BEACON ENVIRONMENTAL

GUIDING SOLUTIONS IN THE NATURAL ENVIRONMENT

7370 Centre Road Geomorphic Assessment

Tributary of Uxbridge Brook

Township of Uxbridge

Prepared For:

Bridgebrook Corporation

Prepared By:

Beacon Environmental Limited

Date: *Project:*

March 2021 **217431.1**

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1. Introduction

Beacon Environmental Limited (Beacon) has been retained by Bridgebrook Corporation to undertake a geomorphic assessment for the property located at 7370 Centre Road (Part of Lot 33, Concession 6), in the Township of Uxbridge, Regional Municipality of Durham ('subject property'; **Figure 1**). The subject property is approximately 40.2 hectares in area and extends between 6th Concession Road and Centre Road. The subject property is located within the *Protected Countryside – Towns and Villages* lands of the *Greenbelt Plan* area, and is therefore, subject to the corresponding policies of the *Greenbelt Plan* as well as the Regional Municipality of Durham and Township of Uxbridge Official Plans and Lake Simcoe Region Conservation Authority (LSRCA) regulations. A tributary of Uxbridge Brook traverses the southeast corner of the subject property.

The purpose of this geomorphic assessment is to characterize existing conditions along the portion of the tributary within the subject property and delineate the meander belt to inform the determination of environmental constraint limits. Specifically, the following tasks were undertaken in support of this study:

- Background review of available materials (topographic mapping, aerial photography, and pertinent studies and reports for the study area);
- Historic assessment to determine current and past extents of the watercourse as well as the extent of historical land-use change that could impact the watercourse;
- Desktop assessment to delineate watercourse reaches based on underlying geomorphic controls;
- Field investigation to characterize existing geomorphic conditions and document evidence of active channel processes on a reach basis following standard rapid assessment protocols; and
- In accordance with applicable policies and guidelines, delineate the meander belt on a reach basis.

2. Policy Context

The following section provides an overview of policy documents relevant to this study.

2.1 Provincial Policy Statement (2020)

The Provincial Policy Statement (OMMAH 2020) issued under the *Planning Act* (1990) outlines areas of provincial interest with respect to natural hazards. In support of the Policy Statement, a Technical Guide - Rivers and Streams: Erosion Hazard Limit document was prepared (MNR 2002) to outline standardized procedures for the delineation and management of riverine erosion hazards in the Province of Ontario. The guide presents erosion hazard protocols based on two generalized landform systems through which watercourses flow: confined and unconfined valley systems. Through this approach, the meander belt width plus an erosion access allowance is defined to determine the erosion hazard limit of an unconfined valley system. For confined valley systems, the erosion hazard limit is governed by geotechnical considerations, including the stable slope allowance and an applicable toe erosion allowance (i.e., channel migration component). In the case of unconfined valley systems, the limits of the erosion hazard are guided by the greater of the regulatory floodline and meander belt.

2.2 Regional Municipality of Durham Official Plan (2017)

The Regional Municipality of Durham Official Plan defines the intent of Regional Council in the guidance of growth and development within the Region. With respect to natural hazards, the Official Plan dictates that

> *…development and site alteration shall not occur during areas that would be rendered inaccessible to people and vehicles during times of flooding hazards, erosion hazards, and/or dynamic beach hazards, unless it has been demonstrated that the site has safe access appropriate for the nature of the development and the natural hazard.*

To accommodate the hazard, setbacks, buffers, and access allowances are determined through technical studies, and must conform to provincial regulations.

2.3 Township of Uxbridge Official Plan (2014)

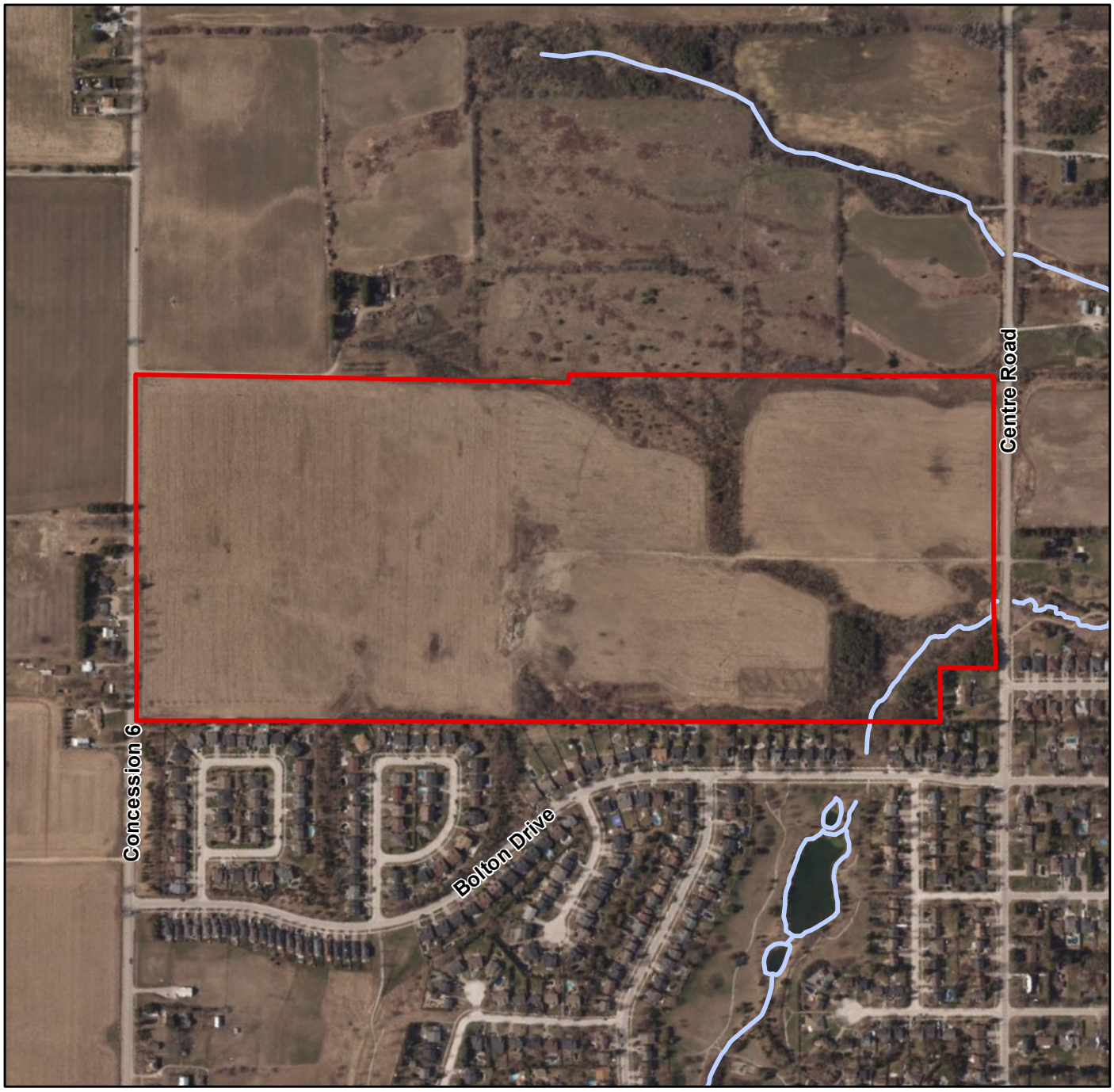
The Township of Uxbridge Official Plan (2014) implements provincial plans and provides land use planning directives for the Township. The subject property has been identified as 'future residential area' within the Secondary Plan Area on Schedule A, 'Land Use and Transportation Plan, Uxbridge Urban Area'. Preliminary natural hazard areas were delineated within the Official Plan, based on information provided by the Conservation Authority. Refinement of the natural hazard boundaries must be completed to the satisfaction of the Township in consultation with the Conservation Authority, as part of the review of specific development activities.

2.4 Lake Simcoe Region Conservation Authority Watershed Policies and Regulations

The Lake Simcoe Region Conservation Authority (LSRCA) regulates hazard lands including watercourses, valleylands, flood hazards, shorelines, and wetlands, and lands adjacent to these features under Ontario Regulation 179/06. The LSRCA *Watershed Development Guidelines* (2020) implement the Conservation Authorities Act (1990), as well as provide details on the requirements for assessing hazard lands. The LSRCA also provides guidance to the Township of Uxbridge on matters related to natural hazards through peer review and technical comment.

In accordance with Section 2(b) of Ontario Regulation 179/06, development is prohibited within river or stream valleys that have depressional features associated with a river or stream, whether or not they contain a watercourse. The limits associated with river or stream valleys are determined in accordance with the following rules:

i. Where the river or stream valley is apparent and has stable slopes, the valley extends from the stable top of bank, plus 15 metres, to a similar point on the opposite side;
ii. Where the river or stream valley is apparent and has unstable slopes, the valley extends from the predicted long term stable slope projected from the existing stable slope or, if the toe of the slope is unstable, from the predicted location of the toe of the slope as a result of stream erosion over a projected 100-year period, plus 15 metres, to a similar point on the opposite side;
iii. Where the river or stream valley is not apparent, the valley extends the greater of,



Site Location	Figure 1
7370 Centre Road, Uxbridge, Geomorphic Assessment	
BEACON ENVIRONMENTAL	Project: 217431.1 Last Revised: March, 2021
Client: Bridgebrook Corporation	Prepared by: DU Checked by: SG
N 1:7,000	Inset Map:1:50,000

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(A) the distance from a point outside the edge of the maximum extent of the flood plain under the applicable flood event standard, plus 15 metres, to a similar point on the opposite side, and
(B) the distance from the predicted meander belt of a watercourse, expanded as required to convey the flood flows under the applicable flood event standard, plus 15 metres, to a similar point on the opposite side.

3. Background Review

3.1 Climate

Climate provides the driving energy for a fluvial system and directly influences basin hydrology and rates of channel erosion, particularly through precipitation. Precipitation records obtained from climate normals (1981-2010) recorded at the Udora Station (ID 6119055), located approximately 17 km north of the subject property, averaged 64 mm per month in winter (November through February), and 80 mm in summer (July and August; Environment Canada 2019). This increase over the summer months is likely a result of convective thunderstorms. While total precipitation amounts are greater during the summer months, snowmelt and rain-on-snow events tend to produce the highest flows within a watershed.

3.2 Geology

The planimetric form of a watercourse is fundamentally a product of the channel flow regime and the availability of sediments (i.e., surficial geology) within the stream corridor. The 'dynamic equilibrium' of these inputs governs channel planform. These factors are influenced in smaller systems by physiography, riparian vegetation and land use. The subject property falls within the Peterborough Drumlin Field physiographic region (Chapman and Putnam 1984), which is characterized by drumlinized till plains. Bedrock geology consists of Ordovician, grey and black shale of the Whitby Formation (Hewitt 1972). Surficial geology consists of alternating bands of coarse-textured glaciolacustrine deposits, consisting of sand, gravel, and minor silt and clay, and stone-poor sandy silt to silty sand-textured till. Modern alluvial surficial deposits are found in the vicinity of the tributary within the subject property.

3.3 Uxbridge Brook Watershed Plan (LSRCA 1997)

In 1997, LSRCA prepared a watershed plan for the Uxbridge Brook in partnership with the Town of Uxbridge to provide guidance to future urban growth and ensure that environmental needs of the watershed are balanced with development. The Uxbridge Brook Watershed Plan identifies resources, management issues, and recommends development constraints and best management practices for the watershed.

Uxbridge Brook drains a total area of 178 km^2 at its outlet to Pefferlaw Brook. The watershed captures portions of the Townships of Uxbridge, Scugog and Brock and the Town of Georgina, with the majority located within the Township of Uxbridge.

While the Watershed Plan generally identifies the headwater tributaries of Uxbridge Brook as providing coldwater aquatic habitat due to groundwater conditions, it does not speak specifically to the tributary within the subject property. The constraint analysis undertaken for the entire watershed as part of this Watershed Plan assigned the tributary of Uxbridge Brook within the subject property a low environmental constraint ranking with respect to future development.

4. Historical Assessment

The following section presents an overview of historic conditions in the vicinity of the subject property with respect to land use, land cover and channel conditions. Historic analyses provide insight into the scale of natural and human-induced changes within a watershed, particularly the degree to which channel planform adjustment and land use has changed over time. In support of the historic assessment, black and white aerial photographs and digital colour imagery from 1967, 1974, 1989, 2002 and 2018 were analysed and compared to obtain a simple, qualitative assessment of the degree of land use and channel planform change over time.

Table 1 provides a summary of specific observations regarding change in land use based on available historical aerial imagery. Historic aerial imagery from each year of record is provided in **Appendix A**.

5. Reach Delineation

To facilitate a systematic evaluation of the Uxbridge Brook tributary, the watercourse was delineated into reaches. Reaches are homogenous sections of channel with regard to form and function and can, therefore, be expected to behave consistently along their length to changes in hydrology and sediment inputs, as well as to other modifying factors (Montgomery and Buffington 1997; Richards et al. 1997). For the purposes of this study, the entire length of tributary within the subject property was delineated as a single reach (Reach UBT-1). As the portion of tributary east of Centre Road was located within a publicly accessible corridor, it was delineated as Reach UBT-2 and was assessed in order to provide a reference condition and more holistic evaluation of Reach UBT-1. A reach map is presented in **Figure 2**.

UBT-1

UBT-2

P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
P20

Centre Road

Bolton Drive

Legend

- Subject Property
- Photo Locations
- Reach Break
- Extent Assessed
- Watercourse (MNRF 2019)

Reach and Photo Locations

Figure 2

7370 Centre Road, Uxbridge,
Geomorphic Assessment

BEACON ENVIRONMENTAL

Project: 217431.1
Last Revised: March, 2021

Client: Bridgebrook Corporation

Prepared by: DU
Checked by: SG

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Table 1. Summary of Key Historical Observations.

Time Period	Scale, Source	Observations
1967	1:5,000 Northway/Photomap/Remote Sensing Ltd.	Land use is predominantly agricultural. A single dwelling (farmhouse) was noted within the subject property. Centre Road to the east and 6th Concession Road to the west were visible, bounding the subject property. Generally, treed areas were were limited to hedgerows between agricultural fields, and along roads. Within the subject property, the tributary of Uxbridge Brook had been channelized. A narrow bank of riparian vegetation was observed in association with the tributary. Upstream (south) of the subject property, the tributary was poorly defined. East of Centre Road, the tributary displays a more natural, sinuous planform.
1974	1:5,000 Northway/Photomap/Remote Sensing Ltd.	Minimal change in land use and channel form was noted between 1967 and 1974. Land use remained agricultural, with a few rural residences.
1989	1:5,000 Northway/Photomap/Remote Sensing Ltd.	While land use remained consistent within the subject property, residential development could be observed to the south in 1989. The residential subdivision south east of North Street and Centre Road had been constructed. Bolton Drive was under construction, as had the online pond within Quaker Common park. Riparian vegetation appeared denser along the tributary within the subject property.
2002	1:5,000 Northway/Photomap/Remote Sensing Ltd.	By 2002, residential development south of the subject property to Brock Street West had largely been completed. Within the subject property, land use remained consistent. Channel planform remained straight; due to the dense nature of riparian vegetation, , instream features/evidence of erosion could not be discerned.
2018	1:5,000 Northway/Photomap/Remote Sensing Ltd.	Residential development has continued to expand south of the subject property. The single dwelling within the subject property can no longer be observed. Mature tree cover can be observed along the tributary, which generally remained straight but displayed a minor increase in sinuosity in the vicinity of Centre Road.

6. Field Assessment

In order to confirm existing geomorphic conditions along the relevant portion of the Uxbridge Brook tributary, a field investigation was conducted on May 16, 2019.

6.1 Methods

The following standardized rapid visual assessment methods were applied during the field assessment:

i. Rapid Geomorphic Assessment (RGA – MOE 2003)

The RGA documents observed indicators of channel instability by quantifying observations using an index that identifies channel sensitivity. Sensitivity is based on evidence of aggradation, degradation, channel widening and planimetric form adjustment. The index produces values that indicate whether the channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40) or in adjustment (score >0.41).

ii. Rapid Stream Assessment Technique (RSAT – Galli 1996)

The RSAT uses an index to quantify overall stream health and includes the consideration of biological indicators (Galli 1996). Observations concerning channel stability, channel scouring/sediment deposition, physical in-stream habitat, water quality, and riparian habitat conditions are used to calculate a rating that indicates whether the channel is in poor (<13), fair (13-24), good (25-34), or excellent (35-42) condition.

iii. Downs Classification Method (Downs 1995)

The Downs (1995) classification method infers present and future potential adjustments based on physical observations, which indicate the stage of evolution, and type of adjustments that can be anticipated based on the channel evolution model. The resultant index classifies streams as stable, laterally migrating, enlarging, undercutting, aggrading, or recovering.

6.2 Results

Results of the rapid assessments are summarized in **Tables 2** and **3** below. A photographic record of site conditions at the time of the assessment is provided in **Appendix B**. Photo locations are shown in **Figure 2**.

6.2.1 UBT-1

Reach UBT-1 was a characterized as a well-defined watercourse situated within an unconfined valley system, with a moderate gradient and low sinuosity. Riparian vegetation extended greater than 5 channel widths and consisted of trees, shrubs, grasses, and herbaceous species. Bank angles ranged between 30-60 degrees, with 30-60% of banks exhibiting indicators of active erosion. Undercuts of 0.20-0.40 m were noted, as well as bank failures in the form of slumping. Bank materials consisted of clay, silt, sand, and gravel. Riffle and pool morphology was observed, with bankfull widths ranging from 1.6-2.5 m and bankfull depths ranging from 0.32-0.60 m. Bed substrate consisted of clay, silt, sand, and gravel in the riffles, and clay, silt, and sand in the pools. Instream vegetation was observed in the form of emergent species.

The RGA score of 0.22 indicated that Reach UBT-1 was in transition (stressed). Planimetric form adjustment was the dominant mode of adjustment, based on the formation of chutes, evolution of a single thread channel to multiple threads, a thalweg out of phase with the meander form, and poorly formed, reworked, or removed bars. The RSAT score of 20.5 indicated that this reach displayed a fair degree of stream health, with riparian habitat conditions, physical instream habitat, and channel stability

contributing to a lower score. The Downs model classified this reach as m – 'lateral migration', based on the initiation of bank erosion/migration along a historically modified (straightened) channel.

6.2.2 UBT-2

Reach UBT-2 was characterized as a well-defined channel situated within an unconfined valley system. The reach displayed a low sinuosity, with a moderate to high sinuosity and gradient, and a moderate degree of entrenchment. Riparian vegetation consisted of trees, shrubs, grasses, and herbaceous species. This riparian buffer measured greater than 5 channel widths in dimension but was fragmented by a trail system that included crossings of the tributary. Bank angles ranged between 60-90 degrees, with 60-100% of banks displaying evidence of active erosion. Undercuts of 0.30 m were noted, as well as bank failures in the form of slumping. Bank material consisted of clay, silt, sand, and gravel. Riffle-pool bed morphology was well developed, with bankfull widths ranging between 1.5-2.5 m and bankfull depths between 0.40-0.55 m. Riffle substrate consisted of sand, gravel, and cobbles, while pool substrate consisted of clay, silt, sand, and gravel. Measurements of meander amplitude were documented to be in the range of 6-10 m

The RGA score of 0.26 indicated that Reach UBT-2 was in transition (stressed). Planimetric form adjustment and widening were determined to be dominant modes of adjustment for this reach. Evidence for planimetric form adjustment included formation of chutes, a thalweg out of phase with the meander form, and poorly formed, reworked, or removed bars. Evidence for widening included basal scour on inside meander bends and both sides of the channel through the riffles, basal scour extending over 50% of the reach length, and fracture lines along the top of banks or slumping banks. The RSAT score of 23.5 indicated that this reach was in a fair degree of stream health, with riparian habitat conditions the main limiting factor. However, physical instream habitat and channel stability were also contributing to the lower score. The Downs model classified this reach as U – 'undercutting', based on active bed and outer bank erosion and bend migration.

Table 2. General Reach Characteristics – Tributary of Uxbridge Brook

Reach	Bankfull Width (m)	Bankfull Depth (m)	Channel Substrate	Riparian Vegetation	Notes
UBT-1	1.6-2.5	0.32-0.60	Clay, silt, sand, gravel	Trees, shrubs, grasses, and herbaceous species	• Woody debris present in channel • Undercut and slumping banks present • Channel has been historically straightened
UBT-2	1.5-2.5	0.40-0.55	Clay, silt, sand, gravel, cobbles	Trees, shrubs, grasses, and herbaceous species	• Undercut and slumping banks present • Pedestrian trail and crossings • Channel worn into underlying till • Knickpoint formation

Table 3. Rapid Assessment Results – Tributary of Uxbridge Brook.

Reach	Rapid Geomorphic Assessment			Rapid Stream Assessment Technique			Downs Classification Method
	Score	Condition	Dominant Mode of Adjustment	Score	Condition	Limiting Factor	
UBT-1	0.22	In Transition	Planimetric Form Adjustment	20.5	Fair	Riparian habitat conditions, physical instream habitat	m – 'lateral migration'
UBT-2	0.26	In Transition	Planimetric Form Adjustment, Widening	23.5	Fair	Riparian habitat conditions, physical instream habitat, channel stability	U – 'undercutting'

7. Analysis

7.1 Meander Belt

The meander belt width is generally defined as the lateral extent that a meandering channel has historically occupied and will likely occupy in the future. The TRCA (2004) Meander Belt Width Delineation Procedures guideline generally represents the standard of practice for the determination of meander belt limits in Southern Ontario.

Following the TRCA (2004) guidelines, and in consideration of the degree of historic modification (channelization) noted within Reach UBT-1, an empirical modelling approach was employed to estimate an appropriate meander belt dimension. These models use simple power functions based on field-based measurements of the average bankfull width (W_b) and cross-sectional area (A), following relations from Williams (1986 – Equations 1 and 2) and Ward (2001 – Equation 3). Research by Ward et al. (2002) indicated that the Williams (1986) equation, at times, under-predicted the belt width dimensions. As such, a modified approach to the relation, which incorporates the average bankfull width and a 20% factor of safety, was applied.

$$B_w = ([18*A^{0.65}]) \quad \text{[Eq. 1]}$$
$$B_w = ([4.3*W_b^{1.12}])*1.2 \quad \text{[Eq. 2]}$$
$$B_w = ([6*W_b^{1.12}]+W_b) \quad \text{[Eq. 3]}$$

Given that the empirical models were not developed based on channels in Southern Ontario, and to ensure an integrated and comprehensive approach, model results were averaged to provide an output for the empirical method. Results of the empirical meander belt analysis, which recommends a dimension of 18 m are summarized in **Table 4**. The meander belt limits were then reviewed to ensure that the dimension was also sufficient to capture areas of standing water or saturated soil that had been observed during the field investigation.

To confirm that the modelled approach provided results that could be considered appropriate for Reach UBT-1, the recommended 18 m meander belt dimension was applied to Reach UBT-2, which displays a more natural channel planform and was considered to represent a suitable reference reach condition. As illustrated in **Figure 3**, the recommended meander belt dimension of 18 m is sufficient to accommodate the governing meander amplitude of 10 m, plus the maximum observed bankfull channel width of 2.5 m, and an additional 5.5 m factor of safety (2.25 m either side) to account for long-term adjustments in channel form**.**

Table 4. Recommended Meander Belt – Reach UBT-1.

Reach	Empirical Approach				Recommended Meander Belt (m)
	Williams – Area (m) (1986)	Williams – Width (m) (1986)	Ward – Width (m) (2001)	Average (m)	
UBT-1	20	14	18	18	18

8. Policy Conformance

As the procedures used to delineate the meander belt are in accordance with applicable guidelines (TRCA 2004) and Provincial Policy, it is our opinion that the findings of this report are in conformance with Ontario Regulation 179/06 and LSRCA Policies.

9. Conclusions

Beacon Environmental Limited (Beacon) was retained by Bridgebrook Corporation to undertake a geomorphic assessment for the subject property located at 7370 Centre Road (Part of Lot 33, Concession 6), in the Township of Uxbridge, Regional Municipality of Durham. A tributary of Uxbridge Brook traverses the southeast corner of the subject property. The purpose of this geomorphic assessment is to characterize existing conditions along the portion of the tributary within the subject property and delineate the meander belt to inform the determination of environmental constraint limits. The following points summarize the key findings of this study:

- A review of background information and aerial imagery indicated that minimal land use change has occurred within the subject property over the available historic record. Adjustments in channel form over time were limited to the historic channelization of the Uxbridge Brook tributary within the subject property.

- Rapid geomorphic assessment results for Reaches UBT-1 and UBT-2 identified the reaches as being in transition or stressed (score of 0.22 and 0.26, respectively).

- The RSAT assessment indicated that Reaches UBT-1 and UBT-2 displayed a fair degree of stream health, with riparian habitat and physical instream habitat conditions noted as limiting factors to overall stream health.

- Referencing an empirical modelling approach and bankfull dimensions from the field assessment, a meander belt width of 18 m is recommended for Reach UBT-1. This dimension was applied to the more naturalized downstream Reach UBT-2 in order to confirm that the empirical approach provided appropriate recommendations.

- The findings of this study are in conformance with Ontario Regulation 179/06.

Should you have any questions or require any additional information please contact the undersigned.

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UBT-1

UBT-2

10 m

Centre Road

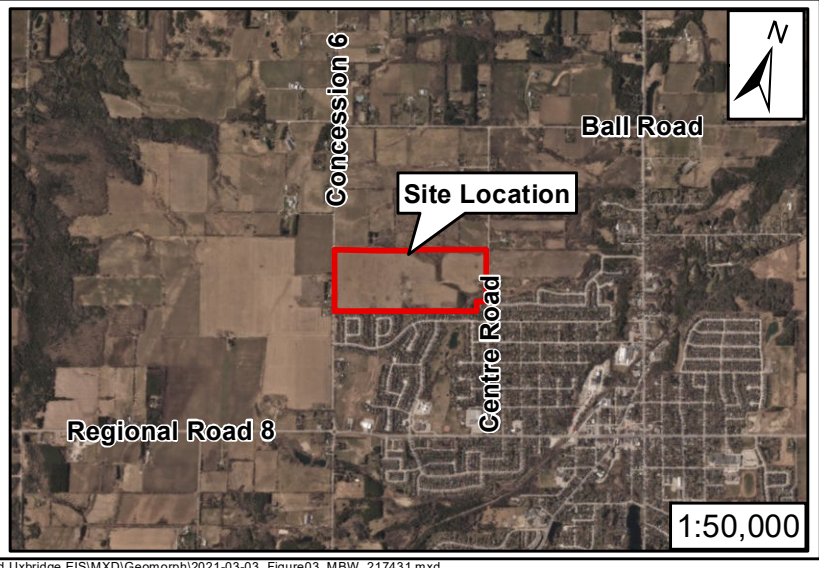
Bolton Drive

Legend

- Subject Property
- Reach Break
- Extent Assessed

Meander Belt (18 m)

- Meander Belt within Subject Property
- Reference Reach
- Reference Reach Meander Amplitude (10 m)
- Watercourse (MNRF 2019)



Meander Belt

Figure 3

7370 Centre Road, Uxbridge,
Geomorphic Assessment

BEACON ENVIRONMENTAL

Project: 217431.1
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Client: Bridgebrook Corporation

Prepared by: DU
Checked by: SG

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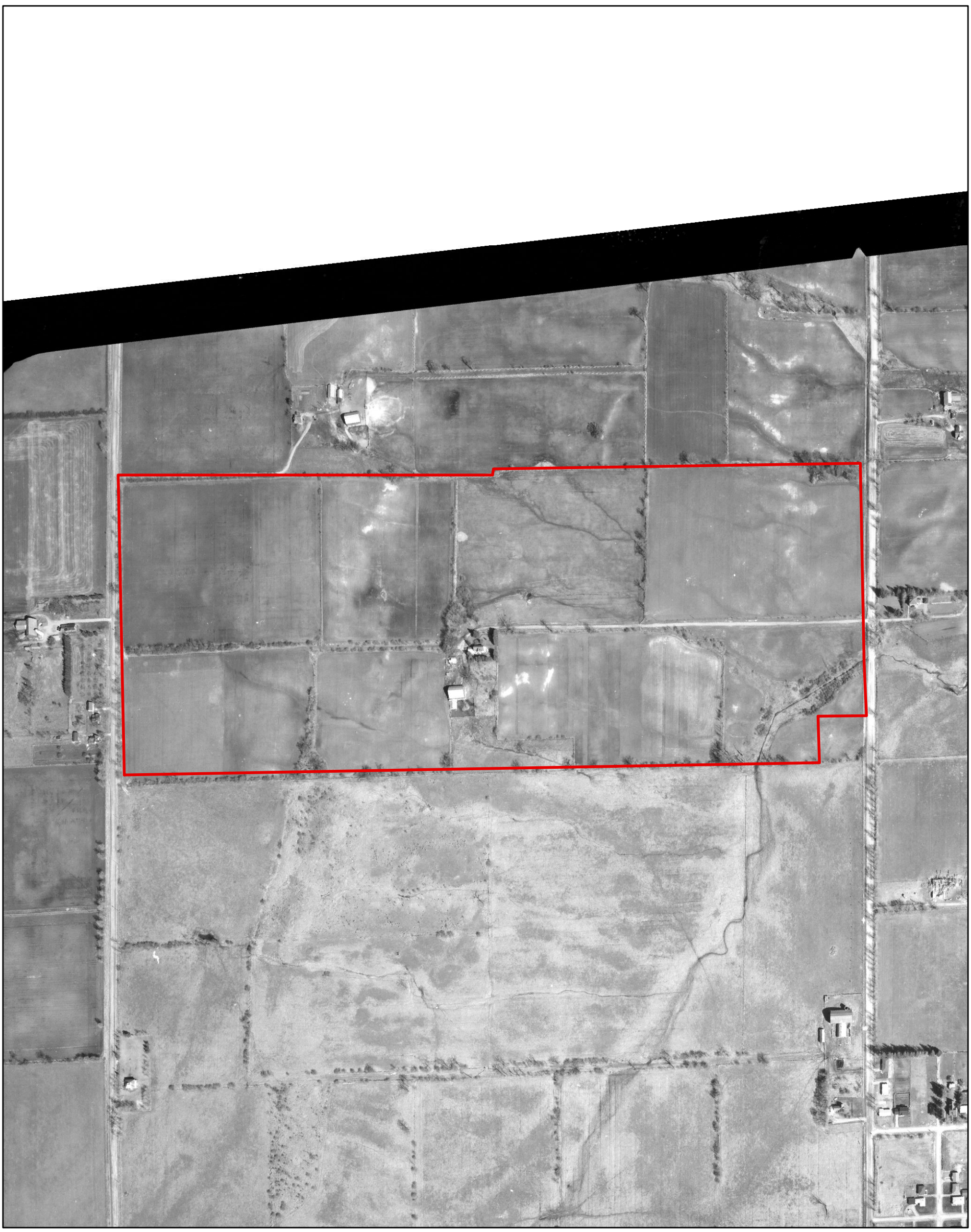
Appendix A

Historical Assessment



Legend

Subject Property (Approximate)

Historical Assessment	**1967**

7370 Centre Road Geomorphic Assessment
Uxbridge Brook Tributary, Township of Uxbridge

BEACON ENVIRONMENTAL

Project: 217431.1
Last Revised: March, 2021

Client: Bridgebrook Corporation

Prepared by: DU
Checked by: SG

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Legend

Subject Property (Approximate)

Historical Assessment	**1974**

7370 Centre Road Geomorphic Assessment
Uxbridge Brook Tributary, Township of Uxbridge

BEACON ENVIRONMENTAL

Project: 217431.1
Last Revised: March, 2021

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Legend

Subject Property (Approximate)

Historical Assessment	**1989**

7370 Centre Road Geomorphic Assessment
Uxbridge Brook Tributary, Township of Uxbridge

BEACON ENVIRONMENTAL

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1:5,000

0 100 200 m

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Legend

Subject Property

Historical Assessment	2002

7370 Centre Road Geomorphic Assessment
Uxbridge Brook Tributary, Township of Uxbridge

BEACON ENVIRONMENTAL

Project: 217431.1
Last Revised: March, 2021

Client: Bridgebrook Corporation	Prepared by: DU Checked by: SG

N

1:5,000

0 100 200 m

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Legend

Subject Property

Historical Assessment	2018

7370 Centre Road Geomorphic Assessment
Uxbridge Brook Tributary, Township of Uxbridge

BEACON ENVIRONMENTAL

Project: 217431.1
Last Revised: March, 2021

Client: Bridgebrook Corporation	Prepared by: DU Checked by: SG

N | 1:5,000 | 0 100 200 m

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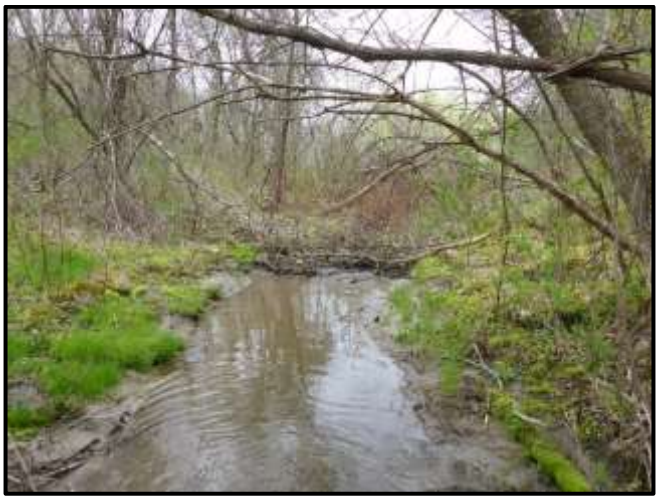
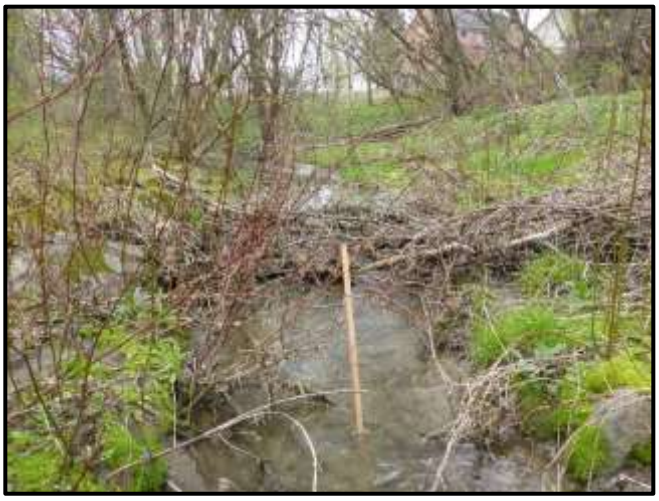
Appendix B

Photographic Record

Photograph 1.
Reach UBT-1
Outlet structure of existing upstream online pond, south of Bolton Drive.

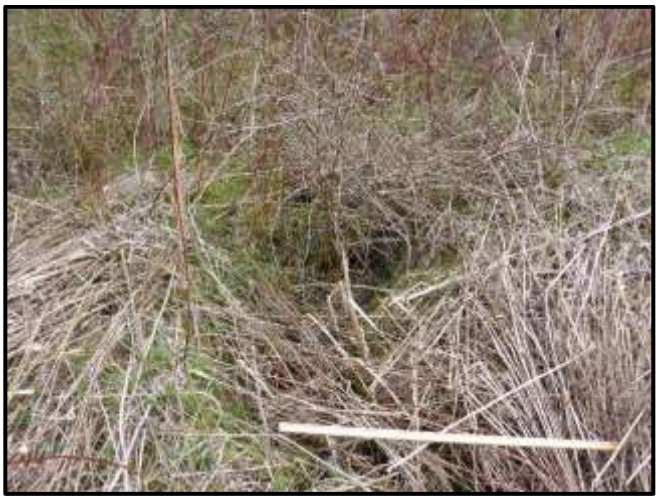


Photograph 2.
Reach UBT-1
Downstream view of general conditions at property limit.

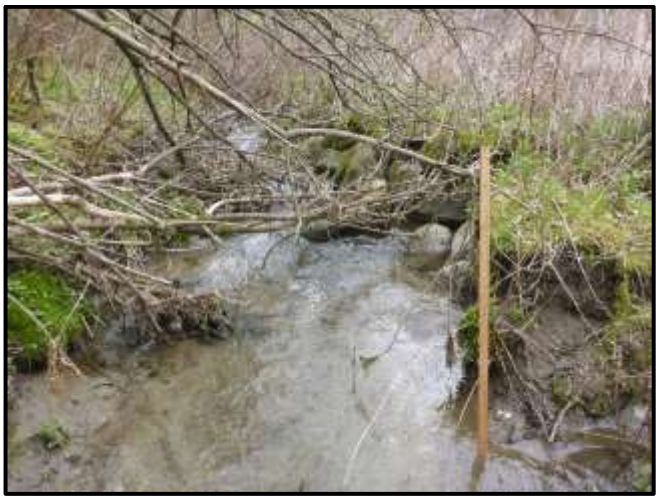


Photograph 3.
Reach UBT-1
Downstream-facing view of a wood debris jam within the channel.

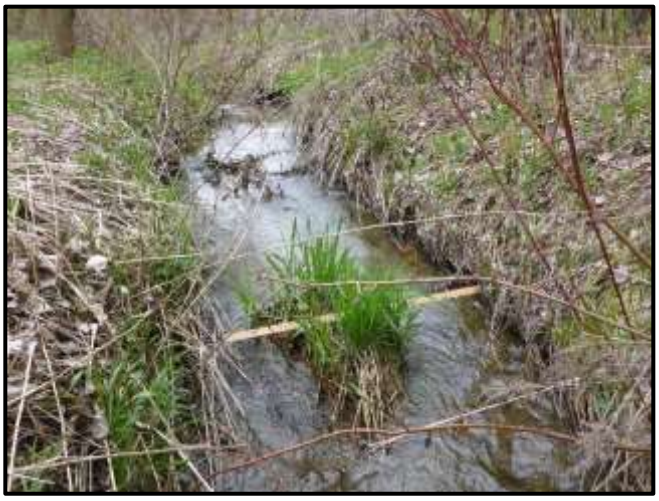
Photograph 4.
Reach UBT-1
Downstream-facing view of an informal crossing over the channel.



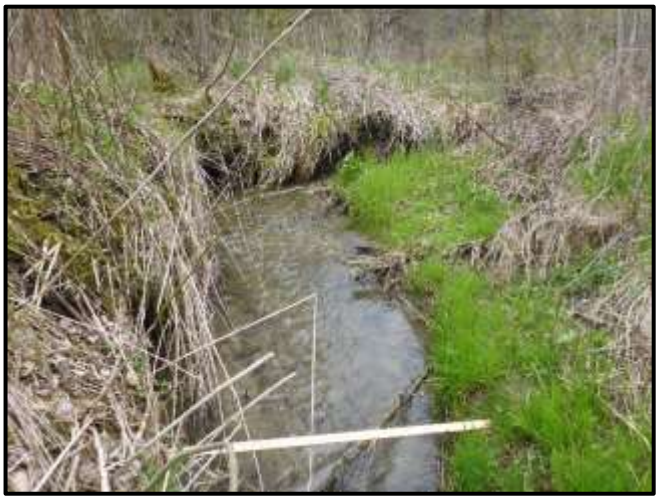
Photograph 5.
Reach UBT-1
Observed area of external drainage entering tributary.



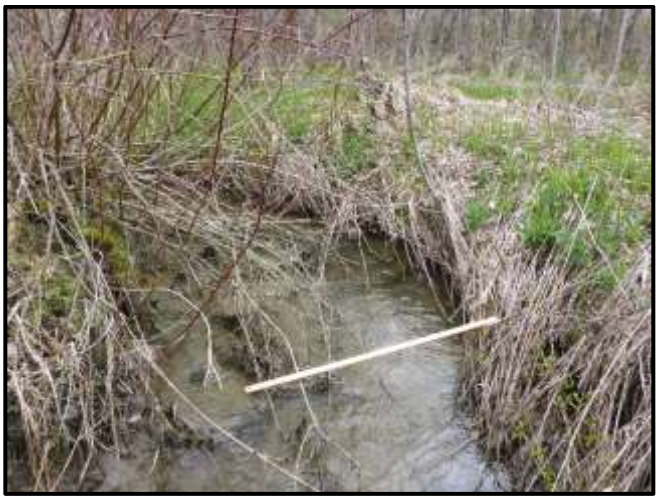
Photograph 6.
Reach UBT-1
Upstream view of instream wood debris and coarser cobble materials along channel bank.



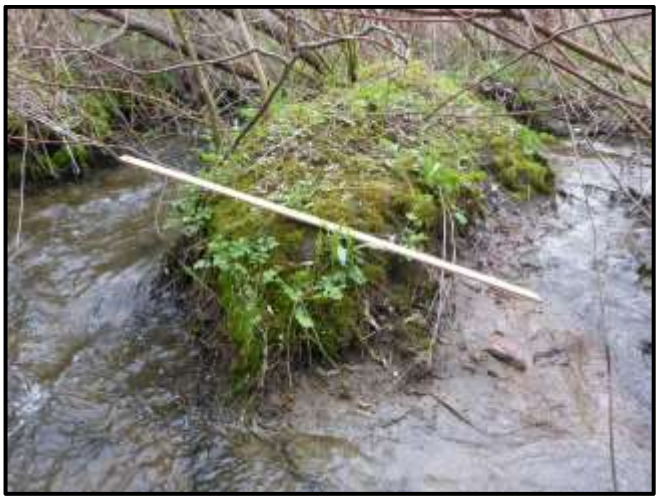
Photograph 7.
Reach UBT-1
Upstream view of emergent vegetation within the channel. Also note basal scour along the banks.



Photograph 8.
Reach UBT-1
Upstream view of basal scour and reworked point bar.

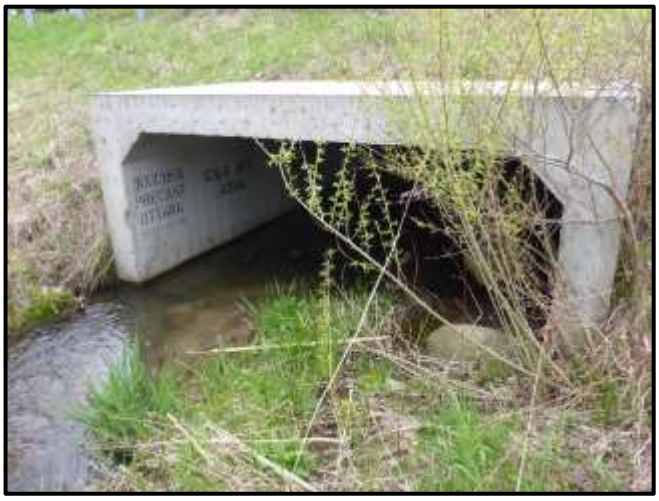


Photograph 9.
Reach UBT-1
Upstream view of basal scour along both inner and outer banks at meander bend.

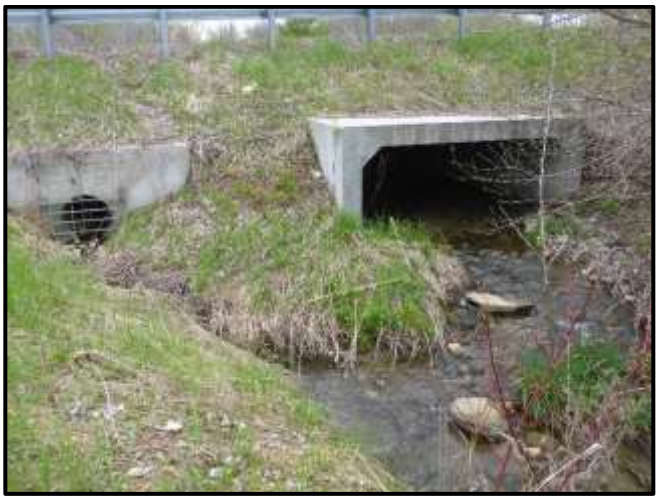


Photograph 10.
Reach UBT-1
Upstream view of secondary channel formation.

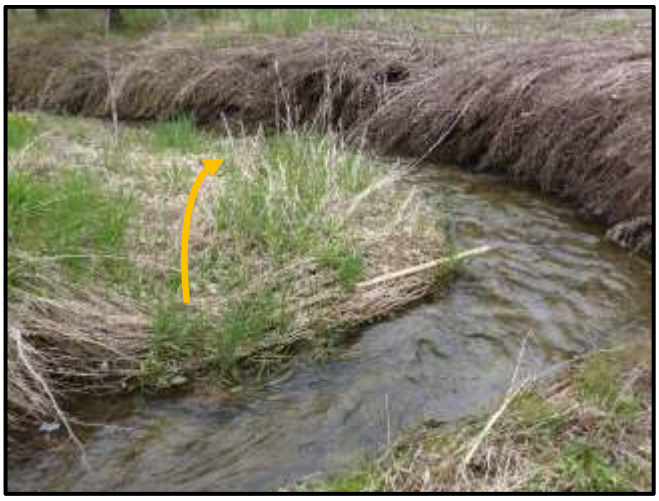
Photograph 11.
Reach UBT-1
Upstream view of riffle and chute formation (photo right).



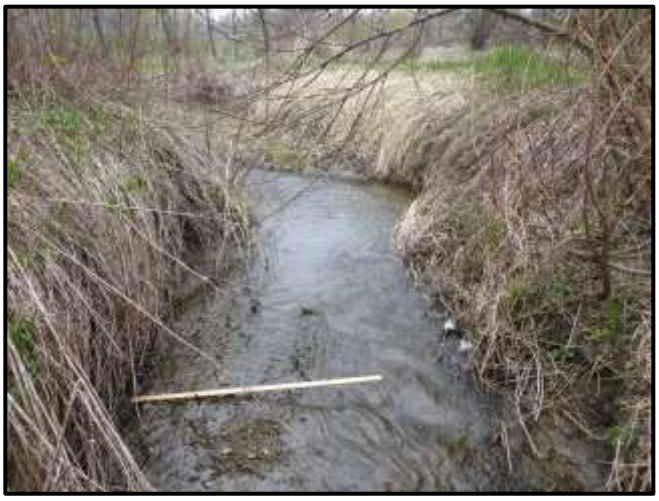
Photograph 12.
Reach UBT-1
Downstream view of Centre Road culvert.



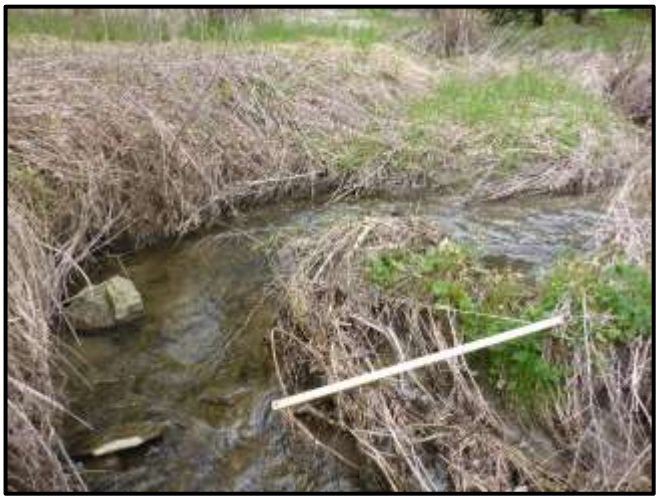
Photograph 13.
Reach UBT-2
Upstream view of Centre Road culvert and stormwater outlet.



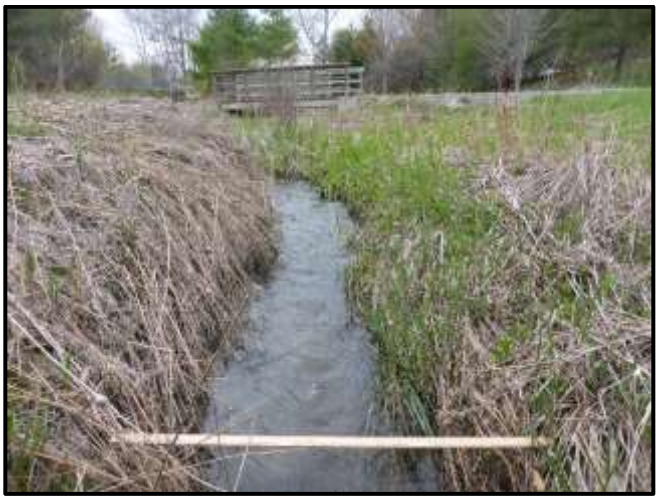
Photograph 14.
Reach UBT-2
Downstream view of basal scour along outside meander bend and evidence of chute formation along inside of bend (arrow).



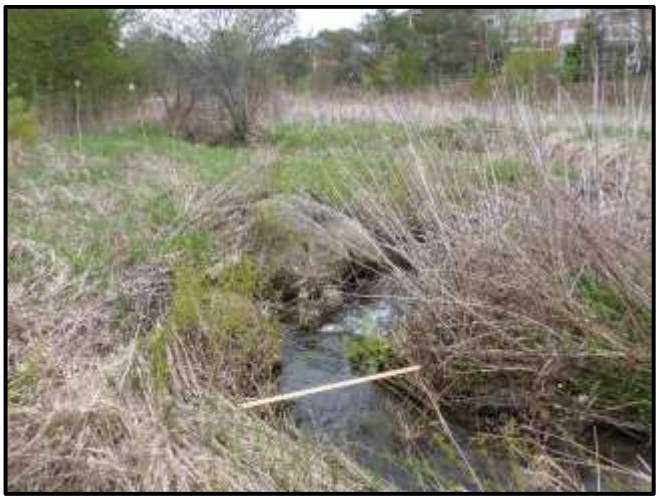
Photograph 15.
Reach UBT-2
Upstream view medial bar formation and basal scour along both banks through riffle.



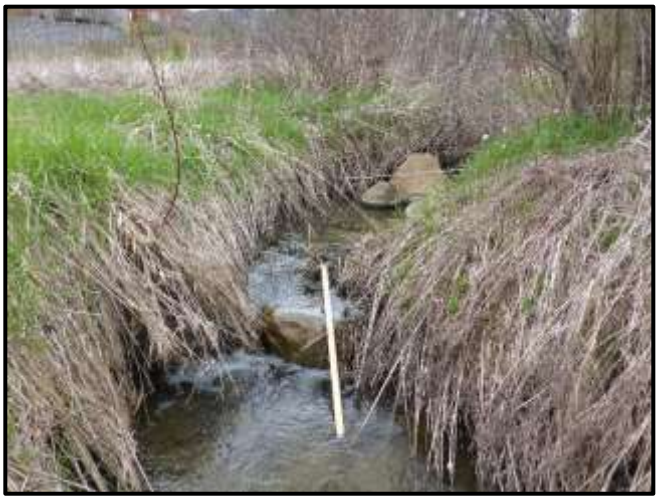
Photograph 16.
Reach UBT-2
Upstream view of evidence of planform adjustment – evolution of cut off meander bend (oxbow) in progress.



Photograph 17.
Reach UBT-2
Upstream view of a trail system and pedestrian crossing.



Photograph 18.
Reach UBT-2
Downstream view of general conditions.



Photograph 19.
Reach UBT-2
Upstream view of steep cascade riffle and basal scour along channel banks.

Photograph 20.
Reach UBT-2
Upstream view of the general conditions at limit of extent assessed.