City of Vaughan

Draft Humber Bridge Trail Bowstring Arch Bridge Municipal Class Environmental Assessment Addendum (Revision to Schedule 'B' Project)

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Executive Summary

In 2013, the City of Vaughan (the City) completed the Humber Bridge Trail Bowstring Arch Bridge Schedule 'B' Municipal Class Environmental Assessment (2013 EA) to identify an appropriate solution to address the structural and safety concerns, as well as access issues, associated with the Bowstring Arch Bridge on the Humber Bridge Trail, east of Highway 27 and north of Major Mackenzie Drive West. Six alternative solutions were comparatively evaluated according to a qualitative assessment, with the bridge rehabilitation alternative ("Alternative No. 2") emerging as the preferred solution.

In late 2013, the City retained Planmac Engineering Inc. to undertake detailed design of the preferred solution. During detailed design, a structural assessment of the existing Bowstring Arch Bridge was completed. In addition to the structural assessment, a life cycle cost analysis was undertaken for the preferred bridge rehabilitation alternative ("Alternative No. 2") as well as for the new concrete bowstring arch bridge ("Alternative No. 3") and the new structural steel girder bridge ("Alternative No. 5") alternatives, which were the next preferred alternatives after the rehabilitation option. The City has considered that the results of this assessment and analysis indicate that the 2013 preferred rehabilitation solution is not viable and has therefore identified the need to amend the 2013 EA in accordance with Municipal Class EA (MCEA) requirements for revisions to Schedule 'B' projects and to identify a new preferred solution.

Given this information, the revised Problem / Opportunity Statement is as follows:

The existing Bowstring Arch Bridge is deteriorating in terms of its structural integrity, resulting in increased concern for the safety of bridge users. This project provides an opportunity to maintain and improve the connection along the Humber Bridge Trail, east of Highway 27, by addressing the Bridge's advanced state of disrepair in a technically and financially viable manner that considers the heritage aspects of the bridge.

With the preferred alternative solution associated with the 2013 EA to rehabilitate the bridge (Alternative No. 2) no longer viable, this addendum comparatively evaluated Alternatives No. 3 and 5 in order to identify a new preferred solution. The reason for the selection of these two alternatives for further evaluation is due to the fact that they were ranked as the 2nd and 3rd best options in the 2013 EA and were also subject to the additional life cycle cost analysis undertaken for the City. Descriptions of Alternatives No. 3 and 5 are provided below. It should be noted that the original Alternatives No. 3 and 5 from the 2013 EA were described as 2-lane bridges. The City has since determined that the bridge does not require two lanes and as such a slight modification was made to the description of these alternatives to only account for one lane, which is reflective of existing conditions.

Alternative No. 3: Complete removal of the existing bridge superstructure on Humber Bridge Trail and construction of a new 1-lane concrete bowstring arch bridge in the same vicinity.

Alternative No. 5: Complete removal of the existing bridge superstructure on Humber Bridge Trail and construction of a new 1-lane structural steel girder bridge in the same vicinity.

It should be noted that the other alternatives considered as part of the 2013 EA (i.e. Alternatives No. 1, 4 and 6) were not re-considered as part of this addendum process, for the following reasons:

Alternative #1 (Do Nothing): Does not address the problem / opportunity statement, conflicts with the City's Pedestrian and Cycling Master Plan and does not address liability issues (as specified in the 2013 EA).

Alternative #4 (New Precast Concrete Box Girder Bridge): Has a higher cost than Alternative No. 5, but is otherwise similar in terms of potential effects. Has a lower cost than Alternative No. 3 but without the culture heritage preservation benefits.

Alternative #6 (Remove Bridge and Provide Alternative Access Road): Has a higher cost than Alternative No. 5 and also a higher potential for effects on the natural environment due to vegetation removal along the new access road. Has a lower cost than Alternative No. 3 but without the culture heritage preservation benefits.

Existing environmental conditions were confirmed by environmental specialists in February 2016. Alternatives No. 3 and 5 were qualitatively assessed against the evaluation criteria used in the 2013 EA, with the addition of a criterion to address the life-cycle costing analysis undertaken. The results of the assessment indicated that both alternatives were similar in terms of potential effects to the natural and social environments. The key differences are that while Alternative No. 3 would have less potential for effects on built heritage resources, Alternative No. 5 has a lower life cycle cost. Overall, the evaluation showed that Alternative No. 5 is the new preferred alternative solution.

The environmental implications of the proposed revisions to the Schedule 'B' project (i.e. the new preferred alternative solution) were identified, as were mitigation measures to eliminate, avoid or minimize potential adverse effects associated with construction and operation of the preferred alternative. Potential environmental effects and associated mitigation measures will be further addressed as part of the detailed design phase.

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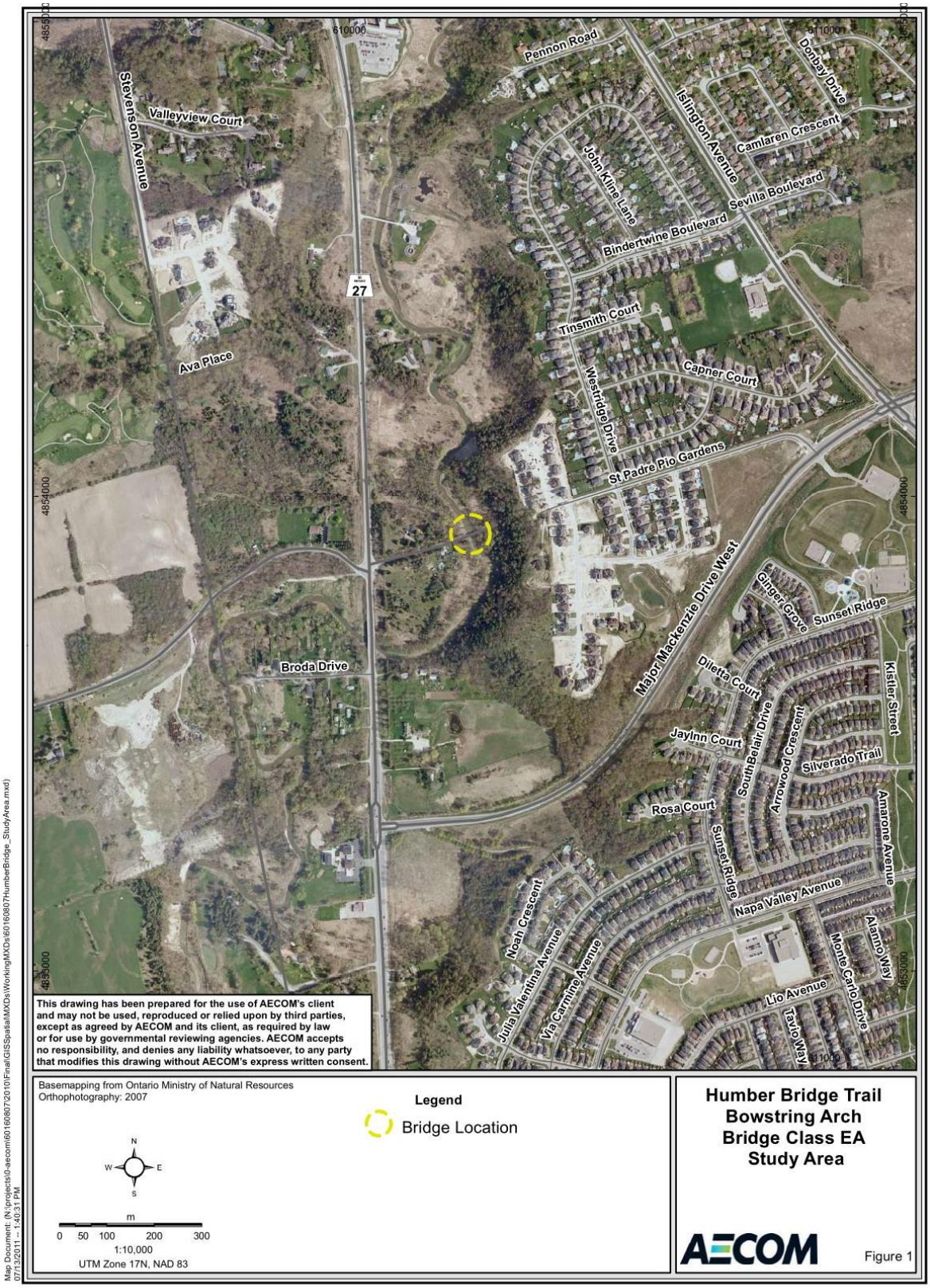
1. Introduction

1.1 Project Background

In 2013, the City of Vaughan (the City) completed the Humber Bridge Trail Bowstring Arch Bridge Schedule 'B' Municipal Class Environmental Assessment (2013 EA) to identify an appropriate solution to address the structural and safety concerns, as well as access issues, associated with the Bowstring Arch Bridge on the Humber Bridge Trail, east of Highway 27 and north of Major Mackenzie Drive West (see **Figure 1**). Six alternative solutions were comparatively evaluated according to a qualitative assessment, with the bridge rehabilitation alternative ("Alternative No. 2") emerging as the preferred solution.

In late 2013, the City retained Planmac Engineering Inc. to undertake detailed design of the preferred solution. During detailed design, a structural assessment of the existing Bowstring Arch Bridge was completed. In addition to the structural assessment, a life cycle cost analysis was undertaken for the 2013 preferred bridge rehabilitation alternative ("Alternative No. 2") as well as for the new concrete bowstring arch bridge ("Alternative No. 3") and the new structural steel girder bridge ("Alternative No. 5") alternatives, which were the next preferred alternatives after the rehabilitation option. The City has considered that the results of this updated assessment and analysis indicate that preferred rehabilitation solution is not financially viable and has therefore identified a need to amend the 2013 EA in accordance with Municipal Class EA (MCEA) requirements for revisions to Schedule 'B' projects and identify a new preferred solution.

Figure 1: Project Study Area



1.2 Municipal Class EA Addendum Process

The MCEA document (2000, as amended in 2007, 2011, and 2015) recognizes that it may be necessary to revise an approved Schedule 'B' project due to changes to the project or a delay in implementation. As such, the MCEA document outlines the process that has been established to address the need for revisions under Section A.4.1.1: 'Revisions to Schedule B Projects'. Significant modifications to a project (in this case the preferred solution to "Rehabilitate the Bridge"), as presented to the public during the screening process and as set out in the Notice of Completion (issued July 25, 2013), are to be reviewed by the proponent (i.e. the City) and documented in the Project File.

The proponent reviews the planning and design process originally undertaken to determine any changes to the project and any associated changes in potential environmental effects and mitigation measures. Once revisions to the Schedule 'B' project are complete, the proponent must issue a Revised Notice of Completion to all potentially affected members of the public and review agencies for a review period of 30 calendar days. As with the original project, the public has the right to request a Part II Order within the 30-day review period; however, there are no public consultation requirements other than issuance of the Revised Notice of Completion. The scope of any Part II Order request must be limited to the Addendum and does not apply to the original submission. If no Part II Order requests are received, the proponent may proceed to implementation of the project.

The proposed changes to this Schedule 'B' project are the result of having to select a different preferred solution after determining that the original preferred solution is no longer viable. There are no other modifications to this project, nor has implementation exceeded the ten (10) year time horizon set out in the MCEA document. On this basis, the City has reviewed the first two phases of the Municipal Class EA process previously completed:

- Phase 1: Define Problem or Opportunity; and
- Phase 2: Identify and Evaluate Alternative Solutions.

The prescribed Phase 1 work is reviewed and summarized in Section 2 below. The review of the Phase 2 tasks, which is described in greater detail in Sections 4 and 5 of this report, included the following activities:

- Re-evaluate the next two top ranking alternatives from the 2013 EA in light of the fact that the preferred alternative is no longer financially viable; and
- Identify any environmental implications and mitigation measures for the new preferred solution.

1.3 Need and Justification for the Proposed Changes

As discussed previously, based on the life cycle analysis performed in late 2013 and considering the advanced state of deterioration of the superstructure during the detailed investigations, the preferred rehabilitation solution ("Alternative No. 2") from the 2013 EA is not financially viable. Specifically, the analysis estimated that the capital costs of implementing Alternative No. 2 is approximately $1,450,000, which is $200,000 (16%) higher than Alternative No. 3 and $620,000 (75%) higher than Alternative No. 5. Furthermore, the life cycle (50 year) costs associated with Alternative No. 2 have been estimated to be approximately $3,470,000, which is $750,000 (28%) higher than Alternative No. 3 and $1,625,000 (88%) higher than Alternative No. 5.

Given the significantly higher costs associated with Alternative No. 2, and considering the uncertainties associated with the feasibility of rehabilitating the superstructure, this solution is no longer feasible. Therefore, this addendum revisits the original 2013 EA findings and comparatively evaluates Alternatives No. 3 and 5 (the next two top ranking alternatives) in order to identify a new preferred solution.

1.4 Consultation Process

The consultation process for this addendum was undertaken in accordance with Municipal Class EA requirements for revisions to Schedule 'B' projects. This requires the issuance of a revised Notice of Completion, which was issued on June 23, 2016. A copy of the revised Notice of Completion is provided in **Appendix A**.

The Ministry of Natural Resources and Forestry (MNRF) and Toronto and Region Conservation Authority (TRCA) were also contacted on February 3, 2016 to confirm background environmental information on the site and possible Species at Risk (SAR). MNRF provided a response on February 3, 2016 which outlined SAR recorded in the vicinity of the bridge since the 2013 EA was completed. No response has been received from TRCA to date.

2. Problem / Opportunity Statement

2.1 Original Problem / Opportunity Statement (2013 EA)

The original Problem / Opportunity Statement as outlined in the 2013 EA was as follows:

The bridge on Humber Bridge Trail is deteriorating in terms of its structural integrity resulting in increased concern for the safety of bridge users and preserving the heritage aspects of the bridge. This project provides an opportunity to maintain and improve the connection along Humber Bridge Trail, east of Highway 27, as well as preserve a local heritage resource, by addressing the Bridge's advanced state of disrepair.

2.2 Revised Problem / Opportunity Statement

Given the information provided in Section 1.3, the revised Problem / Opportunity Statement is as follows:

The existing Bowstring Arch Bridge is deteriorating in terms of its structural integrity, resulting in increased concern for the safety of bridge users.. This project provides an opportunity to maintain and improve the connection along the Humber Bridge Trail, east of Highway 27, by addressing the Bridge's advanced state of disrepair in a technically and financially viable manner that considers the heritage aspects of the bridge.

3. Existing Environmental Conditions

As noted in **Section 1.2**, the intent of the MCEA addendum process is to determine any changes to the project and associated changes in potential environmental effects and mitigation measures. Accordingly, this section focuses on changes to existing environmental conditions since the 2013 EA. Where existing environmental conditions remain the same, an overview of existing environmental conditions as per the 2013 EA is provided for reference to provide background context for the evaluation of alternatives conducted in **Section 4**.

3.1 Technical

The existing structure on Humber Bridge Trail is a single-span bridge crossing the Humber River, with a bowstring arch truss on either side of the deck. The entire bridge is constructed from cast-in-place concrete and accommodates a single lane for two-way vehicular traffic. The deck length is 19.5 metres and the deck width is 3.9 metres.

Overall, the bridge is in poor condition, with a Bridge Condition Index (BCI) of 44.2[1] (a BCI of below 60 is considered 'poor' based on the Ministry of Transportation (MTO) methodology). As outlined in **Section 1.3**, the City conducted a structural assessment of the existing bridge in late 2013 which indicated that rehabilitation of the bridge is not viable.

3.2 Natural Environment

A site visit was undertaken on February 3, 2016 to the Humber River valley approximately 30 m upstream and downstream of the bridge to ensure that the existing natural environment conditions remained the same as in 2013. Any sensitive features were noted and the underside of the bridge was inspected for Barn swallow nests. Current natural environment conditions appeared to be consistent with the 2013 EA results and are summarized below.

As noted in Section 1.4, the MNRF and TRCA were contacted on February 3, 2016 to confirm background information on the site and possible SAR. MNRF provided a response on February 3, 2016 which outlined Species at Risk (SAR) recorded in the vicinity of the bridge since the 2013 EA. No response has been received from TRCA to date.

3.2.1 Terrestrial Environment

The description of existing terrestrial environment within the Study Area is consistent with the 2013 EA. There are no Environmentally Significant Areas (ESAs), provincially or locally significant wetlands (PSWs or LSWs), or Areas of Natural and Scientific Interest (ANSI) present within the Study Area. The Humber River, which occurs within the Study Area, has been designated as a Canadian Heritage River.

[1] *This is lower than the BCI of 49.0 from 2013, indicating that the condition of the bridge is worsening.*

3.2.2 Aquatic Environment

The description of the existing aquatic environment within the Study Area is largely consistent with the 2013 EA. The Humber River river bed was previously described as consisting 'predominantly of silt with overlying boulders and cobble, with the rocky substrates being generally concentrated in the riffle habitats.' In addition, the 2013 EA describes the creek bed material of a small creek that discharges to the river on the left bank approximately 15 m upstream of the bridge as consisting 'of cobble and abundant detritus.' The details regarding river bed and creek bed material as previously described in the 2013 EA could not be confirmed as a result of 2016 field investigations due to partially frozen conditions, but the stable environmental conditions seen in the vicinity of the bridge suggest that the aquatic environment may be assumed to have not changed significantly.

3.2.3 Species at Risk

According to the MNRF, additional Species at Risk (SAR) have been recorded in the vicinity of the bridge since the 2013 EA, including: Bank Swallow (*Riparia riparia*) (threatened), Barn Swallow (*Hirundo rustica*) (threatened), Eastern Meadowlark (*Sturnella magna*) (threatened), Eastern Wood-pewee (*Contopus virens*) (special concern), and Wood Thrush (*Hylocichla mustelina*) (special concern). There is also the potential for three (3) endangered bat species: Eastern Small-footed Myotis (*Myotis leibii*), Little Brown Myotis (*Myotis lucifugus*), and Northern Myotis (*Myotis septentrionalis*).

3.3 Social Environment

Consistent with the 2013 EA, there are three residential properties located on Humber Bridge Trail, one of which falls on the eastern bank of the Humber River and can only be reached using the existing bridge. The City has a legal obligation to ensure that property road access to this property is maintained.

The Study Area lies within the 'Settlement Area Outside the Greenbelt' land designation of the Ontario Greenbelt Plan (2005), linked to the 'Protected Countryside' to the north as part of the 'River Valley Connection.'

According to the *York Region Official Plan* (2010), the Study Area is situated within the 'Regional Greenlands System' which is comprised of natural areas with unique functions, attributes, and linkages. It is the policy of the Official Plan to "identify, protect and restore the Regional Greenlands System," and, as such, approval for any proposed development within these lands will only be granted if it can be proven that there will be no "overall negative effect on the environmental functions, attributes or linkages for which the lands were identified" (York Region Official Plan, 2010).

According to the City of Vaughan's Official Plan *Vaughan Tomorrow* (2010), the Study Area is located within the 'Natural Area and Countryside' designation situated the urban boundary, supporting rural, residential, forested and meadow lands. The existing bridge is considered to be a 'Core Feature' of the City's Natural Heritage Network, which describes an interconnected system of natural features whereby their functions are identified for protection and enhancement.

The *Vaughan Pedestrian and Bicycle Master Plan* (2007) proposes to extend the existing bridge right-of-way easterly to St. Padre Pio Gardens and become a designated 'Neighbourhood Signed Bike Route.' The construction of this bicycle route will improve access and connectivity for pedestrians, hikers and cyclists and serve to better connect the surrounding neighbourhoods in the vicinity of the existing bridge.

3.4 Cultural Environment

3.4.1 Cultural Heritage

The Humber Bridge Trail Bowstring Arch Bridge (formerly Bell Bridge) was built in 1918 and is one of only four concrete bowstring arch bridges that span the Humber River. The bridge originally served as a major river crossing until the Major Mackenzie Drive alignment was moved to its present position in the late twentieth century. Documentation available for the existing bridge indicates that no major rehabilitation or repair work has been undertaken to date, thus the original features and design of the bridge are assumed to be intact.

The description of cultural heritage associated with the Humber Bridge Trail Bowstring Arch Bridge is consistent with the 2013 EA. The Humber Bridge Trail Bowstring Arch Bridge is currently listed on the Vaughan Heritage Inventory (VHI); however, it is not listed on the Listing of Structures of Heritage Significance (LSHS) which serves as the Heritage Register under Section 29 of the *Ontario Heritage Act* (1990).

The Ontario Heritage Bridge Program (OHBP) (1991) uses specific criteria for consistent evaluation of heritage bridges to determine their heritage value and inclusion in the OHBP listing. An OHBP evaluation of the Humber Bridge Trail Bowstring Arch Bridge resulted in a score of 70, which indicates that the existing bridge has high heritage significance; therefore the existing bridge is eligible for inclusion on the OHBP list. Any bridge scoring higher than 60 points will be automatically considered for listing on the OHBP. It should be noted that the list recognizes heritage value but does not protect it through designation under the *Ontario Heritage Act*. The list assists proponents undertaking environmental assessments on bridge rehabilitation and replacement projects by flagging bridges having provincial heritage significance. Bridges can still be modified or demolished so long as the bridge's heritage significance is taken into consideration as part of the planning process.

3.4.2 Archaeological Sites and Potential

The description of existing archaeological sites and potential within the Study Area is consistent with the 2013 EA. There are currently no registered archaeological sites immediately adjacent to the existing bridge; however, there are fourteen (14) sites within 1 km of the bridge that have been registered. The 2013 EA also concluded that the existing footprint of the existing bridge does not retain archaeological potential due to previous ground disturbances, and additional archaeological assessment was therefore not required.

4. Evaluation of Alternative Solutions

4.1 Evaluation Criteria and Process

As per the MCEA process, the first step for Phase 2 (Identify and Evaluate Alternative Solutions) is to select evaluation criteria and confirm the evaluation process. In order to remain consistent with the 2013 EA, the evaluation criteria used for are primarily the same as the criteria used for the 2013 EA. However, due to the additional financial analysis provided to the City, life cycle and future maintenance costs have been added to the financial criteria category. Accordingly, the evaluation criteria used are summarized below:

- Technical: Addresses improved safety for bridge users, constructability of proposed infrastructure and potential future maintenance requirements;
- Natural Environment: Addresses potential effects (short-term and long-term) on terrestrial and aquatic features, baseflow and groundwater;
- Social Environment: Addresses potential disruptions (noise and air quality impacts) to existing residential and recreational land uses;
- Cultural Environment: Addresses potential effects on archaeological and built heritage resources;
- Financial: Addresses overall life cycle cost (construction, future maintenance and potential property acquisition).

4.2 Identification of Alternatives

With the preferred alternative solution associated with the 2013 EA (Alternative No. 2) no longer viable, Alternatives No. 3 and 5 were comparatively evaluated in order to identify a new preferred solution. The reason for the selection of these alternatives for further evaluation is due to the fact that they were ranked as the 2nd and 3rd best options in the 2013 EA and were also subject to the additional financial analysis provided to the City. Descriptions of Alternatives No. 3 and 5 are provided below. It should be noted that the original Alternatives No. 3 and 5 from the 2013 EA were described as 2-lane bridges. The City has since determined that the bridge does not require two lanes and as such a slight modification was made to the description of these alternatives to only account for one lane, which is reflective of existing conditions.

Alternative #3: Complete removal of the existing bridge superstructure on Humber Bridge Trail and construction of a new 1-lane concrete bowstring arch bridge in the same vicinity.

Alternative #5: Complete removal of the existing bridge superstructure on Humber Bridge Trail and construction of a new 1-lane structural steel girder bridge in the same vicinity.

It should be noted that the other alternatives considered as part of the 2013 EA (i.e. Alternatives No. 1, 4 and 6) were not re-considered as part of this addendum process, for the following reasons:

Alternative #1 (Do Nothing): Does not address the problem / opportunity statement, conflicts with the City's Pedestrian and Cycling Master Plan and does not address liability issues (as specified in the 2013 EA).

Alternative #4 (New Precast Concrete Box Girder Bridge): Has a higher cost than Alternative No. 5, but is otherwise similar in terms of potential effects. Has a lower cost than Alternative No. 3 but without the culture heritage preservation benefits.

Alternative #6 (Remove Bridge and Provide Alternative Access Road): Has a higher cost than Alternative No. 5 and also a higher potential for effects on the natural environment due to vegetation removal along the new access road. Has a lower cost than Alternative No. 3 but without the culture heritage preservation benefits.

4.3 Assessment and Evaluation of Alternatives

Alternatives No. 3 and 5 were qualitatively assessed against the evaluation criteria outlined in Section 4.1 above. The results of the assessment are provided in Table 1 below.

Table 1 - Analysis of Alternatives

Areas of Consideration/ Criteria	Alternative No. 3 Remove Existing Bridge Superstructure and Build a New Concrete Bowstring Arch Bridge	Alternative No. 5 Remove Existing Bridge Superstructure and Build a New Structural Steel Girder Bridge
Description of Alternative	**Complete removal of the existing bridge superstructure on Humber Bridge Trail and construction of a new 1-lane concrete bowstring arch bridge in the same vicinity.**	**Complete removal of the existing bridge superstructure on Humber Bridge Trail and construction of a new 1-lane structural steel girder bridge in the same vicinity.**
1. Technical		
1.1 Potential to improve safety for bridge users.	High potential for improvement to the safety of bridge users due to the construction of the new bridge and the removal of the existing superstructure. **HIGH (POSITIVE)**	High potential for improvement to the safety of bridge users due to the construction of the new bridge and the removal of the existing superstructure. **HIGH (POSITIVE)**
1.2 Constructability of proposed infrastructure.	Implementation will be easier as conventional construction methods will be employed. **HIGH CONSTRUCTABILITY**	Implementation will be easier as conventional construction methods will be employed. **HIGH CONSTRUCTABILITY**
1.3 Potential for future maintenance requirements.	Moderate potential for future maintenance requirements for a standard/typical bridge structure. **MODERATE**	Moderate potential for future maintenance requirements for a standard/typical bridge structure. **MODERATE**
2. Natural Environment		
2.1 Potential for short-term construction related effects on the aquatic environment.	High potential for short-term disturbance to riparian vegetation in the vicinity of the abutments, as well as sediment erosion and transport to the Humber River during bridge decommissioning and construction. In-water works are required to remove existing bridge footings, and may be required to construct new bridge footings, posing a risk to fish associated with in water works. However, the implementation of Best Management Practices (work in the dry), in addition to compensation and restoration of disturbed areas, will serve to mitigate and minimize the overall effect. **HIGH**	High potential for short-term disturbance to riparian vegetation in the vicinity of the abutments, as well as sediment erosion and transport to the Humber River during bridge decommissioning and construction. In-water works are required to remove existing bridge footings, and may be required to construct new bridge footings, posing a risk to fish associated with in water works. However, the implementation of Best Management Practices (working in the dry), in addition to compensation and restoration of disturbed areas, will serve to mitigate and minimize the overall effect. **HIGH**
2.2 Potential for short-term construction related effects on	Removal of terrestrial habitat required within the construction envelope and along the access route,	Removal of terrestrial habitat required within the construction envelope and along the access route,

Areas of Consideration/ Criteria	Alternative No. 3 Remove Existing Bridge Superstructure and Build a New Concrete Bowstring Arch Bridge	Alternative No. 5 Remove Existing Bridge Superstructure and Build a New Structural Steel Girder Bridge
the terrestrial environment.	including some mature trees and potential removal of rare species and SAR habitat. Design should avoid sensitive habitat features to the extent possible. Breeding bird timing windows should be adhered to during construction activities to minimize adverse effects on breeding birds. **HIGH**	including some mature trees and potential removal of rare species and SAR habitat. Design should avoid sensitive habitat features to the extent possible. Breeding bird timing windows should be adhered to during construction activities to minimize adverse effects on breeding birds. **HIGH**
2.3 Potential for short-term construction related effects on baseflow and/or groundwater.	Moderate potential for short-term effects on baseflow and groundwater due to the potential need for construction dewatering. Design should minimize work below the water table. Water taken during construction dewatering should be returned to the watercourse quickly following temperature and turbidity testing. **MODERATE**	Moderate potential for short-term effects on baseflow and groundwater due to the potential need for construction dewatering. Design should minimize work below the water table. Water taken during construction dewatering should be returned to the watercourse quickly following temperature and Turbidity testing. **MODERATE**
2.4 Potential for long-term effects on the aquatic environment.	High potential for long-term effects as there is a possibility of permanent removal of fish habitat if the new bridge occupies a different footprint than the existing bridge within the 2 year storm elevation. Design should minimize or maintain a bridge footprint consistent with the existing structure to the extent possible. It would be optimal to clear span the watercourse, resulting in a net gain in fish habitat. **HIGH**	High potential for long-term effects as there is a possibility of permanent removal of fish habitat if the new bridge occupies a different footprint than the existing bridge within the 2 year storm elevation. Design should minimize or maintain a bridge footprint consistent with the existing structure to the extent possible. It would be optimal to clear span the watercourse, resulting in a net gain in fish habitat. **HIGH**
2.5 Potential for long-term effects on the terrestrial environment.	Low potential for long-term effects on the terrestrial environment as post-construction restoration methods are available to compensate for temporary loss of habitat. **LOW**	Low potential for long-term effects on the terrestrial environment as post-construction restoration methods are available to compensate for temporary loss of habitat. **LOW**
2.6 Potential for long-term effects on baseflow and/or groundwater.	Low potential for long-term effects on baseflow and groundwater as active water taking will end following the construction of a new bridge. **LOW**	Low potential for long-term effects on baseflow and groundwater as active water taking will end following the construction of a new bridge. **LOW**
3. Social Environment		
3.1 Potential for disturbing existing residences, community, and recreation facilities through temporary effects (i.e., construction noise, dust, property access disruption, etc.).	Moderate potential for temporary disturbance due to bridge access restrictions during decommissioning of the existing bridge and construction of the new bridge. **MODERATE**	Moderate potential for temporary disturbance due to bridge access restrictions during decommissioning of the existing bridge and construction of the new bridge. **MODERATE**
3.2 Potential to maintain and improve access to the resident on the eastern bank of the Humber River along Humber Bridge Trail.	High potential to maintain and improve access to the resident on the eastern bank of the Humber River along Humber Bridge Trail through the construction of the new bridge. **HIGH (POSITIVE EFFECT)**	High potential to maintain and improve access to the resident on the eastern bank of the Humber River along Humber Bridge Trail through the construction of the new bridge. **HIGH (POSITIVE EFFECT)**

Areas of Consideration/ Criteria	Alternative No. 3 Remove Existing Bridge Superstructure and Build a New Concrete Bowstring Arch Bridge	Alternative No. 5 Remove Existing Bridge Superstructure and Build a New Structural Steel Girder Bridge
3.3 Potential for requiring the acquisition of private property.	High potential for requiring private property for the construction of the new bridge. **HIGH**	High potential for requiring private property for the construction of the new bridge. **HIGH**
3.4 Degree of compatibility with Regional and Local Official Plans, Pedestrian and Bicycle Plans, and other relevant policies and plans.	As part of the active transportation system for pedestrians and cyclists, the replacement of the bridge conforms with the policies of the *York Region Official Plan*. The decommissioning of the existing bridge does not; however, preserve a cultural heritage resource, as per the *Official Plan*. Replacement of the bridge satisfies the *Vaughan Pedestrian and Bicycle Master Plan* by maintaining the connection along Humber Bridge Trail, as this road has been proposed as a designated a Neighbourhood Signed Bike Route. **HIGH COMPATABILITY**	As part of the active transportation system for pedestrians and cyclists, the replacement of the bridge conforms with the policies of the *York Region Official Plan*. The decommissioning of the existing bridge does not; however, preserve a cultural heritage resource, as per the *Official Plan*. Replacement of the bridge satisfies the *Vaughan Pedestrian and Bicycle Master Plan* by maintaining the connection along Humber Bridge Trail, as this road has been proposed as a designated a Neighbourhood Signed Bike Route. **HIGH COMPATABILITY**
3.5 Potential for creating a visually appealing structure.	Moderate potential for creating a visually appealing structure when constructing the new bridge. **MODERATE**	Moderate potential for creating a visually appealing structure when constructing the new bridge. **MODERATE**
4. Cultural Environment		
4.1 Potential for effects on archaeological resources.	Low potential for effects on archaeological resources as decommissioning and new bridge will not require area beyond the existing bridge footprint. Moderate potential for effects on archaeological resources for construction staging areas. **MODERATE**	Low potential for effects on archaeological resources as decommissioning and new bridge will not require area beyond the existing bridge footprint. Moderate potential for effects on archaeological resources for construction staging areas. **MODERATE**
4.2 Potential for effects on built heritage resources.	The cultural heritage study concluded that Humber Bridge Trail Bridge retains high heritage significance. Despite not being included on the City of Vaughan's Listing of Structures of Heritage Significance, it is included in the Vaughan Heritage Inventory. Thus, there is moderate potential for effects on built heritage resources due to the removal of the existing bridge. However, because the design would be sympathetic to the original, the effects would be minimized. **MODERATE**	The cultural heritage study concluded that Humber Bridge Trail Bridge retains high heritage significance. Despite not being included on the City of Vaughan's Listing of Structures of Heritage Significance, it is included in the Vaughan Heritage Inventory. Thus, there is high potential for effects on built heritage resources due to the removal of the existing bridge. **HIGH**
5. Financial		
5.1 Potential cost for acquiring property.	Moderate cost associated with temporary working easements for the decommissioning of the existing bridge and construction of the new bridge. Moderate costs associated with property acquisition for the land upon which the new bridge will be constructed. **MODERATE**	Moderate cost associated with temporary working easements for the decommissioning of the existing bridge and construction of the new bridge. Moderate costs associated with property acquisition for the land upon which the new bridge will be constructed. **MODERATE**

Areas of Consideration/ Criteria	Alternative No. 3 Remove Existing Bridge Superstructure and Build a New Concrete Bowstring Arch Bridge	Alternative No. 5 Remove Existing Bridge Superstructure and Build a New Structural Steel Girder Bridge
5.2 Potential Capital costs to the City of Vaughan for implementation.	Approximately $1,250,000. **HIGH COST**	Approximately $830,000. **MODERATE COST**
5.3 Potential future maintenance costs.	Approximately $5,000 to $6,000 per year in annual maintenance costs. **MODERATE COST**	Approximately $4,000 to $5,000 per year in annual maintenance costs. **MODERATE COST**
5.4 Life Cycle Cost	Total life cycle (50 year) cost is estimated to be approximately $2,720,000. **MODERATE COST**	Total life cycle (50 year) cost is estimated to be approximately $1,845,000. **LOW COST**

As Table 1 indicates, the two alternatives are identical under all criteria but 4.2 (Built Heritage Impacts) and 5.2 (Capital Costs), 5.3 (Future Maintenance Costs), and 5.4 (Life Cycle Costs).

Given that the existing heritage structure is to be removed in either case, the impact under criteria 4.2 is significant and only mitigated to some extent by the reinstatement of a new structure in a style visually sympathetic to the original structure. Since the bowstring arch design is an obsolete style of structural engineering and architecture, a new bridge in that style (i.e. Alternative No. 3) would be consciously attempting to evoke the original design whereas Alternative No. 5 would be a design that is more reflective of 21st century bridge engineering practice. Any user of Alternative No. 3 would see that it is a new structure in an old style. The difference between the two is therefore less than it would be between the original structure and a new steel girder bridge. The cost differences are, however, significant, with the capital and life cycle costs of Alternative No. 3 being in the order of 50 % greater than for Alternative No. 5. Accordingly, Alternative No. 5 is ranked higher than Alternative No. 3.

5. Preferred Alternative and Environmental Implications

5.1 Preferred Alternative

The revised assessment and evaluation of alternative solutions indicated that Alternative No. 5 is the preferred alternative solution. As indicated previously, Alternative No. 5 will result in the removal of the existing bridge superstructure on Humber Bridge Trail and construction of a new 1-lane structural steel girder bridge in the same vicinity.

5.2 Environmental Implications of the Proposed Changes

This section summarizes the potential environmental effects of the preferred alternative. Consistent with the MCEA addendum process, the focus is on the potential environmental implications of the proposed changes only. Therefore, the potential environmental effects and mitigation measures outlined in this section focus only on the differences between Alternative No. 5 and the previously preferred (and approved) Alternative No. 2. Potential environmental effects and associated mitigation measures will be further addressed as part of the detailed design phase.

5.2.1 Natural Environment

5.2.1.1 Terrestrial Features

Potential effects and mitigation measures related to terrestrial features for Alternative No. 5 are anticipated to be the same as those set out in the 2013 EA for Alternative No.2.

5.2.1.2 Aquatic Features

Potential effects and mitigation measures related to aquatic features for Alternative No. 5 are anticipated to be the same as those set out in the 2013 EA for Alternative No.2.

5.2.1.3 Erosion and Sedimentation

Potential erosion and sedimentation effects and mitigation measures for Alternative No. 5 are anticipated to be the same as those set out in the 2013 EA for Alternative No.2.

5.2.1.4 Shoreline / Bank Re-Vegetation

Potential effects and mitigation measures related to shoreline / bank re-vegetation for Alternative No. 5 are anticipated to be the same as those set out in the 2013 EA for Alternative No.2.

5.2.1.5 Fish and Fish Habitat

The 2013 EA noted that the potential long-term effects associated with the construction of Alternative No. 5 would be greater than Alternative No. 2 if the new bridge occupies a greater footprint within the water than the existing bridge. However, as Alternative No. 5 will be retaining the existing abutments and occupy the same footprint, the potential short-term effects on fish and fish habitat associated with Alternative No. 5 are anticipated to be the same as those set out in the 2013 EA for Alternative No 2.

5.2.2 Cultural Environment

The Heritage Impact Assessment undertaken as part of the 2013 EA should be updated during detailed design to reflect the preferred alternative identified in this addendum.

In the absence of any specific heritage bridge guidelines used by the City of Vaughan, the *Ontario Heritage Bridge Guidelines for Provincially Owned Bridges* (MTO, 2008) was reviewed for mitigation options for the Humber Bridge Trail Bowstring Arch Bridge. Section 4.3 of the MTO *Ontario Heritage Bridge Guidelines* identifies eight mitigation options where heritage bridges may be displaced by project activities. These are:

1) Retention of existing bridge with no major modifications undertaken
2) Restoration of missing or deteriorated elements where physical or documentary evidence (e.g. photographs or drawings) exists for their design;
3) Retention of existing bridge with sympathetic modification;
4) Retention of existing bridge with sympathetically designed new structure in proximity;
5) Retention of existing bridge no longer in use for vehicular purposed but adapted for a new use. For example, prohibiting vehicle or restricting truck traffic or adapting for pedestrian walkways, cycle paths, scenic viewing, etc.;
6) Retention of bridge as a heritage monument for viewing purposes only;
7) Relocation of smaller, lighter single span bridges to an appropriate new site for continued use (see 4) or adaptive re-use (see 5); and
8) Bridge removal and replacement with a sympathetically designed structure
    a) Where possible, salvage elements / members of bridge for incorporation into new structure or for future conservation work or displays;
    b) Undertake a full recording and photographic documentation of existing structure.

Provincial Standards and Guidelines for Provincially Owned Bridges (Interim, 2008) require that the eight options above be considered sequentially (i.e. Option 1 must be shown to be non-viable, before Option 2 can be considered, and so on). Section 4.4 of the *Ontario Heritage Bridge Guidelines* further states that for bridge removal and replacement to be determined to be the preferred option, at least one of the following conditions must be demonstrated:

1) The safety of the existing structure is compromised to the extent that rehabilitation is not a practical option. Structural deficiencies that can be addressed through rehabilitation should not be considered under this category.

2) The cost of rehabilitation is prohibitive compared to replacement. This may be the case for a bridge that is severely deteriorated and structurally compromised. Rehabilitation costs that exceed replacement costs by approximately 10% are not considered prohibitive given the intrinsic value of preserving a heritage structure. It is also recognized that long term maintenance costs may be higher for the rehabilitated bridge; however, this fact cannot be a determining factor when considering the retention vs. replacement options.
3) The bridge has been severely altered from its original form. This would be the case for bridges where only a small part of the original structural character remains following repeated rehabilitation episodes. A cultural heritage bridge does not need to be in its original condition. Few survive without alterations on the long journey between their date of origin and today. Integrity is a question of whether the surviving physical features (heritage attributes) continue to represent or support the cultural heritage value of the bridge or its associated landscape.
4) Replacement is required to meet demand requirements that are not achievable through rehabilitation or upgrading of the existing structure.

As outlined in Section 1.3, the cost of rehabilitation is prohibitive compared to replacing the Humber Bridge Trail Bowstring Arch Bridge. Furthermore, there are many uncertainties associated with rehabilitating a structure which is in a very poor condition. Accordingly, the retention and/or rehabilitation of the Humber Bridge Trail Bowstring Arch Bridge is not technically or financially feasible. Since the preferred alternative is a replacement structure, and with consideration given to above, it is recommended that the new superstructure, where feasible, salvage or reuse components of the existing bridge (for example, railings) and that a full recording and photographic documentation of the existing structure be undertaken prior to its removal.

Documentation prior to demolition of an existing bridge creates a record of the structure that can be used by future historians and other researchers. Adequate documentation should occur before and during, demolition and involve high resolution photography, measured drawings and additional structure-specific research and analysis. The quality of the documentation must be such that the bridge can be understood even though the physical evidence has disappeared. Documentation must be placed in a public institution that can store the information safely and make it available to the public.

In the absence of a municipal documentation standard, it is recommended to use the MTO *Environmental Standards and Practices (ESP) Guide*. Section 7.5.2 of the *ESP Guide* outlines the requirement for a Heritage Documentation Report (HDR) for Built Heritage Resources, it states that “where the resource is to be relocated or demolished, a qualified person(s) – cultural heritage specialist should develop a full historical site research, photographs and map recording and documentation of the resource to be displaced or disrupted”.

Photographs and a written report will document most resources; however, some resources may need to be documented with measured drawings.

A HDR for built heritage resources should include:

- A general description of the history of the study area as well as a detailed historical summary of property ownership and building(s) development; if resource is a bridge or engineering work, a detailed historical summary of its construction and its relationship to the development of the study area;
- A description of the resource, both exterior and interior for a building and if a bridge or engineering work, its structural design and materials;
- Overall dimensional measurements of the exterior of a building or structure;
- Overall dimensional measurements for principal rooms (all floors) in the interior and other character-defining details to aid in the building description;
- The measurement of structural members and connections to confirm the original engineering drawings, if available, for a bridge or other engineering work;

- Representative photographs of the exterior (front, back and side views) of a building or structure;
- Representative photographs of the elevations and structural details of a bridge or engineering work;
- Detail photography of character-defining architectural resources or elements on the exterior and interior of a building;
- Detail photography of structural members and design details of a bridge or engineering work;
- Photographic key plans of the exterior and interior of the building, not to scale;
- Photographic key plan for bridges and other engineering works; and
- A site plan.

The final Heritage Documentation Report should be filed with the City of Vaughan, a local archive and\or library and\or municipal department.

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