identified as contributing to the property’s significance as an estate-like property including the rubble stone wall that is located along the property’s edge on Guelph Avenue, the line of trees separating the
main house from the north garage, and the formal driveway approaching the porte cochere.

The Forbes house is proposed to be retained within the proposed subdivision on a 0.44-hectare (1.08 acre) lot with a 77.69 (254.88 foot) frontage on Guelph Avenue. This configuration has been proposed to conserve the identified significant landscape elements as outlined in Figure 7. The lot would conserve approximately 39% of the existing frontage along Guelph Avenue, including a line of mature trees, and approximately one third of the existing rubble stone wall.

The stone wall is currently located in the City’s right of way and is proposed to be documented, dismantled, and reconstructed several metres back on the severed lot so that it will not be damaged by future road widening.

Figure 7: Figure 1: Part of property to be designated, 171 Guelph Avenue, showing “Lot 8” with approximate boundaries: K=Estate House, B=Tree row north side, C=Driveway to porte-cochere, E=Rubble stone wall.

Staff is satisfied that the designation of the Forbes house on a 0.44-hectare lot would protect the property’s key heritage attributes as outlined by the Cultural Heritage Impact Assessment prepared by ASI Heritage and revised February 2020.

Staff is requesting that Council direct staff to issue a Notice of Intention to Designate the Forbes house and associated yard as an individual resource. The designation would be
intended to apply only to the 0.44-hectare (1.08-acre) lot and not the Forbes property as a whole.

**Relocation of the Stone Tower:**

The stone tower has been identified as holding cultural heritage value or interest because of its design or physical value and its associative value. The structure is an early and rare example of a stone agricultural building in the town of Hespeler and shows a high degree of craftsmanship.

The stone tower also has value because of its association with Jacob Hespeler, who contributed significantly to the early development of the Town of Hespeler.

The Cultural Heritage Impact Assessment for the property identifies that the tower was originally constructed as part of an agricultural complex for Jacob Hespeler, which included a stone barn (Figure 8).

It has been suggested that the original purpose of the tower was a dovecote, defined as a structure for housing pigeons or doves. As indicated above, the Winfield Brewster document from 1951 describes that the tower was divided into three levels. The upper floor housed pigeons, the middle floor housed poultry, and the lower floor housed ducks.

Evaluation by ASI Heritage and Owen Scott has suggested that there are, however, some structural differences between the stone tower and two known dovecotes that are still standing in Ontario at Dundurn Castle and Auchmar Estate which suggest that the tower may not have been purpose-built to house pigeons or doves. These confirmed dovecotes display steeply pitched roofs and openings through which pigeons were able to access roosts. This analysis is included as **Appendix B**. In a photograph of the stone tower dating from approximately 1908, a low-pitched roof can be observed **Figure 8**.
Staff is of the opinion that a definitive identification of the stone tower as a dovecote would not change staff’s recommendations. Regardless of its original purpose, staff has identified that the structure is significant because of its physical and design value and its association with Jacob Hespeler and should be conserved.

### Conservation Options

Given the significance of the tower, the heritage staff have considered two options for its conservation: retaining the tower in its current location and relocation to public lands.

### Retaining in the Current Location

Heritage staff have evaluated the potential to retain the stone tower in its existing location either as part of a future condominium or as a public park as part of the proposed development of the property and have determined that there are a number of constraints that may impact the tower’s long-term conservation and limit the viability of this option.

The tower is located in a largely inaccessible location on its current lot and is largely not visible except in its immediate surroundings. The tower is located at the rear of the current property approximately 12 metres from the adjacent industrial property without easy access or visibility from Guelph Avenue or Shaw Avenue East Figure 9. It is separated from the public walking trails along the Speed River both by the adjacent industrial building, a creek, and by train tracks Figure 10. The tower is also located at the low point of the property, which is at bottom of a slope approximately four metres below the street level at Guelph Avenue. These physical characteristics would discourage the general public from accessing the tower if it were retained in its current
location and may encourage misuse or vandalism due to it being sheltered from public view.

Figure 9: Location of Stone Tower with Reference to the Adjacent Industrial Site, August 13 2021.
The owner has not agreed to convey the lands on which the tower is located to the City. If the tower were retained on its current lot as part of the proposed subdivision, it may therefore be located on private property or within a small parkette primarily for use of the subdivision residents. Without access points from Guelph Avenue, it would be accessed only through the subdivision and would not be visually prominent in its low and sheltered location. The physical barriers outlined above would likely discourage the general public from learning about or accessing the tower.

If the tower were retained in its current location, it would also require substantial reconstruction to be accessible to the public which would change its current appearance. The tower is currently unstable and the rear wall has failed Figure 11. The tower would likely require portions of the rear wall to be reconstructed, the entirety of the structure to be repointed, and the structure to be stabilized and protected from further deterioration by constructing a new roof and floor joists.
It is heritage staff’s opinion that retaining the structure in its current location is not ideal for its long-term conservation due to these constraints outlined above and may result in the tower further deteriorating or being damaged over time.

**Relocate to Public Lands**

The owner of 171 Guelph Avenue has agreed to cover the cost to relocate the stone tower to City property. The City has proposed that the structure be relocated to a location approximately 400 metres to the south east of its current location to a location adjacent to the Speed River in Jacob’s Landing Park [Figure 12](#). Parks staff have proposed that the tower could be adaptively reused, potentially as a viewing tower overlooking the mill pond. Two possible locations approximately 50 metres apart have been proposed within Jacob’s Landing Park with the final location to be determined in Site Plan Review. The proposed location is within lands regulated by the Grand River Conservation Authority (GRCA). Reconstruction in this location would require GRCA approval.
In the proposed location, the tower would be visually prominent in the landscape, forming a key part of views of the Speed River from Guelph Avenue and from both riverbanks Figure 13.

Figure 12: Two Approximate Locations Proposed for the Location for the Relocated Tower.
Relocation carries risk of taking away from a structure’s heritage value by removing it from its context. In this case, it is staff’s opinion that relocation of the tower to Jacob’s Landing Park would not take away from the structure’s contextual value and may help to strengthen its association with Jacob Hespeler.

It was identified in the February 2020 Cultural Heritage Impact Assessment regarding 171 Guelph Avenue that the stone tower was constructed as part of an agricultural complex owned by Jacob Hespeler which pre-dates the Forbes House by approximately 40 years. Its associative value was identified due to its connection with Jacob Hespeler, and not the Forbes house or family.

In the nineteenth century when the tower was constructed, Hespeler’s estate included all of the lands comprising Jacob’s Landing Park and 171 Guelph Avenue and extended westward to his home on the west side of Guelph Avenue as one continuous estate. Hespeler was also involved in the damming of the Speed River and the creation of the Mill Pond.

Although the tower was originally constructed as part of an agricultural complex with which it had an immediate contextual relationship, none of those buildings with which it was originally constructed are still standing. Its significance is therefore linked at this time to the broader context of the Hespeler lands rather than to its immediate context, which has been significantly altered since it was constructed.

It is heritage staff’s opinion that the tower’s association with Jacob Hespeler would be preserved and potentially strengthened by relocating it to Jacob’s Landing Park which already commemorates Hespeler’s role in the development of the Town of Hespeler. Locating the tower in this location would allow for opportunities for programming and interpretation creating opportunities for the public to learn about and celebrate its significance to the community and better understand the tower’s contextual relationship to other structures constructed for Jacob Hespeler such as the mill at 19 Guelph Avenue.

It is anticipated that the prominent placement of the tower in Jacob’s Landing Park would contribute to placemaking by inviting the community to learn about and take pride in its past. It would strengthen the identity of the former Town of Hespeler, contribute to its sense of place, and could make the tower a destination within the community.

Prior to the tower being adaptively reused, the Municipal Heritage Advisory Committee and Council would have the opportunity to approve finalized plans.

**Relocation Process**
The stone tower has been evaluated by structural engineers who have recommended that it be relocated by being dismantled and reconstructed in its new location rather than being moved in one piece. This approach is outlined in Appendix D. There is risk for loss of integrity when a structure is dismantled and reconstructed.

In order to maintain the structure’s integrity, heritage staff is recommending that detailed specifications for the cataloguing, storage, reconstruction methods, and mortar materials be submitted to the City to the satisfaction of the Chief Planner prior to any work being undertaken.

Staff is recommending that these specifications include at minimum:

- Thorough documentation of the existing tower by a qualified heritage professional including labeling important stones and documenting original construction methods;
- Preparing a keyed map and storage plan for individual significant stones so they may be reconstructed in similar order and location;
- Documenting and recording mortar colour, composition, average joint size and style for reconstruction;
- Documenting and recording joist pockets and other elements in the walls in detail so that they can be reconstructed accurately;
- Documenting wood locations, species, and sizes;
- Storing significant stones in the same order on individual pallets as they were originally installed;
- Adequately storing all materials to avoid theft or damage;
- Reconstructing the structure in the new location on a new foundation using appropriate heritage methods and mortar types and reconstructing in accordance with the detailed documentation.
- Ensuring that all deconstruction and reconstruction work is undertaken by qualified heritage stone masons.

The owner has agreed to pay for the careful dismantling of the stone tower and storing of materials until approvals for the reconstruction destination site are obtained by the owner. Conditions of approval on the associated planning application outline the owner’s and City’s responsibilities. An example of a similar relocation project is attached as Appendix F.
Heritage staff are satisfied that relocation of the stone tower is an appropriate conservation approach because it would maintain the tower's associative value with Jacob Hespeler and its general context. Careful documentation and storage would ensure that the tower could be dismantled and rebuilt with minimal loss to its integrity.

Regarding timing of work, it is anticipated that the tower would be dismantled and safely stored off site until plans for adaptive reuse have been finalized. After the required funding and approvals for adaptive reuse of the tower have been obtained, the tower would be reconstructed in its new location. The timing of the reconstruction work would be determined by the City of Cambridge finalizing plans for reuse and obtaining the required funding and permits.

If the tower were retained in its current location there may be significant challenges for its future conservation including its location on private property, substantial restoration required, grading, and low visibility and public access. Therefore, heritage staff is recommending that Council approve the relocation of the tower subject to the conditions outlined in Report 22-014(CD). If Council does not approve the relocation of the stone tower, Council has the option to designate the structure under the Ontario Heritage Act in its current location to prevent its demolition or relocation. The designation may be appealed to the Ontario Land Tribunal.

Demolition of Other Buildings:

The Cultural Heritage Impact Assessment identified that the other buildings and structures on 171 Guelph Avenue were not of such significance to recommend their preservation. For properties such as this one, which is listed as a property of interest (not designated) on the Heritage Properties Register, Council is given the opportunity to object to demolition by initiating designation. Individual assessments of these structures are included in Appendix A. Staff agrees with the Cultural Heritage Impact Assessment and is recommending Council approve demolition of the remaining structures.

Staff is recommending that given the age of the north garage and the rubble stone wall, both structures should be thoroughly documented through photographs and scaled drawings, and salvage plans should be submitted to the satisfaction of the Chief Planner prior to a demolition permit being issued.

Council has the option to designate the other buildings, thus preventing demolition. A notice of intention to designate would be issued, followed by the other procedures identified above for the main house. Objection and appeal procedures to the Ontario Land Tribunal are outlined in the Ontario Heritage Act. Since the other buildings are located within the proposed streets, a modification to the draft plan of subdivision would be needed to keep them.

Cultural Heritage Landscape Evaluation
At the July 13, 2021 Council meeting, Council requested that additional information be provided regarding analysis of the property as a Cultural Heritage Landscape. The property was evaluated as a Cultural Heritage Landscape as part of the Heritage Impact Assessment (CHIA) prepared by ASI Heritage and dated February 2020.

“Cultural Heritage Landscape” is a concept derived from the Provincial Policy Statement (2020) which is used to evaluate contextual relationships between buildings and/or other landscape elements. Cultural Heritage Landscapes can be protected through designation under Part IV or Part V of the Ontario Heritage Act or through Official Plan policies.

The authors of the CHIA indicated that while the property does not meet Waterloo Region’s Implementation Criteria for Cultural Heritage Landscapes, several of the property’s landscape elements have been identified as significant because they contribute to its value as a rare example of an estate-like property in Cambridge. Elements contributing to the estate-like quality that were identified in the CHIA were the rows of vegetation demarcating boundaries within the property, the former orchard, the rubble wall, and the formal driveway. With the exception of the orchard, which is now overgrown, substantial portions of these landscape attributes are proposed to be conserved by the proposed development including approximately 40% of the existing frontage along Guelph Avenue including the row of trees, the row of trees separating the Forbes house from the north garage, the portion of the formal driveway accessing the Forbes house, and approximately one third of the rubble stone wall.

No contextual relationship was identified in the CHIA between the remaining structures on site, including the stone tower, the house at 155 Guelph Avenue, and the remaining garages.

Heritage staff is satisfied that the cultural heritage landscape evaluation conducted by ASI Heritage has identified significant landscape attributes and that these attributes will be adequately conserved.

EXISTING POLICY / BY-LAW(S):

Ontario Heritage Act

Part IV Section 29 (1) of the Ontario Heritage Act provides municipalities in Ontario the ability to designate individual properties that are shown to have cultural heritage value to a community.

Section 30 (1) provides that permits for altering the property become void when a Notice of Intention to Designate is served. (They may be issued after heritage approvals.)

Cambridge Official Plan
Section 4.1 of the Official Plan includes Objective a) to “support the conservation, restoration and prominence of the city’s-built heritage as a key identifying feature of the community”.

Section 4.2 of the Official Plan discusses the priorities for cultural heritage resources in the City. Section 4.2.1 states:

1. When development is proposed, the City will encourage the conservation of cultural heritage resources in the following order of preference:

   a) incorporation of cultural heritage resources and their surrounding context into development applications in a manner which does not conflict with the cultural heritage resource; …

   b) promotion of the use of scale and design which blends harmoniously with existing cultural heritage resources when development occurs; and

   c) preservation and adaptive re-use of buildings of cultural heritage significance for compatible residential intensification and/or for other appropriate and compatible uses is encouraged.

FINANCIAL IMPACT:

- There is no fee for designating a property in Cambridge. The City will pay for publishing the Notice of Intention to Designate in the Cambridge Times in the corporate advertisement and for sending the notice to the owner. The City does provide and pay for the installation of a heritage landmark plaque if the owner desires one, at a cost of approximately $500.

- The owner is assuming all costs of the proposed work at the heritage property, including the relocation of the low rubble stone wall.

- The owner will also assume the costs of dismantling, documenting, storing, obtaining approvals, and reconstructing the Stone Tower at the destination location. The preliminary cost estimate of this work is $420,000 based on 2022 costing. In addition to this amount for the relocation of the Stone Tower, the owner will also project manage the adaptive re-use construction to repurpose the structure.

- At this preliminary stage, the stone tower is proposed to be adaptively reused as an observation tower with accessibility features. A preliminary estimate for the cost to the City to adaptively reuse the tower as an observation tower, is approximately $350,000 based on 2022 costing.
• If Council approves the proposed relocation, detailed plans and costing would be prepared as next step for the tower’s re-use. A firm estimate for the required work would be determined and presented for Council’s consideration when plans for adaptive reuse are finalized. The adaptive re-use costs will be the responsibility of the City, with some shared costs between the developer and owner for items required by both parties (e.g. roof). This work would be funded as a future item through the capital budget process. The project would fall within the scope of the Core Areas Transformation Fund program, which may be considered for supplemental funding.

• If Council does not approve the adaptive reuse of the tower, the owner would be responsible for the cost of reconstructing the tower as-is. The City would be responsible for assisting with obtaining the required permits and preparing the new location for the tower at a cost of approximately $100,000 based on 2022 costing, to be funded as a future item through the capital budget process.

• Timing of the reconstruction work would be dependant on finalizing designs, securing funding, obtaining the required permits, and preparing the new site for the tower relocation. To facilitate the tower’s adaptive reuse, it is recommended that the work required to make the tower accessible be undertaken during reconstruction.

• Draft conditions of subdivision were recommended regarding the relocation of the stone tower and outlined in Report 21-037(CD). These conditions outline in more detail the financial responsibilities of the owner and City regarding the relocation of the tower. These conditions are included as Appendix E of this report. As a condition of approval for the relocation of the stone tower, the owner is requested to enter into a detailed agreement with the City accepting responsibility for the owner’s portion of the shared costs of relocating and restoring the tower in the new location.

PUBLIC VALUE:

Leadership:

This project is contributing to residents’ pride of place by conserving significant heritage resources and making opportunities for the public to learn about and enjoy them. Relocating the stone tower to public lands will give the City opportunity to take an active role in improving access to the community’s past and celebrating Cambridge’s unique areas.

ADVISORY COMMITTEE INPUT:

On August 20, 2020 MHAC passed this resolution:
THAT Report 20-016 (MHAC) – Request to Designate a Register-Listed Property – 171 Guelph Avenue (Forbes Estate House), Remove the Stone Tower for Conservation and Demolish Other Buildings and Structures – be received;

AND THAT the Cambridge Municipal Heritage Advisory Committee (MHAC) receives the Heritage Impact Assessment about 155 and 171 Guelph Avenue, prepared by ASI and dated February 19, 2020, included as Attachment 1;

AND THAT the MHAC recommends to Cambridge City Council that the Clerk be authorized to publish a Notice of Intention to Designate the main house and its associated land on the property municipally known as 171 Guelph Avenue because of its cultural heritage significance, in accordance with Part IV of the Ontario Heritage Act;

AND THAT the MHAC recommends that Council approve the request to relocate the Rubble Stone Wall at 171 Guelph Avenue to a line closer to the main house, according to the process described in a letter in Attachment 2 by a qualified stone mason with experience with historic dry stack stone construction at the developer’s cost.

AND THAT the MHAC recommends that Council approve the request to relocate the Stone Tower at 171 Guelph Avenue to an offsite location, preferably on City-owned property if possible, according to the process described in a letter in Attachment 3 by a qualified stone mason using traditional mass masonry construction at the developer’s cost;

AND THAT the MHAC recommends that Council approve the request to demolish all the other buildings and structures at 171 Guelph Avenue, as depicted in the Heritage Impact Assessment (HIA) provided by ASI dated February 2020;

AND THAT the MHAC recommends that a conservation plan for the main house be prepared by a qualified heritage professional, as depicted in the HIA provided by ASI on February 19, 2020, and submitted to MHAC for endorsement before a subdivision plan is registered for the site;

AND THAT the MHAC recommends that the tree management plan be submitted to the MHAC for endorsement before a subdivision plan is registered for the site.

AND FURTHER THAT the MHAC recommends that Council direct staff to update the Heritage Properties Register listing for the remainder of the property of 171 Guelph Avenue after the designation of the main house is finalized.
The requested tree management plan (next-to-last paragraph) was received by staff in November 2020 and submitted to MHAC the next month. On December 17, 2020 MHAC passed this resolution:

THAT Report 20-037 (MHAC) – Tree Management Plan – 171 Guelph Avenue, Forbes Estate – be received;

AND THAT the Municipal Heritage Advisory Committee (MHAC) receives for endorsement the Tree Management Plan (TMP) and its findings as prepared by Dougan & Associates, dated November 3, 2020, and included as Attachment 1 to Report 20-037;

AND THAT MHAC encourages the proponent to plant exclusively a diverse array of native species.

The tree management plan was also submitted to Development Planning staff for inclusion in the site plan process. The report will be made available upon request. City staff advised MHAC on December 17, 2020 that the City’s practice is to require native plantings where possible through review and approval of site plan applications. If the development planning application is eventually approved, a site plan application will need to be finalized for the project prior to construction occurring on the site.

PUBLIC INPUT:
Consultation has been undertaken as part of the Draft Plan of Subdivision and Zoning By-law Amendment applications.

Posted publicly as part of the report process.

INTERNAL / EXTERNAL CONSULTATION:
Heritage Planning staff consulted with Development Planning staff, Parks Planning staff, Legal staff, Regional Heritage Planning staff, the property owner, representatives of the Architectural Conservancy of Ontario, and interested community members.

CONCLUSION:
The main house on the Forbes Estate property at 171 Guelph Avenue is a significant heritage resource and should be designated following the processes of the Ontario Heritage Act. Retaining the house on a 0.44-hectare (1.08-acre) lot would conserve not only the home, but also landscape elements that contribute to its significance as an estate-like property. Heritage staff is recommending that Council approve the request to Designate the house and its immediate yard as an individual heritage resource.
The stone tower is also a significant heritage resource that should be conserved. Staff is recommending that relocation of the tower be permitted in accordance with the conditions outlined in Report 22-014(CD). Heritage staff is of the opinion that relocating the stone tower 400 metres to the south east to Jacob’s Landing Park would not only ensure that the tower is conserved, but also would create opportunities for the community to learn about, engage with, and celebrate its significance.

Staff is satisfied that the remaining structures on the property have been evaluated and have not been found to hold cultural heritage value or interest. Staff is recommending that they be permitted to be demolished in accordance with the conditions outlined in Report 22-014(CD).

**REPORT IMPACTS:**

Agreement: Choose an item

By-law: **Yes**

Budget Amendment: Choose an item

Policy: Choose an item

**APPROVALS:**

This report has been reviewed by the Chief Financial Officer and City Solicitor. It has been reviewed and approved by the Director, Deputy City Manager and City Manager.

**ATTACHMENTS:**

When naming attachments please use the following format:


9.3 APPENDIX III - ARCHIVAL ARCHITECTURAL ELEVATIONS
Drawings of Proposed New Residence to be Erected by Millesier Ont.

6.10.1887

Millesier Ont.
9.4 APPENDIX VI - DRY STONE WALL
Salvage:

- Each 3 meter wall section to fit on 1 single skid. Stone to be organized on the skid based on different sizes, typically with piles of large, medium, and small stones. Stone for the “coq’n’hens at the top of the wall (figure 1) should be set aside as well as through stones and foundation stones (the largest).
- New wall location is approximately 2 meters east from the current location (see site survey for exact location). Each pallet of stone should be set on risers to for vegetation to remain under skid. Each skid should have equal amounts of stone in size for overall consistency during the rebuild.

Foundation:

- Excavate 18” below current grade and remove soil. All tree roots to remain in place. If the location of the wall intercepts a tree on-site, the wall will continue after the tree. Wall base to be 24-30 inches wide, or the length of the average through stone. The width of the wall base has to relate to length of through stones for long-term stability
- Compact natural soil with a powered tamper and use a hand tamper in tight spaces.
- Install 6 inch perforated drainage pipe in the center of the foundation for drainage.
- Using limestone screenings, fill foundation up to grade and tamp every 6 inches adding water to dampen during each lift.
- Equal amount of stone is required on each side of the wall. Starting at the wall foundation leave 18” of clear walking space on each side. Line up the thickest stones nearest to the wall, with stones of decreasing thickness placed progressively farther from the wall. At a minimum sort the stones into rows of big, medium, and small.

Rebuild:

1. Set all the stones so their length goes into the wall, not along it. Just like when stacking firewood, where only the ends of the pieces of wood are visible in the finished stack. By placing the stones length in you are maximizing the friction between stones, and also getting the center of mass of each stone closer to the core of the wall. This is the rule most commonly broken and one of the primary reasons walls fail.
2. Hearting is absolutely key to building a strong wall. It adds many points of contact between stones, increasing friction, and keeps stones from moving independently of the entire wall. However, anything you can readily shovel is too small to be used for hearting, and will act like ball bearings in the wall. Using the fewest, biggest pieces to fill the voids is important.
3. Cross the joints. Just like standard brick work, each stone should span the joint in the course below and sit firmly on the two stones either side of that joint. Vertical joints running up the wall through multiple courses are called Running Joints.
4. Build with the plane of the wall. Set the wall stones so that their faces line up with the outside face of the wall, creating a smooth even plane.
5. Set stones level. Each stone set on the wall needs to be able to support stones on top of it. The simplest way to achieve that is to set each stone so the top (or in some instances the bottom) is level. While there are certain types of construction that do not follow this rule, there always needs to be thought about planning ahead to the stones on the next course.
PART 1 --- GENERAL DESCRIPTION

Work includes furnishing and installing a coursed dry stone retaining wall to be installed to the lines and grades designated on the project’s final construction drawings or as directed by the Architect/Engineer. Included here are the standards of coursed dry stone wall construction, as they should be shown on the construction drawings.

1.02 RELATED SECTIONS

DEFINITIONS:

1. A Dry-Stone Retaining Wall is a type of gravity wall. It is built without any mortar and relies on the mass of the stones and the friction between them to retain soil.

2. Terminology for Dry Stone Walls as used in these specifications:
   2.1. Footing: The prepared surface on which the wall is built
   2.2. Foundation Stones: Large Stones in the bottom of the wall, forming the first course.
   2.3. Lift: A portion of wall vertically above or below a course with through stones. The First Lift Starts on top of the foundation stones and goes up to the first course of through stones. The second lift is the next in height and so on. The number of lifts is determined by the height of the wall.
   2.4. Through Stones: Long stones used to tie the face of the wall back to the stones behind. Through stones are typically placed in level courses with a specified horizontal distance between them. The courses of through stones define the top and bottom of the lifts.
   2.5. Wall Stones: Stones seen in the face of the completed wall.
   2.6. Backing Stones: Stones used behind the face stones to add mass and structure to the wall.
   2.7. Pinning: Stones precisely placed to wedge wall stones in place.
   2.8. Hearting: Stones used to fill voids between wall stones, backing stones, and pinning stones.
   2.9. Cap Stones: Stones that make up the top course of the wall, covering the top of the final lift.
   2.10. Top of Wall Width: Is defined by the top of the Cap Stones
   2.11. Batter: Angle that the face of wall leans back. Typically described in a ratio of ‘distance back’ to ‘height’ such as 1:6.
3. **LAYOUT:**

   3.1. Wall section dimensions are to be determined as follows:
       
       \[
       2 \times \text{Height} \times \text{Slope of Batter} + \text{Top of Wall Width} = \text{Width of Base}
       \]

   3.2. The batter of the exterior face of the wall should be as shown on the construction drawings. The typical range for batter is 1:12 to 1:6. A vertical wall face is not acceptable.

4. **CONTRACTOR REQUIREMENTS**

   The General Contractor shall use certified wall builders (Walers) to place the Wall Stones in each lift. The entire structure must be built under the supervision and in the presence of the certified Waller(s). Certifications are acceptable from the following organizations:

   4.1 Professional status at Dry Stone Canada or:

       Level 2 certification via DSWAUK scheme or Level 1 of the DSC scheme.

       To obtain professional status at Dry Stone Canada one must be, and have completed, the following:
       actively working in dry stone or have completed a level 2 certification or above with the Dry Stone Walling Association of Great Britain or Level 1 certification or above of Dry Stone Conservancy (Kentucky, USA).

       [https://drystonecanada.com/about-professional-walling/](https://drystonecanada.com/about-professional-walling/)

5. **SUBMITTALS:**

   5.1 Certification: Waller certification documentation shall be submitted as part of the bid process.

   5.2 Design: All calculations and drawings shall be prepared and sealed by a professional Civil Engineer (PE), Landscape Architect (PLA), or Architect (RA) who is experienced in dry stone wall construction design and licensed in the state where the wall is to be built. Wall Design must consider all information presented in wall elevation, layout, grading, and landscaping plans including but not limited to back slopes, surcharge loads, soil elevations, fence post locations, tree or shrub planting beds, plant growth, and the inclusion of the storm water drainage piping designed by a qualified professional, which will be located within the retained fill for some walls. The wall design professional shall contact the Landscape Architect to coordinate the plant bed design within retained fill when applicable.

   5.3 Work Documentation: Contractor/certified waller shall submit detailed photographic or video documentation of the project from start to completion. This report is to verify correct building techniques.

   Document to include the following points:

   1. Site before any work has begun
   2. Prepared sub grade
   3. Foundation Stone Placement
   4. Completed First Lift
   5. Through Stones Placement
   6. Completed Second Lift
   7. Through Stones Placement
5.4 Material Submittals: The contractor shall submit samples of stone to be used that will be long lasting, of suitable size and shape for the dimensions and style of wall. Examples are to be submitted a minimum of two weeks prior to start of construction. The material must be suitable meet both the Wall Design Engineering specifications and the requirements of PART 2 of these specifications.

6. Delivery, Storage, and Handling

6.1 Contractor shall check materials upon delivery to assure that specified type and grade of materials have been received.

6.2 Contractor shall prevent excessive ice, mud, soil, clay, and like materials that may adhere, from coming into contact with the stones. Such materials, if present on the stones, must be removed prior to building.

PART 2 MATERIALS

2.1 SELECTION OF STONE

2.2 The building stone selected must provide adequate stones for all parts of the wall. Different types of stone, and/or stones from different sources may be used to achieve the necessary selection (provided all are approved).

2.3 The following types of stones should be evident in appropriate quantities.

1. Foundation Stones (largest stones)
2. Through Stones (must have appropriate length and shape)
3. Cap Stones (must have appropriate dimensions)
4. Wall Stone and Backing Stones (may be further sorted by size)
5. Pinning and Hearting (small stones and stone chips)

2.2 FOOTING MATERIAL

1. Drainage aggregate shall be clean angular stone, allowing water to freely pass through.
2. Material must be stable and firm when compacted.
3. Commonly available crushed stone aggregate in the size range of ¾” to 1 ½” is typically suitable, unless other specified by wall designer.
4. In areas were the ground freezes water must easily pass through the footing material and have a place to drain to well away from the wall.
5. Water must easily pass through the footing material and have a place to drain to well away from the wall.

2.3 WALL STONES/FIRST LIFT MATERIAL

1. A slight reduction in size from the foundation stones, ie: the next largest stones (excluding through stones, caps, or copes).
2. Stones should be grouped by height, as when placed in the wall, so that in installation they will comprise horizontal courses.

2.4 PINNING AND HEARTING MATERIAL
1. Stones of the size to fill gaps and voids between wall stones, backing stones and other elements of the wall.
2. Stones should be the largest size that is possible to use to fill the gaps and voids.
3. Material that can be shoveled by hand is too small for pinning and hearting.

2.5 THROUGH STONES
1. The length of these stones is determined by the width of the wall where they will be placed. The length of the stone must be equal to or greater than the width of the wall where it will be.
2. Stones should be of a shape that will be possible to be structurally built upon, as when placed in the wall.

2.6 WALL STONES/ 2ND AND ADDITIONAL LIFTS
1. A continued reduction in size of stones with each lift.
2. Stones should be grouped by height, as when placed in the wall, so that in installation they will comprise horizontal courses.

2.7 CAP STONES
1. These stones must be the full width of the wall at the top of the final lift.
2. Cap stones must individually be significant in size and weight such that they are difficult to dislodge or move from placement.
3. Stones must be of appropriate size and shape for the type or cap called for in the design.

PART 3 CONSTRUCTION

3.1 EXCAVATION
1. Contractor shall excavate to the lines and grades shown on the project grading plans. Contractor shall take precautions to minimize over excavation. Over excavation shall be filled with compacted infill material, or as directed by the Engineer/Architect, at the Contractor's expense.
2. Contractor shall verify location of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation. Excavation support, if required, is the responsibility of the Contractor.

3.2 FOOTING
1. Following the excavation, the subgrade soil shall be examined by the Owner's Engineer to assure actual foundation soil strength meets or exceeds the assumed design bearing strength. Soils not meeting the required strength shall be removed and replaced with infill soils, as directed by the Owner's Engineer.
2. The subgrade soil shall be proof rolled and compacted to 95% standard Proctor density and inspected by the Owner's Engineer prior to placement of footing material.
3. The footing material shall be placed to the depth and width called for in the construction documents. It shall be proof rolled and compacted to 95% standard Proctor density and inspected by the Owner's Engineer prior to placement of Foundation Stones.
4. If called for, drainage pipe and geosynthetic filter fabric shall be placed as required in the construction drawings.
3.3 SORTING BUILDING STONE MATERIAL

The selected building stone should be sorted through. Similarly sized stones should be grouped together with attention to creating a safe and efficient work site. The following groups should be visible to the trained eye:

1. Foundation Stones (largest stones).
2. Through Stones (must have appropriate length and shape).
3. Cap or Cope Stones (must have appropriate dimensions).
4. Wall Stone and Backing Stones (may be further sorted by size).
5. Pinning and Hearting (small stones and stone chips).

3.4 PREPARING TO BUILD

1. The Contractor shall build the wall in the location shown on the project plans.
2. The Contractor shall build the wall to the dimensions and grades shown on the project plans.
3. The exterior face of the wall shall have no bulges or hollows.
4. String lines or other guides should be used to achieve a straight, even wall face and level courses.

3.5 BUILDING THE WALL

1. All stones shall be placed with their length into the wall structure (Perpendicular to the face of the wall).
2. Stones should be placed so the joints near the face of the wall are tight. The wall stones should be in contact with the wall stones on either side.
3. Stones should be set level.
4. To the greatest extent possible, stones of the same height should be placed next to each other to form an even horizontal course.
5. The underside of the stone shall be free of voids and well packed with footing material.
6. Stones shall be set so that the top edge of the face (portion of stone visible in completed wall) is in line with the plane of the wall.
7. Back stones of equivalent height and size to the foundation stones shall be placed behind the foundation stones. The length of each back stone shall be placed perpendicular to the face of the wall.
8. Pinning and hearting shall be carefully placed by hand to fill all voids and gaps between all foundation stones and back stones. Fewer larger pieces should be used rather than many small pieces.

3.6 WALL STONES – FIRST LIFT

1. All stones shall be placed with their length into the wall structure (Perpendicular to the face of the wall).
2. Stones must span the vertical joints between stones in the course below. Each stone spanning a joint must have at least 1/3 of its width to either side of the joint and must have contact with and bear weight on both wall stones below.
4. Wall stones should not be placed to sit on more than two wall stones in the course below.
5. Stones should be set level. To the greatest extent possible, stones of the same height should be.
6. All stones shall be sound and free of cracks or defects that would interfere with the placement or performance of the stones.
7. Stones should be placed such that there is 3 to 4 points contact with the stone course below. At least two points of contact must be made near front face of the wall.
8. All stones shall be sound and free of cracks or defects that would interfere with the placement or performance of the stones.
9. Stones should be placed such that there is 3 to 4 points contact with the stone course below. At least two points of contact must be made near front face of the wall.
10. Back stones of equivalent height and size to the wall stones shall be placed behind the wall stones. The length of each back stone shall be placed perpendicular to the face of the wall.

11. Pinning and hearting shall be carefully placed by hand to fill all voids and gaps between all wall stones and back stones.

12. Lift height is determined to be whichever distance is greater: up to 30 inches or up to two courses.

C. THROUGH STONES

1. Through Stones are placed on the top of each Lift.
2. Shall be placed no farther apart horizontally than which ever is the greater distance: 3 ft. when measured center to center or two Wall stones between each Through Stones
3. Shall be tightly pinned and hearted beneath so there are no voids.
4. Shall be placed on the wall so they extend all the way through the wall. Should be set so that the length of the stone is approximately perpendicular to the face of the wall.
5. Should be set level.
6. Through Stones must span the vertical joints between stones in the course below. Each stone spanning a joint must have at least 1/3 of its width to either side of the joint, and must have contact with and bear weight on both wall stones below.
7. Through Stones of successive lifts should be placed such that they are centered between the Through Stones on the previous lift.

D. WALL STONES/ 2ND AND ADDITIONAL LIFTS

1. Shall follow all specifications in Section 3.04 B - (Wall Stones/First Lift)

E. PINNING AND HEARTING

1. Shall be placed by hand to the fill voids between other stones.
2. Shall not be placed (pushed in) from the front face of the wall.
3. Pinning stones shall be placed from the interior of the wall.
4. Each void should be placed with the fewer larger stones, rather than many small ones.
5. Shall be placed to securely wedge all other stones in the wall tightly together.
6. Shall not be placed so that downward force will push wall stones out of the wall.

F. CAP STONES

1. Shall be placed so they cover the full width of the top of the wall
2. Cap Stones should be placed so the vertical joints between the stones are not over vertical joints in the course below.
3. Cap Stones shall be placed so they do not tip or shift when weight is applied to the top.
4. Cap should be set so the top of the stones are even, creating a smooth top of the wall.
5. Cap stones should be set level (from the front to the back of the wall).
6. Voids below Cap Stones shall be tightly filled with pinning and hearting stones.
7. Cap Stones should not sit up on pinning stones at the face of the wall. The Cap Stones should make contact the wall stones.

END OF SECTION
To: Municipal Heritage Advisory Committee
Meeting Date: 5/16/2024
Report Title: 24-015(MHAC) Request for Funding from the Designated Heritage Property Grant Program – 27 Carolinian Lane
Report Author: Laura Waldie, Senior Planner-Heritage
Department Approval: Joan Jylanne, Manager of Policy Planning
Department: Community Development
Division: Policy Planning
Report No.: 24-015(MHAC)
File No.: R01.01.98
Ward: Ward 6

RECOMMENDATION(S):
THAT Report 24-015(MHAC) – Request for Funding from the Designated Heritage Property Grant Program – 27 Carolinian Lane - be received;
AND THAT the Municipal Heritage Advisory Committee recommend that the application for funding from the 2024 Operating Budget be approved by the Deputy City Manager of Community Development for the designated property municipally known as 27 Carolinian Lane to a maximum of $5,000 for the repair of two original wood windows and the replication of matching wood storm windows on the front façade of the dwelling as described in Report 24-015(MHAC).
AND THAT the work must be completed by November 1, 2024;
AND FURTHER THAT the grant is conditional on the inspection of the completed work to the satisfaction of heritage planning staff.

EXECUTIVE SUMMARY:
Purpose
This report has been prepared to provide a recommendation to the Municipal Heritage Advisory Committee (MHAC) on a request for funding from the Designation Heritage Property Grant Program for 27 Carolinian Lane.
Key Findings

- The property municipally known as 27 Carolinian Lane is designated under Part IV of the Ontario Heritage Act.

- The property owner is requesting a Designated Heritage Property Grant to assist with the repair of two wood windows, that are original to the house and to replicate, in wood, storms for those windows.

Financial Implications

Funding for this project is available through the 2024 Operating Budget – Designated Heritage Property Grant Program which has a $30,000 budget in 2024 for grant eligible projects. Staff is recommending that the proposed project be funded to a maximum amount of $5,000 (almost half of the costs associated with the higher quote provided). The remainder of the project costs will be the responsibility of the property owner.

STRATEGIC ALIGNMENT:

☐ Strategic Action; or
☒ Core Service

Objective(s): Not Applicable

Strategic Action: Not Applicable

Program: Community Development

Core Service: Heritage Conservation

BACKGROUND:

The property municipally known as 27 Carolinian Lane was designated under Part IV of the Ontario Heritage Act in 2000 for its architectural and historical value. The designation was the result of a development application on the property to develop a new subdivision on the former farmland. The house was constructed in approximately 1857 where the land had been farmed as early as 1831. Many original features of the home, including the windows, have been retained.

The property owners have received several heritage grants since 2001 to maintain the heritage attributes of the property. This application (Appendix A) is seeking to professionally restore two original wood windows in the living room on the ground floor (Appendix B, Figure 1), plus replicate two wood storm windows for the windows being restored. The storm windows were removed several years ago.
ANALYSIS:

Figure 1: Front façade of 27 Carolinian Lane. The two windows being restored and storms added are the two windows on opposite sides of the front door.

Wood window restoration and wood storm window replication is considered an eligible conservation project under the Designated Heritage Property Grant Program. Three quotes were obtained by the property owners. However, one of those quotes was sent in an email and was not presented on company letterhead, nor itemized the steps to be taken. Therefore, the property owner will only be considering the quotes provided by Heritage Mills and Brownes Millwork (Appendix C).

The restoration work has been itemized in the accompanying quotes. The proposed work may include repairing or replacing the weights inside the window frame. This will not be known until the window is removed for conservation. The project also includes replicating appropriate wood storm windows which were removed before the property was designated. The proposed paint will be a latex outdoor primer paint with topcoats. The proposed paint colour will be chosen from a heritage palette to match the existing exterior trim colour.
In cases where both quotes provided are similarly acceptable, grant program precedent is to award funding towards the higher amount should the property owner choose to hire that company.

EXISTING POLICY / BY-LAW(S):

27 Carolinian Lane is designated under Part IV of the Ontario Heritage Act through Designation By-law 137-00.

FINANCIAL IMPACT:

Funding for this project is available through the 2024 Operating Budget – Designated Heritage Property Grant Program which has a $30,000 budget in 2024 for grant eligible projects. Heritage Planning staff is recommending that the proposed project be funded to a maximum amount of $5,000 (almost half of the costs associated with the higher quote provided). The remainder of the project costs will be the responsibility of the property owner.

PUBLIC VALUE:

Sustainability

The City of Cambridge supports sustainability by encouraging adaptive reuse of heritage properties wherever possible.

Transparency

The Municipal Heritage Advisory Committee agenda is posted on the City’s website as part of the reporting process.

PUBLIC INPUT:

The meetings of the Municipal Heritage Advisory Committee (MHAC) are open to the public.

INTERNAL / EXTERNAL CONSULTATION:

The Senior Planner – Heritage liaised with the property owners on what was required for a complete heritage grant application.

CONCLUSION:

Heritage Planning staff recommends that the application for funding be recommended for approval by the Deputy City Manager of Community Development as outlined in report 24-015(MHAC) to a maximum of $5,000 from the Designated Heritage Property Grant Program. The work must be completed by November 1, 2024, and paid invoices submitted to the City no later than December 1 before funds will be disbursed.
REPORT IMPACTS:
Agreement: No
By-law: No
Budget Amendment: No
Policy: No

APPROVALS:
This report has been reviewed and approved for inclusion in the agenda by the respective Divisional Manager.

ATTACHMENTS:
1. 24-015(MHAC) Appendix A – Application form to the Designated Heritage Property Grant Program
2. 24-015(MHAC) Appendix B – Window Pictures for 27 Carolinian Lane
3. 24-015(MHAC) Appendix C – Quotes from Furlan Conservation and Heritage Mill.
To be completed and returned to the Planner-Heritage

APPLICANT:

NAME: Esther Rudd

ADDRESS: 27 Carolinian Lane

CITY: Cambridge POSTAL CODE: N1S 5R5

PHONE: Bus. Res. E-mail: [REDACTED]

Fax: [REDACTED]

SUBJECT LANDS AND/OR PREMISES:

ADDRESS: 27 Carolinian Lane

LEGAL DESCRIPTION: PT SUBDIVISION LT 3 CON 9 WGR NORTH BUMPERIES PART 6 5SR-12404 CAMBRIDGE

HAVE YOU PREVIOUSLY RECEIVED A HERITAGE CONSERVATION FUND LOAN AND/OR GRANT?

Yes ☐ No ☑

IF YES, EXPLAIN:

PROVIDE A DESCRIPTION OF THE PROJECT PROPOSAL AND TWO QUOTES. Include details such as the materials to be used, sizes, mortar mixes, etc. Submit all drawings, photographs and/or other material necessary for a complete understanding of the property work (use additional sheets as required). Please include any available historic photographs.

Restoration of first floor double sash windows and storm windows will be converted to original configuration from 2 pane per sash to 6 panes per sash. We will be retaining the original wooden sashes and historic glass. The storm case to be restored as is (2 panes per sash). We are also doing an analysis of the original paint on the windows to determine what paint colour to use on restored windows.

I certify that to the best of my knowledge, the information provided in this application for funds through the Designated Heritage Property Grant Program is accurate and complete.

SIGNATURE OF APPLICANT Jan 19/24 Date

THIS IS CONSIDERED A PUBLIC DOCUMENT

Personal information contained on this form is collected pursuant to the Ontario Heritage Act and will be used for the purpose of responding to your application. Questions about the collection of personal information should be directed to the City’s Freedom of Information and Privacy Coordinator in the Clerk’s Office at (519) 740-4680.
Window 1: Dining Room Front-facing
Heritage Mill Historic Building Conservation

75 Mercer Street,
Dundas, ONL9H 6C7

Johnathon & Esther Rudd
27 Carolinian Lane
Cambridge ON N1S 5B5

April 15th 2024

Project: Window Restoration 27 Carolinian Lane Cambridge ON

Description of Work Required
Restoration of existing window frames
Restoration of existing sash windows and reconfiguration of sashes to a 6/6 glazing pattern
Potential installation of sash tapes (single hung) and weather sealing to provide operable and functioning windows
Replication and installation of 2 light storm windows
Full preparation and painting of sashes and window frames

Site Visit/As Found Conditions
No site visit undertaken
Reviewed from images supplied by the client
The sashes appear to be original but have been later altered from a 6/6 glazing pattern to a 2/2 glazing pattern
The 4 light storm windows appear to be of a later date
Storm hanger hardware dates from the 20th Century
There are no exterior turn buttons for the storms
Some windows have sash locks
There are no pulleys or counterweights present as the windows are framed sashes and, therefore do not have the capacity (box) to take counterweights.

The windows could potentially be fitted with sash tapes to the bottom sash to allow for an operable balanced sash window (single-hung).

**Recommendations**

Restoration of existing window frames

Restoration of existing sash windows and reconfiguration of sash glazing pattern or exact replication of sashes to a 6/6 glazing configuration. Option taken will depend on the as found condition of existing sashes (there is the possibility of structural damage and issues to top rails, both meeting rails and bottom rails where the central mortises have been cut in to allow for the later 2/2 glazing configuration).

Potential installation of sash tapes (single hung) to provide operable and functioning windows.

Installation of superior silicone bulb, flap and brush-type weather seals to allow for easy operation and excellent draft-proofing of the sash windows.

Replication and fitting of 2 light storm windows.

Full preparation and painting of sashes and window frames.

Lime mortar caulking between secondary brick moulds and masonry walls.

**ESTIMATE**

**Restoration of Window Sashes, Window Frames and Replication of 2 Light Storm Windows**

Note: this estimate applies to ground-floor windows only.

**Specifications for Sash Restoration (shop work)**

- Remove paint back to the bare wood on sashes.
- Remove all glazing compound/putty.
- Remove all existing glass panes.
- Take moisture content (M.C.) readings to ensure correct % M.C. prior to starting any woodwork or painting.
Dutchmen patching (maximum of five (5) per unit) on sashes both external and internal (material for Dutchmen will be reclaimed first growth when possible).

Remove later 2/2 glazing muntins

Either restore existing sashes and replicate muntin bars to reconfigure the sashes to a 6/6 glazing pattern or replicate new complete sashes to a 6/6 glazing pattern (depending on the as found condition)

Priming of all putty rebates to prevent premature failure of putty

Glass to be 3mm float

Glaze sashes with traditional linseed oil putty

Tool putty neatly with site lines to follow rebates of sash with neatly tooled corners

Machine in grooves for bulb and flap weather seals

Apply two (2) coats of Shellac sealer to all sound knots

Scrub sand shellac sealer for good paint bond

One (1) coat alkyd oil-based primer to interior face of sashes

Two (2) top-coats latex paint to interior face of sashes

One (1) coat linseed oil-based primer to exterior face of sashes

Three (3) top-coats linseed oil-based paint to exterior face of sashes

**Specifications for Replication of Storm Windows (shop work)**

To be of true mortise & tenon construction

Glued with exterior grade polyvinyl acetate glue *(see upgrade option B)*

Clear C select eastern white pine further graded during manufacture (no knots, cracks, resin pockets or other defects) (no finger jointed material)

Storm windows to be of true divided light (2 light)

Glass to be 3mm float

Bottom edge of storm windows to have machined drip groove to prevent water retention

Standard profile sash mould (unless stated otherwise)

Sanded to paint grade, all edges eased

Priming of all rebates to prevent premature failure of putty

Storm window(s) to be glazed using traditional linseed oil putty

One (1) coat linseed oil-based primer to exterior side of storm window
Three (3) Two (2) top-coats linseed oil-based paint to exterior side of storm window

One (1) coat acrylic oil-based primer to interior side of storm window

Two (2) top-coats latex to interior face of storm window

Hardware: all zinc plated storm hangers and/or turn buttons as required (see upgrade option C)

Hardware: zinc plated turn buttons (see upgrade option C)

Hardware: hook and eye screws to latch storm open and closed (see upgrade option D)

Option to machine in ventilation holes and hinged flap to allow for ventilation during the shoulder seasons (see upgrade option E)

**Specifications for Frame Restoration (site work)**

- Removal of sashes for restoration work
- Installation of temporary plywood shuttering (painted plywood if specified)
- Remove paint back to the bare wood on frames
- Take moisture content (M.C.) readings to insure correct % M.C. prior to starting any woodwork or painting
- Dutchmen patching (maximum of five (5) per unit) on sash box and sills. (material for Dutchmen will be reclaimed first growth when possible)
- Drill out and wooden plug or epoxy fill loose knots
- Drill out and fill all pitch pockets to prevent resin bleeding through paint
- Epoxy consolidation and filling as required, using conservation grade epoxy
- Sealing of all end grain new work in vulnerable areas to prevent moisture wicking
- Sand all original and new work to paint grade finish
- Return sashes to site for 1st installation
- Adjust fit/sizes of sashes as required to allow sashes to perform and seal correctly
- Return sashes to workshop for prep, painting and glazing
- Return sashes to site for 2nd installation
- Review wall assembly to ascertain if sash tapes can be safety cut into the wall without compromising the strength of the wall assembly
- Install sashes to allow for effortless travel of bottom sashes
- Draft proofing of primary window with H.M. comfort seal system©
Rehang top sash in place and fix in place with stop blocks nailed in place

Caulk top sash from the interior only with best quality paintable latex caulk

If feasible hang bottom sash on best quality sash tapes suitably tensioned to match weight of bottom sash

Apply two (2) coats Shellac sealer to all sound knots

Scruff sand shellac sealer for good paint bond

One (1) coat linseed oil-based primer to exterior side of frame

Three (3) top-coats linseed oil-based paint to exterior side of frame

One (1) coat acrylic oil-based primer to interior side of frame

Two (2) top-coats latex paint to interior face of frame

Localized repointing and caulking between window frame and masonry wall using lime based mortar

Exterior caulking between window and wall to be premium silicone-based caulk with backer rod as required

Hardware- sash locks- use existing and refurbish or replace broken, missing and seized (supply and repairs on allowance)

Notes:

Sills may need to be completely replaced if found to be in a condition that is beyond the scope of restoration; the complete replacement of sills is not priced for in this estimate

Sash windows restoration scope of work will be deemed to end at the stop bead (staff bead) unless specified otherwise.

Interior casings, stools, aprons and any other interior trims are not included in the quote/estimate unless specified otherwise.

Specifications for Storm Window Site Documentation and First and Second Installation

Site survey and measuring on site to ascertain sizes, profiles and placement of storm windows for replication and manufacture

Loading and transportation of new storm windows “in the white” (unpainted) to site

Fitting and installation of new storm windows first install

Loading and transportation of new storm windows back to workshop to allow for finishing and glazing

Loading and transportation of new glazed and painted storm windows to site

Installation of new storms windows second install
All final fitting and adjustments
Daily broom clean site as required
Loading, transportation and disposal of existing storm windows (if applicable)

**Estimated Price for Each Window Unit**: $8,500.00** - $9,600.00 **

**the price is based on a minimum quantity of four window units to be in the contract

*Unit = restoration of window sashes, window frames and replication of 2 light storm windows

Upgrade B:
Epoxy adhesive in lieu of exterior grade polyvinyl acetate glue
Additional cost for upgrade B $90.00 per unit (sash and storm)

Upgrade C:
Heavy-duty stainless-steel hardware in lieu of standard grade zinc plated hardware
Additional cost for upgrade C $35.00 per storm window

Upgrade D:
Heavy-duty stainless-steel stays in lieu of standard zinc plated hook and eyes
Additional cost for upgrade $85.00 per storm window

Upgrade E:
Add ventilation holes and flaps to the storm for use in the shoulder seasons
Additional cost for upgrade E $115.00 per storm window

To accept this contract, please include selections, sign, and initial at the bottom of each page, date and return with the deposit of 25% of the contract plus HST

Date:______________________ Total $ ________________________________________

X ______________________________________________________________________

Jonathan & Esther Rudd 27 Carolinian Lane Cambridge ON
Heritage Mill (HM):
- Maintains an annually reviewed corporate health and safety policy
- Fully compliant with the Ministry of Labour Health and Safety guidelines for construction work
- Is fully compliant with the Workplace Safety Insurance Board (WSIB)
- Is in good standing and is eligible for certificates of clearance from the WSIB
- Fully Insured with General liability coverage of $5,000,000.00

Please Note Heritage Mill (HM) Terms:
- Applicable taxes at the prevailing rate at the time of billing will be added
- This Estimate is valid for a period of 2 weeks from the date of issue
- Booking deposits are required with this signed contract and will be applied to the final invoice
- Booking deposits are required to allow HM to allocate the project time in their schedule
- Booking deposits are non-refundable
- Custom made items (windows, doors, woodwork) will be billed in full upon completion of the manufacture of the items
- Interim/progress invoicing will occur on a percentage of work complete at the time of billing for site work and shop-based restoration work
- Interim/Progress invoices will be due upon receipt
- Payment is required in full upon completion of work
- Interest at two (2) percent per month or part of (24% per year) will be charged on overdue accounts. HM reserves the right to hold deliveries or service on overdue accounts.
- This contract assumes that payments will be made by check or bank transfer (not credit card)
- Additional fees will apply for payment by credit card
- An administrative fee of $25 will apply for all NSF cheques
- Until payment is received in full, HM shall retain title to the goods, the purchaser shall be responsible for damage or loss of goods after delivery, regardless who has title to goods
- Design, drawings, technical specifications are not included in this contract
- Applicable permit fees, building or otherwise are not included in this contract
- Parking fees and parking fines for crew parking for this project will be invoiced as the project progresses (if applicable)
- A waste Disposal fee will be added to the final invoice (if applicable)
- Hardware: supply and installation of new and/or restoration of old and/or existing hardware is not included in this Estimate, it will be charged in addition to the Estimate
- All custom tooling will remain as the property of HM
- Hydro, running water, heat washroom facilities must be available and paid for by the client
- Painting assumes one colour scheme only unless otherwise specified
- Pitch occurs naturally in wood; this shall not be considered a defect
- Pitch naturally occurs in wood, control of the leaching of the pitch in new or existing wood shall not be the responsibility of HM
- Warpage not exceeding one-fourth inch (1/4”) in the plane of the door shall not be considered to be defective
- Warpage in doors exceeding 8’ in height shall not be considered to be defective
- Should the owner wish to act in the capacity of the General Contractor by employing more than one contractor on the site at the same time, HM accepts no responsibility for the actions of the other contractors, or no liability arising from the contractor’s failure to provide adequate insurance, Ministry of Labor Compliance and/or WSIB compliance
- HM reserves the right to work on a site that is fully compliant with Ministry of Labour safety standards, in addition to HM’s own Health and Safety policy
- Interior finishing, drywall, trim, painting by others, moving and draping of furniture appliances and other items not the responsibility of HM unless stated in the description of the work
- Interior work area must be clear of all obstructions, exterior work area must be clear of all obstructions including vegetation (additional charges may apply if clearing of the interior or exterior work area is done by HM).
- HM will post a company sign for the duration of the work period and for a two-week period after completion of the work.
- HM’s work schedule is subject to change.
- Delays that are caused by all others or any permitting process or any stoppage to work howsoever caused will not be the responsibility of HM.
- Should such a delay occur and if it cannot be rectified in a timely manner HM will invoice all labour and materials that have been provided for the project, this invoice will be due immediately upon receipt regardless of the cause of the delay.
- Glass is shipped to site clean, any on-site cleaning of glass shall be the responsibility of the owner.
- All glass replaced specified within the contract with be 3mm float unless stated otherwise.
- Glass breakage will be replaced with new 3mm float.
- Glass breakage onsite after the product has been delivered to site will not be the responsibility of HM.
- Protection of the work completed by HM will not be the responsibility of HM.
- As building envelope and HVAC performance can vary in older buildings, HM shall not be responsible for building envelope and/or HVAC performance.
- HM reserves the right to perform all of the work listed in this contract if all of the work is not selected. Heritage Mill reserves the right to cancel this contract.
- The schedule is subject to change should additional work be added to HM’s general schedule.
- Delays to the work caused by HM not being able to perform the work due to unsafe working conditions caused by others will not be the responsibility of HM.
- Delays to the work caused by HM not being able to perform the work due to scheduling delays by other contractors or any and all delays by the owner will not be the responsibility of HM.
- Delays to the work due to weather conditions shall not be the responsibility of HM.
- Delays due to unforeseen conditions shall not be the responsibility of HM.
- Back charges or any other charges will not be accepted by HM.
- Discussions held between the Purchaser/Owner and any employee of HM do not form part of the order or the contract.
27 Carolinian Lane Oakville for Jonathan Rudd

WINDOW CONSERVATION PROPOSAL

We are a local heritage conservation firm that provides full heritage conservation services throughout the country. We have undertaken projects at several national historic sites in Canada and the United States. We have run window conservation workshops for various government agencies and Willowbank School of Restoration Arts. We operate our business in 3 historic storefronts on Barton Street in Hamilton Ontario.

The conservation plan that is proposed will be guided by sound conservation principles as set forth in The Venice Charter International Charter for the Conservation and Restoration of Monuments and Sites (1964), as well as the Standards and Guidelines for the Conservation of Historic Places in Canada (Standards and Guidelines) and The Ontario Heritage Tool Kit. These guidelines offer consistency when planning for, intervening on, and using historic places and has been adopted by several federal, provincial, territorial, and municipal authorities, as the benchmark for assessing proposed conservation interventions. The intent of this conservation plan will be a minimal intervention approach. Sensitivity to the reversibility of interventions needed during the conservation process will be considered.

Windows are one of the most conspicuous features of any building. More demands are placed on windows than on any other building component. Windows are functional machines that directly control the interface between a building’s exterior and interior environments. Windows admit daylight, views, pleasant sounds and fresh air. They exclude environmental elements, temperature extremes and noise. Heritage windows are a significant architectural element of the building. Divided lights in sash add texture and scale. Each window is a complex assembly whose function and operation must be considered as part of its conservation.

The Standards and Guidelines recommend that heritage windows be repaired, stabilized and maintained.

The historic windows at 27 Carolinian Lane Oakville appear to be original to the building.

Windows are 2 over 2 configurations. Although there appears to have been original 6 over 6 windows that have had the muntin bars removed during its history.

Once original finishes are removed from the sash windows all evidence of finishes will be lost from the historic record. Therefore, it is in good keeping with heritage conservation principle and practices that an architectural paint analysis be undertaken to provide a record of all finishes coating the various window system elements.
Conservation Process

The following will describe conservation of windows.

All work to be completed in situ on site or in my shop in Hamilton where window sashes and other materials will be transported.

- Remove sash, stops and parting strips. Secure sash and transport to my shop in Hamilton for conservation.

- Carefully remove existing glazing with wet steam method to avoid any disturbance of toxic substances which may exist. Carefully preserve any existing original glass. Clean the glass and reuse where necessary. Treat rebates and re-glaze using linseed oil putty system. Replace any broken glass in kind. Up to 7 sq feet of clear glass.

- To strip existing finishes, repair and re-finish the existing exterior woodwork on the sash conserving as much original material as possible, using dutchman repairs, approved consolidants and epoxy fillers only where necessary.

- All Dutchman repairs will be of old reclaimed first growth wood of the same species, attempting to match grain pattern of existing wood. Provide new parting strips as necessary.

- Disassemble to tighten joints as necessary. Repair sash as necessary. Replicate with traditional joinery any missing parts. As necessary, disassemble entire sash and replicate exactly new period muntin bars to match existing to go back to 6/6 configuration.

- Thermal upgrade all perimeter cracks with combination of sprung bronze and v strip weatherstripping.

- Ensure proper weight to counterbalance sash and install new cotton sash cord. Remove and recondition sash pulleys.

- Clean any existing hardware and reinstall. Ensure all hardware operates as designed.

- All woodwork will be top coated with 3 coats of paint of client’s choice. Use a high quality paint.

- Reinstall sash on site. Attempt to salvage, recondition and reuse existing hardware as necessary.

- Assume 2 visits to this site for removal and installation of weatherstripping, sash cord, pulleys and to instal finished product.
Historic Window Conservation

Conservation of double hung window system. Materials. (Wood, epoxy, paint, bronze, sundries)

1. Dining Room - 41" X 72" - restore, convert 2 over 2 to the original 6 over 6.
2. Living Room 1 - 41" X 72" - restore, convert 2 over 2 to the original 6 over 6.
3. Living Room 2 - 41" X 72" - restore, convert 2 over 2 to the original 6 over 6.
   $3950.00 per window (2 sash)
   Storm windows for above openings - $1400.00 each
4. Piano Room - 35" X 64" - restore, convert 2 over 2 to the original 6 over 6.
   $3200.00
   Storm window for above opening - $1100.00
5. Office Room - 35" X 64" - restore, no conversion of panes, it’s 2/2.
6. Bath Room - 35" X 64" - restore, no conversion of panes, it’s 2/2.
   $2850.00 per window (2 sash)
   Storm windows for above opening - $1100.00

Additional comments

Not included: Covering of opening while windows conservation process is undertaken. Use existing storm window system as protection.

Existing hardware will be assessed and restored where possible. New hardware to replace broken or missing components (cost + 25%).

Period historic wavy glass if requested. $30.00 per sq ft.

Architectural paint analysis- $270 per sample (1-page report on each sample micro photography in cross section with each finish layer identified with Munsell colour code included)

Timeline

Fall/winter 2023

+HST
To: Municipal Heritage Advisory Committee  
Meeting Date: 5/16/2024  
Report Title: 24-016(MHAC) Request for Funding from the Designated Heritage Property Grant Program – 360 Clyde Road  
Report Author: Laura Waldie, Senior Planner-Heritage  
Department Approval: Joan Jylanne, Manager of Policy Planning  
Department: Community Development  
Division: Policy Planning  
Report No.: 24-016(MHAC)  
File No.: R01.01.128  
Ward: Ward 7  

RECOMMENDATION(S):  
THAT Report 24-016(MHAC) – Request for Funding from the Designated Heritage Property Grant Program – 360 Clyde Road - be received;  
AND THAT the Municipal Heritage Advisory Committee recommend that the application for funding from the 2024 Operating Budget be approved by the Deputy City Manager of Community Development for the designated property municipally known as 360 Clyde Road to a maximum of $5,000 for the repair of two limestone and granite chimneys on the dwelling as described in Report 24-016(MHAC).  
AND THAT the work must be completed by November 1, 2024;  
AND FURTHER THAT the grant is conditional on the inspection of the completed work to the satisfaction of heritage planning staff.  

EXECUTIVE SUMMARY:  
Purpose  
This report has been prepared to provide a recommendation to the Municipal Heritage Advisory Committee (MHAC) on a request for funding from the Designation Heritage Property Grant Program for 360 Clyde Road.
Key Findings

- The property municipally known as 360 Clyde Road is designated under Part IV of the Ontario Heritage Act.

- The property owners are requesting a Designated Heritage Property Grant to assist with the repair of two limestone and granite chimneys including replacing the metal flashing caps on both.

Financial Implications

Funding for this project is available through the 2024 Operating Budget – Designated Heritage Property Grant Program which has a $30,000 budget in 2024 for grant eligible projects. Staff is recommending that the proposed project be funded to a maximum amount of $5,000 (half of the costs associated with the higher quote provided). The remainder of the project costs will be the responsibility of the property owner.

STRATEGIC ALIGNMENT:

☐ Strategic Action; or
☒ Core Service

Objective(s): Not Applicable

Strategic Action: Not Applicable

Program: Community Development

Core Service: Heritage Conservation

BACKGROUND:

The property municipally known as 360 Clyde Road was designated under Part IV of the Ontario Heritage Act in 2014 for its architectural and historical value. The house was constructed in approximately the early 1850s in the Georgian style. It was owned by Archibald Henderson who owned a sawmill on Mill Creek. For many years it was the caretakers home for the Shade’s Mill Conservation Area until it became a private residence again in 1990.

The property owners received a heritage grant last in 2014 to replace the cedar roof with a new cedar roof. This current application (Appendix A) is seeking to repair both limestone and granite chimneys including the metal chimney flashing caps (Appendix B, Figure 1).
ANALYSIS:

Figure 1: Photos of the chimneys on 360 Clyde Road. Both chimneys have mortar missing and the metal flashing caps have rusted.

Chimney repair is considered an eligible conservation project under the Designated Heritage Property Grant Program. Two quotes were obtained by the property owners.
However, one of those quotes (Mills Masonry) dates to 2022 and is included with the application form in Appendix A. Heritage Planning staff requested an updated quote for Mills Masonry from the property owners to attach to the application for the Municipal Heritage Advisory Committee’s (MHAC’s) review. Therefore, both quotes are up to date and attached as Appendix C.

There are two chimneys, located at either end of the structure. The repair work has been itemized in the accompanying quotes and the repairs will utilize proper lime-based mortar. The existing mortar joints that will undergo repair will be chiselled out by hand and new mortar will be applied in a heavily mortared technique to maintain the heavily mortared appearance found on the rest of the structure. This repair work is necessary to prevent water leakage through the chimneys into the adjacent plaster interior walls. Currently, there is a small spot of water damage seen in the ceiling of one room on the second floor. The owners wish to undertake this repair work this year to prevent further water infiltration.

In cases where both quotes provided are similarly acceptable, grant program precedent is to award funding towards the higher amount should the property owner choose to hire that company.

EXISTING POLICY / BY-LAW(S):

360 Clyde Road is designated under Part IV of the Ontario Heritage Act through Designation By-law 20-14.

FINANCIAL IMPACT:

Funding for this project is available through the 2024 Operating Budget – Designated Heritage Property Grant Program which has a $30,000 budget in 2024 for grant eligible projects. Heritage Planning staff is recommending that the proposed project be funded to a maximum amount of $5,000 (almost half of the costs associated with the higher quote provided). The remainder of the project costs will be the responsibility of the property owner.

PUBLIC VALUE:

Sustainability

The City of Cambridge supports sustainability by encouraging adaptive reuse of heritage properties wherever possible.

Transparency

The Municipal Heritage Advisory Committee agenda is posted on the City’s website as part of the reporting process.
PUBLIC INPUT:
The meetings of the Municipal Heritage Advisory Committee (MHAC) are open to the public.

INTERNAL / EXTERNAL CONSULTATION:
The Senior Planner – Heritage liaised with the property owners on what was required for a complete heritage grant application.

CONCLUSION:
Heritage Planning staff recommends that the application for funding be recommended for approval by the Deputy City Manager of Community Development as outlined in report 24-016(MHAC) to a maximum of $5,000 from the Designated Heritage Property Grant Program. The work must be completed by November 1, 2024, and paid invoices submitted to the City no later than December 1 before funds will be disbursed.

REPORT IMPACTS:
Agreement: No
By-law: No
Budget Amendment: No
Policy: No

APPROVALS:
This report has been reviewed and approved for inclusion in the agenda by the respective Divisional Manager.

ATTACHMENTS:
1. 24-016(MHAC) Appendix A – Application form to the Designated Heritage Property Grant Program plus Thorstone Quote
2. 24-016(MHAC) Appendix B – Chimney Pictures for 360 Clyde Road
3. 24-016(MHAC) Appendix C – Updated Quote from Mills Masonry.
APPLICATION FOR DESIGNED HERITAGE PROPERTY GRANT PROGRAM

MUNICIPAL HERITAGE ADVISORY COMMITTEE

To be completed and returned to the Planner-Heritage

APPLICANT:
NAME: TROY STEWART & CORI MOREAU
ADDRESS: 360 CLYDE RD.
CITY: CAMBRIDGE ONT.
PHONE-Bus. Res. E-mail: [Redacted]
POSTAL CODE: N1R 1L6

SUBJECT LANDS AND/OR PREMISES:
ADDRESS: 360 CLYDE ROAD
LEGAL DESCRIPTION: NORTH DUMFRIES CON 12 PT LOT 5 PT
ROAD ALCAN RP 58 R173392 PART A

HAVE YOU PREVIOUSLY RECEIVED A HERITAGE CONSERVATION FUND LOAN AND/OR GRANT?
Yes [ ] No [ ]

IF YES, EXPLAIN: FOR A NEW CEDAR ROOF → 2014 (YOU)

PROVIDE A DESCRIPTION OF THE PROJECT PROPOSAL AND TWO QUOTES. Include details such as the materials to be used, sizes, mortar mixes, etc. Submit all drawings, photographs and/or other material necessary for a complete understanding of the property work (use additional sheets as required). Please include any available historic photographs.

TO REPAIR THE 2 STONE CHIMNEYS - COOSE MORTER + STONES AROUND TOPS REQUIRE LIME MORTER + RE-POINTING. THERE ARE CURRENTLY 2 METAL CAPS THAT ARE IN POOR SHAPE + ARE LEAKING - PROPOSE TO REPLACE METAL CAPS WITH LIMESTONE + CLAY CHIMNEY POTS - PLEASE FIND 2 QUOTES ATTACHED INCLUDING PHOTOS.

WITH THANKS -

I certify that to the best of my knowledge, the information provided in this application for funds through the Designated Heritage Property Grant Program is accurate and complete.

SIGNATURE OF APPLICANT: [Redacted]
Date: FEB-12-2024

THIS IS CONSIDERED A PUBLIC DOCUMENT

Personal information contained on this form is collected pursuant to the Ontario Heritage Act and will be used for the purpose of responding to your application. Questions about the collection of personal information should be directed to the City’s Freedom of Information and Privacy Coordinator in the Clerk’s Office at (519) 740-4680.
Good morning Troy. Here follows detail and pricing to complete the exterior stone chimney repair above rooftop as discussed on October 25th, 2023.

Supply safe access to work areas of stone repair.
Provide roof protection for the duration of the work.
Remove top corbels of stone, and any additional loose stone beneath. Remove balance of mortar work to a depth of 1”.
Relay all stone to original shape and dimension, true to plumb and level using lime-based heritage mortar.
Repoint and finish all joints using lime-based heritage mortar.
Supply decorative clay top for fireplaces. Form and pour 1-piece concrete cap with 2” overhang and drip ledge.
Disposal of all related debris.

$6100+HST per chimney.

Option to install limestone chimney caps. $2500 per chimney. (Includes product and installation)
Please confirm that you’d like to proceed, and we can add it to our schedule.

*Chimneys need to be accessible and free of all foliage and wildlife. Thorstone is not responsible to removing bats, squirrels, raccoons, or the like. Please have animal control do a thorough review of the chimneys and responsibly complete any removals prior to commencement of masonry work.

Respectfully Submitted.

Joel Bouwman
Thorstone Construction INC
Thorstone.ca
MILLS MASONRY
150 Glenmorris st
Cambridge, ON N1s2z6
Phone: (519) 212-3623
Email: justinmills@rogers.com

<table>
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<th>Description</th>
<th>Total</th>
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<tbody>
<tr>
<td>Chimney restoration</td>
<td>$7,700.00</td>
</tr>
<tr>
<td>To set up skaffold to work safely to repair, and</td>
<td></td>
</tr>
<tr>
<td>restore the two stone chimneys with a two</td>
<td></td>
</tr>
<tr>
<td>piece limestone cap</td>
<td></td>
</tr>
</tbody>
</table>

Subtotal                                         $7,700.00

HST                                              $1,001.00

Total                                            $8,701.00
**MILLS MASONRY**

150 Glenmorris st  
Cambridge, ON N1s2z6  
Phone: (519) 212-3623  
Email: justinmills@rogers.com

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<table>
<thead>
<tr>
<th>Description</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>stone chimney restoration</td>
<td>$8,500.00</td>
</tr>
<tr>
<td>To restore both chimneys with a new two piece limestone cap, and some repointing</td>
<td></td>
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</table>

**Subtotal**  

$8,500.00

**HST**  

$1,105.00

**Total**  

$9,605.00
By signing this document, the customer agrees to the services and conditions outlined in this document.
To: Municipal Heritage Advisory Committee

Meeting Date: 5/16/2024

Report Title: 24-017(MHAC) Request for a Sign Permit for 62 Dickson Street

Report Author: Laura Waldie, Senior Planner-Heritage

Department Approval: Joan Jylanne, Manager of Policy Planning

Department: Community Development

Division: Policy Planning

Report No.: 24-017(MHAC)

File No.: R01.01.95

Ward: Ward 4

RECOMMENDATION(S):

THAT Report 24-017(MHAC) - Request for a Sign Permit for 62 Dickson Street – be received;

AND FURTHER THAT The Municipal Heritage Advisory Committee (MHAC) approve the request for a sign permit for the property known as the Cambridge Centre for the Arts, located at 62 Dickson Street, for an outdoor public art gallery display.

EXECUTIVE SUMMARY:

Purpose

This report has been prepared to provide a recommendation to the Municipal Heritage Advisory Committee (MHAC) on a request for a Sign Permit for the Cambridge Centre for the Arts to display an outdoor public art gallery.

Key Findings

- As part of a placemaking initiative for Civic Square, a public art gallery display has been included for installation on the Cambridge Centre for the Arts building located in the laneway between the Centre and the Fire Hall Museum and Education Centre.
- The Cambridge Arts and Culture Committee endorsed the project in April 2024.
Financial Implications

The eight sign frames, fasteners and eight individual LED lights will initially cost $15,000 to install and a budget of $3,000 a year has been earmarked to maintain and change the displays. Each art board will be $70 to print. These funds have been provided by the Cambridge Arts Guild for the project.

STRATEGIC ALIGNMENT:

☐ Strategic Action; or
☒ Core Service

Objective(s): Not Applicable

Strategic Action: Not Applicable

Program: Community Development

Core Service: Heritage Conservation

BACKGROUND:

The Cambridge Centre for the Arts, also known as the David Durward Centre, was constructed in 1922 by the Public Utilities Commission and was designated in 2000 for its architectural and historic value. The City of Cambridge is the owner and operator of the Cambridge Centre for the Arts which is located in the David Durward Centre.

The Cambridge Centre for the Arts is seeking to install an outdoor art gallery for the citizens of Cambridge. There is a public art gallery display inside the Centre, but the City would like to have an outdoor display to encourage residents and tourists to visit Civic Square. This outdoor public art gallery is being proposed as an annual exhibit but may become semi-annual depending upon available funding.

The intention is to have the outdoor public art gallery installed for the Cambridge Celebration of the Arts event, the week of June 10th.

ANALYSIS:

This outdoor public art gallery space has been included in Council’s overall Civic Square initiative to bring more citizens and residents to the Galt core. The artwork proposed for the outdoor public art gallery will be reproductions only, printed onto smooth, heavy coroplast boards that will fit into a 24x36 inch frame. The artwork will be juried by City staff and local art professionals, similar to how the indoor public art gallery is juried. The artwork, just like the indoor gallery, will feature art works from elementary and high school children, post secondary art students, seniors, local artists and other residents of Cambridge who wish to enter the public art gallery contests.
Figure 1: Approximate placement of public art gallery frames on the wall.

There will be eight frames in total proposed for installation, spaced about three feet apart and the bottom of the frames will be four feet off the ground (Figure 1). There will be a lock on top of the frame to keep the artboard in place. The frames will be black aluminum and will be fastened with bolts through the mortar joints of the building so as not to damage the dressed limestone blocks. The bolts will be sealed with waterproof epoxy so that water will not enter the drill holes.

Each frame is proposed to have a small horizontal LED light bar located about 6 inches above the frame and will be fastened to the wall with bolts through the mortar joints as well. Fastening these lights to the wall will be done in the same manner as the frames themselves. These lights will be used in the evenings to encourage visitors to Civic Square to observe the outdoor gallery. A diagram of frame placements on the wall and the light bars are included in Appendix 1 as a reference guide for placement. None of the frames or light bars will interfere with windows or any other features on the wall.
There has been no history of vandalism in this alleyway. Security for Civic Square is provided by on site security officers located inside City Hall 24 hours a day. Therefore, City staff believes the outdoor public art gallery will be safe from vandalism. However, in case there is damage, the artboards can be reprinted onto new coroplast boards.

Because the artboards will be 24x36 inches each, these frames fall within the 1.2 square metre threshold for signage on a designated heritage structure and, therefore, will not require a sign variance.

EXISTING POLICY / BY-LAW(S):

Ontario Heritage Act

64 Dickson Street is designated under Part IV of the Ontario Heritage Act through Designation By-law 1-00.

Sign By-law 191-03

Section 26 of the City’s Sign By-law states that signage on a Part IV or Part V designated structure must measure no larger than 1.2 square metres. If a sign is larger than this measurement, a sign variance must be approved by Council. The Municipal Heritage Advisory Committee has the delegated authority in the Sign By-law to approve sign permit requests. Any refusal of a sign permit by the MHAC must then be sent to Council for approval.

FINANCIAL IMPACT:

The sign frames, fasteners and lighting will initially cost $15,000 to install and a budget of $3,000 a year has been earmarked to maintain and change the displays. Each artboard will cost $70 to print. These funds will be provided by the Cambridge Arts Guild for the project.

PUBLIC VALUE:

Sustainability

The City of Cambridge supports sustainability by encouraging adaptive reuse of heritage properties wherever possible.

Transparency

The Municipal Heritage Advisory Committee agenda is posted on the City’s website as part of the reporting process.
PUBLIC INPUT:
The meetings of the Municipal Heritage Advisory Committee (MHAC) are open to the public.

INTERNAL / EXTERNAL CONSULTATION:
The Senior Planner – Heritage liaised with the Supervisor of Recreation Arts, Culture and Special Events on what was required for a sign permit.

CONCLUSION:
Heritage Planning staff recommends that the application for a sign permit to install eight sign holders and eight LED light bars for an outdoor public art gallery be approved on the west facing wall of the Cambridge Centre for the Arts for the reasons outlined in report 24-017(MHAC).

REPORT IMPACTS:
Agreement: No
By-law: No
Budget Amendment: No
Policy: No

APPROVALS:
This report has been reviewed and approved for inclusion in the agenda by the respective Divisional Manager.

ATTACHMENTS:
1. 24-017(MHAC) Appendix A – Supporting Information for Sign Permit Application
• Cambridge Centre for the Arts & the Cambridge Arts Guild wants to offer an outdoor art gallery to the citizens of Cambridge.
• This is being proposed as a semi-annual exhibit or annual exhibit (timeline will be dependent on budget)
• Similar to Cambridge Centre for the Arts Gallery, applicants will be juried by City staff and local art professionals.
• Proposed artwork will be a reproduction of 2D visual art (i.e. printmaking, mixed media, photography, digital art).
• The intention is to have this installed for the Cambridge Celebration of the Arts event, the week of June 10th.

This concept has been presented to the Arts & Culture Advisory Committee & they are supportive of this project.
• 8 frames
• Each frame has a light over it (light & install included in this submission)
• Frames are black aluminum 24x36 (with lock on frame to drop artwork in)
• Details of the frame install below
• Bottom of frame is approximately 4ft from ground level
• There has been no history of vandalism in this alleyway – City Hall security and the artwork installed is only reproduction (each artboard is $70 – artboard can replaced if damaged)

Install details of frame - Each frame will have (4) 1.5" - 2" x 3/16" thick, Tapcon brand concrete fasteners

Each fastener will be drilled into the mortar joints, not the brick, and the appropriate plugs with adhesive to ensure fasteners do not loosen.

*note only 5 shown – actual install will have 8
Mounting system for LED light fixtures. Fixtures to be install on VXU boxes for weather resistance. VXU boxes to mount the exterior wall with 2x ¼ x 1½" Tapcon screws. Holes to be pre-drilled and filled with epoxy when required.

Mounting system for conduit: Conduit between LED fixtures to be secured to the building using CSA approve straps. Each strap to be fastened to the exterior wall with a single 1/4x1-½ Tapcon screw. Holes to be predrilled and filled with epoxy when required.

All holes to be made in mortar joint when possible to protect the existing brick.