Township of Uxbridge and Region of Durham

Downtown Uxbridge Flood Reduction

Schedule ‘C’ Municipal Class Environmental Assessment

Environmental Study Report

November 15, 2012

DURHAM REGION

SRM ASSOCIATES

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Study Background

In 1983, a flood relief study was commissioned by the South Lake Simcoe Conservation Authority (now the Lake Simcoe Region Conservation Authority) and the Township of Uxbridge, to establish a comprehensive understanding of the Uxbridge Brook watershed. The study recommended measures to alleviate or minimize the potential for future flood related damage in the downtown area. Various alternatives were developed and examined including construction of upstream detention facilities, diversion of flow, and conveyance capacity improvements. The preferred alternative at that time was to construct new twin 4.2 m x 2.4 m concrete box culverts under Brock Street adjacent to the existing culvert and create an open gabion or concrete gabion-lined channel north of Brock Street. The preferred alternative from 1983 was never constructed, and since the time of that study, watershed models have been updated and the legislative framework for the approval of infrastructure projects has changed considerably.

In 2008, the Lake Simcoe Region Conservation Authority made a presentation to the Township of Uxbridge Council to consider a flood management proposal focused on re-opening Uxbridge Brook through the downtown. It was recognized that the culvert under Brock Street was not able to convey a Regional storm event (Hurricane Hazel), which would result in extensive flooding in the downtown, with water about 1 – 2 m deep on Brock Street. It was recommended that the Township consider the option of removing the culvert under Brock Street, and re-opening Uxbridge Brook through the downtown. Following this presentation, the Uxbridge Watershed Advisory Committee recommended to Council that an update to the 1983 Flood Relief Study be undertaken.

The Township of Uxbridge and the Region of Durham responded by initiating a Schedule 'C' Municipal Class Environmental Assessment in 2010 to investigate opportunities for alleviating or eliminating the flood risk in the downtown Uxbridge area, and address the need for replacement of the existing culvert under Brock Street. The flood risk would occur under a Regional storm event (Hurricane Hazel) for the lands adjacent to the main branch of Uxbridge Brook, from Elgin Pond to just north of Brock Street (downtown Uxbridge). The flood risk is due to the presence of a long culvert which encloses the creek from Centennial Drive to approximately 100 m north of Brock Street.

The following local issues were identified:

- The Regional Storm Floodplain currently encompasses a large portion of the downtown core of the Township of Uxbridge
- A flood hazard exists during the Regional Storm (Hurricane Hazel) for land adjacent to the main branch of Uxbridge Brook, particularly between Elgin Pond and just downstream of Brock Street
- The culvert which encloses Uxbridge Brook between Centennial Drive and the north limit of the parking lot 100 m north of Brock Street acts as a 'bottle-neck' during the Regional storm event

- The preferred solution must consider the constraints of working in the urban downtown which includes existing buildings and uses, significant transportation corridors, effects of flooding, and public uses/objectives
- The preferred solution must consider the objectives of the Uxbridge Brook Watershed Study by LSRCA, and integrate environmental protection and restoration policies where ever possible
- Uxbridge, the Trail Capital of Canada, has an extensive trail system that connects with the Trans Canada and Oak Ridges Trails. Connectivity between the open green space within Centennial Park at Uxbridge Brook and the rail line is disjointed and highly urbanized
- Several community events take place in and around Uxbridge Brook. These events must be considered during the implementation and construction staging of the preferred solution
- Since the preferred solution could require encroachment into existing parking areas, a parking impact study is required to evaluate the potential impact

Alternative Solutions

The first step towards identifying alternative solutions for flood reduction was to undertake a flood modeling analysis. This included a background review of all pertinent information and models available for the study area and an update to the available models to accurately depict the existing conditions. The background review was followed by an iterative modeling analysis of each alternative solution and a subsequent analysis of design alternatives for the preferred solution. Following the modeling updates, several flood reduction options were conceptualized and investigated:

1. **New Larger Culvert under Brock Street** (removal of existing culvert and installation of new larger culvert under Brock Street)
2. **Open Channel at Brock Street** (removal of existing culvert and construction of an open channel with bridges at Brock Street and Centennial Drive)
3. **Overland Flow Route** (removal of buildings on Brock Street above the culvert to create an overland flow route for flood water)
4. **Overflow Pipe under Bascom Street** (construction of an overflow pipe under Bascom Street to convey partial floodwater flows to the outfall at the downstream limit of the existing culvert)
5. **Downstream Improvements** (downstream improvements to alleviate the tailwater at the north side of Brock Street, to be implemented in conjunction with another alternative)

The alternative solutions were reviewed against the road, water, and wastewater project schedules in Appendix 1 of the Municipal Class EA guidance document, to correctly categorize the project. In this case, given the potential cost of the project, and the extensive impacts that could occur from the range of alternative solutions identified, it was most appropriate to classify the project as Schedule ‘C’.

Inventory of the Existing Environment

Geomorphic and aquatic habitat assessments were conducted on Uxbridge Brook to provide an understanding of the local watercourse. The study area encompassed Uxbridge Brook from south of Centennial Drive to the Canadian National (CN) railway north of the downtown area. The study included a review of all pertinent background information associated with the fluvial geomorphology and aquatic and terrestrial habitat within the study area. Available detailed topographic and geologic maps, historic aerial photographs, pertinent previous reports and available data specific to this assessment were examined. A field investigation, including rapid geomorphic assessments and aquatic habitat and terrestrial resource assessments were also completed in the late summer of 2010.

Groundwater conditions were investigated by reviewing Sourcewater Protection Area reports for the Uxbridge Brook subwatershed. These reports indicated that there are three wells in the community of Uxbridge that service approximately 10,000 people. The Wellhead Protection Areas for Uxbridge reflect the regional groundwater flow direction from south to north within the Lake Simcoe watershed and the watershed of the Uxbridge Brook and its tributaries. However, groundwater vulnerability in Uxbridge is typically considered to be low in the areas near the municipal wells because the municipal wells are relatively deep and the overburden above the aquifer is known to be relatively thick.

From a social environment perspective, the most significant environmental condition is the flood hazard in downtown Uxbridge, related to the risk associated with a Regional storm event (Hurricane Hazel). The majority of buildings and streets in the downtown area are vulnerable to flooding in storm events greater than the 100-year storm, and under a Regional storm event, flooding on Brock Street is modeled to be as deep as 2.3 m.

A Phase 1 and 2 Environmental Site Assessment was conducted to identify potentially contaminated areas. The analyses for the soil and groundwater samples showed that the tested parameters generally fall within acceptable standards. The site was found to be suitable for the proposed culvert and no further testing was recommended.

A parking demand study was conducted in the vicinity of the proposed flood reduction alternatives, to address the community concern for adequate parking supply. The study concluded that there are a total of 409 existing parking spaces available within the study area. The results of the data collection also showed that there is a total peak parking demand of 69% (283 of the 409 parking spaces are used), and a surplus of 31% or 126 parking spaces.

A Stage 1 archaeological assessment was conducted to evaluate the study area's potential to contain archaeological resources. A review of historic maps of downtown Uxbridge showed the presence of an important 19th century structure within the study area, likely tied to the beginnings of settlement in Uxbridge. Since there is no conclusive evidence of deep and extensive ground disturbance, or complete removal of archaeological potential associated with the structure, this area will undergo Stage 2 archaeological assessment prior to construction. No other areas of archaeological concern were identified.

A geotechnical investigation was conducted to characterize the subsurface soil conditions and determine the engineering properties of the soils for future use in the design and construction of the project. The area of investigation was focused on the location of the existing culvert under Brock Street. Five boreholes were installed at depths ranging from 12.6 to 20.0 m, and monitoring wells were installed in four of the boreholes for groundwater sampling and monitoring. Information collected from the investigation was used to provide construction-related recommendations for the culvert foundations, wing wall construction, engineered fill, trenches and excavations, sidewalks and landscaping, pavement design, and management of groundwater during construction.

Evaluation of Alternative Solutions

An evaluation matrix approach was used to assess the merits of each of the alternative solutions, based on the issues and constraints identified at the outset of the project. The highest scoring alternative was Alternative 1 – New Larger Culvert under Brock Street, followed by Alternatives 2 and 5, representing an opening of the Uxbridge Brook channel and implementation of downstream improvements. From this evaluation, the preferred solution was determined to be a combination of the top three alternatives. The preferred solution would be comprised of a new larger culvert under Brock Street, with a section open channel north of Brock Street, combined with downstream improvements to reduce the tailwater at Brock Street.

The key component of the preferred flood reduction solution is the new larger culvert under Brock Street, as it had been identified as the flood 'bottle-neck' in this area. To determine an appropriate size for this structure, a range of new culverts of various sizes were analyzed. In addition to modeling the various culvert scenarios, numerous downstream improvements were analyzed for each of the culvert scenarios to assess the potential for further flood reductions.

The original goal of the study was to develop a solution that would flood-proof the downtown, meaning that the flood water would be contained within the culvert below the elevation of the existing basements. As the study progressed however, the Steering Committee re-evaluated the project goal in an effort to achieve a better balance between benefits and impacts. The decision was to revise the goal to keep the Regional storm below the first floor elevations of the buildings. In this scenario, the majority of flood water would be conveyed by the new culverts, but there would be some flooding in the valley and basements south of Brock Street. The flooding would not however, get high enough to overtop Brock Street and flood the downtown.

The best reasonable solution to flood reduction in the downtown was determined to be replacement of the existing culvert, combined with opening of ~60 m of channel. This solution provides an opportunity to open up a section of the watercourse, which would have significant environmental and social benefits.

Recommended Design Concept

Twin culverts are proposed to replace the existing culvert. The west culvert would be 135 m long, with an open-bottom structure aligned with the natural channel of Uxbridge Brook, to maintain fish passage. The culvert would end approximately 40 m north of Brock Street, to allow for creation of an open channel where Uxbridge Brook is currently under the parking lot. The

existing section of culvert under #34 Brock Street (Youth Centre) can be retained. The east culvert would be 195 m long, extending the entire length of the existing structure under Brock Street. This culvert would have a concrete bottom, and would only function during large storm events. The building at #30/32 Brock Street would have to be demolished to accommodate construction of the east culvert.

The section of open channel would have steep side slopes, approximately 4.5 to 6.0 m high, to account for the difference in elevation between the existing ground surface and the invert of the creek. The side slopes would consist of vegetated rock, to balance the need for structural stability and providing shade and habitat for the creek. The channel within the 7.0 m wide corridor would be designed with natural channel design principles, in consultation with the Lake Simcoe Region Conservation Authority. Pedestrian railings would be required along the top of the channel corridor for pedestrian safety.

Public Consultation

A stakeholder list was compiled for the project, representing all parties that could have an interest or regulatory authority over some portion of the project. Notices of Study Commencement, Public Information Centres, and Study Completion were circulated to all stakeholders. The notices were also published in the Uxbridge Times. In addition to mailing of Notices, flyers were posted in the local community, at Zehrs, Wal-Mart, Canadian Tire, Mac's Milk, Vince's Market, Blue Heron Book Store, Presents Presents, Swiss Chalet, Uxpool, the Township Senior Centre, and the Township Arena.

Consultation with the local community occurred via interactions with members of the Uxbridge Watershed Advisory Committee, the Business Improvement Area association, and correspondence with the study team. A presentation was made by the Township and the Uxbridge Watershed Advisory Committee to the Business Improvement Area association, and press briefing was conducted by the Township and the Uxbridge Watershed Advisory Committee. Several news articles were also written about the project, highlighting key developments and issues of interest to the local community.

Correspondence was maintained with review and approval agencies, to determine their particular interests in the project. The Ministry of the Environment provided comment on this project, and the Ministry of Natural Resources deferred comments to the Lake Simcoe Region Conservation Authority (LSRCA). The LSRCA was an active member of the Steering Committee for this project, and as such, provided technical and policy input throughout the course of the study.

Correspondence was also initiated with Indian and Northern Affairs Canada, and the Ministry of Aboriginal Affairs, to identify which First Nations would have a local interest in the project. Upon identification of the First Nations with potential interest in the project, individual mailings of project notices were provided.

Three Public Information Centres (PICs) were held during the Class EA study, to communicate the planning process, significant findings, alternatives considered, and recommended solutions.

The PICs were structured to receive feedback on the various alternatives proposed. Notices for each of the PICs were directly mailed to all stakeholders including local residents, and were advertised in the Uxbridge Times. For each PIC, display panels were available and staff from the Township of Uxbridge, Region of Durham, and SRM Associates were available for one-on-one discussions. Comment forms were also available at the PICs, and on the Township and Region's websites, to provide an opportunity for further input at a later date.

This Environmental Study Report is available for public review and comment for thirty (30) calendar days from November 15, 2012. Copies of the report are available for reviewing during normal business hours at the following locations:

Uxbridge Public Library
9 Toronto St. S
Uxbridge, ON, L9P 1T1

Township of Uxbridge
51 Toronto St. S
Uxbridge, ON L9P 1T1

Region of Durham – Clerks Office
605 Rossland Road East, Level 5
Whitby, ON L1N 6A3

If concerns regarding the project cannot be resolved in discussion with the Township and Region, a person or party may request that the Minister of the Environment make an order for the project to comply with Part II of the Environmental Assessment Act (referred to as a Part II Order), which requires an Individual Environmental Assessment. Requests must be received by the Minister within the 30-day review period. If no new or outstanding concerns are brought forward during the review period, the Township and Region may complete detailed design and construction of the project.

Anyone wishing to request a Part II Order must submit a written request, by the end of the thirty (30) calendar day review period on December 17, 2012, to the Minister of the Environment at the following address, with a copy sent to the Township Clerk (address below) and the Township's Director of Public Works.

Hon. Jim Bradley
Minister of the Environment
77 Wellesley Avenue
Ferguson Block, 11th Floor
Toronto, ON, M7A 2T5

Ben Kester, C.E.T.
Director of Public Works
Township of Uxbridge
51 Toronto St. S
Uxbridge, ON, L9P 1T1

Clerk
Township of Uxbridge
51 Toronto St. S
Uxbridge, ON, L9P 1T1

1 Introduction

A severe flood hazard exists under a Regional storm event (Hurricane Hazel) for the lands adjacent to the main branch of Uxbridge Brook, from Elgin Pond to just north of Brock Street (downtown Uxbridge). The flood hazard is due to the presence of a long culvert which encloses the creek from Centennial Drive to approximately 100 m north of Brock Street (**Figure 1**).

The Township of Uxbridge and the Region of Durham initiated a Schedule 'C' Municipal Class Environmental Assessment to investigate opportunities for alleviating or eliminating the flood risk in the downtown Uxbridge area, and address the need for replacement of the existing culvert under Brock Street. The Class Environmental Assessment was completed in accordance with the Schedule 'C' process of the Municipal Engineers Association Municipal Class Environmental Assessment (2011).

Figure 1. Extent of the Regional Storm Floodplain in downtown Uxbridge

1.1 Historical Records of Flooding

Historical records of flooding in the downtown Uxbridge area have been documented since 1932. Newspaper records from the Uxbridge Library were searched to provide an understanding of the flooding history in the downtown. Key articles and issues are summarized in **Table 1**, and copies of the articles are provided as **Appendix A**.

Table 1. Historical newspaper records of flooding in downtown Uxbridge

Date	Article highlights
February 18, 1932	• Bascom Street flooded • Bridge at Electric Light Pond swept downstream
March 5, 1953	• Elgin Pond overflowed its banks • Basements flooded
October 21, 1954	• Aftermath of Hurricane Hazel (October 15, 1954) • Telephone and hydro lines down • Roofs torn off, trees down, bridges out • Basement flooding
October 28, 1954	• Flood relief fundraising
November 4, 1954	• Mayor's appeal for continued flood relief donations
April 15, 1965	• Brookdale Dam gives way after heavy rains and floods downtown • Extensive basement flooding • Roads washed out • Damage to property

The Class EA study team also met with local historian Allan McGillivray, and reviewed a book entitled "Uxbridge – The Good Old Days: Life in the 1950s and 1960s" by J. Peter Hvidsten to further document the history of flooding in downtown Uxbridge.

It was documented that Hurricane Hazel passed through the Uxbridge area in October of 1954, but the Town suffered little damage compared to other communities to the south. The "Great Flood" however, was attributed to the breaking of the Brookdale Dam in April of 1965. This flood was described by local residents as the worst in the history of the Town. Water levels, resulting from a heavy rain, caused the dam to collapse and allow water to rush along the creek channel into Elgin Pond. The pond overflowed across Mill Street and down Bascom Street and spilled over the banks into the creek. The creek in downtown Uxbridge expanded as debris blocked the culvert under Brock Street, creating a small lake south of the stores. Roads were washed out and considerable damage occurred on many properties. Basements were flooded, causing damage to property.

1.2 Flood Relief Study of the Town of Uxbridge (1983)

The first hydrologic and hydraulic study for Uxbridge Brook was completed in 1978. The models created at that time indicated that a large flood hazard existed along Uxbridge Brook such that

the Regional Storm (Hurricane Hazel) Floodplain encompassed the entire downtown core. This hindered development within the downtown and triggered the need for further study of flood remediation measures.

In 1983, a flood relief study was commissioned by the South Lake Simcoe Conservation Authority (now the Lake Simcoe Region Conservation Authority) and the Township of Uxbridge, to establish a comprehensive understanding of the Uxbridge Brook watershed. The study reviewed the floodlines developed in 1978, and recommended measures to alleviate or minimize the potential for future flood related damage in the downtown area.

The study concluded that the most distinguishing hydraulic feature during severe floods was the constriction caused by a combination of an undersized Brock Street culvert and extensive blockages of overland flow paths due to the presence of commercial buildings. Other major hydraulic characteristics of the Uxbridge Brook were noted, including the outlets from each of the reservoirs located upstream of the downtown area (Electric Light Pond, Brookdale Dam and Elgin Mill Pond). Under existing conditions, the potential for flood damage during a Regional Storm event in the downtown core would be extensive, especially in the vicinity of Brock Street.

Various alternatives were developed and examined including construction of upstream detention facilities, diversion of flow, and conveyance capacity improvements. The preferred alternative at that time was to construct new twin 4.2 m x 2.4 m concrete box culverts under Brock Street adjacent to the existing culvert and create an open gabion or concrete gabion-lined channel north of Brock Street (**Figures 2 and 3**). The preferred alternative was not constructed, and since the time of the 1983 study, watershed models have been updated and the legislative framework for the approval of infrastructure projects has changed considerably.

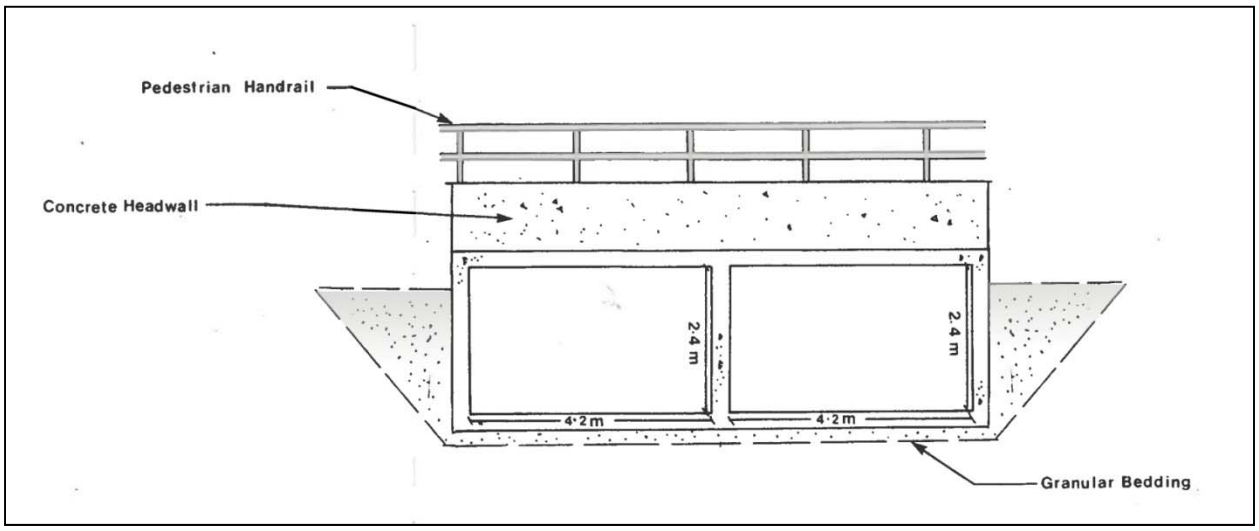

Figure 2. Cross-section of overflow culverts proposed in the 1983 Flood Relief Study

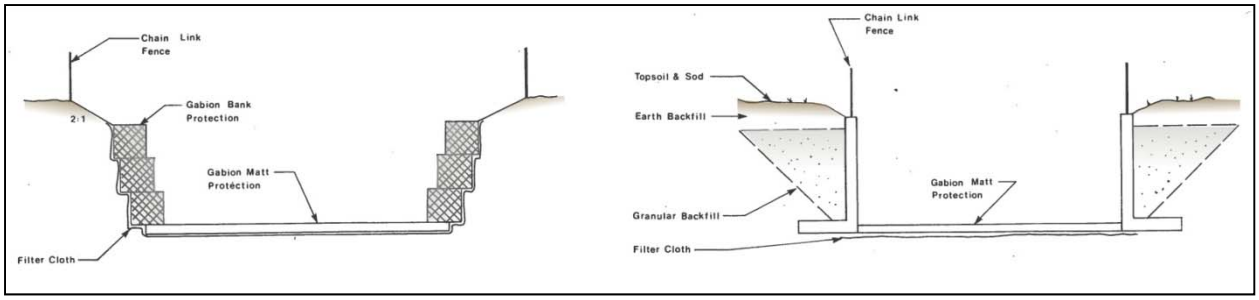

Figure 3. Cross-sections of the open channel proposed north of Brock Street in the 1983 Flood Relief Study

1.3 LSRCA Flood Management Proposal (2008)

In January 2008, the Lake Simcoe Region Conservation Authority (LSRCA) made a presentation to the Township of Uxbridge Council to consider a flood management proposal focused on re-opening Uxbridge Brook through the downtown (A**ppendix B**). The LSRCA recognized that culvert under Brock Street was able to convey a 1 in 100 year storm event, but during the peak of a Regional storm event (Hurricane Hazel), flows at the culvert would be ten times greater than a 1 in 100 year storm event. Consequently, there would be extensive flooding in the downtown during the peak of a Regional storm event, with water about 1 – 2 m deep on Brock Street.

The LSRCA recommended that the Township consider the option of removing the culvert under Brock Street, and re-opening Uxbridge Brook through the downtown. The result would be a significant reduction in the Regional Storm Floodplain, and subsequent redevelopment opportunities in the downtown area. There would also be significant benefits to fish habitat. The LSRCA indicated to Council that a Municipal Class Environmental Assessment would be appropriate to further evaluate flood reduction options.

1.4 Township of Uxbridge Council Decisions

Following the flood management proposal presented to Township of Uxbridge Council by the Lake Simcoe Region Conservation Authority (section 1.3), the Uxbridge Watershed Advisory Committee recommended to Council that an update to the 1983 Flood Relief Study be undertaken, and that an updated evaluation of the condition of the existing culvert under Brock Street be initiated.

In June 2008, Council approved a motion that "*the General Purpose and Administration Committee direct the Chief Administrative Officer, Manager of Development Services and Director of Public Works, in conjunction with the Lake Simcoe Region Conservation Authority and Region of Durham, to develop a Terms of Reference and cost estimate in regards to downtown flooding to be dealt with during the 2009 budget*". The Terms of Reference, and supporting Hydrotechnical Assessment of Downstream Effects are provided as **Appendix C**.

In June 2009, Council approved the Terms of Reference, and provided direction to consider a Municipal Class Environmental Assessment for downtown flood reduction in the 2010 budget.

In September 2009, a Downtown Uxbridge Culvert Replacement Technical Project Steering Committee was established, with a mandate to:

1. In general to ensure that the overall objectives of the project remain in focus
2. Through the Committee Chair, provide overall guidance and direction to the consultant undertaking the Class Environmental Assessment and the design consultant
3. To seek financial assistance from Federal, Provincial, and other funding agencies
4. Liaise as necessary with the Township and Regional Councils, other governments, the public at large, concerned citizens, and affected property owners
5. Undertake such other activities as the Committee deems necessary during the progress of the project

The membership of the Committee is comprised of:

- Director of Public Works, Township of Uxbridge
- Township of Uxbridge Wards 4 & 5 Councillors
- Regional Municipality of Durham representative
- Lake Simcoe Region Conservation Authority
- Ministry of the Environment
- Uxbridge Watershed Advisory Committee
- Business Improvement Area representative
- Environmental Assessment consultant
- Citizen volunteers

Meetings with the Steering Committee were held throughout the Class Environmental Assessment study, and the meeting reports are provided as **Appendix D**.

2 Identify Problem or Opportunity

2.1 Need and Justification

Prior studies concluded that a severe flood hazard exists under a Regional storm (Hurricane Hazel) event for the lands adjacent to the main branch of Uxbridge Brook, from Elgin Pond to just north of Brock Street (downtown Uxbridge). The flood hazard is due to the presence of a long culvert which encloses the creek from Centennial Drive to approximately 100 m north of Brock Street. The extent of the Regional Storm Floodplain in the downtown area limits opportunities for development, and exposed a significant number of properties to extensive flood risks. Thus the problem statement for this project was established as:

> *A severe flood hazard under the Regional Storm Event (Hurricane Hazel) exists for lands adjacent to Uxbridge Brook, especially in the downtown core at Brock Street. The flood hazard is due to the presence of a long culvert which encloses Uxbridge Brook between Centennial Drive and the north limit of the parking lot 100 m north of Brock Street. The deteriorated condition of the culvert necessitates a solution that includes replacement of the existing structure.*

The study objectives were defined as:

- Build upon the 1983 Flood Relief Study, confirm that prior assumptions and studies are still valid, and propose new ideas where appropriate to best fit the engineering, environment, and permitting needs of current day
- Reduce potential risk to personal safety and life and damage to properties associated with flooding in the downtown area
- Reduce the extent of the Regional Storm Floodplain and related development controls that currently encompasses a large portion of the downtown area, thereby increasing development potential

2.2 Study Area

The Class Environmental Assessment study area includes the Regional Storm Floodplain along the stream reaches of Uxbridge Brook from downstream of the Electric Light Pond and Elgin Pond to the railway just north of Main Street North (**Figure 4**).

Within the study area, the following local issues were identified:

- The Regional Storm Floodplain currently encompasses a large portion of the downtown core of the Township of Uxbridge
- A flood hazard exists during the Regional Storm (Hurricane Hazel) for land adjacent to the main branch of Uxbridge Brook, particularly between Elgin Pond and just downstream of Brock Street

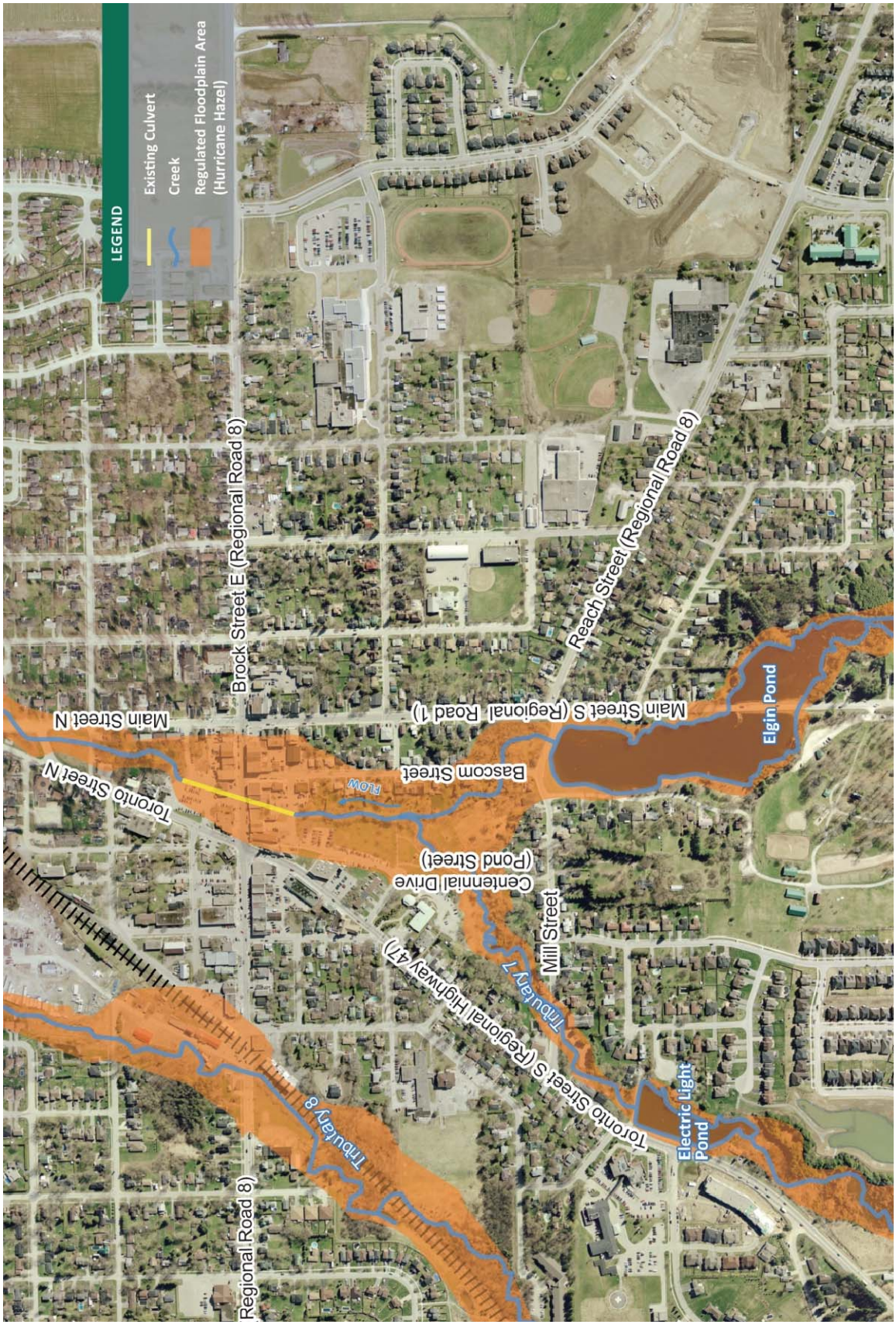

Figure 4. Class Environmental Assessment study area

- The culvert which encloses Uxbridge Brook from Centennial Drive to the parking lot 100 m north of Brock Street acts as a 'bottle-neck' during the Regional storm event
- The preferred solution must consider the constraints of working in the urban downtown which includes existing buildings and uses, significant transportation corridors, effects of flooding, and public uses/objectives
- The preferred solution must consider the objectives of the Uxbridge Brook Watershed Study, and integrate environmental protection/restoration policies wherever possible
- Uxbridge, the Trail Capital of Canada, has an extensive trail system that connects with the Trans Canada and Oak Ridges Trails. Connectivity between Centennial Park at Uxbridge Brook and the rail line is disjointed and highly urbanized
- Several community events take place in and around Uxbridge Brook. These events must be considered during the implementation and construction of the preferred solution
- Since the preferred solution could require encroachment into existing parking areas, a parking impact study is required to evaluate the potential impact

2.3 Assessment of Culvert Condition

Several reports were completed to document the existing condition of the culvert under Brock Street (**Appendix E**):

1. Visual Inspection of the Uxbridge Brook Culvert (2009)
2. Review of Video Record of Culvert Inspection, Uxbridge Brook Culvert (2009)
3. Municipal Culvert Appraisal (2009)
4. Inspection of Masonry Arch Culvert Under Brock Street (2010)

The reports document that the culvert is comprised of nine sections (**Figure 5**), each with varying dimensions and materials, in various conditions. **Table 2** summarizes the nine components of the structure.

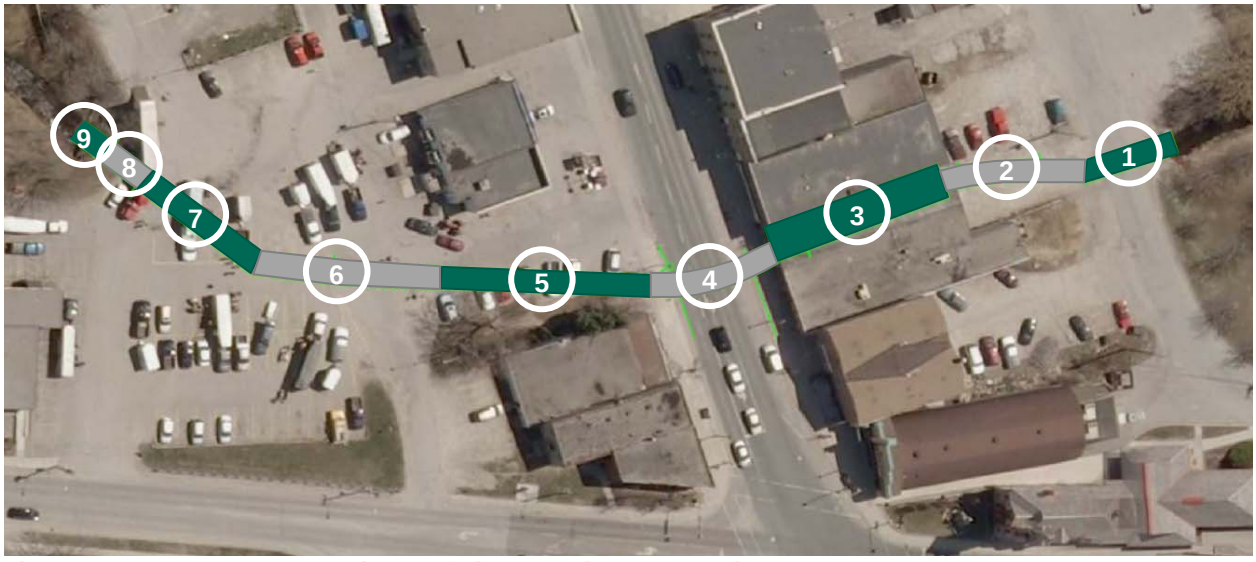

Figure 5. Component sections of the Brock Street culvert

Table 2. Description of the component sections of the Brock Street culvert

 Section 1 Steel CSP arch with galvanized coating 3.4 m wide, 2.3 m high, 14.6 m long	 Section 2 Concrete culvert 3.1 to 3.3 m wide, 1.6 to 2.2 m high, 22.4 m long
 Section 3 Concrete culvert 5.5 m wide, 2.3 m high, 32 m long	 Section 4 Stone archway 3.5 m wide, 2.4 m high, 22.5 m long
 Section 5 Steel CSP arch with galvanized coating 3.3 m wide, 2.2 m high, 30.5 m long	 Section 6 Steel CSP with galvanized coating 3.7 to 4.0 m wide, 1.9 to 2.2 m high, 29 m long

Table 2. Description of the component sections of the Brock Street culvert

Section 7
Steel CSP arch with galvanized coating
3.8 m wide, 2.1 m high, 19.7 m long

Section 8
Steel CSP arch with galvanized coating
3.8 m wide, 2.1 m high, 10.3 m long

Section 9
Steel CSP arch with galvanized coating
3.8 m wide, 2.1 m high, 10 m long

On September 21, 2010, a visual inspection of the building foundations on the south side of Brock Street, above the culvert, was conducted to assess the extent to which the foundations were connected with the culvert. On October 12, 2010, a further visual inspection of the culvert in this location was conducted by exposing the foundation at the interface with the culvert (**Figure 6**).

From this inspection, it was clear that the building at #34 Brock Street (Youth Centre) is supported on the culvert chamber at least along the south end of the building. It is not certain that the alignment of the chamber matches that of the building as it extends to the north, however, it is a logical conclusion.

Figure 6. **Exposure of building foundation at #34 Brock Street**

2.4 Uxbridge Brook Watershed Plan

In January of 1996 the Lake Simcoe Region Conservation Authority (LSRCA) commenced work on a watershed plan for the Uxbridge Brook, as requested by, and in partnership with the Township of Uxbridge.

One of the key components of the watershed plan was an environmental constraint analysis, used to identify lands which should be protected from future development, and/or where special conditions should be imposed during development to mitigate associated harmful environmental impacts. To identify constraints, consideration was given to existing agency policy area restrictions and the preservation of lands deemed necessary to maintain ecological processes.

Areas of high constraint generally included areas where existing government policies or legislative controls existed (i.e. significant wetlands, stream corridors, flood or fill lines, or, vulnerable ground water areas). Areas of medium constraint included areas where secondary land use constrictions applied (i.e. ground water recharge/discharge areas, buffer areas or environmentally significant areas). The remaining areas were designated as low environmental constraint (**Figure 7**).

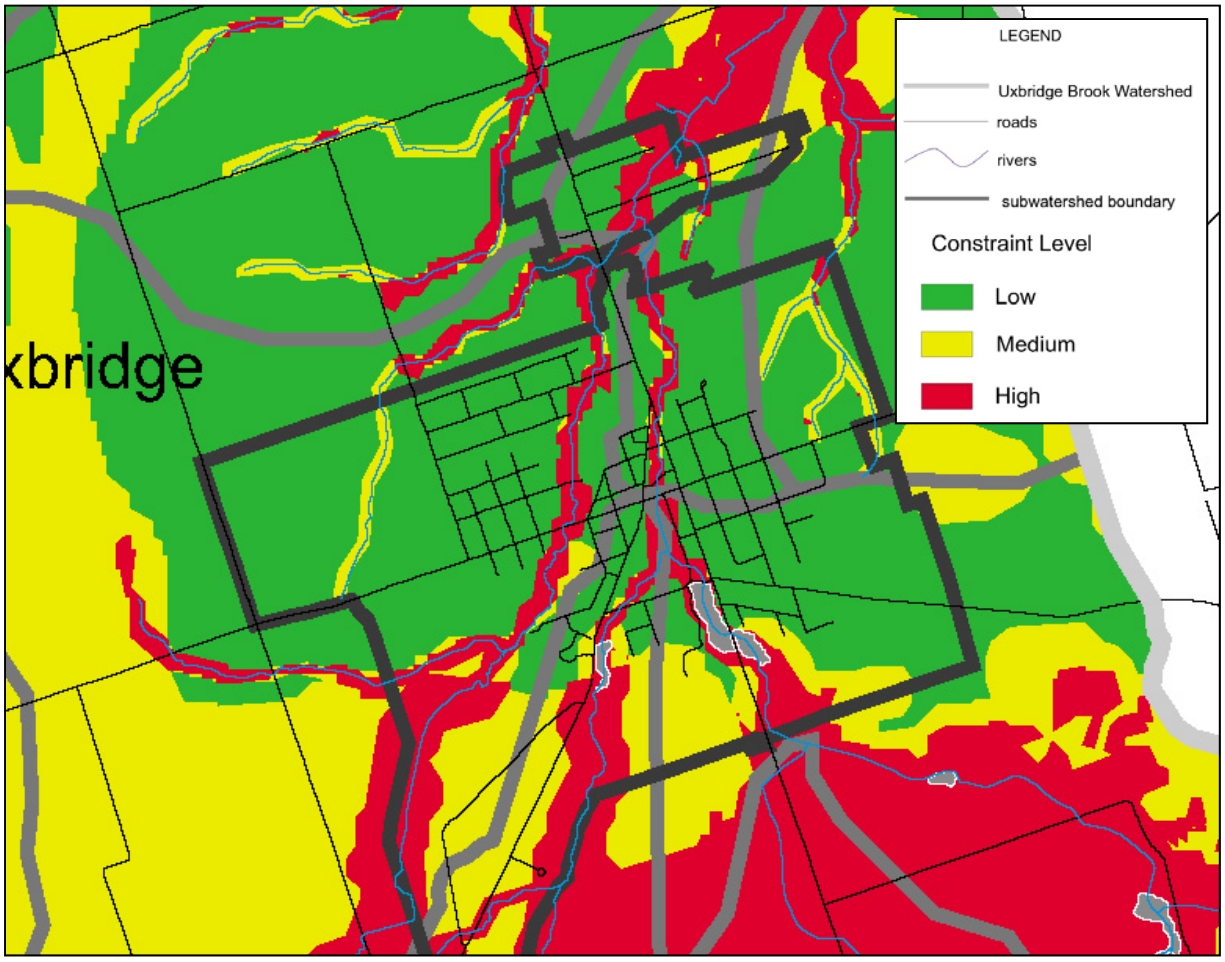

Figure 7. Environmental constraint mapping from the Uxbridge Brook Watershed Plan (LSRCA)

Figure 7 shows that areas of high environmental constraint are located adjacent to Uxbridge Brook and the wetlands adjacent to its tributaries. For the downtown Uxbridge area, this includes the section of Uxbridge Brook that passes through the Brock Street culvert. The environmental constraint in this location is related to the Regional Storm Floodplain that extends across the downtown area.

2.5 Uxbridge Downtown Community Improvement Plan

In 2009, the Downtown Uxbridge Community Improvement Plan (CIP) was established. Together with a number of other programs being undertaken by the Township of Uxbridge and key stakeholders, including the Downtown Uxbridge Vision & Action Plan, the CIP is intended to stimulate development/redevelopment in downtown Uxbridge. The intent is to allow the Community's vision for the area, as established in the Township's Official Plan and the "Downtown Uxbridge Vision Statement" which forms part of the Downtown Vision & Action Plan, to be realized.

The Downtown was identified by the Township as a priority area because of a range of issues including lack of easily accessible off-street parking and loading areas, vacant and underutilized infill lands and buildings, inadequate pedestrian walkways, deficient amenities, and deteriorated building facades and signage.

The Vision for the downtown area, as identified in the "Downtown Uxbridge Vision Statement" is as follows:

> *Downtown Uxbridge is the vibrant focus of a thriving small town set in rolling hills and reflecting its strong agricultural heritage.*
>
> *There is an active street scene, with people – residents and visitors – shopping, browsing, enjoying the company of friends in restaurants and cafes, and strolling along pleasant and attractive streets. A range of stores, more varied and attractive than in the past, and other commercial enterprises, many run by local entrepreneurs, has made it attractive as a place to shop and conduct business. Vacant stores are a thing of the past. The pedestrian orientation of the downtown streets is evident from the modest flow of traffic, with few trucks. A small park, or "town square" in the centre of town provides a focal point for community activities, or for simply relaxing in a pleasant park setting. The town's farming roots are evident from the colourful farmer's market that attracts both residents and visitors, and provides a valuable means for area farmers to offer their produce. A grocery in the downtown provides essentials without the need for a car.*
>
> *The Uxbridge Brook, once completely out of sight in the downtown area, is once again visible, providing an attractive natural feature to complement the large shade trees along the main streets. The streets themselves reflect Uxbridge's heritage and history, with buildings that have had their exteriors remodelled or renovated in keeping with established heritage guidelines, and signage and street furnishings in tasteful harmony. The rear aspects of buildings facing public*

areas are no longer an eyesore. The older heritage buildings are complemented by some newer structures (some replacing eyesores or deteriorating buildings), some of which may be more modern in design, but enhance the character of the town.

Uxbridge's reputation as an intensively artistic community is evident from the many works of public art installed around the town, giving it a unique character. And its designation as "The Trail Capital of Canada" is evident from the extensions of the extensive trail system that reach into the downtown, enabling people to walk or bicycle from downtown into surrounding natural areas. Ease of access is provided through numerous public parking areas, well-marked and attractive in design and landscaping. Similarly, ease of access for the physically challenged is provided at most stores and all public facilities. The downtown has a diversified population of residents, with accommodation suited to varying economic levels.

In short, downtown Uxbridge is a place that attracts visitors and tourists, and tempts travelers to stop and explore, with appropriate accommodation for those who wish to stay overnight. The downtown offers a good livelihood to business enterprises located there, and provides a commercial and recreational focus for residents.

Uxbridge is a small town in a rural community, with a downtown that has become an attractive destination for visitors and an effective focus for residents, through a bold approach by the Council and the community, including enlightened planning, good design and wise investment of resources."

3 Identification of Alternative Solutions

3.1 Flood Modeling Analysis

The first step towards identifying alternative solutions for flood reduction was to undertake a flood modeling analysis. This included a background review of all pertinent information and models available for the study area and an update to the available models to accurately depict the existing conditions. The background review was followed by an iterative modeling analysis of each alternative solution and a subsequent analysis of design alternatives for the preferred solution. **Table 3** summarizes the information used for this study.

Flood modeling analyses require computer aided models to replicate the response of a watershed during a storm event. The models allow engineers to predict how the watershed will respond during severe rainfall events. The analyses require a hydrologic model to determine the amount of stormwater runoff (flow) in the watershed's watercourses. A hydraulic model is then utilized to calculate the resultant water levels in the watercourse based on the flows determined by the hydrologic model.

Table 3. Information sources for the flood modeling analyses

Reports	
Flood Relief Study of the Town of Uxbridge (prepared for the South Lake Simcoe Conservation Authority and the Township of Uxbridge)	Cumming-Cockburn & Associates Limited (1983)
Hydrology Report Pefferlaw Brook-Beaverton River Watershed Study (prepared for the South Lake Simcoe Conservation Authority)	Marshall Macklin Monaghan Limited (1980)
Hydrologic Modelling Final Report Pefferlaw River, Uxbridge Brook, Beaver River, White's Creek, and Beaverton Creeks (prepared for Lake Simcoe Region Conservation Authority)	MMM Group Limited (2008)
Revision to Uxbridge Brook Hydrologic Model (prepared for Lake Simcoe Region Conservation Authority)	MMM Group Limited (2009)
Uxbridge Brook Watershed Plan (prepared for the Township of Uxbridge)	Lake Simcoe Region Conservation Authority (1997)
Hydrotechnical Assessment of Downstream Effects (prepared for the Township of Uxbridge)	McCormick Rankin Corporation (2010)
Floodplain Mapping	
Regulatory Flood Line Mapping (approved by the Minster of Natural Resources) based on the flood resulting from a rainfall actually experienced during Hurricane Hazel (1954)	

Table 3. Information sources for the flood modeling analyses (cont'd)

GIS Data and Ortho Photography			
GIS Data Layer of Existing Floodline			
GIS Data Layer of the Hydraulic Model Cross-Section Locations			
Ortho photographs of the Township of Uxbridge			
Engineering Drawings			
Regional Municipality of Durham, Contract No. D85-1 Engineering Drawings U-84-R-76, U-84-R-77, U-84-R-81, U-84-WS-92, U-84-W-97			
Regional Municipality of Durham, Contract No. D82-14 Engineering Drawings U-80-S-39A, U-82-W-58A			
Town of Uxbridge Project No. T-1794-33, Engineering Drawing 1			
Town of Uxbridge Project No. T-1794-31, Engineering Drawing 1			
Models			
Type of Model	Date	Modeling Platform	Description
Hydraulic	1983	HEC 2	1983 study model
	December 2007	HEC-RAS	1983 HEC 2 model converted to HEC-RAS
	March 2011	HEC-RAS	Current approved hydraulic model for Uxbridge Brook
Hydrology	February 2009	Visual Otthymo	Current approved hydrologic model for Uxbridge Brook

The Uxbridge Brook watershed has been previously studied with respect to its hydrologic and hydraulic function. Hydrologic function refers to the response of a watershed during a storm event (flow). Hydraulic function refers to the response of the watercourse system to increased flow during and following storm events (water levels). Computer aided models are utilized to replicate and predict how a watershed will respond (hydrologically and hydraulically) during significant rainfall events.

The current hydrologic model for Uxbridge Brook was developed in September 2008 and subsequently updated in February 2009. The model was created using the software modeling package Visual Otthymo. This is a typical hydrologic modeling platform utilized by Conservation Authorities throughout southern Ontario. The model simulates the precipitation runoff from a watershed system.

Hydrologic modeling is used in floodplain analyses to determine the resultant flow in a watercourse within the watershed during extreme rainfall events. Extreme rainfall events for use in hydrologic models are developed based on measured rainfall data gathered from rain gauge stations. A statistical extraction of the data is completed to predict the intensity of potential extreme weather events, such as the 100-year storm event (a storm event which has a 1% chance of being equalled or exceeded in any single year). Historical rainfall data from an extreme weather event such as a tropical storm may also be used.

The floodplain mapping for Uxbridge Brook is based on modeling a historic rainfall event which occurred in 1954. The tropical storm Hurricane Hazel was felt throughout southern Ontario, lasting two days with a record total rainfall of over 280 mm in 48 hours. Current models estimate that Uxbridge Brook would experience a total flow of 105 m^3/s through the downtown area should a storm of similar magnitude re-occur. It should be noted that the models are created based on provincial guidelines and have built-in redundancies and safety factors which provide a conservative estimate of rainfall runoff rates.

The first hydraulic models for Uxbridge Brook were developed in 1978 and subsequently updated in 1983. These original models were created in the Hydrologic Engineering Center HEC 2 software package. The HEC 2 computer model was not considered applicable for the analysis of the culvert at Brock Street due to the complexity of analyzing the hydraulic conveyance of flows through several segments of culvert (each of varying size and material). A rating curve was thus developed through manual calculations to establish the flow characteristics of the culvert. According to the 1983 rating curve, the existing culvert can safely convey the flows that would occur during a 1 in 100-year storm event (approximately 11 m^3/s). This means that during a Regional storm event (i.e. if Hurricane Hazel were to occur over Uxbridge) flows in excess of the 11 m^3/s would first overtop Centennial Drive, followed by Brock Street, inundating the downtown core. Velocities on Brock Street would exceed 2 m/s which would result in vehicles being swept away and significant structural damage to buildings. Water surface elevations in the downtown area would be approximately 1.5 m above Brock Street, thereby flooding adjacent buildings.

The 1983 hydraulic model was converted to an updated version of the HEC 2 modeling software called Hydrologic Engineering Centers River Analysis System (HEC-RAS) in 2007. Since 2007, several minor model updates have been completed by LSRCA. The extent of the Uxbridge Brook floodplain through downtown Uxbridge as established by the current hydraulic model is provided on the approved Regulatory Floodplain Mapping (**Figure 8**).

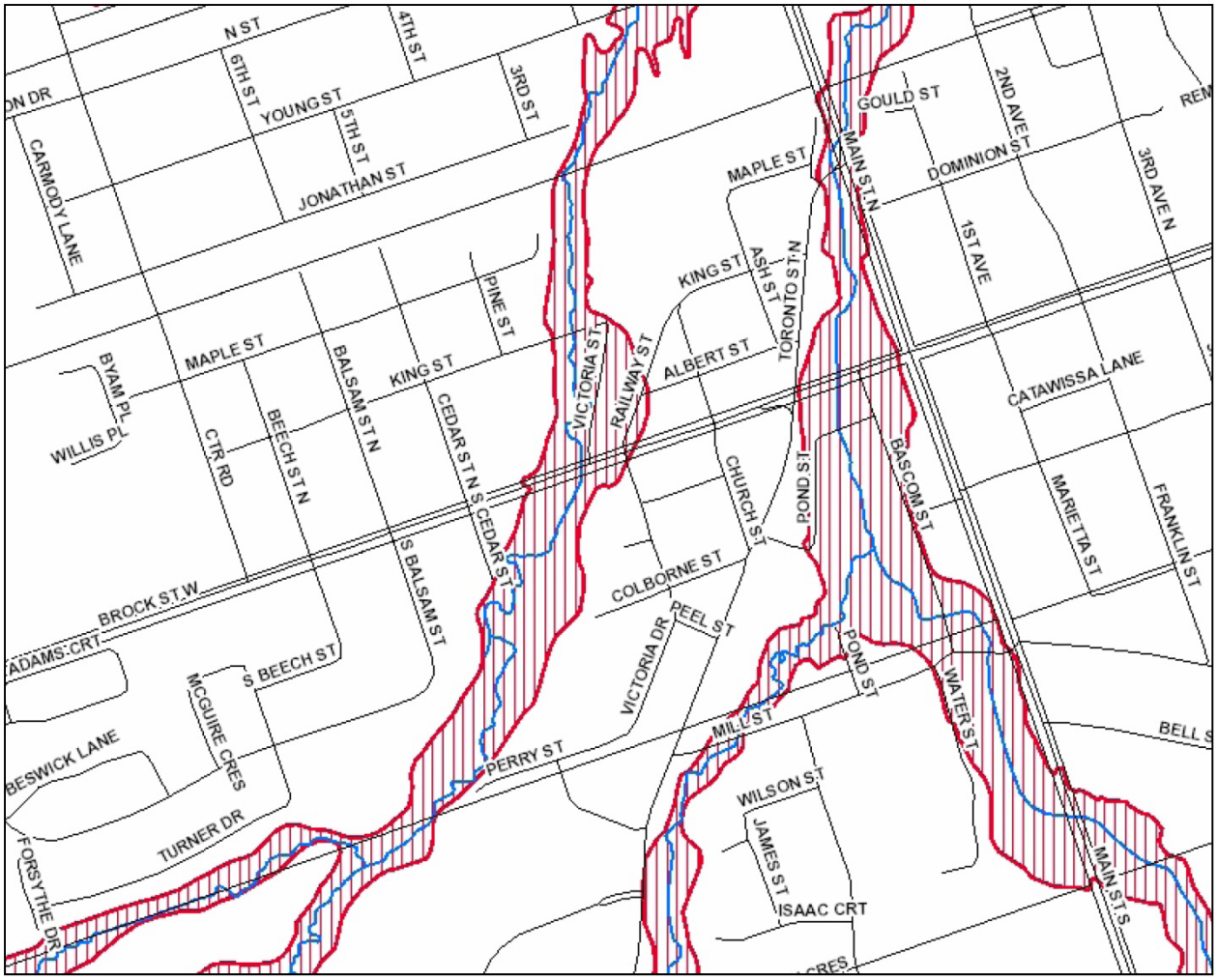

Figure 8. Regulatory Floodplain (Regional Storm Floodplain) as provided by LSRCA

3.2 Model Updates

A review of the approved current hydraulic model revealed that an existing creek crossing at Toronto Street was not considered in the model. Historically, Toronto Street did not cross Uxbridge Brook; it continued in a north-easterly direction from Brock Street along Uxbridge Brook to a cul-de-sac which ended west of Main Street. The construction of the current section of Toronto Street which crosses the creek and meets Main Street approximately 75 m north of Dominion Street was constructed after development of the 1986 HEC 2 model.

The hydraulic model software (HEC-RAS) calculates the water surface elevations within the creek valley starting at the furthest downstream point in the creek system. The upstream water surface elevations are calculated iteratively based on the previous calculated water surface elevation. Under existing conditions, the majority of flow during the Regional Storm event would overtop Brock Street. Due to the vertical separation between Brock Street and the downstream channel, the exclusion of the Toronto Street crossing from the model does not impact the existing floodlines. Nonetheless, any structural improvements which would lower the Regional

storm floodline elevation in the downtown core significantly should consider the downstream restriction at Toronto Street as the downstream condition could impact the hydraulic capacity of a new structure at Brock Street.

Engineering drawings provided by the Township of Uxbridge and the Regional Municipality of Durham confirmed the road crossing details including the type and size of infrastructure and the vertical geometry of the roadway. Lake Simcoe Region Conservation Authority updated the model in March 2011 to include the road crossing and culvert based on the available engineering drawings.

During the model review process, it was also noticed that the buildings in the downtown core had undergone modifications since the model was first created. Current ortho-photography was utilized to confirm the location of buildings throughout the downtown area. Revisions were accordingly made to the buildings in the model throughout cross-sections numbered 42 to 44. Additionally, creek invert adjustments were made through cross-sections numbered 35 to 39 based on available engineering drawings and contour mapping. Lastly, the overbank stations at cross-section number 40 were also revised to more accurately depict the existing creek bank locations. Once the existing conditions model was finalized with these changes, alternative solutions to flood reduction could be modeled and evaluated to determine the preferred solution.

It should be noted that the 2011 LSRCA HEC-RAS model did not include the Brock Street culvert due to the multiple sizes and material types (refer to Section 2.3), and the extended length of the culvert. Similar to the HEC 2 model, LSRCA utilized the previously established rating curve for the culvert to establish the flow through the culvert during different storm events and the resulting water surface elevation upstream of the culvert. As in the 1983 model, the total flow through the culvert under existing conditions was determined to be approximately 26 m^3/s. This corresponds to approximately 79 m^3/s overtopping Brock Street during the Regional storm event (Hurricane Hazel).

3.3 Alternative Solutions

Following the modeling updates, several flood reduction options were conceptualized and investigated. The alternatives were:

1. **New Larger Culvert under Brock Street** (removal of existing culvert and installation of new larger culvert under Brock Street)
2. **Open Channel at Brock Street** (removal of existing culvert and construction of an open channel with bridges at Brock Street and Centennial Drive)
3. **Overland Flow Route** (removal of buildings on Brock Street above the culvert to create an overland flow route for flood water)
4. **Overflow Pipe under Bascom Street** (construction of an overflow pipe under Bascom Street to convey partial floodwater flows to the outfall at the downstream limit of the existing culvert)
5. **Downstream Improvements** (downstream improvements to alleviate the tailwater at the north side of Brock Street, to be implemented in conjunction with another alternative)

3.3.1 Alternative 1 – New Larger Culvert under Brock Street

This alternative included the removal and replacement of the entire length of the existing culvert. The replacement culvert would be a larger structure capable of conveying more flow than the existing structure up to the Regional storm event. Several iterations of this alternative were developed and investigated.

The first iteration included modeling the structure selected as the preferred alternative in the 1983 study (twin 4.2 m x 2.4 m box culverts). At the time, this was the largest available pre-fabricated box culvert. Due to model updates, the size does not provide the same relief as previously anticipated.

The second iteration modeled was the installation of a culvert which would only require demolition of one municipally-owned building.

The third iteration was to determine the largest culvert size required, regardless of property acquisition requirements, to reduce flooding such that the first floor of the building fronting Brock Street would be out of the floodplain. Various levels of flooding within the basement were investigated from no flooding to 0.5 m depth of flooding. It was determined that a 20 m by 2.7 m culvert would be required to reduce the flooding such that only 0.5 m of flooding would occur in the basements of the buildings fronting Brock Street. A conceptual illustration is provided as **Figure 9**, and the resultant floodline is depicted on **Figure 10**.

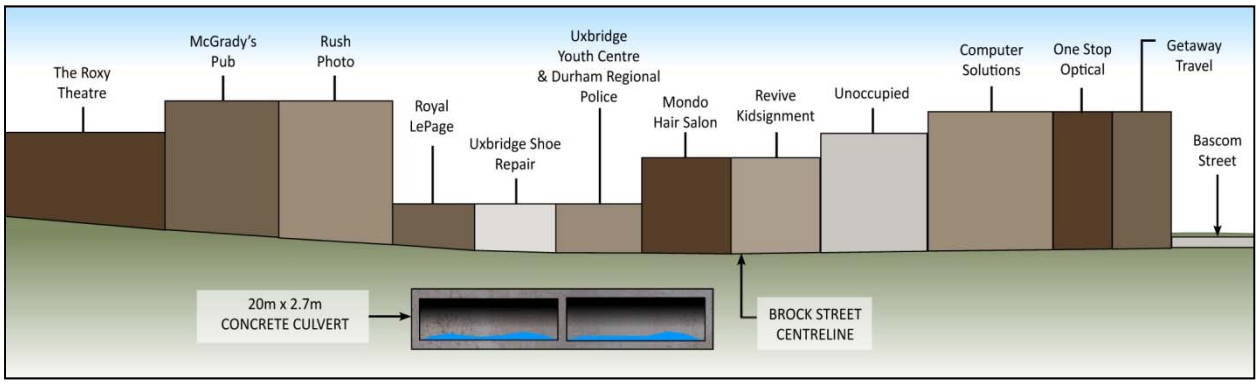

Figure 9. Conceptual illustration of Alternative Solution #1

The analysis of the culvert replacement was completed utilizing the HEC-RAS model. In the 1983 HEC 2 model a rating curve was developed to model the existing conditions of the varying culvert segments. Since the proposed culvert would have a consistent size and material, the use of the HEC-RAS software was considered applicable. The accuracy of the HEC-RAS results were confirmed using culvert analysis software called CulvertMaster to ensure the validity of the findings.

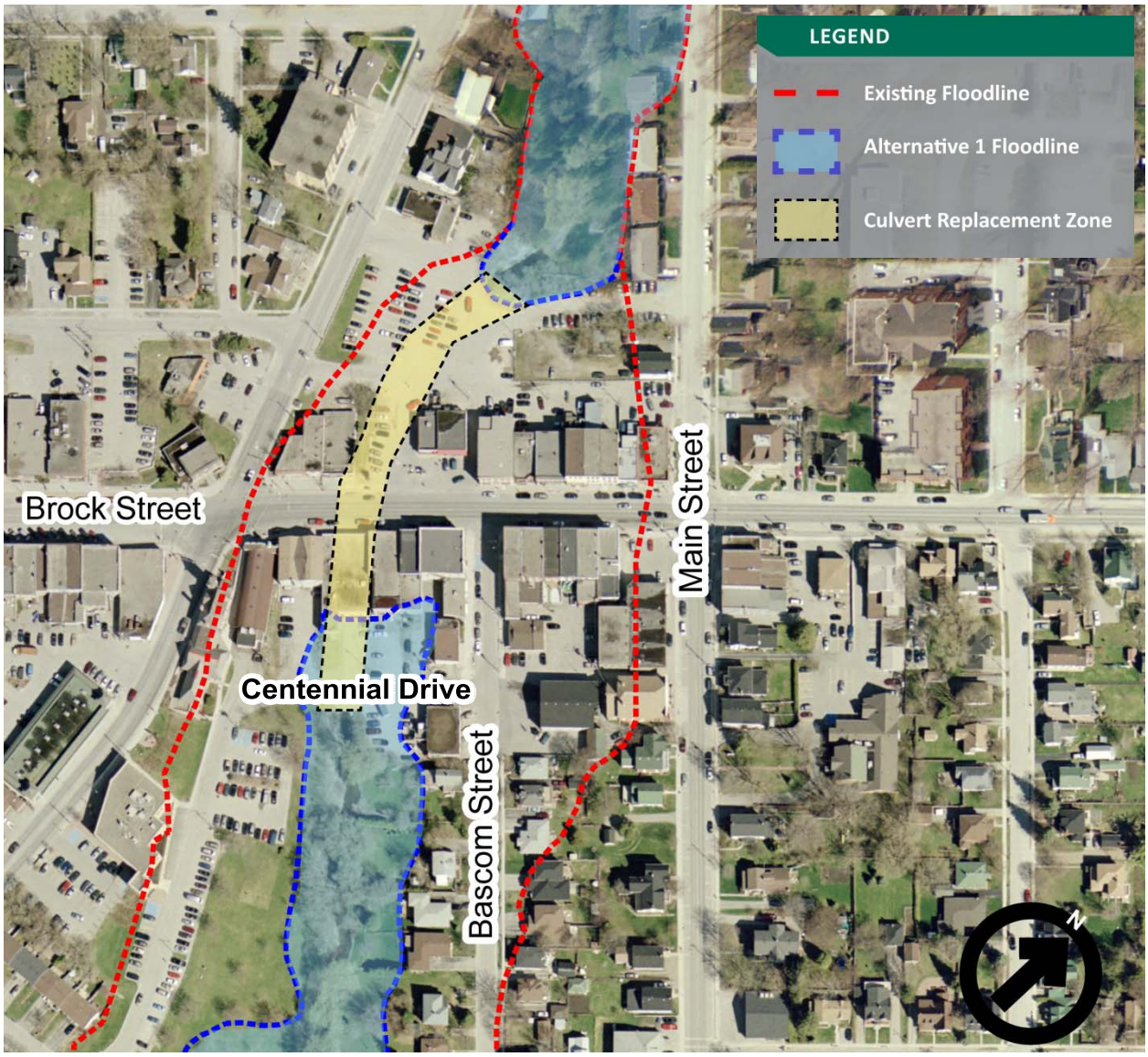

Figure 10. Modeled floodline resulting from Alternative Solution #1

3.3.2 Alternative 2 – Open Channel at Brock Street

This alternative includes the removal of the entire length of existing culvert, and replacing it with an open channel, with bridges constructed at the Brock Street and Centennial Drive crossings.

The intent of this alternative was to construct a channel and bridges capable of conveying the Regional storm event under Brock Street. In order to achieve this, a 20 m by 3.2 m bridge would be required at Brock Street and a 20 m by 1.5 m bridge at Centennial Drive. The channel would be 20 m wide between Centennial and Brock, connecting to the existing Uxbridge Brook valley at the north and south limits of the existing culvert (**Figure 11**). Similar to Alternative 1, the determination of the hydraulic capacity of bridge structures was completed utilizing the HEC-RAS model. The resultant floodline is depicted on **Figure 12**.

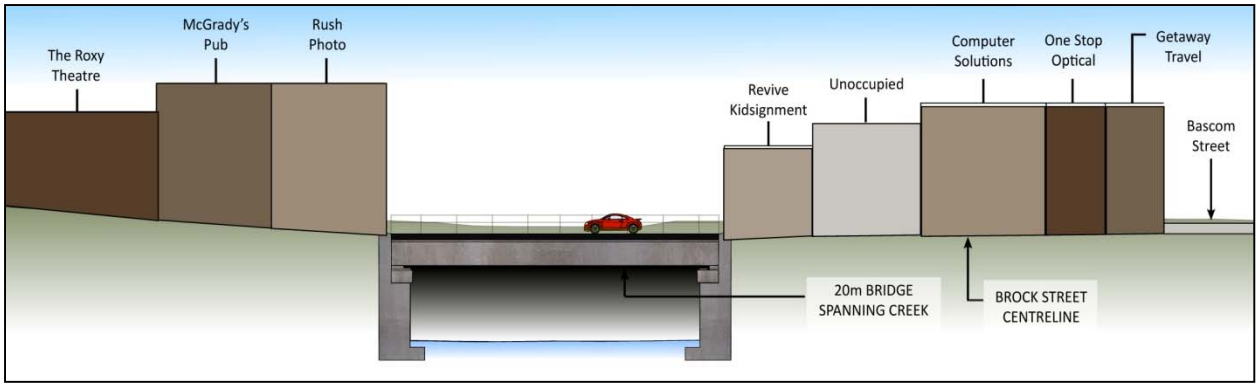

Figure 11. Conceptual illustration of Alternative Solution #2

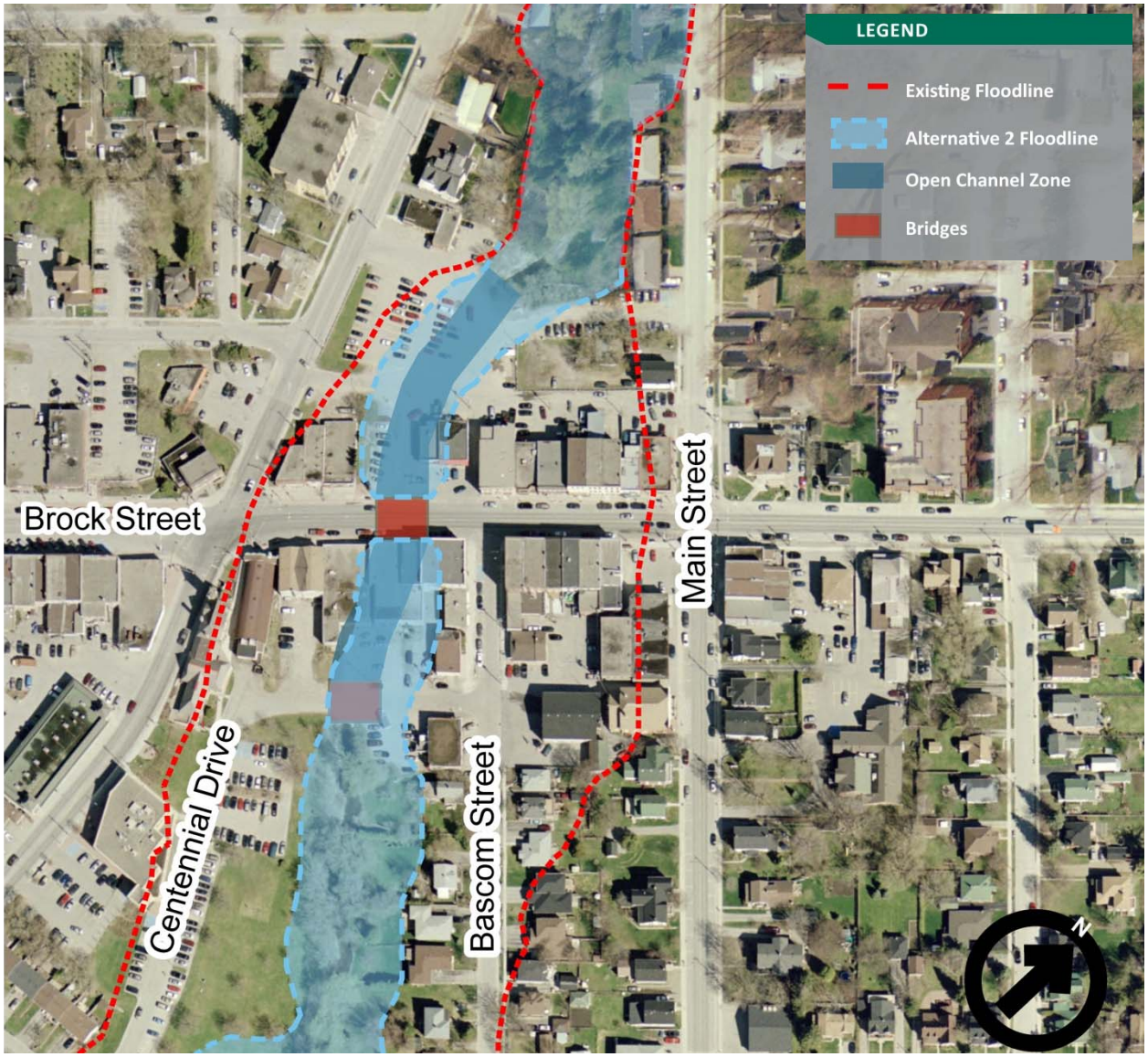

Figure 12. Modeled floodline resulting from Alternative Solution #2

3.3.3 Alternative 3 – Overland Flow Route

The demolition of multiple buildings on the north and south sides of Brock Street to create an overland flow path for flood flows was investigated as a flood remediation measure. An array of widths for the overland flow path was analyzed ranging from 5 m to 25 m wide. The smallest opening would require removal of one municipally-owned building and the largest would require removal of all buildings between the Youth Centre Building and Getaway Travel (a total of seven buildings) in addition to the Mac's Milk building on north side of Brock Street (**Figure 13**). The resultant floodlines from the creation of a 25 m wide overland flow path do not represent a substantial reduction in the floodplain (**Figure 14**).

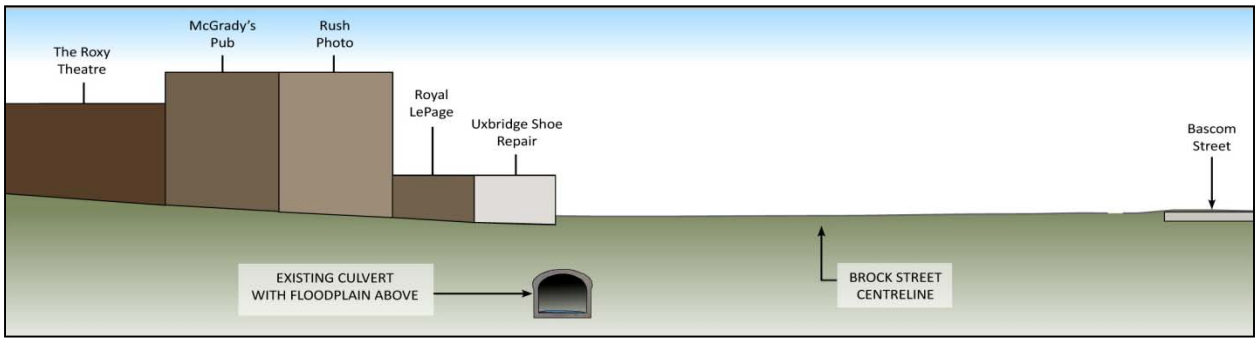

Figure 13. Conceptual illustration of Alternative Solution #3

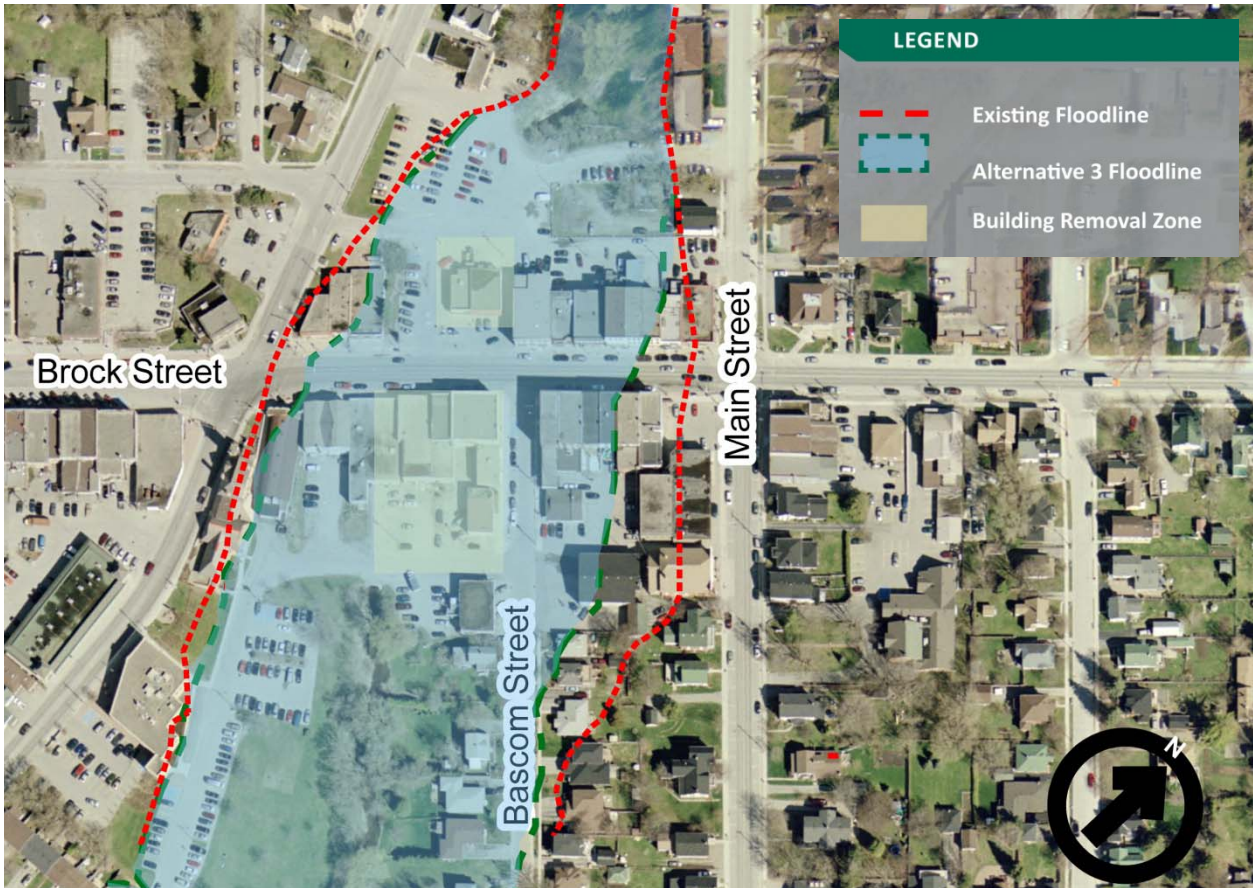

Figure 14. Modeled floodline resulting from Alternative Solution #3

An overland flow path would require that floodwaters reach a vertical elevation equivalent to the crest of Brock Street at a minimum. This represents a minimal improvement over existing conditions. Additionally, improvements would still be required at the existing culvert to address the aging infrastructure issues. The analysis of the overland flow path was completed utilizing the HEC-RAS model and validated using hydraulic conveyance software called FlowMaster.

3.3.4 Alternative 4 – Overflow Pipe under Bascom Street

Construction of a separate pipe system under Bascom Street to convey partial floodwater flows to the outfall at the downstream limit of existing culvert was considered as an alternative solution (**Figure 15**). Similar to Alternative 3, the existing culvert would remain and improvements would still be required to address the aging infrastructure issues.

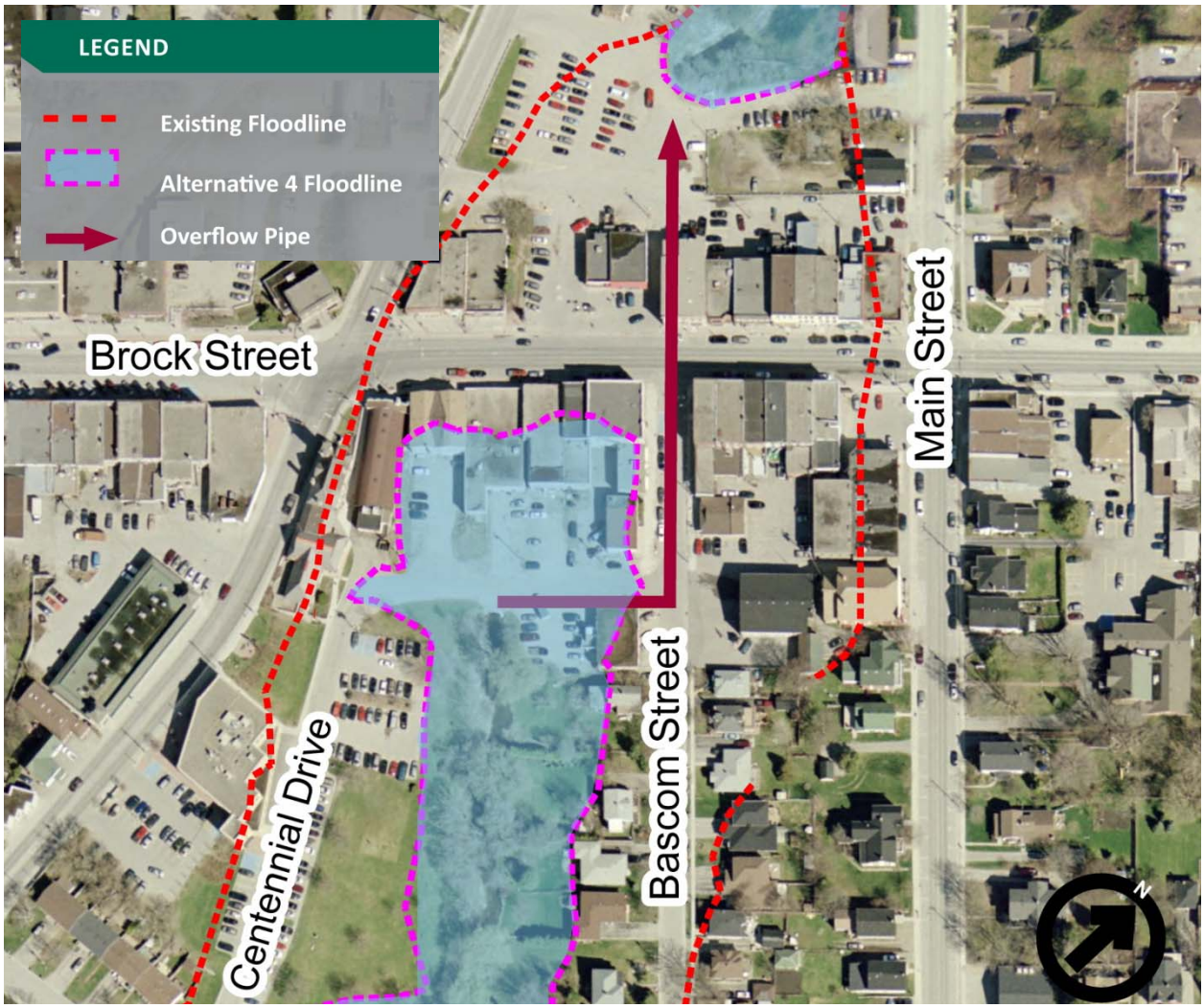

Figure 15. Modeled floodline resulting from Alternative Solution #4

An iterative approach was taken to determine the by-pass pipe size required, irrespective of property ownership, to convey the Regional storm event such that the first floor of the buildings fronting Brock Street would be removed from the floodplain. From the analysis it was

determined that a 10.5 m by 2.7 m box culvert would be required to meet these criteria. The resultant floodline would provide improvement over the existing condition. The analysis of the overflow pipe was completed utilizing the CulvertMaster software to determine the upstream flood elevation required to convey the flows over and above the existing pipe capacity downstream of the downtown area.

3.3.5 Alternative 5 – Downstream Improvements

The conveyance capacity, and thus the size of any proposed culvert, can be highly dependent on the downstream water surface elevation (tailwater elevation) depending on the hydraulic conditions of the culvert and watercourse. If the hydraulics of the culvert are controlled by characteristics of the outlet of the culvert, lower tailwater elevations translate to more capacity within the culvert. For this reason, alternative solutions which could lower the tailwater downstream (north) of Brock Street and thus provide additional flood capacity were also considered (**Table 4**). The downstream improvements considered included widening the existing floodplain through excavation, increasing the size of culverts under downstream road crossings at Dominion Street, Toronto Street and Main Street, replacement of existing downstream culverts with bridges, and/or removal of one or more of the crossing streets (**Figure 16**).

These measures were considered as an additional opportunity to provide flood reduction in combination with one of the preceding alternatives. In one scenario, whereby a 20 m wide channel and 20 m bridges would be constructed downstream of the existing culvert outfall to Main Street, the tailwater elevation would be reduced by approximately 1 m. This alternative could not be implemented as a standalone solution as it would not reduce flooding in the downtown; however, in combination with one of the preceding alternatives such as culvert replacement, it would provide an additional reduction in flooding over and above the improvements depicted on **Figures 9 to 15** as it would lower the tailwater elevation.

Table 4. Summary of the five flood reduction alternative solutions

Alternative and Size of Infrastructure		Flood Elevation Upstream of Brock St.	Tailwater Elevation at Existing Culvert Outlet
EXISTING CONDITIONS		268.87 m	263.43 m
1	New Larger Culvert under Brock Street • 20 m by 2.7 m culvert	263.80 m	263.43 m
2	Open Channel at Brock Street • 20 m x 3.2 m bridge at Brock Street • 20 m x 1.5 m bridge at Centennial Drive • 20 m channel	263.90 m	263.43 m
3	Overland Flow Route • 25 m overland flow route	267.60 m	263.43 m
4	Overflow Pipe under Bascom Street • 10.5 m by 2.7 m pipe	265.00 m	263.43 m
5	Downstream Improvements • 20 m channel and 20 m bridges at Dominion, Toronto & Main Streets	268.80 m	262.40 m

Note: Brock Road Elevation ~ 265.7 m; Centennial Road Elevation ~ 262.8 m

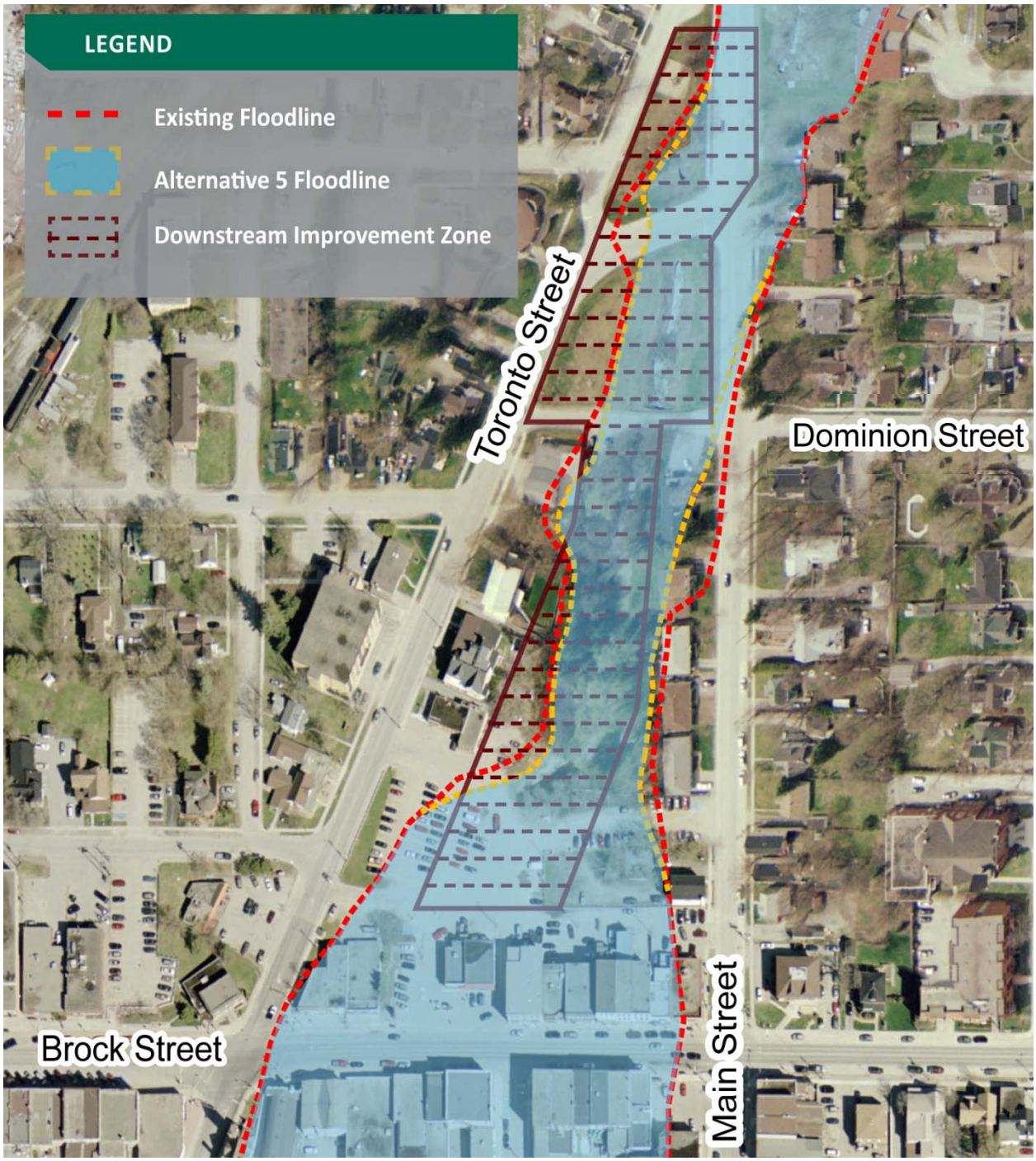

Figure 16. Modeled floodline resulting from Alternative Solution #5

4 Selection of Class EA Schedule

The Municipal Class Environmental Assessment (EA) process was developed by the Municipal Engineers Association (MEA 2000, amended 2007 and 2011), to streamline the EA process for recurring municipal projects that are similar in nature, usually limited in scale, and with a predictable range of environmental effects that are responsive to mitigating measures. The Municipal Class EA process is outlined on **Figure 17**.

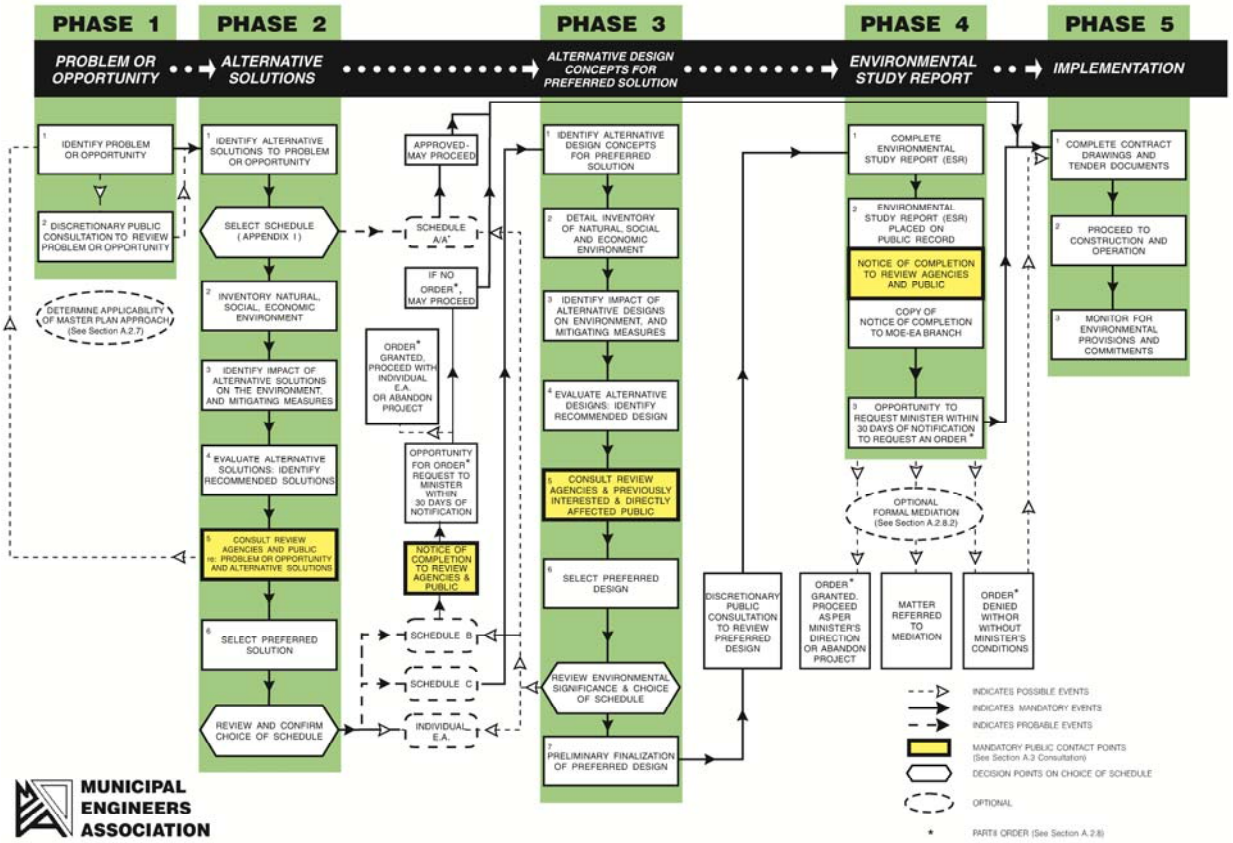

Figure 17. Municipal Class Environmental Assessment process

In Phase 2 of the process, the proponent is required to examine the range of alternatives that are being considered, and select the appropriate 'schedule' to follow. Projects are classified according to their potential for adverse environmental effect. The classifications are:

Schedule A
These projects are limited in scale, have minimal adverse environmental effects, and typically consist of normal maintenance and operational activities. These projects are considered pre-approved and may proceed without following the full Class EA planning process.

Schedule A+
These projects are also limited in scale, have minimal adverse environmental effects, and are considered pre-approved, but there is a requirement for public notification prior to construction or implementation of the project. The purpose of the notification is to inform the public of

projects occurring in their local area. Although the public is informed of the project, there is no appeal mechanism to the MOE; concerns are addressed at municipal council.

Schedule B
These projects have the potential for some adverse environmental effects, thus requiring a screening process involving mandatory contact with directly affected public and relevant review agencies. If all concerns can be adequately addressed, the project may proceed. These projects generally include improvements and minor expansions to existing facilities.

Schedule C
These projects have potential for significant environmental effect and are subject to the full planning and documentation procedures specified in the Class EA document. An Environmental Study Report must be prepared and submitted for review by the public and relevant review agencies. If all public and agency comments and issues are resolved during the public review period, the project may proceed. These projects generally include construction of new facilities or major expansions to existing facilities.

The road, water, and wastewater project schedules in Appendix 1 of the MEA document were reviewed, to correctly categorize the project. Works undertaken in a watercourse for the purpose of flood control are classified as Schedule 'B', and culvert replacement is classified as Schedule A+. However, it is clearly noted that if potential major impacts are likely (e.g. property acquisition, impacts to fisheries, impacts to a community), the project should be elevated to an appropriate higher schedule. In this case, given the potential cost of the project, and the extensive impacts that could occur from the range of alternative solutions identified, it was most appropriate to classify the project as Schedule 'C'.

5 Inventory of Existing Environment

5.1 Natural Environment

5.1.1 Uxbridge Brook Geomorphic Assessment

Uxbridge Brook, with a drainage area of 178 km^2, originates in the Oak Ridges Moraine and flows north to Pefferlaw Brook, eventually outletting to Lake Simcoe (LSRCA, 1997). The majority of the stream length is located in the Regional Municipality of Durham and the Township of Uxbridge. The catchment area upstream of the Town is approximately 20 km^2 (Cumming-Cockburn & Associates Limited, 1983). This subwatershed, particularly in the headwater region, is recognized by both Lake Simcoe Region Conservation Authority (LSRCA) and the Ministry of Natural Resources (MNR) as supporting significant cold and warm water fisheries.

Notably, a 191 m portion of Uxbridge Brook is currently piped in the downtown area, which flows underneath commercial properties and Brock Street. The culvert is able to convey the 100-year storm event, but constriction of flow at the culvert during the Regional event presents a considerable flood hazard to the downtown area. In support of the Class Environmental Assessment, an investigation and evaluation of existing geomorphic, aquatic and terrestrial conditions was completed to inform the development of alternative solutions to reduce the risk of flooding in the downtown area.

To provide context for the study, reaches upstream and downstream from the piped portion of the watercourse were also investigated. The study area encompassed Uxbridge Brook from south of Centennial Drive to the Canadian National (CN) railway north of the downtown area. The study included a review of all pertinent background information associated with the fluvial geomorphology and aquatic and terrestrial habitat within the study area. Available detailed topographic and geologic maps, historic aerial photographs, pertinent previous reports and available data specific to this assessment were examined. A field investigation, including rapid geomorphic assessments and aquatic habitat and terrestrial resource assessments were also completed in the late summer of 2010. The full report is provided as **Appendix F**.

Reach Delineation and Stream Corridor Characterization

Reach delineation was completed utilizing a series of historical aerial photographs, topographic and surficial geology maps, and reports. Reach delineation is typically based on changes in channel planform and active geomorphological processes, which are directly related to local surficial geology, gradient, hydrology, land use, and riparian vegetation. Each reach is therefore expected to adjust in a generally uniform manner along its full length to changes in hydrology and sediment supply, as well as other modifying factors. Four reaches were delineated within the study area and were subsequently verified in the field (**Figure 18**). The gradient, channel sinuosity, and length of each reach were determined using a 2008 ortho-photograph provided by the Region of Durham and are summarized in **Table 5**.

Figure 18. Reach delineation and existing environmental conditions along Uxbridge Brook

Table 5. Uxbridge Brook reach characteristics

Reach	Gradient (%)	Sinuosity	Length (m)
UX1	0.69	1.13	288
UX2	0.80	1.02	459
UX3	n/a – piped channel section		
UX4	0.26	1.03	175

Historical Assessment

Historical mapping was examined using black and white aerial photographs for the years 1959, 1971 and 1978 from the University of Waterloo Map Library to review historic channel adjustments and assess the channel's dynamic equilibrium. A digital colour image from 2008 obtained from the Region of Durham was also examined to provide context.

In 1959, the surrounding land use was dominated by urban development that extended from the Elgin Mill Pond to the CN railway. Agricultural fields surrounded the Town of Uxbridge. Riparian vegetation upstream and downstream from the Town largely consisted of forest with major localized gaps in the downstream channel reaches. Between 1959 and 1978, there was a notable increase in residential development, particularly northwest of the Town, and a moderate decrease in overall forest cover. By 2008, residential development had expanded significantly to the north, east and west, while the headwater region of Uxbridge Brook to the south remained largely natural.

In 1959, the watercourse flowed through an open area upstream, between the confluence south of Centennial Drive and Brock Street (Reach UX4), and appeared to be artificially straightened. Despite the increase in residential houses along the east bank and the development of a park on the west bank, there appeared to be no change in channel planform between 1959 and 2008 within Reach UX4.

In 1959, the portion of watercourse between Brock Street and Main Street North (Reaches UX2 and UX3) flowed through a fragmented forest and channel sinuosity was low. There was no discernable change in channel planform between 1959 and 1978. The majority of newer commercial development in the downtown area east of the intersection of Brock Street and Toronto Street North occurred between 1971 and 1978 and it is likely that the piped portion of Uxbridge Brook was extended north during this period in order to facilitate development.

Forest cover was dense in the 1959 imagery for the portion of watercourse between Main Street North and the CN railway (UX1). Where the channel could be delineated sinuosity appeared to be moderate. A portion of the forest vegetation north of the watercourse was removed between 1959 and 1971 likely to facilitate construction of a treatment plant. It was not possible to determine adjustments in channel planform as it was largely obscured by vegetation for the

period examined. However, the removal of vegetation and urban and residential development upstream and within the downtown area of the Town, likely resulted in increased surface runoff to Uxbridge Brook.

Watershed Characteristics

The planimetric form of a watercourse is fundamentally a product of the channel flow regime and the availability and type of sediments (i.e. surficial geology) within the channel corridor. The 'dynamic equilibrium' of these inputs governs channel planform. These factors are influenced on smaller systems by physiography, riparian vegetation and land use.

The dominant physiographic feature in the headwater region of Uxbridge Brook is located in the Oak Ridges Moraine, located south of the Town of Uxbridge. The watercourse then flows though organic deposits (peat, muck and marl, 1-7 m thick) and river deposits (gravel, sand, silt and clay (Sharpe et al., 1997). Three aquifers (lower, intermediate, and upper) are located in the subwatershed and are a regionally significant groundwater resource (LSRCA, 1997). The upper aquifer (259 m a.s.l.) is generally unconfined and consists of sand and gravel up to 25 m thick. The aquifer flows in a northerly direction and discharges towards Uxbridge Brook. The intermediate aquifer (244 to 259 m a.s.l.) consists of medium sand with locally cemented gravel and is approximately 27 m thick. However, in some locations it may be intermittent or combined with the lower aquifer.

Recharge occurs from the upper aquifer along the moraine and discharge occurs from the intermediate aquifer to the upper aquifer. The lower aquifer (198 to 216 m a.s.l.) consists of sand and gravel deposits up to 20 m thick. This aquifer, along with the upper and intermediate aquifers, receives recharge from the headwater areas of the Beaver River to the east and Pefferlaw Brook to the west (LSRCA, 1997).

Precipitation from climate normals (1971-2000) recorded at the Stouffville WPCP station southeast of the intersection of Main Street and Ninth Line in the Town of Stouffville (23 km southwest of the study site) averaged 63 mm per month in winter (November to February inclusive) and 88 mm in summer (July and August; Environment Canada, 2011). The increase in precipitation in summer months is likely related to convective storm events caused by daytime heating, which produce high intensity flows. However, the overall highest instream flows likely occur during the spring freshet.

Existing Fluvial Geomorphic Conditions

Field data and observations were collected to identify active geomorphic processes, assess channel stability and to characterize existing geomorphic conditions using rapid assessment techniques. Two rapid visual assessment methods were conducted on the reaches as part of the geomorphic analysis; a Rapid Geomorphic Assessment (RGA) and a Rapid Stream Assessment Technique (RSAT).

The RGA documents observed indicators of channel instability by quantifying observations using an index that identifies channel sensitivity. Sensitivity is based on evidence of aggradation, degradation, channel widening and planimetric form adjustment. The index

produces values that indicate whether the channel is stable/in regime (score <0.20), stressed / transitional (score 0.21-0.40) or in adjustment (score >0.41). The RSAT offers a slightly different approach by using an index to quantify overall stream health and includes the consideration of biological indicators. Observations concerning channel stability, channel scouring/sediment deposition, physical instream habitat, water quality, and riparian habitat conditions are used in an index to produce values that indicate whether the channel is in poor (<13), fair (13-24), good (25-34), or excellent (35-42) condition.

Additional observations including bankfull channel dimensions, substrate and bank materials, estimated bank angle, terrestrial and aquatic vegetation cover, and channel disturbances were also noted. General characteristics of each reach and the results of the RGAs and RSATs are provided in **Tables 6 and 7**.

Table 6. General reach characteristics

Reach	Bankfull Width (W) & Depth (D)	Substrate		Riparian Vegetation	Notes
		Pool	Riffle		
UX1	W: 7-12 m D: 0.5-1.0 m	sand, silt and clay	coarse gravel and sand, few cobbles	mainly mature deciduous trees and grasses	low sinuosity & gradient; moderate entrenchment; high turbidity; garbage & woody debris jams; undercut outer banks; exposed roots; iron staining; outflanked gabions at SWM outfalls
UX2	W: 7-8 m D: 0.5-1.0 m	sand, silt and clay	gravel and cobbles	mainly established to mature deciduous trees and grasses	low sinuosity in residential areas; fragmented riparian buffer zone; 12 m entrenchment; garbage and woody debris; valley wall contacts; evidence of seepage into channel; concrete slabs and rubble revetments
UX3	piped – RGA / RSAT not completed				
UX4	W: 6.5-8 m D: 0.8-1.5 m	sand, silt and clay	gravel and cobbles; boulders and concrete rubble	mainly established deciduous trees and grasses	low sinuosity and gradient; reach within park and residential area; moderately entrenched; 5-30% eroded; riffle-pool spacing 20 m; rooted submerged vegetation; iron staining; concrete rip-rap for bank stabilization

Table 7. Results of the rapid geomorphic assessments

Reach	Rapid Geomorphic Assessment (RGA)			Rapid Stream Assessment Technique (RSAT)		
	Score	Condition	Dominant System Adjustment	Score	Condition	Limiting Feature(s)
UX1	0.38	In Transition / Stress	Aggradation	22	Fair	Physical instream habitat
UX2	0.33	In Transition / Stress	Widening	23	Fair	Riparian habitat conditions
UX3	piped – RGA / RSAT not completed					
UX4	0.25	In Transition / Stress	Widening	26	Good	Riparian habitat conditions

Reach UX1 begins at the abandoned CN railway crossing of Uxbridge Brook at the treatment plant, upstream to the crossing at Main Street North (about 300 m). The surrounding land use consisted of residential homes, a public park and forest. The upstream channel was partially confined whereas the downstream channel, closer to Main Street North, was confined. The extent of riparian vegetation was continuous and consisted of trees and grasses. The channel sinuosity and gradient were low. Bankfull widths and depths ranged from 7 to 12 m and 0.5 to 1 m, respectively. Garbage and woody debris jams were frequent and occurred on average approximately every 15 m to 25 m. Erosion and bank undercutting occurred along the outer bends of the channel, exposing tree and grass roots. A valley wall contact and evidence of seepage, iron staining and exposed till were also noted downstream of the stormwater outfall outletting from the treatment plant mid-reach. The base and sides of the stormwater outfall were protected by concrete slabs and gabions, which were outflanked.

Runs were the dominant morphological feature within the channel and the substrate consisted of clay to gravel. Where observed, riffle substrate consisted of coarse sand to gravel with occasional cobbles and concrete rubble. Pool substrate consisted of clay to sand. Based on the results of the rapid assessments, Reach UX1 had an RGA score of 0.38, indicating the channel was in transition/stress. The dominant systematic adjustment was evidence of aggradation, mainly due to siltation in the pools, sediment accumulation in the riffles (embedded) and the presence of medial bars. The RSAT result of 22 indicated that the reach was in fair condition, and the limiting feature was physical instream habitat.

Reach UX2 extends from Main Street North to the parking lot near Brock Street and Main Street North (about 400 m). The surrounding land use consisted of largely residential homes and urban space. The channel was confined and flowed through a number of watercourse crossings at roads. Channel entrenchment (~12 m) may be associated with fill material placed in the floodplain during past urban infrastructure expansion. However, this was not confirmed through the historical aerial photo assessment. Channel sinuosity was low and gradient was low to moderate. The extent of the riparian vegetation was fragmentary due to urbanization in which residential and industrial properties were manicured to the channel edge. Where forested, the riparian vegetation consisted of trees and grasses. The bankfull width and depth ranged from 7 to 8 m and 0.5 to 1.0 m, respectively. Exposed pipes, garbage debris and woody debris jams were common in the channel banks and bed. A stormwater outfall, perpendicular to the culvert at Dominion and Toronto Street North, was protected by concrete rubble. The culvert at the downstream end of the reach break was protected by rip rap.

Runs were the dominant morphological feature within the reach with pool features present. Pools consisted of fine sands, silt and clay and riffles, and consisted of gravel to cobbles. Rooted submergent vegetation was also noted. Based on the results of the rapid assessments, Reach UX2 had an RGA score of 0.33, indicating the channel was in transition/stress. The dominant systematic adjustment was evidence of widening due to basal scour, exposed tree roots, leaning and fallen trees and occurrences of large woody organic debris. The RSAT result of 23 indicated that the reach was in fair condition, and the limiting feature was riparian habitat conditions.

Reach UX3 extends from the parking lot on Brock Street and Main Street North to Centennial Drive (about 190 m). As the entire reach was piped, rapid geomorphic assessments were not completed. Overall, the culvert appeared to be smaller than the average bankfull width for the upstream and downstream reaches. However, no significant erosion was observed in the vicinity of the culvert footprint.

Reach UX4 extends to approximately 175 m south from Centennial Drive. The surrounding land use was parkland (left bank, downstream direction) and residential (right bank). The channel was confined on the left bank, partially confined on the right bank, moderately entrenched. The riparian vegetation consisted of trees and grasses, was fragmentary, and was approximately less than one channel width. Channel sinuosity was low and gradient was moderate. Bankfull width and depth ranged from 6.5 to 8 m and 0.75 to 1.5 m, respectively. Bank material ranged from clay to sand with organics. Erosion was observed along the banks causing the exposure of tree and grass roots. A suspended armour layer was also noted. Minor bank armouring (concrete rubble) was present adjacent to private property in some sections of the reach. Riffles were dominant and consisted of gravels to cobbles, with small boulders occasional and concrete rubble. Pools were deep (~0.65 m) with substrate consisting of silt and clay. Based on the results of the rapid assessments, Reach UX4 had an RGA score of 0.25, indicating the channel was in transition/stress. The dominant systematic adjustment was evidence of widening due to exposed tree roots, leaning and fallen trees and occurrences of large woody organic debris. The RSAT result of 26 indicated that the reach was in good condition, and the limiting feature was riparian habitat conditions.

5.1.2 Uxbridge Brook Aquatic and Terrestrial Habitat

Fisheries and aquatic habitat assessments were completed to document and define the extent and quality of all existing aquatic habitat within the study area. The watercourses were divided into reaches for field assessment concurrently with the geomorphic component of this study.

Approximately 65 to 75% of the watershed is buffered with riparian vegetation 30 m wide on either side of the watercourse (LSRCA, 2009). However, land use is dominated by commercial and residential development. Wetland habitat was not documented in the study area but was observed upstream and downstream in natural areas (LSRCA, 1997).

Ecological Land Classification (ELC) information was provided by LSRCA for review (**Figure 18**). Downstream of Reach UX1, north of the CN railway, the ecological communities adjacent to Uxbridge Brook consisted of areas of deciduous forest (FOD), cultural meadow (CUM), cultural woodland (CUW), cultural thicket (CUT) and mixed swamp (SWM). The majority of Reach UX1 consisted of mainly coniferous forest (FOC) and was characterized as having greater than 75% coniferous canopy cover. Only one other ELC community was delineated along the main branch of Uxbridge Brook, south of Reach UX4, and consisted of cultural woodland (CUW) and open water (OAO, Elgin Mill Pond). The tributary of Uxbridge Brook, south of the study area, contained a thicket swamp (SWT) community.

Approximately 187 species of wildlife are known to utilize the Uxbridge Brook subwatershed for their life stages (LSRCA, 1997). Forty-three species of flora and fauna are considered to be rare

or endangered in the watershed. Based on a search of the Natural Heritage Information Centre database, no Species at Risk, Environmentally Sensitive Areas, or Provincially Significant Wetlands are documented in the study area. This was confirmed by mapping provided by LSRCA.

According to the Uxbridge Brook Watershed Plan, 18 species of fish were documented in the subwatershed and were comprised of a mix of cold and warmwater species including Brook Trout and Sculpin, which are both coldwater thermal indicators (LSRCA, 1997). Other species included Largemouth Bass, Brown Trout, and Rainbow Trout. Benthic invertebrate composition provides information about the quality of water in the watershed. According to the Watershed Report Card (2009) the water quality in the Uxbridge Brook subwatershed was 'excellent'. However, the aquatic habitat of the Uxbridge Brook subwatershed was given an Index of Biotic Integrity of 'fair'.

Issues associated with development in the watershed include soil erosion and sediment related activities, urban runoff from stormwater and runoff from existing uncontrolled urban areas that do not have stormwater quality control (LSRCA, 1997). Phosphorus concentrations in the Uxbridge Brook are above the provincial water quality objective (<0.03 mg/L) and varied from 0.03 to 0.10 mg/L over a five year monitoring period (LSRCA, 2009).

Available background information was reviewed and compiled and watercourse mapping for the study area was overlaid on an ortho-photograph. A field investigation was undertaken along the main branch of Uxbridge Brook from approximately 175 m south of Centennial Drive to the railway to identify and assess the existing aquatic and riparian habitat conditions. Although four reaches were delineated based on terrestrial and aquatic habitat, land use and the existing road network, only three reaches were assessed as one reach was piped (Reach UX3). Each reach was assessed to document the aquatic habitat characteristics and georeference key features or points of interest such as barriers, groundwater upwellings, and valley wall contacts. Observations also included flow regime, channel type, riparian cover, instream cover, substrate composition, bankfull channel dimensions, woody debris distribution, water quality and groundwater indicators, thermal regime indicators and observations of use by fish.

Reach UX1 was a typical forest channel dominated by run habitat with deep pools and a few riffles. Pool depths were generally greater than 0.6 m with the majority deeper than 1 m. Pool substrate was composed of sand and exposed till was documented in one pool. Riffle substrate consisted of sand and gravel. This reach was composed of approximately 10% riffles, 70% runs and 20% pools. In-stream cover included frequent occurrences of large woody debris, deep pools, undercut banks (greater than 0.5 m) and overhanging vegetation. The channel had a low to moderate gradient and was in a partially to completely confined valley. Two valley wall contacts were observed at the downstream limit of the reach. A pedestrian bridge, historically a CN railway and at an elevation approximately 10 m above the channel bed, was located near the downstream limit of the reach. Nutrient input from an active perched storm sewer outlet was observed at the upstream limit of Reach UX1. Bank materials include organic matter, clay and silt. Aquatic vegetation in the channel included filamentous and non-filamentous algae. Fish were observed throughout the reach.

The terrestrial habitat of Reach UX1 consisted of a deciduous dominated forest with a wide riparian zone greater than 30 m. The community was dominated by Manitoba Maple and Eastern White Cedar, with clusters of other species including Silver Maple, Green Ash, American Beech, and Common Buckthorn. The canopy age class was mature (>30 years), with 75 to 85% canopy cover over the channel.

Reach UX2 was an entrenched, straightened ravine channel between watercourse crossings, residential properties, and along road embankments. The toe of the slope was located at the edge of the channel banks. The habitat was dominated by runs with few pools and riffles. Pools were approximately 0.6 m to 1 m deep and were composed of sand substrate. One riffle was documented with coarse materials including cobbles and small boulders. Substrate became coarser in the downstream direction. The reach was composed of approximately 10% riffles, 70% runs and 20% pools. In-stream cover included boulders at the downstream limit of the reach, undercut banks (up to 0.50 m deep), overhanging vegetation, few deep pools and a high frequency of large woody debris. Iron staining and seepage from the channel banks were also documented in the reach. The channel was fragmented by three watercourse crossings and manicured to the edge of the watercourse in the residential neighbourhoods. Aquatic vegetation included filamentous and non-filamentous algae. Fish observed at the time of the survey included darter species.

The reach provides ravine terrestrial habitat with a narrow riparian zone. The channel was tree-lined and dominated by deciduous species of Silver Maple, Manitoba Maple, American Basswood, Weeping Willow, Balsam Poplar, Crabapple, American Beech, Eastern White Cedar, White Willow, White Ash and Common Buckthorn. The age class was established to mature (>5 years) and provided 70 to 75% canopy cover over the ravine.

Reach UX3 consisted of a piped channel under commercial properties and Brock Street. Therefore, aquatic and terrestrial assessments could not be completed. The inlet and outlet of the culvert were documented to be in good condition (i.e. no erosion or scour) relative to potential to impact aquatic habitat.

Reach UX4 was located within a forest at the upstream limit and in between residential properties and a recreational park for the majority of the channel length. Majority of the riparian zone was approximately 2 - 3 m wide. The habitat was dominated by riffles with few pools and some runs. Pools were shallower in comparison to upstream reaches. Riffle materials included sand to boulders. In-stream cover included a moderate frequency of large woody debris, boulder refugia and few pools. Bank stabilization features include concrete slabs and rip rap stabilization. Tree species found within this reach include Eastern White Cedar, Manitoba Maple, White Ash, and Silver Maple. The lawns of residential properties and the recreational park were manicured to the edge of the channel in many sections along the reach.

5.1.3 Source Water Protection Areas

In 2010, a Source Water Protection Area Study was completed for the Lakes Simcoe and Couchiching – Black River Areas. The purpose of the study, in part, is to provide fact-based guidance to the development of policies to protect municipal sources of drinking water. Source

water vulnerability is determined by looking at the landscape around a water source and determining how the geology, geography, hydrogeology and soil (among other things) work together to affect how slowly or quickly the water is moving toward the source of drinking water. If the water moves quickly, it follows that a contaminant would also move quickly; therefore, that area will be more vulnerable. If it is more difficult for the contaminant to get to the source, the landscape is less vulnerable.

For the Uxbridge Brook subwatershed, there are three wells located in the community of Uxbridge that service approximately 10,000 people. The Wellhead Protection Areas around these facilities are the primary 'Vulnerable Areas' identified to ensure the protection of the municipal water supply wells (**Figure 19**). The Wellhead Protection Areas for Uxbridge reflect the regional groundwater flow direction from south to north within the Lake Simcoe watershed and the watershed of the Uxbridge Brook and its tributaries. However, groundwater vulnerability in Uxbridge is typically considered to be low in the areas near the municipal wells because the municipal wells are relatively deep and the overburden above the aquifer is known to be relatively thick.

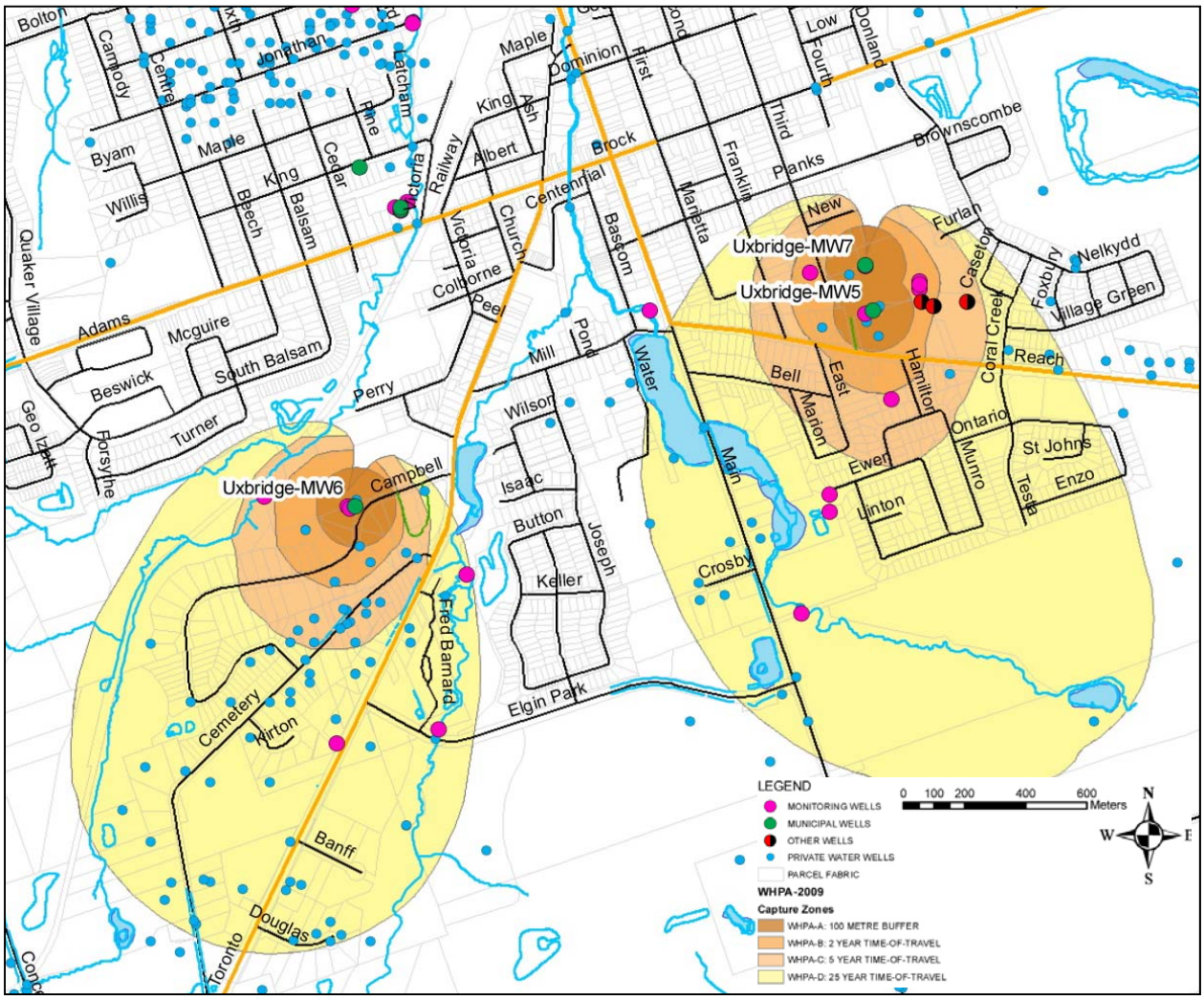

Figure 19. Wellhead Protection Areas (LSRCA)

5.2 Social Environment

5.2.1 Vulnerable Features in the Floodplain

From a social environment persepective, the most significant existing condition is the flood hazard in downtown Uxbridge, related to the risk associated with a Regional storm event (Hurricane Hazel). The Lake Simcoe Region Conservation Authoirty provided mapping of the vulnerable features in the floodplain, for the Uxbridge area (**Figure 20**).

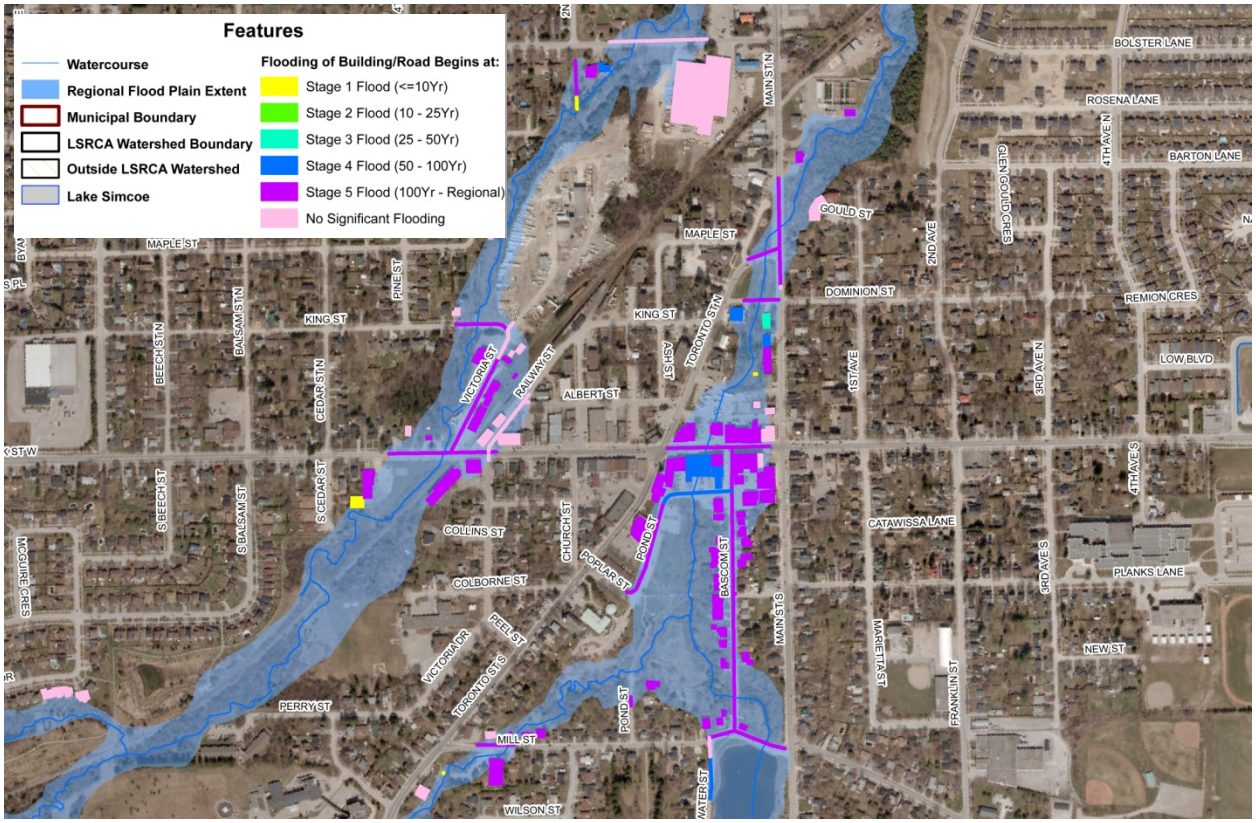

Figure 20. Vulnerable features in the floodplain (LSRCA)

Figure 20 illustrates that the majority of buildings and streets are vulnerable to flooding in the downtown area for storm events greater than the 100-year storm. Under a Regional storm event, flooding on Brock Street is modeled to be as deep as 2.3 m. An illustration of the modeled water depth on Brock Street during a Regional event is provided as **Figure 21**.

Figure 21. Illustration of modeled water depth on Brock Street during a Regional storm event

5.2.2 Phase 1 and 2 Environmental Site Assessments

Phase 1 and 2 Environmental Site Assessments were conducted to identify potentially contaminated areas. The Phase 1 assessment consisted of a review of available records, which indicated that the following items were found in the study area and required further investigation:

- Records of underground storage tanks
- Various waste generators and manufacturers, including a dry cleaner
- Spills within the study area, including spills of gasoline fuel and heating oil
- The valley south of Brock Street was historically used as a landfill

The Phase 2 investigation was conducted to establish a chemical profile of the current soil and groundwater conditions in the study area based on the areas of concern identified in Phase 1. Soil and groundwater samples were submitted for chemical analyses in accordance with the fine and medium textured soil quality criteria set out in the *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*. Samples retrieved at areas within 30 m of the adjacent watercourse were analyzed for conformance to the Table 8 *Generic Site Condition Standards for Use within 30 m of a Water Body in a Potable Ground Water Condition* for all non-agricultural property uses. Samples from the remainder of the site were analyzed for conformance with the Table 2 *Full Depth Generic Site Condition Standards in a Potable Ground Water Condition*.

The analyses for the soil and groundwater samples showed that the tested parameters generally fall within acceptable standards. The site was found to be suitable for the proposed culvert and no further testing was recommended. Full reports for each assessment are provided as **Appendices G and H** (with information from private properties blacked-out).

5.2.3 Parking Demand Study

At the outset of the Class EA study, it was identified that parking supply is a concern to the local community. To investigate the concern that parking supply may not meet the current parking demand, a parking demand study was conducted in the vicinity of the proposed flood reduction alternatives. The full report is provided as **Appendix I**.

A manual count of parked vehicles within the study area was conducted on Friday, November 5 and Saturday, November 6, 2010 and Friday, November 12 and Saturday, November 13, 2010 between the hours of 10:00 am and 6:00 pm. The number of occupied spaces was noted every half hour during the above times. The study area included on-street and off-street parking (**Figure 22**). The existing on-street and off-street parking supply is detailed by Zone in **Table 8**.

The on-street parking areas were:

- Railway Street from Brock Street to Spruce Street
- Brock Street from Railway Street to 1st Avenue/Marietta Street
- Main Street from Brock Street to Planks Lane and Brock Street to Dominion Street
- Toronto Street from Albert Street to Main Street
- Bascom Street from Brock Street to Centennial Drive

The off-street parking areas were:

- Centennial Drive parking lot
- Church Street parking lot
- Toronto Street/Main Street parking lot
- Albert Street north and south parking lots

Figure 22. On-street and off-street parking areas assessed in the study

As shown in **Table 8**, there are 187 existing on-street parking spaces and 222 existing off-street parking lot spaces for a total of 409 existing parking spaces within the study area.

On-Street Parking

The highest weekday peak parking demand for all on-street parking (Zones S1 to S8) was 128 parking spaces at 12:30 pm on Friday, November 12, 2010. This represents a peak utilization of the on-street parking supply of 68.45%. There was a peak parking demand of 118 parking spaces on the first Friday at 1:00 pm which represents a peak utilization of the on-street parking supply of 63.10%. The foregoing shows a consistent demand for on-street parking during the

weekday peak period and indicates substantial surplus capacity during the weekday peak period.

The highest Saturday peak parking demand for all on-street parking (Zones S1 to S8) was 135 parking spaces at 2:00 pm on November 13, 2010. This represents a peak utilization of the on-street parking supply of 72.19%. There was a peak parking demand of 107 parking spaces on the first Saturday at 1:30 pm which represents a peak utilization of the on-street parking supply of 57.22%. The foregoing indicates a substantial surplus of on-street parking capacity during the Saturday study periods.

Table 8. Existing parking supply summary

Zone		Description	Designated Spaces
On-Street	S1	Railway Street (Brock Street to Spruce Street)	26
	S2	Brock Street (Railway Street to Toronto Street)	49
	S3	Brock Street (Toronto Street to Main Street)	25
	S4	Brock Street (Main Street to 1st Avenue / Marietta Street)	11
	S5	Main Street (Brock Street to Planks Lane)	34
	S6	Main Street (Dominion Street to Brock Street)	20
	S7	Toronto Street (Albert Street to Main Street)	15
	S8	Bascom Street (Brock Street to Centennial Drive)	7
		Sub-Total (On-Street Parking)	**187**
Off-Street	P1	Centennial Drive parking lot	74
	P2	Church Street parking lot	26
	P3	Toronto Street / Main Street parking lot	59
	P4	Albert Street north parking lot	30
	P5	Albert Street south parking lot	33
		Sub-Total (Off-Street Parking)	**222**
		Total Parking Supply	**409**

On Friday November 12, 2010 in Zone S4 (Brock Street) one vehicle was observed illegally parked at 2:00 pm and two vehicles at 2:30 pm. On Saturday November 13, 2010 in Zone S5 (Brock Street) one vehicle was observed illegally parked at 2:30 pm. Both Zones S4 and S5 are in an area of dense retail development and it is reasonable to assume the illegal parking was the result of patrons making a short-term stop to access one of the retail locations.

Off-Street Parking

The highest weekday peak parking demand for all off-street parking (Zones P1 to P5) was 148 parking spaces at 10:30 am on Friday, November 12, 2010. This represents a peak utilization of the off-street parking supply of 66.67%. There was a peak parking demand of 146 parking spaces on the first Friday at 11:00 am and 11:30 am which represents a peak utilization of the off-street parking supply of 65.77%.

The foregoing shows a very consistent demand for off-street parking (less than 1% variation) during the weekday peak period and indicates substantial surplus capacity within the off-street parking facilities. The highest Saturday peak parking demand for all off-street parking (Zones P1

to P5) was 115 parking spaces at 2:00 pm on November 13, 2010. This represents a peak utilization of the on-street parking supply of 51.80%. There was a peak parking demand of 96 parking spaces on the first Saturday at 2:00 pm which represents a peak utilization of the on-street parking supply of 43.24%. The foregoing indicates substantial surplus off-street parking capacity during the Saturday study periods.

There was one instance of illegal parking observed in Zone P3 (Parking lot between Toronto St. and Main St.) on Friday November 12, 2010 at 2:30 pm. This lot has an oddly shaped configuration providing an opportunity for vehicles to park in an undesignated area. The illegally parked vehicle was not observed at 3:00 pm, indicating this was a short-term situation.

Analysis

The peak parking demand for on-street parking occurred on Saturday November 13, 2010 with 135 of the 187 available parking spaces used representing a utilization of 72.19%. This results in a surplus of 27.81% or 52 on-street parking spaces.

The peak parking demand for off-street parking occurred on Friday November 12, 2010 with 148 of the 222 available parking spaces used representing a utilization of 66.67%. This results in a surplus of 33.33% or 74 off-street parking spaces.

There are a total of 409 existing parking spaces available within the study area. Based on a worst case scenario (combining the on-street peak parking demand of 135 spaces and the off-street peak parking demand of 148 spaces), there is demand for 283 parking spaces representing a total peak parking demand of 69%. This results in a surplus of 31% or 126 parking spaces.

5.3 Cultural Environment

Stage 1 archaeological background research was conducted to evaluate the study area's potential to contain archaeological resources. Potential is assessed based on a combination of physical and historical features, as well as the proximity of previously identified archaeological sites. If potential is established anywhere within the study area limits, a Stage 2 assessment must be conducted to confirm the presence of archaeological resources.

Consideration is given to areas of early Euro-Canadian settlement, including places of early military pioneer or pioneer settlement (e.g. pioneer homesteads, isolated cabins, farmstead complexes), early wharf or dock complexes, and pioneer churches and early cemeteries, as having archaeological potential. There may be commemorative markers of their history, such as local, provincial, or federal monuments or heritage parks. Early historical transportation routes (trails, passes, roads, railways, portage routes), properties listed in a municipal register or designated under the Ontario Heritage Act or a federal, provincial, or municipal historic landmark or site, and properties that local histories or informants have identified with possible archaeological sites, historical events, activities, or occupations are also considered to have archaeological potential.

To establish the archaeological and historical significance of the study area, a comprehensive review of listed and designated heritage properties, and registered archaeological sites within close proximity to its limits was conducted. Furthermore, a review of the physiography of the overall area and its correlation to locating archaeological remains, as well as consultation of available historical documentation was performed. The full report is provided as **Appendix J**.

Historical Context

In 1855 the western portion of the village was surveyed, and a plan dividing the land into village lots was lithographed. A review of this plan revealed that the site originally chosen at the beginning of Euro-Canadian settlement in Uxbridge in 1806 was occupied by a mill, and a portion of this structure falls within the study area. Several other buildings were also shown to have existed in immediate proximity to the study area around this time.

Further review of the 1877 Illustrated Historical Atlas of the County of Ontario revealed that the mill still existed in the southern end of the study area at this time, albeit reduced in size. Although no other structures were explicitly depicted to lie within the study area in the 1877 map, the town lots in and around the study area would have probably had buildings and occupants, since the vicinity is in an advantageous position within the urban core of Uxbridge. A photo taken circa 1890 confirmed that structures did exist along the south side of Brock Street between Toronto and Bascom Streets.

In addition to the study area's documented proximity to Euro-Canadian historic structures, it lies immediately adjacent to Brock Street, one of the side roads that were originally laid out in the survey of Uxbridge Township to facilitate access to lands opened for settlement. Because transportation routes such as early settlement roads and trails also contain potential for heritage features adjacent to their rights-of-way, high potential for the location of Euro-Canadian historic archaeological resources within undisturbed portions of the study area close to these documented historic features can be established.

Archaeological Context

In terms of archaeological potential, potable water is a highly important resource necessary for any extended human occupation or settlement. As water sources have remained relatively stable in southern Ontario since post-glacial times, proximity to water can be regarded as a useful index for the evaluation of archaeological site potential. Indeed, distance from water has been one of the most commonly used variables for predictive modeling of site location. In Southern Ontario, undisturbed lands in proximity to a water source are considered to be of elevated archaeological potential. Secondary hydrological features such as swamps, marshes and creeks would have helped supply plant and food resources to the surrounding area, and consequently support high potential for locating archaeological resources within 300 metres of its limits. Since the Uxbridge Brook is situated within the study area, there is high archaeological potential within the study area limits.

Registered Archaeological Sites & Previous Archaeological Assessments

To compile an inventory of archaeological resources for the study area, the Ontario Archaeological Sites Database maintained by the Ministry of Tourism, Culture and Sport

(MTCS) was consulted. According to the MTCS, no sites were registered within a 1 km radius of the study area. In addition, the MTCS has no documentation for other archaeological fieldwork previously conducted within and directly adjacent (within 50 m) to the study area. It must be noted, however, that the paucity of archaeological sites in proximity to the study area is not reflective of the scale of previous inhabitation, but more likely a lack of detailed archaeological surveys within the immediate area.

Heritage Properties and Known Historic Sites

Consultation of the records for listed and designated heritage properties within the Ontario Heritage Properties Database confirmed that although no designated heritage properties are encompassed within the study area, there are five properties designated under the Ontario Heritage Act within 300 m of the study area. The Township of Uxbridge has also installed "Heritage Pride" Plaques on several historic buildings in the downtown core, in recognition of their cultural heritage value. Since these Euro-Canadian sites of historic and cultural heritage significance pre-date 1900 and are located within 300 m of the study area limits, they contribute to the potential to recover archaeological remains within the study area.

Results of Stage 1 Assessment

Areas identified as having been subjected to deep and extensive disturbance include the footprints of existing structures (30-34 Brock Street), the existing paved roadway (Brock Street), and the limits of the existing culvert installations (**Figure 23)**.

Figure 23. Areas of archaeological potential

Building footprints are considered to be extensive and deep land alterations that can cause severe damage to the integrity of archaeological resources, thus removing archaeological potential. It is known that the structure at #34 Brock Street post-dates 1972, since it was built on top of the Uxbridge Brook culvert on the south side of Brock Street. Any prior structure in the area of #34 Brock Street would have been demolished to facilitate construction. Historic photographs also show that the adjacent #30-32 Brock Street was already standing at that time, and it appears to have deep basement foundations. This suggests that the potential for intact and undisturbed pre-1900 archaeological deposits had already been removed.

The existing paved roadway (Brock Street) that bisects the study area is also determined to have been subjected to extensive and deep disturbance. The construction and paving of this roadway, as well as the installation of utilities that usually run alongside or underneath the pavement, would have caused extensive and deep disturbance to any archaeological resources that could have been present, thus resulting in the removal of archaeological potential.

A consultation of available archival photographs recording construction activities during the installation of the Uxbridge Brook culverts immediately north and south of Brock Street suggests that deep and extensive disturbance had already occurred. Therefore, the current limits of the culvert installations contain no archaeological potential.

A review of historic maps of downtown Uxbridge has indicated that the footprint of an important 19th century structure that is likely tied to the beginnings of settlement in Uxbridge is partially encompassed within the study area. Within an urban context, deeply buried archaeological resources can remain sealed and, thus, entirely preserved, where extensive excavation activities have not occurred. Since there is no conclusive evidence of deep and extensive ground disturbance and the complete removal of archaeological potential within the remainder of the footprint of the structure first depicted in the 1855 map, this area is therefore recommended to undergo Stage 2 archaeological assessment (refer to **Figure 23**). A Stage 2 archaeological assessment is not recommended in any other location.

5.4 Technical Studies

5.4.1 Geotechnical Investigation

A geotechnical investigation was conducted to characterize the subsurface soil conditions and determine the engineering properties of the soils for future use in the design and construction of the project. The area of investigation was focused on the location of the existing culvert under Brock Street.

Five boreholes were installed at depths ranging from 12.6 to 20.0 m, and monitoring wells were installed in four of the boreholes for groundwater sampling and monitoring. Information collected from the investigation was used to provide construction-related recommendations for the culvert foundations, wing wall construction, engineered fill, trenches and excavations, sidewalks and landscaping, pavement design, and management of groundwater during construction. The full report is provided as **Appendix K**.

6 Evaluation of Alternative Solutions

An evaluation matrix approach was used to assess the merits of each of the alternative solutions presented in Section 3, based on the issues and constraints identified at the outset of the project (**Table 9**). The issues and constraints were sorted into the categories of natural environment, social environment, cultural environment, economic environment, and technical factors, and each category was evaluated by the members of the project team.

Evaluation Scoring:

- ✗ Does not address project problems
- ▼ Overall negative effect
- O Neutral effect
- ✓ Overall positive effect
- ✸ Ideal

The highest scoring alternative was Alternative 1 – New Larger Culvert under Brock Street, followed by Alternatives 2 and 5, representing an opening of the Uxbridge Brook channel and implementation of downstream improvements.

Table 9. Evaluation matrix of the alternative solutions

Category	Evaluation Criteria	Do Nothing	Alternative 1 New Larger Culvert Under Brock Street	Alternative 2 Remove the Culvert and Install Bridges at Road Crossings	Alternative 3 Create an Overland Flow Route (Building Removal)	Alternative 4 Install an Overflow Pipe along Bascom Street	Alternative 5 Downstream Improvements to Reduce Tailwater
Natural Environment	Effect on creek channel stability	○ No impacts. Existing channel is generally stable.	✓ May improve flow and sediment transport processes during larger return-period flows. Provides an opportunity to create inlet and/or outlet pool features at culvert ends.	✓ Crossing structures would be sized for channel migration. Opportunity to improve channel form and function and allow for migration within the floodplain, where feasible. May reinstate a more natural flow and sediment transport regime.	○ No changes to the watercourse.	○ No changes to the watercourse.	✸ Opportunity to enhance the corridor through varying channel and floodplain improvements. Allow the channel to migrate, where feasible, and reinstate a more natural flow and sediment transport regime.
	Effect on fish habitat	▼ No changes to the watercourse and no opportunity to improve fish habitat and/or fish passage.	✓ Improve fish passage opportunity upstream through reduction of fish velocity thresholds. Provide resting areas (i.e. inlet and outlet pool features) at culvert ends.	✓ Channel day-lighting and enhancement of aquatic habitat through the installation of new channel. Improvement to fish passage and potential for increase in particulate organic matter inputs, canopy and instream cover.	▼ No changes to the watercourse and no opportunity to improve fish habitat and/or fish passage.	▼ No changes to the watercourse and no opportunity to improve fish habitat and/or fish passage.	✸ Enhance aquatic habitat through the installation of varying habitat components. Increase particulate organic matter inputs, canopy cover and instream cover.
	Effect on riparian zone	▼ No changes to the watercourse, and no opportunity to improve riparian habitat conditions.	▼ No changes to the watercourse, and no opportunity to improve riparian habitat conditions.	✓ Installation of riparian vegetation and potential enhancement of terrestrial habitat. Potential for contribution to a continuous natural riparian corridor.	▼ No changes to the watercourse, and no opportunity to improve riparian habitat conditions.	▼ No changes to the watercourse, and no opportunity to improve riparian habitat conditions.	✸ Installation of larger riparian vegetation area and enhancement of terrestrial habitat.
Social Environment	Reduction of the floodplain in the downtown	▼ 0% reduction in the floodplain; ~2.3m flood depth on Brock Street.	✸ 34% reduction in the floodplain; no flood flow overtop of Brock Street.	✸ 31% reduction in the floodplain; no flood flow overtop of Brock Street.	▼ 7% reduction in the floodplain; ~1.3m flood depth on Brock Street.	✸ 31% reduction in the floodplain; no flood flow overtop of Brock Street.	▼ 2% reduction in the floodplain; ~2.3m flood depth on Brock Street.
	Improvements to egress / ingress, habitable space on Brock Street (access and safety during a flood)	▼ 0% access and safety improvement during a flood.	✸ 100% access and safety improvement during a flood.	✸ 100% access and safety improvement during a flood.	▼ 25% access and safety improvement during a flood.	✸ 100% access and safety improvement during a flood.	▼ 0% access and safety improvement during a flood.
	Requirement for building removal	✓ No requirement for building removal.	▼ 5 buildings north & south of Brock Street might have to be demolished with major shoring to 3.	▼ 5 buildings north & south of Brock Street would have to be demolished with major shoring to 3. Occupants of the buildings to be demolished would have to re-locate.	▼ 9 buildings north & south of Brock Street would have to be demolished. This would require many businesses to re-locate.	▼ 1 building would have to be removed and 2 shored.	✓ No requirement for building removal.
	Encroachment of works onto private property	✓ No encroachment onto private property.	▼ 4 non-municipal buildings north & south of Brock Street would be affected. Easements may be required over these properties if re-developed.	▼ 4 non-municipal buildings north & south of Brock Street would be affected, with permanent loss of private property.	▼ 8 non-municipal buildings north & south of Brock Street would be affected, with permanent loss of private property.	▼ 1 non-municipal building north of Brock Street would be affected. Easement may be required over this property if re-developed.	○ No buildings affected; easements may be required on up to 10 properties for downstream improvement work in backyard areas.
	Effect on parking availability	✓ No effect on parking; status quo maintained.	✓ No effect on parking; status quo maintained. Parking demand during construction could be accommodated within the surrounding area.	✓ 17% overall reduction in parking availability. The increased demand could be accommodated within the surrounding area with the remaining legal parking spaces.	✓ No effect on parking; status quo maintained. Potential to increase off-site parking due to building removal.	✓ No effect on parking; status quo maintained. Parking demand during construction could be accommodated within the surrounding area.	✓ 10% overall reduction in parking availability. Increased demand could be accommodated in the surrounding area with the remaining legal parking spaces.
	Opportunities for leisure or trail facilities	▼ No opportunity for adding leisure or trail facilities.	▼ No opportunity for adding leisure or trail facilities.	✓ Leisure or trail facilities could be incorporated along the channel, but the space restrictions are limiting.	✓ Leisure or trail facilities could be incorporated into the newly created open space.	▼ No opportunity for adding leisure or trail facilities.	✓ Leisure or trail facilities could be incorporated into the newly created open space.
	Duration of construction disturbance	✓ No construction required.	▼ ~6 months construction for building demolition and culvert replacement. Reconstruction of buildings would create additional disturbance.	▼ ~6 months construction for building demolition and channel creation.	○ ~2 months construction for building demolition.	▼ ~6 months construction for building demolition, utility re-locates and installation of pipe.	○ ~3 months construction for downstream improvements.
Economic Environment	Capital cost (comparative estimate)	✸ None	▼ $3.5M	▼ $5M	✓ $1M	▼ $4M	▼ $3M
	Operation and maintenance	▼ Continuous monitoring and repairs.	✓ Minimal	✓ Minimal	✓ Minimal	✓ Minimal	✓ Minimal
	Opportunities for re-development	▼ No opportunity for re-development.	✸ ~ 32 properties removed from the regulatory floodplain.	✓ ~ 36 properties removed from the regulatory floodplain, but 5 buildings permanently lost.	▼ ~ 12 properties removed from the regulatory floodplain.	✸ ~ 32 properties removed from the regulatory floodplain.	▼ No opportunity for re-development.
Cultural Environment	Archaeological resources	✓ No impact to buried cultural heritage.	○ If construction extends beyond the existing alignment of the culvert, there is potential to disturb deeply buried resources tied to the 1850s mill.	○ If construction extends beyond the existing alignment of the culvert, there is potential to disturb deeply buried resources tied to the 1850s mill.	✓ No impact to buried cultural heritage.	✓ No impact to buried cultural heritage.	▼ Potential disruption to historic and pre-contact Aboriginal resources.
Technical Factors	Addressing the tailwater flooding on the Brock Street culvert	✗ Does not reduce the tailwater flooding on the Brock Street culvert.	✗ Does not reduce the tailwater flooding on the Brock Street culvert.	✗ Does not reduce the tailwater flooding on the Brock Street culvert.	✗ Does not reduce the tailwater flooding on the Brock Street culvert.	✗ Does not reduce the tailwater flooding on the Brock Street culvert.	✸ Potential for significant reduction or elimination of the tailwater flooding.
	Requirement for utility relocation	✓ No requirement for utility relocation.	○ Would require some relocation of utilities.	▼ Would require significant relocation of utilities.	○ Would require some relocation of utilities.	▼ Would require significant relocation of utilities.	○ Would require some relocation of utilities.
	Addressing the deteriorated condition of the existing culvert	✗ Does not address the deteriorated condition of the existing culvert.	✸ Replaces the existing deteriorated culvert with a new structure.	✸ Removes the deteriorated culvert.	✗ Does not address the deteriorated condition of the existing culvert.	✗ Does not address the deteriorated condition of the existing culvert.	✗ Does not address the deteriorated condition of the existing culvert.
	Effect on structural integrity of existing buildings	✓ No effect on existing buildings.	▼ Significant work will be required for the foundations of the buildings that are to remain, to ensure they remain stable during and after re-construction.	▼ Significant work will be required for the foundations of the buildings that are to remain, to ensure they remain stable during and after re-construction.	○ Minor work will be required for the foundations of the buildings that are to remain, to ensure they remain stable during and after re-construction.	○ Minor work will be required for the foundations of the buildings that are to remain, to ensure they remain stable during and after re-construction.	✓ No effect on existing buildings.
	Construction complexities	✓ No construction required.	▼ Difficult to construct new culverts under existing buildings, where building salvage will be attempted. Basements may be permanently lost.	✓ The work would be relatively straightforward under a full road closure and after adjacent buildings are removed.	✓ Building demolition is straightforward.	▼ Installation of a large overflow pipe would be difficult in the confined area of Bascom Street. Conflict with existing infrastructure would be significant.	✓ Downstream improvements options are routine and straightforward.
Summary Rating		▼	✸	✓	▼	▼	✓

7 Recommended Solution

7.1 Preferred Alternative

The highest scoring alternative in **Table 9** was Alternative 1 – New Larger Culvert under Brock Street, followed by Alternatives 2 and 5, representing an opening of the Uxbridge Brook channel and implementation of downstream improvements. From this evaluation, the preferred solution was determined to be a combination of the top three alternatives. The preferred solution would be comprised of a new larger culvert under Brock Street, with a section open channel north of Brock Street, combined with downstream improvements to reduce the tailwater at Brock Street.

Advantages

- Using downstream improvements to reduce the tailwater at Brock Street could result in reduced structure size requirements for the culvert replacement (cost-savings)
- Significant floodplain reduction
- Provides an opportunity for re-opening and re-naturalizing some of the channel that has been previously enclosed by the existing culvert
- Opportunity for re-development in the downtown
- Opportunity to replace deteriorated culvert
- Opportunity for open space, trails, or leisure facilities

Disadvantages

- Would affect property beyond that owned by the Township
- Would impact some buildings and basements
- Prolonged construction disturbance
- Costly

7.2 Confirm Municipal Class EA Schedule

As required in the Municipal Class EA process, the road, water, and wastewater project schedules in Appendix 1 of the MEA document were re-reviewed after selection of the preferred solution, to confirm categorization of the project. The recommended design involves work in a watercourse for the purpose of flood control, which triggers the Schedule ‘B’ process. The culvert replacement is classified as Schedule A+. However, the identified impacts (e.g. property acquisition, impacts to fisheries, impacts to a community) are considered major, therefore the Schedule ‘C’ classification was confirmed to be appropriate.

8 Identification of Alternative Design Concepts

Following the selection of the preferred solution (a combination of Alternatives 1, 2 and 5), alternative design concepts for the preferred solution were identified.

The key component of the preferred flood reduction solution is the new larger culvert under Brock Street, as it had been identified as the flood 'bottle-neck' in this area. To determine an appropriate size for this structure, a range of new culverts of various sizes were analyzed. A decision was made to evaluate culvert size options on a storefront-by-storefront footprint basis, as it was logical to match culvert sizes with the spatial impacts of any buildings that would require removal. The analysis began with a structure size that could be fit under a single storefront, and subsequent storefront-width structure size options were added until a size was reached that could accommodate a Regional storm event. The resulting design scenarios ranged from a culvert under one storefront, to multiple culverts under five storefronts.

In addition to modeling the various culvert scenarios, numerous downstream improvements were analyzed for each of the culvert scenarios to assess the potential for further flood reductions. Specifically, the following downstream improvements were considered:

- Opening ~60 m of channel north of Brock Street
- Valley widening downstream (north of Brock Street)
- New 5 x 2.5 m culvert at Dominion Street
- Removal of Dominion Street to widen the valley

In total, 25 scenarios were analyzed and are summarized in **Table 10**.

The columns of **Table 10** represent the five culvert size scenarios on a storefront-by-storefront footprint. The rows of the table represent the additional "layers" of downstream improvements described above, to increase the potential for flood reduction. Each of these 25 combinations was modeled, and the resulting data cells in the table represent the modeled flood elevation for each combination. Preliminary cost estimates were also developed, to assess the value of investment for each combination.

The original goal of the study was to develop a solution that would flood-proof the downtown, meaning that the flood water would be contained within the culvert below the elevation of the existing basements (263.3 m). **Figure 24** illustrates the original flood-proofing goal relative to a cross-section of the buildings along the south side of Brock Street, as viewed from Centennial Drive.

From a review of **Table 10**, it is apparent that there are only two solutions that result in a flood elevation at or below 263.3 m (bottom right hand corner of the table). Thus, to flood-proof the downtown as per the original goal, the Township and Region would need to invest $19 million, acquire and demolish the buildings housing five storefronts, acquire property for valley cutting north of Brock Street, and remove Dominion Street altogether to widen the valley.

Table 10. Preliminary evaluation of alternative design concepts

	1 culvert 3.0 x 2.4 m Under 1 storefront	1 culvert 8.0 x 2.5 m Under 2 storefronts	2 culverts 7.0 x 2.5 m & 8.0 x 2.5 m Under 3 storefronts	2 culverts 9.5 x 2.5 m ea Under 4 storefronts	3 culverts 8.5 x 2.5 m ea Under 5 storefronts
Replacement of the full length of existing culvert DS TW = 263.43 m	~ 268.8 m $1.8 million	~ 266.5 m $5.9 million	~ 264.4 m $10.0 million	~ 263.8 m $11.9 million	~ 263.6 m $16.2 million
Replacement of ~135 m of existing culvert, & open ~60 m of channel north of Brock Street DS TW = 263.43 m	~ 268.8 m $3.5 million	~ 266.5 m $7.0 million	~ 264.6 m $9.8 million	~ 264.0 m $12.0 million	~ 263.8 m $15.7 million
Replacement of full length of existing culvert & valley widening downstream DS TW = 263.14 m	~ 268.6 m $4.1 million	~ 266.4 m $8.2 million	~ 264.4 m $12.2 million	~ 263.7 m $14.2 million	~263.5 m $18.5 million
Replacement of full length of existing culvert & valley widening downstream & 5 x 2.5 m culvert at Dominion Street DS TW = 263.00 m	~ 268.5 m $4.3 million	~ 266.3 m $8.4 million	~ 264.2 m $12.4 million	~ 263.6 m $14.4 million	~ 263.3 m $18.7 million
Replacement of full length of existing culvert & valley widening downstream & removal of Dominion Street DS TW = 262.81 m	~ 268.5 m $4.4 million	~ 266.3 m $8.5 million	~ 264.1 m $12.5 million	~ 263.4 m $14.5 million	~ 263.1 m $18.8 million

Existing upstream flood elevation ~ 268.9 m
Approximate 1st floor elevation ~ 265.9 m
Approximate basement floor elevation ~ 263.3 m
Current downstream tailwater elevation (DS TW) ~ 263.4 m

Once the magnitude of the solution became clear, the study team reconvened with the Steering Committee for the project, and re-evaluated the project goal. It was determined that a better balance of benefits and impacts could be achieved by aiming to keep the Regional storm below the first floor elevations of the buildings. In this scenario, the majority of flood water would be conveyed by the new culverts, but there would be some flooding in the valley and basements south of Brock Street (**Figure 25**). The flooding would not however, get high enough to overtop Brock Street and flood the downtown.

With this revised target, a much broader range of solutions would be available. From a review of the flood elevations in **Table 10**, it is apparent that any combination of approaches in the three

right-hand columns would achieve the goal of containing the flood waters below the 265.9 m elevation. The flood waters would stay in the valley, and the downtown area would remain dry.

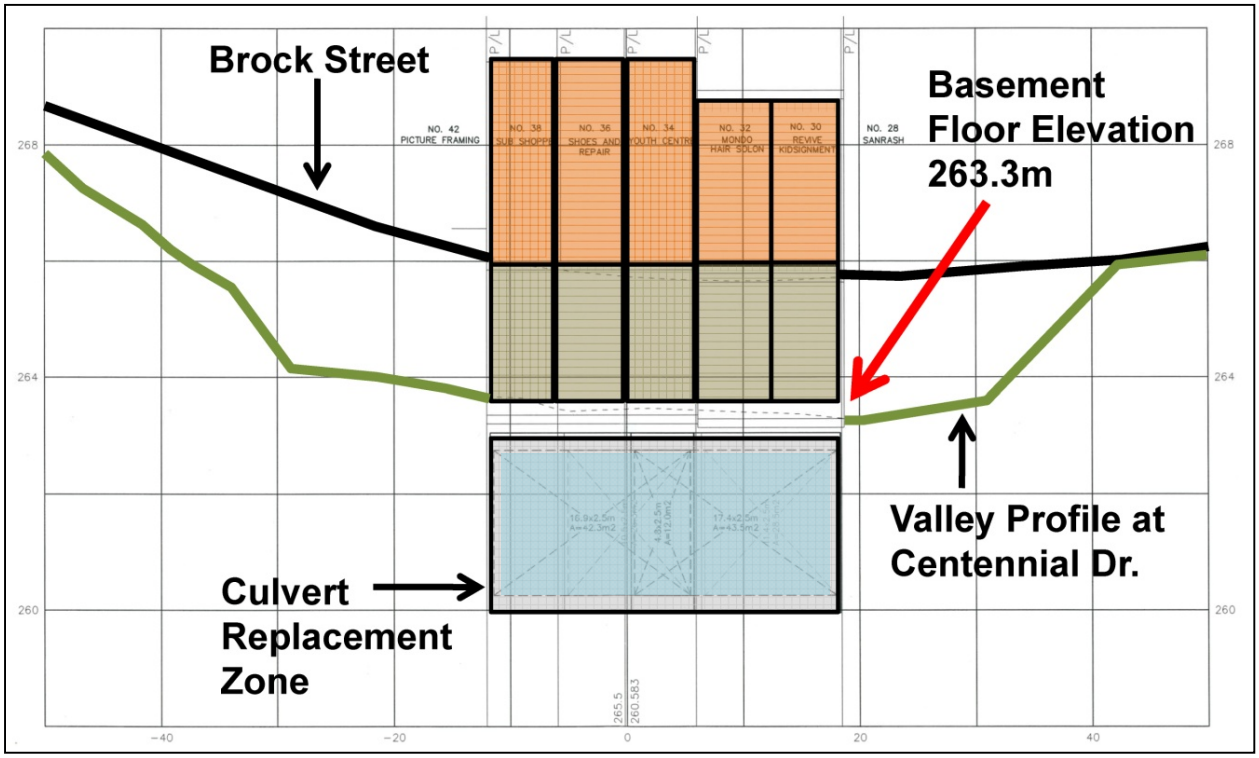

Figure 24. Original flood reduction objective for the study

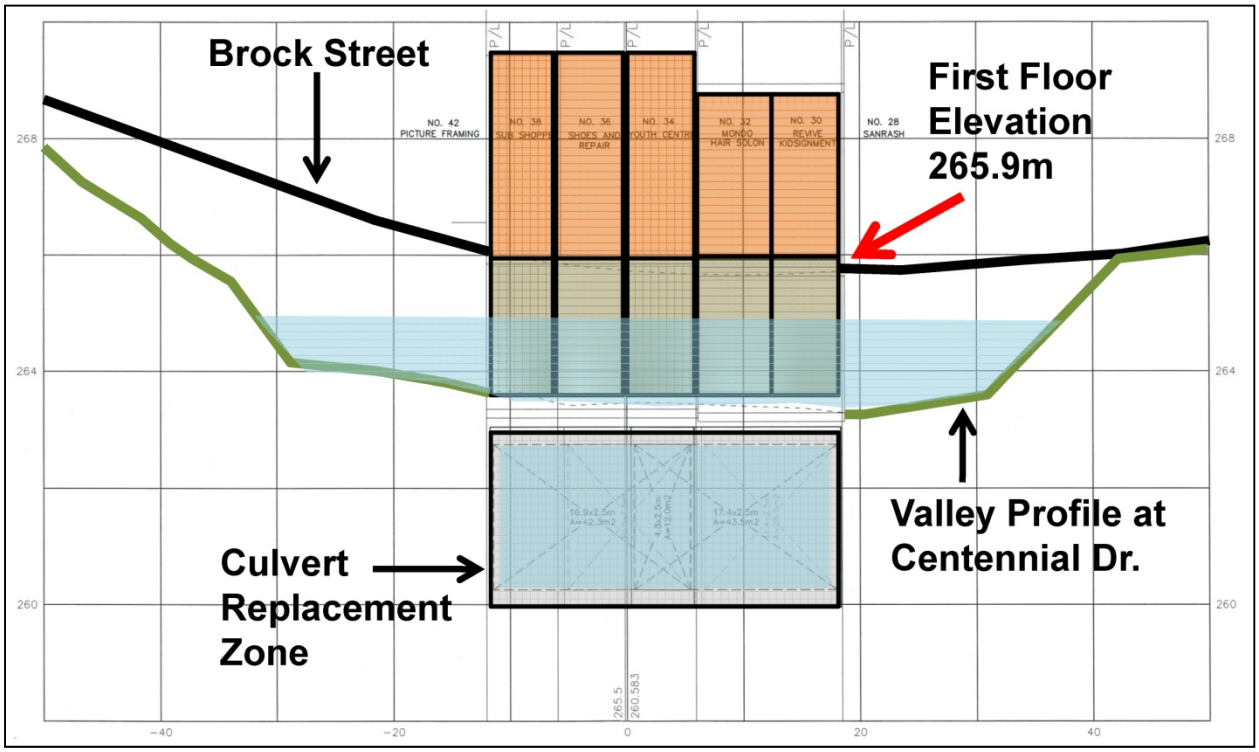

Figure 25. Revised flood reduction objective for the study

9 Evaluation of Design Concepts and Environmental Impact Mitigation

9.1 Evaluation of Design Concepts

Upon agreement to revise the project goal to keep the Regional storm below the first floor elevations of the buildings, the range of combination in the three right-hand columns of Table 10 were further evaluated.

From a social and economic point of view, it was decided by the team to limit the number of businesses potentially affected by construction of the project. Therefore, it was prudent to select a solution from the middle column of Table 10, representing an impact to three storefronts. Within the 3 storefront column on the table, there are layers of flood reduction that can be achieved, ranging from culvert replacement only (top cell), to the most aggressive solution involving valley enlargement north of Brock Street and removal of Dominion Street (bottom cell). An examination of the resulting flood elevations however, illustrates that there is only 30 cm difference in water elevation between the solutions in the top and bottom cells of column.

It was decided by the team that a minor (30 cm) reduction in water depth within already-flooded basements would not justify the social and economic costs of the most aggressive approach (bottom cell in the column). Therefore, the top two cells in the middle column of Table 10 represent the best reasonable solutions to flood reduction in the downtown (Replacement of the full length of the culvert, or replacement of ~135 m of culvert, and opening ~60 m of channel). These two approaches were evaluated in detail, as summarized in **Table 11**.

Evaluation Scoring:

▼ Negative O Neutral ✓ Positive

Table 11. Evaluation of short-listed design alternatives

Evaluation Criteria		2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East and West culverts 195 m long No open channel	2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East culvert 195 m long West culvert 135 m long 60 m open channel
Natural Environment	Length and stability of natural channel in the Uxbridge Brook system	▼ Replacement of the full length of the existing culvert does not provide any opportunity for increasing the length of open creek channel in the Uxbridge Brook system. However, pool enhancement could occur at the outlet of the new culvert.	✓ Eliminating 60 m of culvert provides an opportunity for increasing the length of open creek channel in the Uxbridge Brook system.

Table 11. Evaluation of short-listed design alternatives (cont'd)

Evaluation Criteria		2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East and West culverts 195 m long No open channel	2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East culvert 195 m long West culvert 135 m long 60 m open channel
Natural Environment	Water Quality	✓ Improvement to flow and sediment transport processes during large flow events.	✓ Improvement to flow and sediment transport processes during large flow events.
	Quality of fish habitat	▼ Without eliminating part of the culvert, there is no opportunity to improve the quality of fish habitat. The design will ensure however, that fish can pass through the culvert to maintain connectivity in the system. Resting areas for fish could be created upstream and downstream of the culvert.	✓ By opening part of the system, there is an opportunity to improve the quality of fish habitat. The design will also ensure that fish can pass through the culvert to maintain connectivity in the system. Resting areas for fish could be created upstream and downstream of the culvert. There will also be an increase in particulate organic matter input, and canopy and instream cover.
	Quality of riparian zone	▼ Without eliminating part of the culvert, there is limited opportunity to improve the quality of riparian habitat along the creek. Re-vegetation along the banks at the inlet and outlet of the new culvert could occur, but no additional creek bank would be available for re-vegetation.	✓ By opening part of the system, there is opportunity to improve the quality of riparian habitat along the creek. Vegetation of the engineered side slopes can be accomplished through the use of "green" rock protection, and installation of plant material to shade the creek and improve the visual appeal of the channel.
Social Environment	Reduction of the floodplain in the downtown	✓ There would be an approximate 4.5 m reduction in flood elevation from existing conditions, meaning that flood waters would stay within the creek valley during a severe storm event, and no longer overtop and flood the downtown. This would remove the majority of buildings in the downtown area from the floodplain.	✓ There would be an approximate 4.5 m reduction in flood elevation from existing conditions, meaning that flood waters would stay within the creek valley during a severe storm event, and no longer overtop and flood the downtown. This would remove the majority of buildings in the downtown area from the floodplain.

Table 11. Evaluation of short-listed design alternatives (cont'd)

Evaluation Criteria		2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East and West culverts 195 m long No open channel	2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East culvert 195 m long West culvert 135 m long 60 m open channel
Social Environment	Requirement for easement / acquisition of private property	O To implement this solution, the property at #30/32 Brock Street requires acquisition, and the existing building to be demolished. After construction, the building could be replaced, if desired. In addition, small portions of other private properties will require acquisition and/or easements for construction.	O To implement this solution, the property at #30/32 Brock Street requires acquisition, and the existing building to be demolished. After construction, the building could be replaced, if desired. In addition, small portions of other private properties will require acquisition and/or easements for construction. The open channel would be primarily on land owned by the Township.
	Effect on parking availability	O There would be no loss or gain in parking spaces.	O The open creek channel would result in a loss of approximately 12 parking spaces. The loss could be offset by creating parking in the footprint of the building to be demolished, or building a parking structure in the downtown area.
	Effect on aesthetic quality of downtown	O After construction, the only visual change in the downtown area would be from the loss of the building at #30/32 Brock Street. Should a decision be made to replace this building however, the downtown area would look essentially the same as prior to construction.	✓ After construction, the main visual change in the downtown area would be from creation of an open channel north of Brock Street. The visual impact from loss of the building at #30/32 Brock Street depends on future decisions regarding replacement.
	Compatibility with Downtown Community Improvement Plan	✓ Removes restrictions on redevelopment in the downtown associated with the Regulatory floodplain, for the majority of buildings in the area.	✓ Removes restrictions on redevelopment in the downtown associated with the Regulatory floodplain, for the majority of buildings in the area. Also, contributes to the objective of reinstating Uxbridge Brook as a feature in the downtown area.

Table 11. Evaluation of short-listed design alternatives (cont'd)

Evaluation Criteria		2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East and West culverts 195 m long No open channel	2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East culvert 195 m long West culvert 135 m long 60 m open channel
Social Environment	Opportunity for leisure or trail facilities	✓ If the building at #30/32 Brock Street is not replaced after construction, there would be opportunity to create a pedestrian pathway to connect Centennial Drive and Brock Street.	✓ If the building at #30/32 Brock Street is not replaced after construction, there would be opportunity to create a pedestrian pathway to connect Centennial Drive and Brock Street. Also, there is opportunity to create future open space or leisure facilities adjacent to the open section of the creek north of Brock Street.
Economic Environment	Estimated construction cost (not including building demolition costs)	▼ $10 million	▼ $10 million
	Future development opportunities	✓ Removes restrictions on redevelopment in the downtown associated with the Regulatory floodplain, for the majority of buildings in the area.	✓ Removes restrictions on redevelopment in the downtown associated with the Regulatory floodplain, for the majority of buildings in the area.
Cultural Environment	Effect on archaeology resources	O There is preliminary evidence of an historic mill site near the existing culvert behind the buildings on the south side of Brock Street. Additional archaeological investigations will be required prior to construction, but there is no effect on location of the proposed culvert.	O There is preliminary evidence of an historic mill site near the existing culvert behind the buildings on the south side of Brock Street. Additional archaeological investigations will be required prior to construction, but there is no effect on location of the proposed culvert.

Table 11. Evaluation of short-listed design alternatives (cont'd)

Evaluation Criteria		2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East and West culverts 195 m long No open channel	2 culverts (7.0 x 2.5 m & 8.0 x 2.5 m) under 3 storefronts East culvert 195 m long West culvert 135 m long 60 m open channel
Technical Factors	Difficulty of construction	▼ Due to the varying design constraints in the downtown, the culvert will have to be designed and constructed with 4 zones: 1) under and adjacent to buildings on the south side of Brock Street; 2) under Brock Street; 3) between buildings on the north side of Brock Street; and 4) in the parking lot behind the buildings north of Brock Street.	▼ Due to the varying design constraints in the downtown, the culvert will have to be designed and constructed with 4 zones: 1) under and adjacent to buildings on the south side of Brock Street; 2) under Brock Street; 3) between buildings on the north side of Brock Street; and 4) in the parking lot behind the buildings north of Brock Street.
	Addressing the deteriorated condition of the existing culvert	✓ Removes all deteriorated sections of the existing culvert. Minor repairs are required for the section of culvert that would remain under the Youth Centre.	✓ Removes all deteriorated sections of the existing culvert. Minor repairs are required for the section of culvert that would remain under the Youth Centre.
	Effect on Uxbridge Brook Water Pollution Control Plant	o There are no changes to the downstream flood elevations past Main Street. Therefore, there is no impact to the Uxbridge Brook Water Pollution Control Plant, which is farther downstream.	o There are no changes to the downstream flood elevations past Main Street. Therefore, there is no impact to the Uxbridge Brook Water Pollution Control Plant, which is farther downstream.
			RECOMMENDED DESIGN

Either of the design options could be recommended, as the resulting flood elevation and construction costs are similar. The option in the right-hand side of the table however, provides an opportunity to open up a section of the watercourse, which would have significant environmental and social benefits. For this reason, the option with an open channel was chosen as the preferred design.

9.2 Environmental Impact Mitigation

9.2.1 Uxbridge Brook

Fluvial geomorphology and habitat conditions were determined though a review of background information including historical aerial photographs, topographic and geology maps, and reports. To verify the background review and provide an update to existing conditions, field investigations of geomorphic and aquatic and terrestrial resources were completed. Based on the field investigations, there were no significant concerns throughout the study area with respect to active channel erosion and stability. There were no significant ecological communities within the study area according to the ecological land classification (ELC) provided by LSRCA, with the exception of the coniferous forest (FOC) within reach UX1 and the cultural woodland (CUW) in Reach UX4. Neither of these areas would be affected by construction of the recommended design. No Species at Risk, Environmentally Significant Areas, or Provincially Significant Wetlands were noted within the study area.

Given that there are no sensitive aquatic features in the section of Uxbridge Brook affected by the recommended design, mitigation of environmental impacts should be focused on Best Management Practices during construction. Overall the habitat enhancements associated with opening approximately 60 m of channel are expected to outweigh minor, short-term construction-related effects.

Design considerations and management strategies should be directed towards aquatic and terrestrial habitat issues and concerns. Aquatic issues include the lack of vegetated buffers, reduced refuge for fish, overland flow into watercourses, bank erosion/stabilization, destruction of habitat and confined channels. Terrestrial issues include loss of forest species diversity and density and destruction of natural corridors.

9.2.2 Groundwater

The Class EA study area is greater than 400 m from the Wellhead Protection Areas in Uxbridge, and groundwater vulnerability in the area is considered low. Therefore, no impacts to groundwater are anticipated from construction of the preferred design.

9.2.3 Parking

The preferred design for the proposed works results in the loss of approximately 12 off-street parking spaces in Zone P3 located between Toronto Street and Main Street. The data collected during the parking demand survey indicated that the parking facility in Zone P3, which will be affected by the proposed works, was operating near or at capacity during the weekday morning to late afternoon hours. This parking area is utilized during the weekday by commuters accessing GO Transit and patrons of the surrounding businesses. While the reduction of parking spaces may inconvenience a small number of weekday users, the nearby parking facilities on Albert Street (Zone P4 & P5) and the on-street parking within in the area, can easily accommodate these users.

The parking demand study indicated that the parking facility in Zone P3 was underutilized on both Saturdays during the survey period. The peak parking demand was 43 spaces on November 13, 2010 between 2:00 and 3:00 pm. This represents a peak utilization of 72.88% based on the current 59 space availability, and 91.48% utilization based on the future reduced supply of 47 parking spaces. Based on the foregoing, there will be a surplus of 4 parking spaces and the reduced parking supply will adequately meet the needs of Saturday users.

The loss of parking spaces due to the proposed works will result in a surplus of 62 parking spaces in the off-street parking areas and an overall surplus of 114 parking spaces. It should be noted that the estimated loss of 12 parking spaces could potentially be regained, should the Township opt to utilize the vacant lands resulting from the demolition of the existing building at 30/32 Brock Street as a parking facility.

9.2.4 Cultural Heritage

The Stage 1 archaeological assessment of the construction area for the replacement of the Uxbridge Brook culvert under Brock Street has indicated that, based on historical documentation and the visual documentation of current features, there is potential for the recovery of deeply-buried historic Euro-Canadian archaeological resources within one section of the study area. In light of these results, the following recommendations are presented:

1. No further assessment is required in areas of low archaeological potential shown on **Figure 23**.
2. The footprint of the structure identified on **Figure 23** should be subjected to a Stage 2 archaeological assessment, under the field supervision and monitoring of a licensed archaeologist, prior to any construction activities, in order to minimize impacts to heritage resources. This area should be surveyed employing deep, sub-surface excavation with a backhoe or equivalent heavy machinery in order to verify the presence of, and to assess, deeply buried archaeological resources. The trench should be excavated in order to obtain sections and clear profiles. The suggested trench location is indicated on **Figure 23**. Should significant archaeological resources be encountered, additional background research or fieldwork may be required by the Ministry of Tourism, Culture and Sport (MTCS).
3. Other paved areas lying outside the area of high archaeological potential are considered to have low archaeological potential, with no documented pre-1900 structures known to have existed within their limits. Therefore no further assessment is recommended for these areas.

The above recommendations are subject to MTCS approval. No excavation activities should take place within the study area prior to the MTCS (Heritage Operations Unit) confirming in writing that all archaeological licensing and technical review requirements have been satisfied.

10 Recommended Design Concept

10.1 Conceptual Design

As indicated in Section 9, the recommended design is replacement of the existing culvert with two new culverts having a total span of 15 m, and opening of ~60 m of Uxbridge Brook north of Brock Street (**Figures 26 and 27**). The full conceptual design drawing is provided as **Appendix L**.

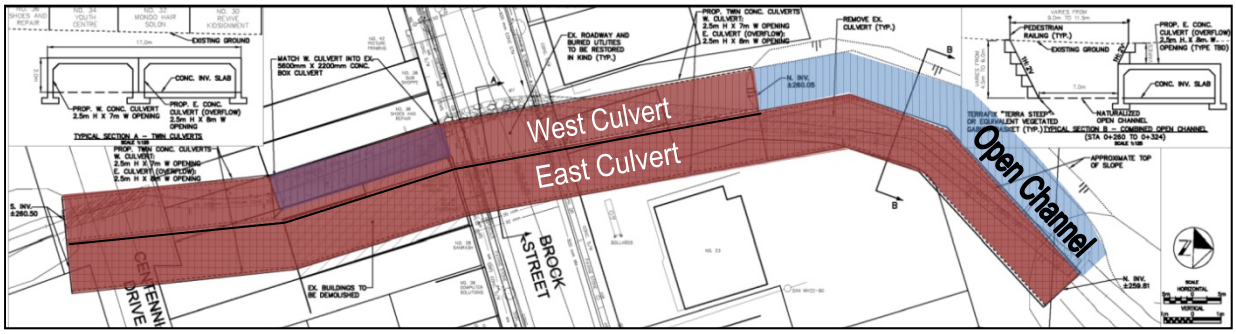

Figure 26. Illustration of the recommended conceptual design

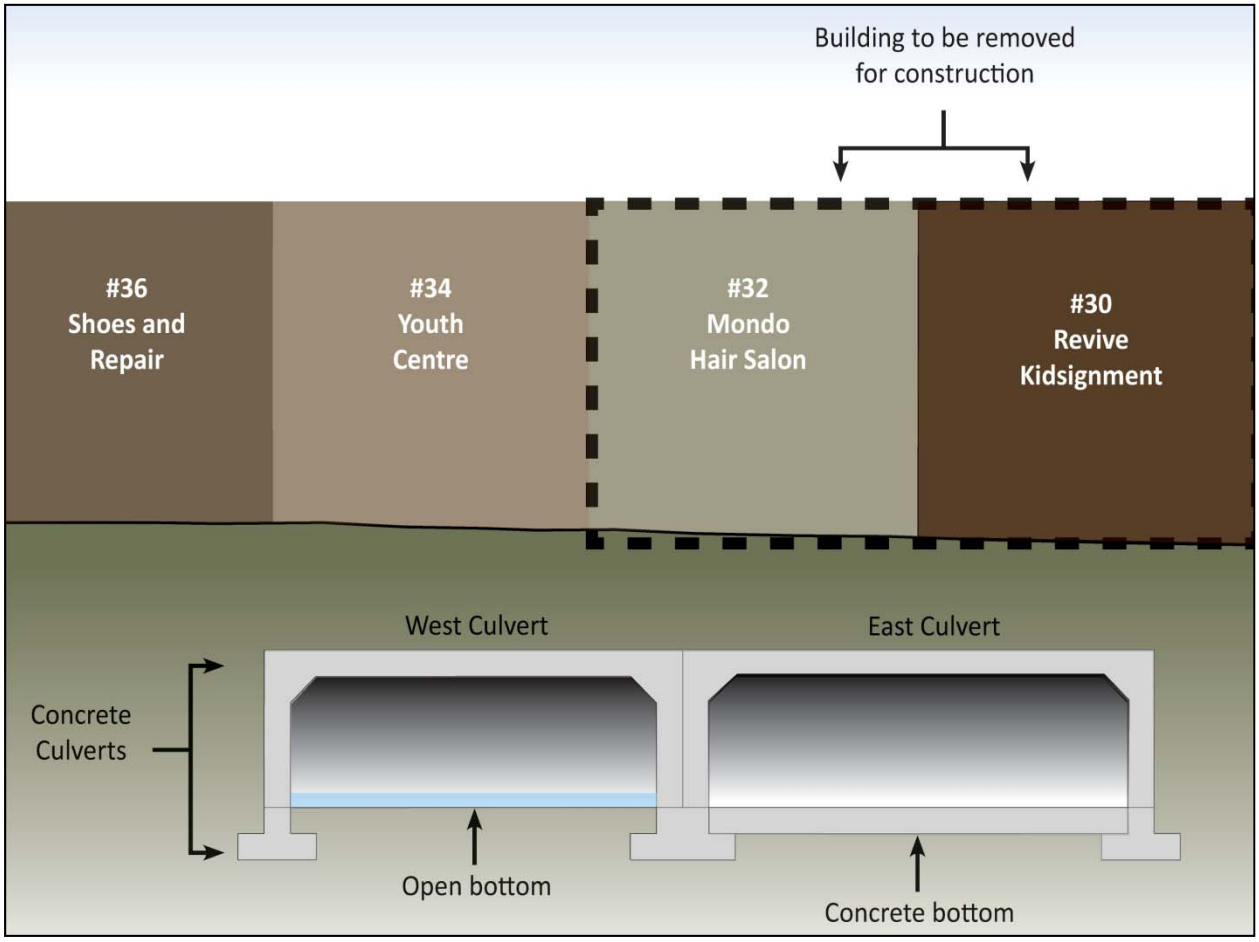

Figure 27. Conceptual cross-section of the proposed culverts (cross-section A-A)

It is proposed that the west culvert be 135 m long, with an open-bottom structure aligned with the natural channel of Uxbridge Brook, to maintain fish passage. The culvert will end approximately 40 m north of Brock Street, to allow for creation of an open channel where Uxbridge Brook is currently under the parking lot (shown in blue on **Figure 26**). The existing section of culvert under #34 Brock Street (Youth Centre) can be retained (shown in purple on **Figure 26**). The east culvert would be 195 m long, extending the entire length of the existing structure under Brock Street. This culvert would have a concrete bottom, and would only function during large storm events. The building at #30/32 Brock Street would have to be demolished to accommodate construction of the east culvert.

The design team contacted Con Span Canada, to confirm that straight line precast units can be used to approximate the curved alignment shown on **Figure 26**. It was confirmed that the radius and smoothness of the curvature is feasible, and can be adjusted during detailed design.

The section of open channel would have steep side slopes, approximately 4.5 to 6.0 m high, to account for the difference in elevation between the existing ground surface and the invert of the creek (**Figure 28**). The side slopes would consist of vegetated rock, to balance the need for structural stability and providing shade and habitat for the creek. The channel within the 7.0 m wide corridor would be designed with natural channel design principles, in consultation with the Lake Simcoe Region Conservation Authority. Pedestrian railings would be required along the top of the channel corridor for pedestrian safety.

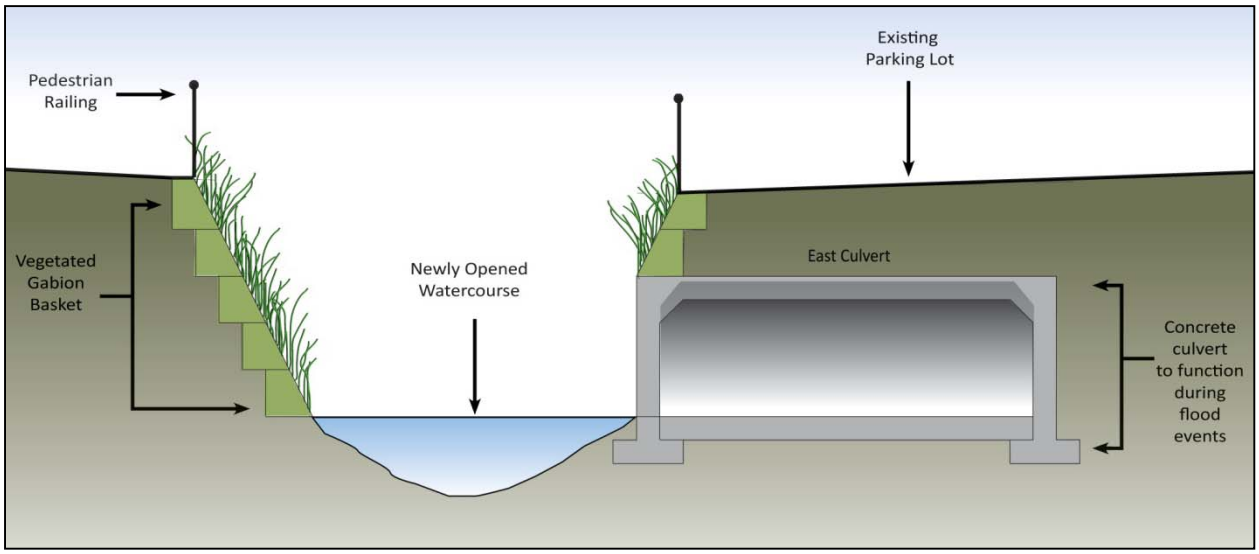

Figure 28. Conceptual cross-section of the proposed open channel (cross-section B-B)

10.2 Permitting and Approval Requirements / Guidelines

Each of the following permits and/or approvals applies to the implementation of the project.

Fisheries Act

Uxbridge Brook meets the definition of direct fish habitat under the federal Fisheries Act. Fisheries and Oceans Canada (DFO) has signed a Level 3 partnership agreement with the Lake Simcoe Region Conservation Authority to review proposed projects under Section 35 of the Fisheries Act which deals with the management and protection of fish habitat. The LSRCA

determines how the proponent can mitigate any potential impacts to fish and fish habitat. If impacts to fish and fish habitat can be mitigated, then the CA issues a Letter of Advice. If impacts to fish and fish habitat cannot be fully mitigated, the LSRCA works with the proponent and reviews the fish habitat compensation plan. The project is then forwarded to the local DFO District Office for authorization under the Fisheries Act.

Greenbelt Act

Section 4.2.1 of the Greenbelt Plan contains policies that pertain to infrastructure projects. The Class EA study area falls within an area designated under the Greenbelt Plan. Infrastructure projects that are approved under the Environmental Assessment Act are permitted, provided that the policies of the Plan are adhered to. The policies were reviewed, and the project as proposed meets all requirements.

- The culvert reconstruction serves growth and development within southern Ontario by maintaining transportation facilities that connect settlement areas
- The proposed culvert reconstruction minimizes intrusion into the Greenbelt by keeping to the existing infrastructure location
- Design and construction practices proposed minimize negative impacts and disturbance to the existing landscape
- The culvert reconstruction is coordinated as part of an infrastructure maintenance plan
- The design of the culvert reconstruction minimizes encroachment into key natural heritage features and key hydrologic features of the Greenbelt

Planning Act

Under the authority of Section 3 of the Planning Act, the Provincial Policy Statement provides policy direction on matters of Provincial interest related to land use planning and development. Specific policies pertaining to infrastructure, natural heritage and cultural heritage were reviewed, and it was determined that the project as proposed meets all requirements.

- The culvert reconstruction is coordinated as part of an infrastructure maintenance plan
- The proposed culvert reconstruction will improve use of an existing facility, and improve the safety of emergency services delivery over the long-term
- The infrastructure improvements gave consideration to the wise use and management of resources in the area
- Impacts to natural heritage features and functions of the area were avoided or minimized. The culvert reconstruction does not interfere with provincially significant natural features of the study
- Site alteration within areas identified as fish habitat was planned in accordance with provincial and federal requirements
- Significant archaeological resources have been identified, and measures recommended to protect these resources

Lake Simcoe Protection Plan

Under the Lake Simcoe Protection Act (2008), the Lake Simcoe Protection Plan was developed, as part of an overall strategy to protect and restore the ecological health of the Lake Simcoe watershed. The Plan generally applies to all waters draining into Lake Simcoe.

Within the Shorelines and Natural Heritage section of the Plan, there are policies that specifically relate to both Lake Simcoe and its streams. These policies were reviewed, and it was determined that the project meets all applicable requirements of the Plan:

- The culvert structure will not impede the natural flow of water within the watercourse
- Natural shoreline treatments (bioengineering) are proposed in any areas that will be disturbed by construction
- The culvert replacement will not interfere with any ongoing or planned stewardship or remediation efforts on the watercourse
- The proposed design improves fish habitat, enhances riparian zone function, protects important ecological features, controls potential for sedimentation and erosion, and utilizes native vegetation to enhance wildlife habitat

Ontario Water Resources Act

If construction dewatering will require groundwater takings in excess of 50,000 L per day, a Permit to Take Water will be required from the Ministry of Environment.

Ontario Regulation 179/06 – Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses

The proposed culvert reconstruction falls within an area regulated by the Lake Simcoe Region Ontario Conservation Authority (LSRCA). Under Section 28 of the Conservation Authorities Act, each Conservation Authority has the ability to regulate alterations or interference with watercourses or wetlands in the area over which it has jurisdiction. Any work within a regulated area requires a permit from the LSRCA.

11 Public Consultation Summary

11.1 Stakeholders

A stakeholder list was compiled for the project, representing all parties that could have an interest or regulatory authority over some portion of the project. The stakeholder list was comprised of members of the general public, adjacent property owners, government review agencies, municipal staff, First Nations, and any other organizations or individuals that expressed an interest in the project. The list of stakeholders is provided as **Appendix M**.

11.2 Notices and Advertisements

As part of the public consultation process, several formal notices and advertisements were published and distributed to the project stakeholders. Specifically, Notices of Study Commencement, Public Information Centres, and Study Completion were circulated to all stakeholders. The notices were also published in the Uxbridge Times. In addition to mailing of Notices, flyers were posted in the local community, at Zehrs, Wal-Mart, Canadian Tire, Mac's Milk, Vince's Market, Blue Heron Book Store, Presents Presents, Swiss Chalet, Uxpool, the Township Senior Centre, and the Township Arena. Copies of all notices and are provided in **Appendix N**.

11.3 Consultation with the Community

Consultation with the local community occurred via interactions with members of the Uxbridge Watershed Advisory Committee, the Business Improvement Area association, and correspondence with the study team. All project correspondence is provided in **Appendix O**.

Several news articles were also written about the project, highlighting key developments and issues of interest to the local community. Articles were published on November 26, 2009, August 25, November 25, November 30, and December 2, 2010, July 19, October 27, and November 10, 2011. Copies of the news articles are provided as **Appendix P**.

A presentation was made by the Township and the Uxbridge Watershed Advisory Committee to the Business Improvement Area association on August 9, 2011. A press briefing was also conducted by the Township and the Uxbridge Watershed Advisory Committee on October 24, 2011. Copies of the presentations are provided as **Appendix Q**.

11.4 Consultation with Review Agencies

In response to the project Notices, comments were received from review and approval agencies, indicating their particular interests in the project. All Class EA related correspondence is provided within **Appendix O**. As the provincial agency with responsibility for administering the Environmental Assessment Act, the Ministry of the Environment (MOE) provided specific comment on this project. **Table 12** summarizes the issues that were raised by the MOE, and the approach that was taken to address each of the concerns.

The Ministry of Natural Resources deferred comments to the Lake Simcoe Region Conservation Authority (LSRCA) for this project, noting that they should be contacted only if Species at Risk were found within the study area. The LSRCA was an active member of the Steering Committee for this project, and as such, provided technical and policy input throughout the course of the study.

Table 12. Comments received from the MOE and resulting project action

Issue	Response / Action
Impacts to ecosystem form and function must be avoided where possible.	Ecosystem form and function was studied as part of the existing environment documentation. Important features were identified and considered during the planning and design phases of the project. Mitigation measures were outlined for any potential residual impacts.
All natural heritage features must be identified and described, to develop appropriate mitigation measures.	A natural heritage inventory was conducted as part of the existing environment documentation. No provincially significant natural heritage features were identified within the study area.
Demonstrate that there will be no negative impact to the form and function of the watercourses in the study area. The MOE guideline for *Evaluating Construction Activities Impacting on Water Resources* should be followed.	A study of Uxbridge Brook within the Class EA study area was conducted to determine the local sensitivities of the site. The MOE guidelines were reviewed, and appropriate mitigation measures were recommended to minimize potential impact. It is expected that the recommended design will have an overall benefit to fish habitat.
A stormwater management plan should be prepared as part of the Class EA. The MOE *Stormwater Management Planning and Design Manual (2003)* should be used for designing control methods.	A stormwater management plan was not prepared, as no storm sewers are being proposed, nor increases to impervious areas, nor alteration to existing drainage patterns.
The study area is within an area of high aquifer vulnerability. Potential impacts to groundwater dependent natural features should be addressed.	The proposed construction area is greater than 400 m from the Wellhead Protection Areas in Uxbridge, and groundwater vulnerability in the area of proposed construction is considered low. Therefore, no impacts to groundwater are anticipated from construction of the preferred design.
Any requirements for groundwater takings should be identified, and takings exceeding 50,000 L/day will require a Permit to Take Water under the *Ontario Water Resources Act*.	If construction dewatering will require groundwater takings in excess of 50,000 L/day; a Permit to Take Water will be obtained from the Ministry of Environment.

Table 12. Comments received from the MOE and resulting project action (cont'd)

Issue	Response / Action
Dust and noise control measures should be addressed in construction plans to minimize effects on sensitive land uses. If dust suppressants are proposed, only non-chloride based compounds should be used to protect water quality.	At the time of detailed design, the drawings are to specify that Regional and Township noise by-laws be respected for hours of construction operation. During dry periods, bare soil should be covered with water and non-chloride dust suppressant to limit generation of excessive dust. All disturbed areas are to be restored quickly.
Prior to removal or movement of soil, contaminant levels testing should occur. If soils are contaminated, disposal should be consistent with Part XV.1 of the *Environmental Protection Act* and Ontario Regulation 153/04.	Soil samples from the geotechnical investigation were analyzed and compared with criteria under the Ministry of Environment's Soil, Groundwater and Sediment Standards for Use under Part XV.1 of the *Environmental Protection Act*. The parameters tested satisfy the commercial standards.
The location of underground storage tanks should be identified, and measures should be taken to ensure integrity of the tanks. The MOE Spills Action Centre must be contacted in the event of a spill.	A search of Regional and Township records was conducted to determine the presence of underground storage tanks. There are no known underground storage sites in the proposed area of construction.
Any current or historical waste disposal sites should be identified, and status determined pursuant to Section 46 of the *Environmental Protection Act*.	A search of Regional and Township records was conducted to determine the presence of waste disposal sites. There are no known sites in the proposed area of construction.
Underground transmission lines should be identified, and owners consulted to avoid impacts to this infrastructure.	Underground transmission line companies were contacted as part of the stakeholder consultation for this project. No facilities were identified in the proposed area of construction.
Design and construction reports and plans should be based on a best management practice approach to limit impact on the existing environment.	At the time of detailed design, the drawings are to specify appropriate mitigation measures and best management practices for construction.
All waste generated during construction must be disposed of in accordance with MOE requirements.	At the time of detailed design, the drawings are to specify appropriate waste disposal methods.
Contractors must be made aware of all environmental protection measures, and mitigation measures should be monitored during construction. A post-construction monitoring plan is also recommended.	At the time of detailed design, the drawings are to specify appropriate details of environmental protection measures, mitigation strategies, and construction monitoring, to be reviewed by the contractors prior to construction.

Table 12. Comments received from the MOE and resulting project action (cont'd)

Issue	Response / Action
Demonstrate adherence to Section 4.2.1 – General Infrastructure Policies of the *Greenbelt Plan*.	The *Greenbelt Plan* was reviewed, and it was confirmed that the proposed project conforms to all relevant infrastructure policies.
Demonstrate consistency with applicable policies of the 2005 *Provincial Policy Statement*.	The *Provincial Policy Statement* was reviewed, and it was confirmed that the proposed project conforms to all relevant policies.
Provide clear and complete documentation of the Class EA planning process, and demonstrate how public consultation requirements have been met.	Full public consultation was employed throughout the Class EA process, with all required documentation provided within this Environmental Study Report (including appendices).
Identify all potential impacts of the alternative solutions considered. Provide supporting studies referenced in the Class EA document.	Supporting studies for the Class EA are summarized in this report and are appended for public and agency review.
Provide a list of all permits and approvals that are required for implementation of the preferred solution.	All required permits and approvals are identified in this Environmental Study Report.
Review all applicable MOE guidelines and reference relevant information in the Environmental Study Report.	All applicable MOE guidelines were reviewed and referenced in this report as appropriate.
Contact the Ministry of Aboriginal Affairs and the Department of Indian and Northern Affairs to determine potentially affected Aboriginal peoples in the project area.	First Nations groups and the associated provincial and federal agencies responsible for First Nations affairs were contacted through the public consultation process for this Class EA.
Provide notification directly to the Aboriginal peoples who may be affected by the project, and provide an opportunity to participate in public consultation on the project.	Notification to specific First Nations groups identified as having an interest in the Class EA study area were contacted directly to solicit input and provide an opportunity for participation in consultations.

11.5 Consultation with First Nations

To assist with developing a meaningful stakeholders list for the project, and to fulfill the requirements of the Class EA process, correspondence was initiated with Indian and Northern Affairs Canada, and the Ministry of Aboriginal Affairs, to identify which First Nations would have a local interest in the project. Upon identification of the First Nations with potential interest in the project, individual mailings of project notices were provided. Full correspondence details are provided in **Appendix O**.

11.6 Public Information Centres

Three Public Information Centres (PICs) were held during the Class EA study, to communicate the planning process, significant findings, alternatives considered, and recommended solutions. The PICs were also structured to receive feedback on the various alternatives proposed. Notices for each of the PICs were directly mailed to all stakeholders including local residents, and were advertised in the Uxbridge Times.

For each PIC, display panels were available and staff from the Township of Uxbridge, Region of Durham, and SRM Associates were available for one-on-one discussions. Comment forms were also available to provide an opportunity for further input at a later date. Comment forms were available at the PICs and on the Township and Region's websites. A presentation to Council was also provided prior to PIC #3.

Attendance registers, presentation material, and summary reports from each of the PICs are provided as **Appendix R**.

12 Confirm Recommended Design and Municipal Class EA Schedule

The last step in the Municipal Class EA process is to confirm the recommended solution, and confirm selection of the appropriate project 'schedule'.

The road, water, and wastewater project schedules in Appendix 1 of the MEA document were re-reviewed, to confirm categorization of the project. The recommended design involves work in a watercourse for the purpose of flood control, which triggers the Schedule 'B' process. The culvert replacement is classified as Schedule A+. However, the identified impacts (e.g. property acquisition, impacts to fisheries, impacts to a community), are considered major, therefore the project is most appropriately classified as Schedule 'C'.

13 Environmental Study Report and Notice of Completion

At the conclusion of the Class EA process, an Environmental Study Report is completed, and a Notice of Study Completion is filed. The Notice was mailed directly to all stakeholders and advertised in the Cosmos on November 15 and 22, 2012. A copy of the notice is provided in **Appendix N**.

This Environmental Study Report is available for public review and comment for thirty (30) calendar days from November 15 to December 17, 2012. Copies of the report are available for reviewing during normal business hours at the following locations:

Uxbridge Public Library
9 Toronto St. S
Uxbridge, ON L9P 1T1

Township of Uxbridge
51 Toronto St. S
Uxbridge, ON L9P 1T1

Region of Durham – Clerks Office
605 Rossland Road East, Level 5
Whitby, ON L1N 6A3

If concerns regarding the project cannot be resolved in discussion with the Township and Region, a person or party may request that the Minister of the Environment make an order for the project to comply with Part II of the Environmental Assessment Act (referred to as a Part II Order), which requires an Individual Environmental Assessment. Requests must be received by the Minister within the 30-day review period. If no new or outstanding concerns are brought forward during the review period, the Township and Region may complete detailed design and construction of the project.

Anyone wishing to request a Part II Order must submit a written request, by the end of the thirty (30) calendar day review period on December 17, 2012, to the Minister of the Environment at the following address, with a copy sent to the Township Clerk (address below) and the Township's Director of Public Works.

Hon. Jim Bradley
Minister of the Environment
77 Wellesley Avenue
Ferguson Block, 11th Floor
Toronto, ON M7A 2T5

Ben Kester, C.E.T.
Director of Public Works
Township of Uxbridge
51 Toronto St. S
Uxbridge, ON L9P 1T1

Clerk
Township of Uxbridge
51 Toronto St. S
Uxbridge, ON L9P 1T1