Towerhill Developments Inc.

Environmental Impact Study

Millbrook, Ontario

16-4800
September 2020

DILLON CONSULTING

75 YEARS

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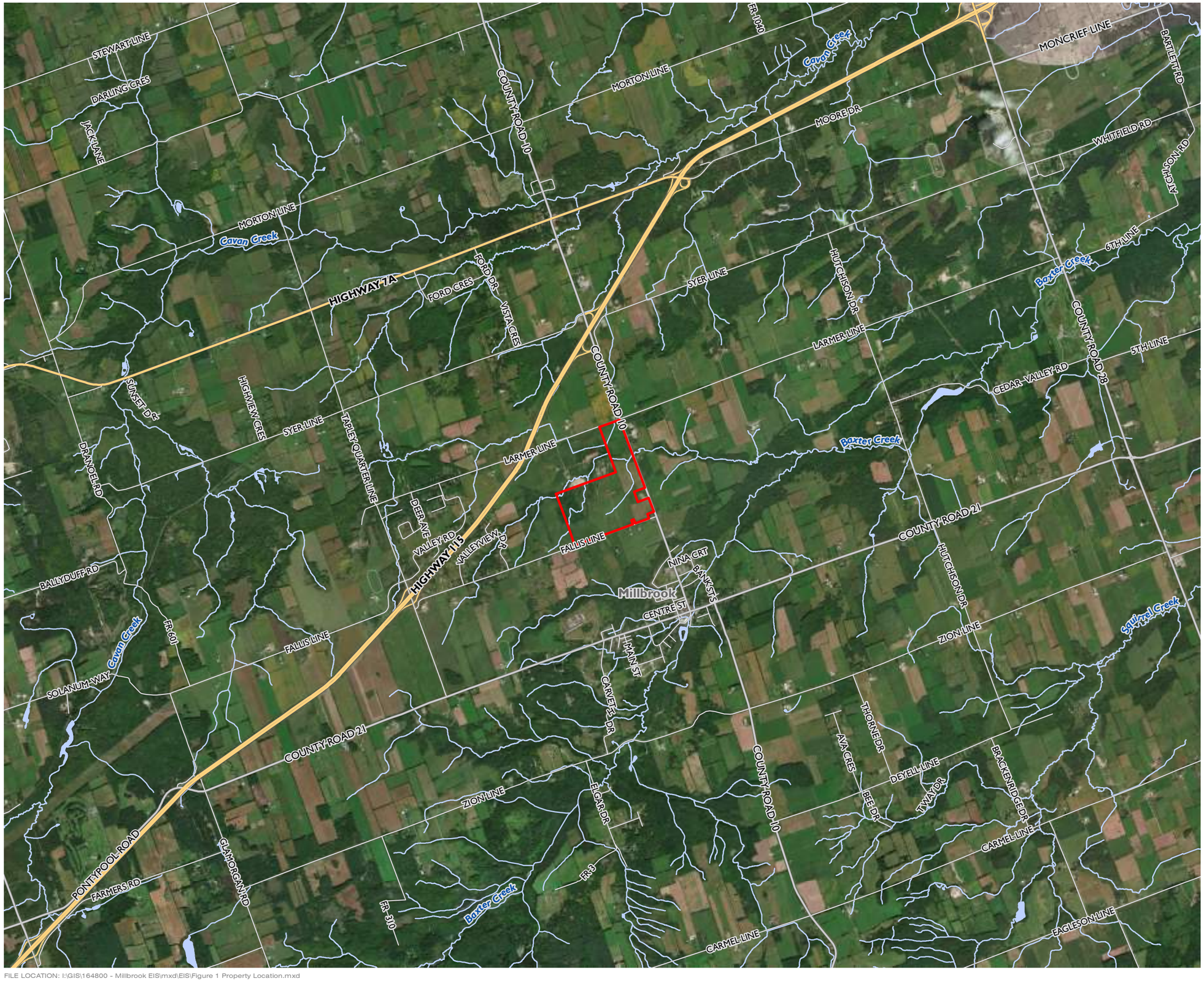
1.0 Introduction

Dillon Consulting Limited (Dillon) was retained by Tower Hill Developments Inc. (Tower Hill) to complete an Environmental Impact Study (EIS) in support of an application for Draft Plan of Subdivision for a property legally described as Part Lots 11 & 12, Concession 6, Township of Cavan-Monaghan, Peterborough County (the "Study Area") (Figure 1). The Study Area is located at 862 Fallis 6th Line, near the Village of Millbrook, fronting on Fallis Line to the south, County Road 10 to the east, and Larmer Line to the north.

The purpose of the EIS is to document existing conditions of the natural environment; determine the potential limits of development; evaluate the potential for environmental impacts associated with the proposed development; and recommend mitigation, restoration, enhancement measures, and/or compensation measures, where necessary, to avoid impacts to the natural environment. The EIS has been prepared in general accordance with the Otonabee Region Conservation Authority (ORCA) EIS Terms of Reference & Submission Standards (December 2015), following the Terms of Reference (TOR) established in consultation with the ORCA and agreed to through correspondence between Dillon and ORCA on September 29, 2017 (see Appendix A).



MILLBROOK
EIS

FIGURE 1
PROPERTY LOCATION

Study Area

1:50,000

0 250 500 1,000 m

N
W E
S

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

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PROJECT: 164800
STATUS: DRAFT
DATE: 2018-05-07

FILE LOCATION: I:\GIS\164800 - Millbrook EIS\mxd\EIS\Figure 1 Property Location.mxd

2.0 Planning Context

The following section has been prepared to identify the applicable land use planning policies related to the natural environment. Various regulatory agencies and legislative authorities have established a number of policies with the purpose of protecting ecological features and functions as outlined below. Table 1 lists the relevant policies and legislation applicable to the protection of natural heritage features within the Township of Cavan-Monaghan, and more specifically, the Study Area; as well as supporting guidance documents and resources consulted respective to each policy. This table also includes additional background information sources used to help identify and define natural heritage features within the province of Ontario, and Eco-region 6E specifically. This section is not intended to constitute a complete land use planning assessment as it focuses on the relevant environmental policies and regulations. The documents referenced below can be read in their entirety for a more detailed understanding of the land use policy framework applicable to the Study Area.

Table 1: Policies, Legislation and Background Resources Searched

POLICY	GUIDELINES AND SUPPORTING DOCUMENTS
PROVINCE OF ONTARIO	
Planning Act, 1990: Provincial Policy Statement (2014)	Policies within Section 2.1 related to natural heritage features
	Ministry of Natural Resources and Forestry (MNRF) Peterborough District Main Contact: Cara Hernould, A/District Planner • Records for sensitive species, significant wildlife habitat, and wetlands provided.
	MNRF Natural Heritage Information Centre (NHIC) Square #17QJ0491, 17QJ0492 • Species of Conservation Concern • Species at Risk • Natural heritage features
	Ecological Land Classification for Southern Ontario, Second Approximation, 2008
	Natural Heritage Reference Manual, Second Edition, March 2010
	Ontario Wetland Evaluation System, Southern Manual, Third Edition, 2013
	MNRF Significant Wildlife Habitat Technical Guide (2000) • Significant Wildlife Habitat Eco-region 6E Criterion Schedules, 2015
	Fisheries and Oceans Canada (DFO) • Ontario South West Map 6 of 34 (September 2016)
	Federal Species at Risk Public Registry, accessed June 2017
	Ontario Breeding Birds Atlas (OBBA) Square #17QJ09
	Ontario Reptile and Amphibian Atlas- online data accessed June 2017
	Ontario Butterfly Atlas- online data accessed June 2017
	Atlas of the Mammals of Ontario, 1994
Places to Grow Act, 2005:	Section 1.2.3, 4.2.4 and Schedule 1

POLICY	GUIDELINES AND SUPPORTING DOCUMENTS
Places to Grow: Growth Plan for the Greater Horseshoe (2017)	
Endangered Species Act (2007)	MNRF Species at Risk in Ontario (SARO) List (O.Reg. 230/08), June 2017
	MNRF Peterborough District Main Contact: Cara Hernould, A/District Planner • Records for SAR within the vicinity of the Study Area received
	MNRF NHIC Square #17QJ4091, 17QJ4092 • Species at Risk occurrence records
	OBBA Square #17QJ09
	Ontario Reptile and Amphibian Atlas- online data accessed June 2017
TOWNSHIP OF CAVAN-MONAGHAN	
Township of Cavan Monaghan Official Plan(2013)	Schedules A-1, B, B-1
COUNTY OF PETERBOROUGH	
Peterborough County Official Plan (2017)	Map A
CONSERVATION AUTHORITY	
Conservation Authorities Act, 1990: Ontario Regulation 167/06	Otonabee Region Conservation Authority • Floodplain mapping

Relevant or applicable policies within each document that relate to the natural environment and apply to the Study Area are outlined in subsequent sections.

2.1 Provincial Policy Statement, 2014

The Provincial Policy Statement, 2014 (PPS) provides overall policy direction on matters of provincial interest related to land use planning and development in Ontario. The PPS sets forth a vision for Ontario's land use planning system by managing and directing land use to achieve efficient development and land use patterns, wise use and management of resources, and protecting public health and safety.

This report deals specifically with Policy 2.1, Natural Heritage, and Policy 2.2, Water, which provides for the protection and management of natural heritage and water resources, which include the following:

- significant wetlands;
- significant coastal wetlands;
- significant woodlands;
- significant valleylands;
- significant wildlife habitat;

- significant areas of natural and scientific interest (ANSIs);
- fish habitat;
- sensitive surface water features; and,
- sensitive ground water features.

The PPS defines "significant" to mean:

- in regard to wetlands, coastal wetlands and areas of natural and scientific interest, an area identified as provincially significant by the Ontario Ministry of Natural Resources using evaluation procedures established by the Province, as amended from time to time;
- in regard to woodlands, an area which is ecologically important in terms of features such as species composition, age of trees and stand history; functionally important due to its contribution to the broader landscape because of its location, size or due to the amount of forest cover in the planning area; or economically important due to site quality, species composition, or past management history. These are to be identified using criteria established by the Ontario Ministry of Natural Resources; and,
- in regard to other features and areas in policy in 2.1, ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system".

The PPS defines "sensitive" to mean:

- in regard to surface water features and ground water features, means areas that are particularly susceptible to impacts from activities or events, including, but not limited to, water withdrawals, and additions of pollutants.

Potential significance of natural heritage features may be evaluated based on size, age, presence of rare or sensitive species, species diversity, and linkage functions, taking into consideration factors such as adjacent land use and degree of disturbance. Criteria for determining significance follow guidance outlined in the Natural Heritage Reference Manual (MNRF, 2010) and the Significant Wildlife Habitat Technical Guide Eco-Region 6E Criterion Schedules (MNRF, 2015), where applicable.

Significance of natural features identified within the Study Area is further discussed in **Section 5.0** of this report.

2.2 Growth Plan for the Greater Golden Horseshoe, 2017

Pursuant to the Places to Grow Act, 2005, the Growth Plan for the Greater Golden Horseshoe, 2017 (Growth Plan) was approved on June 16, 2006. The Growth Plan has been amended three times since its release in 2006. The first amendment was released in January 2012 and contains policies, schedules and definitions that apply in the Simcoe Sub-area. The second amendment was released in June 2013 to

update and extend the Growth Plan's population and employment forecasts. The third amendment was released on May 18, 2017, and came into effect on July 1, 2017.

The Growth Plan requires the identification of water resource systems and the protection of key hydrologic features and key hydrologic areas, similar to the level of protection provided in the Greenbelt (MMAH, 2006). This provides a consistent framework for water protection across the Greater Golden Horseshoe (GGH), and builds on existing plans and policies. The Growth Plan also provides for the identification and protection of natural heritage systems in the GGH outside of the Greenbelt Area and settlement areas in order to provide consistent and long-term protection for natural heritage systems across the GGH (MMAH, 2006).

Section 1.2.3 of the Growth Plan resolves potential conflicts between the Growth Plan and other provincial plans (e.g. PPS): "The policies of this Plan take precedence over the policies of the PPS to the extent of any conflict, except where the relevant legislation provides otherwise. Where the policies of this Plan address the same, similar, related, or overlapping matters as policies in the PPS, applying the more specific policies of this Plan satisfies the requirements of the more general policies in the PPS".

The Growth Plan recognizes the Study Area as "Greater Golden Horseshoe Growth Plan Area", and no other specific designation with applicable policies. Therefore, with respect to the natural environment, the applicable policies of the PPS supersede those of the Growth Plan and will be assessed as such in this EIS.

2.3 Endangered Species Act, 2007

In June 2008, the Endangered Species Act, 2007 (ESA) came into effect in Ontario. The purpose of the ESA is to identify Species at Risk (SAR) based on the best available scientific information; to protect SAR and their habitats, to promote the recovery of SAR; and to promote stewardship activities to assist in the protection and recovery of SAR in Ontario. There are two applicable regulations under the ESA; Ontario Regulation 230/08 (the SARO List); and, Ontario Regulation 242/08 (General). These regulations serve to identify which species and habitat receive protection and provide direction on the current implementation of the ESA.

The potential for SAR and SAR habitat to be impacted as a result of the proposed development is discussed further in Section 3.2.7.

2.4 Peterborough County Official Plan

The County of Peterborough (the "County") Official Plan (OP) (consolidated to 2017) was prepared to direct and guide the actions of local municipalities and the County in policy planning and physical planning on a very broad basis (Peterborough County 2017). The County OP has two functions; it serves as the upper tier OP for the County, as well as the lower tier OP for four of the local municipalities. The OP implements a strategic approach to land use planning based on a watershed planning process. This

Plan sets out the general direction for planning and development in Peterborough County by prescribing strategic goals, objectives and policies; and establishes a vision in which planning and stewardship protect and enhance a diverse landscape, lifestyle and sense of community for the County. The County supports the intent of the Provincial Policy Statement, and is consistent with the 2014 Provincial Policy Statement in amending and updating the OP. Local municipal official plans complement the County OP by providing detailed strategies, policies and land use designations for the planning and development at a local municipal level.

The Study Area is located within a Settlement Area and Rural Area as indicated in Map A of the County OP (Appendix B). In accordance with Section 4.2 of the County OP, land use designations and detailed policies for existing and future growth settlement areas will continue to be the responsibility of local municipalities in their OPs.

2.5 Township of Cavan Monaghan

The Township of Cavan Monaghan (the "Township") OP (2015) has been prepared to implement the Oak Ridges Moraine Conservation Plan, the Growth Plan for the Greater Golden Horseshoe and the Provincial Policy Statement, 2005. In accordance with the provisions of the Planning Act, where conflict between this Plan and the Peterborough County Official Plan occurs, the provisions of the County Plan shall prevail except where the local plan is more restrictive.

The Settlement Areas in the Township include Millbrook; in which the majority of the Study Area falls. Millbrook will develop on the basis of full municipal services, including municipal sewage treatment and water supply services. For this reason, it is referred to as an Urban Settlement Area as shown on Schedule A and A-1 (Appendix B). Portions of the Study Area within the Millbrook Urban Settlement Area are designated as Residential, Institutional, and Urban Employment Areas. Outside of the Settlement Area boundary, lands within either "Countryside Areas" are designated as Agricultural (Schedule A, Appendix B) with Significant Woodland within the northwest portions of the Study Area (Schedule B, Appendix B).

The Township's Natural Heritage System includes significant wildlife habitat, significant wetlands, significant woodlands, significant valleylands, areas of natural and scientific interest, buffer areas around these features and lands that link those areas. As depicted in Schedule A and A-1, portions of the Study Area fall within the Natural Heritage System, and are designated as Natural Linkage Areas, and Natural Core Areas (outside of Settlement boundary only) (Appendix B).

The overall objectives of the Natural Heritage System policies include maintaining, improving and where possible, restoring the health, diversity, size and connectivity of natural heritage features, hydrologically sensitive features and related ecological functions. Therefore, with respect to the natural environment, the applicable policies of the PPS and the Township OP supersede those of the County OP and will be assessed accordingly in this EIS.

2.6 Otonabee Region Conservation Authority (Ontario Regulation 167/06)

In accordance with Section 28 of the Conservation Authorities Act, 1990, ORCA is authorized to implement and enforce the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation (Ontario Regulation 167/06). Section 2(1) of this Regulation lists areas within ORCA's jurisdiction where development is prohibited without proper permissions from the ORCA. Such areas include, but are not limited to, river or stream valleys, hazardous lands, and wetlands.
In participating in the review of applications under the Planning Act and Environmental Assessment Act(s), ORCA ensures that applicants and approval authorities are aware of any Section 28 Regulation requirements under the Conservation Authorities Act, where applicable. Further, ORCA assists in the coordination of these applications to avoid ambiguity, conflict and unnecessary delay or duplication in the process.

The Study Area is located within ORCA's Regulated Area in association with the identified watercourses.

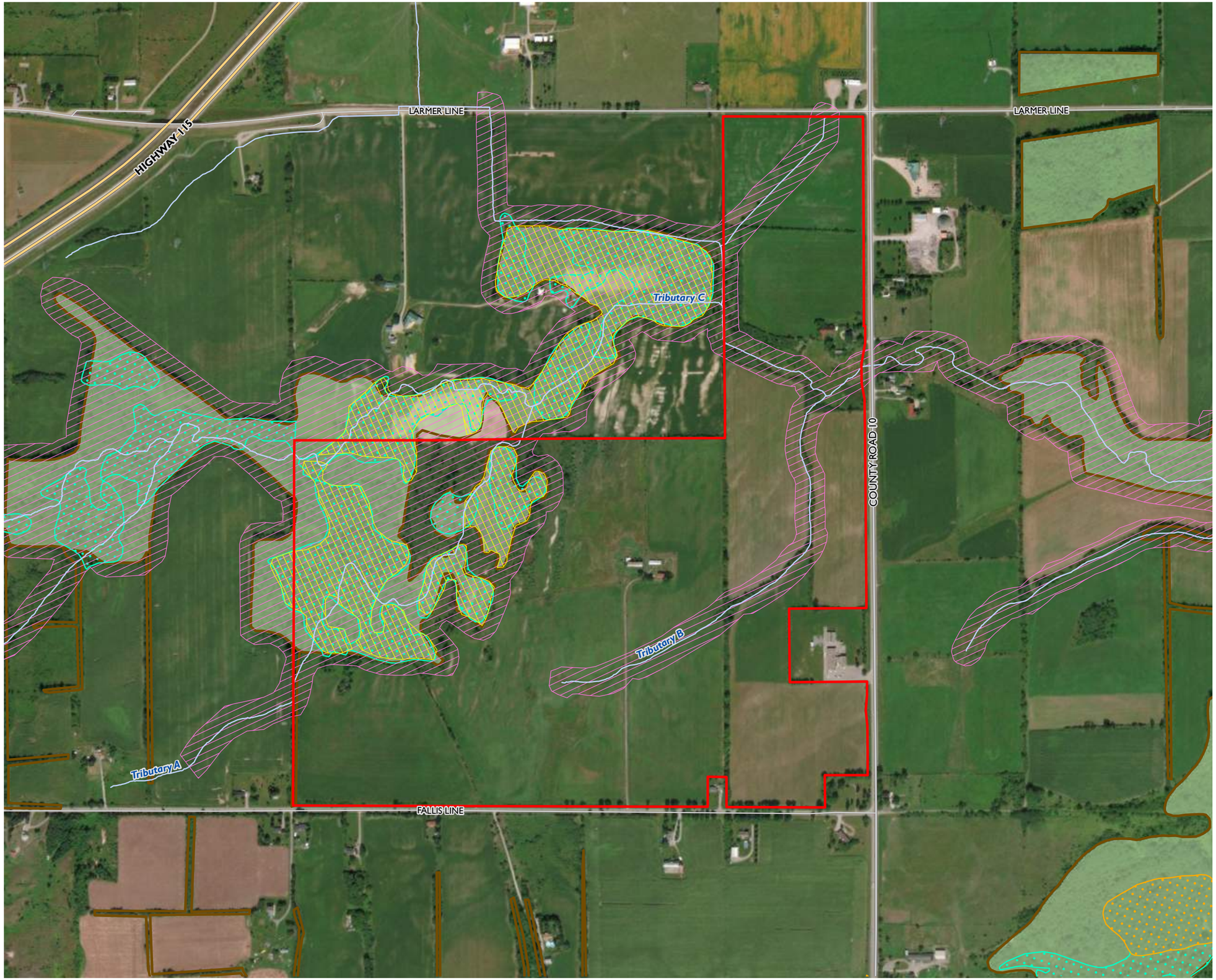

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FIGURE 2
PROVINCIAL AND AGENCY
LAND USE DESIGNATIONS

- Study Area
- Natural Core Area
- Natural Linkage Area
- Locally Significant Wetland
- Unevaluated Wetland
- Significant Woodland
- Water Body (MNRF)
- Woodlands (MNRF)

1:7,500

0 100 200 400 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF, TOWNSHIP OF CAVAN MONAGHAN

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 164800
STATUS: DRAFT
DATE: 10/3/2018

FILE LOCATION: G:\GIS\164800 - Millbrook EIS\mxd\EIS\Figure 2 Provincial and Agency Land Use Designations.mxd

3.0 Results of Background Review

A desktop review of the Study Area indicates that the Study Area is currently comprised of active agricultural fields with areas of woodland and unevaluated wetland within the north and west portions, and several mapped watercourses within the Study Area boundary. The Study Area is bounded by Fallis Line to the south, County Road 10 to the east, Larmer Line to the north, and agricultural lands and woodland and wetland areas to the north and west.

A review of available historic aerial photos dating back to 1954 indicates that the Study Area has not experienced significant change over that time (Appendix C). The area north of the Village of Millbrook is largely agricultural in nature and has remained relatively the same for the past several decades.

Through consultation with ORCA, areas within the Study Area were identified as part of the 'Kawarthas Naturally Connected' (KNC) Natural Heritage System (NHS) (Natural Core and Natural Linkage Areas in Figure 2). The KNC landscape-scale NHS for Peterborough County and the City of Kawartha Lakes was developed by a collaborative, multi-partner technical team and is intended as technical information to support municipalities' land use planning efforts to address their responsibilities under the PPS and Planning Act (ORCA, 2017). Areas within the western section of the Study Area were therefore identified as regionally important for their woodland and wetland features. In addition, the cold water streams identified by ORCA within the Study Area, functionally link wetland and woodland areas both within the Study Area and adjacent areas.

3.1 Aquatic Environment

3.1.1 Watershed Summary

The Study Area is located within the Otonabee Region Watershed which covers an area of 1,951 km^2 and includes 12 subwatersheds. More specifically, the Study Area is located within the Baxter Creek subwatershed, which covers an area of 92 km^2 within the southwest portion of the larger Otonabee River watershed. The Otonabee Region Watershed Report Card (ORCA, 2013) has described the Baxter Creek subwatershed as a cold water fish community with 'good' conditions (grade of B) based on results of benthic invertebrate sampling and nutrient parameters. The Baxter Creek subwatershed also received a B in forest cover while the most common grade throughout the Otonabee River watershed was given a grade of D (poor). Stressors within the watershed include removal of riparian vegetation, nutrient loading, use of water for irrigation purposes, and tile drainage within agricultural lands (ORCA, 2013).

3.1.2 Fish Habitat

Fish habitat, as defined in the Fisheries Act, means spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life process. In accordance with the guidance provided in the MNRF Natural Heritage Reference Manual (2010), all

water features (except human-made off-stream ponds) are considered fish habitat by ORCA, unless it can be demonstrated that the feature does not constitute fish habitat pursuant to the Fisheries Act.

Based on the presence of several mapped watercourses within the Study Area, there is potential for fish habitat to be present. Water features generally support three major types of aquatic communities: coldwater, coolwater and warmwater communities. The community types reflect the thermal conditions of the waterbody and are often defined by either temperature or the composition of fish and invertebrate species present.

Through communications with ORCA, the Study Area was identified as part of Management Zone B of the Peterborough Area Cold Water Streams Strategy (CWSS), and ORCA has indicated that watercourses within the property are considered to be cold water fish habitat. Coldwater and coolwater streams are particularly sensitive to land use impacts, which is due to the relatively narrow habitat requirements of resident fishes (e.g., requiring clean cold water, high levels of dissolved oxygen, etc.). Fish species identified within the system include Brook Stickleback (Culaea inconstans), Brassy Minnow (Hybognathus hakinsoni), Pearl Dace (Margariscus margarita), Common Shiner (Luxilus cornutus), Bluntnose Minnow (Pimephales notatus), Eastern Blacknose Dace (Rhinichthys atratulus), White Sucker (Catostomus commersonii), and Northern Redbelly Dace (Chrosomus eos).

The potential for fish habitat within the Study Area is discussed further in **Section 5.1**.

3.2 Terrestrial Environment

3.2.1 Landforms, Soils, and Geology

The Study Area lies over Paleozoic Middle Ordovician bedrock consisting of limestone, dolostone, shale, arkose, sandstone (Ministry of Northern Development and Mines 1991). The Study Area is situated in the physiographic region known as the Peterborough Drumlin field (Chapman and Putnam, 1984). To the south along the border of the Oak Ridges Moraine, the till in somewhat more sandy with site and fine sand. Locally, the site is identified to be within an area known as “sand plains” (Department of Mines and Northern Affairs, 1972) with drumlinized till pains to the south and north.

The Ontario Geological Survey indicates the Quaternary geology to be of glaciofluvial ice deposits in the southern area and glaciofluvial outwash deposits in the northern area with till materials to the north and west. The available MOECC well records indicated that soils were generally clay with sand and gravel layers and limestone at depth. More specifically, soils consists of Otonabee Loam (brown loam and light brown loam over brownish clayey loam underlain by grey stony loam; high in lime and moderately stony); Schomberg Clay Loam (grey-brown clay loam and greyish loam over brownish clay underlying material mainly stonefree clay with some stony clay loam,; high in lime); Bottomland (land lying along stream courses and subject to flooding); Lyons Loam (dark greyish brown loam over highly mottles

greyish stony loam with numerous boulders and stones). Bedrock was encountered at depths ranging from 30 m to 94 m.

According to Valdor Water Resources (Valdor), 2020, the topography in within Study Area exhibits rolling to hilly topography; generally sloping down in a north-easterly direction from Fallis Line (252 m) towards Baxter Creek to the north (241 m). The 11 m differential equates to an overall average slope of 1.5%, which is considered to be relatively moderate (Valdor, 2020). Surface water runoff would flow according to the local topography and eventually to Baxter Creek. Water levels obtained March 24, 2014 from temporary piezometers installed in three of the test holes in the Study Area yielded water levels ranging from approximately 0.3 to 3.2 mbeg. These results are consistent with the published mapping with respect to glaciofluvial deposits across within areas north and south of Fallis Line; comprised of deposits of clay and sandy soils.

Refer to the Hydrogeological Assessment Report (Geo-Logic Inc. 2015) and Geotechnical Investigation Report (Geo-Logic Inc. 2015) for further details on soils and geology.

3.2.2 Wetlands

Wetlands within the vicinity of the Study Area are considered southern wetlands based on their location south of the northern limit of Ecoregions 5E, 6E, and 7E as shown on Figure 1 of the PPS, 2014. Unevaluated wetlands were identified through background mapping within and adjacent to the Study Area, as shown on Figure 2. In addition, two Evaluated- Other wetlands were identified within the vicinity of the Study Area; Tapley South, and Millbrook Northeast, the latter located just south of Fallis Line Road and County Road 10 approximately 350 m south of the Study Area boundary.

In addition, distinctive landscape features were identified within the unevaluated wetland area through both background review and consultation with ORCA, as visible in aerial imagery on Figure 2. These distinctive wetland formations have been noted in the Cavan Township Environmentally Sensitive Areas Study as “ice-block ridges” and associated wetland depressions; which, according to ORCA, form a unique type of habitat in Peterborough County. These areas are presumed to be in various stages of succession and may provide valuable habitat for waterfowl, wading birds and furbearers (ORCA, 2017). Based on this, ORCA requested that a wetland evaluation be completed on wetlands within the Study Area and considered as part of the larger unevaluated wetland area.

Wetlands are discussed further in **Section 5.2.3**.

3.2.3 Woodlands

Woodlands were identified through background review in association with the wetland areas to the within the north and west portions of the Study Area and continuing west of the property. These woodlands are identified as Significant Woodland in the Cavan Monaghan Official Plan (Schedule B, Figure 2). No other woodlands were identified within the Study Area.

Woodlands are discussed further in Section 5.2.4.

3.2.4 Valleylands

No significant valleylands were identified within or adjacent to the Study Area.

3.2.5 Areas of Natural and Scientific Interest

No significant ANSIs were identified within or adjacent to the Study Area.

3.2.6 Significant Wildlife Habitat

The Significant Wildlife Habitat Technical Guide (MNRF 2000) defines Species of Conservation Concern as globally, nationally, provincially, regionally, or locally rare (S-Rank of S2 or S3)and federally endangered and threatened species; but do not include SAR (listed as endangered or threatened under the ESA, 2007). Through background review, several Species of Conservation Concern listed in Table 2 have been identified with the potential to occur within or adjacent to the Study Area, and will help to determine the potential for Significant Wildlife Habitat (SWH).

Table 2: Species of Conservation Concern with potential to occur within the Study Area

SCIENTIFIC NAME	COMMON NAME	SARA[1]	ESA[2]	S-RANK[3]	INFO SOURCE[4]
BIRDS					
Ammodramus savannarum	Grasshopper Sparrow	---	SC	S4B	OBBA
Chordeiles minor	Common Nighthawk	THR	SC	S4B	OBBA
Contopus virens	Eastern Wood-pewee	---	SC	S4B	MNRF, OBBA
Hylocichla mustelina	Wood Thrush	---	SC	S4B	MNRF, OBBA
Melanerpes erythrocephalus	Red-headed Woodpecker	THR	SC	S4B	MNRF
Vermivora chrysoptera	Golden-winged Warbler	THR	SC	S4B	OBBA
HERPETOZOA					
Chelydra serpentina	Snapping Turtle	SC	SC	S3	MNRF, ON
Graptemys geographica	Northern Map Turtle	SC	SC	S3	ON
Thamnophis sauritus septentrionalis	Eastern Ribbonsnake	SC	SC	S3	ON
LEPIDOPTERA					
Danaus plexippus	Monarch	SC	SC	S2N, S4B	TEA

[1]Federal Species at Risk Act (THR= threatened; SC= Special Concern); [2]Provincial Endangered Species Act (SC= Special Concern); [3]S-Rank is an indicator of commonness in the Province of Ontario. A scale between 1 and 5, with 5 being very common and 1 being the least common. [4]Information sources include MNRF = Ministry of Natural Resources and Forestry; OBBA = Ontario Breeding Bird Atlas; ON = Ontario Nature: Ontario Reptile and Amphibian Atlas; TEA = Toronto Entomologists' Association; --- denotes no information or not applicable.

A review of the MNRF background data suggests that several SWH types may occur in association with woodland and wetland communities within the Study Area:

- Bat maternity colonies;
- Colonially-nesting bird breeding habitat (trees/shrub);
- Waterfowl nesting;
- Seeps and springs;
- Amphibian breeding habitats (woodlands);
- Amphibian breeding habitats (wetlands); and,
- Special concern and rare wildlife species.

The potential for SWH to be present within the Study Area is discussed further in Section 5.2.5.

3.2.7 Species at Risk

A number of SAR listed as endangered and threatened under the ESA have been identified with potential to occur within the vicinity of the Study Area (see Table 3).

Table 3: Species at Risk with potential to occur within the Study Area

SCIENTIFIC NAME	COMMON NAME	SARA[1]	ESA[2]	S-RANK[3]	INFO SOURCE[4]
VASCULAR PLANTS					
Juglans cinerea	Butternut	END	END	S3?	MNRF
BIRDS					
Caprimulgus vociferus	Eastern Whip-poor-will	THR	THR	S4B	OBBA
Chaetura pelagica	Chimney Swift	THR	THR	S4B, S4N	OBBA
Dolichonyx oryzivorus	Bobolink	---	THR	S4B	MNRF, OBBA
Hirundo rustica	Barn Swallow	---	THR	S4B	MNRF, OBBA
Riparia riparia	Bank Swallow	---	THR	S4B	OBBA
Sturnella magna	Eastern Meadowlark	---	THR	S4B	MNRF, OBBA
MAMMALS					
Myotis lucifugus	Little Brown Myotis	END	END	S4	OMA
Myotis septentrionalis	Northern Myotis	END	END	S3	OMA
Pipistrellus subflavus	Tri-coloured Bat	END	END	S3?	OMA
Myotis leibii	Eastern Small-footed Bat	---	END	S2S3	OMA

[1]Federal Species at Risk Act (END= Endangered, THR= Threatened); [2]Provincial Endangered Species Act (END= Endangered, THR= Threatened);[3]S-Rank is an indicator of commonness in the Province of Ontario. A scale between 1 and 5, with 5 being very common and 1 being the least common. [4]Information sources include MNRF = Ministry of Natural Resources and Forestry; OBBA = Ontario Breeding Bird Atlas; ON = Ontario Nature: Ontario Reptile and Amphibian Atlas; TEA = Toronto Entomologists' Association; --- denotes no information or not applicable.

3.2.7.1 Species at Risk Habitat

An information request was submitted to the MNRF Peterborough District Office in order to obtain SAR records to help narrow our focus on potential SAR and/or SAR habitat within the Study Area (Appendix

D). The MNRF identified the following endangered and threatened species within the vicinity of the Study Area;

- Butternut;
- Bobolink;
- Eastern Meadowlark; and,
- Barn Swallow.

In addition, based on MNRF and ORCA consultation, as well as a review of applicable background resources including NHIC, and Fisheries and Oceans Canada (DFO) Ontario South West Map 6 of 34, no rare fish species or aquatic SAR have been flagged within this area.

The potential for SAR and SAR habitat within the Study Area is discussed further in **Section 5.2.6**.

4.0 Field Work Methodology

The results of the background review were used to assist in scoping the 2017 field program. Fieldwork conducted for the EIS occurred between October 2016 and August 2020 when weather conditions and timing were deemed suitable based on the survey protocols being implemented (Table 4). Fieldwork consisted of Ecological Land Classification (ELC) of vegetation communities, a wetland evaluation, botanical surveys, breeding bird surveys, amphibian breeding surveys, and several aquatic surveys completed up to 2020. Any incidental wildlife observations made during the surveys were also documented. The following sub-sections outline the survey methodologies used in the EIS.

Table 4: Dates and Times of Field Surveys

DATE	TIME	WEATHER CONDITIONS	AIR TEMP (°C)	PURPOSE OF VISIT
October 15, 2016	1:00 pm	Partial cloud cover	17	Site recon., aquatic survey
April 21, 2017	11:26 pm	Cloudy, light breeze	6	Amphibian breeding survey #1
May 18, 2017	9:17 pm	Clear, slight breeze	17	Amphibian breeding survey #2
May 18, 2017	3:00 pm	Slight cloud cover, breezy	22	Spring vegetation survey
June 8, 2017	6:06 am	Clear	8	Breeding bird survey #1
June 20, 2017	5:42 pm	Sunny, slight cloud cover	26	Aquatic habitat assessment
June 21, 2017	4:40 am	Slight cloud cover, slight breeze	13	Breeding bird survey #2, ELC, OWES
June 29, 2017	9:41 pm	Slight cloud cover, no wind	22	Amphibian breeding survey #3
July 28, 2017	1:00 pm	Partial cloud cover, slight breeze	23	Summer vegetation survey
May 9, 2018	10:00 am	Sunny, 30% cloud cover	19	Headwater Drainage Features Assessment
June 12, 2020	---	30% could cover	13	Flow check, Rapid Macroinvertebrate Assessment
June 19, 2020	---	5% cloud cover	21	Flow check
June 23, 2020	---	Rain, 95% cloud cover	22	Flow check
July 6, 2020	---	Sunny, 0% could cover	30	Installation of temperature loggers
August 6, 2020	---	---	---	Retrieval of temperature loggers

--- denotes no information available

4.1 Aquatic Assessment

Tributaries within the Study Area have been labelled as Tributary A, B and C for ease of reference, as indicated on Figure 3. Tributary B is proposed to be realigned as part of this development. As a result several aquatic assessments and other studies have been completed by Dillon and other disciplines in support of the proposed realignment.

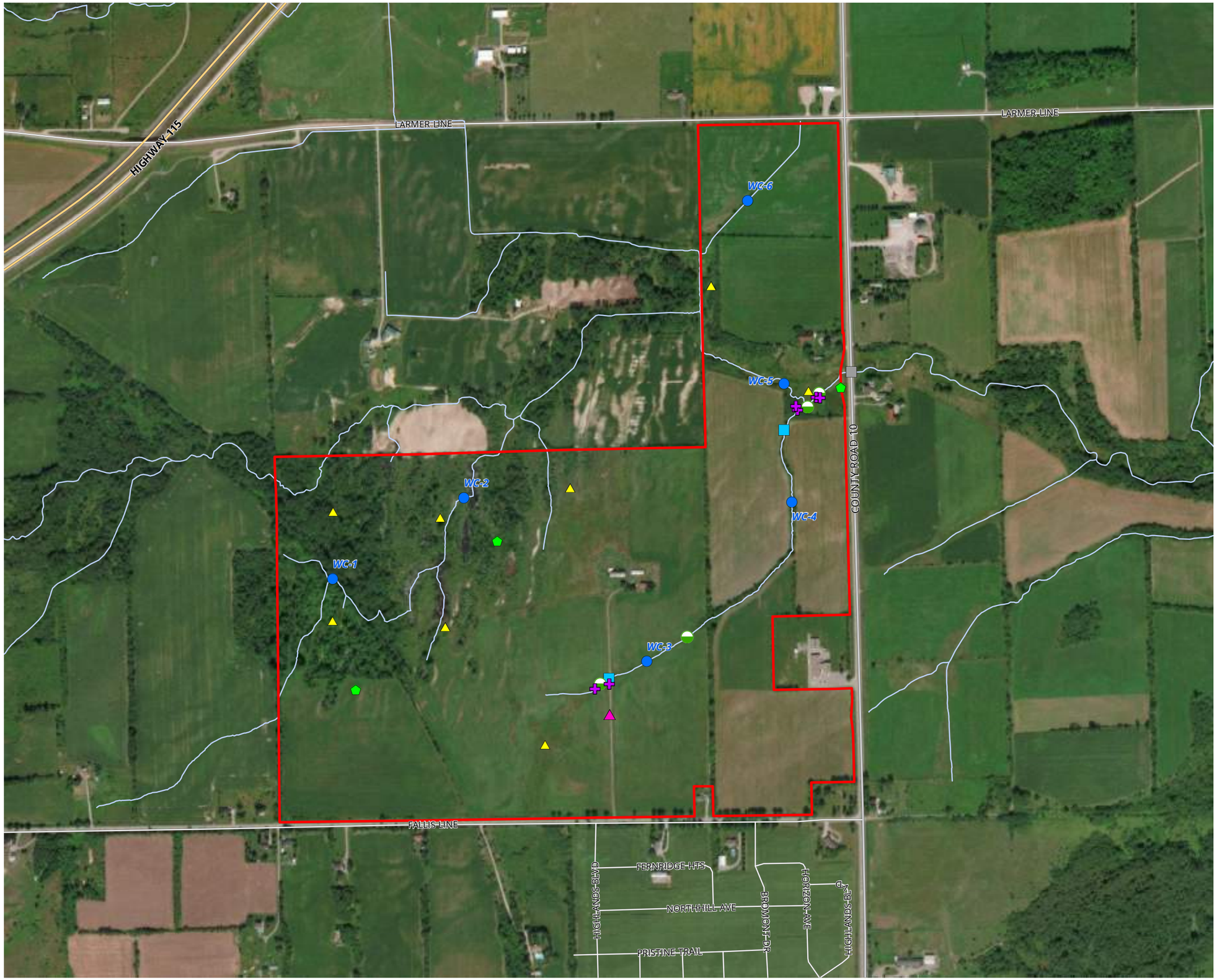

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FIGURE 3
2017 SURVEY LOCATIONS

- Study Area
- Sampling Location
- Temperature Logger
- Breeding Bird Survey Location
- Benthic Sampling Location
- Amphibian Breeding Habitat Survey Location
- Bridge
- Culvert
- Driveway
- Watercourse

1:7,500

0 50 100 200 300 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

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During the preliminary site visit conducted on October 15, 2016, two Dillon biologists walked Tributary B to determine hydroperiod, potential groundwater inputs, habitat, channel modifiers, etc. The second aquatic survey was completed by Dillon in June of 2017 to determine if flows were present during baseflow periods (summer). During the site visit a high level stream assessment was completed in order to collect information on flow, potential for fish, and water temperature. Sampling locations WC-3-WC-4 are shown on Figure 3. This information was used in combination with data provided by Waters Edge from May of 2017 to determine the potential for impacts as a result of the proposed development.

The results of these studies were compiled into a Fisheries Act Request for Review for submission to DFO and a Letter of Advice was subsequently received. Refer to Appendix E for a summary of the DFO submission package.

The additional field surveys completed in 2020 as requested through consultation with ORCA are detailed below.

4.1.1 Flow Spot Checks

In addition to the benthic sampling visit, two additional site visits were conducted in the month of June 2020, one 48 hours after a large rain event, and one during a rain event, to determine if there would be flow present within Tributary B.

The results are discussed in **Section 5.1.2**.

4.1.2 Benthic Macroinvertebrate Survey

During the benthic assessment, the rapid macroinvertebrate collection method was used following S2.M1 of the OSAP Manual (2017) in order to determine if large-bodied macroinvertebrates are present that are known to be sensitive to water quality, and used as a coarse indicator of water quality conditions. In accordance with the protocol, sampling procedures require holding a dip net to the substrate and kicking up the substrate in a 1 m^2 area upstream to dislodge invertebrates and collecting them in the net. While this protocol followed to the extent possible, due to the lack of water (and flow) present within Tributary B, the Dillon biologist kicked three areas that contained standing water within the upstream portion of the tributary only, in an effort to collect as much data as possible given the conditions at the time of sampling (Figure 3).

The results are discussed in **Section 5.1.2.2**.

4.1.3 Temperature Loggers

Temperature loggers were installed both within Tributary B and C, and adjacent to each location (to collect air measurements), and remained in place for a full month to record a range of water temperatures throughout the hottest, driest period of the summer in accordance with OSAP S5.M2 See Figure 3 for sampling locations).

The results are discussed in **Section 5.1.2**.

4.2 Terrestrial Assessments

4.2.1 Ecological Land Classification

Vegetation communities were assessed using ELC in order to identify and assess potential natural heritage features within the Study Area. During the field investigations, vegetation was characterized using the ELC System for Southern Ontario (Lee et al., 1998; and Second Approximation, 2008) in order to classify and map ecological communities to the vegetation level. The ecological community boundaries were determined through the review of aerial photography and then further refined through on site vegetation and tree surveys. In addition to the vegetation survey, a basic soil assessment was conducted to identify the soil moisture class within the ecosystem.

The ELC protocol recommends that a vegetation community be a minimum of 0.5 ha in size before it is defined. Based on the composition of vegetation communities within the Study Area, patches of vegetation less than 0.5 ha or disturbed/planted vegetation were described, provided they clearly fit within an ELC vegetation type.

Results of the ELC survey are included in **Section 5.2.1**.

4.2.2 Vegetation Inventory

Spring and summer botanical surveys were conducted in 2017 in addition to the ELC and OWES survey in which vegetation species were also documented. During these surveys, vegetation was inventoried to determine the presence, richness and abundance of floral species within the Study Area. Species nomenclature is based on the Ontario Plant List (Newmaster et al,. 1998).

Results of the botanical surveys are discussed in **Section 5.2.2**.

4.2.3 Wetlands

Due to the presence of two evaluated wetland complexes located within the vicinity of the Study Area, wetlands within the Study Area were evaluated following the Ontario Wetland Evaluation System – Southern Manual, 3rd Edition, Version 3.3 (MNRF, 2014) (OWES) by an MNRF certified wetland evaluator. In accordance with the OWES, wetlands are assessed based on their perceived values in maintaining natural processes (ecosystem values). They are also assessed on the benefits provided to society (human utility values).

The wetland evaluation was conducted to confirm and/or revise the wetland boundaries based on field studies carried out over three seasons (spring/summer/fall) in 2017. Data collected by Dillon staff throughout the 2017 field season was then applied to the OWES and used to calculate the evaluation score to determine if unevaluated wetland units meet the criteria for provincial significance.

The results of the wetland evaluation are discussed in Section 5.2.3.

4.2.4 Significant Wildlife Habitat

The potential for several SWH types was identified though background review in association with woodland and wetland areas to the north and west. As a result, both breeding bird and amphibian breeding surveys were conducted in 2017 to establish baseline conditions within the Study Area and confirm whether SWH is present for birds and amphibians. In addition, specific indicators of wildlife use and incidental wildlife observations were recorded during other field surveys to infer the potential for other SWH types. Vegetation surveys were also conducted, as described above, to determine whether Special Concern or rare vegetation species or communities exist within the Study Area.

Specific surveys for other species (including bats) were not conducted as tree removal will be limited to small trees and shrubs along the watercourse and central hedgerow. Areas identified with the potential to contain bat maternity colonies (woodland ecosites) will be protected from development activities.

Results of field surveys have been included in **Section 5.2.5**.

4.2.4.1 Breeding Bird Survey

Breeding bird surveys conducted within the Study Area followed the methods outlined in the Ontario Breeding Bird Atlas Guide for Participants (Cadman et al 2007), and were completed in early and late June of 2017 (two surveys) in an effort to capture both early and late season breeding birds. Specifically, surveys consisted of point counts generally conducted between dawn and five hours after sunrise that were used to establish quantitative estimates of bird abundance in suitable habitat types within the Study Area. During the surveys evidence of breeding behaviour was recorded which generally includes, but is not limited to, males singing, nest building, egg incubation, territorial defence, carrying food, and feeding their young.

To supplement the surveys, area searches of the habitat were completed using binoculars to observe species presence and breeding activity. Area searches involved noting all individual bird species and their corresponding breeding evidence within the Study Area. A total of eight point counts locations were established within the Study Area as shown on Figure 3.

Results of breeding bird studies within the Study Area are included in **Section 5.2.5.1**.

4.2.4.2 Amphibian Breeding Survey

Amphibian monitoring followed the Marsh Monitoring Program protocol (Bird Studies Canada, 2009). In accordance with the protocol, three different surveys were conducted between April 1 and June 30, with at least two weeks between each survey. Surveys began at least one half hour after sunset during evenings with a minimum night temperature of 5°C, 10°C, and 17°C for each of the three respective surveys.

The calling activity of individuals estimated to be within 100 m of the observation point were documented. All individuals beyond 100 m were recorded as outside the count circle and calling activity was not recorded. Calling activity was then ranked using one of the three abundance code categories:

Code 1: Calls not simultaneous, number of individual can be accurately counted;
Code 2: Some calls simultaneous, number of individuals can be reliably estimated;
Code 3: Calls continuous and overlapping, number of individuals cannot be estimated.

In areas were appropriate habitat exists vernal pools were also visually examined for egg masses and amphibian larvae in conjunction with other field surveys. These searches occurred between April and June when amphibians were concentrated around suitable breeding habitat. A total of three amphibian monitoring stations were surveyed within the Study Area, as shown on Figure 3.

Results of amphibian breeding studies within the Study Area are included in **Section 5.2.5.2**.

4.2.4.3 Incidental Wildlife

A general wildlife assessment was completed within the Study Area through incidental observations while on site. Any incidental observations of wildlife were noted, as well as other wildlife evidence such as dens, tracks, and scat. For each observation, notes, and when possible, photos were taken. These observations helped to determine potential ecological functions, linkages, etc. within the Study Area. Results relating to incidental wildlife within the Study Area have been included in **Section 5.2.5.3**.

5.0 Results of Detailed Field Work

A biophysical inventory of natural features within the Study Area was completed in accordance with the methods detailed in **Section 4.0**. The analysis of data collected from secondary source information and during field studies in 2017, was used to evaluate the significance of natural heritage features within the Study Area.

5.1 Aquatic Environment

5.1.1 Tributary A

Tributary A originates north of Fallis Line to the west of the Study Area within open agricultural fields. It enters the Study Area into the woodland/ wetland complex and continues north where it enters Tributary C north of the Study Area. During the site visit water temperature observed at sampling point WC-1 was 17°C and 25°C at point WC-2. No flow was observed within Tributary A during the site visit, however Cyprinid fish species were observed at point WC-2 (flooded area). In addition, it was noted that 8-10 Wood Ducks were observed in this area. Moss and algae were observed at sampling point WC-1.

5.1.2 Tributary B and C

Tributary B originates within a meadow marsh area within a low spot in the agricultural field that contains dense forbs and grasses and no defined channel was identified. This area was confirmed through ELC in the summer as Cattail Mineral Meadow Marsh (MAMM1-2) (Figure 3). It should be noted that most of this this low-lying wetland area has since been removed by the municipality as part of a grading project (with the exception of the Tributary B area which remains). As Tributary B passes under the farm driveway to the east, it is constricted by a culvert that has almost completely collapsed and is surrounded by large boulders and boards presenting a barrier to potential fish passage and effective flow (refer to photos in Appendix F). As Tributary B continues northeast, it becomes more defined and channelized (straightened) through the agricultural field before entering a treed fencerow lined with boulders placed by the (previous) farmer. The tributary continues northeast, where it crosses a farm laneway with a partially plugged culvert; another barrier to potential fish movement and flow within the tributary, before entering a wooded area and finally an open meadow where it outlets into Tributary C. It was noted that during site visits that the bank of Tributary C is quite steep with a large drop pf approximately 1 m at its confluence with Tributary B, creating a barrier for fish to pass upstream into Tributary B through the dense grass during low flow.

During the first site visit in October 2016, it was expected that water would have been present if fed by groundwater (cold water) sources; however the entire length of Tributary B was dry and no defined channel was observed in the upstream portion. During the same site visit in October, Tributary C was also dry from the western property boundary, to downstream of its confluence with Tributary B. Downstream of the confluence with Tributary B, Tributary C contained substantial flow near the bridge

at County Road 10, likely fed by groundwater sources within the wetland area immediately adjacent to County Road 10, flowing east. Refer to Photos 15-18 of Appendix F.

The summer of 2017 was exceptionally wet, receiving a greater than average amount of rainfall, with rainfall often occurring over several consecutive days throughout the summer. However, During Dillon's June 2017 site visit, Tributary B was described as channelized and having ephemeral and intermittent flow with pooling after a rain event in June and potential tile drain inputs from agricultural lands. It should be noted that 11.9 mm of rainfall was recoded at the Peterborough Airport on June 20; following sporadic rain events on several days leading up to the site visit, and this was evidenced by pooled water within the agricultural fields. During the spot checks in June 2020, low flow was observed within sections of the downstream reaches 48 hours after a large rain event (20+ mm) but water did not reach Tributary C since flow was observed to dissipate prior to the confluence downstream. Standing water was present in the upstream reach, west of the collapsed culvert. During a rain event, standing water was present in the upstream reach but the downstream reaches were dry with areas of wetted substrate. No water was present within Tributary B after a week of dry weather.

In June 2017, the water temperature within Tributary B was recorded as 25°C within pooled areas but little to no flow was observed (see point WC-3 in Figure 3). At the second survey point further downstream within the shaded woodland section, WC-4 as noted on Figure 3, flow was observed the temperature within this portion of the tributary was recorded at 18°C.

Three points in total were sampled in 2020 using temperature loggers; one upstream, one downstream, and one within Tributary C as a comparison point. It should be noted, that the downstream portion of Tributary B was dry for the entire monitoring period, and so the data recorded does not reflect water temperature, but temperature at substrate level; and has therefore, not been considered in the data analysis.

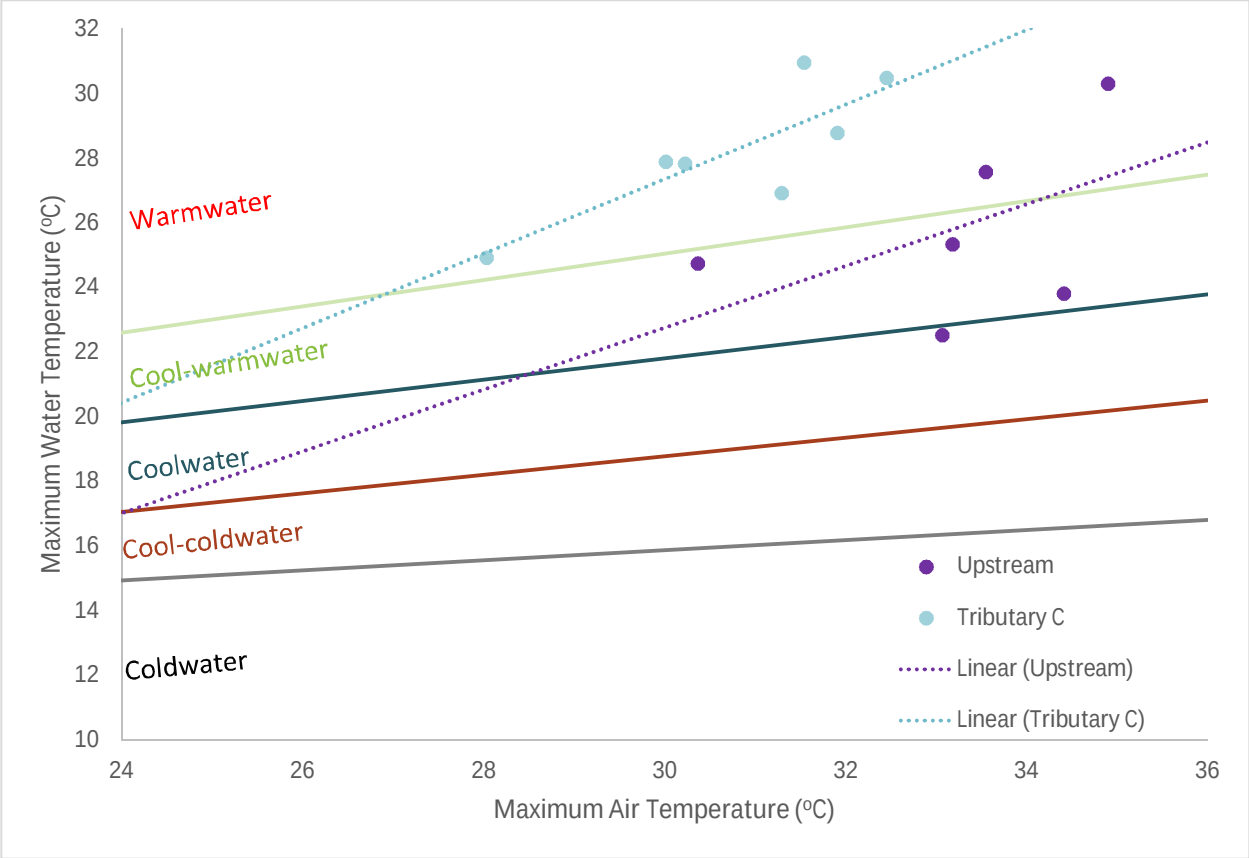
The data collected from the temperature loggers in 2020 was reviewed, and as per the OSAP protocol, all of the days within the sampling period that had a maximum air temperature of ≥ 24.5°C and that had experienced no precipitation for the previous 48 hours were considered, which included July 6-10, and July 25-26, 2020. For each of these days, both the maximum air temperature and water temperature average between 16:00 hrs and 18:00 hrs were pulled into Table 5, below.

Table 5: Temperature Logger Results

DATE 2020	TRIBUTARY B UPSTREAM		TRIBUTARY B DOWNSTREAM*		TRIBUTARY C (for comparison purposes)	
	Max. Air Temp °C	Avg. Water Temp °C b/w 1600-1800 hr	Max. Air Temp °C	Avg. Water Temp °C b/w 1600-1800 hr	Max. Air Temp °C	Avg. Water Temp °C b/w 1600-1800 hr
July 6	33.07	22.54	29.04	22.32	30.01	27.91
July 7	34.41	23.81	32.41	23.36	31.91	28.80
July 8	33.18	25.34	30.47	22.98	30.23	27.85
July 9	36.19	29.60	32.81	24.01	32.45	30.51
July 10	34.90	30.31	31.49	24.10	31.54	30.98
July 25	30.37	24.75	28.50	20.48	28.04	24.92
July 26	33.55	27.59	32.35	21.85	31.30	26.94
Average	33.66	26.27	31.01	22.73	30.78	28.27

**The entire downstream reach of Tributary B was dry throughout the monitoring period. As a result, the temperatures recorded* do not accurately reflect water temperature, but the air temperature at the substrate levels

The OSAP Manual defines thermal regime of watercourses using an algorithm based on air temperature. Using the data extracted to Table 5, a scatter plot was created to show the distribution of data and then compared to the thermal regime nomogram first created by Stoneman and Jones (1996) and adapted by Chu et al. (2009) and used in the OSAP manual.



Inset 1: Thermal Regime of Tributary B and C

Based on the trend in data shown above, the thermal regime in Tributary B falls within the "Cool-Warmwater" zone (warmwater in accordance with Stoneman and Jones [1996]); while Tributary C falls within the "Warmwater Zone". The results for Tributary B were expected based on the results of the previous data collected on site between 2016 and 2018. The results for Tributary C, however, were somewhat surprising as Baxter Creek is described as a cold water system; but reflects observations we have recorded within Tributary C, that has been dry during certain periods of the year.

5.1.2.1 Fish Habitat in Tributary B and C

Information received from ORCA indicated that wetlands upstream to the north and west of the property contain fish habitat, and therefore Tributary C would function to convey flows from those upstream wetlands to downstream reaches and provide direct fish habitat for part of the year. It was noted that during site visits that the bank of Tributary C is quite steep at its confluence with Tributary B creating a barrier for fish to pass upstream into Tributary B through the dense grass during low flow. Based on this, Tributary B may contain seasonal fish habitat downstream during high water periods (i.e., spring freshet) however, the tributary is dry for the most of the year. Furthermore, barriers present throughout the tributary prevent effective passage of fish upstream, and therefore, the primary function of Tributary B is likely contribution of allochthonous flows to downstream reaches. Furthermore, consultation with DFO suggested that these barriers, specifically the steep drop down to Tributary C,

present a danger to fish of getting trapped within Tributary B during high water and having no way of escaping back into the downstream system.

Please refer to the Headwater Drainage Features Assessment in Appendix F for further details. Potential impacts to watercourses are discussed in **Section 8.1.1**.

5.1.2.2 Benthic Invertebrate Sampling in Tributary B and C

In accordance with the protocol, organisms should be picked from sampling trays until at least 100 individuals were obtained for each replicate or the entire sample is to be processed. Since only 36 individual organisms were collected from Tributary B in total, all were identified to the major taxonomic groups (see Table 6). Since replicates were not taken as this was a high level assessment, although 110 organisms were picked from Tributary C for comparison purposes, all were identified, as detailed in Table 6.

Table 6: Benthic Macroinvertebrate

FAMILY	TAXA	NUMBER IDENTIFIED IN FIELD	RANKING	WATER QUALITY	DEGREE OF ORGANIC POLLUTION	TOTAL	AVERAGE TOLERANCE LEVEL
Tributary B							
Snails	Gastropoda	26	8	Very Poor	Severe Organic Pollution Likely	208	
Other True Flies	Misc. Diptera	3	5	Good	Some Organic Pollution Probable	15	
Fishflies	Megaloptera	1	4	Very Good	Possible Slight Organic Pollution	4	
Molluscs (Clams)	Bivalvia	1	8	Very Poor	Severe Organic Pollution Likely	8	
Aquatic Mites	Acari	3	4	Very Good	Possible Slight Organic Pollution	12	
Sow Bugs	Isopoda	1	8	Very Poor	Severe Organic Pollution Likely	8	
Beetles	Coleoptera	1	4	Very Good	Possible Slight Organic Pollution	4	
Total		36				259	7.19
Tributary C							
Snails	Gastropoda	10	8	Very Poor	Severe Organic Pollution Likely	80	
Other True Flies	Misc. Diptera	2	5	Good	Some Organic Pollution Probable	10	
Horseflies	Tabinidae	1	6	Fairly Poor	Substantial pollution likely	6	
No-see-ums	Ceratopogonidae	3	6	Fairly Poor	Substantial pollution likely	18	
Molluscs (Clams)	Bivalvia	5	8	Very Poor	Severe Organic Pollution Likely	40	
Mayflies	Ephemeroptera	9	5	Good	Some Organic Pollution Probable	45	
Segmented Worms	Oliochaeta	1	8	Very Poor	Severe Organic Pollution Likely	8	
Caddisflies	Trichoptera	19	4	Very Good	Possible Slight Organic Pollution	76	
Midges	Chironimidae	24	7	Poor	Very Substantial Pollution Likely	168	
Beetles	Coleptera	16	4	Very Good	Possible Slight Organic Pollution	64	
Stoneflies	Plecoptera	17	1	Very Poor	Severe Organic Pollution Likely	17	
Roundworms	Nemata	3	N/A	Very Poor	Severe Organic Pollution Likely	N/A	
Total		110				532	4.83

The tolerance index, or Biotic Index (BI), was developed by Hilsenhoff (Hilsenhoff, 1988) to summarize the various tolerances of the benthic arthropod community with a single value. Tolerance values (Rank) range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes for Tolerance values range from 0 to 10 (i.e. rank increases as water quality decreases). The Modified Family Biotic Index (FBI) was later developed to detect organic pollution and is based on the original species-level index (BI) of Hilsenhoff, 1998, and to be used as a rapid analysis method. The specimens collected within both Tributary B and C were analyzed to the family level, in accordance with OSAP S2.M1, and the rankings were determined based on a combination of (Mandaville, 2002) and those adapted for southern Ontario by Kilgour and Stanfield in 2006.

The average tolerance level within Tributary B was 7.19, indicating "Poor" water quality and very substantial pollution likely; acknowledging that only a small pool of water was present for sampling within Tributary B. However, this would be reflective of agricultural drains and streams that would receive a significant amount of organic pollution through surface runoff. The average tolerance level within Tributary C was 4.83, indicating "Good" water quality, evidenced by sensitive species including Plecoptera (Stoneflies).

Invertebrates can be used to assist in determining hydroperiod, as intermittent streams may show presence of damselfly nymphs, clams, and scuds and absence of caddisfly larvae, mayfly nymphs, stonefly nymphs, black flies, etc. in summer (TRCA & CVC, 2014). In contrast, invertebrates within ephemeral features include presence of worms and leaches in the absence of the intermittent indicators or contain no aquatic macroinvertebrates. This suggests that Tributary B should be classified as Intermittent.

5.2 Terrestrial Environment

5.2.1 Ecological Land Classification

A total of nine communities were observed within the Study Area during the ELC survey, seven of which are considered natural vegetation communities. The location, type, and boundaries of these communities are delineated in Figure 4. All vegetation communities surveyed within the Study Area are considered common in Ontario. Table 7 outlines the communities documented during ELC surveys and summarizes the dominant vegetation cover. Reference photos for each of the plant communities observed can be found in Appendix G.

Within the Study Area, the natural vegetation communities have been disturbed due to adjacent agricultural uses and contain invasive species (Common Buckthorn (Rhamnus cathartica), Manitoba Maple (Acer negundo), and Reed Canary Grass (Phalaris arundinacea)).

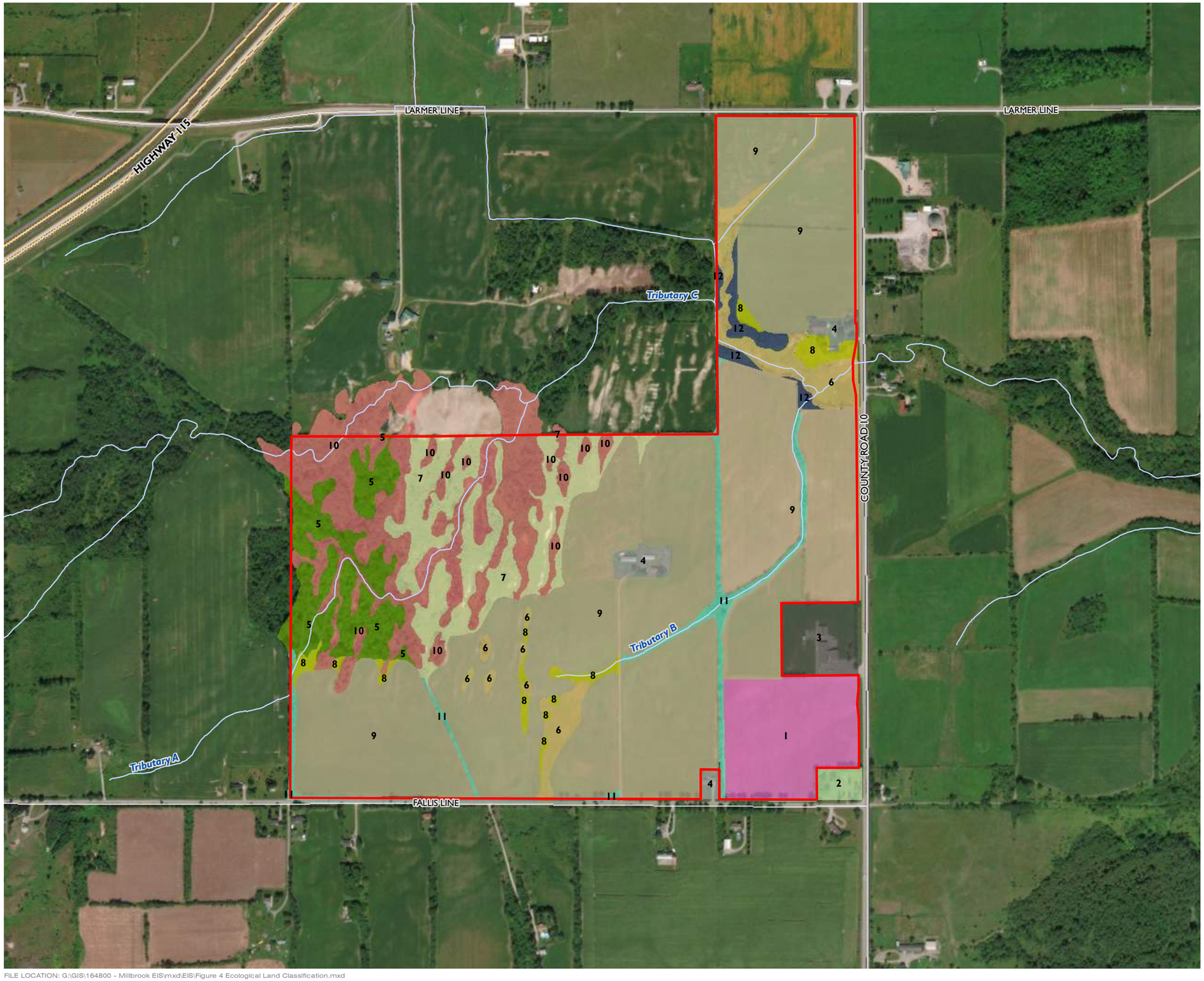


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FIGURE 4
ECOLOGICAL LAND CLASSIFICATION

Study Area

Water Body

Ecological Land Classification

1. Cleared Land
2. CGL: Greenlands (Cemetery)
3. CVI_3: Transportation and Utilities
4. CVR_4: Rural Residential Property
5. FODM6-5: Dry-Fresh Sugar Maple-Hardwood Deciduous Forest
6. MAMM1-2: Cattail Mineral Meadow Marsh
7. MEMM3: Dry-Fresh Mixed Meadow
8. MEMM4: Fresh-Moist Mixed Meadow
9. OAGM1: Annual Row Crop
10. SWDM4: Mineral Deciduous Swamp
11. TAGM5: Fencerow/Riparian
12. THDM5: Fresh-Moist Deciduous Thicket Ecosite

1:7,500

0 100 200 400 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF, TOWNSHIP OF CAVAN MONAGHAN

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

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DATE: 10/3/2018

FILE LOCATION: G:\GIS\164800 - Millbrook EIS\mxd\EIS\Figure 4 Ecological Land Classification.mxd

Table 7: Ecological Land Classification

ELC CODE	VEGETATION	PHOTO APP. F
FODM6-5: Fresh - Moist Sugar Maple Hardwood Forest	The canopy and sub-canopy consists of Sugar Maple (Acer saccharum), American Basswood (Tilia americana) and American Beech (Fagus grandifolia). Shrub species present include Common Buckthorn (Rhamnus cathartica), Choke Cherry (Prunus virginiana), Alternate-leaved Dogwood (Cornus alternifolia) and Purple-flowering Raspberry (Rubus odoratus). Herbaceous species include Blue Cohosh (Caulophyllum thalictroides), Virginia Creeper (Parthenocissus quinquefolia), Enchanter's Nightshade (Circaea canadensis) and Ostrich Fern (Matteuccia struthiopteris).	1
SWDM4: Mineral Deciduous Swamp	The canopy and sub-canopy consists predominantly of Freeman's Maple (Acer × freemannii) and Trembling Aspen (Populus tremuloides) with occasional American Elm (Ulmus americana), Green Ash (Fraxinus pennsylvanica) and Yellow Birch (Betula alleghaniensis). Willows (Salix spp.) and Red-osier Dogwood (Cornus sericea ssp. sericea) are the most common species in the shrub layer. Herbaceous species present consist of Spotted Jewelweed (Impatiens capensis), Sensitive Fern (Onoclea sensibilis), Rice Cutgrass (Leersia oryzoides), Bittersweet Nightshade (Solanum dulcamara) and Yellow Marsh Marigold (Altha palustris).	2-3
MAMM1-2: Cattail Mineral Meadow Marsh	The community contains a few Freeman's Maples and American Basswoods at the canopy level, and woody shrubs including Buckthorn, Pussy Willow (Salix discolor) and White Meadowsweet (Spiraea alba). The ground layer included terrestrial plants such as Swamp Milkweed (Asclepias incarnate) and Blue Vervain (Verbena hastata) as well as emergent aquatic plants including Broad-leaved Cattail (Typha latifolia), American Burreed (Sparganium americanum) and Northern Water-plantain (Alisma triviale) at the perimeter of open water ponds.	4-6
MEMM4: Fresh-Moist Mixed Meadow	Ground cover consisted primarily of Common Timothy grass (Phleum pratensis), Garden Bird's-foot Trefoil (Lotus corniculatus) and Cow Vetch (Vicia cracca) with Awnless Brome (Bromus inermis), Orchard Grass (Dactylis glomerata) and Reed Canary Grass (Phalaris arundinacea) associates. Woody vegetation is uncommon in this community, but includes young Black Walnut (Juglans nigra), Eastern Redcedar (Juniperus occidentalis), Common Buckthorn and Staghorn Sumac (Rhus typhina).	7
MEMM3: Dry-Fresh Mixed Meadow	Scattered Scott's Pine (Pinus sylvestris) as well as occasional Common Apple (Malus pumila) and Common Buckthorn occur in this mostly open/herbaceous ecosite. The predominant groundcover vegetation is Awnless Brome with Canada Goldenrod (Solidago canadensis ssp. canadensis) and Garden Bird's-foot Trefoil also common.	8
TAGM5: Hedgerow	These narrow strips of vegetation between agricultural field consisted mainly of Common Buckthorn, Staghorn Sumac and Manitoba Maple, with Riverbank Grape (Vitis riparia) and Virginia creeper (Parthenocissus quinquefolia) climbing underneath the canopy	9
OAGM1: Annual Row Crop	Cultivated fields	10-11
CVR_4: Rural Residential	N/A	17
THDM5: Fresh-Moist Deciduous Thicket	Common Buckthorn, Choke Cherry, Alternate-leaved Dogwood, Staghorn Sumac, Manitoba Maple, Riverbank Grape, and Virginia creeper.	N/A

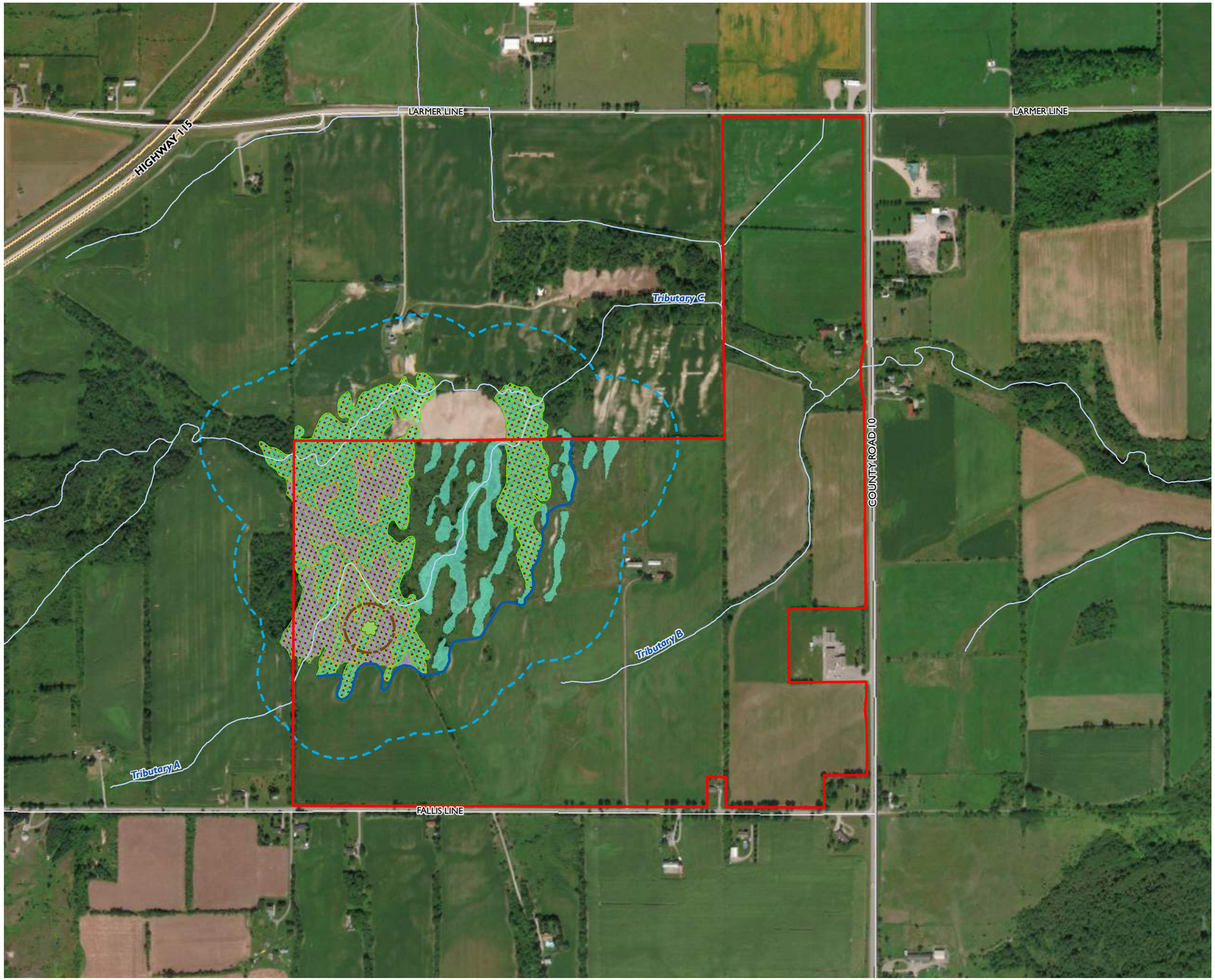

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FIGURE 5
SIGNIFICANT NATURAL FEATURES

- Study Area
- Butternut Observed
- 50 m Butternut Setback
- Core Wetland Boundary
- Water Body
- Wetland- Evaluated-Other
- Significant Woodland

Significant Wildlife Habitat

- Seeps and Springs
- Special Concern and Rare Wildlife Species:
  - Eastern Wood-pewee
  - Wood Thrush
  - Striped Cream Violet

Candidate Significant Wildlife Habitat

- Bat Maternity Colony
- Waterfowl Nesting Habitat

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0 100 200 400 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF, TOWNSHIP OF CAVAN MONAGHAN

MAP CREATED BY: GM
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FILE LOCATION: G:\GIS\164800 - Millbrook EIS\mxd\EIS\Figure 5 Significant Natural Features.mxd

5.2.2 Vegetation

A total of 147 plant species were documented during 2017 field studies. Of the 147 species, approximately 73% are listed as native species considered to be common (S4) to very common (S5) in the province of Ontario; and approximately 27% are listed as introduced species, therefore a status ranking is not applicable as the species is not a suitable target for conservation activities (SE or SNA rank). Of the native species observed, one species, Butternut (Juglans cinerea), is listed as endangered under the ESA (Figure 5). In addition, two Species of Conservation Concern were noted in within the Significant Woodland, Scarlet Beebalm (Monarda didyma), and Striped Cream Violet (Viola striata). Due to the common use of Scarlet Beebalm in landscaping and the fact that it rarely occurs naturally within this area, it is expected that this individual is not likely natural. Based on the presence of the Striped Cream Violet, the FOD woodland community is considered SWH for Special Concern and Rare Wildlife Species (Figure 5).

The Co-efficient of Conservatism (CC) provides additional information on the nature of the vegetation communities within the Study Area. The CC values range from 0 to 10 and represent an estimated probability that a plant is likely to occur in a landscape that is relatively unaltered or is in a pre-settlement condition. For example, a CC of 0 is given to plants such as Manitoba Maple that demonstrate little fidelity to any remnant natural community, i.e. may be found almost anywhere. Similarly, a CC of 10 is applied to plants like Shrubby Cinquefoil (*Potentilla fructicosa*) that are almost always restricted to a pre-settlement remnant, i.e. a high quality natural area. Introduced plants were not part of the pre-settlement flora, so no CC values have been applied to these species.

Of the 147 species identified within the Study Area, several species had a CC value of 7 or greater indicating a generally un-altered landscape; typical of a naturally occurring environment, although several non-native or invasive species were observed. A full list of the vegetation species observed within the Study Area has been included in Appendix H.

Potential impacts related to vegetation within the Study Area are included in **Section 8.1.5**.

5.2.3 Wetlands

The unevaluated wetlands located within and adjacent to the Study Area have been named the Millbrook North Wetland Complex for the purposes of the OWES study and EIS, and confirmed through consultation with MNRF, Peterborough District Office. The Millbrook North Wetland Complex is comprised of two wetland units located northwest of the Town of Millbrook and roughly bound by Fallis Line to the south, County Road 10 to the east, Larmer Line to the north and Highway 115 to the west. The proposed wetland complex is also located between two other evaluated wetlands that include:

- The Tapley South Wetland Complex, evaluated as “other” which indicates a non-significant scoring for the complex but is potentially locally significant. This wetland is located northwest of the Baxter Creek Headwaters wetland complex at Tapley Quarter Line/Larmer Line and overlaps the same watershed/catchment area.

- The Millbrook Northeast Wetland Complex, evaluated as "other" which indicates a non-significant scoring for the complex but is potentially locally significant. This wetland is located to the south/southeast, with units located in the Town of Millbrook and along Baxter Creek.

The two units that make up the Millbrook North Wetland Complex and provide ecological support to the health of Baxter Creek and the downstream evaluated wetland, Millbrook Northeast. The units have been evaluated as a distinct complex instead of added to the neighbouring evaluated wetland complexes due to the following:

- Located further than 750 m from the Tarpley Wetland Complex; and,
- Located within 750 m of the Millbrook Northeast Wetland Complex but within a separate watershed/catchment area.

The two units that form the Millbrook North Wetland Complex are comprised of a number of smaller units that are generally less than 0.5 hectares in size and associated with glacial activity (ice-block ridges). Due the number of smaller units, it was decided to combine these into one larger unit as the units are generally all hydrologically connected.

Please note that we have identified a "Core Wetland Area" as part of this evaluation as the ice block ridges have left remnant wetland pockets within the agricultural fields, however they are much smaller than the 2 ha complexing size criteria and do not provide important terrestrial functions. See photos 10-16 in Appendix G.

Dillon's completed wetland evaluation was submitted and subsequently approved by the MNRF Peterborough District Office. The final OWES scoring record has been included in Appendix I.

5.2.4 Woodlands

Woodlands were investigated as part of ELC and botanical surveys in 2017. Significant Woodlands within the Study Area are comprised of Fresh - Moist Sugar Maple Hardwood Forest and Mineral Deciduous Swamp communities as described in Table 7. One Butternut tree was identified within the Significant Woodland (Figure 5). As the proposed development is located more than 50 m from the Butternut tree, no impacts to the individual are anticipated. No other significant woodlands were identified within the Study Area.

Potential impacts related to Significant Woodlands and other vegetation communities within the Study Area are included in **Section 8.1**.

5.2.5 Significant Wildlife Habitat

As the Significant Woodland and core wetland communities will be protected as part of the proposed development, specific surveys for bat maternity colonies were not conducted as part of this EIS. As a result we have identified candidate SWH for Bat Maternity Colonies within the woodland and wetland

communities (Figure 5). The results of the breeding bird and amphibian surveys as they apply to SWH are detailed below.

5.2.5.1 Breeding Bird Survey

A total of 52 bird species were observed during breeding bird surveys in 2017 (Table 8). Although most species observed are considered common and secure (S4) to very common (S5) in the province of Ontario, several are considered Species of Conservation Concern, and one SAR, Barn Swallow (Hirundo *rustica*) was observed within the Study Area as a flyover.

Of the 52 species observed, two species; Scarlet Tanager (Piranga olivacea) and Canada Warbler (Cardellina canadensis); are considered area sensitive and considered under woodland area-sensitive breeding bird habitat in the Ecoregion 6E Criterion Schedule (MNRF 2015). In addition, Species of Conservation Concern were observed which fall under Special Concern and Rare Wildlife Species SWH including Wood Thrush (Hylocichla mustelina) and Eastern Wood-pewee (Contopus virens). Although the criteria for woodland area-sensitive species within the woodlands related to size is not met (i.e., must be ≥30 ha with interior habitat); because species such as Eastern Wood-pewee, and Wood Thrush were observed that do not fit into a specific SWH type, the deciduous forest community (FODM6-5) would be considered SWH for Special Concern and Rare Wildlife Species (Figure 5).

Table 8: Breeding Bird Survey Results

SCIENTIFIC NAME	COMMON NAME	SRANK[2]	SARA[3]	ESA[4]	BREEDING EVIDENCE[1]
Actitis macularius	Spotted Sandpiper	S5	---	---	O
Aix sponsa	Wood Duck	S5	---	---	H, S
Agelaius phoeniceus	Red-winged Blackbird	S4	---	---	S, O, F/O
Anas platyrhynchos	Mallard	S5	---	---	F/O
Bombycilla cedrorum	Cedar Waxwing	S4B	---	---	F/O
Bonasa umbellus	Ruffed Grouse	S4	---	---	AREA
Cardellina canadensis	Canada Warbler	S4B	THR	SC	ASEAR
Cardellina pusilla	Wilsons Warbler	S4B	---	---	S
Cardinalis cardinalis	Northern Cardinal	S5	---	---	S
Carduelis tristis	American Goldfinch	S5B	---	---	F/O
Cathartes aura	Turkey Vulture	S5B	---	---	F/O
Charadrius vociferus	Killdeer	S5B,S5N	---	---	S
Colaptes auratus	Northern Flicker	S4B	---	---	ASEAR
Contopus virens	Eastern Wood-pewee	S4B	---	SC	S
Corvus brachyrhynchos	American Crow	S5B	---	---	F/O
Cyanocitta cristata	Blue Jay	S5	---	---	S
Dryocopus pileatus	Pileated Woodpecker	S5	---	---	S

SCIENTIFIC NAME	COMMON NAME	SRANK[2]	SARA[3]	ESA[4]	BREEDING EVIDENCE[1]
Dumetella carolinensis	Gray Catbird	S4B	---	---	S/P
Empidonax alnorum	Alder Flycatcher	S5B	---	---	S
Empidonax minimus	Least Flycatcher	S4B	---	---	S
Empidonax traillii	Willow Flycatcher	S5B	---	---	S
Geothlypis philadelphia	Mourning Warbler	S4B	---	---	ASEAR
Geothlypis trichas	Common Yellowthroat	S5B	---	---	S
Hirundo rustica	Barn Swallow	S4B	---	THR	F/O
Hylocichla mustelina	Wood Thrush	S4B	---	SC	S
Icterus galbula	Baltimore Oriole	S4B	---	---	S/P,O
Larus delawarensis	Ring Billed Gull	S5B,S4N	---	---	F/O
Melospiza melodia	Song Sparrow	S5B	---	---	S
Mniotilta varia	Black-and-white Warbler	S5B	---	---	S
Molothrus ater	Brown- headed Cowbird	S4B	---	---	S
Myiarchus crinitus	Great Crested Flycatcher	S4B	---	---	S
Oreothlypis ruficapilla	Nashville Warbler	S5	---	---	S
Passerculus sandwichensis	Savannah Sparrow	S4B	---	---	S
Pheucticus ludovicianus	Rose-breasted Grosbeak	S4B	---	---	S
Picoides pubescens	Downy Woodpecker	S5	---	---	S
Picoides villosus	Hairy Woodpecker	S5	---	---	P
Piranga olivacea	Scarlet Tanager	S4B	---	---	S
Poecile atricapillus	Black-capped Chickadee	S5	---	---	O,S
Quiscalus quiscula	Common Grackle	S5B	---	---	F/O
Sayornis phoebe	Eastern Phoebe	S5B	---	---	O
Setophaga citrina	Hooded Warbler	S4B	THR	---	S
Setophaga pensylvanica	Chestnut sided warbler	S5B	---	---	S
Setophaga petechia	Yellow Warbler	S5B	---	---	S
Setophaga ruticilla	American Redstart	S5B	---	---	S
Tachycineta bicolor	Tree Swallow	S4B	---	---	F/O
Toxostoma rufum	Brown Thrasher	S4B	---	---	S, P
Turdus migratorius	American Robin	S5B	---	---	F/O
Tyrannus tyrannus	Eastern Kingbird	S4B	---	---	H
Vermivora chrysoptera	Golden-winged Warbler	S4B	THR	SC	AREA,O
Vireo gilvus	Warbling Vireo	S5B	---	---	S
Vireo olivaceus	Red-eyed Vireo	S5B	---	---	S
Zenaida macroura	Mourning Dove	S5	---	---	F/O

[1]Breeding Bird Codes from Breeding Bird Atlas of Ontario (Cadman et al. 2007)

Observed Confirmed

X Species observed in its breeding season (no breeding evidence)

Possible

H Species observed in its breeding season in suitable nesting habitat
S Singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

Probable

P Pair observed in suitable nesting habitat in nesting season
T Permanent territory presumed through registration of territorial song, or the occurrence of an adult bird, at the same place, in breeding habitat, on at least two days a week or more apart, during its breeding season.
D Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
V Visiting probable nest site
A Agitated behaviour or anxiety calls of an adult
B Brood Patch on adult female or cloacal protuberance on adult male
N Nest-building or excavation of nest hole, except by a wren or a woodpecker
NB Nest-building or excavation of nest hole by a species other than a wren or a woodpecker
DD Distraction display or injury feigning
NU Used nest or egg shells found (occupied or laid within the period of the survey)
FY Recently fledged young (nidicolous species) or downy young (nidifugous species), including incapable of sustained flight
AE Adult leaving or entering nest sites in circumstances indicating occupied nest
FS Adult carrying fecal sac
CF Adult carrying food for young
NE Nest containing eggs
NY Nest with young seen or heard

[2]Federal Species at Risk Act (THR= threatened); [3]Provincial Endangered Species Act (THR= threatened; SC= Special Concern); [4]S-Rank is an indicator of commonness in the Province of Ontario. A scale between 1 and 5, with 5 being very common and 1 being the least common; ---denotes no information or not applicable.

In addition, as noted in **Section 5.1.1**, several Wood Ducks were observed within the breeding season within the wetland complex and therefore, it is possible that SWH for Waterfowl Nesting Areas exists in association with the open water pockets of the wetland. Since specific waterfowl nesting surveys were not conducted, for the purposes of this report we have identified candidate SWH for Waterfowl Nesting within the wetland (Figure 5). In accordance with the Ecoregion 6E Criterion Schedule (MNRF 2015), the extent of the SWH for Waterfowl Nesting Areas is 120 m upland from a wetland or cluster of wetlands where waterfowl nesting is known to occur. Upland areas should be at least 120 m wide in order to provide protection from predators locating nests. As a result, and based on the configuration of the wetland pockets within the Study Area, upland ELC communities adjacent (and connecting) the individual wetland pockets have been considered the limit of the candidate SWH. As agricultural fields would not provide movement areas or protection from predators, these communities have not been considered as part of the Candidate SWH for the purposes of this EIS.

Potential impacts to SWH are discussed in **Section 8.1.6**.

5.2.5.2 Amphibian Survey

Potential amphibian breeding habitat was identified within the Significant Woodland/ wetland complex. In accordance with the Ecoregion 6E Criterion Schedule (MNRF 2015), the Study Area was considered under Amphibian Breeding Woodland Habitat based on the presence of vernal pools within the wetland polygons. In order for Amphibian Breeding Woodland Habitats to be significant, they must contain one or more of the listed newt/salamander species; at least two or more of the listed frog/toad species with at least 20 individuals (adults or egg masses) of each species; or at least two of the listed frog/toad species with Call Code 3.

Several amphibian species including Spring Peeper (Pseudacris crucifer), American Toad (Anaxyrus americanus), Gray Treefrog (Hyla versicolor), and Pickerel Frog (Lithobates palustris) were heard calling throughout the three amphibian breeding surveys conducted in 2017. In addition, tadpoles were noted in wetland communities during the ELC survey. The only two species considered under woodland habitat observed are Spring Peeper and Gray Treefrog; however Spring Peeper was the only species that was recorded with a Call Code of 3 on any of the three survey days. Therefore, according to the Ecoregion 6E Criterion Schedule (MNRF 2015) no SWH for breeding amphibians is present within the Study Area.

Potential impacts to general wildlife habitat are discussed in **Section 8.1.6**.

5.2.5.3 Incidental Wildlife

Incidental wildlife species observed within the Study Area are listed in Table 9 below. With the exception of Monarch (Danaus plexippus) (Special Concern), all of the species listed below are considered common and secure in Ontario (S5). Potential impacts related to wildlife within the Study Area are included in **Section 8.1.6**.

Table 9: Incidental Wildlife Observations

SCIENTIFIC NAME	COMMON NAME	SRANK[2]	SARA[3]	ESA[4]	EVIDENCE
BIRDS					
Agelaius phoeniceus	Red-winged Blackbird	---	---	S4	Observed during ELC
Vireo olivaceus	Red-eyed Vireo	---	---	S5B	Observed during ELC
Buteo jamaicensis	Red-tailed Hawk	---	---	S5	Observed during ELC
Aix sponsa	Wood Duck	---	---	S5	Observed during ELC
HERPETOFAUNA					
Chrysemys picta marginata	Midland Painted Turtle	---	---	S4	Observed during ELC
unknown	Tadpoles	---	---	---	Observed during ELC
MAMMALS					
Castor canadensis	Beaver	---	---	S5	Dam in wetland
Odocoileus virginianus	White-tailed Deer	---	---	S5	Tree stand in forest
LEPIDOPTERA					
Danaus plexippus	Monarch	SC	SC	S2N,S4B	Observed during ELC

[1]Federal Species at Risk Act (THR= threatened); [2]Provincial Endangered Species Act (THR= threatened; SC= Special Concern); [3]S-Rank is an indicator of commonness in the Province of Ontario. A scale between 1 and 5, with 5 being very common and 1 being the least common; ---denotes no information or not applicable.

5.2.6 Species at Risk

As noted in previous sections, both Butternut and Barn Swallow were observed within the Study Area, however those species are not anticipated to be impacted by the proposed development. No other SAR or SAR habitat was noted within the Study Area.

6.0 Ecological Function

Natural features within and adjacent to the Study Area were analyzed to determine their ecological function. At the larger landscape scale, the Study Area exists as part of the Peterborough Drumlin field and in the vicinity of several non-PSW wetland complexes. Wetlands within the Study Area provides ecological and hydrological function, providing habitat to SAR and Species of Conservation Concern in the form of several types of SWH; and acting as a Core Area and Linkage Area of the County's NHS; connecting to adjacent woodlands and habitats through a vegetated corridor and surface water conveyance along the Baxter Creek Tributary (Tributary A and C). General ecological functions of natural features within the Study Area include prevention of erosion and runoff, facilitating hydrological and nutrient cycling, and improving localized soil, water and air quality. Within the proposed development area, treed areas provide limited cover, foraging, refuge, and nesting habitat for urban terrestrial wildlife.

6.1 Hydrological Function

As indicated in the Hydrogeological Assessment Report (Geo-Logic Inc. 2015), a flow divide appears to exist where the shallow groundwater flow direction is toward the north and south at Fallis Line.

Geo-Logic Inc. states that there is not a shallow water table aquifer at the site within the till material where seepage was observed. Fine grained materials have high moisture content as they are able to retain more water but this does not indicate that they comprise a water table aquifer (Geo-Logic Inc. 2015). Though the moisture content of fine grained materials may be higher, the yield of water at significant quantities from these soils, in comparison with a water table aquifer that is comprised generally of sand and gravel is not expected. The water levels also reflect seasonal spring conditions with ponded surface water (Geo-Logic Inc. 2015).

At a few of the piezometer stations monitored by Geo-Logic Inc. in 2015, hydrostatic pressure from water encountered within sand seams appears to have created a potentiometric water level near the surface. However the potentiometric surface is not a water table surface but a potential water level from the water bearing sand seams encountered at depth; similar to what would occur in a well, where the water surface is above the top of the aquifer unit. Thus, significant quantities of groundwater within the shallow soils are not expected within the Study Area.

As indicated in the Hydrogeological Assessment Report (Geo-Logic Inc. 2015), surface waters flows in accordance with the local topography through Tributaries A, B and C, and eventually into Baxter Creek.

6.2 Aquatic and Terrestrial Habitat Function

According to ORCA's Watershed Panning & Regulations Policy Manual (2015), wetlands are important natural features on the landscape, performing many important ecological functions including moderating water flow by absorbing surface water runoff then slowly releasing it. This helps to reduce flooding and to sustain stream flows during dry spells. Many wetland areas recharge groundwater by moving surface water into the groundwater system. As a result, they play an important role in protecting and improving water quality, provide for fish and wildlife habitat and offer a number of associated recreational opportunities. The lands that surround wetland areas are also important; in sustaining the wetlands vital hydrologic and ecological functions (ORCA 2015).

Woodlands are also an integral component of the natural heritage system; providing environmental and economic benefits to both the private landowner and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products (ORCA 2015).

The Millbrook North Wetland Complex, as a whole, provides important habitat for wildlife in the form of several types of SWH; including Special Concern and Rare Wildlife Species (Eastern Wood-pewee, Wood Thrush, and Striped Cream Violet); and candidate Waterfowl Nesting Areas and Bat Maternity Colonies. The wetlands also provide general habitat and protection and cover to common plants and wildlife including amphibians. Some pockets of wetland are still present within the field but have been disconnected from the core wetland complex, separated by agricultural activities.

As for surface water features, while Tributaries A and C are surrounded by natural vegetation communities, Tributary B is located within an active agricultural field with little riparian vegetation for much of its length. In addition, barriers to fish movement and effective flow conveyance exist along Tributary B in the form of crushed and/ or plugged culverts beneath the driveway and farm laneway (refer to photos in Appendix E). In addition, the bank of Tributary C is quite steep at its confluence with Tributary B creating a barrier for fish to pass upstream into Tributary B through the dense grass during low flow. Based on this, Tributary B may contain seasonal fish habitat downstream during high water periods (i.e., spring freshet); however, barriers present throughout the tributary prevent effective passage of fish upstream, and therefore, the primary function of Tributary B is contribution of allochthonous flows to downstream reaches.

The remaining areas of the Study Area, and the majority of the proposed development area, provide minimal ecological function for plant and wildlife species as a result of the active agricultural use.

6.3 Connectivity and Linkage Function

Areas within the Study Area have been designated by both the County and the Township as Natural Core Areas and Natural Linkage Areas; and are associated with the wetland complex and Baxter's Creek corridor. As mentioned above, these areas connect adjacent woodlands and other habitats through a vegetated corridor and surface water conveyance along the Baxter Creek Tributary (Tributary A and C).

Natural Core Areas include areas with the highest concentration of sensitive and/or significant natural features and functions. These areas are to be managed as a connected and integrated natural heritage system recognizing the functional inter-relationships between them (Cavan-Monaghan 2015). This designation also applies to lands that form a natural 30 m buffer from significant natural heritage features. Natural Linkages Areas includes lands forming a 120 m vegetative buffer from Key Natural Heritage Features in the Natural Heritage System. This designation forms part of a central corridor system that supports or has the potential to support movement of plants and animals and provide linkages to natural heritage features (Cavan-Monaghan 2015).

Within the Township of Cava-Monaghan and the jurisdiction of ORCA, the emphasis is on system integrity and the importance of a holistic or systems-based approach. Linkages are a key element of a natural heritage system that helps support the natural movement pattern of plants and animals that is necessary for biodiversity conservation and long term sustainability (ORCA 2015). A systems approach considers features as well as functions and is premised on a precautionary approach that considers the needs of more sensitive species from a landscape perspective (ORCA 2015).

Potential impacts to linkage functions as a result of the proposed development are discussed further in **Section 8.1.1.1**.

7.0 Description of Development

The proposed development includes construction of 765 residential units, which include 245 townhouses, 328 single-detached houses and 192 residential apartments; with associated stormwater management infrastructure, asphalt-paved roadways, and servicing. The land uses include Residential, Institutional, Parks & Open Space, Commercial, and Natural Core Area. The development will front on both Fallis Line and County Road 10. Access for the subdivision will consist of a road network with two road connections off Fallis Line and one road connection to County Road 10. The proposed servicing will be installed at depths of up to approximately 10 m mbeg or shallower, and will be municipally serviced for water and sewer (Figure 6).

Construction of the proposed development would include the removal of select trees, shrubs and other vegetation from the development area. Landscaping would include, but is not limited to, the the insallation of patios, fencing, sod, and tree plantings.

As part of the proposed development, Tributary B is to be realigned to the west to accommodate the residential development. The realignment of Tributary B will involve creation of approximately 1172 m of new naturalized channel, flowing northeast along the western development boundary creating a robust naturalized barrier between the wetland complex and the development. The newly aligned watercourse will have a buffer of 30 m on either side of the meanderbelt (11 m) and will be located outside of the 30 m wetland buffer. Once the channel is created, the existing Tributary B will be infilled, resulting in a net increase in 264 m in channel length. The existing confluence with Tributary will be maintained at the downstream end of the realignment to prevent potential downstream impacts.

The realignment channel will be zoned as Environmental Protection for long-term protection. Please refer to the DFO Request for Review in Appendix E for details of the realignment.

The associated impacts of the development and the mitigation measures will be discussed in **Sections 8** and 9.

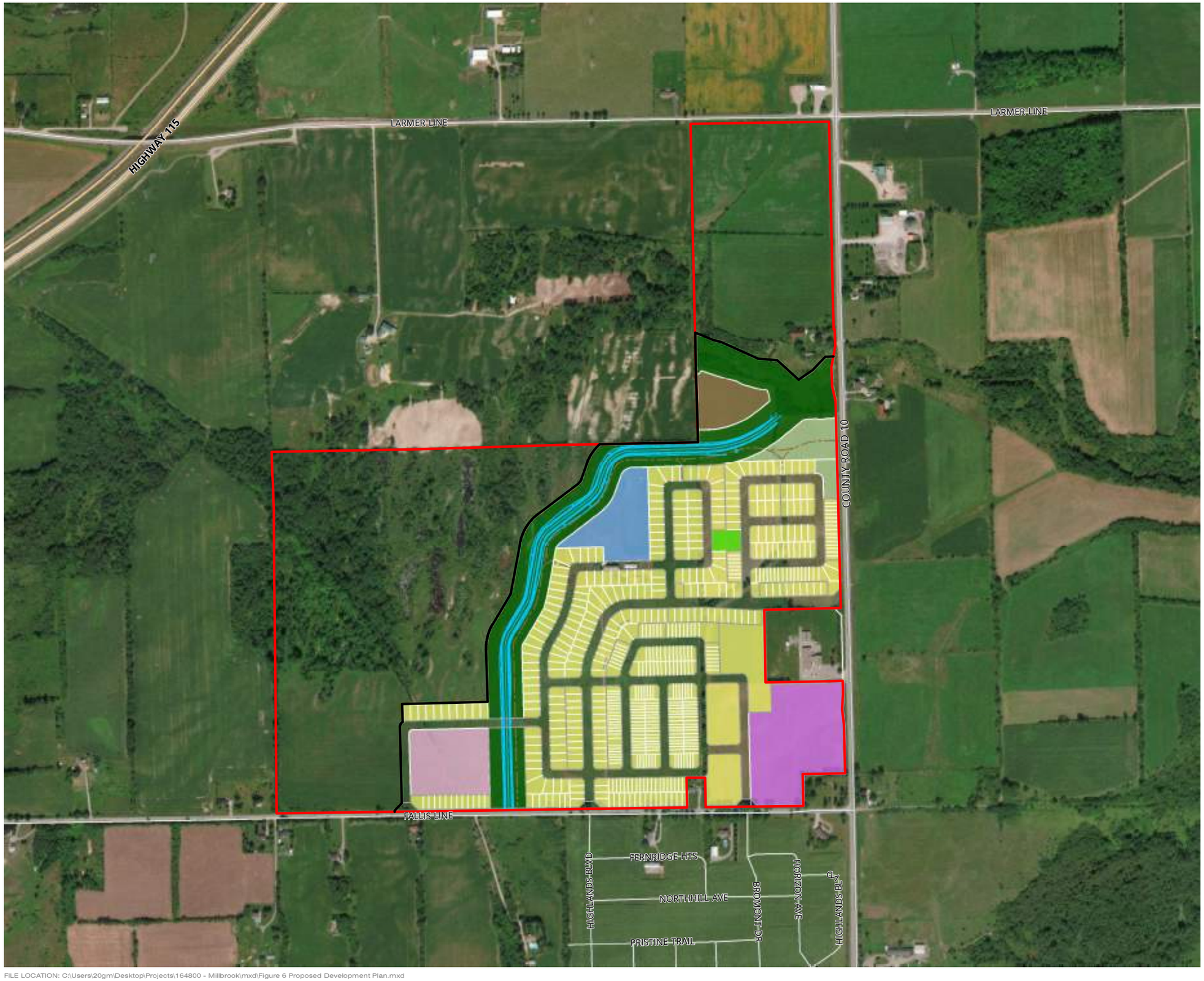

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FIGURE 6
PROPOSED DEVELOPMENT PLAN

- Study Area
- Limit of Development
- Proposed Channel
- Proposed Lot Line
- Proposed Road
- Proposed Trail
- Agricultural
- Environmental Protection
- Institutional
- Open Space
- Park
- Recreation Centre
- Residential
- SWM Pond

1:7,500

0 50 100 200 300 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 164800
STATUS: DRAFT
DATE: 2020-08-26

FILE LOCATION: C:\Users\20gm\Desktop\Projects\164800 - Millbrook\mxd\Figure 6 Proposed Development Plan.mxd

8.0 Potential Impact Assessment

8.1 Potential Direct Impacts

Potential direct impacts are those that are immediately evident as a result of the development. Typically, the adverse effects of potential direct impacts are most evident during the site preparation and construction phase of a development. Potential direct impacts of the proposed residential development include the following:

- Diversion of surface water flows;
- Erosion and sedimentation of adjacent natural features (Significant Woodland and wetland);
- Reduction of hydrological function (groundwater);
- Reduction of hydrological function (infiltration);
- Tree and vegetation removal; and,
- Loss of/ disturbance to wildlife and wildlife habitat (including SAR).

The proposed site plan and environmental impacts of development are shown in Figure 7.

8.1.1 Diversion of Surface Water Flows

The health of watercourses is integral to the health of a watershed as they provide key ecological functions and hydrologic functions such as fish habitat and habitat for wildlife, sediment and nutrient transport and deposition, transfer media for energy and organisms, source of water supply and important contributions to the hydrologic cycle (ORCA 2015).

The structure and function of watercourses are influenced by channel morphology, sediment characteristics and the nature of the riparian vegetation. Changes to channel morphology can reduce the ability of the watercourse to process sediment causing erosion and changing the amount or size of bed load being moved (ORCA 2015). Loss of riparian vegetation can result in more pollutants and run-off being transferred from the land to the water, impacting water quality and flooding downstream reaches. In addition, loss of riparian vegetation or changes to upstream or source of water supply can have impacts to the thermal regime of the watercourse. These changes affect riparian and aquatic habitat and can impair the watercourse for use by fish, wildlife, humans and other organisms (ORCA 2015).

The overall topography north of Fallis Line generally drains to Tributary B, which flows in a north-easterly direction. Tributary B drains into Tributary C, located along the southern boundary of the Study Area, before passing through a concrete box culvert at County Road 10. The total upstream drainage area of the Tributary C is 1,055.74 ha; and its associated floodplain will be entirely contained within open space blocks protecting proposed lots from flooding (Valdor, 2020).

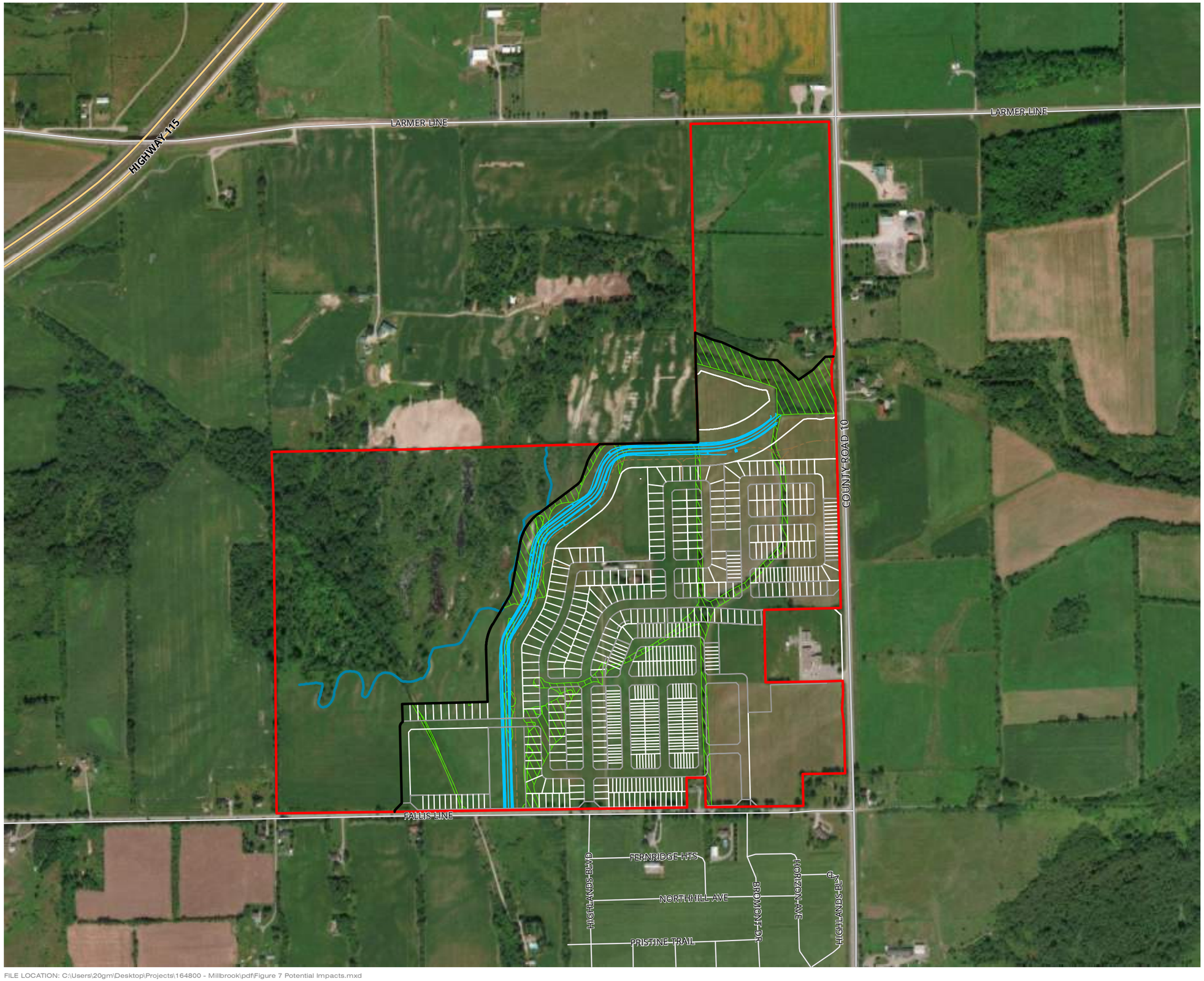

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FIGURE 7
POTENTIAL IMPACTS

- Study Area
- Limit of Development
- Proposed Channel
- Proposed Lot Line
- Proposed Road
- Proposed Trail
- Core Wetland Boundary
- Vegetation to be Removed (6.91 ha)

1:7,500

0 50 100 200 300 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 164800
STATUS: DRAFT
DATE: 2020-08-26

FILE LOCATION: C:\Users\20gm\Desktop\Projects\164800 - Millbrook\pdf\Figure 7 Potential Impacts.mxd

As mentioned, the proposed development plan includes the realignment of Tributary B around the development at its western boundary. In its current state, Tributary B contains standing water for the majority of its length, contains barriers to flow and fish movement and contains little terrestrial or riparian function. As a result, realignment of the tributary is expected to provide ecological and hydrological benefit; providing effective conveyance of flow downstream with robust riparian buffers creating additional habitat and corridor linkage function.

In order to determine the Regulatory flow through the Study Area associated with Tributary B, the upstream drainage areas were delineated, and hydrologic modelling was completed. The total upstream drainage area is 28.41 ha. Based on this analysis, it was determined that the Regional Storm is the Regulatory Storm with a peak flow of 2.228 cms (Valdor, 2020).

The uncontrolled Regional flow from the SWM pond is 4.187 cms. The proposed channel must therefore convey a total flow of 6.415 cms (Valdor, 2020). The proposed channel will be 1.1 m deep with an 11.00 m wide bottom (low flow channel), 3:1 side slopes and a minimum slope of 0.5%. The floodplain associated with the Tributary B will be entirely contained within the proposed channel which will be located within an EP block. As a result, the proposed lots will be protected from flooding (Valdor, 2020).

Refer to **Section 9.1-9.3** for mitigation measures related to surface flows.

8.1.1.1 Loss of Linkage Function

While areas designated as Natural Core Area will be preserved through the proposed development process, there are areas designated as Natural Linkage Area within the proposed development area. Natural Linkage Areas are defined by the County as areas forming part of a central corridor system that have the potential to support movement of plants and animals between the Natural Core Areas, Natural Linkage Areas, river valleys and stream corridors. Where development is proposed in the Natural Linkage Areas the Township requires that the Linkage function will be preserved and enhanced as the result of the proposed development.

While Tributaries A and C are surrounded by natural vegetation communities, Tributary B is located within an active agricultural field with little riparian vegetation for much of its length, and therefore likely provides marginal terrestrial habitat function in its current state. In addition, potential barriers to fish movement and effective flow conveyance exist along Tributary B in the form of crushed and/ or plugged culverts beneath the driveway and farm laneway (refer to photos in Appendix E). As a result, nutrient inputs from adjacent agricultural use and warming of pooled waters within the tributary pose in impact to downstream watercourses.

Furthermore, it was noted that during site visits that the bank of Tributary C is quite steep at its confluence with Tributary B and the grade difference is creating a barrier for fish to passage upstream into Tributary B through the dense grass during low flow. Based on this, Tributary B may contain

seasonal fish habitat downstream during high water periods (i.e., spring freshet). However, barriers present throughout the tributary prevent effective passage of fish upstream, and therefore, the primary function of Tributary B is likely contribution of allochthonous flows to downstream reaches.

Furthermore, consultation with DFO suggested that these barriers, specifically the grade difference to Tributary 3, present a danger to fish of getting trapped within Tributary B during high water and having no way of escaping back into the downstream system.

As a result, Tributary B is providing marginal function as a Linkage Area. Mitigation measures related to maintaining linkage functions within the Study Area have been included in **Section 9.1**.

8.1.2 Erosion and Sedimentation of Natural Features

Construction activity, especially operations involving the handling of earthen material, dramatically increases the availability of particulate matter for erosion and transport by surface drainage. In order to mitigate the adverse environmental impacts caused by the release of silt-laden stormwater runoff into receiving watercourses, measures for erosion and sediment control are required for construction sites. This is an extremely important component of land development that plays a large role in the protection of downstream watercourses and aquatic habitat.

Due to the potential for reduction in infiltration rate post-development, there is the potential for swamps, forests, and watercourses to be impacted as a result of development if construction best management practices are not implemented.

Potential impacts to these features may include, but are not limited to:

- Reduced water quality and degradation of downstream aquatic habitat (e.g. surface water flow into the wetland to the west and Baxter Creek downstream of the Study Area); and,
- Disturbance to or loss of additional vegetation due to the deposition of dust and/or overland mobilization of soil.

As a result, control measures must be selected that are appropriate for the erosion potential of the site and it is important that they be implemented and modified on a staged basis to reflect the site activities. Furthermore, their effectiveness decreases with sediment loading and therefore inspection and maintenance is required.

Refer to **Section 9.3** for mitigation measures related to erosion and sedimentation within the Study Area.

8.1.3 Reduction of Hydrological Function (Groundwater)

As apparent on Figure 4, a few small wetland pockets are isolated within the agricultural fields and been disconnected from the periphery of the wetland and core wetland complex that are proposed for

removal. In addition, there is one area of cattail marsh to the south within a low lying area that is proposed for removal.

As mentioned in **Section 6.1**, Geo-Logic Inc. has indicated that there is not a shallow water table aquifer at the site. The water levels during their assessments reflected seasonal spring conditions with ponded surface water, and a water table aquifer that is comprised generally of sand and gravel is not expected. Furthermore, at a few of the piezometer stations hydrostatic pressure from water encountered within sand seams appears to have created a potentiometric water level near the surface; similar to what you would see in a well. As a result, significant quantities of groundwater within the shallow soils are not expected within the Study Area, and as a result, impacts to groundwater are not anticipated.

Measures to prevent impacts to groundwater will be included in the integrated SWM system for the proposed development, which may include LID techniques related to groundwater. Refer to **Section 9.2**.

8.1.4 Reduction of Hydrological Function (Infiltration)

The pre-development baseline site infiltration condition was calculated as 0.510. The calculations indicate that the existing annual surplus is 155,524 m^3 and the annual infiltration capacity is 79,317 m^3 (Valdor, 2020).

Under post-development conditions and without implementing any infiltration mitigation measures, it is estimated that approximately 45,779 m^3 of water will infiltrate the ground. This represents 57.7% of the existing infiltration volume (Valdor, 2020). The notable reduction in infiltration volume is the result of an increase in the impervious area associated with the proposed development. Therefore, mitigation measures are necessary to achieve the site infiltration water balance (Valdor, 2020).

Refer to **Section 9.4** for mitigation measures related to infiltration.

8.1.5 Tree and Vegetation Removal

The proposed development plan indicates tree and ground vegetation removal limited to the development area as shown on Figure 7 to facilitate grading and construction of the development.

Tree removal would result in a reduction of tree cover, marginal wildlife habitat loss, and alteration of soil conditions. On a site level, the impacts of tree and vegetation removal may include:

- Direct loss of trees;
- Decreased floral species richness and abundance;
- Altered soil conditions and water availability;
- Alteration of microclimate;
- Loss of native seed banks; and,
- Physical injury, root damage, and compaction of trees not intended for removal that may result from construction operations.

As previously stated in this report, with the exception of Tributary B, which in its current states is not providing valuable hydrologic or fish habitat function; the Study Area is largely agricultural and provides minimal ecological function and thus, the removal will result in minimal habitat loss, minimal reduction of natural cover in the area, and minimal reduction in ecological function. Refer to **Section 9.5**-9.6 for mitigation and enhancement opportunities.

8.1.6 Loss of and/or Disturbance to Wildlife and Wildlife Habitat

Both SWH and Candidate SWH types were identified in association with woodland and wetland communities within the Study Area. In accordance with the PPS (2014), ORCA recommends that development and/or site alteration not be permitted in SWH or the applicable buffers unless it has been demonstrated that there will be no negative impact on the wildlife habitat or its ecological functions (ORCA 2015). Since development activities are proposed wholly outside of the Significant Woodland and core wetland areas, the potential for impacts to SAR or Species of Conservation Concern utilizing the woodland/ wetland complex is limited. Although the proposed realigned tributary is to encroach into the delineated candidate Waterfowl Nesting Area SWH, establishment of the realigned channel and its corridor to the east of the core wetland boundary is expected to provide added protection to the woodland and wetland communities as well as additional aquatic habitat and surface flow area, benefitting SWH for Waterfowl Nesting Areas and other SWH functions of the wetland/ woodlands. As a result, negative impacts to wildlife within adjacent natural features are not anticipated.

There is, however, potential for flora and fauna to be impacted by vegetation clearing and other activities within the proposed development area. Habitat for flora and fauna may be impacted by construction in the following ways:

- Displacement, injury, or death resulting from contact with heavy equipment during clearing and grading activities;
- Disturbance to wildlife as a result of noise associated with construction activities, particularly during breeding periods; and,
- Loss of general wildlife habitat.

Wildlife impact mitigation measures have been recommended for the development area and are included in Section 9.7.

8.2 Potential Indirect Impacts

Potential indirect impacts are those that do not always manifest in the core development area, but in the lands adjacent to the development. Potential indirect impacts can begin in the construction phase; however, they can continue post-construction. Potential indirect impacts of the proposed development include anthropogenic disturbance and colonization of non-native and/or invasive species.

8.2.1 Anthropogenic disturbance

Disturbance to local wildlife communities due to indirect impacts on the lands adjacent to the proposed development could result if left unmitigated. Noise, light, vibration and human presence are indirect impacts that can adversely influence the population size and breeding success of local wildlife. These effects are more pronounced when new development is introduced in non-urban areas. Lands within the development area are already disturbed with agricultural activities and therefore, with the establishment of appropriate buffers from natural areas, the proposed development is not anticipated to cause a negative impact to natural areas.

Refer to **Section 9.5** for mitigation recommendations related to buffers.

8.2.2 Colonization of Non-native and/or Invasive Species

Physical site disturbance can increase the likelihood that non-native and/or invasive flora species will be introduced to the surrounding vegetation communities. Invasive flora can establish in disturbed sites more efficiently than native flora and can then encroach into adjacent undisturbed areas. This is already occurring in some areas where species such as Common Buckthorn and Reed Canary Grass were observed. In order to maximize ecological function within the development area, removal of invasive species paired with planting of native tree and shrub species is recommended.

Refer to **Section 9.6** for mitigation recommendations related to invasive species.

9.0 Mitigation and Opportunities for Enhancement

Mitigation involves the avoidance or minimization of developmental impacts through good design, construction practices and/or restoration and enhancement activities. The feasibility of mitigation options has been evaluated based on the existing conditions within and adjacent to the Study Area. The impact assessment highlighted six potential direct impacts, which include diversion of surface water flows, erosion and sedimentation of natural features, reduction of hydrological function (groundwater and infiltration), tree and vegetation removal, and potential loss of or disturbance to wildlife.

A variety of mitigation techniques can be used to minimize or eliminate the potential impacts noted above. These measures may include a landscaping and plating plan, a wildlife impact mitigation plan, a SWM plan, erosion and sediment control plan and an environmental monitoring plan. Each mitigation measure is introduced below. Detailed mitigation measures will be finalized in consultation with the ORCA and the Township as part of the preliminary and Detailed Design of the development.

9.1 Realignment of Tributary B

As mentioned, the proposed development plan includes the realignment of Tributary B along the western boundary of the development. In its current state, Tributary B contains standing water for the majority of its length, contains two barriers to flow and fish movement (collapsed/plugged culverts) and contains little riparian vegetation. As a result, nutrient inputs from adjacent agricultural use and warming of pooled waters within the tributary pose an impact to downstream watercourses which are designated as cold water systems.

Tributary B is designated as a Natural Linkage Area in the Township OP. Where development is proposed in the Natural Linkage Areas the Township requires that the Linkage function will be preserved and enhanced as the result of the proposed development. In its current state, Tributary B is located within an active agricultural field with little riparian vegetation for much of its length, and therefore likely provides marginal terrestrial habitat function in its current state. In addition, potential barriers to fish movement and effective flow conveyance exist along Tributary B in the form of collapsed and/ or plugged culverts beneath the driveway and farm laneway (refer to photos in Appendix E).

ORCA generally recommends that all watercourses and adjacent areas remain in their natural state and that base flow and velocity be maintained. However, proposals to realign natural watercourses or previously realigned watercourses may be supported if the alterations are proven to establish flood relief, erosion control, or fisheries and/or environmental enhancement to ORCA's satisfaction (ORCA 2015).

Realignment of Tributary B will involve creation of approximately 1172.37 m of new, naturalized channel, flowing northeast outside of the western development boundary; resulting in an additional ~264 m of channel length when compare the existing condition within Tributary B. Furthermore, the total amount of area to be created below the high water mark for the realignment is 12,896 m^2, which equates to an increase of approximately 10,426.25 m^2 of habitat below the high water mark, and approximately 434.7 m^2 of potential fish habitat. Refer to Attachments A and B of Appendix E.
The upstream limit of the channel will originate at Fallis Line along the southern property boundary; incorporating a few disconnected wetland pockets along the periphery of the Significant Woodland/ wetland complex; and conveying flows from south of Fallis Line as well as surface water inputs within the property north and east toward Tributary C, and ultimately Baxter Creek. This will create a connected linkage corridor that does not currently exist in Tributary B. The existing confluence with Tributary C will be maintained at the downstream end of the realigned tributary to prevent potential downstream impacts.

Measures used to protect fish and fish habitat from development proposals in or around water include timing windows, which restrict work around water to times outside of the critical life stages of fish based on the water feature's thermal condition; and, buffer widths (ORCA 2015). Within the MNRF Peterborough District, the timing restrictions are as follows:

- Coldwater: April 1st – June 30th
- Warmwater: October 1st- May 31st
- Both: October 1st – June 30th.

Due to the thermal regime of Tributary B and C falling between cool-warmwater and warmwater, no in-water work should occur between October 1st- May 31st of a given year, unless no water is present (work in the dry). Refer to Appendix E for further mitigation measures related to in-water works.

The thermal regime of the water feature not only affects the timing for which works in and around water may be restricted to protect the local fish population, but it also has bearing on determining an appropriate buffer width for development and/or site alteration proposals adjacent to a water feature. Maintaining an appropriate shoreline buffer is another measure used to protect fish and fish habitat from development impacts (ORCA 2015). The minimum recommended natural vegetated cover adjacent to fish habitat is 30 m for both coldwater and warmwater fisheries.

The new realigned channel will flow between the development and a wetland complex to the west with a buffer of approximately 30 m on either side, effectively providing protection to both the created fish habitat within the realigned channel; as well as the wetland and SWH within the wetland. Application of natural channel design principles will be paired with native tree and shrub plantings to enhance water quality and the quality of habitat to be supported within the realigned channel and channel corridor. Enhancement activities within the corridor and buffer areas, will also increase the amount of terrestrial available habitat and overall wildlife corridor and linkage, and provide protection to the wetland and

associated tributaries through filtration of overland flows, and protection from edge effects. Furthermore, on the development side of the realigned channel will be the back lots of houses, rather than roadways, providing further protection to the corridor.

Two 2.4 m wide by 1.2 m high open-bottom concrete box culverts are proposed at Street "K" where it crosses the proposed channel. The culverts have been sized to convey the regional flow. As per Table 3 of the Fish and Wildlife Crossing Guidelines (Credit Valley Conservation, 2017), the minimum recommended openness ration for mid-sized mammals is 0.1, with a minimum height of 1 m. The openness ratio for the proposed culverts has been calculated at 0.144, and therefore meets these minimum requirements (Valdor, 2020).

As a result, realignment of this tributary as proposed will not only maintain the current linkage function, but provide a greater, enhanced function as it will connect to upstream flows at Fallis Line, form part of a larger corridor incorporated into the wetland/ Significant Woodland; provide additional terrestrial and aquatic habitat. Furthermore, the realigned tributary will provide protection to confirmed and candidate SWH habitat within the wetland complex, as well as a protected movement corridor along the periphery of the wetland. Refer to Appendix E for details on the channel realignment.

9.2 Stormwater Management Plan and Low Impact Design

As per the Township engineering design criteria, the proposed development is to be serviced with a minor storm sewer system that is designed to convey runoff from the 5-year storm event. The major system will generally be comprised of an overland flow route along the municipal road network directing drainage to a safe outlet. This major system will convey flows which are in excess of the capacity of the minor storm sewer system (Valdor, 2020).

The proposed SWM facility shall be designed to provide quality control, erosion control, and flood control as per the requirements of the MECP, ORCA and the Township, which include (Valdor, 2020). At the request of the Township, the SWM pond has been revised to accommodate an additional 5.6 ha of land to the west of the site, along the north side of Fallis Line in order to demonstrate that the proposed SWM pond has adequate capacity to provide the required levels of quality, quantity and erosion control for both development conditions (Valdor, 2020).

The proposed SWM pond is to be located within the north-west corner of the proposed development and will discharge into the realigned Tributary B. The proposed SWM pond has been designed to service a total area of approximately 41.49 ha (46.44 ha with the future development area to the west). Per the Township standards, MOE SWM pond criteria and recommendations in the geotechnical report, the SWM pond design includes 5H:1V side slopes, a 4.0 m wide maintenance access road to the headwalls and control structure, and access to the bottom of the forebay with a maximum 10% slope (Valdor, 2020).

9.2.1 Quality Control

Various source controls, conveyance and end-of-pipe SWM facilities were considered to provide the appropriate level of stormwater quality control. Reduced lot grades, rear and side yard swales, and discharge of roof leaders to pervious surfaces will augment the control provided by the SWM facility and promote infiltration where possible. Based on a preliminary review of available controls, it appears that the primary and most effective option to provide water quality control for runoff from the contributing drainage areas is a SWM facility (Valdor, 2020). In accordance with the ORCA requirements for development within the Baxter Creek watershed, Enhanced (Level 1) water quality protection shall, therefore, be provided by the proposed SWM facility (Valdor, 2020).

Based on the inclusion of the potential future development area to the west, the total drainage area for quality control purposes is 46.44 ha. Based on a total average assumed imperviousness of 66.0%, the required permanent pool volume is 8,158 m^3 (Valdor, 2020). In order to maintain a permanent pool of water in the pond and to prevent the mixing of surface water with ground water, the pond must be constructed in native, undisturbed till material or lined with either an imported clay material or synthetic material. Based on the composition of the soils within the proposed development area (clayey, silty till with sand and gravel), it has been assumed that a pond liner will be required (Valdor, 2020). This will confirmed at Detailed Design.

The normal water level of the permanent pool for the pond is set at an elevation of 241.50 m. The bottom of the pond is set at an elevation of 239.50 m, providing a permanent pool depth of 2.00 m in the forebay and main cell. The actual permanent pool storage volume provided is approximately 8,622 m^3 which is greater than the minimum required volume (8,158 m^3) (Valdor, 2020).

Drainage will be conveyed to the SWM pond via the storm sewer system, or overland via the road network to the low point adjacent to the SWM pond maintenance access road. Discharge from the SWM pond will be released to the proposed realigned channel, which will in turn discharge to Tributary C immediately upstream of County Road 10 (Valdor, 2020).

9.2.2 Erosion Control

In accordance with the ORCA guidelines, erosion control shall be provided using an extended detention active storage zone sized to capture the runoff resulting from a 25 mm rainfall event and to release the runoff over a period of at least 24 hours (Valdor, 2020).

Based on the modelling of this storm condition, the estimated runoff volume is 13.71 mm distributed over the 46.44 ha catchment area draining to the SWM pond for a required erosion control volume of 6,367 m^3. Based on the design for the SWM pond, the erosion control volume provided is 6,443 m^3 at an elevation of 242.35 m. This exceeds the required erosion control volume of 6,367 m^3 for the pond. The proposed extended detention depth is 0.85 m, which is less than the maximum recommended extended detention depth of 1.00 m (Valdor, 2020).

The extended detention function of the pond will be controlled with a 180 mm diameter orifice plate to achieve the minimum required drawdown time of 24 hours (48 hours is considered preferable) (Valdor, 2020).

9.2.3 Quantity Control

As per the ORCA and Township's standards. The SWM facility shall be designed to control the post-development peak flow to pre-development levels for the 2-year through 100-year design storms and to safely convey the greater of the uncontrolled 100-year or Regional flow.

The SWM pond has been designed with a total active storage volume of 19,088 m^3 at an elevation of 243.50 m. The expected maximum storage required during 100-year storm conditions is approximately 16,790 m^3 for the current development conditions, and 18,744 m^3 for the potential future development condition. The provided active storage is therefore sufficient (Valdor, 2020).

9.2.4 Thermal Mitigation

Mitigation measures will also be incorporated into the SWM pond design to minimize thermal impacts to the receiving watercourse. These measures include use of a bottom draw pipe and a planting strategy to promote shading along the pond perimeter.

Instead of the common perforated riser configuration, a bottom draw pipe will be implemented for the extended detention component to discharge water from the deepest section of the pond where the water temperature is lowest, providing benefit to the thermal regime of the receiving watercourse (Valdor, 2020). The planting strategy will provide the SWM pond with a natural appearance and provide environmental benefits. The plan will indicate shade producing species to minimize solar heating of the permanent pool during the summer months. The forebay provides an additional pond perimeter where this vegetation can be planted (Valdor, 2020).

Refer to the Functional Servicing Report by Valdor, 2020 for further details on SWM.

9.3 Erosion and Sediment Control Plan

The proposed development area is to be graded in accordance with the Township grading criterion which dictates that road grades are to range from 0.5% to 5.0% and that sodded yard areas are to range from 2.0% to 5.0%. For large grade differentials, a maximum slope 3H:1V can be used for sodded embankments. In areas where space is limited, retaining walls can be utilized to accommodate grade differentials, however, their use should be minimized (Valdor, 2020).

Based on the topographic survey, the proposed subdivision configuration and the Township's criteria, a preliminary grading design has been prepared. The preliminary grading design, considered the following factors:

- Achieve the Township's lot grading criteria.
- Meet the Township's vertical road design parameters.
- Minimize the requirement for retaining walls.
- Match existing grades along the adjacent properties and road allowances.
- Grading along existing road allowances is to have consideration for their future urbanization and grades are to be established to accommodate future boulevard slopes in the range of 2 to 4%.
- Provide an overland flow route to direct drainage to a safe outlet.
- Provide sufficient cover over the sanitary sewer (Valdor, 2020).

An analysis of the earthworks will be conducted using modelling software at the Detailed Design stage to optimize the cut and fill volumes in an effort to achieve a balance. Based on the preliminary design, no significant difficulties are anticipated in achieving the municipal grading design standards. It is anticipated that the lots will generally be split draining and the lots along the north, east and west limits of the site will be basement walk-out type lots. Due to grading constraints associated with the required minimum cover over the sanitary sewer at the north east corner of the site, a retaining wall will be required along County Road 10 (Valdor, 2020).

As previously stated, control measures must be selected that are appropriate for the erosion potential for the site. On relatively large sites, measures for erosion and sediment control typically include the use of sediment control basins, silt fencing, a mud mat and sediment traps. The following is a description of the sediment controls to be implemented for the proposed development:

- Temporary Sediment Control Basins are commonly used to clarify silt-laden stormwater runoff by promoting sedimentation of the suspended particles in the runoff through long detention times. The proposed SWM pond will be utilized as temporary sediment control basins during construction.
- Silt Fences are to be installed adjacent to all property limits subject to drainage from the development area prior to topsoil stripping and in other locations, such as at the bases of topsoil stockpiles. It is recommended that earthworks not extend immediately adjacent to the silt fence and instead a 1-2 m vegetated buffer be maintained for additional protection. Heavy duty silt fence is recommended to be installed adjacent to the wetland consisting of two rows of silt fencing with straw bales between.
- Mud Mat is to be installed at the construction entrance prior to commencing earthworks to minimize the tracking of mud onto municipal roads.
- Sediment Traps are to be installed at all catchbasin locations once the storm sewer system has been constructed to prevent silt laden runoff from entering.
- Rock Check Dams are to be constructed in swales and ditches to reduce velocities and trap sediment (Valdor, 2020).

Furthermore, as the proposed development area falls within the ORCA Regulated Area, a grading permit is required under Ontario Regulation 166/06 prior to commencing topsoil stripping and earthworks. The

permit application should be submitted in conjunction with the detailed design at the subdivision engineering stage.

Refer to the Functional Servicing Report (Valdor, 2020) for further details on erosion and sediment control.

9.4 Water Balance

In accordance with the requirements of the ORCA, a site water balance assessment was completed for the proposed development to determine the overall infiltration deficit under proposed conditions and to design infiltration facilities as part of an overall mitigation strategy to maintain pre-development infiltration volumes. Data for the assessment was obtained from soil mapping obtained from the Ontario Soil Survey mapping for Durham County, satellite imagery, the Stormwater Management Planning and Design Manual (Ministry of the Environment, March 2003) and the Geotechnical Investigation Report for the proposed development.

With regards to land use, the analysis reflects existing conditions which is described as predominantly agricultural, with pockets of pasture and shrub areas. The proposed land use is primarily residential with the pervious component being limited to the lawn areas. The proposed bypass channel and open space blocks will also consist of lawn areas, and a portion of the existing pasture and shrub areas will remain undeveloped.

As mentioned previously, under post-development conditions and without implementing any infiltration mitigation measures, it is estimated that infiltration would be approximately 57.7% of the existing infiltration volume due to the increase in impervious cover. In order to minimize the impact of development on the future water balance for the site, infiltration mitigation measures will be promoted and incorporated within the proposed development. These measures include basic and enhanced best management practices (BMPs) as follows:

Basic Best Management Practices

- Roof down spouts of the dwellings will be directed to pervious lawn areas and grassed swales where feasible to promote infiltration;
- Where applicable, grassed swales will be constructed alongside and rear lot lines;
- Where possible, the fine grading of lots will be completed with an extra depth of topsoil to encourage infiltration and absorption.

Under proposed conditions with the implementation of the above basic infiltration BMPs, approximately 55,779 m^3 of water will infiltrate the ground which equates to approximately 70.3% of the pre-development infiltration volume (Valdor, 2020).

Enhanced Best Management Practices

In an effort to better match the existing infiltration volumes, enhanced infiltration BMPs in the form of infiltration trenches are required. Through the implementation of the proposed infiltration trenches, the annual infiltration capacity can increase by 23,871 m^3. As a result, the post-development infiltration volumes for the site will be 79,650 m^3, which is 100.4% of the pre-development volume. Based on the water balance calculations completed, a minimum drainage area of 8.60 ha, including rear yard and roof areas, will need to be directed to the proposed infiltration trenches to achieve the required annual infiltration volume. These details will be confirmed at Detailed Design.

The proposed infiltration trenches will be lined with filter fabric, filled with 50 mm diameter clear stone and will be designed to overflow into the storm sewer, or sheet flow into the open pace blocks, once the storage capacity of the trench is exceeded.

Refer to the Functional Servicing Report by Valdor (2020) for further information.

9.5 Natural Heritage Buffers

The development area will be limited to the boundaries shown on Figure 6, with an approximately 30 m buffer applied to the wetland complex. In order to off-set the minimal encroachment proposed within a few of the isolated wetland pockets along the periphery of the core wetland area, enhancement activities are recommended, which include planting of native tree and shrub species along the realigned channel corridor to increase the quality of habitat within the buffer, and to provide better protection to wildlife and adjacent natural features within the wetland and Significant Woodland area. Furthermore, activities where encroachment into isolated periphery wetland pockets is proposed are associated with the stream realignment, and therefore, those disconnected pockets will be incorporated into the realigned stream.

In its current state, the buffer areas consist primarily of agricultural lands. Enhancement activities within the buffer areas, including plantings associated with the realigned channel corridor will increase the amount of available habitat and overall wildlife corridor. In addition, this naturalized, vegetated buffer will provide protection to adjacent natural features within the wetland and associated tributaries, through filtration of overland flows, and protection from edge effects to the wetland. As the proposed buffer enhancements will not only increase the overall quality of available habitat within the buffer, but also the quality and protection of both aquatic and terrestrial habitat within the adjacent natural features.

Buffer enhancement plantings should be detailed in a Landscaping and Planting Plan, described below.

9.6 Landscaping and Planting Plan

The proposed development plan will require the removal of select trees and shrubs, and other vegetation within the Study Area. It is recommended that a Landscaping and Planting Plan be prepared for the proposed development to off-set vegetation removal and incorporate natural plantings within the development, where possible. Compensation plantings of trees are generally based on the number of removals required to facilitate construction of the development. The exact number of compensation plantings and locations is to be determined through Detailed Design of the development. The planting plan may include, but is not limited to:

- A mix of native deciduous and coniferous trees and shrubs throughout the development and buffer area;
- Sodding within the residential portions of the development; and
- A native seed mix recommended by suppliers for enhancement within buffer areas.

A landscaping plan has already been completed as part of the channel realignment works and is included in Appendix E. The channel plantings plan includes native tree and shrub species to be planted within the wetland buffer area as well as native seed mixes. Refer to Appendix E for further details.

The following monitoring and maintenance measures may also be recommended for both the buffer and channel enhancement areas:

- Removal of invasive tree and shrubs (i.e., buckthorn), where applicable;
- Watering and weeding of newly planted areas as required for proper establishment of plantings; and
- Replacement of dead material from previous year's planting.

9.7 Wildlife Impact Mitigation Plan

Strategies to mitigate impacts to general wildlife prior to and during construction are proposed. These may include (but are not limited to):

- Clearing vegetation outside the breeding bird season (April 1 to August 31);
- Should any clearing be required during the breeding bird season (April 1 to August 31), nest searches conducted by a qualified person must be completed 48 hours prior to clearing activities. If nests are found, work within 10 m of the tree should cease until the young of year have fledged or until the nest is determined to be inactive. If no nests are present, clearing may occur. This is in accordance with the federal *Migratory Birds Convention Act*;
- Schedule vegetation clearing and grading activities to avoid disturbance to breeding amphibians and other sensitive wildlife species, where possible;
- Where possible, maximize the distance of construction equipment used from the woodland/wetland edge to avoid disturbing wildlife;

- Limit the use of lighting, where possible. Avoid light effects entering the woodland/wetland (eliminate light trespass), where possible;
- Installation of wildlife exclusion fencing and escape routes, which direct wildlife away from the construction area and to more suitable habitat;
- Visual monitoring for wildlife species and avoidance where encountered, if possible;
- If necessary, have a qualified biologist monitor construction in the areas of potential wildlife habitat. If wildlife are found within the construction area they will be re-located to an area outside of the development into an area of appropriate habitat, as necessary;
- Construction crews working on site should be educated on local wildlife and take appropriate measures for avoiding wildlife; and
- Should an animal be injured or found injured during construction they should be transported to an appropriate wildlife rehabilitation center.

In addition, as Barn Swallow was observed within the Study Area; although as a flyover and specific habitat use was not noted.

9.8 Environmental Monitoring Plan

The Environmental Monitoring Plan (EMP), if necessary, would be carried out through the duration of construction activities on-site to ensure that the erosion and sediment control measures operate effectively. The duration of construction is defined as the period of time from the beginning of earthworks until the site is stabilized. Site stabilization is defined as the point in time when the roads have been paved, buildings have been built, lawns have been sodded and restoration plantings have been completed.

Erosion and sediment control measures should be regularly monitored and are likely to require periodic cleaning (e.g. removal of accumulated silt), maintenance and/or re-construction. Inspections of the erosion and sediment controls on the construction site should be undertaken by a certified sediment and erosion control monitor. If damaged control measures are observed they should be repaired and/or replaced promptly. Site inspection staff and construction managers should refer to the Erosion and *Sediment Control Inspection Guide* (2008) prepared by the Greater Golden Horseshoe Area Conservation Authorities. This guide provides information related to the inspection reporting, problem response and proper installation techniques.

The EMP should be implemented during active construction periods in the development area with the following frequency:

- On a bi-weekly basis;
- After every 10 mm or greater rainfall event;
- After significant snow melt events; and/ or
- Prior to forecasted rainfall events.

If damaged control measures are found they should be repaired and/or replaced within 48 hours. Site inspection staff and construction managers should refer to the Erosion and Sediment Control Inspection Guide (2008) prepared by the Greater Golden Horseshoe Area Conservation Authorities. This Inspection Guide provides information related to the inspection reporting, problem response and proper installation techniques.

Protected vegetation areas may also require periodic monitoring to ensure that they are not being impacted by the proposed development. Should impacts be observed, necessary steps will be taken to ensure that the impacted vegetation is either restored or replaced.

The details of the EMP would be confirmed through consultation with ORCA and/or the Township at the Detailed Design stage.

10.0 Summary

This EIS was prepared for in support of an application for Draft Plan of Subdivision for a property known as Towerhill Development North, located at Fallis Line and County Road 10, in the Township of Cavan-Monaghan, Peterborough County. An EIS was required due to the presence of natural heritage features including woodlands and wetlands, which have the potential to be impacted by development activities. The findings of the biophysical inventory, which consisted of secondary source reviews supported by a full field program, are summarized below.

The presence of a Significant Woodland, non-Provincially Significant Wetland, and associated SWH and candidate SWH was confirmed through field surveys in 2017. The majority of lands within the proposed development area consist of agricultural fields and therefore, do not contain significant natural features. The Significant Woodland, wetland complex, and core SWH within the Study Area will be protected from development. In addition, establishment of buffers, along with enhancement through planting of native species within the buffer area are proposed to provide further protection to Significant Woodland/ wetland and wildlife habitat.

A number of policies and guidance documents are outlined in section relating to the natural environment. Specifically, natural heritage policies under Section 2.1 of the PPS; Section 6 of the Cavan-Monaghan Official Plan; and Section 2.3 of the ORCA Watershed Planning & Regulations Policy Manual (2015). Policies related to protection of natural features have been addressed as part of this EIS; summarized in the following paragraphs.

An OWES wetland evaluation has been conducted for wetlands within the Study Area and considering wetlands beyond the Study Area; the results of which have been approved by the MNRF Peterborough District for incorporation into the provincial mapping layers. The OWES evaluation conclude that no significant wetlands are present within the Study Area. Furthermore, all development activities including creation of the realigned channel will be 30 m from the core wetland boundary and the Significant Woodland. Therefore, no development is proposed within 30 m of the Significant Woodland or a Provincially Significant Wetland.

As confirmed through correspondence with DFO, no fish habitat is present within the Study Area, and therefore, no development is proposed within fish habitat. Furthermore, creation of the realigned channel will provide more potential habitat for fish than is currently available within the Study Area.

In general, natural heritage features within the Study Area have been protected and in some cases enhanced with the creation of a natural meandering channel bordering the wetland, Significant Woodland, and SWH; and creating a permanent protected movement corridor that currently exists as agricultural fields, effectively separating the natural areas from the proposed development.

Development of the project with the realigned channel is therefore expected to enhance linkage function within the natural heritage system, provide a layer of protection to the core natural areas, and increase the amount of available habitat within the Study Area.

A portion of fringe wetland and candidate SWH for Waterfowl Nesting Areas will be incorporated to the realigned channel. Due to the existing agricultural nature of the proposed development area, the addition of the realigned tributary will contribute to the candidate Waterfowl Nesting Areas by providing more habitat, as well as a protected corridor for movement along the edge of the wetlands and protection from predators. Protection from predators in the form of natural vegetated cover within 120 m of a wetland is a key function of the SWH buffer for Waterfowl Nesting Areas that does not currently exist within the Study Area. Therefore, as mentioned, establishment of this channel will increase the amount of available habitat within the NHS and the Study Area, and also create a protected movement between the core areas and the proposed development.

The proposed realigned channel will provide a greater amount (and higher quality) fish habitat, and will also benefit the core natural features within the Study Area. Vegetated buffers consisting of native tree, shrub, and grass species will be established within the riparian areas within approximately 30 m of the realigned channel rom the edge of the meanderbelt; or high water mark. The SWM pond proposed for the development will tie into the realigned channel (outlet), but will be sited outside of the 30 m watercourse buffer and floodplain. Vegetated buffers and other SWM mitigation measures have been proposed to avoid potential negative impacts to downstream reaches of the tributary.

Lastly, appropriate steps will be taken with respect to SAR to avoid contravention of the ESA, 2007.

Potential ecological impacts of development may include diversion of surface water flows, erosion and sedimentation, tree and vegetation removal, and general impacts to wildlife. These impacts can be avoided or minimized by implementing the mitigation, restoration, and management measures described in this report.

Appendix A

Terms of Reference

MEMO

TO: Erin McGauley, Otonabee Region Conservation Authority

FROM: Whitney Moore, Dillon Consulting Limited

cc: Andrew McLeod, Towerhill Developments Inc.
Luka Kot, Towerhill Developments Inc.

DATE: June 19, 2017

SUBJECT: Environmental Impact Study Terms of Reference for the Towerhill Developments Inc. property located at Fallis Line and County Road 10 in Millbrook, Ontario.

OUR FILE: 16-4800

Introduction

Dillon Consulting Limited (Dillon) has been retained by Towerhill Developments Inc. to undertake environmental studies for a proposed residential development at County Road 10 and Fallis Line in the community of Millbrook, Ontario. As such, Towerhill Developments Inc. and Dillon are taking a pro-active approach to environmental-first planning and undertaking the appropriate environmental studies that are required to complete an Environmental Impact Study (EIS) and utilizing the results in the planning of this property. A figure outlining the location of the subject property is attached.

In keeping with the general policies of the Otonabee Region Conservation Authority (ORCA) Environmental Impact Study Terms of Reference & Submission Standards (2015), we have prepared the following Terms of Reference (TOR). Below, we present the TOR in a check-list format to ensure that the required work and/or studies are known and agreed to prior to the commencement of work, to facilitate a stream-lined and timely review process.

Terms of Reference

General Policies

☒ The EIS must be undertaken by a qualified professional in environmental or related sciences to provincial standards and/or the satisfaction of the ORCA.

☒ A visit to the site may be required by the Authority prior to, during, or upon receipt of the EIS.

☒ The staking of significant natural features (i.e., woodlands, wetlands, etc.) by the Authority may be required. Staking will generally occur between the end of May and the end of October. Any staking that occurs outside of this time may require a confirmatory visit between May and October.

Existing Conditions

☒ The existing conditions of the subject site must be clearly described and clearly mapped on aerial photographs.

☒ The description must include the zoning and all designations of all Official Plan(s) (OP) on the subject site. This includes any land use designations from other municipal planning documents, such as Secondary Plans.

☒ Land use designations from any other applicable planning documents (e.g., Oak Ridges Moraine Conservation Plan) must be clearly described and the limits identified in the mapping.

☒ The EIS shall identify the components of the natural heritage system (should it be located on the subject lands). The boundaries of the natural heritage system shall be confirmed in the field by the proponent, mapped on a figure in the report and approved by the Authority and the planning authority.

☒ All natural heritage features (woodlands, wetlands, Areas of Natural and Scientific Interest (ANSIs), valleylands, significant wildlife habitat, etc.) and watercourses must be identified in the mapping and described in the report.

☒ A description of the soils, landforms and surficial geology based on a review of available mapping and literature must be described in the report. Any staking done to date as well as the calculated hazard limits will be provided on constraints mapping. If available, topographical information will be provided on constraints mapping.

☒ Hydrological and hydrogeological resources and issues, including surface water features, recharge/discharge zones, groundwater quality and quantity, groundwater elevations and flow directions, and connections between groundwater and surface water features will be identified based on the information available from the consulting team.

☒ A wetland evaluation is required following the Ontario Wetland Evaluation System (OWES) for Southern Ontario (MNRF, 2013). The evaluation will be completed by an MNRF-certified OWES evaluator within the Study Area only, where land access is permissible. The results of the OWES evaluation will be incorporated into the EIS report, and provided to ORCA and the MNRF.

Note: Areas of unevaluated wetland have been identified within the western portions of the Study Area. These wetlands form part of the Natural Heritage System.

☒ The vegetation communities must be identified using the Ecological Land Classification (ELC) system to vegetation type, where possible. The communities must be identified in the mapping, using the appropriate ELC codes, as well as described in the text. As a component of the ELC, a plant list must be included as an appendix. The list must include an analysis for the presence of federal, provincial, regional and/or watershed rare, threatened or endangered species. This should include information from the MNRF district office and NHIC.

☒ Two-season (spring and summer) plant survey is required to identify rare or uncommon species. The list must include an analysis for the presence of federal, provincial, regional and/or watershed rare, threatened or endangered species. This should include information from the MNRF district office and NHIC.

☒ The EIS requires a breeding bird survey. The survey must be conducted during the breeding bird season at an appropriate time of day in appropriate weather conditions and by a qualified professional. A minimum of two surveys are required and they must follow generally accepted scientific protocols, not necessarily atlasing methods. A list of the breeding birds is required as an appendix. The list must include an analysis for the presence of federal or provincial rare, threatened or endangered species. Watershed rarity status shall be determined in conjunction with the Conservation Authority.

☒ The EIS requires a breeding amphibian survey. The survey must be conducted during the breeding amphibian season and by a qualified professional. For calling amphibians a minimum of three surveys are required. These surveys must span the full amphibian breeding season to ensure that the peak periods of activity for early and late breeding species are accounted for. For non-calling amphibians, appropriate methodology must be used. A list of the breeding amphibians is required as an appendix. The list must include an analysis for the presence of federal, provincial, threatened or endangered species. Watershed rarity status shall be determined in conjunction with the Conservation Authority.

☒ A fisheries assessment shall be provided due to the presence of potential suitable fish habitat and confirmed on-site by the ORCA and MNRF. Existing data regarding fish species shall be obtained from ORCA and/or the MNRF and used for the fisheries assessment. The assessment shall include a description of watercourses or other fish habitat on and/or adjacent to the property (where site access is permitted).

Note: A watercourse has been identified within subject lands. A Fisheries Act Request for Review is currently underway to identify potential for impacts of development and mitigation measures to ensure no serious harm to fish or fish habitat, as requested by the client.

☐ The fisheries assessment will include community sampling through electrofishing and/or netting during the appropriate season, under a collection permit issued by the MNRF.

Note: Fish community sampling is not proposed. An information request was submitted to ORCA on November 4, 2016 requesting fisheries sampling information, and data was received on November 9, 2016; with additional data received on February 24, 2017.

☒ All incidental wildlife observed shall be reported on and listed in an appendix. The list must include an analysis for the presence of federal or provincial rare, threatened or endangered species. Watershed rarity status shall be determined in conjunction with the Conservation Authority.

☒ A functional assessment of the subject site describing the ecology of the natural heritage features and functions (including components of the natural heritage system) within and

adjacent to the subject site should be provided. The functional assessment may include ecological function, wetland functions, natural heritage features and landscapes, benefits of importance to humans, and corridors and linkages, as required.

Evaluation of the Ecological Impacts

☒ Mapping (at a minimum) shall consist of the following:

a) All mapping must have a title, figure number, north arrow, legend and scale or scale bar.
b) A site location map that provides the regional or watershed context of the subject site.
c) The extent of natural heritage features identified must be clearly demarcated on an air photo base, if applicable.
d) The locations of all watercourses and waterbodies and an indication of their flow and thermal regimes.
e) Vegetation communities must be delineated and identified using ELC.
f) The location of any rare, threatened or endangered species and/or populations shall be identified, if appropriate.
g) The location of any important wildlife features (i.e., hibernacula, den, stick nest, etc.) shall be identified.

☒ The potential impacts to the features and functions of natural areas shall be identified and discussed.

☒ An assessment of the potential impact on wildlife at a local, watershed and provincial (if applicable) level shall be provided.

☒ In the case of significant natural features (as confirmed through field studies), the EIS must demonstrate that there is no development or site alteration within the feature with the exception of uses as specified in the OP and/or prior approvals. The EIS must determine appropriate buffers from significant natural features.

☒ If applicable, where natural features or natural vegetation communities are proposed for removal, the quantity of removal shall also be included.

☒ An assessment of the potential impact on the natural heritage system, including any linkage areas that have been identified shall also be included.

Recommendations and Mitigation Measures

☒ Avoidance of any natural heritage system feature is the preferred approach to mitigation unless otherwise specified in the OP and/or prior approvals.

☒ Determine adequate buffers through the identification of the critical function and protection zones of any identified natural areas.

☒ Where avoidance of a feature is not feasible or possible, mitigation approaches/techniques must be provided. These may include edge management plans, buffer plantings, fencing, low impact designs (LID), etc.

☒ In cases where a linkage area has been identified on a property, the EIS must demonstrate how it will be integrated into the proposed development plan.

☒ Recommendations for Best Management Practices during construction should be provided. This may include silt fencing, tree protection, fencing, identification of timing or seasonal constraints to construction or restoration, etc.

☒ Mitigation for negative impacts on the natural features or their ecological functions (or to achieve no net negative impact) may include, at the discretion of the planning authority in conjunction with the Conservation Authority, approaches to replace lost areas or functions. If acceptable, replacement shall, to the extent possible, occur within the same subwatershed as the proposed development or site alteration. The appropriate amount of replacement will be determined through discussions with the Conservation Authority and the planning authority and will be agreed to by all parties in writing.

☒ If monitoring is required, the details of a monitoring program must be agreed to in writing by the Authority, planning authority and other parties.

Conclusions

The EIS will address conformity with the following:

☒ Policies and requirements of the Township of Cavan Monaghan and the County of Peterborough Official Plans.

☒ Policies and requirements of other applicable planning documents (i.e., Oak Ridges Conservation Plan, etc.)

☒ Requirements of the ORCA.

Species at Risk

Should any Species at Risk or their habitat be identified during the EIS process and confirmed in the field, the MNRF will be notified and we will address any species at risk requirements as outlined in the *Endangered Species Act, 2007* under separate cover with MNRF. The ORCA will be informed of MNRF approvals that are acquired.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

MILLBROOK
INFORMATION REQUEST

PROJECT LOCATION

Project Location
Road

0 50 100 200 Metres

SCALE 1:9,585

N
W E
S

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF

MAP CREATED BY: LK
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT:

STATUS: DRAFT

DATE: 2016-11-04

Appendix B

Official Plan Schedules

Township of Cavan Monaghan
Official Plan - Schedule 'A-1'

Land Use and Transportation

MILLBROOK

Settlement Area

Legend

- Millbrook Urban Settlement Area
- Built Boundary
- Oak Ridges Moraine Boundary

Land Use

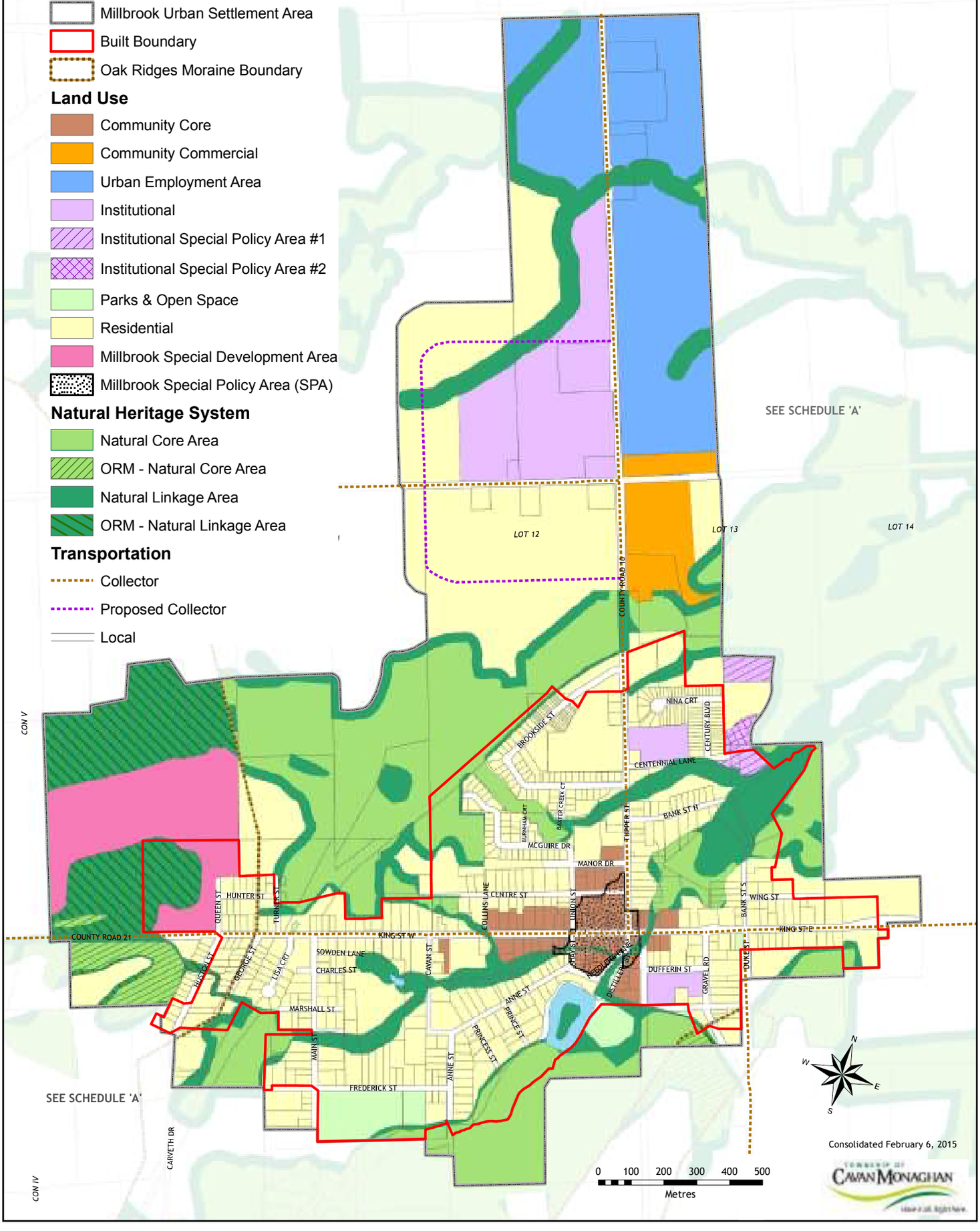
- Community Core
- Community Commercial
- Urban Employment Area
- Institutional
- Institutional Special Policy Area #1
- Institutional Special Policy Area #2
- Parks & Open Space
- Residential
- Millbrook Special Development Area
- Millbrook Special Policy Area (SPA)

Natural Heritage System

- Natural Core Area
- ORM - Natural Core Area
- Natural Linkage Area
- ORM - Natural Linkage Area

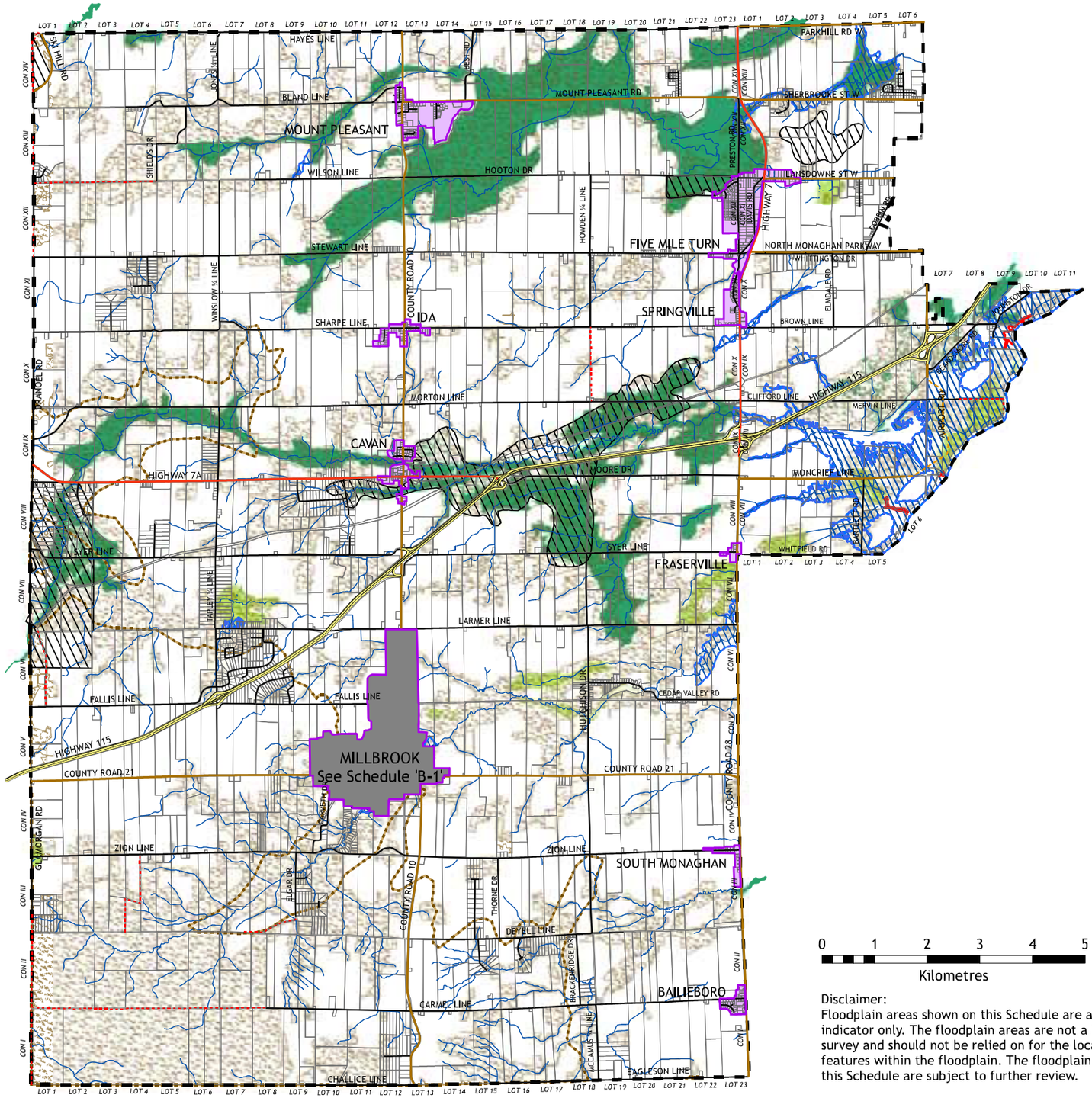
Transportation

- Collector
- Proposed Collector
- Local



Consolidated February 6, 2015

Township of Cavan Monaghan Official Plan - Schedule 'B' Natural Heritage System and Environmental Constraints



Legend

- Settlement Areas
- Hamlet
- Millbrook Urban Settlement Area

Natural Features

- Watercourse
- Oak Ridges Moraine Boundary
- ANSI
- Fish Spawning Area
- Floodplain Area
- Significant Woodland
- Other Wetland
- Provincially Significant Wetland

Transportation

- Freeway
- King's Highway
- County Road
- Proposed Arterial Road
- Township Road
- Private Road

0 1 2 3 4 5

Kilometres

Disclaimer:
Floodplain areas shown on this Schedule are a general indicator only. The floodplain areas are not a legal plan of survey and should not be relied on for the location of features within the floodplain. The floodplain areas on this Schedule are subject to further review.

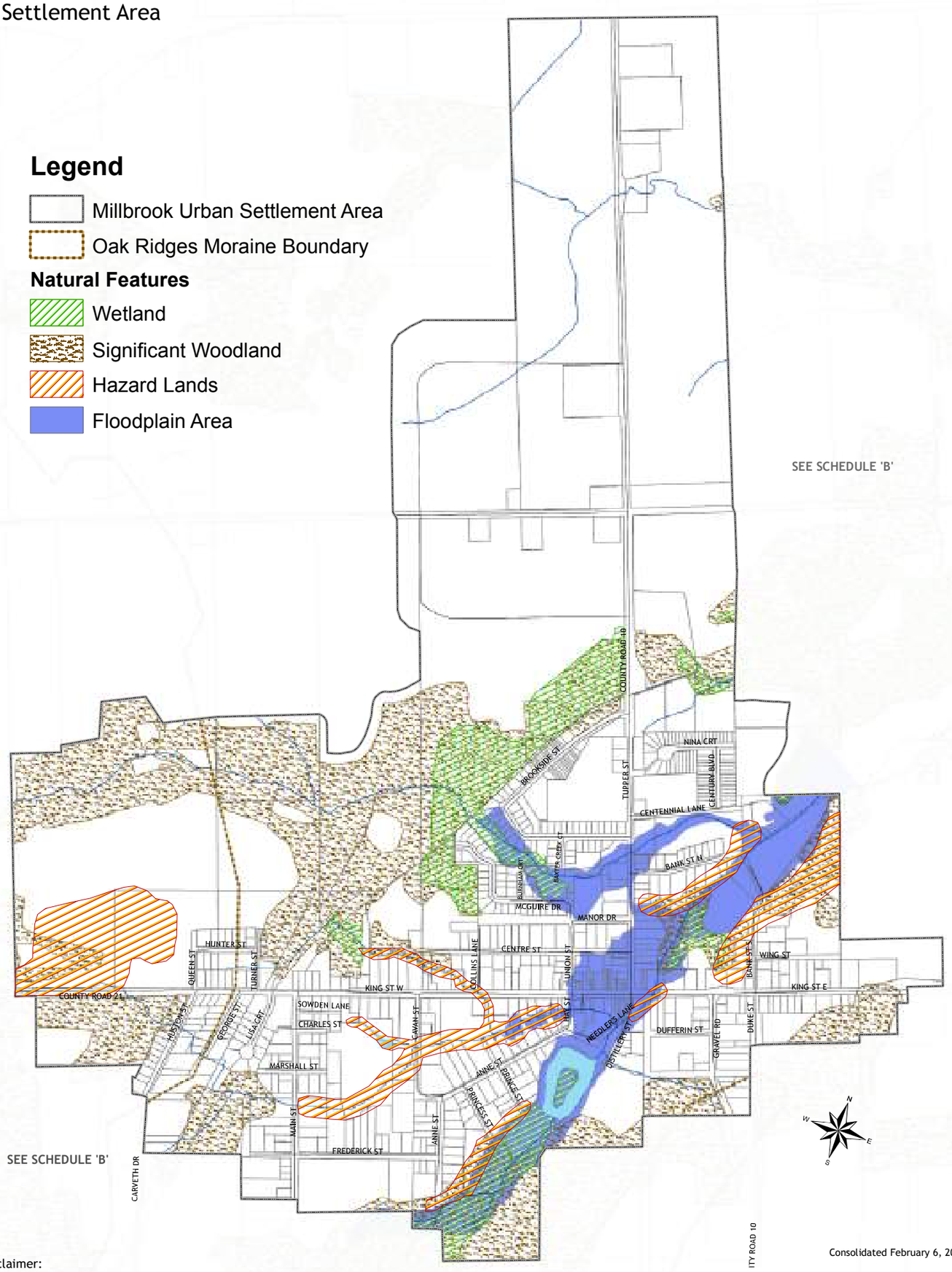
Consolidated February 6, 2015

Township of Cavan Monaghan
Official Plan - Schedule 'B-1'

Natural Heritage System and Environmental Constraints

MILLBROOK

Settlement Area



Disclaimer:
Floodplain areas shown on this Schedule are a general indicator only. The floodplain areas are not a legal plan of survey and should not be relied on for the location of features within the floodplain. The floodplain areas on this Schedule are subject to further review.

Consolidated February 6, 2015

TOWNSHIP OF CAVAN MONAGHAN

Appendix C

Historic Photos


HIGHWAY
CANADIAN
Millbrook

Appendix D

Species at Risk Screening

DILLON CONSULTING

Moore, Whitney <wmoore@dillon.ca>

RE: Information Request- County Road 10 and Fallis Line, Millbrook

1 message

Hernould, Cara (MNRF) <Cara.Hernould@ontario.ca> Wed, Aug 2, 2017 at 11:15 AM
To: "wmoore@dillon.ca" <wmoore@dillon.ca>

Hi Whitney,

MNRF Peterborough District has received your information request regarding the wetland and Species at Risk Screening with respect to the project area located on the Northeast corner of County Road 10 and Fallis Line in part of Lot 11 and 12, Concession 6 and part of Lot 12, Concession 5, at the Township of Cavan. We provide the following general information for your consideration:

Wetlands

The subject property is near (not adjacent) to the Millbrook Northeast evaluated wetland and contains an unevaluated wetland. We recommend contacting the local Conservation Authority for more information on approvals that may be required.

Species at Risk

A review of our best available information indicates that there are occurrences of Snapping Turtle (Special Concern) in the immediate area of the site. Also, there are occurrences of Wood Thrush (Special Concern), Red-headed woodpecker (Special Concern), Eastern Wood-Peewee (Threatened), Eastern Meadowlark (Threatened), Butternut (Endangered), Bobolink (Threatened), and Barn Swallow (Threatened) in the general area (5 km) of the proposed activities. Although no other threatened or endangered species or their habitat have been documented in the area of the proposed projects, these features may be present and this list should not be considered complete.

Species listed as endangered or threatened on the Species at Risk in Ontario (SARO) list are protected under the Endangered Species Act, 2007 (ESA). Section 9(1) of the ESA prohibits a person from killing, harming, harassing, capturing or taking a member of a species listed as endangered, threatened or extirpated on the SARO list. Section 10(1) of the ESA prohibits the damage or destruction of habitat of a species listed as endangered or threatened on the SARO list.

Since comprehensive mapping for most Species at Risk is not available, a site assessment is recommended to identify the presence of any Species at Risk and/or their habitat on the subject lands, as a decision should not be made in the absence of such information. The focus of the site assessment can include a review of the information about known occurrences provided by MNRF above along with other information sources such as species distributions and habitat requirements as well as field visits using MNRF approved protocols during the appropriate seasons by a qualified professional. Due to the species that are potentially present at this site, the following recommendations should help prevent adverse impacts:

Birds

Workers must be vigilant and check work areas for the presence of breeding birds and nests containing eggs and/or young. If breeding birds and/or nests are encountered, works should not continue in the location of the nest until after August 1 (or as soon as it has been determined that that the young have left the nest). Please note that the breeding bird season in the subject area extends from April 15 to July 31.

Specific Barn Swallow Information: Barn Swallow nests may be present under bridges and/or culverts. Therefore, the underside of these structures should be assessed for Barn Swallow nests before proceeding. If no nests are present, a contravention of the ESA is unlikely. However, if nests are present, construction should not begin until after August 15 of any year. If nests will be impacted during the nesting season or if the structure will no longer be suitable for nesting post-construction, ESA requirements will apply to the activity. A regulatory provision is available that allows eligible activities that impact to Barn Swallow to register and follow all the rules in regulation in place of applying for a permit under the ESA. See our website for more information on regulatory requirements for Barn Swallow.

Turtles and Snakes

Workers must be vigilant and check work areas for the presence of turtles. If turtles or snakes are encountered, whenever possible, work should be temporarily suspended until the animal is out of harm's way. Workers should report any turtle observations (including photographs and coordinates) to the Peterborough District Office immediately at (705) 755-2001. Please note that the turtle nesting season in the subject area extends from May 15th to September 30th. Therefore, activities which may cause adverse impacts to a species or habitat (e.g. use of heavy equipment) should commence after September 30th.

Butternut:

If a Butternut tree(s) is identified and is to be removed, trimmed or is in close proximity to the application of herbicides, a Butternut Health Assessment should be conducted by an individual trained and certified by MNRF as a Butternut Health Assessor (BHA) under the Butternut Health Assessment in Ontario protocol. All Butternut Health Assessments must be submitted to the MNRF District office for a 30 day review period before proceeding. Depending on the results of the assessment, you may have different options for how to proceed - Please see the online factsheet for more information. Please note that the ideal time of year to properly identify Butternut (and to distinguish between Butternut and Butternut Hybrids) is between the leaf on and leaf off period (approximately June to August). Workers should report any Butternut observations (including photographs and coordinates) to the Peterborough District office immediately upon discovery. For those Butternut that are not proposed for removal, a minimum protective buffer of a 25 metre radius from the stem of each Butternut is required to prevent root disturbance. A larger area up to 50 m may also be considered protected habitat for the tree. Within the 25 metre buffer area, activities that would remove or significantly compact the roots and soil, and cause direct harm to the Butternut are not permitted. Within the 25-50 metre buffer area, activities that would significantly damage or destroy habitat e.g. by impacting the tree's ability to disperse seeds are also not permitted. Removal of other vegetation and careful logging practices within this radius are permitted.

As of July 1, 2013, there are new regulatory provisions provided under the ESA. This regulatory provision allows eligible activities, such as work undertaken to repair, modify, demolish, replace or general maintenance of a structure or the removal of buildings and/or excavation of land, vegetation removal, etc. that is considered to be species at risk habitat to proceed without a permit, provided the proponent register with the Ministry of Natural Resources and Forestry and then follow the specific rules in regulation under the ESA. These rules include, but are not limited to, preparing a mitigation plan and implementing steps to minimize the adverse effects of the activity on the species identified.

- Information on the new ESA regulatory provision that come into effect on July 1, 2013
- The amended ESA regulation (O.Reg 242/08)

If an impact to a Species at Risk or its habitat cannot be avoided, a person(s) should contact MNRF to discuss options, including applying for an authorization under the ESA. In situations where an activity is not registered with or authorized by the MNRF, a person(s) must comply with the ESA by modifying proposed activities to avoid impacts to Species at Risk and habitat protected under the ESA.

It is highly recommended that landowners and on-site workers familiarize themselves with information found on MNRF's Species at Risk website.

During on-site activities, should any species at risk or their habitat be potentially impacted, MNRF should be contacted immediately and operations should be modified to avoid any negative impacts to species at risk or their habitat until further discussions with MNRF can occur regarding opportunities for mitigation. If any species at risk are found, the Peterborough District MNRF office should be contacted at 705-755-2001. If possible, pictures of the species at risk and coordinates for the location where it was observed should be provided to MNRF.

Significant Wildlife Habitat

The site is near (not adjacent) to a deer wintering area which typically must be identified during site-specific investigations. Significant wildlife habitat may include features such as: seasonal concentration areas for wildlife species (e.g. snake hibernaculum), rare vegetation communities (e.g. tallgrass prairie), specialized habitats of wildlife (e.g. turtle nesting and over-wintering areas), habitats of species of conservation concern (e.g. Special Concern species as identified on the Species at Risk in Ontario list) and animal movement corridors (e.g. amphibian movement corridors). We recommend that you contact the local planning authority for potential study requirements for the identification of Significant Wildlife Habitat. In addition, when no information is available, we refer you to the Significant Wildlife Habitat Technical Guide and the recently approved Ecoregion Criterion Schedules for the identification of Significant Wildlife Habitat (January 2015). The Ecoregion Criterion Schedules and newly approved Significant Wildlife Habitat Mitigation Support Tool (MiST) can be downloaded here: https://www.ontario.ca/search/natural-heritage-planning-resources-municipal-planning. MNRF considers these documents to be the best available information to identify significant wildlife habitat.

Other Approvals

It is the responsibility of the proponent to acquire all other information and necessary approvals from any other municipal, provincial or federal authority under other legislation. We recommend that you contact your local Conservation Authority, Department of Fisheries and Oceans, Ministry of the Environment and Climate Change, Ministry of Tourism, Culture and Sport, etc.

If you have any questions regarding the above comments, don't hesitate to contact me. Please reference the file number in the subject line for any future correspondence.

Sincerely,

Cara Hernould

A| District Planner

Peterborough District | Ministry of Natural Resources and Forestry

300 Water St. Peterborough ON

705.755.3360

Cara.Hernould@ontario.ca

From: Moore, Whitney [mailto:wmoore@dillon.ca]
Sent: March-29-17 1:40 PM
To: Spang, Elizabeth (MNRF)
Cc: 164800; Luka Kot; Andrew Mcleod; Allen Benson
Subject: Information Request- County Road 10 and Fallis Line, Millbrook

Hi Liz,

Thanks very much for providing the info for the Lily Lake project. I have another information request for you, this one in Millbrook.

The location is Part Lot 11 & 12, Concession 6 and Part Lot 12, Concession 5, Geographic Township of Cavan; located at the northwest corner of Fallis Line and County Road 10.

I have attached a map of the site for your reference.

Please let me know if you have any questions or would like to discuss.

Thanks again!

Whitney

Whitney Moore B.Sc. (Hons.)
Dillon Consulting Limited
177 Colonnade Rd South, Suite 101
Ottawa, Ontario, K2E 7J4
T - 613.745.2213 ext. 3040
F - 613.745.3491
M - 613.797.1235
WMoore@dillon.ca
www.dillon.ca

Please consider the environment before printing this email

3 attachments

MillbrookInfoRequest.pdf
1947K

Millbrook NorthEast Wetland Summary.pdf

Appendix E

Fisheries Act Request for Review

Fisheries and Oceans Canada | Pêches et Océans Canada

1028 Parsons Road
Edmonton, AB
T6X 0J4

February 5, 2018

Your file *Votre référence*
N/A

Our file *Notre référence*
17-HCAA-01461

Towerhill Developments Inc.
Attn: Andrew McLeod
2800 Highway 7
Concord, ON
L4K 1W8

Dear Mr. McLeod:

Subject: Implementation of mitigation measures to avoid and mitigate serious harm to fish – Channel Realignment, Millbrook Development, Tributary of Baxter Creek, Township of Cavan-Monaghan

The Fisheries Protection Program (the Program) of Fisheries and Oceans Canada received your proposal on October 13, 2017.

Your proposal has been reviewed to determine whether it is likely to result in serious harm to fish which is prohibited under subsection 35(1) of the *Fisheries Act*.

Our review consisted of:

- "Request for Review", submitted by Dillon Consulting Ltd, on behalf of Towerhill Developments Inc., dated October 13, 2017.
- "Millbrook Subdivision, Fallis Line and Country Road 10, Millbrook, Ontario, Towerhill Development Inc., Natural Channel Design: Channel Realignment Design Brief", prepared by Water's Edge Environmental Solutions Team Ltd., dated July 26, 2017.
- Meeting with Dillon Consulting Inc., confirming habitat characteristics and barriers to fish passage, on January 17, 2018

We understand that you propose to infill an existing tributary to Baxter Creek near Millbrook, ON and replace it with a newly constructed channel located south of the original. Works will include:

- removal of vegetation for equipment staging and operation;
- infilling 2,470m² of a tributary; and
- constructing 12,896m² of a new, naturalized channel.

Provided that the mitigation measures outlined in the above stated documents are incorporated into your plans, the Program is of the view that your proposal will not result in serious harm to fish. No formal approval is required from the Program under the *Fisheries Act* in order to proceed with your proposal.

If your plans have changed or if the description of your proposal is incomplete, or changes in the future, you should consult our website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html) or consult with a qualified environmental consultant to determine if further review is required by the Program.

Please notify this office at least 10 days before starting your project. A copy of this letter should be kept on site while the work is in progress.

If you have any questions, please contact Brett Ellis at (780) 495-2959, or by email at brett.ellis@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,

Jason Shpeley
A/Senior Fisheries Biologist
Fisheries Protection Program
Fisheries and Oceans Canada

cc. Allen Benson, Dillon Consulting Ltd.
Whitney Moore, Dillon Consulting Ltd.
Brett Ellis, Fisheries and Oceans Canada

Attachment A:

Figures

MILLBROOK
FISHERIES REQUEST FOR REVIEW

FIGURE 1
PROPERTY LOCATION

Property Boundary

1:50,000

0 250 500 1,000 m

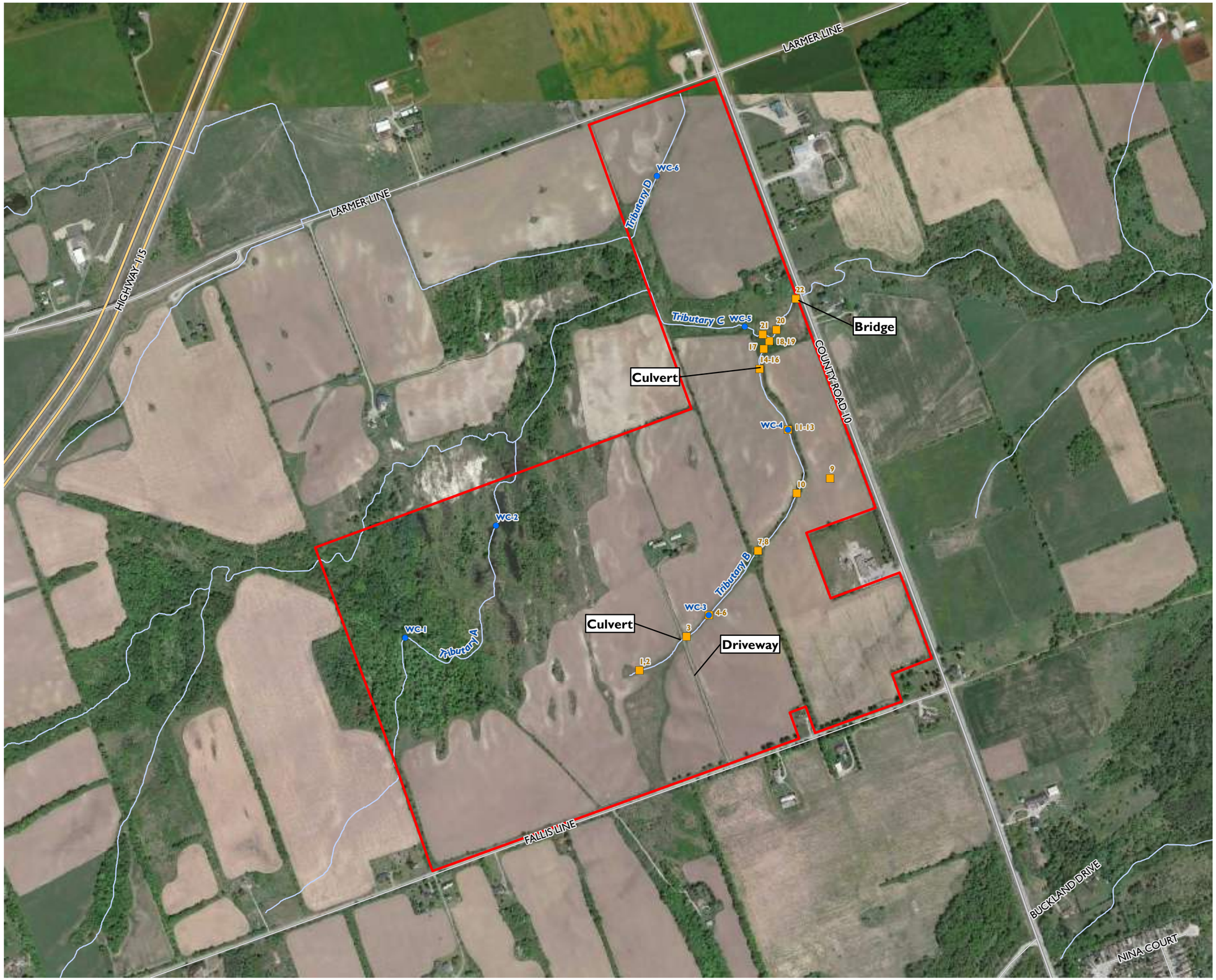
MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 164800
STATUS: DRAFT
DATE: 2017-09-28

FILE LOCATION: I:\GIS\164800 - Millbrook EIS\mxd\Figure 1 Property Location.mxd



MILLBROOK
FISHERIES REQUEST FOR REVIEW

FIGURE 2
SAMPLING AND PHOTO LOCATIONS

- Property Boundary
- Sampling Location
- Photo Location
- Water Body

1:8,000

0 50 100 200 m

N
W E
S

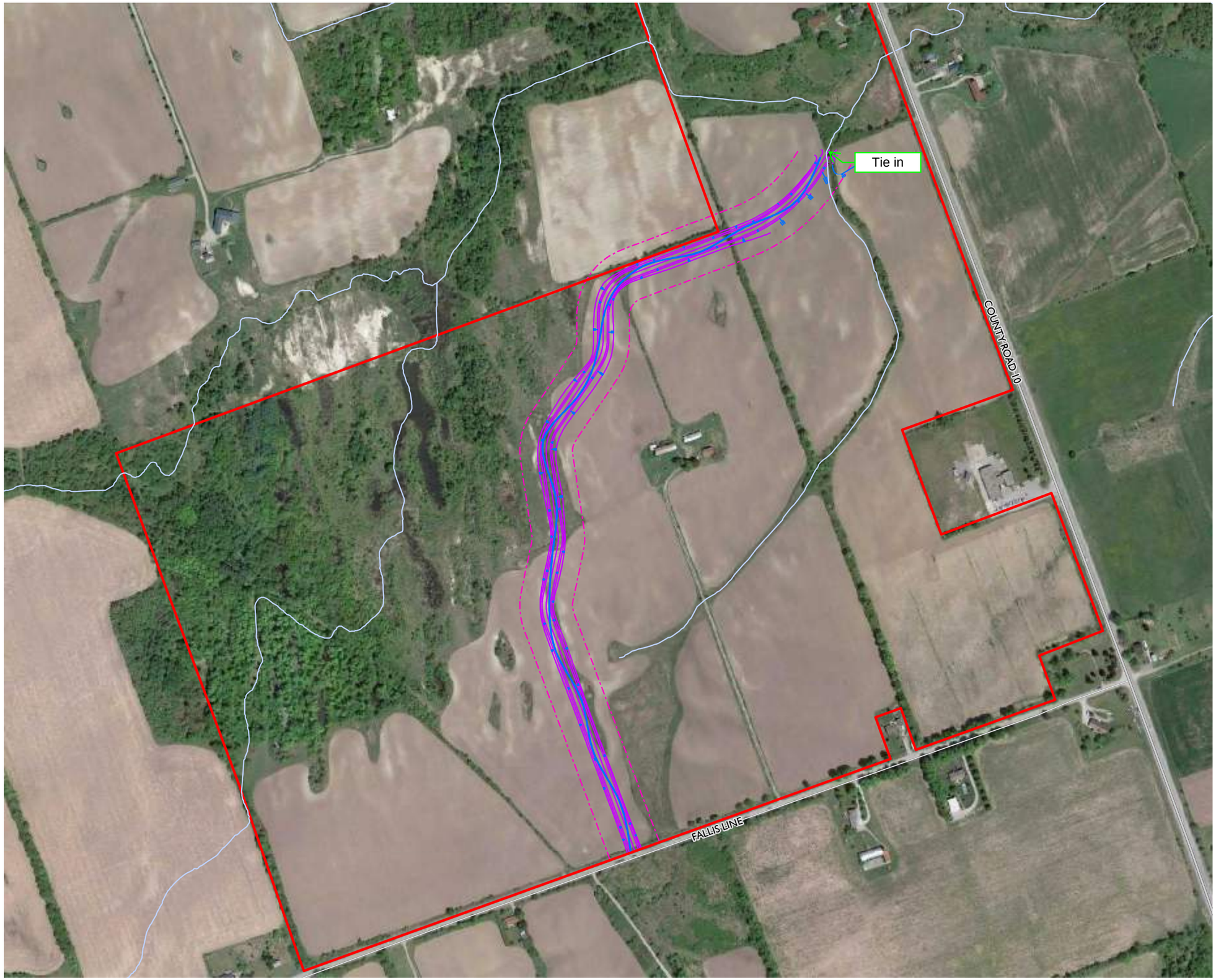
MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 164800
STATUS: DRAFT
DATE: 2017-09-28

FILE LOCATION: I:\GIS\164800 - Millbrook EIS\mxd\Figure 2 Sampling and Photo Locations.mxd



MILLBROOK
FISHERIES REQUEST FOR REVIEW

FIGURE 3
PROPOSED CHANNEL REALIGNMENT

- Property Boundary
- Water Body
- Revised Channel
- Meanderbelt/Low-flow Channel
- 30 m Buffer

1:5,000

0 50 100 200 m

N W E S

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

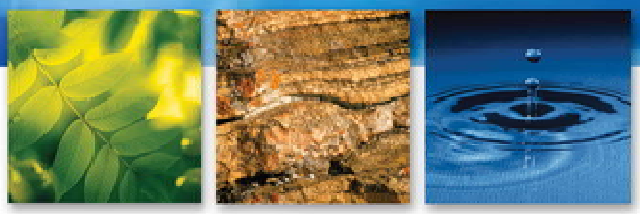
DILLON CONSULTING

PROJECT: 164800
STATUS: DRAFT
DATE: 2017-09-28

FILE LOCATION: I:\GIS\164800 - Millbrook EIS\mxd\Figure 3 Proposed Channel Design.mxd

Attachment B:

Channel Realignment Design Brief



water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.

Millbrook Subdivision, Fallis Line and Country Road 10, Millbrook, Ontario, Towerhill Development Inc.

Natural Channel Design: Channel Realignment Design Brief

July 26, 2017

July 26, 2017
WE 17007

Towerhill Development Inc.
c/o Mr. Oliver Beaudin, B.Eng.
Project Manager, Water Resources
Valdor Engineering Inc.
741 Rowntree Dairy Road, Suite 2,
Woodbridge, Ontario
L4L 5T9

Dear Mr. Beaudin:

RE: Millbrook Subdivision, Fallis Line and County Road 10 – Millbrook, Ontario
Natural Channel Design of Realigned Channel – Design DRAFT Brief

Water's Edge was authorized by Towerhill Development Inc. (c/o Valdor Engineering Inc.) to complete a realignment of the existing watercourse that runs through the Millbrook Subdivision located at the north-west corner of Fallis Line and County Road 10 in Millbrook, Ontario. This work will be part of the Phase 2 construction of the Millbrook Subdivision. This report outlines the existing geomorphic stream conditions and outlines a proposed design for channel realignment. We request the approval of these proposed designs by Valdor Engineering Inc. The following information was provided to Water's Edge by Valdor Engineering Inc. in order to conduct this work:

(1) Finalized CAD base plan with final alignment;

(2) Soils, geotechnical and hydrogeologic reports (GEO-LOGIC INC., 2014a and GEO-LOGIC INC., 2014b); and

(3) Existing benchmarks from surveys.

It was reported to Water's Edge that the preliminary realigned channel design will be approximately 1400 m long with an average grade of 0.5%. The approximate area that will be draining to this feature is 35 ha. To ensure that this preliminary design is appropriate, as was proposed, a desktop geomorphic assessment of the stream system is required prior to geomorphic and topographic field investigations. This report will discuss the findings of these assessments and provide a design brief.

1.0 BA CKGROUND REVIEW

Millbrook, Ontario is part of the Township of Cavan Monaghan within the Peterborough County located approximately 20 km southwest of Peterborough, Ontario. Millbrook, Ontario boasts historic relevance to the rural surrounding area such as Needler's Mill and the Robert Deyell House. Generally, the surrounding area is a mix of industrial, agricultural and commercial activities.

The study area for this report is part of Phase 2 of the construction of the Millbrook Subdivision. The study area is located at the intersection of Fallis Line and County Road 10 (north of Fallis Line and west of County Road 10). The study reach currently flows through the center of the proposed subdivision development. The study area and reach can be seen in **Figure 1.1.**

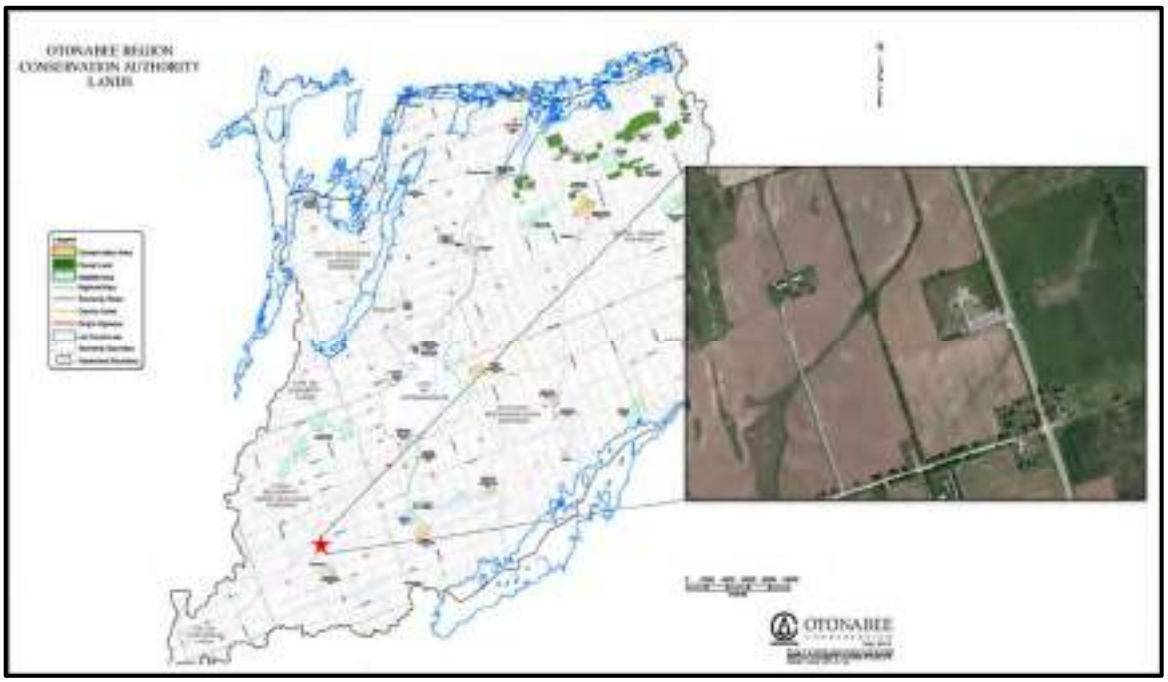


Figure 1.1 – Modified Optonabee Conservation Authority (2010) jurisdiction with study area (red start) indicated and inset map showing the study reach.

2.0 WATERSHED DESKTOP ASSESSMENT

A review of pertinent background information regarding the site was conducted. Within the following sub-sections a brief description of the relevant watershed and physiographic geology characteristics are given for the study area. General watershed characteristics and physiographic geology are important to understand river reach form, process and adjustment over time.

2.1 Wa tershed characteristics

The study reach proposed to be moved during Phase 2 of the Millbrook Subdivision development is appears to be a headwater stream in the middle of agricultural farmlands with some rural residential area surrounding it. The study reach confluences just north of the Phase 2 subdivision with another tributary that flows in the easterly direction (**Figure 2.1**). Both tributaries flow eastwards towards Baxter Creek. Based on a preliminary desktop analysis, the study reach is a first order stream.

Land use of the watershed was collected using the Ontario Flow Assessment Tool from the Ministry of Natural Resources and Forestry. As previously mentioned, the study area and surrounding area is predominantly agricultural and undifferentiated rural land use. There are also intermittent locations of mixed (i.e., deciduous and coniferous) trees. Northwest of the subdivision there is a swap area with coniferous tress in place. Directly south of the study area is the Phase 1 subdivision and further south is the urban development of Millbrook, Ontario.

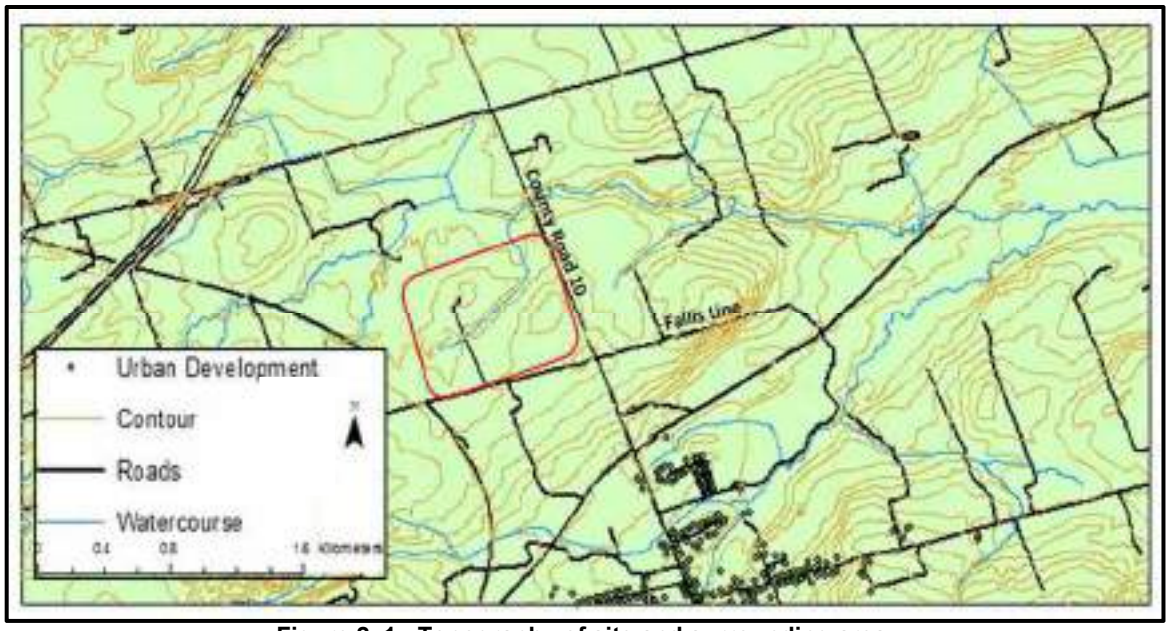


Figure 2. 1 - Topography of site and surrounding area.

2.2 Geology and Physiography

The topography of the surrounding area has some gentle hills. Chapman and Putman (1982) reported the study area to be predominately a sand plain, kame moraine. The quaternary geology was obtained using the Ministry of Northern Development and Mines (MNDM) CLAIMaps tool. It was determined that the majority the study area was formed from varying glacial deposits. The glacial deposits are 1-50 m thick and mainly sandy silt to sandy till with some stone content. The west end of the study area and headwaters of the study reach is formed with silt and clay (massive to laminated) glacial lake deposits. As previously mentioned there is a downstream confluence. The tributary that confluences with the study reach is composed of the same glacial lake deposits of the study reach (i.e. composed of silt and clay). The channel that the two tributaries confluence into is a geologic area of sand and gravel river deposits.

3.0 DESKTOP ASSESSMENT

A preliminary evaluation of the study reach was conducted. Generally, this assessment was conducted to provide initial planform characteristics, reach limits, and study reach delineation. This desktop assessment will aid in efficient preparation and execution of geomorphic field surveying and data collection. The following section will include a brief background review discussion and assessment of the study area and reach using publicly available aerial photography.

3.1 Background Review & Historical Assessment

Aerial images of the study area were obtained from readily available sources (Google Earth and University of Toronto Spatial Maps Library). Generally, these images were used to determine historical alternations such as land use changes or road re-alignment in addition to pertinent adjustments in channel planform. A range of images from 1954 to 2017 were obtained. All aerial images were examined and some were eliminated due to poor quality or obstruction of view due to cloud cover. These satellite images were georeferenced using projected shapefiles in ArcMAP 10.3.

An analysis of the channel planform was completed to determine channel adjustment over the years and the pre-development or pre-alignment length and width of the channel. The geometry and the planform of the channel will help classify the study reach into a channel type. The existing channels geomorphic form and processes will aid and serve as a base level prototype for the re-aligned channel.

Generally, based on the aerial images available for analysis, no significant changes in land use or in road re-alignment were present. South of the study area, the downtown core of Millbrook, Ontario was present at the earliest aerial image that was analyzed. **Figure 3.1-A** shows the 1954 aerial image with the georeferenced channel planform outlined in blue. The area is predominantly for used agricultural activity such as row crops. A municipal office is present on the east side of the proposed development area (on County Road 10). A small marsh or wetland is present, in the northwest area. On each georectified image, the left and right banks of the channel was delineated using ArcMAP Software. For the time range investigated, the planform of the channel did not change enough for it a migration rate of the respective banks to be calculated. The georeferenced banks of the channel (blue) was overlaid on the 2015 aerial image (**Figure 3.1-B**). The existing channel length was measured along the thalweg of the channel using present day aerial imagery. The channel length from the headwaters to the downstream confluence was calculated to be 908m.

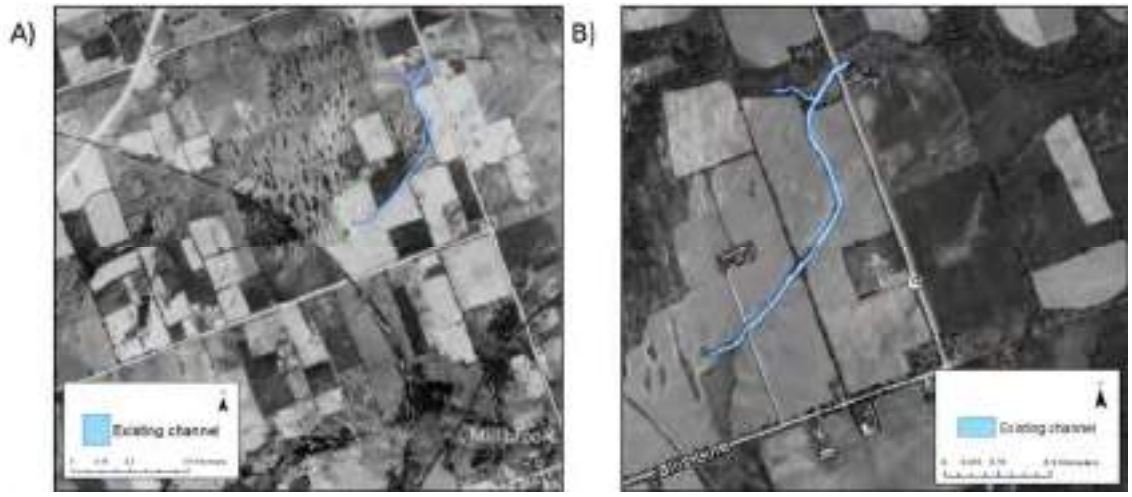


Figure 3. 1 - A) 1954 and B) 2015 georeferenced aerial image with outline of channel.

3.2 Meander Belt Width Assessment

A desktop meander belt width assessment was completed for the study reach. The purpose of this assessment is to determine trends in the watercourse alignment within the valley of the channel with the use of a series of air photos over time. Defining the meander belt width of the channel will allow for erosion limits for the study reach to be determined. It is well known that there is a dynamic energy balance within fluvial systems that are governed by sediment load and discharge. In part, this balance can be seen adjusting during three processes: erosion, slope alteration and flooding. Determination of the meander belt width or the erosional hazards limits can guide design to ensure that there is an appropriate maximum lateral extent for the channel to adjust within. This can infer a lateral width that is recommended to remain undeveloped to ensure long term integrity of the channel and surrounding infrastructure.

The Ontario Ministry of Natural Resources document entitled, “Technical Guide – River and Stream Systems: Erosion Limit” Policy 3.1.1 was also considered when defining the meander belt width of

the study reach. Generally, this document simplifies the variety of combinations of physical landforms into two basic types:

(1) Confined system

(2) Unconfined system

The study area is in an unconfined river system. This means that there is no discernable valley break in slope within the study rea. This classification is typical for the study area, as the surrounding area is flat with some gently rolling hills. A preliminary meander belt allowance was determined to be approximately twenty times the channel bankfull width. This yielded a preliminary meander belt allowance of 54m which is an overestimation of the channel properties and additional protocols were considered to appropriately quantify the meander belt width of the study reach.

Assessment of the meander belt width was undertaken in accordance to the Toronto and Region Conservation Authority document entitled, "TRCA Meander Belt Width Delineation Procedures". Generally, there are two procedures within this document:

(1) Following the meander pattern of the system as it proceeds downstream around a meander belt axis; or

(2) Following the down valley meandering trend of the river along a linear axis.

The planform from the 2015 georectified aerial image was used in the meander belt width delineation. The channel limits from the historical aerial images were overlaid but since there was no evidence of channel migration, the meander belt width delineation was based on the 2015 aerial image. Aerial images considered had a time interval range of 63-years to ensure no significant channel adjustment was left out of the detailed analysis. This time interval range allowed for a conservative approach to be taken, above the recommended 20- to 30- year time interval of aerial images. The TRCA (2005) protocol assumes that there is no change in the hydrology regime of the study area, which, based on the proposed use of appropriate stormwater management techniques to mitigate the increased runoff from the Phase 2 subdivision will also be assumed in this analysis.

The meander belt width assessment can be seen in **Map 1** and **Table 3.1.** A meander belt axis was defined along the study reach (purple dashed line). The meander belt axis is a conceptual line that is drawn through the centerline of the channel that represents the general down-valley orientation of the channel. The preliminary meander belt width (yellow dashed line) and existing meander belt width (peach dashed line) were measured to 3m and 5.7m, respectively. The final belt width (red dashed line) using this protocol was found to be 6.3m.

Table 3. 1 - Summary of meander belt width assessment.

Preliminary MBW [m] (A)	Mean Channel Width [m] (B)	Existing MBW [m] (A + B = C)	Final MBW [m] (C*1.10)
3	2.7	5.7	6.3

To ensure an accurate and reliable meander belt width that can be used to recommend a post-development low-flow channel that is able to meet the proposed requirements, a final approach was considered to quantify the existing meander belt width of the existing channel conditions. A suite of empirical regime equations developed by Ward and Mecklenburg (2011) in conjunction with

Williams (1986) equations were used to compare against the three aforementioned approaches. Average values of cross-sectional area, width and mean bankfull depth were (see **Section 4.0**) inputted as 0.41m^2, 2.7m and 0.16m, respectively. Three different equations were used to compute meander belt widths using cross-sectional area, width and depth. Meander belt width minimum, maximum and mean values can be seen in **Table 3.2**. The overall, average meander belt width was found to be 11m.

Table 3. 2 - Summary of Williams (1986) and Ward and Mecklenburg (2011) meander belt width assessment for study reach.

Input parameter	Value	Equation	Meander belt width (min) [m]	Meander belt width (mean) [m]	Meander belt width (max) [m]
XS area [m^2]	0.41	$L_m = 30A^{0.68}$	6	10	16
Bankfull width [m]	2.70	$L_m = 7.5W^{1.13}$	8	13	23
Bankfull depth [m]	0.16	$L_m = 240D^{1.81}$	4	9	20
average =				11	

A meander belt width assessment was also conducted on a reference reach within the study area (see **Map 2**). This representative reach has similar sub-watershed characteristics to the study reach (geology, physiography) and is of similar geometric size. The representative reach was dissimilar from the study reach due to the sinuosity of the channel. This sinuous, representative reach was conducted in order to ensure a conservative meander belt width was selected. The same procedure was adopted for this representative reach, as was mentioned above. The results from the TRCA method can be seen in **Table 3.3** . The Ward and Mecklenburg (2011) and Williams (1986) approach was also conducted for the representative reach. The bankfull conditions were assumed to be the same as the representative reach. The results for this analysis can be seen in **Table 3.4**.

Table 3. 1 - Summary of meander belt width assessment for representative reach.

Preliminary MBW [m] (A)	Mean Channel Width [m] (B)	Existing MBW [m] (A + B = C)	Final MBW [m] (C*1.10)
31	2.3	33.3	36.6

Table 3. 2 - Summary of Williams (1986) and Ward and Mecklenburg (2011) meander belt width assessment for representative reach.

Input parameter	Value	Equation	Meander belt width (min) [m]	Meander belt width (mean) [m]	Meander belt width (max) [m]
XS area [m^2]	0.41	$L_m = 30A^{0.68}$	6	10	16
Bankfull width [m]	2.30	$L_m = 7.5W^{1.13}$	6	11	19
Bankfull depth [m]	0.16	$L_m = 240D^{1.81}$	4	9	20
average =				11	

A summary of all meander belt width assessments can be seen in **Table 3.5** for comparison. A meander belt width of 11m is recommended for design purposes of the realigned low-flow channel.

Table 3. 3 - Summary of meander belt width assessments.

Method	Site	MBW [m]
TRCA	Study reach	6
Williams	Study reach	11
TRCA	Representative reach	37
Williams	Representative reach	11
average =		**16**

4.0 FIELD RECONNAISSANCE

On May 24, 2017, a geomorphic survey was completed for the entire reach as well as downstream of the confluence. In the following sub-sections a general description of the reach will be discussed. The long profile and multiple cross-sectional surveys were completed alongside additional geomorphic data that was collected using the Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment Technique (RSAT).

4.1 General Reach Descriptions

In the aforementioned subsection, the total study reach length is 908m. For the purposes of analysis this reach will be segmented into numerous study reaches. At the end of each study reach, the Typically, channel reach is defined by channel length (ranging from 200m to 2km in length) that have similar channel characteristics. Channel reaches are generally 200m in length and include two meander bends. However, the sinuosity of the study reach is very limited so similar geomorphic

units will be identified for the existing channel. Channel characteristics that can aid in reach delineation include, but are not limited to, the following: valley or channel slope, channel form and/or function, morphology, substrate composition, riparian buffer composition and hydrology.

Field photographs from May 24, 2017 can be seen in **Appendix B**. The direction, position that the photograph was taken and a detailed comment of the photograph are included for each photograph. An upstream and downstream view of each of 21 cross-sectional profiles is included. The Appendix is organized starting at the headwaters (Cross-Section 1) and continues working the way downstream to the confluence of the tributary that flows to Baxter Creek (Cross-Section 21). Additional cross-sectional surveys were included at the confluence and downstream of the confluence. Knowledge of geomorphic processes and cross-sectional geometry downstream of the proposed segment of channel realignment will be useful to the design of channel tie-ins. It will become evident throughout the general discussion of the reach that reaches of geomorphic similarity are present.

The overall characteristics of the channel are that typical of a headwaters channel (**Appendix B – Photograph No. 1**). The low-lying topography, gentle, tranquil flow and grassy bed and banks are that of a traditional headwaters channel. However, the study tributary is straight with very little sinuosity which deviated from the traditional headwater planform shape and primarily serves as a drainage ditch for the surrounding agricultural fields. The study reach flows from the headwaters through three agricultural fields and converges with a tributary that flows into Baxter Creek. Generally, the bed of the channel is flat and covered with vegetation such as long grasses (see example at **Appendix B – Photograph No. 2**). In the upstream part of the reach, changes in bed

roughness was due to the presence of vegetation with sturdier or more woody trunks (see example at **Appendix B – Photograph No. 16**). Downstream of these vegetative patches on the bed it was observed that a slight pool (deeper water depth) had formed and the cross-sectional width was slightly larger (see example at **Appendix B – Photograph No. 6**).

It was evident that the downstream portion of the river (that flows parallel to Country Road 10) had some pre-existing bank stabilization measures. Bank stabilization measures included earthen river stone berms that disconnected the main channel from the floodplain (see example at **Appendix B – Photograph No. 30**). This section of the channel had a bed that, based on a qualitative inspection, appeared to be composed of sandy-silts. Some large cobbles and boulders were periodically placed on the stream bed (see example at **Appendix B – Photograph No. 32**). Some degradation of the bed was observed in these downstream sections (see example at **Appendix B – Photograph No. 34**). A compressed culvert (**Appendix B – Photograph No. 37**) with an approximate diameter of 0.4m served as a drainage feature to allow the flow to pass beneath two agricultural fields. Downstream of this culvert, the morphology of the channel was significantly different. Generally, the bed composition and sinuosity changes and a riffle-pool morphology was observed. There were some significant meanders in the channel and exposed, depositional point bar features were observed (**Appendix B – Photograph No. 39**). Downstream of this, the study reach confluences and eventually flows into Baxter Creek. Downstream of the confluence, the channel is significantly wider with a substantially greater flow depth and bed is composed of a mix of grasses and larger river stones (**Appendix B – Photograph No. 41 and 43**) at riffle sections and exposed, depositional point-bars are observed in the meander bends (**Appendix B – Photograph No. 42**). Larger cobbles and boulders in the channel bed have diverted the flow in some areas (**Appendix B – Photograph No. 44**). These features have increased the localized channel bed roughness and encouraged further sediment to accumulate surrounding them which has resulted in the growth of small depositional features covered in grassy vegetation. The farthest downstream section surveyed was the concrete, rectangular culvert that underpasses County Road 10 (**Appendix B – Photograph No. 45**). The right floodplain and bank was quite saturated and some flow diversion channels resulted in a multitude of grassy islands.

4.2 Rapid Field Assessments

Two rapid field assessments methods were conducted: Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment Technique (RSAT). These rapid field assessments indicate the existing channel conditions. The RGA is a checklist document that records the following parameters:

(1) Aggradation;

(2) Degradation;

(3) Widening; and

(4) Planform adjustment.

Results indicate channel stability by classifying data into the following three categories: (1) in regime/stable; (2) transitional/stress; and (3) in adjustment/unstable. The data sheet for the RGA can be seen in **Appendix C** . Overall, the study reach was given the classification of being transitional (**Table 4.1**). Evidence of aggradation within the study reach was observed due to the presence of some siltation within the pools, medial bars and poor longitudinal sorting of bed materials. Generally, there processes were seen in the mid- and downstream portions of the reach (Cross-Sections 25 to 31) where channel modification techniques had been implemented. The vegetated upstream reach segments were vegetated and had very little sediment transport occurring. The second classification system used in the RGA form pertains to evidence of degradation. The RGA form is tailored to urban degradation issues (i.e., stormwater management)

that are not applicable to the present state of the study area. However, there was evidence of some degradation in a circular culvert (located between Cross-Sections 18 and 19) that had been compressed and the flow was cutting underneath it. There was minimal evidence of widening beyond the typical width adjustments seen between the riffle and pool areas. There was some evidence of falling trees and gates. Finally, there was also minimal evidence of planimetric form adjustment. Some examples of the evidence documented to infer planimetric form changes are some cut formations, and grassy islands forming as previously discussed.

RSAT is takes a semi-quantitative approach to characterize stream conditions with the following indicators of abiotic and biotic quality:

(1) Channel stability

(2) Channel scouring and sediment deposition;

(3) Physical in-stream habitat;

(4) Water quality

(5) Riparian habitat conditions; and

(6) Biological conditions.

The data from an RSAT form is then summed and a final index of overall stream quality is binned in categories ranging from Excellent to Degraded. Overall, the study reach was given the classification of being in Fair (**Table 4.2**). Channel stability was quantified using the criteria of bank stability, stream bed stability, and cross-sectional shape. The channel stability for the study reach was deemed excellent. Finally, channel scour and sediment deposition was quantified as being fair.

Table 4. 1 - Summary table of Rapid Geomorphic Assessment results.

Stability Index (SI) Value	Classification Interpr	etation
SI ≤ 0.20	In Regime	The channel morphology is within a range of variance for rivers of similar hydrographic characteristics and evidence of instability is isolated or associated with normal river meander processes.
0.21 ≤ SI ≤0.40	Transitional/Stressed	Channel morphology is within a range of variance for rivers of similar hydrographic characteristics but the evidence of instability is frequent.
SI ≥ 0.40	In Adjustment	Channel morphology is not within the range of variance and evidence of instability is wide spread.

Table 4. 2 - Summary table of Rapid Stream Assessment Technique results.

RSAT Score	Ranking
41-50	Excellent
31-40	Good
21-30	Fair
11-20	Poor
0-10	Degraded

4.3 Detailed field survey

A detailed geomorphic survey was conducted and data was analyzed and processed using computational software. The location of the 21 geomorphic cross-sectional surveys can be seen in **Map 3**. Results from this analysis can be seen in **Appendix C**. A long profile for the study reach was generated and can be seen in **Figure C.1** with each of the Cross-sectional (XS) locations identified. The average slope of the study reach was found to be 0.24%. On the long profile Cross-sections, water surface and bankfull elevations were labelled were applicable to infer energy gradient. Plots of Cross-sections 1 to 21 can be seen **Figure C. 2** to **C.22**. Summary tables of relevant geomorphic parameters can be seen in **Tables 3.3 and 3.4**. An average of all 21 cross-sections geomorphic parameters can be seen in **Table 3.5**. These tables report the following parameters: bankfull width, depth and area; wetted perimeter; hydraulic radius, entrenchment ratio (value and classification); width to depth ratio (value and classification); and Rosgen classification. Geometric parameters related to discharges (i.e., bankfull width, depth and area, wetted perimeter; hydraulic radius) guide decision making during bankfull channel discharge calculations and representative dimensions for channel design. Entrenchment ratios is a quantification of floodplain and main channel connectivity. Width-to-depth ratio quantifies channel flow to be one- or two-dimensional and can therefore infer whether discharges effect the banks. Overall, the planform shape of the channel was observed to be fairly straight with some adjustment in channel widths and a meander The Rosgen system uses the aforementioned parameters to classify the general geomorphic processes of the channel. This allows ease of replication during design protocols.

Table 4. 3 - Summary table of study area geomorphic parameters from Cross-Section (XS) 1 to 11.

	XS1	XS2	XS3	XS4	XS5	XS6	XS7	XS8	XS9	XS10	XS11
Bankfull width [m]	1.71	1.96	2.38	5.61	2.32	3.28	2.24	2.67	3.29	1.86	2.42
Bankfull depth [m]	0.16	0.17	0.17	0.14	0.16	0.12	0.14	0.22	0.13	0.11	0.18
Bankfull area [m^2]	0.28	0.33	0.40	0.76	0.37	0.39	0.32	0.58	0.42	0.21	0.44
Wetted perimeter [m]	1.83	2.17	2.52	5.68	2.47	3.41	2.31	2.85	3.33	1.95	2.53
Hydraulic radius [m]	0.15	0.15	0.16	0.13	0.15	0.11	0.14	0.20	0.13	0.11	0.17
Entrenchment ratio [m]	7.08	4.97	5.03	3.27	5.67	5.57	4.84	4.02	1.35	2.64	7.69
Width-Depth ratio [m]	10.69	11.53	14.00	40.07	14.50	27.33	16.00	12.14	25.31	16.91	13.44
Rosgen classification	E	E	C	C to D	C	C	C	C	F	C	C
Entrenchment classification*	SE	SE	SE	SE	SE	SE	SE	SE	E	SE	SE
W:D classification**	L	L	M to H	Very H	M to H	M to H	M to H	M to H	M to H	M to H	M to H

*SE = slightly entrenched; M E = moderately entrenched; E = entrenched

**L = low; M = moderate; H = high

Table 4.4 - Summary table of study area geomorphic parameters from Cross-Section (XS) 12 to 21.

	XS12	XS13	XS14	XS15	XS16	XS17	XS18	XS19	XS20	XS21
Bankfull width [m]	3.28	5.88	n/a	3.28	3.68	1.67	1.83	1.15	1.20	n/a
Bankfull depth [m]	0.20	0.06	n/a	0.19	0.13	0.26	0.28	0.18	0.16	n/a
Bankfull area [m^2]	0.66	0.33	n/a	0.61	0.47	0.43	0.51	0.21	0.20	n/a
Wetted perimeter [m]	3.39	5.92	n/a	3.38	3.75	2.15	2.43	1.38	1.48	n/a
Hydraulic radius [m]	0.19	0.06	n/a	0.18	0.12	0.20	0.21	0.15	0.13	n/a
Entrenchment ratio [m]	5.39	2.55	n/a	2.50	1.50	12.08	8.16	4.03	2.32	n/a
Width-Depth ratio [m]	16.40	98.00	n/a	17.26	28.31	6.42	6.54	6.39	7.50	n/a
Rosgen classification	C	C to D	n/a	C	B	E	E	E	E	n/a
Entrenchment classification*	SE	SE	n/a	SE	ME	SE	SE	SE	SE	n/a
W:D classification**	M to H	Very H	n/a	M to H	M to H	L	L	L	L	n/a

*SE = slightly entrenched; M E = moderately entrenched; E = entrenched

**L = low; M = moderate; H = high

Table 4.5 - Average of geomorphic parameters for all Cross-Sections.

	Average
Bankfull width [m]	2.72
Bankfull depth [m]	0.17
Bankfull area [m^2]	0.42
Wetted perimeter [m]	2.89
Hydraulic radius [m]	0.15
Entrenchment ratio [m]	4.77
Width-Depth ratio [m]	20

Channel stability can be inferred from parameters such as the entrenchment ratio. Generally, an entrenchment ratio threshold of < 1.4 persists. The upstream Cross-Sections were determined to be slightly entrenched (SE) from Cross-Sections 1 through 8 and the same classification was seen at the downstream end. Cross-Section 9 was found to be entrenched. In future design protocols, non-entrenched or slightly entrenched cross-sectional profiles will be used as representative Cross-sections that function well geomorphically. Entrenched channels typically infer degradation of the channel bed which can lead to toeing or even slumping of the banks. Channels that are not entrenched have connectivity to floodplains during greater than bankfull flow events. Overall, within the study reach the banks were observed to be stable based on both qualitative and quantitative analysis due to properties such as vegetated bed and banks that offer channel stability.

Cross-Sectional geometry of the existing channel also offer stability of the channel to resist the typical flow conditions of the drainage feature. Generally, the upstream study reach with the vegetated bed and banks had a V shaped cross-section (see **Figure C.2**). Near the large meander in the study reach where bank stabilization techniques such as riprap had been implemented, the channel had a more rectangular cross-sectional shape. The farthest downstream section of the channel composed of a sandy-silt bed had a more U-shaped cross-section prior to the confluence with the tributary that flows into Baxter Creek (see **Figure C.22**). A sediment sample was taken downstream of Cross-Section 20 where the bed was no longer vegetated and a d_{50} of 0.46mm was determined. Conditions such as bankfull conditions were identified in the field and reported at each Cross-Section (green dots) where there was a break in the bank slope. Geomorphic principles infer

that bankfull conditions should occur where there is a break in the slope of the bank and the main channel connects to the floodplain. Deviation from this during design practices results in an over- or under-sized channel for the hydrology of the channel. A cross-section that exhibits proper connection of the main channel to the floodplain was identified in Cross-Section 4 (**Figure C.5**). Overall, based on this analysis, channel stability and appropriate cross-sectional shapes were seen in the upstream cross sections and will be used to guide design of the relocated channel.

4.4 Chan nel flows

The bankfull discharge is typically considered to be a channel forming or dominant discharge. This estimation was conducted using field collected bankfull indicators such as a break in bank slope, distinct changes in vegetation, soil, etc.. When re-naturalizing the channel, natural channel design concepts include the creation of a bankfull flow channel to accommodate the dominant discharge. Using data from the geomorphic field work, and using a friction factor and relative roughness methodology, bankfull flows in the existing system were estimated to be 0.39 m^3/s.

5.0 RECOMMENDED DESIGN OPTIONS

The overall objective of natural channel designs is to rehabilitate and restore the channels form and function. The same principles pertaining to natural channel design can be applied to channel re-alignment projects. Based on the desktop analysis and field surveys discussed above, recommended design options are discussed. The design concepts presented herein are drafted at a high-level to be compared against the “do nothing” approach. The range of solutions are limited to the available space, proposed subdivision lot-lines and roadway constraints. Sufficient detail is included to allow selection of an appropriate design option, at which time, details and plans will be developed in support of permitting and construction. As per the request of the client, channel corridor alignment and the modification plans will be discussed and confirmation of these preliminary design stages are required prior to the determination of more detailed design components.

The following preliminary design options were developed based on natural channel design principles. Generally, existing geomorphic conditions and knowledge of similar systems were used as the foundation of the designs. If approval is given, the detailed design will be tested and adjusted against our database of completed projects across southern Ontario. The proposed increase in channel length and alteration to grade of the channel will be adjusted accordingly and considered in each of the following design concepts. All design concepts are for the main channel and floodplain area and more detailed features such as upstream and downstream tie-ins will be addressed at subsequent design stages. The existing and proposed channel alignment can be seen on **Map 4**.

Option 1– Do Nothing

This option would allow the channel to maintain its existing shape, behavior and future rate of adjustment. However, the channel would pass through the proposed subdivision development of the Millbrook Phase 2 site.

Option 2 – Meandering Channel Realignment:

This channel design option includes a sinuous, meandering channel. The channel is proposed to have a low sinuosity, with a riffle-pool morphology. Generally, this design would mimic existing channel geometry and characteristics. This option will allow the main channel to have connectivity to both sides of the stream. In keeping with this assessment of the channel and by taking into account the existing geometric planform parameters such as radius of curvature, sinuosity, and meander amplitude, a sinuous channel pattern has

been proposed. The radii of curvatures used range between 2 and 7m (based on regime equations). Similarly, a meander belt width of approximately 11m will be used. To appease geomorphic processes, the channel cross-sectional geometry will be reduced from its present conditions to accommodate for the two-fold increase in channel length (i.e., increase in length to border the Phase 2 site and length required for meandering) while maintaining sufficient geometry to drain the required 32 hectares. This will also dictate a decrease in channel slope. To counteract the reduction in natural channel processes that are required for proper form and function such as sediment transport and continuity throughout the natural channel reach the channel geometry will be reduced. Working with geomorphic principles and pre-existing conditions will result in a meandering natural channel design with optimal geomorphic function. Bed and bank composition will aim to mimic the natural morphology of the grassy river stone exhibited at the upstream and downstream confines of the study reach.

Option 3 – Channel Realignment:

This channel realignment design proposes to follow the proposed alignment in a straight planform shape. The main channel would have floodplain connectivity. The cross-sectional, geometric shape would match existing conditions of the channel. The channel length will be required to increase and the slope will be decreased. As a result, the dimensions of the cross-sectional geometry will also likely need to be size down from the present conditions to maintain sediment continuity throughout the reach. Small riffle-like features of stone are proposed to be implemented at equally spaced intervals within the channel as a precautionary grade control feature and the rest of the bed will be composed of grass to replicate existing channel conditions.

5.1 Preliminary Design Dimensions for Meandering Channel Realignment

Preliminary design dimensions for "***Option 2 – Meandering Channel Realignment***" are discussed in the following section. The design dimensions are determined from the desktop and field based assessments. Based on the 32 hectare drainage area of the proposed subdivision, the Water's Edge database was utilized to determine the preliminary channel dimensions. The channel width was determined to be 0.82m and depth to be 0.18m. A summary of the Water's Edge database results can be seen in **Table 5.1**.

Table 5. 1 - Summary of channel dimensions derived from Water's Edge Database

Water's Edge Database Results	
Watershed area [km^2]	0.32
Width [m]	0.82
Depth [m]	0.18
Area [m^2]	0.15

The Williams (1986) relationships were considered for preliminary design dimensions. Designs aimed to achieve a maximum radius of the lateral width constraints of the proposed development. Julien (2002) and Newbury (2008) were also considered when optimizing the radius of curvature of the channel in relation to the bankfull channel width. The Rosgen (1994) classification system was subsequently considered to further guide design dimensions. Based on the existing and proposed conditions the Rosgen C4 Type channel was determined to be a suitable choice to guide designs. The design constraints for a Rosgen C4 Type channel can be seen in **Table 5.3**.

Table 5. 2 - Rosgen C-4 type channel properties

	Rosgen constraints for C4 type channel:	
Slightly entrenched	ratio > 2.2	can vary by +/- 0.2 units
Moderate to high width/depth	> 12	can vary by +/- 2.0 units
Moderate to high sinuosity	> 1.2	can vary by +/- 0.2 units
Slope Range	0.001-0.02	

Post-development valley slope was determined using the upstream (246.25m) and downstream (236.60m) tie-in elevations provide plan drawings provided by Valdor Engineering Inc. The total valley distance was obtained to be 1166.41m. This gives a channel slope of **0.008**. The representative reach (see **Map 2**) sinuosity was determined to be 1.3. The low flow channel has a maximum radius of curvature at the apex of each meander bend and the sinuosity was relaxed so that the resulting channel was not extremely tortuous. The final channel length was determined to be **1172.37m**.

In-stream channel features were selected to be riffles and pools. Riffle design was based on estimating critical flow depths and specific energy relationships at the upstream crest of the riffles during bankfull events while assuming a rectangular cross-section. Final average riffle and pool design dimensions can be seen in **Table 5.4**. On either side of the low-flow channel, a relief zone of 0.27m in width will be placed on either size to relieve stresses during higher flow events. This will reduce the potential for detrimental channel adjustment. Banks will be stabilized with geotextile. **Drawing 1** shows the planform and cross section of the pool and riffle.

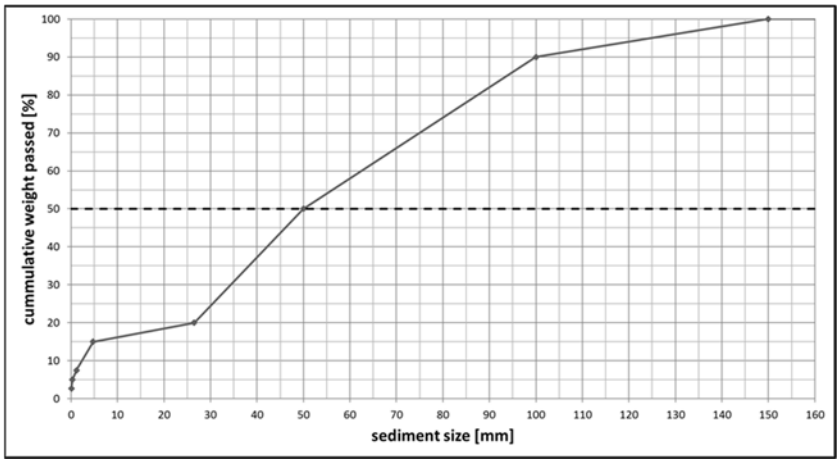
Table 5. 3 - In-stream feature design dimensions

	Dimensions				
Feature	**Height [m]**	**Length [m]**	**Gradient [m]**	**Spacing [m]**	**Depth [m]**
Riffle	0.08	1.025	0.01	6.15	--
Pool	--	--	--	--	0.34

Substrate sizing of the riffle features was also determined based on entrainment thresholds for a range of sediment sizes using a safety factor of 1.2. The final distribution of sediment sizes can be seen in **Figure 5.1** which gives a d_{50} of **50mm**. Sediment sizes including and smaller than 26.5mm were determined to be entrained during bankfull flow events and sizes larger would not be entrained. This balance allows for sediment continuity to occur while maintaining channel stability.

Figure 5. 1 - Riffle sediment sizing and distribution curve

	Sediment Size [mm]
	0.075
WEEST Granular "B" Type II	0.3
	1.18
	4.75
	26.5
25-50	50
50-100	100
100-150	150
150-200	200
200-250	250
250-300	300
300-500	500
500-750	750
750-1000	1000



6.0 SUMMA RY AND CONCLUSIONS

Based on the desktop analysis and field reconnaissance, the following can be concluded:

(1) ***Historical assessment:***
A preliminary desktop assessment was conducted on the study reach using historical aerial photographs. Generally, the study area was found to be a predominately agricultural area situated north of the urban center of Millbrook, Ontario.

(2) ***Channel migration:***
Aerial imagery was georeferenced over a range of time steps in order to investigate channel migration and no significant migration using a desktop approach was determined.

(3) ***Meander belt width assessment:***
A meander belt width assessment was conducted on the study reach. The TRCA Meander Belt Width Delineation Procedure and Ward and Mecklenburg (2011) was used to determine the active belt width of the channel. This meander belt width indicates the lateral extent required for the re-aligned channel. The meander belt width for the study reach was found to be 11m.

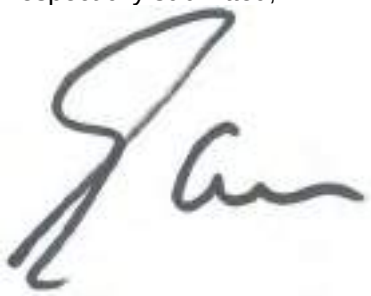
(4) ***Field investigation of study reach:***
General reach descriptions and a geomorphic analysis of the reach was conducted. Generally, the upstream reach was a grassy swale with reeds and low flows. At the mid-length cross-sections, near the location where the channel meanders and begins to flow northwards toward the confluence, there were berms built. The downstream section before the confluence was composed of sandy silts. The overall study reach was given a Rapid Geomorphic Assessment classification of being in transition and a Rapid Stream Assessment Technique score of fair.

(5) ***Geomorphic analysis of study reach:***
Twenty-one geomorphic and topographic surveys were conducted along the length of the study reach. Analysis of this data provided quantitative geomorphic parameters such as bankfull geometry and entrenchment values. Generally, bankfull geometries were consist throughout the reach apart from locations where the channel had been modified. The channel was overall slightly entrenched, which provides a multitude of representative cross-sections that can be used to guide channel design.

(6) ***Recommended design options:***
Based on the aforementioned desktop and field analysis of the study reach three design options were recommended using a natural and adaptive channel design approach. Recommended planform and in-channel feature design dimensions for the meandering channel option were also presented.

Should you have any comments or require clarification on any matter pertaining to the information contained in this report, please do not hesitate to contact Water's Edge.

Respectfully submitted,



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President, Sr. Geomorphologist
Water's Edge Environmental Solutions Team Ltd.

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Attachments:

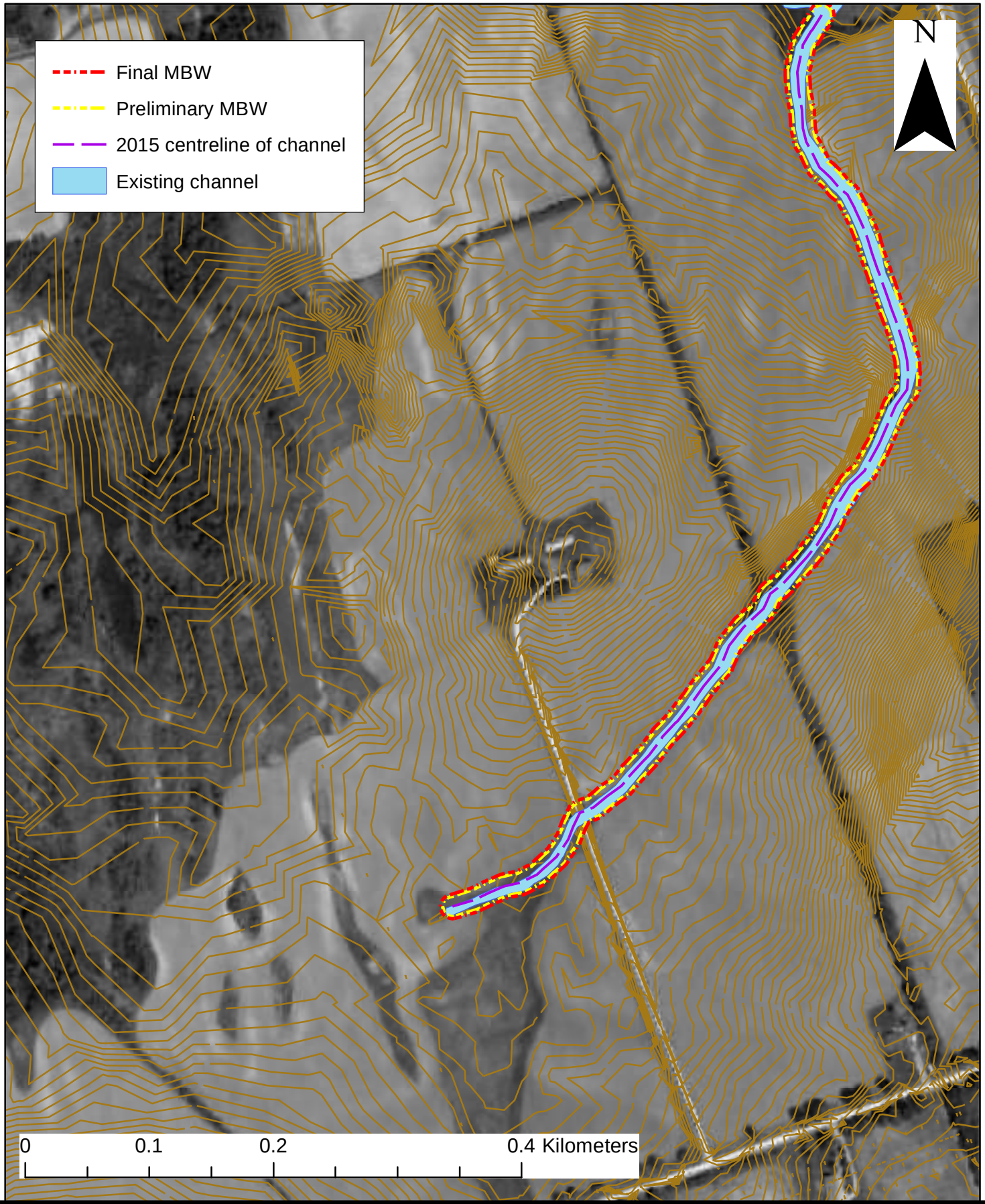
Maps 1 -4

Drawing 1

Appendix A: Field Photographs

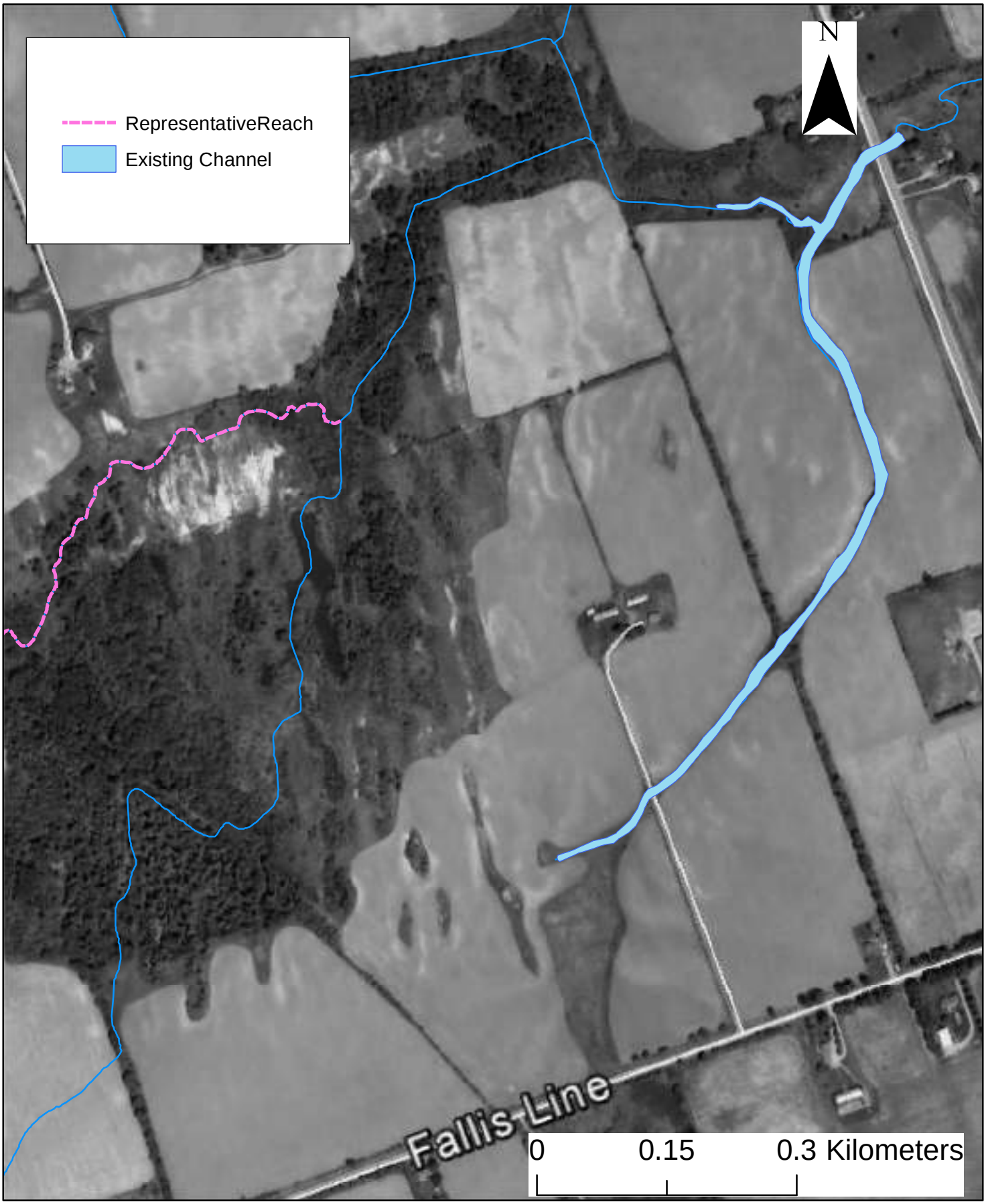
Appendix B: Topographic and Geomorphic Survey

Appendix C: Field Sheets

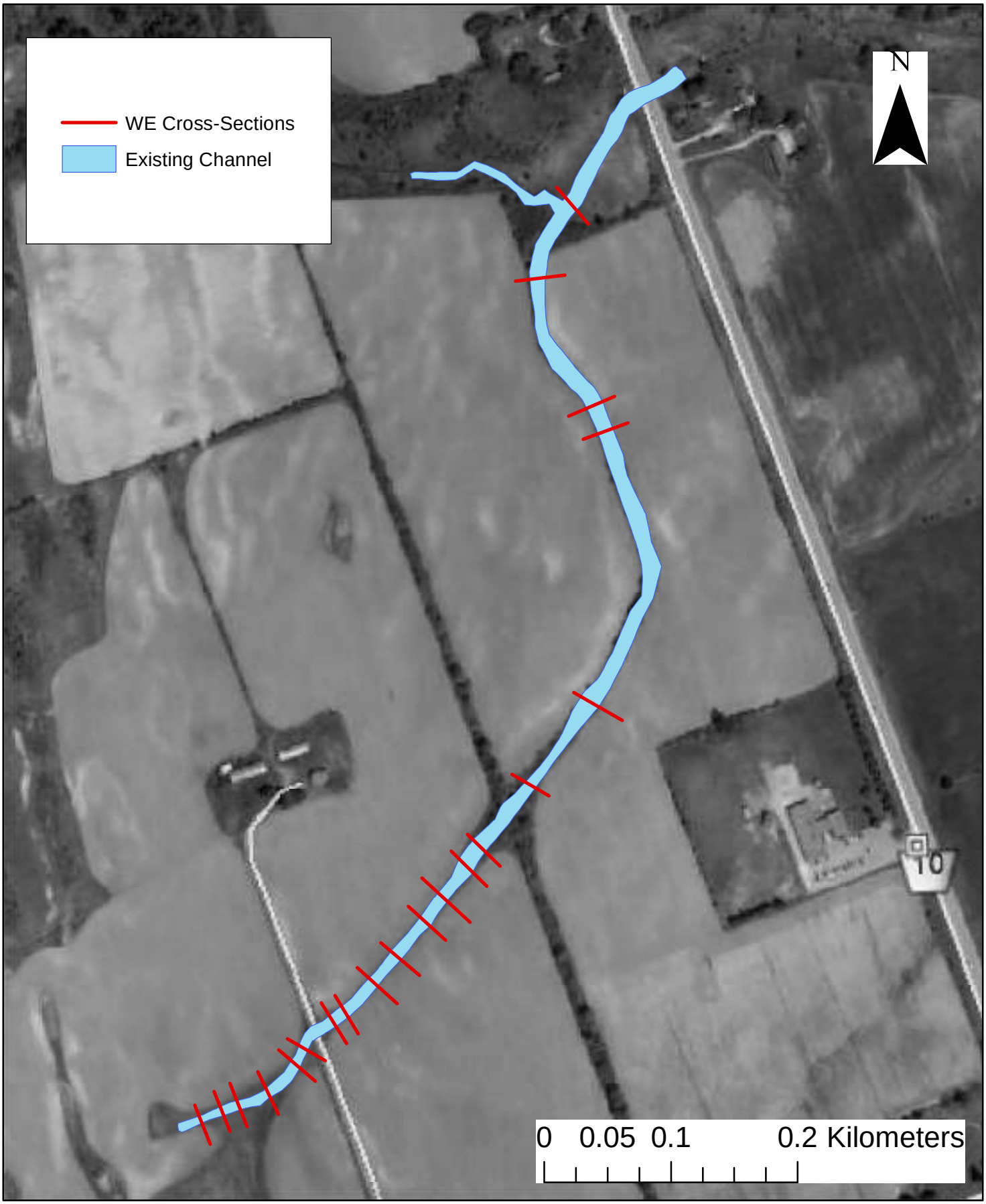


water's edge
ENVIRONMENTAL SOLUTIONS TEAM

Millbrook Subdivision Phase 2 Millbrook, Ontario		Map No.: 1	Date: May. 19, 2017
Meander Beltwidth Assessment and Analysis		Checked By: EG	Drawn By: EHG



waters edge ENVIRONMENTAL SOLUTIONS TEAM	Millbrook Subdivision Phase 2 Millbrook, Ontario	Map No.: 2	Date: Jun. 5, 2017
	Meander Beltwidth Representative Reach	Checked By: EG	Drawn By: EHG



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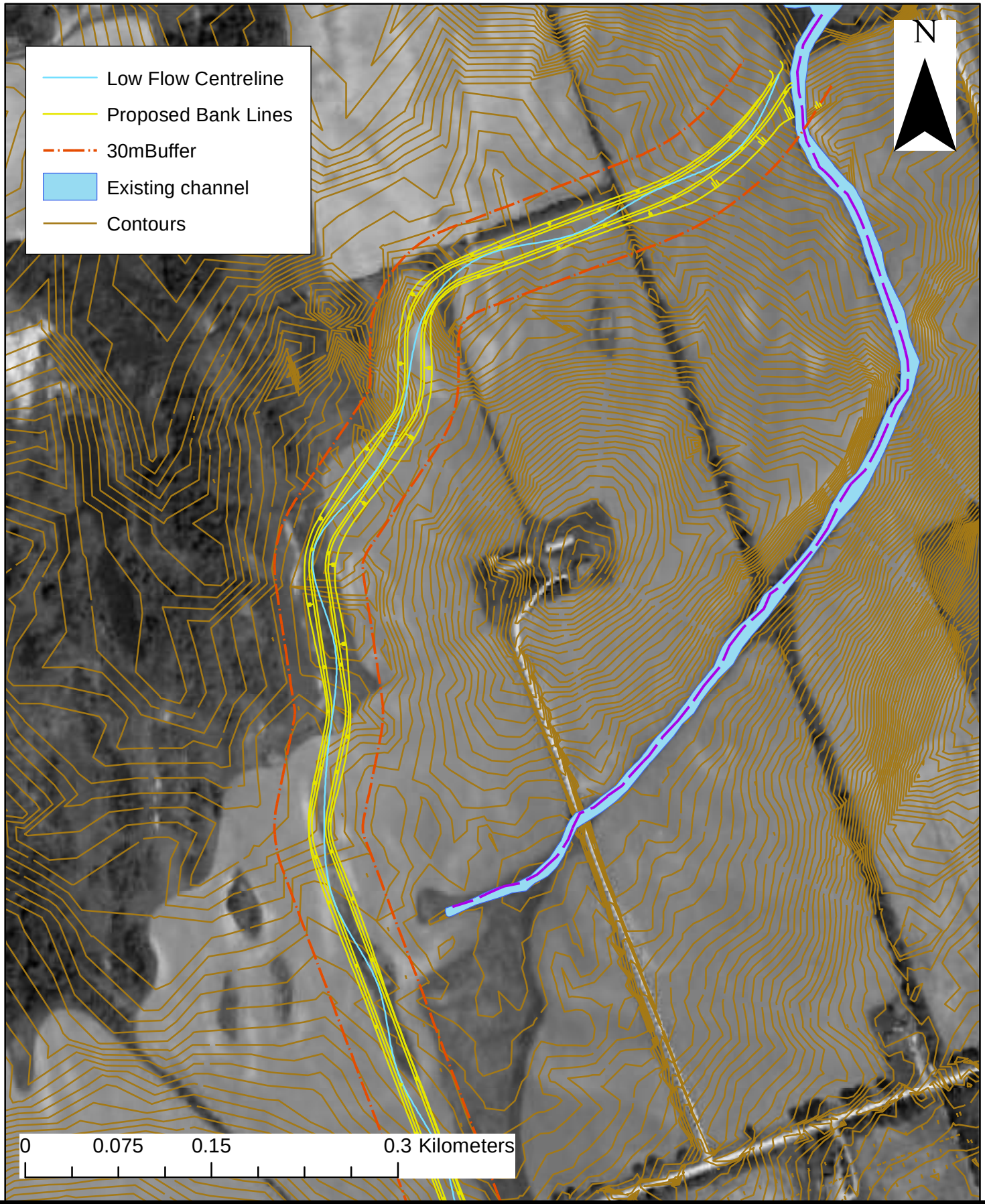
ENVIRONMENTAL SOLUTIONS TEAM

Millbrook Subdivision Phase 2 Millbrook, Ontario		Map No.: 3	Date: May. 19, 2017
Water's Edge Cross-Sections Geomorphic Cross-Section Analysis		Checked By: EG	Drawn By: EHG



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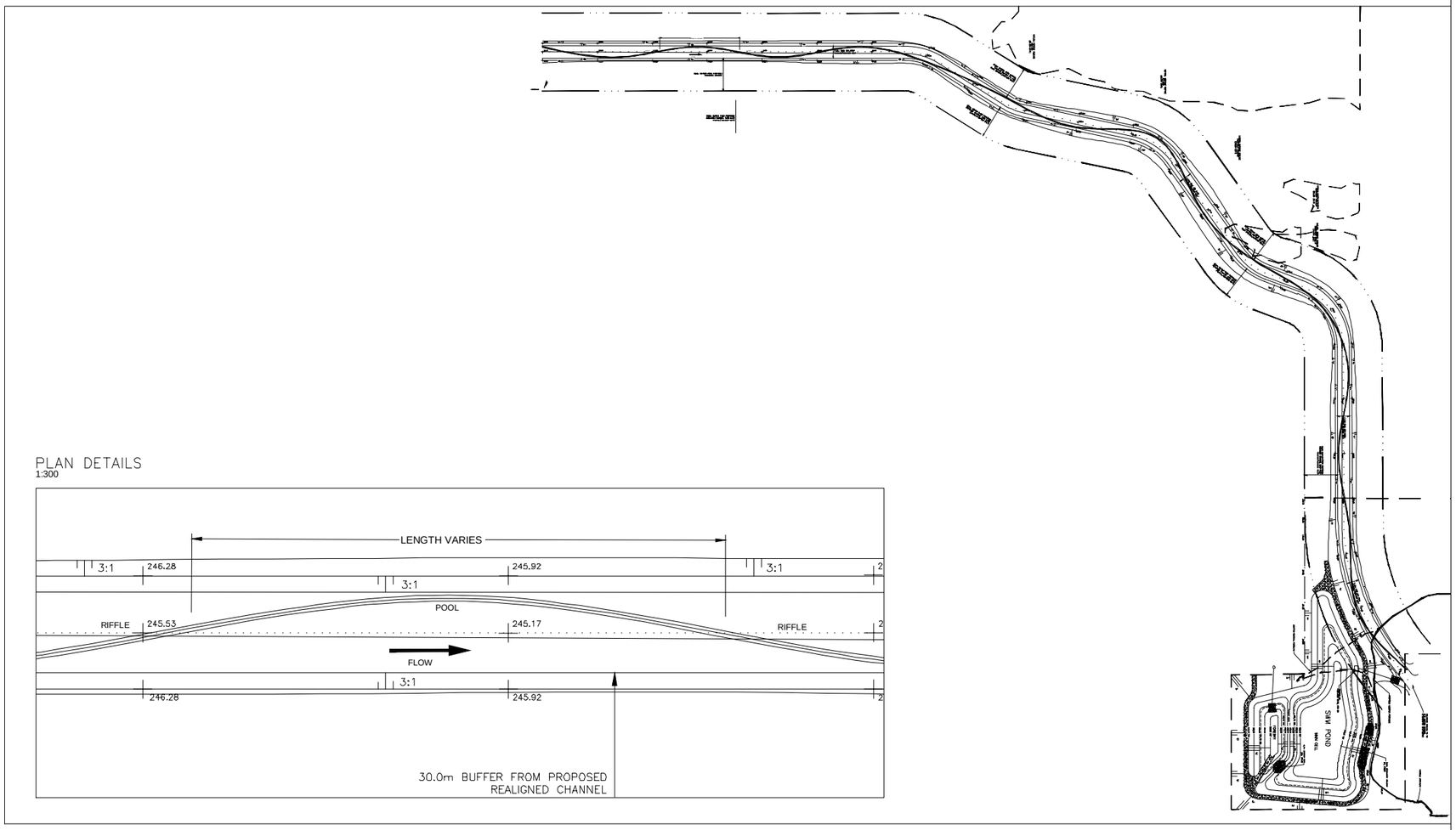
ENVIRONMENTAL SOLUTIONS TEAM

Millbrook Subdivision Phase 2
Millbrook, Ontario

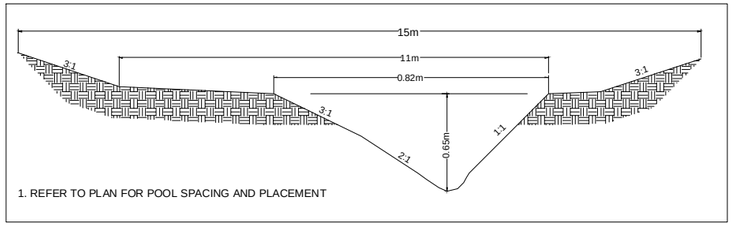
Existing and Proposed Channel
Channel Alignment Assessment

Map No.:	Date:
4	Jul. 26, 2017
Checked By:	**Drawn By:**
EG	EHG

PLAN
1:2000

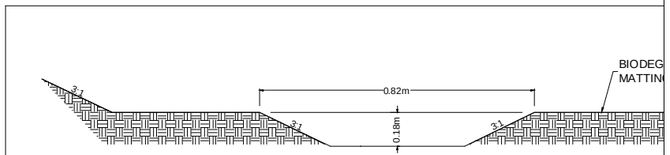


PLAN DETAILS
1:300



1. REFER TO PLAN FOR POOL SPACING AND PLACEMENT

D1 POOL (TYPICAL)
N.T.S.



1. D50 = 50mm
2. Depth = 0.18m

D2 RIFFLE: (TYPICAL)
N.T.S.

APPENDIX A:

Field Photographs (May 24, 2017)

PHOTOGRAPH NO.: 1
FROM: Left bank
LOOKING: Upstream at the headwaters of the tributary
COMMENT: Grassy, forbes-like channel, small cross-sectional geometry

PHOTOGRAPH NO.: 2
FROM: Left bank
LOOKING: Upstream at Cross-Section 1
COMMENT: Channel width has appeared to have naturally increased from upstream; banks are stable

PHOTOGRAPH NO.: 3
FROM: Left bank
LOOKING: Downstream at Cross-Section 1
COMMENT: Banks and floodplains are stabilized by a variety of long grasses; appear to be stable

PHOTOGRAPH NO.: 4
FROM: Left bank
LOOKING: Upstream at Cross-Section 2
COMMENT: Small tree on left bank; tall vegetation within the channel

PHOTOGRAPH NO.: 5
FROM: Left bank
LOOKING: Downstream at Cross-Section 2
COMMENT: Channel bed has significantly more dense grasses and vegetation

PHOTOGRAPH NO.: 6
FROM: Left Bank
LOOKING: Upstream at Cross-Section 3
COMMENT: Tall vegetation in channel (increase in roughness of the bed) is slightly narrower than the downstream pool; naturally, there is a greater water depth in the pool

PHOTOGRAPH NO.: 7
FROM: Left Bank
LOOKING: Downstream at Cross-Section 3
COMMENT: Tall vegetation within the channel bed is seen again; downstream there is a small shrub on the right bank diverting flow to the left

PHOTOGRAPH NO.: 8
FROM: Left Bank
LOOKING: Upstream at Cross-Section 4
COMMENT: Channel width has narrowed; numerous breaks in the slope of the banks

PHOTOGRAPH NO.: 9
FROM: Left bank
LOOKING: Downstream at Cross-Section 4
COMMENT: Deeper pool is seen with less dense vegetation on the channel bed; width has increased

PHOTOGRAPH NO.: 10
FROM: Left bank
LOOKING: Upstream at Cross-Section 5
COMMENT: Small exposed, bar-like, depositional features within the channel have grown new grasses

PHOTOGRAPH NO.: 11
FROM: Left bank
LOOKING: Downstream at Cross-Section 5
COMMENT: Significant flattening of vegetation is seen on both the left and right banks due to runoff

PHOTOGRAPH NO.: 12
FROM: Left bank
LOOKING: Upstream at Cross-Section 6
COMMENT: Section of small, dense shrubs, flow path of channel is less defined and there is diversion of flow around the vegetation

PHOTOGRAPH NO.: 13
FROM: Left bank
LOOKING: Downstream at Cross-Section 6
COMMENT: Small shrubs on right bank have grown over top of the channel and diverted flow path

PHOTOGRAPH NO.: 14
FROM: Left bank
LOOKING: Upstream at Cross-Section 7
COMMENT: Very little flow is present; bed, banks and terraces are stabilized by short grasses

PHOTOGRAPH NO.: 15
FROM: Left bank
LOOKING: Downstream at Cross-Section 7
COMMENT: Tall vegetation is seen downstream and channel narrows slightly

PHOTOGRAPH NO.: 16
FROM: Left bank
LOOKING: Upstream at Cross-Section 8
COMMENT: Some tall grasses on the left bank have been flattened due to runoff; channel width is smaller but cut deeper

PHOTOGRAPH NO.: 17
FROM: Left bank
LOOKING: Downstream at Cross-Section 8
COMMENT: Shrub on the right bank is diverting flow into a patch of taller willows

PHOTOGRAPH NO.: 18
FROM: Left bank
LOOKING: Upstream at Cross-Section 9
COMMENT: Little flow through channel, riparian buffer is made of small grasses and some erosion is seen on left bank due to agricultural activities

PHOTOGRAPH NO.: 19
FROM: Left bank
LOOKING: Downstream at Cross-Section 9
COMMENT: Some flattening of vegetation due to runoff is seen on left bank

PHOTOGRAPH NO.: 20
FROM: Left bank
LOOKING: Upstream at Cross-Section 10
COMMENT: Grasses are slightly taller on the banks, channel bed is cut slightly deeper

PHOTOGRAPH NO.: 21
FROM: Left bank
LOOKING: Downstream at Cross-Section 10
COMMENT: Grasses have overgrown and are creating shade over the channel; some anthropogenic erosion seen on left bank

PHOTOGRAPH NO.: 22
FROM: Left bank
LOOKING: Upstream at Cross-Section 11
COMMENT: Some flattening of vegetation seen on the left bank; little flow in channel; stable tree is noted on the right bank

PHOTOGRAPH NO.: 23
FROM: Left bank
LOOKING: Downstream at Cross-Section 11
COMMENT: Channel has narrowed and become slightly deeper; two small trees and shrubs are noted on the right banks

PHOTOGRAPH NO.: 24
FROM: Left bank
LOOKING: Upstream at Cross-Section 12
COMMENT: Width of riparian buffer has increased; channel has widened and there is less vegetation overhanging the channel

PHOTOGRAPH NO.: 25
FROM: Left bank
LOOKING: Downstream at Cross-Section 12
COMMENT: Channel meanders slightly to the right before entering a reach with a dense thicket of older growth vegetation

PHOTOGRAPH NO.: 26
FROM: Upstream
LOOKING: Upstream at Cross-Section 13
COMMENT: Berm of earth and river stone has been built on the left bank; dense growth of older trees on both the left and right banks; channel bed is composed of more sandy silts and fewer long grasses

PHOTOGRAPH NO.: 27
FROM: Left bank
LOOKING: Downstream at Cross-Section 13
COMMENT: Woody debris is covering the channel

PHOTOGRAPH NO.: 28
FROM: Left bank
LOOKING: Upstream at Cross-Section 14
COMMENT: Few younger, small shrubs have grown on the left bank, grassy berm (appears to be man-made) is on the right bank

PHOTOGRAPH NO.: 29
FROM: Left bank
LOOKING: Downstream at Cross-Section 15
COMMENT: Flow in channel is significantly greater; Larger shrubs on the left bank; Berm on the right bank

PHOTOGRAPH NO.: 30
FROM: Left bank
LOOKING: Berm built of earthen river stone, located between Cross-Section 15 and 16
COMMENT: Berm has eliminated connectivity of main channel to the floodplain; dense tree cover

PHOTOGRAPH NO.: 31
FROM: In the stream
LOOKING: Upstream at Cross-Section 16
COMMENT: Channel bed appears to be degrading; banks have eroded a bit but remain fairly stable.

PHOTOGRAPH NO.: 32
FROM: In the stream
LOOKING: Downstream at Cross-Section 16
COMMENT: Large stone riprap (approximately 15 to 30 cm) in size have been placed in the channel bed; channel bed composed of sandy-silt; downstream there is a slight increase of channel width and banks have slightly collapsed

PHOTOGRAPH NO.: 33
FROM: In the stream
LOOKING: Upstream at Cross-Section 17
COMMENT: Old gate on the left bank is falling in; some bank instability; runoff has resulted in riling on the left bank; bed of channel appears to be degrading; some sinuosity of channel

PHOTOGRAPH NO.: 34
FROM: Center of channel
LOOKING: Downstream at Cross-Section 17
COMMENT: Left bank is slightly upstable; riparian buffer has increased

PHOTOGRAPH NO.: 35
FROM: Center of channel
LOOKING: Upstream at Cross-Section 18
COMMENT: Some toeing of banks; bed has degraded; lack of connection between banks and floodplains

PHOTOGRAPH NO.: 36
FROM: Center of channel
LOOKING: Downstream at Cross-Section 18
COMMENT: Runoff and bank instability appear on the left bank; river flowing into dense thicket of vegetation

PHOTOGRAPH NO.: 37
FROM: Center of channel
LOOKING: Upstream (between Cross-Section 18 and 19) at culvert
COMMENT: Culvert has been compressed; river stone (range in size from 15cm to 30cm) at the outlet; water flowing beneath the culvert from other side

PHOTOGRAPH NO.: 38
FROM: Center of channel, slightly downstream of Cross-Section 22
LOOKING: Upstream (between Cross-Section 18 and 19) at culvert
COMMENT: River-stone riprap has significant moss cover and little water flowing overtop; downstream is sandy-silt

PHOTOGRAPH NO.: 39
FROM: Left bank
LOOKING: Downstream (between Cross-Section 18 and 19 and downstream of culvert)
COMMENT: Bed composed of sandy-silt with some larger stones; significant meander in the channel and development of a point bar terrace on the right bank; banks appear to be fairly stable; some overhanging vegetation on the right bank

PHOTOGRAPH NO.: 40
FROM: Right bank
LOOKING: Upstream at Cross-Section 19 (at confluence of study reach with Baxter Creek)
COMMENT: Channel is significantly wider with substantially greater flow depth;

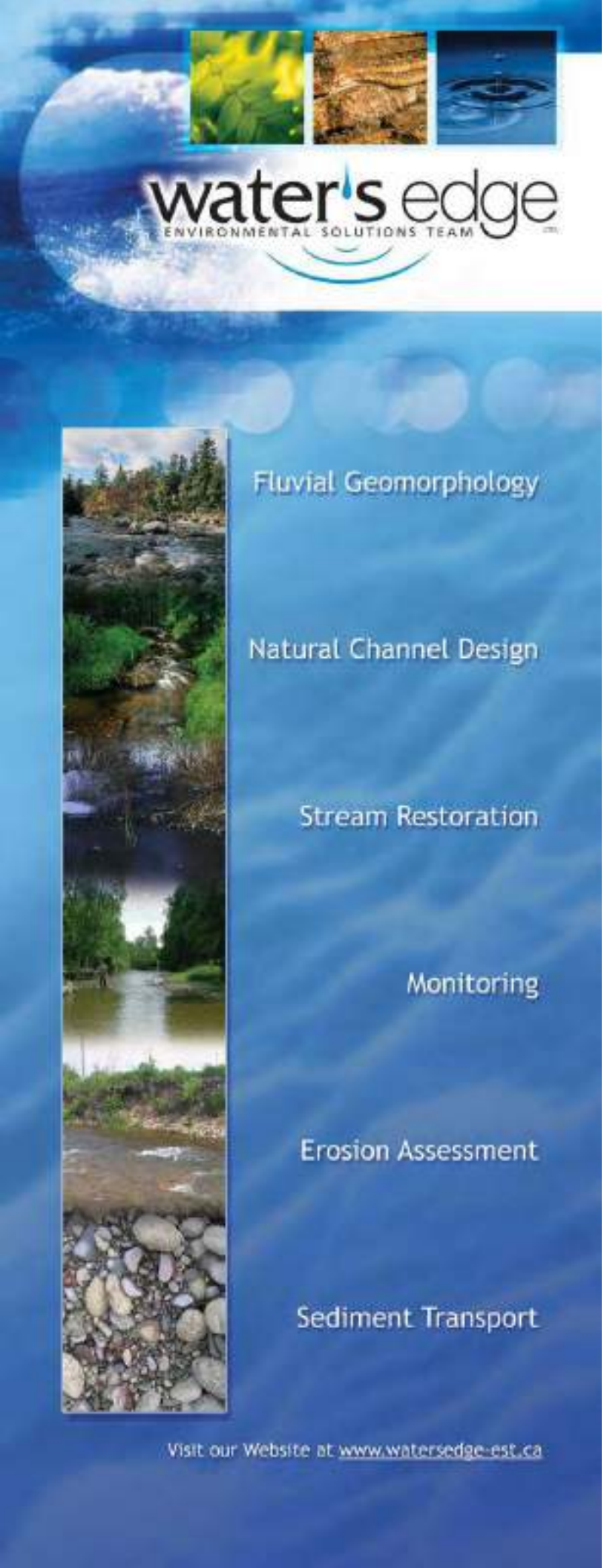
PHOTOGRAPH NO.: 41
FROM: Right bank
LOOKING: Downstream at Cross-Section 19 (at confluence of study reach with Baxter Creek)
COMMENT: Bed is composed of a mix of grasses and larger river stone; right bank is saturated

PHOTOGRAPH NO.: 42
FROM: Center of channel
LOOKING: Upstream at Cross-Section 20
COMMENT: Exposed, depositional bar has formed on the right bank

PHOTOGRAPH NO.: 43
FROM: Right bank
LOOKING: Downstream at Cross-Section 20
COMMENT: Discharge has increased; right bank is saturated and slightly unstable

PHOTOGRAPH NO.: 44
FROM: Right bank
LOOKING: Upstream at Cross-Section 21
COMMENT: Larger cobbles and boulders in the channel have diverted the flow; these features have increase channel roughness and encouraged further sediment to accumulate resulting in the growth of depositional features with grassy vegetation

PHOTOGRAPH NO.: 45
FROM: Right bank
LOOKING: Downstream at Cross-Section 21 at culvert (downstream of Cross-Section 21)
COMMENT: Right bank is saturated; some flow diversion channels exist on right floodplain; right floodplain has resulted in grassy islands; concrete, rectangular culvert underpasses County Road 10



APPENDIX B:

Topographic and Geomorphic Survey

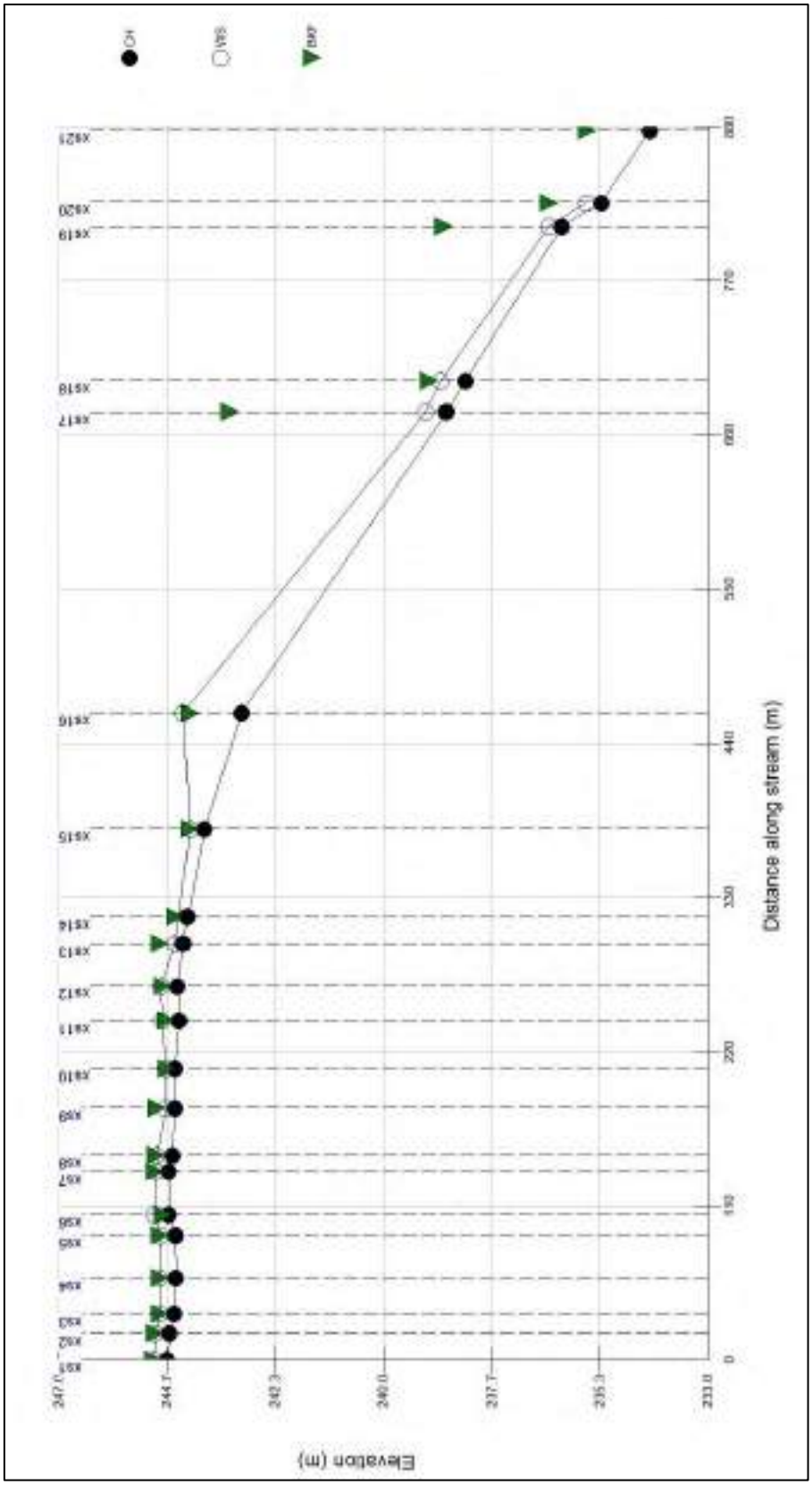


Figure C.1 – Long profile of study reach.

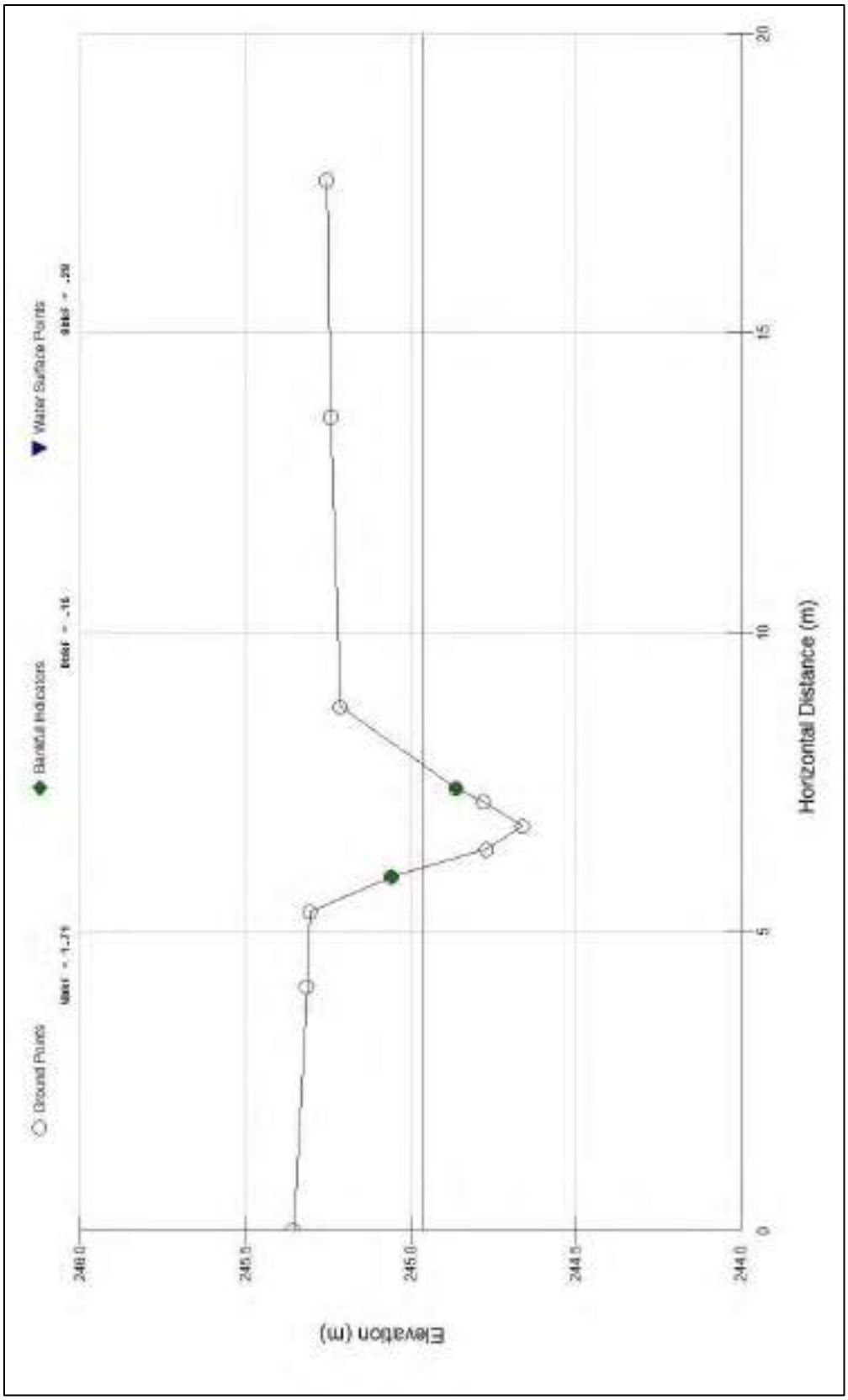


Figure C.2 – Cross-section 1 of study reach.

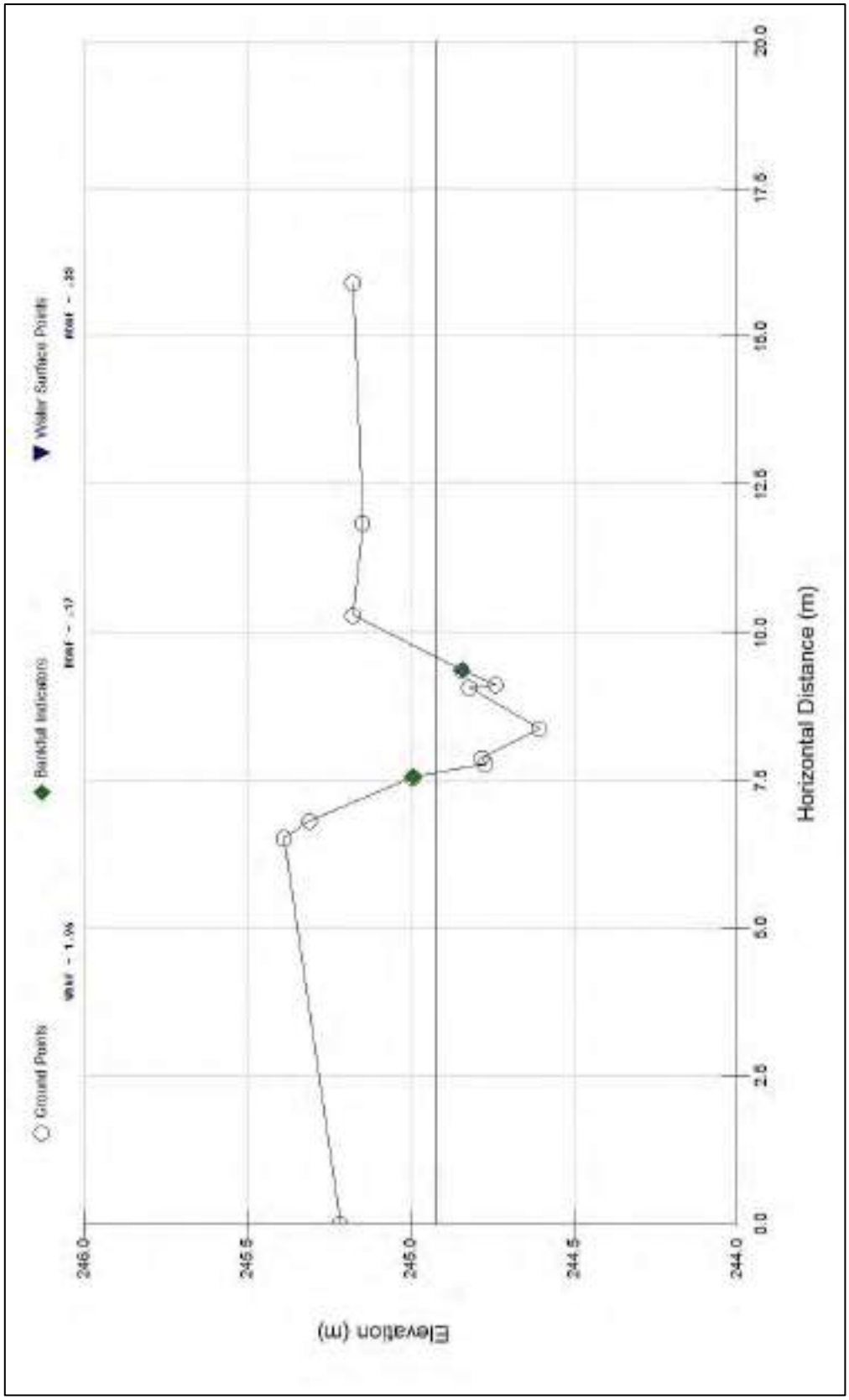


Figure C.3 – Cross-section 2 of study reach.

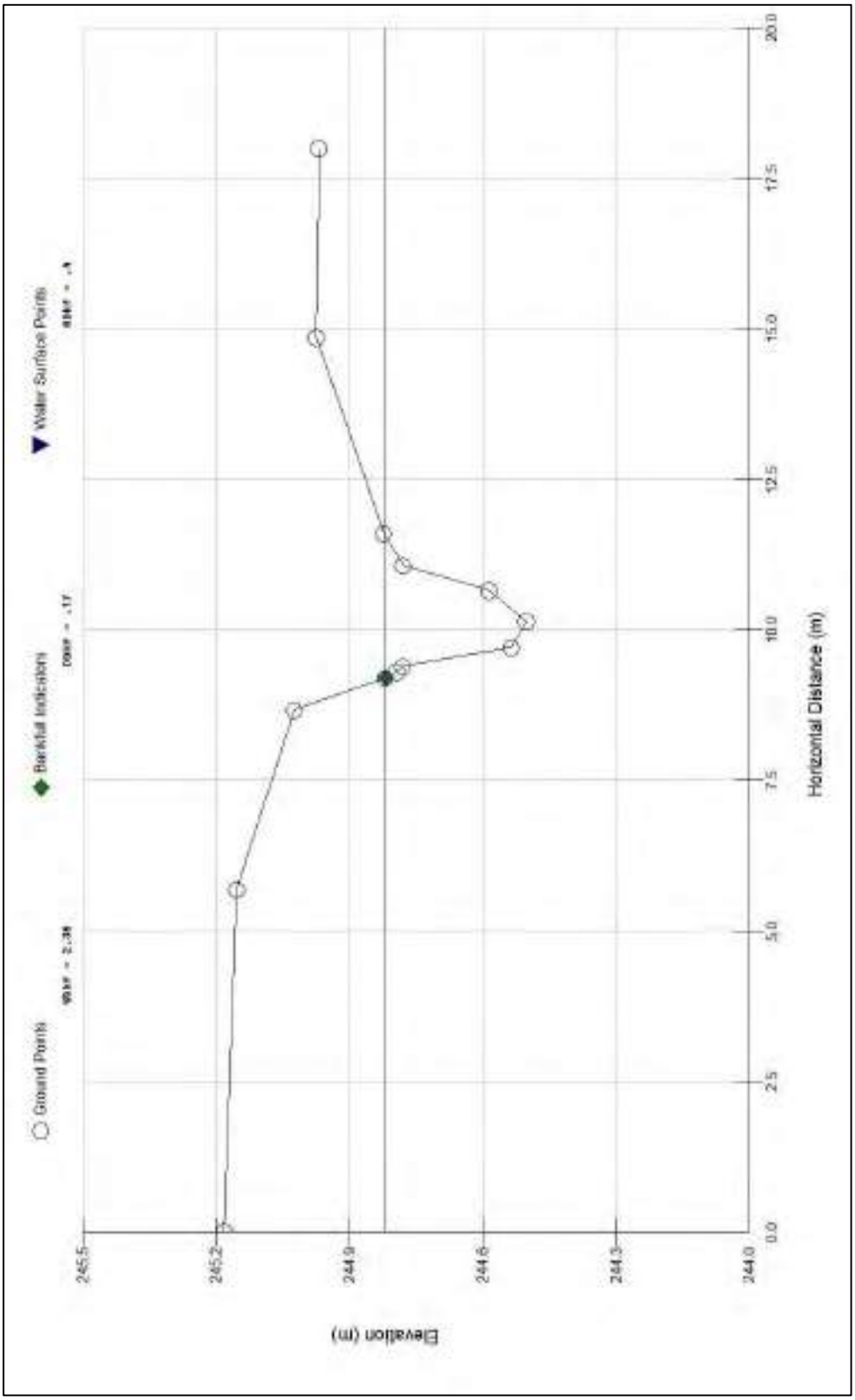


Figure C.4 – Cross-section 3 of study reach.

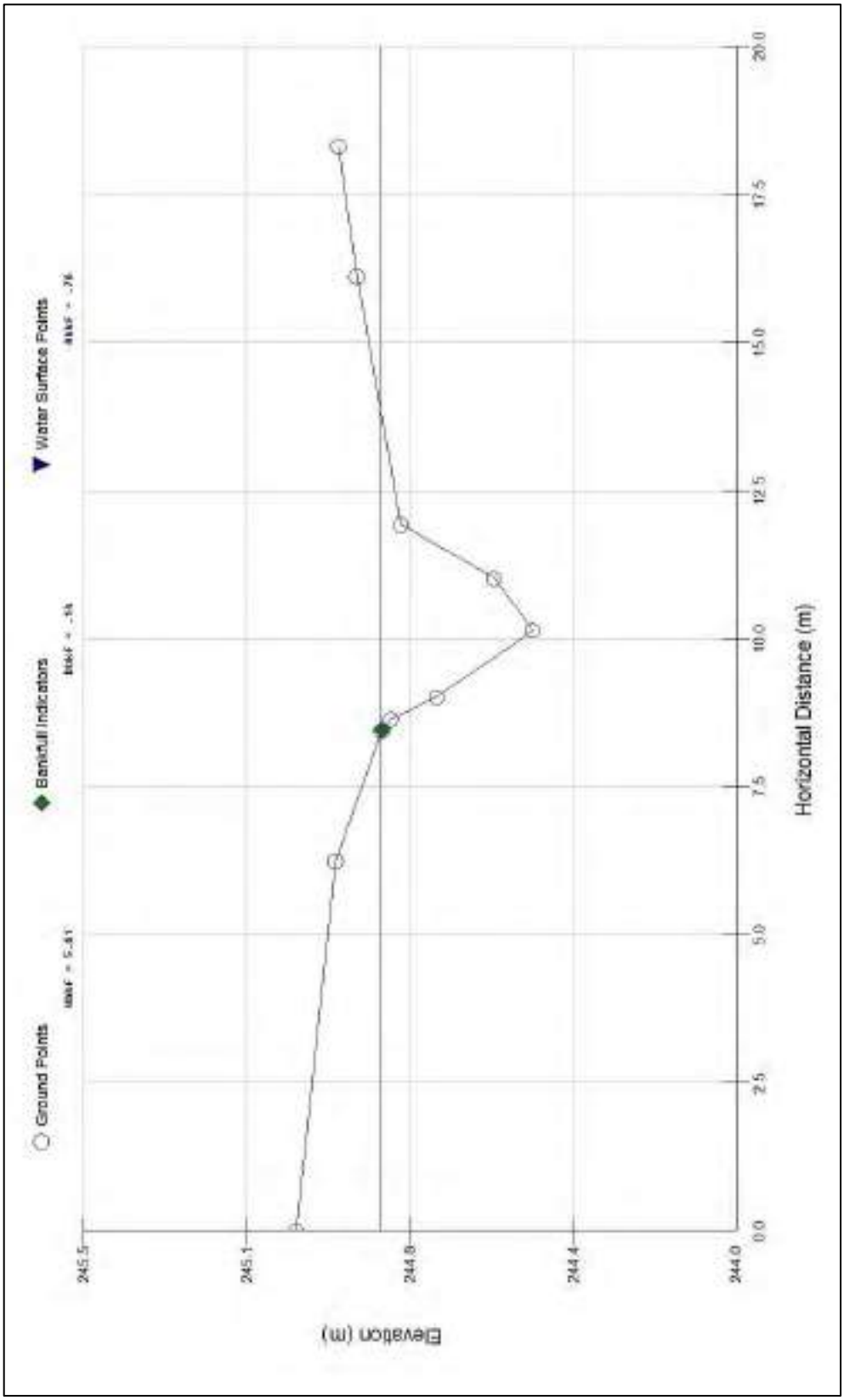


Figure C.5 – Cross-section 4 of study reach.

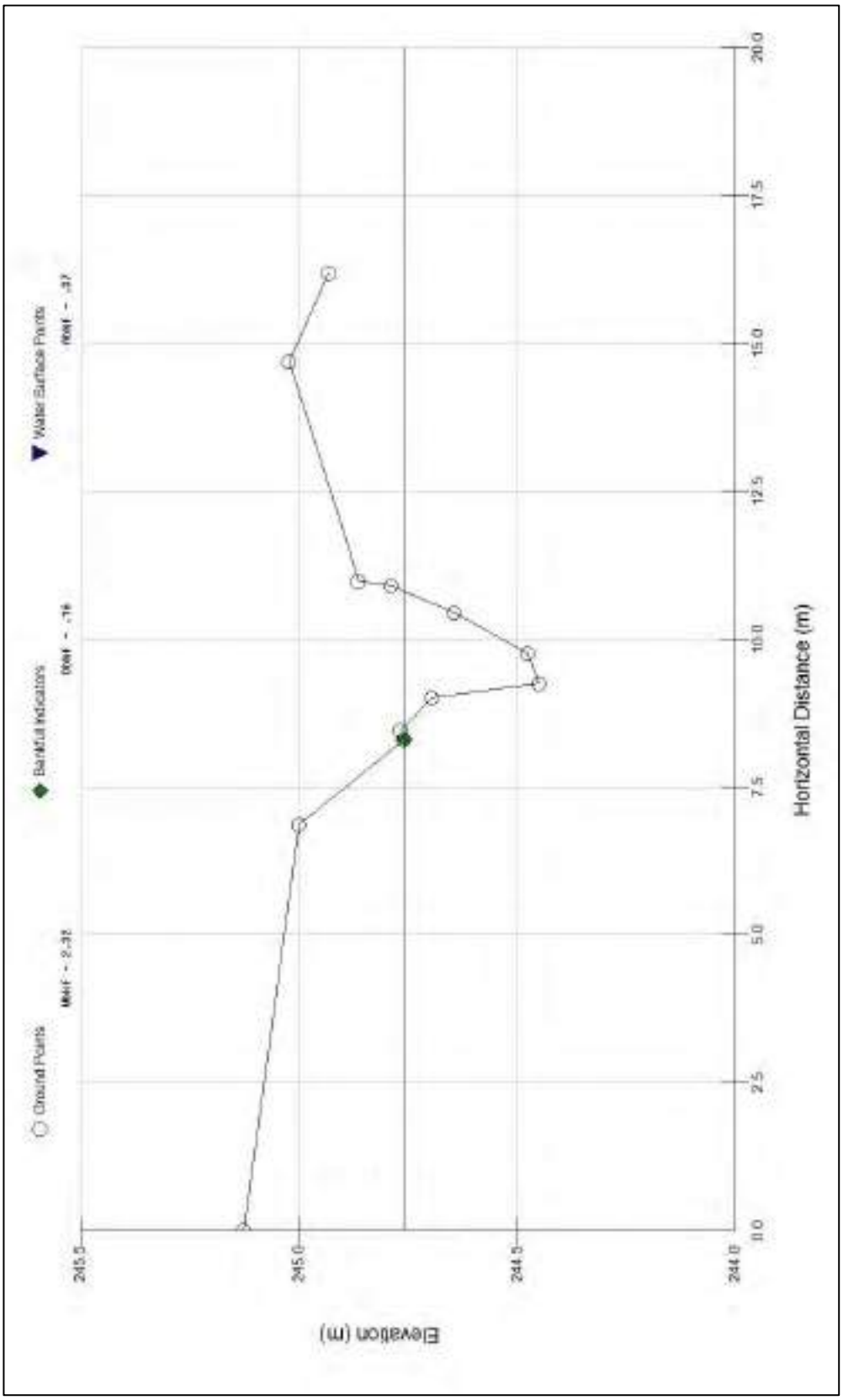


Figure C.6 – Cross-section 5 of study reach.

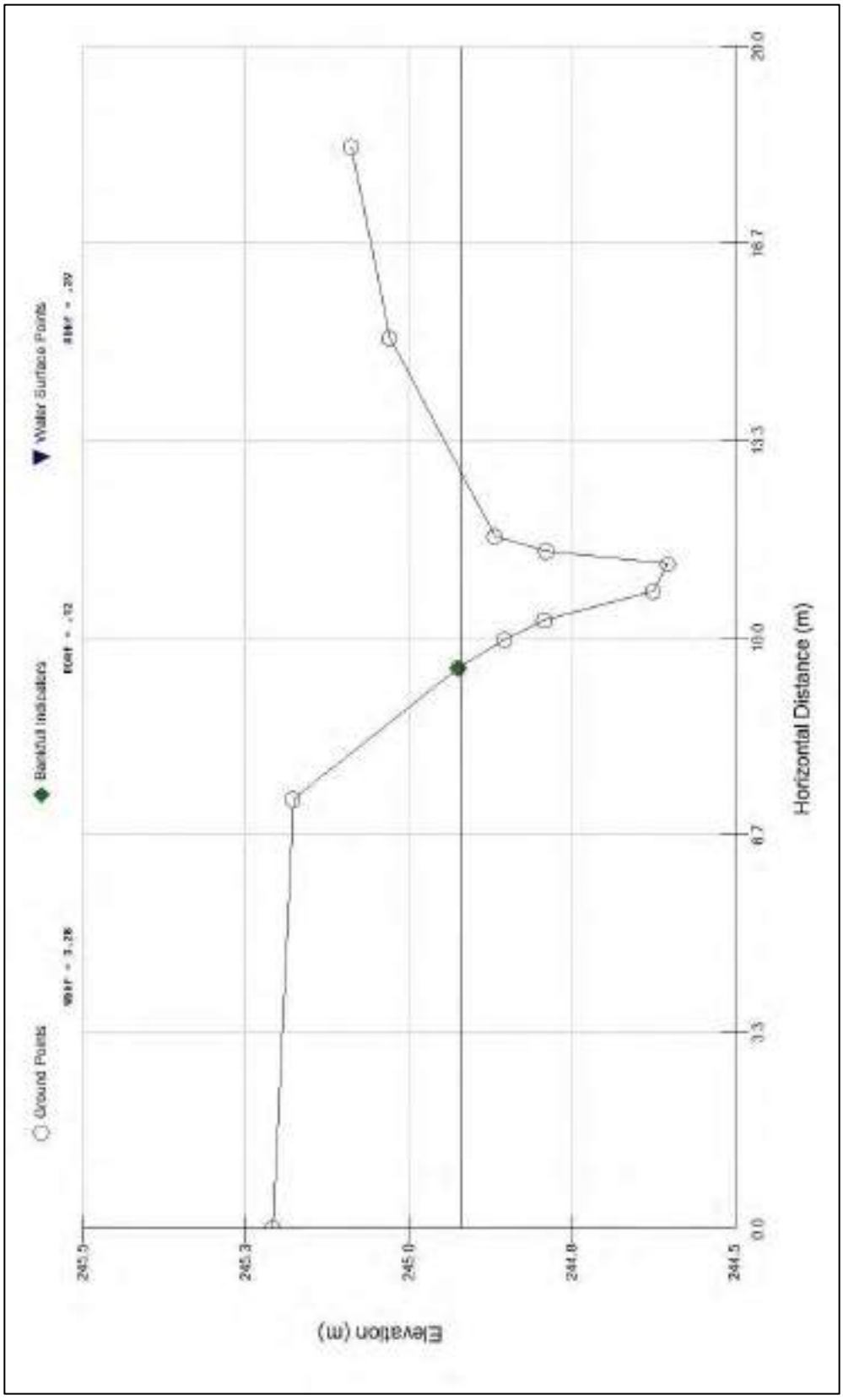


Figure C.7 – Cross-section 6 of study reach.

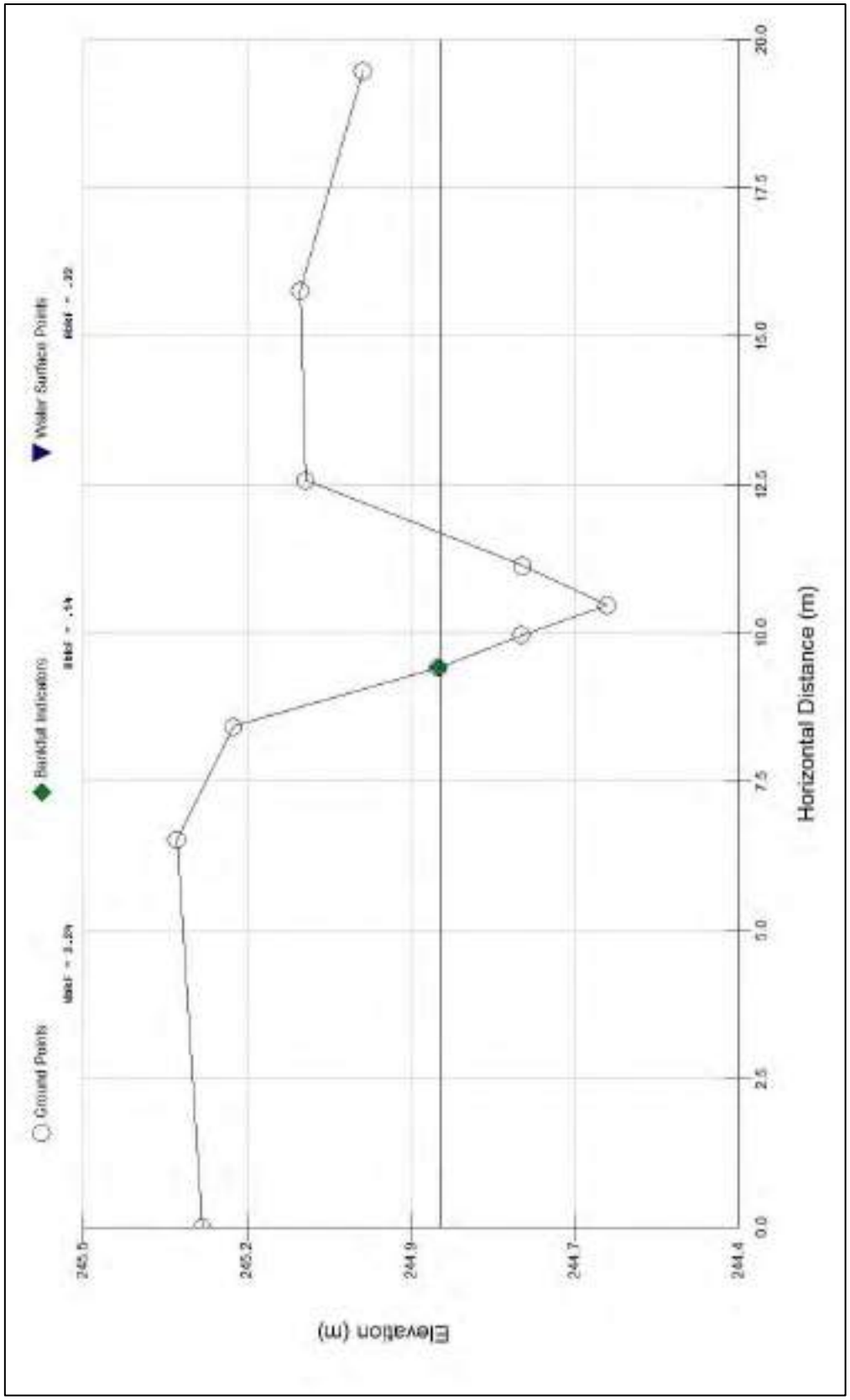


Figure C.8 – Cross-section 7 of study reach.

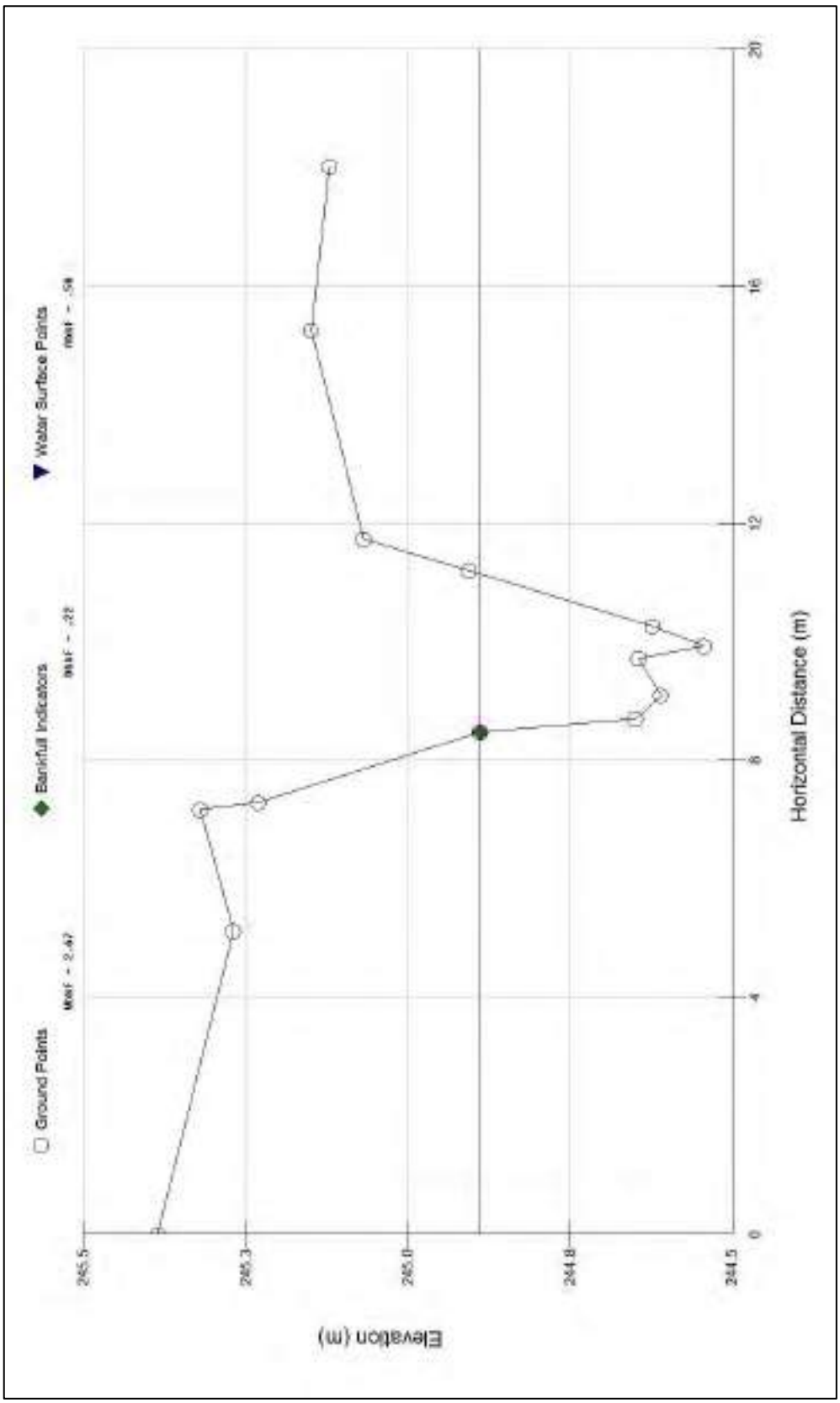


Figure C.9 – Cross-section 8 of study reach.

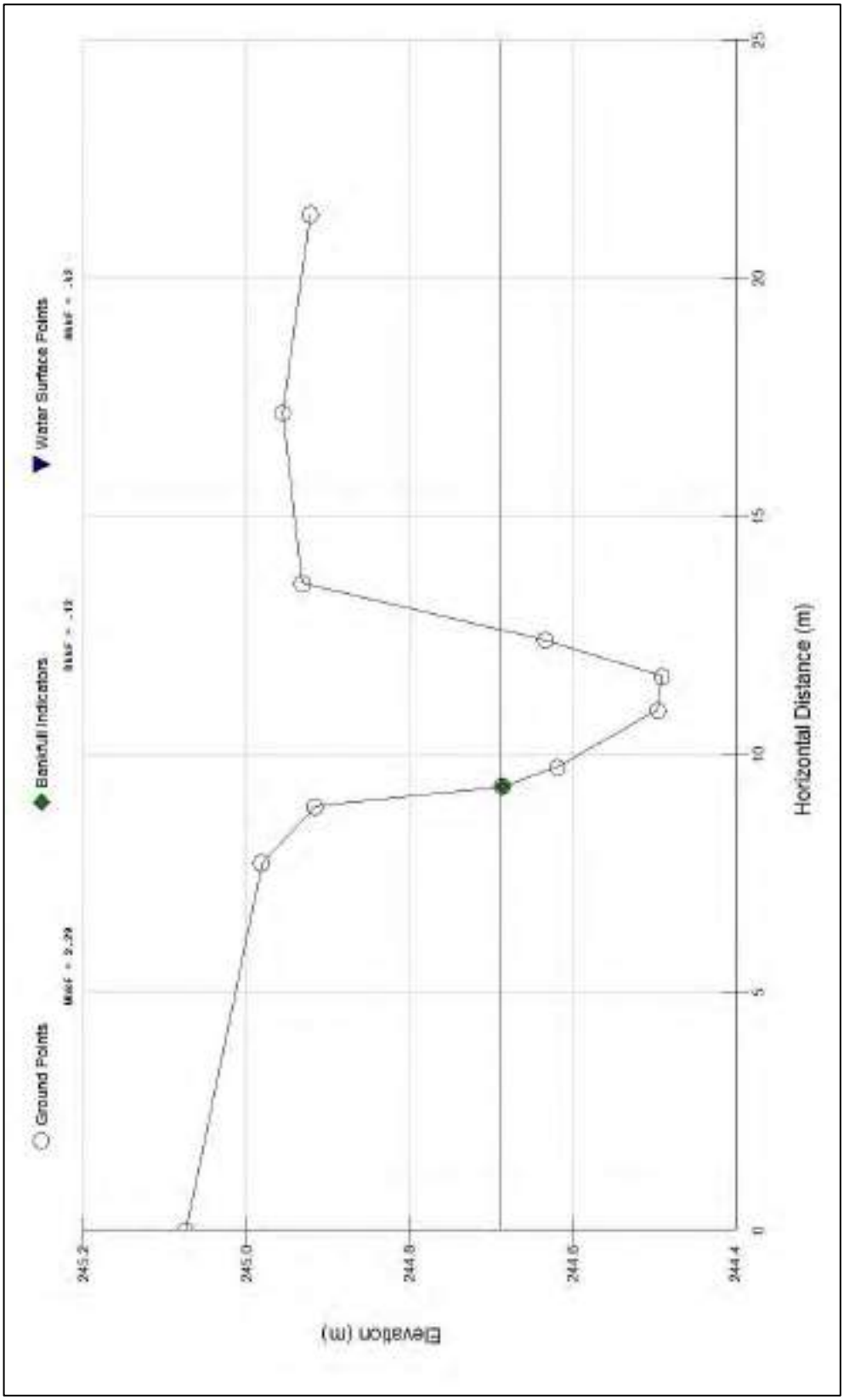


Figure C.10 – Cross-section 9 of study reach.

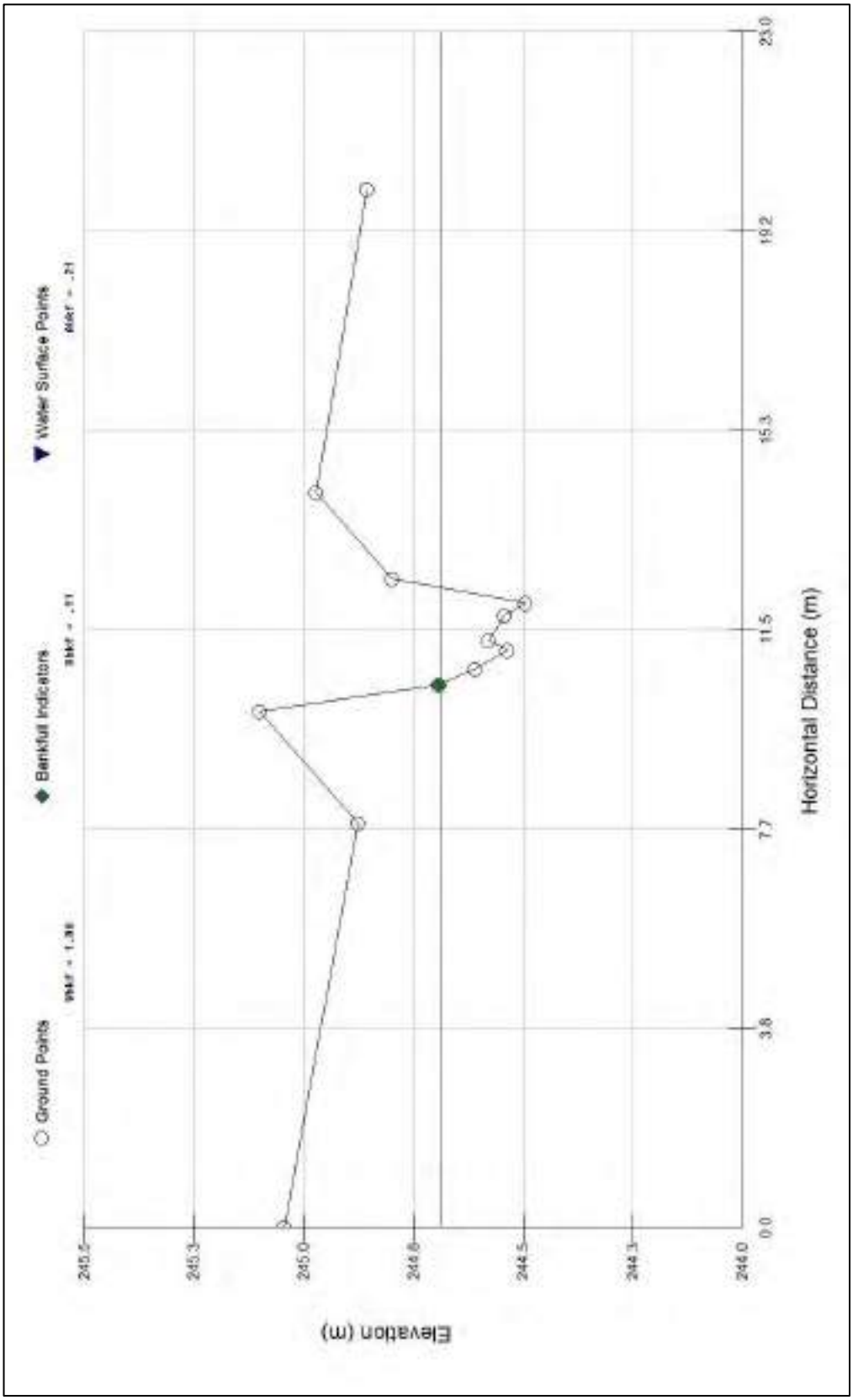


Figure C.11 – Cross-section 10 of study reach.

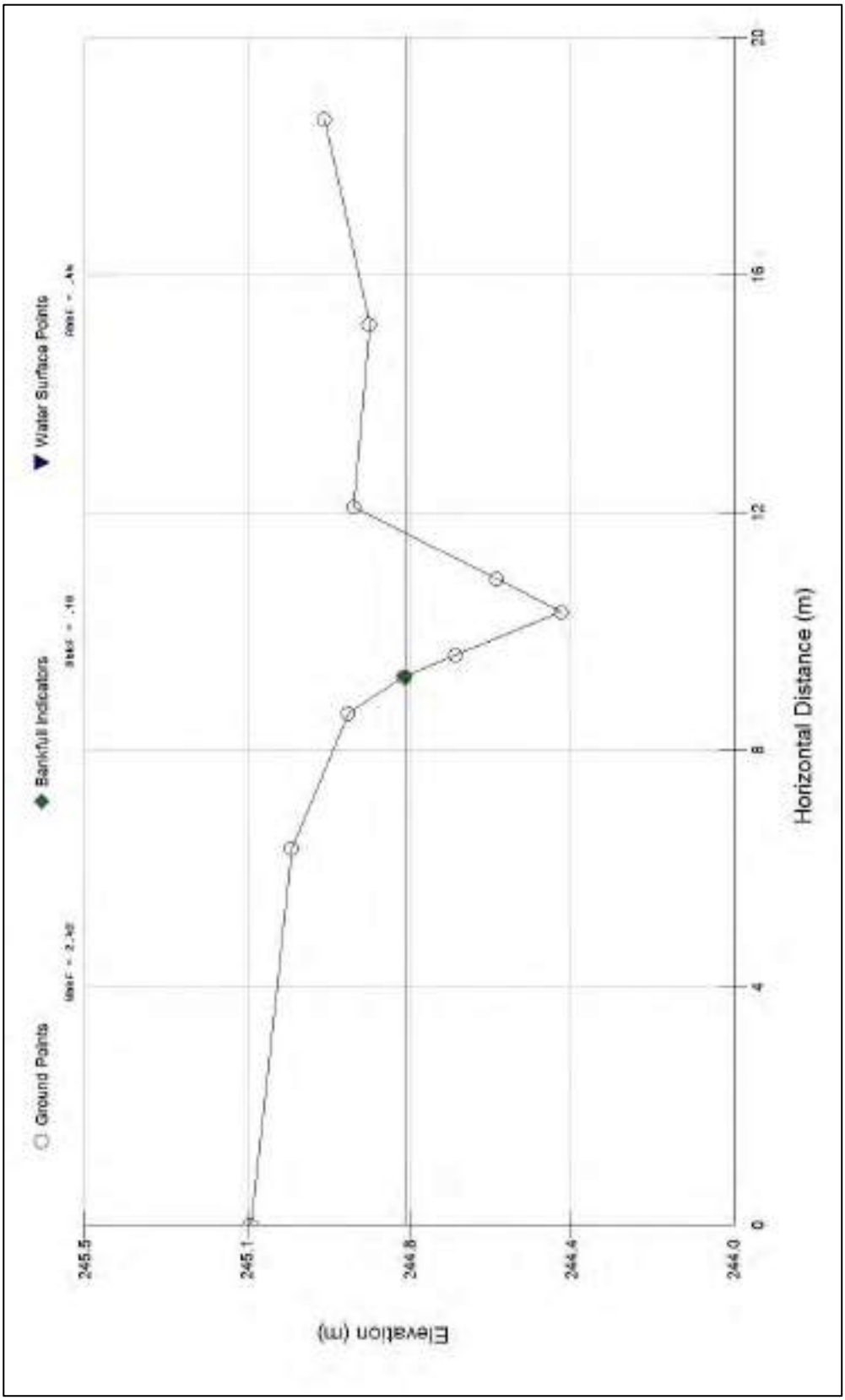


Figure C.12 – Cross-section 11 of study reach.

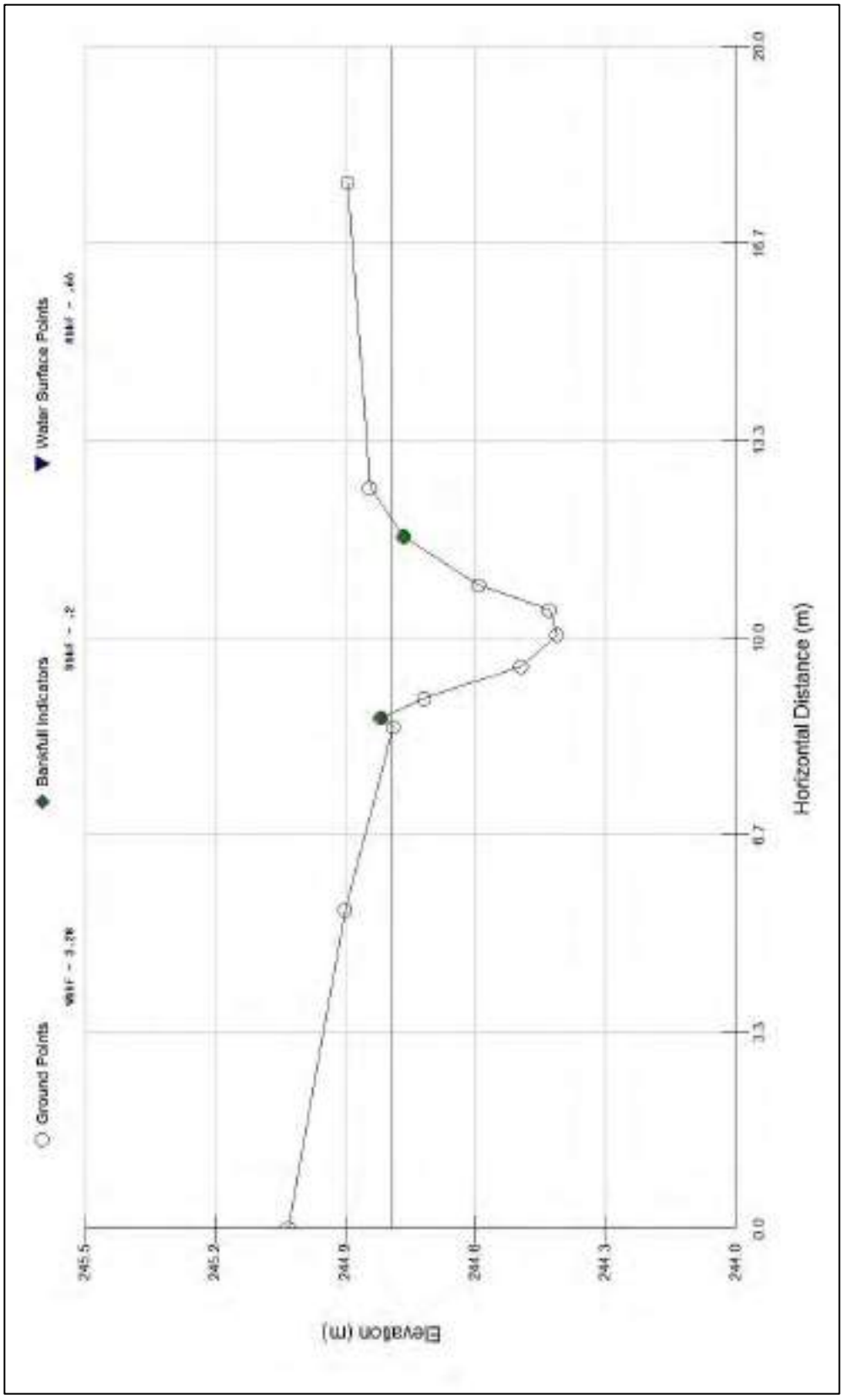


Figure C.13 – Cross-section 12 of study reach.

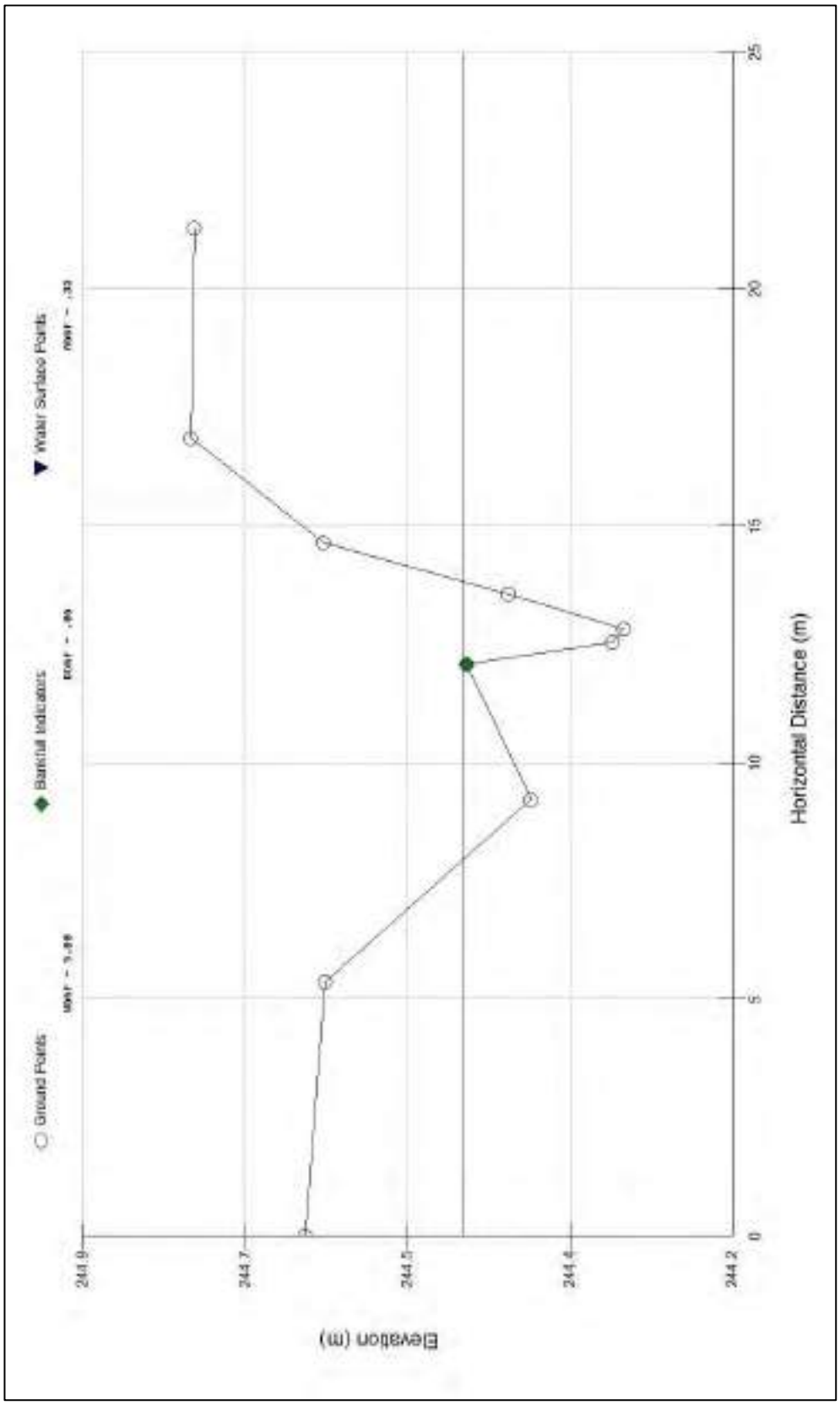


Figure C.14 – Cross-section 13 of study reach.

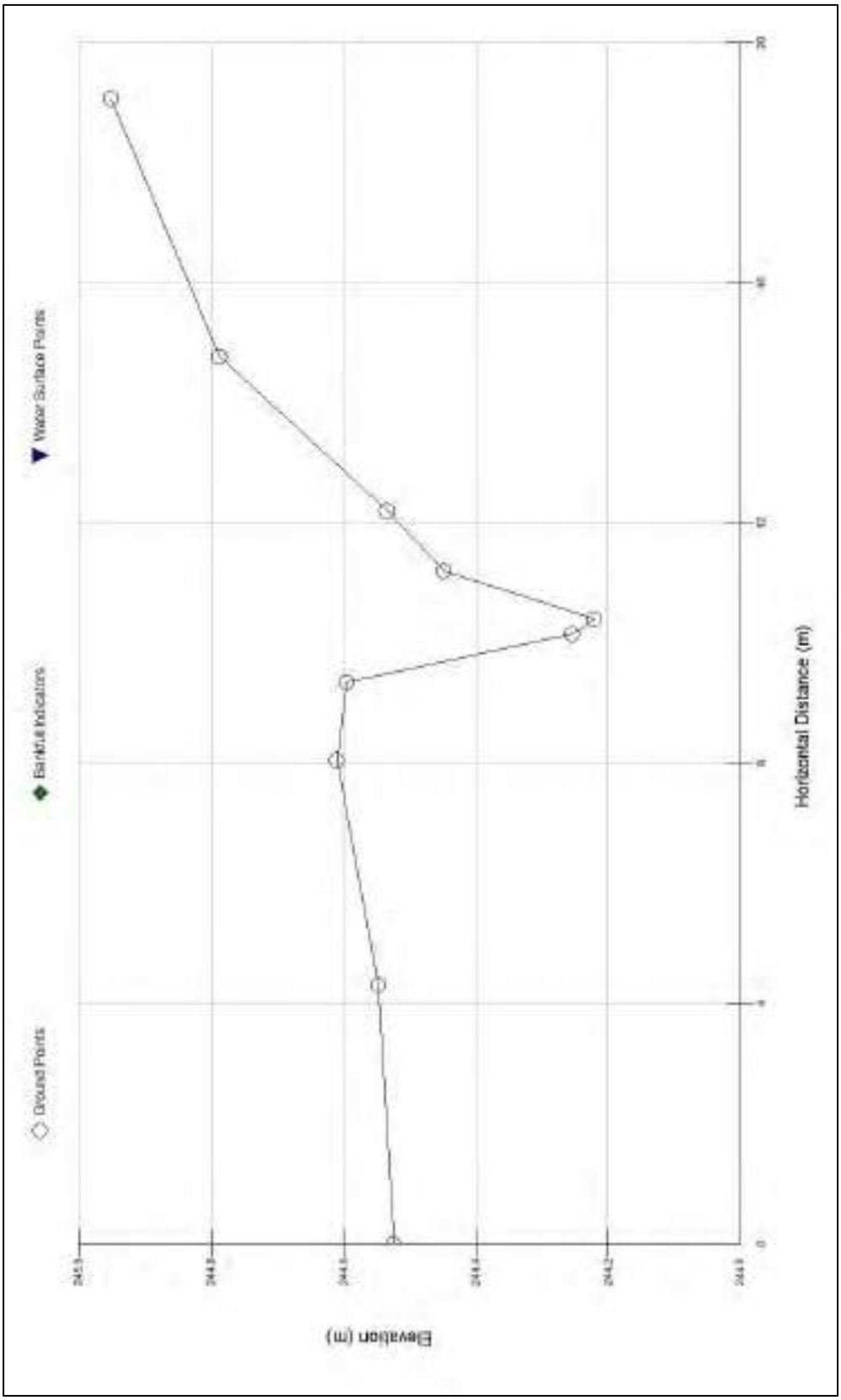


Figure C.15 – Cross-section 14 of study reach.

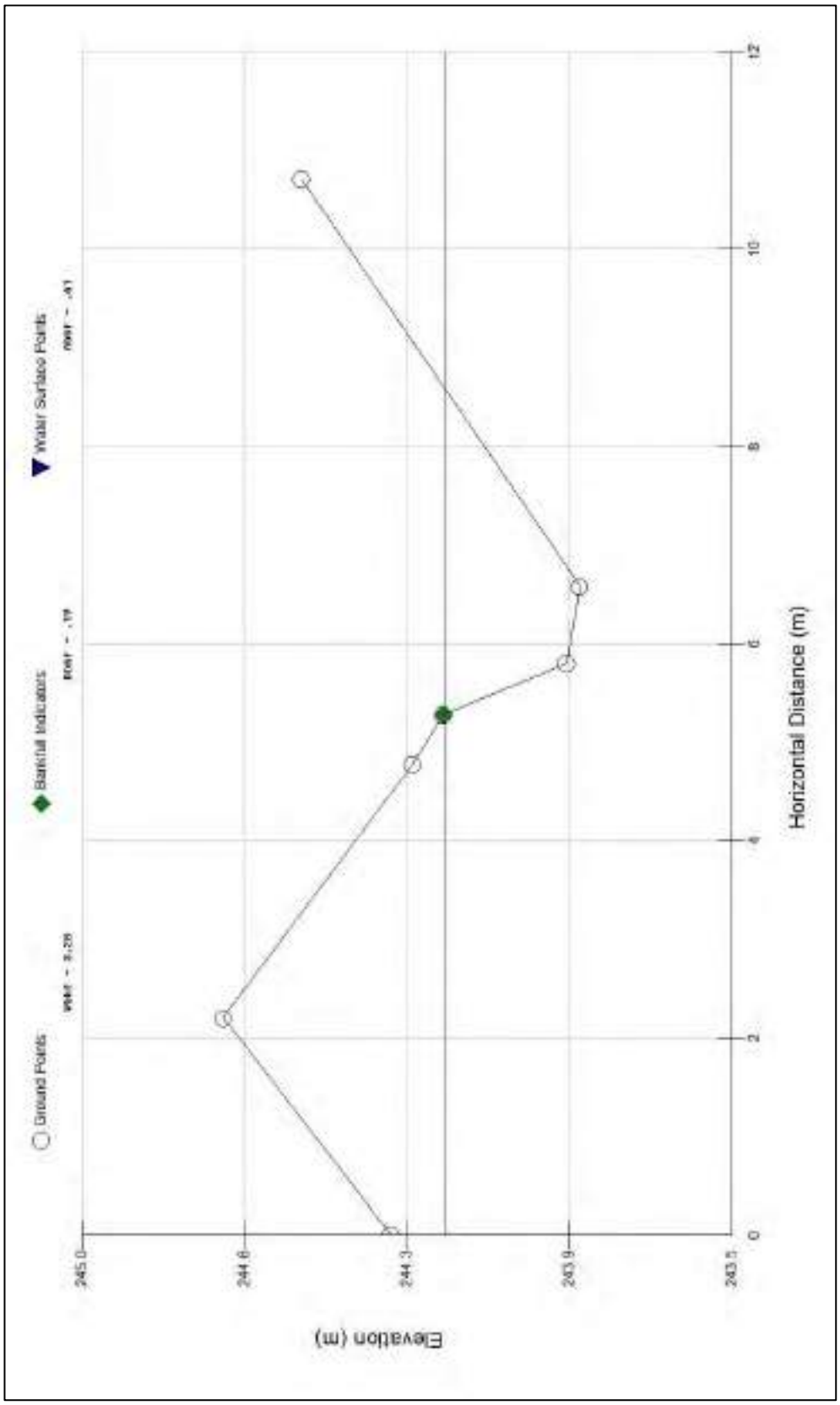


Figure C.16 – Cross-section 15 of study reach.

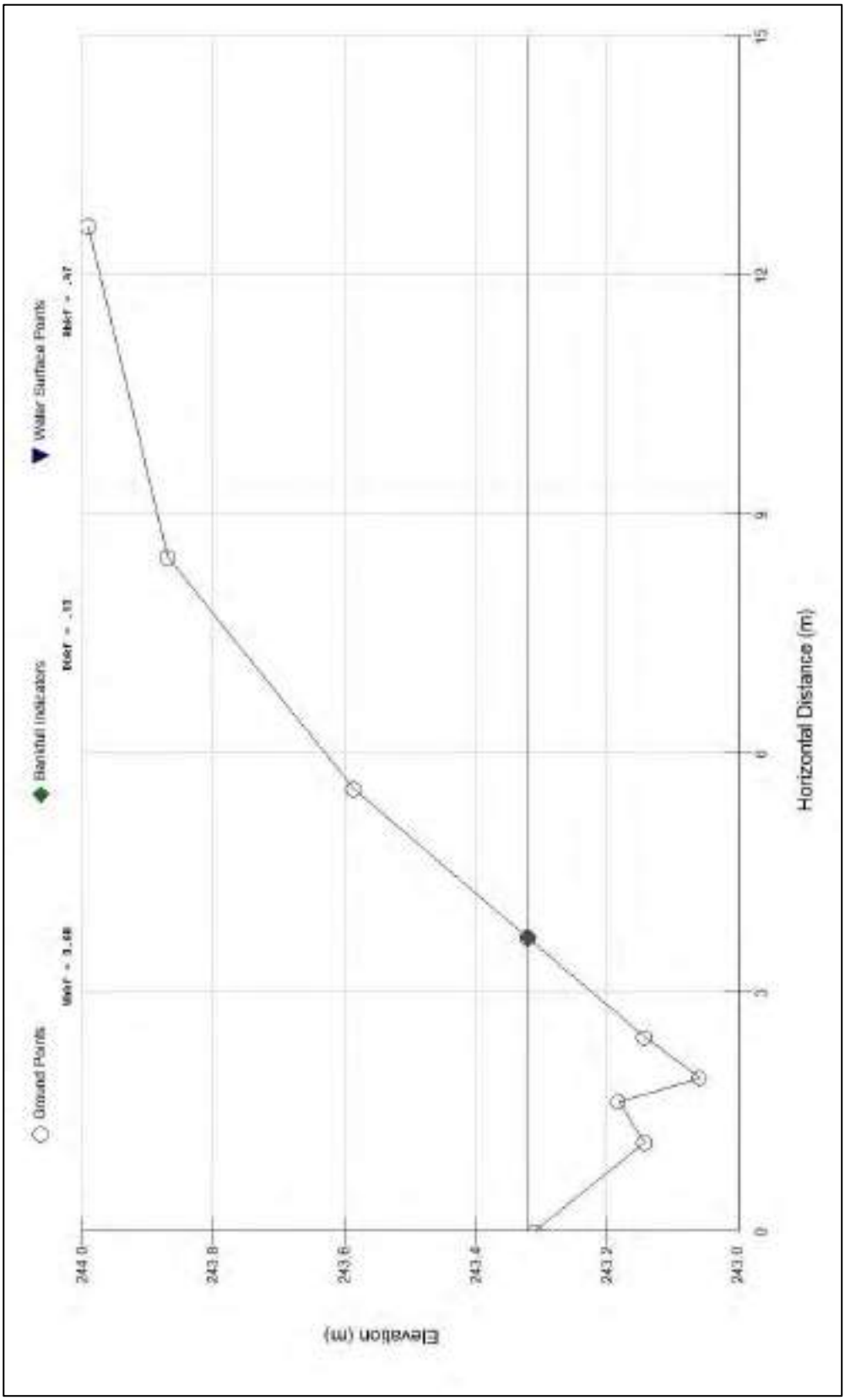


Figure C.17 – Cross-section 16 of study reach.

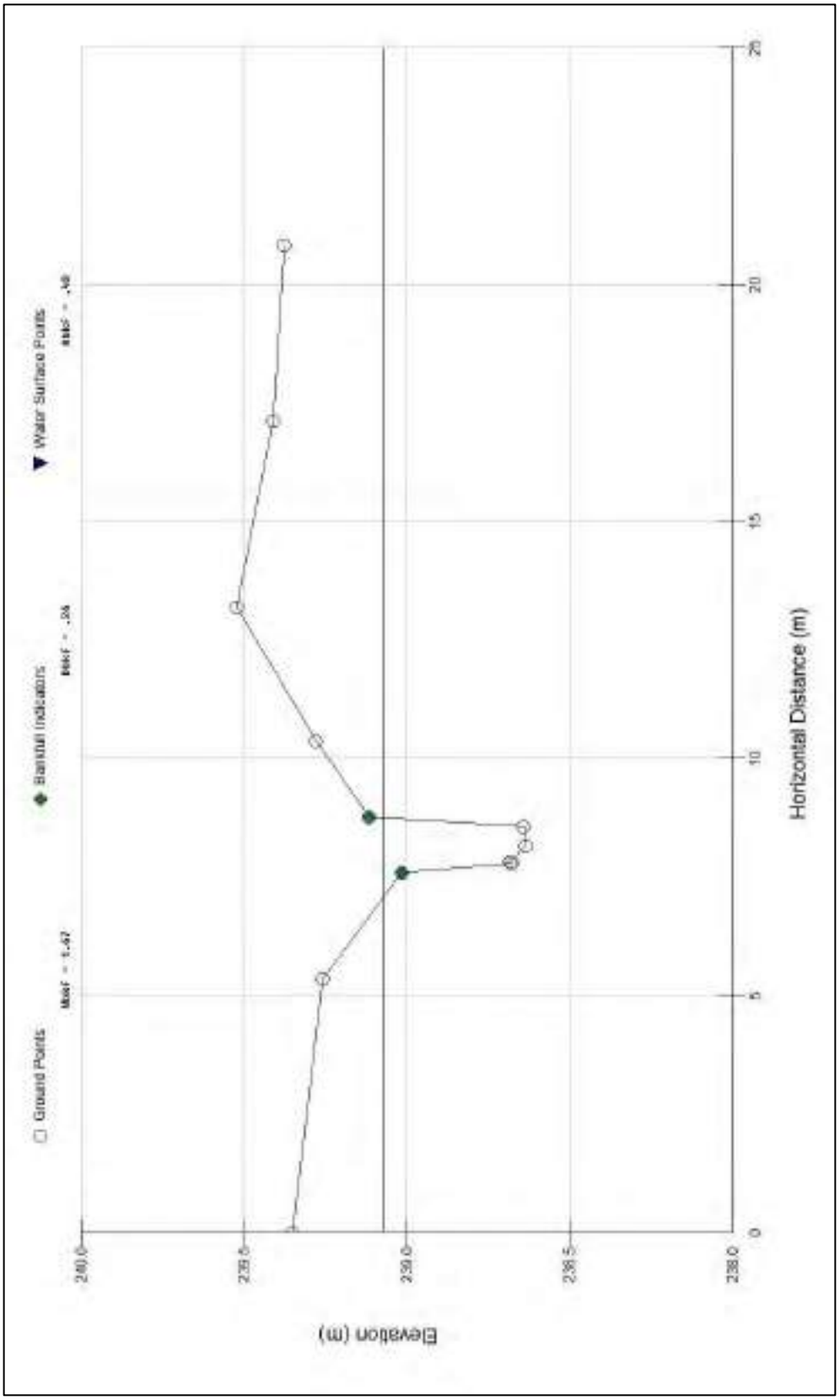


Figure C.18 – Cross-section 17 of study reach.

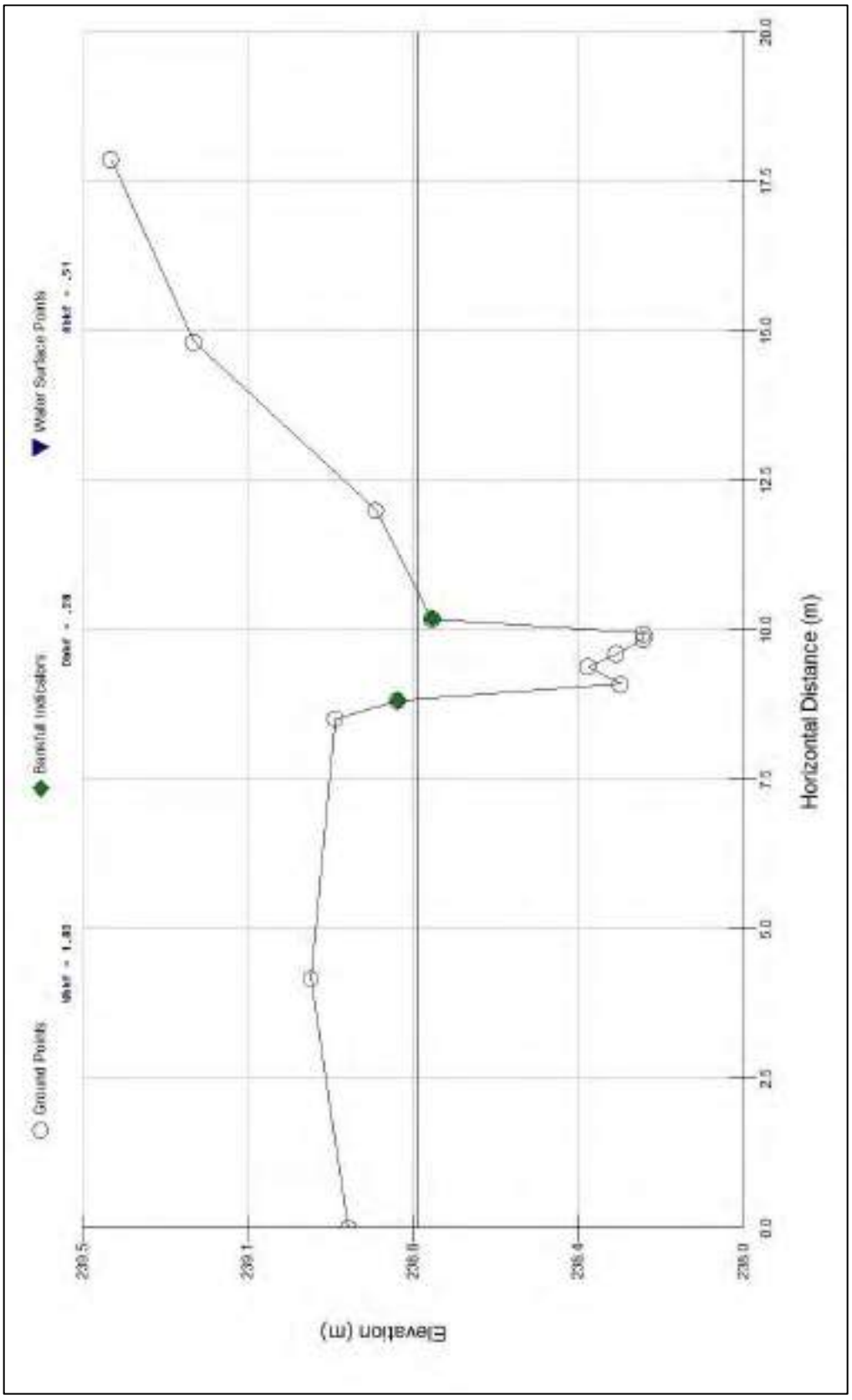


Figure C.19 – Cross-section 18 of study reach.

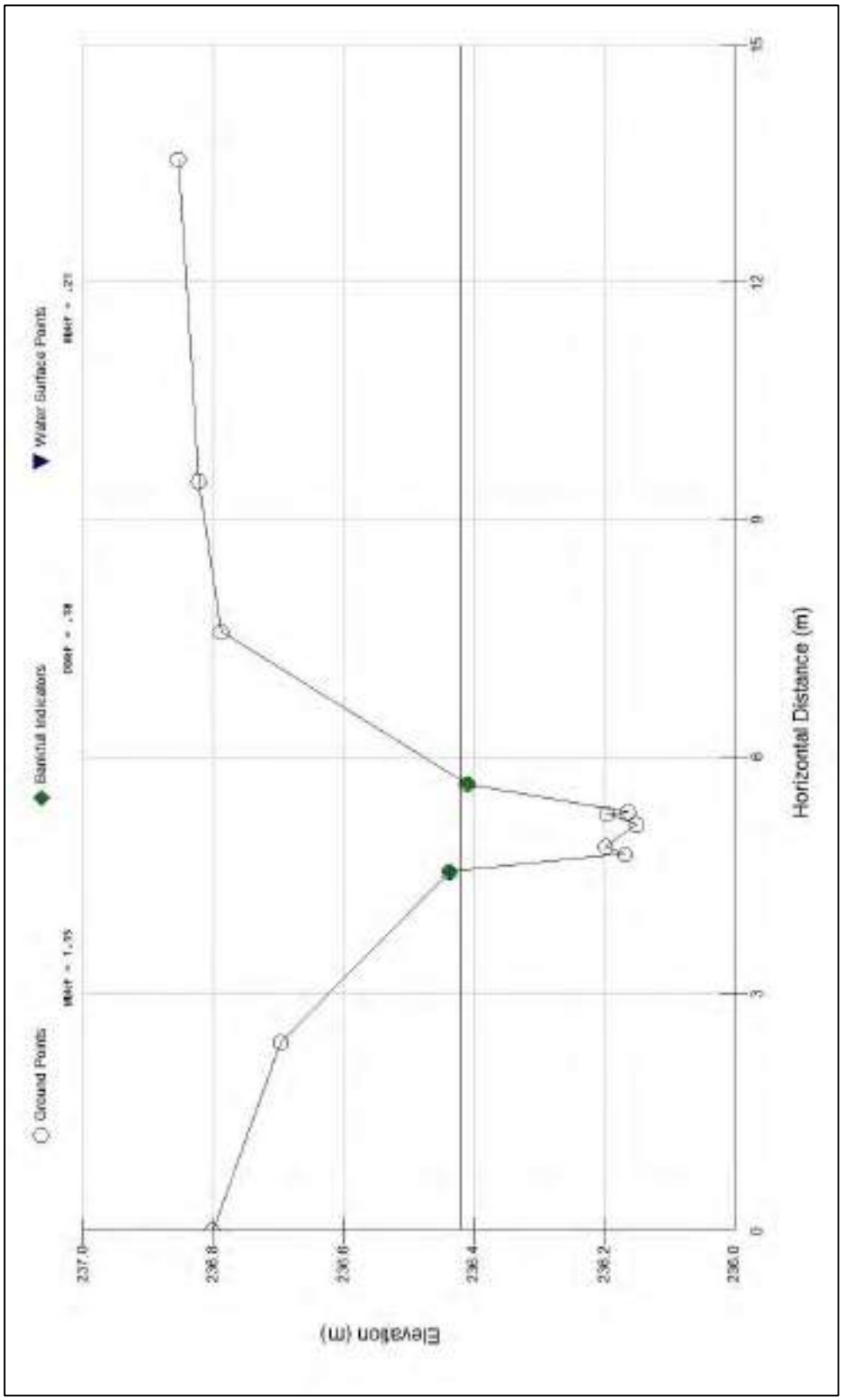


Figure C.20 – Cross-section 19 of study reach.

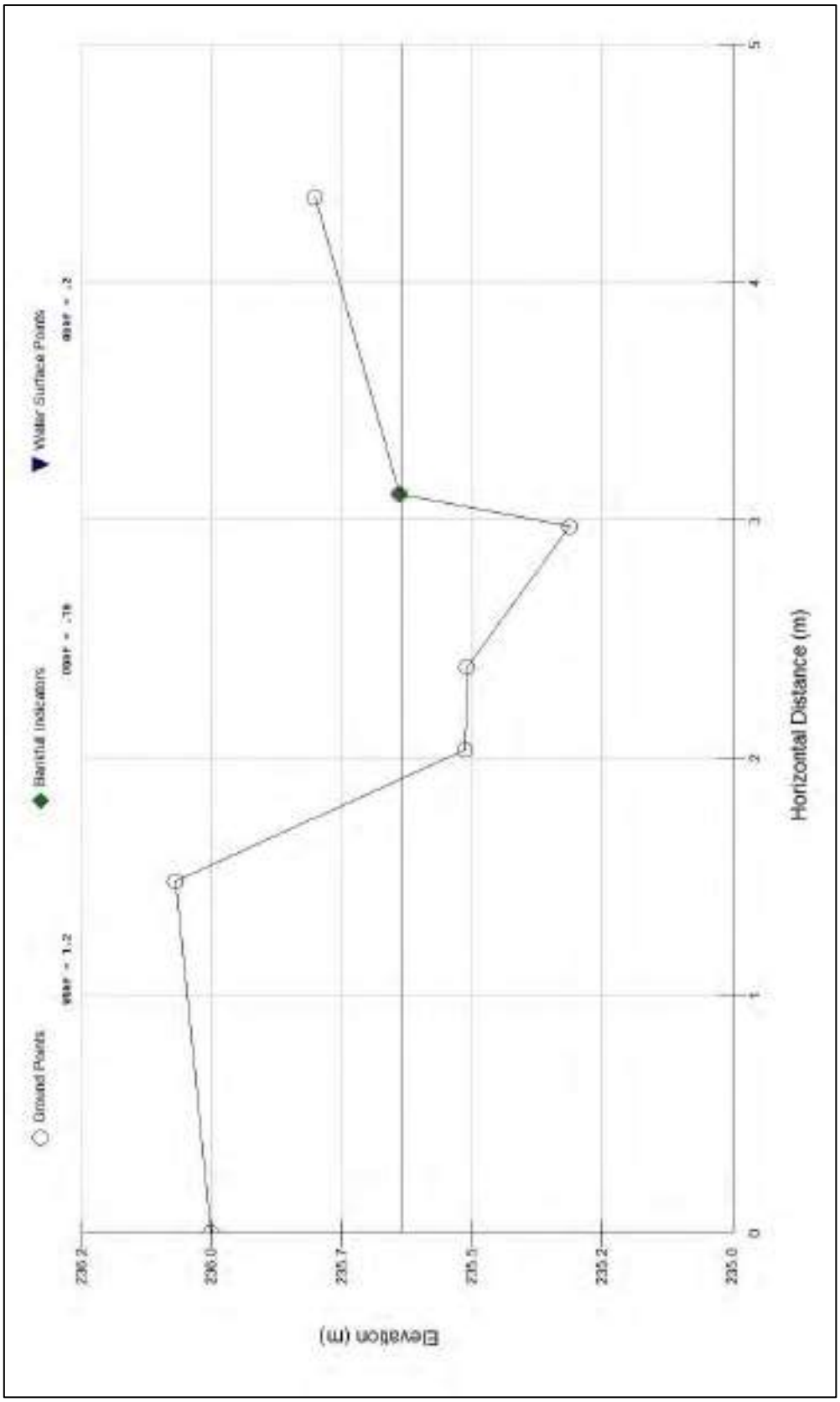


Figure C.21 – Cross-section 20 of study reach.

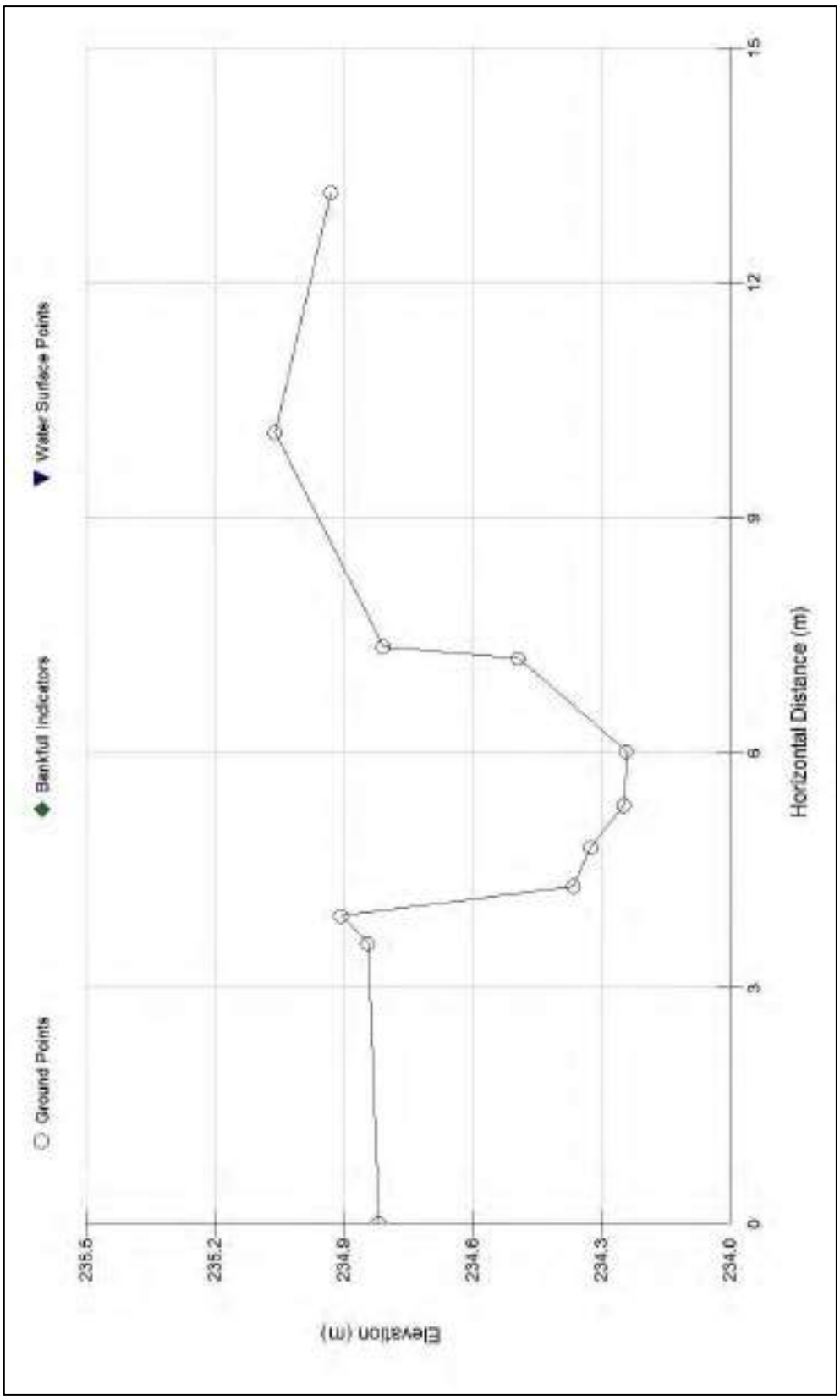
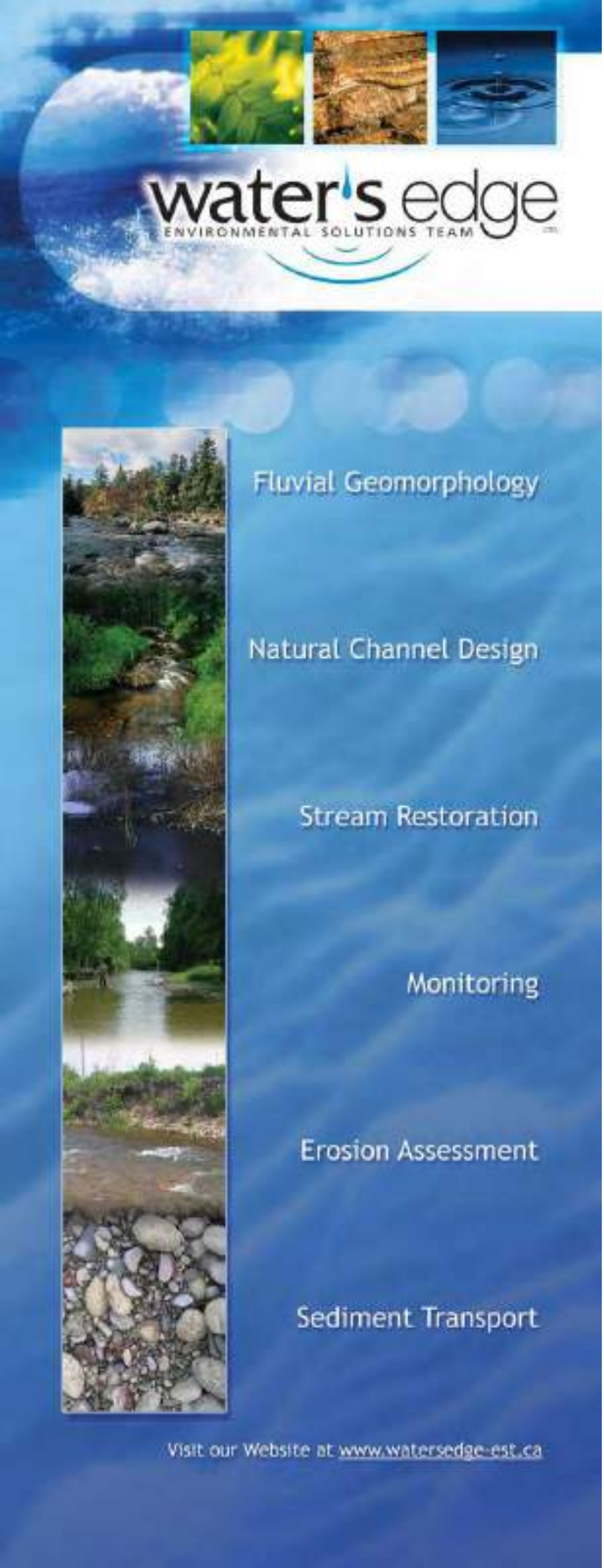


Figure C.22 – Cross-section 21 of study reach.



APPENDIX C:

Field Sheets

Rapid Geomorphic Assessment

Date: 25-May-17
Evaluator: EHG
Stream: Tributary of Millbrook Subdivision Phase 2 - 17007
Conditions: Overcast (7am) transition to sunny with few clouds (11am)

Form / Process (1)	Geomorphic Indicator No (2)	Description (3)	Present No (4)	Present Yes (5)	Factor Value (6)
Evidence of Aggradation	1	Lobate bar	1		
	2	Coarse material in riffles embedded	1		
	3	Siltation in pools		1	
	4	Medial bars		1	
	5	Accretion on point bars	1		
	6	Poor longitudinal sorting of bed materials		1	
	7	Deposition in the overbank zone	1		
		Sum of Indices	4	3	0.43
Evidence of Degradation (DI)	1	Exposed bridge footing(s)	n/a		
	2	Exposed sanitary/storm sewer/pipeline/etc.	n/a		
	3	Elevated storm sewer outfall(s)	n/a		
	4	Undermined gabion baskets/concrete aprons/etc.	n/a		
	5	Scour pools d/s of culverts/storm sewer outlets	n/a		
	6	Cut face on bar forms	n/a		
	7	Head cutting due to knick point migration	n/a		
	8	Terrace cut through older bar material	n/a		
	9	Suspended armour layer visible in bank	n/a		
	10	Channel worn into undisturbed overburden/bedrock	n/a		
		Sum of Indices	0	0	n/a
Evidence of Widening (WI)	1	Fallen/leaning trees/fence posts/etc.		1	
	2	Occurrence of large organic debris		1	
	3	Exposed tree roots	1		
	4	Basal scour on inside meander bends	1		
	5	Basal scour on both sides of channel through riffle	1		
	6	Gabion baskets/concrete walls/etc. out flanked	n/a		
	7	Length of basal scour >50% through subject reach	1		
	8	Exposed length of previously buried pipe/cable/etc.	n/a		
	9	Fracture lines along top of bank	1		
	10	Exposed building foundation	n/a		
		Sum of Indices	5	2	0.29
Evidence of Planimetric Form Adjustment (PI)	1	Formation of cut (s)		1	
	2	Single thread channel to multiple channel		1	
	3	Evolution of pool-riffle form to low bed relief form	1		
	4	Cutoff channel(s)	1		
	5	Formation of island(s)		1	
	6	Thalweg alignment out of phase meander form	1		
	7	Bar forms poorly formed/reworked/removed	1		
		Sum of Indices	4	3	0.43
Stability Index (SI) = (AI + DI+ WI+ PI) /m					0.29
			Condition:	Transitional	

-grassy, forbe-like channel that primarily serves as a drainage ditch for surrounding agricultural fields
-upstream channel bed is grassy and straight, downstream channel bed is sandy/silt with some meanders
-compression of culvert underpassing the transition between agricultural fields (not included in DI section of RGA form it is not an urban issue)

RAPID STREAM ASSESSMENT TECHNIQUE (RSAT) Evaluation

Creek Name: **RSAT Section #:**

Assessor: **Date:**

Coordinates:

Evaluation Category	Relative Significance	Criteria	Rating Excellent	Good	Fair	Poor	Score
1 Channel Stability	Indicative of hydrologic/flow regime alteration and general condition of physical aquatic habitat. Provides insight into past, present and possible future changes in channel morphometry	Bank Stability	>80%	71-80 %	50-70 %	< 50 %	10
		Stream Bend Stability Outer bank height/bank overhang	<0.60 m / <0.60m	0.60 to 0.90 m / 0.60 to 0.75 m	0.90 to 1.20 m / 0.75 to 0.90 m	>1.20 m / >0.90 m	10
		Exposed roots and falls	old and large / 0-1	some young / 2-3	young common / 4-5	young abundant / >6	11
		Bottom 1/3 of Bank	resistant plant/soil	resistant plant/soil	highly erodable plant/soil	highly erodable plant/soil	9
		Cross-Section	V or U	V or U	Trapezoidal	Trapezoidal	10
		Typical Score:	**9 to 11**	**6 to 8**	**3 to 5**	**0 to 2**	**10.00**
	NOTES: Stable with rectangular or u shaped cross sections						
2 Channel Scour and Sediment Deposition	Relates to level of uncontrolled stormwater runoff, sediment load and transport and degradation of instream habitat.	Riffle Embeddedness	<25% sand & silt	25-50%	50-75%	>75%	7
		# of deep pools / substrate	high # / <30% fines	mod # / 30-60% fines	low-mod # / 60-80% fines	few # / >80 % fines	5
		Streak marks/sediment deposits absent	marks / dep absent	uncommon	common	common	7
		large sand deposits/fresh	rare / no fresh dep.	uncommon and small localized dep	common and small localized dep.	common and heavy dep along major portion	7
		Point bar/vege/sand	few / well vege / none	small/well vege/little	mod-large& unstable/high am't of sand common	mod-large& unstable/high am't of sand at most bends	5
		Typical Score:	**7 to 8**	**5 to 6**	**3 to 4**	**0 to 2**	**3.00**
	NOTES: Upstream is predominately grassed beds and downstream has some sandy/silt beds with cobble/boulders in some places.						
3 Physical In-stream Habitat	Relates to the ability of a stream to meet basic physical requirements necessary for the support of a well-balanced aquatic community (eg: depth of flow, water velocity, water temperature, substrate type and quality, etc).	Wetted Perimeter	> 85% of bottom width	61-85%	40 - 60 %	< 40 %	7
		Diversity of structure, velocity and depth of flow	All forms present, diverse vel. and depth of flow	Good mix of form, rel. diverse velocity and depth	Few pools, riffles and runs dominant, vel & depth gen shallow/slow	dominated by 1 type (usually runs) and 1 vel/depth (usually slow & shallow	1
		Riffle substrate	cobble, gravel, rubble, boulder mix with little sand & >50 % cobble	Good mix of gravel, cobble and rubble & 25-49% cobble	predominantly small cobble, gravel and sand & 5 - 24 % cobble	Predominantly gravel with high % sand & <5% cobble	1
		Riffle depth	>0.20 m	0.15 - 0.19 m	0.10 - 0.14 m	< 0.10 m	1
		Large Pool Depth	> 0.60 m	0.45 - 0.59 m	0.30 - 0.44 m	< 0.30 m	1
		Channel Process	No channel alteration of significant point bar formation or enlargement	Slight increase in point bar formation or slight amount of channel mod.	Mod. increase in point bars and / or channel mod.	extensive channel alteration or point bar formation / enlargement	7
		Riffle-Pool Ratio	0.9 - 1.1 to 1	0.7 - 0.89 to 1 or 1.11 - 1.3 to 1	0.5 - 0.69 to 1 or 1.31 - 1.5 to 1	< 0.49 to 1 or > 1.51 to 1	1
		Stream Temp. on a Summer Afternoon	< 20 ○ C	20 to 24 ○ C	24 to 26 ○ C	>27 ○ C	5
		Typical Score:	**7 to 8**	**5 to 6**	**3 to 4**	**0 to 2**	**2.43**
	NOTES: See above comments.						
4 Water Quality	Indicative of watershed perturbations / general level of human activity, point and non-point source loads, and aquatic habitat conditions.	Substrate Fouling (on rock underside)	None: 0 -10%	Light: 11-20%	Mod: 21 - 50 %	High >50%	7
		Total Dissolved Solids (TDS)	<50mg/L	50-100 mg/L	101-150 mg/L	>150 mg/L	8
		Clearness of Water	>0.90 m visibility	0.45 - 0.89 m	0.15 - 0.44 m	<0.15 m visible	7
		Odour	None	Slight organic odour	Slight - Moderate odour	Moderate to strong odour	8
		Typical Score:	**7 to 8**	**5 to 6**	**3 to 4**	**0 to 2**	**7.50**
	NOTES: Downstream sections (specifically downstream of confluence) has much more coverage.						
5 Riparian Habitat Conditions	Provides insight into change(s) in stream energetics, temperature regime, and both aquatic and terrestrial habitat conditions	Width of Riparian Buffer	Wide > 200' with mature forests on both sides	Forested buffer >100' along major portion	Predom. Wooded but major localized gaps	Mostly non-wooded vegetation, narrow width.	2
		Canopy coverage (Shading)	>80% shading	60-79% shading	50-60 % shading	<50 % shading	1
		Typical Score:	**6 to 7**	**4 to 5**	**2 to 3**	**0 to 1**	**1.50**
	NOTES: Flows through three agricultural fields						
6 Biological Indicators	Best overall indication of stream health and level of watershed perturbation	Diversity of macro-invert community	Diverse community present (mayflies, stoneflies, and cased caddisflies (few snails or leeches)	Mayflies and caddisflies (stoneflies absent)	Pollution-tolerant species; aquatic worms dominant	Poor diversity dominated by midgeflies, aquatic worms and snails.	2
		Number of Individuals	Mod to High #	Mod to High #	Low - Mod #	Low #	1
		Typical Score:	**7 to 8**	**5 to 6**	**3 to 4**	**0 to 2**	**1.50**
	NOTES: Some small fish noted downstream.						

TOTAL SCORE:	**25.93**
CONDITION:	**Fair**

Attachment C:

Site Photos

Photo 1 October 14, 2016 Looking downstream toward County Road 10 from the far upstream end of Tributary B. Channel difficult to detect. Dry and overgrown with grasses.	
Photo 2 October 14, 2016 Channel bed more evident walking downstream. No bare soil, only dense grass.	
Photo 3 October 14, 2016 Downstream of driveway. Caved in culvert, almost completely closed in. Dry channel.	

Photo 4 October 14, 2016 Downstream of driveway culvert. Grassed channel. Dry.	
Photo 5 June 20, 2017 Downstream of driveway channel at WC-3. No flow observed, some pooled water. Stream bed overgrown with grasses. Water pooled in agricultural fields to either side of the tributary from recent rain events.	
Photo 6 June 20, 2017 Downstream of driveway channel at WC-3, no flow observed in channel.	

Photo 7 October 14, 2016 Entering hedgerow. Channel contained some bare substrate, but was dry and covered with leaf litter.	
Photo 8 October 14, 2016 Within hedgerow.	
Photo 9 October 14, 2016 View of hedgerow looking west.	

Photo 10 October 14, 2016 Hedgerow. Contained rocks/boulders along banks (from farm fields). Channel was overgrown.	
Photo 11 October 14, 2016 Grassed section of channel. Dry. Looking downstream.	
Photo 12 June 20, 2017 Grassed section of channel looking upstream at WC-4.	

Photo 13 June 20, 2017 Flow observed in channel downstream of driveway at WC-4.	
Photo 14 October 14, 2016 Substrate further downstream near laneway crossing. More cobble than bare substrate near the culvert entrance.	
Photo 15 October 14, 2016 Partially plugged culvert looking upstream at laneway crossing.	

Photo 16 October 14, 2016 Substrate downstream of laneway culvert. Bare in some spots, contained weeds and some rocks.	
Photo 17 October 14, 2016 Channel downstream of laneway. Contained bare soil, eroded banks and apples from trees within hedgerow.	
Photo 18 October 14, 2016 Confluence of Tributary B and C looking upstream into Tributary B. There is a steep drop of approximately 0.5-1 m from the bed of Tributary B to the bed of Tributary C, through this small grassed channel.	

Photo 19 June 20, 2017 Confluence of Tributary B and C, looking into Tributary C.	
Photo 20 October 14, 2016 Tributary C looking downstream toward County Road 10 at confluence with Tributary B. Dry with grasses in bed.	
Photo 21 June 20, 2017 Tributary C looking downstream toward County Road 10 near the confluence with Tributary B, at WC-5. Substantial flow.	

Photo 22

October 14, 2016

Looking upstream at Tributary C from bridge at County Road 10. Evidence of groundwater inputs downstream of the confluence of Tributary C and B, which was dry.

Attachment D:

Landscaping and Planting Plan

GENERAL NOTES

THE LANDSCAPE CONTRACTOR IS RESPONSIBLE FOR ANY COSTS ASSOCIATED WITH THE FAILURE OF THE LANDSCAPE CONTRACTOR TO OBTAIN THE APPROVAL OF THE LANDSCAPE ARCHITECT PRIOR TO MAKING ANY CHANGES TO THE SPECIFIED MATERIALS AND/OR ANY OTHER SPECIFIED INSTRUCTIONS.

CONTRACTOR TO CONTACT ALL UTILITY COMPANIES TO CHECK LOCATIONS AND OBTAIN STAKEOUTS OF ALL UTILITY LINES BEFORE EXCAVATION. OBTAIN ALL NECESSARY PERMITS BEFORE COMMENCEMENT OF CONSTRUCTION. REPORT IN WRITING ANY DISCREPANCIES IN THE DRAWINGS, SPECIFICATIONS AND CONTRACT DOCUMENTS TO THE LANDSCAPE ARCHITECT BEFORE THE END OF THE BIDDING PROCESS AND COMMENCEMENT OF CONSTRUCTION. THESE SPECIFICATIONS MAY BE SUPERSEDED BY ADDITIONAL SPECIFICATIONS SET OUT IN THE TENDER DOCUMENTS. CONTRACTOR TO REVIEW ALL DOCUMENTS.

GRADING

ROUGH GRADING

ROUGH GRADE AND FILL AREAS TO ESTABLISH SUBGRADE AS REQUIRED. PROVIDE DRAINAGE PATTERN AS INDICATED ON DRAWINGS. ROUND SMOOTHLY ALL TOPS AND TOES OF SLOPES. COMPACT ALL AREAS TO 95% STANDARD PROCTOR DENSITY UNLESS SPECIFIED OTHERWISE, EXISTING TREES TO REMAIN ON SITE ARE TO BE PROTECTED AS PER MUNICIPAL STANDARDS.

FINE GRADING

FINE GRADE ALL AREAS TO FINISHED GRADES AS SHOWN ON LAYOUT OR GRADING PLAN OR ARCHITECT'S SITE PLAN. PROVIDE UNIFORM SLOPES AWAY FROM THE BUILDING, UNLESS SPECIFIED OTHERWISE. SLOPES MAY NOT EXCEED 33 1/3% (3:1) UNLESS OTHERWISE SPECIFIED

SOIL

REPORTS

LANDSCAPE CONTRACTOR TO PROVIDE A **SOIL REPORT OF ANY NEW MATERIAL BROUGHT TO THE SITE**. THE REPORT MUST CONFIRM TEXTURE AND FERTILITY. THE REPORT MUST ALSO CONFIRM THE SOIL IS FREE FROM HEAVY METALS, TOXIC ELEMENTS, AND GROWTH INHIBITING COMPONENTS.

STOCK PILED ON SITE TOPSOIL MUST BE TESTED BY AGRI-FOODS LABORATORIES 503 IMPERIAL RD N, GUELPH, ON N1H 6T8 (519) 837-1600

- A TOPSOIL BASIC TEST IS REQUIRED, BEFORE CONDUCTING TEST THE LANDSCAPE CONTRACTOR IS TO INQUIRE IF AN ATRAZINE AND/OR HEAVY METAL TEST IS REQUIRED,
- ALLOW AT LEAST 2 WEEKS FOR THE TEST(S) TO BE CONDUCTED PRIOR TO INSTALLATION ON SITE,
- SUBMIT TOPSOIL REPORT TO TERRAPLAN FOR REVIEW AND RECOMMENDATIONS FOR AMENDMENT,
- ALL TOPSOIL MUST MEET SPECIFICATIONS,

STOCK PILED ON SITE PLANTING SOIL MUST BE TESTED BY AGRI-FOODS LABORATORIES 503 IMPERIAL RD N, GUELPH, ON N1H 6T8 (519) 837-1600

- A SOIL BASIC TEST IS REQUIRED, BEFORE CONDUCTING TEST THE LANDSCAPE CONTRACTOR IS TO INQUIRE IF AN ATRAZINE AND/OR HEAVY METAL TEST IS REQUIRED,
- ALLOW AT LEAST 2 WEEKS FOR THE TEST(S) TO BE CONDUCTED PRIOR TO INSTALLATION ON SITE,
- SUBMIT TOPSOIL REPORT TO TERRAPLAN FOR REVIEW AND RECOMMENDATIONS FOR AMENDMENT,

TOPSOIL FOR SODDED AREAS:

MIXTURE OF MINERAL PARTICULATES, MICRO ORGANISMS AND ORGANIC MATTER WHICH PROVIDES SUITABLE MEDIUM FOR SUPPORTING INTENDED PLANT GROWTH.
GRO-BARK: GRO-TURF - ORGANIC TOP DRESS (905) 846-5155 OR APPROVED EQUAL
SCARIFY THE SUBSOIL PRIOR TO THE SPREADING THE TOPSOIL. REMOVE ALL DEBRIS AND LEAVE A FINE-TEXTURED EVEN SURFACE. ALL TOPSOIL TO BE IMPORTED UNLESS PREVIOUSLY APPROVED BY LANDSCAPE ARCHITECT. OBTAIN APPROVAL FOR THE QUALITY OF ANY IMPORTED TOPSOIL BEFORE DELIVERY TO THE SITE.

PLANTING SOIL

PLANTING SOIL FOR BACKFILLING TREE PLANTING PITS SHALL CONSIST OF A MIXTURE OF 5 PARTS TOPSOIL AND 1 PART PEAT MOSS OR SCREENED LEAF COMPOST BLENDED IN A UNIFORM MIXTURE. BACKFILL SOIL SHALL NOT BE MIXED IN A FROZEN OR MUDDY (SATURATED) CONDITION. BACKFILL SOIL SHALL BE FERTILE, FRIABLE SANDY LOAM CAPABLE OF SUSTAINING VIGOROUS PLANT GROWTH WITH AN ACIDITY RANGE FROM 6.5 TO 7.5 pH AND FREE FROM ANY PLANT GROWTH INHIBITING COMPOUNDS. BACKFILL SOIL SHALL BE FREE FROM CLAY LUMPS AND OTHER EXTRANEOUS MATTER. STONES SHALL BE LESS THAN 25mm IN DIAMETER SHALL COMPROMISE NO MORE THAN 5% OF BACKFILL SOIL BY VOLUME.
DURING THE BACKFILLING PROCESS, BONE MEAL SHALL BE INCORPORATED INTO THE BACKFILL SOIL MIXTURE IN A UNIFORM DISTRIBUTION AT A QUANTITY OF 0.5 Kg PER CUBIC METRE OF BACKFILL SOIL.
PROVIDE RECENT SOIL REPORT PRIOR TO ORDER, FERTILIZER TO BE MIXED INTO SOIL OFF SITE AS REQUIRED.

FERTILIZER: AS REQUIRED BASED ON PROVIDED SOIL REPORT PRIOR TO ORDERING MINERAL FERTILIZER ADDED AS REQUIRED AT THE DIRECTION OF THE LANDSCAPE ARCHITECT
MAJOR SOIL NUTRIENTS PRESENT IN FOLLOWING RATIOS:

- NITROGEN (N): 20 TO 40 MICROGRAMS OF AVAILABLE N PER GRAM OF SOIL,
- PHOSPHORUS (P): 10 TO 20 MICROGRAMS OF PHOSPHATE PER GRAM OF SOIL,
- POTASSIUM (K): 80 TO 120 MICROGRAMS OF POTASH PER GRAM OF SOIL,
- CALCIUM, MAGNESIUM, SULPHUR AND MICROAUTRIENTS PRESENT IN BALANCED RATIOS TO SUPPORT GERMINATION AND/OR ESTABLISHMENT OF INTENDED VEGETATION.

NOTE: IF THE EXISTING SOIL CONDITIONS ARE CLAY OR WET IN NATURE, CONTACT THE LANDSCAPE ARCHITECT FOR INSTRUCTIONS OF A SUITABLE SOIL MIXTURE OR DRAINAGE DETAIL. FAILURE TO DO THIS MAY RESULT IN DELAY OF APPROVAL AND ACCEPTANCE.

THE LANDSCAPE CONTRACTOR IS RESPONSIBLE FOR ANY COSTS ASSOCIATED WITH THE FAILURE OF THE LANDSCAPE CONTRACTOR TO OBTAIN THE APPROVAL OF THE LANDSCAPE ARCHITECT PRIOR TO MAKING ANY CHANGES TO THE SPECIFIED MATERIALS AND/OR ANY OTHER SPECIFIED INSTRUCTIONS.

PREPARATION OF PLANTING BEDS ALL PLANT BEDS TO BE CONTINUOUS.

- EXCAVATE ALL PLANTING BEDS TO THE DEPTH AS INDICATED ON THE DRAWINGS AND DETAILS, MIN 600mm (2.0').
- BACKFILL ALL PANTING BEDS AS PER SPECIFICATION UNDER PLANTING SOIL SECTION.
- ALL PLANTING BED EDGES TO BE MAINTAINED BY SOD EDGE TRIMMER.
- ALL PLANTING BEDS TO HAVE A 25mm (1") CUT AT EDGE TO BE MAINTAIN A CLEAN SEPARATION BETWEEN SOD AND BED,
- PREPARE THE PLANTING BEDS FOR PLANTING BEFORE THE DELIVERY OF THE PLANT MATERIAL TO THE JOB SITE.

SOD

- USE #1 BLUEGRASS - FESCUE SOD SOD WHICH CONFORMS WITH THE SPECIFICATIONS OF THE NURSERY SOD GROWERS ASSOCIATION OF ONTARIO,
- ALL SODDED AREAS SHALL RECEIVE A MINIMUM OF 100mm (4") OF TOPSOIL
- SOD SLOPES ARE NOT TO EXCEED 3:1, IF APPROVED BY LANDSCAPE ARCHITECT A SLOPE IN EXCESS OF 4:1 TO BE PEGGED USING WOOD PEGS ,
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR CUTTING ALL SODDED AND SEEDED AREAS AT LEAST TWO (2) TIMES BEFORE FINAL INSPECTION FOR ACCEPTANCE OF THE LANDSCAPE WORK.

PLANT MATERIALS ALL PLANT MATERIAL SHALL CONFORM TO THE STANDARDS OF THE CANADIAN NURSERY TRADES ASSOCIATION FOR SIZE AND SPECIES.

- ALL SHRUB AND TREE MATERIAL SHALL BE CONTAINER GROWN, POTTED, OR BALL AND BURLAP, UNLESS OTHERWISE NOTED.
- BARE ROOT PLANTING SHALL BE ACCEPTABLE FOR CERTAIN SPECIES DURING EARLY SPRING UPON APPROVAL OF THE LANDSCAPE ARCHITECT ONLY.
- CONTRACTOR SHALL MAKE REQUESTS FOR ROOT CONDITION SUBSTITUTION IN WRITING TO THE LANDSCAPE ARCHITECT PRIOR TO COMMENCEMENT OF PLANTING OPERATIONS.
- ALL PLANT MATERIAL TO BE CLAY GROWN STOCK UNLESS OTHERWISE NOTED.

PLANT MATERIAL SIZES AND CONDITIONS

- THE INDIMDUAL **PLANT GROUPING TOTAL AS ILLUSTRATED ON THE PLANTING PLAN SUPERSEDES THE ESTIMATED QUANTITY ON THE MASTER PLANT LIST.**
- CONTRACTOR MUST REPORT ANY DISCREPANCIES TO THE LANDSCAPE ARCHITECT IN WRITING BEFORE COMMENCING ANY WORK.
- CONTRACTOR WILL ASSUME FULL RESPONSIBILITY IF LANDSCAPE ARCHITECT IS NOT NOTIFIED OF DISCREPANCIES.
- ALL TREES, SHRUBS AND GROUND COVERS SHALL BE PLANTED AS DETAILED, AND AS SHOWN ON THE LANDSCAPE DRAWING
- PLANT MATERIAL SIZES, SPACING, AND CONDITIONS ARE TO BE AS INDICATED ON THE LANDSCAPE DRAWING,
- USE ONLY PLANT MATERIAL TRUE TO NAME, SIZE, AND GRADE AS SPECIFIED ON PLANTING PLAN. PROVIDE SUFFICIENT LABELS OR MARKINGS TO INDICATE CLEARLY THE VARIETY, SIZE AND GRADE OF EACH SPECIMEN, OR BUNDLE.
- OBTAIN APPROVAL FOR SUBSTITUTIONS AS TO VARIETY, SIZE OR GRADE FROM THE LANDSCAPE ARCHITECT.
- USE ONLY NURSERY STOCK GROWN UNDER PROPER HORTICULTURAL PRACTICES, VIABLE, FREE FROM PEST AND DISEASE AND UNDAMAGED,
- LANDSCAPE CONTRACTOR TO INSTALL NEW SOD AND NEW TOPSOIL AS PER SPECIFICATIONS AND GENERAL NOTES THROUGHOUT THE SITE AS DESIGNED.
- NEW TOPSOIL AND SOD SHALL EXTEND THROUGH THE MUNICIPAL BOULEVARD TO THE REAR OF THE MUNICIPAL CURB.

SODDED AREAS AND PLANTING BED EDGING

CONTRACTOR TO INSTALL NEW SOD AND NEW TOPSOIL AS PER SPECIFICATIONS AND GENERAL NOTES THROUGHOUT THE SITE AS DESIGNED. NEW TOPSOIL AND SOD SHALL EXTEND THROUGH THE MUNICIPAL BOULEVARD TO THE REAR OF THE MUNICIPAL CURB.

ALL PLANTING BEDS THAT ARE SURROUNDED BY SOD SHOULD BE CUT AND EDGED AT A 45° ANGLE, SO THERE IS A CLEAR AND WELL DEFINED SEPARATION BETWEEN THE PLANTING BEDS AND SODDED AREAS.

PLANT MATERIAL INSTALLATION

ALL TREES, SHRUBS AND GROUND COVERS SHALL BE PLANTED AS DETAILED AND AS SHOWN ON THE PLANTING PLAN. ALL BEDS TO RECEIVE A COVER OF CLEAN MULCH TO A DEPTH OF 75mm(3"), FOR GUYING AND STAKING TREES, REFER TO PLANTING DETAILS. WRAP ALL DECIDUOUS TREES UNDER EXPERIENCED SUPERVISION ONLY TO THE SPECIFICATIONS OF THE LANDSCAPE ONTARIO HORTICULTURAL TRADES ASSOCIATION (LOHTA).

PLANT MATERIAL SIZES AND CONDITIONS ARE TO BE AS INDICATED ON THE LANDSCAPE DRAWING.

THE INDIVIDUAL PLANT GROUPING TOTAL AS ILLUSTRATED ON THE PLANTING PLAN SUPERSEDES THE ESTIMATED QUANTITY ON THE MASTER PLANT LIST. CONTRACTOR MUST REPORT ANY DISCREPANCIES TO THE LANDSCAPE ARCHITECT IN WRITING BEFORE COMMENCING ANY WORK. CONTRACTOR WILL ASSUME FULL RESPONSIBILITY IF LANDSCAPE ARCHITECT IS NOT NOTIFIED OF DISCREPANCIES.

* MULCH - SHREDDED PINE MULCH BY "GRO BARK" OR APPROVED EQUAL. LANDSCAPE ARCHITECT TO APPROVE MULCH BEFORE INSTALLATION. GENERAL MAINTENANCE

PROPER MAINTENANCE PROCEDURES ARE TO BE FULLY ADMINISTERED FOR ALL NEWLY CONSTRUCTED LANDSCAPE WORK, IN ACCORDANCE WITH LANDSCAPE ONTARIO SPECIFICATIONS (SECTION 1E - MAINTENANCE WORK). THIS SHALL APPLY ONLY DURING THE CONSTRUCTION PERIOD, UNLESS OTHERWISE SPECIFIED. CONTRACTOR IS RESPONSIBLE FOR MAINTENANCE OF SOD AND PLANTING UNTIL FINAL ACCEPTANCE BY LANDSCAPE ARCHITECT.

RODENT PROTECTION - THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL TREES AND SHRUBS FOR WINTER PROTECTION AND FROM RODENT INJURY FOR THE DURATION OF THE GUARANTY PERIOD. PROTECTIVE GUARDS SHALL BE EMPLOYED AROUND ALL DECIDUOUS TREES. GUARDS TO BE 150MM DIA. PVC PIPE OR AS MUNICIPAL GUIDELINES. GUARDS SHALL BE INSTALLED PRIOR TO THE APPLICATION OF THE MULCH AND SHOULD BE PLACED A MINIMUM OF 50MM (2") OUT FROM THE TREE TRUNK ON ALL SIDES.

ALL SHRUBS AND CONIFEROUS TREES SHALL HAVE AN APPLICATION OF "SKOOT" OR APPROVED EQUIVALENT RODENT FORMULA, TO BE APPLIED AT THE END OF OCTOBER. FOLLOW MANUFACTURER'S DIRECTIONS FOR APPLICATION.

GENERAL REQUIREMENTS

USE ABOVE SPECIFICATIONS IN CONJUNCTION WITH THE GENERAL LANDSCAPE SPECIFICATIONS OF THE LANDSCAPE ONTARIO HORTICULTURAL TRADES ASSOCIATION (LOHTA) AND THE NURSERY SOD GROWERS ASSOCIATION OF ONTARIO. USE ONLY PLANT MATERIAL TRUE TO NAME, SIZE AND GRADE AS SPECIFIED ON PLANTING PLAN; PROVIDE SUFFICIENT LABELS OR MARKINGS TO INDICATE CLEARLY THE VARIETY, SIZE AND GRADE OF EACH SPECIMEN OR BUNDLE.

OBTAIN APPROVAL FOR SUBSTITUTIONS AS TO VARIETY, SIZE OR GRADE FROM THE LANDSCAPE ARCHITECT. USE ONLY NURSERY STOCK GROWN UNDER PROPER HORTICULTURAL PRACTICES, VIABLE, FREE FROM PEST AND DISEASE AND UNDAMAGED. CHECK LOCATIONS AND OBTAIN STAKEOUTS OF ALL UTILITY LINES BEFORE EXCAVATION. OBTAIN ALL NECESSARY PERMITS BEFORE COMMENCEMENT OF CONSTRUCTION. REPORT IN WRITING ANY DISCREPANCIES IN THE DRAWINGS, SPECIFICATIONS AND CONTRACT DOCUMENTS TO THE LANDSCAPE ARCHITECT BEFORE THE END OF THE BIDDING PROCESS AND COMMENCEMENT OF CONSTRUCTION. THESE SPECIFICATIONS MAY BE SUPERSEDED BY ADDITIONAL SPECIFICATIONS SET OUT IN THE TENDER DOCUMENTS. CONTRACTOR TO REVIEW ALL DOCUMENTS.

GUARANTEE PERIOD

PROVIDE ONE FULL YEAR GUARANTEE ON ALL LANDSCAPE WORK FROM DATE OF FINAL ACCEPTANCE BY LANDSCAPE ARCHITECT. GUARANTEE PERIOD MAY BE EXTENDED TO TWO FULL YEARS DEPENDING ON MUNICIPAL STANDARDS. CONTRACTOR TO VERIFY WITH OWNER AND LANDSCAPE ARCHITECT.

1 LANDSCAPE SPECIFICATIONS NEW

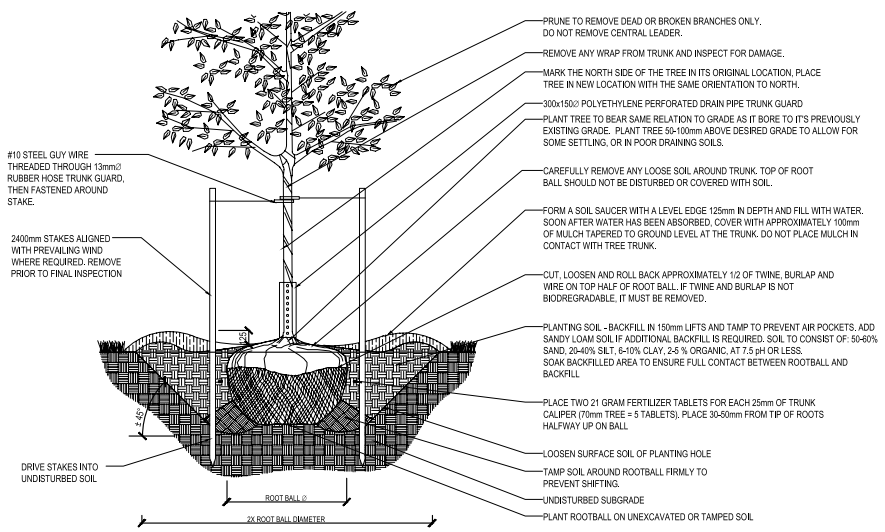
1:20

P-2016-16,153-09

2 PLANT MATERIAL INSTALLATION-STORM WATER MANAGEMENT POND

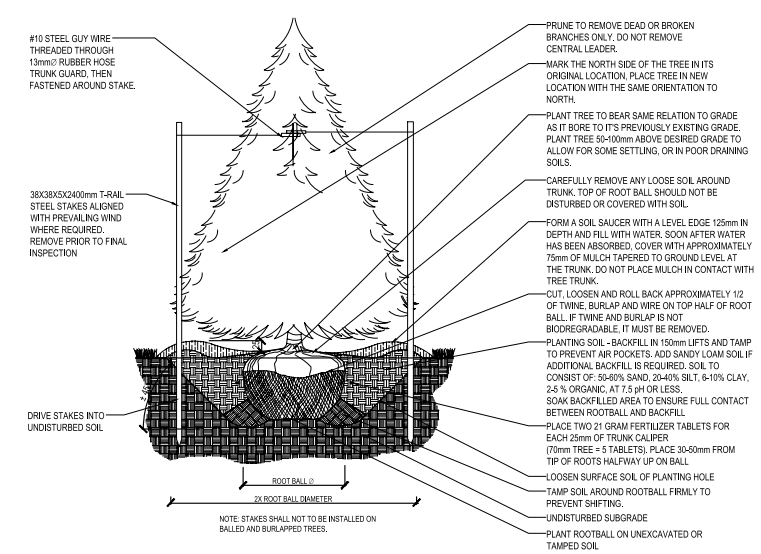
1:20

P-2016-16,153-11



3 STAKED B&B DECIDUOUS TREE INSTALLATION DETAIL

SCALE=NO SCALE



4 STAKED B&B CONIFEROUS TREE PLANTING DETAIL

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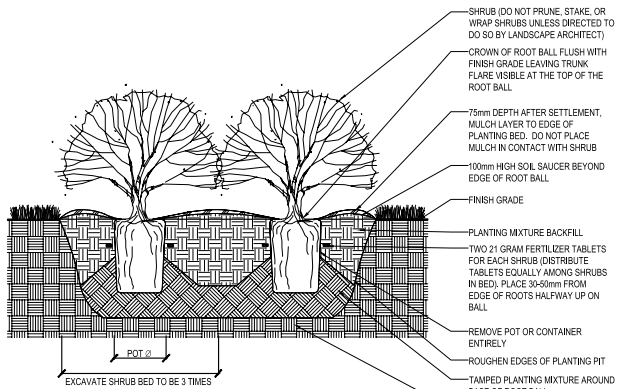
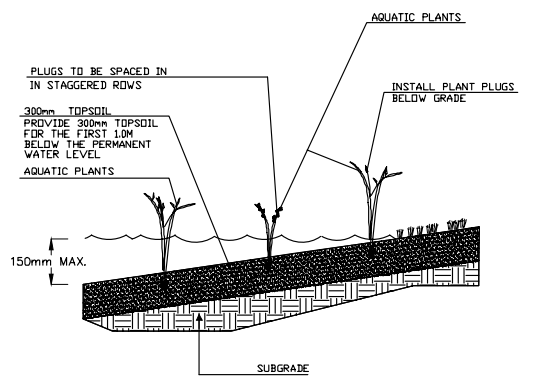


5 POTTED SHRUB BED PLANTING DETAIL

NO SCALE



1. PLANT PLUGS SHOULD NOT BE PLANTED MORE THAN 150mm BELOW THE PERMANENT POOL ELEVATION.
2. THE ALIGNMENT SHOWN ON DRAWING LP-103 SHOULD BE USED AS A GUIDELINE ONLY. THE LANDSCAPE ARCHITECT WILL CONFIRM THE LOCATION AND ALIGNMENT ON SITE.

6 AQUATIC PLANTING DETAIL

NO SCALE

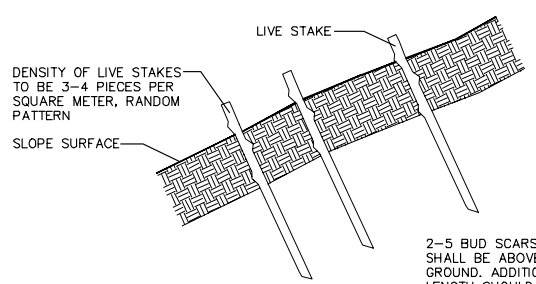
NOTE: THE CONTRACTOR IS TO SUPPLY TOPSOIL FILL MATERIAL TO THE DEPTHS INDICATED ON THE CHART BELOW.

TOPSOIL DEPTH CHART

LANDSCAPE AREAS	DEPTH IN mm
LAWN AREAS (SOD)	150
LAWN AREAS (SEED)	150
PLANTING BEDS - GRASSES, PERENNIALS AND GROUNDCOVER	300
PLANTING BEDS - MEDIUM AND SMALL SHRUBS	450
RAISED PLANTERS	600
SHADE AND ORNAMENTAL TREES	PER TREE INSTALLATION DETAIL

7 SOIL DEPTH CHART

SCALE=NO SCALE



NOTES:
1. LIVE STAKES MUST BE CUT FROM DORMANT MATERIALS.
2. LIVE STAKES SHALL BE PLANTED THE SAME DAY AS HARVESTED, OR STORED FOR A PERIOD OF NO LONGER THAN (2) DAYS.
3. THE CONTRACTOR SHALL PROTECT PLANT MATERIAL FROM DRYING AND OVERHEATING AT THE TIME OF HARVEST, DURING TRANSPORT AND DURING THE CONSTRUCTION PROCESS. SOAK CUTTINGS FOR A MINIMUM OF 24 HOURS PRIOR TO INSTALLATION.
4. LIVE STAKES TO BE 25-50mm DIAMETER AND CUT TO A LENGTH OF 750-1000mm.
5. MAKE AN ANGLE CUT AT THE BASIL END, OR BOTTOM OF THE STAKE. TRIM ALL SIDE BRANCHES, TAKING CARE NOT TO DAMAGE THE BARK.
6. DO NOT PLANT UPSIDE DOWN.
7. LIVE STAKES SHOULD BE INSTALLED USING A DEADBLOW HAMMER(LARGE RUBBER MALLET WITH THE HEAD FILLED WITH LEAD PELLETS).
8. 80% OF STAKE TO BE BELOW SURFACE.
9. GENTLY TAMP THE LIVE STAKE INTO THE GROUND AT RIGHT ANGLES TO THE SLOPE.
10. IF THE SOIL IS COMPACT A PILOT HOLE MADE WITH A STEEL BAR SHOULD BE USED.
11. IF USING A PILOT HOLE REPACK THE SOIL AROUND THE STAKE.
12. DENSITY OF STAKES TO BE 3-4 PIECES PER SQUARE METER, RANDOM PATTERN.
13. NATIVE SPECIES TO INCLUDE:
SALIX BEBBIANA-BEAKED WILLOW
SALIX DISCOLOR-PUSSY WILLOW
SALIX EXIGUA-SANDBAR WILLOW

8 LIVE STAKE DETAIL

1:20

P-2017-17,181-01

NOT FOR CONSTRUCTION

no.	revision	date	by
1	ISSUED FOR CLIENT REVIEW	2017-09-15	TL

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ALL DRAWINGS TO BE USED FOR CONSTRUCTION ONLY WHEN SIGNED BY THE LANDSCAPE ARCHITECT.

signed _____ date _____

terraplan LANDSCAPE ARCHITECTS
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20 Champlain Blvd, Suite 102 - Toronto ON - M3H 2Z1 info@terraplan.ca www.terraplan.ca

CLIENT

MILLBROOK SUBDIVISION
PHASE 2
PETERBOROUGH, ONTARIO

PROJECT

LANDSCAPE DETAILS

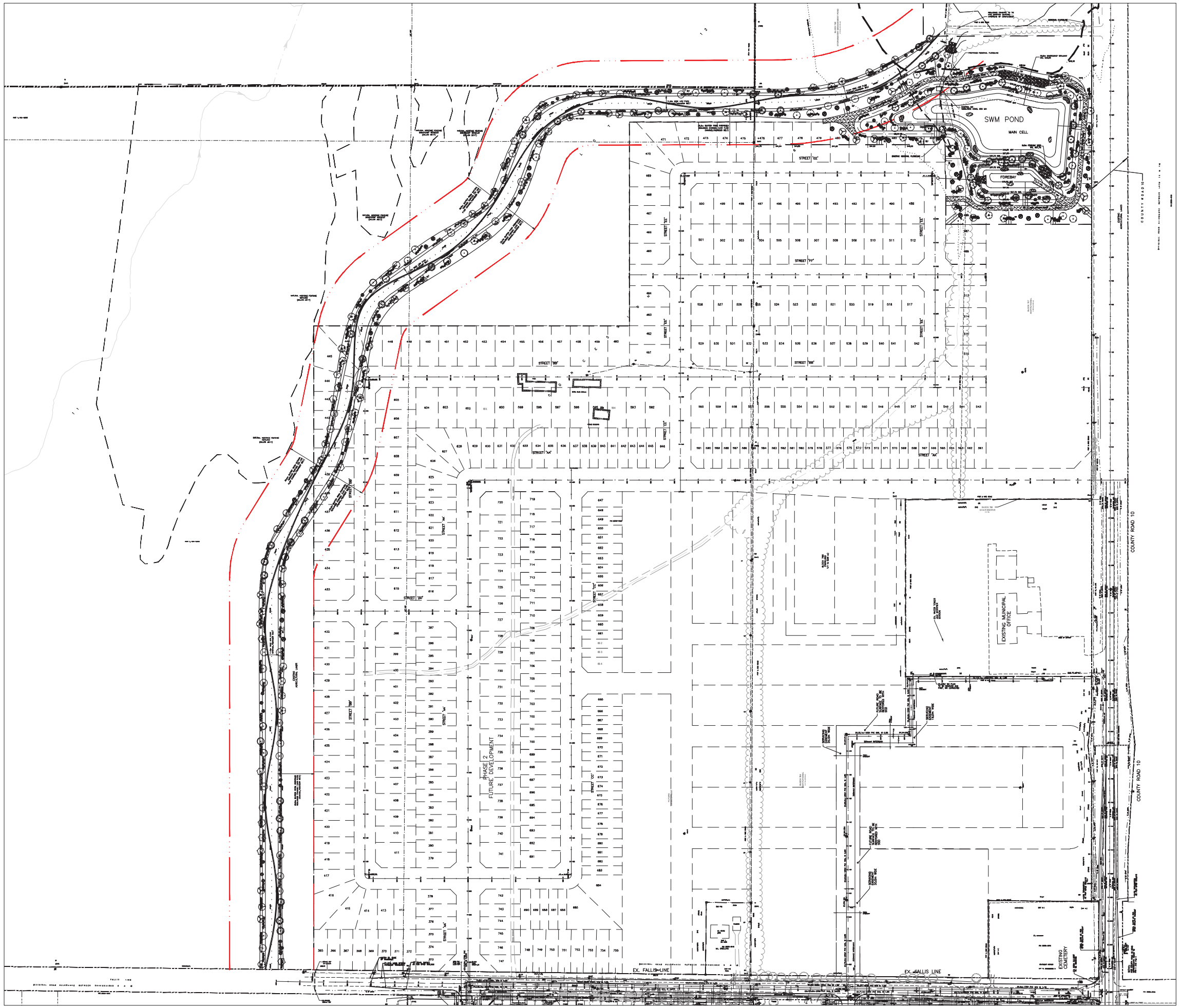
DRAWING

DRAWN: TL
CHECKED:
SCALE: N.T.S.
DATE: 2017-07-04
PROJECT NO.: 17-181

SHEET NO.: LD-100

ASSOCIATION OF LANDSCAPE ARCHITECTS ONTARIO PAUL MARZA MEMBER OALA

September 19, 2017 2:36 PM I:\01-PROJECTS\2017\17-181 MILLBROOK PHASE 2-POND & CHANNEL\01-CAD\01-CURRENT PLOTTING\PA17-181-LD-100-DETAILS.DWG



GENERAL NOTES

1. Drawing is in metric scale. Dimensions under 1000 mm are shown as whole number.
2. No extra will be allowed for discrepancies between the drawings and actual site conditions unless reported in writing prior to commencement of work.
3. Do not leave any holes open overnight.
4. Make good all damage resulting from the work at no extra cost.
5. Keep area outside construction zone clean and usable by others at all times.
6. No stockpile is allowed on site without Owner's approval and direction.
7. Contractor is to submit samples of all proposed materials in this contract for approval prior to placing orders.
8. Contractor to request stake out and verify locations for all utilities prior to any construction, and report all conflicts to the Landscape Architects in writing. Contractor to obtain written instructions prior to starting work.
9. This drawing to be read in conjunction with Architect's site plan and engineering drawings.
10. All shrubs and coniferous planting to be in continuous beds. All planting to meet municipality's specifications.
11. Contractor to layout all landscape elements, and confirm locations with the Landscape Architect prior to proceeding.
12. Landscape contractor must always follow the approved engineering grading plans. Report any discrepancies to landscape architect and engineer.
13. Master plant list ,all plant material to be clay grown stock, Contractor to confirm that the plant quantities shown on the plant list conform to the landscape Drawings. Landscape drawings supersede the plant list totals. Any discrepancies not reported shall be the responsibility of the landscape contractor.
14. All shrubs to be fibre pot container stock. All trees to be string ball stock.
15. Contractor shall provide marked-up redline plans showing as-built conditions to the Landscape Architect prior to obtaining substantial completion.
16. Contractor to install new sod and new topsoil as per specifications and general notes throughout the site as designed. New topsoil and sod shall extend through the municipal boulevard to the rear of the municipal curb.
17. All planting beds that are surrounded by sod should be cut and edged at a 45° angle, so there is a clear and well defined separation between the planting beds and sodded areas.
18. The Landscape Contractor is to inform Terraplan 30 days prior to the start date of the landscape construction.
19. The Landscape Contractor must contact Terraplan to confirm start date 7 days prior to commencing the landscape construction.
20. In the event that the soil being used on the site deviates from the soil specifications provided by Terraplan, the Landscape Contractor must provide reputable soil analysis. Soil used on the site must be approved by Terraplan.
21. Terraplan inspections are required prior to payment.

NOT FOR CONSTRUCTION

LEGEND
ALL ITEMS ARE TO BE PROVIDED UNLESS OTHERWISE NOTED

- DECIDUOUS TREE
- CONIFEROUS TREE
- SHRUB BED
- AQUATICS PLANTS
- 8190–STORMWATER POND MIXTURE FOR LOWER AREAS OF POND
- 8140–NATIVE UPLAND & FORAGE MIX FOR UPPER AREAS OF POND & DISTURBED AREAS

no.	revision	date	by
1	ISSUED FOR CLIENT REVIEW	2017-09-15	TL

signed _____ date _____

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20 Champlain Blvd, Suite 102 - Toronto ON - M3H 2Z1 info@terraplan.ca www.terraplan.ca

CLIENT

MILLBROOK SUBDIVISION
PHASE 2
PETERBOROUGH, ONTARIO

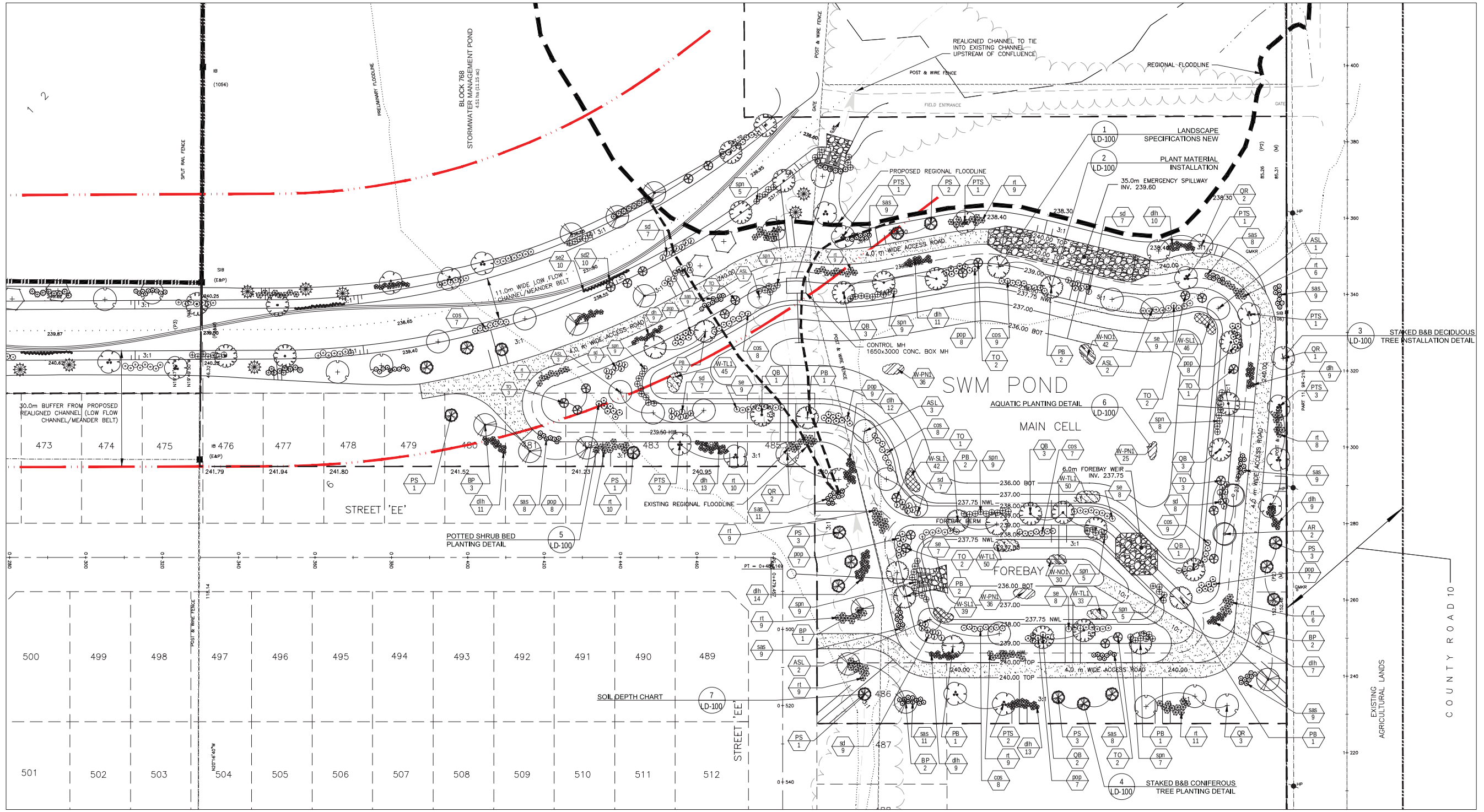
PROJECT
OVERALL LANDSCAPE PLAN

DRAWING

DRAWN: TL
CHECKED:
SCALE: 1:1500
DATE: 2017-07-04
PROJECT NO.: 17-181

SHEET NO.: LP-100

ASSOCIATION OF LANDSCAPE ARCHITECTS ONTARIO — PAUL MARSALA — OALA MEMBER



NOT FOR CONSTRUCTION

LEGEND
ALL ITEMS ARE TO BE PROVIDED UNLESS OTHERWISE NOTED

- DECIDUOUS TREE
- CONIFEROUS TREE
- SHRUB BED
- AQUATICS PLANTS
- PLANT KEY (ID / QTY)
- DETAIL KEY (3 / LD-100)

PLANT SCHEDULE SWM POND

CONIFEROUS TREE	CODE	QTY	BOTANICAL NAME	COMMON NAME	B&B	70	REMARKS
	PS	14	PINUS STROBUS	WHITE PINE	POT	80CM HT.	NATIVE
	TO	18	THUJA OCCIDENTALIS	WHITE CEDAR	POT	80CM HT.	NATIVE
DECIDUOUS TREES	**CODE**	**QTY**	**BOTANICAL NAME**	**COMMON NAME**	**B&B**	**70**	**REMARKS**
	AR	2	ACER RUBRUM	RED MAPLE	B & B OR POT	1.5M HT.	NATIVE
	ASL	12	ACER SACCHARINUM	SILVER MAPLE	B & B OR POT	1.5M HT.	
	BP	8	BETULA PAPYRIFERA	PAPER BIRCH	B & B OR POT	1.5M HT	NATIVE
	PB	12	POPULUS BALSAMIFERA	BALSAM POPLAR	B & B OR POT	1.5M HT.	
	PTS	11	POPULUS TREMULOIDES	QUAKING ASPEN	B & B OR POT	1.5M HT.	NATIVE
	QB	13	QUERCUS BICOLOR	SWAMP WHITE OAK	B & B OR POT	1.5M HT.	NATIVE
	QR	8	QUERCUS RUBRA	RED OAK	B & B OR POT	1.5M HT.	NATIVE
DECIDUOUS SHRUBS	**CODE**	**QTY**	**BOTANICAL NAME**	**COMMON NAME**	**CONT**	**HT.**	**REMARKS**
	cos	49	CORNUS STOLONIFERA	RED OSIER DOGWOOD	BAREROOT	30CM HT.	NATIVE
	dlh	127	DIERVILLA LONICERA	BUSH HONEYSUCKLE	BAREROOT	30CM HT.	NATIVE
	pop	61	PHYSOCARPUS OPULIFOLIUS	NINEBARK	BAREROOT	30CM HT.	NATIVE
	rt	112	RHUS TYPHINA	STAGHORN SUMAC	BAREROOT	30CM HT.	NATIVE
	sd	45	SALIX DISCOLOR	PUSSY WILLOW	BAREROOT	30CM HT.	NATIVE
	se	41	SALIX EXIGUA	SANDBAR WILLOW	BAREROOT	30CM HT.	NATIVE
	spn	67	SAMBUCUS CANADENSIS	ELDERBERRY	BAREROOT	30CM HT.	NATIVE
	sas	100	SYMPHORICARPOS ALBUS	SNOWBERRY	BAREROOT	30CM HT.	
AQUATIC PLANTS	**CODE**	**QTY**	**BOTANICAL NAME**	**COMMON NAME**	**CONT**	**SPACING**	**REMARKS**
	W-NO1	72	NYMPHAEA ODORATA	WHITE WATER-LILY	BARE ROOT TUBER, PLT. @ 60CM O/C	600mm	
	W-PN1	97	POTAMOGETON NATANS	FLOATING-LEAVED PONDWEED	30CM ROOTED CUTTING, PLT. @ 60CM O/C	600mm	
	W-SL1	127	SAGITTANA LATIFOLIA	BROADLEAVED ARROWHEAD	1" PLUG, PLT. @ 60CM O/C	600mm	
	W-TL1	178	TYPHA LATIFOLIA	BROADLEAVED CATTAIL	BARE ROOT TUBERS, PLT. @ 60CM O/C	600mm	

NOTE:
SHRUBS TO BE BAREROOT ONLY IF INSTALLED IN THE SPRING. SHRUBS TO BE CONTAINER GROWN IF INSTALLED ANY OTHER TIME OF THE YEAR.

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no.	revision	date	by
1	ISSUED FOR CLIENT REVIEW	2017-09-15	TL

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signed _____ date _____

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CLIENT

MILLBROOK SUBDIVISION
PHASE 2
PETERBOROUGH, ONTARIO

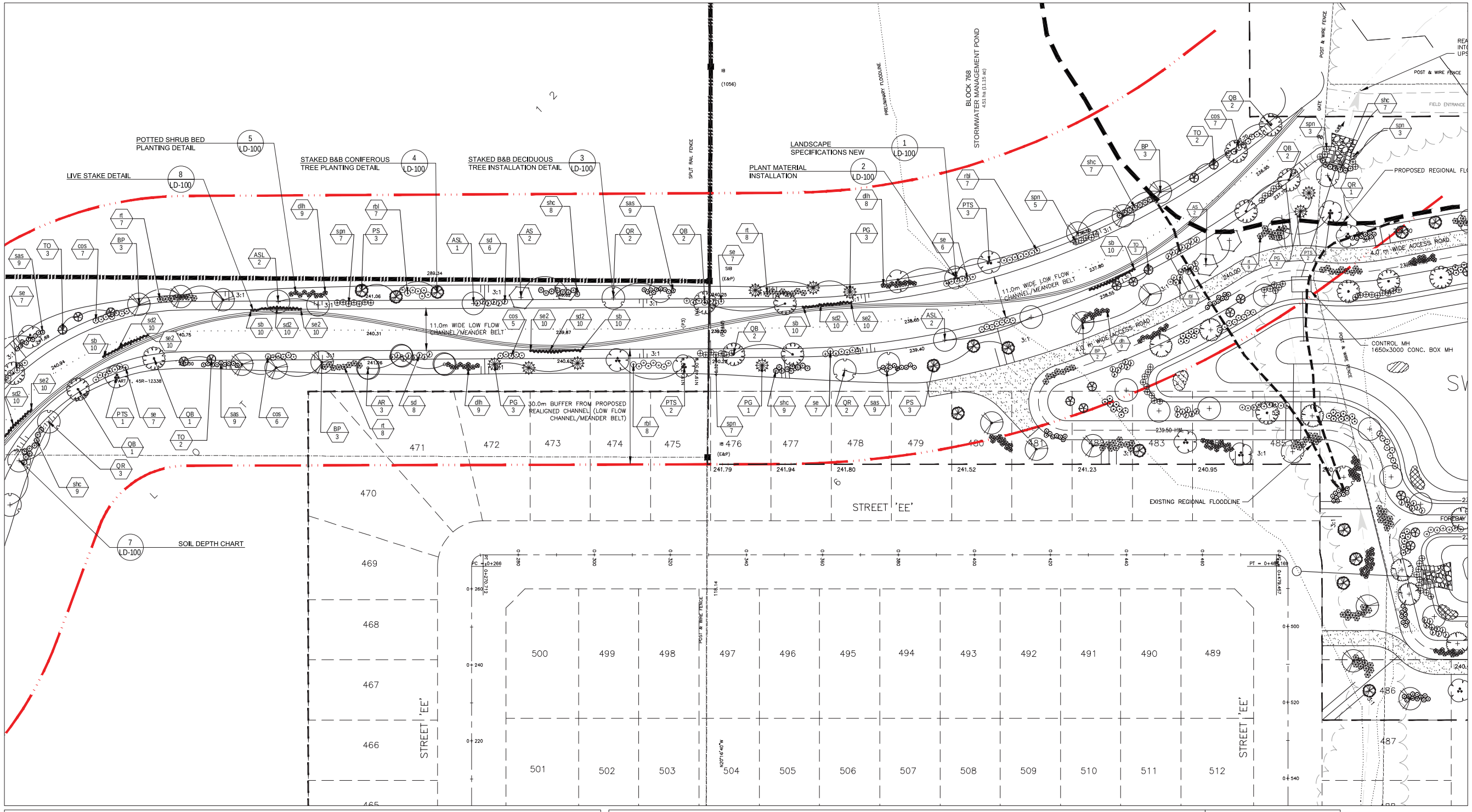
PROJECT
STORM WATER MANAGEMENT POND LANDSCAPE PLAN

DRAWING

DRAWN: TL
CHECKED:
SCALE: 1:500
DATE: 2017-07-04
PROJECT NO.: 17-181

SHEET NO.: LP-101

ASSOCIATION OF LANDSCAPE ARCHITECTS ONTARIO — PAUL MARSALA — MEMBER — OALA



PLANT SCHEDULE CHANNEL

CONIFEROUS TREE	CODE	QTY	BOTANICAL NAME	COMMON NAME	B&B	70	REMARKS
	PG	14	PICEA GLAUCA	WHITE SPRUCE	POT	80CM HT.	NATIVE
	PS	16	PINUS STROBUS	WHITE PINE	POT	80CM HT.	NATIVE
	TO	28	THUJA OCCIDENTALIS	WHITE CEDAR	POT	80CM HT.	NATIVE
DECIDUOUS TREES	**CODE**	**QTY**	**BOTANICAL NAME**	**COMMON NAME**	**B&B**	**70**	**REMARKS**
	AR	12	ACER RUBRUM	RED MAPLE	B & B OR POT	1.5M HT.	NATIVE
	ASL	28	ACER SACCHARINUM	SILVER MAPLE	B & B OR POT	1.5M HT.	
	AS	20	ACER SACCHARUM	SUGAR MAPLE	B & B OR POT	1.5M HT	
	BP	25	BETULA PAPYRIFERA	PAPER BIRCH	B & B OR POT	1.5M HT	NATIVE
	PTS	25	POPULUS TREMULOIDES	QUAKING ASPEN	B & B OR POT	1.5M HT.	NATIVE
	QB	27	QUERCUS BICOLOR	SWAMP WHITE OAK	B & B OR POT	1.5M HT.	NATIVE
	QR	18	QUERCUS RUBRA	RED OAK	B & B OR POT	1.5M HT.	NATIVE

DECIDUOUS SHRUBS	CODE	QTY	BOTANICAL NAME	COMMON NAME	CONT	HT.	REMARKS
	cos	108	CORNUS STOLONIFERA	RED OSIER DOGWOOD	BAREROOT	30CM HT.	NATIVE
	dlh	106	DIERVILLA LONICERA	BUSH HONEYSUCKLE	BAREROOT	30CM HT.	NATIVE
	rt	96	RHUS TYPHINA	STAGHORN SUMAC	BAREROOT	30CM HT.	NATIVE
	rbl	93	ROSA BLANDA	SMOOTH ROSE	BAREROOT	30CM HT.	NATIVE
	sd	94	SALIX DISCOLOR	PUSSY WILLOW	BAREROOT	30CM HT.	NATIVE
	se	104	SALIX EXIGUA	SANDBAR WILLOW	BAREROOT	30CM HT.	NATIVE
	spn	92	SAMBUCUS CANADENSIS	ELDERBERRY	BAREROOT	30CM HT.	NATIVE
	shc	101	SHEPHERDIA CANADENSIS	BUFFALOBERRY	BAREROOT	30CM HT.	NATIVE
	sas	101	SYMPHORICARPOS ALBUS	SNOWBERRY	BAREROOT	30CM HT.	
LIVE STAKES	**CODE**	**QTY**	**BOTANICAL NAME**	**COMMON NAME**	**CONT**	**HT.**	**REMARKS**
	sb	160	SALIX BEBBIANA	BEAKED WILLOW	LIVE STAKE	25-50MM DIA., 750-1000MM LENGTH	NATIVE
	sd2	160	SALIX DISCOLOR	PUSSY WILLOW	LIVE STAKE	25-50MM DIA., 750-1000MM LENGTH	NATIVE
	se2	160	SALIX EXIGUA	SANDBAR WILLOW	LIVE STAKE	25-50MM DIA., 750-1000MM LENGTH	NATIVE

NOTE:
SHRUBS TO BE BAREROOT ONLY IF INSTALLED IN THE SPRING. SHRUBS TO BE CONTAINER GROWN IF INSTALLED ANY OTHER TIME OF THE YEAR.

1:500 0 5 10 15 20 25 50m

NOT FOR CONSTRUCTION

LEGEND
ALL ITEMS ARE TO BE PROVIDED UNLESS OTHERWISE NOTED

- DECIDUOUS TREE
- CONIFEROUS TREE
- SHRUB BED
- LIVE STAKES
- PLANT KEY (ID / QTY)
- DETAIL KEY (3 / LD-100)

no.	revision	date	by
1	ISSUED FOR CLIENT REVIEW	2017-09-15	TL

CONTRACTOR MUST VERIFY ALL DIMENSIONS ON THE JOB AND REPORT ANY DISCREPANCY TO THE LANDSCAPE ARCHITECT BEFORE PROCEEDING WITH THE WORK.
ALL DRAWINGS AND SPECIFICATIONS ARE INSTRUMENTS OF SERVICE AND THE PROPERTY OF THE LANDSCAPE ARCHITECT WHICH MUST BE RETURNED AT THE COMPLETION OF THE WORK.
ALL DRAWINGS TO BE USED FOR CONSTRUCTION ONLY WHEN SIGNED BY THE LANDSCAPE ARCHITECT.

signed _____ date _____

terraplan LANDSCAPE ARCHITECTS
VISION. DELIVERED.
20 Champlain Blvd. Suite 102 - Toronto ON - M3H 2Z1 info@terraplan.ca www.terraplan.ca

CLIENT

MILLBROOK SUBDIVISION
PHASE 2
PETERBOROUGH, ONTARIO

PROJECT

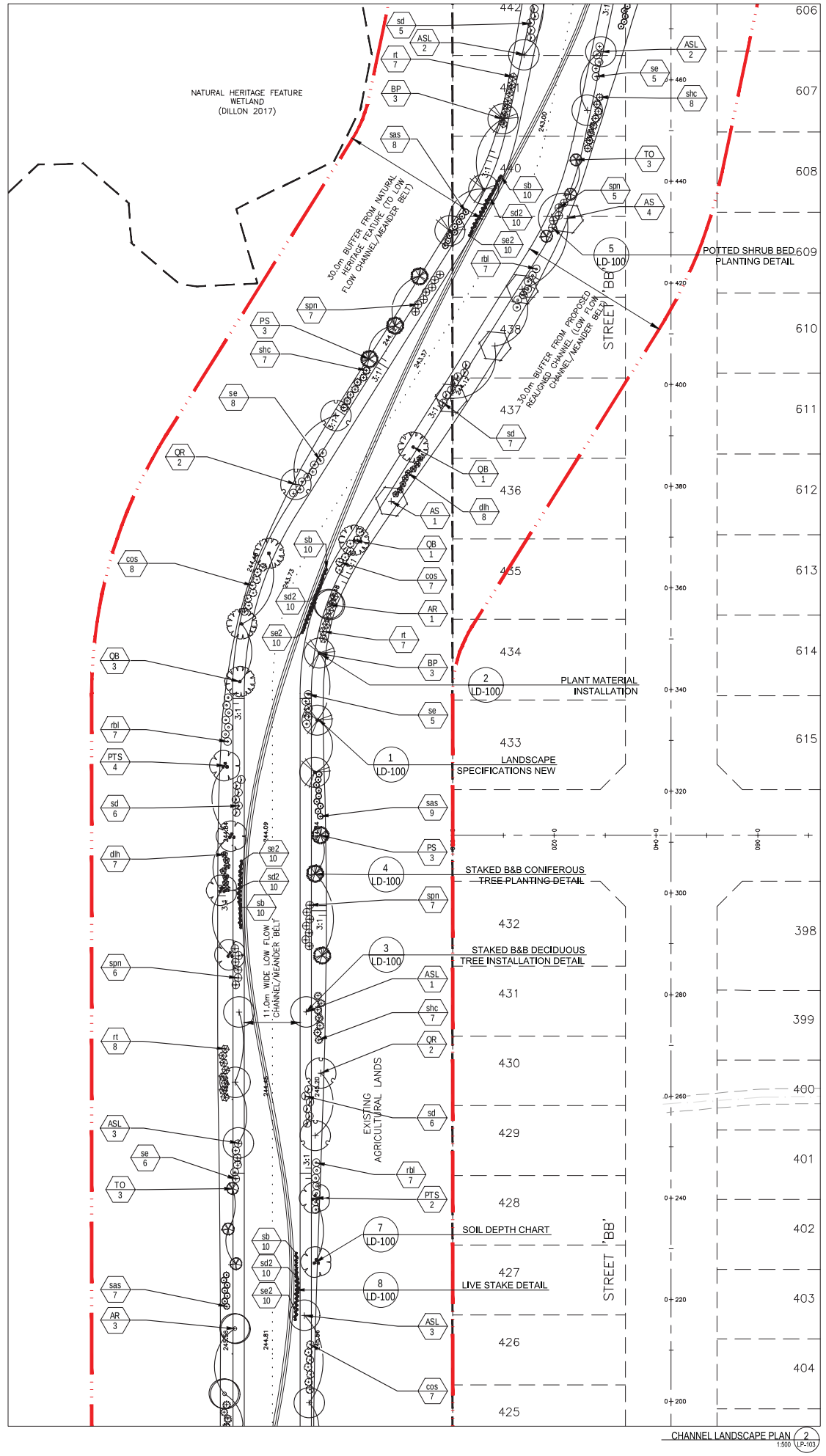
CHANNEL LANDSCAPE PLAN

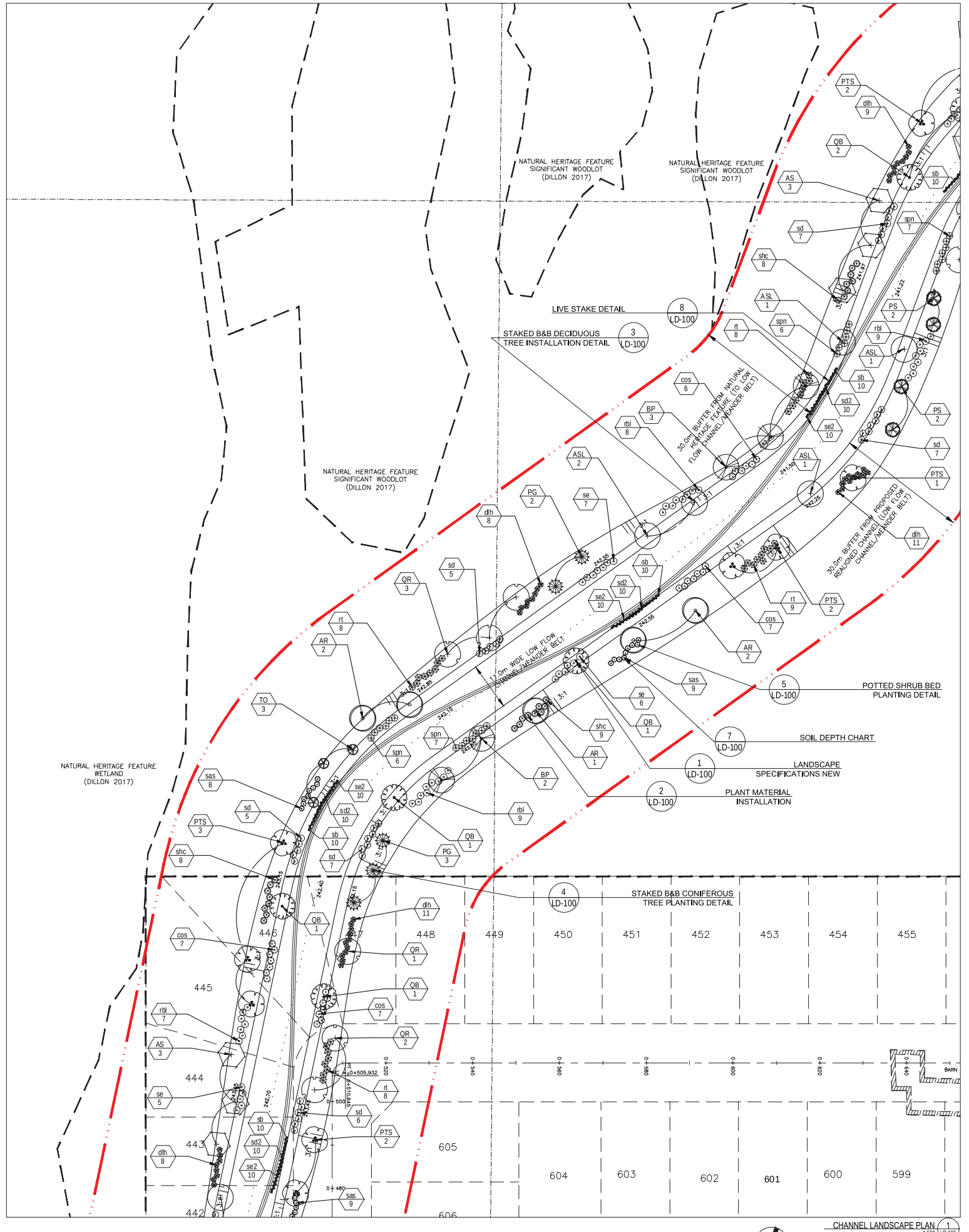
DRAWING

DRAWN: TL
CHECKED:
SCALE: 1:500
DATE: 2017-07-04
PROJECT NO.: 17-181

ASSOCIATION OF LANDSCAPE ARCHITECTS ONTARIO PAUL MARRAS MEMBER OALA

SHEET NO.: LP-102





NOT FOR CONSTRUCTION

LEGEND
ALL ITEMS ARE TO BE PROVIDED UNLESS OTHERWISE NOTED

- DECIDUOUS TREE
- CONIFEROUS TREE
- SHRUB BED
- LIVE STAKES
- PLANT KEY (10 QTY)
- DETAIL KEY (3 LD-100)

NOTE:
REFER TO DRAWING LP-102 FOR CHANNEL PLANT LIST.

no.	revision	date	by
1	ISSUED FOR CLIENT REVIEW	2017-09-15	TL

CONTRACTOR MUST VERIFY ALL DIMENSIONS ON THE JOB AND REPORT ANY DISCREPANCY TO THE LANDSCAPE ARCHITECT BEFORE PROCEEDING WITH THE WORK.
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CLIENT

MILLBROOK SUBDIVISION
PHASE 2
PETERBOROUGH, ONTARIO

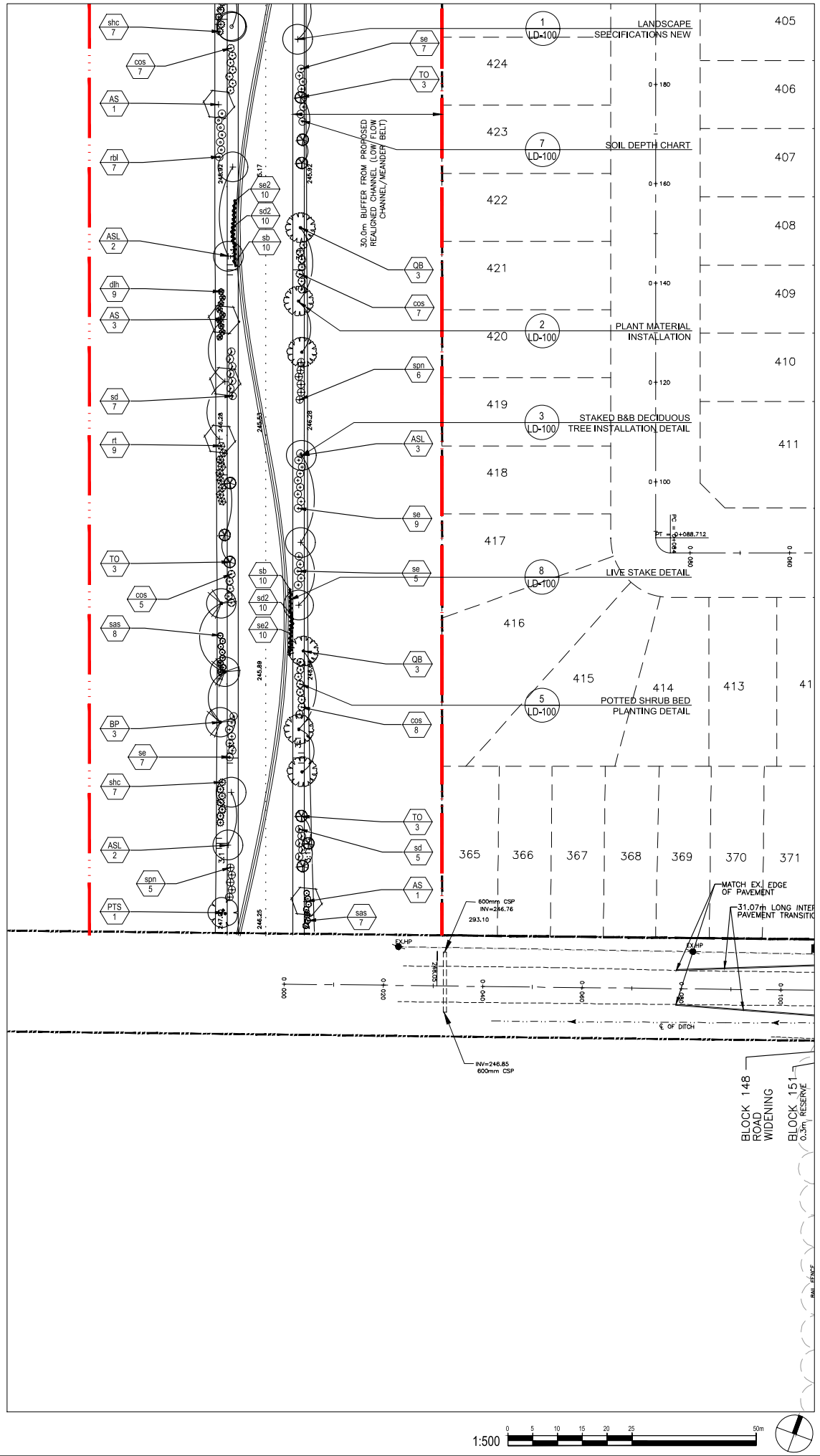
PROJECT
CHANNEL LANDSCAPE PLAN

DRAWING

DRAWN: TL
CHECKED:
SCALE: 1:500
DATE: 2017-07-04
PROJECT NO.: 17-181

SHEET NO.: LP-103

ASSOCIATION OF LANDSCAPE ARCHITECTS ONTARIO — PAUL MARSALL — OALA MEMBER



NOT FOR CONSTRUCTION

LEGEND
ALL ITEMS ARE TO BE PROVIDED UNLESS OTHERWISE NOTED

- DECIDUOUS TREE
- CONIFEROUS TREE
- SHRUB BED
- LIVE STAKES
- ID / QTY — PLANT KEY
- # / LD-100 — DETAIL KEY

NOTE:
REFER TO DRAWING LP-102 FOR CHANNEL PLANT LIST.

no.	revision	date	by
1	ISSUED FOR CLIENT REVIEW	2017-09-15	TL

CONTRACTOR MUST VERIFY ALL DIMENSIONS ON THE JOB AND REPORT ANY DISCREPANCY TO THE LANDSCAPE ARCHITECT BEFORE PROCEEDING WITH THE WORK.
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signed _____ date _____

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CLIENT

MILLBROOK SUBDIVISION
PHASE 2
PETERBOROUGH, ONTARIO

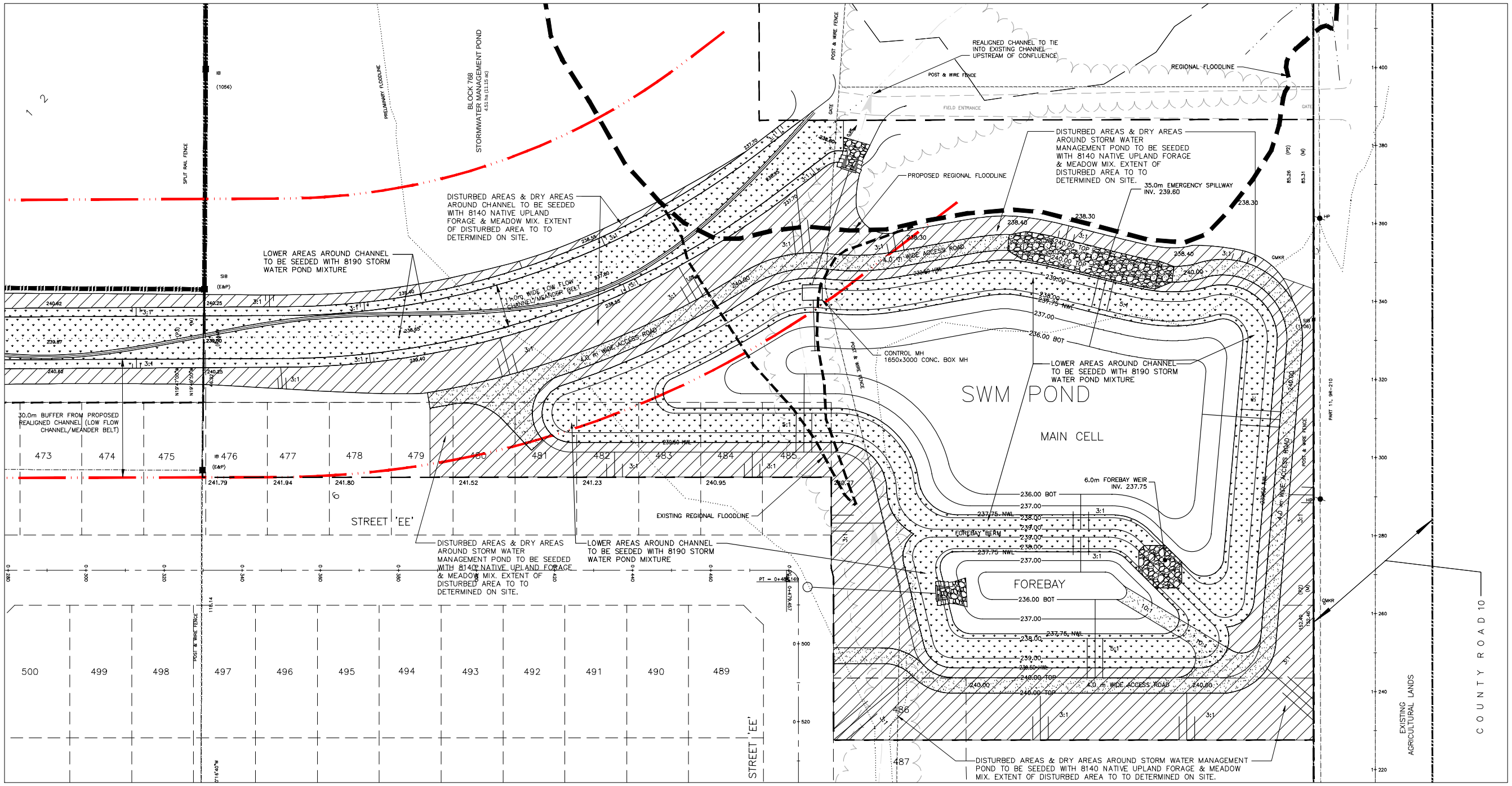
PROJECT
CHANNEL LANDSCAPE PLAN

DRAWING

DRAWN: TL
CHECKED:
SCALE: 1:500
DATE: 2017-07-04
PROJECT NO.: 17-181

SHEET NO.: LP-104

ONTARIO ASSOCIATION OF LANDSCAPE ARCHITECTS — PAUL MARSALL — OALA MEMBER



8190 – STORMWATER POND MIXTURE
FOR LOWER AREAS OF POND:

SPECIES
Annual Ryegrass (Lolium multiflorum)–15%
Black Eyed Susan (Rudbeckia hirta)–3%
Canada Bluegrass (Poa Compressa)–25%
Fox sedge (carex vulpinoidea)–15%
Indiangrass (Sorghastrum nutans)–15%
New England Aster (Aster novae–angiais)–2%
Virginia Wild Rye (Elymus virginicus)–25%

8140–NATIVE UPLAND FORAGE & MEADOW MIX
FOR UPPER AREAS OF POND:

SPECIES
Canada Wild Rye (Elmus Canadensis)–35%
Fowl Bluegrass (Poa palustris)–10%
Fox sedge (carex vulpinoidea)–5%
Little Bluestem (Schizachyrium Scoparium)–5%
Sand Dropseed (Sporobolus cryptandrus)–10%
Virginia Wild Rye (Elymus virginicus)–35%

APPLICATION RATES FOR BOTH SEED MIXES 22–25 kg/ha

SEED ANNUAL RYEGRASS AS A NURSE CROP AND FOR EROSION CONTROL AT 22–25 kg/ha

SEED MIXES TO BE PROVIDED BY: OSC SEEDS
P.O. BOX 7
WATERLOO, ON N2J 3Z6
TEL. 1–519–886–0557
FAX 1–519–886–0605
EMAIL: seeds@oscseeds.com

SEED MIXES TO BE INSTALLED HYDRAULICALLY WITH SOIL GUARD BONDED FIBRE MATRIX BY FIBRAMULCH (905)761–6969.

HYDROSEEDING TO BE INSTALLED BY COMPETENT AND QUALIFIED CONTRACTOR.

THE CONTRACTOR SHALL NOT CARRY OUT THE WORK UNDER ADVERSE WEATHER CONDITIONS SUCH AS HIGH WIND, FROZEN GROUND OR GROUND COVERED WITH SNOW, ICE OR STANDING WATER.

A SOIL TEST SHOULD BE PERFORMED BY A COMPETENT HYDROSEEDING CONTRACTOR TO VERIFY MIXTURE AND PERCENTAGES REQUIRED.

TOPSOIL REQUIREMENTS:

ACTIVE STORAGE AND UPLAND AREAS:
PROVIDE 0.45 METERS OF TOPSOIL FOR THE FIRST 1.0 METER ABOVE THE PERMANENT WATER LEVEL.

WITHIN PERMANENT POOL:
PROVIDE 0.30 METERS OF TOPSOIL FOR THE FIRST(1.0) METER BELOW THE PERMANENT WATER LEVEL.

MONITORING:
THE PERMANENT WATER ELEVATION IN THE SWM POND SHOULD BE OBSERVED TWICE A YEAR FOR APPROXIMATELY TWO (2) YEARS BY THE DESIGN ENGINEER AND LANDSCAPE ARCHITECT TO ENSURE THAT THE FACILITY IS FUNCTIONING AS DESIGNED, PRIOR TO PLANTING AQUATICS (OTHER THAN TEMPORARY PLANTING OF CATTAILS IN SEDIMENT FOREBAY) IN ORDER TO ALLOW TIME FOR CONDITIONS IN THE POND TO STABILIZE. A TWO YEAR GUARANTEE OF THE PLANTED MATERIAL IS REQUIRED.

STABILIZATION:
STABILIZE TOPSOIL WITHIN THE CONSTRUCTION YEAR'S GROWING SEASON. IF THIS CANNOT BE ACHIEVED, THEN TOPSOIL SHOULD NOT BE SPREAD UNTIL THE FOLLOWING SPRING AND SOME INTERIM STABILIZATION MEASURE SHOULD BE USED TO PREVENT EROSION OF GRADED SUBSTRATE. STABILIZE TOPSOIL PRIOR TO PLANTING WOODY MATERIAL USING A LAKE SIMCOE REGION CONSERVATION AUTHORITY APPROVED SEED MIX. SEED MIXES TO BE INSTALLED HYDRAULICALLY WITH SOIL GUARD BONDED FIBRE MATRIX BY FIBRA MULCH (905 761–6969) FOR SLOPE STABILIZATION. UPON COMPLETION OF GRADING AND TOPSOIL INSTALLATION, STABILIZATION OF TOPSOIL WITH SEED MIX INSTALLATION MUST OCCUR WITHIN 24 HOURS.

SEED MIX PREPARATION:
GRADE SUB–GRADE, ELIMINATE UNEVEN AREAS AND LOW SPOTS, ENSURE POSITIVE DRAINAGE. REMOVE DEBRIS, ROOTS, BRANCHES, STONES IN EXCESS OF 50MM DIAMETER AND OTHER DELETERIOUS MATERIALS. REMOVE SUBSOIL THAT HAS BEEN CONTAMINATED WITH OIL, GASOLINE OR CALCIUM CHLORIDE. DISPOSE OF REMOVED MATERIAL AS DIRECTED BY LANDSCAPE ARCHITECTS.

GRADE SUB–GRADE FOR HYDRO–SEEDING TO A UNIFORM SURFACE AND REMOVE VEGETATION WHICH MAY INTERFERE WITH SEEDING OPERATIONS. LOOSEN SOIL TO DEPTH OF 25MM MINIMUM AND REMOVE STONES AND FOREIGN MATERIAL WHICH PROTRUDE MORE THAN 75MM ABOVE THE SURFACE.

ALL AREAS TO BE HYDROSEEDED TO RECEIVE MIN. 150mm OF TOPSOIL.

MAINTENANCE:
SEEDED AREAS TO BE MAINTAINED BY CONTRACTOR ENSURING ADEQUATE WATER, FERTILIZER, MAINTENANCE AND REPAIR UNTIL SEEDED AREAS ARE PROPERLY ESTABLISHED. AREAS SEEDED IN FALL WILL BE ACCEPTED IN FOLLOWING SPRING, ONE MONTH AFTER START OF GROWING SEASON PROVIDED ACCEPTANCE CONDITIONS ARE FULFILLED.

NOT FOR CONSTRUCTION

LEGEND
ALL ITEMS ARE TO BE PROVIDED UNLESS OTHERWISE NOTED

8190–STORMWATER POND MIXTURE FOR LOWER AREAS OF POND

8140–NATIVE UPLAND & FORAGE MIX FOR UPPER AREAS OF POND & DISTURBED AREAS

no.	revision	date	by
1	ISSUED FOR CLIENT REVIEW	2017-09-15	TL

signed date

terraplan LANDSCAPE ARCHITECTS
VISION. DELIVERED.
20 Champlain Blvd, Suite 102 - Toronto ON - M3H 2Z1 info@terraplan.ca www.terraplan.ca

CLIENT

MILLBROOK SUBDIVISION
PHASE 2
PETERBOROUGH, ONTARIO

PROJECT
STORM WATER MANAGEMENT POND AND CHANNEL SEED MIX PLAN

DRAWING

DRAWN: TL
CHECKED:
SCALE: 1:500
DATE: 2017-07-04
PROJECT NO.: 17-181

SHEET NO.: LP-105

ASSOCIATION OF LANDSCAPE ARCHITECTS ONTARIO PAUL MARSALA MEMBER OALA

8190 – STORMWATER POND MIXTURE
FOR LOWER AREAS OF POND:

SPECIES
Annual Ryegrass (Lolium multiflorum)–15%
Black Eyed Susan (Rudbeckia hirta)–3%
Canada Bluegrass (Poa Compressa)–25%
Fox sedge (carex vulpinoidea)–15%
Indiangrass (Sorghastrum nutans)–15%
New England Aster (Aster novae–angiais)–2%
Virginia Wild Rye (Elymus virginicus)–25%

8140–NATIVE UPLAND FORAGE & MEADOW MIX
FOR UPPER AREAS OF POND:

SPECIES
Canada Wild Rye (Elmus Canadensis)–35%
Fowl Bluegrass (Poa palustris)–10%
Fox sedge (carex vulpinoidea)–5%
Little Bluestem (Schizachyrium Scoparium)–5%
Sand Dropseed (Sporobolus cryptandrus)–10%
Virginia Wild Rye (Elymus virginicus)–35%

APPLICATION RATES FOR BOTH SEED MIXES 22–25 kg/ha

SEED ANNUAL RYEGRASS AS A NURSE CROP AND FOR EROSION CONTROL AT 22–25 kg/ha

SEED MIXES TO BE PROVIDED BY: OSC SEEDS
P.O. BOX 7
WATERLOO, ON N2J 3Z6
TEL. 1–519–886–0557
FAX 1–519–886–0605
EMAIL: seeds@oscseeds.com

SEED MIXES TO BE INSTALLED HYDRAULICALLY WITH SOIL GUARD BONDED FIBRE MATRIX BY FIBRAMULCH (905)761–6969.

HYDROSEEDING TO BE INSTALLED BY COMPETENT AND QUALIFIED CONTRACTOR.

THE CONTRACTOR SHALL NOT CARRY OUT THE WORK UNDER ADVERSE WEATHER CONDITIONS SUCH AS HIGH WIND, FROZEN GROUND OR GROUND COVERED WITH SNOW, ICE OR STANDING WATER.

A SOIL TEST SHOULD BE PERFORMED BY A COMPETENT HYDROSEEDING CONTRACTOR TO VERIFY MIXTURE AND PERCENTAGES REQUIRED.

TOPSOIL REQUIREMENTS:

ACTIVE STORAGE AND UPLAND AREAS:
PROVIDE 0.45 METERS OF TOPSOIL FOR THE FIRST 1.0 METER ABOVE THE PERMANENT WATER LEVEL.

WITHIN PERMANENT POOL:
PROVIDE 0.30 METERS OF TOPSOIL FOR THE FIRST(1.0) METER BELOW THE PERMANENT WATER LEVEL.

MONITORING:
THE PERMANENT WATER ELEVATION IN THE SWM POND SHOULD BE OBSERVED TWICE A YEAR FOR APPROXIMATELY TWO (2) YEARS BY THE DESIGN ENGINEER AND LANDSCAPE ARCHITECT TO ENSURE THAT THE FACILITY IS FUNCTIONING AS DESIGNED, PRIOR TO PLANTING AQUATICS (OTHER THAN TEMPORARY PLANTING OF CATTAILS IN SEDIMENT FOREBAY) IN ORDER TO ALLOW TIME FOR CONDITIONS IN THE POND TO STABILIZE. A TWO YEAR GUARANTEE OF THE PLANTED MATERIAL IS REQUIRED.

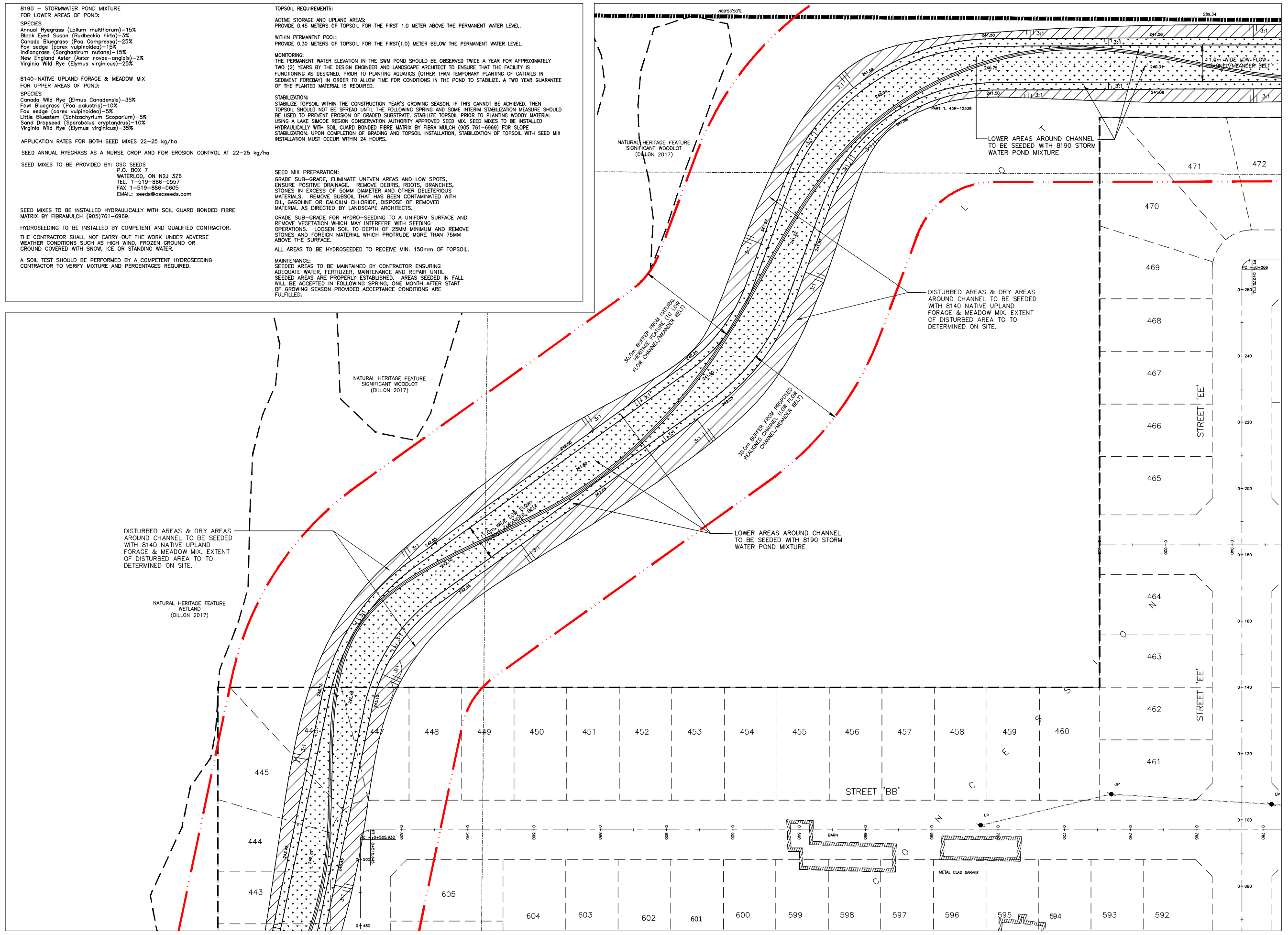
STABILIZATION:
STABILIZE TOPSOIL WITHIN THE CONSTRUCTION YEAR'S GROWING SEASON. IF THIS CANNOT BE ACHIEVED, THEN TOPSOIL SHOULD NOT BE SPREAD UNTIL THE FOLLOWING SPRING AND SOME INTERIM STABILIZATION MEASURE SHOULD BE USED TO PREVENT EROSION OF GRADED SUBSTRATE. STABILIZE TOPSOIL PRIOR TO PLANTING WOODY MATERIAL USING A LAKE SIMCOE REGION CONSERVATION AUTHORITY APPROVED SEED MIX. SEED MIXES TO BE INSTALLED HYDRAULICALLY WITH SOIL GUARD BONDED FIBRE MATRIX BY FIBRA MULCH (905 761–6969) FOR SLOPE STABILIZATION. UPON COMPLETION OF GRADING AND TOPSOIL INSTALLATION, STABILIZATION OF TOPSOIL WITH SEED MIX INSTALLATION MUST OCCUR WITHIN 24 HOURS.

SEED MIX PREPARATION:
GRADE SUB–GRADE, ELIMINATE UNEVEN AREAS AND LOW SPOTS, ENSURE POSITIVE DRAINAGE. REMOVE DEBRIS, ROOTS, BRANCHES, STONES IN EXCESS OF 50MM DIAMETER AND OTHER DELETERIOUS MATERIALS. REMOVE SUBSOIL THAT HAS BEEN CONTAMINATED WITH OIL, GASOLINE OR CALCIUM CHLORIDE, DISPOSE OF REMOVED MATERIAL AS DIRECTED BY LANDSCAPE ARCHITECTS.

GRADE SUB–GRADE FOR HYDRO–SEEDING TO A UNIFORM SURFACE AND REMOVE VEGETATION WHICH MAY INTERFERE WITH SEEDING OPERATIONS. LOOSEN SOIL TO DEPTH OF 25MM MINIMUM AND REMOVE STONES AND FOREIGN MATERIAL WHICH PROTRUDE MORE THAN 75MM ABOVE THE SURFACE.

ALL AREAS TO BE HYDROSEEDED TO RECEIVE MIN. 150mm OF TOPSOIL.

MAINTENANCE:
SEEDED AREAS TO BE MAINTAINED BY CONTRACTOR ENSURING ADEQUATE WATER, FERTILIZER, MAINTENANCE AND REPAIR UNTIL SEEDED AREAS ARE PROPERLY ESTABLISHED. AREAS SEEDED IN FALL WILL BE ACCEPTED IN FOLLOWING SPRING, ONE MONTH AFTER START OF GROWING SEASON PROVIDED ACCEPTANCE CONDITIONS ARE FULFILLED.



1:500

0 5 10 15 20 25 50m

NOT FOR CONSTRUCTION

LEGEND
ALL ITEMS ARE TO BE PROVIDED UNLESS OTHERWISE NOTED

- 8190–STORMWATER POND MIXTURE FOR LOWER AREAS OF CHANNEL
- 8140–NATIVE UPLAND & FORAGE MIX FOR UPPER AREAS OF CHANNELL & DISTURBED AREAS

no.	revision	date	by
1	ISSUED FOR CLIENT REVIEW	2017-09-15	TL

terraplan LANDSCAPE ARCHITECTS
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CLIENT

MILLBROOK SUBDIVISION
PHASE 2
PETERBOROUGH, ONTARIO

PROJECT
CHANNEL SEED MIX PLAN

DRAWING

DRAWN: TL
CHECKED:
SCALE: 1:500
DATE: 2017-07-04
PROJECT NO.: 17-181

SHEET NO.: LP-106

ASSOCIATION OF LANDSCAPE ARCHITECTS ONTARIO — PAUL MARSALA — OALA MEMBER

8190 – STORMWATER POND MIXTURE
FOR LOWER AREAS OF POND:

SPECIES
Annual Ryegrass (Lolium multiflorum)–15%
Black Eyed Susan (Rudbeckia hirta)–3%
Canada Bluegrass (Poa Compressa)–25%
Fox sedge (carex vulpinoidea)–15%
Indiangrass (Sorghastrum nutans)–15%
New England Aster (Aster novae–anglais)–2%
Virginia Wild Rye (Elymus virginicus)–25%

8140–NATIVE UPLAND FORAGE & MEADOW MIX
FOR UPPER AREAS OF POND:

SPECIES
Canada Wild Rye (Elmus Canadensis)–35%
Fowl Bluegrass (Poa palustris)–10%
Fox sedge (carex vulpinoidea)–5%
Little Bluestem (Schizachyrium Scoparium)–5%
Sand Dropseed (Sporobolus cryptandrus)–10%
Virginia Wild Rye (Elymus virginicus)–35%

APPLICATION RATES FOR BOTH SEED MIXES 22–25 kg/ha

SEED ANNUAL RYEGRASS AS A NURSE CROP AND FOR EROSION CONTROL AT 22–25 kg/ha

SEED MIXES TO BE PROVIDED BY: OSC SEEDS
P.O. BOX 7
WATERLOO, ON N2J 3Z6
TEL. 1–519–886–0557
FAX 1–519–886–0605
EMAIL: seeds@oscseeds.com

SEED MIXES TO BE INSTALLED HYDRAULICALLY WITH SOIL GUARD BONDED FIBRE MATRIX BY FIBRAMULCH (905)761–6969.

HYDROSEEDING TO BE INSTALLED BY COMPETENT AND QUALIFIED CONTRACTOR.

THE CONTRACTOR SHALL NOT CARRY OUT THE WORK UNDER ADVERSE WEATHER CONDITIONS SUCH AS HIGH WIND, FROZEN GROUND OR GROUND COVERED WITH SNOW, ICE OR STANDING WATER.

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TOPSOIL REQUIREMENTS:

ACTIVE STORAGE AND UPLAND AREAS:
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WITHIN PERMANENT POOL:
PROVIDE 0.30 METERS OF TOPSOIL FOR THE FIRST(1.0) METER BELOW THE PERMANENT WATER LEVEL.

MONITORING:
THE PERMANENT WATER ELEVATION IN THE SWM POND SHOULD BE OBSERVED TWICE A YEAR FOR APPROXIMATELY TWO (2) YEARS BY THE DESIGN ENGINEER AND LANDSCAPE ARCHITECT TO ENSURE THAT THE FACILITY IS FUNCTIONING AS DESIGNED, PRIOR TO PLANTING AQUATICS (OTHER THAN TEMPORARY PLANTING OF CATTAILS IN SEDIMENT FOREBAY) IN ORDER TO ALLOW TIME FOR CONDITIONS IN THE POND TO STABILIZE. A TWO YEAR GUARANTEE OF THE PLANTED MATERIAL IS REQUIRED.

STABILIZATION:
STABILIZE TOPSOIL WITHIN THE CONSTRUCTION YEAR'S GROWING SEASON. IF THIS CANNOT BE ACHEVED, THEN TOPSOIL SHOULD NOT BE SPREAD UNTIL THE FOLLOWING SPRING AND SOME INTERIM STABILIZATION MEASURE SHOULD BE USED TO PREVENT EROSION OF GRADED SUBSTRATE. STABILIZE TOPSOIL PRIOR TO PLANTING WOODY MATERIAL USING A LAKE SIMCOE REGION CONSERVATION AUTHORITY APPROVED SEED MIX. SEED MIXES TO BE INSTALLED HYDRAULICALLY WITH SOIL GUARD BONDED FIBRE MATRIX BY FIBRA MULCH (905 761–6969) FOR SLOPE STABILIZATION. UPON COMPLETION OF GRADING AND TOPSOIL INSTALLATION, STABILIZATION OF TOPSOIL WITH SEED MIX INSTALLATION MUST OCCUR WITHIN 24 HOURS.

SEED MIX PREPARATION:

GRADE SUB–GRADE, ELIMINATE UNEVEN AREAS AND LOW SPOTS, ENSURE POSITIVE DRAINAGE. REMOVE DEBRIS, ROOTS, BRANCHES, STONES IN EXCESS OF 50MM DIAMETER AND OTHER DELETERIOUS MATERIALS. REMOVE SUBSOIL THAT HAS BEEN CONTAMINATED WITH OIL, GASOLINE OR CALCIUM CHLORIDE, DISPOSE OF REMOVED MATERIAL AS DIRECTED BY LANDSCAPE ARCHITECTS.

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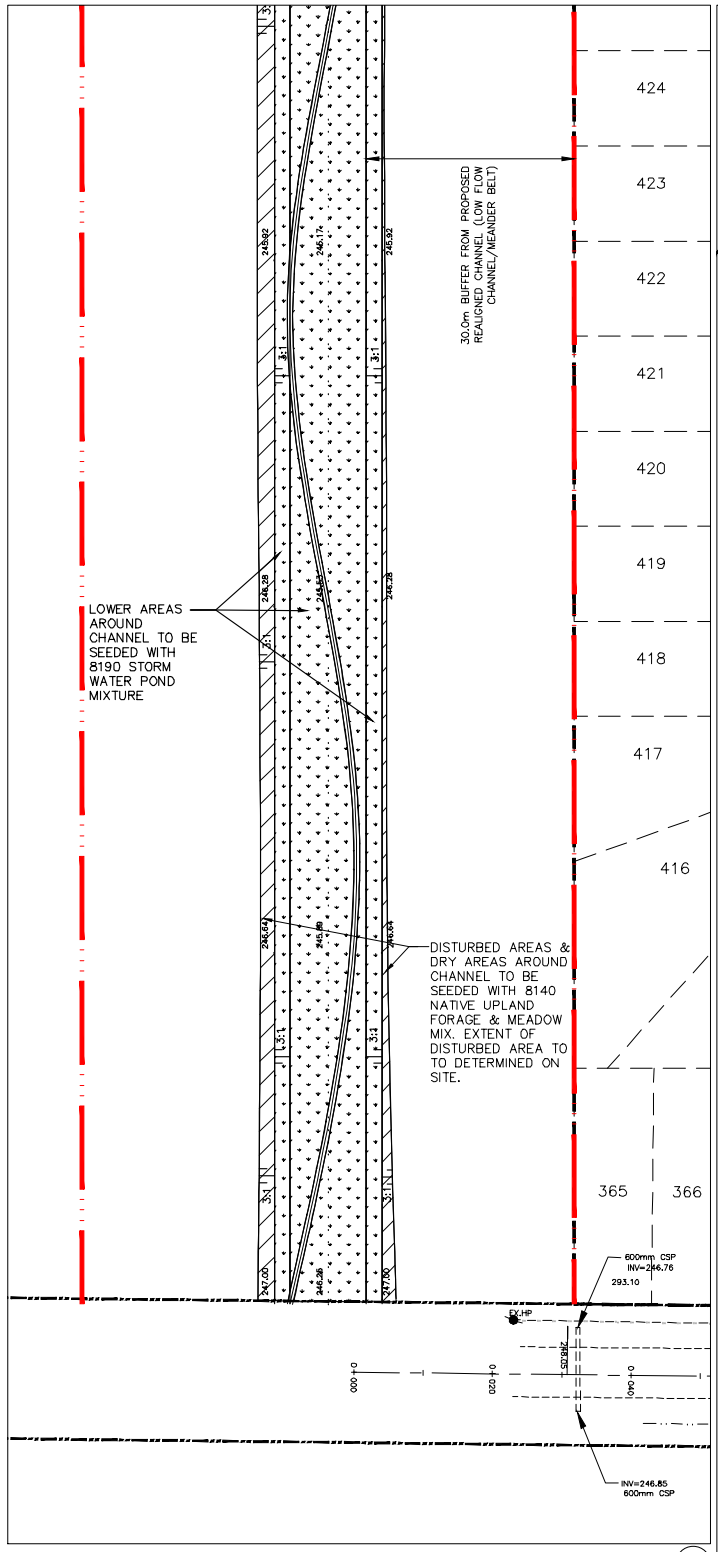
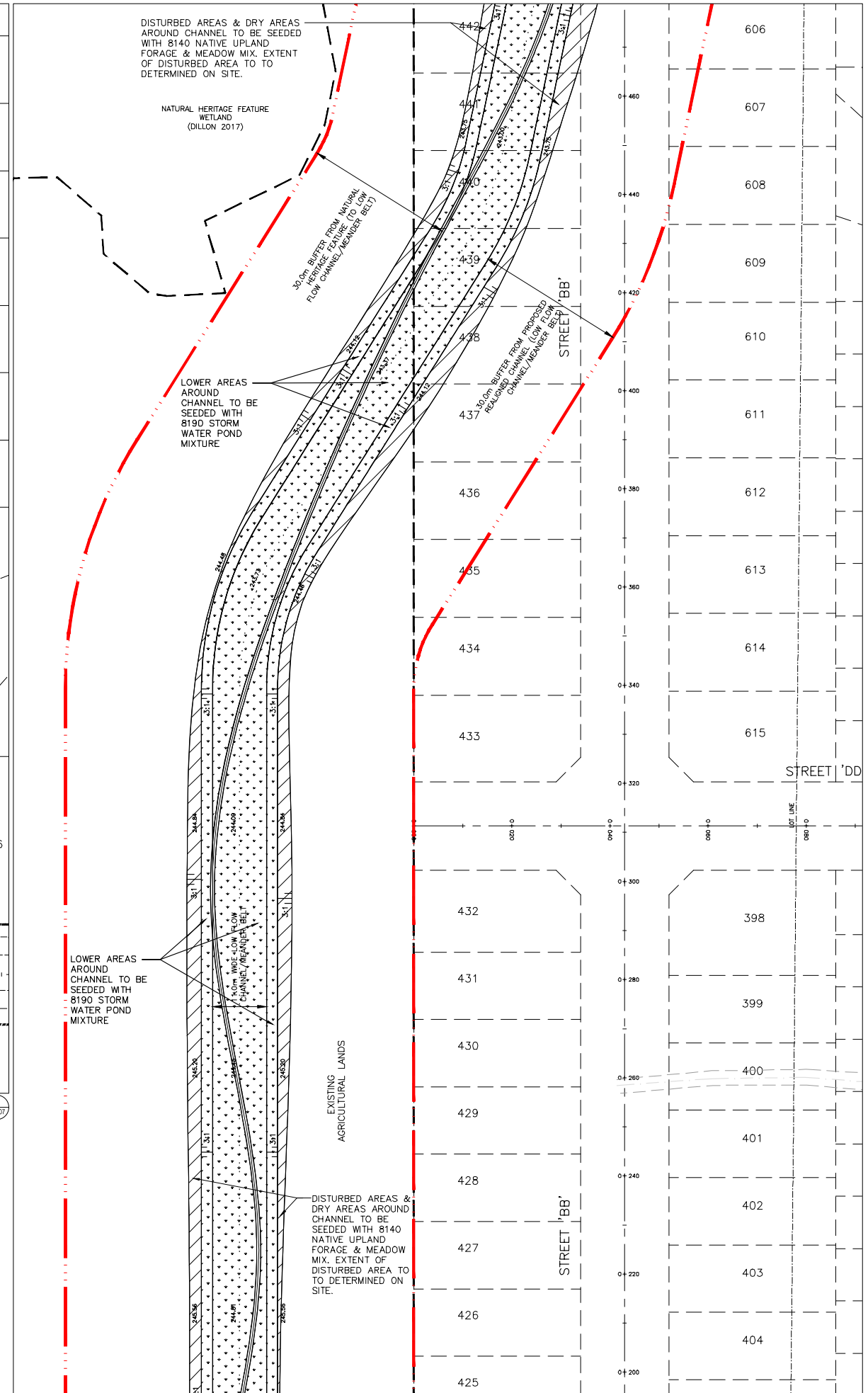
MAINTENANCE:
SEEDED AREAS TO BE MAINTAINED BY CONTRACTOR ENSURING ADEQUATE WATER, FERTILIZER, MAINTENANCE AND REPAIR UNTIL SEEDED AREAS ARE PROPERLY ESTABLISHED. AREAS SEEDED IN FALL WILL BE ACCEPTED IN FOLLOWING SPRING, ONE MONTH AFTER START OF GROWING SEASON PROVIDED ACCEPTANCE CONDITIONS ARE FULFILLED.



CHANNEL SEED MIX PLAN 2
1:500 LP-107



1:500 0 5 10 15 20 25 50m

CHANNEL SEED MIX PLAN 1
1:500 LP-107

NOT FOR CONSTRUCTION

LEGEND
ALL ITEMS ARE TO BE PROVIDED UNLESS OTHERWISE NOTED

8190–STORMWATER POND MIXTURE FOR LOWER AREAS OF CHANNEL

8140–NATIVE UPLAND & FORAGE MIX FOR UPPER AREAS OF CHANNELL & DISTURBED AREAS

no.	revision	date	by
1	ISSUED FOR CLIENT REVIEW	2017-09-15	TL

CONTRACTOR MUST VERIFY ALL DIMENSIONS ON THE JOB AND REPORT ANY DISCREPANCY TO THE LANDSCAPE ARCHITECT BEFORE PROCEEDING WITH THE WORK.
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ALL DRAWINGS TO BE USED FOR CONSTRUCTION ONLY WHEN SIGNED BY THE LANDSCAPE ARCHITECT.

signed _____ date _____

terraplan LANDSCAPE ARCHITECTS
VISION. DELIVERED.
20 Champlain Blvd, Suite 102 - Toronto ON - M3H 2Z1 info@terraplan.ca www.terraplan.ca

CLIENT

MILLBROOK SUBDIVISION
PHASE 2
PETERBOROUGH, ONTARIO

PROJECT
CHANNEL SEED MIX PLAN

DRAWING

DRAWN: TL
CHECKED:
SCALE: 1:500
DATE: 2017-07-04
PROJECT NO.: 17-181

SHEET NO.: LP-107

ASSOCIATION OF LANDSCAPE ARCHITECTS ONTARIO PAUL MARSALL OALA MEMBER

Attachment E:

ORCA Correspondence

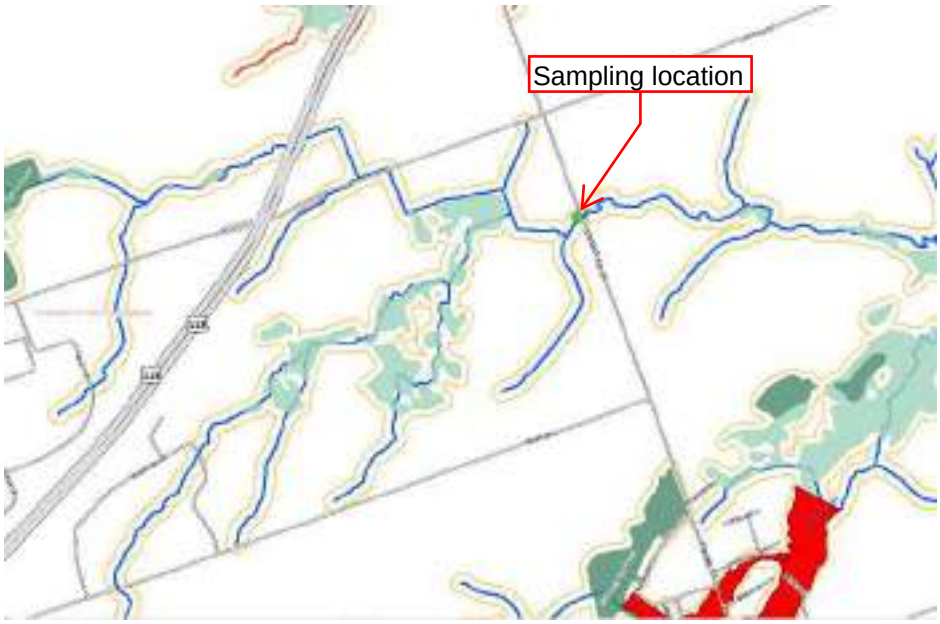
ORCA Plan Review and Permitting Data Request

To: **Whitney Moore, Dillon Consulting**
From: **Erin McGauley**
CC: **Jennifer Clinesmith, File**
Date: **November 9, 2016**
Subject: **Data Request, Dillon Consulting, Millbrook Subdivision (Larmer Line – Fallis Dr.)**
Related File: **2014-SD003 (Towerhill Subdivision)**

ORCA Plan Review and Permitting Environmental staff have received a data request from Dillon Consulting for fisheries information for the Millbrook subdivision site located between Larmer Line and Fallis Drive, west of County Road 10.

The following information is provided regarding fisheries resources and mapping of the area.
The headwater streams on the site are all identified as 'Cold Water' via the Peterborough Area Cold Water Stream Strategy. MNRF layers in ORCA's GIS system note the following details for all stream segments identified in the area of interest:

FISHERIES_MANAGEMENT_ZONE_ID:	99
FISH_SPECIES_SUMMARY:	brook stickleback, brassy minnow, pearl dace, common shiner, bluntnose minnow, eastern blacknose dace, white sucker, northern redbelly dace
ARA_IDENT_1:	PB-0002-BAX



Light blue areas on the map above show the location of unevaluated wetlands on the site, which appear to include open-water habitat which may support fish.

The Otonabee Region Conservation Authority
250 Milroy Drive, Peterborough, ON K9H 7M9
Phone: 705-745-5791 Fax: 705-745-7488
Email: otonabeeca@otonabee.com Website: www.otonabee.com

ORCA's policies regarding fish habitat and planning can be found in section 2.3 (7) of the Watershed Planning and Regulation Policy Manual found on ORCA's website: www.otonabee.com

Sincerely,

Erin McGauley, MSc.
ORCA Watershed Biologist

Attachment F:

DFO Correspondence

Fisheries and Oceans Canada | Pêches et Océans Canada

1028 Parsons Road
Edmonton, AB
T6X 0J4

February 5, 2018

Your file *Votre référence*
N/A

Our file *Notre référence*
17-HCAA-01461

Towerhill Developments Inc.
Attn: Andrew McLeod
2800 Highway 7
Concord, ON
L4K 1W8

Dear Mr. McLeod:

Subject: Implementation of mitigation measures to avoid and mitigate serious harm to fish – Channel Realignment, Millbrook Development, Tributary of Baxter Creek, Township of Cavan-Monaghan

The Fisheries Protection Program (the Program) of Fisheries and Oceans Canada received your proposal on October 13, 2017.

Your proposal has been reviewed to determine whether it is likely to result in serious harm to fish which is prohibited under subsection 35(1) of the *Fisheries Act*.

Our review consisted of:

- "Request for Review", submitted by Dillon Consulting Ltd, on behalf of Towerhill Developments Inc., dated October 13, 2017.
- "Millbrook Subdivision, Fallis Line and Country Road 10, Millbrook, Ontario, Towerhill Development Inc., Natural Channel Design: Channel Realignment Design Brief", prepared by Water's Edge Environmental Solutions Team Ltd., dated July 26, 2017.
- Meeting with Dillon Consulting Inc., confirming habitat characteristics and barriers to fish passage, on January 17, 2018

We understand that you propose to infill an existing tributary to Baxter Creek near Millbrook, ON and replace it with a newly constructed channel located south of the original. Works will include:

- removal of vegetation for equipment staging and operation;
- infilling 2,470m² of a tributary; and
- constructing 12,896m² of a new, naturalized channel.

Provided that the mitigation measures outlined in the above stated documents are incorporated into your plans, the Program is of the view that your proposal will not result in serious harm to fish. No formal approval is required from the Program under the *Fisheries Act* in order to proceed with your proposal.

If your plans have changed or if the description of your proposal is incomplete, or changes in the future, you should consult our website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html) or consult with a qualified environmental consultant to determine if further review is required by the Program.

Please notify this office at least 10 days before starting your project. A copy of this letter should be kept on site while the work is in progress.

If you have any questions, please contact Brett Ellis at (780) 495-2959, or by email at brett.ellis@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

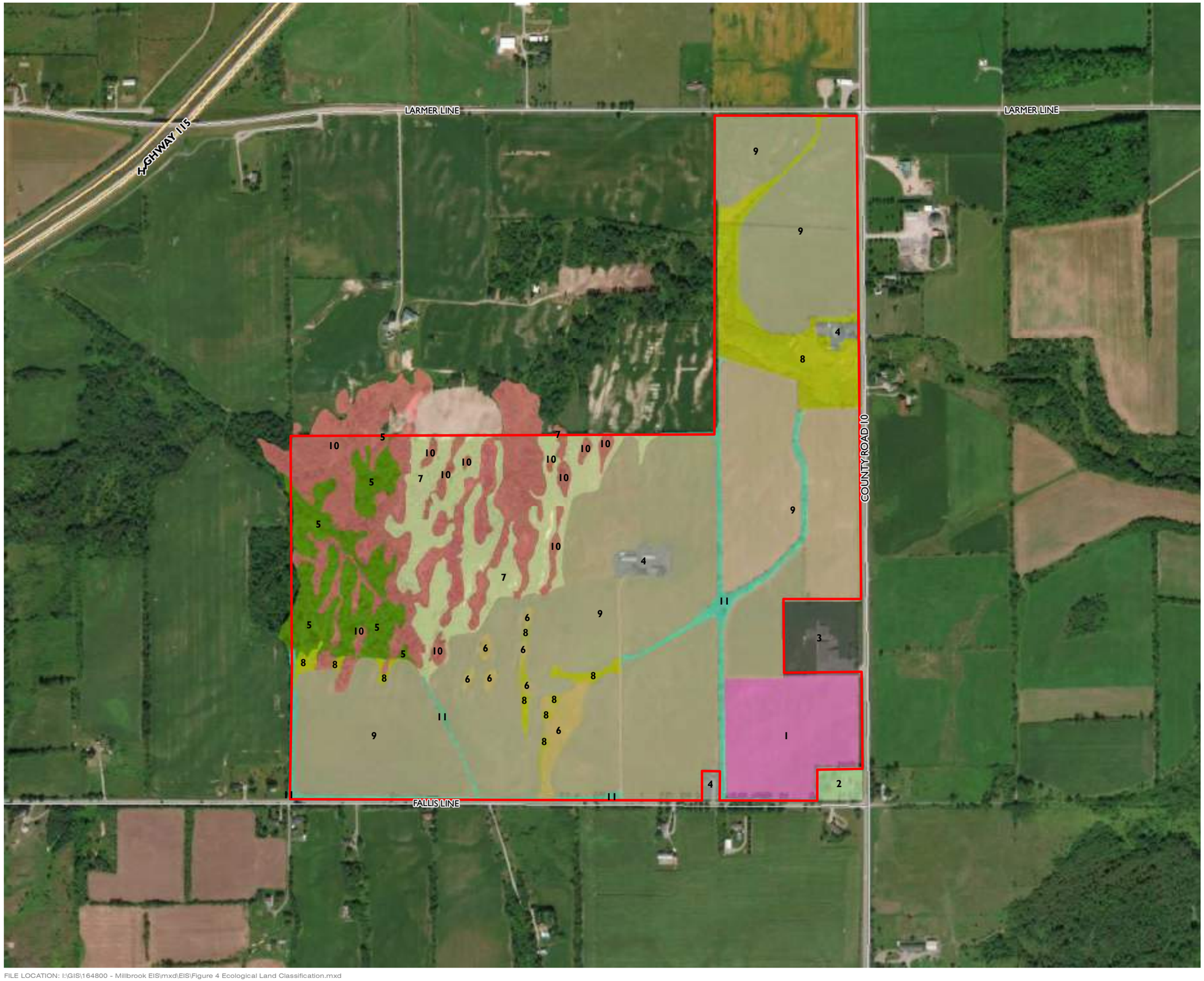
Yours sincerely,

Jason Shpeley
A/Senior Fisheries Biologist
Fisheries Protection Program
Fisheries and Oceans Canada

cc. Allen Benson, Dillon Consulting Ltd.
Whitney Moore, Dillon Consulting Ltd.
Brett Ellis, Fisheries and Oceans Canada

Attachment G:

Ecological Land Classification



MILLBROOK
EIS

FIGURE 4
ECOLOGICAL LAND CLASSIFICATION

Property Boundary

Ecological Land Classification

1. Cleared Land
2. CGL: Greenlands (Cemetery)
3. CVI_3: Transportation and Utilities
4. CVR_4: Rural Residential Property
5. FODM6-5: Dry-Fresh Sugar Maple-Hardwood Deciduous Forest
6. MAMM1-2: Cattail Mineral Meadow Marsh
7. MEMM3: Dry-Fresh Mixed Meadow
8. MEMM4: Fresh-Moist Mixed Meadow
9. OAGM1: Annual Row Crop
10. SWDM4: Mineral Deciduous Swamp
11. TAGM5: Fencerow/Riparian

1:7,500

0 100 200 400 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF, TOWNSHIP OF CAVAN MONAGHAN

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 164800
STATUS: DRAFT
DATE: 2017-10-19

FILE LOCATION: I:\GIS\164800 - Millbrook EIS\mxd\EIS\Figure 4 Ecological Land Classification.mxd

ELC Code	Classification	Vegetation
FODM6-5	Fresh - Moist Sugar Maple Hardwood Forest	The canopy and sub-canopy consists of Sugar Maple (*Acer saccharum*), American Basswood (*Tilia americana*) and American Beech (*Fagus grandifolia*). Shrub species present include Common Buckthorn (*Rhamnus cathartica*), Choke Cherry (*Prunus virginiana*), Alternate-leaved Dogwood (*Cornus alternifolia*) and Purple-flowering Raspberry (*Rubus odoratus*). Herbaceous species include Blue Cohosh (*Caulophyllum thalictroides*), Virginia Creeper (*Parthenocissus quinquefolia*), Enchanter's Nightshade (*Circaea canadensis*) and Ostrich Fern (*Matteuccia struthiopteris*).
SWDM4	Mineral Deciduous Swamp	The canopy and sub-canopy consists predominantly of Freeman's Maple (*Acer × freemannii*) and Trembling Aspen (*Populus tremuloides*) with occasional American Elm (*Ulmus americana*), Green Ash (*Fraxinus pennsylvanica*) and Yellow Birch (*Betula alleghaniensis*). Willows (Salix spp.) and Red-osier Dogwood (*Cornus sericea ssp. sericea*) are the most common species in the shrub layer. Herbaceous species present consist of Spotted Jewelweed (*Impatiens capensis*), Sensitive Fern (*Onoclea sensibilis*), Rice Cutgrass (*Leersia oryzoides*), Bittersweet Nightshade (*Solanum dulcamara*) and Yellow Marsh Marigold (*Altha palustris*).
MAMM1-2	Cattail Mineral Meadow Marsh	The community contains a few Freeman's Maples and American Basswoods at the canopy level, and woody shrubs including Buckthorn, Pussy Willow (*Salix discolor*) and White Meadowsweet (*Spiraea alba*). The ground layer included terrestrial plants such as Swamp Milkweed (*Asclepias incarnate*) and Blue Vervain (*Verbena hastata*) as well as emergent aquatic plants including Broad-leaved Cattail (*Typha latifolia*), American Burreed (*Sparganium americanum*) and Northern Water-plantain (*Alisma triviale*) at the perimeter of open water ponds.
MEMM4	Fresh-Moist Mixed Meadow	Ground cover consisted primarily of Common Timothy grass (*Phleum pratensis*), Garden Bird's-foot Trefoil (*Lotus corniculatus*) and Cow Vetch (*Vicia cracca*) with Awnless Brome (Bromus inermis), Orchard Grass (*Dactylis glomerata*) and Reed Canary Grass (*Phalaris arundinacea*) associates. Woody vegetation is uncommon in this community, but includes young Black Walnut (*Juglans nigra*), Eastern Redcedar (*Juniperus occidentalis*), Common Buckthorn and Staghorn Sumac (*Rhus typhina*).
MEMM3	Dry-Fresh Mixed Meadow	Scattered Scott's Pine (*Pinus sylvestris*) as well as occasional Common Apple (*Malus pumila*) and Common Buckthorn occur in this mostly open/herbaceous ecosite. The predominant groundcover vegetation is Awnless Brome with Canada Goldenrod (*Solidago canadensis ssp. canadensis*) and Garden Bird's-foot Trefoil also common.
TAGM5	Hedgerow	These narrow strips of vegetation between agricultural field consisted mainly of Common Buckthorn, Staghorn Sumac and Manitoba Maple, with Riverbank Grape (*Vitis riparia*) and Virginia creeper (*Parthenocissus quinquefolia*) climbing underneath the canopy
OAGM1	Annual Row Crop	Cultivated fields
CVR_4	Rural Residential	N/A

Appendix F

Headwater Drainage Features Assessment

To: Paul Finigan, Otonabee Region Conservation Authority

From: Whitney Moore, Dillon Consulting Limited

cc: Nicole Sgrignuoli, Towerhill Development Ltd.

Jennifer Clinesmith, Otonabee Region Conservation Authority

Date: August 28, 2020

Subject: Towerhill North Headwater Drainage Features Assessment

Our File: 16-4800

Introduction

Dillon Consulting Limited (Dillon) was retained by Towerhill North Developments Inc. in order to complete an assessment of a mapped tributary, referred to as "Tributary B", in support of a proposed development referred to as Towerhill North located at Fallis Line and County Road 10 in the Township of Cavan- Monaghan (The Township), County of Peterborough.

Tributary B is a mapped watercourse in the Township OP and other provincial mapping layers, but exists as a farm ditch with little to no flow throughout the year. As a result, Dillon completed a very high level aquatic assessment as part of the field program and submitted a Request for Review to Fisheries and Oceans Canada (DFO) for realignment of the tributary into a naturalized channel providing both conveyance of flow as well as corridor of aquatic and terrestrial habitat, separating existing woodland and wetland features to the west from the proposed development.

Information on the tributary had been provided to the Otonabee Region Conservation Authority (ORCA) via several memos and comment responses throughout the past several years. Since this was a mapped feature, a Headwater Drainage Features Assessment (HDFA) was not initially conducted to assess the tributary (headwaters are zero or first order streams). At the request of ORCA, on additional assessment was completed in May of 2018 following the HDFA rapid method, to capture information in accordance with Ontario Stream Assessment Protocol Section 4, Module 10 (MNRF, 2017) and the Evaluation, Classification and Management of Headwater Drainage Features (TRCA & CVC 2014).

During the last project team meeting held at the Township Office on October 30 2019, ORCA had requested that Dillon provide a comprehensive assessment of the stream from an HFDA perspective, in order to justify moving the feature as is currently proposed.

Since that time, a second round of consultation was completed with ORCA and the Township where it was requested that additional data be collected on fish, benthic invertebrates, and water temperature to support the EIS and the proposal to realign Tributary B.

We have prepared this HDFA using the data that has been collected on the watercourse to date to provide ORCA with further justification for the realignment of Tributary B to move forward with draft plan approval for the proposed development and permitting under the Ontario Regulation 167/06.

Evaluation

Methodology

Tributary B was assessed several times throughout the life of the project; including an initial site visit by Dillon in October 2016, followed by RSAT assessments conducted by Waters Edge in May, 2017 and an aquatic site visit by Dillon in June 2017. At that time it was determined that due to the ephemeral/ intermittent nature of the feature, the pooling of water observed in June after a rain event, and the dry conditions observed in October, there would not likely be flow present in July or August to necessitate another assessment. However, based on subsequent comments received from ORCA in 2018, a confirmatory HDFA (one site visit) was conducted by Dillon on in accordance to OSAP Module S4.M10 (Rapid Assessment). In addition, after further consultation with ORCA in 2019 and 2020, additional site visits were conducted in 2020 to sample for benthic macroinvertebrates, confirm presence absence of flow through the month of June 2020 during various weather events, and collect temperature data through installation of temperature loggers. It should be noted that fish community sampling was also requested, however, by the time the Licence to Collect Fish was obtained from the Ministry of Natural Resources and Forestry (August 7, 2020), Tributary B did not contain enough water (only limited pooled water upstream), so electrofishing was not possible. The dates and methods of these site visits are described below. Please refer to the Channel Brief by Waters Edge previously provided under separate cover for more information on the RSAT assessment.

Table 1: Aquatic Assessment Dates

Date	Consultant	Assessment	Protocol
October 15, 2016	Dillon	Preliminary Site Visit	N/A
May 25, 2017	Waters Edge	Stream Assessment	RSAT
June 20, 2017	Dillon	Aquatic Assessment	OSAP
May 9, 2018	Dillon	Headwater Drainage Features Assessment	OSAP S4.M10
June 12, 2020	Dillon	Flow check, Rapid Macroinvertebrate Assessment	N/A, OSAP S2.M1
June 19, 2020	Dillon	Flow check	N/A
June 23, 2020	Dillon	Flow check	N/A
July 6, 2020	Dillon	Installation of temperature loggers	OSAP S5.M2
August 6, 2020	Dillon	Retrieval of temperature loggers	OSAP S5.M2

During the preliminary site visit conducted on October 15, 2016, two Dillon biologists walked Tributary B to determine hydroperiod, potential groundwater inputs, habitat, channel modifiers, etc.

The Rapid Stream Assessment Technique (RSAT) was conducted by Water's Edge to evaluate the existing channel conditions for Tributary B. A figure providing the locations of survey stations for channel morphology assessments conducted by Water's Edge has been provided in **Attachment A**. While Waters

Edge does not specify which OSAP module was used during their assessment, a total of 20 cross-sections positioned throughout the existing channel of Tributary B were surveyed in 2017.

The second aquatic survey was completed by Dillon in June of 2017 to determine if flows were present during baseflow periods (summer). During the site visit a high level stream assessment was completed in order to collect information on flow, potential for fish, and water temperature. Sampling locations WC-3-WC-4 are shown on the figure in **Attachment B**.

During the benthic assessment, the rapid macroinvertebrate collection method was used following S2.M1 of the OSAP Manual (2017) in order to determine if large-bodied macroinvertebrates are present that are known to be sensitive to water quality, and used as a coarse indicator of water quality conditions. In accordance with the protocol, sampling procedures require holding a dip net to the substrate and kicking up the substrate in a 1 m^2 area upstream to dislodge invertebrates and collecting them in the net. While this protocol followed to the extent possible, due to the lack of water (and flow) present within Tributary B, the Dillon biologist kicked three areas that contained standing water within the upstream portion of the tributary only, in an effort to collect as much data as possible given the conditions at the time of sampling.

Two additional site visits were conducted in the month of June, one 48 hours after a large rain event, and one during a rain event, to determine if there would be flow present within Tributary B.
Lastly, temperature loggers were installed both within the tributary and adjacent (to collect air measurements), and remained in place for a full month to record a range of water temperatures throughout the hottest, driest period of the summer in accordance with OSAP S5.M2.

All of the sampling locations are included in Figure 1 of **Attachment B**.

Results

Hydrology

Tributary B originates within a meadow marsh area within a low spot in the agricultural field that contains dense forbs and grasses and no defined channel was identified. This area was confirmed through ELC in the summer as Cattail Mineral Meadow Marsh (MAMM1-2) (Figure 2, **Attachment B**). It should be noted that most of this this low-lying wetland area has since been removed by the municipality as part of a grading project (with the exception of the Tributary B area which remains). As Tributary B passes under the farm driveway to the east, it is constricted by a culvert that has almost completely collapsed and is surrounded by large boulders and boards presenting a barrier to potential fish passage and effective flow (see Photos 3 and 4 of **Attachment C**). As Tributary B continues northeast, it becomes more defined and channelized (straightened) through the agricultural field before entering a treed fencerow lined with boulders placed by the (previous) farmer. The tributary continues northeast, where it crosses a farm laneway with a partially plugged culvert; another barrier to potential fish movement and flow within the tributary, before entering a wooded area and finally an open meadow where it outlets into Tributary C. It was noted that during site visits that the bank of Tributary C

is quite steep with a large drop pf approximately 1 m at its confluence with Tributary B, creating a barrier for fish to pass upstream into Tributary B through the dense grass during low flow.

During the first site visit in October 2016, it was expected that water would have been present if fed by groundwater (cold water) sources; however the entire length of Tributary B was dry and no defined channel was observed in the upstream portion. During the same site visit in October, Tributary C was also dry from the western property boundary, to downstream of its confluence with Tributary B. Downstream of the confluence with Tributary B, Tributary C contained substantial flow near the bridge at County Road 10, likely fed by groundwater sources within the wetland area immediately adjacent to County Road 10, flowing east. Refer to Photos 15-18 of **Attachment C**.

Through their assessment in May of 2017, Water's Edge determined the total RSAT score for the watercourse to be 25.93, with an overall ranking of "Fair." Low flow was observed throughout the channel during the assessment, and the stream temperature of Tributary B was assessed to be between 24 - 27 ^{o}C. Measurements for the bankful width and depth for these survey stations are provided in Tables 4.3 and 4.4 of the Natural Channel Design: Channel Realignment Brief submitted by Water's Edge on July 26, 2017. In the Brief, the channel was assessed through aerial photographs to be approximately 908 m long from the headwaters to the downstream confluence. The average channel width of Tributary B was calculated to be 2.72 m.

The summer of 2017 was exceptionally wet, receiving a greater than average amount of rainfall, with rainfall often occurring over several consecutive days throughout the summer. However, During Dillon's June 2017 site visit, Tributary B was described as channelized and having ephemeral and intermittent flow with pooling after a rain event in June and potential tile drain inputs from agricultural lands. It should be noted that 11.9 mm of rainfall was recoded at the Peterborough Airport on June 20; following sporadic rain events on several days leading up to the site visit, and this was evidenced by pooled water within the agricultural fields. During the spot checks in June 2020, low flow was observed within sections of the downstream reaches 48 hours after a large rain event (20+ mm) but water did not reach Tributary C since flow was observed to dissipate prior to the confluence downstream. Standing water was present in the upstream reach, west of the collapsed culvert. During a rain event, standing water was present in the upstream reach but the downstream reaches were dry with areas of wetted substrate. No water was present within Tributary B after a week of dry weather.

Thermal Regime

In June 2017, the water temperature within Tributary B was recorded as 25^{o}C within pooled areas but little to no flow was observed (see point WC-3 in Figure 1 of **Attachment B**). At the second survey point further downstream within the shaded woodland section, WC-4 as noted on Figure 1 of **Attachment B**, flow was observed the temperature within this portion of the tributary was recorded at 18^{o}C. The temperatures recorded in the summer season are consistent with data previously recorded in spring during the RSAT assessment.

Three points in total were sampled in 2020 using temperature loggers; one upstream, one downstream, and one within Tributary C as a comparison point. It should be noted, that the downstream portion of

Tributary B was dry for the entire monitoring period, and so the data recorded does not reflect water temperature, but temperature at substrate level; and has therefore, not been considered in the data analysis.

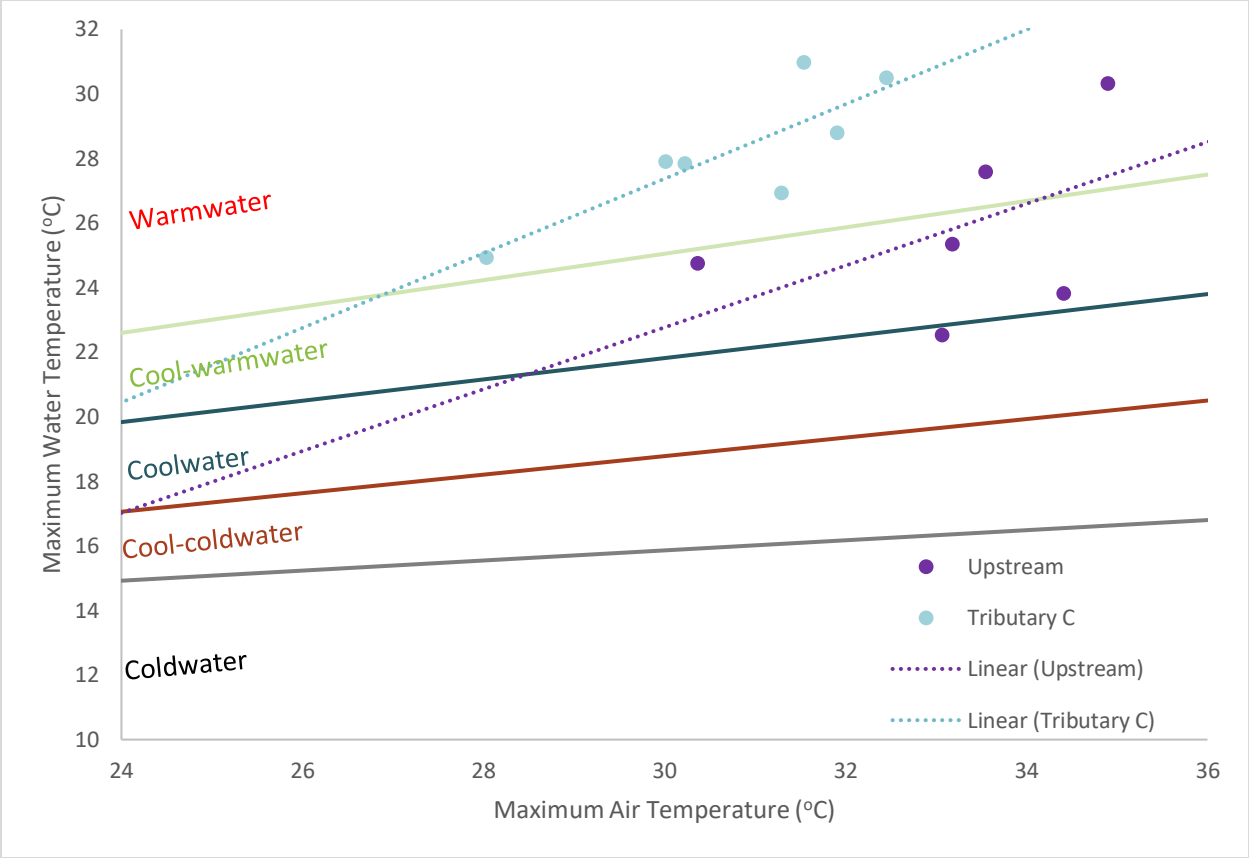
The data collected from the temperature loggers in 2020 was reviewed, and as per the OSAP protocol, all of the days within the sampling period that had a maximum air temperature of ≥ 24.5°C and that had experienced no precipitation for the previous 48 hours were considered, which included July 6-10 and July 25-26, 2020. For each of these days, the maximum air temperature and water temperature average between 16:00 hrs and 10:00 hrs were pulled into **Table 2**, below, in accordance with the applicable protocols.

Table 2: Temperature Logger Data

Date 2020	Tributary B Upstream		*Tributary B Downstream**		Tributary C (for comparison purposes)	
	Max. Air Temp °C	Avg. Water Temp °C b/w 1600-1800 hr	*Max. Air Temp °C*	*Avg. Water Temp °C b/w 1600-1800 hr*	Max. Air Temp °C	Avg. Water Temp °C b/w 1600-1800 hr
July 6	33.07	22.54	29.04	22.32	30.01	27.91
July 7	34.41	23.81	32.41	23.36	31.91	28.80
July 8	33.18	25.34	30.47	22.98	30.23	27.85
July 9	36.19	29.60	32.81	24.01	32.45	30.51
July 10	34.90	30.31	31.49	24.10	31.54	30.98
July 25	30.37	24.75	28.50	20.48	28.04	24.92
July 26	33.55	27.59	32.35	21.85	31.30	26.94
Average	**33.66**	**26.27**	***31.01***	***22.73***	**30.78**	**28.27**

**The entire downstream reach of Tributary B was dry throughout the monitoring period. As a result, the temperatures recorded do not accurately reflect water temperature, but the air temperature at the substrate levels*

The OSAP Manual defines thermal regime of watercourses using an algorithm based on air temperature. Using the data extracted to **Table 2**, a scatter plot was created to show the distribution of data and then compared to the thermal regime nomogram first created by Stoneman and Jones (1996) and adapted by Chu *et al*. (2009) and used in the OSAP manual.



Inset 1: Thermal Regime within Tributary B- Upstream

Based on the trend in data shown above, the thermal regime in Tributary B falls within the "Cool-Warmwater" zone (warmwater in accordance with Stoneman and Jones [1996]); while Tributary C fall siwthin the "Warmwater Zone". The results for Tributary B were expected based on the results of the previous data collected on site between 2016 and 2018. The results for Tributary C, however, were somewhat surprising as Baxter Creek is described as a cold water system; but reflects observations we have recorded within Tributary C, that has been dry during certain periods of the year.

Benthic Invertebrate Sampling

In accordance with the protocol, organisms should be picked from sampling trays until at least 100 individuals were obtained for each replicate or the entire sample is to be processed. Since only 36 individual organisms were collected from Tributary B in total, all were identified to the major taxonomic groups (see **Table 3**). Since replicates were not taken as this was a high level assessment, although 110 organisms were picked from Tributary C for comparison purposes, all were identified, as detailed in **Table 3**.

Table 3: Benthic Macroinvertebrate Data

Family	Taxa	Number Identified in Field	Ranking	Water Quality	Degree of Organic Pollution	Total	Average Tolerance Level
Tributary B							
Snails	Gastropoda	26	8	Very Poor	Severe Organic Pollution Likely	208	
Other True Flies	Misc. Diptera	3	5	Good	Some Organic Pollution Probable	15	
Fishflies	Megaloptera	1	4	Very Good	Possible Slight Organic Pollution	4	
Molluscs (Clams)	Bivalvia	1	8	Very Poor	Severe Organic Pollution Likely	8	
Aquatic Mites	Acari	3	4	Very Good	Possible Slight Organic Pollution	12	
Sow Bugs	Isopoda	1	8	Very Poor	Severe Organic Pollution Likely	8	
Beetles	Coleoptera	1	4	Very Good	Possible Slight Organic Pollution	4	
Total		**36**				**259**	**7.19**
Tributary C							
Snails	Gastropoda	10	8	Very Poor	Severe Organic Pollution Likely	80	
Other True Flies	Misc. Diptera	2	5	Good	Some Organic Pollution Probable	10	
Horseflies	Tabinidae	1	6	Fairly Poor	Substantial pollution likely	6	
No-see-ums	Ceratopogonidae	3	6	Fairly Poor	Substantial pollution likely	18	
Molluscs (Clams)	Bivalvia	5	8	Very Poor	Severe Organic Pollution Likely	40	
Mayflies	Ephemeroptera	9	5	Good	Some Organic Pollution Probable	45	
Segmented Worms	Oliochaeta	1	8	Very Poor	Severe Organic Pollution Likely	8	
Caddisflies	Trichoptera	19	4	Very Good	Possible Slight Organic Pollution	76	
Midges	Chironimidae	24	7	Poor	Very Substantial Pollution Likely	168	
Beetles	Coleptera	16	4	Very Good	Possible Slight Organic Pollution	64	
Stoneflies	Plecoptera	17	1	Very Poor	Severe Organic Pollution Likely	17	
Roundworms	Nemata	3	N/A	Very Poor	Severe Organic Pollution Likely	N/A	
Total		**110**				**532**	**4.83**

The tolerance index, or Biotic Index (BI), was developed by Hilsenhoff (Hilsenhoff, 1988) to summarize the various tolerances of the benthic arthropod community with a single value. Tolerance values (Rank) range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes for Tolerance values range from 0 to 10 (i.e. rank increases as water quality decreases). The Modified Family Biotic Index (FBI) was later developed to detect organic pollution and is based on the original species-level index (BI) of Hilsenhoff, 1998, and to be used as a rapid analysis method. The specimens collected within both Tributary B and C were analyzed to the family level, in accordance with OSAP S2.M1, and the rankings were determined based on a combination of (Mandaville, 2002) and those adapted for southern Ontario by Kilgour and Stanfield in 2006.

The average tolerance level within Tributary B was 7.19, indicating "Poor" water quality and very substantial pollution likely; acknowledging that only a small pool of water was present for sampling within Tributary B. However, this would be reflective of agricultural drains and streams that would receive a significant amount of organic pollution through surface runoff. The average tolerance level within Tributary C was 4.83, indicating "Good" water quality, evidenced by sensitive species including Plecoptera (Stoneflies).

Although water quality is not measured value for the purposes of an HDFA, the presence of invertebrates within Tributary B does assist with confirming the hydrology classification of the tributary (i.e., ephemeral vs. intermittent). As per the HDFA guidelines, intermittent features contain extended contribution from wetlands and are typically still flowing in late spring but dry or surface damp by July and there may be some sorting and channel form. Invertebrates can be used to assist in determining hydroperiod, including presence of damselfly nymphs, clams, and scuds and absence of caddisfly larvae, Mayfly nymphs, stonefly nymphs, black flies, etc. in summer (TRCA & CVC, 2014). In contrast, invertebrates within ephemeral features include presence of worms and leaches in the absence of the intermittent indicators or contain no aquatic macroinvertebrates. This suggests that Tributary B should be classified as Intermittent.

Fish Habitat

Information received from ORCA indicated that wetlands upstream to the north and west of the property contain fish habitat, and therefore Tributary C would function to convey flows from those upstream wetlands to downstream reaches and provide direct fish habitat for part of the year. It was noted that during site visits that the bank of Tributary C is quite steep at its confluence with Tributary B creating a barrier for fish to pass upstream into Tributary B through the dense grass during low flow. Based on this, Tributary B may contain seasonal fish habitat downstream during high water periods (i.e., spring freshet) however, the tributary is dry for the most of the year. Furthermore, barriers present throughout the tributary prevent effective passage of fish upstream, and therefore, the primary function of Tributary B is likely contribution of allochthonous flows to downstream reaches. Furthermore, consultation with DFO suggested that these barriers, specifically the steep drop down to Tributary C, present a danger to fish of getting trapped within Tributary B during high water and having no way of escaping back into the downstream system.

Classification

For the purposes of this assessment we have broken down the tributary into segments based on physical modifiers within the channel (culverts, flow change, vegetation change, substrate charge, etc.), but have grouped as one tributary for the overall analysis. Refer to Table D-1 of **Attachment D** for the data table. Please note that this only includes data from the May 9, 018 site visit, following the HDFA protocol.

Segment B-1

Segment B-1 is the most upstream reach of Tributary B. It originates within a low-lying wetland area within an agricultural field. This portion of the tributary collects flow from spring melt and rain events, but does not appear to convey flow at any point during the year. Although there is no defined channel within Segment B-1, it would be classified as Intermittent, based on the pooled water noted throughout the summer season and the presence of aquatic macroinvertebrates. At the downstream end of Segment B-1 there is a crushed in culvert under the driveway through which water could be conveyed to downstream reaches of Tributary B during high water; however due to the condition of the culvert and the position (perched well above the level of Segment B-1), flow is not likely conveyed through the culvert. It more likely that flows are captured within Segments B-1 and B-2 as a result of topography of the site (sheet flow).

Segment B-2

Segment B-2 originates at the crushed in culvert beneath the driveway and flows northeast across the agricultural field. Although no substrates were visible within this segment, a channel was present. During site visits no flow was observed in this segment, only pooling of water after rain events. This segment primarily collects sheet flow from the adjacent fields and coveys it downstream during spring melt. Vegetation present within the segment was meadow with a few sparse shrubs and cattails.

Segment B-3

Segment B-3 begins where the vegetation transitions from meadow to treed fencerow along the tributary. Segment B-3 continues northeast and contained minimal flow during site visits. Furthermore, Segment B-3 was well defined, and contained damp substrates during other site visits, with evidence of channel sorting and sediment transport. The function of this channel has been enhanced through historic placement of field stone (boulders) along its banks which have since naturalized with meadow vegetation creating artificial banks along its length. Little vegetation was observed along the stream bed, and the presence of cobble was noted (stones picked from field and thrown into channel over the years). Segment B-3 ends where it meets a plugged culvert at a farm laneway.

Segment B-4

Segment B-4 originates at the partially plugged culvert entering into a woodland. The channel is well defined here with mud substrate and cobble. Flow was observed here during spring and early summer site visits, but not into mid-late summer or during the fall. Damp substrates were observed through

summer and into fall. The tributary exits the woodland and flows across a dense meadow where it enters into Tributary C at a steep drop of about 1 m.

Management Recommendations

In accordance with the observations noted above and detailed in Table D-2 of **Attachment D**, the following classifications are applicable to Tributary B:

Hydrology

Valued Functions – Intermittent: Water is present in the spring as a result of seasonally high groundwater discharge or seasonally extended contributions from wetlands or other areas that support intermittent flow or water storage conditions. These features are typically still flowing in late spring but dry or surface-damp by July. There may be some substrate sorting and channel form. Invertebrates can be used to assist in determining hydroperiod, including presence of damselfly nymphs, clams, and scuds and absence of caddisfly larvae, Mayfly nymphs, stonefly nymphs, black flies etc. in summer.

Riparian habitat

Important Functions (Segment B4) – the feature type is wetland and/or any of the riparian corridor categories (0-1.5 m, 1.5-10 m, or 10-30 m on either side of the feature) is dominated by forest or thicket/scrubland communities or wetland.

Valued Functions (Segment B1-3) – any of the riparian corridor categories (0-1.5 m, 1.5-10 m, or 10-30 m on either side of the feature) is dominated by meadow and there are no important riparian functions.

Fish and Fish habitat

Contributing Functions (all) – Contributing fish habitat. Transport of allochthonous materials (detritus, insects, etc.) to downstream fish-bearing reaches provides sources of food.

Terrestrial habitat

Limited Functions (Segment B1-3) – No terrestrial habitat present.

Valued Functions (Segment B4) – General amphibian habitat: stepping stone habitat (stop over to higher quality habitat) or suitable for feeding or hydration for low mobility wildlife (i.e. amphibians). Wetland habitat occurs within the corridor, but no breeding amphibians are present.

Management Recommendations

In accordance with Figure 2 of the Evaluation, Classification and Management of Headwater Drainage Features (TRCA & CVC, 2014). Segments B-1 to B-3 have received a management recommendation of Mitigation, described as follows:

Mitigation – Contributing Functions: e.g. contributing fish habitat with meadow vegetation or limited cover

- Replicate or enhance functions through enhanced lot level conveyance measures, such as well-vegetated swales (herbaceous, shrub and tree material) to mimic online wet vegetation pockets, or replicate through constructed wetland features connected to downstream;
- Replicate on-site flow and outlet flows at the top end of system to maintain feature functions with vegetated swales, bioswales, etc. If catchment drainage has been previously removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e. restore original catchment using clean roof drainage);
- Replicate functions by lot level conveyance measures (e.g. vegetated swales) connected to the natural heritage system, as feasible and/or Low Impact Development (LID) stormwater options (refer to Conservation Authority Water Management Guidelines for details);

Due to the riparian cover adjacent to Segment B-4, it has received a management recommendation of Conservation, as described below:

Conservation – Valued Functions: e.g. seasonal fish habitat with woody riparian cover; marshes with amphibian breeding habitat; or general amphibian habitat with woody riparian cover.

- Maintain, relocate, and/or enhance drainage feature and its riparian zone corridor;
- If catchment drainage has been previously removed or will be removed due to diversion of stormwater flows, restore lost functions through enhanced lot level controls (i.e. restore original catchment using clean roof drainage), as feasible;
- Maintain or replace on-site flows using mitigation measures and/or wetland creation, if necessary;
- Maintain or replace external flows,
- Use natural channel design techniques to maintain or enhance overall productivity of the reach;
- Drainage feature must connect to downstream.

Discussion

The subject lands are designated as Urban Settlement, containing areas specifically designated for residential, institutional and urban employment areas within the Township OP. An assessment of alternatives was considered, and it was determined that development would be severely hindered, and likely not feasible, if Tributary B is to remain in-situ. Such a situation would therefore conflict with Planning policies and goals for development, at all levels, which promote appropriate growth, efficient use of land, and efficient use of municipal infrastructure within urban Settlement Areas. In accordance with the management recommendations above, the client is proposing to realign Segments B-1 – B-3 of Tributary B, while conserving Segment B-4, in order to make development of the property possible.

In its current state, Tributary B contains standing water for the majority of its length, contains two barriers to flow and fish movement (crushed in culverts) and contains little riparian vegetation. As a result, nutrient inputs from adjacent agricultural use and warming of pooled waters within the tributary pose in impact to downstream watercourses which are designated as cold water systems. As a result, this should not be considered vulnerable or sensitive surface water or groundwater feature. In addition,

Further, realignment of the tributary will be of ecological and hydrological benefit; providing effective conveyance of flow downstream. In addition, a 30 m buffer of naturalized plantings has been included in plans for the proposed realignment. The buffer would be considered an enhancement in comparison to the existing riparian cover of Tributary B and would provide additional habitat. Lastly, the realignment and buffer would provide added protection to the existing core wetland boundary located northwest of the property.

References

Chu. *et. al*. 2009. Evaluation of a Simple Method to Classify the Thermal Characteristics of Streams Using a Nomogram of Daily Maximum Air and Water Temperatures. North American Journal of Fisheries Management. 29:1605-1619.

L. Stanfield and B. Kilgour. 2006. Effects of Percent Impervious Cover on Fish and Benthos Assemblages and Instream Habitats in Lake Ontario Tributaries. American Fisheries Society Symposium. 48:577-599.

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S. M. Mandaville. 2002. Benthic Macroinvertebrates in Freshwaters- Taxa Tolerance Values, Metrics, and Protocols. Soil & Water Conservation Society of Metro Halifax.

Stoneman and Jones. 1996. A Simple Method to Classify Stream Thermal Stability with Single Observation of Daily Maximum Water and Air Temperatures. North American Journal of Fisheries Management. 16:4, 728-737.

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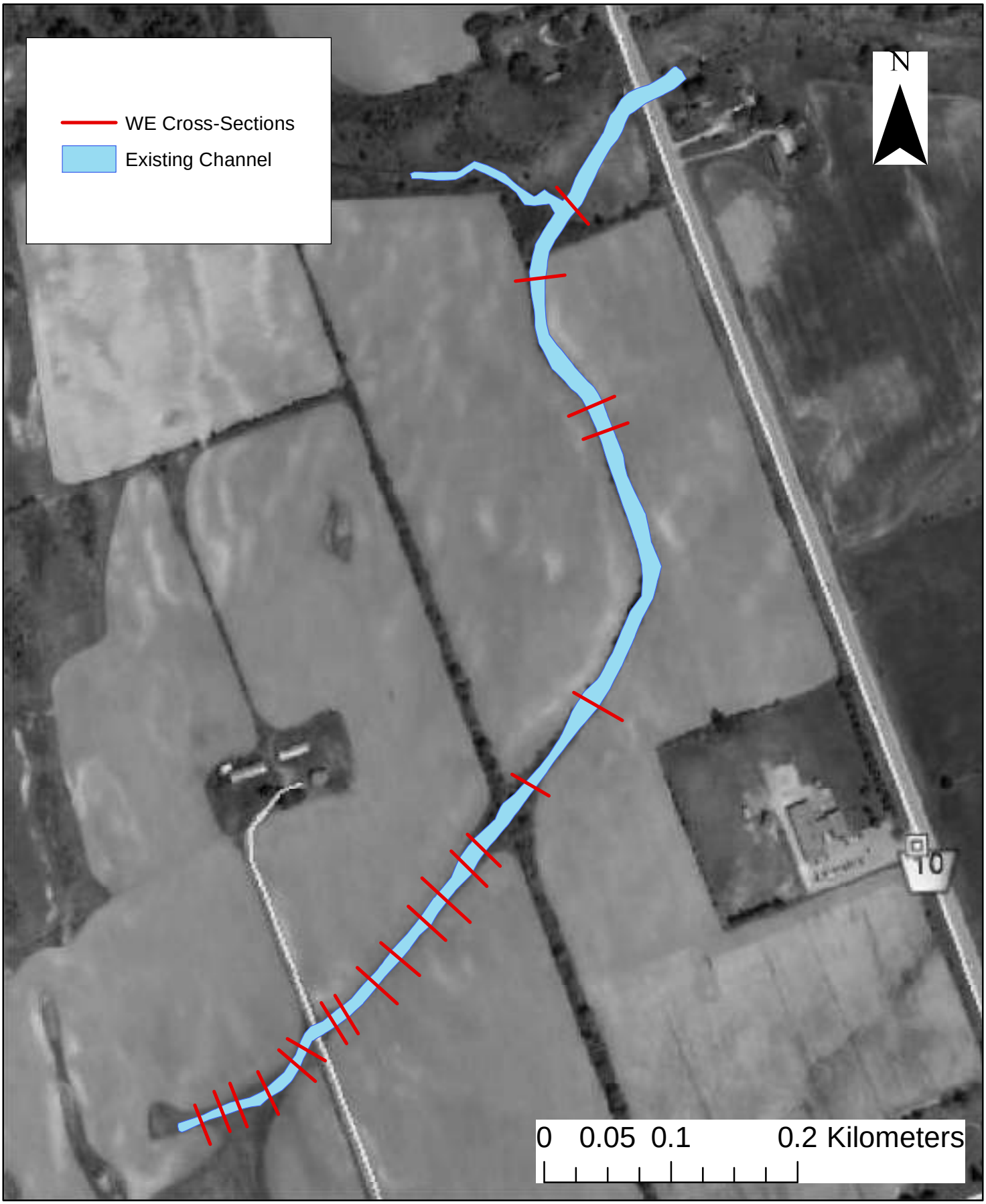
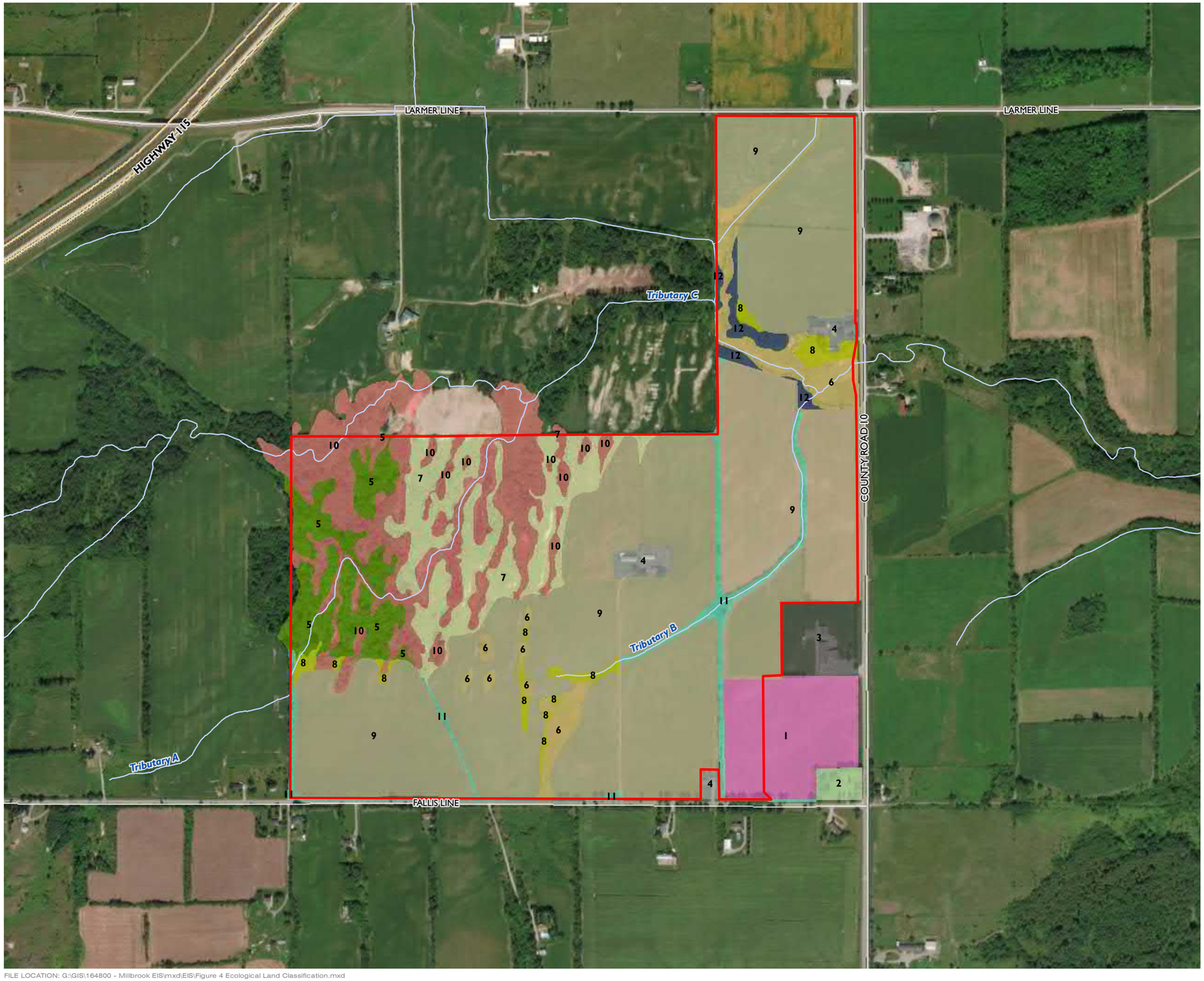
Attachment A: Waters Edge Figure



water's edge
ENVIRONMENTAL SOLUTIONS TEAM

Millbrook Subdivision Phase 2 Millbrook, Ontario		Map No.: 3	Date: May. 19, 2017
Water's Edge Cross-Sections Geomorphic Cross-Section Analysis		Checked By: EG	Drawn By: EHG

Attachment B: Ecological Land Classification and Sampling Locations



MILLBROOK

Figure 1
ECOLOGICAL LAND CLASSIFICATION

Study Area
Water Body

Ecological Land Classification

1. Cleared Land
2. CGL: Greenlands (Cemetery)
3. CVI_3: Transportation and Utilities
4. CVR_4: Rural Residential Property
5. FODM6-5: Dry-Fresh Sugar Maple-Hardwood Deciduous Forest
6. MAMM1-2: Cattail Mineral Meadow Marsh
7. MEMM3: Dry-Fresh Mixed Meadow
8. MEMM4: Fresh-Moist Mixed Meadow
9. OAGM1: Annual Row Crop
10. SWDM4: Mineral Deciduous Swamp
11. TAGM5: Fencerow/Riparian
12. THDM5: Fresh-Moist Deciduous Thicket Ecosite

1:7,500

0 100 200 400 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF, TOWNSHIP OF CAVAN MONAGHAN

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

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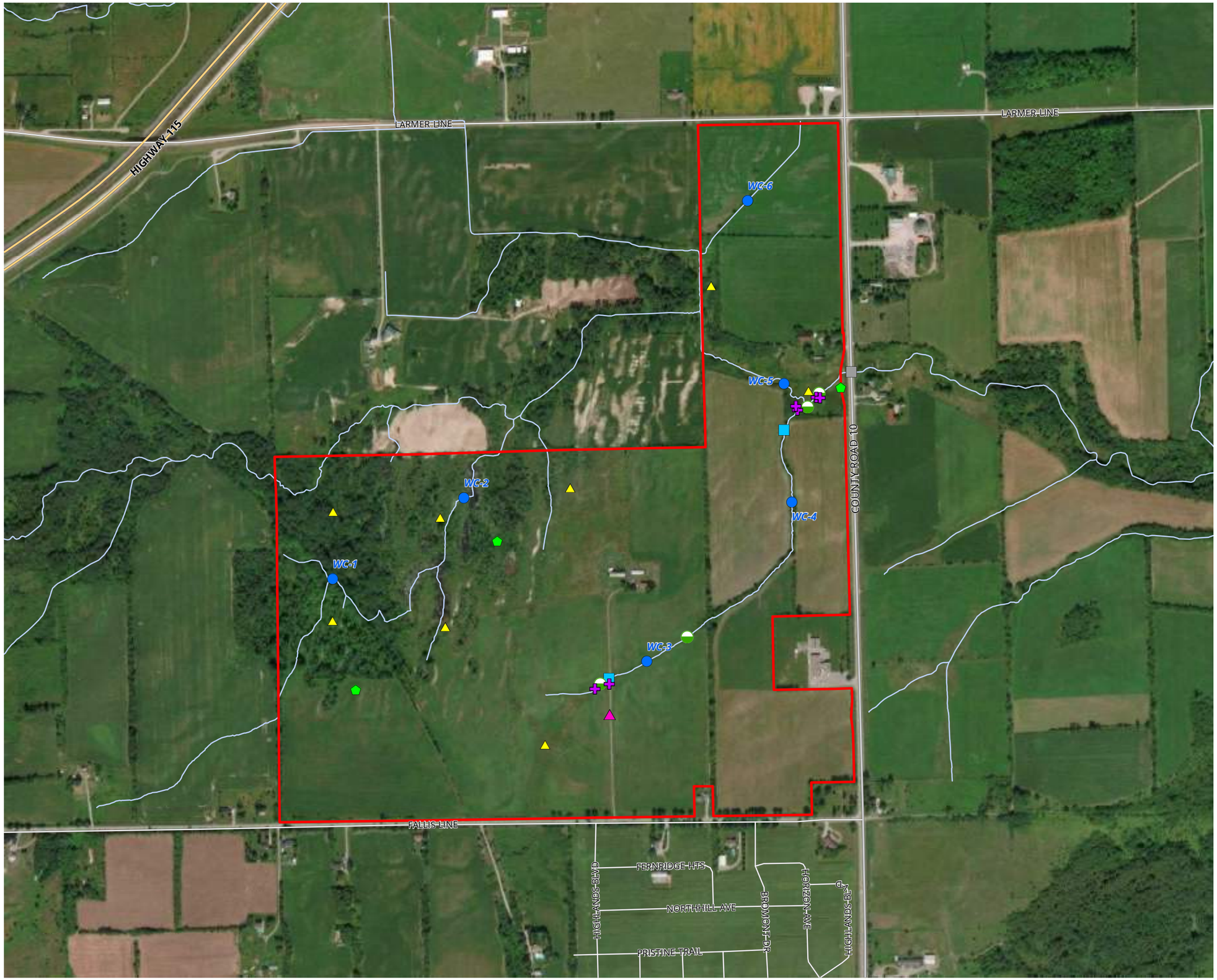
PROJECT: 164800
STATUS: DRAFT
DATE: 10/3/2018

FILE LOCATION: G:\GIS\164800 - Millbrook EIS\mxd\EIS\Figure 4 Ecological Land Classification.mxd



MILLBROOK

Figure 2
2017 SURVEY LOCATIONS

- Study Area
- Sampling Location
- Temperature Logger
- Breeding Bird Survey Location
- Benthic Sampling Location
- Amphibian Breeding Habitat Survey Location
- Bridge
- Culvert
- Driveway
- Watercourse

1:7,500

0 50 100 200 300 m

MAP DRAWING INFORMATION:
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DATE: 2020-08-27

FILE LOCATION: C:\Users\20gm\Desktop\Projects\164800 - Millbrook\mxd\Figure 3 2017 Survey Locations.mxd

Attachment C: Photos

Photo 1 October 15, 2016 Upstream end (Segment B-1) of Tributary B looking downstream toward County Road 10	
Photo 2 October 15, 2016 Upstream end (Segment B-1) of Tributary B looking downstream toward County Road 10	
Photo 3 October 15, 2016 West side of culvert across driveway (upstream end)	

Photo 4 October 15, 2016 East side of culvert across driveway (downstream end)	
Photo 5 October 15, 2016 Segment B-2 looking downstream toward County Road 10	
Photo 6 October 15, 2016 Segment B-2	

Photo 7 October 15, 2016 Segment B-3 looking downstream	
Photo 8 October 15, 2016 Segment B-2	
Photo 9 October 15, 2016 View of Segment B-3 from field adjacent to County Road 10	

Photo 10 October 15, 2016 Segment B-3	
Photo 11 October 15, 2016 Segment B-3	
Photo 12 October 15, 2016 Segment B-3 looking north at culvert across farm laneway	

Photo 13 October 15, 2016 Segment B-4 looking south at culvert across farm laneway	
Photo 14 October 15, 2016 Segment B-4	
Photo 15 October 15, 2016 Segment B-4 looking up the confluence at Tributary C	

Photo 16 October 15, 2016 Tributary C looking upstream	
Photo 17 October 15, 2016 Looking upstream at Tributary C from the bridge at County Road 10	
Photo 18 October 15, 2016 Looking upstream at Tributary C from the bridge at County Road 10	

Photo 19 June 20, 2017 Segment B-1	
Photo 20 June 20, 2017 Segment B-1	
Photo 21 June 20, 2017 Segment B-2 looking downstream	

Photo 22 June 20, 2017 Segment B-2 looking downstream	
Photo 23 June 20, 2017 Segment B-2 looking downstream	
Photo 24 June 20, 2017 Tributary C looking upstream	

Photo 25 June 20, 2017 Tributary C looking downstream toward County Road 10	
Photo 26 May 9, 2018 Segment B-1 looking downstream	
Photo 27 May 9, 2018 Segment B-1 looking upstream	

Photo 28 May 9, 2018 Segment B-1 looking upstream	
Photo 29 May 9, 2018 Segment B-1 looking at culvert across driveway	
Photo 30 May 9, 2018 Possible iron staining in Segment B-2	

Photo 31 May 9, 2018 Segment B-2 looking upstream	
Photo 32 May 9, 2018 Segment B-3 looking upstream	
Photo 33 May 9, 2018 Segment B-2 looking upstream	

Photo 34 May 9, 2018 Segment B-3 looking downstream	
Photo 35 May 9, 2018 Segment B-4 looking upstream adjacent to Tributary C	
Photo 36 May 9, 2018 Looking up Segment B-4 at the confluence of Tributary C	

Photo 37 May 9, 2018 Tributary C looking upstream	
Photo 38 June 12, 2020 Segment B-1	
Photo 39 June 12, 2020 Segment B-1 looking upstream	

Photo 40 June 12, 2020 Segment B-2 looking downstream	
Photo 41 June 12, 2020 Segment B-2	
Photo 42 June 12, 2020 Segment B-3	

Photo 43 June 12, 2020 Segment B-3	
Photo 44 June 12, 2020 Segment B-3	
Photo 45 June 12, 2020 Segment B-3	

Photo 46 June 12, 2020 Segment B-3	
Photo 47 June 12, 2020 Segment B-3	
Photo 48 June 12, 2020 Segment B-4	

Photo 49 June 12, 2020 Segment B-4	
Photo 50 June 12, 2020 Segment B-4 looking toward Tributary C (downstream)	
Photo 51 June 12, 2020 Segment B-4 looking toward Tributary C (downstream)	

Photo 52 June 12, 2020 Tributary C looking upstream	
Photo 53 June 12, 2020 Tributary C looking downstream	
Photo 54 June 23, 2020 Segment B-1 looking downstream during rain event	

Photo 55 June 23, 2020 Segment B-1 looking upstream during rain event	
Photo 56 June 23, 2020 Segment B-2 during rain event	
Photo 57 June 23, 2020 Segment B-2 looking downstream during rain event	

Photo 58 June 23, 2020 Segment B-2 during rain event	
Photo 59 June 23, 2020 Segment B-3 looking downstream during rain event	
Photo 60 June 23, 2020 Segment B-3 looking downstream during rain event	

Photo 61 June 23, 2020 Segment B-3 during rain event	
Photo 62 June 23, 2020 Segment B-4 near confluence during rain event	
Photo 63 June 23, 2020 Segment B-4 near confluence during rain event	

Photo 64 June 23, 2020 Looking into Tributary C at confluence during rain event	
Photo 65 July 6, 2020 Upstream section of Tributary B. Contained pockets of pooled water	
Photo 66 July 6, 2020 Upstream section of Tributary B. Contained pockets of pooled water	

Photo 67 July 6, 2020 Downstream section of Tributary B. Stream bed dry to confluence	
Photo 68 July 6, 2020 Downstream section of Tributary B. Stream bed dry to confluence	
Photo 69 July 6, 2020 Confluence where Tributary B meets Tributary C- Dry	

Photo 70 July 6, 2020 Confluence where Tributary B meets Tributary C. Dry down to Tributary C	
Photo 71 July 6, 2020 Tributary C logger (for comparison)	
Photo 72 July 6, 2020 Tributary C- water present	

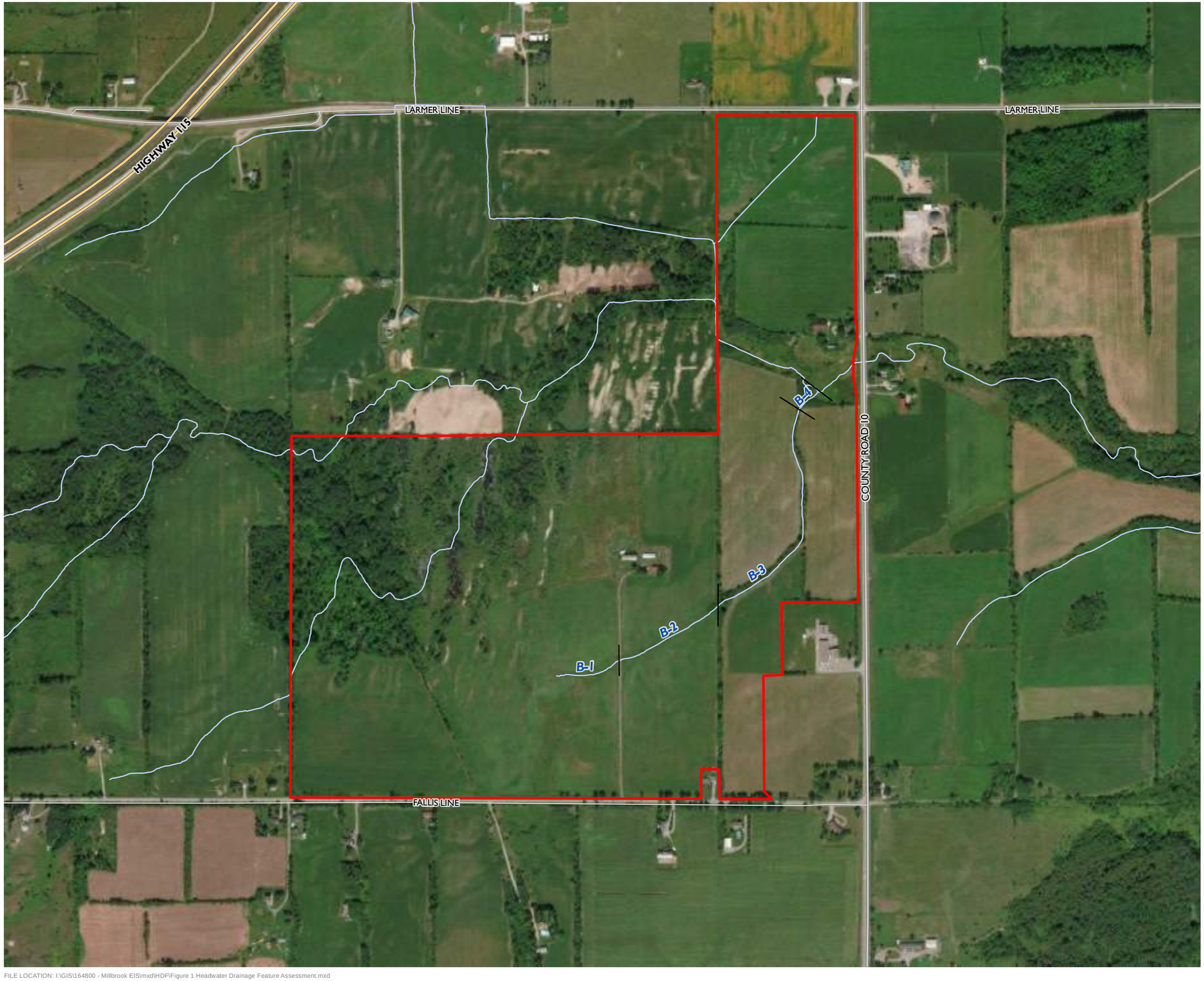
Attachment D: HDFA Results

Table D-1: Results of May 2018 HDF Assessment

DRAINAGE FEATURE SEGMENT	DILLON SITE VISIT	DATE OF FIELD WORK	FLOW ASSESSMENT	VEGETATION ASSESSMENT		CHANNEL FORM				SEDIMENT TRANSPORT		COMMENTS	PHOTO REFERENCES ATTACH. C
			FLOW INFLUENCE (FI) / CONDITION (FC) / TYPE (FT)	RIPARIAN 0-30 m	TERRESTRIAL Over 30 m	AVERAGE WETTED WIDTH (m)	AVERAGE DEPTH (m)	AVERAGE BANKFULL WIDTH (m)	SUBSTRATE	SEDIMENT TRANS.	SEDIMENT DEP.		
TRIBUTARY B													
B-1	3	9-May-18	**Flow observed** FI: Baseflow (3) FC: Standing Water (2) FT: Swale (7)	Meadow (4)/ Wetland (5)	Cropped (3)	1.24	0.12	2.53	Si	None	None	- Early May site visit to supplement summer and fall surveys of previous years - Meadow swale containing wetland species originating in the centre of the field - No defined channel - No flow observed during any of the site visits in 2016-2018 although pockets of water/ pooling was observed during this site visit and after rain events in 2017 - Crushed in culvert at laneway crossing- difficult to locate; covered by old boards	26-29
B-2	3	9-May-18	**Flow observed** FI: Base flow (3) FC: Standing Water (2) FT: Defined Natural Channel (1)	Meadow (4)/ Forest (6)	Cropped (3)	0.66	0.14	1.5	Si	Instream bank erosion (valley)	None	- Contained mostly meadow vegetation with a few shrubs and pockets of cattails - No flow observed during any of the site visits in 2016-208, only standing water and pooling after rain events - Some sediment deposition and iron staining observed coming from laneway culvert	30-33
B-3	3	9-May-18	**Flow observed** FI: Base flow (3) FC: Minimal Flow (4) FT: Defined Natural Channel (1)	Forest (6)	Cropped (3)	0.54	0.05	1.04	Si	Instream bank erosion (valley)	Moderate	- Meadow and fencerow riparian habitat with rocky berms on either side created by farmer - Minimal flow observed - Treed, but not considered forest- as per definition	34
B-4	3	9-May-18	**Flow observed** FI: Base flow (3) FC: Subs. Flow (5) FT: Channelized (2)	Forest (6)	Forest (6)/ Meadow (4)	1.12	0.165	2.7	Si	Sheet Erosion	Minimal	- On downstream end of plugged culvert substantial flow was observed, possibly due to tile drainage (unknown location) - Shaded by trees, and rocky cobble within stream bed - Tributary exits the woodland and flows through a patch of thick meadow before entering Tributary C to the north at a steep drop >1 m - SWM pond has been created to the east as part of a municipal project	35-36

Table D-2: HDFA Management Recommendations

Segment	STEP 1		STEP 2	STEP 3	STEP 4	Results per Segment	Overall Management Recommendation
	Hydrology	Modifiers	Riparian	Fish Habitat	Terrestrial Habitat		
B-1	Valued Function: Intermittent	Nutrient inputs, crushed in culvert/ barrier to flow at downstream end	Valued (avg): Meadow with wetland and crop	Contributing Function: mainly for transport of allochthonous materials to downstream fish bearing reaches	Limited Function: No terrestrial habitat present	Mitigation: Contributing Functions	**MITIGATION**
B-2	Valued Function: Intermittent	Crushed in culvert at upstream end	Valued Function: meadow	Contributing Function: mainly for transport of allochthonous materials to downstream fish bearing reaches	Limited Function: No terrestrial habitat present	Mitigation: Contributing Functions	
B-3	Valued Function: Intermittent	Plugged culvert at downstream end	Valued Function: meadow	Contributing Function: mainly for transport of allochthonous materials to downstream fish bearing reaches	Limited Function: No terrestrial habitat present	Mitigation: Contributing Functions	
B-4	Valued Function: Intermittent	Plugged culvert at upstream end, steep drop-off at confluence with Tributary C	Important (avg): Forest and meadow	Contributing Function: mainly for transport of allochthonous materials to downstream fish bearing reaches	Valued: Suitable feeding of hydration for low mobility wildlife. Wetland habitat occurs in the corridor but no breeding amphibians are present.	Conservation: Valued Functions	**CONSERVATION**



MILLBROOK
EIS

FIGURE 1
HEADWATER DRAINAGE
FEATURE ASSESSMENT

Study Area
Water Body

1:7,500

0 100 200 400 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF, TOWNSHIP OF CAVAN MONAGHAN

MAP CREATED BY: GM
MAP CHECKED BY: WM
MAP PROJECTION: NAD 1983 UTM Zone 17N

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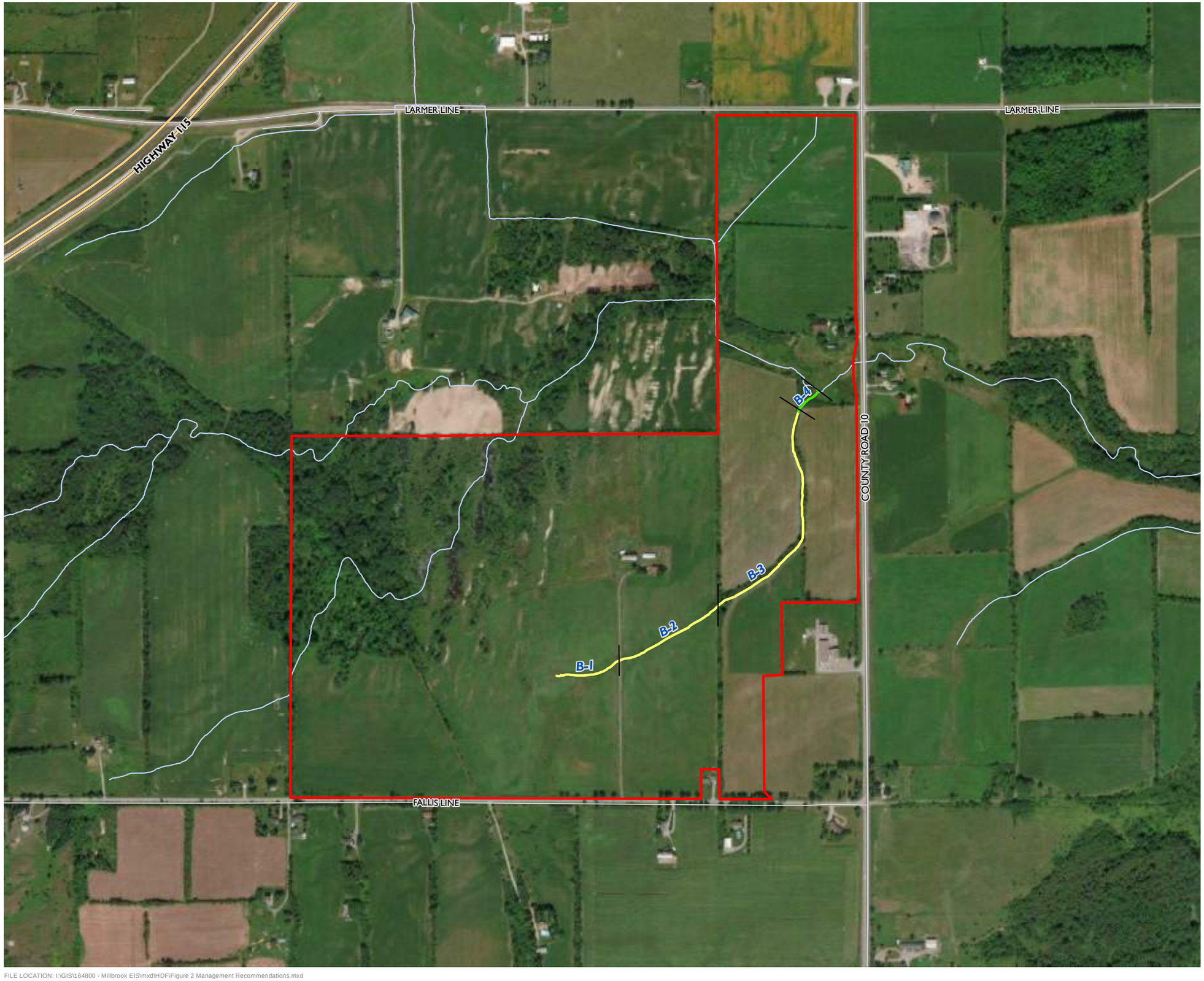


MILLBROOK EIS

FIGURE 2
MANAGEMENT RECOMMENDATIONS

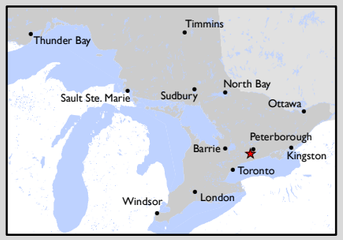
Study Area

Managment Recommendations

Conservation

Mitigation

Water Body (Unclassiified)



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MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF, TOWNSHIP OF CAVAN MONAGHAN

MAP CREATED BY: GM
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MAP PROJECTION: NAD 1983 UTM Zone 17N

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PROJECT: 164800

STATUS: DRAFT

DATE: 2020-04-30

FILE LOCATION: I:\GIS\164800 - Millbrook EIS\mxd\HDF\Figure 2 Management Recommendations.mxd

Appendix G

Site Photos

Ecological Land Classification Photos

Photo 1 June 21, 2017 FODM6-5 Fresh-Moist Sugar Maple Hardwood Forest	
Photo 2 June 21, 2017 SWDM4 Mineral Deciduous Swamp	
Photo 3 June 21, 2017 SWDM4 Mineral Deciduous Swamp	

Ecological Land Classification Photos

Photo 4 June 21, 2017 MAMM1-2 Cattail Mineral Meadow Marsh	
Photo 5 June 21, 2017 MAMM1-2 Cattail Mineral Meadow Marsh	
Photo 6 June 21, 2017 MAMM1-2 Cattail Mineral Meadow Marsh	

Ecological Land Classification Photos

Photo 7 June 21, 2017 MEMM4 Fresh-Moist Mixed Meadow	
Photo 8 June 21, 2017 MEMM3 Dry-Fresh Mixed Meadow	
Photo 9 June 21, 2017 TAGM5 Fencerow/ Riparian	

Ecological Land Classification Photos

Photo 10 June 21, 2017 OAGM1 Annual Row Crop (with isolated wetland pocket)	
Photo 11 June 21, 2017 OAGM1 Annual Row Crop (with isolated wetland pocket)	
Photo 12 October 15, 2016 Isolated wetland pocket	

Ecological Land Classification Photos

Photo 13 October 15, 2016 Isolated wetland pocket	
Photo 14 October 15, 2016 Isolated wetland pocket looking toward the farmhouse	
Photo 15 October 15, 2016 Isolated wetland pocket	

Ecological Land Classification Photos

Photo 16 October 15, 2016 Isolated wetland pocket	
Photo 17 June 21, 2017 CVR_4 Rural Residential	

Appendix H

Vegetation Inventory

FAMILY[1]	SCIENTIFIC NAME	COMMON NAME	INVASIVE RANKING[2]	NOXIOUS[3]	ELC HABITAT OBSERVED IN[4]				SARA[5]	ESA[6]	SRANK[7]	CC[8]	CW[9]	REGIONAL RARITY[10]
					Deciduous Forest	Mixed Meadow	Cattail Marsh	Deciduous Swamp						
Equisetaceae	Equisetum arvense	Field Horsetail	---	---	●	●			---	---	S5	0	0	
Equisetaceae	Equisetum fluviatile	Water Horsetail	---	---				●	---	---	S5	7	-5	X
Dennstaedtiaceae	Pteridium aquilinum	Bracken Fern	---	---	●				---	---	S5	2	3	
Dryopteridaceae	Dryopteris marginalis	Marginal Wood Fern	---	---	●				---	---	S5	5	3	
Dryopteridaceae	Matteuccia struthiopteris	Ostrich Fern	---	---	●				---	---	S5	5	-3	
Dryopteridaceae	Onoclea sensibilis	Sensitive Fern	---	---	●			●	---	---	S5	4	-3	X
Cupressaceae	Juniperus communis	Ground Juniper	---	---	●	●			---	---	S5	4	3	
Cupressaceae	Juniperus virginiana	Eastern Red Cedar	---	---		●			---	---	S5	4	3	
Pinaceae	Pinus sylvestris	Scotch Pine	2	---		●			---	---	SNA	---	5	
Alismataceae	Alisma triviale	Northern Water-plantain	---	---			●	●	---	---	S5	---	---	X
Araceae	Arisaema triphyllum	Jack-in-the-pulpit	---	---	●				---	---	S5	5	-2	
Cyperaceae	Carex bebbii	Bebb's Sedge	---	---	●				---	---	S5	3	-5	
Cyperaceae	Carex gracillima	Graceful Sedge	---	---		●			---	---	S5	4	3	
Cyperaceae	Carex grayi	Asa Gray Sedge	---	---				●	---	---	S4	8	-4	
Cyperaceae	Carex pedunculata	Long-stalked Sedge	---	---	●				---	---	S5	5	5	
Cyperaceae	Carex rostrata	Beaked Sedge	---	---	●				---	---	S4?	7	-5	
Cyperaceae	Carex vulpinoidea	Fox Sedge	---	---			●	●	---	---	S5	3	-5	X
Cyperaceae	Schoenoplectus tabernaemontani	Soft-stemmed Bulrush	---	---				●	---	---	S5	5	-5	X
Poaceae	Bromus inermis	Awnless Brome	4	---		●			---	---	SNA	---	5	
Poaceae	Dactylis glomerata	Orchard Grass	4	---	●	●			---	---	SNA	---	3	
Poaceae	Elymus hystrix	Bottlebrush Grass	---	---				●	---	---	S5	5	5	SR
Poaceae	Elymus repens	Creeping Wildrye	6	---			●		---	---	SNA	---	3	
Poaceae	Glyceria striata	Fowl Mannagrass	---	---			●	●	---	---	S5	3	-5	X
Poaceae	Leersia oryzoides	Rice Cutgrass	---	---				●	---	---	S5	3	-5	X
Poaceae	Phalaris arundinacea	Reed Canary Grass	9	---		●	●	●	---	---	S5	0	-4	X
Poaceae	Phleum pratense	Common Timothy	---	---		●	●		---	---	SNA	---	3	X
Poaceae	Phragmites australis ssp. australis	European Common Reed	9	---			●		---	---	SNA	---	-4	
Poaceae	Poa compressa	Canada Bluegrass	3	---		●			---	---	SNA	0	2	
Iridaceae	Iris versicolor	Harlequin Blue Flag	---	---				●	---	---	S5	5	-5	X
Liliaceae	Allium tricoccum var. tricoccum	Wild Leek	---	---	●				---	---	S4	7	2	
Liliaceae	Erythronium americanum	Yellow Trout-lily	---	---	●				---	---	S5	5	5	
Liliaceae	Maianthemum canadense	Wild Lily-of-the-valley	---	---	●				---	---	S5	5	0	
Liliaceae	Maianthemum stellatum	Star-flowered False Solomon's-seal	---	---	●				---	---	S5	6	1	
Liliaceae	Trillium grandiflorum	White Trillium	---	---	●				---	---	S5	5	5	

FAMILY[1]	SCIENTIFIC NAME	COMMON NAME	INVASIVE RANKING[2]	NOXIOUS[3]	ELC HABITAT OBSERVED IN[4]				SARA[5]	ESA[6]	SRANK[7]	CC[8]	CW[9]	REGIONAL RARITY[10]
					Deciduous Forest	Mixed Meadow	Cattail Marsh	Deciduous Swamp						
Smilacaceae	Smilax herbacea	Herbaceous Carrionflower	---	---	●				---	---	S4	5	0	
Orchidaceae	Epipactis helleborine	Eastern Helleborine	---	---	●				---	---	SNA	---	5	
Sparganiaceae	Sparganium americanum	American Burreed	---	---			●		---	---	S4?	6	-5	
Typhaceae	Typha latifolia	Broad-leaved Cattail	---	---			●	●	---	---	S5	3	-5	SR
Apiaceae	Daucus carota	Wild Carrot	3	---		●			---	---	SNA	---	5	
Apiaceae	Pastinaca sativa	Wild Parsnip	9	Y		●			---	---	SNA	---	5	
Apiaceae	Sium suave	Hemlock Water-parsnip	---	---				●	---	---	S5	4	-5	X
Aristolochiaceae	Asarum canadense	Canada Wild-ginger	---	---	●				---	---	S5	6	5	
Asteraceae	Ageratina altissima	White Snakeroot	---	---			●		---	---	S5	5	3	X
Asteraceae	Antennaria parlinii ssp. parlinii	Parlin's Pussytoes	---	---	●				---	---	SU	2	5	
Asteraceae	Arctium minus	Common Burdock	---	---		●			---	---	SNA	---	5	
Asteraceae	Centaurea nigra	Black Knapweed	---	Y		●			---	---	SNA	---	5	
Asteraceae	Cirsium arvense	Canada Thistle	6	---	●	●			---	---	SNA	---	3	
Asteraceae	Erigeron philadelphicus	Philadelphia Fleabane	---	---		●			---	---	S5	1	-3	
Asteraceae	Eutrochium maculatum var. maculatum	Spotted Joe Pye Weed	---	---				●	---	---	S5	3	-5	X
Asteraceae	Hieracium pilloseloides	Smooth Yellow Hawkweed	---	---		●			---	---	SNA	---	5	
Asteraceae	Leucanthemum vulgare	Oxeye Daisy	3	---		●			---	---	SNA	---	5	
Asteraceae	Prenanthes alba	White Rattlesnake-root	---	---	●				---	---	S5	6	3	
Asteraceae	Solidago canadensis var. canadensis	Canada Goldenrod	---	---		●			---	---	S5	1	3	
Asteraceae	Solidago flexicaulis	Zigzag Goldenrod	---	---	●				---	---	S5	6	3	
Asteraceae	Taraxacum officinale	Common Dandelion	---	---		●			---	---	SNA	---	3	
Asteraceae	Tussilago farfara	Colt's-foot	4	Y				●	---	---	SNA	---	3	X
Brassicaceae	Thlaspi arvense	Field Penny-cress	---	---		●			---	---	SNA	---	5	
Caryophyllaceae	Silene vulgaris	Maiden's Tears	---	---		●			---	---	SNA	---	5	
Cornaceae	Cornus alternifolia	Alternate-leaved Dogwood	---	---	●	●			---	---	S5	6	5	
Cornaceae	Cornus obliqua	Silky Dogwood	---	---				●	---	---	S5	5	-4	X
Cornaceae	Cornus sericea ssp sericea	Red-osier Dogwood	---	---		●		●	---	---	S5	2	-3	X
Caprifoliaceae	Sambucus racemosa ssp. Pubens	Red-berried Elderberry	---	---	●				---	---	S5	5	2	
Caprifoliaceae	Viburnum lentago	Nannyberry	---	---			●		---	---	S5	4	-1	X
Caprifoliaceae	Viburnum opulus ssp. trilobum	Highbush Cranberry	---	---	●				---	---	S5	---	---	
Fabaceae	Amphicarpaea bracteata	American Hog-peanut	---	---	●				---	---	S5	4	0	
Fabaceae	Lotus corniculatus	Garden Bird's-foot Trefoil	---	---		●			---	---	SNA	---	1	
Fabaceae	Melilotus albus	White Sweet-clover	9	---		●			---	---	SNA	---	3	
Fabaceae	Trifolium pratense	Red Clover	---	---		●			---	---	SNA	---	2	

FAMILY[1]	SCIENTIFIC NAME	COMMON NAME	INVASIVE RANKING[2]	NOXIOUS[3]	ELC HABITAT OBSERVED IN[4]				SARA[5]	ESA[6]	SRANK[7]	CC[8]	CW[9]	REGIONAL RARITY[10]
					Deciduous Forest	Mixed Meadow	Cattail Marsh	Deciduous Swamp						
Fabaceae	Vicia cracca	Tufted Vetch	---	---		●			---	---	SNA	---	5	
Betulaceae	Betula alleghaniensis	Yellow Birch	---	---				●	---	---	S5	6	0	SR
Betulaceae	Ostrya virginiana	Eastern Hop-hornbeam	---	---	●				---	---	S5	4	4	
Fagaceae	Fagus grandifolia	American Beech	---	---	●				---	---	S4	6	3	
Fagaceae	Quercus rubra	Northern Red Oak	---	---	●				---	---	S5	6	3	
Apocynaceae	Apocynum cannabinum	Hemp Dogbane	---	---		●			---	---	S5	3	0	
Asclepiadaceae	Asclepias incarnata	Swamp Milkweed	---	---	●		●	●	---	---	S5	6	-5	X
Asclepiadaceae	Asclepias syriaca	Common Milkweed	---	---		●			---	---	S5	0	5	
Asclepiadaceae	Cynanchum rossicum	European Swallow-wort	9	Y	●	●			---	---	SNA	---	5	
Balsaminaceae	Impatiens capensis	Spotted Jewelweed	---	---	●			●	---	---	S5	4	-3	X
Oxalidaceae	Oxalis dillenii	Slender Yellow Wood-sorrel	---	---	●				---	---	S5?	0	3	
Juglandaceae	Juglans cinerea	Butternut	---	---	●				END	END	S3?	6	2	
Juglandaceae	Juglans nigra	Black Walnut	---	---	●	●			---	---	S4	5	3	
Boraginaceae	Echium vulgare	Common Viper's-bugloss	---	---		●			---	---	SNA	---	5	
Lamiaceae	Lycopus americanus	American Water-horehound	---	---				●	---	---	S5	4	-5	X
Lamiaceae	Monarda didyma	Scarlet Beebalm	---	---		●			---	---	S3	8	3	
Verbenaceae	Verbena hastata	Blue Vervain	---	---			●		---	---	S5	4	-4	X
Tiliaceae	Tilia americana	American Basswood	---	---	●		●		---	---	S5	4	3	SR
Onagraceae	Circaea canadensis	Broad-leaved Enchanter's Nightshade	---	---	●				---	---	S5	3	3	
Onagraceae	Oenothera biennis	Common Evening Primrose	---	---		●			---	---	S5	0	3	
Onagraceae	Oenothera parviflora	Small-flowered Evening Primrose	---	---		●			---	---	S5	1	3	
Polygonaceae	Persicaria amphibia var. stipulacea	Flanged Smartweed	---	---			●		---	---	S5?	---	---	SR
Polygonaceae	Rumex crispus	Curly Dock	---	---		●			---	---	SNA	---	-1	
Primulaceae	Lysimachia ciliata	Fringed Loosestrife	---	---				●	---	---	S5	4	-3	X
Berberidaceae	Berberis vulgaris	European Barberry	6	Y				●	---	---	SNA	---	3	
Berberidaceae	Caulophyllum thalictroides	Blue Cohosh	---	---	●				---	---	S5	6	5	
Berberidaceae	Podophyllum peltatum	May-apple	---	---	●				---	---	S5	5	3	
Ranunculaceae	Actaea pachypoda	White Baneberry	---	---	●				---	---	S5	6	5	
Ranunculaceae	Anemone acutiloba	Sharp-lobed Hepatica	---	---	●				---	---	S5	6	5	
Ranunculaceae	Anemone cylindrica	Long-fruited Anemone	---	---		●			---	---	S4	7	5	
Ranunculaceae	Caltha palustris	Yellow Marsh Marigold	---	---				●	---	---	S5	5	-5	X
Ranunculaceae	Ranunculus abortivus	Kidney-leaved Buttercup	---	---	●				---	---	S5	2	-2	
Ranunculaceae	Ranunculus acris	Tall Buttercup	---	---		●			---	---	SNA	---	-2	
Ranunculaceae	Thalictrum dioicum	Early Meadow-rue	---	---	●				---	---	S5	5	2	

FAMILY[1]	SCIENTIFIC NAME	COMMON NAME	INVASIVE RANKING[2]	NOXIOUS[3]	ELC HABITAT OBSERVED IN[4]				SARA[5]	ESA[6]	SRANK[7]	CC[8]	CW[9]	REGIONAL RARITY[10]
					Deciduous Forest	Mixed Meadow	Cattail Marsh	Deciduous Swamp						
Rhamnaceae	Rhamnus cathartica	Common Buckthorn	9	Y	●	●	●		---	---	SNA	---	3	X
Vitaceae	Parthenocissus quinquefolia	Virginia Creeper	---	---	●				---	---	S4?	6	1	
Vitaceae	Vitis riparia	Riverbank Grape	---	---		●	●	●	---	---	S5	0	-2	X
Grossulariaceae	Ribes cynosbati	Prickly Gooseberry	---	---	●				---	---	S5	4	5	
Rosaceae	Agrimonia gryposepala	Hooked Agrimony	---	---	●	●			---	---	S5	2	2	
Rosaceae	Amelanchier spicata	Running Serviceberry	---	---	●				---	---	S4?	7	3	
Rosaceae	Fragaria virginiana	Wild Strawberry	---	---		●			---	---	S5	2	1	
Rosaceae	Geum canadense	White Avens	---	---	●				---	---	S5	3	0	
Rosaceae	Malus baccata	Siberian Crabapple	---	---		●			---	---	SNA	---	---	
Rosaceae	Malus pumila	Common Apple	---	---					---	---	SNA	---	5	
Rosaceae	Potentilla recta	Sulphur Cinquefoil	---	---		●			---	---	SNA	---	5	
Rosaceae	Prunus serotina	Wild Black Cherry	---	---		●			---	---	S5	3	3	
Rosaceae	Prunus virginiana	Choke Cherry	---	---	●				---	---	S5	2	1	
Rosaceae	Rubus allegheniensis	Alleghany Blackberry	---	---		●			---	---	S5	2	2	
Rosaceae	Rubus idaeus ssp. idaeus	Common Red Raspberry	---	---	●				---	---	SNA	---	5	
Rosaceae	Rubus odoratus	Purple-flowering Raspberry	---	---	●				---	---	S5	3	5	
Rosaceae	Spiraea alba	White Meadowsweet	---	---			●		---	---	S5	3	-4	X
Rubiaceae	Galium aparine	Cleavers	---	---	●				---	---	S5	4	3	
Rubiaceae	Sherardia arvensis	Blue Field Madder	---	---		●			---	---	SNA	---	---	
Salicaceae	Populus balsamifera	Balsam Poplar	---	---			●		---	---	S5	4	-3	X
Salicaceae	Populus grandidentata	Large-tooth Aspen	---	---				●	---	---	S5	5	3	X
Salicaceae	Populus tremuloides	Trembling Aspen	---	---	●			●	---	---	S5	2	0	X
Salicaceae	Salix alba	White Willow	3	---					---	---	SNA	---	-3	
Salicaceae	Salix discolor	Pussy Willow	---	---		●	●		---	---	S5	3	-3	X
Salicaceae	Salix eriocephala	Heart-leaved Willow	---	---			●		---	---	S5	4	-3	X
Salicaceae	Salix fragilis	Crack Willow	3	---				●	---	---	S4?	---	-1	SR
Aceraceae	Acer negundo	Manitoba Maple	4	---				●	---	---	S5	0	-2	SR
Aceraceae	Acer saccharinum	Silver Maple	---	---				●	---	---	S5	5	-3	SR
Aceraceae	Acer saccharum	Sugar Maple	---	---	●				---	---	S5	4	3	
Aceraceae	Acer x freemanii	Freeman's Maple	---	---			●	●	---	---	SNA	---	---	SR
Anacardiaceae	Rhus typhina	Staghorn Sumac	---	---	●	●			---	---	S5	1	5	
Anacardiaceae	Toxicodendron radicans	Climbing Poison Ivy	---	Y	●				---	---	S5	5	-1	
Oleaceae	Fraxinus americana	White Ash	---	---	●	●			---	---	S4	4	3	
Oleaceae	Fraxinus nigra	Black Ash	---	---				●	---	---	S4	7	-4	X

FAMILY[1]	SCIENTIFIC NAME	COMMON NAME	INVASIVE RANKING[2]	NOXIOUS[3]	ELC HABITAT OBSERVED IN[4]				SARA[5]	ESA[6]	SRANK[7]	CC[8]	CW[9]	REGIONAL RARITY[10]
					Deciduous Forest	Mixed Meadow	Cattail Marsh	Deciduous Swamp						
Oleaceae	Fraxinus pennsylvanica	Green Ash	---	---	●			●	---	---	S4	3	-3	X
Oleaceae	Syringa vulgaris	Common Lilac	4	---				●	---	---	SNA	---	5	
Scrophulariaceae	Mimulus ringens	Square-stemmed Monkeyflower	---	---			●		---	---	S5	6	-5	X
Scrophulariaceae	Verbascum thapsus	Common Mullein	---	---		●			---	---	SNA	---	5	
Solanaceae	Solanum dulcamara	Bittersweet Nightshade	4	---				●	---	---	SNA	---	0	X
Ulmaceae	Ulmus americana	American Elm	---	---	●	●		●	---	---	S5	3	-2	X
Urticaceae	Boehmeria cylindrica	False Nettle	---	---				●	---	---	S5	4	-5	X
Urticaceae	Laportea canadensis	Wood Nettle	---	---				●	---	---	S5	6	-3	X
Violaceae	Viola pubescens var. pubescens	Downy Yellow Violet	---	---	●				---	---	S5	5	4	
Violaceae	Viola sororia	Woolly Blue Violet	---	---		●			---	---	S5	4	1	
Violaceae	Viola striata	Striped Cream Violet	---	---	●				---	---	S3	8	-3	

1 – Species are listed by commonly accepted taxonomic hierarchy; 2 – Invasive Ranking as determined by the Invasive Exotic Plant Species Rankings for Southern Ontario (Draft - Urban Forest Associates/MNRF, 2014), species that are designated as 4,5,6 are more locally invasive and tend to be naturalized whereas 7,8,9 are highly invasive often forming monocultures; 3 – Noxious designation as determined by the Schedule of Noxious Weeds under the Ontario Weed Control Act, RSO 1990; 4 – based on the ELC communities documented by Dillon Consulting Limited; 5 – as designated under Schedule 1 of the federal Species at Risk Act, 2002; 6 – as designated under the provincial Endangered Species Act, 2007; 7 – provincial conservation rankings as determined by the NHIC , S1 - Extremely rare in Ontario; usually 5 or fewer occurrences in the province, or only a couple remaining hectares , S2 - Very rare in Ontario; usually between 6 and 20 occurrences in the province, or only a few remaining hectares, S3 - Rare to uncommon in Ontario; usually between 21 and 80 occurrences in the province; may have fewer occurrences, but with some extensive examples remaining , S4 - Considered to be common in Ontario. It denotes a species that is apparently secure, with over 80 occurrences in the province, S5 - Indicates that a species is widespread in Ontario. It is demonstrably secure in the province,? - A question mark following the rank indicates that there is some uncertainty with the classification due to insufficient information. These provincial ranks may further be modified, S2S3 - Indicates that an element is rare, but insufficient information exists to accurately assign a single rank, SNR - Unranked — conservation status Not Ranked, SNA - Not Applicable – a conservation status rank is not applicable because the species is not a suitable target for conservation activities, SX - Indicates that an element is extirpated from the province, SU - Indicates that the status is uncertain due to insufficient information, SE - Exotic species, non-native to Ontario; 8 - Coefficient of Conservatism (CC) as determined by the NHIC's Floristic Quality Assessment System for Southern Ontario (1995); 9 - Coefficient of Wetness (CW) as determined by the NHIC's Floristic Quality Assessment System for Southern Ontario (1995); 10 – Regional Rarity in Peterborough, Northumberland, Durham and the former Victoria County as determined in the Distribution and Status of the Vascular Plants of Central Region (Riley, 1989), X = native species present and all introduced species, R = native species and provincially rare, SR = site record only

Appendix I

Wetland Scoring Record

Digital Form ver. 3.2:2014Oct17

Wetland Evaluation Edition	3.2	This Update:
		2020-July.

Milbrook North

Wetland code eg. KG-LNA-QC-001

Comments

Resubmission due to addressing MNRF comments of first submission and subsequent re-scoring-Jan2020

Aboriginal Values (sect. 2.8.1) re-evaluated and scored 30 points - 2020-07-13 C. Higgins

Additional Information

Include relevant information that can not be entered in the wetland data record(Ex. Sections that have not been completed.)

Wetland Name:	**Milbrook North**		
Wetland Significance:	**Non-PSW**	LIO OGF ID #:	
	Last Evaluated (field):	2017-Apr., May, June.	
	Last (Previous) Update:	2020-Jan.	
Special Planning Considerations:		**Scores**	
Wetland Area:	18.56 ha	Biological:	144
Total Detention Area:	95.7 ha	Social:	105
Catchment Area:	1181 ha	Hydrological:	154
Information Source:	Field Studies 2017	Special Features:	168
Submitted by:	Whitney Moore - Dillian Consulting Ltd.	Overall:	571
Approved by:	Andy Margetson		
Date:	July 22, 2020		

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