Prepared for:

The Corporation of the City of Mississauga

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Schedule B Class Environmental Assessment – Project File

Loyalist Creek Erosion Control Project behind Thorn Lodge Drive

A project file submitted by:

Aquafor Beech Ltd.

October 18, 2021

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Aquafor Beech Reference:
66712

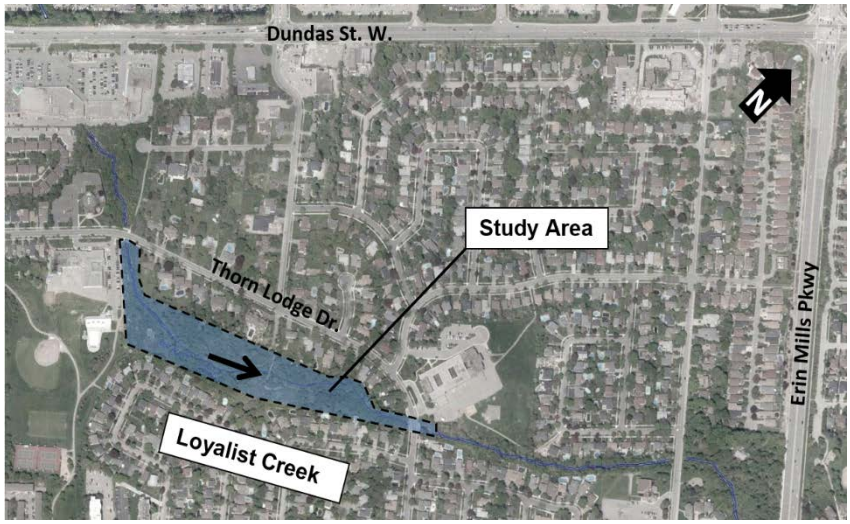
NOTICE OF STUDY COMPLETION

Municipal Class Environmental Assessment (EA) Study: Loyalist Creek Erosion Control Project behind Thorn Lodge Drive

PROJECT BACKGROUND

The City of Mississauga has completed a Municipal Class Environmental Assessment (Class EA) Study for erosion control and restoration of Loyalist Creek behind Thorn Lodge Drive.

The Study was undertaken to address existing erosion and safety issues along the creek. Some of the existing creek banks are lined with stone-filled gabion baskets that are approaching the end of their lifespan and have begun to collapse. Other creek banks are lined with large armourstone blocks, some of which have become dislodged. Upstream stone material is also accumulating at the base of the study area, restricting flow conveyance.



STUDY COMPLETION

Based on the Study findings and feedback received, a reach-based solution was selected as the preferred approach to provide long-term erosion control while managing the extent of environmental impacts. Local restoration works are recommended within the upstream and downstream reaches of the study area (Reaches 1 and 3), and engineered channel restoration is recommended in the mid-to-lower reach (Reach 2)

A Project File Report has been prepared to document the planning and decision-making process for this study. By this Notice, the Project File is being made available for review over an extended timeframe of 45 days, from October 26, 2021 to December 10, 2021 on the City's project website:

https://www.mississauga.ca/projects-and-strategies/environmental-assessments/loyalist-creek-erosion-control-project-behind-thorn-lodge-drive/

Should a member of the public request a hard copy of the Project File, the City will assess how this might be delivered in a manner that is consistent with regional and provincial guidelines supporting physical distancing during the current pandemic.

PROVIDING COMMENTS

If you have any questions, comments or concerns, please contact the project team by December 10, 2021:

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In addition, a request may be made to the Ministry of the Environment, Conservation and Parks for an Order requiring a higher level of study on the grounds that the requested Order may prevent, mitigate, or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. This request should be sent in writing or email by December 10, 2021 to the addresses listed below:

Minister of Environment, Conservation and Parks
Ministry of Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto ON M7A 2J3
minister.mecp@ontario.ca

Director, Environmental Assessment Branch
Ministry of Environment, Conservation and Parks
135 St. Clair Ave. W, 1st Floor
Toronto ON, M4V 1P5
EABDirector@ontario.ca

A copy of the Order request should also be sent to the City of Mississauga project manager.

This Study was conducted in accordance with the planning process for Schedule "B" projects as outlined in the *Municipal Engineers Association Municipal Class Environmental Assessment* (October 2000, as amended in 2007, 2011, and 2015), which is approved under the *Ontario Environmental Assessment Act*. Personal information submitted is collected under the authority of the Environmental Assessment Act and will become part of the record that is available to the general public.

This Notice issued on **October 26, 2021**.

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1 INTRODUCTION

1.1 Overview of Study and Problem

Aquafor Beech Limited (Aquafor), was retained by the City of Mississauga to provide comprehensive engineering, geomorphic, ecological, and Environmental Assessment (EA) services to complete the Schedule B Municipal Class EA Loyalist Creek Erosion Control project.

This Project File is intended to document the process used to determine the preferred restoration strategy for the deteriorated Loyalist Creek corridor behind Thorn Lodge Drive. The project will provide long-term protection against channel erosion that will reduce the risk to public safety and municipal infrastructure, prevent future property damage, and improved overall health of the watercourse. The general extent of the study area is illustrated in Figure 1-1.

Figure 1-1. Loyalist Creek Study Area – Thorn Lodge Drive

1.2 The Environmental Assessment Process

The Environmental Assessment Act was legislated by the Province of Ontario in 1975 to ensure that an Environmental Assessment (EA) is conducted prior to the onset of development and development-related (servicing) projects. The "environment" as defined by the EA Act is understood broadly to include the biophysical, socio-cultural, built and economic environments and the interrelationships between them. The EA Act applies primarily to public sector undertakings and extends to private sector projects where designated under the regulation. Depending on the individual project to be completed, there are different processes that municipalities must follow to meet Ontario's Environmental Assessment requirements.

The EA Act draws a distinction between "Individual" and "Class" environmental assessments. Individual EAs are prepared for large, complex projects in which significant environmental impacts are foreseeable. A "Terms of Reference" are devised which outline the EA process, and the final EA document is submitted to the Ministry of the Environment, Conservation and Parks (MECP) for approval. Alternatively, a Class EA is a streamlined approval process for a group of routine undertakings with predictable environmental impacts. Once a Class EA planning document is approved by the MECP, all projects of this type are pre-approved provided that they adhere to its design. In this fashion, the Class EA process expedites approval for smaller, recurring projects.

The Municipal Class EA, which is followed here, outlines how municipal infrastructure projects are planned in accordance with the EA Act. The Municipal Class EA is consistent with the EA Act's five key principles for successful planning:

- Consultation with affected parties early on and throughout the process, such that the planning process is a cooperative venture;
- Consideration of a reasonable range of alternatives, both the functionally different "alternatives to" and the "alternative methods" of implementing the solution;
- Identification and consideration of the effects of each alternative on all aspects of the environment;
- Systematic evaluation of alternatives in terms of their advantages and disadvantages, to determine their net environmental effects; and,
- Provision of clear and complete documentation of the planning process followed, to allow "traceability" of decision-making with respect to the project.

As the project being undertaken is defined as an Erosion project, the Schedule B process as defined in the Municipal EA (2015) document is applicable.

A summary of the Class EA process and phases is provided below, with the accompanying flow chart (Figure 1-2) illustrating the process followed in the planning and design of projects covered by this Class Environmental Assessment:

Phase 1: Identify the problem or deficiency.

Phase 2: Identify alternative solutions to the problem by taking into consideration the existing environment, and establish the preferred solution taking into account public and agency review and input. At this this point, determine the appropriate Schedule for the undertaking and document decisions in a Project File for Schedule B projects, or proceed through the following phases for Schedule C projects.

Phase 3: Examine alternative methods of implementing the preferred solution, based upon the existing environment, public and government agency input, anticipated environmental effects and methods of minimizing negative effects and maximizing positive effects.

Phase 4: Document, in an Environmental Study Report, a summary of the rationale and the planning, design, and consultation process of the project as established throughout the above phases, and make such documentation available for scrutiny by review agencies and the public.

Phase 5: Complete contract drawings and documents, and proceed to construction and operation; monitor construction for adherence to environmental provisions and commitments. Where special conditions dictate, also monitor the operation of the completed facilities. Public and agency consultation is also an important and necessary component of the five phases.

The Municipal Engineers Association's Class EA document also classifies projects as Schedule A, A$^+$, B or C depending on their level of environmental impact and public concern.

- Schedule 'A' projects are limited in scale, have minimal adverse environmental effects and generally include routine maintenance and operational activities. These projects are pre-approved and may proceed to implementation without following the full Class EA planning process.

- Schedule 'A+' projects have minimal adverse environmental effects and are pre-approved, however the public is to be advised prior to project implementation."

- Schedule 'B' projects have the potential for some adverse environment effects. Projects generally include improvements and minor expansions to existing facilities. These projects require completion of Phases 1 and 2 of the Class EA process, before proceeding to Phase 5 Implementation.

- Schedule 'C' projects have the potential for significant environment effects. Projects generally include the construction of new facilities and major expansions to existing facilities. These projects require completion of Phases 1 through 4 of the Class EA process, before proceeding to Phase 5 Implementation."

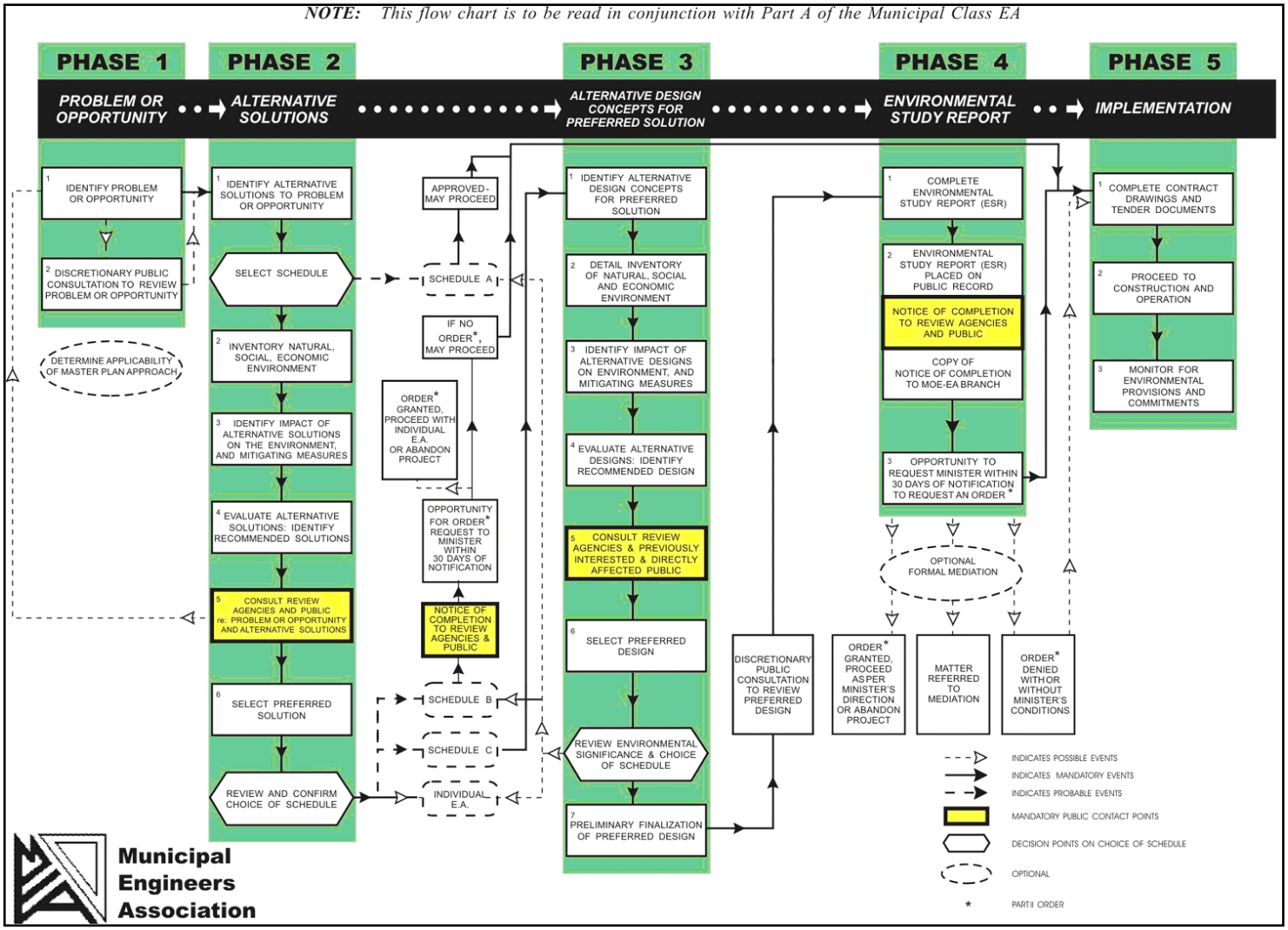


Figure 1-2. Municipal Class Environmental Assessment Planning and Design Process (MCEA, 2015).

2 PHASE 1 – PROBLEM IDENTIFICATION

2.1 Problem Identification

Loyalist Creek watershed, with a total drainage area of 9.83 km2, is a subwatershed of the Lower Credit Watershed within the jurisdiction of Credit Valley Conservation (CVC). The watercourse is located within a highly urbanized watershed that encompasses land uses including residential, industrial commercial and very little open space.

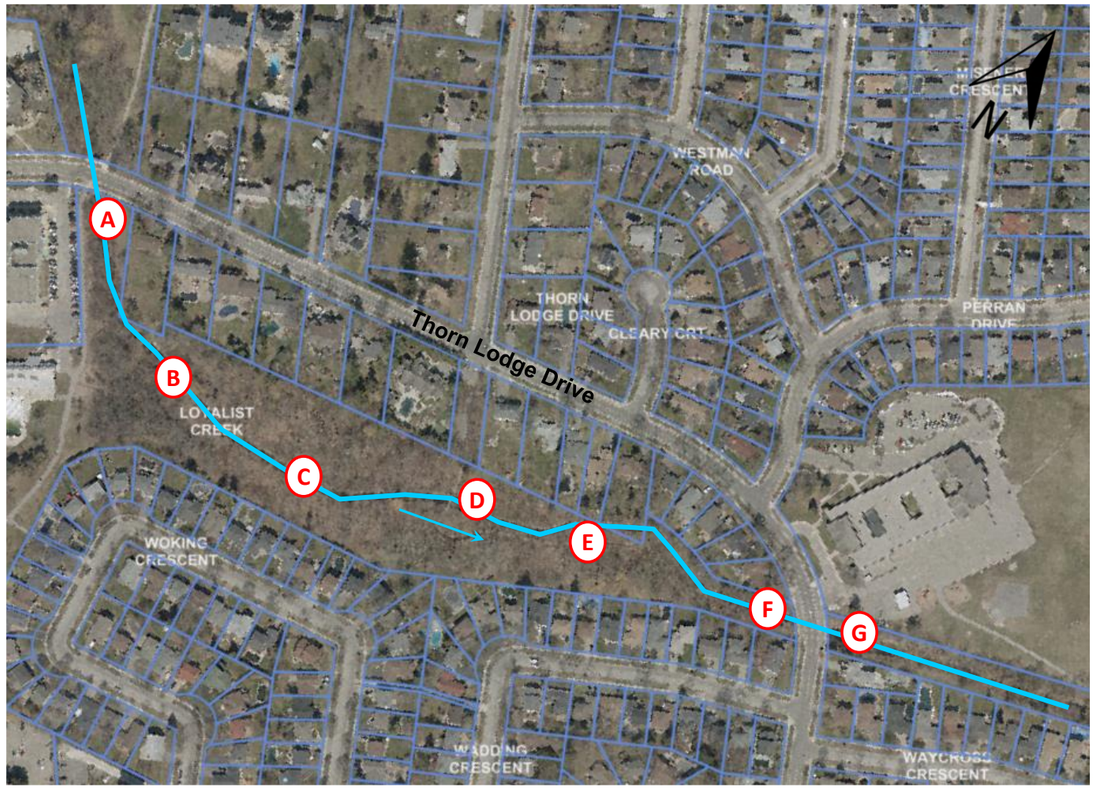
Specific to the ~ 650m corridor behind Thorn Lodge Drive, Loyalist Creek has been channelized within a narrow right of way to accommodate the adjacent residential community development. Through the 1970s to 1980s, a series of channelization works from downstream to upstream were undertaken, limiting natural planform adjustment of Loyalist Creek using a combination of armourstone retaining walls for the upstream section, and gabion baskets downstream. To offset the impacts of continuing urbanization, rehabilitation works were completed for the upstream half of the creek, involving reposition of dislodged stones, grouting the armourstone base, and incorporation of a low flow channel.

As observed during the site reconnaissance exercise, Loyalist Creek exhibits various conditions and levels of deterioration throughout the study area. The armourstone walls are in moderate condition, with potential risks of undermining due to toe erosion, as well as poor drainage and loss of material behind the walls. The gabion baskets, however, show signs of significant erosion and failures, with the majority of the base row deteriorated such that all stone materials have been washed downstream, with the upper rows floating above. Without intervention, eroded banks and incised channels can lead to significant increases in risk and mass failures of the channel and adjacent private properties. A photographic compilation of the existing conditions, highlighting the areas of pertinent risk to be considered through the EA are shown in Figure 2-1.

2.2 Study Objective

The objective of this study is to assess the existing condition of Loyalist Creek and explore and assess alternatives to address the erosion concerns within the selected reaches.

The main focus of this study is to find a preferred alternative that will maintain and protect the adjacent properties and the infrastructure at a reasonable cost, while enhancing ecological and aquatic conditions of the corridor. This solution will include erosion mitigation and prevention measures for Loyalist Creek and the adjacent lands, and will ensure conveyance capacities and flooding is not negatively impacted.



A. Upstream Thorn Lodge Drive culvert with brick-lined wingwalls in fair conditions.

B. Section of armourstone retaining walls in fair conditions.

C. Section of armourstone retaining walls in poor conditions, with dislocated stone and loss of drainage material.

D. Existing deteriorated stormwater outfall immediately downstream of pedestrian bridge.

E. Failure of gabion baskets and loss of tableland in close proximity of private property.

F. Failing gabion baskets with empty bottom, upstream of the downstream Thorn Lodge Drive culvert.

G. Large accumulation of engineered material, backwatering and impacting conveyance of culvert.

Figure 2-1. A Photographic Compilation of the Existing Conditions.

3 PHASE 2 – SITE SPECIFIC INVENTORIES

To address Phase 2 of the EA process, site-specific studies were conducted to support the selection and design of the preferred alternative. A summary of the site-specific inventories that were conducted as part of the study process is provided below.

3.1 Surveys and Property Assessment

At the outset of the field assessments, a detailed total-station survey was undertaken to accurately define the topographic features within the study area, including the identified reaches of Loyalist Creek corridor, bridge crossings, and storm sewer infrastructure. The survey was completed in sufficient detail to enable the completion of geomorphic analysis, hydraulic modelling and detailed design. The key parameters of the survey included:

- Longitudinal profile of Loyalist Creek, surveying the channel alignment;
- Cross-sections perpendicular to the channel and extended in sufficient detail beyond the top of bank for undertaking hydraulic analysis;
- Municipal infrastructure including the storm sewer outfalls, culvert crossings, and wingwall structures;
- Existing trail and pedestrian bridge network;
- Vegetation communities that could potentially be impacted as a result of the implementation of the restoration works; and,
- Potential construction access routes.

The survey was completed using a combination of a total station and GPS techniques in order to confirm accuracy of survey consistent with UTM NAD 83 Zone 17 projection, and geodetic elevations consistent with City horizontal controls, and overlays the base-mapping provided by the City, which includes property parcels, building limits, storm sewer network alignment and contours.

The topographic information was compiled into planform and profile drawings as shown in Figure 3-1 and Figure 3-2. These drawings highlight the confined nature of the Loyalist Creek and its position and context within residential communities.

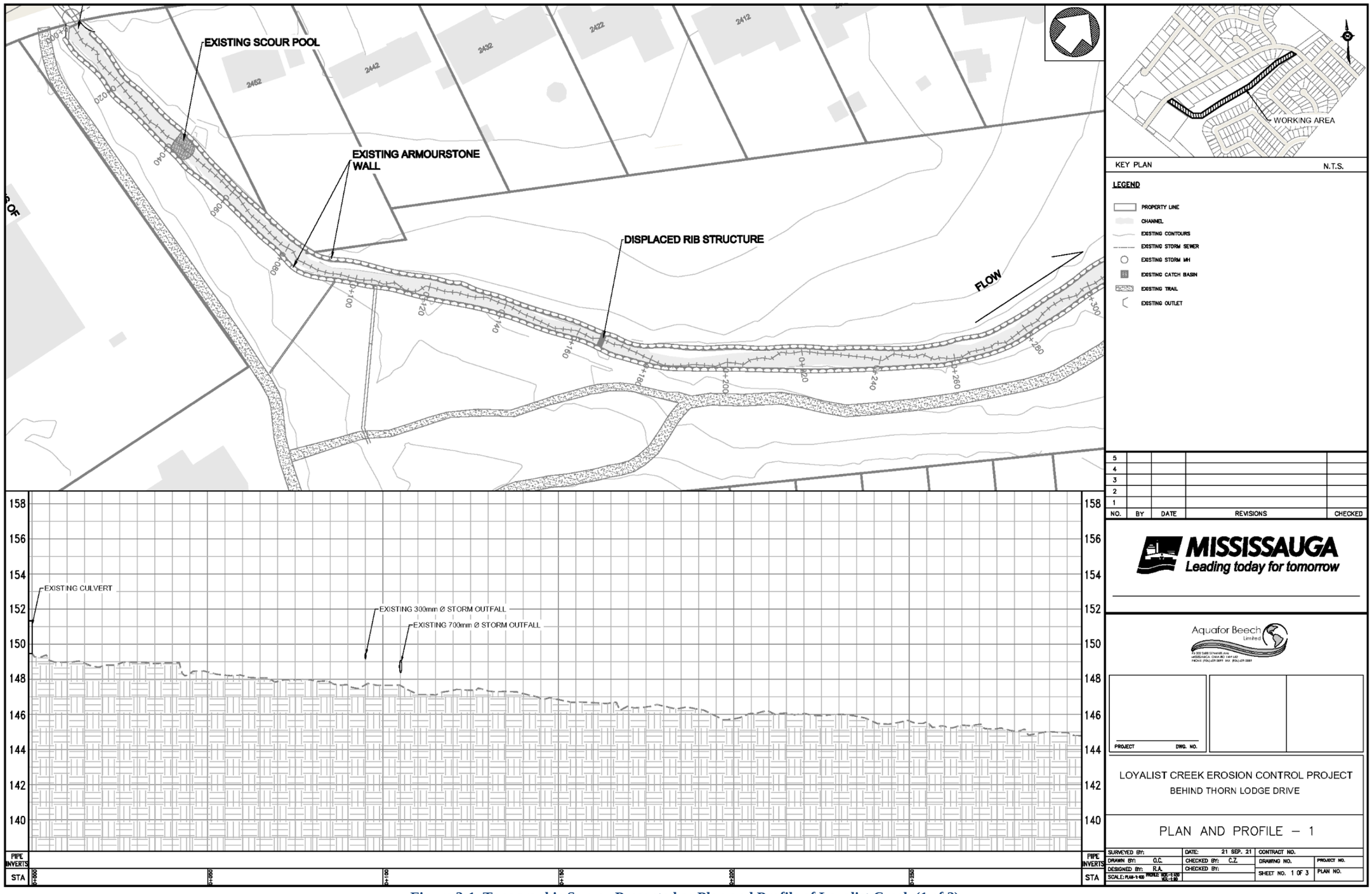


Figure 3-1. Topographic Survey Presented as Plan and Profile of Loyalist Creek (1 of 2).

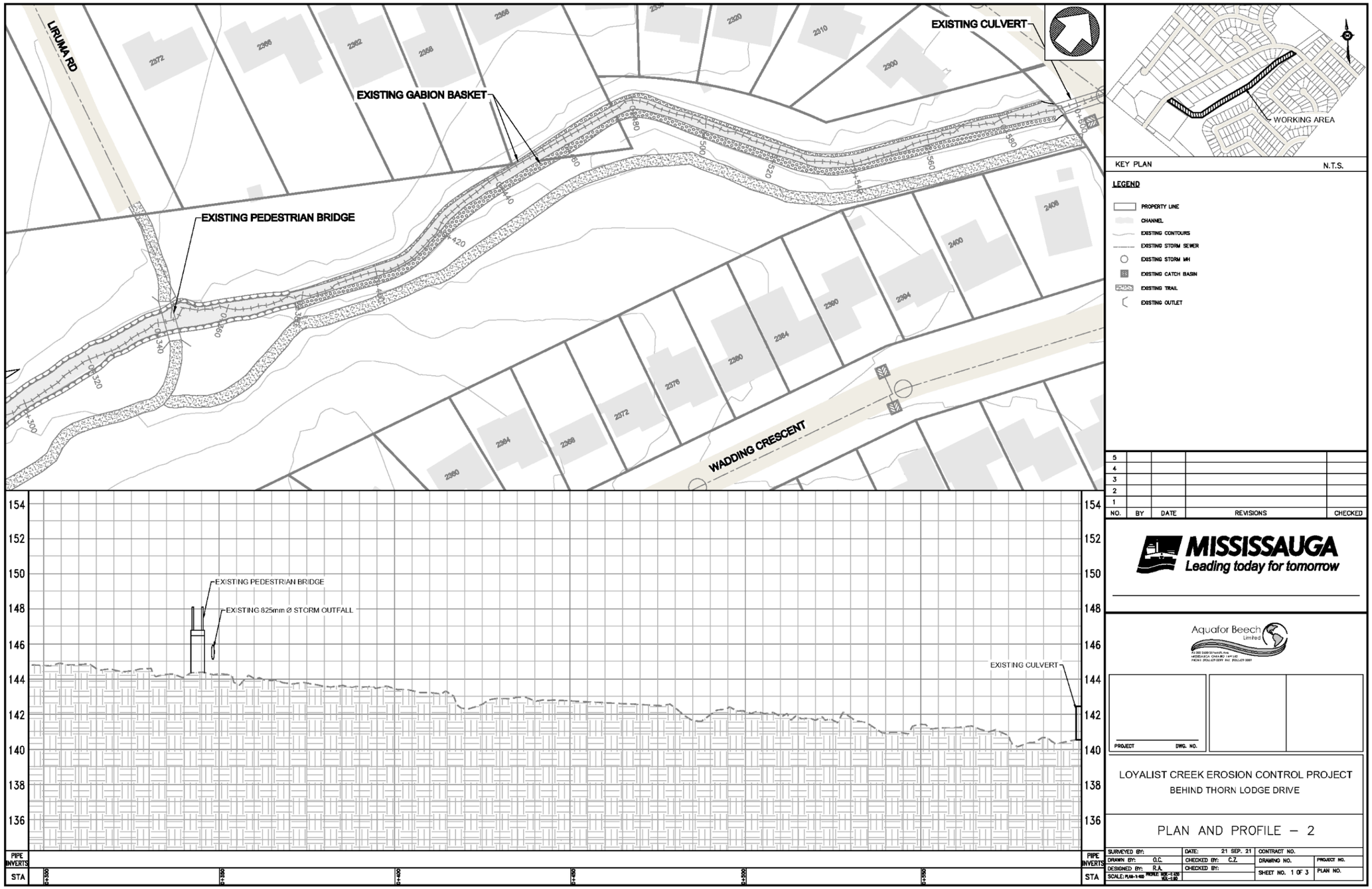


Figure 3-2. Topographic Survey Presented as Plan and Profile of Loyalist Creek (2 of 2).

3.2 Geographic and Geotechnical Investigations

The Loyalist Creek watershed is situated on young tills within the Iroquois Plain physiographic region of southern Ontario (Sharpe, 1980). Draining into the lower Credit River, the watershed is primarily characterized by three stratigraphic units: Halton Till, Bedrock, and Modern Alluvium (Ontario Geological Survey, 2005). Review of the study area quaternary geology confirms the study area is defined by shale bedrock, with Halton Till extending beyond the corridor.

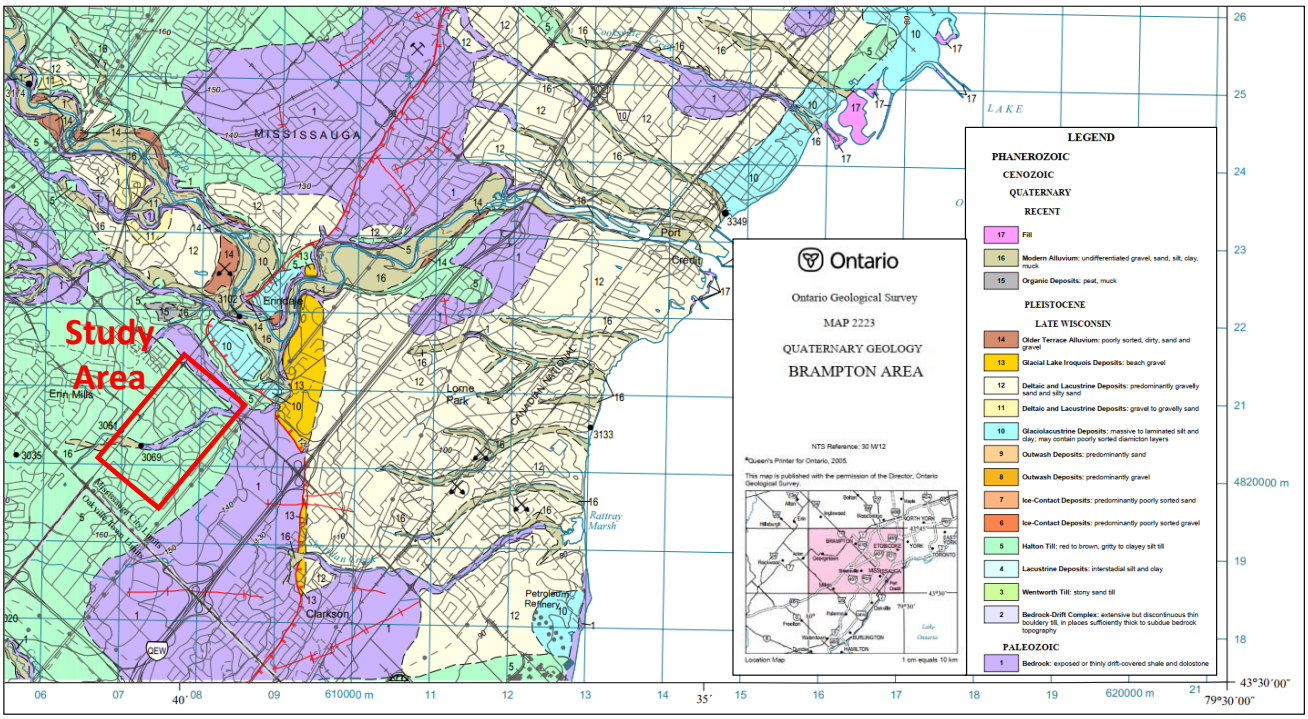


Figure 3-3. Modified Quaternary Geology Map 2223 – Brampton Area (Karrow & Easton, 2015).

It is recommended that a thorough geotechnical investigation of the study area should be carried out in order to accurately characterize the depth of overburden layers, as well as to provide insight to stable slope formation at the detailed design stage.

3.3 Geomorphic and Erosion Assessment

The Loyalist Creek watershed is an urbanized watershed which exhibits relatively flashy hydrologic responses under wet weather conditions, and has required extensive erosion control in the form of bed and bank engineering to mitigate mass creek erosion, as well as risks to adjacent private properties and recreational trails. An investigation of the historical alteration of the creek corridor provides insight and understanding of the existing conditions, particularly mass changes to the alignment, and the natural tendencies of the creek to return to pre-disturbed conditions while addressing unstable levels of shearing and velocities.

A compilation of the aerial photos and drawing records is presented in Figure 3-4 below, which highlights some of the following key features:

- 1954 – Loyalist Creek in its historical alignment, running through farmlands. Extensive canopy cover along the corridor.
- 1966 – The residential neighborhood and road network north of the creek began to grow. The downstream section of Loyalist Creek within the study area was straightened.

- 1977 – The residential neighborhood and road network within the surrounding area have been significantly developed. Continued channelization of Loyalist Creek downstream of Thorn Lodge Drive.
- 1989 – Engineering design for the upstream section of Loyalist Creek. Channelized in both plan and profile using armourstones. Construction likely caused significant loss of mature trees and vegetation cover within the corridor.
- 1992 – Loyalist Creek in its present planform, with engineered banks and bed consisting of armourstone and gabion baskets. The pedestrian bridge connecting Liruma Rd to the walking trail was constructed.
- 2020 – Existing conditions including deteriorated armourstone retaining walls, failed gabion baskets, and channel planimetric adjustment.

Figure 3-4. Comparison of Aerial Imagery and Design Records.

When completing a geomorphic assessment, it is common practice to refer a segment of watercourse that exhibits similar channel form, floodplain access, adjacent landuse and valley setting as a 'Reach'. Based upon the historic aerial imagery and field reconnaissance, Loyalist Creek within the study area was divided into three (3) distinct reaches, as depicted in Figure 3-5 below.

Moreover, when undertaking a stream restoration study at a scale consistent with this EA, consideration of separate restoration plans or alternatives for each reach enables a design methodology which is specifically refined to address the channel characteristics and risks of that reach.

Summarized in the following sections are the geomorphic and erosion conditions of each reach of Loyalist Creek.

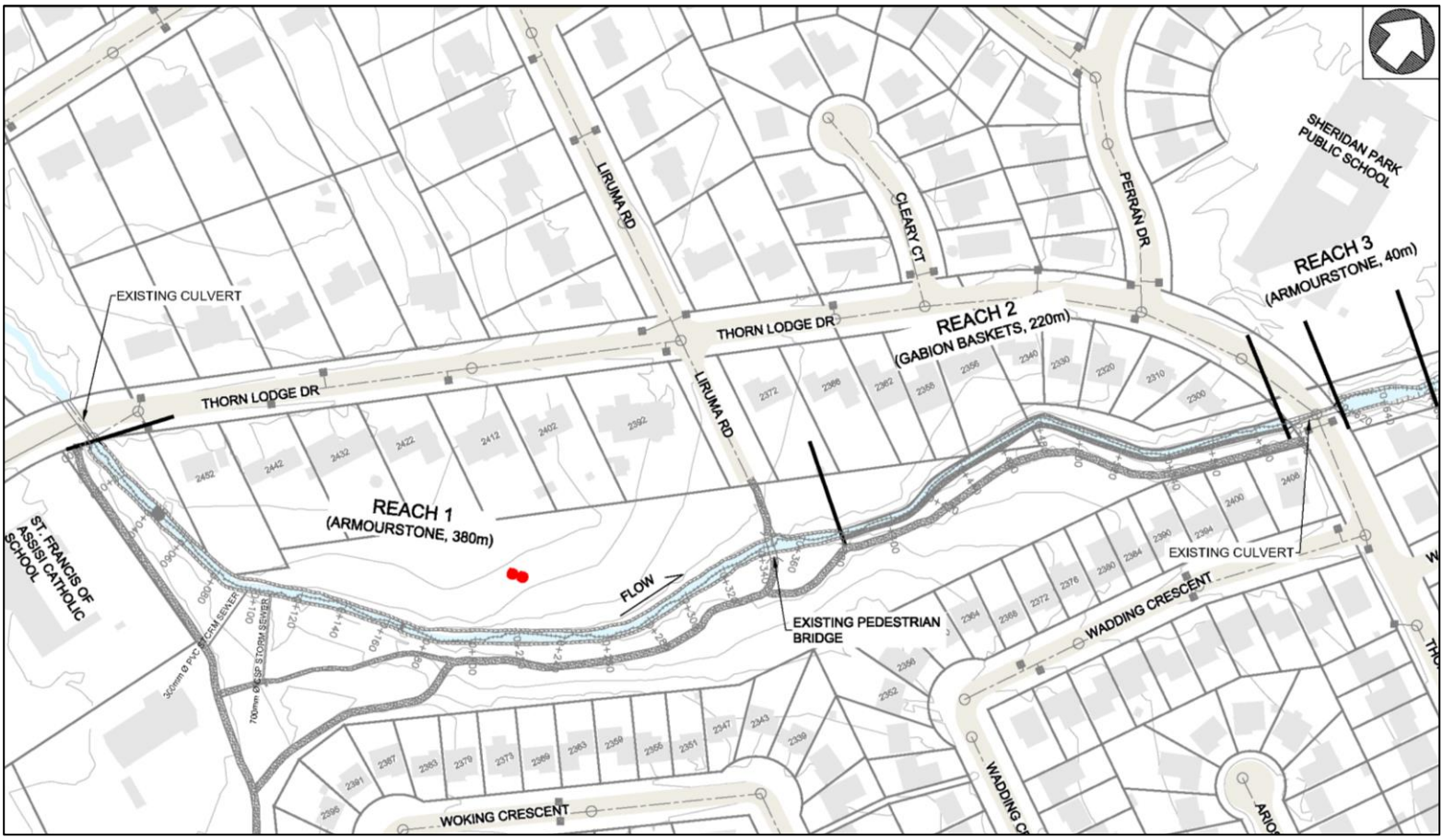


Figure 3-5. Loyalist Creek Reach Delineation.

3.3.1 *Reach 1 – West Thorn Lodge Drive Culvert to Pedestrian Bridge*

Reach 1, approximately 380m in length, is a completely engineered channel section which exhibits negligible geomorphic conditions. Specifically, planform adjustment of the channel is limited by the existing armourstone retaining walls and the profile is primarily controlled by a series of grade control structures (weirs). However, due to the age of the structures, irregular sized stones, and loss of drainage materials behind the walls, there are intermittent dislocations of stones throughout the reach. Two existing storm sewer outlets were also identified within this reach, which are in poor condition and in need of repair to prevent ultimate failure.

With regards to consideration of horizontal erosion hazards, the Technical Guide River & Stream Systems: Erosion Hazard Limit (MNRF, 2002) can be applied to the study area. The erosion hazard limit is illustrated in cross section in Figure 3-6, followed by Table 3-1 which summarizes the typical erosion allowances associated with a natural channel setting. This information is presented as reference to inform the susceptibility to erosion of Loyalist Creek over a long-term horizon.

As identified above that Reach 1 is entirely engineered and exhibit signs of stress and erosion, the existing erosion hazards within the creek corridor are relatively low. Moreover, no slope stability concerns are present within the study area where no valley slopes exist. However, if the existing armourstone walls continue to deteriorate without intervention, extensive erosion and loss of tableland are expected to happen in a short timeframe, especially within the areas identified in poor conditions under the do-nothing alternative.

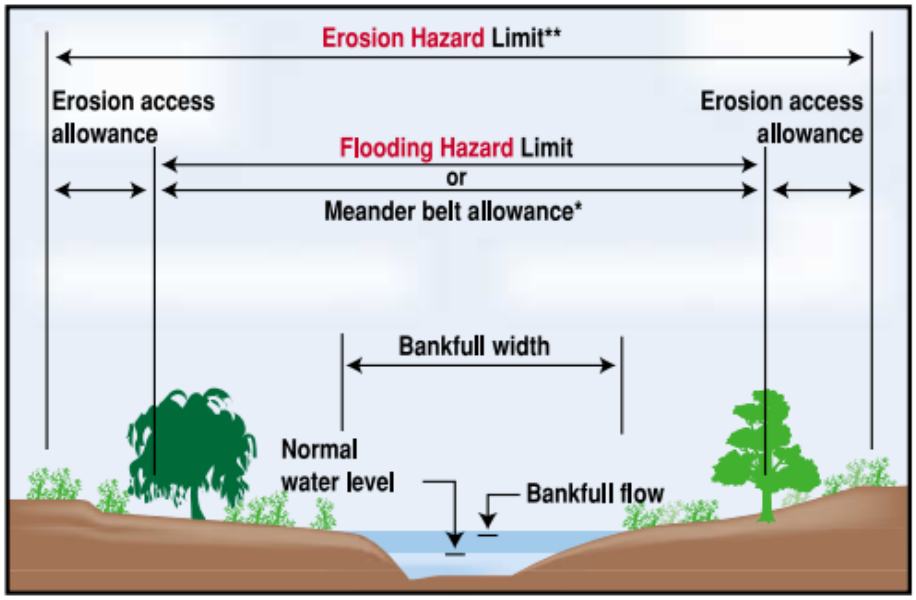


Figure 3-6. MNRF Guideline for Determining an Erosion Hazard Corridor within Unconfined Systems Such as Loyalist Creek.

Table 3-1. MNRF Erosion Allowance Guidelines for Watercourses in Valley Settings.

MINIMUM TOE EROSION ALLOWANCE - River within 15 m of Slope Toe *				
Type of Material Native Soil Structure	Evidence of Active Erosion** or Bankfull Flow Velocity > Competent Flow Velocity***	No Evidence of Active Erosion** or Flow Velocity << Competent Flow Velocity***		
		Bankfull Width		
		< 5 m	5 - 30 m	> 30 m
1. Hard Rock (granite)	0 - 2 m	0 m	0 m	1 m
2. Soft Rock (shale, limestone) Cobbles, Boulders	2 - 5 m	0 m	1 m	2 m
3. Stiff/Hard Cohesive Soil (clays, clayey silt) Coarse Granular (gravels), Tills	5 - 8 m	1 m	2 m	4 m
4. Soft/Firm Cohesive Soil Fine Granular (sand, silt), Fill	8 - 15 m	1 - 2 m	5 m	7 m

* If a valley floor is > 15 m width, still may require study or inclusion of a toe erosion allowance.

** Active Erosion is defined as: bank material is bare and exposed directly to stream flow under normal or flood flow conditions and, where undercutting, over steepening, slumping of a bank or high down stream sediment loading is occurring. An area may be exposed to river flow but may not display "active erosion" (i.e. is not bare or undercut) either as a result of well rooted vegetation or as a result of shifting of the channel or because flows are relatively low velocity. The toe erosion allowances presented in the right half of Table 2 are suggested for sites with this condition.

*** Competent Flow velocity; the flow velocity that the bed material in the stream can support without resulting in erosion or scour. Consideration must also be given to potential future meandering of the watercourse channel.

Source: Ontario Ministry of Natural Resources (2002), "Technical Guide River & Stream Systems: Erosion Hazard Limit, pp38

3.3.2 *Reach 2 – Pedestrian Bridge to East Thorn Lodge Drive Culvert*

Reach 2, approximately 220m in length, is also a completely engineered channel section. Within this reach, the creek was lined with gabion baskets along banks and bed. Confined by the residential properties to its north, the northern bank of Reach 2 consists of 2x one-meter basket layers, forming a near vertical slope. In contrast, the channel is well connected to the floodplain of the city owned parklands along its southerly boundary, with the bank constructed using 6-7x thirty-centimeter basket layers, forming a 3(H):1(V) slope.

Channel morphology of this reach includes failure of the northern gabion basket bank and large scour pools where the base layer of baskets is empty, creating mechanisms of destabilization. This poses significant risks to the residential properties located marginally beyond top of bank. The bed was historically lined with gabion baskets which now have started to rupture and cause intermittent outcroppings and incision of shale bedrock. The degradation rates are currently controlled by the veneer of gabion; however, without intervention, the channel bed will continue to undercut and lead to mass failures of the channel.

The existing erosion hazards are estimated to be in the range of 5-8 meters in a 100-year time span for Reach 2, given the deteriorated conditions of the engineered measures and signs of significant stress and erosion. Without intervention, the erosion rate could be accelerated by the mass failure of the gabion baskets and could be as great as 15 meters over a 100-year span.

3.3.3 *Reach 3 – Downstream Reach*

Reach 3 is a shorter reach, approximately 40m in length, just downstream of the east Thorn Lodge Drive culvert. Within this reach, the channel is confined on both sides to ~25m wide corridor, with residential properties to the east and Sheridan Park Public School to the west. Downstream of the culvert, the channel also has historically had erosion control measures applied, within armourstone retaining walls along both banks. The armourstone walls, along with the densely vegetated upper slopes, provide lateral stability to the channel with minimal erosion risks to adjacent properties. Moreover, a significant amount of riprap has washed down from the upstream broken gabion baskets and accumulated within the reach, posing risks of backwatering and flooding of the culvert.

The existing erosion hazards as identified in Figure 3-6 and Table 3-1 are considered relatively low for Reach 3. However, without intervention, more frequent and increased levels of flooding of the culvert as well as the creek corridor will damage the culvert and undermine the exiting armourstone retaining walls, creating unstable slopes and risks to the adjacent properties.

3.4 Hydrologic & Hydraulic Assessment

A review of the study area hydrology and hydraulic conditions was undertaken to determine the existing flood levels / floodlines of Loyalist Creek within the study area, as well as to gain an understanding of the hydraulic parameters observed under the range of flood flow conditions which attribute to erosion and channel alteration. Given the presence of flood-susceptible buildings within the watershed, even small increases in flood levels would be considered unacceptable when evaluating alternative solutions and design opportunities.

3.4.1 *Loyalist Creek Hydrology*

At the onset of the study, a hydraulic (HEC-RAS) model was obtained from CVC which addresses a range of hydrologic conditions (i.e., flood flow scenarios), including the Regional event and return period events for 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year storms, under existing and future landuse conditions. Table 3-2 below summarizes the range of flood flows of Loyalist Creek through the study area. For the purpose of this EA, the flood flows under the existing landuse conditions will be used.

Table 3-2. Summary of Loyalist Creek Flow Regime within Study Area.

Return Period	2-year	5-year	10-year	25-year	50-year	100-year	Regional
Flow (m^3/s) – Existing Landuse Conditions	12.5	17.7	25.6	31.7	38.2	47	67.3
Flow (m^3/s) – Future Landuse Conditions	13.3	21.7	30.7	37.3	43.4	50.7	67.5

3.4.2 *Loyalist Creek Hydraulics*

For the purposes of this EA, the Loyalist Creek 1D HEC-RAS model obtained from CVC was used to define the existing hydraulic conditions within the study area. The schematics and cross-section arrangement of the existing HEC model within the study boundary are depicted in Figure 3-7. The model was run under a mixed flow regime and a summary of the hydraulic modeling results for each of the various flood flow events is provided below in Table 3-3. The detailed model results are included in Appendix A.

In addition, the existing regulatory floodplain limits as approved by CVC are presented in Figure 3-8.

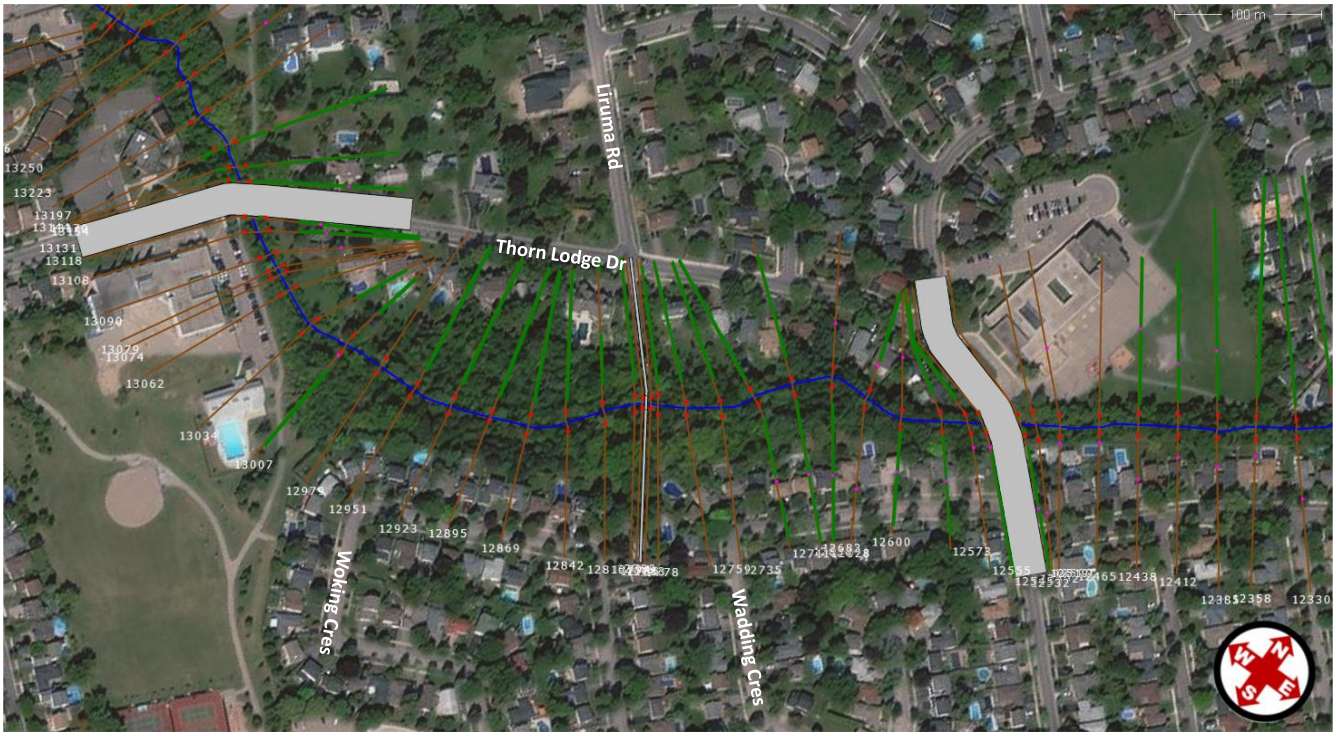


Figure 3-7. Existing HEC-RAS Schematic of Loyalist Creek behind Thorn Lodge Drive.

Table 3-3. Summary of Hydraulic Parameters for Flood Flow Events.

Flood Event	Flow (m3/s)	Hydr. Depth (m)	Velocity (m/s)		Channel Shear (N/m^2)		Channel Power (N/m*s)		Top Width (m)
		Avg.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
2-year	12.5	1.02	1.89	2.62	100.03	249.13	207.59	653.70	6.64

5-year	17.7	1.19	1.99	2.66	118.71	257.47	252.37	658.91	8.32
10-year	25.6	1.13	1.93	2.65	127.92	217.97	266.66	558.81	18.47
25-year	31.7	1.00	1.97	2.69	137.27	229.94	293.30	612.23	26.98
50-year	38.2	0.93	2.07	2.92	149.54	273.35	333.20	798.41	33.07
100-year	47.0	0.96	2.19	3.36	164.68	330.44	386.62	1066.21	40.72
Regional	67.3	1.08	2.43	3.95	199.82	560.30	530.20	2214.35	51.11

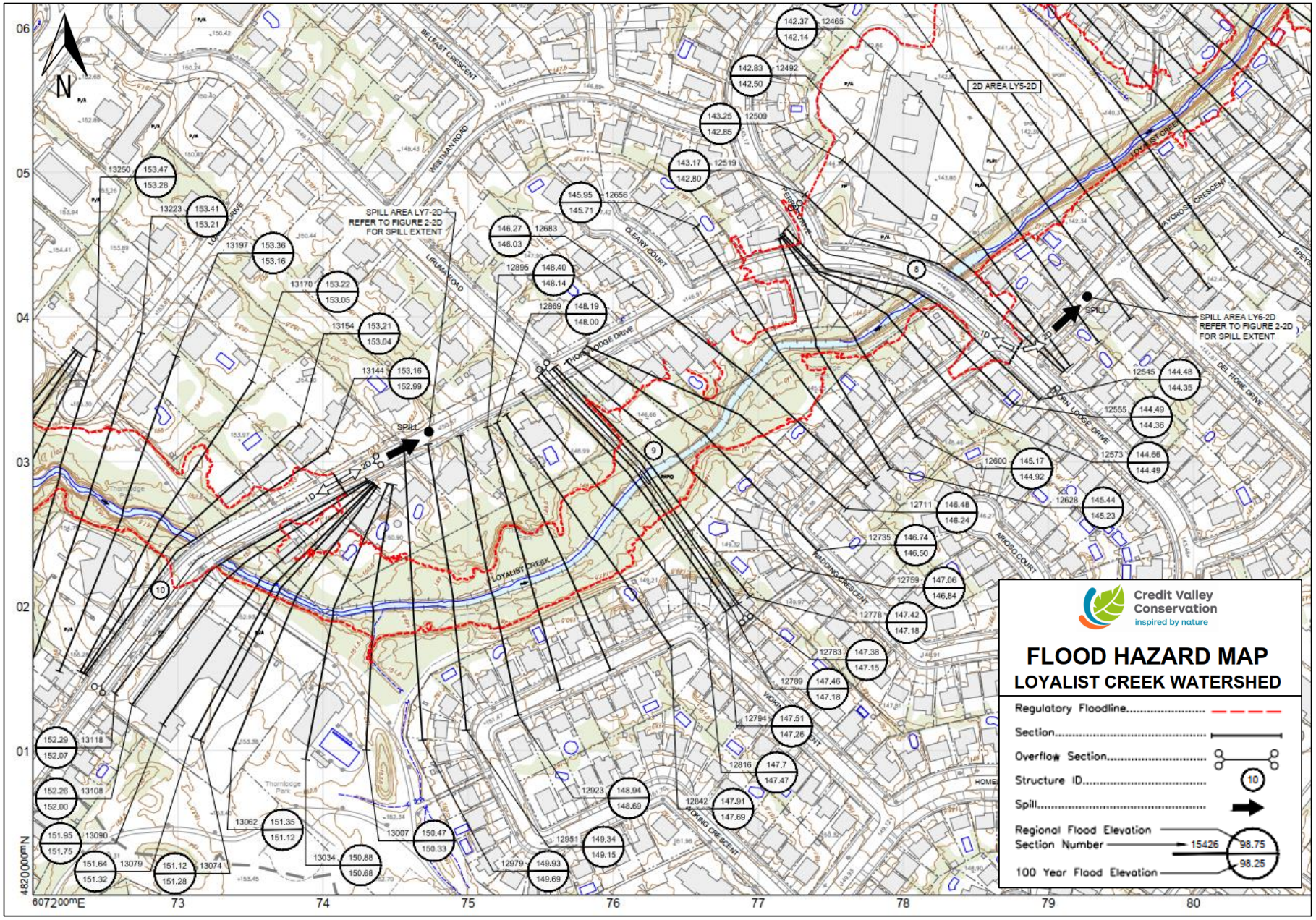


Figure 3-8. CVC Regulatory Floodplain Mapping of Loyalist Creek within Study Area.

The results of the hydraulic assessment demonstrate that Loyalist Creek experiences high velocities, shearing forces, and channel power under the range of flood flow conditions, which can contribute to continuous erosion and increased levels of channel activity under extreme wet-weather flow events. These conditions have been considered in the process of defining the types of restoration options, the sizing and resistance thresholds for materials, and appropriate channel planform configurations.

In order to provide further insight into the impact of the hydraulics parameters, Aquafor reviewed the published data on the critical erosional thresholds for river bed and bank materials as presented in Table 3-4. A comparison between Table 3-3 and Table 3-4 suggests shearing and velocity conditions will surpass the permissible thresholds for natural materials, and in turn, careful attention to stone sizing and placement of material will be required to mitigate failure of the reconstructed channel banks.

Table 3-4. Erosion Thresholds for Stream Bed and Bank Materials. (Fischenich, 2001)

	Permissible Shear Stress		Permissible Velocity	
	N/m^2	N/m^2	m/s	m/s
Fine Gravels	3.6		0.76	
Stiff Clay	12.4		0.91	1.37
Alluvial Silt	12.4		1.14	
Graded Silt to Cobble	18.2		1.14	
Shales and Hardpan	32.1		1.83	
Non-Uniform Gravel / Cobble				
2-inch	32.1		0.91	1.83
6-inch	95.8		1.22	2.29
12-inch	191.5		1.68	3.66
Long native grasses	57.5	81.4	1.22	1.83
Short native and bunch grass	33.5	45.5	0.91	1.22
Reed plantings	4.8	28.7		
Hardwood tree plantings	19.2	119.7		
Wattles	9.6	47.9	0.91	
Reed fascine	28.7	59.8	1.52	
Coir roll	143.6	239.4	2.44	
Vegetated coir mat	191.5	383.0	2.90	
Live brush mattress (initial)	19.2	196.3	1.22	
Live brush mattress (grown)	186.7	392.6	3.66	
Brush layering (initial/grown)	19.2	299.2	3.66	
Live fascine	59.8	148.4	1.83	2.44
Live willow stakes	100.5	148.4	0.91	3.05
Gabions	478.8		4.27	5.79
Concrete / Armourstone	598.5		5.49	

3.5 Fish Habitat Assessment

Fish community and aquatic habitat were investigated as a part of this study on June 4, 2020 by Aquafor Beech aquatic biology staff in accordance with Ontario Stream Assessment Protocol (OSAP), Section 4, Module 1: Rapid Assessment Methodology for Channel Structure (Stanfield, 2017). The aquatic components of the site are described in the following subsections. Photographs from Aquafor's site visits are included below with OSAP field sheets provided as Appendix B.

3.5.1 *Aquatic Habitat*

The study site is located within the Loyalist Creek subwatershed of the Credit River watershed, or "Subwatershed 1" as defined by the Credit River Conservation Authority (CVC) in the City of Mississauga. CVC has undertaken fish community assessments within Subwatershed 1 and more specifically, within Loyalist Creek both upstream at Dundas Street West and downstream at Erin Mills Parkway. A general location of the study area in relation to the CVC fish community study locations, denoted by the blue stars, is shown in Figure 3-9. Subwatershed 1: Loyalist Creek is bordered by very little natural heritage cover, with the majority of the landuse south of Highway 403 contributed by urban areas. The majority of the reaches upstream of the confluence with the main branch of the Credit River, approximately 2 km downstream of the study area, is surrounded by residential, industrial and commercial landuse.

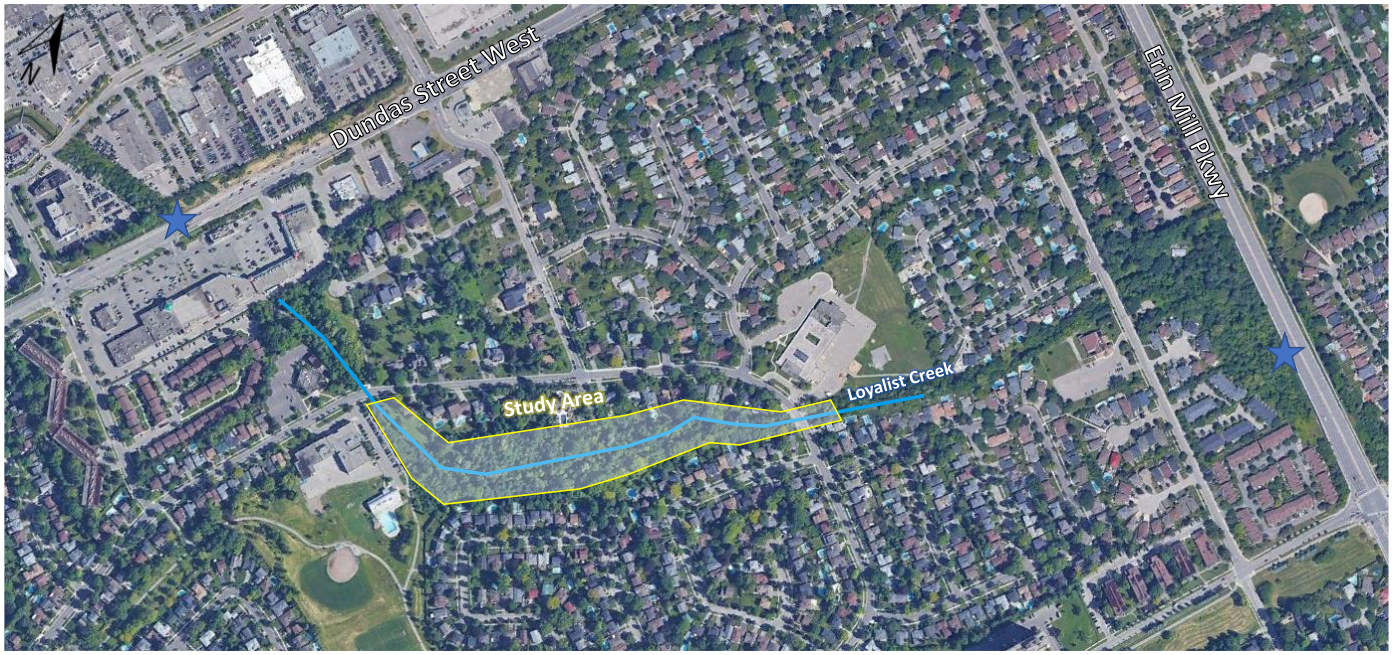


Figure 3-9. CVC Fish Community Study Locations near Study Area.

The Credit River Fisheries Management Plan (MNRF and CVC, 2002) includes the Loyalist Creek subwatershed within the Credit River Lower Watershed, noting the following for the watershed area, "This area is highly urbanized and urban growth is anticipated to continue relatively rapidly. The area includes the western edge of Brampton, and most of Mississauga. Many of the tributaries in the lower watershed have been channelized or placed in sewers. Below Highway 401, water quality in the main stem of the Credit and its tributaries is generally poor."

As noted above, the study area falls within this description and site investigations confirm that much of the creek is channelized, with the left and right bank flanked by a small natural area and a well-used pedestrian trail known as the "Thorn Lodge Park Trail". Beyond this trail on either bank is residential landuse. The downstream extent is bounded by Erin Mills Parkway and the upstream by Dundas Street West, with a Catholic School and parking lot on the left bank. The study area was observed from the downstream to the upstream extents, with photo inventories

to accompany the following observations. At the time of the field investigations conducted by Aquafor biology staff in 2020, flow was representative of normal summer conditions allowing for great visibility.

The downstream extent at Erin Mills Parkway is serviced by a closed bottom box culvert (Photo 1) where it continues upstream through a stepped gabion line corridor (Photo 2). At the time of investigation, flow was bounded by the gabion lined banks creating uniform channel characteristics defined by a mean stream width of 4 m and a mean depth at crossovers of 80 mm. Substrate consisted of angular stones (Photo 3) likely introduced during channelization works and by failing gabion baskets observed upstream (Photo 4). Smaller gravels and cobbles were observed in pool areas like that shown in Photo 4 and in deposition areas, while the majority of the habitat consisted of shallow riffles created by gabion knickpoints (Photo 5) and shallow, uniform runs (Photo 6) dominated by angular stones or rip rap. Habitat characteristics continued in this manner approximately 240 m upstream to a pedestrian bridge perpendicular to Liruma Road. Here, the creek became channelized by armourstone walls (Photo 7Photo 9). A storm sewer outlet was observed at the downstream side of the pedestrian bridge (Photo 8). Substrate and habitat remained fairly consistent throughout this reach, with riffles created artificially through armourstone ribs and angular stones observed throughout (Photo 9Photo 10). Some riffles could constitute as fish barriers to non-jumping species, with jumping heights ranging upwards to ~200 mm (Photo 10).

Cover remained consistent throughout the entire reach, with instream cover provided by the large angular stones and rooted macrophytes where riparian areas were not limited by channelization (Photo 11). Overhanging canopy cover was quite high, with the riparian area beyond the channelized banks consisting of well-established mixed deciduous forest. Very little instream vegetation was observed at the time of observations, limited to filamentous algae and rooted macrophytes from the riparian cover. A number of other storm water contributions were observed throughout the upstream reaches, with the upstream extent serviced by a closed bottom culvert beneath Dundas Street West, of which demonstrated multiple stormwater inputs which likely contribute to aquatic health impacts (Photo 12). The channel bed immediately downstream of the culvert consisted of a gabion style apron, which then transitioned into the typical angular stone and armourstone profile described above.

Overall, aquatic habitat remained consistent through the study area, demonstrating characteristics of a channelized, urban-impacted watercourse consistent with the description of the Lower Credit River Watershed (MNRF and CVC, 2002). No fish were observed in the habitat found within the study area. The stormwater inputs noted above, along with major road crossings, encroaching residential lawns, adjacent recreational trails and upstream commercial areas are all likely sources or nutrient and pollutant loading.

3.5.2 *Fish Communities*

The Credit River Fisheries Management Plan does not detail the community within Loyalist Creek; however, the CVC has provided results of past fish community studies from three (3) investigations using backpack electrofishing techniques. Locations of such investigations are shown in Figure 3-9 and denoted by the blue stars. On three (3) separate occasions, with the most recent occurring in 2001, no fish were observed within the study area (CVC, 2020). Furthermore, as discussed above, no fish were observed during the field investigations conducted by Aquafor Beech Limited biology staff. While these observations suggest that the study area does not provide direct habitat to fish within Loyalist Creek, the aquatic habitat discussed above demonstrates the potential for localized communities or vagrant species. The study area should therefore be considered as potential direct habitat and certain contributing habitat to downstream reaches of Loyalist Creek and the greater Credit River Watershed.

3.5.3 *Department of Fisheries and Oceans (DFO) Self-Assessment*

The federal *Fisheries Act* requires that projects avoid causing the death of fish and the harmful alteration, disruption or destruction of fish habitat unless authorized by the Minister of Fisheries and Oceans Canada (DFO). This applies to work being conducted in or near waterbodies that support fish at any time during any given year or are connected to waterbodies that support fish at any time during any given year. As noted above, records or observations are not available that support the claim that the study area within Loyalist Creek may contain fish at any time during any given year. However, the study area is connected to waterbodies, such as the Credit River,

that do support fish at any time during any given year. Furthermore, there is potential that the study area could support localized communities or vagrant species. Therefore, the *Fisheries Act* applies to works conducted in or near water at the site.

Upon completion of the detailed design for the channel works at the study site, the works should be cross-referenced with the DFO "Projects Near Water" online service to determine if a request for regulatory review under the federal Fisheries Act is required (Department of Fisheries and Oceans, 2019). Based on field investigations conducted by Aquafor staff and background information provided by the CVC, the study area demonstrates the potential to contain fish at any time during any given year, with a certain connection to waterbodies that do support fish at any time during any given year. It is therefore the opinion of Aquafor Beech Limited that a request for regulatory review by Fisheries and Oceans Canada will be required. It is recommended that the detailed design exercise the measures listed by Fisheries and Oceans Canada to avoid contravention with the Federal Fisheries Act and exercise due diligence by further mitigating accidental death of fish and the harmful alteration, disruption or destruction of fish habitat.

Photo 1. Downstream extent at Erin Mills Pkwy, looking downstream.

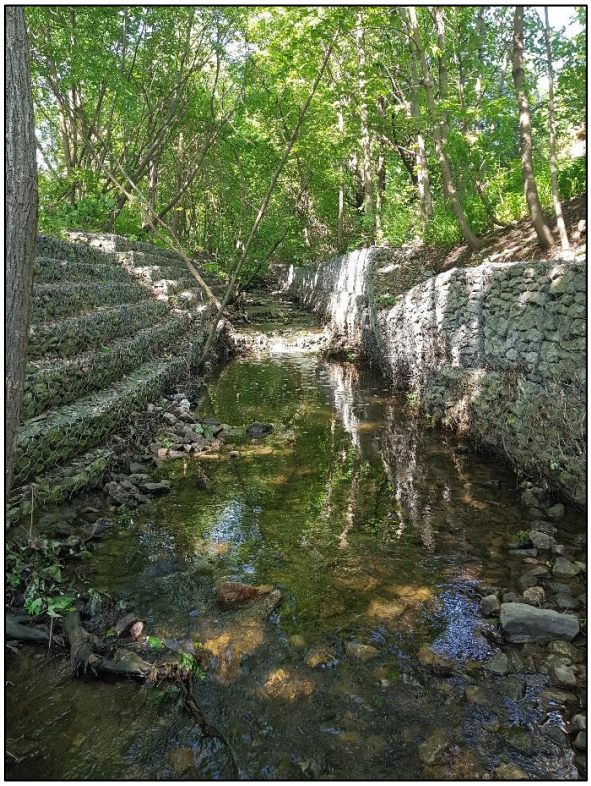


Photo 2. Downstream extent, looking upstream.

Photo 3. Typical substrate and bank profile of Reach 2.

Photo 4. Failing gabion bank, north bank.

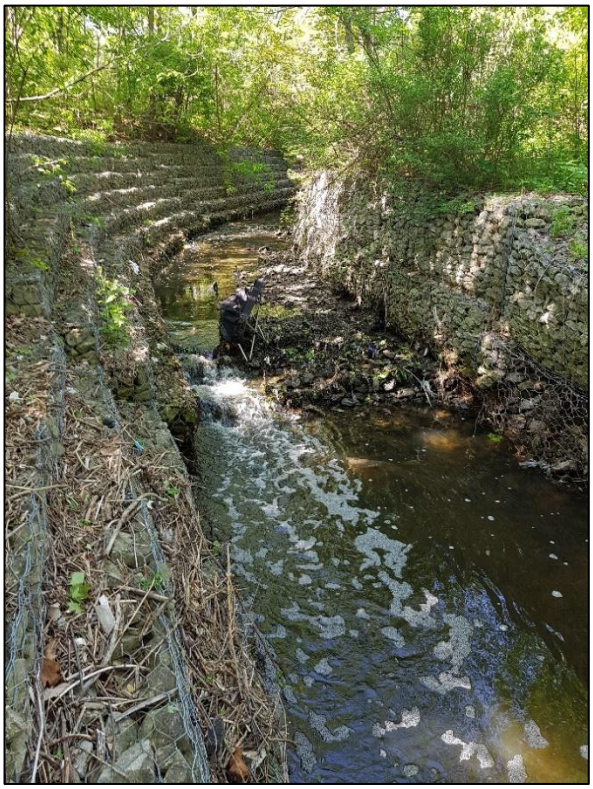


Photo 5. Gabion knickpoint, looking upstream.

Photo 6. Shallow run, looking downstream.

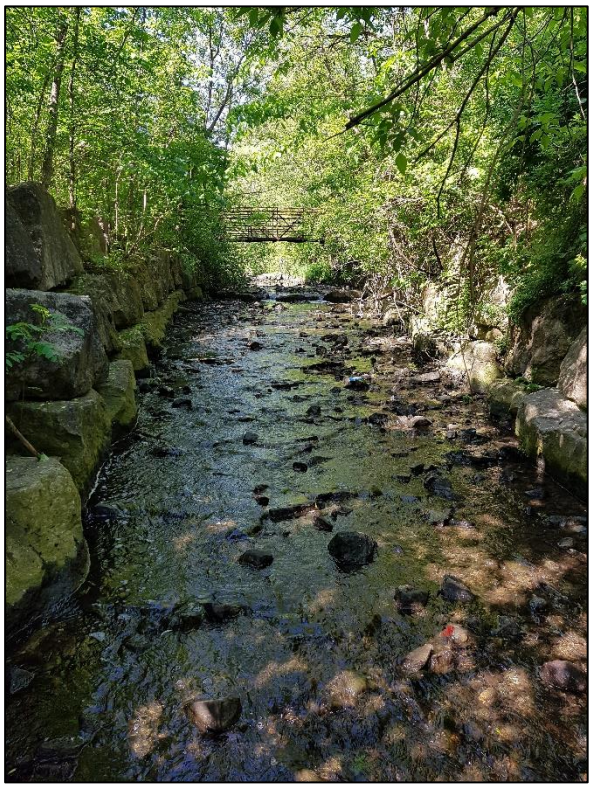


Photo 7. Looking upstream to Liruma Road pedestrian bridge.

Photo 8. Storm sewer outlet, downstream of pedestrian bridge.

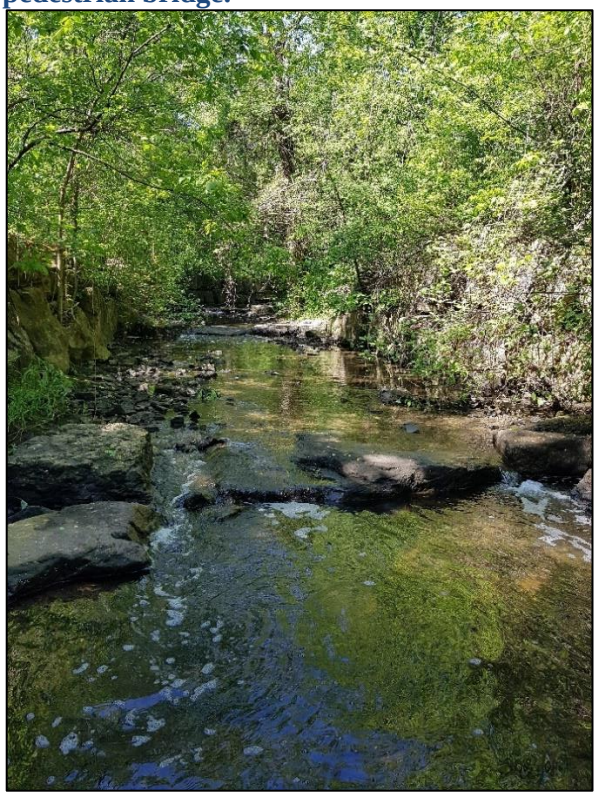


Photo 9. Armourstone riffle within Reach 1, looking upstream.

Photo 10. Perched armourstone riffle, looking upstream.

Photo 11. Rooted macrophytes, left bank.

Photo 12. Upstream extent at Dundas Street West.

3.6 Terrestrial Resources Assessment

3.6.1 *Vegetation Communities and Flora*

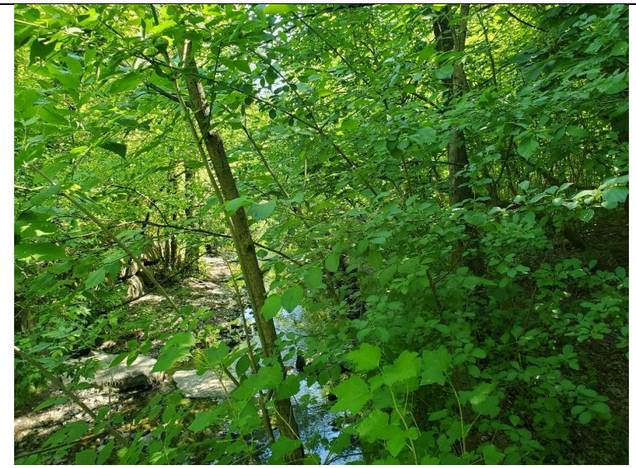
Vegetation communities and flora within the study area were identified during field surveys completed on June 18, 2020. A complete list of the vegetation communities and flora recorded during field surveys are detailed in the following subsections.

Vegetation Communities

Vegetation communities within the study area were classified and delineated according to the Ecological Land Classification (ELC) for Southern Ontario, First Approximation (Lee, et al., 1998). A total of four polygons were delineated, comprised of four distinct vegetation community types. Under the First Approximation ELC methods, the four communities could not be classified to the vegetation type, therefore community classification was refined using the 2008 daft vegetation codes. This site is highly urbanized with significant evidence of anthropogenic disturbances. The riparian corridor that makes up the study area is bound by residential development on all sides with a well-used trail transecting the majority of the wooded area.

The vegetation communities within the study area are detailed in Table 3-5, and illustrated on Figure 3-10. Field sheets are located in Appendix C2.

Table 3-5. Vegetation Communities within Study Area.

Polygon	Ecological Land Classification		Ranking		Description	Representative Photos
	Code	Name	Global	Provincial		
1	CUT1 (THDM 2-6)	Mineral Cultural Thicket (Buckthorn Deciduous Shrub Thicket)	-	-	This community is predominantly Common Buckthorn (*Rhamnus catharitca*) throughout the understory and subcanopy. There are some American Elm (*Ulmus americana*) and Siberian Elm (*Ulmus pumila*) along with some Manitoba Maple (*Acer negundo*). With the density of Common Buckthorn, the ground layer is significantly shaded allowing for mainly Garlic Mustard (*Alliaria petiolata*) to dominate along with seedling Common Buckthorn. 60 species were recorded in this polygon of which 33 were introduced and 23 are native species (two species were only identified to genus level). Of the 33 introduced species 24 have an exotic status of SE5 indicating that they are wide spread throughout Ontario. There were no significant species nor any species with a high Coefficient of Conservatism (CC) (greater than or equal to 7). This community exhibits significant signs of anthropogenic disturbance and acts as a seed source for many invasive species such as Common Buckthorn, Siberian Elm, and Garlic Mustard. This community did not contain any obligate wetland species (only found in wetland communities) and eight facultative wetland species (usually found in wetland communities), all of which were found in low abundances.	
2	FOD4 (FOD4-6)	Dry-fresh Deciduous Forest (Dry-fresh Norway Maple Deciduous Forest)	-	-	This community the encompasses the majority of the riparian zone of watercourse and has the walking trail in it. The canopy is dominated by Norway Maple (*Acer plataniodes*) with some Black Walnut (*Juglans nigra*). Canopy closure was greater than 60%. The understory is moderately sparce, approximately 10-20% cover, with Common Buckthorn, Green Ash (*Fraxinus pennsylvanica*), and Multiflora Rose (*Rosa multiflora*). The ground layer is densely covered with Garlic Mustard, Common Buckthorn seedlings, and Climbing Euonymus (*Euontmus fortunei*). Similar to polygon 1, this polygon is predominantly introduced species with 31 introduced and 25 native species (five species were identified only to genus level). There were no significant species nor any species with a high CC value.	

Polygon	Ecological Land Classification		Ranking		Description	Representative Photos
	Code	Name	Global	Provincial		
3	CUS1 (WODM 4-4)	Mineral Cultural Savannah (Dry-fresh Walnut Deciduous Walnut Woodland)	-	-	This community is characterized by a moderately sparse canopy (20-30% closure) and little shrub cover. The canopy was predominately Black Walnut with a few Red Oak (*Quercus rubra*), Common Hackberry (*Celtus occidentalis*), and American Elm. The understory contained Black Raspberry (*Rubus occidentalis*), Multiflora Rose, and Thicket Creeper (*Parthenocissus vitacea*). The ground layer contained Kentucky Bluegrass (Poa pratensis) with some Goutweed (*Aegopodium podagraria*), European Swallowwort (*Vincetoxicum rossicum*) also known as Dog-strangling Vine, and Dames Rocket (*Hesperis matronalis*). Although this polygon contained several invasive species including Multiflora Rose and Goutweed, there was more native species than introduced (17 introduced, 22 native species, and 4 identified to the genus level only) indicating this community is of slightly higher quality than the other communities within the study area. Both Common Hackberry and Eastern Hemlock (Tsuga canadensis) have high CC values with 8 and 7 respectively.	
4	CUW1 (WODM 4)	Mineral Cultural Woodland (Dry-fresh Deciduous Woodland)	-	-	This community is located on the north side of the study area. The dominant species in this polygon is variable with a mix of Silver Maple (*Acer saccharinum*), Manitoba Maple, Norway Maple, and Black Walnut. The understory is dominated by Common Buckthorn, Green Ash, and Multiflora Rose. The ground layer is dominated by non-native species including Garlic Mustard, Common Burdock (*Arctium minus*), and Multiflora Rose. There was 42 non-native species and 40 native species (one species identified only to the genus level). This community contained two Butternuts (*Juglans cinerea*) which if genetically pure are endangered provincially and federally; locations depicted on Error! Reference source not found. and f urther discussion in **Section** Error! Reference source not found.. Additionally, there was one species, Common Hackberry with a high CC value.	

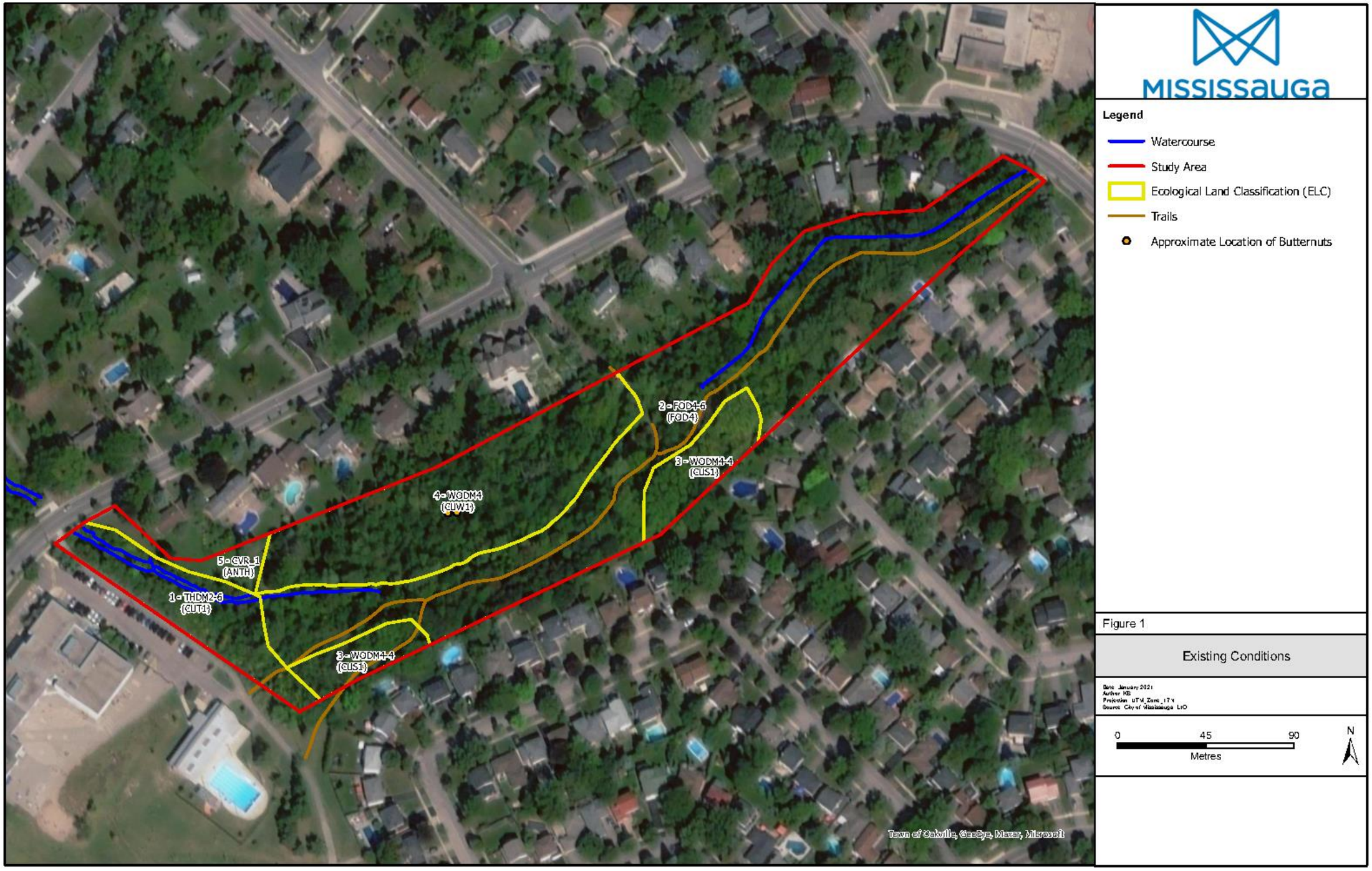


Figure 3-10. ELC Vegetation Community Mapping.

Botanical Inventory

A total of 130 vascular plant species were identified within the study area, plus five additional species identified to genus due to a lack of diagnostic features at the time of survey. Table 3-6, below, provides an overview of the results of the botanical inventory. One federal and provincially significant species was recorded, Butternut. CVC's list for the Greater Toronto Area (GTA) published in Plants of the Credit River Watershed (2002) was referenced for regional rarity which states that for urban areas. One species with local rarity was found in polygon 4, Eastern Ninebark (*Physocarpus opulifolius*).

Table 3-6: Botanical Inventory Characteristics

Species Breakdown	Total Species: Native Species: Introduced Species: Species identified only to genus:	135 63 (46.6%) 67 (49.6%) 5 (3.7%)	The species are almost split between native and non-native to Ontario. Of the introduced species Garlic Mustard, Common Buckthorn, and European Swallow-wort (a.k.a. Dog strangling Vine) are considered non-native invasive species.
Significance	Federally rare species: Provincially rare species: Regionally Rare species:	1 1 1	2 Butternuts were found in polygon 4 and are considered endangered federally and provincially. Ninebark is listed as rare regionally.
Coefficient of Conservatism	Number of species with CC greater than 7:	3	• Common Hackberry (*Celtis occidentalis*) - 8 • Common Snowberry (*Symphoricarpos albus*) - 7 • Eastern Hemlock (*Tsuga canadensis*) - 7 CC values are range from 1 to 10 and are assigned based on a species' likelihood to be found in a relatively unaltered landscape (Oldham *et al.* 1995). Plants with high CC values are found only in a relatively narrow range of conditions provided by specific habitats and tend to be intolerant to anthropogenic disturbances. Species with low CC values are able to persist in a wide variety of habitats and are generally more tolerant to anthropogenic disturbances.
Floristic Quality Index	FQI:	28.25	FQI is a calculated value based on species richness and quality of species (i.e., CC value), see below for the equation. A high FQI indicates a higher quality of habitat. $FQI = average\ CC\sqrt{species\ richness}$ Calculation is based on the number of species with CC values assigned (64). Generally, FQI greater than 50 is considered high; 30 to 39 is medium, and less than 30 is considered low. This site has an FQI of 28.25 which is low likely due to intense urban influences surrounding the study area and the presence of non-native invasive species.

Refer to Appendix C1 for a complete annotated list of vascular plants identified within the study area and Appendix C2 for compiled field sheets.

3.7 Ministry of Natural Resources and Forestry (MNRF) Species at Risk Screening

For the purpose of this study, Species at Risk (SAR) are defined as species listed as Endangered (END), Threatened (THR), or Special Concern (SC) under the Ontario *Endangered Species Act* (ESA) and/or the federal *Species at Risk Act* (SARA). A screening exercise for SAR was completed through a review of background information including: the Ontario Natural Heritage Information Center (NHIC) online species occurrence database, community science websites iNaturalist and eBird, the Ontario Breeding Bird Atlas (OBBA), the Ontario Reptile and Amphibian Atlas (ORAA), the Ontario Butterfly Atlas, and DFO's online SAR mapping. Correspondence was also sent to the Ontario Ministry of the Environment, Conservation, and Parks requesting any further information they felt was relevant to the project. The resulting list of species was screened by comparing the habitat requirements of each species to the habitat that is present in the study area. The results of the SAR screening are detailed in Appendix D. Species which were determined to be present or potentially present in the study area are discussed further below.

3.7.1 *Butternut – Present – Endangered*

Two specimens were found on the north side of the watercourse within ELC polygon 4. Butternuts should be subject to a Butternut Health Assessment in keeping with provincial standards prior to any proposed impact to or removal of a tree. Depending on the results of that assessment and the degree of proposed disturbance, impacts to 'retainable' Butternuts may be subject to compensation requirements (i.e., replanting and monitoring) and the requirement to register the project with the MECP as a regulatory exemption.

3.7.2 *Barn Swallow – Potentially Present – Threatened*

This species builds cup-shaped mud nests on structures such as culverts and bridges. Within the study area, the pedestrian bridge is not considered suitable nesting habitat as the underside is very exposed with shallow beams. The concrete box culverts at the upstream and downstream limits, however, could potentially support nesting. Although the culverts are not expected to be directly impacted by the proposed works, if an active nest is noted in proximity to construction at any time, that work should cease and additional consultation with the appropriate authorities will be needed to ensure that Barn Swallows are not harassed and that the project remains in compliance with the ESA.

3.7.3 *Eastern Wood-Pewee– Potentially Present – Special Concern*

This forest bird has been reported in close proximity to the study area and is expected to have suitable nesting habitat present in the study area. As a Special Concern species, Eastern Wood-pewee does not receive regulatory protection under federal or provincial SAR legislation. Active nests of this and other bird species are, however, protected under the *Migratory Birds Convention Act*, and therefore restrictions on vegetation clearing during the bird nesting season will apply.

3.7.4 *Bats (Eastern Small-footed Myotis, Little Brown Myotis, Northern Myotis, and Tri-colored Bat) – Potentially Present – Endangered*

Ontario's four Endangered bat species generally occur in wooded habitats providing features such as standing snags, cavity trees, trees with loose/exfoliating bark, and/or large-diameter oaks and maples. Projects involving the removal of trees are expected to require additional analysis (including roost tree surveys and/or acoustic monitoring according to the MNRF's 2017 "Survey Protocol for Species at Risk Bats within Treed Habitats - Little Brown Myotis, Northern Myotis & Tri-Colored Bat") in order to confirm SAR presence/absence and provide sufficient information to the MECP to determine any requirements for the project under the ESA.

3.8 Archaeological Assessment

A Stage 1 archaeological assessment was carried out by Archaeological Services Inc. (ASI) in through 2020 and 2021. The assessment included review of background documentation and field investigations to determine if the project exhibits archaeological potential and therefore, whether a Stage 2 assessment will be required.

The Stage 1 background study determined that one previously registered archaeological site (AjGv-76 – Pre-Contact Indigenous; Euro-Canadian) is located within one kilometer of the study area. The assessment also indicated that part of the study area exhibits archaeological potential and will require Stage 2 assessment by test pit survey at five-meter intervals, prior to any proposed impacts to the property, to be undertaken at the detailed design stage. A summary of the assessment results is shown in Figure 3-11 and the full archaeological report is included in Appendix E.

Figure 3-11. Results of the Stage 1 Archaeological Assessment. (ASI, 2021)

3.9 Land Ownership and Easements

Loyalist Creek within the study area mostly flows through the City property of Thorn Lodge Park, with the exception of three sections running through private properties. As depicted in the figure below, the City maintains easements for the creek sections within 2452 and 2358 Thorn Lodge Drive, and has approached the landowner at 2356 Thorn Lodge Drive to discuss options for maintaining or moving the section of creek through that property.

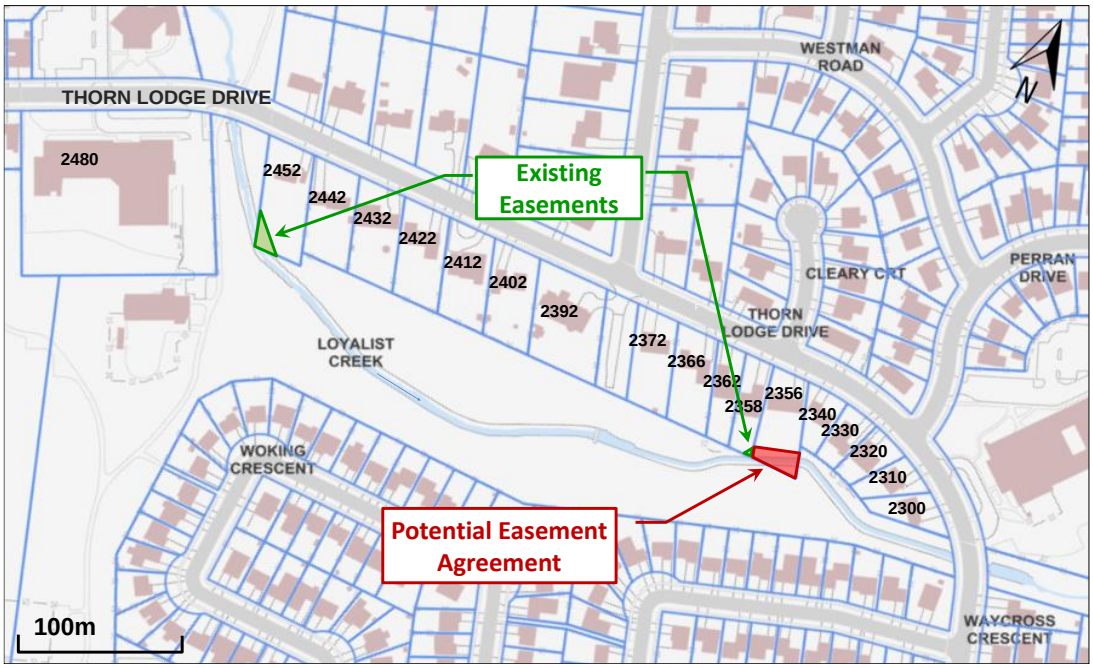


Figure 3-12. Landownership and Easements of Loyalist Creek within Study Area.

4 DEVELOPMENT OF THE PREFERRED SOLUTION

4.1 Alternative No. 1 – Do Nothing

This alternative involves leaving the existing channel to continue actively eroding, downcutting, and depositing washed out material into the downstream Loyalist Creek system. Existing risks with regards to loss of tablelands in close proximity to residential properties, over steepened banks, public safety, and undermining of infrastructure would remain and accelerate.

Figure 4-1 and Figure 4-2 included below depict the most failed section of the gabion baskets and the deteriorated stormwater infrastructure within the study area. Color coding in Figure 4-3 and Figure 4-4 highlight the various conditions of the existing creek banks and bed throughout the corridor, which will be used to as a reference point when defining the priority of restoration locations, extent and types of restoration measures, and appropriate channel planform configurations.

Although capital costs associated with creek rehabilitation would not be incurred with this alternative, maintenance, monitoring and repair costs would occur. The implementation of an on-going erosion risk monitoring program for the channel and the adjacent properties is recommended. In addition, the existing failure of the gabion baskets and further damage to private properties would require emergency repairs on an as-needed basis. A cost estimate for Alternative 1 is included in Table 4-1. Throughout the estimated remaining lifespan of the gabion baskets (~5 year), a total cost of $865,000 might be expected.

Figure 4-1. The Most Failed Section of Gabion Baskets within Study Area.

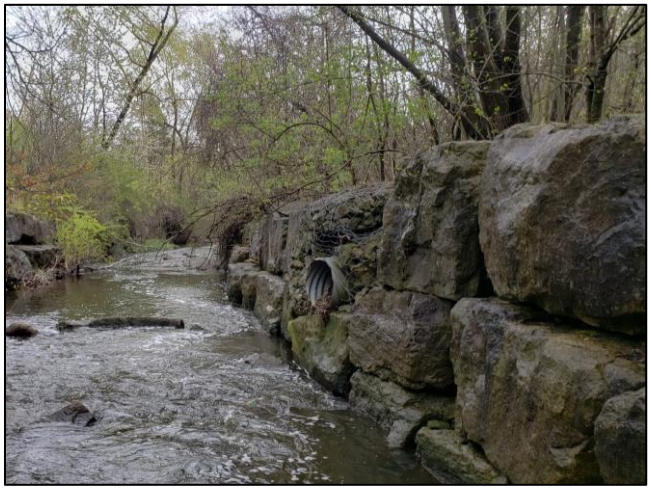


Figure 4-2. Deteriorated Stormwater Outlet Inset within Gabion Baskets Surrounded by Armourstone.

Table 4-1. Preliminary Cost Estimates for Alternative 1 – Do Nothing.

Item	Description	Qty	Unit	Unit Price	Extended Price (Excl. HST)
Section "A" – Reach 1					
1	Ongoing Risk Monitoring	1	Year	$15,000.00	$15,000.00
2	Emergency Repairs	1	Year	$20,000.00	$20,000.00
Subtotal Section A (Excl of HST)					$35,000.00
Section "B" – Reach 2					
1	Ongoing Risk Monitoring	1	Year	$20,000.00	$20,000.00
2	Emergency Repairs	1	Year	$50,000.00	$50,000.00
Subtotal Section B (Excl of HST)					$70,000.00
Section "C" – Reach 3					
1	Ongoing Risk Monitoring	1	Year	$8,000.00	$8,000.00
2	Emergency Repairs	1	Year	$20,000.00	$20,000.00
Subtotal Section C (Excl of HST)					$28,000.00
Section "D" – Contingency					
1	Contingency (30%)	1	LS	$39,900.00	$39,900.00
Subtotal Section D (Excl of HST)					$39,900.00

Section "A" – Reach 1	$35,000.00
Section "B" – Reach 2	$70,000.00
Section "C" – Reach 3	$28,000.00
Section "D" – Contingency (30%)	$39,900.00
Sub Total (Excl of taxes)	**$172,900.00**
HST @ 13%	$22,477.00
Total (Incl of taxes)	$195,377.00

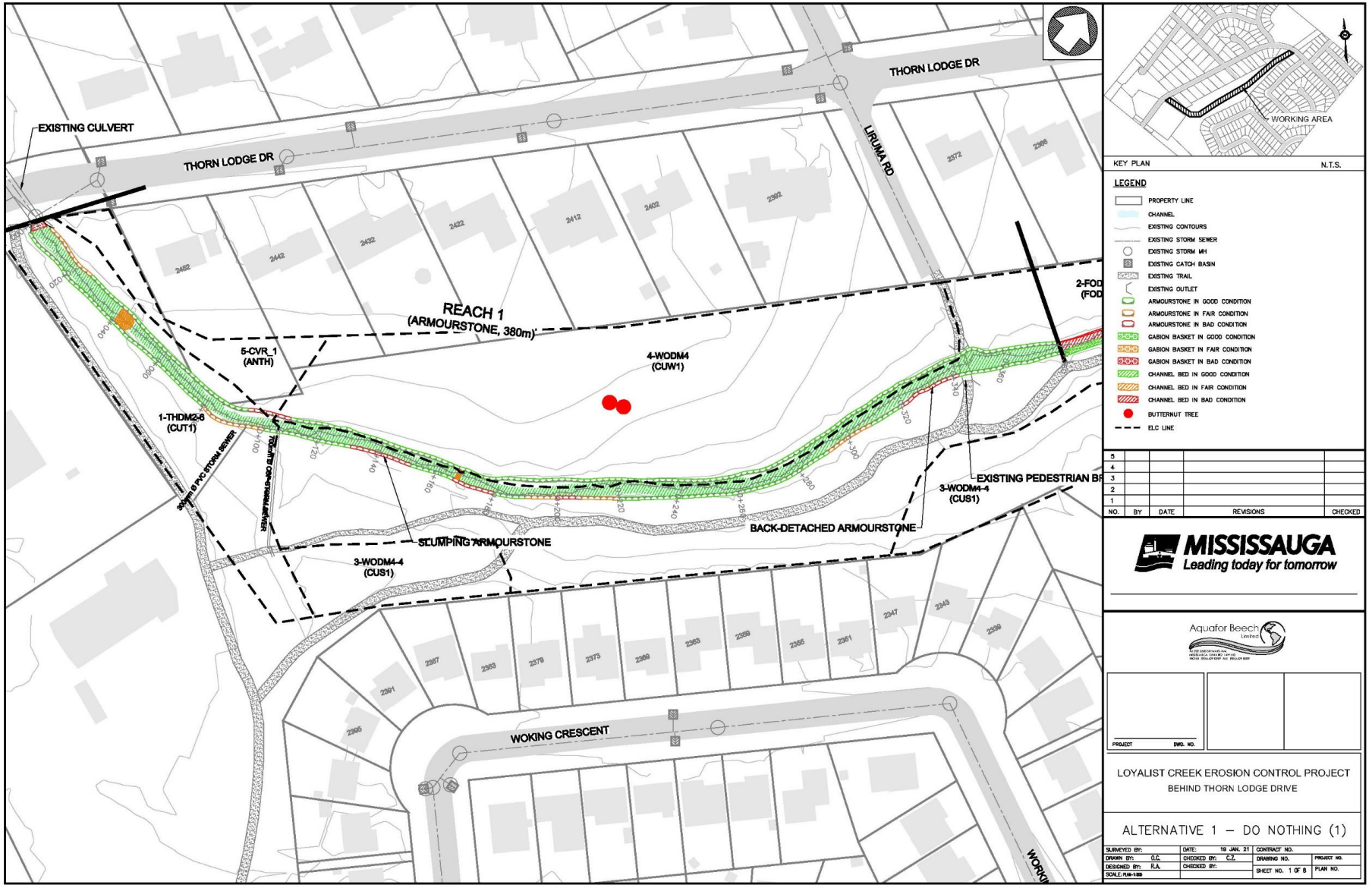


Figure 4-3. Alternative No. 1 – Do Nothing (I of 2).

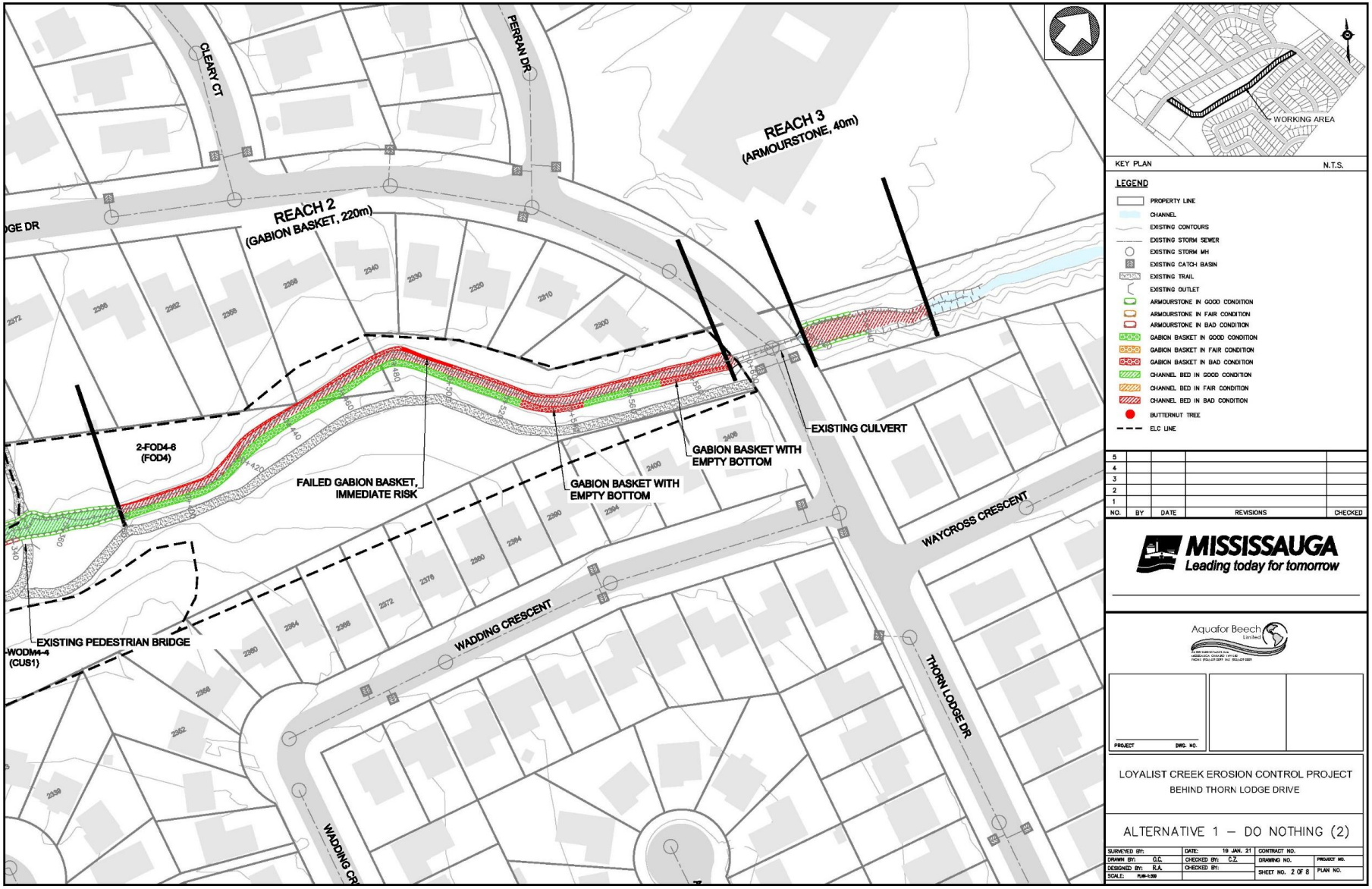


Figure 4-4. Alternative No. 1 – Do Nothing (2 of 2).

4.2 Alternative No. 2 – Local Restoration Works

This alternative would involve undertaking channel restoration works at priority problem locations as defined in the Do-Nothing alternative, including repair of dispositioned armourstones, replacement of failed gabion baskets, installation of additional bed treatments and stabilization of undermining infrastructure. Where residential dwellings are located in close proximity to top of bank, local bank stabilization treatments / channel realignment would be put in place, using either hardened (engineered) type treatments, or more natural (vegetation & biotechnical engineered) type treatments. Benefits of local works include minimal disruption to the local natural environment, quick implementation to minimize short term risk. The lifespan of these works is generally defined as moderate. Intermediate and long term fluvial processes often / eventually undermine these works, or similar issues are transcribed downstream.

An example of local restoration works is as shown in Figure 4-5, and a preliminary design planform of Alternative 2 is also illustrated in Figure 4-6. With respect to cost, this option is estimated to have a moderate cost due to the limited work extents. The preliminary construction cost estimate for Alternative 2 is set out in Table 4-2.

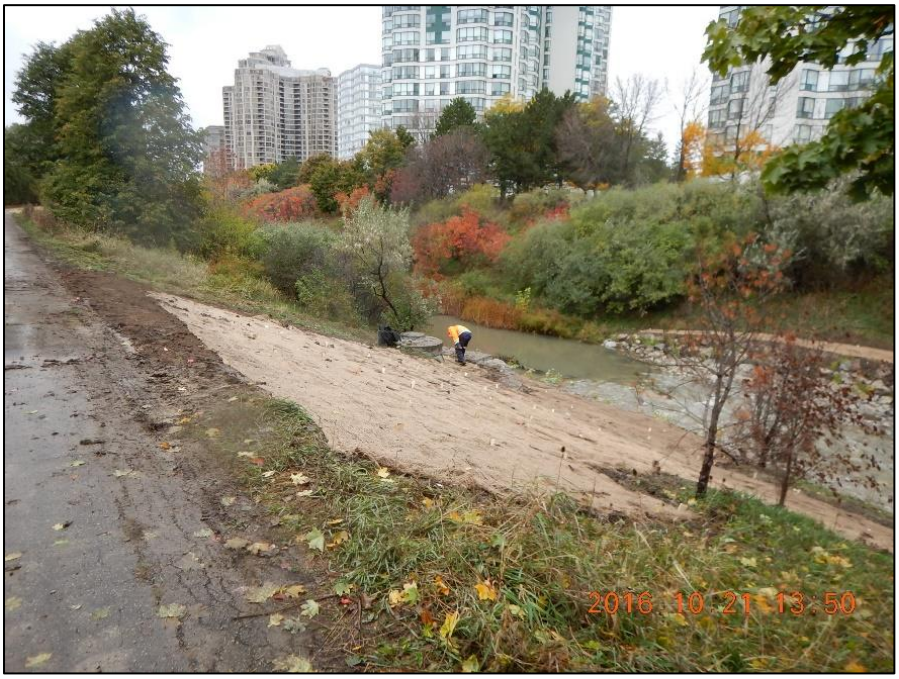


Figure 4-5. An Example of Local Restoration Works.

Table 4-2. Preliminary Cost Estimate for Alternative 2 – Local Restoration Works.

Item	Description	Qty	Unit	Unit Price	Extended Price (Excl. HST)
Section "A" – Site Preparation & Removals					
1	Field Office	1	LS	$15,000.00	$15,000.00
2	Construction Layout, Utility & Locates	1	LS	$15,000.00	$15,000.00
3	Traffic Control	1	LS	$12,000.00	$12,000.00
4	Project Signage	2	ea.	$1,000.00	$2,000.00
5	Mobilization & Demobilization	1	LS	$40,000.00	$40,000.00
6	Access Route & Staging Areas	1	LS	$18,000.00	$18,000.00
7	Clearing, Grubbing & Tree Removals	1	LS	$30,000.00	$30,000.00
8	Supply, Install & Remove Temporary Sediment Control/Tree Protection Fence	1500	m	$12.00	$18,000.00
9	Stream Control, Bypass Pumping & Dewatering	1	LS	$70,000.00	$70,000.00
10	MNRF Fish Collection Permit and Fish Rescues	1	LS	$10,000.00	$10,000.00

Subtotal Section A (Excl of HST)					$230,000.00
Section "B" – Reach 1					
1	Remove and Dispose of Armourstone	180	m	$80.00	$14,400.00
2	Excavate, Earthwork & Grading	1	LS	$15,000.00	$15,000.00
3	Local Repair of Armourstone Walls and Scour Protection	180	m	$3,000.00	$540,000.00
4	Storm Outfall Restoration	2	ea.	$8,000.00	$16,000.00
5	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$15,000.00	$15,000.00
6	Supply & Placement of Topsoil (300mm)	1	LS	$20,000.00	$20,000.00
7	Supply & Application of Terraseed Mixture	1	LS	$15,000.00	$15,000.00
8	Restoration of Trail - Paved	120	m	$400.00	$48,000.00
9	Restoration of Trail - Unpaved	300	m	$200.00	$60,000.00
Subtotal Section B (Excl of HST)					$729,000.00
Section "C" – Reach 2					
1	Remove and Dispose of Gabion Baskets	319	m	$80.00	$25,520.00
2	Excavate, Earthwork & Grading	1	LS	$25,000.00	$25,000.00
3	Local Repair of Gabion Basket Banks and Bed	220	m	$9,000.00	$1,980,000.00
4	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$35,000.00	$35,000.00
5	Supply & Placement of Topsoil (300mm)	1	LS	$50,000.00	$50,000.00
6	Supply & Application of Terraseed Mixture	1	LS	$35,000.00	$35,000.00
7	Restoration of Trail - Unpaved	220	m	$200.00	$44,000.00
Subtotal Section C (Excl of HST)					$2,169,000.00
Section "D" – Reach 3					
1	Excavate, Earthwork, Grading & Disposal of Materials	1	LS	$15,000.00	$15,000.00
2	Remove and Reuse Accumulated Gabion Stones	40	m	$3,000.00	$120,000.00
3	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$5,500.00	$5,500.00
4	Supply & Placement of Topsoil (300mm)	1	LS	$6,500.00	$6,500.00
5	Supply & Application of Terraseed Mixture	1	LS	$5,500.00	$5,500.00
Subtotal Section D (Excl of HST)					$152,500.00
Section "E" – Restoration Plantings					
1	Supply & Planting of Trees	1	LS	$130,000.00	$130,000.00
2	Supply & Planting of Shrubs	1	LS	$85,000.00	$85,000.00
Subtotal Section E (Excl of HST)					$215,000.00
Section "F" – Contingency					
1	Contingency (20%)	1	LS	$668,600.00	$668,600.00
Subtotal Section F (Excl of HST)					$668,600.00

Section "A" – Site Preparation & Removals	$230,000.00
Section "B" – Reach 1	$729,000.00
Section "C" – Reach 2	$2,169,000.00
Section "D" – Reach 3	$152,500.00
Section "E" – Restoration Plantings	$215,000.00
Section "F" – Contingency	$668,600.00
Sub Total (Excl of taxes)	**$4,164,100.00**
HST @ 13%	$541,333.00
Total (Incl of taxes)	$4,705,433.00

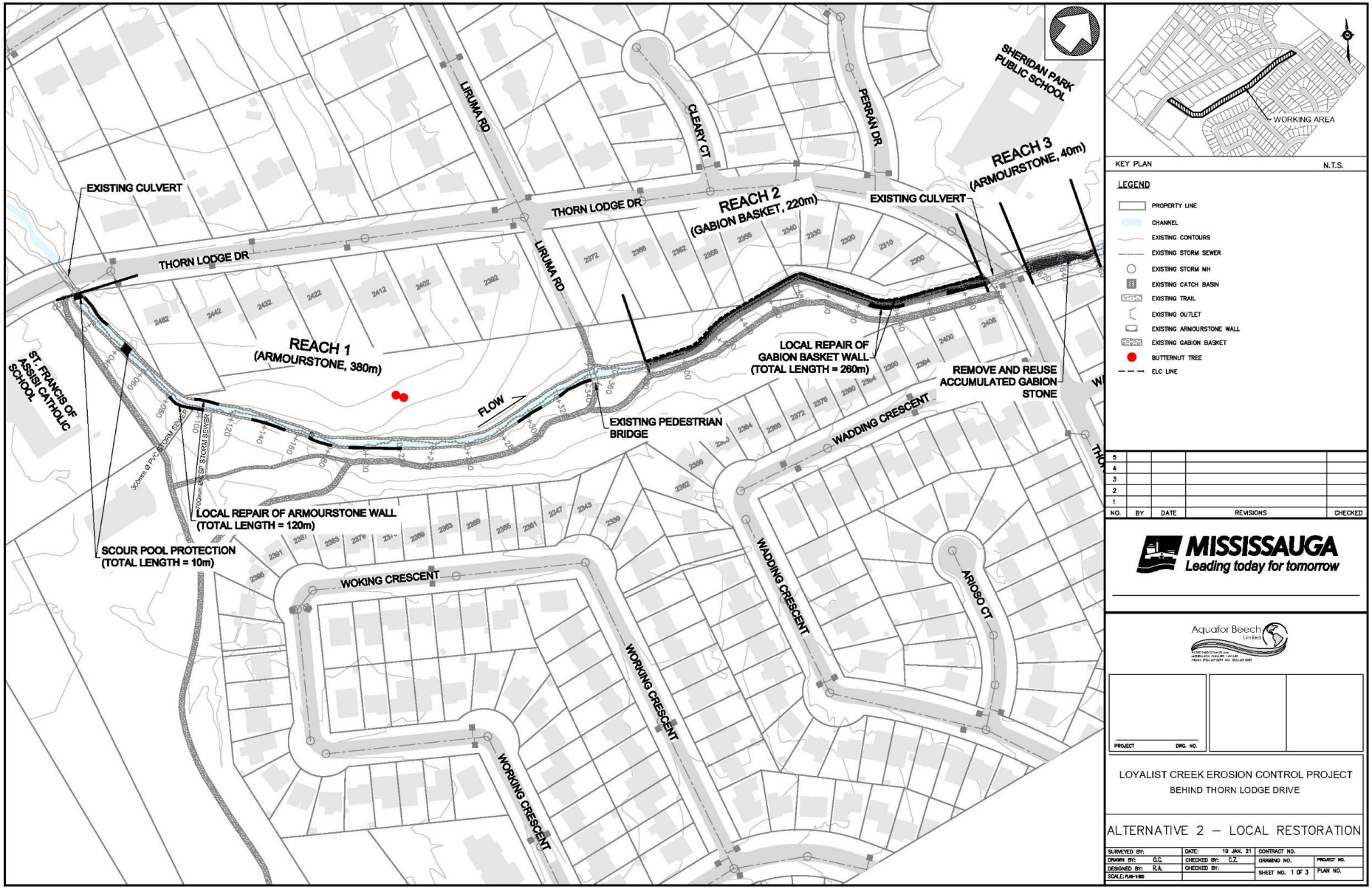


Figure 4-6. Alternative No. 2 – Local Restoration Works.

4.3 Alternative No. 3 – Engineered Channel Restoration

This alternative would involve the restoration of Loyalist Creek on a reach scale. The intent is to replace all existing bank structures with new armourstone walls, while maintaining the width and alignment of the existing channel. This alternative would require moderate disruption to the natural environment and adjacent properties, and would provide long-term erosion protection to the watercourse. However, the creek would still run through private properties, which may cause risks to the properties again in the long term. Improvement to the aquatic and terrestrial habitats is relatively low as minimal in-water and riparian vegetation could be planted. The lifespan of these works is generally defined as long, however, long-term maintenance or repair after significant rainfall will typically be required to meet lifespan expectations.

An example of reach based engineered channel restoration works is shown in Figure 4-7 and a preliminary design planform of Alternative 3 is also illustrated in Figure 4-8. As for cost, the implementation of this option would have a high level of cost due to the significant amount of hard armouring materials that will be required to be used. The preliminary construction cost estimate for Alternative 3 is set out in Table 4-3.

Figure 4-7. An Example of Engineered Channel Restoration.

Table 4-3. Preliminary Cost Estimate for Alternative 3 – Engineered Channel Restoration.

Item	Description	Qty	Unit	Unit Price	Extended Price (Excl. HST)
Section "A" – Site Preparation & Removals					
1	Field Office	1	LS	$15,000.00	$15,000.00
2	Construction Layout, Utility & Locates	1	LS	$15,000.00	$15,000.00
3	Traffic Control	1	LS	$12,000.00	$12,000.00
4	Project Signage	2	ea.	$1,000.00	$2,000.00
5	Mobilization & Demobilization	1	LS	$50,000.00	$50,000.00
6	Access Route & Staging Areas	1	LS	$25,000.00	$25,000.00
7	Clearing, Grubbing & Tree Removals	1	LS	$50,000.00	$50,000.00
8	Supply, Install & Remove Temporary Sediment Control/Tree Protection Fence	1660	m	$18.00	$29,880.00
9	Stream Control, Bypass Pumping & Dewatering	1	LS	$90,000.00	$90,000.00
10	MNRF Fish Collection Permit and Fish Rescues	1	LS	$10,000.00	$10,000.00

Subtotal Section A (Excl of HST)					$298,880.00
Section "B" – Reach 1					
1	Remove and Dispose of Armourstone	760	m	$80.00	$60,800.00
2	Excavate, Earthwork & Grading	1	LS	$25,000.00	$25,000.00
3	Engineered Channel Restoration - Armourstone	380	m	$10,000.00	$3,800,000.00
4	Storm Outfall Restoration	2	ea.	$8,000.00	$16,000.00
5	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$45,000.00	$45,000.00
6	Supply & Placement of Topsoil (300mm)	1	LS	$80,000.00	$80,000.00
7	Supply & Application of Terraseed Mixture	1	LS	$45,000.00	$45,000.00
8	Restoration of Trail - Paved	120	m	$400.00	$48,000.00
9	Restoration of Trail - Unpaved	300	m	$200.00	$60,000.00
Subtotal Section B (Excl of HST)					$4,179,800.00
Section "C" – Reach 2					
1	Remove and Dispose of Gabion Baskets	440	m	$80.00	$35,200.00
2	Excavate, Earthwork & Grading	1	LS	$25,000.00	$25,000.00
3	Engineered Channel Restoration - Armourstone	220	m	$10,000.00	$2,200,000.00
4	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$45,000.00	$45,000.00
5	Supply & Placement of Topsoil (300mm)	1	LS	$70,000.00	$70,000.00
6	Supply & Application of Terraseed Mixture	1	LS	$45,000.00	$45,000.00
7	Restoration of Trail - Unpaved	220	m	$200.00	$44,000.00
Subtotal Section C (Excl of HST)					$2,464,200.00
Section "D" – Reach 3					
1	Remove and Dispose of Armourstone	80	m	$80.00	$6,400.00
2	Excavate, Earthwork & Grading	1	LS	$20,000.00	$20,000.00
3	Engineered Channel Restoration - Armourstone	40	m	$10,000.00	$400,000.00
4	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$10,000.00	$10,000.00
5	Supply & Placement of Topsoil (300mm)	1	LS	$18,000.00	$18,000.00
6	Supply & Application of Terraseed Mixture	1	LS	$10,000.00	$10,000.00
Subtotal Section D (Excl of HST)					$458,000.00
Section "E" – Restoration Plantings					
1	Supply & Planting of Trees	1	LS	$170,000.00	$170,000.00
2	Supply & Planting of Shrubs	1	LS	$95,000.00	$95,000.00
Subtotal Section E (Excl of HST)					$265,000.00
Section "F" – Contingency					
1	Contingency (20%)	1	LS	$1,441,576.00	$1,441,576.00
Subtotal Section F (Excl of HST)					$1,441,576.00

Section "A" – Site Preparation & Removals	$298,880.00
Section "B" – Reach 1	$4,179,800.00
Section "C" – Reach 2	$2,464,200.00
Section "D" – Reach 3	$458,000.00
Section "E" – Restoration Plantings	$265,000.00
Section "F" – Contingency	$1,441,576.00
Sub Total (Excl of taxes)	**$9,107,456.00**
HST @ 13%	$1,183,969.28
Total (Incl of taxes)	$10,291,425.28

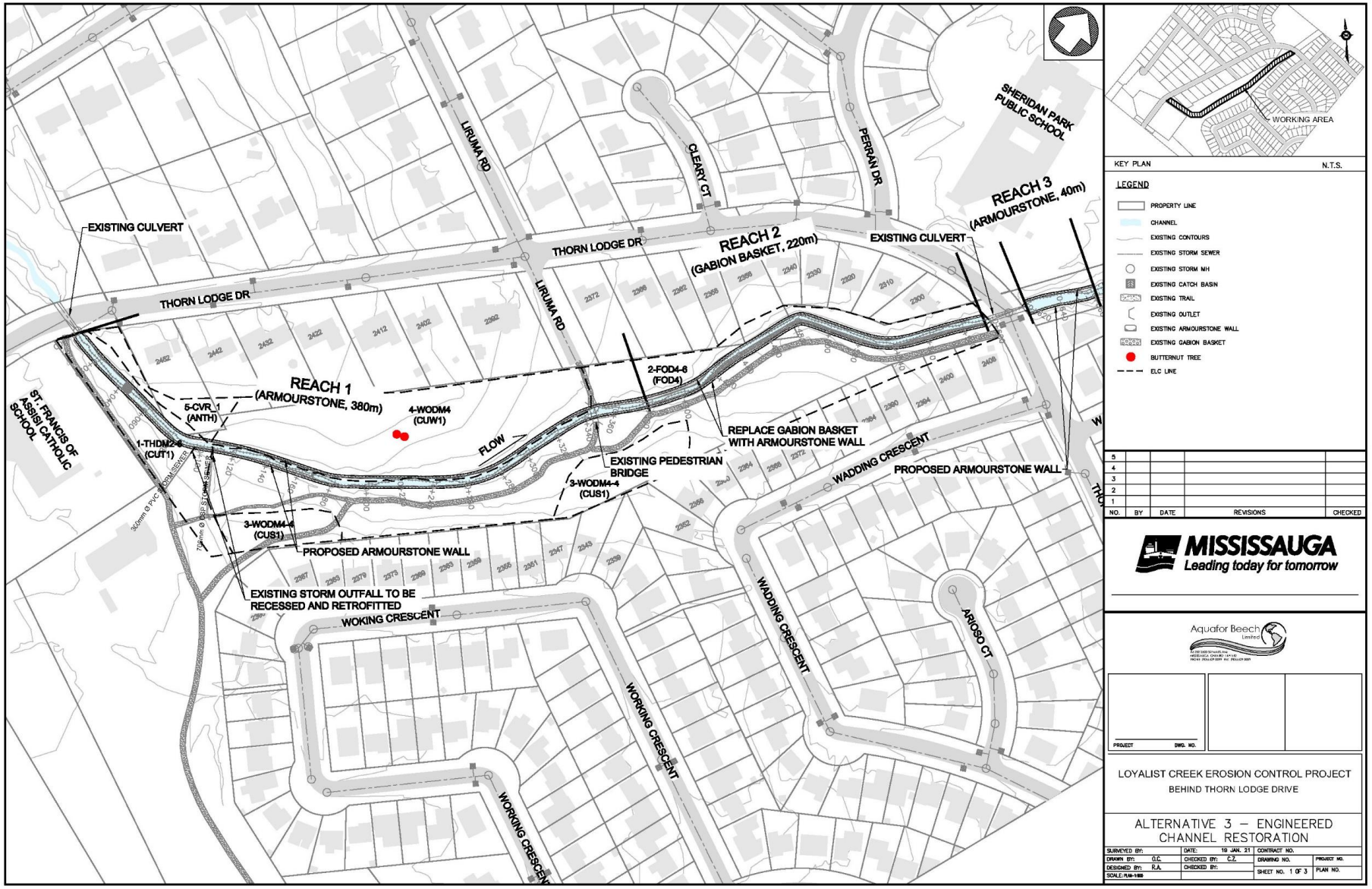


Figure 4-8. Alternative No. 3 – Engineered Channel Restoration.

4.4 Alternative No. 4 – Natural Channel Restoration

For this alternative, the creek would be restored to a more naturalized form while maintaining a fixed (existing) alignment where property constraints dictate. The channel restoration would involve a continuous realignment of the Loyalist Creek throughout the length of the study area, recreating the channel bed and banks using natural channel design techniques in combination with engineered methods. This alternative would provide the City with the opportunities to move and fix the creek beyond private property boundaries, minimizing the risks to the landowners and allowing for easier access to the City to undertake future maintenance and repair works. This alternative would involve the highest level of disruption to local residents and natural environment. Once completed however, it will provide improved conditions in terms of the natural function and processes of the watercourse. All disrupted areas will be restored with native plantings and seed mixes designed to provide stability and sustainability.

An example of natural channel restoration is shown in Figure 4-9, and the preliminary design planform of Alternative 4 is illustrated in Figure 4-10. The implementation of this option would have a relatively high cost as well, as illustrated in Table 4-4 below.

Figure 4-9. An Example of Natural Channel Restoration.

Table 4-4. Preliminary Cost Estimates for Alternative 4 – Natural Channel Restoration.

Item	Description	Qty	Unit	Unit Price	Extended Price (Excl. HST)
Section "A" – Site Preparation & Removals					
1	Field Office	1	LS	$15,000.00	$15,000.00
2	Construction Layout, Utility & Locates	1	LS	$15,000.00	$15,000.00
3	Traffic Control	1	LS	$12,000.00	$12,000.00
4	Project Signage	2	ea.	$1,000.00	$2,000.00
5	Mobilization & Demobilization	1	LS	$50,000.00	$50,000.00
6	Access Route & Staging Areas	1	LS	$25,000.00	$25,000.00
7	Clearing, Grubbing & Tree Removals	1	LS	$75,000.00	$75,000.00
8	Supply, Install & Remove Temporary Sediment Control/Tree Protection Fence	1700	m	$18.00	$30,600.00
9	Stream Control, Bypass Pumping & Dewatering	1	LS	$90,000.00	$90,000.00
10	MNRF Fish Collection Permit and Fish Rescues	1	LS	$10,000.00	$10,000.00

Subtotal Section A (Excl of HST)					$324,600.00
Section "B" – Reach 1					
1	Remove and Dispose of Armourstone	760	m	$80.00	$60,800.00
2	Excavate, Earthwork & Grading	1	LS	$30,000.00	$30,000.00
3	Natural Channel Restoration	380	m	$8,000.00	$3,040,000.00
4	Storm Outfall Restoration	3	ea.	$8,000.00	$24,000.00
5	Pedestrian Bridge Replacement	1	ea.	$80,000.00	$80,000.00
6	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$55,000.00	$55,000.00
7	Supply & Placement of Topsoil (300mm)	1	LS	$90,000.00	$90,000.00
8	Supply & Application of Terraseed Mixture	1	LS	$55,000.00	$55,000.00
9	Restoration of Trail - Paved	120	m	$400.00	$48,000.00
10	Restoration of Trail - Unpaved	300	m	$200.00	$60,000.00
Subtotal Section B (Excl of HST)					$3,542,800.00
Section "C" – Reach 2					
1	Remove and Dispose of Gabion Baskets	440	m	$80.00	$35,200.00
2	Excavate, Earthwork & Grading	1	LS	$35,000.00	$35,000.00
3	Natural Channel Restoration	200	m	$8,000.00	$1,600,000.00
4	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$55,000.00	$55,000.00
5	Supply & Placement of Topsoil (300mm)	1	LS	$80,000.00	$80,000.00
6	Supply & Application of Terraseed Mixture	1	LS	$55,000.00	$55,000.00
7	Restoration of Trail - Unpaved	70	m	$200.00	$14,000.00
8	Trail Realignment - Unpaved	150	m	$250.00	$37,500.00
Subtotal Section C (Excl of HST)					$1,911,700.00
Section "D" – Reach 3					
1	Remove and Dispose of Armourstone	80	m	$80.00	$6,400.00
2	Excavate, Earthwork & Grading	1	LS	$20,000.00	$20,000.00
3	Natural Channel Restoration	40	m	$8,000.00	$320,000.00
4	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$10,000.00	$10,000.00
5	Supply & Placement of Topsoil (300mm)	1	LS	$18,000.00	$18,000.00
6	Supply & Application of Terraseed Mixture	1	LS	$10,000.00	$10,000.00
Subtotal Section D (Excl of HST)					$378,000.00
Section "E" – Restoration Plantings					
1	Supply & Planting of Trees	1	LS	$195,000.00	$195,000.00
2	Supply & Planting of Shrubs	1	LS	$130,000.00	$130,000.00
Subtotal Section E (Excl of HST)					$325,000.00

Section "F" – Contingency					
1	Contingency (20%)	1	LS	$1,220,820.00	$1,220,820.00
Subtotal Section F (Excl of HST)					$1,220,820.00

Section "A" – Site Preparation & Removals	$324,600.00
Section "B" – Reach 1	$3,542,800.00
Section "C" – Reach 2	$1,911,700.00
Section "D" – Reach 3	$378,000.00
Section "E" – Restoration Plantings	$325,000.00
Section "F" – Contingency	$1,220,820.00
Sub Total (Excl of taxes)	**$7,702,920.00**
HST @ 13%	$1,001,379.60
Total (Incl of taxes)	$8,704,299.60

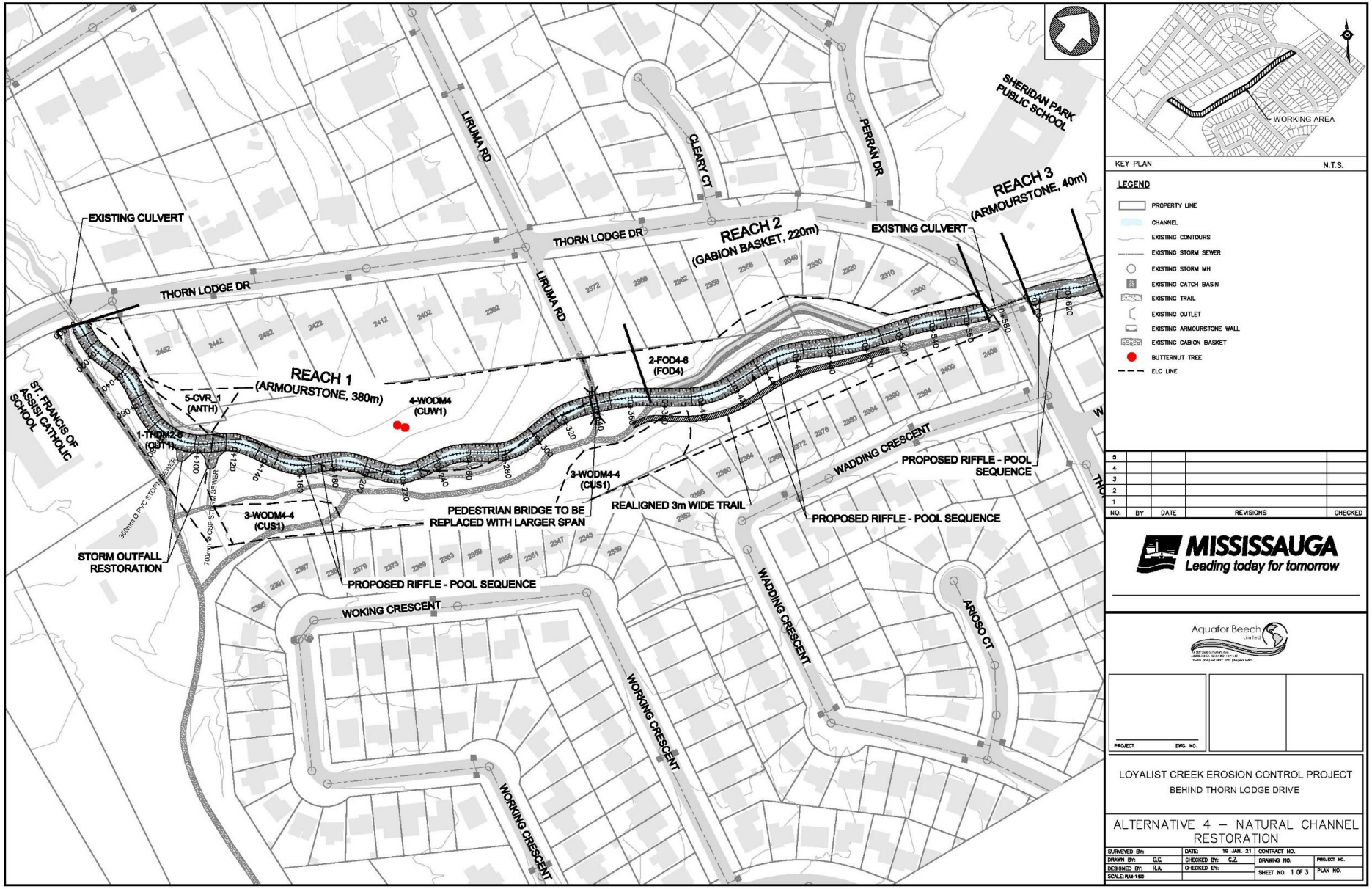


Figure 4-10. Alternative No. 4 – Natural Channel Restoration.

4.5 Evaluation of Alternatives

Each alternative was compared using selected criteria in order to apply a ranking and select the most appropriate remediation alternative. The criteria that were used as the basis for this evaluation included:

1. Physical and Natural
    a. Erosion
    b. Water Quality
    c. Aquatic Habitat
    d. Terrestrial Habitat
    e. Terrestrial Vegetation

2. Social and Cultural
    a. Public Safety
    b. Landowner Impacts
    c. Benefit to Community
    d. Aesthetic Value

3. Technical and Engineering
    a. Impact on Existing Infrastructure
    b. Constructability
    c. Lifespan of Proposed Works

4. Economic
    a. Capital Costs
    b. Operations and Maintenance Costs

For each criterion, a score was applied that ranged from 0 to 4 (Table 4-5), where:

- 0 = Unfavourable, no improvement or negative impact;
- 2 = Acceptable; and,
- 4 = Favourable, most improvement or most positive impact.

Table 4-5. Ranking Scheme for Criteria Evaluation of Each Alternative.

Ranking Scale						
Unfavourable / No Improvement / Negative Impact	0	1	2	3	4	**Favourable Most Improvement / Most Positive Impact**

The evaluation was completed with input from Aquafor technical staff, as well as representatives of the City of Mississauga by assigning a preliminary ranking score to each alternative. The ranking scores were then normalized to provide equal weighting for each category of evaluation criteria.

The sum of the criterion scores was determined for each alternative on a reach basis and the alternative with the highest total score was deemed to be the preferred alternative for that reach. A summary of scores of all four alternatives for each reach is presented through Table 4-6 to Table 4-8.

This ranking has been presented to the public, landowners and relevant stakeholders, and was then updated based on comments received as well as based on supplementary technical investigations.

Table 4-6. Evaluation of Alternatives for Reach 1.

EVALUATION CRITERIA		Reach 1							
		Alternative 1 - Do Nothing		Alternative 2 - Local Restoration		Alternative 3 - Engineered Channel Restoration		Alternative 4 - Natural Channel Restoration	
		Score	Explanation	Score	Explanation	Score	Explanation	Score	Explanation
Physical and Natural Criteria		***1.00***		***1.63***		***1.50***		***1.38***	
Erosion	Rate of erosion, slope failures, and loss of tablelands	0	Continued erosion, slope failures and loss of tablelands	3	Local repair using engineered materials would provide erosion control	4	Long-term erosion protection with minimal opportunities for planform adjustment	4	Minimized rate of erosion and loss of table / private property land, provided stable slopes
Water Quality	Impact on water quality	0	Hardened banks remain and lack of tree canopy keeps water warmer. No improvement to water quality.	2	Some improvement to water quality.	2	Some improvement of water quality.	3	Future vegetation cover from new riparian plantings will help to shade creek and keep the water cooler, as well as holding the banks together to reduce sedimentation from bank erosion.
Aquatic Habitat	Impact on contributing aquatic habitat	0	No improvement to habitat. Possibility the habitat will degrade as armourstone continue to fail and collect debris.	2	Knickpoint would be mitigated to allow fish access to upstream reaches. Substrate other than cobble could be added to the reach.	2	Knickpoint would be mitigated to allow fish access to upstream reaches. Substrate other than cobble could be added to the reach.	4	Restoring the creek to a meandering form would encourage proper river function in the development of runs/riffles/pools, providing better habitat for fish and their forage. New riparian plantings would provide shade to creek and provide habitat for forage.
Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	4	Habitat stays in current condition, relatively healthy.	3	Minor impact to ecological communities due to construction will be mitigated by planting native species.	2	Additional localized loss of vegetation due to construction. Limited opportunity to enhance riparian habitat diversity	0	Likely removal of candidate bat maternity roosting sites and impact on existing 2x butternut trees. Loss of forest canopy cover until plantings mature and replace canopy.
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	4	Vegetation composition remains the same.	3	Limited vegetation loss due to construction. It will be mitigated through native species plantings. Potential removal of dead trees and invasive shrubs	2	Moderate level of tree removal required, however, native species would be replanted for compensation	0	Significant loss of mature trees along the reach, including recently re-planted woodlot. Native species will be replanted for compensation
Social and Cultural Criteria		***1.09***		***1.50***		***1.56***		***1.72***	
Public Safety	Impact on public safety	1	Continued erosion and bank failure would create risks to public safety	3	Improved public safety by reducing erosions and stabilizing banks.	3	Improved public safety by reducing erosions and stabilizing banks. However, certain safety measures may be required due to deep channel (~2m) with steep bank slopes.	4	Stable slope and natural meander form, flooding risks minimized.
Landowner Impacts	Impact on adjacent private properties and the City-owned Park	1	Continued erosion and unstable slopes would potentially lead to loss of table / parklands	4	Minor disturbance to parkland due to construction access. Reduced risks of property loss.	2	Moderate disturbance to parkland due to construction. Reduced risks of property loss	1	Moderate disturbance to parkland due to construction. Impact on 1 landowner who has the creek within his/her property.
Benefit to Community	Access to trails, enjoyment of surrounding lands	4	No disturbance to access to trails, enjoyment of surrounding lands	3	Minor disturbance to access to trails, enjoyment of surrounding lands	2	Disturbance to access to trails due to construction, however, trail will be restored.	2	Disturbance to access to trails due to construction, however, trail will be restored.
Aesthetic Value	Impact on existing and proposed aesthetic value	1	Low aesthetic value due to deteriorated structure within the channel	2	Some improvement of the value of the creek corridor.	3	Improvement of the natural look and aesthetic value of the creek corridor.	4	Significant enhancement of the natural look of the creek corridor and aesthetic value of creek corridor
Technical and Engineer Criteria		***1.25***		***1.88***		***1.67***		***1.88***	
Impact on Existing Infrastructure	Protection or potential failure of infrastructure (bridges, trails, and storm outfalls)	1	Continued degradation of storm outfalls and risks to existing bridge.	3	Repair of degraded storm outfalls. Risks to existing bridge remain.	3	Repair of degraded storm outfalls. Existing bridge abutments would be protected.	4	Repair of degraded storm outfalls. Existing bridge will be replaced.
Constructability	Easiness to access, move equipment and construct	4	No construction activity	3	Reach is accessible, with narrower corridor within a few sections. Local repair allows smaller machine to work within narrow corridor. Moderate clearing and grubbing required. No work within private property.	2	Reach is accessible, moderate clearing and grubbing required. Work within private property is required.	1	Reach is accessible, moderate clearing and grubbing required. Work within private property
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	1	Structures in various lifespan (good - fair - bad)	3	Long-term lifespan of works.	3	Long-term life span ~ 50 years.	4	Long lifespan of works > 50 years.
Economic Criteria		***1.25***		***1.88***		***0.94***		***1.56***	
Capital Costs	One time cost to City	4	No capital cost to City	3	3rd Highest construction costs	0	Highest construction costs associated with significant amount of hard materials.	1	2nd highest construction costs
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	0	Regular monitoring and maintenance to mitigate the deterioration of the channel and tablelands. Emergency repairs on as-needed bases in perpetuity	3	Minimal monitoring and maintenance.	3	Long-term maintenance required to meet lifespan expectations.	4	Minimal maintenance required.
TOTAL SCORE		**4.59**		**6.88**		**5.67**		**6.53**	

Table 4-7. Evaluation of Alternatives for Reach 2.

EVALUATION CRITERIA		Reach 2							
		Alternative 1 - Do Nothing		Alternative 2 - Local Restoration		Alternative 3 - Engineered Channel Restoration		Alternative 4 - Natural Channel Restoration	
		Score	Explanation	Score	Explanation	Score	Explanation	Score	Explanation
Physical and Natural Criteria		***1.00***		***1.13***		***1.75***		***1.38***	
Erosion	Rate of erosion, slope failures, and loss of tablelands	0	Continued erosion, slope failures and loss of tablelands	3	Local repair using engineered materials would provide erosion control, however, erosion would continue to occur at other locations	4	Long-term erosion protection with minimal opportunities for planform adjustment	4	Minimized rate of erosion and loss of tablelands, provided stable slopes
Water Quality	Impact on water quality	0	Eroded banks remain and lack of tree canopy keeps water warmer. No improvement to water quality.	1	Limited improvements to the water quality	3	Some improvement of water quality.	3	Future vegetation cover from new riparian plantings will help to shade creek and keep the water cooler, as well as holding the banks together to reduce sedimentation from bank erosion.
Aquatic Habitat	Impact on contributing aquatic habitat	0	No improvement to habitat. Possibility the habitat will degrade as gabion baskets continue to fail and collect debris.	1	Limited improvement of aquatic habitat which may be suitable for different types of forage for fish.	3	Removal of failed gabions baskets will improve instream conditions. Engineered riffles provide habitat for forage (such as important benthic macroinvertebrates).	4	Restoring the creek to a meandering form would encourage proper river function in the development of runs/riffles/pools, providing better habitat for fish and their forage. New riparian plantings would provide shade to creek and provide habitat for forage.
Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	4	Habitat stays in current condition.	2	Moderate impact to ecological communities.	2	Moderate impact to ecological communities. Loss of forest canopy cover until plantings mature and replace canopy	0	Likely removal of candidate bat maternity roosting sites. Loss of forest canopy cover until plantings mature and replace canopy.
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	4	Vegetation composition remains the same.	2	Limited vegetation loss due to construction will be mitigated through native species plantings. Potential removal of dead trees and invasive shrubs	2	Moderate level of tree removal required, however, native species would be replanted for compensation.	0	Significant mature tree loss due to construction, including recently re-planted woodlot. Native species will be planted for compensation.
Social and Cultural Criteria		***0.94***		***1.00***		***1.56***		***1.56***	
Public Safety	Impact on public safety	0	Continued erosion and bank failure would create risks to public safety. Immediate risk to 1 landowner where the gabion baskets have completed failed.	2	Improved public safety by reducing erosions and stabilizing banks.	3	Improved public safety by reducing erosions and stabilizing banks. However, certain safety measures may be required due to deep channel (~2m) with steep bank slopes.	4	Stable slope and natural meander form, flooding risks minimized
Landowner Impacts	Impact on adjacent private properties and the City-owned Park	1	Continued erosion and unstable slopes would potentially lead to loss of table / park lands.	2	Minor disturbance to parkland due to construction access. Reduced risks of property loss	2	Moderate disturbance to parkland due to construction. Significant reduction of risks of property loss.	1	Major disturbance to parkland due to construction. Impact on private landowners who have the creek within their properties
Benefit to Community	Access to trails, enjoyment of surrounding lands	4	No disturbance to access to trails, enjoyment of surrounding lands	2	Disturbance to access to trails due to construction, however, trail will be restored.	2	Disturbance to access to trails due to construction, however, trail will be restored.	1	Realignment and reconstruction of trails will be required.
Aesthetic Value	Impact on existing and proposed aesthetic value	1	Low aesthetic value due to structure failures within the channel.	2	Some improvement of the aesthetic value of the creek corridor.	3	Improvement of the natural look and aesthetic value of the creek corridor.	4	Significant enhancement of the natural look of the creek corridor and aesthetic value of creek corridor
Technical and Engineer Criteria		***1.46***		***1.67***		***1.88***		***1.88***	
Impact on Existing Infrastructure	Protection or potential failure of infrastructure (bridges, trails, and storm outfalls)	3	No immediate risk to infrastructure	3	No immediate risk to infrastructure	4	Reduced risk to infrastructure.	4	Reduced risk to infrastructure.
Constructability	Easiness to access, move equipment and construct	4	No construction activity	3	Reach is accessible, moderate clearing and grubbing required. Work within private property is required.	2	Reach is accessible, moderate to high level of clearing and grubbing required. Work within private properties is required.	1	Reach is accessible, high level of clearing and grubbing required. Work within private properties is required.
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	0	Structures at the end of lifespan	2	Moderate lifespan of works	3	Long-term life span ~ 50 years.	4	Long lifespan of works > 50 years.
Economic Criteria		***1.25***		***1.25***		***0.94***		***1.25***	
Capital Costs	One time cost to City	4	No capital cost to City	3	3rd Highest construction costs	0	Highest construction costs associated with significant amount of hard materials.	1	2nd highest construction costs
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	0	Regular monitoring and maintenance to mitigate the deterioration of the channel and tablelands. Emergency repairs on as-needed bases in perpetuity	1	Annual monitoring and maintenance required.	3	Long-term maintenance required to meet lifespan expectations.	3	Long-term maintenance required for creek section adjacent to private properties.
TOTAL SCORE		**4.65**		**5.04**		**6.13**		**6.06**	

Table 4-8. Evaluation of Alternatives for Reach 3.

EVALUATION CRITERIA		Reach 3							
		Alternative 1 - Do Nothing		Alternative 2 - Local Restoration		Alternative 3 - Engineered Channel Restoration		Alternative 4 - Natural Channel Restoration	
		Score	Explanation	Score		Score	Explanation	Score	Explanation
Physical and Natural Criteria		***1.00***		***1.75***		***1.63***		***1.88***	
Erosion	Rate of erosion, slope failures, and loss of tablelands	0	Continued erosion, bedrock incision carrying further downstream	3	Local repair by removing and reshaping the channel would minimize erosion.	4	Long-term erosion protection with minimal opportunities for planform adjustment	4	Minimized rate of erosion and loss of table / golf course land, provided stable slopes
Water Quality	Impact on water quality	0	Accumulated gabion remains. No improvement to water quality.	3	Removing and reshaping the accumulated gabions will improve the backwatered area upstream. Lowering the amount of stagnant water will improve water quality downstream.	3	Some improvement of water quality.	4	Future vegetation cover from new riparian plantings will help to shade creek and keep the water cooler, as well as holding the banks together to reduce sedimentation from bank erosion.
Aquatic Habitat	Impact on contributing aquatic habitat	0	No improvement to habitat. Possibility the habitat will degrade as armourstone continue to fail and collect debris.	2	The possible water quality improvements would make this reach suitable for different types of forage for fish.	2	The possible water quality improvements would make this reach suitable for different types of forage for fish.	3	Development of runs/riffles/pools, providing better habitat for fish and their forage. New riparian plantings would provide shade to creek and provide habitat for forage.
Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	4	Habitat stays in current condition.	3	Minor impact to ecological communities.	2	Moderate impact to ecological communities. Loss of forest canopy cover until plantings mature and replace canopy	2	Likely removal of candidate bat maternity roosting sites. Loss of forest canopy cover until plantings mature and replace canopy . Opportunity to enhance riparian habitat diversity
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	4	Vegetation composition remains the same.	3	Limited vegetation loss due to construction will be mitigated through native species plantings throughout the reach.	2	Significant vegetation loss due to construction, however, it will be mitigated through native species plantings.	2	Significant vegetation loss due to construction, however, it will be mitigated through native species plantings.
Social and Cultural Criteria		***0.94***		***1.50***		***1.56***		***1.41***	
Public Safety	Impact on public safety	0	Continued bank and bed erosion would create risks to public safety.	3	Improved public safety by reducing erosions and flooding	4	Improved public safety by reducing erosions and flooding	4	Stable slope and natural meander form.
Landowner Impacts	Impact on adjacent private properties and the City-owned Park	1	Continued erosion and unstable slopes would potentially lead to loss of table / parklands.	3	Minor disturbance to parkland as only small equipment is required for construction, as well as adjacent properties.	1	Major disturbance to parkland due to construction. Disturbance to adjacent properties due to narrow corridor	1	Major disturbance to parkland due to construction. Disturbance to adjacent properties due to narrow corridor.
Benefit to Community	Access to trails, enjoyment of surrounding lands	4	No disturbance to access to trails, enjoyment of surrounding lands	3	Minor disturbance.	2	Moderate disturbance.	1	Major disturbance.
Aesthetic Value	Impact on existing and proposed aesthetic value	1	Low aesthetic value due to accumulated gabion and debris within the channel	3	Improvement of the aesthetic value of the creek corridor.	3	Improvement of the natural look and aesthetic value of the creek corridor.	3	Improvement of the natural look and aesthetic value of the creek corridor.
Technical and Engineer Criteria		***1.67***		***1.67***		***1.46***		***1.67***	
Impact on Existing Infrastructure	Protection or potential failure of infrastructure (bridges, trails, and storm outfalls)	3	No immediate risk to infrastructure	3	No immediate risk to infrastructure	3	No immediate risk to infrastructure	3	No immediate risk to infrastructure
Constructability	Easiness to access, move equipment and construct	4	No construction activity	3	Only small equipment is required.	1	Access would be difficult due to narrow corridor	1	Access would be difficult due to narrow corridor
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	1	Structures near end of lifespan	2	Moderate lifespan of works	3	Long-term life span ~ 50 years.	4	Long lifespan of works > 50 years.
Economic Criteria		***1.25***		***1.88***		***0.94***		***1.25***	
Capital Costs	One time cost to City	4	No capital cost to City	3	3rd Highest construction costs	0	Highest construction costs associated with significant amount of hard materials.	1	2nd highest construction costs
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	0	Regular monitoring and maintenance to mitigate the deterioration of the channel and tablelands. Emergency repairs on as-needed bases in perpetuity	3	Minimal monitoring and maintenance	3	Long-term maintenance required to meet lifespan expectations.	3	Minimal maintenance required.
TOTAL SCORE		**4.85**		**6.79**		**5.58**		**6.20**	

4.6 Public, Stakeholder, and Agency Consultation

Throughout the study process, an extensive consultation program that involved the pubic, stakeholders and representatives of the various agencies was implemented. The process included an online Public Information Centre (PIC) and onsite meetings with CVC staff.

These points of contact satisfied the general criteria defined within the Municipal Class EA process for Schedule B projects, where a mandatory two (2) points of public contact are required. Moreover, the following public and agency interactions were completed:

- Notice of Study Commencement;
- Notice of online PIC
- EA Study Information Slides and narrated video (presented at the online PIC); and
- Notice of Completion.

An overview of the PIC boards and a summary of the consultation program are presented below.

4.7 Notice of Commencement

The Notice of Commencement for the study was published in the Mississauga News on July 23rd, 2020 and on the City of Mississauga's website.

Review agencies, First Nations, and key stakeholders were also notified, including Ministry of the Environment, Conservation and Parks (MECP), CVC, MNRF, Region of Peel, Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI), Fisheries and Oceans Canada (DFO), etc. In addition, hard copies of the notice were also delivered to the properties that are immediately adjacent to the Loyalist Creek corridor. A copy of the notice is included in Appendix F1 and a list of the stakeholders that participated in the process is included as Appendix F2.

The purpose of the notice was to notify the public that a Class EA study had been initiated, to provide background on the problem definition, and to provide contact information for the representatives of the City and Aquafor who people could engage with throughout the study process.

4.8 Pubic & Stakeholder Consultation

4.8.1 *Public Information Centre*

Due to the ongoing Public Health Emergency related to COVID-19, an online Public Information Centre was arranged to allow local residents and interested members of the public an opportunity to review and comment on the project findings to date, the alternative solutions being considered and the evaluation process. The online PIC included a narrated video presentation and online survey platform to gather input and feedback. The PIC materials were made available to the public on the City's website from June 18th, 2021 to July 19th, 2021.

The presentation narrated a set of boards outlining the study purpose, background, findings, as well as next steps. A copy of the PIC boards presented is attached in Appendix F3. The presentation boards outline the following items:

- The study area
- The objectives of the study and the purpose of the public information package;
- The Municipal Class EA – Schedule B process;
- The existing conditions of Loyalist Creek within the study area;
- The problems and opportunities;
- The site specific inventories and findings through the study;
- The alternatives for the study areas;
- The evaluation criteria and preliminary scoring; and

- The next steps in the process.

A great number of comments were received from the public regarding the study and the materials presented at the online PIC, mostly from the local residents that live in the vicinity of the study area. A significant number of residents expressed concern about the initial recommendation that Alternative 4 (natural channel restoration) be applied in Reach 2. The community noted that the woodlot in Reach 2 is highly valued and were concerned that the re-alignment of the creek, as defined under Alternative 4, would result in the loss of many trees, some of which were just recently re-planted by the community in response to losses due to ash borer disease. The study team and City have updated the initial evaluation results for the creek alternatives to reflect this feedback and concluded that Alternative 3 (engineered channel restoration) be recommended for Reach 2. Under Alternative 3, the existing creek alignment and width will be maintained, resulting in less disruption to the surrounding vegetation communities.

With respect to Reach 1 and Reach 3, the comments received were supportive of the recommended Alternative 2 (local restoration works).

The PIC invitation letter, public information package (presentation boards), and consolidated comments from the public are provided in Appendix F.

4.8.2 *Credit Valley Conservation (CVC)*

Credit Valley Conservation (CVC) has been included throughout the process of this study, including attendance at site meetings and providing comments and feedback at interim stages. CVC has included engineering, planning and ecology representation during all points of contact.

4.8.3 *First Nations*

First Nations, including the Mississaugas of the Credit First Nation, the Haudenosaunee Development Institute, and the Six Nations of the Grand River were notified about the project at the time of initiation of the study and prior to the date of the PIC.

As mentioned in Section 3.8, a Stage 2 Archaeologic investigation is required for select locations within the study area, during which all three First Nations will be invited to participate. The Stage 2 archaeology investigation is scheduled to be undertaken in late 2021 or early 2022, in conjunction with the detailed design.

5 SELECTION AND DESCRIPTION OF PREFERRED ALTERNATIVE

5.1 Selection of Preferred Alternative

Based on the evaluation criteria, consultation with the City, stakeholders and the public, the preferred alternative for the restoration of Loyalist Creek within the study area is **Local Restoration (Alternative No. 2) for Reach 1 and 3 and Engineered Channel Restoration (Alternative No. 3) for Reach 2**. The preferred alternative focuses on the restoration works at priority locations and replacement/retrofit of failing armourstone to protect public safety for Reach 1 and Reach 3, as well as the continuous restoration of the entire Reach 2 using engineering materials to minimize erosion and planform adjustment.

The preferred alternative provides the long-term erosion protection for the creek and streambank, with the least invasive approach. This option also has a shorter construction duration, addressing most of the concerns of the public. As noted in Section 3.9, some restoration works will need to be undertaken within private properties and municipal easements/approvals will be required at these locations.

5.2 Conceptual Design of Preferred Alternative

The conceptual design for the preferred alternative is illustrated in Figure 5-1. Locations of the priority repair / retrofit areas, erosion control structures, and the length of each reach are highlighted in the general plan. Technical details will be refined through the detailed design process.

The concept drawings are typically of interest to the regulatory conservation authority (CVC), in order to confirm that the preferred alternative will be consistent with permitting requirements, and also highlighted through the public consultation program as being imperative to the study.

5.3 Description of Preferred Alternative

For the preferred alternative within Reach 1, the dislocated armourstones within the identified areas will be reconstructed with new armourstone of more consistent size and shape, as well as proper drainage on the back. The two deteriorated storm sewer outlets will also be repaired to reduce the risk of failure. Similarly, within Reach 3, restoration works will be performed at strategic locations. The excess deposited engineering material causing backwatering will be removed to improve the conveyance of the upstream culvert.

As for Reach 2, more extensive restoration works will be carried out to protect the creek corridor. The reach will be restored with new armourstone retaining walls along both banks, intended to minimize the rate of erosion and mitigate risks to the adjacent private properties. Although it is planned to maintain the existing creek alignment, considerations will be given to “smoothing” the sharp bend in the middle of Reach 2 to limit channel migration. In addition, a series of runs, riffles, and pools will be incorporated into the design, encouraging proper river function and potential fish passage.

For all three reaches, following construction, full vegetative restoration will be undertaken, with native grasses, shrubs and trees. The plantings will compensate for loses resulting from construction activities, and will provide additional bank stability and reinforcement. To minimize the potential impacts on SARs, it is recommended that potentially suitable maternity roosting sites are retained on the landscape; construction designs should avoid these trees if possible. In addition, it is recommended that once the detailed design for the proposed erosion control works is completed, an IGF is to be completed so that the MNRF can determine if a permit is required under the ESA (2007).

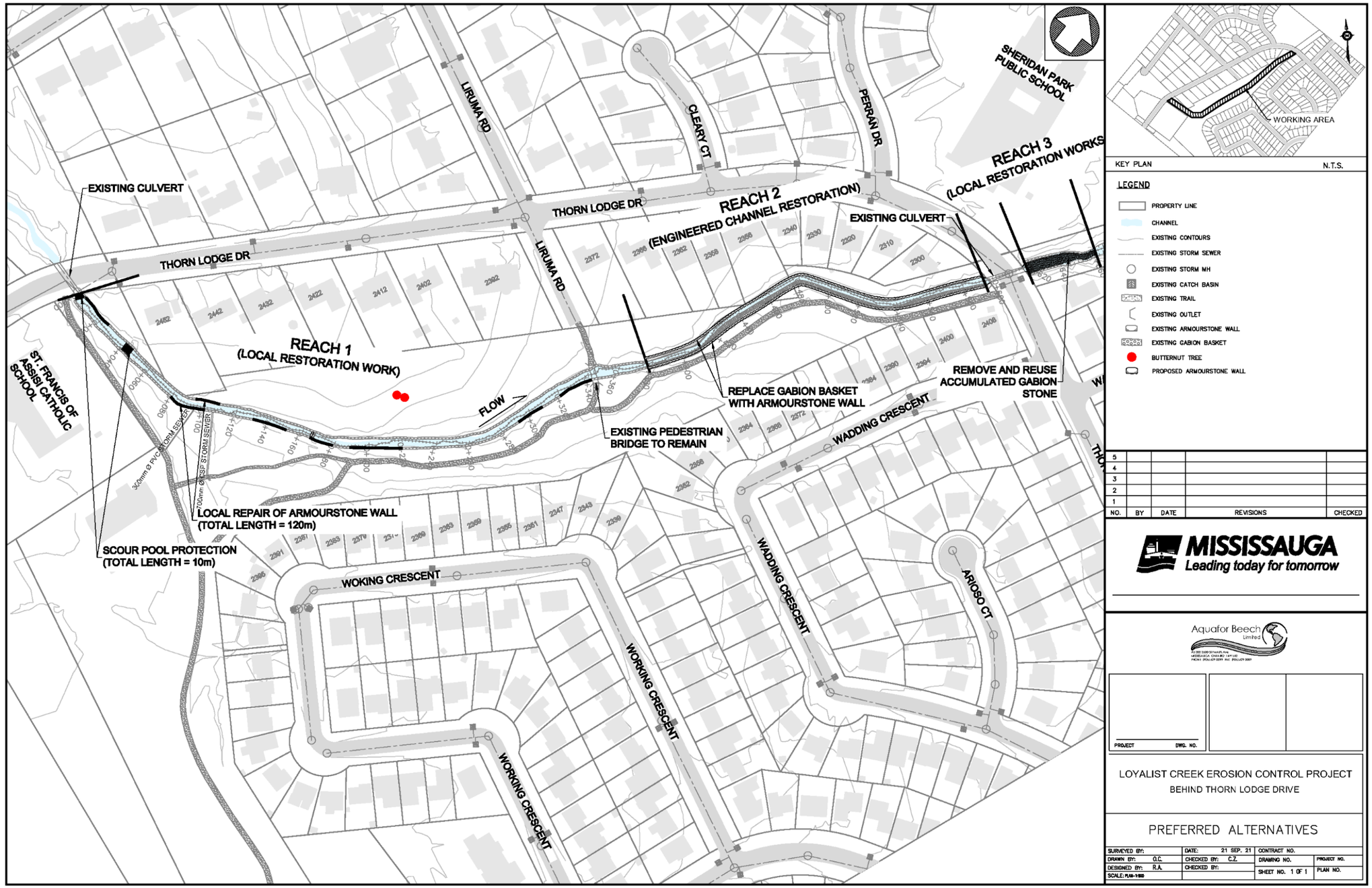


Figure 5-1. Preliminary Design for the Preferred Alternative.

5.4 Construction Timing

The City plans to proceed with the construction of the preferred alternative following the completion of the detailed design.

Due to the steepness of bank slopes and the existing erosion, it is preferred that these works be undertaken in the winter months, when the ground is frozen and more solid. This will generally provide more stable conditions for the heavy machinery. The construction is tentatively scheduled for 2022.

Should any construction works be undertaken during the summer season, it is recommended that vegetation removal occur prior to the generalized nesting period (i.e. between April 1st and August 31st), to ensure that the proposed works do not contravene the federal Migratory Birds Convention Act (1994), which protects the nests of most breeding bird species in Ontario. Should work occur within the generalized nesting period, it is recommended that a Qualified Avian Ecologist conduct a nest search prior to construction and, if applicable, establish temporary Nest Protection Zones for any found nests which will remain in place until all fledged birds have left the vicinity or as advised by a qualified wildlife biologist.

5.5 Preliminary Cost Estimate

A preliminary cost estimate for the preferred alternative has been summarized in Table 5-1 below. Cost estimates are based on unit prices of similar projects that have been recently completed. These costs do not include additional fees such as engineering and other technical services. The total approximate cost to implement the preferred solution is approximately $4.6M (excluding HST). As indicated, this is an approximate, preliminary cost estimate, and will be refined as part of the detailed design.

Table 5-1. Preliminary Cost Estimate for the Preferred Alternative.

Item	Description	Qty	Unit	Unit Price	Extended Price (Excl. HST)
Section "A" – Site Preparation & Removals					
1	Field Office	1	LS	$15,000.00	$15,000.00
2	Construction Layout, Utility & Locates	1	LS	$15,000.00	$15,000.00
3	Traffic Control	1	LS	$12,000.00	$12,000.00
4	Project Signage	2	ea.	$1,000.00	$2,000.00
5	Mobilization & Demobilization	1	LS	$40,000.00	$40,000.00
6	Access Route & Staging Areas	1	LS	$20,000.00	$20,000.00
7	Clearing, Grubbing & Tree Removals	1	LS	$40,000.00	$40,000.00
8	Supply, Install & Remove Temporary Sediment Control/Tree Protection Fence	1600	m	$18.00	$28,800.00
9	Stream Control, Bypass Pumping & Dewatering	1	LS	$75,000.00	$75,000.00
10	MNRF Fish Collection Permit and Fish Rescues	1	LS	$10,000.00	$10,000.00
11	Removal & Disposal of Excess Pipe, Armourstone, Filter Fabric, Gabion Baskets, Wire Mesh	1	LS	$45,000.00	$45,000.00
Subtotal Section A (Excl of HST)					$302,800.00
Section "B" – Reach 1 - Local Channel Restoration					
12	Excavate, Earthwork, Grading & Disposal of Materials	1	LS	$15,000.00	$15,000.00
13	Local Repair of Armourstone Walls and Scour Protection	180	m	$3,000.00	$540,000.00
14	Storm Outfall Restoration	2	ea.	$8,000.00	$16,000.00
15	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$15,000.00	$15,000.00
16	Supply & Placement of Topsoil (300mm)	1	LS	$20,000.00	$20,000.00
17	Supply & Application of Terraseed Mixture	1	LS	$15,000.00	$15,000.00
18	Restoration of Trail - Paved	120	m	$400.00	$48,000.00
19	Restoration of Trail - Unpaved	300	m	$200.00	$60,000.00
Subtotal Section B (Excl of HST)					$729,000.00

Section "C" – Reach 2 - Engineered Channel Restoration					
20	Excavate, Earthwork, Grading & Disposal of Materials	1	LS	$40,000.00	$40,000.00
21	Engineered Channel Restoration	220	m	$10,000.00	$2,200,000.00
22	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$45,000.00	$45,000.00
23	Supply & Placement of Topsoil (300mm)	1	LS	$70,000.00	$70,000.00
24	Supply & Application of Terraseed Mixture	1	LS	$45,000.00	$45,000.00
25	Restoration of Trail - Unpaved	220	m	$200.00	$44,000.00
Subtotal Section C (Excl of HST)					$2,444,000.00
Section "D" – Reach 3 - Local Channel Restoration					
26	Excavate, Earthwork, Grading & Disposal of Materials	1	LS	$15,000.00	$15,000.00
27	Remove and Reuse Accumulated Gabion Stones	40	m	$3,000.00	$120,000.00
28	Supply & Placement of Erosion Control Blanket - Coir Mat	1	LS	$5,500.00	$5,500.00
29	Supply & Placement of Topsoil (300mm)	1	LS	$6,500.00	$6,500.00
30	Supply & Application of Terraseed Mixture	1	LS	$5,500.00	$5,500.00
Subtotal Section D (Excl of HST)					$152,500.00
Section "E" – Restoration Plantings					
31	Supply & Planting of Trees	1	LS	$150,000.00	$150,000.00
32	Supply & Planting of Shrubs	1	LS	$90,000.00	$90,000.00
Subtotal Section E (Excl of HST)					$240,000.00
Section "F" – Contingency					
33	Contingency (20%)	1	LS	$743,160.00	$743,160.00
Subtotal Section F (Excl of HST)					$743,160.00

Section "A" – Site Preparation & Removals	$302,800.00
Section "B" – Reach 1 - Local Channel Restoration	$729,000.00
Section "C" – Reach 2 - Engineered Channel Restoration	$2,444,000.00
Section "D" – Reach 3 - Local Channel Restoration	$152,500.00
Section "E" – Restoration Plantings	$240,000.00
Section "F" – Contingency	$743,160.00
Sub Total (Excl of taxes)	**$4,611,460.00**
HST @ 13%	$599,489.80
Total (Incl of taxes)	$5,210,949.80

6 IMPLEMENTATION PLAN

This chapter summarizes the implementation considerations associated with the various elements of the Preferred Alternative as described in Chapter 5.

The next steps for implementation of the preferred alternative include:

- Issuance of the Notice of Completion;
- Detailed design and associated investigations;
- Easement negotiations;
- Permits and Approvals;
- Contract document preparation and tender;
- Construction; and,
- Post Construction Monitoring.

The steps required to address the above tasks have been outlined below.

6.1 Notice of Completion

The Notice of Completion will be provided to all stakeholders, agencies and residents on the study distribution list, and copies of the Project File report will be available for review by the public.

6.2 Detailed Design and Investigations

The detail design package should include the preparation of 70%, 95% and final design drawings for review by the City, CVC and relevant stakeholders. The detail design package should include, but not be limited to, the following components:

- General plan (detailing structures, property lines and services);
- Site plan (including site access, staging and stockpile area delineation);
- Plan and profile drawings (detailing location of existing utilities and existing bridge);
- Erosion and sediment control plan (as per the Erosion and Sediment Guidelines for Urban Construction, GGHACA);
- Landscape restoration plan (including tree removal, preservation and planting plan);
- Storm outfall restoration plan;
- Trail restoration plan; and
- Associated design brief

The following implementation measures must be considered at the detailed design and implementation stages:

Construction Staging, Erosion and Sediment Control Measures

Appropriate plans are to be included within the detailed design package, based on consultations with the City and CVC. These plans will include information such as access route and staging areas, with comprehensive erosion and sediment control requirements to be implemented throughout construction. This will include both flow management plans to enable working in dry conditions, as well as detailed fencing and delineation of the extents of disturbance. In this regard, all areas of disturbance will be fully restored and stabilized to prevent loss and contribution of sediments downstream.

Tree Protection and Restoration Plan

Tree protection fences following the specifications in CVC's Landscaping and Tree Protection Guidelines should be erected along all construction access routes and work areas. If possible, it is also recommended that planting areas be fenced off for two years to protect newly planted vegetation and to allow time for growth and to anchor soils. Some mature trees will need to be removed to accommodate construction. To compensate, native trees and

shrubs that fit the existing vegetation communities will be included within the restoration plan of the detailed design drawings. CVC's Plant Selection Guideline and Healthy Soils Guideline for the Natural Heritage System will be reviewed when developing the plan.

Utility Locations

All utility organizations should be contacted for as-constructed drawings and to complete field-marking of all underground services within the proposed restoration area. The utilities may include, but are not limited to, electricity, natural gas, cable television, telephone, water, sanitary sewer and storm sewer. All utility relocation is to be completed prior to the tender of the Erosion Control Works. At storm outfalls, the structure stability and flow hydraulics of the outfall channel must be considered in the detailed design.

Hydraulic Assessment

A detailed hydraulic assessment of the proposed conditions will be conducted and the results will be included in the detailed design brief. Computation of peak velocities for bank full and peak floods will be included and incorporated into evaluation of the proposed remedial measures. The assessment will be used to confirm that no negative flooding impacts will result from the proposed works, a condition of the CVC permit.

Tendering Support for Construction

All tender documentation will be completed applicable to the City of Mississauga standards, with Special Provisions and Schedule of Quantities with refined engineering cost estimates provided. The package will include Project Descriptions, Special Provisions, Specifications, Form of Tender and a Schedule of Prices. The final detailed design drawings will be issued as a set of contract drawings with the completed tender package. The contract drawings will be stamped by a professional engineer, signed, and labeled "Issued for Tender" complete with all necessary material and performance specifications. Aquafor will typically assist the City during the tendering and procurement period as required, providing responses and clarification to bidders during the procurement process.

6.3 Permits

Prior to construction it will be necessary to coordinate environmental approvals and permits necessary to complete the intended works. At this time, it is Aquafor's understanding that approvals from CVC, MNRF, and DFO may be required. A brief summary of permits and approvals is included below:

CVC – O. Reg. 166/06 Permit
This typically involves two submissions (70% & 95% design), and will include supporting design brief information.

DFO – Assessment under the Federal Fisheries Act
Aquafor's certified fisheries biologist will complete a Self-Assessment based on the detailed design for the proposed works. Based on similar experiences, at minimum a Letter of Advice will be required from DFO.

MECP 17(2) (b/ c) Species at Risk Permit
Depending on the results of the IGF and further field investigations, MECP will confirm whether a SAR permit will be required.

Approvals may be also required from the Region of Peel and other utilities for working adjacent to their infrastructure.

6.4 Construction Services

Aquafor will provide inspection and resident services during construction under the guidance of a professional engineer who has been integrated in the design and well versed in similar construction projects. Tasks undertaken as part of the supervision role will include:

- Attend regular (bi-weekly) progress meetings, including pre-construction meeting, prepare and distribute meeting minutes within 3 days of the meeting;
- Respond to inquiries and request for information from external agencies, public stakeholders;
- Preparation of progress payment certificates and recording material quantities as they arrive to site;
- Overseeing the day-to-day construction and providing interpretation of the drawings;
- Ensuring that contractor's methodology complies with requirements of design;
- Monitor the traffic control measures to ensure they are consistent with traffic control plans;
- Inspect all layout and construction work to ensure compliance with the contract specifications and drawings;
- Provide advice to the contractor regarding the interpretation of the contract drawings and specifications and the preparation of supplemental details, instruction and clarifications as required;
- Notify the contractor of any deficiencies in the construction of the work, instructing the contractor to take appropriate corrective measures, confirm and report results of the corrective measures during construction. The deficiency list will be maintained and coordination of rectification throughout the 2-year maintenance period;
- Review, monitor and ensure compliance with contractor environmental conditions (i.e., ESC Plan).
- Preparation and issuance of substantial Performance certificate and recommendations; and
- Undertake a complete and thorough inspection of the contractor's work and prepare a report which lists all outstanding deficiencies at the end of the warranty period and coordinate and ensure that contractor corrects all warranty deficiencies expeditiously and to the satisfaction of the City.

6.5 Monitoring Program

A 3-year annual monitoring plan is recommended following completion of construction, which will include Warranty Period engineering review, as well as assessment of the efficacy of restoration plantings. The program should include time for inspection of both the channel works and vegetation plantings by the project geomorphologist/engineer, as well as the ecologist. Both the monitoring and warranty will be defined to suit the detailed design, and satisfy City, CVC and other agency requirements.

6.6 As-Constructed Drawings and Analysis

This task will set baseline conditions following construction, which will enable future monitoring and comparative analysis. Specifically, Aquafor will undertake an as-built survey of completed channel works (plan, profile, and cross sections) to verify implementation of design within reasonable tolerances. As-constructed drawings, together with a report summarizing pre- and post-construction conditions would be provided. The report would comment on significant deficiencies found with recommendations for correction or adaptive management as required.

Should CVC or the City wish the HEC model be updated to match as-built conditions (should the comparative analysis to the design highlight differential condition), Aquafor will update the HEC model accordingly to confirm no negative impacts to flooding.

7 REFERENCES

Brouillet L, Desmet P, Coursol F, Meades SJ, Favreau M, Anions M, Bélisle P, Gendreau C, Shorthouse D, and contributors. 2010+. *Database of Vascular Plants of Canada (VASCAN)*. Online at http://data.canadensys.net/vascan and http://www.gbif.org/dataset/3f8a1297-3259-4700-91fc-acc4170b27ce, released on 2010-12-10. Version [xx]. GBIF key: 3f8a1297-3259-4700-91fc-acc4170b27ce. Data paper ID: doi: http://doi.org/10.3897/phytokeys.25.3100 [accessed on [07/24/2019]]

Chapman, L.J. and Putnam, D.F. 1984. *Physiography of Southern Ontario*. Ontario Geologic Survey. Map P. 2715.

Credit Valley Conservation (CVC). 2002. *Plants of the Credit River Watershed*. Available at: https://cvc.ca/watershed-science/plants-animals-communities/plants-and-animals-of-the-credit/plants/

Fischenich, C. 2011. *Stability Thresholds for Stream Restoration Materials*. ERDC TN-EMRRP-SR-29

Karrow, P.F. and Easton, J. 2005. *Quaternary Geology of the Brampton area.* Ontario Geologic Survey. Map 2223.

Lee, H., Bakowsky, W. Riley, J., Bowles, J., Puddister, M., Uhlig, P., and McMurray, S. 1998. *Ecological Land Classification for Southern Ontario: First Approximation and Its Application.* North Bay: Ontario Ministry of Natural Resources, Southcentral Science Section, 1998. Print.

Ministry of Environment and Climate Change. 2015. *Municipal Class Environmental Assessment*. Retrieved from http://www.municipalclassea.ca/manual/page1.html

Natural Heritage Information Centre (NHIC). 2019. All Species. Available at: https://www.ontario.ca/page/get-natural-heritage-information

Oldham, M., Bakowsky, W., Sutherland, D. 1995. *Floristic Quality Assessment System for Southern Ontario.* Natural Heritage Information Centre, Ontario Ministry of Natural Resources.

Ontario Ministry of Natural Resources. 2002. *Technical Guide River & Stream Systems: Erosion Hazard Limit.*

Sharpe, D.R. 1980. *Quaternary Geology of Toronto and Surrounding Area*. Ontario Geologic Survey. Preliminary Map P. 2204.

Appendix A – Detailed HEC-RAS Results

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	14338	2yr_Ex	8.9	158.91	158.01	1.08	0.000231	0.42	2.37	1.01	20.95	19.37	0.13
1	14338	5yr_Ex	14.8	159.34	158.14	1.42	0.000276	0.5	3.7	1.85	29.51	20.72	0.13
1	14338	10yr_Ex	21.3	159.72	158.27	1.69	0.00033	0.57	5.22	2.96	37.61	22.21	0.14
1	14338	25yr_Ex	26.4	159.97	158.35	1.85	0.000376	0.61	6.49	3.95	43.29	23.41	0.14
1	14338	50yr_Ex	32	160.21	158.44	2	0.000419	0.65	7.81	5.08	49.16	24.58	0.15
1	14338	100yr_Ex	39.4	160.55	158.56	2.21	0.000444	0.68	9.11	6.22	57.71	26.15	0.15
1	14338	Regional_Ex	52.1	161.21	158.72	2.63	0.000404	0.69	9.84	6.75	75.91	28.82	0.14
1	14310	2yr_Ex	8.9	158.9	158.01	1.05	0.000484	0.5	4.84	2.41	17.91	17.01	0.15
1	14310	5yr_Ex	14.8	159.33	158.17	1.37	0.000557	0.58	7.18	4.17	25.48	18.66	0.16
1	14310	10yr_Ex	21.3	159.7	158.31	1.63	0.000617	0.65	9.45	6.14	32.77	20.07	0.16
1	14310	25yr_Ex	26.4	159.95	158.41	1.8	0.000667	0.7	11.21	7.82	37.84	21.03	0.17
1	14310	50yr_Ex	32	160.19	158.52	1.96	0.000716	0.74	13.05	9.7	43.06	22.02	0.17
1	14310	100yr_Ex	39.4	160.53	158.64	2.16	0.000736	0.78	14.77	11.48	50.69	23.48	0.17
1	14310	Regional_Ex	52.1	161.19	158.83	2.53	0.000664	0.77	15.53	12.04	67.23	26.61	0.16
1	14282	2yr_Ex	8.9	158.87	158.06	1.02	0.001056	0.66	10.17	6.67	13.56	13.3	0.21
1	14282	5yr_Ex	14.8	159.29	158.25	1.29	0.001232	0.76	14.92	11.31	19.53	15.11	0.21
1	14282	10yr_Ex	21.3	159.66	158.42	1.53	0.001348	0.84	19.19	16.08	25.42	16.63	0.22
1	14282	25yr_Ex	26.4	159.91	158.54	1.68	0.001425	0.89	22.24	19.85	29.59	17.59	0.22
1	14282	50yr_Ex	32	160.15	158.66	1.83	0.001495	0.94	25.31	23.88	33.91	18.53	0.22
1	14282	100yr_Ex	39.4	160.48	158.81	2.02	0.001487	0.98	27.76	27.12	40.33	19.93	0.22
1	14282	Regional_Ex	52.1	161.15	159.03	2.37	0.001261	0.95	27.49	26.2	54.67	23.04	0.2
1	14254	2yr_Ex	8.9	158.83	158.11	0.99	0.001435	0.76	13.39	10.21	11.67	11.73	0.24
1	14254	5yr_Ex	14.8	159.24	158.3	1.27	0.001665	0.88	19.65	17.33	16.78	13.18	0.25
1	14254	10yr_Ex	21.3	159.61	158.49	1.51	0.001837	0.98	25.46	24.84	21.83	14.5	0.25
1	14254	25yr_Ex	26.4	159.84	158.61	1.65	0.001964	1.04	29.75	30.92	25.4	15.38	0.26
1	14254	50yr_Ex	32	160.08	158.74	1.79	0.002079	1.1	34.05	37.42	29.12	16.25	0.26
1	14254	100yr_Ex	39.4	160.41	158.89	1.98	0.00206	1.13	37.22	42.2	34.75	17.51	0.26
1	14254	Regional_Ex	52.1	161.09	159.12	2.32	0.001736	1.09	36.51	39.93	47.63	37.63	0.23
1	14226	2yr_Ex	8.9	158.78	158.14	0.92	0.0021	0.83	18.25	15.12	10.74	11.67	0.28
1	14226	5yr_Ex	14.8	159.18	158.34	1.19	0.002251	0.94	25.11	23.57	15.77	13.21	0.27
1	14226	10yr_Ex	21.3	159.54	158.52	1.42	0.002359	1.02	31.17	31.93	20.79	14.6	0.27
1	14226	25yr_Ex	26.4	159.78	158.65	1.56	0.002479	1.08	35.81	38.84	24.34	15.58	0.28
1	14226	50yr_Ex	32	160.01	158.77	1.69	0.002597	1.14	40.45	46.09	28.08	16.64	0.28

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	14226	100yr_Ex	39.4	160.35	158.92	1.87	0.002501	1.16	43.01	49.93	33.94	18.17	0.27
1	14226	Regional_Ex	52.1	161.04	159.15	2.18	0.001986	1.09	39.78	43.37	47.79	24.18	0.24
1	14198	2yr_Ex	8.9	158.71	158.1	0.9	0.002536	0.82	21.52	17.7	10.82	12.08	0.28
1	14198	5yr_Ex	14.8	159.11	158.3	1.17	0.002558	0.93	28.09	26	15.99	13.66	0.27
1	14198	10yr_Ex	21.3	159.47	158.47	1.41	0.002576	1.01	33.73	33.95	21.16	15.05	0.27
1	14198	25yr_Ex	26.4	159.71	158.59	1.56	0.002629	1.07	38	40.51	24.77	15.88	0.27
1	14198	50yr_Ex	32	159.94	158.71	1.7	0.002696	1.12	42.36	47.55	28.51	16.75	0.27
1	14198	100yr_Ex	39.4	160.28	158.86	1.89	0.002557	1.14	44.52	50.93	34.44	18.21	0.27
1	14198	Regional_Ex	52.1	160.98	159.08	2.13	0.00208	1.07	40.95	43.7	48.82	32.58	0.23
1	14170	2yr_Ex	8.9	158.67	157.96	0.92	0.001449	0.62	12.68	7.86	14.36	15.68	0.21
1	14170	5yr_Ex	14.8	159.07	158.12	1.19	0.001451	0.7	16.46	11.55	21.09	17.65	0.2
1	14170	10yr_Ex	21.3	159.43	158.28	1.43	0.001465	0.77	19.81	15.18	27.8	19.43	0.2
1	14170	25yr_Ex	26.4	159.67	158.38	1.57	0.001518	0.81	22.48	18.27	32.48	20.7	0.21
1	14170	50yr_Ex	32	159.9	158.48	1.71	0.001548	0.86	24.98	21.39	37.37	21.8	0.21
1	14170	100yr_Ex	39.4	160.24	158.61	1.92	0.001442	0.87	25.99	22.67	45.17	29.39	0.2
1	14170	Regional_Ex	52.1	160.96	158.81	2.23	0.00109	0.82	23.37	19.2	63.42	200.57	0.17
1	14143	2yr_Ex	9.7	158.61	157.87	1.01	0.001929	0.82	18.34	15.1	11.78	11.61	0.26
1	14143	5yr_Ex	16.1	159	158.09	1.27	0.002287	0.97	27.03	26.19	16.61	13.04	0.27
1	14143	10yr_Ex	23.3	159.35	158.29	1.48	0.002603	1.09	35.61	38.72	21.42	14.45	0.29
1	14143	25yr_Ex	28.7	159.57	158.42	1.61	0.002791	1.16	41.32	47.81	24.8	15.42	0.29
1	14143	50yr_Ex	34.5	159.8	158.55	1.72	0.002948	1.22	46.68	56.75	28.38	16.47	0.3
1	14143	100yr_Ex	42.7	160.14	158.72	1.86	0.002969	1.24	50.82	63.13	34.38	18.47	0.29
1	14143	Regional_Ex	58.6	160.88	159	1.82	0.002808	1.15	50.01	57.41	51.11	244.26	0.27
1	14121	2yr_Ex	9.7	158.55	157.84	0.98	0.003407	0.84	31.32	26.45	11.49	11.76	0.27
1	14121	5yr_Ex	16.1	158.93	158.06	1.21	0.003711	0.99	42.11	41.52	16.33	13.45	0.29
1	14121	10yr_Ex	23.3	159.28	158.27	1.42	0.003916	1.1	51.6	56.63	21.23	15	0.29
1	14121	25yr_Ex	28.7	159.5	158.4	1.54	0.004016	1.16	57.47	66.8	24.69	16.02	0.3
1	14121	50yr_Ex	34.5	159.72	158.53	1.65	0.004091	1.22	62.7	76.23	28.38	17.17	0.3
1	14121	100yr_Ex	42.7	160.07	158.69	1.79	0.003889	1.23	64.5	79.38	34.69	19.41	0.29
1	14121	Regional_Ex	58.6	160.84	158.97	1	0.002013	1.01	41.56	41.82	61.83	105.91	0.22
1	14115	2yr_Ex	9.7	158.54	157.72	1.02	0.002246	0.76	21.24	16.05	12.84	12.56	0.24
1	14115	5yr_Ex	16.1	158.92	157.95	1.24	0.002641	0.89	30.33	27.1	18.02	14.48	0.26

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	14115	10yr_Ex	23.3	159.26	158.15	1.45	0.002865	1	38.2	38.25	23.27	16.06	0.27
1	14115	25yr_Ex	28.7	159.49	158.28	1.58	0.002976	1.06	43.16	45.94	26.97	17.09	0.27
1	14115	50yr_Ex	34.5	159.71	158.41	1.68	0.003103	1.12	47.94	53.55	30.88	18.37	0.28
1	14115	100yr_Ex	42.7	160.06	158.58	1.8	0.003024	1.13	50.28	56.93	37.71	20.91	0.27
1	14115	Regional_Ex	58.6	160.83	158.85	1.07	0.001548	0.93	32.72	30.45	67.33	92.6	0.2
1	14112 16 Pedestrian Cr		Bridge										
1	14109	2yr_Ex	9.7	158.53	157.74	1.02	0.002462	0.77	23.06	17.74	12.6	12.4	0.24
1	14109	5yr_Ex	16.1	158.91	157.96	1.24	0.00286	0.91	32.6	29.65	17.7	14.28	0.26
1	14109	10yr_Ex	23.3	159.25	158.16	1.43	0.003112	1.02	40.96	41.7	22.89	15.97	0.27
1	14109	25yr_Ex	28.7	159.48	158.29	1.56	0.003229	1.08	46.12	49.83	26.56	17.07	0.28
1	14109	50yr_Ex	34.5	159.7	158.42	1.68	0.003285	1.13	50.55	57.23	30.47	18.17	0.28
1	14109	100yr_Ex	42.7	160	158.58	1.8	0.003348	1.18	55.31	65.16	36.25	20.15	0.28
1	14109	Regional_Ex	58.6	160.73	158.86	1.01	0.001955	1	37.66	37.8	61.91	89.41	0.22
1	14104	2yr_Ex	9.7	158.51	157.77	1	0.002994	0.81	27.94	22.74	11.92	11.98	0.26
1	14104	5yr_Ex	16.1	158.89	157.99	1.2	0.003479	0.96	39.06	37.43	16.8	13.98	0.28
1	14104	10yr_Ex	23.3	159.23	158.2	1.4	0.003671	1.07	47.88	51.04	21.86	15.6	0.29
1	14104	25yr_Ex	28.7	159.45	158.33	1.53	0.00376	1.13	53.36	60.23	25.43	16.64	0.29
1	14104	50yr_Ex	34.5	159.67	158.45	1.64	0.003822	1.18	58.17	68.63	29.24	17.83	0.29
1	14104	100yr_Ex	42.7	159.98	158.62	1.77	0.003803	1.22	62.56	76.52	34.91	19.69	0.29
1	14104	Regional_Ex	58.6	160.72	158.9	1.05	0.002067	1	41.04	41	60.68	73.06	0.22
1	14082	2yr_Ex	9.7	158.43	157.76	0.96	0.003734	0.87	33.61	29.2	11.17	11.69	0.28
1	14082	5yr_Ex	16.1	158.8	157.98	1.18	0.00414	1.02	45.87	46.91	15.74	13.3	0.3
1	14082	10yr_Ex	23.3	159.13	158.18	1.36	0.004436	1.14	56.49	64.3	20.47	15	0.31
1	14082	25yr_Ex	28.7	159.35	158.31	1.48	0.004529	1.2	62.63	75.29	23.87	16.08	0.32
1	14082	50yr_Ex	34.5	159.57	158.44	1.59	0.004566	1.25	67.75	84.89	27.54	17.27	0.32
1	14082	100yr_Ex	42.7	159.88	158.6	1.73	0.004466	1.29	71.8	92.69	33.08	19.14	0.31
1	14082	Regional_Ex	58.6	160.65	158.88	1.16	0.002872	1.09	52.36	57.21	55.48	148.68	0.25
1	14056	2yr_Ex	9.7	158.33	157.71	0.91	0.003457	0.89	29.83	26.59	10.88	11.91	0.3
1	14056	5yr_Ex	16.1	158.69	157.93	1.14	0.003875	1.05	41.53	43.5	15.37	13.45	0.31
1	14056	10yr_Ex	23.3	159.02	158.13	1.33	0.004177	1.16	51.9	60.4	20.02	15.07	0.32
1	14056	25yr_Ex	28.7	159.23	158.25	1.46	0.004244	1.23	57.7	70.79	23.39	16.04	0.32
1	14056	50yr_Ex	34.5	159.45	158.37	1.58	0.004257	1.28	62.6	79.93	27.02	17.1	0.32

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	14056	100yr_Ex	42.7	159.76	158.53	1.71	0.004209	1.31	66.93	87.67	32.6	19.09	0.32
1	14056	Regional_Ex	58.6	160.58	158.81	1.22	0.002713	1.09	48.75	52.91	55.45	48.61	0.25
1	14029	2yr_Ex	9.7	158.22	157.67	0.84	0.004854	0.96	38.48	36.96	10.1	12.06	0.34
1	14029	5yr_Ex	16.1	158.56	157.9	1.07	0.005012	1.11	50.52	56.01	14.52	13.54	0.34
1	14029	10yr_Ex	23.3	158.88	158.09	1.27	0.005124	1.22	60.96	74.51	19.06	14.98	0.35
1	14029	25yr_Ex	28.7	159.1	158.22	1.39	0.005153	1.28	66.95	85.73	22.41	16.1	0.35
1	14029	50yr_Ex	34.5	159.32	158.33	1.5	0.005134	1.32	71.72	94.84	26.09	17.42	0.35
1	14029	100yr_Ex	42.7	159.63	158.49	1.63	0.004901	1.34	74.34	99.56	31.88	19.61	0.34
1	14029	Regional_Ex	58.6	160.5	158.75	1.36	0.003017	1.12	53.34	59.54	53.05	48.68	0.26
1	14002	2yr_Ex	9.7	158.09	157.56	0.85	0.004626	1	37.26	37.19	9.72	11.46	0.35
1	14002	5yr_Ex	16.1	158.42	157.78	1.06	0.005195	1.17	51.88	60.59	13.79	13.03	0.36
1	14002	10yr_Ex	23.3	158.73	157.98	1.25	0.005419	1.29	63.58	81.89	18.09	14.48	0.37
1	14002	25yr_Ex	28.7	158.95	158.1	1.37	0.005427	1.35	69.84	94.09	21.3	15.51	0.37
1	14002	50yr_Ex	34.5	159.17	158.23	1.5	0.005298	1.39	74.24	102.98	24.87	16.59	0.36
1	14002	100yr_Ex	42.7	159.49	158.39	1.69	0.004819	1.4	75.65	106.06	30.46	18.06	0.34
1	14002	Regional_Ex	58.6	160.42	158.66	1.42	0.002774	1.15	52.76	60.69	51.47	72.54	0.26
1	13975	2yr_Ex	9.7	157.91	157.55	0.71	0.008483	1.17	57.71	67.42	8.3	11.66	0.44
1	13975	5yr_Ex	16.1	158.23	157.76	0.94	0.00796	1.3	70.7	92.02	12.37	13.21	0.43
1	13975	10yr_Ex	23.3	158.55	157.94	1.14	0.007364	1.39	79.43	110.16	16.8	14.7	0.41
1	13975	25yr_Ex	28.7	158.77	158.06	1.27	0.006939	1.42	83.26	118.4	20.18	15.83	0.4
1	13975	50yr_Ex	34.5	159.01	158.17	1.4	0.006443	1.44	84.89	121.89	24.03	17.14	0.39
1	13975	100yr_Ex	42.7	159.36	158.33	1.59	0.005435	1.41	81.18	114.28	30.33	19.04	0.36
1	13975	Regional_Ex	58.6	160.35	158.59	1.17	0.002391	1.06	45.73	48.27	57.23	48.92	0.24
1	13948	2yr_Ex	9.7	157.59	157.34	0.67	0.013289	1.46	84.79	123.74	6.65	9.93	0.57
1	13948	5yr_Ex	16.1	157.95	157.56	0.9	0.011001	1.52	93.77	142.44	10.6	11.77	0.51
1	13948	10yr_Ex	23.3	158.3	157.76	1.11	0.009372	1.55	98.08	151.75	15.06	13.55	0.47
1	13948	25yr_Ex	28.7	158.55	157.89	1.25	0.008365	1.55	98.43	152.49	18.53	14.78	0.44
1	13948	50yr_Ex	34.5	158.81	158.02	1.4	0.007346	1.53	96.27	147.61	22.5	16.08	0.41
1	13948	100yr_Ex	42.7	159.19	158.18	1.54	0.006204	1.46	89.4	130.44	29.26	19.05	0.38
1	13948	Regional_Ex	58.6	160.29	158.45	1.58	0.002578	1.01	45.03	45.55	58.3	124.96	0.24
1	13922	2yr_Ex	9.7	157.42	156.7	1.01	0.002852	0.84	26.39	22.15	11.56	11.39	0.27
1	13922	5yr_Ex	16.1	157.81	156.92	1.28	0.003188	0.99	36.81	36.54	16.22	12.72	0.28

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13922	10yr_Ex	23.3	158.18	157.12	1.51	0.003336	1.1	45.36	50.05	21.12	13.97	0.29
1	13922	25yr_Ex	28.7	158.43	157.25	1.67	0.003334	1.16	49.89	57.8	24.77	14.84	0.29
1	13922	50yr_Ex	34.5	158.7	157.38	1.83	0.003234	1.2	52.94	63.27	28.87	15.75	0.28
1	13922	100yr_Ex	42.7	159.09	157.54	2.07	0.002922	1.21	53.73	64.87	35.37	66.25	0.27
1	13922	Regional_Ex	58.6	160.24	157.83	1.98	0.001262	0.97	32.64	31.77	63.8	181.16	0.18
1	13892	2yr_Ex	9.7	157.31	156.74	0.91	0.003818	0.96	32.74	31.45	10.1	11.04	0.32
1	13892	5yr_Ex	16.1	157.69	156.95	1.17	0.004058	1.11	44.11	48.94	14.51	12.39	0.33
1	13892	10yr_Ex	23.3	158.05	157.15	1.42	0.004014	1.21	52.43	63.5	19.24	13.52	0.32
1	13892	25yr_Ex	28.7	158.31	157.28	1.59	0.003887	1.26	56.54	71.19	22.79	14.3	0.32
1	13892	50yr_Ex	34.5	158.58	157.41	1.77	0.003678	1.29	58.99	75.89	26.81	15.17	0.31
1	13892	100yr_Ex	42.7	158.99	157.57	2.02	0.003222	1.28	58.56	75.11	33.29	36.26	0.29
1	13892	Regional_Ex	58.6	160.21	157.85	1.69	0.001235	0.93	30.2	28.04	63.13	190.35	0.18
1	13863	2yr_Ex	9.7	157.17	156.69	0.86	0.004828	1.11	38.92	43.13	8.75	10.16	0.38
1	13863	5yr_Ex	16.1	157.53	156.91	1.11	0.005155	1.27	52.93	67.2	12.68	11.43	0.38
1	13863	10yr_Ex	23.3	157.9	157.11	1.36	0.005003	1.36	62.11	84.67	17.09	12.61	0.37
1	13863	25yr_Ex	28.7	158.16	157.25	1.53	0.004756	1.4	66.02	92.41	20.5	13.44	0.36
1	13863	50yr_Ex	34.5	158.45	157.38	1.69	0.004424	1.41	67.86	95.78	24.44	14.43	0.35
1	13863	100yr_Ex	42.7	158.88	157.55	1.94	0.003742	1.38	65.43	90.19	30.98	15.95	0.32
1	13863	Regional_Ex	58.6	160.17	157.84	1.76	0.001232	0.98	31.36	30.62	63.72	124.43	0.19
1	13833	2yr_Ex	9.7	156.94	156.65	0.73	0.009235	1.41	63.94	90.32	6.87	9.36	0.53
1	13833	5yr_Ex	16.1	157.3	156.87	0.98	0.00857	1.53	78.65	120.7	10.49	10.66	0.49
1	13833	10yr_Ex	23.3	157.69	157.07	1.24	0.007328	1.56	83.72	130.69	14.93	12.05	0.45
1	13833	25yr_Ex	28.7	157.98	157.21	1.42	0.006461	1.55	83.9	130.33	18.48	13.04	0.42
1	13833	50yr_Ex	34.5	158.28	157.34	1.61	0.005558	1.53	81.41	124.15	22.62	14.07	0.38
1	13833	100yr_Ex	42.7	158.75	157.52	1.89	0.004314	1.45	73.59	106.41	29.53	15.64	0.34
1	13833	Regional_Ex	58.6	160.13	157.81	1.92	0.001317	0.96	32.03	30.72	62.2	200.09	0.19
1	13813	2yr_Ex	9.7	156.76	156.55	0.66	0.006894	1.55	42.85	66.38	6.26	9.54	0.61
1	13813	5yr_Ex	16.1	157.15	156.76	0.93	0.00621	1.56	54.08	84.36	10.32	11.1	0.52
1	13813	10yr_Ex	23.3	157.57	156.96	1.2	0.005268	1.52	58.55	88.75	15.37	31.97	0.44
1	13813	25yr_Ex	28.7	157.87	157.09	1.41	0.004463	1.48	57.87	85.63	19.4	47.86	0.4
1	13813	50yr_Ex	34.5	158.2	157.22	1.62	0.003801	1.44	56.38	81.05	24	55.9	0.36
1	13813	100yr_Ex	42.7	158.68	157.39	1.91	0.003005	1.35	52.15	70.48	31.6	75.47	0.31
1	13813	Regional_Ex	58.6	160.11	157.67	1.85	0.001108	0.95	27.43	26.07	64.55	232.42	0.18

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13803	2yr_Ex	9.7	156.75	156.28	0.84	0.001999	1.05	15.48	16.24	9.25	10.96	0.36
1	13803	5yr_Ex	16.1	157.14	156.48	1.12	0.002328	1.17	23.79	27.82	13.77	12.26	0.35
1	13803	10yr_Ex	23.3	157.56	156.67	1.46	0.002058	1.22	27.21	33.13	19.13	13.65	0.32
1	13803	25yr_Ex	28.7	157.86	156.79	1.76	0.001688	1.24	26.83	33.29	23.13	41.49	0.3
1	13803	50yr_Ex	34.5	158.18	156.92	2.08	0.001391	1.26	26.16	32.97	27.38	45.18	0.28
1	13803	100yr_Ex	42.7	158.67	157.08	2.57	0.00106	1.27	24.58	31.1	33.75	53.76	0.25
1	13803	Regional_Ex	58.6	160.08	157.35	3.97	0.000465	1.12	16.7	18.74	52.25	189.93	0.18
1	13787 15 Woodchester D		Culvert										
1	13771	2yr_Ex	9.7	156.55	156.07	0.85	0.000635	0.99	4.94	4.87	9.83	11.57	0.34
1	13771	5yr_Ex	16.1	156.87	156.26	1.09	0.000808	1.18	7.99	9.43	13.65	12.52	0.36
1	13771	10yr_Ex	23.3	157.19	156.44	1.39	0.000761	1.32	9.57	12.62	17.66	13.47	0.36
1	13771	25yr_Ex	28.7	157.41	156.56	1.61	0.000702	1.4	10.25	14.34	20.51	14.14	0.35
1	13771	50yr_Ex	34.5	157.64	156.68	1.84	0.00065	1.47	10.84	15.96	23.44	14.83	0.35
1	13771	100yr_Ex	42.7	157.95	156.83	2.15	0.000592	1.56	11.53	17.97	27.4	15.77	0.34
1	13771	Regional_Ex	58.6	158.68	157.1	2.55	0.000621	1.51	14.07	21.31	38.7	17.95	0.3
1	13761	2yr_Ex	9.7	156.47		0.7	0.001766	1.44	11.64	16.79	6.72	9.56	0.55
1	13761	5yr_Ex	16.1	156.77		0.92	0.002112	1.66	17.95	29.71	9.73	10.61	0.55
1	13761	10yr_Ex	23.3	157.09		1.12	0.002212	1.75	22.83	39.97	13.31	11.89	0.53
1	13761	25yr_Ex	28.7	157.32		1.26	0.002149	1.77	24.94	44.2	16.19	12.81	0.5
1	13761	50yr_Ex	34.5	157.57		1.42	0.002012	1.78	26.12	46.39	19.43	13.68	0.48
1	13761	100yr_Ex	42.7	157.9		1.63	0.001821	1.77	26.97	47.71	24.14	14.81	0.44
1	13761	Regional_Ex	58.6	158.65		2.08	0.00128	1.62	23.94	38.71	36.24	17.41	0.36
1	13748	2yr_Ex	9.7	156.46	156.11	0.76	0.001807	1.27	12.98	16.42	7.66	10.02	0.46
1	13748	5yr_Ex	16.1	156.76	156.33	0.97	0.002143	1.49	19.39	28.98	10.77	11.08	0.48
1	13748	10yr_Ex	23.3	157.07	156.52	1.18	0.00219	1.61	23.85	38.44	14.46	12.26	0.47
1	13748	25yr_Ex	28.7	157.31	156.65	1.32	0.002112	1.65	25.72	42.37	17.42	13.16	0.46
1	13748	50yr_Ex	34.5	157.55	156.79	1.48	0.001979	1.66	26.79	44.55	20.74	14.03	0.44
1	13748	100yr_Ex	42.7	157.88	156.95	1.68	0.001797	1.67	27.52	45.9	25.6	15.21	0.41
1	13748	Regional_Ex	58.6	158.64	157.24	2.15	0.001241	1.54	23.98	36.93	38.05	17.7	0.34
1	13729	2yr_Ex	9.7	156.44	156	0.81	0.002192	1.09	16.66	18.12	8.92	11.08	0.39
1	13729	5yr_Ex	16.1	156.74	156.21	1	0.002513	1.3	23.55	30.68	12.36	12.37	0.42

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13729	10yr_Ex	23.3	157.05	156.4	1.2	0.002437	1.41	27.24	38.44	16.51	13.79	0.41
1	13729	25yr_Ex	28.7	157.29	156.53	1.34	0.002272	1.44	28.24	40.7	19.91	14.91	0.4
1	13729	50yr_Ex	34.5	157.54	156.65	1.51	0.002026	1.45	28.23	41.06	23.72	15.76	0.38
1	13729	100yr_Ex	42.7	157.87	156.81	1.72	0.001764	1.46	27.96	40.86	29.22	16.97	0.36
1	13729	Regional_Ex	58.6	158.64	157.09	2.15	0.001192	1.35	23.4	31.68	43.28	20.15	0.3
1	13724	2yr_Ex	9.7	156.42	156.03	0.78	0.002605	1.15	18.53	21.39	8.4	10.8	0.42
1	13724	5yr_Ex	16.1	156.71	156.23	0.98	0.002904	1.38	25.87	35.7	11.67	11.91	0.45
1	13724	10yr_Ex	23.3	157.03	156.42	1.19	0.002744	1.49	29.6	44.07	15.65	13.15	0.44
1	13724	25yr_Ex	28.7	157.26	156.55	1.34	0.00252	1.52	30.55	46.47	18.87	14.06	0.42
1	13724	50yr_Ex	34.5	157.51	156.68	1.5	0.002276	1.53	30.73	47.13	22.5	15.02	0.4
1	13724	100yr_Ex	42.7	157.85	156.84	1.71	0.001982	1.54	30.4	46.72	27.79	16.27	0.38
1	13724	Regional_Ex	58.6	158.62	157.11	2.12	0.001331	1.41	25.22	35.6	41.52	19.63	0.31
1	13721 14 Pedestrian Cr		Bridge										
1	13717	2yr_Ex	9.7	156.39	156.05	0.75	0.003226	1.25	21.71	27.19	7.74	10.36	0.46
1	13717	5yr_Ex	16.1	156.67	156.26	0.94	0.003561	1.49	30.15	44.96	10.8	11.45	0.49
1	13717	10yr_Ex	23.3	156.99	156.45	1.15	0.003274	1.59	33.82	53.84	14.63	12.69	0.47
1	13717	25yr_Ex	28.7	157.23	156.58	1.31	0.002934	1.61	34.32	55.38	17.79	13.58	0.45
1	13717	50yr_Ex	34.5	157.48	156.71	1.47	0.002598	1.62	34.06	55.08	21.34	14.5	0.43
1	13717	100yr_Ex	42.7	157.82	156.87	1.68	0.002227	1.61	33.31	53.64	26.52	15.75	0.4
1	13717	Regional_Ex	58.6	158.6	157.15	2.15	0.001422	1.47	26.98	39.65	39.87	18.58	0.32
1	13712	2yr_Ex	9.7	156.36	156.07	0.69	0.004791	1.32	31	40.97	7.34	10.67	0.51
1	13712	5yr_Ex	16.1	156.64	156.28	0.88	0.004749	1.53	39.31	60.06	10.54	11.91	0.52
1	13712	10yr_Ex	23.3	156.97	156.47	1.11	0.003943	1.59	40.54	64.4	14.67	13.27	0.48
1	13712	25yr_Ex	28.7	157.22	156.59	1.27	0.003378	1.59	39.6	63.07	18.02	14.23	0.45
1	13712	50yr_Ex	34.5	157.47	156.72	1.45	0.00286	1.58	38.05	60.31	21.77	15.06	0.42
1	13712	100yr_Ex	42.7	157.82	156.87	1.68	0.002359	1.57	36.2	56.93	27.15	16.16	0.39
1	13712	Regional_Ex	58.6	158.6	157.14	2.21	0.001446	1.44	28.64	41.34	40.6	18.4	0.31
1	13695	2yr_Ex	9.7	156.23	156.06	0.61	0.005619	1.54	32.4	49.8	6.31	10.35	0.63
1	13695	5yr_Ex	16.1	156.53	156.25	0.83	0.004861	1.69	37.86	63.86	9.55	11.49	0.59
1	13695	10yr_Ex	23.3	156.89	156.44	1.09	0.003599	1.68	36.41	61.04	13.9	12.76	0.51
1	13695	25yr_Ex	28.7	157.15	156.57	1.27	0.003004	1.66	35.15	58.3	17.3	13.65	0.47
1	13695	50yr_Ex	34.5	157.41	156.68	1.45	0.002551	1.64	33.85	55.43	21.07	14.57	0.43

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13695	100yr_Ex	42.7	157.77	156.84	1.69	0.002103	1.61	32.33	52.21	26.44	15.66	0.4
1	13695	Regional_Ex	58.6	158.57	157.11	2.1	0.001394	1.46	26.41	38.62	40.08	19.11	0.32
1	13682	2yr_Ex	9.7	156.04	156.01	0.51	0.011688	2.05	56.67	116.25	4.73	9.3	0.92
1	13682	5yr_Ex	16.1	156.43	156.21	0.8	0.005903	1.84	44.43	81.65	8.76	10.97	0.66
1	13682	10yr_Ex	23.3	156.83	156.41	1.07	0.003907	1.73	38.87	67.16	13.49	12.66	0.53
1	13682	25yr_Ex	28.7	157.11	156.53	1.26	0.003087	1.68	36.15	60.85	17.05	13.48	0.48
1	13682	50yr_Ex	34.5	157.38	156.66	1.45	0.002575	1.65	34.4	56.92	20.85	14.35	0.44
1	13682	100yr_Ex	42.7	157.74	156.82	1.68	0.002135	1.62	32.8	53.29	26.28	15.63	0.4
1	13682	Regional_Ex	58.6	158.55	157.09	2.14	0.001341	1.45	25.94	37.74	40.28	18.87	0.32
1	13673	2yr_Ex	9.7	155.98	155.84	0.58	0.007648	1.66	42.07	69.8	5.85	10.04	0.69
1	13673	5yr_Ex	16.1	156.41	156.04	0.89	0.004002	1.52	33.34	50.52	10.63	11.93	0.51
1	13673	10yr_Ex	23.3	156.82	156.22	1.16	0.002834	1.47	30.47	44.78	15.85	13.71	0.44
1	13673	25yr_Ex	28.7	157.1	156.36	1.36	0.002273	1.45	28.72	41.68	19.78	14.89	0.4
1	13673	50yr_Ex	34.5	157.37	156.48	1.63	0.001789	1.45	27.04	39.18	23.81	15.92	0.36
1	13673	100yr_Ex	42.7	157.74	156.64	1.99	0.001403	1.47	25.92	38.03	29.1	17.26	0.33
1	13673	Regional_Ex	58.6	158.55	156.9	2.38	0.001013	1.35	22.1	29.79	43.48	21.1	0.28
1	13660 Motorway Bouleva		Culvert										
1	13638	2yr_Ex	9.7	154.19	153.21	1.2	0.00099	0.61	10.98	6.65	16.02	13.3	0.18
1	13638	5yr_Ex	16.1	154.6	153.41	1.48	0.001251	0.74	16.92	12.57	21.67	14.64	0.2
1	13638	10yr_Ex	23.3	154.97	153.59	1.72	0.001451	0.85	22.66	19.34	27.29	15.86	0.21
1	13638	25yr_Ex	28.7	155.21	153.7	1.88	0.001551	0.92	26.32	24.12	31.31	16.67	0.21
1	13638	50yr_Ex	34.5	155.46	153.83	2.03	0.001618	0.97	29.62	28.71	35.59	17.5	0.22
1	13638	100yr_Ex	42.7	155.8	153.98	2.24	0.001653	1.02	33.2	33.97	41.73	18.62	0.22
1	13638	Regional_Ex	58.6	156.43	154.25	2.61	0.001616	1.08	37.54	40.73	54.02	20.69	0.21
1	13628	2yr_Ex	9.7	154.13	153.59	0.91	0.003067	1.06	25.83	27.35	9.16	10.08	0.35
1	13628	5yr_Ex	16.1	154.52	153.82	1.15	0.003576	1.2	37.88	45.49	13.41	11.63	0.36
1	13628	10yr_Ex	23.3	154.88	154.02	1.37	0.003837	1.3	48.03	62.67	17.86	13.03	0.36
1	13628	25yr_Ex	28.7	155.13	154.16	1.51	0.003899	1.36	53.71	72.87	21.16	13.97	0.35
1	13628	50yr_Ex	34.5	155.37	154.3	1.64	0.003928	1.39	58.62	81.64	24.77	15.08	0.35
1	13628	100yr_Ex	42.7	155.72	154.47	1.82	0.003784	1.41	62.44	88.23	30.22	16.61	0.33
1	13628	Regional_Ex	58.6	156.35	154.77	2.18	0.003229	1.41	63.58	89.59	41.59	19.05	0.3

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13612	2yr_Ex	9.7	154.08	153.48	0.94	0.003744	0.95	32.87	31.17	10.23	10.92	0.31
1	13612	5yr_Ex	16.1	154.47	153.7	1.2	0.003981	1.09	44.14	48.33	14.7	12.29	0.32
1	13612	10yr_Ex	23.3	154.83	153.9	1.43	0.004076	1.2	53.53	64.5	19.34	13.54	0.32
1	13612	25yr_Ex	28.7	155.07	154.03	1.59	0.004032	1.26	58.56	73.92	22.74	14.3	0.32
1	13612	50yr_Ex	34.5	155.32	154.16	1.75	0.003932	1.31	62.53	81.71	26.4	15.09	0.32
1	13612	100yr_Ex	42.7	155.66	154.32	1.96	0.003715	1.34	65.81	88.38	31.8	16.22	0.31
1	13612	Regional_Ex	58.6	156.31	154.61	2.34	0.003232	1.37	67.62	92.39	42.89	18.35	0.29
1	13586	2yr_Ex	9.7	153.98	153.4	0.92	0.003761	0.98	32.32	31.65	9.91	10.81	0.33
1	13586	5yr_Ex	16.1	154.36	153.62	1.16	0.004114	1.13	44.35	50.1	14.25	12.28	0.33
1	13586	10yr_Ex	23.3	154.71	153.82	1.39	0.00419	1.23	53.64	66.22	18.87	13.59	0.33
1	13586	25yr_Ex	28.7	154.96	153.95	1.56	0.004068	1.29	58.05	74.65	22.32	14.32	0.33
1	13586	50yr_Ex	34.5	155.21	154.09	1.73	0.003906	1.32	61.44	81.38	26.04	15.06	0.32
1	13586	100yr_Ex	42.7	155.57	154.25	1.96	0.003618	1.35	63.97	86.64	31.53	16.09	0.31
1	13586	Regional_Ex	58.6	156.22	154.54	2.35	0.003107	1.37	65.32	89.52	42.76	18.17	0.29
1	13560	2yr_Ex	9.7	153.84	153.38	0.87	0.004901	1.21	39.78	48.18	8.01	9.18	0.41
1	13560	5yr_Ex	16.1	154.19	153.61	1.1	0.005764	1.41	58.25	81.84	11.46	10.43	0.43
1	13560	10yr_Ex	23.3	154.54	153.84	1.31	0.006002	1.52	71.97	109.65	15.29	11.64	0.42
1	13560	25yr_Ex	28.7	154.79	153.98	1.46	0.005922	1.57	78.42	122.94	18.31	12.56	0.41
1	13560	50yr_Ex	34.5	155.05	154.12	1.61	0.005638	1.59	82.18	130.68	21.7	13.46	0.4
1	13560	100yr_Ex	42.7	155.41	154.3	1.74	0.005486	1.58	86.14	136.11	27.02	15.57	0.38
1	13560	Regional_Ex	58.6	156.1	154.61	2.13	0.004178	1.52	80.05	121.45	38.62	18.1	0.33
1	13533	2yr_Ex	9.7	153.71	153.21	0.87	0.00601	1.07	48.09	51.69	9.03	10.4	0.37
1	13533	5yr_Ex	16.1	154.04	153.42	1.08	0.006687	1.27	66.42	84.14	12.71	11.72	0.39
1	13533	10yr_Ex	23.3	154.39	153.63	1.3	0.006484	1.37	76.84	105.04	17.05	13.11	0.38
1	13533	25yr_Ex	28.7	154.65	153.77	1.45	0.006025	1.4	79.64	111.14	20.57	14.14	0.37
1	13533	50yr_Ex	34.5	154.92	153.9	1.61	0.005469	1.4	80.01	112.28	24.59	15.23	0.35
1	13533	100yr_Ex	42.7	155.3	154.07	1.81	0.004818	1.4	78.83	109.98	30.61	16.93	0.33
1	13533	Regional_Ex	58.6	156.02	154.35	2.12	0.003367	1.32	64.72	85.35	44.44	25.02	0.29
1	13517	2yr_Ex	9.7	153.51	153.32	0.64	0.012265	1.59	74.62	118.65	6.1	9.48	0.63
1	13517	5yr_Ex	16.1	153.84	153.53	0.9	0.010602	1.7	88.56	150.5	9.47	10.58	0.57
1	13517	10yr_Ex	23.3	154.22	153.73	1.15	0.008673	1.7	92.33	157.38	13.67	11.84	0.51
1	13517	25yr_Ex	28.7	154.5	153.86	1.34	0.007432	1.68	91.09	152.73	17.12	12.79	0.46
1	13517	50yr_Ex	34.5	154.79	153.99	1.52	0.006439	1.64	89.01	146.2	21	13.84	0.43

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13517	100yr_Ex	42.7	155.19	154.16	1.73	0.005477	1.59	86.04	137.13	26.79	15.48	0.39
1	13517	Regional_Ex	58.6	155.95	154.44	2.07	0.003861	1.47	74.58	109.35	40.04	21.64	0.32
1	13512	2yr_Ex	9.7	153.36	153.26	0.59	0.023295	1.91	130.46	249.21	5.08	8.59	0.79
1	13512	5yr_Ex	16.1	153.75	153.49	0.86	0.015514	1.84	125.27	230.76	8.74	10.12	0.63
1	13512	10yr_Ex	23.3	154.15	153.7	1.15	0.011113	1.78	117.35	208.98	13.08	11.43	0.53
1	13512	25yr_Ex	28.7	154.45	153.83	1.34	0.009097	1.73	111.28	192.79	16.57	12.39	0.48
1	13512	50yr_Ex	34.5	154.75	153.96	1.52	0.007646	1.69	105.9	178.78	20.44	13.42	0.44
1	13512	100yr_Ex	42.7	155.15	154.13	1.74	0.006352	1.63	99.92	162.98	26.18	15.08	0.4
1	13512	Regional_Ex	58.6	155.92	154.42	2.02	0.004649	1.48	85.61	126.95	39.52	19.99	0.33
1	13502	2yr_Ex	9.7	153.24		0.75	0.008067	1.54	54.4	83.92	6.29	8.33	0.57
1	13502	5yr_Ex	16.1	153.66		1.14	0.006522	1.63	62.84	102.52	9.87	8.64	0.49
1	13502	10yr_Ex	23.3	154.07		1.51	0.006005	1.72	72.8	125.55	13.51	8.95	0.45
1	13502	25yr_Ex	28.7	154.36		1.76	0.005809	1.78	79.52	141.67	16.11	9.16	0.43
1	13502	50yr_Ex	34.5	154.64		2	0.005737	1.84	86.78	159.83	18.73	9.37	0.42
1	13502	100yr_Ex	42.7	155.02		2.01	0.006843	1.9	105.57	200.07	22.53	11.18	0.43
1	13502	Regional_Ex	58.6	155.82		1.86	0.007035	1.7	108.62	185.06	34.4	18.53	0.4
1	13303	2yr_Ex	9.7	151.75	151.43	0.73	0.004207	1.2	28.66	34.35	8.09	11.03	0.45
1	13303	5yr_Ex	16.1	152.26	151.61	1.17	0.002713	1.16	28.43	32.93	13.9	11.9	0.34
1	13303	10yr_Ex	23.3	152.7	151.79	1.54	0.002394	1.2	32.09	38.64	19.35	12.6	0.31
1	13303	25yr_Ex	28.7	152.98	151.91	1.75	0.002372	1.25	35.76	44.87	22.87	13.05	0.3
1	13303	50yr_Ex	34.5	153.13	152.03	1.84	0.002823	1.39	44.72	61.94	24.91	13.5	0.33
1	13303	100yr_Ex	42.7	153.3	152.18	1.94	0.003536	1.57	58.91	92.48	27.2	13.99	0.36
1	13303	Regional_Ex	58.6	153.54	152.45	2.09	0.005065	1.91	90.24	172.69	30.62	14.69	0.42
1	13293	2yr_Ex	9.7	151.72	151.3	0.73	0.005432	1.03	37	38.16	9.4	12.9	0.39
1	13293	5yr_Ex	16.1	152.24	151.51	1.14	0.003068	0.97	31.95	30.94	16.63	14.61	0.29
1	13293	10yr_Ex	23.3	152.69	151.68	1.4	0.002681	0.99	34.19	33.69	23.64	23.6	0.27
1	13293	25yr_Ex	28.7	152.97	151.78	1.38	0.002693	1	36.86	36.93	28.7	39.49	0.26
1	13293	50yr_Ex	34.5	153.12	151.89	1.3	0.00304	1.09	43.67	47.42	32.3	47.24	0.28
1	13293	100yr_Ex	42.7	153.29	152.04	1.26	0.003283	1.2	52	62.52	36.82	59.46	0.29
1	13293	Regional_Ex	58.6	153.54	152.29	1.49	0.003821	1.42	69.13	98	44.04	61.19	0.32
1	13276	2yr_Ex	9.7	151.69		1.08	0.000883	0.6	8.88	5.28	16.3	15.03	0.18
1	13276	5yr_Ex	16.1	152.23		1.49	0.000802	0.65	10.94	7.11	24.77	16.6	0.17

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13276	10yr_Ex	23.3	152.68		0.72	0.000841	0.7	13.39	9.32	37.66	52.3	0.17
1	13276	25yr_Ex	28.7	152.96		0.96	0.000668	0.69	12.37	8.48	52.75	54.92	0.15
1	13276	50yr_Ex	34.5	153.12		1.09	0.000691	0.73	13.77	10.09	61.39	56.14	0.16
1	13276	100yr_Ex	42.7	153.29		1.22	0.000749	0.8	16.11	12.94	71.29	58.22	0.17
1	13276	Regional_Ex	58.6	153.54		1.42	0.000887	0.94	21.12	19.75	86.37	60.96	0.19
1	13250	2yr_Ex	9.7	151.64		1.03	0.002365	0.84	22.53	18.95	11.53	11.17	0.26
1	13250	5yr_Ex	16.1	152.18		1.39	0.002074	0.89	26.27	23.45	18.03	12.94	0.24
1	13250	10yr_Ex	23.3	152.63		1.01	0.002144	0.94	30.85	28.89	26.49	26.29	0.24
1	13250	25yr_Ex	28.7	152.91		1.05	0.001865	0.93	30.17	28.09	35.08	33.33	0.22
1	13250	50yr_Ex	34.5	153.06		1.07	0.001957	1.01	34.34	34.58	40.35	37.77	0.23
1	13250	100yr_Ex	42.7	153.23		1.16	0.002113	1.11	40.29	44.54	46.87	40.41	0.24
1	13250	Regional_Ex	58.6	153.47		1.27	0.002493	1.29	52.95	68.33	57.12	45.01	0.27
1	13223	2yr_Ex	9.7	151.53	150.92	1.01	0.004039	1.06	37.29	39.69	9.11	8.98	0.34
1	13223	5yr_Ex	16.1	152.08	151.16	1.33	0.003603	1.11	43.11	47.72	14.54	10.92	0.31
1	13223	10yr_Ex	23.3	152.54	151.38	0.89	0.003187	1.14	46.12	52.65	22.34	25	0.29
1	13223	25yr_Ex	28.7	152.84	151.53	0.72	0.002338	1.1	40.32	44.31	32.82	45.38	0.25
1	13223	50yr_Ex	34.5	153	151.67	0.76	0.002324	1.15	43.28	49.92	40.41	52.88	0.26
1	13223	100yr_Ex	42.7	153.16	151.87	0.82	0.00237	1.23	47.75	58.6	49.98	61.19	0.26
1	13223	Regional_Ex	58.6	153.41	152.2	1.01	0.002505	1.35	55.93	75.59	65.13	64.57	0.27
1	13197	2yr_Ex	9.7	151.46		1.08	0.002616	0.9	25.63	23.12	10.75	9.96	0.28
1	13197	5yr_Ex	16.1	152.01		1.19	0.002465	0.96	30.97	29.66	16.85	14.17	0.26
1	13197	10yr_Ex	23.3	152.48		0.96	0.002007	1	32.18	32.23	26.1	27.29	0.24
1	13197	25yr_Ex	28.7	152.8		0.87	0.001776	0.98	31.25	30.66	36.66	42.08	0.22
1	13197	50yr_Ex	34.5	152.95		0.78	0.001955	1.05	36.05	38.01	43.62	55.93	0.23
1	13197	100yr_Ex	42.7	153.11		0.87	0.002012	1.13	40.1	45.16	53.72	61.97	0.24
1	13197	Regional_Ex	58.6	153.35		1.06	0.002172	1.25	47.87	59.89	68.79	65.15	0.25
1	13170	2yr_Ex	9.7	151.35	150.69	1.13	0.004339	1.07	44.64	47.76	9.07	9.73	0.32
1	13170	5yr_Ex	16.1	151.91	150.93	1.29	0.003681	1.15	50.61	58.43	14.06	17.25	0.3
1	13170	10yr_Ex	23.3	152.38	151.16	1.58	0.002928	1.24	52.92	65.38	19.93	35.46	0.28
1	13170	25yr_Ex	28.7	152.7	151.31	1.9	0.002592	1.28	54.31	69.68	23.9	43.32	0.27
1	13170	50yr_Ex	34.5	152.86	151.47	1.04	0.00246	1.31	55.07	71.93	35.1	48.05	0.27
1	13170	100yr_Ex	42.7	153.01	151.67	1.1	0.002812	1.45	66.81	97.07	40.49	68.76	0.29
1	13170	Regional_Ex	58.6	153.21	152.07	1.29	0.00356	1.72	91.15	156.65	48.04	76.27	0.33

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13154	2yr_Ex	9.7	151.19	150.82	0.93	0.008285	1.51	70.1	105.83	6.43	7.91	0.5
1	13154	5yr_Ex	16.1	151.79	151.08	1.35	0.005641	1.48	68.9	102.07	10.87	14.39	0.41
1	13154	10yr_Ex	23.3	152.35	151.32	0.8	0.002916	1.11	44.44	49.4	25.73	39.61	0.28
1	13154	25yr_Ex	28.7	152.69	151.49	0.94	0.001673	0.94	30.42	28.63	42.2	47.64	0.21
1	13154	50yr_Ex	34.5	152.85	151.66	1.04	0.001657	0.98	32.47	31.97	49.33	51.81	0.22
1	13154	100yr_Ex	42.7	153	151.86	1.17	0.001777	1.07	37.3	39.83	56.62	53.57	0.23
1	13154	Regional_Ex	58.6	153.2	152.12	1.35	0.002175	1.25	49.7	62.12	66.45	56.39	0.25
1	13144	2yr_Ex	9.7	151.12	150.52	1.36	0.003673	1.58	31.34	49.46	6.15	4.51	0.43
1	13144	5yr_Ex	16.1	151.66	150.84	1.16	0.010341	1.76	83.53	146.8	9.16	8.48	0.52
1	13144	10yr_Ex	23.3	152.18	151.15	1.66	0.006328	1.74	73.72	128.28	13.39	13.55	0.43
1	13144	25yr_Ex	28.7	152.63	151.57	0.67	0.004301	1.17	50.08	58.34	29.29	50.31	0.31
1	13144	50yr_Ex	34.5	152.8	151.75	0.81	0.003631	1.15	46.98	53.95	36.52	64.87	0.29
1	13144	100yr_Ex	42.7	152.95	151.94	0.87	0.00351	1.2	49.7	59.59	43.87	80.31	0.29
1	13144	Regional_Ex	58.6	153.15	152.55	1.03	0.003808	1.34	59.92	80.3	54.06	83.76	0.3
1	13131 10 Thorn Lodge D		Culvert										
1	13118	2yr_Ex	9.7	150.7	150.14	1.34	0.004119	1.64	34.05	55.71	5.93	4.43	0.45
1	13118	5yr_Ex	16.1	150.98	150.47	1.6	0.006683	2.25	61.86	139.02	7.16	4.47	0.57
1	13118	10yr_Ex	23.3	151.39	150.78	1.35	0.016014	2.47	142.48	352.28	9.42	7.22	0.68
1	13118	25yr_Ex	28.7	151.64	150.99	1.48	0.016171	2.56	160.96	412.74	11.19	9.16	0.67
1	13118	50yr_Ex	34.5	151.8	151.4	1.57	0.017927	2.77	191.75	530.36	12.47	10.47	0.7
1	13118	100yr_Ex	42.7	152.01	151.64	1.32	0.02642	2.78	262.54	730.23	15.35	12.13	0.77
1	13118	Regional_Ex	58.6	152.29	152.08	0.67	0.030087	3.1	334.94	1038.85	19.82	33.11	0.82
1	13108	2yr_Ex	9.7	150.69	150.1	1.04	0.004754	1.18	44.33	52.09	8.25	7.9	0.37
1	13108	5yr_Ex	16.1	150.98	150.36	1.24	0.006912	1.51	75.48	114.16	10.64	8.56	0.43
1	13108	10yr_Ex	23.3	151.36	150.6	1.46	0.007431	1.65	94.15	155.75	14.08	9.65	0.44
1	13108	25yr_Ex	28.7	151.61	150.76	1.26	0.008239	1.73	108.97	188.69	16.63	13.17	0.45
1	13108	50yr_Ex	34.5	151.77	150.92	0.71	0.009624	1.84	129.08	238.07	19.84	27.76	0.48
1	13108	100yr_Ex	42.7	151.93	151.12	0.76	0.010583	1.98	149.41	295.71	24.69	32.62	0.5
1	13108	Regional_Ex	58.6	152.26	151.48	1.02	0.009484	1.95	146.76	286.24	35.92	49.02	0.47
1	13090	2yr_Ex	12.5	150.36	150.2	0.88	0.016087	2.23	123.67	275.96	5.6	6.4	0.76
1	13090	5yr_Ex	17.7	150.57	150.41	1.01	0.019467	2.52	171.09	430.74	7.03	6.93	0.8

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13090	10yr_Ex	25.6	150.93	150.69	1.22	0.020269	2.65	210.85	558.81	9.66	7.92	0.77
1	13090	25yr_Ex	31.7	151.17	150.88	0.84	0.019747	2.69	227.18	612.23	12.25	14.58	0.74
1	13090	50yr_Ex	38.2	151.39	151.17	0.69	0.016265	2.62	211.63	554.77	16.96	24.71	0.67
1	13090	100yr_Ex	47	151.67	151.47	0.93	0.01216	2.42	178.76	431.79	24.03	25.89	0.58
1	13090	Regional_Ex	67.3	151.95	151.73	1.18	0.0131	2.64	213.78	565.13	31.36	26.48	0.61
1	13079	2yr_Ex	12.5	150.03	150.03	0.7	0.032087	2.62	203.01	531.06	4.78	6.83	1
1	13079	5yr_Ex	17.7	150.3	150.22	0.91	0.026965	2.66	216.25	574.55	6.66	7.33	0.89
1	13079	10yr_Ex	25.6	150.75		1.23	0.019338	2.52	204.02	514.08	10.16	8.25	0.73
1	13079	25yr_Ex	31.7	150.98		1.27	0.018501	2.61	220.18	574.78	12.18	9.6	0.7
1	13079	50yr_Ex	38.2	151.08	150.82	0.72	0.0217	2.92	273.35	798.41	13.53	18.87	0.76
1	13079	100yr_Ex	47	151.21	151.21	0.73	0.024514	3.23	330.44	1066.21	16.29	22.33	0.82
1	13079	Regional_Ex	67.3	151.63	151.63	0.86	0.019456	3.16	311.93	984.81	28.28	32.76	0.73
1	13074	2yr_Ex	12.5	150.02	149.64	1.01	0.011482	1.71	102.07	174.17	7.33	7.26	0.54
1	13074	5yr_Ex	17.7	150.33		1.25	0.010998	1.82	117.5	214.05	9.72	7.8	0.52
1	13074	10yr_Ex	25.6	150.77		1.51	0.010617	1.93	134.96	259.97	13.29	8.8	0.5
1	13074	25yr_Ex	31.7	151		0.82	0.010595	2.02	148.48	300.65	16.75	20.31	0.5
1	13074	50yr_Ex	38.2	151.13		0.69	0.01204	2.23	178.31	397.61	19.53	28.19	0.53
1	13074	100yr_Ex	47	151.24	150.67	0.63	0.014465	2.5	223.53	559.78	23.12	36.49	0.59
1	13074	Regional_Ex	67.3	151.12	151.45	0.69	0.037943	3.95	560.3	2214.35	19.33	27.99	0.95
1	13062	2yr_Ex	12.5	149.84		1.09	0.011476	1.9	103.82	197.31	6.58	6.01	0.58
1	13062	5yr_Ex	17.7	150.12		1.29	0.013023	2.12	135.78	287.43	8.36	6.47	0.59
1	13062	10yr_Ex	25.6	150.52		1.28	0.015842	2.29	180.91	414.67	11.18	8.75	0.62
1	13062	25yr_Ex	31.7	150.77	150.18	0.53	0.015536	2.37	195.44	462.36	14.68	27.6	0.61
1	13062	50yr_Ex	38.2	150.9	150.4	0.52	0.016038	2.49	215.08	535.99	19.1	37.04	0.62
1	13062	100yr_Ex	47	151.06	151	0.61	0.015921	2.57	227.44	584.33	25.17	41.4	0.62
1	13062	Regional_Ex	67.3	151.34	151.25	0.84	0.014972	2.6	234.34	609.79	37.43	44.54	0.6
1	13034	2yr_Ex	12.5	149.32	149.18	0.83	0.02354	2.28	176.01	401.28	5.48	6.57	0.8
1	13034	5yr_Ex	17.7	149.6	149.39	1.02	0.022412	2.39	201.34	481.96	7.39	7.25	0.76
1	13034	10yr_Ex	25.6	149.99	149.67	1.26	0.019896	2.45	217.97	532.97	10.47	8.28	0.69
1	13034	25yr_Ex	31.7	150.3	149.85	0.62	0.018241	2.35	215.85	508.28	14.26	23	0.65
1	13034	50yr_Ex	38.2	150.52	150.03	0.63	0.014739	2.27	196.06	444.97	20.68	32.59	0.59
1	13034	100yr_Ex	47	150.62	150.5	0.69	0.017153	2.51	237.99	596.41	23.98	34.72	0.63
1	13034	Regional_Ex	67.3	150.88	150.83	0.8	0.018172	2.7	275.49	743.34	34.23	49.33	0.65

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	13007	2yr_Ex	12.5	148.77	148.57	0.9	0.01761	2.15	138.29	297.13	5.82	6.47	0.72
1	13007	5yr_Ex	17.7	149.08	148.78	1.12	0.016328	2.22	156.06	346.84	7.96	7.11	0.67
1	13007	10yr_Ex	25.6	149.52	149.06	1.27	0.016658	2.24	181.36	406.84	11.41	8.99	0.64
1	13007	25yr_Ex	31.7	149.85	149.26	1.28	0.016889	2.16	188.37	406.42	14.69	11.52	0.61
1	13007	50yr_Ex	38.2	150.1	149.46	0.84	0.016961	2.1	191.82	402.11	18.67	22.23	0.59
1	13007	100yr_Ex	47	150.28	149.69	0.72	0.012985	2	167.04	333.86	28.39	44.09	0.53
1	13007	Regional_Ex	67.3	150.47	150.23	0.72	0.014956	2.33	218.27	509.28	37.6	66.01	0.58
1	12979	2yr_Ex	12.5	148.31		0.9	0.012563	2.31	97.6	225.44	5.41	6.02	0.78
1	12979	5yr_Ex	17.7	148.62		1.07	0.01413	2.39	129.81	310.25	7.41	6.89	0.74
1	12979	10yr_Ex	25.6	149		1.26	0.015885	2.51	169.92	425.98	10.21	8.11	0.71
1	12979	25yr_Ex	31.7	149.26		1.29	0.018178	2.53	201.25	508.16	12.55	9.75	0.71
1	12979	50yr_Ex	38.2	149.45	149.07	0.78	0.02017	2.62	232.47	609.76	14.85	18.93	0.73
1	12979	100yr_Ex	47	149.63	149.34	0.52	0.021174	2.71	257.45	697.73	20.32	39.36	0.74
1	12979	Regional_Ex	67.3	149.93	149.91	0.68	0.016912	2.76	249.69	688.35	34.05	50	0.68
1	12951	2yr_Ex	12.5	147.95	147.73	0.87	0.016927	2.06	132.42	272.43	6.08	6.99	0.7
1	12951	5yr_Ex	17.7	148.21	147.95	1.02	0.017978	2.21	163.51	361.38	8.01	7.86	0.7
1	12951	10yr_Ex	25.6	148.55	148.22	1.2	0.018552	2.36	197.38	465.49	10.86	9.05	0.69
1	12951	25yr_Ex	31.7	148.78	148.4	1.06	0.018049	2.43	212.78	516.58	13.18	12.41	0.67
1	12951	50yr_Ex	38.2	148.97	148.57	0.67	0.016625	2.5	219.98	550.19	16.87	25.34	0.65
1	12951	100yr_Ex	47	149.1	148.84	0.65	0.017517	2.72	252.53	686.44	20.86	33.97	0.68
1	12951	Regional_Ex	67.3	149.34	149.31	0.88	0.018732	3.08	309.64	953.51	28.54	37.97	0.72
1	12923	2yr_Ex	12.5	147.35	147.25	0.78	0.022507	2.31	159.36	368.23	5.41	6.96	0.84
1	12923	5yr_Ex	17.7	147.61	147.45	0.95	0.021625	2.43	185.3	449.47	7.3	7.65	0.79
1	12923	10yr_Ex	25.6	148.03	147.71	1.17	0.018677	2.37	194.8	461.06	10.82	9.23	0.7
1	12923	25yr_Ex	31.7	148.22	147.89	1.23	0.020993	2.5	229.94	575.09	12.67	10.32	0.72
1	12923	50yr_Ex	38.2	148.44	148.07	0.77	0.02242	2.48	247.93	615.13	15.97	20.87	0.72
1	12923	100yr_Ex	47	148.64	148.37	0.64	0.018281	2.49	236.17	586.89	22.38	35.14	0.66
1	12923	Regional_Ex	67.3	148.94	148.81	0.84	0.015858	2.62	247.32	648.99	33.43	39.75	0.64
1	12895	2yr_Ex	12.5	146.96	146.77	0.9	0.007757	2.08	57.33	119.48	6	6.69	0.7
1	12895	5yr_Ex	17.7	147.24	146.96	1.14	0.006952	2.25	62.68	141.18	7.86	6.9	0.67
1	12895	10yr_Ex	25.6	147.72	147.22	0.75	0.004671	2.26	56.96	128.63	12.08	20.84	0.57
1	12895	25yr_Ex	31.7	147.83	147.4	0.63	0.005556	2.58	72.55	187.02	14.31	36.28	0.63

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	12895	50yr_Ex	38.2	147.92	147.59	0.61	0.006651	2.91	91.16	265.54	16.4	43.31	0.7
1	12895	100yr_Ex	47	148	147.98	0.6	0.00833	3.36	119.51	401.63	18.81	52.12	0.78
1	12895	Regional_Ex	67.3	148.4	148.4	0.88	0.006831	3.46	118.79	410.95	32.8	60.09	0.73
1	12869	2yr_Ex	12.5	146.69	146.49	0.89	0.015085	2.07	118.32	245.46	6.03	6.73	0.7
1	12869	5yr_Ex	17.7	147.01	146.69	1.13	0.013938	2.15	134.34	289.05	8.23	7.28	0.65
1	12869	10yr_Ex	25.6	147.59	146.95	0.5	0.01706	1.84	151.73	279.34	14.52	37.83	0.59
1	12869	25yr_Ex	31.7	147.72	147.16	0.55	0.016264	1.93	162.09	313.49	18.6	46.7	0.59
1	12869	50yr_Ex	38.2	147.83	147.4	0.63	0.016049	2.04	175.15	357.52	22.26	48.55	0.59
1	12869	100yr_Ex	47	147.95	147.78	0.74	0.015723	2.16	189.26	408.19	26.71	49.77	0.59
1	12869	Regional_Ex	67.3	148.19	147.99	0.95	0.015313	2.38	217.68	517.66	35.61	51.74	0.6
1	12842	2yr_Ex	12.5	146.44	146.03	0.97	0.009044	1.58	79.07	125.27	7.89	8.16	0.51
1	12842	5yr_Ex	17.7	146.79	146.23	1.2	0.008051	1.62	86.2	139.86	10.91	9.06	0.47
1	12842	10yr_Ex	25.6	147.28	146.48	0.66	0.008639	1.55	96.08	148.61	18.13	33.77	0.44
1	12842	25yr_Ex	31.7	147.4	146.64	0.58	0.010026	1.69	115.72	195.02	22.18	49.83	0.48
1	12842	50yr_Ex	38.2	147.51	146.8	0.65	0.010119	1.79	126.72	226.55	26.43	55.45	0.49
1	12842	100yr_Ex	47	147.64	147.01	0.75	0.010077	1.9	138.21	261.99	31.89	60.25	0.49
1	12842	Regional_Ex	67.3	147.91	147.58	0.97	0.009555	2.06	153.98	316.48	43.51	64.2	0.49
1	12816	2yr_Ex	12.5	146.1	145.8	0.98	0.011604	1.91	99.33	189.55	6.55	6.67	0.61
1	12816	5yr_Ex	17.7	146.49	146.01	1.22	0.010614	1.92	110.35	211.34	9.24	7.58	0.55
1	12816	10yr_Ex	25.6	147.04	146.28	0.56	0.010488	1.5	100.69	150.9	20.08	37.1	0.46
1	12816	25yr_Ex	31.7	147.13	146.47	0.64	0.011186	1.64	116.65	190.78	23.39	37.63	0.49
1	12816	50yr_Ex	38.2	147.26	146.91	0.71	0.010089	1.67	117.06	195.21	28.37	41.61	0.47
1	12816	100yr_Ex	47	147.41	147.08	0.81	0.009284	1.72	120.24	206.98	34.57	44.59	0.46
1	12816	Regional_Ex	67.3	147.7	147.27	1.05	0.008234	1.83	128.21	235.01	47.36	47.23	0.45
1	12794	2yr_Ex	12.5	145.9	145.49	1.01	0.010392	1.67	91.85	153.22	7.49	7.44	0.53
1	12794	5yr_Ex	17.7	146.31	145.69	1.23	0.008831	1.63	94.41	153.74	10.87	8.87	0.47
1	12794	10yr_Ex	25.6	146.87	145.96	0.67	0.005772	1.43	76.6	109.46	21.31	31.93	0.37
1	12794	25yr_Ex	31.7	146.91	146.15	0.68	0.007921	1.7	107.82	183.53	22.55	33.34	0.44
1	12794	50yr_Ex	38.2	147.04	146.32	0.71	0.007878	1.79	116.53	209.1	27.31	38.38	0.44
1	12794	100yr_Ex	47	147.2	146.75	0.82	0.007701	1.88	124.63	234.77	33.56	42.83	0.45
1	12794	Regional_Ex	67.3	147.51	147.08	1.06	0.0072	2.02	136.28	275.56	46.62	51.53	0.44
1	12789	2yr_Ex	12.5	145.87	145.23	1.33	0.005893	1.43	59.67	85.44	8.73	6.58	0.4

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	12789	5yr_Ex	17.7	146.28	145.43	1.39	0.005731	1.54	70.25	108.39	11.52	8.31	0.38
1	12789	10yr_Ex	25.6	146.84	145.69	0.72	0.003656	1.49	59.77	89.24	23.27	32.47	0.32
1	12789	25yr_Ex	31.7	146.86	145.88	0.72	0.005406	1.82	88.98	162.29	23.77	32.84	0.39
1	12789	50yr_Ex	38.2	146.97	146.06	0.7	0.006192	2.01	106.8	215.08	27.69	39.48	0.42
1	12789	100yr_Ex	47	147.11	146.32	0.72	0.006729	2.18	122.93	268.15	33.67	46.63	0.44
1	12789	Regional_Ex	67.3	147.46	147.05	0.93	0.005818	2.22	121.33	268.8	52.11	56.17	0.42
1	12786 9 Pedestrian Cro		Bridge										
1	12783	2yr_Ex	12.5	145.86	145.19	1.28	0.001944	1.24	18.65	23.16	10.07	7.84	0.35
1	12783	5yr_Ex	17.7	146.27	145.36	1.24	0.001641	1.32	19.67	26.02	13.68	11.02	0.33
1	12783	10yr_Ex	25.6	146.7	145.59	0.78	0.001582	1.48	23.07	34.16	20.65	26.38	0.33
1	12783	25yr_Ex	31.7	146.84	145.76	0.72	0.00188	1.68	29.16	49.05	25.01	34.75	0.36
1	12783	50yr_Ex	38.2	146.96	145.92	0.78	0.002153	1.86	35.17	65.53	29.27	37.47	0.39
1	12783	100yr_Ex	47	147.1	146.12	0.77	0.002471	2.07	42.79	88.77	35.12	45.84	0.42
1	12783	Regional_Ex	67.3	147.38	146.86	0.86	0.002892	2.41	55.8	134.6	50.22	58.22	0.46
1	12778	2yr_Ex	12.5	145.79	145.28	1.13	0.007376	1.53	70.2	107.41	8.17	7.26	0.46
1	12778	5yr_Ex	17.7	146.23	145.48	1.15	0.008356	1.49	83.76	124.41	11.92	10.34	0.44
1	12778	10yr_Ex	25.6	146.7	145.74	0.61	0.006289	1.35	74.38	100.52	21.9	42.9	0.38
1	12778	25yr_Ex	31.7	146.84	145.95	0.71	0.006127	1.43	80.3	114.7	27.28	63.61	0.38
1	12778	50yr_Ex	38.2	146.97	146.16	0.83	0.006029	1.5	85.91	128.7	32.23	70.37	0.38
1	12778	100yr_Ex	47	147.12	146.51	0.92	0.006011	1.59	93.75	148.94	38.39	86.53	0.38
1	12778	Regional_Ex	67.3	147.42	146.88	1.19	0.005814	1.74	106.23	184.46	51.05	96.54	0.39
1	12759	2yr_Ex	12.5	145.52	145.13	1.18	0.009565	2.08	87.08	181.54	6	5.08	0.61
1	12759	5yr_Ex	17.7	145.9	145.39	1.36	0.011511	2.2	119.51	262.39	8.06	5.93	0.6
1	12759	10yr_Ex	25.6	146.42	145.74	0.61	0.012408	2.04	137.82	281.23	14.87	33.27	0.56
1	12759	25yr_Ex	31.7	146.55	145.98	0.69	0.012382	2.17	151.1	327.96	18.34	59.3	0.56
1	12759	50yr_Ex	38.2	146.66	146.47	0.76	0.01305	2.33	170.43	397.31	21.23	61.27	0.59
1	12759	100yr_Ex	47	146.79	146.62	0.87	0.013632	2.51	192.21	482	24.88	62.32	0.61
1	12759	Regional_Ex	67.3	147.06	146.87	1.09	0.014021	2.8	228.01	637.7	32.72	64.96	0.63
1	12735	2yr_Ex	12.5	145.05	144.96	0.92	0.02362	2.6	182.1	474.33	4.8	5.23	0.87
1	12735	5yr_Ex	17.7	145.49	145.21	1.13	0.019832	2.41	186.82	450.69	7.34	6.48	0.72
1	12735	10yr_Ex	25.6	145.98	145.54	0.64	0.020753	2.29	209.1	478.66	11.61	25.39	0.68
1	12735	25yr_Ex	31.7	146.14	145.77	0.62	0.019696	2.35	218.01	512.45	15.5	40.97	0.66

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	12735	50yr_Ex	38.2	146.28	146.18	0.75	0.018708	2.39	223.08	533.29	18.93	44.96	0.65
1	12735	100yr_Ex	47	146.44	146.31	0.9	0.017652	2.43	227.79	553.11	23.05	58.34	0.63
1	12735	Regional_Ex	67.3	146.74	146.53	1.07	0.0165	2.55	244.77	623.75	30.97	66.23	0.62
1	12711	2yr_Ex	12.5	144.82	144.2	1.17	0.008148	1.62	75.93	123.36	7.69	6.56	0.48
1	12711	5yr_Ex	17.7	145.26	144.45	1.18	0.008995	1.59	87.95	140.22	11.1	17.73	0.47
1	12711	10yr_Ex	25.6	145.74	144.79	0.83	0.0077	1.53	88.96	136.09	17.41	35.01	0.42
1	12711	25yr_Ex	31.7	145.91	145.03	0.91	0.007572	1.64	98.5	161.72	21.17	39.33	0.43
1	12711	50yr_Ex	38.2	146.04	145.28	0.97	0.007997	1.78	112.83	200.97	24.28	48.91	0.44
1	12711	100yr_Ex	47	146.19	145.53	0.96	0.008501	1.95	130.92	254.9	28.31	68.2	0.46
1	12711	Regional_Ex	67.3	146.48	145.96	1.24	0.009036	2.22	161.74	358.88	37.05	80.95	0.49
1	12683	2yr_Ex	12.5	144.47	144.12	1.09	0.010326	2.1	89.95	188.52	5.96	5.48	0.64
1	12683	5yr_Ex	17.7	144.87	144.39	1.19	0.012092	2.09	117.2	244.7	8.48	7.14	0.61
1	12683	10yr_Ex	25.6	145.43	144.74	0.72	0.011441	1.82	120.65	219.22	15.51	28.34	0.52
1	12683	25yr_Ex	31.7	145.66	144.98	0.75	0.009249	1.76	111.44	196.28	21.13	43.56	0.48
1	12683	50yr_Ex	38.2	145.81	145.31	0.84	0.008699	1.82	115.61	210.82	25.34	51.24	0.47
1	12683	100yr_Ex	47	145.97	145.55	1	0.008337	1.91	122.36	233.38	30.15	59.53	0.47
1	12683	Regional_Ex	67.3	146.26	145.84	1.3	0.00817	2.1	140.82	295.96	39.01	69.04	0.48
1	12656	2yr_Ex	12.5	144.18	143.78	1.08	0.01303	1.88	117.45	220.71	6.65	6.17	0.58
1	12656	5yr_Ex	17.7	144.54	144.02	1.25	0.013242	1.95	137.43	268.46	9.06	7.27	0.56
1	12656	10yr_Ex	25.6	145.08	144.33	1.27	0.013261	1.85	146.05	270.49	13.82	12.7	0.52
1	12656	25yr_Ex	31.7	145.3	144.55	0.76	0.01477	1.91	164.5	314.34	16.92	28.86	0.54
1	12656	50yr_Ex	38.2	145.46	144.77	0.77	0.013479	1.98	169.3	334.85	21.09	36.29	0.53
1	12656	100yr_Ex	47	145.64	145.02	0.91	0.012379	2.05	174.97	358.78	26.11	48.12	0.52
1	12656	Regional_Ex	67.3	145.95	145.58	1.14	0.011763	2.24	197.77	443.78	35.26	59.94	0.52
1	12628	2yr_Ex	12.5	143.82	143.43	1.06	0.012407	1.93	109.68	211.49	6.48	6.11	0.6
1	12628	5yr_Ex	17.7	144.17	143.69	1.23	0.012889	2.01	132.04	265.85	8.79	7.12	0.58
1	12628	10yr_Ex	25.6	144.68	144	1.16	0.0146	1.91	151.97	290.59	13.39	11.53	0.56
1	12628	25yr_Ex	31.7	144.86	144.21	1.1	0.01494	2.05	171.92	352.31	15.71	14.27	0.57
1	12628	50yr_Ex	38.2	145	144.46	0.91	0.015876	2.2	196.52	432.93	18.04	19.74	0.59
1	12628	100yr_Ex	47	145.17	144.71	0.89	0.016639	2.36	222.35	523.95	21.64	24.4	0.61
1	12628	Regional_Ex	67.3	145.44	145.23	0.95	0.018945	2.65	278.69	737.33	28.94	59.92	0.65
1	12600	2yr_Ex	12.5	143.35	143.07	1.01	0.019236	2.18	159.9	348.94	5.73	5.69	0.69

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	12600	5yr_Ex	17.7	143.66	143.33	1.13	0.020894	2.31	196.06	452.41	7.67	6.78	0.69
1	12600	10yr_Ex	25.6	144.14	143.66	1.16	0.021213	2.21	212.4	470.21	11.56	9.93	0.65
1	12600	25yr_Ex	31.7	144.45	143.89	0.84	0.015359	2.06	180.41	371.33	16.43	19.61	0.56
1	12600	50yr_Ex	38.2	144.62	144.11	0.79	0.01441	2.09	183.54	383.49	20.44	25.86	0.55
1	12600	100yr_Ex	47	144.84	144.45	0.82	0.012639	2.01	171.75	346.07	26.85	35.46	0.52
1	12600	Regional_Ex	67.3	145.17	144.79	1.05	0.009944	2.03	163.33	331.21	38.53	44.31	0.47
1	12573	2yr_Ex	12.5	142.56	142.47	0.89	0.032876	2.62	249.13	653.7	4.76	5.33	0.89
1	12573	5yr_Ex	17.7	142.92	142.73	1.07	0.028591	2.56	257.47	658.91	6.92	6.47	0.79
1	12573	10yr_Ex	25.6	143.69	143.05	1.36	0.014122	1.95	164.43	321	13.11	9.62	0.53
1	12573	25yr_Ex	31.7	144.13	143.26	1.53	0.010628	1.78	139.75	249.29	17.77	11.64	0.46
1	12573	50yr_Ex	38.2	144.26	143.44	1.55	0.012572	1.97	170.68	335.57	19.43	12.52	0.5
1	12573	100yr_Ex	47	144.43	143.66	1.28	0.014311	2.17	206.75	449.66	21.92	17.17	0.54
1	12573	Regional_Ex	67.3	144.66	144.1	1.06	0.019028	2.64	295.88	780.84	27.16	46.78	0.63
1	12555	2yr_Ex	12.5	142.1	142.02	0.88	0.01962	2.61	147.38	385.34	4.78	5.41	0.89
1	12555	5yr_Ex	17.7	142.58	142.26	1.15	0.015251	2.29	146.39	335.55	7.72	6.73	0.68
1	12555	10yr_Ex	25.6	143.54	142.57	1.49	0.007273	1.6	92.41	147.46	16.04	10.77	0.42
1	12555	25yr_Ex	31.7	144.03	142.78	1.15	0.00527	1.45	78.26	113.64	22.2	19.37	0.35
1	12555	50yr_Ex	38.2	144.15	142.99	1.07	0.006169	1.62	96.29	155.75	24.71	23	0.38
1	12555	100yr_Ex	47	144.31	143.23	1.12	0.006955	1.78	115.1	204.3	28.65	25.61	0.41
1	12555	Regional_Ex	67.3	144.5	143.67	1.27	0.010168	2.2	176.71	387.91	33.71	42.37	0.49
1	12545	2yr_Ex	12.5	142.1	141.43	1.41	0.003291	1.53	30.87	47.29	8.16	5.8	0.41
1	12545	5yr_Ex	17.7	142.56	141.64	1.52	0.004655	1.54	49.18	75.93	11.46	7.91	0.4
1	12545	10yr_Ex	25.6	143.52	141.92	2.34	0.002091	1.32	34.73	45.99	19.33	12.92	0.28
1	12545	25yr_Ex	31.7	144.01	142.21	0.97	0.002377	1.1	37.59	41.46	30.42	31.43	0.25
1	12545	50yr_Ex	38.2	144.13	142.41	0.94	0.002727	1.23	45.69	56.1	34.49	36.56	0.27
1	12545	100yr_Ex	47	144.29	142.62	0.81	0.002977	1.35	53.65	72.25	41.41	51.19	0.28
1	12545	Regional_Ex	67.3	144.49	143.07	0.62	0.003993	1.65	78.01	128.39	54.13	87.85	0.33
1	12532 8 Thorn Lodge Dr		Culvert										
1	12519	2yr_Ex	12.5	141.33	140.88	1.26	0.004851	1.83	41.93	76.71	6.83	5.41	0.52
1	12519	5yr_Ex	17.7	141.6	141.1	1.52	0.00557	2.13	54.64	116.53	8.3	5.48	0.55
1	12519	10yr_Ex	25.6	141.98	141.39	1.44	0.01102	2.34	112.46	262.91	10.95	8.54	0.62
1	12519	25yr_Ex	31.7	142.22	141.6	1.62	0.011104	2.48	128.08	317.34	12.79	9.58	0.62

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	12519	50yr_Ex	38.2	142.44	141.9	1.84	0.010457	2.62	137.35	360.13	14.57	10.58	0.62
1	12519	100yr_Ex	47	142.71	142.14	2.1	0.010119	2.82	152.01	428.77	16.66	11.75	0.62
1	12519	Regional_Ex	67.3	143.16	142.55	2.56	0.010798	3.32	197.31	655.16	20.27	13.88	0.66
1	12509	2yr_Ex	12.5	141.32	140.83	1	0.005003	1.36	45.43	61.6	9.22	9.19	0.43
1	12509	5yr_Ex	17.7	141.61	141.01	1.18	0.005556	1.48	58.81	86.92	11.98	10.18	0.44
1	12509	10yr_Ex	25.6	141.97	141.24	1.39	0.00602	1.61	74.86	120.41	15.91	11.44	0.44
1	12509	25yr_Ex	31.7	142.22	141.4	1.54	0.006185	1.68	84.6	142.5	18.82	12.24	0.43
1	12509	50yr_Ex	38.2	142.46	141.55	1.67	0.006302	1.75	93.47	163.35	21.86	13.07	0.43
1	12509	100yr_Ex	47	142.74	141.75	1.82	0.006514	1.83	104.93	191.65	25.73	14.14	0.43
1	12509	Regional_Ex	67.3	143.25	142.12	2.01	0.007542	2.01	134.71	270.86	33.47	16.65	0.45
1	12492	2yr_Ex	12.5	141.13	140.83	0.93	0.009078	1.82	75.54	137.7	6.86	7.4	0.6
1	12492	5yr_Ex	17.7	141.38	141.03	1.1	0.010359	2.02	100.67	203.14	8.77	7.98	0.61
1	12492	10yr_Ex	25.6	141.71	141.28	1.31	0.011637	2.23	132.87	296.16	11.49	8.75	0.62
1	12492	25yr_Ex	31.7	141.93	141.46	1.45	0.01226	2.35	153.5	360.11	13.51	9.31	0.62
1	12492	50yr_Ex	38.2	142.15	141.63	1.58	0.012711	2.44	172.18	419.95	15.66	9.92	0.62
1	12492	100yr_Ex	47	142.41	141.84	1.7	0.013583	2.56	198.19	507.52	18.35	10.77	0.63
1	12492	Regional_Ex	67.3	142.82	142.27	1.82	0.017648	2.91	277.55	808.32	23.11	12.67	0.69
1	12465	2yr_Ex	12.5	140.71	140.61	0.72	0.022761	2.14	148.77	318.56	5.84	8.08	0.8
1	12465	5yr_Ex	17.7	140.96	140.78	0.92	0.019943	2.22	162.78	362.02	7.96	8.69	0.74
1	12465	10yr_Ex	25.6	141.31	141.01	1.16	0.017611	2.31	179.04	412.79	11.1	9.6	0.68
1	12465	25yr_Ex	31.7	141.55	141.17	1.31	0.016413	2.34	188.02	440.36	13.54	10.33	0.65
1	12465	50yr_Ex	38.2	141.79	141.33	1.43	0.015585	2.38	196.98	468.9	16.05	11.23	0.63
1	12465	100yr_Ex	47	142.06	141.52	1.46	0.014513	2.45	207.03	507.02	19.35	13.21	0.61
1	12465	Regional_Ex	67.3	142.37	141.92	1.11	0.016134	2.91	274.82	798.75	24.45	22.03	0.67
1	12438	2yr_Ex	12.5	140.33	139.98	0.95	0.009953	1.75	84.94	148.26	7.16	7.54	0.57
1	12438	5yr_Ex	17.7	140.6	140.18	1.13	0.010649	1.9	106.75	202.96	9.31	8.22	0.57
1	12438	10yr_Ex	25.6	140.95	140.44	1.31	0.011775	2.06	136.26	281.32	12.4	9.43	0.58
1	12438	25yr_Ex	31.7	141.19	140.62	1.39	0.012655	2.14	155.69	332.63	14.84	10.65	0.58
1	12438	50yr_Ex	38.2	141.43	140.79	1.45	0.01341	2.18	172.4	376.51	17.49	12.09	0.58
1	12438	100yr_Ex	47	141.72	141.01	1.25	0.013651	2.2	184.8	406.24	21.57	17.25	0.57
1	12438	Regional_Ex	67.3	142.1	141.46	0.98	0.012338	2.35	201.71	473.36	31.22	44.29	0.56
1	12412	2yr_Ex	12.5	139.81	139.74	0.75	0.020793	2.39	143.43	342.99	5.23	6.93	0.88

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	12412	5yr_Ex	17.7	140.03	139.94	0.9	0.022679	2.61	184.73	482.14	6.78	7.52	0.88
1	12412	10yr_Ex	25.6	140.33	140.2	1.09	0.023469	2.79	228.85	638.61	9.17	8.4	0.85
1	12412	25yr_Ex	31.7	140.54	140.38	1.21	0.023663	2.88	254.8	732.56	11.03	9.09	0.83
1	12412	50yr_Ex	38.2	140.75	140.55	1.32	0.023793	2.95	278.42	821.51	12.95	9.79	0.82
1	12412	100yr_Ex	47	141.04	140.76	1.4	0.023948	2.93	298.28	872.6	16.07	11.47	0.79
1	12412	Regional_Ex	67.3	141.45	141.37	0.89	0.022869	3.06	304.23	932.39	23.14	27.51	0.81
1	12385	2yr_Ex	12.5	139.29	139.13	0.75	0.023054	1.97	159	313.53	6.34	8.45	0.73
1	12385	5yr_Ex	17.7	139.53	139.31	0.94	0.020773	2.1	176.6	371.01	8.43	8.96	0.69
1	12385	10yr_Ex	25.6	139.9	139.53	1.22	0.017056	2.16	183.46	396.71	11.84	9.74	0.63
1	12385	25yr_Ex	31.7	140.11	139.69	1.36	0.016822	2.27	201.11	456.58	13.96	10.23	0.62
1	12385	50yr_Ex	38.2	140.3	139.84	1.48	0.017348	2.4	223.91	536.28	15.95	10.76	0.63
1	12385	100yr_Ex	47	140.54	140.03	1.53	0.019092	2.51	255.92	643.21	18.7	12.19	0.65
1	12385	Regional_Ex	67.3	140.92	140.42	0.98	0.021364	2.73	310.47	846.47	26.5	27.51	0.68
1	12358	2yr_Ex	12.5	138.88	138.52	0.91	0.011183	1.6	91.44	146.02	7.83	8.62	0.54
1	12358	5yr_Ex	17.7	139.16	138.71	1.1	0.01087	1.71	106.33	181.9	10.35	9.42	0.52
1	12358	10yr_Ex	25.6	139.57	138.94	1.16	0.011852	1.73	124.5	215.41	14.8	12.71	0.51
1	12358	25yr_Ex	31.7	139.81	139.1	1.01	0.010878	1.75	127.41	222.66	18.38	26.7	0.49
1	12358	50yr_Ex	38.2	140.03	139.27	1.11	0.009493	1.77	126.53	223.81	22.62	76.97	0.47
1	12358	100yr_Ex	47	140.3	139.5	1.02	0.007725	1.74	118	204.82	30.06	104.81	0.43
1	12358	Regional_Ex	67.3	140.7	139.9	1.37	0.006669	1.79	120.65	216.1	41.8	124.63	0.4
1	12330	2yr_Ex	12.5	138.49	138.25	0.89	0.010862	2.01	86.18	173.13	6.22	6.97	0.68
1	12330	5yr_Ex	17.7	138.73	138.47	1.07	0.011824	2.22	110.1	244.65	7.97	7.47	0.69
1	12330	10yr_Ex	25.6	139.05	138.73	1.27	0.013666	2.46	149.2	366.44	10.42	8.21	0.7
1	12330	25yr_Ex	31.7	139.26	138.91	1.39	0.014969	2.6	177.52	461.13	12.2	8.8	0.7
1	12330	50yr_Ex	38.2	139.46	139.09	1.47	0.016349	2.71	206.25	559.55	14.08	9.55	0.71
1	12330	100yr_Ex	47	139.75	139.31	0.99	0.018445	2.71	237.96	645.83	17.8	17.92	0.71
1	12330	Regional_Ex	67.3	140.21	139.9	0.92	0.015389	2.74	241.08	660.11	27.94	39.27	0.65
1	12303	2yr_Ex	12.5	138.29	137.86	0.94	0.008831	1.43	75.61	107.77	8.77	9.37	0.47
1	12303	5yr_Ex	17.7	138.52	138.04	1.08	0.010054	1.62	98.55	159.39	10.94	10.16	0.5
1	12303	10yr_Ex	25.6	138.8	138.27	1.24	0.011415	1.83	128.5	235.59	13.96	11.23	0.53
1	12303	25yr_Ex	31.7	138.99	138.42	1.35	0.012119	1.96	147.88	289.85	16.17	11.97	0.54
1	12303	50yr_Ex	38.2	139.17	138.58	1.46	0.012634	2.07	165.69	343.09	18.45	12.68	0.55
1	12303	100yr_Ex	47	139.41	138.76	1.54	0.013423	2.18	187.01	407.14	21.59	25.7	0.56

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	12303	Regional_Ex	67.3	139.88	139.13	1.21	0.013597	2.3	213.42	490.9	30.14	104.71	0.56
1	12275	2yr_Ex	12.5	137.9	137.71	0.68	0.022346	1.69	142.44	240.65	7.4	10.88	0.65
1	12275	5yr_Ex	17.7	138.11	137.86	0.84	0.020049	1.81	156.91	283.51	9.8	11.66	0.63
1	12275	10yr_Ex	25.6	138.39	138.06	1.05	0.017824	1.94	172.95	334.73	13.23	12.6	0.6
1	12275	25yr_Ex	31.7	138.59	138.19	1.19	0.016574	2.01	181.72	364.46	15.81	13.25	0.59
1	12275	50yr_Ex	38.2	138.79	138.32	1.32	0.015927	2.07	191.93	398.26	18.41	14	0.58
1	12275	100yr_Ex	47	139.01	138.47	1.43	0.015932	2.17	208.58	452.13	21.68	16.68	0.58
1	12275	Regional_Ex	67.3	139.47	138.8	1.4	0.016956	2.27	236.77	536.52	29.73	44.17	0.59
1	12248	2yr_Ex	12.5	137.25	137.11	0.74	0.018719	2.1	128.95	270.65	5.96	8	0.78
1	12248	5yr_Ex	17.7	137.48	137.3	0.9	0.018975	2.24	156.04	349.53	7.9	8.82	0.76
1	12248	10yr_Ex	25.6	137.85	137.54	1.11	0.016618	2.23	167.66	373.36	11.5	10.39	0.68
1	12248	25yr_Ex	31.7	138.07	137.7	1.21	0.016582	2.28	183.36	418.83	13.88	11.44	0.66
1	12248	50yr_Ex	38.2	138.27	137.86	1.31	0.016542	2.35	198.07	464.63	16.28	13.03	0.65
1	12248	100yr_Ex	47	138.5	138.05	1.47	0.015973	2.45	214.32	525.58	19.17	25.47	0.65
1	12248	Regional_Ex	67.3	138.83	138.42	1.58	0.017335	2.86	278.04	794.18	23.67	45.83	0.69
1	12220	2yr_Ex	12.5	136.72	136.66	0.71	0.014939	2.36	98.09	231.82	5.29	7.47	0.9
1	12220	5yr_Ex	17.7	137.05	136.85	0.91	0.012539	2.23	105.23	234.69	7.94	8.68	0.74
1	12220	10yr_Ex	25.6	137.49	137.1	1.15	0.011198	2.09	117.05	244.88	12.24	10.68	0.62
1	12220	25yr_Ex	31.7	137.68	137.27	1.21	0.012844	2.21	142.43	315.03	14.33	11.81	0.64
1	12220	50yr_Ex	38.2	137.85	137.43	1.22	0.014785	2.33	165.98	386.21	16.42	13.43	0.67
1	12220	100yr_Ex	47	138.05	137.63	1.19	0.017309	2.42	191.57	463.92	19.41	16.26	0.71
1	12220	Regional_Ex	67.3	138.35	138.06	0.77	0.020836	2.64	245.7	647.78	26.99	51.44	0.75
1	12193	2yr_Ex	12.5	136.56	136.18	0.94	0.003994	1.65	33.69	55.65	7.57	8.04	0.54
1	12193	5yr_Ex	17.7	136.91	136.38	1.12	0.002968	1.66	29.66	49.27	10.66	9.51	0.5
1	12193	10yr_Ex	25.6	137.37	136.64	1.12	0.002213	1.63	22.53	36.81	15.67	24.41	0.49
1	12193	25yr_Ex	31.7	137.54	136.82	1.08	0.002415	1.74	25.07	43.53	18.29	41.46	0.52
1	12193	50yr_Ex	38.2	137.68	136.98	0.75	0.002627	1.84	29.46	54.19	21.96	90.8	0.53
1	12193	100yr_Ex	47	137.85	137.2	0.89	0.002782	1.94	35.2	68.13	27.08	97.22	0.53
1	12193	Regional_Ex	67.3	138.09	137.71	1.1	0.003535	2.27	52.52	119.08	34.48	99.77	0.57
1	12167	2yr_Ex	12.5	136.44	136.11	0.88	0.006113	1.63	49.14	79.89	7.69	8.73	0.55
1	12167	5yr_Ex	17.7	136.82	136.29	1.11	0.005321	1.57	53.31	83.5	11.3	10.19	0.47
1	12167	10yr_Ex	25.6	137.3	136.52	1.14	0.006363	1.5	69.64	104.44	17.1	15	0.44

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	12167	25yr_Ex	31.7	137.46	136.68	0.89	0.006539	1.63	79.99	130.06	20.07	37.45	0.45
1	12167	50yr_Ex	38.2	137.6	136.85	0.96	0.006651	1.75	89.65	156.84	23.26	58.3	0.46
1	12167	100yr_Ex	47	137.76	137.06	1.03	0.006744	1.89	100.94	190.69	27.37	66.59	0.47
1	12167	Regional_Ex	67.3	137.94	137.5	1.15	0.009071	2.35	151.01	355.15	32.39	69.88	0.56
1	12141	2yr_Ex	12.5	136.31	135.79	0.97	0.006663	1.32	59.98	78.94	9.5	9.76	0.43
1	12141	5yr_Ex	17.7	136.72	135.98	1	0.005486	1.25	58.98	73.68	14.44	14.43	0.37
1	12141	10yr_Ex	25.6	137.2	136.21	0.9	0.003924	1.2	53.57	64.22	23.37	41.41	0.32
1	12141	25yr_Ex	31.7	137.36	136.37	0.98	0.00416	1.28	60.7	77.58	27.88	55.46	0.33
1	12141	50yr_Ex	38.2	137.5	136.56	1.09	0.004373	1.36	67.51	91.63	31.92	62.63	0.34
1	12141	100yr_Ex	47	137.67	136.73	1.15	0.004514	1.45	74.21	107.29	36.98	70.4	0.35
1	12141	Regional_Ex	67.3	137.82	137.16	1.23	0.006516	1.84	116.33	213.51	42.03	73.56	0.42
1	12126	2yr_Ex	12.5	136.15	135.68	1	0.009098	1.57	81.87	128.54	7.96	7.93	0.5
1	12126	5yr_Ex	17.7	136.59	135.9	0.82	0.007687	1.48	81.8	121.32	12.15	14.84	0.44
1	12126	10yr_Ex	25.6	137.13	136.17	0.73	0.003544	1.3	55.33	71.94	24.6	33.68	0.32
1	12126	25yr_Ex	31.7	137.3	136.36	0.88	0.003397	1.35	58.23	78.9	30.39	53.3	0.31
1	12126	50yr_Ex	38.2	137.45	136.56	1.02	0.003405	1.42	62.73	89.28	35.28	68.19	0.32
1	12126	100yr_Ex	47	137.62	136.8	1.16	0.003436	1.51	68.54	103.33	41.21	99.99	0.32
1	12126	Regional_Ex	67.3	137.74	137.24	1.25	0.005369	1.95	112.99	220.66	45.57	104.93	0.41
1	12116	2yr_Ex	12.5	136.01	135.35	1.52	0.010239	1.76	98.18	172.53	7.11	4.69	0.45
1	12116	5yr_Ex	17.7	136.4	135.59	1.27	0.009534	1.94	112.91	219.13	9.74	10.04	0.44
1	12116	10yr_Ex	25.6	137	135.92	0.68	0.005749	1.81	89.43	161.64	18.75	32.17	0.36
1	12116	25yr_Ex	31.7	137.18	136.27	0.7	0.005677	1.88	94.38	177.18	24.51	40.55	0.36
1	12116	50yr_Ex	38.2	137.38	136.52	0.7	0.004451	1.74	79.42	138.4	36.45	51.95	0.33
1	12116	100yr_Ex	47	137.58	137.09	0.62	0.003643	1.65	69.5	114.56	49.53	79.95	0.3
1	12116	Regional_Ex	67.3	137.7	137.33	0.67	0.004863	1.95	96.37	188.26	59.73	88.71	0.35
1	12099 7 Fifth Line Wes		Culvert										
1	12091	2yr_Ex	12.5	135.61	135.3	1.21	0.00768	2.22	62.81	139.33	5.63	10.57	0.64
1	12091	5yr_Ex	17.7	135.69	135.53	1.29	0.0129	2.95	109.75	323.98	6	13.61	0.83
1	12091	10yr_Ex	25.6	135.93	135.93	0.93	0.015191	3.55	150.48	533.5	7.7	37.86	0.91
1	12091	25yr_Ex	31.7	136.17	136.17	1.16	0.013817	3.72	157.71	586.04	9.62	45.12	0.89
1	12091	50yr_Ex	38.2	136.37	136.37	1.37	0.013392	3.93	170.22	669.06	11.28	47	0.9
1	12091	100yr_Ex	47	136.6	136.6	1.6	0.013228	4.21	188.27	793.03	13.22	48.91	0.91

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	12091	Regional_Ex	67.3	136.96	136.96	0.77	0.006649	3.31	110.24	364.49	47.16	77.91	0.66
1	12081	2yr_Ex	12.5	135.62		0.5	0.007611	1.21	63.06	76.53	12.37	24.6	0.42
1	12081	5yr_Ex	17.7	135.76		0.46	0.008128	1.38	77.82	107.48	16.4	35.76	0.44
1	12081	10yr_Ex	25.6	135.89	135.64	0.52	0.009494	1.62	102.87	166.76	21.61	41.8	0.48
1	12081	25yr_Ex	31.7	135.99	135.76	0.6	0.009501	1.72	112.34	193.08	26.04	43.36	0.49
1	12081	50yr_Ex	38.2	136.09	135.86	0.69	0.009336	1.8	119.39	214.34	30.5	44.5	0.49
1	12081	100yr_Ex	47	135.59	135.95	0.48	0.121756	4.8	987.29	4739.93	11.65	24.29	1.66
1	12081	Regional_Ex	67.3	136.49	136.13	0.97	0.008419	2.02	139.04	281.11	49.06	50.39	0.49
1	12063	2yr_Ex	14.9	135.47	135.25	0.45	0.007914	1.27	65.72	83.17	16.22	45.11	0.43
1	12063	5yr_Ex	21	135.61	135.39	0.58	0.007814	1.38	74.86	103.54	21.07	46.11	0.44
1	12063	10yr_Ex	27.9	135.74	135.48	0.69	0.007703	1.49	83.37	124.21	25.92	47.55	0.45
1	12063	25yr_Ex	34.4	135.84	135.56	0.78	0.007834	1.59	92.36	146.89	29.78	48.41	0.46
1	12063	50yr_Ex	41.4	135.94	135.62	0.87	0.007928	1.68	100.96	170.05	33.62	49.1	0.46
1	12063	100yr_Ex	50.3	136.05	135.7	0.97	0.008118	1.8	111.97	201.29	37.97	49.76	0.48
1	12063	Regional_Ex	74.8	136.31	135.89	1.2	0.008601	2.07	139.93	289.06	48.36	51.43	0.5
1	12035	2yr_Ex	14.9	134.95	134.93	0.41	0.025404	2.29	179.37	410.12	8.14	19.9	0.83
1	12035	5yr_Ex	21	135.12	135.12	0.43	0.020985	2.37	180.14	426.43	12.28	28.39	0.78
1	12035	10yr_Ex	27.9	135.23	135.23	0.5	0.021129	2.57	203.66	522.65	15.79	31.63	0.79
1	12035	25yr_Ex	34.4	135.34	135.34	0.53	0.019679	2.65	209.66	555.08	19.71	37.01	0.78
1	12035	50yr_Ex	41.4	135.42	135.42	0.58	0.020522	2.82	233.02	657.34	22.64	38.75	0.8
1	12035	100yr_Ex	50.3	135.51	135.51	0.64	0.021205	3	257.97	774.53	26.2	40.87	0.83
1	12035	Regional_Ex	74.8	135.7	135.7	0.75	0.023913	3.48	331.47	1152.95	34.27	45.67	0.9
1	12007	2yr_Ex	14.9	134.59	134.5	0.36	0.008855	1.54	66.28	102.03	16.72	47.94	0.55
1	12007	5yr_Ex	21	134.7	134.59	0.46	0.008708	1.67	74.4	124.03	21.94	49.99	0.56
1	12007	10yr_Ex	27.9	134.81	134.67	0.56	0.008634	1.79	82.59	147.84	27.07	51.94	0.57
1	12007	25yr_Ex	34.4	134.9	134.73	0.65	0.008584	1.89	89.46	169.04	31.41	53.35	0.58
1	12007	50yr_Ex	41.4	134.99	134.79	0.73	0.00853	1.98	96.13	190.76	35.76	54.38	0.58
1	12007	100yr_Ex	50.3	135.09	134.86	0.83	0.008479	2.09	103.98	217.66	40.91	55.58	0.59
1	12007	Regional_Ex	74.8	135.35	135.02	1.05	0.00834	2.34	122.53	286.94	53.82	59.22	0.6
1	11979	2yr_Ex	14.9	134.12	134.12	0.31	0.021584	2	152.01	303.84	10.21	33.19	0.74
1	11979	5yr_Ex	21	134.24	134.23	0.4	0.020202	2.14	165.26	353.12	14.4	35.85	0.73
1	11979	10yr_Ex	27.9	134.35	134.32	0.5	0.019662	2.28	180.96	412.62	18.31	36.85	0.74

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	11979	25yr_Ex	34.4	134.44	134.39	0.58	0.019381	2.4	194.56	466.73	21.59	37.41	0.74
1	11979	50yr_Ex	41.4	134.52	134.46	0.65	0.019334	2.52	209.47	528.04	24.74	37.89	0.75
1	11979	100yr_Ex	50.3	134.62	134.54	0.74	0.019166	2.65	225.64	598.6	28.52	38.44	0.76
1	11979	Regional_Ex	74.8	134.85	134.74	0.93	0.019568	3	272.56	817.29	37.42	40.2	0.79
1	11951	2yr_Ex	14.9	133.74	133.43	0.36	0.008803	1.5	67.49	100.96	11.59	35.3	0.53
1	11951	5yr_Ex	21	133.87	133.62	0.4	0.009733	1.69	84.55	142.57	16.46	45.55	0.56
1	11951	10yr_Ex	27.9	133.98	133.86	0.5	0.01006	1.85	97.99	181.3	21.07	46.83	0.58
1	11951	25yr_Ex	34.4	134.07	133.95	0.57	0.010275	1.98	108.83	215.18	24.9	48.63	0.6
1	11951	50yr_Ex	41.4	134.15	134.03	0.65	0.010412	2.09	118.88	248.76	28.72	49.52	0.61
1	11951	100yr_Ex	50.3	134.26	134.11	0.74	0.010217	2.2	127.2	279.32	33.56	50.64	0.61
1	11951	Regional_Ex	74.8	134.49	134.3	0.93	0.010802	2.51	157.65	395.74	43.95	53.51	0.65
1	11924	2yr_Ex	14.9	133.44	133.36	0.37	0.013947	1.58	97.04	153.09	13.03	35.04	0.59
1	11924	5yr_Ex	21	133.57	133.46	0.46	0.013411	1.71	108.59	185.3	17.67	38.58	0.59
1	11924	10yr_Ex	27.9	133.64	133.56	0.52	0.01634	1.98	142.96	283.52	20.33	39.24	0.66
1	11924	25yr_Ex	34.4	133.72	133.63	0.59	0.01673	2.12	159.17	337.78	23.52	44.61	0.68
1	11924	50yr_Ex	41.4	133.8	133.69	0.66	0.016977	2.25	174.4	392.41	26.74	50.36	0.69
1	11924	100yr_Ex	50.3	133.89	133.77	0.71	0.017429	2.41	195.12	471.05	30.79	55.94	0.71
1	11924	Regional_Ex	74.8	134.12	133.98	0.92	0.016865	2.67	225.44	602.54	40.82	59.04	0.72
1	11896	2yr_Ex	14.9	133.23	133.04	0.42	0.004781	1.08	38.97	42.14	22.39	53.49	0.37
1	11896	5yr_Ex	21	133.38	133.14	0.56	0.004079	1.11	39.02	43.36	30.47	58.5	0.35
1	11896	10yr_Ex	27.9	133.32	133.21	0.5	0.009969	1.67	89.57	149.24	27.14	54.21	0.54
1	11896	25yr_Ex	34.4	133.42	133.26	0.6	0.009318	1.72	91.99	157.79	32.23	61.21	0.53
1	11896	50yr_Ex	41.4	133.51	133.31	0.68	0.008959	1.78	95.99	170.52	37.08	67.3	0.53
1	11896	100yr_Ex	50.3	133.62	133.38	0.79	0.008302	1.82	97.93	178.55	43.34	68.99	0.52
1	11896	Regional_Ex	74.8	133.88	133.52	1.04	0.007742	1.99	110.13	219.66	57.49	71.99	0.52
1	11868	2yr_Ex	14.9	132.64	132.54	0.77	0.035715	2.34	254.67	597.02	6.36	8.22	0.85
1	11868	5yr_Ex	21	132.77	132.77	0.8	0.050459	2.82	379.31	1069.19	7.45	9.36	1
1	11868	10yr_Ex	27.9	132.99	132.85	0.56	0.013628	1.72	129.92	222.92	22.01	39.29	0.54
1	11868	25yr_Ex	34.4	133.11	132.85	0.53	0.011811	1.73	126.59	218.64	28.33	58.24	0.51
1	11868	50yr_Ex	41.4	133.23	132.94	0.65	0.010408	1.73	122.98	212.76	34.64	61.81	0.49
1	11868	100yr_Ex	50.3	133.39	133.06	0.79	0.008691	1.71	115.04	196.17	42.92	63.82	0.46
1	11868	Regional_Ex	74.8	133.66	133.25	1.03	0.008282	1.87	130.41	243.74	57.97	71.49	0.46

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	11840	2yr_Ex	14.9	131.86	131.77	0.64	0.017532	2.48	136.35	337.62	6.21	9.7	0.85
1	11840	5yr_Ex	21	132.17	132.07	0.63	0.019136	2.38	164.14	390.38	10.11	16	0.78
1	11840	10yr_Ex	27.9	132.36	132.29	0.72	0.019137	2.43	182.73	444.91	13.5	18.69	0.76
1	11840	25yr_Ex	34.4	132.47	132.39	0.71	0.020031	2.65	210.43	558.65	15.63	21.9	0.79
1	11840	50yr_Ex	41.4	132.59	132.51	0.72	0.019542	2.8	226.6	634.59	18.48	25.68	0.79
1	11840	100yr_Ex	50.3	132.64	132.64	0.74	0.024298	3.21	293.77	943.28	19.92	26.98	0.89
1	11840	Regional_Ex	74.8	133.18	133.03	0.95	0.011967	2.83	203.2	574.23	40.2	48.78	0.66
1	11811	2yr_Ex	14.9	131.27	131.27	0.55	0.028176	2.32	147.6	342.71	6.42	11.69	1
1	11811	5yr_Ex	21	131.43	131.43	0.64	0.03131	2.51	191.4	480.44	8.37	13.03	1
1	11811	10yr_Ex	27.9	131.59	131.59	0.61	0.0317	2.61	222.34	579.34	10.89	17.93	0.97
1	11811	25yr_Ex	34.4	131.72	131.72	0.68	0.029637	2.72	237.28	645.06	13.2	19.35	0.95
1	11811	50yr_Ex	41.4	131.81	131.81	0.63	0.030829	2.92	269.73	788	15.1	23.95	0.97
1	11811	100yr_Ex	50.3	131.99	131.99	0.7	0.02315	2.86	243.2	695.54	20.13	28.61	0.87
1	11811	Regional_Ex	74.8	133.09		1.31	0.003219	1.69	67.53	114.2	61.42	47.05	0.36
1	11792	2yr_Ex	14.9	130.4	130.52	0.47	0.044319	2.95	200.83	592.27	5.05	10.75	1.37
1	11792	5yr_Ex	21	130.56	130.67	0.59	0.04172	3.1	236.09	731.11	6.78	11.51	1.29
1	11792	10yr_Ex	27.9	130.71	130.82	0.71	0.039545	3.26	268.22	874.3	8.56	12.05	1.24
1	11792	25yr_Ex	34.4	130.84	130.95	0.81	0.03876	3.41	298.11	1015.51	10.1	12.49	1.21
1	11792	50yr_Ex	41.4	130.99	131.09	0.92	0.036031	3.44	313.36	1077.54	12.04	13.12	1.15
1	11792	100yr_Ex	50.3	131.43	131.25	1.15	0.020752	2.71	225.74	611.47	18.57	16.13	0.81
1	11792	Regional_Ex	74.8	133.06		1.48	0.002039	1.45	51.67	74.73	63.75	43.09	0.28
1	11782	2yr_Ex	14.9	130.05	129.74	0.83	0.003504	1.43	26.62	37.98	10.44	15.85	0.5
1	11782	5yr_Ex	21	130.31	129.87	1.09	0.002869	1.53	28.11	42.99	13.73	15.89	0.47
1	11782	10yr_Ex	27.9	130.57	130.01	1.35	0.002526	1.64	30.15	49.35	17.04	15.92	0.45
1	11782	25yr_Ex	34.4	130.8	130.13	1.58	0.002333	1.73	32.02	55.3	19.92	15.96	0.44
1	11782	50yr_Ex	41.4	131.03	130.25	1.81	0.002191	1.81	33.92	61.5	22.83	17.71	0.43
1	11782	100yr_Ex	50.3	131.42	130.39	2.2	0.001743	1.81	31.97	57.88	27.78	18.83	0.39
1	11782	Regional_Ex	74.8	133.07	130.75	2.42	0.000583	1.02	15.09	15.45	82.58	55.31	0.18
1	11744 6 Erin Mills Par		Culvert										
1	11703	2yr_Ex	14.9	129.17	128.39	1.26	0.000821	0.86	9.58	8.25	17.29	16.53	0.24
1	11703	5yr_Ex	21	129.44	128.53	1.53	0.00092	1	12.8	12.8	21.01	17.22	0.26
1	11703	10yr_Ex	27.9	129.71	128.66	1.8	0.001019	1.13	16.36	18.49	24.68	17.9	0.27

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	11703	25yr_Ex	34.4	129.93	128.77	2.01	0.001116	1.24	19.81	24.61	27.69	18.46	0.28
1	11703	50yr_Ex	41.4	130.14	128.88	2.22	0.001224	1.35	23.66	32.05	30.56	18.99	0.29
1	11703	100yr_Ex	50.3	130.37	129.02	2.45	0.001363	1.49	28.71	42.71	33.81	19.59	0.3
1	11703	Regional_Ex	74.8	131.03	129.36	3.1	0.001572	1.74	40.33	70.31	42.9	23.75	0.32
1	11693	2yr_Ex	14.9	129.09	128.8	0.73	0.003775	1.3	25.87	33.62	11.46	15.64	0.48
1	11693	5yr_Ex	21	129.38	128.92	0.97	0.003179	1.31	28.53	37.23	16.09	16.66	0.42
1	11693	10yr_Ex	27.9	129.66	129.04	1.16	0.003134	1.33	33.57	44.75	20.93	18.1	0.4
1	11693	25yr_Ex	34.4	129.89	129.16	1.29	0.003237	1.36	38.67	52.63	25.28	19.62	0.38
1	11693	50yr_Ex	41.4	130.11	129.26	1.4	0.003352	1.39	43.73	60.79	29.78	21.2	0.37
1	11693	100yr_Ex	50.3	130.36	129.39	1.53	0.003473	1.43	49.48	70.71	35.2	22.97	0.37
1	11693	Regional_Ex	74.8	131.04	129.72	1.81	0.003402	1.42	57.48	81.67	52.65	29.11	0.34
1	11677	2yr_Ex	14.9	128.93	128.65	0.82	0.013259	1.73	102.88	177.55	8.63	10.47	0.61
1	11677	5yr_Ex	21	129.22	128.83	0.98	0.012219	1.75	112.93	198.17	11.97	12.16	0.56
1	11677	10yr_Ex	27.9	129.5	129.02	1.12	0.011589	1.79	122.02	217.98	15.62	13.92	0.54
1	11677	25yr_Ex	34.4	129.73	129.16	1.22	0.011297	1.81	129.46	234.74	18.97	15.55	0.52
1	11677	50yr_Ex	41.4	129.95	129.31	1.3	0.01111	1.83	135.81	248.63	22.61	17.39	0.51
1	11677	100yr_Ex	50.3	130.2	129.48	1.39	0.010879	1.86	142.46	264.37	27.11	19.49	0.5
1	11677	Regional_Ex	74.8	130.91	129.87	1.7	0.007844	1.73	125.77	217.77	43.2	25.44	0.42
1	11651	2yr_Ex	14.9	128.19	128.19	0.81	0.028142	2.82	204.76	577.71	5.28	6.5	1
1	11651	5yr_Ex	21	128.42	128.42	0.96	0.031338	3.06	265.24	812.52	6.86	7.18	1
1	11651	10yr_Ex	27.9	128.65	128.65	1.06	0.034599	3.23	325.27	1050.42	8.64	8.14	1
1	11651	25yr_Ex	34.4	128.84	128.84	1.15	0.036487	3.36	371.15	1246.38	10.24	8.91	1
1	11651	50yr_Ex	41.4	129.01	129.01	1.23	0.038113	3.49	415.76	1452.29	11.85	9.61	1
1	11651	100yr_Ex	50.3	129.22	129.22	1.33	0.038846	3.61	458.25	1655.69	13.92	10.43	1
1	11651	Regional_Ex	74.8	130.48	129.68	1.85	0.014101	2.44	232.28	567.71	30.61	16.56	0.57
1	11636	2yr_Ex	14.9	127.46	127.62	0.61	0.040991	3.36	232.64	781.09	4.44	7.31	1.38
1	11636	5yr_Ex	21	127.66	127.82	0.73	0.044251	3.52	300.43	1056.1	5.97	8.17	1.31
1	11636	10yr_Ex	27.9	127.85	128.01	0.85	0.045997	3.67	360.47	1321.48	7.61	8.97	1.27
1	11636	25yr_Ex	34.4	128	128.18	0.95	0.04699	3.82	409.24	1565.14	8.99	9.49	1.25
1	11636	50yr_Ex	41.4	128.15	128.33	1.04	0.047838	3.94	454.64	1789.38	10.52	10.14	1.23
1	11636	100yr_Ex	50.3	128.87	128.51	1.43	0.018144	2.67	236.33	632	18.81	13.12	0.71
1	11636	Regional_Ex	74.8	130.44	128.93	2.16	0.005103	1.66	100.05	166.11	45.05	20.84	0.36

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	11626	2yr_Ex	14.9	127.46		1.18	0.002173	1.04	21.41	22.24	14.34	12.13	0.31
1	11626	5yr_Ex	21	127.66		1.38	0.002802	1.25	31.37	39.32	16.75	12.16	0.34
1	11626	10yr_Ex	27.9	127.85		1.56	0.003466	1.46	43.06	62.98	19.07	12.2	0.37
1	11626	25yr_Ex	34.4	128.06		1.77	0.003715	1.58	51.06	80.9	21.71	12.24	0.38
1	11626	50yr_Ex	41.4	128.43		2.13	0.003282	1.58	51.93	82.15	26.17	12.31	0.35
1	11626	100yr_Ex	50.3	128.88		2.45	0.003148	1.58	55.68	88.2	31.76	12.94	0.32
1	11626	Regional_Ex	74.8	130.44		1.63	0.001458	1.35	39.23	52.87	62.24	38.09	0.22
1	11198	2yr_Ex	14.9	113.59	113.81	0.45	0.058441	3.87	240.48	930.96	3.85	8.6	1.85
1	11198	5yr_Ex	21	113.7	113.99	0.56	0.057104	4.37	286.55	1251.63	4.81	8.6	1.87
1	11198	10yr_Ex	27.9	113.81	114.16	0.67	0.055708	4.81	329.14	1583.33	5.8	8.6	1.87
1	11198	25yr_Ex	34.4	114.32	114.32	1.18	0.015003	3.39	140.34	475.89	10.14	8.63	1
1	11198	50yr_Ex	41.4	114.47	114.47	1.33	0.014957	3.61	153.82	554.82	11.48	8.63	1
1	11198	100yr_Ex	50.3	114.66	114.66	1.51	0.015045	3.86	170.23	656.26	13.05	8.64	1
1	11198	Regional_Ex	74.8	115.12	115.12	1.97	0.015209	4.39	207.65	912.27	17.03	8.65	1
1	11173	2yr_Ex	14.9	109.79	110.12	0.3	0.178863	5.25	513.54	2696.7	2.84	9.6	3.08
1	11173	5yr_Ex	21	109.88	110.27	0.36	0.183175	5.6	647.33	3627.77	3.75	10.28	2.96
1	11173	10yr_Ex	27.9	109.97	110.42	0.43	0.190031	5.9	793.9	4681.94	4.73	10.96	2.87
1	11173	25yr_Ex	34.4	110.05	110.54	0.49	0.190749	6.09	903.28	5498.84	5.65	11.53	2.78
1	11173	50yr_Ex	41.4	110.13	110.66	0.55	0.191573	6.29	1010.02	6353.59	6.58	12.05	2.72
1	11173	100yr_Ex	50.3	111.73	110.8	1.57	0.005296	1.55	78.31	121.16	32.51	20.77	0.39
1	11173	Regional_Ex	74.8	112.42	111.14	1.42	0.003182	1.45	64.39	93.36	58.09	40.79	0.32
1	11163	2yr_Ex	14.9	110.13	109.8	0.79	0.006884	1.41	52.13	73.55	10.56	13.31	0.51
1	11163	5yr_Ex	21	110.45	109.95	1.01	0.005713	1.4	54.77	76.56	15.02	14.87	0.44
1	11163	10yr_Ex	27.9	110.77	110.1	1.22	0.004921	1.38	56.61	78.35	20.16	19.02	0.4
1	11163	25yr_Ex	34.4	111.06	110.22	1.38	0.004422	1.37	57.64	78.93	25.12	23.5	0.37
1	11163	50yr_Ex	41.4	111.36	110.35	1.47	0.004148	1.34	58.73	78.77	30.91	28.34	0.35
1	11163	100yr_Ex	50.3	111.71	110.5	1.73	0.003305	1.31	54.91	71.79	38.62	30.39	0.31
1	11163	Regional_Ex	74.8	112.39	110.85	1.74	0.002543	1.36	56.16	76.64	57.33	73.97	0.29
1	11153	2yr_Ex	14.9	110.09	109.56	0.97	0.004205	1.12	37.57	41.94	13.35	13.97	0.36
1	11153	5yr_Ex	21	110.42	109.72	1.29	0.003387	1.18	39.41	46.57	17.77	14.97	0.33
1	11153	10yr_Ex	27.9	110.74	109.86	1.62	0.002957	1.25	42.22	52.87	22.28	15.75	0.31
1	11153	25yr_Ex	34.4	111.03	109.98	1.9	0.002731	1.31	45.01	59.09	26.2	17.77	0.3
1	11153	50yr_Ex	41.4	111.32	110.1	2.18	0.002577	1.37	48.01	65.89	30.17	23.46	0.3

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	11153	100yr_Ex	50.3	111.66	110.23	2.42	0.002452	1.44	51.74	74.55	34.92	27.28	0.29
1	11153	Regional_Ex	74.8	112.3	110.57	3.05	0.002544	1.71	67.26	114.72	44.15	93.03	0.31
1	11142 3 Robin Drive		Culvert										
1	11127	2yr_Ex	14.9	108.99	108.99	0.65	0.016613	2.53	92.85	235.03	5.89	9.03	1
1	11127	5yr_Ex	21	109.16	109.16	0.82	0.015982	2.83	108.9	308.57	7.41	9.04	1
1	11127	10yr_Ex	27.9	109.33	109.33	0.99	0.015592	3.11	124.52	387.43	8.97	9.04	1
1	11127	25yr_Ex	34.4	109.48	109.48	1.14	0.015433	3.34	137.97	460.43	10.31	9.05	1
1	11127	50yr_Ex	41.4	109.63	109.63	1.29	0.015385	3.55	151.48	538.28	11.65	9.06	1
1	11127	100yr_Ex	50.3	109.81	109.81	1.46	0.015329	3.79	166.76	632.16	13.27	9.06	1
1	11127	Regional_Ex	74.8	110.25	110.25	1.91	0.015397	4.32	203.3	878.87	17.3	9.08	1
1	11117	2yr_Ex	14.9	108.18	108.36	0.35	0.075556	3.41	252.97	863.67	4.36	12.58	1.85
1	11117	5yr_Ex	21	108.82	108.5	0.91	0.006823	1.64	57.99	95.02	12.82	14.13	0.55
1	11117	10yr_Ex	27.9	109.15	108.63	1.19	0.004987	1.58	54.8	86.35	17.71	14.88	0.46
1	11117	25yr_Ex	34.4	109.41	108.75	1.38	0.004563	1.59	57.83	92.14	21.59	15.62	0.43
1	11117	50yr_Ex	41.4	109.58	108.87	1.5	0.004916	1.7	67.47	114.48	24.4	16.26	0.44
1	11117	100yr_Ex	50.3	109.77	109.01	1.37	0.005492	1.82	80.9	147.62	27.73	20.22	0.46
1	11117	Regional_Ex	74.8	110.09	109.35	1.32	0.007912	2.21	127.73	282.49	35.49	26.86	0.53
1	11098	2yr_Ex	23.8	108.24	107.76	1.12	0.008544	1.73	89.15	154.04	13.77	12.34	0.52
1	11098	5yr_Ex	35.2	108.62	108.03	1.35	0.008792	1.88	110.45	207.97	18.69	13.81	0.52
1	11098	10yr_Ex	46.7	108.94	108.27	1.54	0.008986	2	127.92	255.25	23.4	15.18	0.51
1	11098	25yr_Ex	57.3	109.19	108.45	1.22	0.009614	2.09	145.49	303.85	28.26	23.21	0.52
1	11098	50yr_Ex	66.5	109.36	108.59	1.35	0.009319	2.16	153.16	330.76	32.43	24.03	0.52
1	11098	100yr_Ex	77.3	109.55	108.75	1.41	0.00906	2.23	161.28	359.83	37.31	26.41	0.51
1	11098	Regional_Ex	98.7	109.92	109.05	1.56	0.009023	2.3	174.9	402.58	47.47	30.43	0.51
1	11068	2yr_Ex	23.8	108.05	107.49	1.16	0.005826	1.54	62.98	97.25	15.41	13.28	0.46
1	11068	5yr_Ex	35.2	108.41	107.74	1.34	0.006914	1.72	86.13	148.14	20.47	15.28	0.47
1	11068	10yr_Ex	46.7	108.72	107.96	1.35	0.007583	1.81	103.5	187.24	25.92	19.23	0.48
1	11068	25yr_Ex	57.3	108.96	108.14	1.37	0.007317	1.9	112.16	212.56	30.9	22.58	0.47
1	11068	50yr_Ex	66.5	109.15	108.29	1.42	0.006835	1.96	116.01	226.85	35.41	25.51	0.46
1	11068	100yr_Ex	77.3	109.36	108.46	1.51	0.006349	2.02	119.83	242.37	40.69	29.16	0.45
1	11068	Regional_Ex	98.7	109.72	108.75	1.73	0.005673	2.13	126.32	269.66	50.9	36.7	0.44

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	11039	2yr_Ex	23.8	107.49	107.47	0.8	0.030289	2.7	228.72	617.21	8.82	11.06	0.96
1	11039	5yr_Ex	35.2	107.82	107.72	1.04	0.025458	2.77	247.29	685.44	12.7	12.24	0.87
1	11039	10yr_Ex	46.7	108.15		1.26	0.021291	2.75	248.93	684.51	16.98	13.5	0.78
1	11039	25yr_Ex	57.3	108.42		1.42	0.019483	2.76	255.58	704.43	20.79	14.68	0.74
1	11039	50yr_Ex	66.5	108.64		1.52	0.018635	2.76	262.12	722.6	24.12	15.87	0.71
1	11039	100yr_Ex	77.3	108.88		1.62	0.017908	2.76	269.04	742.68	28	17.25	0.69
1	11039	Regional_Ex	98.7	109.28		1.83	0.016461	2.79	278.72	777.56	35.38	19.31	0.66
1	11009	2yr_Ex	23.8	106.86		1.14	0.017215	2.3	175.27	403.48	10.34	9.1	0.69
1	11009	5yr_Ex	35.2	107.11		1.29	0.022662	2.76	259.54	716.33	12.75	9.9	0.78
1	11009	10yr_Ex	46.7	107.33	107.14	1.41	0.026985	3.11	336.85	1047.66	15.02	10.64	0.84
1	11009	25yr_Ex	57.3	107.52	107.36	1.51	0.030132	3.37	400.72	1348.63	17.03	11.3	0.88
1	11009	50yr_Ex	66.5	107.66	107.54	1.58	0.032489	3.56	452.75	1611.96	18.68	11.81	0.9
1	11009	100yr_Ex	77.3	107.82	107.72	1.67	0.034578	3.75	506.53	1899.62	20.61	12.38	0.93
1	11009	Regional_Ex	98.7	108.08	108.06	1.79	0.039373	4.12	620.09	2557.57	23.93	13.35	0.98
1	10980	2yr_Ex	23.8	106.32		0.72	0.021045	2.19	152.79	335.18	10.88	15.19	0.81
1	10980	5yr_Ex	35.2	106.57		0.87	0.018506	2.39	173.67	414.91	15.09	17.29	0.77
1	10980	10yr_Ex	46.7	106.8		1.04	0.017062	2.53	190.83	483.33	19.17	18.51	0.75
1	10980	25yr_Ex	57.3	106.99		1.17	0.016303	2.64	205.46	542.66	22.78	19.51	0.73
1	10980	50yr_Ex	66.5	107.13		1.26	0.016383	2.76	222.66	613.92	25.45	20.13	0.74
1	10980	100yr_Ex	77.3	107.28		1.35	0.016868	2.86	243.66	697.64	28.6	21.14	0.74
1	10980	Regional_Ex	98.7	107.53		1.43	0.01675	3.09	276.42	854.37	34.21	23.98	0.75
1	10950	2yr_Ex	23.8	105.96		0.95	0.008986	1.51	87.4	131.69	15.83	16.64	0.48
1	10950	5yr_Ex	35.2	106.28		1.05	0.008353	1.67	102.18	170.59	21.85	20.79	0.47
1	10950	10yr_Ex	46.7	106.55		1.19	0.008217	1.8	115.71	207.72	27.65	23.19	0.47
1	10950	25yr_Ex	57.3	106.76		1.3	0.008019	1.88	125.28	236.14	32.8	25.17	0.47
1	10950	50yr_Ex	66.5	106.9		1.37	0.007982	1.99	135.55	269.49	36.53	26.71	0.47
1	10950	100yr_Ex	77.3	107.05		1.44	0.008038	2.1	147.94	311.4	40.65	28.21	0.48
1	10950	Regional_Ex	98.7	107.32		1.46	0.008244	2.32	172.44	400.36	48.96	33.42	0.5
1	10921	2yr_Ex	23.8	105.34		0.89	0.028243	2.5	233.07	582.71	9.52	10.76	0.85
1	10921	5yr_Ex	35.2	105.68		1.07	0.026932	2.62	266.89	698.82	13.44	12.59	0.81
1	10921	10yr_Ex	46.7	105.94	105.74	1.03	0.024349	2.77	287.7	795.56	17.37	16.87	0.78
1	10921	25yr_Ex	57.3	106.17		1.07	0.022833	2.8	297.67	834.87	21.64	20.3	0.76
1	10921	50yr_Ex	66.5	106.32	106.09	1.07	0.021941	2.91	312	906.45	24.82	23.31	0.75

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	10921	100yr_Ex	77.3	106.44	106.27	1.13	0.022144	3.07	340.38	1046.41	27.79	24.53	0.76
1	10921	Regional_Ex	98.7	106.66	106.53	1.27	0.02239	3.36	390	1310.4	33.39	26.19	0.78
1	10891	2yr_Ex	23.8	104.68	104.37	1.04	0.020404	2.15	195.98	421.62	11.06	10.59	0.67
1	10891	5yr_Ex	35.2	105.02	104.68	1.24	0.020687	2.36	235.29	554.72	14.93	12.01	0.68
1	10891	10yr_Ex	46.7	105.31	104.91	1.39	0.021004	2.51	266.83	668.6	18.64	19.42	0.68
1	10891	25yr_Ex	57.3	105.55	105.12	1.2	0.021629	2.6	291.03	755.49	22.25	33.8	0.68
1	10891	50yr_Ex	66.5	105.72	105.28	1.01	0.021369	2.68	307.22	823.47	25.91	42.94	0.68
1	10891	100yr_Ex	77.3	105.88	105.47	1.12	0.020032	2.77	317.41	878.94	30.09	44.8	0.67
1	10891	Regional_Ex	98.7	106.17	105.86	1.36	0.017573	2.88	326.15	939.91	38.27	46.83	0.65
1	10862	2yr_Ex	23.8	103.77	103.72	0.88	0.033363	2.75	275.42	756.23	8.67	9.81	0.93
1	10862	5yr_Ex	35.2	104.05	104	1.06	0.034797	3.02	342.26	1034.97	11.64	10.98	0.94
1	10862	10yr_Ex	46.7	104.32	104.25	1.17	0.036064	3.17	392.21	1241.75	14.75	12.55	0.93
1	10862	25yr_Ex	57.3	104.5	104.45	1.25	0.036169	3.35	434.48	1453.83	17.15	13.67	0.94
1	10862	50yr_Ex	66.5	104.65	104.59	1.32	0.035405	3.5	464.17	1622.49	19.16	14.55	0.94
1	10862	100yr_Ex	77.3	104.8	104.74	1.4	0.03479	3.65	496.58	1812.76	21.48	15.34	0.94
1	10862	Regional_Ex	98.7	105.09	105.05	1.51	0.034302	3.89	552.99	2148.91	26.16	25.3	0.94
1	10832	2yr_Ex	23.8	102.75	102.68	0.89	0.037297	2.66	307.35	817.81	8.94	10.02	0.9
1	10832	5yr_Ex	35.2	103.07	102.95	1.1	0.03439	2.83	346	980.28	12.42	11.3	0.86
1	10832	10yr_Ex	46.7	103.36	103.19	1.26	0.032217	2.93	370.93	1088.43	15.91	12.6	0.83
1	10832	25yr_Ex	57.3	103.6	103.39	1.42	0.030065	3.02	387.28	1170.12	18.96	13.34	0.81
1	10832	50yr_Ex	66.5	103.76	103.54	1.52	0.030372	3.15	418.07	1318.3	21.09	13.84	0.82
1	10832	100yr_Ex	77.3	103.91	103.7	1.55	0.031206	3.33	460.45	1535.46	23.22	14.96	0.83
1	10832	Regional_Ex	98.7	104.16	103.99	1.66	0.032489	3.67	539.81	1979.59	27.22	16.38	0.86
1	10803	2yr_Ex	23.8	102.15	101.72	1.15	0.011767	1.9	123.78	235.16	12.53	10.87	0.57
1	10803	5yr_Ex	35.2	102.5	102	1.34	0.013064	2.12	159.67	338.1	16.62	12.36	0.58
1	10803	10yr_Ex	46.7	102.81	102.24	1.48	0.014096	2.27	189.27	428.75	20.62	15.43	0.59
1	10803	25yr_Ex	57.3	103.06	102.44	1.54	0.014946	2.34	210.68	493.41	24.47	22.87	0.6
1	10803	50yr_Ex	66.5	103.23	102.61	1.46	0.014956	2.45	227.18	556.15	27.44	29.24	0.61
1	10803	100yr_Ex	77.3	103.39	102.79	1.58	0.014831	2.59	246.55	638.29	30.43	32.8	0.61
1	10803	Regional_Ex	98.7	103.65	103.12	1.77	0.015048	2.86	286.73	818.95	35.66	44.06	0.63
1	10773	2yr_Ex	23.8	101.39	101.39	0.82	0.031685	2.84	244.28	692.71	8.39	10.25	1
1	10773	5yr_Ex	35.2	101.68	101.66	1.01	0.031604	3.07	298.43	915.46	11.47	11.35	0.97

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	10773	10yr_Ex	46.7	101.92	101.89	1.17	0.031947	3.25	345.71	1125.15	14.35	12.31	0.96
1	10773	25yr_Ex	57.3	102.15	102.09	1.24	0.033214	3.32	383.48	1272.23	17.27	13.9	0.95
1	10773	50yr_Ex	66.5	102.33	102.26	1.29	0.033826	3.34	407.24	1359.49	19.92	15.41	0.94
1	10773	100yr_Ex	77.3	102.52	102.42	1.36	0.033601	3.36	426.41	1434.64	22.98	16.89	0.92
1	10773	Regional_Ex	98.7	102.84	102.71	1.48	0.032743	3.41	453.96	1548.48	28.94	19.52	0.89
1	10744	2yr_Ex	23.8	100.81	100.46	1.01	0.015046	1.96	141.24	276.73	12.15	12.07	0.62
1	10744	5yr_Ex	35.2	101.17		1.19	0.01532	2.09	168.73	353.01	16.83	14.2	0.61
1	10744	10yr_Ex	46.7	101.37		1.31	0.017841	2.36	215.72	509.34	19.78	15.16	0.66
1	10744	25yr_Ex	57.3	101.52		1.41	0.019889	2.6	258.76	671.5	22.08	15.67	0.7
1	10744	50yr_Ex	66.5	101.63		1.49	0.021533	2.78	295.25	820.41	23.93	16.08	0.73
1	10744	100yr_Ex	77.3	101.77		1.51	0.023543	2.96	336.85	997.26	26.11	17.28	0.76
1	10744	Regional_Ex	98.7	102.01	101.73	1.01	0.027017	3.21	405.8	1301.95	32.09	31.84	0.8
1	10714	2yr_Ex	23.8	100.41	100.03	0.93	0.012455	1.93	122.5	236.16	12.36	13.34	0.6
1	10714	5yr_Ex	35.2	100.76	100.31	0.69	0.013455	2.01	148.16	297.78	19.35	39.4	0.59
1	10714	10yr_Ex	46.7	100.99	100.63	0.87	0.011813	2.09	153.03	319.33	26.18	42.91	0.57
1	10714	25yr_Ex	57.3	101.15	100.86	1.03	0.0115	2.21	165.63	365.97	30.83	43.7	0.57
1	10714	50yr_Ex	66.5	101.27	100.96	1.15	0.011378	2.31	176.64	408.14	34.43	44.25	0.57
1	10714	100yr_Ex	77.3	101.4	101.07	1.28	0.011291	2.42	189.02	457.51	38.33	44.85	0.58
1	10714	Regional_Ex	98.7	101.61	101.25	1.5	0.011533	2.64	216.66	572.34	44.9	49.11	0.59
1	10685	2yr_Ex	23.8	99.99	99.73	0.85	0.017422	1.87	140.23	261.73	12.75	15.03	0.65
1	10685	5yr_Ex	35.2	100.31	99.96	0.96	0.018206	1.96	166.32	325.87	17.97	18.7	0.64
1	10685	10yr_Ex	46.7	100.58	100.15	0.95	0.018032	1.96	176.69	346.02	23.99	28.17	0.62
1	10685	25yr_Ex	57.3	100.76	100.35	1.1	0.016589	2.03	184.45	374.57	28.57	37.5	0.6
1	10685	50yr_Ex	66.5	100.88	100.49	1.19	0.016495	2.12	197.98	420.16	31.79	40.07	0.6
1	10685	100yr_Ex	77.3	101.01	100.6	1.28	0.016519	2.22	213.81	475.72	35.29	41.4	0.61
1	10685	Regional_Ex	98.7	101.22	100.8	1.31	0.016171	2.43	242.7	589.69	41.85	46.64	0.62
1	10658	2yr_Ex	23.8	99.17	99.16	0.73	0.036747	2.59	257	665.91	9.19	12.54	0.97
1	10658	5yr_Ex	35.2	99.42	99.39	0.89	0.037074	2.84	313.53	891.18	12.38	13.94	0.96
1	10658	10yr_Ex	46.7	99.62	99.59	1.01	0.037873	3.05	364.21	1111.22	15.31	15.12	0.97
1	10658	25yr_Ex	57.3	99.78	99.77	1.02	0.041241	3.21	418	1341.16	17.88	17.61	0.99
1	10658	50yr_Ex	66.5	99.91	99.91	0.96	0.037181	3.3	424.28	1398.66	20.51	28.07	0.96
1	10658	100yr_Ex	77.3	100.06	100.06	1	0.033456	3.38	428.73	1448.46	23.87	32.47	0.93
1	10658	Regional_Ex	98.7	100.3	100.3	1.12	0.029805	3.56	450.92	1606.19	30.04	35.87	0.9

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	10631	2yr_Ex	23.8	98.47		0.65	0.021579	2.21	177.32	392.71	12.14	18.75	0.76
1	10631	5yr_Ex	35.2	98.76		0.78	0.021433	2.21	195.87	433.42	18.13	23.18	0.72
1	10631	10yr_Ex	46.7	99.02		0.81	0.020499	2.11	196.43	415.36	25.41	31.35	0.67
1	10631	25yr_Ex	57.3	99.19		0.78	0.019116	2.13	199.88	426.57	31.02	39.97	0.65
1	10631	50yr_Ex	66.5	99.3	99.04	0.74	0.018374	2.2	208.17	457.94	36.02	48.43	0.64
1	10631	100yr_Ex	77.3	99.39	99.13	0.68	0.019109	2.32	228.46	528.99	41.24	60.63	0.66
1	10631	Regional_Ex	98.7	99.57	99.38	0.71	0.017968	2.45	245.4	602.12	53.1	74.46	0.65
1	10604	2yr_Ex	23.8	98.11	97.75	0.71	0.009841	1.68	92.32	155.16	15.62	21.9	0.54
1	10604	5yr_Ex	35.2	98.36	98.03	0.85	0.011091	1.87	118.57	221.61	21.43	25.12	0.56
1	10604	10yr_Ex	46.7	98.61	98.22	0.73	0.011813	1.88	131.91	247.85	28.81	39.26	0.55
1	10604	25yr_Ex	57.3	98.79	98.37	0.58	0.01262	1.84	138.84	255.76	38.06	66.13	0.55
1	10604	50yr_Ex	66.5	98.92	98.49	0.52	0.012298	1.86	142.52	264.49	49.39	94.11	0.54
1	10604	100yr_Ex	77.3	99.07	98.66	0.6	0.009655	1.77	125.35	222.34	64.8	108.88	0.49
1	10604	Regional_Ex	98.7	99.36	98.82	0.86	0.005454	1.52	85.95	130.38	97.1	112.74	0.38
1	10578	2yr_Ex	23.8	97.83	97.56	0.64	0.013656	1.52	106.36	161.79	17.81	27.79	0.54
1	10578	5yr_Ex	35.2	98.03	97.77	0.72	0.016661	1.62	131.5	212.78	24.13	33.68	0.57
1	10578	10yr_Ex	46.7	98.34	97.9	0.6	0.011587	1.47	107.85	158.16	40.1	67.17	0.48
1	10578	25yr_Ex	57.3	98.58	98.01	0.78	0.007427	1.2	74.01	89.02	57.11	73.21	0.38
1	10578	50yr_Ex	66.5	98.75	98.11	0.94	0.005476	1.13	62.45	70.43	69.54	74.06	0.33
1	10578	100yr_Ex	77.3	98.94	98.2	1.12	0.004181	1.08	54.56	58.73	83.49	74.8	0.3
1	10578	Regional_Ex	98.7	99.27	98.22	1.43	0.002958	1.03	47.25	48.86	108.91	76.21	0.26
1	10551	2yr_Ex	23.8	97.3	97.22	0.52	0.023838	1.92	154.82	297.57	15.28	29.46	0.75
1	10551	5yr_Ex	35.2	97.68		0.8	0.010033	1.56	95.06	148.21	27.83	34.85	0.5
1	10551	10yr_Ex	46.7	98.14		1.17	0.004456	1.26	58.27	73.7	44.76	38.42	0.34
1	10551	25yr_Ex	57.3	98.43		1.41	0.003431	1.21	52.16	63.27	56.1	39.72	0.31
1	10551	50yr_Ex	66.5	98.62		1.57	0.003177	1.22	52.48	64.27	63.72	40.64	0.3
1	10551	100yr_Ex	77.3	98.82		1.73	0.003004	1.25	53.68	66.85	71.94	41.57	0.29
1	10551	Regional_Ex	98.7	99.16		1.94	0.002734	1.32	57.4	75.79	86.71	44.75	0.28
1	10524	2yr_Ex	23.8	96.9		1.17	0.007325	1.54	78.58	120.78	15.49	13.19	0.45
1	10524	5yr_Ex	35.2	97.48		0.94	0.004388	1.42	65.01	92.64	27.99	29.75	0.36
1	10524	10yr_Ex	46.7	98.03		1.37	0.002611	1.24	48.09	59.53	45.33	33.12	0.28
1	10524	25yr_Ex	57.3	98.34		1.58	0.00239	1.24	48.25	59.86	55.74	35.3	0.27

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	10524	50yr_Ex	66.5	98.53		1.71	0.002414	1.28	51.38	65.8	62.6	36.64	0.27
1	10524	100yr_Ex	77.3	98.73		1.78	0.002505	1.34	56.1	75.14	70.09	39.28	0.27
1	10524	Regional_Ex	98.7	99.08		1.68	0.002482	1.43	62.38	89.39	85.1	50.55	0.28
1	10504	2yr_Ex	23.8	96.79		1.1	0.006429	1.33	67.31	89.55	17.89	16.21	0.4
1	10504	5yr_Ex	35.2	97.43		1.24	0.00333	1.14	48.67	55.73	32.75	26.32	0.29
1	10504	10yr_Ex	46.7	98		1.66	0.002069	1.04	38.55	40.19	48.6	29.23	0.24
1	10504	25yr_Ex	57.3	98.3		1.89	0.001939	1.08	40.42	43.67	57.68	30.51	0.23
1	10504	50yr_Ex	66.5	98.49		2	0.001946	1.14	44.03	50.33	63.53	31.76	0.24
1	10504	100yr_Ex	77.3	98.69		2.1	0.001985	1.22	48.55	59.04	69.86	33.26	0.24
1	10504	Regional_Ex	98.7	99.03		2.03	0.002066	1.35	57.23	77.14	82.08	40.46	0.25
1	10496	2yr_Ex	23.8	96.77	95.84	1.55	0.001957	1.03	26.8	27.64	23.07	15.39	0.26
1	10496	5yr_Ex	35.2	97.41	96.03	2.08	0.001475	1.08	27.51	29.66	32.67	22.79	0.23
1	10496	10yr_Ex	46.7	97.98	96.21	1.52	0.001168	1.08	26.63	28.77	49.76	36.65	0.21
1	10496	25yr_Ex	57.3	98.28	96.36	1.77	0.001151	1.15	29.11	33.46	59.84	41.59	0.21
1	10496	50yr_Ex	66.5	98.48	96.48	1.68	0.00129	1.15	32.27	36.95	71.7	42.78	0.21
1	10496	100yr_Ex	77.3	98.67	96.62	1.8	0.001336	1.21	35.53	43.12	80.19	44.6	0.21
1	10496	Regional_Ex	98.7	99.01	96.86	1.86	0.001415	1.34	41.59	55.54	96.33	51.74	0.22
1	10479 2 Mississauga Ro		Culvert										
1	10467	2yr_Ex	23.8	96.69	95.65	1.69	0.00143	1	21.67	21.57	23.92	14.74	0.24
1	10467	5yr_Ex	35.2	97.25	95.85	2.24	0.001317	1.1	25.67	28.35	31.88	15.1	0.24
1	10467	10yr_Ex	46.7	97.68	96.03	1.05	0.001148	1	23.92	23.92	61.21	58.36	0.2
1	10467	25yr_Ex	57.3	97.98	96.18	1.27	0.001065	1.03	24.71	25.55	79.37	88.25	0.19
1	10467	50yr_Ex	66.5	98.2	96.31	1.47	0.000976	1.04	24.38	25.36	93.3	90.02	0.19
1	10467	100yr_Ex	77.3	98.46	96.45	1.71	0.000876	1.04	23.69	24.62	109.54	91.26	0.18
1	10467	Regional_Ex	98.7	98.93	96.71	2.16	0.00073	1.04	22.56	23.38	140.25	93.04	0.17
1	10455	2yr_Ex	23.8	96.65	95.88	0.93	0.006787	1.1	61.27	67.16	21.72	23.35	0.36
1	10455	5yr_Ex	35.2	97.24	96.13	1.14	0.003097	0.94	40.96	38.52	39.32	37	0.25
1	10455	10yr_Ex	46.7	97.67	96.43	0.98	0.00211	0.89	34.85	31.18	57.98	63.14	0.22
1	10455	25yr_Ex	57.3	97.97	96.55	1.21	0.00163	0.87	31.58	27.62	76.94	68.15	0.2
1	10455	50yr_Ex	66.5	98.19	96.65	1.42	0.001401	0.87	30.12	26.17	91.24	69.15	0.18
1	10455	100yr_Ex	77.3	98.45	96.76	1.67	0.001189	0.86	28.47	24.49	107.8	70.09	0.17
1	10455	Regional_Ex	98.7	98.93	97	2.13	0.000924	0.85	26.32	22.41	138.93	72.17	0.16

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	10440	2yr_Ex	23.7	96.51	95.68	1.2	0.006977	1.34	76.5	102.33	17.72	14.7	0.39
1	10440	5yr_Ex	35.5	97.14	95.96	1.66	0.004591	1.29	67.86	87.61	27.5	35.89	0.32
1	10440	10yr_Ex	46.2	97.63	96.18	0.91	0.00248	1	41.3	41.45	56.7	62.64	0.24
1	10440	25yr_Ex	56.5	97.94	96.44	1.14	0.001775	0.93	34.18	31.91	77.98	68.32	0.2
1	10440	50yr_Ex	65.3	98.17	96.58	1.36	0.001455	0.9	31.03	28.07	93.7	68.69	0.19
1	10440	100yr_Ex	76.4	98.43	96.72	1.62	0.001218	0.89	28.82	25.57	111.68	70.23	0.17
1	10440	Regional_Ex	99.9	98.92	97.01	2.07	0.000966	0.88	27.05	23.91	145.27	73.41	0.16
1	10414	2yr_Ex	23.7	96.33	95.53	1.49	0.005	1.47	65.87	96.64	16.15	49.12	0.38
1	10414	5yr_Ex	35.5	96.99	95.81	1.83	0.004564	1.49	72.87	108.63	23.82	66.41	0.35
1	10414	10yr_Ex	46.2	97.46	96.04	2.09	0.004203	1.52	76.91	117.04	30.36	81.19	0.34
1	10414	25yr_Ex	56.5	97.77	96.24	2.13	0.004197	1.61	85.16	137.45	35.18	92.94	0.34
1	10414	50yr_Ex	65.3	97.99	96.4	2.35	0.004119	1.7	91.55	155.55	38.81	94.42	0.34
1	10414	100yr_Ex	76.4	98.24	96.58	2.6	0.004112	1.81	100.27	181.07	42.87	95.8	0.35
1	10414	Regional_Ex	99.9	98.68	96.97	3.04	0.004232	2.02	119.77	242.31	50.21	97.9	0.36
1	10388	2yr_Ex	23.7	96.17	95.47	1.45	0.005391	1.6	67.77	108.77	14.77	53.72	0.43
1	10388	5yr_Ex	35.5	96.84	95.76	1.8	0.004875	1.6	75.32	120.34	22.22	74.72	0.38
1	10388	10yr_Ex	46.2	97.33	95.99	1.91	0.004659	1.6	80.57	128.95	28.96	83.48	0.36
1	10388	25yr_Ex	56.5	97.64	96.19	1.95	0.004286	1.69	85.47	144.15	33.91	101.51	0.36
1	10388	50yr_Ex	65.3	97.87	96.36	2.17	0.004161	1.77	91.05	160.95	37.8	103.65	0.36
1	10388	100yr_Ex	76.4	98.12	96.56	2.42	0.004114	1.87	98.84	184.9	42.11	105.11	0.36
1	10388	Regional_Ex	99.9	98.56	96.95	2.86	0.004182	2.08	116.58	242.78	49.84	108	0.37
1	10371	2yr_Ex	23.7	96.12	95.26	1.47	0.00474	1.32	62.77	82.59	18.01	71.95	0.35
1	10371	5yr_Ex	35.5	96.8	95.53	1.93	0.003673	1.32	62.47	82.44	26.9	81.29	0.3
1	10371	10yr_Ex	46.2	97.29	95.74	2.22	0.003384	1.36	65.79	89.24	34.06	102.15	0.29
1	10371	25yr_Ex	56.5	97.61	95.93	2.06	0.003797	1.45	76.58	110.78	39.11	114.54	0.31
1	10371	50yr_Ex	65.3	97.83	96.07	2.25	0.003677	1.52	81.55	123.67	43.51	115.78	0.31
1	10371	100yr_Ex	76.4	98.08	96.25	2.5	0.00363	1.61	88.58	142.24	48.36	116.79	0.31
1	10371	Regional_Ex	99.9	98.53	96.58	2.95	0.003691	1.79	104.71	187.47	57.04	118.79	0.32
1	10361	2yr_Ex	23.7	96.05	95.1	1.73	0.005531	1.45	69.81	101.32	16.33	72.77	0.35
1	10361	5yr_Ex	35.5	96.72	95.4	2.21	0.005016	1.55	79.41	123.27	22.87	85.76	0.33
1	10361	10yr_Ex	46.2	97.2	95.64	1.83	0.004613	1.65	86.06	141.69	29.16	108.55	0.32
1	10361	25yr_Ex	56.5	97.5	95.84	1.94	0.004621	1.77	95.94	169.77	34.41	122.74	0.33

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	10361	50yr_Ex	65.3	97.72	96.01	2.16	0.004647	1.86	103.68	193.04	38.39	123.58	0.33
1	10361	100yr_Ex	76.4	97.97	96.21	2.41	0.004743	1.98	113.89	224.99	42.75	124.49	0.34
1	10361	Regional_Ex	99.9	98.41	96.59	2.84	0.005039	2.2	136.2	300.09	50.49	126.67	0.36
1	10357 1 Private Entran		Culvert										
1	10352	2yr_Ex	23.7	95.81	95.09	1.64	0.009224	1.82	113.69	206.75	13.03	64.4	0.45
1	10352	5yr_Ex	35.5	96.2	95.42	1.97	0.011683	2.19	165.52	363.07	16.18	77.02	0.5
1	10352	10yr_Ex	46.2	96.49	95.67	2.2	0.013803	2.49	212.86	529.08	18.59	84.86	0.53
1	10352	25yr_Ex	56.5	96.74	95.9	2.16	0.017365	2.71	267.39	723.38	20.88	91.07	0.59
1	10352	50yr_Ex	65.3	96.96	96.08	2.06	0.020286	2.82	307.3	866.82	23.15	99.08	0.63
1	10352	100yr_Ex	76.4	97.21	96.3	1.9	0.022146	2.92	340.83	996.06	26.25	118.84	0.65
1	10352	Regional_Ex	99.9	97.64	96.86	1.9	0.019274	3.1	359.03	1111.69	33.67	131.24	0.63
1	10342	2yr_Ex	23.7	95.27	95.27	0.95	0.031179	3.05	266.32	812.25	7.77	29.98	1
1	10342	5yr_Ex	35.5	95.59	95.59	1.17	0.033485	3.38	345.43	1167.54	10.5	40.79	1
1	10342	10yr_Ex	46.2	95.83	95.83	1.33	0.03494	3.62	406.48	1470.78	12.77	63.2	1
1	10342	25yr_Ex	56.5	96.05	96.05	1.45	0.036256	3.77	457.33	1725.11	14.98	68.22	1
1	10342	50yr_Ex	65.3	96.22	96.22	1.54	0.037341	3.89	498.06	1939.62	16.77	72.73	1
1	10342	100yr_Ex	76.4	96.42	96.42	1.66	0.037663	4.03	539.21	2174.39	18.95	78.84	1
1	10342	Regional_Ex	99.9	96.78	96.78	1.88	0.038771	4.3	622.1	2674.87	23.23	92.92	1
1	10329	2yr_Ex	23.7	95.11	94.8	1.04	0.015489	1.98	149.5	296.74	11.94	30.62	0.62
1	10329	5yr_Ex	35.5	95.4	95.06	1.27	0.017177	2.32	199.23	461.71	15.32	40.01	0.66
1	10329	10yr_Ex	46.2	95.62	95.26	1.44	0.018592	2.57	241.69	620.86	17.99	50.15	0.68
1	10329	25yr_Ex	56.5	95.8	95.44	1.58	0.019774	2.77	279.74	776.14	20.36	57.54	0.7
1	10329	50yr_Ex	65.3	95.97	95.58	1.69	0.020187	2.89	304.03	880.01	22.56	62.63	0.71
1	10329	100yr_Ex	76.4	96.15	95.75	1.8	0.021249	3.06	339.36	1037.53	24.99	70	0.73
1	10329	Regional_Ex	99.9	96.56	96.08	1.97	0.022141	3.23	386.71	1248.77	30.94	84.58	0.73
1	10307	2yr_Ex	23.7	94.76	94.51	0.9	0.016794	1.92	143.15	275.06	12.33	29.54	0.65
1	10307	5yr_Ex	35.5	95.03	94.74	1.12	0.017328	2.2	181.67	399.23	16.15	35.18	0.66
1	10307	10yr_Ex	46.2	95.2	94.91	1.24	0.019855	2.48	229.39	567.96	18.66	39.04	0.71
1	10307	25yr_Ex	56.5	95.31	95.07	1.29	0.024287	2.77	291.31	806.71	20.4	43.74	0.78
1	10307	50yr_Ex	65.3	95.44	95.2	1.29	0.027996	2.9	335.17	971.36	22.53	49.37	0.82
1	10307	100yr_Ex	76.4	95.57	95.39	1.31	0.031913	3.07	388.32	1193.75	24.85	53.35	0.86
1	10307	Regional_Ex	99.9	96.27	95.7	1.43	0.016241	2.49	253.33	629.76	40.57	75.15	0.61

Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Chan	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
1	10284	2yr_Ex	23.7	94.34	94.15	0.68	0.023493	1.72	151.11	259.5	13.8	31.65	0.67
1	10284	5yr_Ex	35.5	94.34	94.34	0.68	0.05244	2.57	337.7	866.98	13.83	31.68	1
1	10284	10yr_Ex	46.2	94.49	94.49	0.65	0.049058	2.72	367.62	999.88	17.15	39.66	0.98
1	10284	25yr_Ex	56.5	94.65	94.65	0.66	0.040355	2.69	349.14	940.31	22.31	49.27	0.9
1	10284	50yr_Ex	65.3	94.74	94.74	0.72	0.039523	2.79	367.27	1022.99	25.36	51.95	0.89
1	10284	100yr_Ex	76.4	94.84	94.84	0.8	0.039195	2.9	391.72	1136.42	28.82	54.12	0.9
1	10284	Regional_Ex	99.9	96.23	95.02	1.18	0.003244	1.38	70.38	97.41	95.1	117.04	0.28

Appendix B – Fish Habitat Assessment Field Sheets

Site Identification

Stream Code	Site Code	Sample	Date (yyyy-mm-dd)
		01	2020-06-04

Stream Name: LOYALIST CREEK

Alternate Site Code:

Site Length (m): 600.0

*** Record using NAD83 datum

	Zone	Easting	Northing
Uncorr. UTM	17	607468.0	4820194.0
Corr. UTM	17		

OR → Lat. / Long. DD MM SS.sss

Source of Uncorrected UTM Coordinates: [X] GPS/DGPS [ ] GIS [ ] OBM [ ] Other

Source of Corrected UTM Coordinates: [ ] FWIS [ ] Ortho-photos [ ] GIS [ ] Other

Name of Layer Used for Correction:

Access Route

N ON WINSTON CHURCHILL FROM HWY 403 E ON THORN LODGE DR, PARK AT CATHOLIC SCHOOL @ U/S END OF CREEK / TRAIL

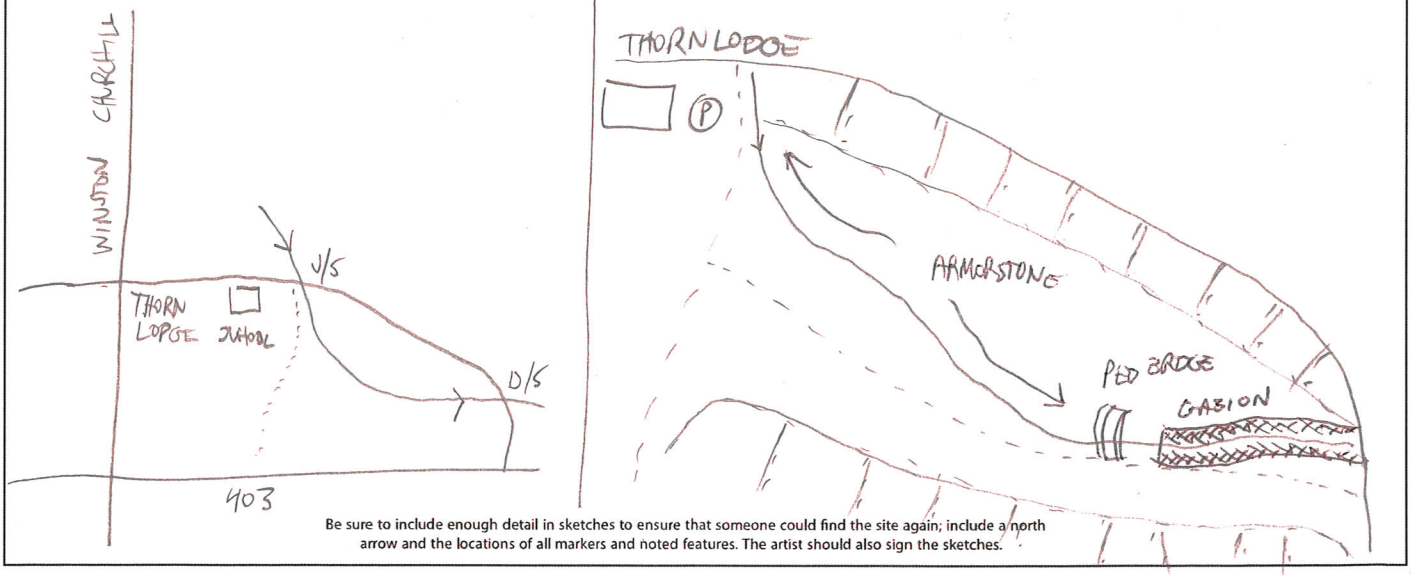
Site Description

UPSTREAM EXTENT @ ROAD CROSSING / TRAIL

[ ] Site Was Unsampleable - add reason(s) on reverse

Sketches

Site/Access Route Sketch



Be sure to include enough detail in sketches to ensure that someone could find the site again; include a north arrow and the locations of all markers and noted features. The artist should also sign the sketches.

Comments

WOOD THRUST, NO FISH

Crew Leader (init. & last name): G EBY

Crew	Recorder	Entered	Verified	Corrected

Site Features

Mandatory Fields In Grey
Must be filled out for processing

Stream Code | Site Code | Sample | Date (mm-dd)

Stream Name: LOYALIST

For each landuse, check box that applies. Be sure to include comments explaining the particulars, including names and numbers of contacts

Site Features	Ongoing & Active	Historical Evidence	No Evidence but Reported	No Evidence	Unknown	Comments
Potential Point or Non-point Source Contaminant Sources	X					OUTFALLS, ROADS, RES
Major Nutrient Sources Upstream	X					"
Channel Hardening or Straightening	X					GABION, ARMORSTONE, CULVERTS
Adjacent Landuses that Destabilize Banks	X					ENCROACHING LAWNS, PED TRAIL
Sediment Loading or Deprivation				X		
Instream Habitat Modifications	X					GABION, ARMORSTONE, R135
Barriers and/or Dams in the Vicinity of the Site	X					KNICKPOINTS, ARMORSTONE R135
High Fishing Pressure				X		
Log Jam Deflectors				X		
Springs or Seeps at the Site					X	PVC PIPE W FLOWING WATER, MAY BE GROUND WATER?
Impervious Substrate Limiting Burrowing Depth of Fish	X					CLOSED CULVERTS
Fish Stocked Near Sample Site				X		
Other Activities that Could Influence Biota or Habitat				X		
Intensive Logging Activitties within the Riparian Zone				X		

Sources of Information
Visual Immediate: X | Visual Extended: ☐ | Interview: ☐ | Maps & Photos: ☐

Temperatures
Time (24hr): : | Air Temp (°C) | Water Temp (°C) | Max Air Temp (°C) | Max. Water Temp (°C) | Source of Max. Air Temp

Riparian Vegetation Community
Only check one box for each bank and zone.

Dominant Vegetation Type

Riparian Zone	Left Bank: None	Lawn	Crop-land	Mea-dow	Scrub-land	Forest	Wet-lands	Right Bank: None	Lawn	Crop-land	Mea-dow	Scrub-land	Forest	Wet-lands
1.5-10m	☐	☐	☐	☐	☐	X	☐	☐	☐	☐	☐	☐	X	☐
10-30m	☐	☐	☐	☐	☐	X	☐	☐	☐	☐	☐	☐	X	☐
30-100m	☐	X	☐	☐	☐	☐	☐	☐	X	☐	☐	☐	☐	☐

Comments

Crew Leader (initial & last name): EBY

Crew Initials	Recorder	Ent/Scanned	Verified	Corrected

Rapid Assessment Methodology Field Form

Mandatory Fields In Grey
Must be filled out for processing

Stream Code | Site Code | Sample: 01

Date: YY 20 – MM 06 – DD 04

Site Type: ☐ Calibration ☒ Survey

Stream Name: LOYALIST

Crew Leader (initial & last name): GEBY

Crew:

Recorder:

Channel Structure

Depth (mm)	Pools (Hydraulic Head = 0-3 mm)		Glides (Hydraulic Head = 4-7 mm)		Slow Riffles (Hydraulic Head = 8-17 mm)		Fast Riffles (Hydraulic Head > 17 mm)	
	No Cover	Cover Present	No Cover	Cover Present	No Cover	Cover Present	No Cover	Cover Present
0 - 100 mm			05	13	04	19		
101 - 600 mm	03	03	02	04				
601 - 1000 mm								
> 1000 mm								
Total # Points	03	03	07	17	04	14		

Note: Grey hatched areas are for tally marks.

Instream Cover

Cover Types	Flat Rock	Round Rock	Wood	Macrophytes	Bank	Other
Number of Points	☒☒ 20	06		02		

Substrate Types

6 POINTS PER TRANSECT

NO TRANS ☐

	Fines (<2 mm)	Gravel (2-100 mm)	Cobble (100-1000mm)	Bedrock (>1000mm)	gavia feces
Point Particle	14	16	18		
Maximum Particle	06	06	36		

Bank Stability

RIBS/KP/BARRIERS ☒

POOL D/S OF KP ~600 M

Mean Stream Width (m): 4.0

Mean Depth at Crossover (mm): 80

Maximum Particle Size (mm): ARMORSTONE 620 MM

Eroding Bank		Angle > 45°, erodible soil, undercut or bare soil
Vulnerable Bank		Angle > 45°, erodible soil, no sign of recent erosion
Protected Bank	16 ☒	Angle > 45°, non-erodible material/soil
Deposition Zone		Angle < 45°, (gradual slope from river), fine grained sediments

Comments: ROOTS ON L/B COVER, SOME VEG, ALGAE IN JAR

Ent/Scanned | Verified | Corrected

Appendix C1 – Annotated List of Vascular Plants

Vascular Plant List

1 - CUT1	2 - FOD4	3 - CUS1	4 - CUW1	Scientific Name	Common Name	S RANK	COSEWIC	SARA	SARO	CC	CW	CVC	Native Status
X	X		X	*Acer negundo*	Manitoba Maple	S5				0	0		N
X	X	X	X	*Acer platanoides*	Norway Maple	SNA					5		I
	X			*Acer rubrum*	Red Maple	S5				4	0		N
	X		X	*Acer saccharinum*	Silver Maple	S5				5	-3		N
	X		X	*Aegopodium podagraria*	Goutweed	SNA					0		I
	X		X	*Aesculus hippocastanum*	Horse Chestnut	SNA					5		I
			X	*Agrostis stolonifera*	Creeping Bentgrass	SNA					-3		I
X			X	*Alliaria petiolata*	Garlic Mustard	SNA					0		I
			X	*Ambrosia artemisiifolia*	Common Ragweed	S5				0	3		N
			X	*Amelanchier arborea*	Downy Serviceberry	S5				5	3		N
			X	*Arctium lappa*	Great Burdock	SNA					3		I
X	X	X	X	*Arctium minus*	Common Burdock	SNA					3		I
			X	*Bromus hordeaceus ssp. hordeaceus*	Soft Brome	SNA					5		I
X			X	*Bromus inermis*	Smooth Brome	SNA					5		I
	X	X	X	*Carex blanda*	Woodland Sedge	S5				3	0		N
		X		*Carex gracillima*	Graceful Sedge	S5				4	3		N
		X		*Carex molesta*	Troublesome Sedge	S4S5				5	0		N
		X	X	*Carex radiata*	Eastern Star Sedge	S5				4	0		N
	X			*Carex retrorsa*	Retrorse Sedge	S5				5	-5		N
			X	*Carya ovata*	Shagbark Hickory	S5				6	3		N
		X		*Catalpa bignonioides*	Southern Catalpa	SNA					3		I
	X			*Celastrus orbiculatus*	Oriental Bittersweet	SNA					5		I
		X	X	*Celtis occidentalis*	Common Hackberry	S4				8	0		N
X	X	X	X	*Circaea canadensis ssp. canadensis*	Canada Enchanter's Nightshade	S5				2	3		N
			X	*Cirsium arvense*	Creeping Thistle	SNA					3		I

Vascular Plant List

1 - CUT1	2 - FOD4	3 - CUS1	4 - CUW1	Scientific Name	Common Name	S RANK	COSEWIC	SARA	SARO	CC	CW	CVC	Native Status
	X		X	*Cirsium vulgare*	Bull Thistle	SNA					3		I
X				*Convolvulus arvensis*	Field Bindweed	SNA					5		I
X	X		X	*Cornus alternifolia*	Alternate-leaved Dogwood	S5				6	3		N
			X	*Cornus drummondii*	Rough-leaved Dogwood	S4				4	0		N
X	X			*Cornus obliqua*	Pale Dogwood	S5				2	-3		N
			X	*Cornus racemosa*	Gray Dogwood	S5				2	0		N
	X			*Crataegus monogyna*	English Hawthorn	SNA					3		I
	X	X	X	*Dactylis glomerata*	Orchard Grass	SNA					3		I
X	X		X	*Daucus carota*	Wild Carrot	SNA					5		I
		X		*Diervilla lonicera*	Northern Bush-honeysuckle	S5				5	5		N
X			X	*Dipsacus fullonum*	Common Teasel	SNA					3		I
X				*Elaeagnus angustifolia*	Russian Olive	SNA					3		I
X			X	*Elymus repens*	Creeping Wildrye	SNA					3		I
	X			*Equisetum arvense*	Field Horsetail	S5				0	0		N
X	X			*Erigeron annuus*	Annual Fleabane	S5				0	3		N
			X	*Erigeron philadelphicus var. philadelphicus*	Philadelphia Fleabane	S5				1	-3		N
X	X		X	*Euonymus alatus*	Winged Euonymus	SNA					5		I
	X	X	X	*Euonymus fortunei*	Climbing Euonymus	SNA					5		I
X				*Eurybia macrophylla*	Large-leaved Aster	S5				5	5		N
X				*Euthamia graminifolia*	Grass-leaved Goldenrod	S5				2	0		N
			X	*Fagus grandifolia*	American Beech	S4				6	3		N
		X	X	*Fragaria vesca*	Woodland Strawberry	S5				4	3		N

Vascular Plant List

1 - CUT1	2 - FOD4	3 - CUS1	4 - CUW1	Scientific Name	Common Name	S RANK	COSEWIC	SARA	SARO	CC	CW	CVC	Native Status
			X	*Fragaria virginiana ssp. glauca*	Smooth Wild Strawberry	S4S5				2	3		N
X	X		X	*Fraxinus pennsylvanica*	Green Ash	S4				3	-3		N
	X			*Galium mollugo*	Smooth Bedstraw	SNA					5		I
			X	*Geranium maculatum*	Spotted Geranium	S5				6	3		N
		X	X	*Geranium robertianum*	Herb-Robert	S5				2	3		N
X	X			*Geum aleppicum*	Yellow Avens	S5				2	0		N
X				*Geum laciniatum*	Rough Avens	S4				4	-3		N
			X	*Glechoma hederacea*	Ground Ivy	SNA					3		I
			X	*Glyceria striata var. striata*	Fowl Mannagrass	S5				3	-5		N
		X	X	*Hemerocallis lilioasphodelus*	Yellow Daylily	SNA					5		I
	X	X	X	*Hesperis matronalis*	Dame's Rocket	SNA					3		I
X			X	*Hypericum perforatum ssp. perforatum*	Common St. John's-wort	SNA					5		I
			X	*Juglans cinerea*	Butternut	S2?	END		END	6	3		N
X	X	X	X	*Juglans nigra*	Black Walnut	S4?				5	3		N
	X	X		*Juncus effusus*	Soft Rush	S5				4	-5		N
X				*Leonurus cardiaca ssp. cardiaca*	Common Motherwort	SNA					5		I
X	X	X	X	*Ligustrum vulgare*	European Privet	SNA					3		I
	X			*Lonicera maackii*	Amur Honeysuckle	SNA					5		I
X				*Lotus corniculatus*	Garden Bird's-foot Trefoil	SNA					3		I
	X		X	*Lysimachia ciliata*	Fringed Loosestrife	S5				4	-3		N
X				*Malus pumila*	Common Apple	SNA					5		I
			X	*Matricaria discoidea*	Pineappleweed	SNA					3		I
X			X	*Medicago lupulina*	Black Medic	SNA					3		I

Vascular Plant List

1 - CUT1	2 - FOD4	3 - CUS1	4 - CUW1	Scientific Name	Common Name	S RANK	COSEWIC	SARA	SARO	CC	CW	CVC	Native Status
X			X	*Morus alba*	White Mulberry	SNA					0		I
X			X	*Oxalis stricta*	Upright Yellow Wood-sorrel	S5				0	3		I
X	X	X	X	*Parthenocissus vitacea*	Thicket Creeper	S5				4	3		N
X				*Phalaris arundinacea*	Reed Canary Grass	S5				0	-3		N
X				*Phragmites australis ssp. australis*	European Reed	SNA					-3		I
			X	*Physocarpus opulifolius*	Eastern Ninebark	S5				5	-3	rare	N
X		X	X	*Picea abies*	Norway Spruce	SNA					5		I
		X		*Picea glauca*	White Spruce	S5				6	3		N
			X	*Pinus nigra*	Black Pine	SNA					5		I
			X	*Plantago lanceolata*	English Plantain	SNA					3		I
X	X	X	X	*Poa pratensis*	Kentucky Bluegrass	S5				0	3		N
			X	*Populus grandidentata*	Large-toothed Aspen	S5				5	5		N
X			X	*Potentilla recta*	Sulphur Cinquefoil	SNA					5		I
	X		X	*Prunus avium*	Sweet Cherry	SNA					5		I
			X	*Prunus serotina var. serotina*	Black Cherry	S5				3	3		N
		X		*Prunus virginiana var. virginiana*	Choke Cherry	S5				2	3		N
		X		*Pulmonaria officinalis*	Blue Lungwort	SNA							I
X				*Pyrus communis*	Common Pear	SNA					5		I
X			X	*Quercus alba*	White Oak	S5				6	3		N
X	X	X	X	*Quercus macrocarpa*	Bur Oak	S5				5	3		N
	X			*Quercus robur*	English Oak	SNA					5		I
		X		*Quercus rubra*	Northern Red Oak	S5				6	3		N
X	X	X	X	*Ranunculus acris*	Tall Buttercup	SNA					0		I
X	X		X	*Ranunculus recurvatus var. recurvatus*	Hooked Buttercup	S5				4	-3		N

Vascular Plant List

1 - CUT1	2 - FOD4	3 - CUS1	4 - CUW1	Scientific Name	Common Name	S RANK	COSEWIC	SARA	SARO	CC	CW	CVC	Native Status
	X			*Ranunculus repens*	Creeping Buttercup	SNA					0		I
X	X	X	X	*Rhamnus cathartica*	Common Buckthorn	SNA					0		I
X			X	*Rhus typhina*	Staghorn Sumac	S5				1	3		N
	X			*Ribes americanum*	Wild Black Currant	S5				4	-3		N
	X		X	*Robinia pseudoacacia*	Black Locust	SNA					3		I
X				*Rosa blanda*	Smooth Rose	S5				3	3		N
X	X	X	X	*Rosa multiflora*	Multiflora Rose	SNA					3		I
X				*Rubus idaeus ssp. strigosus*	Wild Red Raspberry	S5				2	3		N
	X	X	X	*Rubus occidentalis*	Black Raspberry	S5				2	5		N
X				*Rumex crispus*	Curly Dock	SNA					0		I
			X	*Rumex obtusifolius*	Bitter Dock	SNA					-3		I
	X		X	*Salix alba*	White Willow	SNA					-3		I
			X	*Salix discolor*	Pussy Willow	S5				3	-3		N
X		X		*Salix x fragilis*	(Salix alba X Salix euxina)	SNA							I
X	X			*Solanum dulcamara*	Bittersweet Nightshade	SNA					0		I
X	X	X	X	*Solidago canadensis*	Canada Goldenrod	S5				1	3		
			X	*Solidago flexicaulis*	Zigzag Goldenrod	S5				6	3		N
			X	*Sonchus oleraceus*	Common Sow-thistle	SNA					3		I
	X			*Sorbaria sorbifolia*	False Spiraea	SNA					5		I
	X			*Sorbus aucuparia*	European Mountain-ash	SNA					5		I
	X			*Symphoricarpos albus*	Common Snowberry	S5				7	3		
X				*Symphyotrichum lanceolatum*	Panicled Aster	S5				3	-3		
	X			*Syringa reticulata ssp. reticulata*	Japanese Tree Lilac	SNA							I
			X	*Syringa vulgaris*	Common Lilac	SNA					5		I

Vascular Plant List

1 - CUT1	2 - FOD4	3 - CUS1	4 - CUW1	Scientific Name	Common Name	S RANK	COSEWIC	SARA	SARO	CC	CW	CVC	Native Status
X	X	X		*Taraxacum officinale*	Common Dandelion	SNA					3		I
X			X	*Tilia americana*	American Basswood	S5				4	3		N
X	X			*Tilia cordata*	Little-leaf Linden	SNA					5		I
		X		*Tsuga canadensis*	Eastern Hemlock	S5				7	3		N
X	X	X	X	*Ulmus americana*	American Elm	S5				3	-3		N
X				*Ulmus pumila*	Siberian Elm	SNA					3		I
	X			*Veronica officinalis*	Common Speedwell	SNA					5		I
			X	*Viburnum opulus ssp. trilobum var. americanum*	Highbush Cranberry	S5				5	-3		N
X			X	*Vicia cracca*	Tufted Vetch	SNA					5		I
			X	*Vinca minor*	Periwinkle	SNA					5		I
X	X	X	X	*Vincetoxicum rossicum*	European Swallow-wort	SNA					5		I
X	X	X	X	*Vitis riparia*	Riverbank Grape	S5				0	0		N
X	X	X		*Crateageous sp.*	Hawthorn species								
X	X	X	X	*Lonicera sp.*	Honeysuckle species								
	X	X		*Geum sp.*	Avens sp.								
	X			*Viola sp*	Violet species								
	X	X		*Carex sp.*	Sedge Species								

Scientific Name and Common Name (NHIC, 2019)

Based on NHIC's species list for Ontario downloaded on May 29, 2019.

S-Ranks (NHIC, 2019)

Provincial Rarity List

S1 Critically Imperiled—Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

S2 Imperiled—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

S3 Vulnerable—Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure—Common, widespread, and abundant in the nation or state/province.

S#S# Range Rank —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

SX Apparently extirpated from Ontario, with little likelihood of rediscovery. Typically not seen in the province for many decades, despite searches at known historic sites.

SE Exotic; not believed to be a native component of Ontario's flora.

COSEWIC (NHIC, 2019)

Federal Rarity List

EXT Extinct - A species that no longer exists.

EXP Extirpated - A species no longer existing in the wild in Canada, but occurring elsewhere.

END Endangered - A species facing imminent extirpation or extinction.

THR Threatened - A species likely to become endangered if limiting factors are not reversed.

SC Special Concern (formerly vulnerable) - A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

NAR Not At Risk - A species that has been evaluated and found to be not at risk of extinction given the current circumstances.

DD Data Deficient (formerly Indeterminate) - Available information is insufficient to resolve a species' eligibility for assessment or to permit an assessment of the species' risk of extinction.

* - Species on Schedule 1 of Species At Risk Act (SARA)

Exotic Status (NHIC, 2019)

If an element is known to occur as an exotic in Ontario, the status value assigned to the element is SE. A ? qualifier added to that value indicates uncertainty about whether it is exotic or native. Numeric ranks of 1 through 5 added to the exotic status indicate the element's abundance in Ontario, with 1 indicating the least abundance and 5 the most.

Coefficient of Conservatism and Coefficient of Wetness (NHIC, 2019)

CC = Coefficient of Conservatism. Rank of 0 to 10 based on plants degree of fidelity to a range of ecological parameters: (0-3) Taxa found in a variety of plant communities; (4-6) Taxa typically associated with a specific plant community but tolerate moderate disturbance; (7-8) Taxa associated with a plant community in an advanced successional stage that has undergone minor disturbance; (9-10) Taxa with a high fidelity to a narrow range of synecological parameters.

CW = Coefficient of Wetness. -Value between 5 and –5. A value of –5 is assigned to Obligate Wetland (OBL) and 5 to Obligate Upland (UPL), with intermediate values assigned to the remaining categories (Oldham et al., 1995).

Regional Rarity

Greater Toronto Area (CVC, 2002)

Rare by an	"A species that occurs at fewer than 40 locations in the Greater Toronto Area (location is defined exclusion zone with a 1km radius around each known location for a given species.)"

Native Status

VASCAN database (Brouillet et al. 2010)

N	Native to Ontario
I	I

Appendix C2 – ELC Assessment Field Sheets

ELC

SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

Slope | UTM

	P/A	PP	Dr	Position	Aspect	%	Type	Class	Z	EASTING	NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC
PLANT SPECIES LIST

SITE: Loyalist
POLYGON: 001
DATE: JUN 18, 2020
SURVEYOR(S): ND + KB

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER

ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	2	3	4	COL.
MORALB					
FRAXPEN					
ACERNEG					
JUGNG					
QUERMAC					
ACERPLAT					
MALUSPUM					
SALIX BAB					
ULMAME					
TILIAME					
TILIA CORD					
AESLANG					
ULMPUM					
PICE (NOR)					
QUERALB					
PYRCOM					
CRAT					
ROSAMULT					
EUNEUAT					
RUBIDE					
PARTVIT					
LONIC					
ROSA BLAN					
CORNALT					
RRIVET					
CORNAMOM					
RHUSTYPH (sumac)					
VITRIP					
RHAMCAT			D	A	

SPECIES CODE	LAYER 1	2	3	4	COL.
PHALARU					
BROMINE					
RUMCRIS					
ALLIPET					
DAUCAR.					
CONUARV					
TARAOFF					
POAPRAT					
DSV					
SOLI					
RANUNACR					
RANUREU					
VICCRA					
LOTCORN					
Sunflower					
SYMPHLAN					
ELYREP					
DIPFUL					
ARCMIN					
GEUM ALEP					
POTREP					
GEUM LACI					
LEONCAR					
HYPPERF					
MEDILUP					
PHARAG					
EUTHGRAM					
SYMPMAC					
CIRCCUT					
SOLIDUL					
OXALSTR					
ERIGANN					

DOWO, KILDEER, Catbird

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: Loyalist		POLYGON:	
	SURVEYOR(S): ND + KB	DATE: Jun 18, 2020	TIME: start	
			finish	
	UTMZ:	UTME:	UTMN:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
☐ TERRESTRIAL	☐ ORGANIC	☐ LACUSTRINE	☐ NATURAL	☐ PLANKTON	☐ LAKE
☐ WETLAND	☐ MINERAL SOIL	☐ RIVERINE	☐ CULTURAL	☐ SUBMERGED	☐ POND
☐ AQUATIC	☐ PARENT MIN.	☐ BOTTOMLAND		☐ FLOATING-LVD.	☐ RIVER
	☐ ACIDIC BEDRK.	☐ TERRACE		☐ GRAMINOID	☐ STREAM
	☐ BASIC BEDRK.	☐ VALLEY SLOPE		☐ FORB	☐ MARSH
	☐ CARB. BEDRK.	☐ TABLELAND		☐ LICHEN	☐ SWAMP
		☐ ROLL. UPLAND		☐ BRYOPHYTE	☐ FEN
		☐ CLIFF		☐ DECIDUOUS	☐ BOG
SITE		☐ TALUS	**COVER**	☐ CONIFEROUS	☐ BARREN
		☐ CREVICE / CAVE		☐ MIXED	☐ MEADOW
☐ OPEN WATER		☐ ALVAR			☐ PRAIRIE
☑ SHALLOW WATER		☐ ROCKLAND	☐ OPEN		☐ THICKET
☐ SURFICIAL DEP.		☐ BEACH / BAR	☐ SHRUB		☐ SAVANNAH
☐ BEDROCK		☐ SAND DUNE	☐ TREED		☐ WOODLAND
		☐ BLUFF			☐ FOREST
					☐ PLANTATION

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY	2	2	ULM > ACER NEG.
2	SUB-CANOPY			RHAM CAT > MALUS
3	UNDERSTOREY		4	RHAM >> Everything else
4	GRD. LAYER			RHAM CAT = ALLIPET > POA.

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		CUT
ECOSITE:		
VEGETATION TYPE:		
☐ INCLUSION		
☐ COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

COMMUNITY PROFILE DIAGRAM

DISTURBANCE (CIRCLE ALL THAT APPLY)				
LOGGING/SUGAR BUSH	GAPS IN FOREST CANOPY	LIVESTOCK	INVASIVE SP./ GARDEN PLANTS	TRACKS/TRAILS/REC. USE
DUMPING	EARTH DISPLACEMENT	NOISE	DISEASE/DEATH OF TREES/HERBS	WIND THROW
DEER BROWSING	BEAVER ACTIVITY	FLOODING	FIRE/ICE DAMAGE	OTHER

Notes:

FOD4. Acer Plat Dom.

ELC SOILS ONTARIO	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

	P/A	PP	Dr	Position	Aspect	Slope %	Type	Class	Z	UTM EASTING	UTM NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC PLANT SPECIES LIST	SITE: Loyalist
	POLYGON: 002
	DATE: JUN 13, 2020
	SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER

ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	2	3	4	COL.
JUGNIG	O				
SALIX					
ACERPLAT	D				
ROBPSE					
~~EFFTOCC~~					
~~PICFA (Nat)~~					
ULMAME	R	O			
FRAXPEN			O		
QUER(ENG)					
QUERMAC					
ACERNEG					
TILIACOR					
PRUNAVI					
Horsechest					
ACERSILV	O				
ACERRUB			R		
RUBOCC					
RIBESAME					
CORNAT					
LONIMAC?					
CELORB					
Asp. Lilac					
CORAMO					
VITRIP					
LONIC					
PARTVIT					
PRIVET					
CRAT					
RHAMCAT					
ROSAMULT					
~~EUNALA~~					

SPECIES CODE	LAYER 1	2	3	4	COL.
POAPRAT					
ARCMIN					
RUBUSOCC					
GEUM					
CIRCLUT					
DSV					
EUNFOR					
SOLIDCAN					
HESPMAT					
GEUMALE?					
RANACR					
~~LYTHSAL~~					
VEROFFIC					
CIRCVULG					
PARTQUIN					
ERIGANN					
RANREC					
RANREP					
CAREX BIA					
JUNEFF (PATH)					
GEUMALE?					
VIOLA SP.					
TARAOFF					
Goutweed					
DACTGLOM					
CAREX.					
CAREX RECUR					
GALIMOLL					
EQUIARV.					

SORBAUC
Snowberry (SYMPALB)
LYSCILI
SOLADULC
CRATMOND.
False spirea

Page ..... of .....

Waibling Vireo, Robin, Amgo., MALLARD, COWBIRD
Cardinal, Oriole, Red eyed Vireo, Amgo

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE:		POLYGON:	
	SURVEYOR(S):	DATE:	TIME: start / finish	
	UTMZ:	UTME:	UTMN:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
☐ TERRESTRIAL ☐ WETLAND ☐ AQUATIC	☐ ORGANIC ☐ MINERAL SOIL ☐ PARENT MIN. ☐ ACIDIC BEDRK. ☐ BASIC BEDRK. ☐ CARB. BEDRK.	☐ LACUSTRINE ☐ RIVERINE ☐ BOTTOMLAND ☐ TERRACE ☐ VALLEY SLOPE ☐ TABLELAND ☐ ROLL. UPLAND ☐ CLIFF ☐ TALUS ☐ CREVICE / CAVE ☐ ALVAR ☐ ROCKLAND ☐ BEACH / BAR ☐ SAND DUNE ☐ BLUFF	☐ NATURAL ☐ CULTURAL	☐ PLANKTON ☐ SUBMERGED ☐ FLOATING-LVD. ☐ GRAMINOID ☐ FORB ☐ LICHEN ☐ BRYOPHYTE ☐ DECIDUOUS ☐ CONIFEROUS ☐ MIXED	☐ LAKE ☐ POND ☐ RIVER ☐ STREAM ☐ MARSH ☐ SWAMP ☐ FEN ☐ BOG ☐ BARREN ☐ MEADOW ☐ PRAIRIE ☐ THICKET ☐ SAVANNAH ☐ WOODLAND ☐ FOREST ☐ PLANTATION
SITE ☐ OPEN WATER ☐ SHALLOW WATER ☑ SURFICIAL DEP. ☐ BEDROCK			**COVER** ☐ OPEN ☐ SHRUB ☐ TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			ACERPLAT >> JUGNIG > everything else
2	SUB-CANOPY			ACER PLAT
3	UNDERSTOREY			RHAMCAT > FRAX > Rose.
4	GRD. LAYER			ALLIPE > RHAMCAT > JUNTOR

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

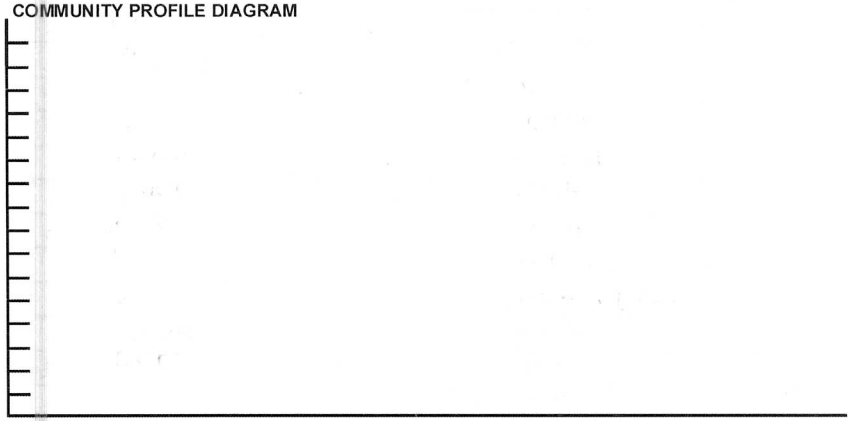
COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		FOD4
ECOSITE:		
VEGETATION TYPE:		
☐ INCLUSION		
☐ COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

COMMUNITY PROFILE DIAGRAM



DISTURBANCE (CIRCLE ALL THAT APPLY)				
LOGGING/SUGAR BUSH	GAPS IN FOREST CANOPY	LIVESTOCK	INVASIVE SP./ GARDEN PLANTS	TRACKS/TRAILS/REC. USE
DUMPING	EARTH DISPLACEMENT	NOISE	DISEASE/DEATH OF TREES/HERBS	WIND THROW
DEER BROWSING	BEAVER ACTIVITY	FLOODING	FIRE/ICE DAMAGE	OTHER

Notes:

Open Inclusion → ACERPLAT Dom.

New: Autumn olive, Lungwort, Carex ovales, SORBUS ANC, TILIAAME, FRAGUES, SYMPHLANC, TSUGCAN, RUMEXCRI, SOLI sp.

↳ Shrubby to low canopy cover.

Some areas of main community have densely covered ground, others sparse.

Black Walnut Savannah

ELC

SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

Slope UTM

	P/A	PP	Dr	Position	Aspect	%	Type	Class	Z	EASTING	NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC

PLANT SPECIES LIST

SITE: Loyalist
POLYGON: 3
DATE: JUN 18 2020
SURVEYOR(S): NDT KB

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER

ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	2	3	4	COL.
JUG NIG	D				
SALIX BAB					
QUERRUB					
CATALP (S)					
CELTOCC					
PICFA (NOR)					
ULMAME					
ACERPLAT					
QUERMAC		R	O		
TSUGCAN			R		
ACERPLAT					
PICEGLA					
CRAT					
PRUNVIRG					
LONIC					
RUBOCC			A		
PRIVET					
PARTHVT			A		
PIER LON.					
VITRIP					
RHAMCAT					
ROSAMULT			A		

SPECIES CODE	LAYER 1	2	3	4	COL.
POAPRAT					
ARCMIN					
GEUM					
CIRCLUT					
DSV					
EUOFGR					
SOLICAN					
HESPMAT					
CAREX (Sedges)					
Goutweed					
HESPMAT					
PACTGLOM					
Day lily					
FRAGVES.					
LUNGWORT					
TARAOFF					
JUNC. (PATH)					
GERROB					
RANACR					

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CRAT, carpenter bee, honeybee

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE:		POLYGON:	
	SURVEYOR(S):	DATE:	TIME: start	
			finish	
	UTMZ:	UTME:	UTMN:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
☐ TERRESTRIAL	☐ ORGANIC	☐ LACUSTRINE	☐ NATURAL	☐ PLANKTON	☐ LAKE
☐ WETLAND	☐ MINERAL SOIL	☐ RIVERINE	☐ CULTURAL	☐ SUBMERGED	☐ POND
☐ AQUATIC	☐ PARENT MIN.	☐ BOTTOMLAND		☐ FLOATING-LVD.	☐ RIVER
	☐ ACIDIC BEDRK.	☐ TERRACE		☐ GRAMINOID	☐ STREAM
	☐ BASIC BEDRK.	☐ VALLEY SLOPE		☐ FORB	☐ MARSH
	☐ CARB. BEDRK.	☐ TABLELAND		☐ LICHEN	☐ SWAMP
SITE		☐ ROLL. UPLAND	COVER	☐ BRYOPHYTE	☐ FEN
☐ OPEN WATER		☐ CLIFF	☐ OPEN	☐ DECIDUOUS	☐ BOG
☐ SHALLOW WATER		☐ TALUS	☐ SHRUB	☐ CONIFEROUS	☐ BARREN
☑ SURFICIAL DEP.		☐ CREVICE / CAVE	☐ TREED	☐ MIXED	☐ MEADOW
☐ BEDROCK		☐ ALVAR			☐ PRAIRIE
		☐ ROCKLAND			☐ THICKET
		☐ BEACH / BAR			☐ SAVANNAH
		☐ SAND DUNE			☐ WOODLAND
		☐ BLUFF			☐ FOREST
					☐ PLANTATION

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			
2	SUB-CANOPY			
3	UNDERSTOREY			
4	GRD. LAYER			

HT CODES: **1** = >25 m **2** = 10<HT≤25 m **3** = 2<HT≤10 m **4** = 1<HT≤2 m **5** = 0.5<HT≤1 m **6** = 0.2<HT≤0.5 m **7** = HT<0.2 m

CVR CODES **0**= NONE **1**= 0% < CVR ≤ 10% **2**= 10 < CVR ≤ 25% **3**= 25 < CVR ≤ 60% **4**= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:		
☐ INCLUSION		
☐ COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

COMMUNITY PROFILE DIAGRAM

DISTURBANCE (CIRCLE ALL THAT APPLY)				
LOGGING/SUGAR BUSH	GAPS IN FOREST CANOPY	LIVESTOCK	INVASIVE SP./ GARDEN PLANTS	TRACKS/TRAILS/REC. USE
DUMPING	EARTH DISPLACEMENT	NOISE	DISEASE/DEATH OF TREES/HERBS	WIND THROW
DEER BROWSING	BEAVER ACTIVITY	FLOODING	FIRE/ICE DAMAGE	OTHER

Notes:

Cultural woodland

ELC

SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

Slope UTM

	P/A	PP	Dr	Position	Aspect	%	Type	Class	Z	EASTING	NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC

PLANT SPECIES LIST

SITE: Loyalist
POLYGON: 4
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER

ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	2	3	4	COL.
FRAX PEN					
ACER SILV					
CARO VA	R		R		
ACER PLAT					
PRUN SER					
JUG NIG	✓	✓	✓		
ROB PSEU					
ULM AME					
Horsechest					
PRUN AVI					
ACER NEG					
TILI AME					
SALIX.					
JUG CIN					
FAG GRAN			R		
QUER MAC					
MOR ALB					
SALIX DISC.					
FRAG SUPP					
CORN ALT					
RHUS TYPH					
EUN EUR					
PRIVET					
CRAT					
ROSA MUL					
VITIRIP					
PART QUI					
AMEL.					
RHAM CAT					
LONIC					
CORN AMOM					

SPECIES CODE	LAYER 1	2	3	4	COL.
Goldenrod					
RAN ACR					
PAN CAR					
BLECHEN					
ARE MIN					
MEH LUP					
SONCH OLE					
CIRC LUT					
OXA STRI					
SOL I CAN					
ART LAP					
ALLI PET					
CIR VUL					
Sunflowers					
HYPE PERF					
LYS CIL.					
PSV					
RUMEX OBT					
VINC MIN					
FRAG VES					
POA PRA					
VIB OP AM					
EUN FOR					
GER MAC					
CIRS ARV					
GER ROB					
HESP MAT					
DIPS FULL					
POT REC					
RANROOT					
SOLIDEA					
CIRC LUT					

QUER ALB
SALIX ALB
MOR ALB
POP UGRA
PIN NIG.
CELTOCC
PICE ABI

x 2 →

SYR VUL
CORN RAC
RUB OCC
NINBOR.

CAREX.
VICCRA
FRIGA
Daylily
ELYPER
AMBART
POA PRA
PACT GL
BROMINE
PINAPPLE
POA com
Glyceria
PLANLAN

Page ..... of .....

Toad, Chickadee, MOOO, Bunny, House finch

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE:		POLYGON:	
	SURVEYOR(S):	DATE:	TIME: start	
			finish	
	UTMZ:	UTME:	UTMN:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
☐ TERRESTRIAL ☐ WETLAND ☐ AQUATIC	☐ ORGANIC ☐ MINERAL SOIL ☐ PARENT MIN. ☐ ACIDIC BEDRK. ☐ BASIC BEDRK. ☐ CARB. BEDRK.	☐ LACUSTRINE ☐ RIVERINE ☐ BOTTOMLAND ☐ TERRACE ☐ VALLEY SLOPE ☐ TABLELAND ☐ ROLL. UPLAND ☐ CLIFF ☐ TALUS ☐ CREVICE / CAVE ☐ ALVAR ☐ ROCKLAND ☐ BEACH / BAR ☐ SAND DUNE ☐ BLUFF	☐ NATURAL ☐ CULTURAL	☐ PLANKTON ☐ SUBMERGED ☐ FLOATING-LVD. ☐ GRAMINOID ☐ FORB ☐ LICHEN ☐ BRYOPHYTE ☐ DECIDUOUS ☐ CONIFEROUS ☐ MIXED	☐ LAKE ☐ POND ☐ RIVER ☐ STREAM ☐ MARSH ☐ SWAMP ☐ FEN ☐ BOG ☐ BARREN ☐ MEADOW ☐ PRAIRIE ☐ THICKET ☐ SAVANNAH ☐ WOODLAND ☐ FOREST ☐ PLANTATION
SITE ☐ OPEN WATER ☒ SHALLOW WATER ☐ SURFICIAL DEP. ☐ BEDROCK			**COVER** ☐ OPEN ☐ SHRUB ☐ TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			Variable → ACERSILV = ACER = JUGNIG.
2	SUB-CANOPY			
3	UNDERSTOREY			RHAM = FRAX > ROSA
4	GRD. LAYER			ALLIPET = ARCT = ROSA

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

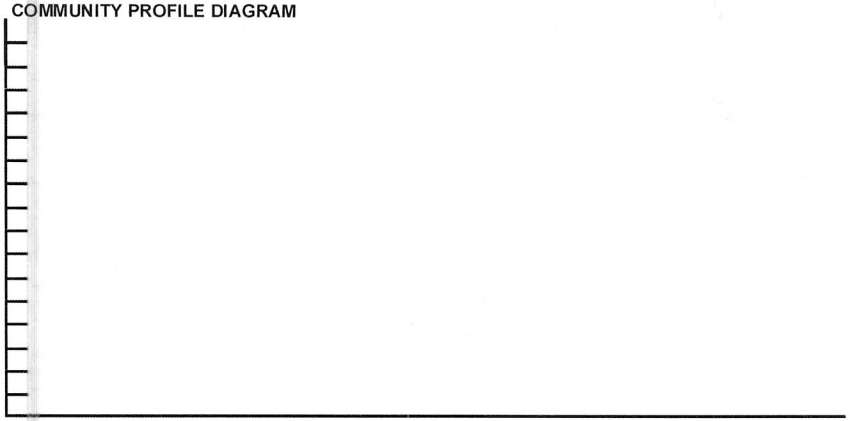
COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		CUN1
ECOSITE:		
VEGETATION TYPE:		
☐ INCLUSION		
☐ COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

COMMUNITY PROFILE DIAGRAM



DISTURBANCE (CIRCLE ALL THAT APPLY)				
LOGGING/SUGAR BUSH	GAPS IN FOREST CANOPY	LIVESTOCK	INVASIVE SP./ GARDEN PLANTS	TRACKS/TRAILS/REC. USE
DUMPING	EARTH DISPLACEMENT	NOISE	DISEASE/DEATH OF TREES/HERBS	WIND THROW
DEER BROWSING	BEAVER ACTIVITY	FLOODING	FIRE/ICE DAMAGE	OTHER

Notes:

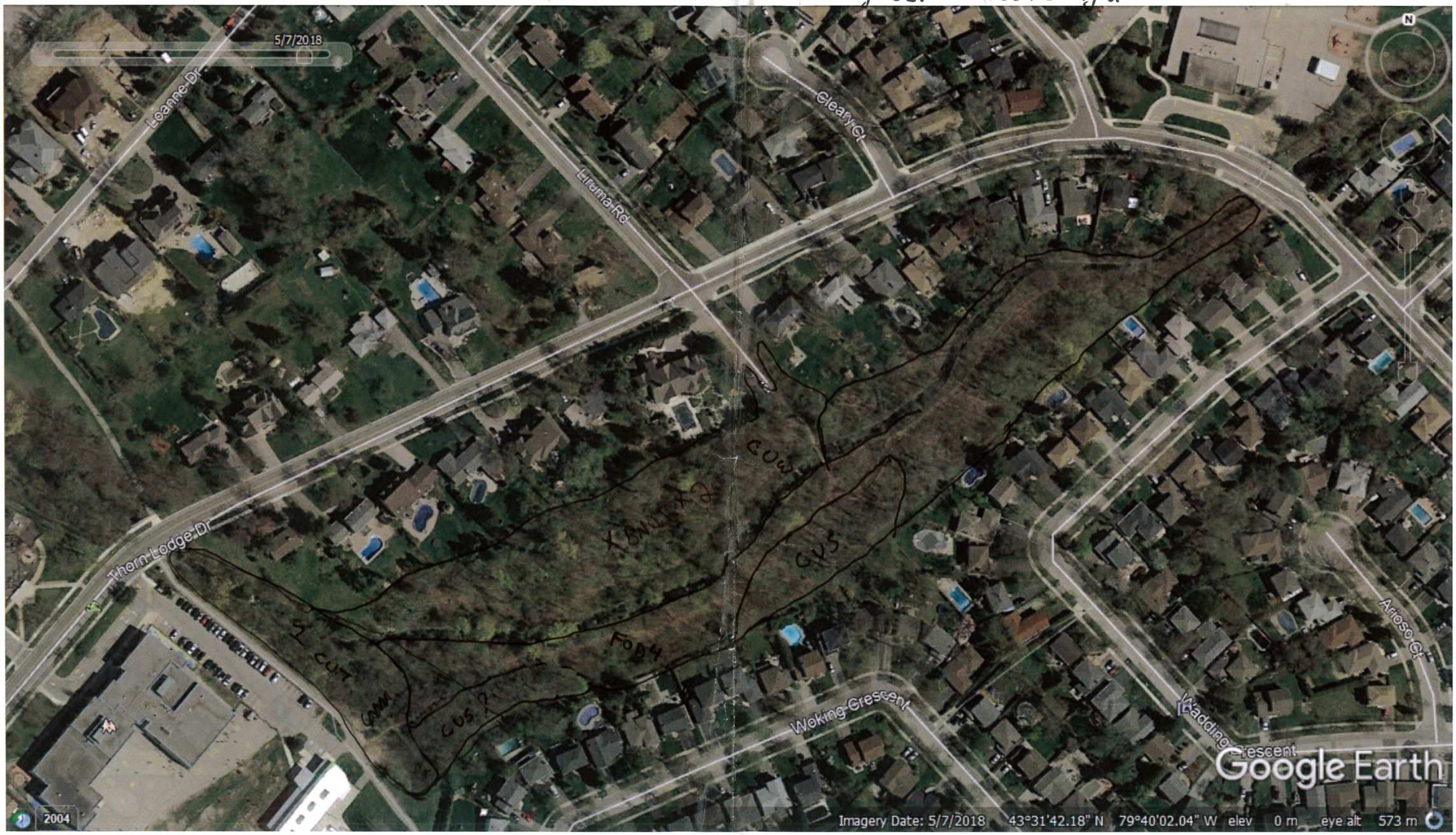
Possible CAT3

2 BNUTS → larger is healthy, good canopy
minimal sign of cankers

→ smaller is poor health, crown dieback, evidence of cankers

No low branches.

City of
Loyalist - Mississauga.



Appendix D – Ministry of Natural Resources and Forestry Species at Risk Assessment

Species at Risk and Species of Conservation Concern Screening Table

Species		COSEWIC Status	COSSARO Status	G-Rank	S-Rank	Source	Habitat Requirements	Assessment of Species Occurrence in Study Area
Scientific Name	**Common Name**							
BIRDS								
Riparia riparia	Bank Swallow	THR	THR	G5	S4B	MECP	Sand, clay or gravel riverbanks or steep riverbank cliffs; lakeshore bluffs or easily crumbled sand or gravel; gravel pits, road cuts, grassland or cultivated fields that are close to water. Nesting sites are limiting factor for species presence.	**Not present**: The majority of the banks within the study area are gabion baskets and not suitable for nesting.
Hirundo rustica	Barn Swallow	THR	THR	G5	S4B	MECP	Prefers farmland, lake/river shorelines, wooded clearings, urban populated areas, rocky cliffs and wetlands. They nest inside or outside buildings, under bridges and in road culverts, or on rock faces and caves.	**Potentially present**: No evidence of Barn Swallow nests was observed on the pedestrian bridge; the bridge itself is very exposed with shallow beams on the underside and is therefore not considered to provide suitable Barn Swallow nesting habitat in the future. However, the concrete box culverts at the upstream and downstream extents of the study area could provide potential nesting areas. These culverts are not expected to be directly impacted by the proposed works.
Ammodramus henslowii	Henslow's Sparrow	END	END	G4	SHB	NHIC	Prefers to breed in wet meadows, weedy pastures, and lowland prairie as well as hayfields.	**Not present**: No open habitat present.
Dolichonyx oryzivorus	Bobolink	THR	THR	G5	S4B	MECP	COSEWIC (2010, p. iv) defines bobolink habitat as follows: "Since the conversion of the prairie to cropland and the clearing of the eastern forests, the Bobolink has nested in forage crops…The bobolink also occurs in various grassland habitats including wet prairie, graminoid peatlands and abandoned fields dominated by tall grasses, remnants of uncultivated virgin prairie (tall-grass prairie), no-till cropland, small-grain fields, restored surface mining sites and irrigated fields in arid regions." Requires large tracts of grassland habitat (>50 ha).	**Not present**: No open habitat present.
Cardellina canadensis	Canada Warbler	THR	SC	G5	S4B	MECP	An interior forest species; dense, mixed coniferous, deciduous forests with closed canopy, wet bottomlands of cedar or alder; shrubby undergrowth in cool moist mature woodlands; riparian habitat; usually requires at least 30 ha.	**Not present**: forest habitat is not present in the study area.
Chaetura pelagica	Chimney Swift	THR	THR	G5	S4B, S4N	MECP	Historically found in deciduous and coniferous, usually wet forest types, all with a well-developed, dense shrub layer. However, modern populations are almost exclusively found in in urban areas in large, uncapped chimneys.	**Potentially present outside of project area**: buildings present on nearby properties have potential to provide suitable nesting sites. No individuals were observed during site visits, however, and no buildings will be impacted by the proposed works.
Contopus virens	Eastern Wood-Pewee	SC	SC	G5	S4B	eBird	Associated with deciduous and mixed forests. Within mature and intermediate age stands it prefers areas with little understory vegetation as well as forest clearings and edges.	**Potentially present**: forest habitat is present in the study area. No individuals were observed during Aquafor's site visits; however, it was reported in the adjacent Thornlodge Park on eBird and is presumed using the wooded habitat along the watercourse.
Hylocichla mustelina	Wood Thrush	THR	SC	G5	S4B	MECP	Nests mainly in second-growth and mature deciduous and mixed forests, with saplings and well-developed understory layers. Prefers large forest mosaics, but may also nest in small forest fragments.	**Not present**: ideal forest habitat is not present in the study area.
INSECTS								
Danaus plexippus	Monarch	END	SC	G5	S2N, S4B	iNaturalist	Exist primarily where milkweed (*Asclepias spp.*) (obligate larval host plant) and other wildflowers exist. This includes abandoned farmland, roadsides and other open spaces.	**Not present**: No open habitat present.

Species at Risk and Species of Conservation Concern Screening Table

Species		COSEWIC Status	COSSARO Status	G-Rank	S-Rank	Source	Habitat Requirements	Assessment of Species Occurrence in Study Area
Scientific Name	**Common Name**							
MAMMALS								
Myotis leibii	Eastern Small-footed Myotis	END	END	G4	S2S3	n/a	Overwintering habitat: Caves and mines that remain above 0°C. Maternal Roosts: primarily under loose rocks on exposed rock outcrops, crevices and cliffs, and occasionally in buildings, under bridges and highway overpasses, and under tree bark.	Only Little Brown Myotis was listed on background sources, but habitat is reviewed for all four species on all projects in southern Ontario as species are often present but unreported. **Potentially present**: maternity roosting habitat may be present. **Field studies needed to confirm presence of trees with suitable cavities and loose bark. For projects requiring removal of trees providing suitable habitat, acoustic monitoring is generally required to obtain project approval under the Endangered Species Act.* **Overwintering Habitat Not Present:** Caves and mines are not present within the study area.
Myotis lucifugus	Little Brown Myotis	END	END	G5	S4	City of Mississauga Natural Areas	Overwintering habitat: Caves and mines that remain above freezing. Maternal roosts: Often associated with buildings (attics, barns, etc.). Occasionally found in trees (25-44 cm dbh).	
Myotis septentrionalis	Northern Myotis	END	END	G4	S3	n/a	Overwintering habitat: Caves and mines that remain above 0°C. Maternal Roosts: Often associated with cavities of large diameter trees (25-44 cm dbh). Occasionally found in structures (attics, barns etc.)	
Perimyotis subflavus	Tri-coloured Bat	END	END	G5	S3?	n/a	Overwintering habitat: Caves and mines that remain above 0°C. Maternal Roosts: Can be in trees or dead clusters of leaves or arboreal lichens on trees. May also use barns or similar structures.	
PLANTS								
Juglans cinerea	Butternut	END	END	G4	S2?	City of Mississauga Natural Areas	Generally grows in rich, moist, and well-drained soils often found along streams. It may also be found on well-drained gravel sites, especially those made up of limestone. It is also found, though seldomly, on dry, rocky and sterile soils. In Ontario, the Butternut generally grows alone or in small groups in deciduous forests as well as in hedgerows. MNRF considers Butternut habitat includes suitable lands within 50 m of a Butternut tree.	**Confirmed:** Two specimens were found on the north side of the watercourse within ELC polygon 4.
FISH								
Lethenteron appendix	American Brook Lamprey	-	-	G4	S3	City of Mississauga Natural Areas	Adults in gravel/sand riffles and runs of creeks and small- to medium-sized rivers with strong flow and clear waters; ammocoetes in sandy or silty pools; preferred water temperature range 9-12°C.	**Not present**: Watercourse does not meet the habitat requirements.

Appendix E – Stage 1 Archaeological Study Report by ASI

STAGE 1 ARCHAEOLOGICAL ASSESSMENT
LOYALIST CREEK EROSION CONTROL
LOTS 32-33, CON 1 SDS
(FORMER TOWNSHIP OF TORONTO, COUNTY OF PEEL)
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL, ONTARIO

ORIGINAL REPORT

Prepared for:

Aquafor Beech Ltd.
55 Regal Road, Unit 3
Guelph, ON N1K 1B6

Archaeological Licence #P383 (Williams)
Ministry of Heritage, Sport, Tourism and Culture Industries PIF# P383-0226-2020
ASI File: 20EA-042

10 March 2021

ASI
Providing Archaeological & Cultural Heritage Services
528 Bathurst Street Toronto, ONTARIO M5S 2P9
416-966-1069 F 416-966-9723 asiheritage.ca

Stage 1 Archaeological Assessment
Loyalist Creek Erosion Control
Lots 32-33, Con 1 SDS
(Former Township of Toronto, County of Peel)
City of Mississauga
Regional municipality of Peel, Ontario

EXECUTIVE SUMMARY

ASI was contracted by Aquafor Beech Ltd. to conduct a Stage 1 Archaeological Assessment (Background Research and Property Inspection) as part of the Loyalist Creek project in the City of Mississauga. This project involves an area of approximately 550 metres southeast along Loyalist Creek through a portion of Thornlodge Park, with some creek segments located within the residential properties on the south side of Thorn Lodge Drive.

The Stage 1 background study determined that one previously registered archaeological site is located within one kilometre of the Study Area, but not within 50 metres. The property inspection determined that parts of the Study Area exhibit archaeological potential and will require Stage 2 assessment.

In light of these results, the following recommendations are made:

1. The Study Area exhibits archaeological potential. These lands require Stage 2 archaeological assessment by test pit survey at five metre intervals prior to any proposed impacts to the property;

2. The remainder of the Study Area does not retain archaeological potential on account of deep and extensive land disturbance. These lands do not require further archaeological assessment; and,

3. Should the proposed work extend beyond the current Study Area, further Stage 1 archaeological assessment should be conducted to determine the archaeological potential of the surrounding lands.

PROJECT PERSONNEL

Senior Project Manager:	Lisa Merritt, MSc. (P094) *Partner / Director* *Environmental Assessment Division*
Project Coordinator:	Hannah Brouwers, Hon. BA (R1270) *Archaeologist / Project Administrator* *Environmental Assessment Division*
	Katrina Thach, Hon. BA (R1225) *Archaeologist / Project Coordinator* *Environmental Assessment Division*
Project Director (Licensee):	Blake Williams, MLit (P383) *Associate Archaeologist / Technical Writer* *Mitigation Division*
Project Manager:	Eliza Brandy, MA (R1109) *Associate Archaeologist / Project Manager* *Environmental Assessment Division*
Field Director:	Alexis Dunlop MSc (P1146) *Lead Bioarchaeologist / Manager* *Laboratory and Fieldwork Services, Operations Division*
Report Preparation:	Eliza Brandy
	Danielle Bella, Hon. BA *Archaeologist / Technical Writer* *Environmental Assessment Division*
Graphics:	Jonas Fernandez, MSc (R281) *Lead Archaeologist / Manager - Fleet & Geomatics Specialist* *Operations Division*
	Andrew Clish, BES (P046) *Senior Archaeologist / Senior Field Director, Laboratory & Fieldwork Services* *Operations Division*
	Carolyn Nettleton, BA (Hon) *Archaeologist / GIS Technician* *Operations Division*
Report Reviewer:	Lisa Merritt

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1.0 PROJECT CONTEXT

Archaeological Services Inc. (ASI) was contracted by Aquafor Beech Ltd. to conduct a Stage 1 Archaeological Assessment (Background Research and Property Inspection) as part of the Loyalist Creek Erosion Control project in the City of Mississauga (Figure 1). This project involves an area of approximately 550 metres southeast along Loyalist Creek through a portion of Thornlodge Park, with some creek segments located within the residential properties on the south side of Thorn Lodge Drive.

All activities carried out during this assessment were completed in accordance with the *Ontario Heritage Act* (1990, as amended in 2018) and the 2011 *Standards and Guidelines for Consultant Archaeologists* (S & G), administered by the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI 2011), formerly the Ministry of Tourism, Culture and Sport.

1.1 Development Context

All work has been undertaken as required by the *Environmental Assessment Act*, RSO (Ministry of the Environment 1990 as amended 2010) and regulations made under the Act, and are therefore subject to all associated legislation. This project is being conducted in accordance with the Municipal Engineers' Association document *Municipal Class Environmental Assessment* (2000 as amended in 2007, 2011 and 2015).

Authorization to carry out the activities necessary for the completion of the Stage 1 archaeological assessment was granted by Aquafor Beech Ltd. on July 21, 2020.

1.2 Historical Context

The purpose of this section, according to the S & G, Section 7.5.7, Standard 1, is to describe the past and present land use and the settlement history and any other relevant historical information pertaining to the Study Area. A summary is first presented of the current understanding of the Indigenous land use of the Study Area. This is then followed by a review of the historical Euro-Canadian settlement history.

1.2.1 Indigenous Land Use and Settlement

Southern Ontario has been occupied by human populations since the retreat of the Laurentide glacier approximately 13,000 years before present (BP) (Ferris 2013). Populations at this time would have been highly mobile, inhabiting a boreal-parkland similar to the modern sub-arctic. By approximately 10,000 BP, the environment had progressively warmed (Edwards and Fritz 1988) and populations now occupied less extensive territories (Ellis and Deller 1990).

Between approximately 10,000-5,500 BP, the Great Lakes basins experienced low-water levels, and many sites which would have been located on those former shorelines are now submerged. This period produces the earliest evidence of heavy wood working tools, an indication of greater investment of labour in felling trees for fuel, to build shelter, and watercraft production. These activities suggest prolonged seasonal residency at occupation sites. Polished stone and native copper implements were being produced by approximately 8,000 BP; the latter was acquired from the north shore of Lake Superior, evidence of extensive exchange networks throughout the Great Lakes region. The earliest evidence for cemeteries

dates to approximately 4,500-3,000 BP and is indicative of increased social organization, investment of labour into social infrastructure, and the establishment of socially prescribed territories (Ellis et al. 1990; Ellis et al. 2009; Brown 1995:13).

Between 3,000-2,500 BP, populations continued to practice residential mobility and to harvest seasonally available resources, including spawning fish. The Woodland period begins around 2,500 BP and exchange and interaction networks broaden at this time (Spence et al. 1990:136, 138) and by approximately 2,000 BP, evidence exists for small community camps, focusing on the seasonal harvesting of resources (Spence et al. 1990:155, 164). By 1,500 BP there is macro botanical evidence for maize in southern Ontario, and it is thought that maize only supplemented people's diet. There is earlier phytolithic evidence for maize in central New York State by 2,300 BP - it is likely that once similar analyses are conducted on Ontario ceramic vessels of the same period, the same evidence will be found (Birch and Williamson 2013:13–15). As is evident in detailed Anishinaabek ethnographies, winter was a period during which some families would depart from the larger group as it was easier to sustain smaller populations (Rogers 1962). It is generally understood that these populations were Algonquian-speakers during these millennia of settlement and land use.

From the beginning of the Late Woodland period at approximately 1,000 BP, lifeways became more similar to that described in early historical documents. Between approximately 1000-1300 Common Era (CE), the communal site is replaced by the village focused on horticulture. Seasonal disintegration of the community for the exploitation of a wider territory and more varied resource base was still practised (Williamson 1990:317). By 1300-1450 CE, this episodic community disintegration was no longer practised and populations now communally occupied sites throughout the year (Dodd et al. 1990:343). From 1450-1649 CE this process continued with the coalescence of these small villages into larger communities (Birch and Williamson 2013). Through this process, the socio-political organization of the First Nations, as described historically by the French and English explorers who first visited southern Ontario, was developed.

By 1600 CE, the communities within Simcoe County had formed the Confederation of Nations encountered by the first European explorers and missionaries. In the 1640s, the traditional enmity between the Haudenosaunee and the Huron-Wendat (and their Algonquian allies such as the Nippissing and Odawa) led to the dispersal of the Huron-Wendat. Shortly afterwards, the Haudenosaunee established a series of settlements at strategic locations along the trade routes inland from the north shore of Lake Ontario. By the 1690s however, the Anishinaabeg were the only communities with a permanent presence in southern Ontario. From the beginning of the eighteenth century to the assertion of British sovereignty in 1763, there was no interruption to Anishinaabeg control and use of southern Ontario.

1.2.1 Treaties

The Study Area is within Treaty 13a, signed on August 2, 1805 by the Mississaugas and the British Crown in Port Credit at the Government Inn. A provisional agreement was reached with the Crown on August 2, 1805, in which the Mississaugas ceded 70,784 acres of land bounded by the Toronto Purchase of 1787 in the east, the Brant Tract in the west, and a northern boundary that ran six miles back from the shoreline of Lake Ontario. The Mississaugas also reserved the sole right of fishing at the Credit River and were to retain a one-mile strip of land on each of its banks, which became the Credit Indian Reserve. On September 5, 1806, the signing of Treaty 14 confirmed the Head of the Lake Purchase between the Mississaugas of the Credit and the Crown (Mississauga of the New Credit First Nation 2001; Mississaugas of the Credit First Nation 2017).

1.2.2 Euro-Canadian Land Use: Township Survey and Settlement

Historically, the Study Area is located in the Former Toronto Township, County of Peel in Lots 32-33 & Concession 1 South of Dundas Street (SDS).

The S & G stipulates that areas of early Euro-Canadian settlement (pioneer homesteads, isolated cabins, farmstead complexes), early wharf or dock complexes, pioneer churches, and early cemeteries are considered to have archaeological potential. Early historical transportation routes (trails, passes, roads, railways, portage routes), properties listed on a municipal register or designated under the *Ontario Heritage Act* or a federal, provincial, or municipal historic landmark or site are also considered to have archaeological potential.

For the Euro-Canadian period, the majority of early nineteenth century farmsteads (i.e., those that are arguably the most potentially significant resources and whose locations are rarely recorded on nineteenth century maps) are likely to be located in proximity to water. The development of the network of concession roads and railroads through the course of the nineteenth century frequently influenced the siting of farmsteads and businesses. Accordingly, undisturbed lands within 100 m of an early settlement road are also considered to have potential for the presence of Euro-Canadian archaeological sites.

The first Europeans to arrive in the area were transient merchants and traders from France and England, who followed Indigenous pathways and set up trading posts at strategic locations along the well-traveled river routes. All of these occupations occurred at sites that afforded both natural landfalls and convenient access, by means of the various waterways and overland trails, into the hinterlands. Early transportation routes followed existing Indigenous trails, both along the lakeshore and adjacent to various creeks and rivers (ASI 2006).

Toronto Township

At the conclusion of the American War of Independence (1774-1783), the British were forced to recognize the emergence of a new political frontier, one that had to be maintained by a strong military presence. In addition, a number of British loyalists travelled north and crossed the border in order to remain in British territory. Many of them were given land grants by the Crown in exchange for loyal service. These new developments ultimately led to the purchase of Mississauga land by the Crown in 1787 (although boundary disputes were not resolved until the signing of a treaty in 1805). The Study Area is located within these “New Survey” lands, which were surveyed in 1806.

The Township of Toronto was originally surveyed in 1806 by Mr. Wilmot, Deputy Surveyor. The first settler in this Township, and also the County of Peel, was Colonel Thomas Ingersoll. The whole population of the Township in 1808 consisted of seven families, scattered along Dundas Street. The number of inhabitants gradually increased until the war broke out in 1812, which gave considerable check to its progress. When the war was over, the Township’s growth revived, and the rear part of the Township was surveyed and called the “New Survey.” The greater part of the New Survey was granted to a colony of Irish settlers from New York City, who suffered persecution during the war (Walker and Miles 1877).

The Hamilton and Toronto Railway

The Hamilton and Toronto Railway was formed in 1852, and in 1855, completed its lake shore route across the south end of Lot 11. In 1871, the railway was amalgamated with the Great Western Railway,

which in turn, was amalgamated in 1882, with the Grand Trunk Railway. The Grand Trunk Railway was amalgamated in 1923, with Canadian National Railway (Andreae 1997:126–127).

1.2.3 Historical Map Review

The 1859 *Tremaine's Map of the County of Peel* (Tremaine 1859) and the 1877 *Illustrated Historical Atlas of the County of Peel,* Toronto Township page (Walker and Miles 1877) were examined to determine the presence of historic features within the Study Area during the nineteenth century (Table 1; Figures 2-3).

It should be noted, however, that not all features of interest were mapped systematically in the Ontario series of historical atlases, given that they were financed by subscription, and subscribers were given preference with regard to the level of detail provided on the maps. Moreover, not every feature of interest would have been within the scope of the atlases.

In addition, the use of historical map sources to reconstruct/predict the location of former features within the modern landscape generally proceeds by using common reference points between the various sources. These sources are then geo-referenced in order to provide the most accurate determination of the location of any property on historic mapping sources. The results of such exercises are often imprecise or even contradictory, as there are numerous potential sources of error inherent in such a process, including the vagaries of map production (both past and present), the need to resolve differences of scale and resolution, and distortions introduced by reproduction of the sources. To a large degree, the significance of such margins of error is dependent on the size of the feature one is attempting to plot, the constancy of reference points, the distances between them, and the consistency with which both they and the target feature are depicted on the period mapping.

Table 1: Nineteenth-century property owner(s) and historical features(s) within or adjacent to the Study Area

		1859		*1877*	
Con #	**Lot #**	**Property Owner(s)**	**Historical Feature(s)**	**Property Owner(s)**	**Historical Feature(s)**
1 SDS	32	General Adamson	Tributary	Charles Mitchel	Tributary, orchard
1 SDS	33	C. & T. Boyes	Tributary	Chas Johnson Saml Conorer	Tributary Tributary

The 1859 and 1877 maps indicate the only feature within the Study Area is Loyalist Creek. Dundas Street runs northwest of the Study Area. By 1877 an orchard is shown adjacent the Study Area to the southeast on Lot 32, Concession 1 South of Dundas Street, the property of Charles Mitchel.

1.2.4 Twentieth-Century Mapping Review

The 1915, 1942, and 1994 National Topographic Series (NTS) Brampton Sheets (Department of Militia and Defence 1915; Department of National Defence 1942; Department of Energy, Mines and Resources 1994), as well as the 1954 aerial imagery (Hunting Survey Corporation Limited 1954) were examined to determine the extent and nature of development and land uses within the Study Area (Figures 4-7).

The 1915 and 1942 maps show the Study Area has remained unchanged into the twentieth century. The 1954 aerial imagery shows the Study Area in open fields, and the original alignment of Loyalist Creek. By 1994, Thorn Lodge Drive has been constructed. It wraps around the Study Area and meets the Loyalist Creek at two points. The majority of the Study Area is within greenspace, with residential subdivisions surrounding its length.

Section 8.0 includes a series of aerial photography between 1966 and 2015 (City of Mississauga) serving to highlight the construction of residential subdivisions adjacent the Study Area (Image 1) and the channelization of Loyalist Creek (Images 2-5).

1.3 Archaeological Context

This section provides background research pertaining to previous archaeological fieldwork conducted within and in the vicinity of the Study Area, its environmental characteristics (including drainage, soils or surficial geology and topography, etc.), and current land use and field conditions. Three sources of information were consulted to provide information about previous archaeological research: the site record forms for registered sites available online from the MHSTCI through "Ontario's Past Portal"; published and unpublished documentary sources; and the files of ASI.

1.3.1 Current Land Use and Field Conditions

A review of available Google satellite imagery since 2004 shows that the Study Area has remained relatively unchanged.

A Stage 1 property inspection was conducted on Thursday September 10, 2020 that noted that most of the Study Area is within Thornlodge Park, located on the south side of Thorn Lodge Drive. The Study Area is bounded by residential subdivisions and St. Francis of Assisi Catholic School. Loyalist Creek within the Study Area has been channelized with multi-tier armourstone and gabion banks. The armourstone banks extend from upstream to just downstream of the pedestrian bridge off Thorn Lodge Drive where it transitions to a gabion channel extending to the second crossing of Thorn Lodge Drive. The banks of the Loyalist Creek are sloped from channelization. The Study Area includes a wooded lot and walking paths. Figure 11 demonstrates the topographic survey of existing features provided by Aquafor Beech Ltd. for the Study Area.

1.3.2 Geography

In addition to the known archaeological sites, the state of the natural environment is a helpful indicator of archaeological potential. Accordingly, a description of the physiography and soils are briefly discussed for the Study Area.

The S & G stipulates that primary water sources (lakes, rivers, streams, creeks, etc.), secondary water sources (intermittent streams and creeks, springs, marshes, swamps, etc.), ancient water sources (glacial lake shorelines indicated by the presence of raised sand or gravel beach ridges, relic river or stream channels indicated by clear dip or swale in the topography, shorelines of drained lakes or marshes, cobble beaches, etc.), as well as accessible or inaccessible shorelines (high bluffs, swamp or marsh fields by the

edge of a lake, sandbars stretching into marsh, etc.) are characteristics that indicate archaeological potential.

Water has been identified as the major determinant of site selection and the presence of potable water is the single most important resource necessary for any extended human occupation or settlement. Since water sources have remained relatively stable in Ontario since 5,000 BP (Karrow and Warner 1990:Figure 2.16), 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.

Other geographic characteristics that can indicate archaeological potential include: elevated topography (eskers, drumlins, large knolls, and plateaux), pockets of well-drained sandy soil, especially near areas of heavy soil or rocky ground, distinctive land formations that might have been special or spiritual places, such as waterfalls, rock outcrops, caverns, mounds, and promontories and their bases. There may be physical indicators of their use, such as burials, structures, offerings, rock paintings or carvings. Resource areas, including; food or medicinal plants (migratory routes, spawning areas) are also considered characteristics that indicate archaeological potential (S & G, Section 1.3.1).

The Study Area is located within the shale plains of the Iroquois Plain physiographic region of southern Ontario (Chapman and Putnam 1984).

The Iroquois Plain physiographic region of southern Ontario is a lowland region bordering Lake Ontario. This region is characteristically flat, and formed by lacustrine deposits laid down by the inundation of Lake Iroquois, a body of water that existed during the late Pleistocene. This region extends from the Trent River, around the western part of Lake Ontario, to the Niagara River, spanning a distance of 300 km (Chapman and Putnam 1984:190). The old shorelines of Lake Iroquois include cliffs, bars, beaches and boulder pavements. The old sandbars in this region are good aquifers that supply water to farms and villages. The gravel bars are quarried for road and building material, while the clays of the old lake bed have been used for the manufacture of bricks (Chapman and Putnam 1984:196).

Figure 8 depicts surficial geology for the Study Area. The surficial geology mapping demonstrates that the Study Area is underlain by clay to silt-textured till and Paleozoic bedrock (Ontario Geological Survey 2010). Soils in the Study Area consist of Oneida clay loam, a grey-brown podzolic with good drainage; Cooksville clay loam, a grey-brown podzolic with imperfect drainage; and Bottom Land, an alluvial with variable drainage (Figure 9).

The Study Area is along Loyalist Creek, within the Loyalist Creek subwatershed of the Credit River watershed. Loyalist Creek is a small tributary of the Credit River, originating near Winston Churchill Boulevard and Dundas Street West, draining into the Credit River east of Mississauga Road near Blythe Road (Credit Valley Conservation 2009a).

The Credit River watershed drains an area of approximately 860 square kilometres from its headwaters in Orangeville, Erin, and Mono, passing through part of the Niagara Escarpment and the Oak Ridges Moraine, and draining into Lake Ontario at the town of Port Credit (Credit Valley Conservation 2009b). The river was named "*Mis.sin.ni.he*" or "*Mazinigae-zeebi*" by the Mississaugas, and surveyor Augustus Jones believed this signified "the trusting creek", or could also be translated as "to write or give and make credit", while the French name used when the river was first mapped in 1757 was "*Riviere au Credit*". These names refer to the fur trading period, when the French, British, and Indigenous traders would meet along this river (Jameson 1838:73–74; Smith 1987:255–257; Rayburn 1997:84; Scott 1997:182; Gibson

2002:177; Robb et al. 2003:6). The Credit River was historically considered to be one of the best potential power sources for milling in all of southern Ontario, which led to the development of early of saw and grist mill industries, and later textile mills, distilleries, bottling plants, and hydro-electric plants spawned communities throughout the river valley, typically close to the Niagara Escarpment (Town of Caledon 2009:7.1).

1.3.3 Previous Archaeological Research

In Ontario, information concerning archaeological sites is stored in the Ontario Archaeological Sites Database (OASD) maintained by the MHSTCI. This database contains archaeological sites registered within the Borden system. Under the Borden system, Canada has been divided into grid blocks based on latitude and longitude. A Borden block is approximately 13 km east to west, and approximately 18.5 km north to south. Each Borden block is referenced by a four-letter designator, and sites within a block are numbered sequentially as they are found. The Study Area under review is located in Borden blocks *AjGw* and *AjGv*.

According to the OASD, one previously registered archaeological site is located within one kilometre of the Study Area, which is not within 50 metres of the Study Area (MHSTCI 2020). A summary of the site is provided below.

Table 2: List of previously registered sites within one kilometre of the Study Area

Borden #	Site Name	Cultural Affiliation	Site Type	Researcher
AjGv-76	Shaft 3 FS 1	Pre-Contact Indigenous; Euro-Canadian	Unspecified; Homestead;	ARA 2011, 2012

ARA – Archaeological Research Associates Ltd.

According to the background research, no previous reports detail fieldwork within 50 m of the Study Area.

2.0 FIELD METHODS: PROPERTY INSPECTION

A Stage 1 property inspection must adhere to the S & G, Section 1.2, Standards 1-6, which are discussed below. The entire property and its periphery must be inspected. The inspection may be either systematic or random. Coverage must be sufficient to identify the presence or absence of any features of archaeological potential. The inspection must be conducted when weather conditions permit good visibility of land features. Natural landforms and watercourses are to be confirmed if previously identified. Additional features such as elevated topography, relic water channels, glacial shorelines, well-drained soils within heavy soils and slightly elevated areas within low and wet areas should be identified and documented, if present. Features affecting assessment strategies should be identified and documented such as woodlots, bogs or other permanently wet areas, areas of steeper grade than indicated on topographic mapping, areas of overgrown vegetation, areas of heavy soil, and recent land disturbance such as grading, fill deposits and vegetation clearing. The inspection should also identify and document structures and built features that will affect assessment strategies, such as heritage structures or landscapes, cairns, monuments or plaques, and cemeteries.

The Stage 1 archaeological assessment property inspection was conducted under the field direction of Alexis Dunlop (P1146) of ASI, on September 10, 2020, in order to gain first-hand knowledge of the geography, topography, and current conditions and to evaluate and map archaeological potential of the Study Area. It was a visual inspection from publicly accessible lands and did not include excavation or collection of archaeological resources.

Fieldwork was conducted when weather conditions were deemed clear with good visibility (overcast and seasonally warm), per S & G Section 1.2., Standard 2. Field observations are compiled onto the existing conditions of the Study Area in Section 7.0 (Figures 10-11) and associated photographic plates are presented in Section 8.0 (Plates 1-10).

3.0 ANALYSIS AND CONCLUSIONS

The historical and archaeological contexts have been analyzed to help determine the archaeological potential of the Study Area. Results of the analysis of the Study Area property inspection and background research are presented in Section 3.1.

3.1 Analysis of Archaeological Potential

The S & G, Section 1.3.1, lists criteria that are indicative of archaeological potential. The Study Area meets the following criteria indicative of archaeological potential:

- Previously identified archaeological sites (AjGv-76);
- Water sources: primary, secondary, or past water source (Loyalist Creek);
- Early historic transportation routes (Dundas Street); and
- Well-drained soils (Oneida clay loam)

According to the S & G, Section 1.4 Standard 1e, no areas within a property containing locations listed or designated by a municipality can be recommended for exemption from further assessment unless the area can be documented as disturbed. The Municipal Heritage Register was consulted and no properties within the Study Area are Listed or Designated under the Ontario Heritage Act.

The criteria listed above are indicative of potential for the identification of Indigenous and Euro-Canadian archaeological resources, depending on soil conditions and the degree to which soils have been subject to deep disturbance.

The property inspection determined that the Study Area exhibits archaeological potential. These areas will require Stage 2 archaeological assessment prior to any development. According to the S & G Section 2.1.2, test pit survey is required on terrain where ploughing is not viable, such as wooded areas, properties where existing landscaping or infrastructure would be damaged, overgrown farmland with heavy brush or rocky pasture, and narrow linear corridors up to 10 metres wide (Plates 1, 4, 6, 9; Figure 10: areas highlighted in green).

The remainder of the Study Area has been subjected to deep soil disturbance events, including the channelization of Loyalist Creek, additions of retaining walls, ditches, culverts, storm sewer outfall, and residential construction, and according to the S & G Section 1.3.2 do not retain archaeological potential (Plates 1, 3, 5, 7-8, 10; Figure 10: areas highlighted in yellow). These areas do not require further survey.

3.2 Conclusions

The Stage 1 background study determined that one previously registered archaeological sites are located within one kilometre of the Study Area. The property inspection determined that parts of the Study Area exhibit archaeological potential and will require Stage 2 assessment.

4.0 RECOMMENDATIONS

In light of these results, the following recommendations are made:

1. The Study Area exhibits archaeological potential. These lands require Stage 2 archaeological assessment by test pit survey at five metre intervals, where appropriate, prior to any proposed impacts to the property;

2. The remainder of the Study Area does not retain archaeological potential on account of deep and extensive land disturbance. These lands do not require further archaeological assessment; and,

3. Should the proposed work extend beyond the current Study Area, further Stage 1 archaeological assessment should be conducted to determine the archaeological potential of the surrounding lands.

NOTWITHSTANDING the results and recommendations presented in this study, ASI notes that no archaeological assessment, no matter how thorough or carefully completed, can necessarily predict, account for, or identify every form of isolated or deeply buried archaeological deposit. In the event that archaeological remains are found during subsequent construction activities, the consultant archaeologist, approval authority, and the Cultural Programs Unit of the MHSTCI should be immediately notified.

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

ASI also advises compliance with the following legislation:

- This report is submitted to the Ministry of Heritage, Sport, Tourism and Culture Industries as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, RSO 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological field work and report recommendations ensure the conservation, preservation and protection of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Heritage, Sport, Tourism and Culture Industries, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

- It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological field work on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

- Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48 (1) of the *Ontario Heritage Act*.

- The *Cemeteries Act*, R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

6.0 REFERENCES CITED

Ambrose, M.T.
1982 *An Archaeological Survey of Highway 407 from Highway 10 to Airport Road (W.P. 87-78-00), Regional Municipality of Peel*. Report on file with the Ontario Ministry of Heritage, Sport, Tourism and Culture Industries, Toronto.

Andreae, C.
1997 *Lines of Country: An Atlas of Railway and Waterway History in Canada*. Boston Mills Press, Erin, Ontario.

ASI, (Archaeological Services Inc.)
2006 *Historical Overview and Assessment of Archaeological Potential Don River Watershed, City of Toronto*. Report on file with the Ontario Ministry of Heritage, Sport, Tourism and Culture Industries, Toronto.

2013 *Archaeological Management Plan for the Region of York*. Long Range Planning, York Region.

Assikinack, F.
1858 Legends and Traditions of the Odawa Indians. *The Canadian Journal, Second Series* III:115–125.

Biggar, H.P., ed,
1971 *The Works of Samuel De Champlain. Translated by H.H. Langton and W.F. Ganong 1922-1936*. 6 vols. The Champlain Society, Toronto, Ontario.

Birch, J., and R.F. Williamson
2013 *The Mantle Site: An Archaeological History of an Ancestral Wendat Community*. Rowman & Littlefield Publishers, Inc., Latham.

Bowman, I.
1975 *History of the Peninsula Portage and Canoe Route: Colpoy's Bay to Lake Huron - with an Overview of Indian Occupation of the Bruce Peninsula*. Toronto.

Brown, J.
1995 On Mortuary Analysis – with Special Reference to the Saxe-Binford Research Program. In *Regional Approaches to Mortuary Analysis*, L. A. Beck, ed, pp. 3–23. Plenum Press, New York.

Chapman, L.J., and F. Putnam
1984 *The Physiography of Southern Ontario*. Vol. 2. Ontario Geologic Survey, Special Volume. Ontario Ministry of Natural Resources, Toronto.

City of Mississauga
Mississauga City Mosaics. http://www6.mississauga.ca/missmaps/maps.aspx#map=12/-8872114.52/5390002.6/0.9075712110370514.

Mississauga City Mosaics. http://www6.mississauga.ca/missmaps/maps.aspx#map=17/-8868660.17/5392654.42/0.9075712110370517.

Copway, G.
1850 *The Traditional History and Characteristic Sketches of the Ojibway Nation*. Charles Gilpin, London.

1851 *The Traditional History and Characteristic Sketches of the Ojibway Nation.* Benjamin B. Mussey & Co., Boston.

1858 *Indian Life and Indian History*. Albert Colby and Company, Boston.

Credit Valley Conservation
2009a 1, 2, 3, 4 - Loyalist, Carolyn, Sawmill and Mullet Creek Subwatersheds. http://www.creditvalleyca.ca/wp-content/uploads/2012/06/Sub1234_Final-_20120604.pdf.

2009b *Rising to the Challenge: A Handbook for Understanding and Protecting the Credit River Watershed*.

Department of Energy, Mines and Resources
1994 Brampton Sheet 30M/12. National Topographic System.

Department of Militia and Defence
1915 Brampton Sheet N35.

Department of National Defence
1942 Brampton Sheet. National Topographic System.

Dodd, C.F., D.R. Poulton, P.A. Lennox, D.G. Smith, and G.A. Warrick
1990 The Middle Ontario Iroquoian Stage. In *The Archaeology of Southern Ontario to A.D. 1650*, C. J. Ellis and N. Ferris, eds, pp. 321–360. Occasional Publication of the London Chapter OAS Number 5. Ontario Archaeological Society Inc., London, ON.

Edwards, T.W.D., and P. Fritz
1988 Stable-Isotope Palaeoclimate Records from Southern Ontario, Canada: Comparison of Results from Marl and Wood. *Canadian Journal of Earth Sciences* 25:1397–1406.

Ellis, C.J., and D.B. Deller
1990 Paleo-Indians. In *The Archaeology of Southern Ontario to A.D. 1650*, C. J. Ellis and N. Ferris, eds, pp. 37–64. Occasional Publication of the London Chapter OAS Number 5. Ontario Archaeological Society Inc., London, ON.

Ellis, C.J., I.T. Kenyon, and M.W. Spence
1990 The Archaic. In *The Archaeology of Southern Ontario to A.D. 1650*, C. J. Ellis and N. Ferris, eds, pp. 65–124. Occasional Publication of the London Chapter OAS Number 5. Ontario

Archaeological Society Inc., London, ON.

Ellis, C.J., P.A. Timmins, and H. Martelle
2009 At the Crossroads and Periphery: The Archaic Archaeological Record of Southern Ontario. In *Archaic Societies: Diversity and Complexity across the Midcontinent.*, T. D. Emerson, D. L. McElrath, and A. C. Fortier, eds, pp. 787–837. State University of New York Press, Albany, New York.

Ferris, N.
2013 Place, Space, and Dwelling in the Late Woodland. In *Before Ontario: The Archaeology of a Province*, pp. 99–111. McGill-Queen's University Press. http://www.jstor.org/stable/j.ctt32b7n5.15.

Gibson, M.M.
2002 Changes at the River's Mouth: The Port Credit Community. In *Mississauga: The First Ten Thousand Years*. F.A. Dieterman. Eastend Books, Toronto.

Gould, A.
1981 *History of the Mississauga Indians. Appendix to the Maracle Site Report*.

Heritage Mississauga
2012 Heritage Guide: Mississauga. <http://www.heritagemississauga.com/assets/Heritage%20Guide%20-%20Final%20-%202012.pdf>.

2019 Port Credit. http://www.heritagemississauga.com/page/Port-Credit.

Hunting Survey Corporation Limited
1954 Digital Aerial Photographs. https://mdl.library.utoronto.ca/collections/air-photos/1954-air-photos-southern-ontario/index.

Jameson
1838 *Winter Studies and Summer Rambles in Canada*. London.

Johnson, I.V.B.
1986 The Early Mississauga Treaty Process, 1781-1819 in Historical Perspective. PhD Dissertation, University of Toronto.

Johnston, D.
2004 *Connecting People to Place: Great Lakes Aboriginal in Cultural Context*. Unpublished paper prepared for the Ipperwash Commission of Inquiry. http://www.attorneygeneral.jus.gov.on.ca/inquiries/ipperwash/transcripts.pdf.

Jones, P.
1861 *History of the Ojebway Indians : With Especial Reference to Their Conversion to Christianity*. A. W. Bennett, London. https://archive.org/details/historyofojebway00jonerich.

Karrow, P.F., and B.G. Warner
1990 The Geological and Biological Environment for Human Occupation in Southern Ontario. In *The Archaeology of Ontario to A.D. 1650*, pp. 5–36. Occasional Publications 5. London Chapter, Ontario Archaeological Society, London.

Konrad, V.A.
1974 Iroquois Villages on the North Shore of Lake Ontario, 1665-1687. presented at the Fall Meeting of the Ontario Historical Geographers, November 9, Carleton University, Ottawa, Ontario.

1981 An Iroquois Frontier: The North Shore of Lake Ontario during the Late Seventeenth Century. *Journal of Historical Geography* 7(2):129–144.

MacLeod, P.
1992 The Anishinabeg Point of View: The History of the Great Lakes Region to 1800 in Nineteenth-Century Mississauga, Odawa, and Ojibwa Historiography. *Canadian Historical Review* 73(2):194–210.

MHSTCI, (Ministry of Heritage, Sport, Tourism and Culture Industries)
1990 *Ontario Heritage Act, R.S.O. 1990, c. O.18 [as Amended in 2019]*.

2020 Ontario's Past Portal. *PastPortal*. https://www.pastport.mtc.gov.on.ca.

Ministry of the Environment
1990 Environmental Assessment Act, R.S.O. Province of Ontario.

Ministry of Tourism and Culture
2011 *Standards and Guidelines for Consultant Archaeologists*. Cultural Programs Branch, Ontario Ministry of Tourism and Culture, Toronto.

Mississauga of the New Credit First Nation
2001 *Toronto Purchase Specific Claim: Arriving at an Agreement*. Hagersville.

Mississaugas of the Credit First Nation
2014 History. http://www.newcreditfirstnation.com/our-culture.html.

2017 Treaty Lands and Territory. http://mncfn.ca/category/treaty-lands-and-territory/.

Municipal Engineers Association
2000 *Municipal Class Environmental Assessment, Last Amended 2015*.

Ontario Geological Survey
2010 Surficial Geology of Southern Ontario. Miscellaneous Release — Data 128 – Revised. http://www.geologyontario.mndm.gov.on.ca/mndmaccess/mndm_dir.asp?type=pub&id=MRD128-REV.

Paudash, R.
1905 The Coming of the Mississagas. *Ontario Historical Society Papers and Records* 6(190).

Rayburn, A.
1997 *Place Names of Ontario*. University of Toronto Press, Toronto.

Robb, G., P. Dilse, H. Henderson, B. Hermsen, W. Shearer, and P. Stewart
2003 *Heritage Conservation Feasibility Study of Old Port Credit Village, Stage 1 Report. Prepared for the City of Mississauga*. November 28.

Schmalz, P.S.
1977 *The History of the Saugeen Indians*. Ontario Historical Society, Ottawa.

1991 *The Ojibwa of Southern Ontario*. University of Toronto Press.

Scott, W.B.
1997 *Ontario Place Names: The Historical, Offbeat or Humorous Origins of More Than 1,000 Communities*. Lone Pine Publishing, Edmonton.

Smith, D.B.
1975 Who Are the Mississauga? *Ontario History* 67(4):311–222.

Smith, D.B.
1987 *Sacred Feathers: The Reverend Peter Jones (Kahkewaquonaby) & the Mississauga Indians*. University of Toronto Press, Toronto.

Smith, D.B.
2000 Kahgegagahbowh. *Dictionary of Canadian Biography Online*. http://www.biographi.ca/009004-119.01-e.php?&id_nbr=4517.

Spence, M.W., R.H. Pihl, and C. Murphy
1990 Cultural Complexes of the Early and Middle Woodland Periods. In *The Archaeology of Southern Ontario to A.D. 1650*, C. J. Ellis and N. Ferris, eds. Occasional Publication of the London Chapter OAS Number 5. Ontario Archaeological Society Inc., London.

Surtees, R.
1985 *A Cartographic Analysis of Indian Settlements and Reserves in Southern Ontario and Southern Quebec, 1763-1867. Research Branch, Indian and Northern Affairs Canada, Ottawa.*

Tanner, H. H., ed,
1987 *Atlas of the Great Lakes Indian History*. Oklahoma University Press, Norman.

Thwaites, R.G.
1896 *The Jesuit Relations and Allied Documents: Travel and Explorations of the Jesuit Missionaries in New France, 1610-1791; the Original French, Latin, and Italian Texts, with English Translations and Notes*. 73 vols. Burrows Brothers, Cleveland.

Town of Caledon
2009 *Cultural Heritage Landscape Inventory Report*.

Tremaine, G.C.
1859 Tremaine's Map of the County of Peel. George C. Tremaine, Toronto.

Von Gernet, A.
2002 *'Within the Prick'd Line': The Historical Context of the 1701 Deed from the Iroquois to the King of England of a Vast Tract of Land. Report Prepared for the Province of Ontario.*

Walker and Miles
1877 Illustrated Historical Atlas of the County of Peel, Ont. Walker and Miles, Toronto.

Williamson, R.F.
1990 The Early Iroquoian Period of Southern Ontario. In *The Archaeology of Southern Ontario to A.D. 1650*, C. J. Ellis and N. Ferris, eds, pp. 291–320. Occasional Publication of the London Chapter OAS Number 5. Ontario Archaeological Society Inc., London.

Williamson, R.F., D.A. Robertson, M.S. Cooper, R.I. MacDonald, S.J. Austin, and R.H. Pihl
2008 Life and Death at the Quarry: The Early Woodland Archaeology of the Peace Bridge Site. *Ontario Archaeology* 85–88:39–68.

Woodland Indian Cultural Education Centre
1985 Mississaugas of New Credit Reserve: Community Profile. <http://www.casbrant.ca/files/upload/Mississaugas%20of%20the%20New2.pdf>.

7.0 MAPS

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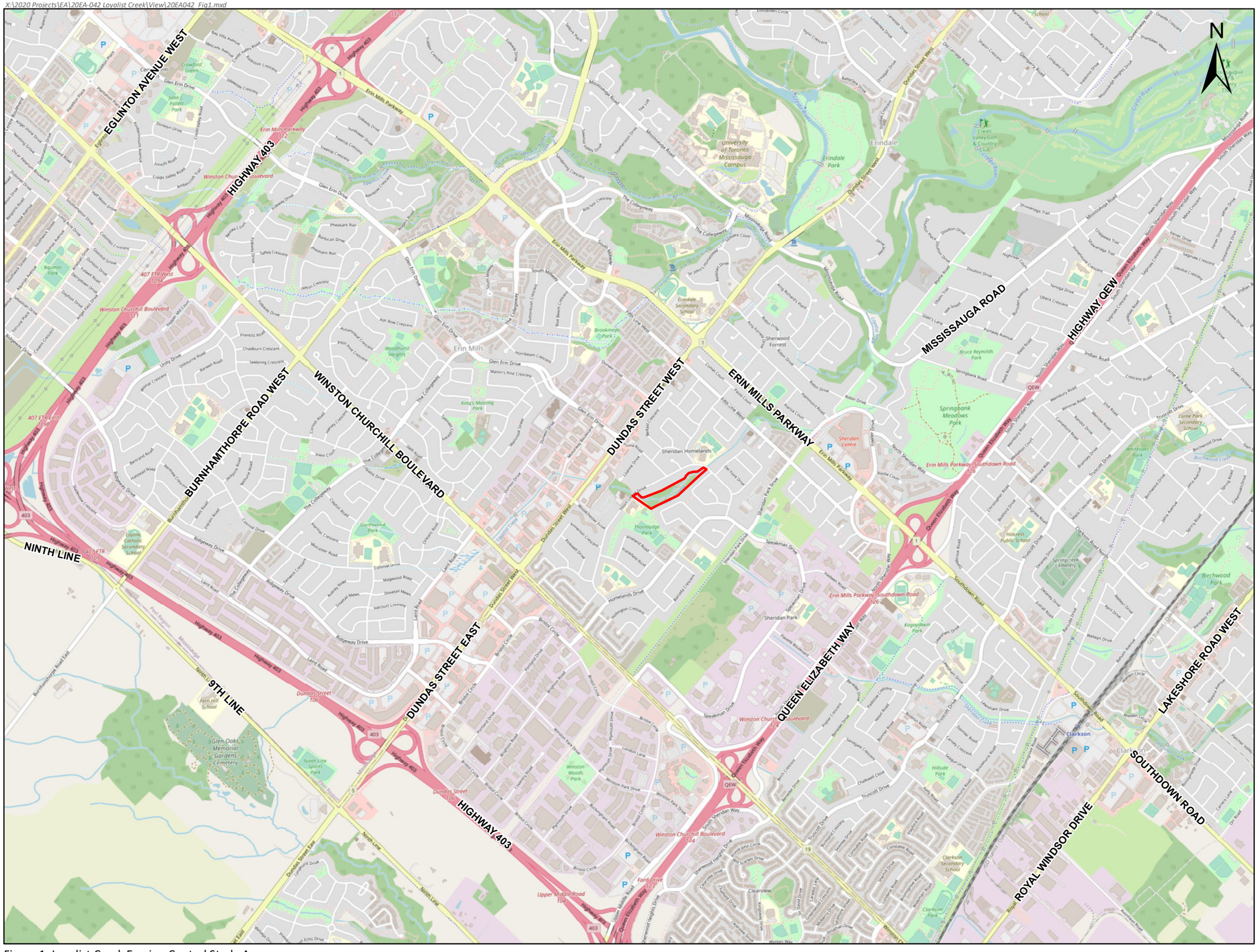

STUDY AREA

Sources:
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ASI PROJECT NO.: 20EA-042
DATE: 2020-09-03

DRAWN BY: A.C.
FILE: 20EA042_Fig1

Providing Archaeological & Cultural Heritage Services
528 Bathurst Street Toronto, ONTARIO M5S 2P9
T 416-966-1069 F 416-966-9723 asiheritage.ca

Figure 1: Loyalist Creek Erosion Control Study Area

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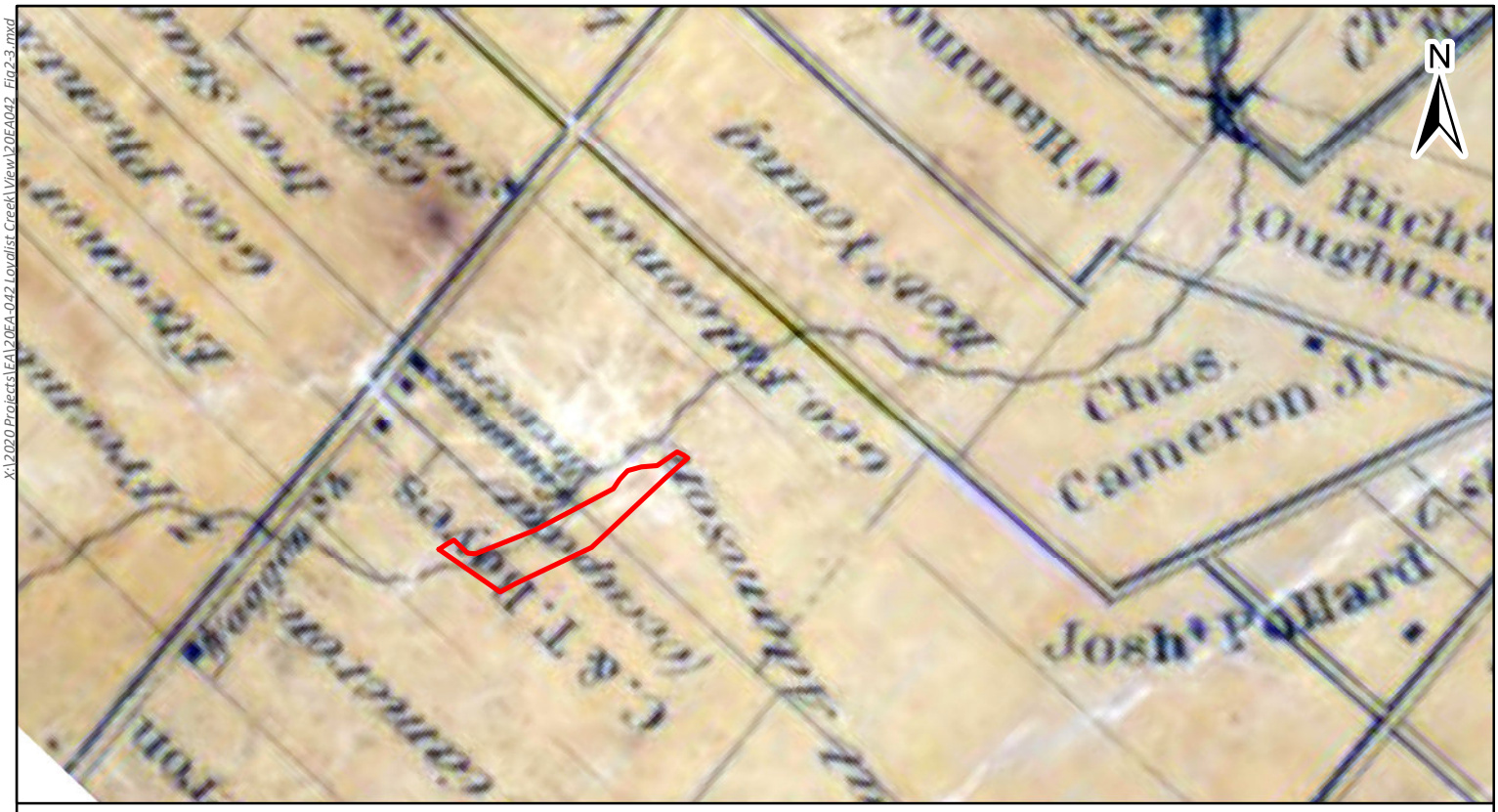

Figure 2: Study Area (Approximate Location) Overlaid on the 1859 Tremaine's Map of the County of Peel

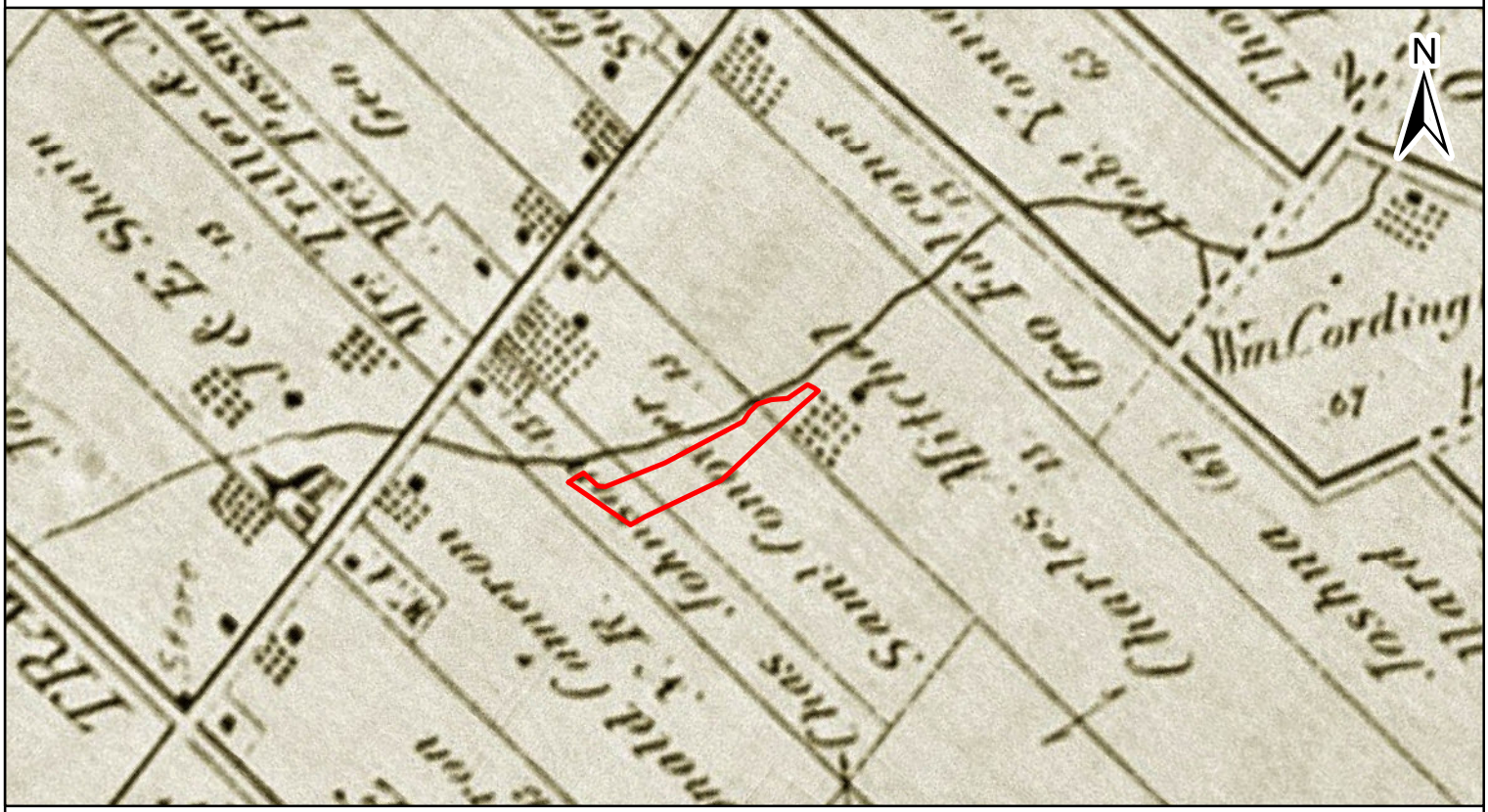

Figure 3: Study Area (Approximate Location) Overlaid on the 1877 Illustrated Historical Atlas of County of Peel

ASI

STUDY AREA

Sources:

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ASI PROJECT NO.: 20EA-042 DRAWN BY: A.C.
DATE: 2020-09-11 FILE: 20EA042_Fig2-3

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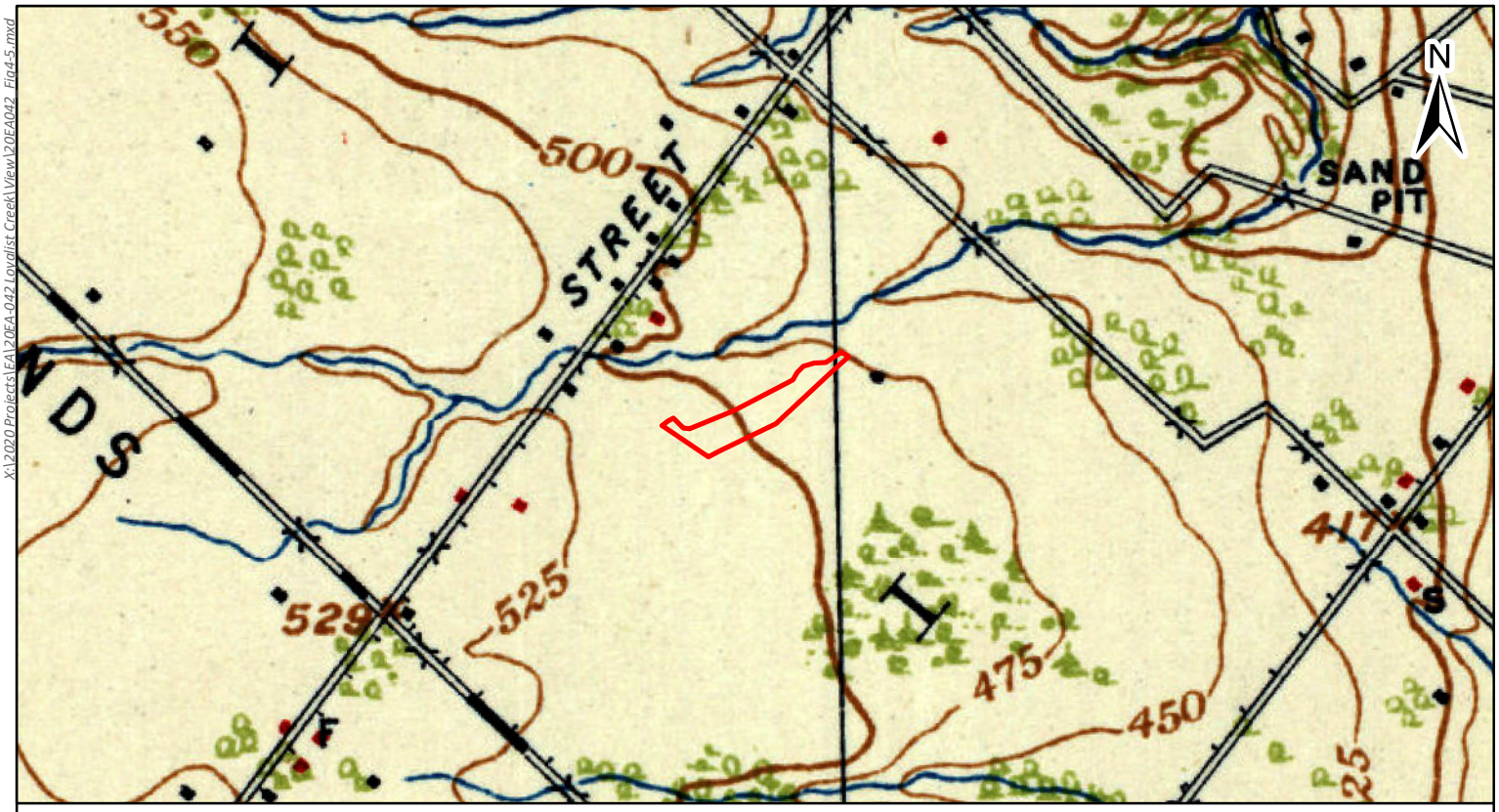

Figure 4: Study Area (Approximate Location) Overlaid on the 1915 NTS Brampton Sheet

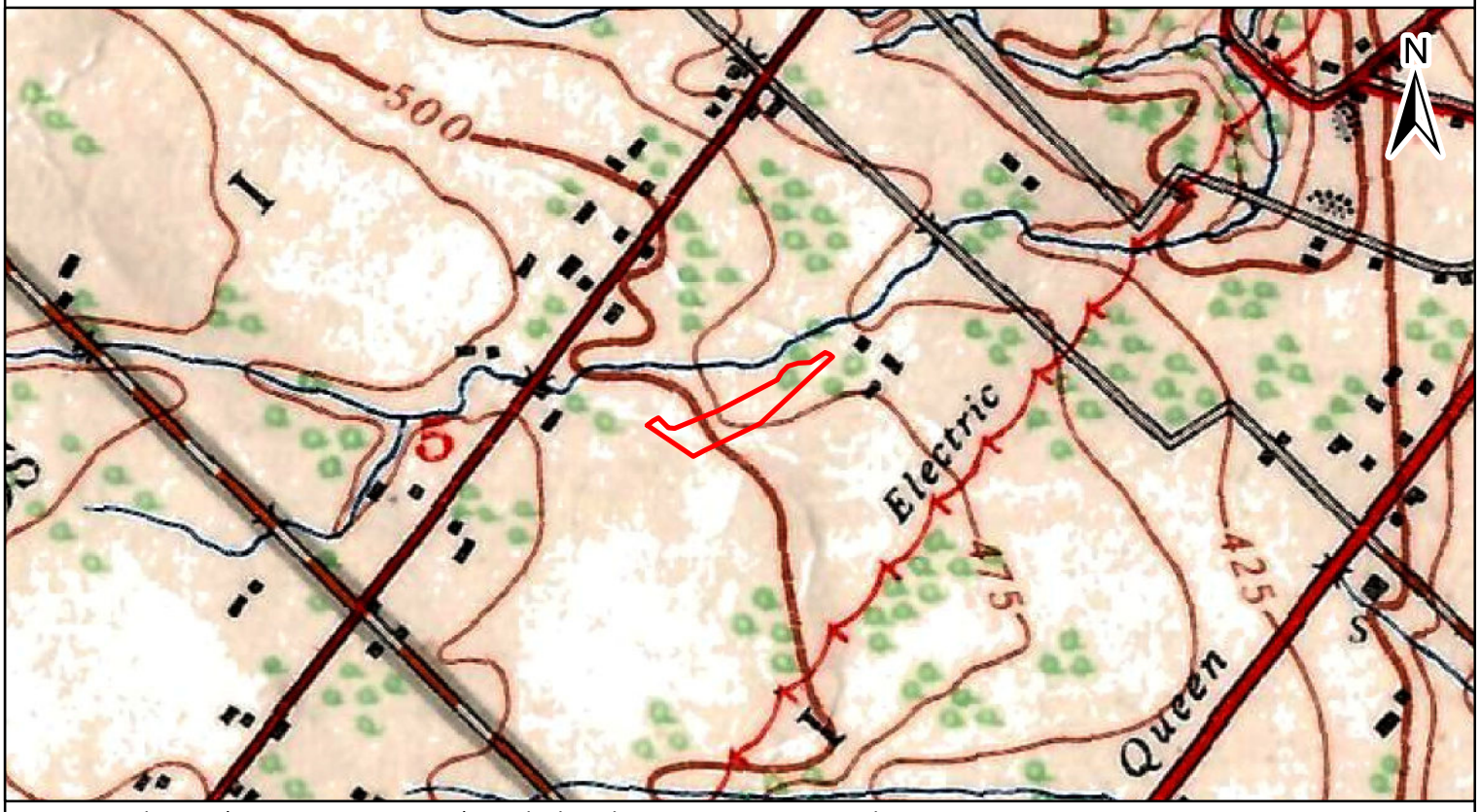

Figure 5: Study Area (Approximate Location) Overlaid on the 1942 NTS Brampton Sheet

ASI

STUDY AREA

Sources:

Projection: NAD 1983 UTM Zone 17N
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Page Size: 8.5 x 11

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Metres

ASI PROJECT NO.: 20EA-042 DRAWN BY: A.C.
DATE: 2020-09-11 FILE: 20EA042_Fig4-5

X:\2020 Projects\EA\20EA-042 Loyalist Creek\View\20EA042_Fig6-7.mxd

Figure 6: Study Area (Approximate Location) Overlaid on the 1954 Aerial Photography

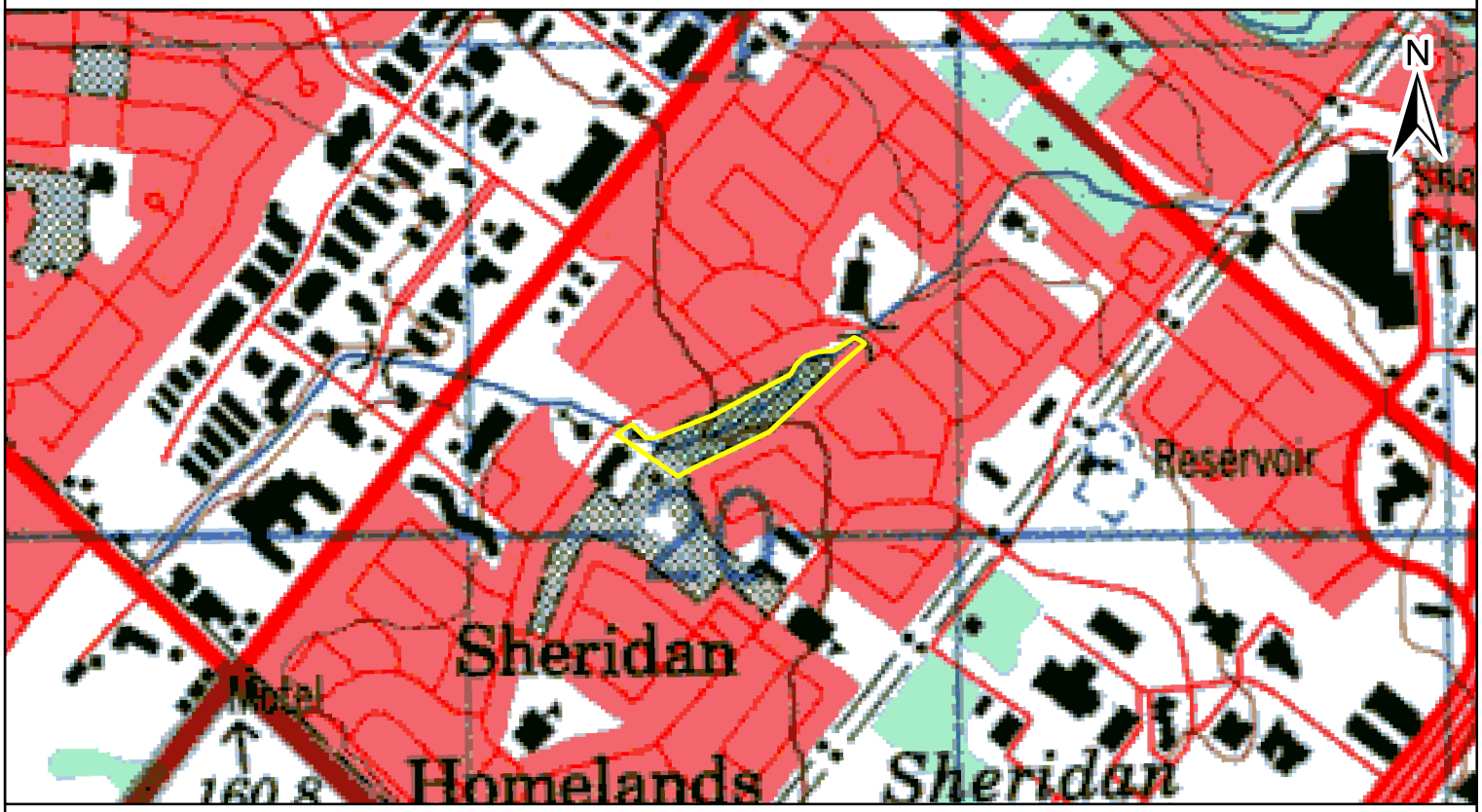

Figure 7: Study Area (Approximate Location) Overlaid on the 1994 NTS Brampton Sheet

ASI

STUDY AREA

Sources:

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DATE: 2020-09-11 FILE: 20EA042_Fig6-7

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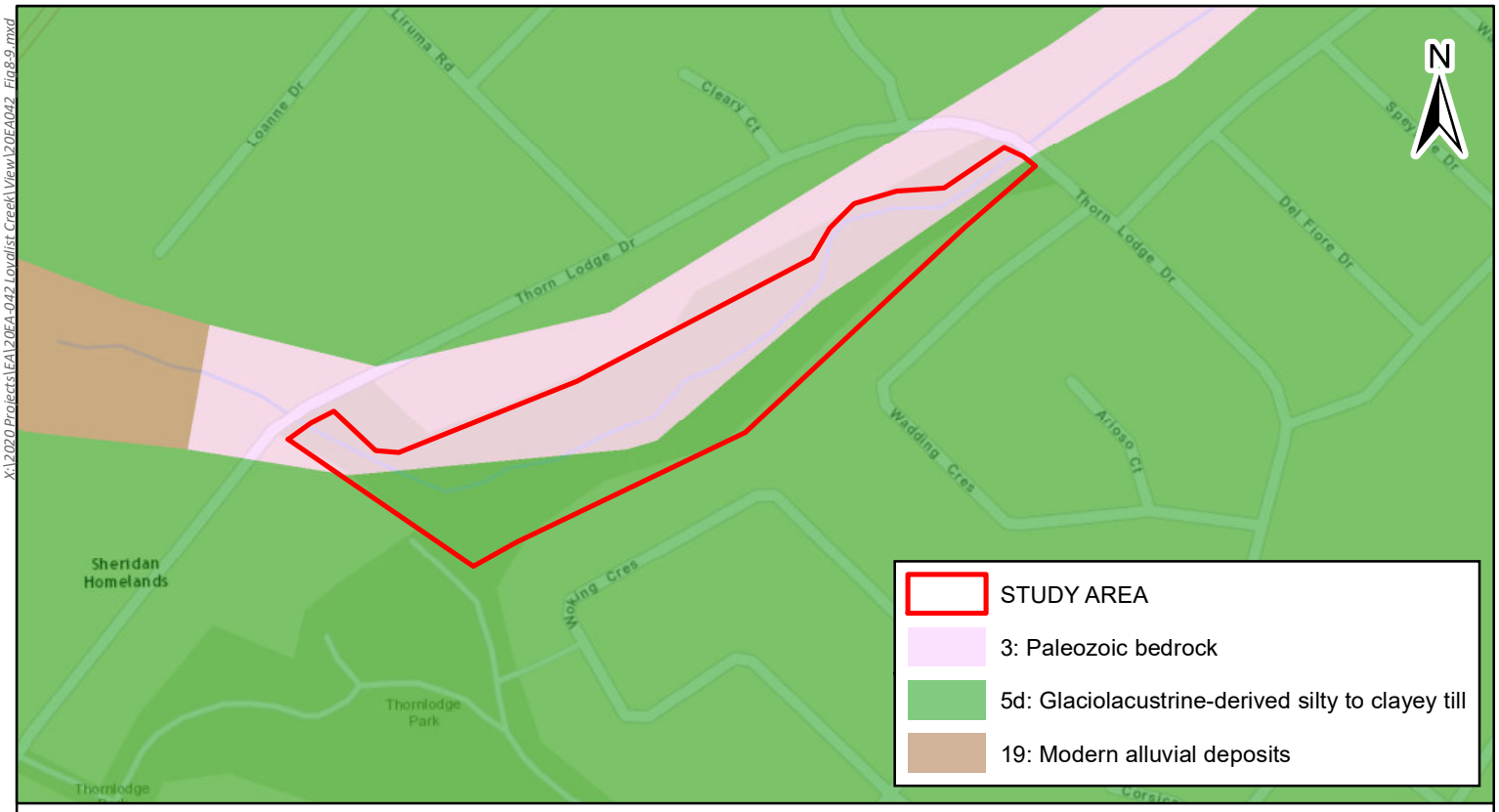

Figure 8: Study Area - Surficial Geology

Figure 9: Study Area - Soil Drainage

ASI

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)

Projection: NAD 1983 UTM Zone 17N
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DATE: 2020-09-11 FILE: 20EA042_Fig8-9

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STUDY AREA

PHOTO LOCATION AND DIRECTION

DISTURBED: NO POTENTIAL

TEST PIT SURVEY (5M INTERVALS)

GeoEye, Maxar, Microsoft

Projection: NAD 1983 UTM Zone 17N
Scale: 1:1,300
Page Size: 11 x 17

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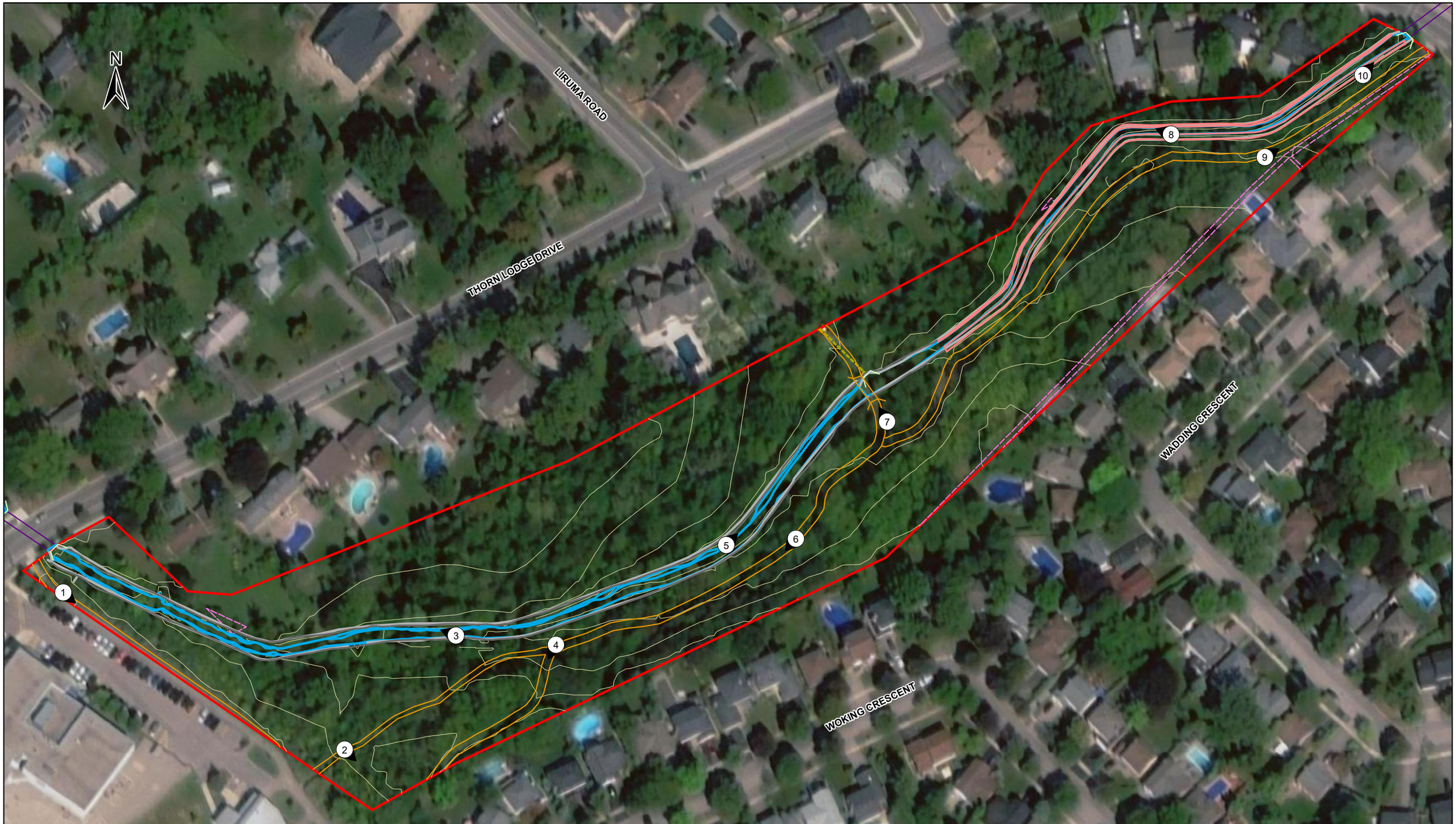
Metres

ASI Project No.: 20EA-042
Date: 2021-01-07 5:00 PM

Drawn By: cnettleton
File: 11x17_Landscape

Figure 10: Loyalist Creek - Results of Stage 1



ASI

STUDY AREA
PHOTO LOCATION AND DIRECTION
TRAIL
EXISTING OUTLET
ARMOURSTONE
GABION BASKET
RETAINING WALL
WATERCOURSE
STORMWATER MAIN
EASEMENT
CONTOUR LINE
CULVERT

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Projection: NAD 1983 UTM Zone 17N
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Page Size: 11 x 17

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Metres

ASI PROJECT NO.: 20EA-042
DATE: 2021-02-05
DRAWN BY: A.C.
FILE: 20EA042_Fig11

Figure 11: Topographic Survey and Existing Features/Utilities

8.0 IMAGES

Plate 1: View of Thornlodge Park Trail; Grassed area requires Stage 2 Survey

Plate 2: View from trail of culvert; Area is disturbed from ditch creation, no potential

Plate 3: View of Loyalist Creek; Creek has been disturbed from channelization, no potential

Plate 4: View from trail; Area beyond trail requires Stage 2 Survey

Plate 5: View of Loyalist Creek; Creek has been disturbed from channelization, no potential

Plate 6: View of trail; Beyond trail requires Stage 2 Survey

Plate 7: View of pedestrian bridge; Area is disturbed, no potential

Plate 8: View of Loyalist Creek; Creek has been disturbed from channelization, no potential

Plate 9: View of trail; Beyond trail requires Stage 2 Survey

Plate 10: View of Loyalist Creek; Creek has been disturbed from channelization, no potential

Aerial Photography

Image 1: 1966 aerial photography of Loyalist Creek during construction of surrounding subdivisions (City of Mississauga)

Image 2: 1977 aerial photography of Loyalist Creek (City of Mississauga)

Image 3: 1985 aerial photography of Loyalist Creek (City of Mississauga)

Image 4: 1992 aerial photography of Loyalist Creek (City of Mississauga)

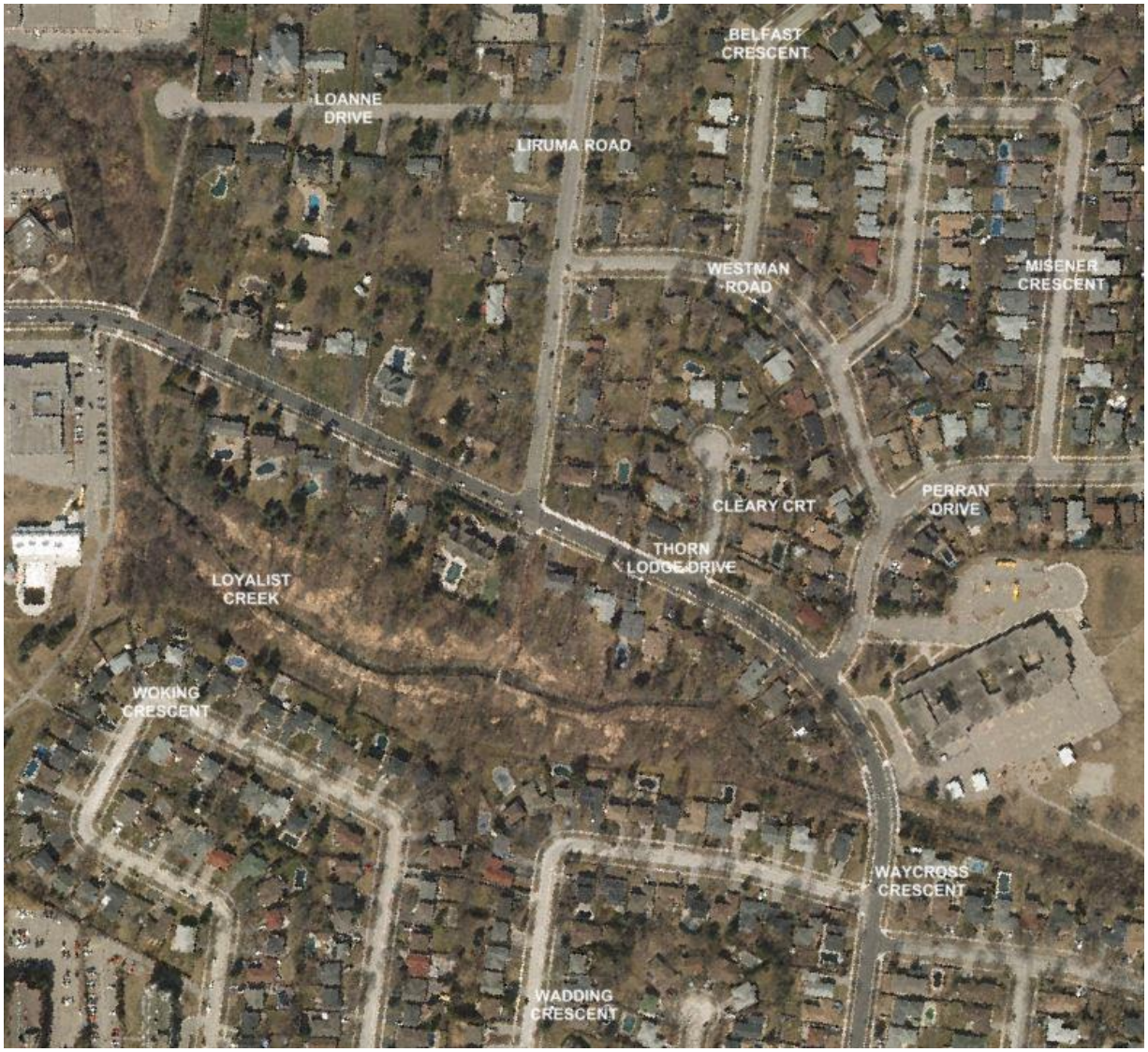


Image 5: 2015 aerial photography of Loyalist Creek (City of Mississauga)

Appendix F – Public Consultation

Appendix F1 – Environmental Assessment Study Notices

MISSISSAUGA

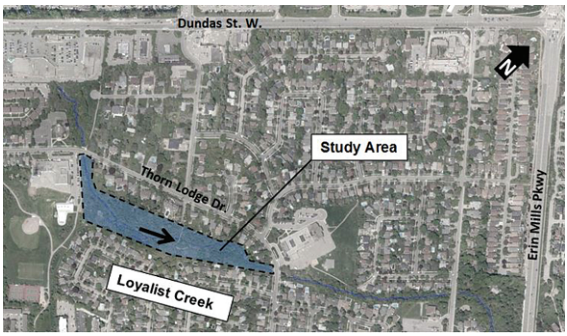
mississauga.ca
@citymississauga
facebook.com/citymississauga

CITY OF MISSISSAUGA – NOTICE OF STUDY COMMENCEMENT

Municipal Class Environmental Assessment Study:
Loyalist Creek Erosion Control Project behind Thorn Lodge Drive

WHAT?

- The City of Mississauga is undertaking a Schedule B Class Environmental Assessment (Class EA) Study for erosion control and restoration of Loyalist Creek behind Thorn Lodge Drive.



WHY?

- Through its ongoing erosion monitoring program, the City of Mississauga recognizes that this section of Loyalist Creek has been impacted by recent large storm events and is in need of rehabilitation to address existing erosion and safety issues.

HOW?

- The study will examine the creek and associated natural resources to identify existing erosion problems, potential future risks, and opportunities for restoration and environmental enhancement.
- Through the Class EA process, multiple alternative solutions will be developed and evaluated by the Study Team and refined through public and agency consultation (see below). The Study Team will then select a Preferred Alternative and proceed with design of the recommended works.
- At the end of the study, a Project File, documenting the study process will be available for public review.

GET INVOLVED!

- Consultation is an important part of the Class EA process. Public input and comment are invited for incorporation into the planning and design of this project.
- A Public Information Centre (PIC) will be held to present the study findings, the alternative solutions being considered, and to answer any questions you may have. Details regarding the PIC will be advertised publicly as the study progresses.
- If you have any questions or comments regarding the study, wish to provide input on the proposed solutions, or wish to be added or removed from the study mailing list, please contact:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
201 City Centre Dr, Suite 800
Mississauga, ON L5B 2T4
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
Aquafor Beech Ltd.
2600 Skymark Avenue, Unit 6-201
Mississauga, ON L4W 5B2
(905) 629-0099, ext. 294
Amos.R@aquaforbeech.com

COVID-19 Community Engagement Update: While we continue to respond to this pandemic, we are working hard to deliver essential services and projects to keep our City moving and safe. While we can't connect in person at this time, we still want to connect! Opportunities to connect with the Study Team and share your input are noted above.

This notice signals the commencement of the Class EA, a study which will define the problem, identify/evaluate alternative solutions, and determine a preferred design in consultation with regulatory agencies and the public. The study is being undertaken in accordance with the planning and design process for Schedule 'B' projects, as outlined in the *"Municipal Class Environmental Assessment"* document (October 2000, amended in 2015), which is approved under the Ontario *Environmental Assessment Act.*

Personal information is collected under the authority of the Environmental Assessment Act and will be used in the assessment process. With exception of personal information, all comments shall become part of the public records. Questions about this collection should be directed to the Project Manager listed above.

This notice was first issued July 23, 2020.

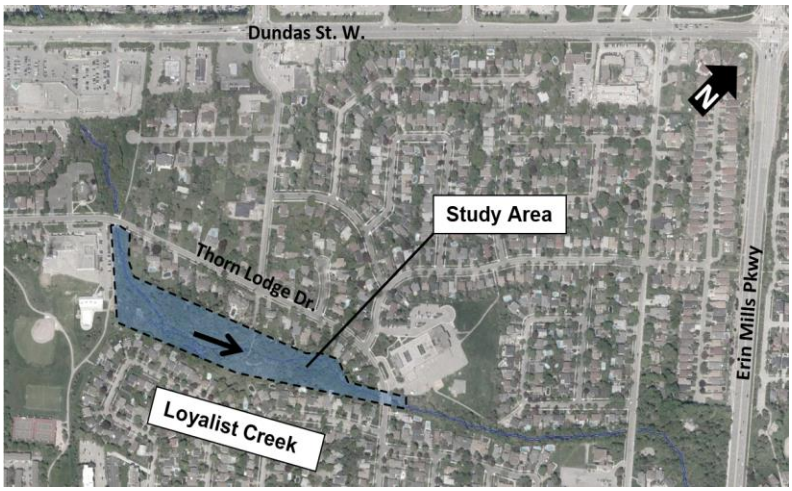
CITY OF MISSISSAUGA
NOTICE OF ONLINE PUBLIC ENGAGEMENT
Municipal Class Environmental Assessment Study:
Loyalist Creek Erosion Control Project behind Thorn Lodge Drive

WHAT?

- The City of Mississauga is undertaking a Schedule B Class Environmental Assessment (Class EA) Study for erosion control and restoration of Loyalist Creek behind Thorn Lodge Drive.

WHY?

- Through its ongoing erosion monitoring program, the City of Mississauga recognizes that this section of Loyalist Creek has been impacted by recent large storm events and is in need of rehabilitation to address existing erosion and safety issues.



HOW?

- The study examined the creek and associated natural resources to identify existing erosion problems, potential future risks, and opportunities for restoration and environmental enhancement.
- Through the Class EA process, multiple alternative solutions are being developed and evaluated by the Study Team and will be refined through public and agency consultation (see below). The Study Team will then select a Preferred Alternative and proceed with design of the recommended works.
- At the end of the study, a Project File report, documenting the study process will be available for public review.

GET INVOLVED!

- Consultation is an essential part of the EA process. We want to ensure that anyone with an interest in the study has the opportunity to provide input.
- As part of the project, online public engagement has been arranged to allow local residents and interested members of the public an opportunity to review and comment on the project findings to date, the alternative solutions being considered and the evaluation process. Input gathered through the online public engagement will be used to support the EA study. Project information will be made available to the public on the City's project website below beginning June 18th 2021 and will be open for comments until July 19th 2021:

https://mississauga.ca/projects-and-strategies/environmental-assessments/loyalist-creek-erosion-control-project-behind-thorn-lodge-drive/

- If you have any questions or comments regarding the study, or would like to be included in the project mailing list, please contact:

Greg Frew, P.Eng.
Project Manager
City of Mississauga
201 City Centre Dr, Suite 800
Mississauga, ON L5B 2T4
(905) 615-3200, ext. 3362
Greg.Frew@mississauga.ca

Robert Amos, P.Eng.
Consultant Project Manager
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Mississauga, ON L4W 5B2
(905) 629-0099, ext. 294
Amos.R@aquaforbeech.com

COVID-19 Community Engagement Update: While we continue to respond to this pandemic, we are working hard to deliver essential services and projects to keep our City moving and safe. While we can't connect in-person at this time, we still want to connect! Opportunities to connect with the Project Team and share your input are noted above.

This notice was first issued June 2021.

Appendix F2 – Stakeholder List

Federal Agencies	Organization	Suffix	First Name	Last Name	Position	Address	City	Province	Postal Code	Email	Telephone	Fax
	Fisheries and Oceans Canada		Alexandra	Sorckoff	Fish and Fish Habitat Protection Biologist	1028 Parsons Rd SW	Edmonton	AB	T6X 0J4	Alexandra.Sorckoff@dfo-mpo.gc.ca		
	Aboriginal Affairs and Northern Development Canada				Environment Unit	25 St. Clair Avenue East 8th Flr	Toronto	ON	M4T 1M2			
	Ministry of Health & Long Term Care				Integrated Policy & Planning Division	80 Grosvenor Street - 8th Floor, Hepburn Block	Toronto	ON	M7A 1R3			
	Ministry of Public Infrastructure					7 Queen's Park Crescent, 6th Floor, Frost Bldg. South	Toronto	ON	M7A 1Y7			
Ontario Ministry	**Organization**	**Suffix**	**First Name**	**Last Name**	**Position**	**Address**	**City**	**Province**	**Postal Code**	**Email**	**Telephone**	**Fax**
	Ministry of Tourism, Culture and Sport	Ms.	Karla	Barboza	Heritage Land Use Planning	Suite 1700, 401 Bay Street	Toronto	ON	M7A 0A7	karla.barboza@ontario.ca	416-314-3108	416-314-7175
	Ministry of Natural Resources and Forestry - Aurora District	Mr.	Mark	Heaton	Fish and Wildlife Biologist	50 Bloomington Road	Aurora	ON	L4G 0L8	mark.heaton@ontario.ca	905-713-7406	
	Ministry of the Environment and Climate Change	Mr.	Trevor	Bell	Environmental Resource Planner and EA Coordinator	5775 Yonge Street, 8th Floor	Toronto	ON	M2M 4J1	trevor.bell@ontario.ca	416-326-3577	
Conservation Authorities	**Organization**	**Suffix**	**First Name**	**Last Name**	**Position**	**Address**	**City**	**Province**	**Postal Code**	**Email**	**Telephone**	**Fax**
	Credit Valley Conservation	Mr.	Jakub	Kilis	Senior Planner, Environmental Assessmer	1255 Old Derry Road	Mississauga	ON	L5N 6R4	jakub.kilis@cvc.ca		
City of Mississauga	**Organization**	**Suffix**	**First Name**	**Last Name**	**Position**	**Address**	**City**	**Province**	**Postal Code**	**Email**	**Telephone**	**Fax**
	City of Missisauga	Mr.	Karen	Ras	Ward 2, Councillor	300 City Centre Drive	Mississauga	ON	L5B 3C1	karen.ras@mississauga.ca	905-896-5100	
	City of Missisauga	Mr.	Greg	Frew	Project Manager	300 City Centre Drive	Mississauga	ON	L5B 3C1	greg.frew@mississauga.ca	905.615.3200 ext. 3362	
	City of Missisauga	Ms.	Ashley	Visneski	Park Planning	300 City Centre Drive	Mississauga	ON	L5B 3C1	Ashley.Visneski@mississauga.ca	905.615.3200 ext. 5360	
	City of Missisauga	Mr.	Raymond	Lau	Park Development	300 City Centre Drive	Mississauga	ON	L5B 3C1	Raymond.Lau@mississauga.ca	905.615.3200 ext. 8734	
Region	**Organization**	**Suffix**	**First Name**	**Last Name**	**Position**	**Address**	**City**	**Province**	**Postal Code**	**Email**	**Telephone**	**Fax**
	Region of Peel	Ms.	Sally	Rook	Manager of Infrastructure Programming and Studies	10 Peel Centre Drive, Suite B, 4th Floor	Brampton	ON	L6T 4B9	sally.rook@peelregion.ca	905-791-7800 Ext. 7842	
	Region of Peel		Maad	Abid Al Hadi	Technical Analyst, Capital Works Wastewater Collection and Conveyance Wastewater Division	10 Peel Centre Drive, Suite B	Brampton	ON	L6T 4B9	Maad.AbidAlHadi@peelregion.ca	905-791-7800 ext. 7815	
	Region of Peel	Mr.	Nicholas	Gan	Wastewater Capital	10 Peel Centre Drive, Suite A, 4th Floor	Brampton	ON	L6T 4B9	Nicholas.gan@peelregion.ca	905-791-7800 x5082	
	Region of Peel	Mr.	Frank	Pugliese	Wastewater Capital					frank.pugliese@peelregion.ca		
First Nations	**Organization**	**Suffix**	**First Name**	**Last Name**	**Position**	**Address**	**City**	**Province**	**Postal Code**	**Email**	**Telephone**	**Fax**
	Mississaugas of the New Credit First Nation	Ms.	Megan	DeVries	Archaeological Operations Supervisor	4065 Highway 6 North	Hagersville	ON	N0A 1H0	Megan.DeVries@mncfn.ca	905 768 4260	
	Six Nations of the Grand River	Ms.	Jen	MtPleasant	Consultation Point Person					jenmtpleasant@sixnations.ca	519-753-0665 x 5425	
	Haudenosaunee Development Institute	Mr.	Wayne	Hill						tworowarchaeology@gmail.com		
Residents / Other	**Organization**	**Suffix**	**First Name**	**Last Name**	**Position**	**Address**	**City**	**Province**	**Postal Code**	**Email**	**Telephone**	**Fax**
	St. Francis of Assisi Catholic School					2480 Thornlodge Drive	Mississauga	ON	L5K 1K5	St.FrancisofAssisiInfo@dpcdsb.org		
			Natasha	Pace		[redacted]	Mississauga	ON	L5K 1Z5	[redacted]	[redacted]	
			Sandra	Pierce			Mississauga	ON				
			Herb	Williams			Mississauga	ON				
			Else	Grech			Mississauga	ON	L5K 1K5			
			Graeme	Lake			Mississauga	ON				
			Roger	Phillpotts			Mississauga	ON				
			Magdalena	Edwards								
			Kathleen	Walker			Mississauga	ON	L5K 1Z3			
			Suzanne and Sean	Wickett			Mississauga	ON				
			Kathleen and Scott	Prosser								
			Eddie and Laurel	Lee								
			Jennifer	Henderson-Pratt								
			Dave	Pearson								
			Gregg	Wassmansdorf								
			Lorne and Rosella	Flynn								
			Timothy	Chang								
			John and Renata	Cvitkovic								
			Laurel	MacKay-Lee								
			Cameron	Evanoff								
			John	Federico								
			Hilda	Farrar								
			Dianne	Tyers								
			Meghan	Shaw								
			Katherine	Fitzgerald								
			Dolores	Wielgus								
			Jeremy	Edwards								
			Halina	Rozpedowska								
			Candide	Monette								
			Daniel									
			Ian	Barnett								
			Martin and Jane	Fraser								
			Sarah	Edwards								

Appendix F3 – Public Information Centre Materials

WELCOME

Loyalist Creek Erosion Control behind Thorn Lodge Drive Class Environmental Assessment

VIRTUAL PUBLIC INFORMATION CENTRE

June 18th, 2021

Your comments are encouraged and appreciated, as this will provide us an opportunity to address project issues and concerns.

Aquafor Beech Limited

MISSISSAUGA

STUDY PURPOSE / PROBLEM DEFINITION

The study is being carried out to define the preferred restoration opportunity to address the erosion issues along Loyalist Creek.

This will improve the stability and health of the watercourse, mitigate risks to private properties, City's infrastructure, public safety, and enhance the aesthetics of the creek corridor.

VIRTUAL PUBLIC INFORMATION CENTRE PURPOSE

This Virtual Public Information Centre (PIC) is Designed to:

- Present information on existing conditions
- Present alternative creek restoration options
- Present study process and timelines

To Gain Community Input on:

- Existing conditions information
- Identification of opportunities and constraints
- Alternative evaluation criteria and scoring
- Selection of preferred solutions

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT PROCESS

CLASS EA PROCESS - SCHEDULE B

Many projects related to municipal systems that are similar in nature, are carried out routinely, and have predictable and mitigatable environmental effects are addressed in accordance with the Municipal Engineers Association “Municipal Class Environmental Assessment” (October 2000, as amended in 2007 & 2015).

This study is being undertaken as a “Schedule B” project under the Municipal Class Environmental Assessment process. The flow chart below illustrates the key steps to be undertaken as part of the EA process.

Phase 1 – Identify Problems

- Identify Problem or Opportunity
- Public Consultation

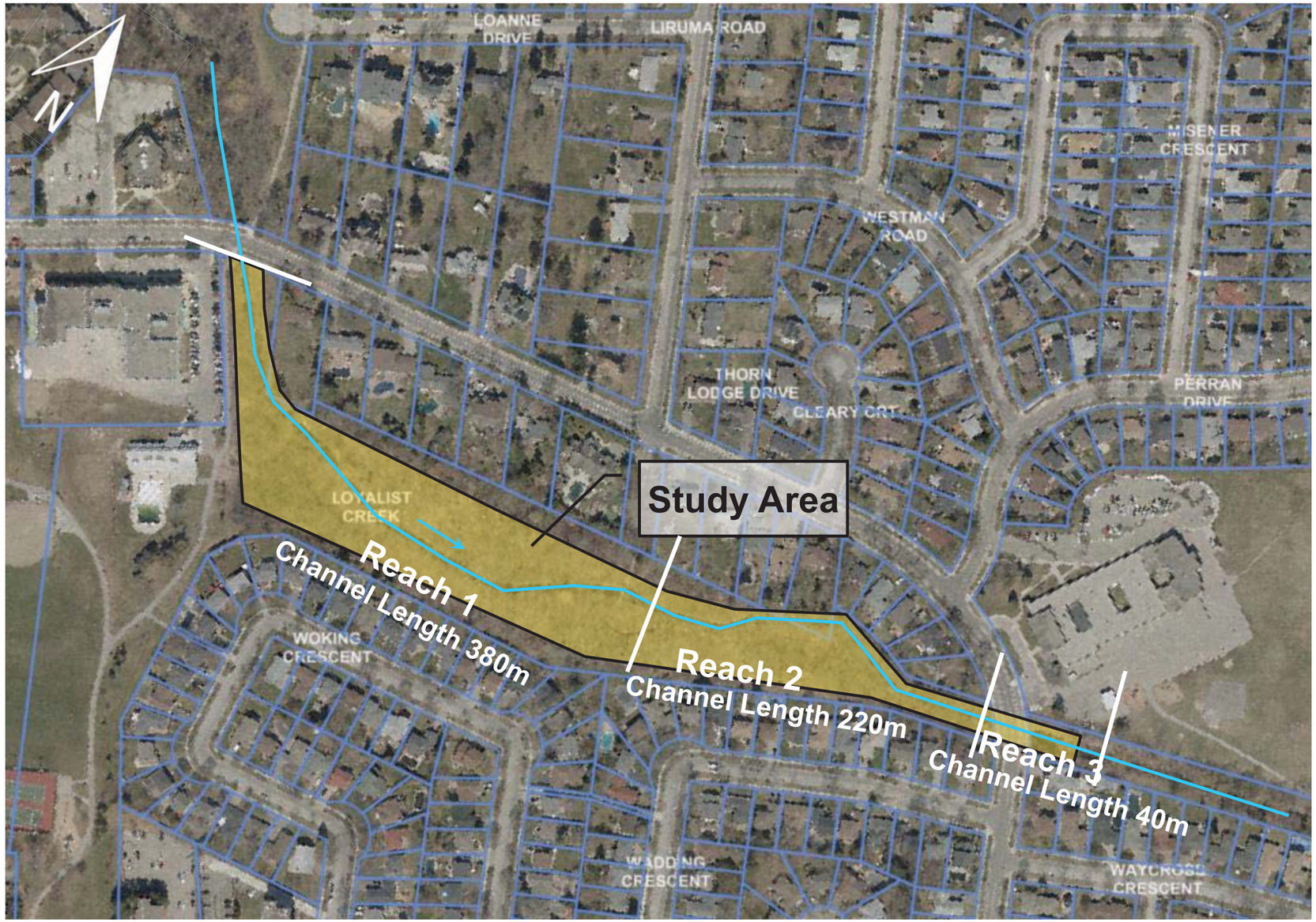
We Are Here →

Phase 2 – Alternate Solutions

- Identify Alternative Solutions
- Inventory Natural, Social, Economic Environment
- Environmental Impacts and Mitigation
- Alternatives Evaluation
- **Review Agency and Public Consultation**
- Select Preferred Solution
- Review and Confirm Choice of Schedule
- Notice of Completion to Review Agency & Public
- Implementation

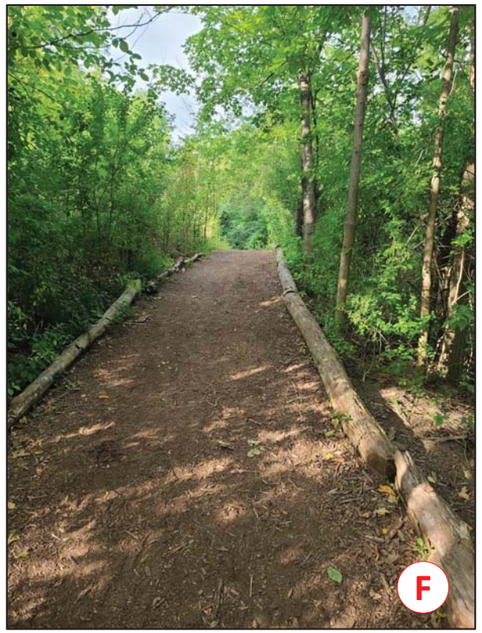
STUDY AREA

Loyalist Creek within the study area flows easterly behind Thorn Lodge Drive. The creek has been historically straightened and channelized, and has since deteriorated. For the purposes of this study, the study area is divided into 3 reaches.



EXISTING CONDITIONS – REACH 1

EXISTING CONDITIONS – REACH 2



EXISTING CONDITIONS – REACH 3

TERRESTRIAL ECOLOGY

Ecological Land Classification (ELC) is a standard practice used to describe, identify, classify and map vegetation communities on the landscape. Community types found within the study area range from cultural thickets to woodlands as shown in the map below.

Legend

- Watercourse
- Study Area
- Ecological Land Classification (ELC)
- Trails
- Approximate Location of Butternuts

THDM2-6
Hawthorn Shrub Thicket

WODM4
Dry-fresh Deciduous Woodland

WODM4-4
Dry-fresh Black Walnut Deciduous Woodland

FOD4-6
Norway Maple Deciduous Forest

AQUATIC ECOLOGY

The study assessed aquatic habitat and fisheries within Loyalist Creek to define existing conditions.

- Fish were not observed within the study area during the field investigation. However, past fish community studies provided fish collection records within the subwatershed.
- No major fish barriers were observed within the site.
- Aquatic habitat is generally in poor conditions, demonstrating characteristics of a channelized, urban-impacted and stormwater fed watercourse.
- Aquatic habitat potentially supports localized communities or vagrant species, and could be improved through restoration by adding more in-water cover and allowing the river to return to a more natural meandering pattern.

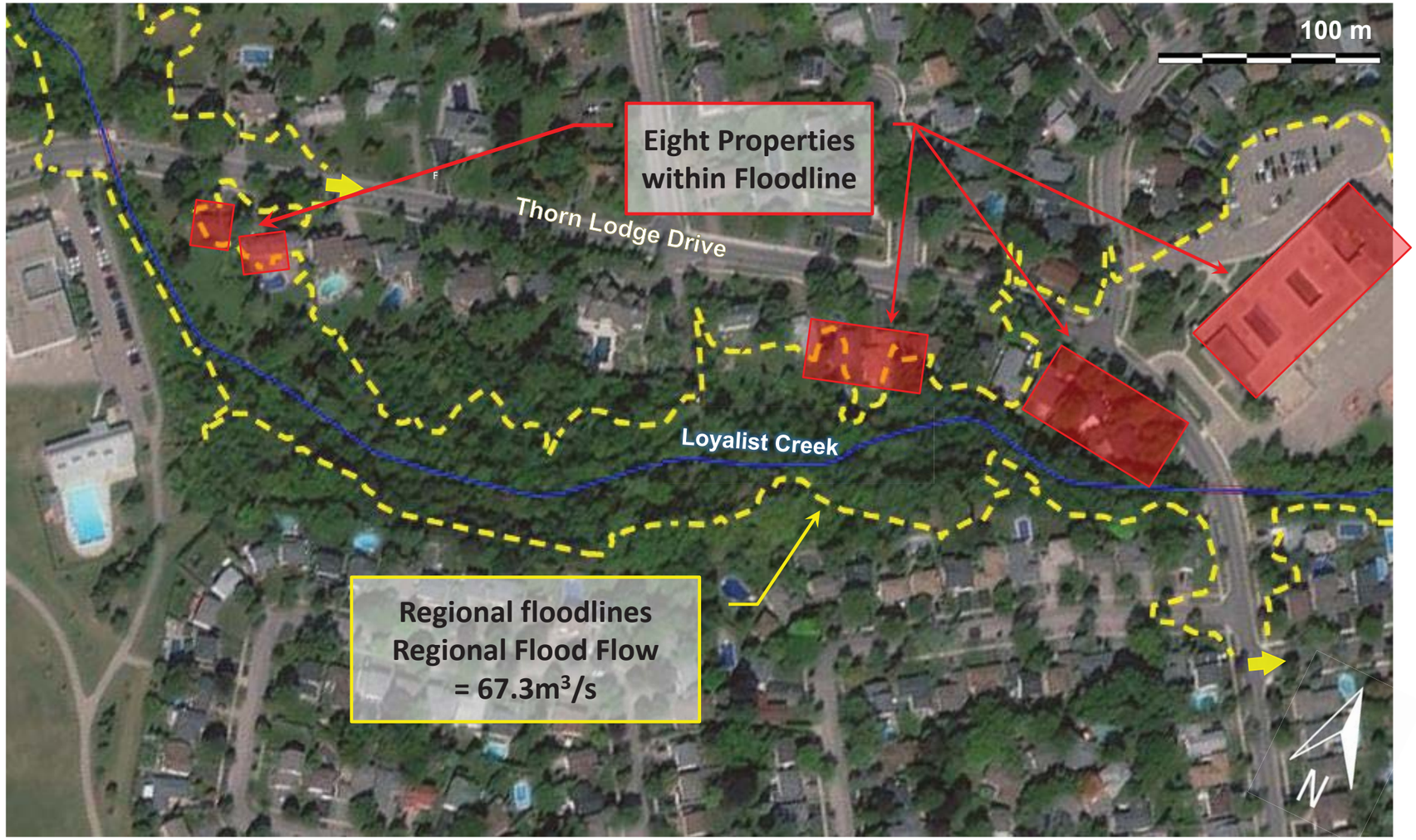
TARGET FISHERIES CONDITIONS

- Improved bank structure, providing cover and riparian vegetation
- Increased channel morphology, providing varied habitat and flow
- Improved variety of substrate to provide a better mix of habitat types and potential spawning areas

HYDROLOGY AND HYDRAULICS

The study looked into Hydrology and Hydraulics of Loyalist Creek in order to understand how water flows through the creek, the forces it exerts under normal and extreme conditions, and the extent of flooding, so as to not worsen or impact flood levels.

The limits of Regional floodplain is shown below, highlighting the private properties within the existing floodplain.



ARCHAEOLOGY

A Stage 1 Archaeological Assessment was completed, involving background research and property inspection in order to determine the potential for the presence of archaeological and cultural resources to exist within the site. The following criteria indicative of archaeological potential were found through the assessment, which in turn recommended that a Stage 2 Archaeological Assessment to be completed, including test pit surveys:

- Water Sources:
  Loyalist Creek

- Early Historic Transportation Routes:
  Dundas Street

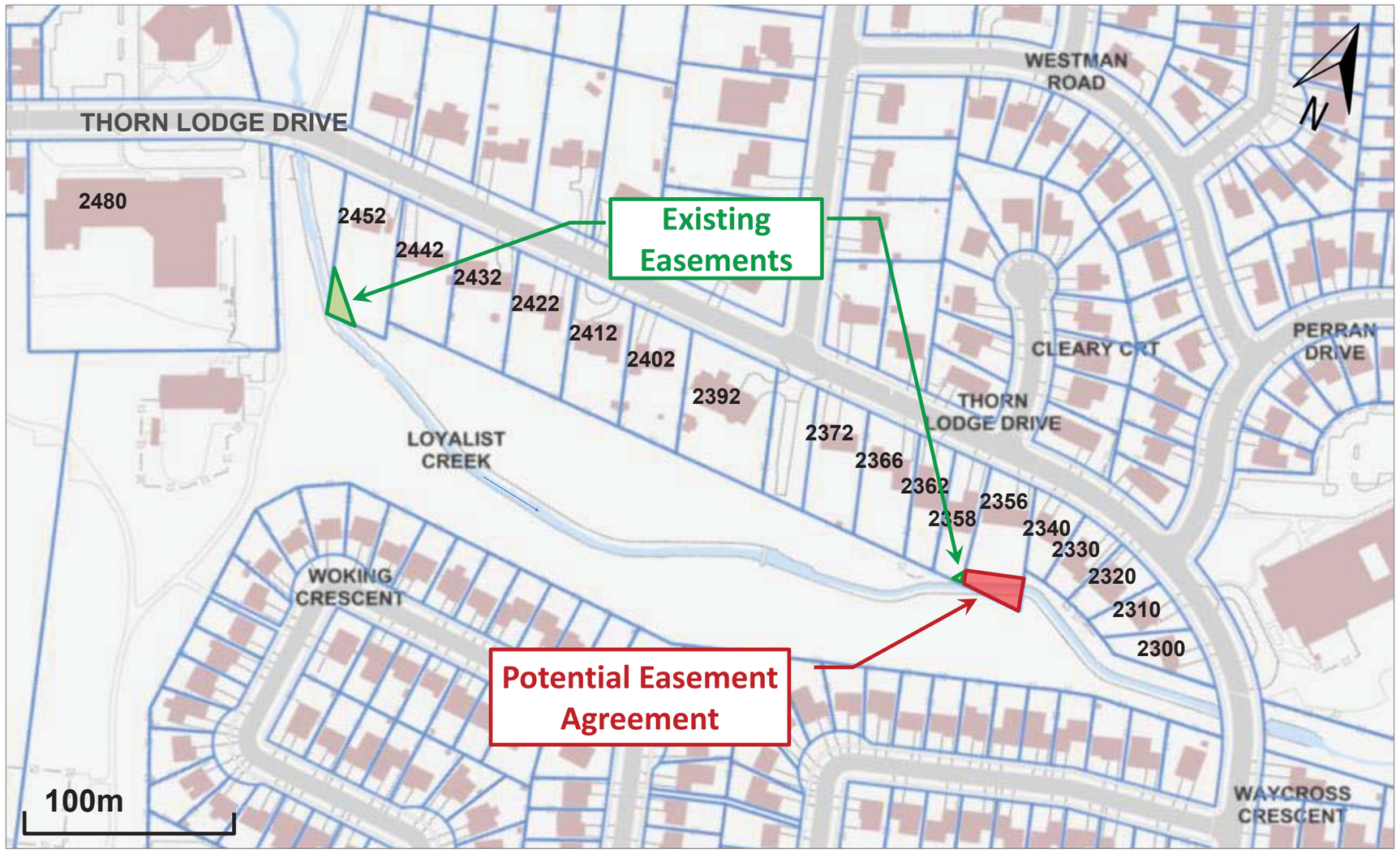
- Previous Identified Archaeological Sites:
  AjGv-76 – Pre Contact Indigenous; Euro-Canadian

- Well Drained Soil:
  Oneida clay loam.

OWNERSHIP AND EASEMENT

Loyalist Creek within the study area mostly flows through the City property of Thorn Lodge Park, with three sections running through private properties.

City maintains easements for the creek sections within 2452 and 2358 Thorn Lodge Drive, and has been discussing options for maintaining or moving the section of creek through 2356 Thorn Lodge Drive.

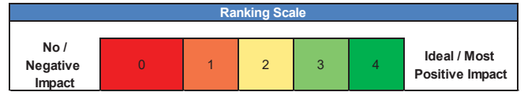


EVALUATION APPROACH AND CRITERIA

There are four alternative approaches being considered for this project:

1. Do Nothing
2. Local Restoration
3. Engineered Channel Restoration
4. Natural Channel Restoration

The following criteria will be used to evaluate each alternative to determine the preferred method for rehabilitation of Loyalist Creek. The evaluation uses a normalized ranking scheme to provide equal weighting for each category of evaluation criteria. A ranking scale from 0 (no / negative impact) to 4 (ideal / most positive impact) is applied to each criterion.



Comment sheets are provided to collect public feedback on the evaluation criteria and preliminary evaluation / outcome.

Physical and Natural Criteria

Erosion	Rate of Erosion, slope failures, and loss of tablelands
Water Quality	Impact on water quality
Aquatic Habitat	Impact on contributing aquatic habitat and linkage
Terrestrial Habitat	Impact on connectivity, diversity, and quantity/quality of habitat
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees

Social and Cultural Criteria

Public Safety	Impact on public safety
Landowner Impacts	Impact on adjacent private properties and the City-owned Park
Benefit to Community	Access to trails, enjoyment of surrounding lands
Aesthetic Value	Impact on existing and proposed aesthetic value

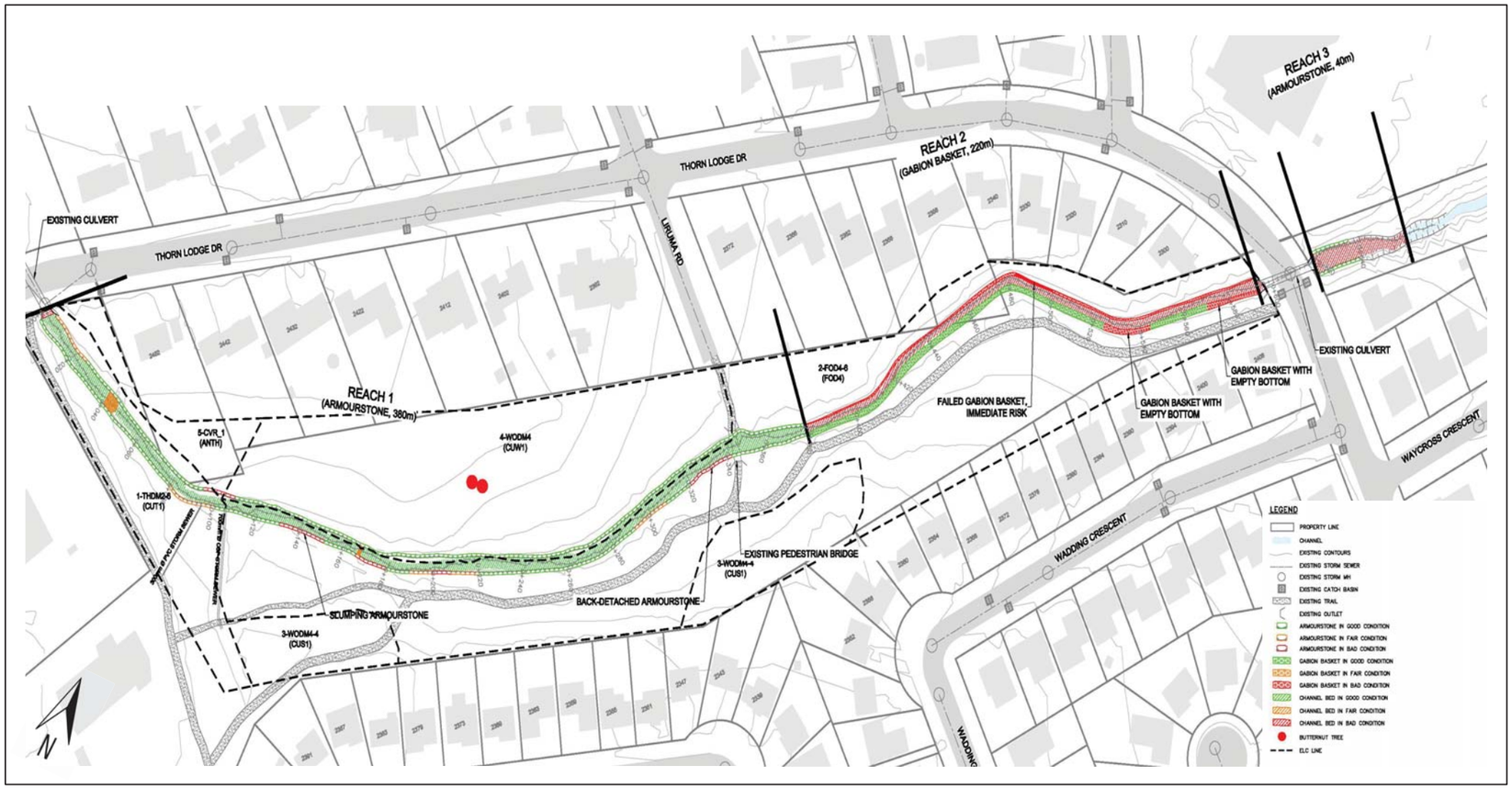
Technical and Engineering Criteria

Existing Infrastructure	Protection or potential failure of infrastructure (bridges, trails, storm outfalls)
Constructability	Easiness to access, move equipment and construct
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated

Economic Criteria

Capital Costs	One time cost to City
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures

Potential Alternative #1
Do Nothing



Existing Conditions / Do Nothing

Alternative # 1 – Do Nothing

Definition: No restoration measures taken, except on emergency basis.

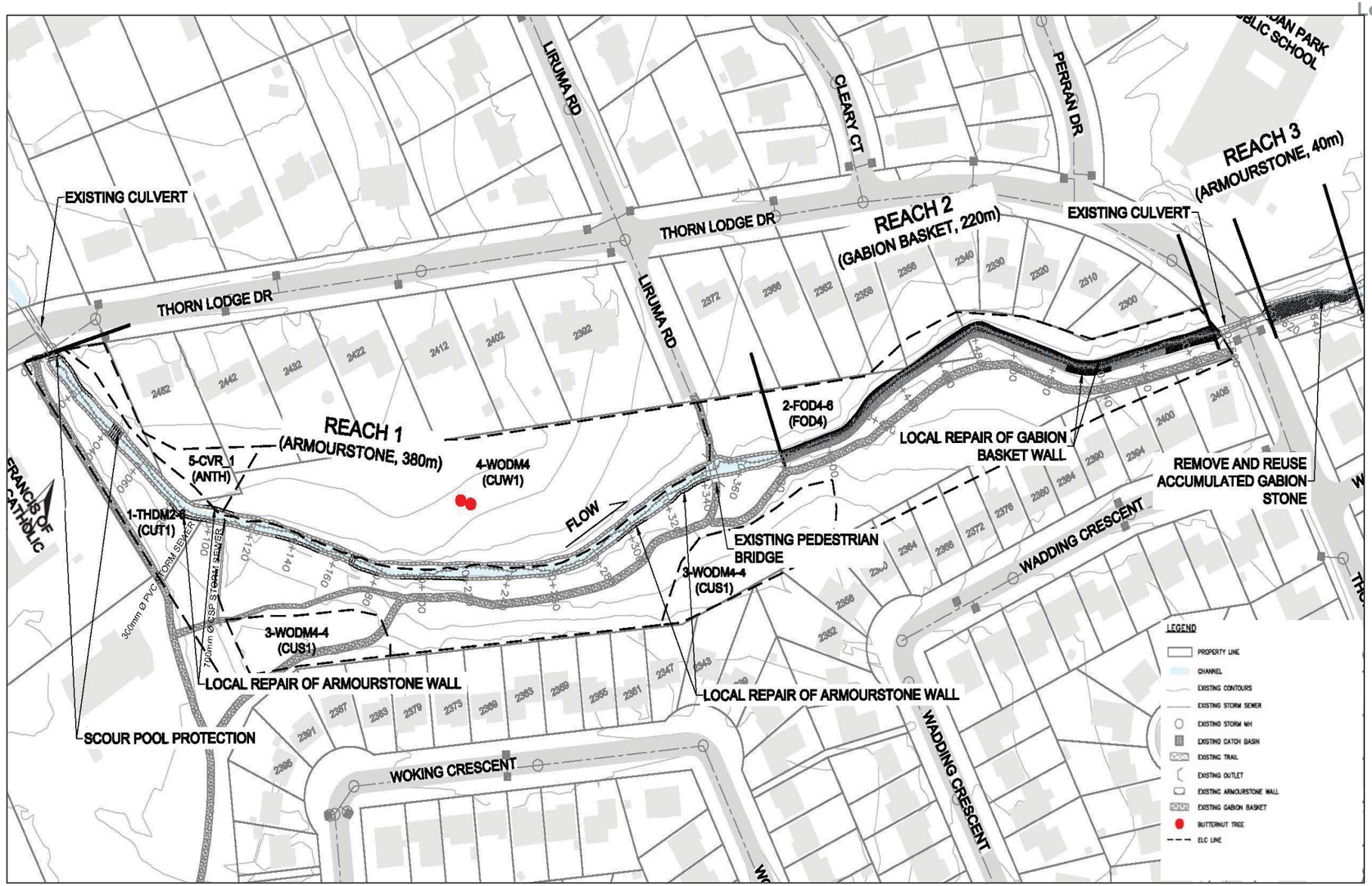
Description: This alternative would involve leaving the existing creek, particularly the gabion baskets which line both banks, to continue failing. Existing risks associated with eroding of streambanks, deteriorated storm outfalls, loss of tableland within private properties, and public safety will remain. Habitat conditions would continue to degrade due to erosion.

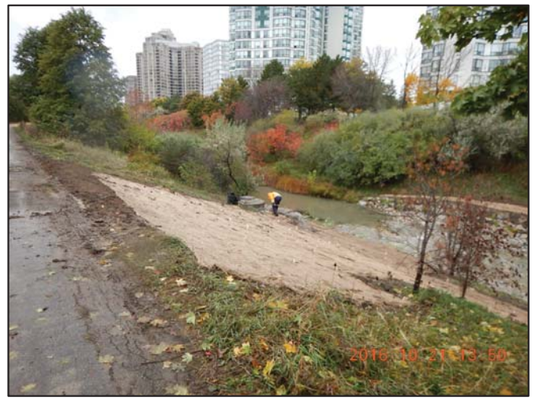
Although no capital costs have been assigned to this alternative, ongoing operation and maintenance activities would continue. Under emergency conditions (i.e. failure) works would occur. Monitoring would be necessary.

Potential Alternative #1
Do Nothing – Cont.

EVALUATION CRITERIA		Alternative 1 - Do Nothing					
		Reach 1		Reach 2		Reach 3	
		Score	Explanation	Score	Explanation	Score	Explanation
Physical and Natural Criteria		***1.0***		***1.0***		***1.0***	
Erosion	Rate of erosion, slope failures, and loss of tablelands	0	Continued erosion, slope failures and loss of table / golf course lands	0	Continued erosion, slope failures and loss of table / golf course lands	0	Continued erosion, bedrock incision carrying further downstream
Water Quality	Impact on water quality	0	Hardened banks remain and lack of tree canopy keeps water warmer. No improvement to water quality.	0	Eroded banks remain and lack of tree canopy keeps water warmer. No improvement to water quality.	0	Accumulated gabion remains. No improvement to water quality.
Aquatic Habitat	Impact on contributing aquatic habitat	0	No improvement to habitat. Possibility the habitat will degrade as armourstone continue to fail and collect debris.	0	No improvement to habitat. Possibility the habitat will degrade as armourstone continue to fail and collect debris.	0	No improvement to habitat. Possibility the habitat will degrade as armourstone continue to fail and collect debris.
Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	4	Habitat stays in current condition, relatively healthy.	4	Habitat stays in current condition.	4	Habitat stays in current condition.
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	4	Vegetation composition remains the same.	4	Vegetation composition remains the same.	4	Vegetation composition remains the same.
Social and Cultural Criteria		***1.1***		***0.9***		***0.9***	
Public Safety	Impact on public safety	1	Continued erosion and bank failure would create risks to public safety	0	Continued erosion and bank failure would create risks to public safety. Immediate risk to 1 landowner where the gabion baskets have completed failed.	0	Continued erosion and bank failure would create risks to public safety.
Landowner Impacts	Impact on adjacent private properties and the City-owned Park	1	Continued erosion and unstable slopes would potentially lead to loss of table / parklands	1	Continued erosion and unstable slopes would potentially lead to loss of table / parklands.	1	Continued erosion and unstable slopes would potentially lead to loss of table / parklands.
Benefit to Community	Access to trails, enjoyment of surrounding lands	4	No disturbance to access to trails, enjoyment of surrounding lands	4	No disturbance to access to trails, enjoyment of surrounding lands	4	No disturbance to access to trails, enjoyment of surrounding lands
Aesthetic Value	Impact on existing and proposed aesthetic value	1	Low aesthetic value due to structure failures within the channel	1	Low aesthetic value due to structure failures within the channel	1	Low aesthetic value due to accumulated gabion and debris within the channel
Technical and Engineer Criteria		***1.3***		***1.5***		***1.7***	
Impact on Existing Infrastructure	Protection or potential failure of infrastructure (bridges, trails, and storm outfalls)	1	Continued degradation of storm outfalls and risks to existing bridge.	3	No immediate risk to infrastructure	3	No immediate risk to infrastructure
Constructability	Easiness to access, move equipment and construct	4	No construction activity	4	No construction activity	4	No construction activity
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	1	Structures in various lifespan (good - fair - bad)	0	Structures at the end of lifespan	1	Structures near end of lifespan
Economic Criteria		***1.3***		***1.3***		***1.3***	
Capital Costs	One time cost to City	4	No capital cost to City	4	No capital cost to City	4	No capital cost to City
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	0	Regular monitoring and maintenance to mitigate the deterioration of the channel and tablelands. Emergency repairs on as-needed bases in perpetuity	0	Regular monitoring and maintenance to mitigate the deterioration of the channel and tablelands. Emergency repairs on as-needed bases in perpetuity	0	Regular monitoring and maintenance to mitigate the deterioration of the channel and tablelands. Emergency repairs on as-needed bases in perpetuity
TOTAL SCORE		**4.6**		**4.6**		**4.9**	

Potential Alternative #2
Local Restoration





Local Restoration

Alternative # 2 – Local Restoration

Definition: Stream restoration works at strategic locations in order to limit the impact of existing erosion problems **.**

Description: This Alternative would involve undertaking stream restoration works at priority problem locations. The proposed works would prevent local erosion of the channel by stabilization of the bed, banks and slopes. Where erosion is creating risks to infrastructure and properties, local bank or slope stabilization treatments would be placed by using either hardened (engineered) type treatments or retrofitting / repairing of existing structures. Benefits of local works include minimal disruption to the local natural environment, quick implementation to minimize short term risk. The lifespan of these works are generally defined as moderate. Intermediate and long term fluvial processes often / eventually undermine works, or similar issues are transcribed downstream.

Potential Alternative #2
Local Restoration

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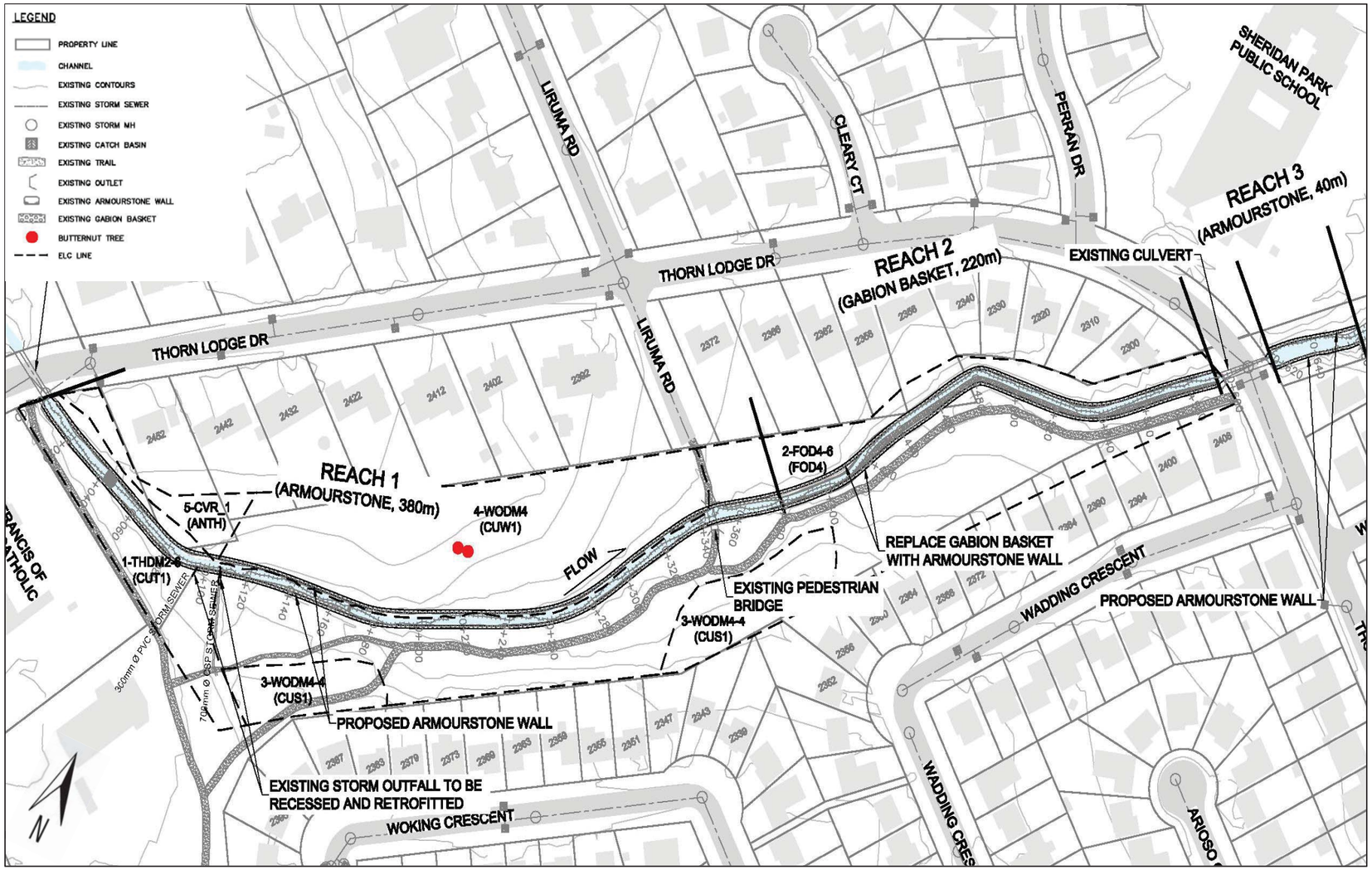
EVALUATION CRITERIA		Alternative 2 - Local Restoration					
		Reach 1		Reach 2		Reach 3	
		Score	Explanation	Score	Explanation	Score	Explanation
Physical and Natural Criteria		***1.6***		***1.1***		***1.8***	
Erosion	Rate of erosion, slope failures, and loss of tablelands	3	Local repair using engineered materials would provide erosion control	3	Local repair using engineered materials would provide erosion control, however, erosion would continue to occur at other locations	3	Local repair by removing and reshaping the channel would minimize erosion.
Water Quality	Impact on water quality	2	Some improvement of water quality.	1	Limited improvements to the water quality	3	Removing and reshaping the accumulated gabions will improve the backwatered area upstream. Lowering the amount of stagnant water will improve water quality downstream.
Aquatic Habitat	Impact on contributing aquatic habitat	2	Knickpoint would be mitigated to allow fish access to upstream reaches. Substrate other than cobble could be added to the reach.	1	Limited improvement of aquatic habitat which may be suitable for different types of forage for fish.	2	The possible water quality improvements would make this reach suitable for different types of forage for fish.
Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	3	Minor impact to ecological communities due to construction will be mitigated by planting native species.	2	Moderate impact to ecological communities.	3	Minor impact to ecological communities.
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	3	Limited vegetation loss due to construction. It will be mitigated through native species plantings throughout the reach; Removal of dead ash trees and invasive shrubs	2	Vegetation loss due to construction will be mitigated through native species plantings throughout the reach; Removal of some dead ash trees and invasive shrubs	3	Vegetation loss due to construction will be mitigated through native species plantings throughout the reach.
Social and Cultural Criteria		***1.4***		***1.0***		***1.5***	
Public Safety	Impact on public safety	3	Improved public safety by reducing erosions and stabilizing banks.	2	Improved public safety by reducing erosions and stabilizing banks.	3	Improved public safety by reducing erosions and flooding
Landowner Impacts	Impact on adjacent private properties and the City-owned Park	3	Minor disturbance to parkland due to construction access. Reduced risks of property loss	2	Minor disturbance to parkland due to construction access. Reduced risks of property loss	3	Minor disturbance to parkland due to construction access, as well as adjacent properties
Benefit to Community	Access to trails, enjoyment of surrounding lands	3	Minor disturbance to access to trails, enjoyment of surrounding lands	2	Disturbance to access to trails due to construction, however, trail will be restored.	3	Minor disturbance.
Aesthetic Value	Impact on existing and proposed aesthetic value	2	Some improvement of the value of the creek corridor.	2	Some improvement of the value of the creek corridor.	3	Improvement of the natural look and aesthetic value of the creek corridor.
Technical and Engineer Criteria		***1.9***		***1.5***		***1.7***	
Impact on Existing Infrastructure	Protection or potential failure of infrastructure (bridges, trails, and storm outfalls)	3	Repair of degraded storm outfalls. Risks to existing bridge remain.	3	No immediate risk to infrastructure	3	No immediate risk to infrastructure
Constructability	Easiness to access, move equipment and construct	3	Reach is accessible, with narrower corridor within a few sections. Local repair allows smaller machine to work within narrow corridor. Moderate clearing and grubbing required. No work within private property	2	Reach is accessible, moderate clearing and grubbing required. Work within private property	3	Only small equipment is required.
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	3	Long-term lifespan of works	2	Moderate lifespan of works	2	Moderate lifespan of works
Economic Criteria		***1.9***		***1.3***		***1.9***	
Capital Costs	One time cost to City	3	3rd Highest construction costs	2	2nd Highest construction costs	3	3rd Highest construction costs
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	3	Minimal monitoring and maintenance.	2	Annual monitoring and maintenance required.	3	Minimal monitoring and maintenance
TOTAL SCORE		**6.8**		**4.8**		**6.8**	

Potential Alternative #3
Engineered Channel Restoration



Engineered Channel Restoration

Alternative # 3 – Engineered Channel Restoration

Definition: Stream restoration in existing alignment, using armourstone as bank protection measures**.**

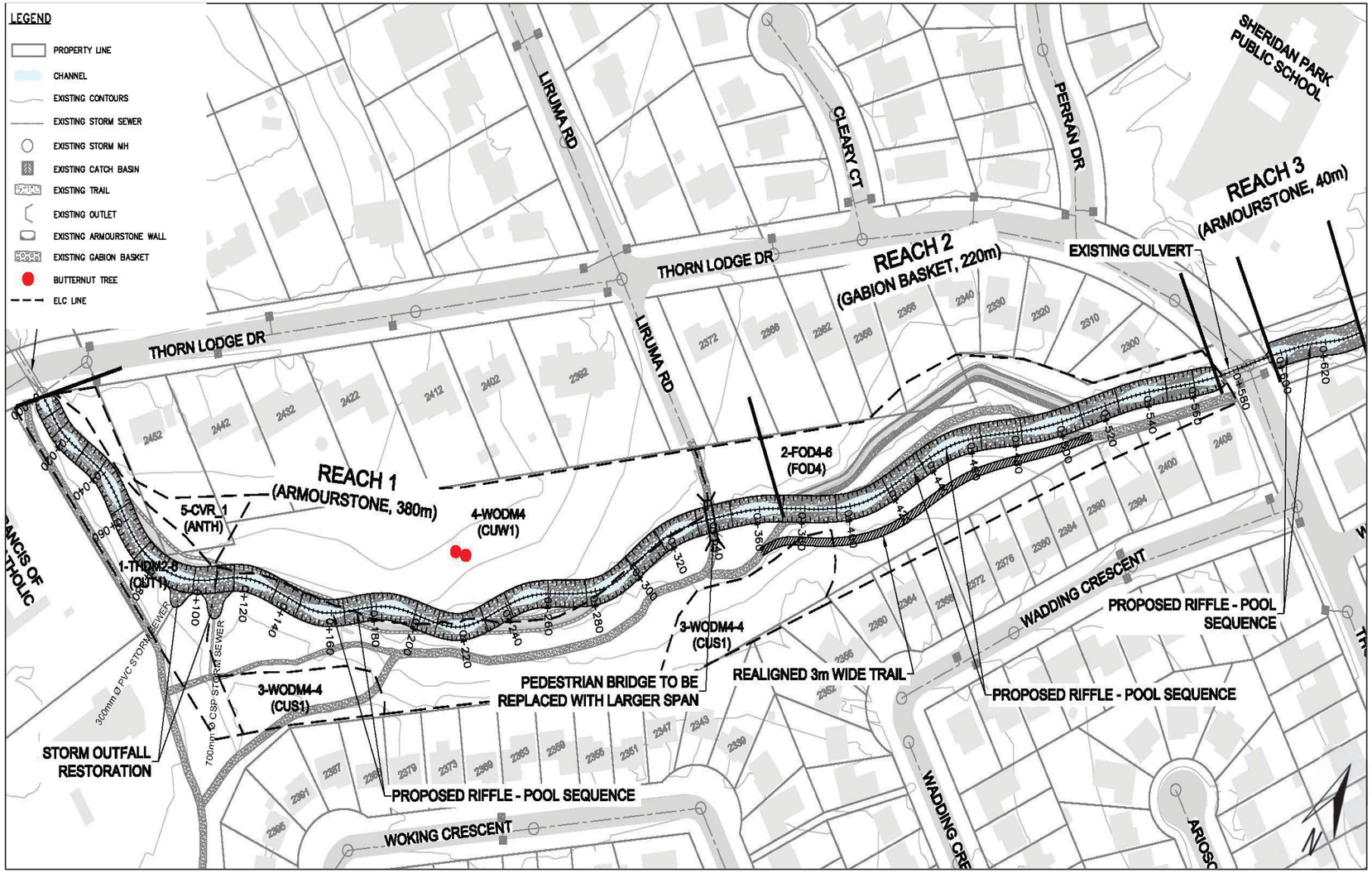
Description: This Alternative would involve a continuous restoration of the Loyalist Creek throughout the study area, replacing all existing bank and bed structures with armourstones. The existing channel width and alignment will be maintained. This alternative will require moderate disruption to the natural environment and adjacent properties, and provide long-term erosion protection to the watercourse. However, the creek will still runs through private properties, which may cause risks to the properties again in the long term. Improvement to the aquatic and terrestrial habitats is relatively low as minimal in-water and riparian vegetation could be planted. The lifespan of these works are generally defined as long, however, long-term maintenance or repair after significant rainfall will typically required to meet lifespan expectations.

Potential Alternative #3
Engineered Channel Restoration

EVALUATION CRITERIA		Alternative 3 - Engineered Channel Restoration					
		Reach 1		Reach 2		Reach 3	
		Score	Explanation	Score	Explanation	Score	Explanation
Physical and Natural Criteria		*1.5*		*1.8*		*1.6*	
Erosion	Rate of erosion, slope failures, and loss of tablelands	4	Long-term erosion protection with minimal opportunities for planform adjustment	4	Long-term erosion protection with minimal opportunities for planform adjustment	4	Long-term erosion protection with minimal opportunities for planform adjustment
Water Quality	Impact on water quality	2	Some improvement of water quality.	3	Some improvement of water quality.	3	Some improvement of water quality.
Aquatic Habitat	Impact on contributing aquatic habitat	2	Knickpoint would be mitigated to allow fish access to upstream reaches. Substrate other than cobble could be added to the reach.	3	Removal of failed gabions baskets to will improve instream conditions. Engineered riffles provide habitat for forage (such as important benthic macroinvertebrates)	2	The possible water quality improvements would make this reach suitable for different types of forage for fish.
Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	2	Additional localized loss of vegetation due to construction will be mitigated by planting native species. Limited opportunity to enhance riparian habitat diversity	2	Moderate impact to ecological communities. Loss of forest canopy cover until plantings mature and replace canopy	2	Moderate impact to ecological communities. Loss of forest canopy cover until plantings mature and replace canopy
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	2	Vegetation loss to established vegetation community. Native species would be replanted for compensation	2	Vegetation loss due to construction will be mitigated through native species plantings throughout the reach; Removal of dead ash trees and invasive shrubs	2	Vegetation loss due to construction will be mitigated through native species plantings throughout the reach;
Social and Cultural Criteria		*1.6*		*1.6*		*1.7*	
Public Safety	Impact on public safety	3	Improved public safety by reducing erosions and stabilizing banks. However, certain safety measures may be required due to deep channel (~2m) with steep bank slopes.	3	Improved public safety by reducing erosions and stabilizing banks. However, certain safety measures may be required due to deep channel (~2m) with steep bank slopes.	4	Improved public safety by reducing erosions and flooding
Landowner Impacts	Impact on adjacent private properties and the City-owned Park	2	Moderate disturbance to parkland due to construction. Reduced risks of property loss	2	Moderate disturbance to parkland due to construction. Reduced risks of property loss	2	Moderate disturbance to parkland due to construction. Disturbance to adjacent properties due to narrow corridor
Benefit to Community	Access to trails, enjoyment of surrounding lands	2	Disturbance to access to trails due to construction, however, trail will be restored.	2	Disturbance to access to trails due to construction, however, trail will be restored.	2	Moderate disturbance.
Aesthetic Value	Impact on existing and proposed aesthetic value	3	Improvement of the natural look and aesthetic value of the creek corridor.	3	Improvement of the natural look and aesthetic value of the creek corridor.	3	Improvement of the natural look and aesthetic value of the creek corridor.
Technical and Engineer Criteria		*1.9*		*1.9*		*1.5*	
Impact on Existing Infrastructure	Protection or potential failure of infrastructure (bridges, trails, and storm outfalls)	4	Repair of degraded storm outfalls. Existing bridge abutments would be protected.	4	Reduced risk to infrastructure.	3	No immediate risk to infrastructure
Constructability	Easiness to access, move equipment and construct	2	Reach is accessible, moderate clearing and grubbing required. Work within private property	2	Reach is accessible, moderate clearing and grubbing required. Work within private property	1	Access would be difficult due to narrow corridor
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	3	Long-term life span ~ 50 years.	3	Long-term life span ~ 50 years.	3	Long-term life span ~ 50 years.
Economic Criteria		*0.9*		*0.9*		*0.9*	
Capital Costs	One time cost to City	0	Highest construction costs associated with significant amount of hard materials.	0	Highest construction costs associated with significant amount of hard materials.	0	Highest construction costs associated with significant amount of hard materials.
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	3	Long-term maintenance required to meet lifespan expectations.	3	Long-term maintenance required to meet lifespan expectations.	3	Long-term maintenance required to meet lifespan expectations.
TOTAL SCORE		**5.9**		**6.1**		**5.7**	

Potential Alternative #4
Natural Channel Restoration

Loyalist Creek Erosion Control Class EA



Natural Channel Restoration

Alternative # 4 – Natural Channel Restoration

Definition: Restoration of the stream to a more naturalized form, realigning the creek away from the private properties.

Description: This Alternative would involve complete restoration of Loyalist Creek throughout the length of the study area, recreating the sinuosity of channel and restoring the channel bed and banks using a combination of natural channel design techniques as well as engineered methods. During construction, this option will involve the highest level of disruption to landowners, local residents, and habitat (including existing vegetation). Once completed however, it will provide improved conditions in terms of the natural function and processes of the watercourse. All disrupted areas will be restored with native plantings and seed mixes designed to provide stability and sustainability.

Potential Alternative #4
Natural Channel Restoration

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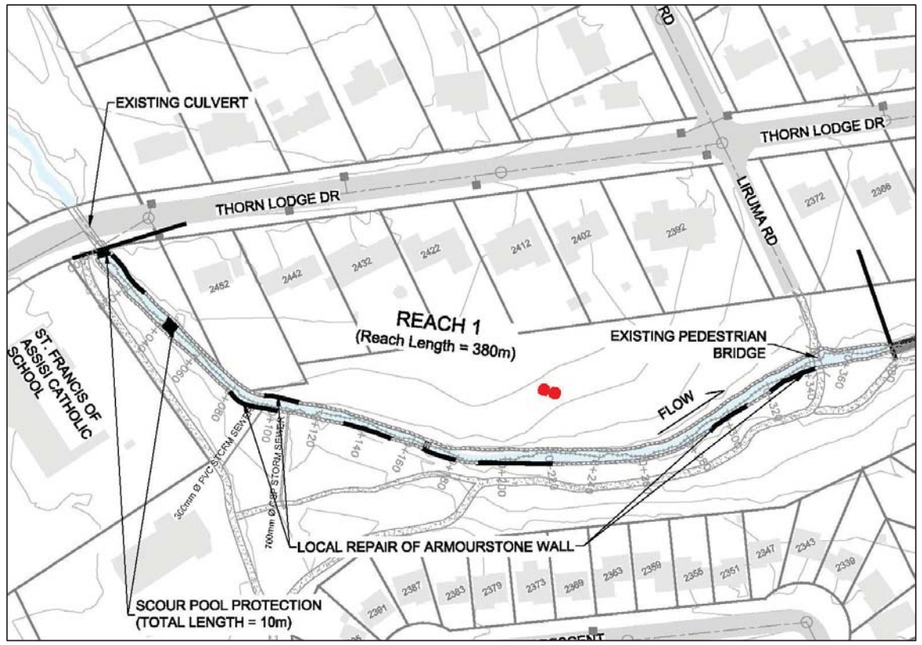
Loyalist Creek Erosion Control Class EA

EVALUATION CRITERIA		Alternative 4 - Natural Channel Restoration					
		Reach 1		Reach 2		Reach 3	
		Score	Explanation	Score	Explanation	Score	Explanation
Physical and Natural Criteria		*1.6*		*1.8*		*1.9*	
Erosion	Rate of erosion, slope failures, and loss of tablelands	4	Minimized rate of erosion and loss of table / golf course land, provided stable slopes	4	Long-term erosion protection with minimal opportunities for planform adjustment	4	Minimized rate of erosion and loss of table / golf course land, provided stable slopes
Water Quality	Impact on water quality	3	Future vegetation cover from new riparian plantings will help to shade creek and keep the water cooler, as well as holding the banks together to reduce sedimentation from bank	3	Some improvement of water quality.	4	Future vegetation cover from new riparian plantings will help to shade creek and keep the water cooler, as well as holding the banks together to reduce sedimentation from bank
Aquatic Habitat	Impact on contributing aquatic habitat	4	Restoring the creek to a meandering form would encourage proper river function in the development of runs/riffles/pools, providing better habitat for fish and their forage. New riparian plantings would provide shade to creek and provide habitat for forage.	3	Removal of failed gabions baskets to will improve instream conditions. Engineered riffles provide habitat for forage (such as important benthic macroinvertebrates)	3	Development of runs/riffles/pools, providing better habitat for fish and their forage. New riparian plantings would provide shade to creek and provide habitat for forage.
Terrestrial Habitat	Impact on connectivity, diversity and quantity/quality of habitat	1	Likely removal of candidate bat maternity roosting sites and impact on existing 2x butternut trees. Loss of forest canopy cover until plantings mature and replace canopy.	2	Moderate impact to ecological communities. Loss of forest canopy cover until plantings mature and replace canopy	2	Likely removal of candidate bat maternity roosting sites. Loss of forest canopy cover until plantings mature and replace canopy . Opportunity to enhance riparian habitat diversity
Terrestrial Vegetation	Impact on existing riparian vegetation and mature trees	1	Vegetation loss to established vegetation community. Native species would be replanted for compensation	2	Vegetation loss due to construction will be mitigated through native species plantings throughout the reach; Removal of dead ash trees and invasive shrubs	2	Vegetation loss due to construction will be mitigated through native species plantings throughout the reach;
Social and Cultural Criteria		*1.7*		*1.6*		*1.4*	
Public Safety	Impact on public safety	4	Stable slope and natural meander form, flooding risks minimized	3	Improved public safety by reducing erosions and stabilizing banks. However, certain safety measures may be required due to deep channel (~2m) with steep bank slopes.	4	Stable slope and natural meander form.
Landowner Impacts	Impact on adjacent private properties and the City-owned Park	1	Moderate disturbance to parkland due to construction. Impact on 1 landowner who has the creek within his/her property.	2	Moderate disturbance to parkland due to construction. Reduced risks of property loss	1	Major disturbance to parkland due to construction. Disturbance to adjacent properties due to narrow corridor
Benefit to Community	Access to trails, enjoyment of surrounding lands	2	Disturbance to access to trails due to construction, however, trail will be restored.	2	Disturbance to access to trails due to construction, however, trail will be restored.	1	Major disturbance.
Aesthetic Value	Impact on existing and proposed aesthetic value	4	Significant enhancement of the natural look of the creek corridor and aesthetic value of creek corridor	3	Improvement of the natural look and aesthetic value of the creek corridor.	3	Improvement of the natural look and aesthetic value of the creek corridor.
Technical and Engineer Criteria		*1.7*		*1.9*		*1.7*	
Impact on Existing Infrastructure	Protection or potential failure of infrastructure (bridges, trails, and storm outfalls)	3	Repair of degraded storm outfalls. Existing bridge will be replaced	4	Reduced risk to infrastructure.	3	No immediate risk to infrastructure
Constructability	Easiness to access, move equipment and construct	1	Reach is accessible, moderate clearing and grubbing required. Work within private property	2	Reach is accessible, moderate clearing and grubbing required. Work within private property	1	Access would be difficult due to narrow corridor
Lifespan of Works	Expected lifespan / years of works before intervention needs to be repeated	4	Long lifespan of works > 50 years.	3	Long-term life span ~ 50 years.	4	Long lifespan of works > 50 years.
Economic Criteria		*1.6*		*0.9*		*1.3*	
Capital Costs	One time cost to City	1	2nd highest construction costs	0	Highest construction costs associated with significant amount of hard materials.	1	3rd highest construction costs
Operations & Maintenance Costs	Requirement for regular, irregular or no maintenance activities and ensure effectiveness of implemented measures	4	Minimal maintenance required.	3	Long-term maintenance required to meet lifespan expectations.	3	Minimal maintenance required.
TOTAL SCORE		**6.6**		**6.1**		**6.2**	

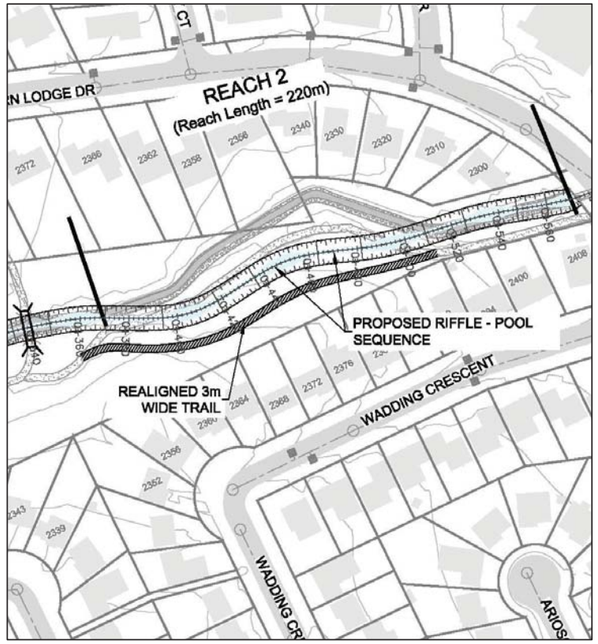
Evaluation of Alternatives

The preliminary preferred alternatives for restoration are summarized below. Your comments on the ranking and preferred method of restoration are encouraged and appreciated. The study team will compile and review all feedback, and then finalize the preferred alternatives for each reach.



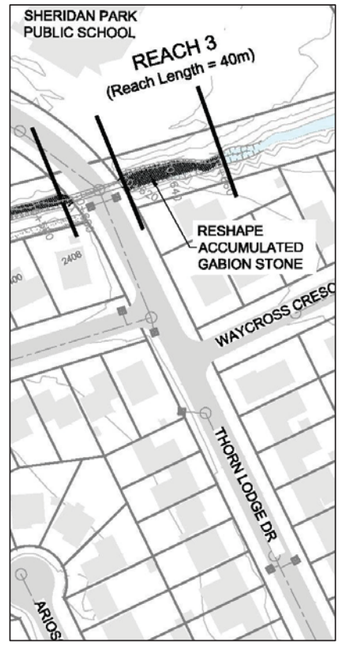
Reach 1 – Local Restoration

Stream restoration works at strategic / priority locations to repair the failing armourstone.



Reach 2 – Natural Channel Restoration

Continuous restoration of entire reach to a more natural form, and enhance terrestrial ecology.



Reach 3 – Local Restoration

Stream restoration works at priority location to reduce backwatering.

NEXT STEPS

PUBLIC CONSULTATION – July, 2021

- Comment forms available for input.
- Consultant team will compile and review feedback, and will confirm or adapt the preliminary preferred alternative in response.

SUBMIT EA PROJECT FILE AND OBTAIN AGENCY APPROVALS – 2021

- EA Project file posted for 30 day review period.

DETAILED DESIGN & IMPLEMENTATION

- Detailed design and permitting to proceed in 2021.
- Construction scheduled for early-mid 2022.

TO PROVIDE COMMENT, OR TO BE ADDED TO THE STUDY STAKEHOLDER LIST, PLEASE CONTACT:

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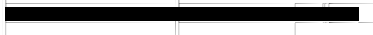
THANK YOU

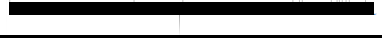
FOR PARTICIPATING IN THE LOYALIST CREEK EROSION CONTROL CLASS ENVIRONMENTAL ASSESSMENT

Appendix F4 – Consolidated Comments from Public

No.	Received Date	From	Address	Contact	Comments
Via Email					
1	9-Jul-21	Suzanne and Sean Wickett	[redacted]		Dear Mr. Frew, We are residents of the Sheridan Homelands neighbourhood and reside at 2384 Wadding Cres., Mississauga. My husband and I would like to express our concern over the proposed changes to the Loyalist Creek, which runs behind our home. We understand that the city is currently recommending Alternative # 4, which we believe is the most devastating/damaging. This option (Alternative # 4) calls for clearing the forest area and rerouting the creek and path much closer to Wadding crescent properties, including our own. We are concerned about the loss of mature trees and all other vegetation that has just recently become established and the huge negative impact on local wildlife. We support Alternative # 3 (replacing gabions w/amour-stone along the existing path), for although Alternative #3 would still cause destruction along the creek, it would allow the preservation of the existing position of the water channel and the existing path, allowing for the preservation of the mature trees on the South side of the path/creek. Our family loves and values the mature wood lot behind the house. We are also concerned that the combined factors of the closer proximity of the re-routed creek in conjunction with the loss of the trees (and their root systems) may cause future erosion issues with our property.
2	9-Jul-21	Magdalena and Marc Edwards	[redacted]		> Good afternoon Karen, > > We trust that you and your family are doing well. > > We are reaching out to you as a community regarding an important matter involving the Loyalist Creek erosion project and the proposed solutions to address the issue. The put forward Alternative #4 (please see link to the study below) would be absolutely devastating to the existing vegetation and wildlife habitats. > > As you know at first hand, the Loyalist Creek has been environmentally devasted six year ago with the removal of hundreds of Ashes due to Emerald Ash Borer. You have been the key person to support our community in the re-naturalization efforts taken within the last six years. You have personally participated in the tree planting events and have been instrumental in protecting and restoring the natural habitat within this creek. We as a community are so proud to see the woods starting to flourish again and are committed to keep on improving and protecting the wooded area. > > We ask for your support to take off the table one of the proposed solutions (Alternative # 4) which would devastate the woods and wildlife as well as erase all the hard work and efforts taken by our community and the City of Mississauga (Yourself and the Forestry Department). > > We ask that the erosion of the creek is addressed and fixed with minimal impact on the woods and wildlife habitat. Viable options as per the study released are Alternative # 2 and Alternative # 3. > > We appreciate everything you have done for our community and the restoration of the natural area, and we hope to continue to have your support in this matter. Please do not hesitate to let us know if there is anything further that our community can do to ensure our concerns are heard. > > We truly appreciate your time and hope to hear from you soon.
3	9-Jul-21	Kathleen and Scott Prosser	[redacted]		> Good afternoon, Karen, > > I'd like to thank Magdalena and Marc for putting in words the concerns we have as Ward 2 residents of Sheridan Homelands. > > The prospect of losing more vegetation along the trail and creek is highly unsettling. Given the extensive urban growth that's taking place around us (new apartment building on Sheridan Park Drive, THP LTC home, extension of Sheridan Park Drive to Winston Churchill), it's especially prudent that we work to preserve as much of our natural landscape as possible. > > I will be adding my voice in opposition to alternative four, and hope that we can count on your support at the municipal level in this effort.
4	12-Jul-21	Eddie and Laurel Lee	[redacted]		> Hi Karen, > > Adding our support to both letters below - thank you Magdalena, Marc and Kathleen for expressing the concerns so well! > > We agree that option 4 significantly undermines all of the great re-naturalization work that was done after the Emerald Ash Borer devastation, and is not a feasible solution. > We support further consideration of options 2 or 3 as more suitable solutions in order to preserve the much loved trail and minimize unnecessary disruption. > > We provided feedback on the Comment Form and would appreciate your continued support.

5	12-Jul-21	Jennifer Henderson-Pratt	[redacted]	> Hi Karen, > > We also join the many voices with great concern over the proposed erosion project set for Loyalist Creek. As you are on the CVC board I think you can also understand the neighborhood's hesitancy in clear cutting a forest, which due to the development of the LTC and other future developments, will be the only green space available to the community of Sheridan Homelands within walking distance. I take a couple of issues with this proposal: > > 1) The forest as you know was decimated 6 years ago due to Ash borers. The community had worked hard re planting trees that were lost and you were also involved in that campaign. To lose those trees that finally established themselves seems counter productive to that initiative. > > 2) Why is the proposed solution alternative #4 (most destructive) being proposed? Alternatives 2 and 3 appear to be just as effective. Why such a dramatic solution of clear cutting a healthy forest and moving trails? > > 3) Why were only a handful of select homeowners asked for public opinion when the entirety of the Sheridan Homelands community is impacted? > > I strongly believe an extension on the public feedback portion of this project should be given. I personally feel signs about this project should be placed at the entrance informing the community of what is proposed and how to give feedback. The project team cannot simply ask for feedback from a handful of home owners, where half would be stakeholders with property interests in this project. This is a large project that impacts the larger surrounding area. Again, happy to speak with you directly on these concerns. I hope we can count on your support to find an alternative option that can address the erosion concerns and keep as much of the surrounding trees intact. Thank you.
6	12-Jul-21	Dave Pearson	[redacted]	> Good morning Karen, > > The comments above reflect my family's feelings almost perfectly. While we appreciate that efforts have been made to find multiple ways of addressing the collapse of the waterway walls, the online resources provided are not fully explained, nor do the conclusions of the study make sense to us with no explanation provided. If options 3 and 4 are truly numerically equal at scores of 6.1 (which is truly an "if" in my mind - as detailed, 4 certainly SEEMS more disruptive, destructive and costly to me) then what is the reason for selecting 4 over 3? If there is any way to minimize canopy destruction, which seems like an important and worthwhile objective but it doesn't appear to be addressed? An open and community focussed explanation of the metrics used to determine the best outcome and a rationalization of the final decision wouldn't just be appreciated, they should be a requirement. > > After all the work that has gone into protecting the woods, culling the affected ash trees, planting new growth, and improving the trail, it would be a shame to do any unnecessary damage to this area (provided we are, of course, correcting the deficiencies with the waterway...we DO understand this is a top priority).
	13-Jul-21	Magdalena and Marc Edwards (repetitive)	[redacted]	> Good morning Greg and Robert, > > I hope everyone is doing well. I'm sure you have noticed that our community has been busy with providing feedback on the proposed creek erosion project. I think you will find this group quite passionate about this subject. There are a lot of questions and requests for addition information and in interest of time, I thought it would be beneficial to compile all inquiries into one email. Below are questions posed by our community. We look forward to hearing from you and receiving additional information on the 7 points listed below. > > • Point # 1 is being raised by majority of residents responding to the feedback. I have included two examples below that illustrate this concern: > • *REACH 2: If options 3 and 4 are truly numerically equal at scores of 6.1 (which is truly an "if" in my mind - as detailed, 4 certainly SEEMS more disruptive, destructive and costly to me) then what is the reason for selecting 4 over 3? > • *REACH 2: Why is the proposed solution alternative #4 (most destructive) being proposed? Alternatives 2 and 3 appear to be just as effective. Why such a dramatic solution of clear cutting a healthy forest and moving trails? > > • Woods surrounding the creek are an essential part of ecosystem and we should protect as much as possible. Project duration is another factor for consideration. Can you provide an estimated duration for each alternative considered? > • Why were only a handful of select homeowners asked for public opinion when the entirety of the Sheridan Homelands community is impacted? I strongly believe an extension on the public feedback portion of this project should be given. I personally feel signs about this project should be placed at the entrance informing the community of what is proposed and how to give feedback. > > • *REACH 2: The impact and duration of recovery to the aesthetic of the surrounding area, especially the woodlands should be a fifth category. The woods have just started to recover after being deforested and disrupted. How long do people want to be impacted by the results of this project. > > • *REACH 2: I think it is safe to say that if we were to incorporate a fifth category in your scoring board: "Impact on existing urban forest and wildlife habitats and duration of recovery", Alternative #4 would score the lowest in this section putting other alternatives forward. > • We value the tree canopy enormously and the wood surrounding the creek are of primary importance in this community. Impossible to assign a dollar value > • to each tree that could be lost in this process. > • > • Are you able to provide more detailed breakdown/raw data for the scoring system? > • We need to better understand the scoring system before making decisions. We did a summary for Reach 1 alternatives for comparison purposes. In the highlights below both alternative 2
	14-Jul-21	Kathleen and Scott Prosser (repetitive)	[redacted]	Dear Greg, Thanks for reaching out to us. We've noticed a great number of users of this creek trail since the pandemic and we just wanted to add what a unique ecological gem it has become. Every year we are visited by screech owls and there are three species of woodpeckers that are nesting along the trail (red bellied, downy, and hairy). Just yesterday we watched a light show by fireflies and we have a family of foxes that come and go. The city has done a great job preserving this small space recently, and we are all in favour of a solution which reinforces portions of walls that have eroded but without nature paying a price by levelling portions of forest. Magda and Marc organized a tree planting event a few years ago and we'd love to put our efforts toward extending this stream path through a Thornlodge park corridor and adding to naturalization. If you ever want to organize an electronic open house, we'd be more than happy to give feedback. We feel that anything we can all do that fosters stewardship of green space and re-naturalization is something everyone will be behind.

7	19-Jul-21	Gregg Wassmansdorf		Absolutely agree with the report recommendations. 1.Local Works for Reaches 1 and 3 seem most practical given the limited physical space available. 2.Reach 2 could have been Engineered or Natural based on the scoring. I agree 100% with the decision to favor a more natural solution, for numerous reasons. I appreciate having access to the full report in PDF plus the YouTube audio narrative to review the study. Nice use of the ArcGIS survey instrument.
8	25-Jul-21	Lorne and Rosella Flynn		Good Afternoon Greg, I hope it is not too late for my wife and I to add our voices to the many who question the choice of 'Alternative #4' as a solution to fix the eroded walls along the Loyalist Creek bank. I would like to first state we were surprised, taken aback, and disappointed to learn a 'consultation process' had already taken place without our knowledge. It was only through the work and effort of Magdalena and Marc Edwards that the choices being pondered were brought to our attention. We feel extremely lucky to live so close to such a lovely, peaceful tract of nature and because of the devastation that would take place, the number of trees needed to be destroyed and the high cost required to do so, we would like you to know we adamantly oppose 'Alternative #4'.
Online Platform				
9	19-Jun-21	Graeme Lake		I would prefer a natural restoration of all the reaches, but if that is not possible, I do support this outcome. I think natural restoration would eliminate the erosion concerns in Reach 2 while bringing environmental benefits. Looking at the other viable solution for Reach 2, I feel the engineered restoration would provide a long term erosion solution but would still required periodic maintenance and no environmental benefits. So I don't feel this solution is as good as the recommended one.
10	19-Jun-21	Else Grech		Yes I do. For Reach 1and Reach 3 the local restoration of the existing armourstone is scored at 6.8, with minimal monitoring and maintenance while having an extremely long lifespan. It would also improve public safety while being the least disruptive to stakeholders. For Reach 2 the Natural Channel Restoration would result in the same score as Option 3 (Engineered Channel Restoration) but the benefit of the Natural Channel Restoration would be the natural look of the creek corridor. This is high on my list re: benefits of this option. Also high on my list is the fact that the life span of this option is high. I have lived at my house for 27 years and, given the average life span in Canada, will have the opportunity to live there for another 30 years...so the lifespan of this option is important. I fully support this outcome.
12	21-Jun-21	Region of Peel		
	7-Jul-21	Magdalena Edwards (also from email)		For Reach 1 and 3 - the Local Works alternative seems the proper choice. However, I do not support the outcome for Reach 2. Alternative# 4 would devastate the area. The destruction, the loss of forest canopy and the negative impact on wildlife is clearly understated in this study and should take a high level of priority. Alternative #3 would at least allow for mature vegetation on the South Side of the creek to be protected. Protecting and enhancing of the existing mature vegetation is crucial to this area. We simply cannot afford to relocate the channel and path at the cost of clear cutting the mature, established vegetation.
11	7-Jul-21	Timothy Chang		I do not support A4 - Natural Channel Restoration for Reach 2 considering it has the same score as A3 - Engineered Channel Restoration (Both at 6.1). The main concern for this A4 for Reach 2 is the disruption to the nature habitat that has already been established. I don't believe the score for A4 should be nearly as high as A3 in this particular reach 2 as A4 poses more disruption to the land and the established habitat. Based on the drawings it looks to be 'clear' cutting all the trees off the ravine - which, imo, should be the lowest score of the 4 options regarding the physical and natural criteria. Specifically for Reach 2, I don't believe the rating metrics is detailed enough to evaluate a complete re-work of the water way. For reach 2, based on the evaluation both A2 and A3 looks for be a much better option and less impact to the community and the local green area.
12	8-Jul-21	John and Renata Cvitkovic		No, You mistakenly claim that Reach 2 scored Natural restoration higher than Engineered. They both scored 6.1. As areas 1 and 3 rated Local restoration higher, this should indicate that an Engineered solution for area 2 is more likely the desired outcome for the entire project area. Given that Natural Channel restoration would cause the greatest disruption to the woods, would likely take the longest duration to recover, and that the issues with the baskets in that area occurred within the last 6 years (lasted for 40 years), it makes more sense and would be much more appealing to perform an Engineered Channel Restoration to repair Reach 2 quickly with new armour stone. It's safe to say this would last another 40-50 years provided it's done properly, with minimal impact to cost, the woods and the community.
	8-Jul-21	MARC EDWARDS (also from email)		Alternative 3 and 4 would the devastating loss to that portion of the forest and I urge that these options will result in the degradation of the area for decades to come. The local community is there to plant, remove invasive species, reverted the area to a re-naturalization zone. We have come too far to watch it stripped away.
	9-Jul-21	Laurel MacKay-Lee (also from email)		I support the recommendations for Reach 1 and 3. I do NOT support the recommendation for Reach 2 as the scoring seems highly subjective and the outcome will be highly unfavourable to landowners - particularly Wadding Cres homeowners who will experience loss of their property and privacy on a permanent basis.
	9-Jul-21	Suzanne and Sean Wickett (also from email)		No, we do not support this outcome. We support Alternative # 3 for Reach 2 because Alternative #4 means loss of mature trees and devastation to animal habitat. We are concerned about having the creek re-routed closer to our property as we have an in-ground pool and feel that closer proximity to the creek could potentially compromise the integrity of our property in the future with increased risk of erosion. The loss of the mature trees behind our back fence will completely change our back yard and could also effect our property value. Our kids love the wooded area behind the house and we love walking there as a family. It is one of our favourite things about the location of our home. We support Alternative #3 because replacing gabions w/amour-stone along the existing path would allow the preservation of the existing position of the water channel and the existing path, allowing to preserve the mature trees on the South side of the path/creek.
13	9-Jul-21	Cameron Evanoff		Support this as it improves the creek and still able to maintain the existing bridges
14	9-Jul-21	John Federico		Alternatiave 3. The creek should be restored/repaired in the simplest way possible, and in no way should the path of the creek be diverted nor should any change be made to the walking path. There should definitely not be any cutting of trees or vegetation which would have a devastating impact on the environment and on the wildlife.

15	10-Jul-21	Hilda Farrar		Do not support Alternative4 at all . I have used this creek daily for over 25 years . Great shade in summer ….. less snow in winter. I am appauled that people who dont even use this path are making such extreme suggestions that affect the community . I would like any of the less invasive and destructive alternatives.
16	11-Jul-21	Natasha Pace		For Reach 2, why is Option #4 Natural Channel Restoration proposed vs. Option #3 Engineered Channel Restoration? Both Options #3 and 4 have a total score of 6.1 for Reach 2, but #4 seems to require more tree canopy destruction. Loyalist Creek is a beautiful, natural environment in Mississauga, and I would like to preserve as much of the tree canopy as possible. As well, Reach 2 Option #3 matches the look-and-feel of Reach 1 with armorstone.
17	12-Jul-21	Dianne Tyers		No, I do not support this outcome for Reach 2. You mistakenly claim that Alternative 4 scored higher than Alternative 3. They both scored 6.1. For Reach 1 and 3 Local Restoration was rightly rated highest, indicating the the least invasive option is preferred. For Reach 2 this should therefore be Alternative 3, which makes the least amount of change to the existing creek channel. Alternative 3 simply requires restorative work on the existing channel, not the rerouting of the whole channel. Given that Alternative 4 would cause the greatest disruption to the area (vegetation, surrounding properties), would take the longest duration for the vegetation to recover, would have the greatest cost, and has unknowns in terms of impacts on the foundations of surrounding properties, Alternative 3 is the only possible option for Reach 2. There is no logical reason to select Alternative 4, and the fact that a rerouting of the channel is even being considered is very disturbing.
18	12-Jul-21			Unfortunately, item by item explanations are needed for each option--esp. optns 3 & 4. I'm sure a detailed presentation by the experts would be most useful--esp. with questions being allowed.
19	12-Jul-21	Meghan Shaw		I do not support alternative 4. The decimation and closure of this area would be devastating to our children and their ability to enjoy the natural area. By the time it is restored they will be grown up. It will take many years for the area to be restored and in the mean time will destroy the natural habitats of countless wildlife.
20	12-Jul-21	Katherine Fitzgerald		While I see that doing nothing would only lead to future problems, it feels far too late to restore this creek to what it was before the city tampered with it in the first place. As the most ecologically disruptive and costly choice, I can't see how your team could have recommended it for any section of the project. Those rock cages are clearly a disaster. Option 3 seems like the wisest choice to me. I would not support natural channel restoration (alternative 4) for any part of the project. We lost a good part of the natural canopy during the oak tree crisis a few years ago, and it's just starting to regenerate now. We can't afford to lose any more trees in this area!
22	12-Jul-21	Kathleen Walker (also from email)		I do not support the choice of Alternative 4 for Reach 2. The loss of vegetation and the current forest canopy will be devastating as it will take YEARS for the trail to return to its current state. There is so much urban growth already happening in our neighbourhood (LTC home; new apartment building; expansion of Sheridan Park Dr. to Winston Churchill) that I feel very strongly we need to preserve as much of our current green space as possible. I would much prefer to see Alternative 2 or 3 applied to Reach 2.
21	12-Jul-21	Rachael Speirs		No. I reject option 4 which will be destructive to the forest canopy and the vegetation that is essential to that forest. I support the least disruptive (2 or 3)
22	12-Jul-21	Dolores Wielgus		I didn't know that you were studying the area. I want the creek to be restored to its natural state. I would like the information on the study to be made available to the public in plain English.
	13-Jul-21	Dave Pearson (also from email)		Why do you think Alternative 4 for Reach 2 is preferred? Your own scoring doesn't support this outcome. I'd like more information on this section especially, as you have two wildly different approaches with the same total score, and have, apparently arbitrarily, picked one.
	14-Jul-21	Jennifer Henderson-Pratt (also from email)		Again I do not support alternative 4. Alt 4 significantly undermines all of the great re-naturalization work that was done after the Emerald Ash Borer devastation, and is not a feasible solution. I would support further consideration of options 2 or 3 as more suitable solutions in order to preserve the much loved trail and minimize unnecessary disruption which would devastate wildlife and the health of the forest and surrounding environments. We do not have any green space left due to the development of the surrounding area. The Loyalist creek is also used as a teaching point for nearby schools for science lessons and environmental lessons. To loose the natural landscape would devastate the community.
23	15-Jul-21	Jeremy Edwards		Erosion issues would be my greatest concern as I currently back on to the creek and live next door to the house with the complete gabion wall failure. Yes, I do support this outcome. There are many failures of the gabion wall in Reach 2. I am currently backing onto the creek right beside the property with the complete gabion wall failure and it is obvious that this occurred here due to the sharp turn in the creek and the water being forced to hit this wall. I am also one of the properties which lies in the flood plane so mitigating this risk to my family and others on the street would make sense.
24	15-Jul-21			Erosion issues as they stand is a serious safety issue that needs to be addressed. I agree. It will have a short term impact on our canopy but if it promotes long term health of our watershed and actually improves it, there are many other benefits that come with that. However I'd like to see a commitment from the city in terms of maintaining the canopy and ensuring that any new planting is being maintained and replaced if newer trees die in the process
25	15-Jul-21			I like the idea of using Arbor stones to help quell erosion issues, but I see it as Local Restoration not a complete reset. At Erindale Park they have them along the banks and allow visitors to sit, relax, or even walk on the stones. Please consider this as part of the solution. I prefer Alternative 2 - Local Works. I trust, have faith, the city will take care to only address those areas needing restoration not the entire system in the execution of this solution.
26	15-Jul-21	Paul Grech		Yes. Best long term results for reach 2 and reach 1 & 3 have already had restorative work completed in past years.
27	17-Jul-21	Halina Rozpedowska		No, I don't support the Alternative 4 for phase 2. Too destructive to the existing vegetation and wildlife life habitats. For phase 1 and 3 the local works is the correct approach
28	18-Jul-21	Candide Monette		We do not support the project with using alternative #4 for reach 2 at all. We moved our entirely family here from Guelph because we love the forest, creek and trail. We use it everyday. We love taking walks and looking at the animals and birds. The #4 alternative would be so destructive to our beautiful forest. We would have construction, noise and traffic for months on end. I would not feel safe sending my kids out to play. We really hope you can pick option #2 to minimize the damage, the noise pollution and construction. We truly believe it is important to fight for our rights to preserve nature as much as possible and want to preserve the urban forest as it has been even more of a peaceful place for neighbors to walk in the shade and enjoy nature during these difficult months. We believe the money can be better spent in other needed areas in our city. Thank you for listening to our family. Candide Monette 2352 Wadding Crescent Mississauga.
29	18-Jul-21	Daniel		Reach 1 and 3 - agree Reach 2 - disagree. This is a small urban forest and alternative 4 would be too destructive to the existing vegetation and animal habitat. Please put heavier weight on the protection of the woods and implement a fix that will have the lowest impact on the woods and wildlife. Do not move, extend the width of the creek, do not create new path at the cost of trees and animal habitats.
30	19-Jul-21	Ian Barnett		What was the type of rock previously used, that failed? If it was a limestone, or similar "aggressive" element, has anyone considered that the issue is the type of rock? I propose that had the cages been filled with river rock then the erosion would not have happened. When is this due? I have many questions and have not yet read the study.

31	19-Jul-21	Martin and Jane Fraser	[redacted]	Like others in the neighbourhood I am concerned about the tree loss due to alternative 4 and don't feel it was represented highly enough in the study. In Reach 2, there seem to be two desired outcomes, 1. repairing the gabion wall as Reach 2 has the biggest gabion failure within it, and 2. no current easement with 2356 Thorn Lodge Drive. One question I have is why the lot for 2356 Thorn Lodge Drive is so much bigger than the rest of the nearby lots. Wasn't that to serve as compensation for the creek being on that property? The location of the creek hasn't changed since the lot was set up so it's always been understood that the creek crosses that property. Anyway, the score for Local Restoration matches the score for Natural Restoration for Reach 2. I suggest that the weight assigned to the loss of trees and forest canopy in the park for a very long period is too low. If that gets bumped up, then that pushes Local Restoration above Natural Restoration for Reach 2.
	20-Jul-21	Gregg Wassmansdorf (also from email)	[redacted]	Absolutely agree with the recommendations. Local Works for Reaches 1 and 3 seem most practical given the limited physical space available. Reach 2 could have been Engineered or Natural based on the scoring. I agree 100% with the decision to favor a more natural solution, for numerous reasons.
32	20-Jul-21	Sarah Edwards	[redacted]	Yes I support the scoring as a resident of 2320 thorn lodge drive, safety is our biggest concern and straightening of the creek will ensure the long term sustainability of the creek walls

zhao.c@aquaforbeech.com

From: Greg Frew <Greg.Frew@mississauga.ca>
Sent: Wednesday, June 16, 2021 12:48 PM
To: Rob Amos (amos.r@aquaforbeech.com); Chunying (Emily) Zhao (zhao.c@aquaforbeech.com)
Subject: Loyalist Creek - 2452 Thorn Lodge Dr.

Hi Rob and Chunying.

I just spoke to Mr. Herb Williams of 2452 Thorn Lodge who's received our PIC Notice for Loyalist Creek with the link to the online material. However he's not a computer user, so he's asked if we can provide a paper copy of the PIC material and survey. Would you be able to print the boards and survey and drop off a copy to his mailbox? Hopefully everything would be legible at 11x17.

I'm not sure if we'll get a survey response from him, but he spoke at length about his dislike for the armourstone banks on the creek. In his opinion they weren't installed correctly and were built too high. He stated that he's never seen the water higher than the second row of armourstone, so his preference is that the top row or two be removed. In his opinion, they are unnecessary and a safety hazard. He asked that I pass this information onto the City's consulting engineer for consideration.

Thanks,
Greg.

MISSISSAUGA

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