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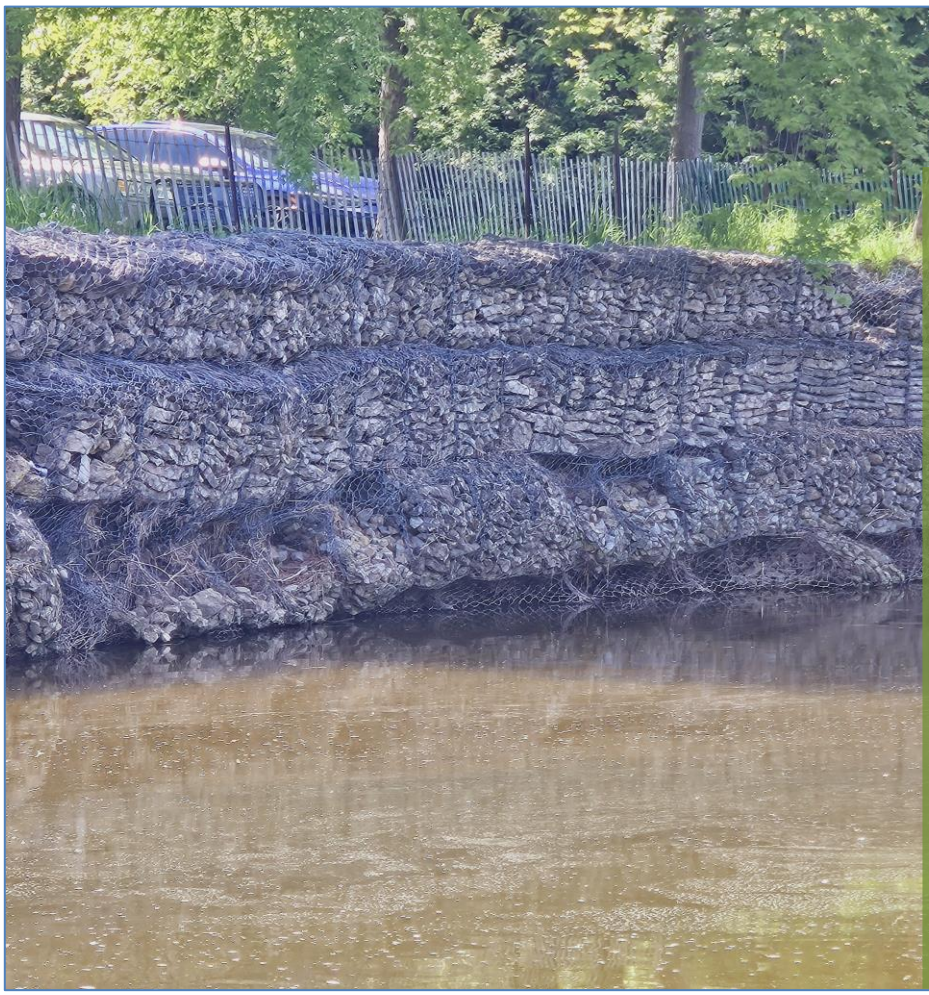
Township of Centre Wellington

1 MacDonald Square
Elora, ON N0B 1S0

Attention: Adam Dickieson,
Engineering Services Coordinator

Veteran's Park Retaining Wall Removal and Bank Naturalization

Conceptual Design Evaluation Report



Submitted by:

Aquafor Beech Ltd.

October 25, 2024

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1 INTRODUCTION

Aquafor Beech Limited (Aquafor), was retained by the Township of Centre Wellington (Township) to provide design services for the removal of a failing gabion basket retaining wall posing risk to Veteran's Park, along Irvine Creek. The site is located on the right bank of the river, at approximately the midsection of Veteran's Park at Water Street, Salem, within Township property **(Figure 1-1**). The purpose of this design brief is to establish the existing conditions and provide an overview of the proposed design methods.

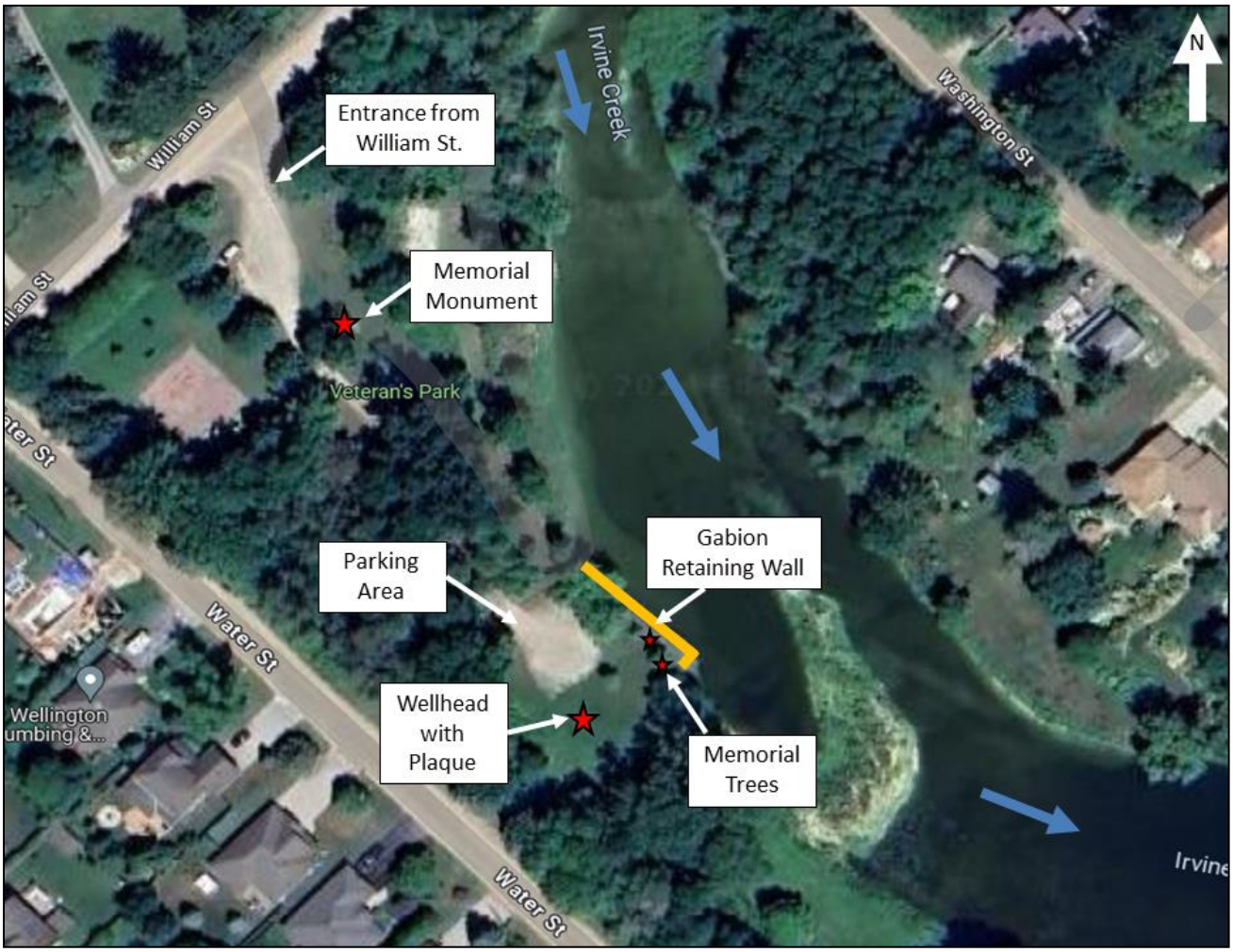


Figure 1-1. Study Area Extents and Features

Irvine Creek is part of the Grand River watershed, with a drainage area of approximately 200 km^2. Its headwaters are generally located to the northwest in the Townships of Wellington North and Mapleton, and drain east towards the Grand River in Centre-Wellington. The main branch of Irvine Creek passes through Salem, Ontario before it outlets to the Grand River in the adjacent Town of Elora.

Veteran's Park in Salem, Ontario is situated along the banks of the main branch of Irvine Creek. Historically, a gabion basket retaining wall has provided bank protection and erosion prevention near the parking area, as highlighted in Figure 1-1. However, the gabion baskets have reached the end of their functional life, having fully corroded and emptied along much of the bottom tier, with the wall now slumping or leaning along most of its length as shown in **Figure 1-2** and **Figure 1-3**.



Figure 1-2: Gabion Basket Retaining Wall



Figure 1-3: Corroded and Empty Gabion Baskets and Slumping Retaining Wall

The intent of this report is to summarize the existing conditions of the area, highlighting ongoing risks, as well as detail a the proposed design.

2 TECHNICAL INVESTIGATIONS

Aquafor has undertaken several investigations and technical assessments to attain a comprehensive understanding of the existing conditions and constraints. A summary of the investigations is below:

2.1 Background Data Review

At the onset of the study, Aquafor reviewed all available background information that was provided by the GRCA and the Township. Data provided for review included:

- GRCA HEC-RAS model and floodplain mapping for Irvine Creek
- Infrastructure and Utilities mapping (AutoCAD/GIS format)
- Property mapping (AutoCAD/GIS format)
- Existing reports associated with the presence of Species at Risk within the study area, particularly Red Side Dace.

This data supplemented the additional information that was included as part of the RFP, including historical aerial photography, site records, and property mapping.

2.2 Topographic Survey and Site Assessment

Aquafor completed a topographic survey in August of 2024 to define the topographic features within the study area. The topographic information was compiled along with background data that was provided by GRCA and the Township's GIS department to create the base mapping for establishing the existing conditions on-site.

The survey was completed using a combination of total station and GPS instruments and exported using the UTM NAD 83 Zone 17 projection, with the GCVD1928 (2010Epoch) vertical datum. The compiled survey data was then overlaid onto base mapping provided by the Township's GIS department, which includes property parcels, building limits, storm and sanitary sewer network alignment and other utilities.

The survey provides an accurate representation of the existing retaining wall, surrounding topography, trees, and other park features, providing sufficient detail for the purposes of the detailed design. The key parameters of the surveys included:

- Updating the location of the top of bank;
- Channel width and geometry
- Longitudinal profile of the creek
- Existing retaining wall
- Infrastructure extents
- Potential access and staging areas
- Trees and vegetation

The topographic information was complied into a planform drawing, overlaying other base mapping, as shown in **Figure 2-1**.

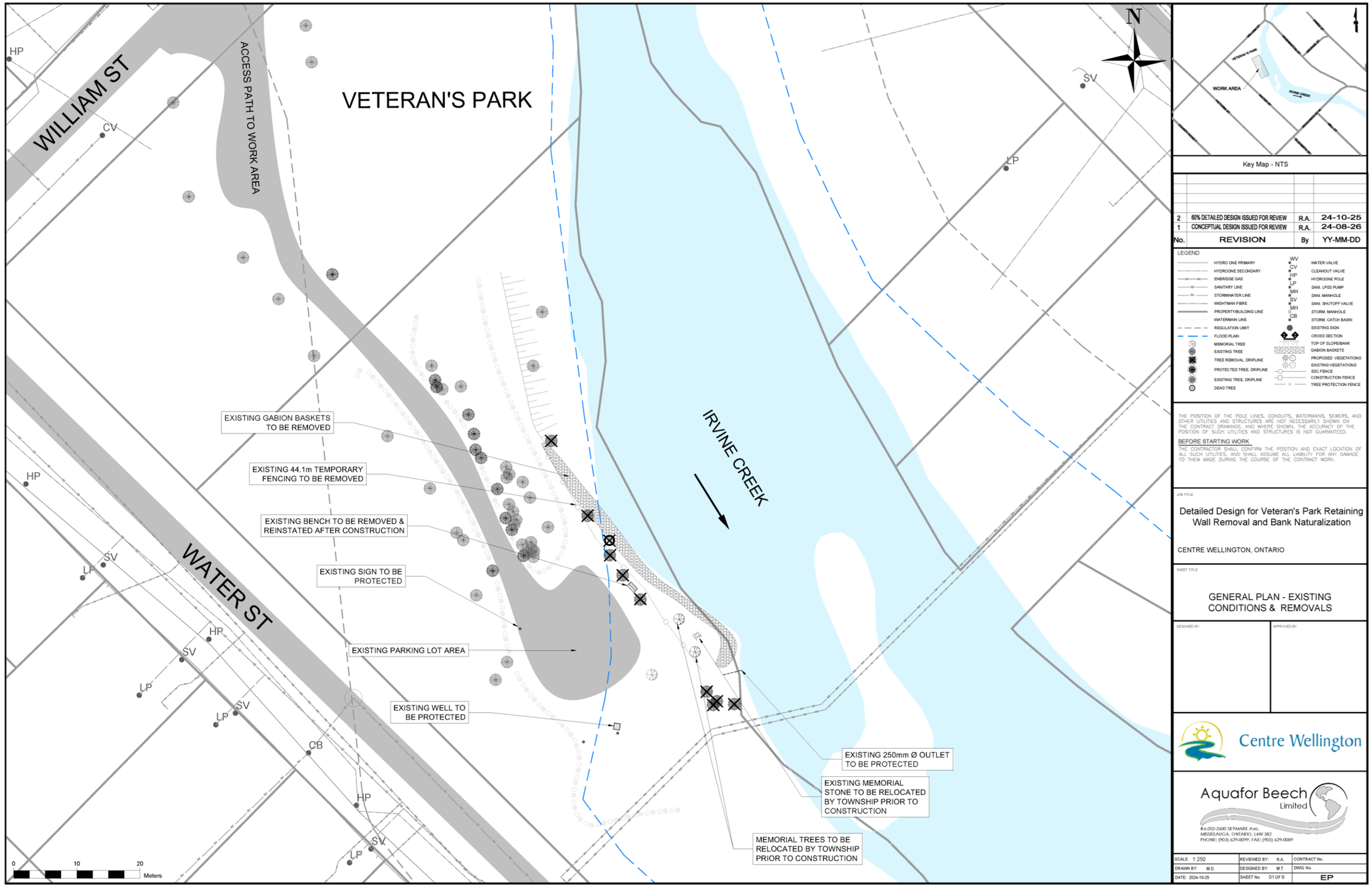


Figure 2-1. Compilation of Base mapping and Existing Conditions

2.2.1 Reach Description

The reach of Irvine Creek within the study area extends from the upstream bridge at Washington Street to the downstream bridge at Wellington Road 18. Average bankfull width of the Reach is 25 m, and average bankfull depth is approximately 3m. Representative photographs of the Reach are shown in **Figure 2-2** and **Figure 2-3**. Within the study area, there is a large deposit of sediment adjacent to the left bank, just downstream of the existing retaining wall. GRCA has indicated that the sediment buildup should not be removed.



Figure 2-2: Irvine Creek facing downstream from the study area



Figure 2-3: Representative photograph of the Reach facing upstream

2.3 Hydraulic Analysis

Per GRCA guidelines, the proposed design should not result in any increase in flood levels. To verify this, a hydraulic assessment is required to determine the impacts of any proposed erosion control works on the flood levels through the project study area.

In support of the detailed design, Aquafor has obtained and reviewed the most recent version of the GRCA's HEC-RAS model for the study area. This model will act as a baseline and was updated for design purposes through the use of remote-sensing products (i.e., DEMs, LIDAR) as well as in-situ field measurements (topographic survey). This provides an 'updated existing conditions' model to confirm the existing flood conditions, as well as define hydraulic parameters for design of the bank protection works. Further hydraulic analysis via a "proposed conditions" scenario was then completed to confirm there are no negative impacts to flooding or erosion relative to existing conditions.

2.3.1 Existing Conditions

The provided HEC-RAS model includes flow data for the 50-year, 100-year, and regional storms. The model contains only one river (Irvine) with one reach (1). There are no cross sections that intersect the current retaining wall, but one approximately 50 m upstream (RS7) and another 40 m downstream (RS6). Cross section locations and the regional flood line (in blue) are shown in **Figure 2-4**.

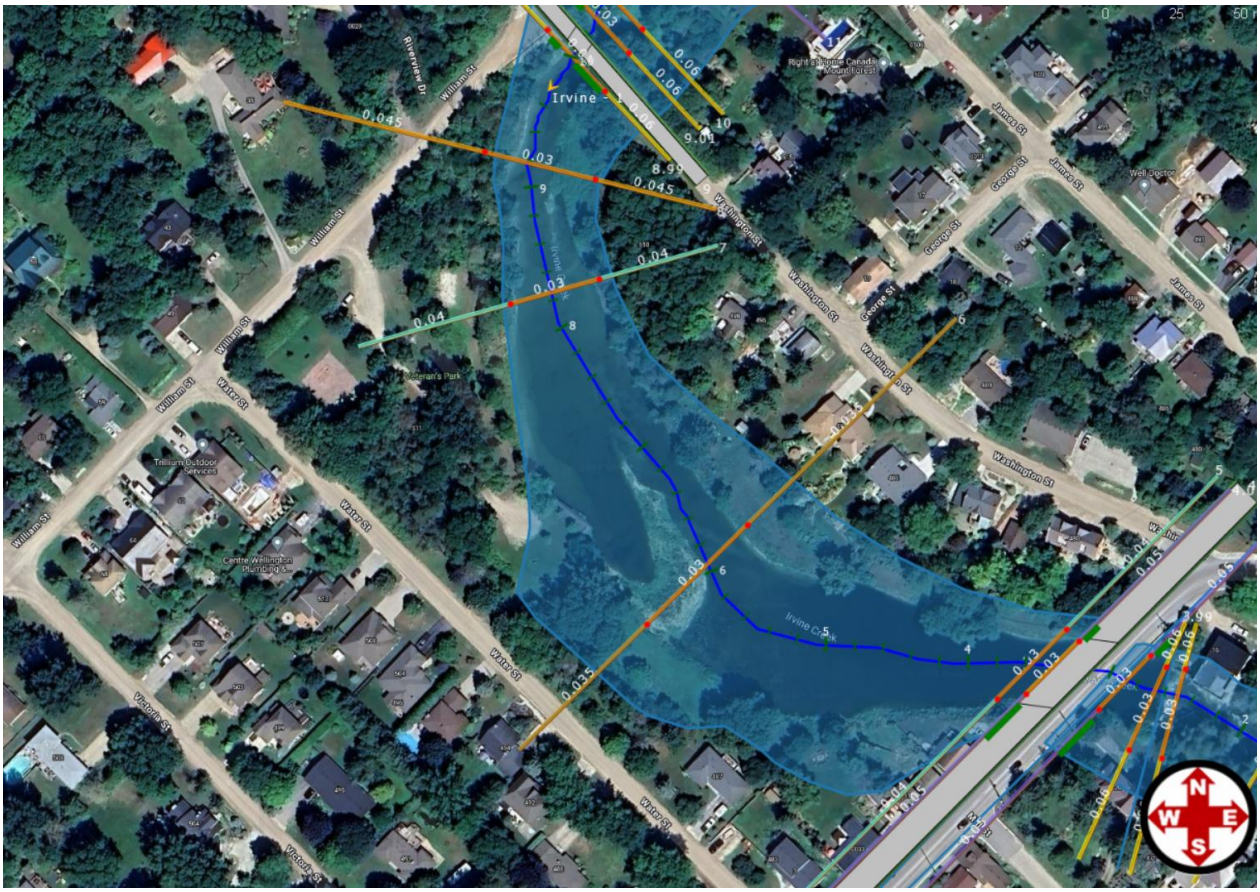


Figure 2-4: Existing HEC-RAS Model and Regional Floodline near Veteran's Park

The model was run under steady flow conditions; the results are summarized in **Table 2-1** below.

Table 2-1: HEC-RAS Exisitng Conditions Summary

River Sta	Profile	Q Total	W.S. Elev	Hydr Depth	Vel Chnl	Shear Chan	Power Chan	Top Width
		(m3/s)	(m)	(m)	(m/s)	(N/m2)	(N/m s)	(m)
5	Regulatory	357	389.67	1.94	2.03	22.1	44.85	108.87
5	100 Year	208	388.7	3.02	1.54	13.54	20.82	46.19
5	50 Year	199	388.63	3.02	1.5	12.9	19.33	45.22
6	Regulatory	357	389.87	2.9	1.04	5.76	5.98	158.58
6	100 Year	208	388.82	2.27	0.87	4.45	3.89	134.43
6	50 Year	199	388.75	2.22	0.86	4.34	3.73	132.8
7	Regulatory	357	389.63	2.87	3.04	55.3	167.88	45.79
7	100 Year	208	388.67	2.43	2.48	39.96	99.08	37.74
7	50 Year	199	388.61	2.39	2.43	38.73	94.29	37.38
8	Regulatory	357	389.99	2.98	1.96	22.38	43.91	79.35
8	100 Year	208	388.91	2.25	1.67	17.96	30.07	69.67
8	50 Year	199	388.84	2.2	1.65	17.61	29.08	69.02

2.3.2 Updated Existing Conditions

The updated existing conditions scenario is labelled "Updated Existing" within the HEC-RAS model. To better define the channel and overbank topography and provide more accurate results, two (2) new cross sections were defined within the study area, representing the proposed design cross sections 2 and 4. These are located at river stations RS 6.4 (XS2), and RS 6.6 (XS4). Cross-section geometry was extracted from the provincial LiDAR data and channel geometry was updated using Aquafor's topographic survey information to accurately represent the existing conditions. Floodline extents were also refined using the LiDAR data. The updated existing model is shown in **Figure 2-5,** below.

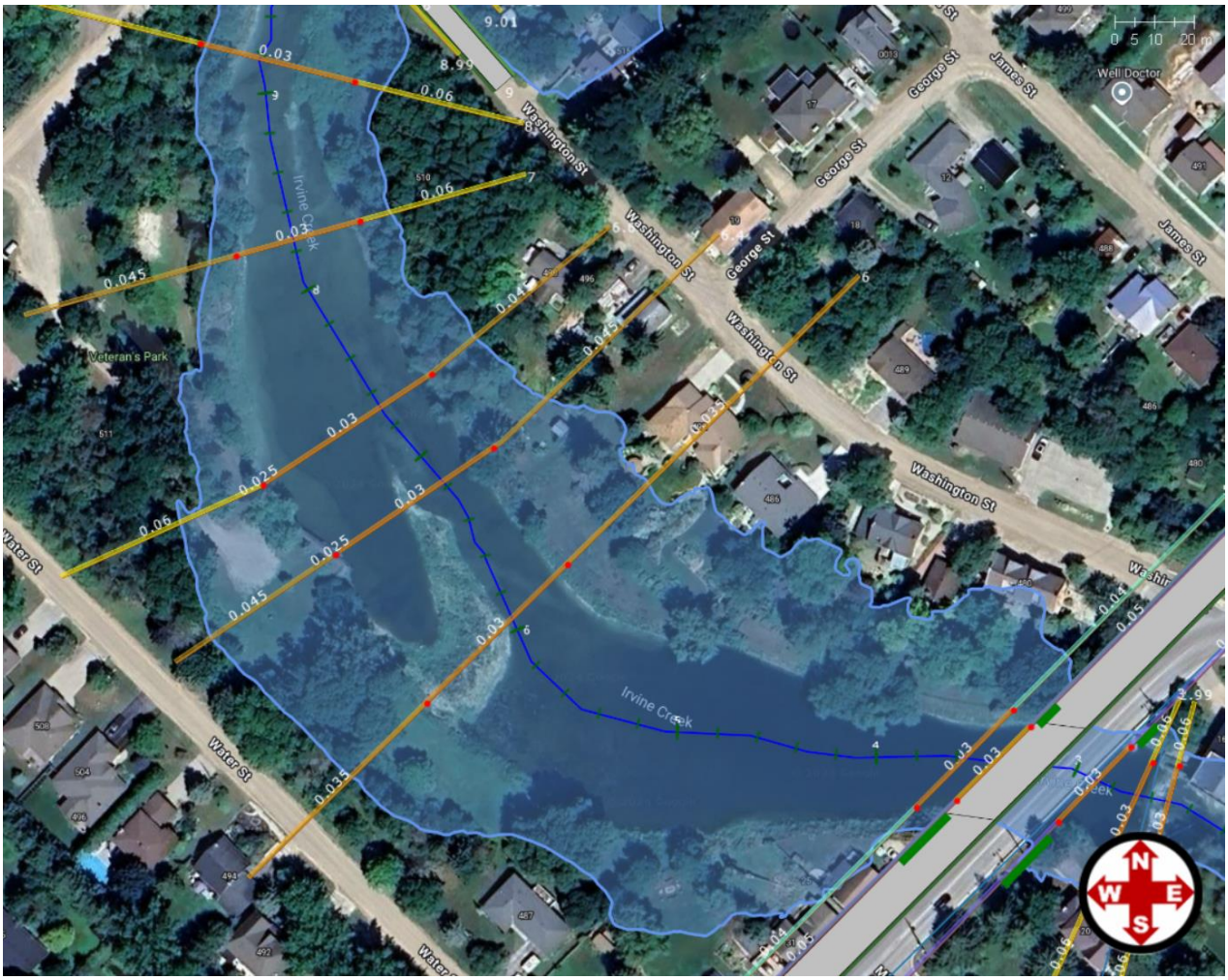


Figure 2-5: Updated Existing HEC-RAS Model and Regional Floodline near Veteran's Park

The updated existing conditions scenario was executed for flood flows under steady flow conditions. A summary of the updated existing model's hydraulic results for the 50-year, 100-year, and Regional return period is presented in **Table 2-2** below.

Table 2-2: HEC-RAS Updated Existing Conditions Summary

River Sta	Profile	Q Total	W.S. Elev	Hydr Depth	Vel Chnl	Shear Chan	Power Chan	Top Width
		(m3/s)	(m)	(m)	(m/s)	(N/m2)	(N/m s)	(m)
5	Regulatory	357	389.67	1.94	2.03	22.1	44.85	108.87
5	100 Year	208	388.7	3.02	1.54	13.54	20.82	46.19
5	50 Year	199	388.63	3.02	1.5	12.9	19.33	45.22
6	Regulatory	357	389.87	2.9	1.04	5.76	5.98	158.58
6	100 Year	208	388.82	2.27	0.87	4.45	3.89	134.43
6	50 Year	199	388.75	2.22	0.86	4.34	3.73	132.8
6.4	Regulatory	357	389.82	2.58	1.61	14.09	22.74	102.33
6.4	100 Year	208	388.79	2.03	1.32	10.34	13.66	82.55
6.4	50 Year	199	388.72	2	1.3	10.01	12.97	81.02
6.6	Regulatory	357	389.84	2.96	1.53	12.53	19.21	86.98
6.6	100 Year	208	388.81	3.12	1.18	8.07	9.51	57.95
6.6	50 Year	199	388.74	3.15	1.15	7.74	8.91	56.21
7	Regulatory	357	389.62	2.86	3.15	59.53	187.37	45.59
7	100 Year	208	388.67	2.43	2.55	42.2	107.54	37.72
7	50 Year	199	388.6	2.39	2.5	40.86	102.18	37.36
8	Regulatory	357	389.99	2.99	2.1	25.72	54.08	79.36
8	100 Year	208	388.92	2.25	1.78	20.27	36.05	69.71
8	50 Year	199	388.84	2.2	1.75	19.85	34.8	69.06

2.3.3 Proposed Conditions

Following development of the detailed design, cross section geometry was updated in the model to reflect the proposed conditions at the added cross sections. This scenario is labelled "Proposed Conditions" within the HEC-RAS model. The proposed conditions scenario was executed for the same range of flood flows under steady flow conditions and compared to updated existing conditions scenario. A summary of the proposed conditions model's hydraulic results for the 50-year, 100-year, and Regional return period is presented in Table 2-3 below.

Table 2-3: HEC-RAS Proposed Conditions Summary

River Station	Profile	Q Total	W.S. Elev	Hydr Depth	Vel Chnl	Shear Chan	Power Chan	Top Width
		(m3/s)	(m)	(m)	(m/s)	(N/m2)	(N/m s)	(m)
5	Regulatory	357	389.67	1.94	2.03	22.1	44.85	108.87
5	100 Year	208	388.7	3.02	1.54	13.54	20.82	46.19
5	50 Year	199	388.63	3.02	1.5	12.9	19.33	45.22
6	Regulatory	357	389.87	2.9	1.04	5.76	5.98	158.58
6	100 Year	208	388.82	2.27	0.87	4.45	3.89	134.43
6	50 Year	199	388.75	2.22	0.86	4.34	3.73	132.8
6.4	Regulatory	357	389.84	2.8	1.41	13.08	18.39	102.58
6.4	100 Year	208	388.8	2.3	1.14	9.42	10.73	82.95
6.4	50 Year	199	388.73	2.28	1.12	9.12	10.19	81.28
6.6	Regulatory	357	389.84	2.95	1.52	15.39	23.35	86.97
6.6	100 Year	208	388.81	3	1.19	10.29	12.22	59.86
6.6	50 Year	199	388.74	2.99	1.16	9.86	11.44	58.6
7	Regulatory	357	389.65	2.87	3.02	54.66	165.08	45.98
7	100 Year	208	388.68	2.44	2.47	39.57	97.69	37.81
7	50 Year	199	388.62	2.4	2.42	38.37	93.02	37.44
8	Regulatory	357	390	3	1.95	22.18	43.32	79.37
8	100 Year	208	388.92	2.26	1.67	17.82	29.73	69.75
8	50 Year	199	388.85	2.2	1.65	17.47	28.75	69.1

A comparison in water surface elevation between the updated existing and proposed conditions is presented in Table 2-4 below. The comparison indicates that there is negligible change to the water surface elevations in all storm events.

Table 2-4: Water Surface Elevation Comparison

River Station	Profile	Q Total	Existing WSE	Proposed WSE	Difference
		(m3/s)	(m)	(m)	(m)
5	Regulatory	357	389.67	389.67	0
5	100 Year	208	388.7	388.7	0
5	50 Year	199	388.63	388.63	0
6	Regulatory	357	389.87	389.87	0
6	100 Year	208	388.82	388.82	0
6	50 Year	199	388.75	388.75	0
6.4	Regulatory	357	389.82	389.84	0.02
6.4	100 Year	208	388.79	388.8	0.01
6.4	50 Year	199	388.72	388.73	0.01
6.6	Regulatory	357	389.84	389.84	0
6.6	100 Year	208	388.81	388.81	0
6.6	50 Year	199	388.74	388.74	0
7	Regulatory	357	389.62	389.65	0.03
7	100 Year	208	388.67	388.68	0.01
7	50 Year	199	388.6	388.62	0.02
8	Regulatory	357	389.99	390	0.01
8	100 Year	208	388.92	388.92	0
8	50 Year	199	388.84	388.85	0.01

2.4 Terrestrial Ecology Review

Aquafor's terrestrial ecologists have reviewed background info and completed field assessments to determine the ecological conditions and potential SAR within the study area. These assessments and findings are discussed in detail in the subsections below.

2.4.1 Vegetation Communities and Flora

Aquafor conducted field investigations on August 16, 2024 to characterize the study area's existing conditions. Vegetation communities were assessed according to Ecological Land Classification (ELC) for Southern Ontario, First Approximation (Lee et al., 1998). Where a suitable community description was not available per the First Approximation, classification was supplemented from the 2008 Draft version for Southern ELC (most equivalent 1998 code is provided in brackets where this applies). A complete botanical species list is provided in **Appendix A**.

WODM4-4 (CUW1): Dry - Fresh Black Walnut Deciduous Woodland

Open woodland is present throughout the park, surrounding mown areas. In general, Black Walnut (*Juglans nigra*) was most abundant in the canopy and subcanopy, with the other most common species including Cottonwood (*Populus deltoides*) and Eastern White Cedar (*Thuja occidentalis*). Other species include Common Apple (*Malus pumila*), Manitoba, Red, Silver and Norway Maples (*Acer negundo, A. rubrum, A. saccharinum, A. platanoides*), Basswood (*Tilia americana*), Black Locust (*Robinia pseudoacacia*), White and Scots Pines (*Pinus strobus* and *P. sylvestris*), and Crack Willow (*Salix* ^{x} *fragilis*). The shrub layer contained a mixture of Black and Red Raspberries (*Rubus occidentalis* and *R. idaeus*), European Buckthorn (*Rhamnus cathartica*), Alternate-leaved Dogwood (*Cornus alternifoilia*), Tatarian Honeysuckle (*Lonicera tatarica*) and Bebb's Willow (*Salix bebbiana*). The ground layer was variable depending on canopy openness, with common cultural meadow species often being present where sunlight was available. Examples include but aren't limited to: Orchard Grass (*Dactylis glomerata*), Canada Goldenrod (*Solidago*

canadensis), Goutweed (*Aegopodium podagraria*), Calico Aster (*Symphyotrichum laternifolia*), New England Aster (*Symphyotrichum novae-angliae*), False Hedge Bindweed (*Calystegia sepium*), Tansy (*Tanacetum vulgare*), Common Sow Thistle (*Sonchus arvensis*), Kentucky Bluegrass (*Poa pratensis*), Common Teasel (*Dipsacus fullonum)*, Chicory (*Cichorium intybus*), Wild Carrot (*Daucus carota*), Common Burdock (*Arctium minus*), and others.

MAM2-10: Mixed Forb Mineral Meadow Marsh

A wetland community dominated by a mixture of wetland forbs is present along the riverbank. Species here include Spotted Joe Pyeweed (*Eutrochium maculatum*), Canada Anemone (*Anemonastrum canadense*), Tall Boneset (*Eupatorium altissimum*), Panicled Aster (*Symphyotrichum lanceolatum*), Blue Vervain (*Verbena hastata*), Grass-leaved Goldenrod (*Euthamia graminifolia*), Spotted Jewelweed (*Impatiens capensis*), Purple-stemmed Angelica (*Angelica atropurpurea*), Northern Water-horehound (*Lycopus uniflora*), Spotted Lady's Thumb (*Persicaria maculosa*), Cocklebur (*Xanthium strumarium*), Burreed (*Sparganium eurycarpum*), Purple Loosestrife (*Lythrum salicaria*) and a few cultural meadow species such as Goldenrods and Asters.

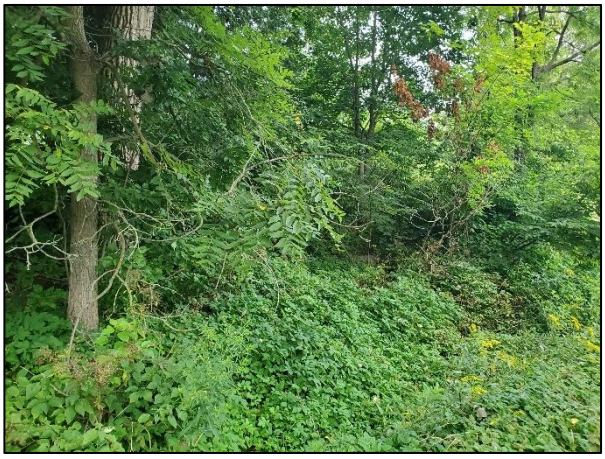


Photo 1: WODM4-4



Photo 2: MAM2-10

Figure 2-6 - Representative ELC Photographs

2.4.2 Terrestrial Wildlife

Targeted surveys for terrestrial wildlife were not included in Aquafor's scope of work for this assignment. Incidental observations of wildlife and wildlife habitat features were recorded during field investigations, including evidence of habitat utilization (e.g., scat, tracks, nests, hair, etc.) where available.

Table 2-5: List of Incidental Wildlife Species Observed

Species Observed		S Rank	SAR Designation (ESA)
Common Name	**Scientific Name**		
Birds			
American Crow	*Corvus brachyrhynchos*	S5	-
Belted Kingfisher	*Megaceryle alcyon*	S5B, S4N	-
Blue Jay	*Cyanocitta cristata*	S5	-
Canada Goose	*Branta canadensis*	S5	-

Double-crested Cormorant	*Phalacrocorax auritus*	S5B,S4N	-
Green Heron	*Butorides virescens*	S4B	-
Mallard	*Anas platyrhynchos*	S5	-
Northern Cardinal	*Cardinalis cardinalis*	S5	-
Nuthatch species	*Sitta sp.*	-	-
Osprey	*Pandion haliaetus*	S5B	-
Yellow Warbler	*Setophaga petechia*	S5B	-
Mammals			
American Red Squirrel	*Tamiasciurus hudsonicus*	S5	-
Gray Squirrel	*Sciurus carolinensis*	S5	-

All of the above species are common and ranked as S5 in Ontario (population secure). Based on the observed study area characteristics, numerous other common suburban/urban wildlife species are also likely to use the habitats types found here, and the study area likely supports a wider range of wildlife than could be confirmed during Aquafor's field investigations.

2.4.3 Species at Risk Screening

Aquafor conducted a screening for Species at Risk (SAR) that may occur in or adjacent to the study area. For the purpose of this design brief, 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). Other Species of Conservation Concern (SOCC) which may have been considered include those with Global Ranks of G1-G3, Sub-national/Provincial ranks of S1-S3, or a local/regional rarity rating as determined by local authorities. Species were screened for their potential to occur based on their habitat requirements and the habitat present in the study area (**Appendix B**). Species with no potential to occur based on the available habitat were screened out of further review. The following species were determined to have some potential to occur based on the presence of suitable habitat features:

- Bald Eagle (*Haliaeetus leucocephalus* – SC) – Bald Eagle nests are typically found near the shorelines of lakes or large rivers, in large super-canopy trees, and may be used over multiple years. Breeding season for Bald Eagles typically begins in mid-February. Recent records of Bald Eagle have been recorded in the vicinity of the study area. Large super canopy trees (such as the large Cottonwoods observed near the access road) should be examined prior to construction to ensure no nesting is occurring on site that may be disrupted by the works.

- Eastern Milksnake (*Lampropeltis Triangulum* – SC federal) – This habitat generalist may utilize a variety of different habitats including open or forested natural areas, but shows preference to sites that can provide hibernation opportunities (old foundations, mammal burrows, old logs, etc.) and are in close proximity to water. Potential impacts can be mitigated through awareness and monitoring to avoid injury or mortality of snakes during construction.

- Eastern Wood-Pewee (*Contopus virens* - SC) – This species nests in deciduous forests, particularly favouring edge habitat which is abundantly available in the study area. Impacts to Eastern Wood-pewee can be reduced by avoiding vegetation clearing during the breeding bird window in any given year (April 1st to August 31st).

- Midland Painted Turtle (*Chrysemys picta marginata* – S4) – Inhabits quiet, warm, shallow water with abundant aquatic vegetation such as ponds, large pools, streams, ditches, swamps, marshy meadows; eggs are laid in sandy places, usually in a bank or hillside, or in fields; basks in groups; not territorial. Potential impacts to this species can be mitigated through awareness and monitoring to avoid injury or mortality of turtles during construction, and avoiding the creation of soil stockpiles or other features which may attract nesting turtles in the spring and early summer will further reduce impacts to this species.

- Monarch (*Danaus plexippus* - SC) - This butterfly is found wherever there are milkweed (*Asclepius* spp.) plants for its caterpillars and wildflowers that supply a nectar source for adults. It is often found on abandoned farmland, meadows, open wetlands, prairies and roadsides that may exist within the study area. Important staging areas during migration occur along the north shores of the Great Lakes. Impacts to this species can be reduced by avoiding vegetation clearing during the growing season (April and October of any given year), including a variety of native, pollinator friendly flowering flora in the restoration seed mix, and avoiding the use of pesticides.

- Snapping Turtle *(Chelydra serpentina* - SC) – This species is often found in large, permanent creeks and waterbodies such as the river that runs through the study area. Potential impacts to this species can be mitigated through awareness and monitoring to avoid injury or mortality of turtles during construction, and by avoiding the creation of soil stockpiles or other features which may attract nesting turtles in the spring and early summer.

- SAR Bats (*Myotis* spp. and *Perimyotis subflavus* - END) – Maternity Roosting for SAR Bats may include large DBH trees with well-developed cavities or leaf clusters. Trees meeting maternity roosting criteria for both species exist within the study area woodlands, particularly any mature host trees (Maple and Oak). Any tree removal required for construction activities are likely to impact bat habitat. **Any proposed tree removals may require the submission of an IGF to the MECP to determine any steps regarding protection or mitigation for this species.** Tree removals should be timed to avoid the bat maternity season which generally runs April 1 – October 1. A bat box ("rocket box") or other structures/features may be requested to compensate for removed habitat.

MECP 17(2) (b / c) Species at Risk Act – Under the evolving MECP policy regarding SAR habitat, a regulatory exemption clause has been published for "non-imminent threats to health and safety" under O.Reg. 242/08 (23.18) to the *Endangered Species Act*, which allows certain works to proceed without a permit regardless of their potential impacts, including:

"Work to protect against drought, flooding, forest fires, ***unstable slopes and erosion as long as the protection does not include the building of new infrastructure****."*

The proposed works in Veterans Park qualify for this exemption, as they are erosion control measures intended to prevent against unstable slope and do not involve the building of new infrastructure.

As part of the exemption, a Notice of Activity must be submitted through the provincial website (My Account) to register the project prior to commencing the proposed works. Although there are no associated additional approval applications or reviews as part of this process, the proposed works are still obligated to minimize their effects on SAR (e.g., by providing mitigation such as timing restrictions on vegetation removal, following in-water works timing windows and standard DFO mitigation measures to prevent harm to fish, and providing habitat restoration/compensation as appropriate). A mitigation plan should be prepared, and records of the activity maintained, should the MECP request a review at a later date.

2.5 Aquatic Ecology Review

Fish community and aquatic habitat within the study area was surveyed on August 16, 2024 by Aquafor Beech Limited aquatic biology staff. Surveys were conducted in accordance with the Ontario Stream Assessment Protocol (OSAP), Section 4, Module 1: Rapid Assessment Methodology for Channel Structure (Stanfield, 2017). The aquatic components of the study area are described in the following subsections. Photographs from Aquafor's site visit are included in the following sections.

Aquatic habitat characteristics, as described in the following section, are major determinants for biotic composition, which is an indicator of aquatic ecosystem health. Understanding aquatic habitat can therefore determine relationships with biotic composition, providing a better understanding of subwatershed health and integrity. While aquatic habitat changes constantly, anthropogenic disturbance can impact habitat, stressing the relationship with aquatic habitat and biological/chemical indicators. The habitat characteristics investigated within the immediate study area as well as the adjacent watercourses include:

- Bank characteristics;
- Stream width (wetted and bankfull);
- Instream cover (e.g., woody debris, undercut banks, boulders, vegetation);
- Riparian cover (vegetation composition, quality and width); and
- Physical barriers to fish movement (e.g., woody or debris jams, knickpoints, etc.)

2.5.1 Aquatic Habitat

One (1) OSAP site was established as part of the study for the Veteran's Park Retaining Wall and Bank Naturalization Project. Within the study area, one watercourse was identified as Irvine Creek. The Irvine Creek subwatershed drains in a south westerly direction through mixed land use of predominantly agriculture, to the Grand River in the Town of Elora, approximately 2 km downstream of the study area.

The site length extended ~40 meters, with observations focusing on the retaining wall in question and the immediate riparian area observed both up- and downstream by which the naturalized design should be replicated. The site was abutted by a well-used park with mowed and maintained lawn, established mixed deciduous forest and a narrow, naturalized meadow riparian area. Observations at the downstream Woolwich St W bridge and the upstream decommissioned Washington St bridge were also noted. OSAP findings and habitat characteristics for the study area is detailed below in **Table 2-6.**

Table 2-6: OSAP findings

Site ID	Veteran's Park Retaining Wall
General Flow Regime	Permanent
Subwatershed/ Watercourse	Irvine Creek, Upper Middle Grand River subwatershed
Site Location	Observations focusing on the retaining wall which abutted Veteran's Park and supported a small gravel parking area for the park. Immediate riparian area was assessed both up- and downstream.
Site Characteristics	Site length was ~40 meters. Average wetted width was ~40 meters, while the average depth at crossovers was ~200 mm. The maximum particle size observed was ~200 mm, which was contributed by cobble. The site was surrounded by a naturalized meadow buffer with overhanging mixed deciduous forest in the upstream extent (**Figure 2-7**), with a narrow meadow buffer bound by mowed park and private residential lawns downstream. Beyond the immediate riparian area, maintained lawn existed on the property, followed by residential development and roads. The tributary was confined by a large dam located immediately downstream of Woolwich St W which dictated the water level and created a widened watercourse immediately within Veteran's Park and adjacent to the retaining wall. Notably, records suggest that Redside dace have been observed upstream of the study area with details provided below.
Habitat Description	The site had poorly distributed habitat types due to the downstream dam dictating water levels and resulting in reservoir-like conditions. The habitat was entirely composed of medium depth pool habitat, reaching up to 600 mm. The watercourse deepened significantly downstream at the Woolwich St W bridge, with pool habitat observed upstream at the decommissioned Washington St bridge, both of which likely provided areas of refuge to fish. Fish habitat was supported by instream cover that consisted of macrophytes, overhanging meadow vegetation and some tree canopy, and very few unembedded round rocks. Grasses were overhanging the watercourse within the meadow riparian buffer, which provided cover and food sources for fish (**Figure 2-8, Figure 2-9 and Figure 2-10**). Overall, the site demonstrated low velocity and flow. Shade and canopy cover was low due to the widened corridor.
Substrate Composition	The site majorly consisted of bedrock, with some fines, gravel and cobble observed throughout (**Figure 2-11**). The watercourse was heavily affected by anthropogenic impacts as channel hardening (i.e. gabion basket, bridge abutments and the downstream dam). The water was clear in color, suggesting that the site supported healthy levels of sediment.
Bank Stability	Banks were classified as stable or protected, with the gabion basket retaining wall demonstrating much of the immediate observations. Due to the widened watercourse and downstream dam, little erosive forces are likely present during high flows as supported by stable banks and areas of deposition. Overall, banks were held together and stabilized with established meadow vegetation in the immediate riparian zone.
Instream and Riparian Vegetation	Some macrophytes were observed, limited to the immediate water's edge due to the predominance of bedrock throughout the channel. Riparian vegetation provided overhanging grasses and shade for the aquatic community. At the downstream extent, lawn extended up to 40 meters from the watercourse. Moving upstream, meadow was located in the immediate riparian zone up to 5 meters on each bank, followed by well-established forest. Residential development and impermeable surfaces existed beyond the naturalized meadow and forest.
Fish Barriers and Other Disturbances	The surrounding anthropogenic land use may contribute contaminant and nutrient sources to the site. Nearby community centers, houses, lawns, roads and upstream agricultural land use are potential sources. The downstream dam and upstream knickpoint at each bridge, respectively, represented fish barriers. Bedrock was abundant throughout the site, which would limit the burrowing depth of fish throughout. Despite this, fish were observed throughout.

In general, the study area of Irvine Creek was surrounded by a narrow buffer of established meadow and forest, along with the well-used Veteran's Park. Anthropogenic influences were throughout and the watercourse was largely impacted by the downstream dam, widening the watercourse to a point that resulted in shallow, unshaded water and little aquatic habitat immediately adjacent to the retaining wall.



Figure 2-7: Typical habitat adjacent to retaining wall



Figure 2-8: Typical habitat beyond wall extents to river right



Figure 2-9: Typical habitat downstream of wall



Figure 2-10: Typical habitat downstream of wall

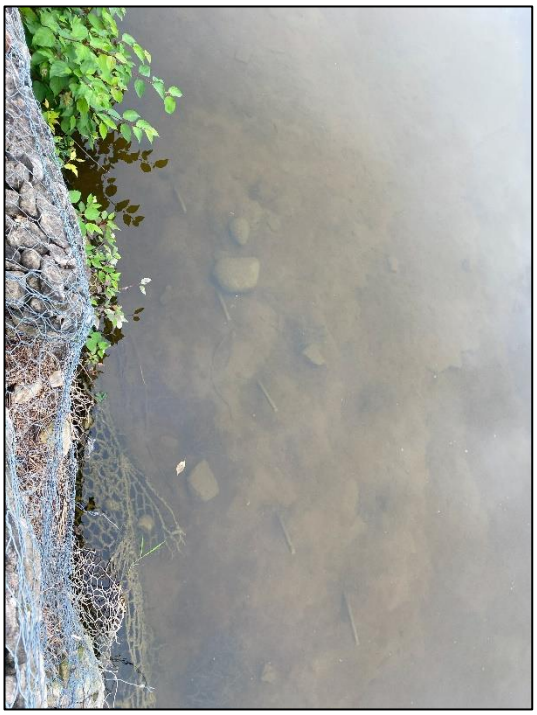


Figure 2-11: Typical substrate adjacent to wall

2.5.2 Fish Community Assessment

The study area is located in Irvine Creek, within the Upper Middle Grand River subatershed. The confluence of Irvine Creek and the Grand River is located ~2 km downstream of the study area, separated by the large dam and fish barrier at Woolwich St W. Irvine Creek supports a cold-cool water fish community with evidence of Redside Dace occupied habitat observed upstream of the study area (CIMA Canada Inc, 2020). Two (2) eDNA studies were completed as a part of the EA Study (CIMA Canada Inc, 2020) for works upstream of the study, with Fall and Spring results displayed below in **Figure 2-12** and **Figure 2-13**, respectively.

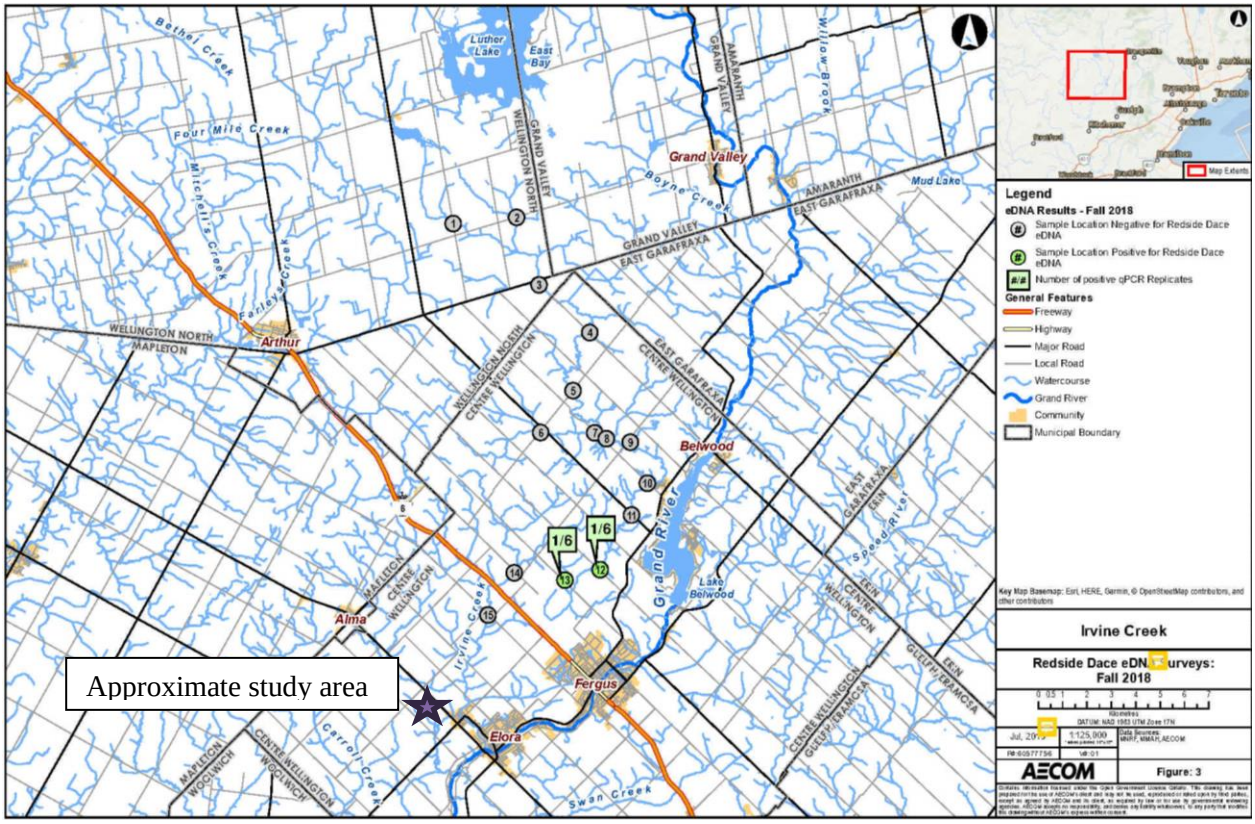


Figure 2-12: Fall eDNA Results (CIMA Canada Inc, 2020)

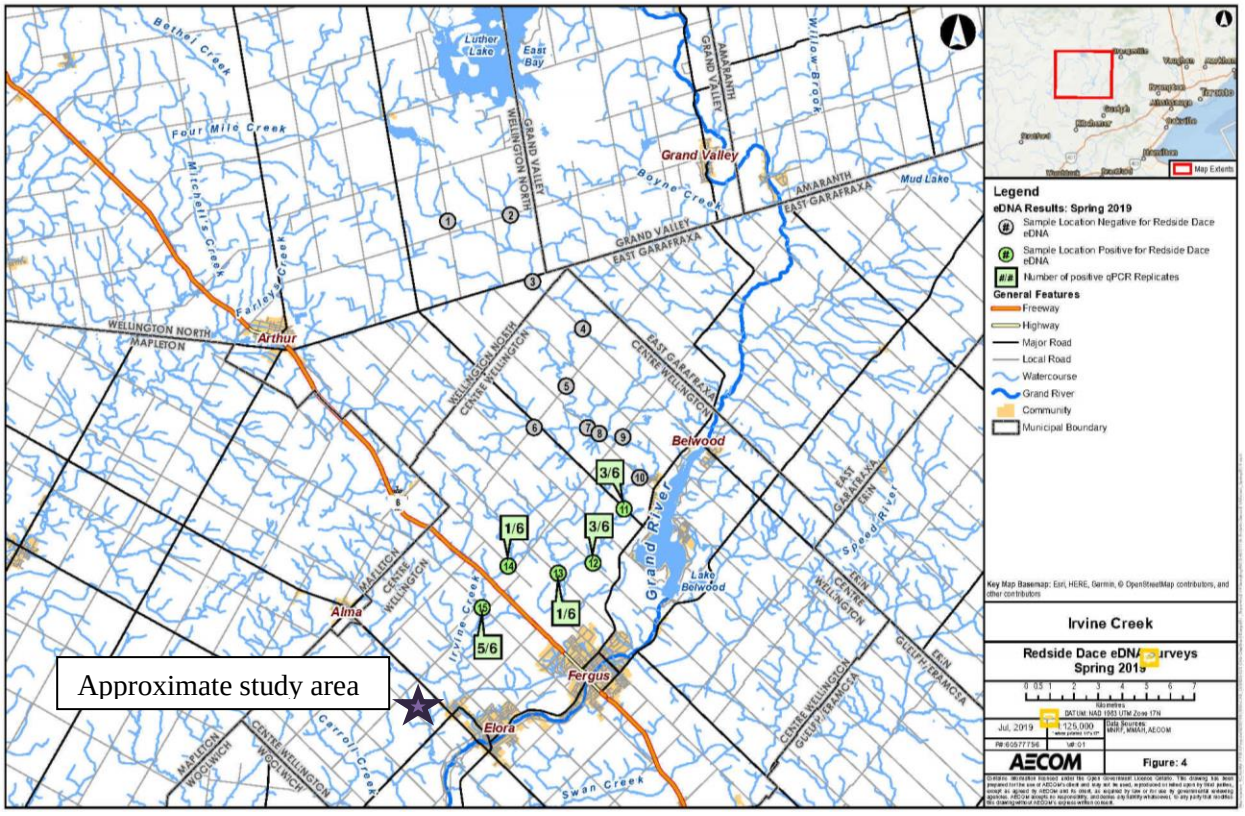


Figure 2-13: Spring eDNA Results (CIMA Canada Inc, 2020)

These results suggest stronger presence of Redside Dace within the spring months, supporting the recommended timing window discussed below. Other fish records are limited, with evidence suggesting that this watercourse

provides habitat to both Spring and Fall spawning species. The thermal regime of the study area is classified as 'cold' water based on water temperature monitoring through the Ministry of Natural Resources data (Ministry of Natural Resources, 2023), with coldwater indicator species (Brook trout) noted in these data.

As detailed above, records suggests that Redside Dace (*Clinostomus elongatus)*, a provincially and federally endangered Species at Risk, is found upstream of the study area. Although the immediate and upstream study area is not indicated as Critical Habitat for Redside Dace or other aquatic SAR by the Fisheries and Oceans Canada, Species at Risk mapping (Fisheries and Oceans Canada, 2023), for the downstream reaches of the Grand River is confirmed as Critical Habitat with Silver Shiner found (or potentially found), although the dam at Woolwich St W represents a significant fish barrier and no records of this species are found in Irvine Creek. As detailed above, habitat observed during field surveys does not align with preferences of Redside Dace, with habitat contributed by slow, unprotected pools, and instream substrate dominated by bedrock (Government of Ontario, 2017). Particularly, the area immediately adjacent to the retaining wall is lacking in cover, aeration and instream habitat to support Redside Dace, with the proposed bank naturalization demonstrating an overall improvement to the habitat and benefit to the species. Alterations to the tributary and/or riparian area of the study area should consider Redside Dace to mitigate potential impacts to the species.

2.5.3 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 Ministry 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, the study area(s) does contain fish at any time during any given year. 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, the study area does contain 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 proponent exercise the Measures to protect fish and fish habitat 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 (Fisheries and Oceans Canada, 2023). It is further recommended that these mitigation measures be included in the detailed designs, with any and all applicable Codes of Practice (Fisheries and Oceans Canada, 2022) exercised where feasible.

As the site may directly or indirectly contribute habitat to Federally listed Species at Risk, this submission for Regulatory Review will also be assessed under the Species at Risk Act for potential implications under the Act. The works should also be submitted to the MECP for Regulatory Review as this species and its habitat is both federally and provincially protected.

Should it be confirmed through these reviews that the study area is within protected habitat, mitigation measures and Best Management Practices shall include those defined in the Guidance for Development Activities in Redside Dace Protected Habitat (Ministry of Natural Resources and Forestry, 2016). That is, any construction activities should consider impacts to the direct stream habitat and indirect habitats, including any temporary disturbances within the riparian habitat (i.e., 30 m on each side of the meander belt).

2.5.4 In-Water Timing Window

As discussed above and as outlined in the federal *Fisheries Act*, the proponent is to exercise mitigation measures to avoid contravention with the Act and exercise due diligence by further mitigating accidental death of fish and the harmful alteration, disruption or destruction of fish habitat. With the proposed works being undertaken within and/or adjacent to Irvine Creek, construction should be undertaken such that the construction timing will be limited to outside of the critical life stages of the fish communities listed above. As Redside dace (*Clinostomus elongatus)*

is potentially found in the study area and is confirmed within the upstream reaches of the study area (CIMA Canada Inc, 2020), the In-water Work Timing Window Guideline (Fisheries and Oceans Canada, 2013) is restricted based on the reproduction requirements of this species-at risk. Therefore, the In-water Work Timing Window Guideline (Fisheries and Oceans Canada, 2013) outlines that based on the reproduction requirements of the fish community within the downstream watercourse and study area, in-water works are to take place within the construction timing window of **July 1st to September 15th** of any given year (Ministry of Natural Resources and Forestry, 2016). These timing window guidelines are to be confirmed by the DFO during the Regulatory Review.

2.6 Tree Inventory

Aquafor's ISA-certified arborist undertook a comprehensive tree inventory on August 16th, 2024 to identify trees that may potentially be removed or damaged to accommodate construction activities. Trees ≥ 10 cm diameter-at-breast height (DBH) were tagged and numbered; pertinent information such as species, DBH, crown reserve (diameter), tree health, and location were recorded. Each individual tree was given a preservation priority status of low, moderate, or high based on the following characteristics:

- **High:** high-quality native species exhibiting good health, condition, large size (generally >30cm diameter-at-breast-height [DBH]), and good growing conditions, or provide habitat for wildlife or Species at Risk;
- **Moderate:** native or non-native (non-invasive) trees with moderate qualities; and
- **Low:** introduced species, trees with poor health, poor structure, small size, and/or status as currently or potentially able to damage or interfere with existing structures.

In total, 56 trees were inventoried and assessed, as summarized in **Table 2-7**. Of these, 44 were identified as native species in Ontario and 12 are considered introduced species. The tree inventory will be used to prepare a Tree Preservation Plan in accordance with the Township's Public Forest Policy and GRCA guidelines. Aquafor will also work with the Township's forestry/parks department to determine an appropriate compensation plan to account for trees that may be removed to accommodate the proposed design.

Table 2-7: Tree Inventory

Tag #	Species Name		Tree Dimensions			Biological Condition	Structure and Form	Natural Heritage Considerations	Preservation Priority
	Scientific Name	Common Name	Aggregate DBH (cm)	Stem Count	Dripline Radius (m)				
1144	*Juglans nigra*	Black Walnut	27.7	4	2.5	F-G	F-G	Native	**Moderate**
1145	*Populus balsamifera*	Balsam Poplar	15.5	1	1.5	P	F	Native	**Low**
1146	*Acer saccharinum*	Silver Maple	24.5	1	2.5	F-G	F-G	**SAR Bat**	**High**
1147	*Acer saccharinum*	Silver Maple	27.0	1	3.0	G	G	**SAR Bat**	**High**
1148	*Acer saccharinum*	Silver Maple	30.5	1	3.0	G	G	**SAR Bat**	**High**
NT01	*Acer rubrum*	Red Maple	15.0	1	2.5	G	G	Native	**High**
1149	*Robinia pseudoacacia*	Black Locust	10.0	1	3.0	G	F-G	Non-native invasive	**Low**
1150	*Robinia pseudoacacia*	Black Locust	14.8	6	3.5	G	F	Non-native invasive	**Low**
1151	*Robinia pseudoacacia*	Black Locust	11.0	1	2.5	G	F-G	Non-native invasive	**Low**
1152	*Robinia pseudoacacia*	Black Locust	13.3	2	3.0	F-G	F	Non-native invasive	**Low**
NT02	*Liriodendron tulipifera*	Tulip tree	8.0	1	1.5	G	G	Non-native invasive	**Low**
1153	*Juglans nigra*	Black Walnut	28.0	1	4.0	G	G	Native	**Moderate**
1154	*Acer negundo*	Manitoba Maple	15.0	1	1.5	P	P	Native invasive	**Low**
1155	*Juglans nigra*	Black Walnut	37.0	1	3.5	G	G	Native	**High**
1156	*Thuja occidentalis*	Eastern White Cedar	33.5	1	2.5	G	F-G	Native	**High**
1157	*Thuja occidentalis*	Eastern White Cedar	29.5	1	2.5	G	F-G	Native	**High**
1158	*Juglans nigra*	Black Walnut	30.0	1	3.5	G	G	Native	**High**
1159	*Juglans nigra*	Black Walnut	33.5	1	4.5	G	G	Native	**High**
1160	*Pinus strobus*	Eastern White Pine	52.0	1	4.0	G	G	Native	**High**
1161	*Acer platanoides*	Norway Maple	21.3	2	3.5	G	F	Non-native invasive	**Low**
1162	*Acer platanoides*	Norway Maple	43.5	1	3.5	G	F-G	Non-native invasive, **SAR Bat**	**Moderate**
1163	*Acer platanoides*	Norway Maple	43.5	1	3.5	G	F-G	Non-native invasive, **SAR Bat**	**Moderate**
1164	*Acer saccharum*	Sugar Maple	24.5	1	3.5	G	G	Native, **SAR Bat**	**High**
1165	*Acer platanoides*	Norway Maple	31.0	1	3.5	F-G	F-G	Non-native invasive, **SAR Bat**	**Moderate**
1166	*Acer platanoides*	Norway Maple	37.5	1	4.5	G	F-G	Non-native invasive, **SAR Bat**	**Moderate**
1167	*Betula papyrifera*	Paper Birch	41.9	3	3.5	G	F-G	Native	**Moderate**
1168	*Thuja occidentalis*	Eastern White Cedar	28.5	1	2.0	G	F-G	Native	**Moderate**
1169	*Thuja occidentalis*	Eastern White Cedar	37.8	4	3.5	G	F-G	Native	**Moderate**
1170	*Thuja occidentalis*	Eastern White Cedar	17.5	1	2.0	G	F-G	Native	**Moderate**
1171	*Thuja occidentalis*	Eastern White Cedar	16.0	1	2.0	G	F-G	Native	**Moderate**
1172	*Populus deltoides*	Eastern Cottonwood	83.0	1	4.0	G	F-G	Native	**High**
1173	*Populus deltoides*	Eastern Cottonwood	78.0	1	4.5	G	F-G	Native	**High**
1174	*Populus deltoides*	Eastern Cottonwood	77.0	1	5.0	G	G	Native	**High**
1175	*Populus deltoides*	Eastern Cottonwood	77.0	1	4.5	G	G	Native	**High**
1176	*Prunus serotina*	Black Cherry	12.5	1	1.5	G	F-G	Native	**Low**
1177	*Acer platanoides*	Norway Maple	17.0	1	3.5	G	F-G	Non-native invasive	**Low**
1178	*Thuja occidentalis*	Eastern White Cedar	14.0	1	2.0	G	G	Native	**Low**
1179	*Thuja occidentalis*	Eastern White Cedar	16.0	1	2.0	G	G	Native	**Moderate**
1180	*Thuja occidentalis*	Eastern White Cedar	25.0	1	1.5	G	G	Native	**Moderate**
1181	*Thuja occidentalis*	Eastern White Cedar	16.5	1	2.5	G	F-G	Native	**Moderate**
1182	*Thuja occidentalis*	Eastern White Cedar	22.5	1	2.0	G	F-G	Native	**Moderate**
1183	*Thuja occidentalis*	Eastern White Cedar	24.0	1	2.0	G	F-G	Native	**Moderate**
1184	*Thuja occidentalis*	Eastern White Cedar	19.5	1	1.0	G	F-G	Native	**Moderate**
1185	*Thuja occidentalis*	Eastern White Cedar	22.0	1	1.5	F	F	Native	**Moderate**
1186	*Thuja occidentalis*	Eastern White Cedar	17.0	1	1.0	G	F-G	Native	**Moderate**
1187	*Thuja occidentalis*	Eastern White Cedar	22.0	1	1.0	G	F-G	Native	**Moderate**
1188	*Thuja occidentalis*	Eastern White Cedar	21.5	1	1.5	F-P	F	Native	**Low**
1189	*Thuja occidentalis*	Eastern White Cedar	21.5	1	1.5	F	F-G	Native	**Low**
1190	*Thuja occidentalis*	Eastern White Cedar	24.0	1	2.0	G	G	Native	**Moderate**
1191	*Acer platanoides*	Norway Maple	12.0	1	2.0	G	F-G	Non-native invasive	**Low**
1192	*Thuja occidentalis*	Eastern White Cedar	17.5	1	2.5	G	G	Native	**Moderate**
1193	*Juglans nigra*	Black Walnut	20.0	1	3.0	G	G-F	Native	**Moderate**
1194	*Thuja occidentalis*	Eastern White Cedar	15.0	1	1.5	G	G	Native	**Moderate**
1195	*Thuja occidentalis*	Eastern White Cedar	14.5	1	1.5	G	G	Native	**Moderate**
1196	*Thuja occidentalis*	Eastern White Cedar	11.5	1	1.5	G	F-G	Native	**Low**
1197	*Juglans nigra*	Black Walnut	42.0	1	2.5	G	G	Native	**High**

2.7 Subsurface Utility Investigation

In support of the technical evaluations and detailed design drawings, Aquafor conducted a thorough review of available utilities data for the study area. The only utility identified within the immediate study area was Enbridge Gas Infrastructure, crossing Irvine Creek underneath the large sediment bar. The Enbridge crossing is not expected to be within the active construction area, and will be marked and protected accordingly.

On-site utility locates were completed in advance of borehole drilling. These locate markings have been surveyed by Aquafor to ensure accuracy of the infrastructure GIS data provided by the Township.

2.8 Geotechnical Investigation

Aquafor is working with Soil-Mat to carry out the geotechnical investigation. The boreholes were advanced using continuous flight power auger equipment on September 3, 2024. The subsurface investigation program is provided below:

- Advance three (3) boreholes behind the existing wall to a maximum depth of 6m or refusal depth below grade.
- Conduct Standard Penetration Tests and retrieval of soil samples continuously at 0.75 m interval (upper 3.0 m depth from each of the boreholes.
- Geotechnical laboratory soil testing on selected samples (as required) to characterize the index properties including water content and grain size distribution.
- Collect and submit three (3) samples for metals, inorganics, and PHCs to aid development of the excess soil management plan in accordance with O.Reg 406/19.

The approximate locations of the boreholes can be observed below in **Figure 2-14**.



Figure 2-14: Proposed Locations of Boreholes for Geotechnical Investigation

Soil stratigraphy at the site generally consists of 200-300mm of topsoil atop a dense mix of sand, gravel and cobbles, until bedrock at approximately 3.5m below ground surface.

The submitted samples for chemical testing were found to meet standards for Ontario Regulation 406/19 Table 1, Table 2.1 and Table 3.1 (Parkland) for the tested parameters, with the exception of electrical conductivity in borehole 3. Per the results, surplus soil may be reused on site or may reasonably be accepted at on off-site Institutional/Commercial/Community property, subject to owner approval and Table 2.1 and 3.1 standards.

The full geotechnical and soil characterization report is included as Appendix D.

3 Detailed Design

3.1 Design Factors

It is imperative that all objectives and constraints are identified at the onset of the design. This ensures that they are considered while developing various elements of the design. Objectives and constraints identified for the study area were as follows:

Objectives:

- *Long Term Erosion Protection* – Deterioration or failure of the existing retaining wall posses a significant risk to the adjacent park. Without any protection measure in place, the bank will erode and increase risks to public safety for those using the park. The proposed design must provide long-term bank stability and toe protection for protection of the park above.
- *Bank Naturalization* – The proposed design should replace the retaining wall with a more ecologically beneficial bank. Objectives should include aquatic and terrestrial habitat improvement as well as aesthetic value.
- *Water Access Feature* – Upon discussion with Township staff, it was determined that nearby residents and park patrons would appreciate the ability to enjoy and access the waterfront within the park. A prospective water access feature has been incorporated into the design. Efforts will be taken to provide a safe area for patrons to enjoy viewing, fishing, and accessing Irvine Creek.
- *Preservation and Improvement of Parkland* –Efforts should be made in order to preserve as much of the existing park space as possible when regrading the bank. Preservation of important park features including memorial trees should a priority. The proposed design should also seek to improve the visual aesthetic of the bank and the park.

Constraints:

- *Disturbance to Surrounding Area* – The project site is located within Township property, and is open to the public. The proposed design must minimize disturbance to public spaces and facilities including the park space and memorials.
- *Disturbance to Terrestrial Vegetation* – Some vegetation may be harmed or removed during construction, however, where mature trees are required for removal to facilitate construction, new trees consistent with the GRCA and Township's standards will be planted. Similarly, seed mixes and species selection will be in compliance with the GRCA's seed mix and planting guidelines. The Township also has two (2) memorial trees within the study area that are to be spaded and moved or protected to facilitate construction.
- *Access Route and Staging Area* – The access route will utilize the existing park entrance managed by the Township. The park is actively used by the public, and will require temporary or partial closures during construction.
- *Flooding Impact* – The proposed design should minimize negative impacts to flooding within the study area. Impacts to flood levels caused by the proposed works will be assessed through hydraulic modeling.

3.2 Proposed Design - Vegetated Buttress

The proposed design would remove the gabion baskets and replace with a vegetated buttress approximately 45 m in length and 4.0 m high. The buttresses will be constructed with alternating lifts of soil and graded stone. The larger stone will form a base level, embedded into the existing bed material, with layers of progressively smaller boulders on top, and soil material to fill the voids. Stone sizing has been confirmed using channel shear stress output from the HEC-RAS model and stone sizing calculations using the either the Komar or Shield's equation.

The buttress is to be installed as high as the existing top of bank (approximately 3-4 m). The buttress will be sloped at an angle no steeper than 2:1(H:V). The buttress stone will be covered with topsoil and native plantings to improve stability and promote naturalization. It is expected that the designed bank will be founded on bedrock which is competent in supporting the proposed buttress of this size. The bottom layer of buttress stone (keystones), will be embedded at least 0.5 into the bedrock to prevent slippage.

Included as part of the design is a sloped access to the water's edge for patrons to view and access the creek. This ramp will be at an appropriate grade for patrons to easily access the water, ideally at a 5:1 (H:V) slope. The ramp will be sheltered from high flows by the proposed bank protection immediately upstream.

Planform schematic of the proposed buttress is included on the following page as **Figure 3-1.**

3.3 Cut/Fill Analysis

Construction of the proposed works will include excavation of some existing materials, including the deteriorated gabion baskets, and placement of the new wall and associated materials. To determine any impact to flood storage, an analysis of the cut and fill volumes below the regional flood elevation was completed. The proposed change in cross sectional area was determined at each design cross section, then multiplied by the length of channel represented by that cross section to determine the volumetric difference. Table 3-1, below, outlines the amount of cut/fill at each cross section and the total cut of 238m^3 for the project. This value represents the increase in water storage during a regional flood scenario that would be occupied by the proposed design.

Table 3-1: Cut/Fill Volumes

XS	Difference in XS Area (m^2)	Length of XS (m)	Volumetric Difference (m^3)
1	1.61	8.9	14.33
2	0.805	13.35	10.75
3	2.41	12.8	30.85
4	-25.665	10.75	-275.90
5	-3.55	5.1	-18.11
TOTAL			-238.08

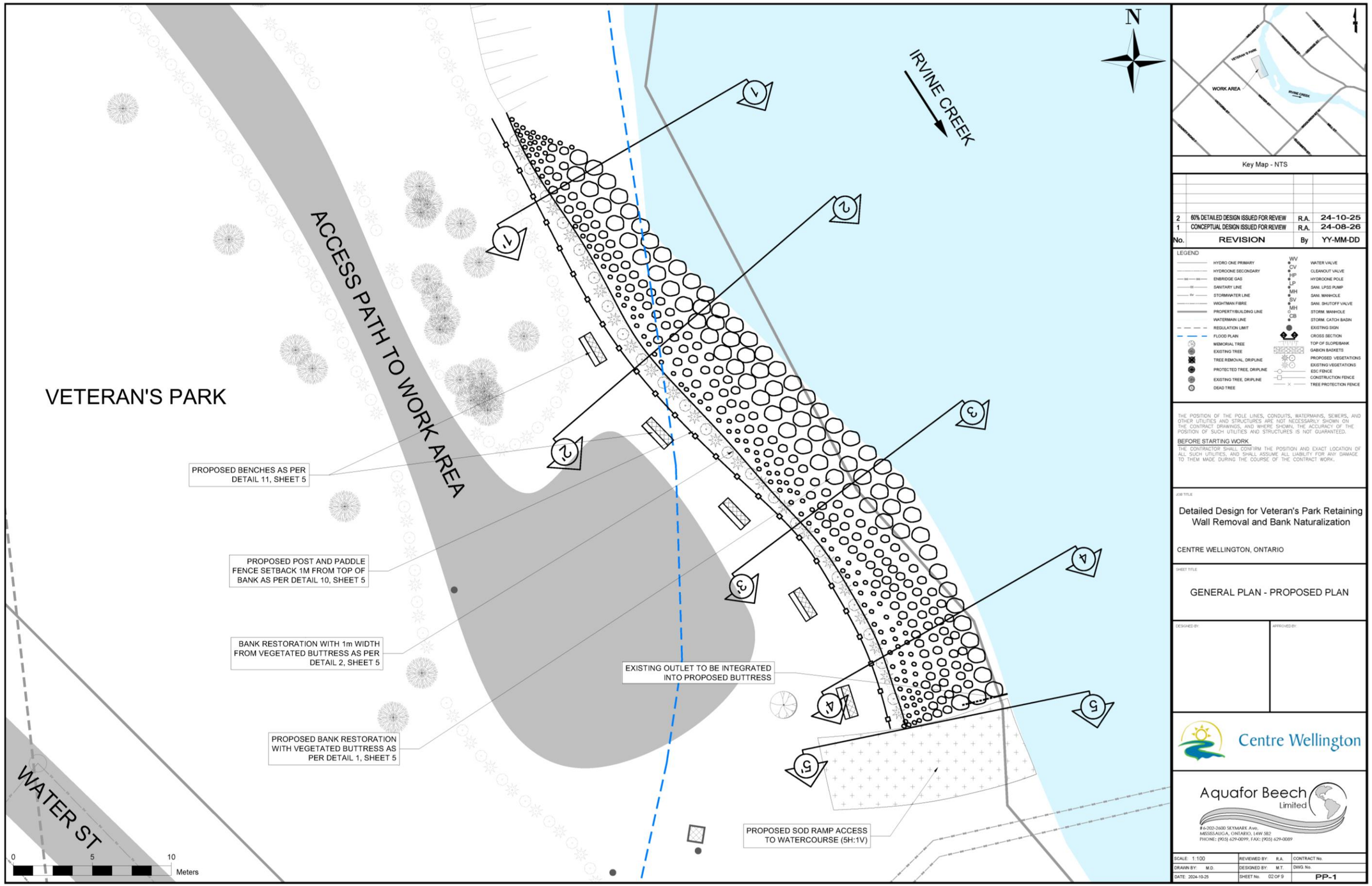


Figure 3-1: Planform Design - Vegetated Buttress

3.4 Stone Sizing Analysis

Results from the hydraulic model were used to confirm the minimum sizing of the toe protection stone. Channel shear and velocity values were used with Shield's and Komar's equations to identify the minimum stone size required. Both D_{50} and D_{84} were defined to ensure resistance under large flood flows. Channel shear stress values and velocity were used to resist up to the 100-year return periods. Stone sizing calculations are shown below:

Shields Equation:

$$\tau_{cr} = Kg(\rho_s - \rho)D$$

Where:

τ_{cr} = *Critical shear stress (N/m^2)*
K = Shields Coefficient dimensionless
g = *Acceleration due to gravity* (m/s^2)
ρ_s = *Density of the sediment (*kg/m^3)
ρ = *Density of the fluid (*kg/m^3)
D= Characteristic particle diameter of the sediment (m)

Komar Equation:

$$v = 57 * D^{0.45}$$

Where:
v = *Velocity (m/s)*
D= Characteristic particle diameter of the sediment (m)

D_{50} design shear value = 15.95 Pa	D_{84} design shear value = 16.48 Pa
D_{50} design velocity value = 1.51 m/s	D_{84} design velocity value = 1.54 m/s
Minimum D_{50} calculated value = 87mm	Minimum D_{84} calculated value = 91 mm
With a FS of 3, D_{50} = 260 mm	With a FS of 3, D_{84} = 275 mm

Komar's equation provided the larger stone sizing values and was used to confirm the minimum stone size. A factor of safety of 1.5 was applied to ensure the stone remain stable and account for changes due to climate change. The stone sizing of the rip rap buttress will need to have a D_{50} greater than 260 mm and D_{84} greater than 275 mm to reduce the risk of being washed away. A recommended stone grading is provided in the detailed design drawings.

3.5 Vegetation Restoration

It will be necessary to remove some trees and other vegetation to facilitate proposed works. Of the 56 trees tagged during the tree inventory assessments, 9 trees have been identified for removal, and 12 injured, as outlined in Table 3-2.

Tree removals on the site must take place outside of the typical bird nesting and bat maternity roost season (April 1 to October 31), or be preceded by an inspection by a qualified individual to confirm the absence of active bird nests or bat activity in keeping with the requirements of the *Migratory Birds Convention Act* and *Endangered Species Act*, respectively.

Table 3-2: Tree Removal List

Tag #	Common Name	*Scientific Name*	Removed/Injured
1144	Juglans nigra	Black Walnut	Remove
1145	Populus balsamifera	Balsam Poplar	Remove
1146	Acer saccharinum	Silver Maple	Remove
1147	Acer saccharinum	Silver Maple	Remove
1148	Acer saccharinum	Silver Maple	Remove
1149	Robinia pseudoacacia	Black Locust	Remove
1150	Robinia pseudoacacia	Black Locust	Remove
1151	Robinia pseudoacacia	Black Locust	Remove
1152	Robinia pseudoacacia	Black Locust	Remove
1154	Acer negundo	Manitoba Maple	Injure
1167	Betula papyrifera	Paper Birch	Injure
1169	Thuja occidentalis	Eastern White Cedar	Injure
1170	Thuja occidentalis	Eastern White Cedar	Injure
1173	Populus deltoides	Eastern Cottonwood	Injure
1174	Populus deltoides	Eastern Cottonwood	Injure
1175	Populus deltoides	Eastern Cottonwood	Injure
1176	Prunus serotina	Black Cherry	Injure
1177	Acer platanoides	Norway Maple	Injure
1182	Thuja occidentalis	Eastern White Cedar	Injure
1183	Thuja occidentalis	Eastern White Cedar	Injure
1187	Thuja occidentalis	Eastern White Cedar	Injure

In compensation for these removals and injuries, a total of 30 trees are intended to be planted within the study area., consistent with a 2(plantings): 1(removal) ratio, and 1(planting):1(injury) ratio. Additionally, 150 shrubs have been recommended for planting, yielding a 5 (shrub): 1 (tree planting) ratio. An additional 340 shrubs will be planted within the vegetated buttress. All recommended planting species and locations are shown in Sheet RP of the Design Drawings.

3.6 Cost Estimate

A detailed cost estimates was prepared for the proposed design. The engineering estimate for construction of the proposed design, including a 20% contingency, is [redacted], as summarized in Table 3-3, below.

Table 3-3: Cost Estimate

Veteran's Park Bank Naturalization						
Township of Centre Wellington						
Item	**Ref.**	**Description**	**Quantity**	**Unit**	**Unit Price**	**Extended Price (Excl. HST)**
Section "A" Site Preparation and Removals						
A1	SP1	Bonds and Insurance	1	LS	[redacted]	[redacted]
A2	SP2	Mobilization & Demobilization	1	LS	[redacted]	[redacted]
A3	SP3	Access Route and Staging Areas, Including Supply & Placement of Mud Mat	1	LS	[redacted]	[redacted]
A4	SP4	Construction Layout and Utility Locates	1	LS	[redacted]	[redacted]
A5	SP5	Flow Management Control, Bypass Pumping & Dewatering	1	LS	[redacted]	[redacted]
A6	SP6	Clearing, Grubbing & Tree Removals	1	LS	[redacted]	[redacted]
A7	SP7	Supply and Install Temporary Construction Fence / Panel Fence / Tree Fence	300	m	[redacted]	[redacted]
A8	SP8	Supply and Install Temporary Sediment Control Fence / Turbidity Curtain	190	m	[redacted]	[redacted]
A9	SP9	Supply, Place and Maintain Temporary Project Sign Boards & Trail Closure Signs	2	LS	[redacted]	[redacted]
A10	SP10	MNRF Fish Collection Permit and Fish Rescues	1	LS	[redacted]	[redacted]
A11	SP11	Site Removals - including gabion basket retaining wall	1	LS	[redacted]	[redacted]
A12	SP12	Mud Tracking and Road Clean-up	1	LS	[redacted]	[redacted]
A13	SP13	Pre and Post Construction Inspections	2	LS	[redacted]	[redacted]
Section "A" Total						[redacted]
Section "B" Creek Works						
B1	SP13	Excavation, Earthworks, Grading & Disposal of Materials Offsite	1	LS	[redacted]	[redacted]
B2	SP14	Supply and Install Vegetated Boulders				
		i) Roundstone as specified	780	tonne	[redacted]	[redacted]
		ii) Topsoil to enhance vegetation	140	m^3	[redacted]	[redacted]
		iii) Stock Plantings (1 gal potted @ 0.5 spacing)	340	ea.	[redacted]	[redacted]
Section "B" Total						[redacted]
Section "C" Restoration Works						
C1	SP16	Supply & Placement of Topsoil for Restoration (300mm)	100	m^3	[redacted]	[redacted]
C2	SP17	Supply & Application of Terraseed Mixture (50 mm) / Sod	340	m^2	[redacted]	[redacted]
C3	SP18	Supply & Placement of Erosion Control Blanket - Coir Mat	340	m^2	[redacted]	[redacted]
C4	SP19	Supply and Planting of Large Caliper Trees	4	ea.	[redacted]	[redacted]
C5	SP20	Supply and Planting of Potted Trees	14	ea.	[redacted]	[redacted]
C6	SP21	Supply and Planting of Shrubs	90	ea.	[redacted]	[redacted]
C7	SP22	Supply and Install Post and Paddle Fence	60	m	[redacted]	[redacted]
C8	SP23	Supply and Install Benches	5	ea.	[redacted]	[redacted]
Section "C" Total						[redacted]
					Subtotal (Excl of HST, Provisional Items)	[redacted]
					[redacted]% Contingency	[redacted]
					Total (Excl of HST)	[redacted]
					Engineering Estimate (Inc. Contingency, Excl. HST)	[redacted]

3.7 Permits and Approvals

Prior to construction it will be necessary to coordinate environmental approvals and permits required to complete the intended works. At this time, it is Aquafor's understanding that approvals from GRCA, MECP, and DFO may be required. Upon approval from the Township, Aquafor will submit the 60% design and associated report to the respective authorities for review. A brief summary of permits and approvals is included below:

GRCA – O. Reg. 166/06 Permit – This typically involves two submissions (60% and 90% design) and will include supporting design brief information.

DFO – Assessment under the Federal Fisheries Act – A certified fisheries biologist should complete a Self Assessment based on the detailed design for the proposed works. It is anticipated that an application for a DFO Request for Review will be required for the proposed design.

MECP 17(2) (b / c) Species at Risk Permit – A Species at Risk Screening should be completed during detailed design. Should the tree impact plan include impacts to candidate Species at Risk bat maternity roosting habitat trees, or potential impacts to any additional SAR be identified, an Information Gathering Form (IGF) may need to be submitted to the MECP. Correspondence with the MECP will confirm whether a SAR permit and/or compensation will be required.

4 SIGNATURES

This report was completed with input from the following consulting staff:

Robert Amos – Project Manager

Mitchell Tulloch – Water Resources Analyst

Mehrshad Dorri – CAD Drafting Technician

Should you have any questions, please do not hesitate to contact the undersigned at 416.705.2367.

Yours truly,

AQUAFOR BEECH LIMITED



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Mitchell Tulloch, BASc., EIT.
Aquafor Beech Limited

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Appendix A – Expanded HEC-RAS Results

HEC-RAS Results – Existing Conditions Scenario

River	Reach	River Sta	Profile	Q Total	W.S. Elev	Crit W.S.	Hydr Depth	E.G. Slope	Vel Chnl	Shear Chan	Power Cha	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m/m)	(m/s)	(N/m2)	(N/m s)	(m2)	(m)	
Irvine	1	5	Regulatc	357	389.67		1.94	0.000506	2.03	22.1	44.85	211.29	108.87	0.29
Irvine	1	5	100 Yea	208	388.7		3.02	0.000376	1.54	13.54	20.82	139.53	46.19	0.25
Irvine	1	5	50 Year	199	388.63		3.02	0.000364	1.5	12.9	19.33	136.56	45.22	0.24
Irvine	1	6	Regulatc	357	389.87		2.9	0.000131	1.04	5.76	5.98	459.12	158.58	0.16
Irvine	1	6	100 Yea	208	388.82		2.27	0.000132	0.87	4.45	3.89	304.88	134.43	0.15
Irvine	1	6	50 Year	199	388.75		2.22	0.000132	0.86	4.34	3.73	295.37	132.8	0.15
Irvine	1	7	Regulatc	357	389.63		2.87	0.001771	3.04	55.3	167.88	131.35	45.79	0.53
Irvine	1	7	100 Yea	208	388.67		2.43	0.001625	2.48	39.96	99.08	91.87	37.74	0.49
Irvine	1	7	50 Year	199	388.61		2.39	0.001602	2.43	38.73	94.29	89.44	37.38	0.48
Irvine	1	8	Regulatc	357	389.99		2.98	0.000653	1.96	22.38	43.91	236.86	79.35	0.33
Irvine	1	8	100 Yea	208	388.91		2.25	0.000701	1.67	17.96	30.07	156.81	69.67	0.32
Irvine	1	8	50 Year	199	388.84		2.2	0.000704	1.65	17.61	29.08	151.74	69.02	0.32

HEC-RAS Results – Updated Existing Conditions Scenario

River	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)	
Irvine	1	5	Regulatory	357	389.67		1.94	0.000506	2.03	22.1	44.85	211.29	108.87	0.29
Irvine	1	5	100 Year	208	388.7		3.02	0.000376	1.54	13.54	20.82	139.53	46.19	0.25
Irvine	1	5	50 Year	199	388.63		3.02	0.000364	1.5	12.9	19.33	136.56	45.22	0.24
Irvine	1	6	Regulatory	357	389.87		2.9	0.000131	1.04	5.76	5.98	459.12	158.58	0.16
Irvine	1	6	100 Year	208	388.82		2.27	0.000132	0.87	4.45	3.89	304.88	134.43	0.15
Irvine	1	6	50 Year	199	388.75		2.22	0.000132	0.86	4.34	3.73	295.37	132.8	0.15
Irvine	1	6.4	Regulatory	357	389.82		2.58	0.000356	1.61	14.09	22.74	263.71	102.33	0.25
Irvine	1	6.4	100 Year	208	388.79		2.03	0.000343	1.32	10.34	13.66	167.83	82.55	0.23
Irvine	1	6.4	50 Year	199	388.72		2	0.00034	1.3	10.01	12.97	162.13	81.02	0.23
Irvine	1	6.6	Regulatory	357	389.84		2.96	0.000301	1.53	12.53	19.21	257.2	86.98	0.23
Irvine	1	6.6	100 Year	208	388.81		3.12	0.00025	1.18	8.07	9.51	180.88	57.95	0.2
Irvine	1	6.6	50 Year	199	388.74		3.15	0.000244	1.15	7.74	8.91	176.92	56.21	0.2
Irvine	1	7	Regulatory	357	389.62		2.86	0.001914	3.15	59.53	187.37	130.59	45.59	0.55
Irvine	1	7	100 Year	208	388.67		2.43	0.001718	2.55	42.2	107.54	91.75	37.72	0.5
Irvine	1	7	50 Year	199	388.6		2.39	0.001692	2.5	40.86	102.18	89.33	37.36	0.5
Irvine	1	8	Regulatory	357	389.99		2.99	0.00075	2.1	25.72	54.08	237.16	79.36	0.35
Irvine	1	8	100 Year	208	388.92		2.25	0.00079	1.78	20.27	36.05	157.14	69.71	0.34
Irvine	1	8	50 Year	199	388.84		2.2	0.000792	1.75	19.85	34.8	152.05	69.06	0.34

HEC-RAS Results – Proposed Scenario

River	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)	
Irvine	1	5	Regulatory	357	389.67		1.94	0.000506	2.03	22.1	44.85	211.29	108.87	0.29
Irvine	1	5	100 Year	208	388.7		3.02	0.000376	1.54	13.54	20.82	139.53	46.19	0.25
Irvine	1	5	50 Year	199	388.63		3.02	0.000364	1.5	12.9	19.33	136.56	45.22	0.24
Irvine	1	6	Regulatory	357	389.87		2.9	0.000131	1.04	5.76	5.98	459.12	158.58	0.16
Irvine	1	6	100 Year	208	388.82		2.27	0.000132	0.87	4.45	3.89	304.88	134.43	0.15
Irvine	1	6	50 Year	199	388.75		2.22	0.000132	0.86	4.34	3.73	295.37	132.8	0.15
Irvine	1	6.4	Regulatory	357	389.84		2.8	0.000325	1.41	13.08	18.39	287.26	102.58	0.22
Irvine	1	6.4	100 Year	208	388.8		2.3	0.00031	1.14	9.42	10.73	190.68	82.95	0.2
Irvine	1	6.4	50 Year	199	388.73		2.28	0.000307	1.12	9.12	10.19	184.92	81.28	0.2
Irvine	1	6.6	Regulatory	357	389.84		2.95	0.000373	1.52	15.39	23.35	256.19	86.97	0.23
Irvine	1	6.6	100 Year	208	388.81		3	0.000327	1.19	10.29	12.22	179.43	59.86	0.21
Irvine	1	6.6	50 Year	199	388.74		2.99	0.000319	1.16	9.86	11.44	175.3	58.6	0.21
Irvine	1	7	Regulatory	357	389.65		2.87	0.001744	3.02	54.66	165.08	132.11	45.98	0.52
Irvine	1	7	100 Year	208	388.68		2.44	0.001605	2.47	39.57	97.69	92.29	37.81	0.48
Irvine	1	7	50 Year	199	388.62		2.4	0.001583	2.42	38.37	93.02	89.83	37.44	0.48
Irvine	1	8	Regulatory	357	390		3	0.000645	1.95	22.18	43.32	237.84	79.37	0.33
Irvine	1	8	100 Year	208	388.92		2.26	0.000694	1.67	17.82	29.73	157.41	69.75	0.32
Irvine	1	8	50 Year	199	388.85		2.2	0.000697	1.65	17.47	28.75	152.3	69.1	0.32

Appendix B – Botanical Species List

Scientific Name	Common Name	CC	CW	COSEWIC	SARA Status	SARO Status	G-Rank	S-Rank	Wellington Country (2006)	Wellington County (2009)	Native/Introduced
Acer negundo	Manitoba Maple	0	0					S5	x		native
Acer platanoides	Norway Maple		5					SNA			introduced
Acer rubrum	Red Maple	4	0					S5	x		native
Acer saccharinum	Silver Maple	5	-3					S5	x		native
Acer saccharum	Sugar Maple	4	3					S5	x		native
Aegopodium podagraria	Goutweed		0					SNA	x		introduced
Anemonastrum canadense	Canada Anemone	3	-3					S5	x		native
Angelica atropurpurea	Purple-stemmed Angelica	6	-5					S5	x		native
Arctium minus	Common Burdock		3					SNA	x		introduced
Bidens connata	Purple-stemmed Beggarticks	5	-3					S4?			native
Calystegia sepium	Hedge False Bindweed	2	0					S5	x		native
Cichorium intybus	Wild Chicory		5					SNA	x		introduced
Cirsium arvense	Canada Thistle		3					SNA	x		introduced
Cirsium vulgare	Bull Thistle		3					SNA	x		introduced
Cornus alternifolia	Alternate-leaved Dogwood	6	3					S5	x		native
Cornus sericea	Red-osier Dogwood	2	-3					S5			native
Dactylis glomerata	Orchard Grass		3					SNA	x		introduced
Daucus carota	Wild Carrot		5					SNA	x		introduced
Dipsacus fullonum	Common Teasel		3					SNA	x		introduced
Echinocystis lobata	Wild Cucumber	3	-3					S5	x		native
Echium plantagineum	Purple Viper's Bugloss							SNA			introduced
Epilobium hirsutum	Hairy Willowherb		-3					SNA	x		introduced
Erigeron annuus	Annual Fleabane	0	3					S5	x		native
Eupatorium perfoliatum	Common Boneset	2	-3					S5	x		native
Euphorbia maculata	Spotted Spurge		3					SNA	x		introduced
Euthamia graminifolia	Grass-leaved Goldenrod	2	0					S5	x		native
Galium mollugo	Smooth Bedstraw		5					SNA	x		introduced
Heracleum mantegazzianum	Giant Hogweed		0					SNA			introduced
Hesperis matronalis	Dame's Rocket		3					SNA	x		introduced

Scientific Name	Common Name	CC	CW	COSEWIC	SARA Status	SARO Status	G-Rank	S-Rank	Wellington Country (2006)	Wellington County (2009)	Native/Introduced
Hypericum perforatum	Common St. John's-wort		5					SNA	x		introduced
Impatiens capensis	Spotted Jewelweed	4	-3					S5	x		native
Juglans nigra	Black Walnut	5	3					S4?	x		native
Lonicera tatarica	Tatarian Honeysuckle		3					SNA	x		introduced
Lycopus uniflorus	Northern Water-horehound	5	-5					S5	x		native
Lythrum salicaria	Purple Loosestrife		-5					SNA	x		introduced
Malus pumila	Common Apple		5					SNA	x		introduced
Melilotus albus	White Sweet-clover		3					SNA			introduced
Mentha canadensis	Canada Mint	3	-3					S5			native
Mentha x piperita	(Mentha aquatica X Mentha spicata)		-5					SNA			introduced
Nepeta cataria	Catnip		3					SNA	x		introduced
Pastinaca sativa	Wild Parsnip		5					SNA			introduced
Persicaria maculosa	Spotted Lady's-thumb		-3					SNA			introduced
Phalaris arundinacea	Reed Canarygrass	0	-3					S5	x		native
Pinus strobus	Eastern White Pine	4	3					S5	x		native
Pinus sylvestris	Scots Pine		3					SNA	x		introduced
Plantago lanceolata	English Plantain		3					SNA	x		introduced
Poa pratensis	Kentucky Bluegrass	0	3					S5			native
Populus deltoides	Eastern Cottonwood	4	0					S5			native
Prunus virginiana	Chokecherry	2	3					S5	x		native
Ranunculus repens	Creeping Buttercup		0					SNA	x		introduced
Rhamnus cathartica	European Buckthorn		0					SNA	x		introduced
Robinia pseudoacacia	Black Locust		3					SNA			introduced
Rubus idaeus	Red Raspberry	2	3					S5			native
Rubus occidentalis	Black Raspberry	2	5					S5	x		native
Rudbeckia laciniata	Cut-leaved Coneflower	7	-3					S5	x		native
Sagittaria latifolia	Broad-leaved Arrowhead	4	-5					S5	x		native
Salix bebbiana	Bebb's Willow	4	-3					S5	x		native
Salix x fragilis	(Salix alba X Salix euxina)							SNA			introduced
Solanum dulcamara	Bittersweet Nightshade		0					SNA	x		introduced

Scientific Name	Common Name	CC	CW	COSEWIC	SARA Status	SARO Status	G-Rank	S-Rank	Wellington Country (2006)	Wellington County (2009)	Native/Introduced
Solidago canadensis var. canadensis	Canada Goldenrod	1	3					S5	x		native
Sonchus arvensis	Field Sow-thistle		3					SNA			introduced
Sparganium eurycarpum	Broad-fruited Burreed	3	-5					S5	x		native
Symphyotrichum lateriflorum	Calico Aster	3	0					S5			native
Symphyotrichum novae-angliae	New England Aster	2	-3					S5	x		native
Tanacetum vulgare	Common Tansy		5					SNA	x		introduced
Thuja occidentalis	Eastern White Cedar	4	-3					S5	x		native
Tilia americana	Basswood	4	3					S5	x		native
Tussilago farfara	Coltsfoot		3					SNA	x		introduced
Verbena hastata	Blue Vervain	4	-3					S5	x		native
Xanthium strumarium	Rough Cockleburr	2	0					S5	x		native
Potamogeton sp.	Pondweeds										

LEGEND

Scientific Name and Common Name (NHIC, 2020)

Based on NHIC's species list for Ontario downloaded in 2023.

COSEWIC (NHIC, 2024)

Federal Rarity List (does not provide protection under any Act)

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) (NHIC, 2024)

Federal Rarity List

EXP Extirpated - a species that no longer exists in the wild in Canada, but exists elsewhere in the wild.

END Endangered - a species that is facing imminent extirpation or extinction.

THR Threatened - a species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.

SC Species of Special Concern - a species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

S-Ranks (NHIC, 2024)

Provincial Rarity List (does not provide protection under any Act)

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.

Species At Risk Ontario (SARO) (NHIC, 2024)

Provincial Rarity List (Species protected under ESA 2007 and listed in O reg. 230/08)

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 - A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Exotic Status (NHIC, 2024)

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, 2024)

CC = Coefficient of Conservatism. Rank of 0 to 10 based on plants degree of fidelity to a range of synecological 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

Wellington County (2006):

Wellington County flora list. 2006. From Newmaster, S.G. and S. Ragupathy. 2005. Flora Ontario – Integrated Botanical Information System (FOIBIS), Phase I. University of Guelph, Canada. http://www.uoguelph.ca/foibis/counties_browse.cfm?qname=wellington

X: Species known to exist in Wellington County

Wellington Country (2009):

Frank, R. and A. Anderson. 2009. The Flora of Wellington County. Wellington County Historical Society, Fergus Ontario. 145 pp.

Defined by the number of survey sites where the species was found.

R1 1-3 sites;

R2 4-6 sites;

R3 6-10 sites.

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]]

Natural Heritage Information Centre (NHIC) (2020). All Species. Available at: https://www.ontario.ca/page/get-natural-heritage-information

Appendix C – Species at Risk Screening

Species		SARA Status	ESA Status	COSEWIC Status	G-Rank	S-Rank	Data Source	Habitat Requirements	Assessment of Species Occurrence in Study Area
Scientific Name	**Common Name**								
BIRDS									
Haliaeetus leucocephalus	Bald Eagle	Not Listed	SC	NAR	G5	S2N, S4B	OBBA, iNaturalist	Prefers deciduous and mixed deciduous forest; and habitat close to water bodies such as lakes and rivers.	**Potentially Present**: This species was not observed in the study area during field investigations. However, recent iNaturalist sighting (2023) documents at least one individual in the park, which contains riverine habitat close to tall supercanopy trees (e.g. large cottonwoods).
Riparia riparia	Bank Swallow	THR	THR	THR	G5	S4B	OBBA	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:** Species was not observed during field investigations, and steep vertical banks or cliffs are not present in the study area.
Hirundo rustica	Barn Swallow	THR	SC	SC	G5	S4B	OBBA	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 (foraging only):** Species was not documented during field investigations and no suitable structures present in study area for nest attachment, although at least one bridge structure exists in the general area. If present, this species is most likely to be foraging over the river.
Dolichonyx oryzivorus	Bobolink	THR	THR	THR	G5	S4B	OBBA	Forage crops fields, 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 (COSEWIC, 2022). Requires large tracts of grassland habitat (>50 ha).	**Not Present**: Preferred habitat (i.e., large tracts of grassland) is not present in the study area. Species was not observed in the study area during field investigations.
Cardellina canadensis	Canada Warbler	THR	SC	SC	G5	S5B	NHIC	An interior forest species, usually requires at least 30 ha; most common in wet, mixed deciduous-coniferous forest types with a closed canopy and well-developed shrub layer. Examples include wet bottomlands of cedar or alder and shrubby undergrowth in cool moist mature woodlands and riparian habitat. During migration, prefers forest edges and riparian habitats.	**Not Present**: Species was not observed during field investigations and suitable forest interior habitat is not present in the study area.
Chaetura pelagica	Chimney Swift	THR	THR	THR	G4G5	S3B	OBBA, eBird	Historically found in deciduous and coniferous, usually wet forest types, all with a well-developed, dense shrub layer. Now, most are found in urban areas in large, uncapped chimneys.	**Potentially Present (foraging only)**: Species was not observed in the study area during field investigations, and the study area contains no buildings with chimneys that may be used for nesting. Species could potentially use area for foraging, if suitable chimneys are available in the surrounding residential lands.

Species		SARA Status	ESA Status	COSEWIC Status	G-Rank	S-Rank	Data Source	Habitat Requirements	Assessment of Species Occurrence in Study Area
Scientific Name	**Common Name**								
Sturnella magna	Eastern Meadowlark	THR	THR	THR	G5	S4B, S3N	OBBA	Open grasslands with dense ground cover, hay fields, meadows, fallow fields. Generally requires large tracts of grassland (>50 ha) but has been observed to use mosaics of smaller grassland areas, pastures, and similar. The MNRF defines general habitat as the nest and suitable habitat within 300 metres of a nest or centre of defended territory (MNRF 2013).	**Not Present**: Large open fields and grasslands of a suitable size are absent from the study area. Species was not observed in the study area during field investigations.
Contopus virens	Eastern Wood-Pewee	SC	SC	SC	G5	S4B	NHIC, OBBA	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:** Species was not observed in the study area during site investigations, and timing of surveys is nearing the end of the breeding window for this species. Notwithstanding, habitat on the site is potentially suitable for nesting in future breeding seasons.
Hylocichla mustelina	Wood Thrush	THR	SC	THR	G4	S4B	NHIC, OBBA	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 Likely Present**: Although a wooded area exist throughout, highly suitable habitat is not generally available within any of the study areas and therefore is unlikely to host a breeding population of this species. Species was not observed in the study area during site investigations.
INSECTS									
Bombus bohemicus	Gypsy Cuckoo Bumble Bee	END	END	END	G3G5	S1S2	NHIC	In Canada, the Gypsy Cuckoo Bumble Bee has been recorded in every province and territory except Nunavut and occurs in diverse habitats such as open meadows, agricultural and urban areas, boreal forest and woodlands (Environment and Climate Change Canada, 2022). It is a parasitic bee reliant on other Bumblebees (e.g., the Rusty-patched and Yellow-banded Bumble Bees) and therefore does not produce worker bees. It is thought to forage on the pollen and nectar of a wide variety of plants. In Ontario, the Gypsy Cuckoo Bumble Bee was historically found throughout most of the province; however in recent years it is known only to occur in Pinery Provincial Park.	**Not Present:** The known population of this species does not occur within the study area.
Danaus plexippus	Monarch	END	SC	END	G4	S2N, S4B	General Screening, OBA	Exist primarily where milkweed (obligate larval host plant) and other wildflowers exist. This includes abandoned farmland, roadsides and other open spaces.	**Likely Present**: Not documented during field investigations in the study area, but some wildflowers are present. No milkweed was noted in the study area so the site likely does not currently provide exceptional breeding habitat for this species.
MAMMALS									

Species		SARA Status	ESA Status	COSEWIC Status	G-Rank	S-Rank	Data Source	Habitat Requirements	Assessment of Species Occurrence in Study Area
Scientific Name	**Common Name**								
Lasiurus borealis	Eastern Red Bat	Not Listed	Not Listed	END	G3G4	S4	General Screening	Use deciduous and coniferous forests of any age class. Maternity roosts occur in tall and large diameter trees. Switch roosting areas multiple times during breeding season, indicating any area size is suitable. Forage in a variety of habitats, including forests of any age class, open or semi-cluttered habitats, above or below canopies. (COSEWIC, 2023) *Although not listed yet under the ESA or SARA, COSEWIC designation suggests this species will likely be listed under such designations in the future.	**Potentially Present:** Suitable forest habitat present within study area. Forest area contains trees suitable for maternity roosts (i.e. tall and large diameter). Foraging habitat potentially available within study site.
Myotis leibii	Eastern Small-footed Myotis	Not Listed	END	Not Listed	G4	S2S3	General Screening	Overwinters in humid caves and mines. Summer maternity habitat poorly understood but thought to occur mainly in rocky habitats and not trees (e.g., under loose rocks on exposed rock outcrops, crevices and cliffs, and occasionally in buildings, under bridges and highway overpasses) (Humphrey, 2017.). Changes roost locations frequently, sometimes daily. Hunts in forests (MNRF, 2000).	**Not Present**: Rock piles, outcrops, and similar features were not observed in the study area. Caves and mines for hibernation are also not present.
Lasiurus cinereus	Hoary Bat	Not Listed	Not Listed	END	G3G4	S4	General Screening	Use deciduous and coniferous forests of any age class. Maternity roosts occur in tall and large diameter trees. Switch roosting areas multiple times during breeding season, indicating any area size is suitable. Forage in open areas such as wetlands, grasslands, open fields with patchily distributed trees. (COSEWIC, 2023) *Although not listed yet under the ESA or SARA, COSEWIC designation suggests this species will likely be listed under such designations in the future.	**Potentially Present:** Suitable forest habitat present within study area. Forest area contains trees suitable for maternity roosts (i.e. tall and large diameter). Foraging habitat potentially available within study site.
Myotis lucifugus	Little Brown Myotis	END	END	END	G3 G4	S3	General Screening	Overwinters in humid caves and mines. Maternity roost habitat often exists in building attics, under bridges, in rock crevices, or in cavities of forest canopy trees. Roost trees will generally be tall, large-diameter snags in the early to middle stages of decay, located in open areas of mature forest (COSEWIC, 2013).	**Maternity Habitat - Potentially Present**: The woodland area within the study area contains trees which were deemed to provide roosting habitat potential (e.g., standing snags or live trees with cavities, loose bark, etc.). **Overwintering Habitat - Not Present:** Caves and mines are not present within the study area.
Myotis septentrionalis	Northern Myotis	END	END	END	G2 G3	S3	General Screening	Overwinters in humid caves and mines. Rarely uses human-made structures for maternity roosting, preferring forests with larger trees. Roost trees will generally be tall, large-diameter snags in the early to middle stages of decay, located in open areas of mature forest. Foraging occurs mainly along waterways, forest edges, and in gaps in the forest (COSEWIC, 2013).	

Species		SARA Status	ESA Status	COSEWIC Status	G-Rank	S-Rank	Data Source	Habitat Requirements	Assessment of Species Occurrence in Study Area
Scientific Name	**Common Name**								
Lasionycteris noctivagans	Silver-haired Bat	Not Listed	Not Listed	END	G3G4	S4	General Screening	Relies on habitats where large, decaying trees are available as they roost primarily under bark and in cavities. Will roost in both coniferous and deciduous large diameter trees. Reproductive females will roost in groups. May occasionally use anthropogenic structures for roosting when natural roosting sites may be scarce. Forage in young and old forest, forest openings, edges and riparian zones during migration. (COSEWIC, 2023) *Although not listed yet under the ESA or SARA, COSEWIC designation suggests this species will likely be listed under such designations in the future.	**Potentially Present:** The forest area adjacent to the SWMF may contain trees which were deemed to provide roosting habitat potential (e.g., standing snags or live trees with cavities, loose bark, etc.). Further investigations will determine if the SWMF itself also contain trees with those characteristics. Foraging habitat potential also available within study site.
Perimyotis subflavus	Tricoloured Bat	END	END	END	G3 G4	S3?	General Screening	Overwinters in humid caves and mines; considered to have narrower range of conditions for hibernation than the other listed bat species. Maternal roosts can occur in trees or dead clusters of leaves or arboreal lichens on trees; large-diameter oaks and maples preferred. May also use barns or similar structures (COSEWIC, 2013; MNRF, 2017).	**Maternity Habitat - Potentially Present**: The woodland area within the study area contains large diameter oaks and maples which were deemed to provide roosting habitat potential. **Overwintering Habitat - Not Present**: Caves and mines are not present within the study area.
REPTILES AND AMPHIBIANS									
Emydoidea blandingii	Blanding's Turtle	END	THR	END	G4	S3	ORAA	Generally occur in freshwater lakes, permanent or temporary pools, slow-flowing streams, marshes and swamps. They prefer shallow water that is rich in nutrients, organic soil and dense vegetation. Adults are generally found in open or partially vegetated sites, and juveniles prefer areas that contain thick aquatic vegetation including sphagnum, water lilies and algae. They dig their nest in a variety of loose substrates, including sand, organic soil, gravel and cobblestone. Overwintering occurs in permanent pools that average about one metre in depth, or in slow-flowing streams.	**Unlikely Present:** Although the study area contains a slow-moving, connective water body, substrate in the river is generally hard-pan, and largely open water (with the exception of a small bay that has formed along a sand bar). Some substrate may be available along the riverbanks for nesting, but the area of impact consists of gabion baskets that will be removed as part of the works and could not support nesting of this species. This species was not observed during field investigations.
Lampropeltis Triangulum	Eastern Milksnake	SC	NAR	SC	G5	S4	ORAA	This habitat generalist may utilize a variety of different habitats including open or forested natural areas, but shows preference to sites that can provide hibernation opportunities (old foundations, mammal burrows, old logs, etc.) and are in close proximity to water. (COSEWIC, 2014)	**Potentially Present**: Not observed during field investigations but could feasibly occur in the study area based on habitat features present (e.g. generalist habitat along river corridor, moderate connectivity to other natural areas).

Species		SARA Status	ESA Status	COSEWIC Status	G-Rank	S-Rank	Data Source	Habitat Requirements	Assessment of Species Occurrence in Study Area
Scientific Name	**Common Name**								
Chrysemys picta marginata	Midland Painted Turtle	SC	Not Listed	SC	G5T 5	S4	ORAA	Generally inhabit slow-moving, quiet, warm, shallow water with abundant aquatic vegetation such as ponds, large pools, streams, ditches, swamps, marshy meadows; eggs are laid in sandy places, usually in a bank or hillside, or in fields and can take advatnage of man-made structures for nesting sites, including roads (especially gravel shoulders), dams and aggregate pits. They bask in groups on logs and rocks at water's surface; not territorial.	**Potentially Present**: The study area contains suitable habitat within Irvine Creek with sufficient depth, size and significant connectivity to other areas. Potential nesting area available on roadside.
Chelydra serpentina	Snapping Turtle	SC	SC	SC	G5	S4	NHIC, ORAA	Generally inhabit shallow waters where they can hide under the soft mud and leaf litter. Nesting sites usually occur on gravely or sandy areas along streams. Snapping turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits.	**Potentially Present**: The study area contains suitable habitat within Irvine Creek with sufficient depth, size and connectivity to other areas. Potential nesting area available on roadside.

*Species ranking for SARA, SARO and COSEWIC are as follows: EXT – Extinct, EXP – Extirpated, END – Endangered, THR – Threatened, SC – Special Concern, NAR – Not at Risk, and DD – Data Deficient
ǂHabitat Requirements were provided by the Significant Wildlife Habitat Guide (MNRF, 2000) unless otherwise cited.

Unregulated Species with High Provincial Rarity Resulting from Background Review:

Tawny Emporer (*Asterocampa clyton*) (S3) - OBA

References:

COSEWIC. 2013. *COSEWIC assessment and status report on the Little Brown Myotis Myotis lucifugus, Northern Myotis Myotis septentrionalis and Tri-colored Bat Perimyotis subflavus in Canada*. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxiv + 93 pp. (Species at Risk Public Registry website).

COSEWIC. 2014. *COSEWIC assessment and status report on the Milksnake Lampropeltis triangulum in Canada*. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x +61 pp.

COSEWIC. 2022. *COSEWIC assessment and status report on the Bobolink Dolichonyx oryzivorus in Canada. Committee on the Status of Endangered Wildlife in Canada.* Ottawa. xi + 60 pp. (Species at risk public registry).

COSEWIC. 2023. *COSEWIC assessment and status report on the Hoary Bat Lasiurus cinereus, Eastern Red Bat Lasiurus borealis and Silver-haired Bat, Lasionycteris noctivagans, in Canada*. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxi + 100 pp. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html).

Environment and Climate Change Canada. 2022. *Recovery Strategy for the Gypsy Cuckoo Bumble Bee (Bombus bohemicus) in Canada [Proposed].* Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. viii + 80 pp.

Humphrey, C. 2017. *Recovery Strategy for the Eastern Small-footed Myotis (Myotis leibii) in Ontario*. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vii + 76 pp.

Jendago. 2023. iNaturalist observation: https://www.inaturalist.org/observations/156081764. Accessed on August 23rd, 2024.

MNRF. 2000. *Significant wildlife habitat technical guide.* 151p

MNRF. 2017. *Survey protocol for species at risk bats within treed habitats Little Brown Myotis, Northern Myotis and Tri-Colored Bat*. Ontario Ministry of Natural Resources and Forestry, Guelph, Ontario. 13 pp.

Appendix D – Geotechnical and Soil Characterization Report

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

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PROJECT NO.: SM 240423-G October 23, 2024

AQUAFOR BEECH LTD.
2600 Skymark Avenue
Mississauga, Ontario
L4W 5B2

Attention: Mitchell Tulloch, BASc.
Water Resources EIT

GEOTECHNICAL INVESTIGATION
PROPOSED RETAINING WALL REMOVAL AND BANK NATURALISATION
VETERAN'S PARK
SALEM, ONTARIO

Dear Mr. Tulloch,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the fieldwork, and report preparation in connection with the above noted project. Our comments and recommendations, based on our observations during our site visit is presented in the following paragraphs.

1. INTRODUCTION

We understand that the project will include the removal and naturalisation of the existing retaining wall located on the south side of Irvine Creek within Veteran's Park in Salem, Ontario. The purpose of this geotechnical investigation work was to assess the subsurface soil conditions, and to provide our comments and recommendations with respect to the design and construction of the proposed development, from a geotechnical point of view.

This report is based on the above summarised project description, and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project design may void the recommendations given in this report. If significant changes are made to the proposed design, this office must be consulted to review the new design with respect to the results of this investigation.

2. PROCEDURE

A total of three [3] sampled boreholes were advanced at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. The boreholes were advanced using continuous flight power auger equipment on September 3, 2024 under the direction of a staff member of SOIL-MAT ENGINEERS & CONSULTANTS LTD., to auger refusal at depths of between approximately 2.4 and 3.4 metres below the existing ground surface. Upon completion of drilling, the boreholes were backfilled in general accordance with Ontario Regulation 903, and the ground surface was reinstated even with the surrounding grade.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples recovered from the borings.

The boreholes were located on site by a representative of SOIL-MAT ENGINEERS. The ground surface elevation at the borehole locations was referenced to a site-specific benchmark, described as the base of the hydro pole on the northwest side of William Street at the entrance to Veteran's Park, as illustrated in the Borehole Location Plan. This benchmark was assigned an elevation of 100.00 metres for convenience.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in Log of Borehole Nos. 1 to 3, inclusive, following the text of this report. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed as the exact depths of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The subject site consists of the area behind the existing gabion basket retaining wall within Veteran's Park in Salem, Ontario. The area behind the wall presently serves as grass surfaced landscaped space adjacent to parking areas for the park. The ground surface is relatively uneven, with minor undulations and it situated roughly 10 metres below the elevation of the adjacent roadways. The existing gabion basket wall is understood to be undercut by erosion resulting in deterioration of the wall and loss of gabion stone.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Topsoil

A surficial veneer of topsoil approximately 200 to 300 millimetres in thickness was encountered at all of the borehole locations. It is noted that the depth of topsoil may vary across the site and from the depths encountered at the borehole locations, and a conservative approach should be taken in estimated topsoil quantities across the site. It is also noted that the term 'topsoil' has been used from a geotechnical point of view, and does not necessarily reflect its nutrient content or ability to support plant life.

Sand, Gravel, and Cobbles

A mix of sand, gravel, and cobbles was encountered beneath the surficial topsoil at all of the borehole locations. The coarse material was brown in colour, and was generally in a compact to dense condition. Frequent cobble inclusions were observed, throughout the depth of the borehole behind the wall, with occasional organic inclusions in the upper levels. The mix of sand, gravel, and cobbles was proven to auger refusal on assumed bedrock or cobbles/boulders at depths of up to approximately 2.4 to 3.4 metres below the existing ground surface. The coarse granular materials encountered may be considered "free draining" and may be suitable for use in the vegetated buttress, pending confirmation of the material in the field at the time of construction. It is possible that the material encountered is comprised of crushed bedrock, used as backfill behind the gabion basket retaining wall.

Bedrock

Based on our observations in the field, bedrock is assumed to be at a depth of approximately 3.5 metres below the top of the wall, roughly level with the creek bed where the bedrock surface was visible. Based on a review of available published information, the bedrock consists of dolostone of the Guelph formation. The dolostone is typically very competent in terms of excavation and support requirements. The bedrock was not cored as part of this investigation.

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicates the subsurface soils to consist of glaciofluvial deposits, including gravelly river deposits with bedrock at relatively shallow depths, consistent with our experience in the area and observations during drilling.

Groundwater Observations

All of the boreholes were recorded as open and 'dry' upon completion of drilling. It is noted that insufficient time would have passed for the static groundwater level to stabilise in the open boreholes. The static groundwater level should be assumed to be roughly coincident with the level of the Irvine Creek, however shallower perched deposits may be encountered, especially during the 'wet' times of the year.

4. STABILISATION DESIGN CONSIDERATIONS

It is understood that the stabilisation works will include the construction of a new vegetated buttress. Conservative soil parameters may be assigned during the design process for the vegetated bank reinforcement based on the subsurface soil encountered at the borehole locations, as follows:

Sand, Gravel, and Cobbles

γ = 22.0 kN/m^3; ϕ = 38^o; c = 0 kPa
Active case: Ka = 0.24
At rest case: Ko = 0.38
Passive case: Kp = 4.2

As evidenced in the borehole logs, a significant amount of cobbles were encountered behind the existing gabion basket retaining wall. The presence of such cobbles, boulders, etc. should be considered when selecting excavation methods, as they may result in excavation difficulties. Such materials may be suitable for reuse in the vegetated buttress, pending confirmation of the materials in the field at the time of construction.

5. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The material in it reflects SOIL-MAT ENGINEERS' best judgment in light of the information available to it at the time of preparation. There may be conditions in the study area which are not represented by these investigations. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SOIL-MAT ENGINEERS accept no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust that this site visit report is sufficient for your present requirements. Should there be any questions regarding the content or comments within this report please do not hesitate to contact our office.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Malcolm Green, B.Tech.
Junior Engineer

Kyle Richardson, P. Eng.
Project Engineer



Enclosure: Drawing No. 1, Borehole Location Plan
Log of Borehole Nos. 1 to 3, inclusive

Distribution: Aquafor Beech Ltd. [pdf]



LEGEND

BH# — Borehole Location

TBM — Temporary Benchmark
Base of telephone pole with assigned elevation of 100.00m.

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 240423-G.

2. Borehole locations are approximate.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Proposed Retaining Wall Removal
Veterans Park – 32 William Street
Salem, Ontario

Borehole Location Plan

Project No. SM 240423-G

Date: September 2024

Drawn: MG

Checked: KR

Drawing No. 1

Log of Borehole No. 1

Project No: SM 240423-G
Project: Proposed Bank Naturalization
Location: Veteran's Park, Elora
Client: Aquafor Beech Ltd.

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4838054
E: 544473

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	90.82		Ground Surface								
0 / 0	90.60		**Topsoil** Approximately 200 millimetres of topsoil.		SS	1	3,9,9,13	18			
3 / 1			**Sand, Gravel, and Cobbles** Brown, occasional organic inclusions in the upper level, compact.		SS	2	12,13,10,9	23			
6 / 2					SS	3	6,12,14,12	26			
7 / 2	88.40		End of Borehole Auger Refusal on Assumed Cobble/Boulder								

NOTES:

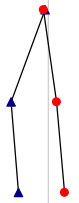
1. Borehole was advanced using solid stem auger equipment on September 3, 2024 to auger refusal on presumed cobble at a depth of 2.4 metres.

2. Borehole was recorded as 'dry' and caved to a depth of 0.9 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Auger
Drill Date: September 3, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Kodiak Drilling

Soil-Mat Engineers & Consultants Ltd.
401 Grays Road, Hamilton, Ontario, L8E 2Z3
T: 905.318.7440, TF: 800.243.1922, F: 905.318.7455
www.soil-mat.ca E: info@soil-mat.ca

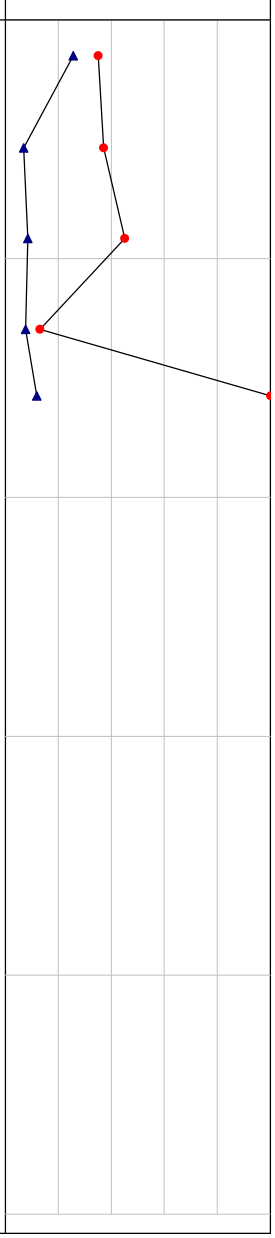
Datum: Temporary Benchmark
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 2

Project No: SM 240423-G
Project: Proposed Bank Naturalization
Location: Veteran's Park, Elora
Client: Aquafor Beech Ltd.

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4838056
E: 544464

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
	90.63		Ground Surface								
0 / 0	90.30		**Topsoil** Approximately 300 millimetres of topsoil.								
1 /			**Sand, Gravel, and Cobbles** Brown, compact to very dense.		SS	1	3,6,29,30	35			
2 /					SS	2	17,18,19,11	37			
3 / 1					SS	3	7,10,35,13	45			
4 /					SS	4	7,5,6,6	13			
5 /					SS	5	50/6"	100			
6 / 2	87.20		End of Borehole Auger Refusal on Assumed Bedrock								
7 /			NOTES: 1. Borehole was advanced using solid stem auger equipment on September 3, 2024 to auger refusal on presumed bedrock at a depth of 3.4 metres. 2. Borehole was recorded as 'dry' and caved to a depth of 0.6 metres upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.								
8 /											
9 / 3											
10 /											
11 /											
12 /											
13 / 4											
14 /											
15 /											
16 / 5											
17 /											
18 /											
19 /											
20 / 6											
21 /											
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23 / 7											
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26 / 8											
27 /											
28 /											
29 / 9											
30 /											
31 /											
32 /											
33 /											



Drill Method: Solid Stem Auger
Drill Date: September 3, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Kodiak Drilling

Soil-Mat Engineers & Consultants Ltd.
401 Grays Road, Hamilton, Ontario, L8E 2Z3
T: 905.318.7440, TF: 800.243.1922, F: 905.318.7455
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Datum: Temporary Benchmark
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 3

Project No: SM 240423-G
Project: Proposed Bank Naturalization
Location: Veteran's Park, Elora
Client: Aquafor Beech Ltd.

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4838039
E: 544492

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	90.34		Ground Surface								
0 / 0	90.10		**Topsoil** Approximately 200 millimetres of topsoil.								
1 / 0			**Sand, Gravel, and Cobbles** Brown, compact to dense.		SS	1	3,4,12,11	16			
2 / 1					SS	2	7,6,7,5	13			
3 / 1					SS	3	7,9,26,26	35			
10 / 3	87.20				SS	4	9,9,11,8	20			
			End of Borehole Auger Refusal on Assumed Bedrock								

NOTES:

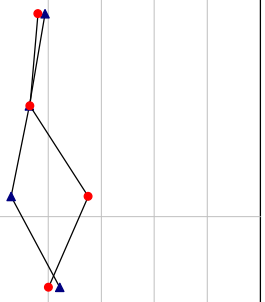
1. Borehole was advanced using solid stem auger equipment on September 3, 2024 to auger refusal on presumed bedrock at a depth of 3.1 metres.

2. Borehole was recorded as 'dry' and caved to a depth of 0.4 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Auger
Drill Date: September 3, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Kodiak Drilling

Soil-Mat Engineers & Consultants Ltd.
401 Grays Road, Hamilton, Ontario, L8E 2Z3
T: 905.318.7440, TF: 800.243.1922, F: 905.318.7455
www.soil-mat.ca E: info@soil-mat.ca

Datum: Temporary Benchmark
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

401 Grays Road · Hamilton, ON · L8E 2Z3

www.soil-mat.ca info@soil-mat.ca 905.318.7440 905.318.7455

PROJECT NO.: SM 240423-E October 23, 2024

AQUAFOR BEECH LTD.
2600 Skymark Ave
Mississauga, Ontario
L4W 5B2

Attention: Mitchell Tulloch, BASc
Water Resources EIT

SOIL CHARACTERISATION REPORT
PROPOSED RETAINING WALL REMOVAL AND BANK NATURALISATION
VETERAN'S PARK
SALEM, ONTARIO

Dear Mr. Tulloch,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed a supplemental excess soil characterisation program in connection with the above noted project. Our formal comments with respect to the off-site disposal/re-use of surplus material on an off-site property are summarised herein.

INTRODUCTION

We understand that the project will include the removal and naturalisation of the existing retaining wall located on the south side of Irvine Creek within Veteran's Park in Salem, Ontario. It is understood that the construction may result in the generation of excess soil that may require off-site disposal. While an estimate of excess soil to be generated is unknown at this time, it is anticipated to be relatively minimal, on the order of a few hundred cubic metres. The purpose of this excess soil characterisation program is to secure representative samples of the overburden soil from the area of proposed construction for submission for background analytical testing and to provide our comments regarding the off-site disposal/re-use of surplus soil from the subject site, in accordance with Ontario Regulation 406/19.

ASSESSMENT OF PAST USES

The subject site consists of the existing gabion stone basket retaining wall located on the south bank of Irvine Creek within Veteran's Park. The surrounding areas consist

predominately of parkland and residential properties. At the time of our site visit there were no notable signs of environmental concern.

Given the land use of the subject site and surrounding areas, as well as the low volume of excess soil expected, the subject site would not be subject to the requirement to register with the RPRA, and by extension required to prepare a formal Assessment of Past Uses [APU], Sampling and Analysis Plan [SAP], and Excess Soil Destination Assessment Report [ESDAR], as per Section 8, as follows:

Notice to be filed on Registry:

> ***8. (****1) Subject to subsections (2) and (3), the project leader for a project, respecting a project area described in subsection (1.1), shall ensure that, before removing from the project area soil that will become excess soil once removed, a notice is filed in the Registry setting out the information listed in Schedule 1. O. Reg. 406/19, s. 8 (1); O. Reg. 555/22, s. 2 (1).*
>
> *(1.1) A project area to which subsection (1) applies is one that meets any of the following criteria:*
>
> *1. After making reasonable efforts to take into consideration any past reports about past uses and activities respecting the project area, the project leader is of the opinion that the project area is or has ever been, in whole or in part, an enhanced investigation project area, except if,*
>
> *i. a record of site condition has been filed in respect of the enhanced investigation project area under Part XV.1 of the Act and the record of site condition does not contain a certification made under subparagraph 4 ii of subsection 168.4 (1) of the Act in respect of a risk assessment, and*
>
> *ii. no part of the project area has been used as an enhanced investigation project area since the filing of the record of site condition mentioned in subparagraph.*
>
> *2. Any part of the project area is located in an area of settlement within the meaning of the* Planning Act *and the amount of soil to be removed from the project area is 2,000 m^3 or more, unless the whole project area is currently used for, or in the case of an unused area, its most recent use was for, any of the following within the meaning of Ontario Regulation 153/04:*
>
> *i. A residential use.*
>
> *ii. An institutional use.*
>
> *iii. A parkland use.*
>
> *iv. An agricultural or other use.*

As such, it is not required to prepare a formal APU, SAP, and ESDAR, or meet the specific sampling frequency as outlined in the Regulation to support the off-site reuse of the subject material. Regardless, this assessment has been conducted as part of our investigation and sampling program.

SAMPLING AND ANALYSIS PLAN

Based on the above, the appropriate scope of analytical testing would include a standard panel of metal and inorganic parameters, petroleum hydrocarbons [PHCs] including benzene, toluene, ethylbenzene, and xylenes [BTEX]. Given the anticipated volume of soil as relatively minimal, on the order of a few hundred cubic metres, it is our opinion that one [1] sample from each location, for a total of three [3] samples, is sufficient to characterise the excess soil for off-site disposal.

SITE VISIT AND SOIL SAMPLING

A representative of SOIL-MAT ENGINEERS visited the site on September 5, 2024. During our site visit, a total of three [3] boreholes, identified as Borehole Nos. 1 to 3, were advanced to refusal at depths of between approximately 2.4 to 3.4 metres below the existing ground surface using continuous flight power auger equipment. A sample of the subsurface soils was collected from each of the borehole locations for background analytical testing as detailed above.

The subsurface soils in the boreholes generally consisted of a surficial veneer of topsoil approximately 200 to 300 millimetres in thickness overlying sand, gravel, and cobbles, proven to auger refusal at depths of between approximately 2.4 and 3.4 metres below the ground surface level. Dolostone bedrock is assumed at a depth of approximately 3.5 metres below the ground surface, roughly level with the creek bed where the bedrock surface was visible.

Soil samples from the boreholes were examined in the field for visual and olfactory evidence of potential impacts such as unusual staining and/or odours, etc. The soil samples were sealed in pre-cleaned wide mouth, amber glass sample jars and/or vials pre-charged with methanol preservative as supplied by the laboratory. The samples were stored and transported in a cooler and kept under ice packs to minimise potential volatilisation of select parameters. New disposable sampling gloves were used for the collection of each soil sample with care given not to make contact with the samples and gloves. Dedicated sample retrieval equipment, including a cleaned stainless-steel split spoon, was used to retrieve each sample before depositing it directly into the lab supplied sample jar.

LABORATORY ANALYTICAL TESTING

The secured soil samples were submitted to AGAT Laboratories [AGAT], [an accredited Canadian Environmental Laboratory] for bulk laboratory analytical testing for the specific parameters identified above, summarised as follows:

Summary of Sample Analyses

Sample ID	M/I	PHC+BTEX
BH1 SS3	✓	✓
BH2 SS4	✓	✓
BH3 SS3	✓	✓

The laboratory analytical test results received in our Office were compared with the applicable Excess Soil Quality Standards and Excess Soil Leachate Screening Standards under Ontario Regulation 406/19: On-Site and Excess Soil Management, outlined as follows:

- **Ontario Regulation 406/19 – Table 1**: Full Depth Background Site Condition Standards Agricultural [AG] and Residential / Parkland / Institutional / Industrial / Commercial / Community [RPI/ICC] land use.
- **Ontario Regulation 406/19 – Table 2.1**: Full Depth Excess Soil Quality Standards Agricultural [AG], Residential / Parkland / Institutional [RPI], and Industrial / Commercial / Community [ICC] land use in a potable groundwater condition.
- **Ontario Regulation 406/19 – Table 3.1**: Full Depth Excess Soil Quality Standards Residential / Parkland / Institutional [RPI] and Industrial / Commercial / Community [ICC] land use in a non-potable groundwater condition.

The results of this laboratory testing are presented in the attached AGAT Certificate of Analysis [AGAT Work Order Number 24T192934].

Based on SOIL-MAT ENGINEERS' field observations and laboratory analytical test results from AGAT, SOIL-MAT ENGINEERS offer the following comments:

1. The submitted samples met the Table 1 [AG] Standards for the parameters tested, with the exception of Sodium Absorption Ratio [SAR] in BH1 SS3, and Electrical Conductivity [EC] in BH3 SS3.

2. The submitted samples met the Table 1 [RPI/ICC], as well as Table 2.1, [AG and RPI] and 3.1 [RPI] Standards for the parameters tested, with the exception of [EC] in BH3 SS3.
3. The submitted samples met the Table 2.1 and 3.1 [ICC] Standards for the parameters tested.
4. The soil sampled during this testing is believed to be representative of the soil conditions at the sample location only. This office should be contacted to reassess the environmental characteristics of the soil if any unusual staining or odours are observed during future construction activities.

Results of the analytical testing and various exceedances detailed above have been summarised in the table below.

Summary of Analytical Results

SAMPLE	TABLE 1		TABLE 2.1			TABLE 3.1	
	AG	RPI/ICC	AG	RPI	ICC	RPI	ICC
BH1 SS3	SAR	✓	✓	✓	✓	✓	✓
BH2 SS4	✓	✓	✓	✓	✓	✓	✓
BH3 SS3	EC	EC	EC	EC	✓	EC	✓

*✓ denotes samples that have met the listed table.

ENVIRONMENTAL CONSIDERATIONS FOR SOIL REUSE

Given the results of the laboratory analytical testing, the following disposal/re-use options are available under Ontario Regulation 406/19.

1. As the tested material has been shown to meet the O. Reg. 406/19 Table 1 [AG and RPI/ICC] and 2.1 [AG] Standards and 2.1 and 3.1 [RPI], with the exception of EC and/or SAR, surplus material generated from the project area may reasonably be accepted at an off-site AG or RPI property subject to Table 1, 2.1, or 3.1 standards, subject to the approval of the property owner and/or their QP, and conditions regarding elevated levels of EC and/or SAR are provided in Note 2, below.
2. The handling and placement of soil impacted by the use of deicing salts (where EC and/or SAR exceed the Standards) is provided as follows:

1. For the purposes of deemed compliance with excess soil quality standards as set out in paragraph 1 of subsection 1 (10.1) of Section A in Part II, salt-impacted excess soil shall be placed in accordance with the following:

a) Salt-impacted excess soil may be placed in any area of the reuse site where it is anticipated a substance will be applied for the safety of vehicular or pedestrian traffic under conditions of snow or ice.

b) Salt-impacted excess soil may be placed at any reuse site used for an industrial or commercial property use.

c) In respect of a reuse site used for a community, parkland, institutional, or residential use,
i. salt-impacted excess soil may be placed at a depth of at least 1.5 metres below the soil surface, or
ii. if subparagraph i does not apply, it must be finally placed in accordance with a landscape plan described in subsection 5(8) of the regulation that meets the requirements set out in paragraph 3.

d) In respect of a reuse site used for an agricultural or other property use,
i. salt-impacted excess soil may be finally placed at a depth of at least 1.5 metres below the soil surface, or
ii. if subparagraph i does not apply, in areas that will not be vegetated and only to achieve a grade necessary to construct a planned building, including a barn or greenhouse, or install a driveway or parking area.

2. Despite paragraph 1, in all cases, salt-impacted excess soil shall not be finally placed at any of the following areas of a reuse site:

a) within 30 metres of a waterbody;

b) within 100 metres of a potable water well or, with respect to an approved lot that may require a potable water well, within 100 metres of the planned water well location or if the location of the well is unknown, the centre of the lot ; or,

c) an area that will be used for growing crops or pasturing livestock unless the salt-impacted excess soil is placed 1.5 metres or greater below the soil surface.
3. A landscape plan for the purposes of subsection 5(8) of the regulation and subclause 1.c)(ii) shall:

A. Identify the areas within the reuse site in which salt-impacted excess soil can be finally placed, which shall include only the following:
a) An area that will be unvegetated and that is not an area of the reuse site described in paragraph 2.

b) An area that is not an area described in paragraph 2 and that will be vegetated with vegetation that,
i. may tolerate elevated levels of chemicals associated with salt-impacted excess soil, or

iii. requires less than 1.5 metres of soil that meets applicable excess soil quality standards to grow successfully.
B. Identify, for each area mentioned in subparagraph A.b):

a) The types of vegetation that may be planted in that area,
b) The acceptable levels of salt-related contaminants that may be tolerated by the vegetation mentioned in subparagraph A.b)i, if applicable, and
c) The depth of soil that must meet the applicable excess soil quality standards in order for the vegetation mentioned in subparagraph A.b)ii to grow successfully, if applicable.

C. Be signed by a person with qualifications as set out in subsection 5(10) of the regulation."

3. As the tested material has been shown to meet the O. Reg. 406/19 Tables 2.1 and 3.1 [ICC] Standards, surplus material generated from the project area may reasonably be accepted at an off-site ICC property subject to Table 2.1 or 3.1 standards, subject to the approval of the property owner and/or their QP.
4. Surplus soil may be re-used on site within the project lands. This may be preferred to disposing of soil off-site.
5. Depending on the requirements of the receiving property, volume of surplus soil to be handled, etc., additional testing may be required.

GEOTECHNICAL CONSIDERATIONS FOR SOIL REUSE

The subsurface soils were noted to consist of sand, gravel, and cobbles below a surficial veneer of topsoil. The coarse granular material may be suitable for use as engineered fill, provided it's free of organics or other deleterious materials, and possibly for use on site in construction of the vegetated buttress, pending confirmation of the condition of the material in the field at the time of construction.

GENERAL COMMENTS

The soil descriptions noted above are based on observations made at the borehole locations only. In the event that the soil conditions encountered differ from those described, SOIL-MAT ENGINEERS should be retained to further assess the environmental and geotechnical characteristics of the soils.

The material in this report reflects SOIL-MAT ENGINEERS' best judgement in light of the information available at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SOIL-MAT ENGINEERS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust this is satisfactory for your purposes. Please feel free to contact our Office if you have any questions, or we may be of further service to you.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Malcolm Green, B.Tech.
Junior Engineer



Kyle Richardson, P. Eng., QP_{ESA}
Project Engineer

Enclosures: Drawing No. 1, Borehole Location Plan
Log of Borehole Nos. 1 to 3, inclusive
AGAT Certificate of Analysis: 24T192934

Distribution: Aquafor Beech Ltd. [pdf]



LEGEND

BH# — Borehole Location

TBM — Temporary Benchmark
Base of telephone pole with assigned elevation of 100.00m.

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 240423-G.

2. Borehole locations are approximate.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Proposed Retaining Wall Removal
Veterans Park – 32 William Street
Salem, Ontario

Borehole Location Plan

Project No. SM 240423-G

Date: September 2024

Drawn: MG

Checked: KR

Drawing No. 1

Log of Borehole No. 1

Project No: SM 240423-G
Project: Proposed Bank Naturalization
Location: Veteran's Park, Elora
Client: Aquafor Beech Ltd.

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4838054
E: 544473

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	90.82		Ground Surface								
0 / 0	90.60		**Topsoil** Approximately 200 millimetres of topsoil.		SS	1	3,9,9,13	18			
3 / 1			**Sand, Gravel, and Cobbles** Brown, occasional organic inclusions in the upper level, compact.		SS	2	12,13,10,9	23			
6 / 2					SS	3	6,12,14,12	26			
7 / 2	88.40		End of Borehole Auger Refusal on Assumed Cobble/Boulder								

NOTES:

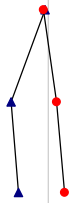
1. Borehole was advanced using solid stem auger equipment on September 3, 2024 to auger refusal on presumed cobble at a depth of 2.4 metres.

2. Borehole was recorded as 'dry' and caved to a depth of 0.9 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Auger
Drill Date: September 3, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Kodiak Drilling

Soil-Mat Engineers & Consultants Ltd.
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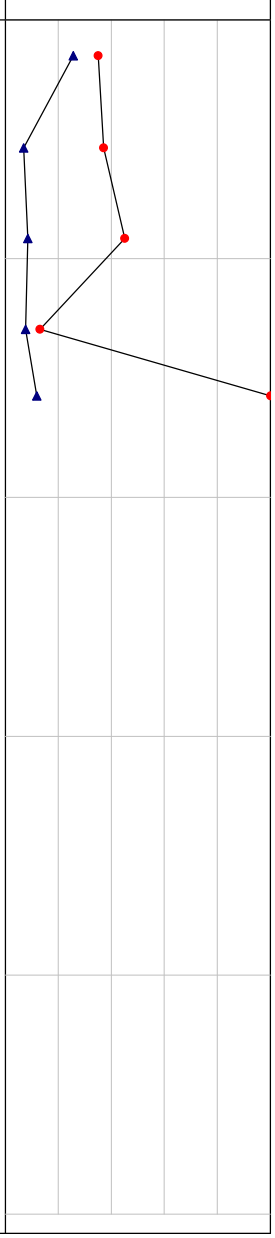
Datum: Temporary Benchmark
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 2

Project No: SM 240423-G
Project: Proposed Bank Naturalization
Location: Veteran's Park, Elora
Client: Aquafor Beech Ltd.

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4838056
E: 544464

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
	90.63		Ground Surface								
0 / 0	90.30		**Topsoil** Approximately 300 millimetres of topsoil.								
1 /			**Sand, Gravel, and Cobbles** Brown, compact to very dense.		SS	1	3,6,29,30	35			
2 /					SS	2	17,18,19,11	37			
3 / 1					SS	3	7,10,35,13	45			
4 /					SS	4	7,5,6,6	13			
5 /					SS	5	50/6"	100			
6 / 2	87.20		End of Borehole Auger Refusal on Assumed Bedrock								
7 /			NOTES: 1. Borehole was advanced using solid stem auger equipment on September 3, 2024 to auger refusal on presumed bedrock at a depth of 3.4 metres. 2. Borehole was recorded as 'dry' and caved to a depth of 0.6 metres upon completion and backfilled as per Ontario Regulation 903. 3. Soil samples will be discarded after 3 months unless otherwise directed by our client.								
8 /											
9 / 3											
10 /											
11 /											
12 /											
13 / 4											
14 /											
15 /											
16 / 5											
17 /											
18 /											
19 /											
20 / 6											
21 /											
22 /											
23 / 7											
24 /											
25 /											
26 / 8											
27 /											
28 /											
29 / 9											
30 /											
31 /											
32 /											
33 /											



Drill Method: Solid Stem Auger
Drill Date: September 3, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Kodiak Drilling

Soil-Mat Engineers & Consultants Ltd.
401 Grays Road, Hamilton, Ontario, L8E 2Z3
T: 905.318.7440, TF: 800.243.1922, F: 905.318.7455
www.soil-mat.ca E: info@soil-mat.ca

Datum: Temporary Benchmark
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 3

Project No: SM 240423-G
Project: Proposed Bank Naturalization
Location: Veteran's Park, Elora
Client: Aquafor Beech Ltd.

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4838039
E: 544492

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	90.34		Ground Surface								
0 / 0	90.10		**Topsoil** Approximately 200 millimetres of topsoil.								
1 / 0			**Sand, Gravel, and Cobbles** Brown, compact to dense.		SS	1	3,4,12,11	16			
2 / 1					SS	2	7,6,7,5	13			
3 / 1					SS	3	7,9,26,26	35			
10 / 3	87.20				SS	4	9,9,11,8	20			
			End of Borehole Auger Refusal on Assumed Bedrock								

NOTES:

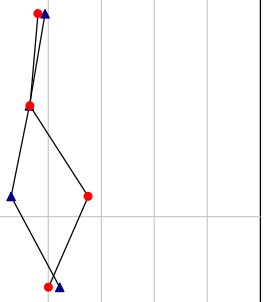
1. Borehole was advanced using solid stem auger equipment on September 3, 2024 to auger refusal on presumed bedrock at a depth of 3.1 metres.

2. Borehole was recorded as 'dry' and caved to a depth of 0.4 metres upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



Drill Method: Solid Stem Auger
Drill Date: September 3, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Kodiak Drilling

Soil-Mat Engineers & Consultants Ltd.
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Datum: Temporary Benchmark
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

AGAT Laboratories

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http://www.agatlabs.com

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT
401 GRAYS ROAD
HAMILTON, ON L8E 2Z3
(905) 318-7440

ATTENTION TO: Malcom Green

PROJECT: 240423

AGAT WORK ORDER: 24T192934

SOIL ANALYSIS REVIEWED BY: Sukhwinder Randhawa, Inorganic Team Lead

TRACE ORGANICS REVIEWED BY: Radhika Chakraberty, Trace Organics Lab Manager

DATE REPORTED: Sep 10, 2024

PAGES (INCLUDING COVER): 12

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
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- *The test results reported herewith relate only to the samples as received by the laboratory.*
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- *This document is signed by an authorized signatory who meets the requirements of the MELCCFP, CALA, CCN and NELAP.*
- *For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.*

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Environmental Services Association of Alberta (ESAA)

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Certificate of Analysis

AGAT WORK ORDER: 24T192934

PROJECT: 240423

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Malcom Green

SAMPLING SITE:Elora, ON

SAMPLED BY:MG

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2024-09-04

DATE REPORTED: 2024-09-10

		SAMPLE DESCRIPTION:		BH1 SS3	BH2 SS4	BH3 SS3
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2024-09-03	2024-09-03	2024-09-03
Parameter	Unit	G / S	RDL	6118419	6118422	6118423
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	3	3	2
Barium	µg/g	220	2.0	53.2	19.2	39.5
Beryllium	µg/g	2.5	0.5	<0.5	<0.5	<0.5
Boron	µg/g	36	5	<5	<5	<5
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.12	0.11	0.27
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	5	15	9	14
Cobalt	µg/g	21	0.8	4.9	2.4	2.5
Copper	µg/g	92	1.0	9.8	12.4	7.2
Lead	µg/g	120	1	12	8	11
Molybdenum	µg/g	2	0.5	<0.5	<0.5	0.5
Nickel	µg/g	82	1	10	5	6
Selenium	µg/g	1.5	0.8	<0.8	<0.8	<0.8
Silver	µg/g	0.5	0.5	<0.5	<0.5	<0.5
Thallium	µg/g	1	0.5	<0.5	<0.5	<0.5
Uranium	µg/g	2.5	0.50	<0.50	<0.50	0.50
Vanadium	µg/g	86	2.0	29.1	11.3	14.7
Zinc	µg/g	290	5	56	49	50
Chromium, Hexavalent	µg/g	0.66	0.2	<0.2	<0.2	<0.2
Cyanide, WAD	µg/g	0.051	0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.184	0.208	**0.982**
Sodium Adsorption Ratio (2:1) (Calc.)	N/A	2.4	N/A	1.81	0.584	0.289
pH, 2:1 CaCl2 Extraction	pH Units		NA	6.77	6.91	12.5

Certified By:



Results relate only to the items tested. Results apply to samples as received.

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Certificate of Analysis

AGAT WORK ORDER: 24T192934

PROJECT: 240423

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Malcom Green

SAMPLING SITE:Elora, ON

SAMPLED BY:MG

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2024-09-04 **DATE REPORTED: 2024-09-10**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 406/19 TABLE 1: Full Depth Background Site Condition - RPIC
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

6118419-6118423 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. SAR is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Results relate only to the items tested. Results apply to samples as received.

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Certificate of Analysis

AGAT WORK ORDER: 24T192934

PROJECT: 240423

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Malcom Green

SAMPLING SITE:Elora, ON

SAMPLED BY:MG

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2024-09-04

DATE REPORTED: 2024-09-10

		SAMPLE DESCRIPTION:		BH1 SS3	BH2 SS4	BH3 SS3
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2024-09-03	2024-09-03	2024-09-03
Parameter	**Unit**	**G / S**	**RDL**	**6118419**	**6118422**	**6118423**
Benzene	µg/g	0.02	0.02	<0.02	<0.02	<0.02
Toluene	µg/g	0.2	0.05	<0.05	<0.05	<0.05
Ethylbenzene	µg/g	0.05	0.05	<0.05	<0.05	<0.05
m & p-Xylene	µg/g		0.05	<0.05	<0.05	<0.05
o-Xylene	µg/g		0.05	<0.05	<0.05	<0.05
Xylenes (Total)	µg/g	0.05	0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g		5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	<50	<50
F4 (C34 to C50)	µg/g	120	50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50	NA	NA	NA
Moisture Content	%		0.1	9.2	7.1	13.0
Surrogate	**Unit**	**Acceptable Limits**				
Toluene-d8	% Recovery	60-140		73	78	81
Terphenyl	%	60-140		69	75	73

Certified By: R. Chakraberty

Results relate only to the items tested. Results apply to samples as received.

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Certificate of Analysis

AGAT WORK ORDER: 24T192934

PROJECT: 240423

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Malcom Green

SAMPLING SITE:Elora, ON

SAMPLED BY:MG

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2024-09-04 **DATE REPORTED: 2024-09-10**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg. 406/19 TABLE 1: Full Depth Background Site Condition - RPIC
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

6118419-6118423 Results are based on sample dry weight.
The C6-C10 fraction is calculated using Toluene response factor.
Xylenes is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.
C6–C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX.
The calculated parameters are non-accredited. The parameters that are components of the calculation are accredited.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contribution.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: R. Chakraberty

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Exceedance Summary

AGAT WORK ORDER: 24T192934

PROJECT: 240423

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Malcom Green

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
6118423	BH3 SS3	ON 406/19 T1 RPIC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.57	0.982

Results relate only to the items tested. Results apply to samples as received.

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Quality Assurance

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 24T192934

PROJECT: 240423

ATTENTION TO: Malcom Green

SAMPLING SITE:Elora, ON

SAMPLED BY:MG

Soil Analysis

RPT Date: Sep 10, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	6118471		<0.8	<0.8	NA	< 0.8	86%	70%	130%	94%	80%	120%	71%	70%	130%
Arsenic	6118471		2	2	NA	< 1	108%	70%	130%	101%	80%	120%	103%	70%	130%
Barium	6118471		71.4	75.6	5.7%	< 2.0	115%	70%	130%	107%	80%	120%	109%	70%	130%
Beryllium	6118471		<0.5	<0.5	NA	< 0.5	88%	70%	130%	99%	80%	120%	89%	70%	130%
Boron	6118471		<5	5	NA	< 5	70%	70%	130%	80%	80%	120%	65%	70%	130%
Boron (Hot Water Soluble)	6116095		<0.10	<0.10	NA	< 0.10	101%	60%	140%	103%	70%	130%	103%	60%	140%
Cadmium	6118471		<0.5	<0.5	NA	< 0.5	111%	70%	130%	99%	80%	120%	107%	70%	130%
Chromium	6118471		16	16	NA	< 5	99%	70%	130%	104%	80%	120%	113%	70%	130%
Cobalt	6118471		4.7	4.9	4.2%	< 0.8	94%	70%	130%	102%	80%	120%	101%	70%	130%
Copper	6118471		8.8	8.9	1.1%	< 1.0	91%	70%	130%	104%	80%	120%	101%	70%	130%
Lead	6118471		9	9	0.0%	< 1	103%	70%	130%	96%	80%	120%	93%	70%	130%
Molybdenum	6118471		<0.5	<0.5	NA	< 0.5	101%	70%	130%	100%	80%	120%	99%	70%	130%
Nickel	6118471		10	10	0.0%	< 1	106%	70%	130%	103%	80%	120%	102%	70%	130%
Selenium	6118471		<0.8	<0.8	NA	< 0.8	72%	70%	130%	98%	80%	120%	102%	70%	130%
Silver	6118471		<0.5	<0.5	NA	< 0.5	106%	70%	130%	103%	80%	120%	105%	70%	130%
Thallium	6118471		<0.5	<0.5	NA	< 0.5	98%	70%	130%	95%	80%	120%	93%	70%	130%
Uranium	6118471		<0.50	0.53	NA	< 0.50	101%	70%	130%	95%	80%	120%	92%	70%	130%
Vanadium	6118471		24.5	25.0	2.0%	< 2.0	101%	70%	130%	104%	80%	120%	113%	70%	130%
Zinc	6118471		39	38	2.6%	< 5	100%	70%	130%	101%	80%	120%	103%	70%	130%
Chromium, Hexavalent	6116813		<0.2	<0.2	NA	< 0.2	110%	70%	130%	98%	80%	120%	72%	70%	130%
Cyanide, WAD	6118273		<0.040	<0.040	NA	< 0.040	97%	70%	130%	100%	80%	120%	100%	70%	130%
Mercury	6118471		<0.10	<0.10	NA	< 0.10	100%	70%	130%	96%	80%	120%	99%	70%	130%
Electrical Conductivity (2:1)	6118445		1.05	1.04	1.0%	< 0.005	97%	80%	120%						
Sodium Adsorption Ratio (2:1) (Calc.)	6118462		0.281	0.271	3.6%	NA									
pH, 2:1 CaCl2 Extraction	6118273		6.86	6.81	0.7%	NA	101%	80%	120%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.

More than 90% of the elements met acceptance limits and overall data quality is acceptable for use. For a multi-element scan up to 10% of analytes may exceed the quoted limits by up to 10% absolute.

Certified By:



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Quality Assurance

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 24T192934

PROJECT: 240423

ATTENTION TO: Malcom Green

SAMPLING SITE:Elora, ON

SAMPLED BY:MG

Trace Organics Analysis

RPT Date: Sep 10, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	6110099		<0.02	<0.02	NA	< 0.02	84%	60%	140%	78%	60%	140%	93%	60%	140%
Toluene	6110099		<0.05	<0.05	NA	< 0.05	74%	60%	140%	80%	60%	140%	81%	60%	140%
Ethylbenzene	6110099		<0.05	<0.05	NA	< 0.05	76%	60%	140%	83%	60%	140%	73%	60%	140%
m & p-Xylene	6110099		<0.05	<0.05	NA	< 0.05	89%	60%	140%	75%	60%	140%	73%	60%	140%
o-Xylene	6110099		<0.05	<0.05	NA	< 0.05	67%	60%	140%	84%	60%	140%	72%	60%	140%
F1 (C6 to C10)	6110099		<5	<5	NA	< 5	100%	60%	140%	94%	60%	140%	89%	60%	140%
F2 (C10 to C16)	6110613		< 10	< 10	NA	< 10	113%	60%	140%	103%	60%	140%	103%	60%	140%
F3 (C16 to C34)	6110613		< 50	< 50	NA	< 50	108%	60%	140%	115%	60%	140%	121%	60%	140%
F4 (C34 to C50)	6110613		< 50	< 50	NA	< 50	65%	60%	140%	106%	60%	140%	95%	60%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: R. Chakraberty

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. RPDs calculated using raw data. The RPD may not be reflective of duplicate values shown, due to rounding of final results.

Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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FAX (905)712-5122
http://www.agatlabs.com

QC Exceedance

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 24T192934

PROJECT: 240423

ATTENTION TO: Malcom Green

RPT Date: Sep 10, 2024		REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Sample Id	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
			Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)										
Boron		70%	70%	130%	80%	80%	120%	65%	70%	130%

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.

More than 90% of the elements met acceptance limits and overall data quality is acceptable for use. For a multi-element scan up to 10% of analytes may exceed the quoted limits by up to 10% absolute.

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Method Summary

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 24T192934

PROJECT: 240423

ATTENTION TO: Malcom Green

SAMPLING SITE:Elora, ON

SAMPLED BY:MG

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Arsenic	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Barium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Beryllium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	modified from EPA 6010D and MSA PART 3, CH 21	ICP/OES
Cadmium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Cobalt	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Copper	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Lead	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Molybdenum	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Nickel	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Selenium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Silver	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Thallium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Uranium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Vanadium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Zinc	MET 93 -6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium, Hexavalent	INOR-93-6068	modified from EPA 3060 and EPA 7196	SPECTROPHOTOMETER
Cyanide, WAD	INOR-93-6052	modified from ON MOECC E3015, SM 4500-CN- I, G-387	SEGMENTED FLOW ANALYSIS
Mercury	MET-93-6103	modified from EPA 7471B and SM 3112 B	ICP-MS
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Sodium Adsorption Ratio (2:1) (Calc.)	INOR-93-6007	modified from EPA 6010D & Analytical Protocol	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6075	modified from EPA 9045D, MCKEAGUE 3.11 E3137	PC TITRATE

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Method Summary

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 24T192934

PROJECT: 240423

ATTENTION TO: Malcom Green

SAMPLING SITE:Elora, ON

SAMPLED BY:MG

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Benzene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Toluene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Ethylbenzene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
m & p-Xylene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
o-Xylene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Xylenes (Total)	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
F1 (C6 to C10)	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	modified from CCME Tier 1 Method	P&T GC/FID
Toluene-d8	VOL-91-5009	modified from EPA SW-846 5030C & 8260D	(P&T)GC/MS
F2 (C10 to C16)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F3 (C16 to C34)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F4 (C34 to C50)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	modified from CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	modified from CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID

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AT Laboratories

Have feedback? Scan here for a quick survey!

5835 Coopers Avenue
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webearth.agatlabs.com

Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #: 24T192934

Cooler Quantity: 1 Large

Arrival Temperatures: 8-9 | 9.2 | 9.8

Depot Temperatures: | |

Custody Seal Intact: ☐ Yes ☐ No ☑ N/A

Notes: Toosea

ormation: Soil-Mat

Malcolm Green

401 Grays Rd. Ham.

705-702-5707 Fax:

; sent to:

Email: mgreen@soilmat.ca

2. Email: kreid@soilmat.ca

Regulatory Requirements:
(Please check all applicable boxes)

☐ Regulation 153/04
Table ___ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☑ Regulation 406
Table 1 *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

☐ Regulation 558
☐ CCME

☐ Sewer Use
☐ Sanitary ☐ Storm
Region
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
Indicate One

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CSR

Project Information:

Project: 240423

Site Location: Elora, On

Sampled By: MG

AGAT Quote #: PO:

Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a **Record of Site Condition (RSC)?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Legal Sample ☐

Invoice Information: Bill To Same: Yes ☑ No ☐

Company:

Contact:

Address:

Email:

Sample Matrix Legend

GW	Ground Water	**SD**	Sediment
O	Oil	**SW**	Surface Water
P	Paint	**R**	Rock/Shale
S	Soil		

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC Y/N	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	O. Reg 153: VOC	O. Reg 153: PAHs	O. Reg 153: PCBs: Aroclors ☐	O. Reg 406: Regulation 406 Characterization Package	O. Reg 406: pH, Metals, BTEX, F1-F4	O. Reg 406: EC, SAR	O. Reg 406: Regulation 406 SPLP Rainwater Leach mSPLP: ☐ Metals ☐ VOCs ☐ SVOCs ☐ OC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs TCLP:	Corrosivity: ☐ Moisture ☐ Sulphide	Potentially Hazardous or High Concentration (Y/N)
1. BH1 SS3	Sept 3	AM PM	3	S			✓		✓										
2. BH2 SS4	1	AM PM	3	S			✓		✓										
3. BH3 SS3	0	AM PM	3	S			✓		✓										
4.		AM PM																	
5.		AM PM																	
6.		AM PM																	
7.		AM PM																	
8.		AM PM																	
9.		AM PM																	
10.		AM PM																	
11.		AM PM																	

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
			[signature]	Sept 9/24	4:15 PM
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page 1 of 1

Nº: T - 161958

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

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