Cardinal Creek Village – South Side

Headwater Drainage Feature Assessment

Prepared for:
Taggard Construction Limited
3187 Albion Rd. S
Ottawa, Ontario
K1V 8Y3

Prepared by:
Bowfin Environmental Consulting Inc.
168 Montreal Road
Cornwall, Ontario
K6H 1B3

March 2021

Table of Contents

List of Figures

List of Tables

List of Photos

1.0 INTRODUCTION

Taggart Construction, here after referred to as the proponent, is proposing to develop the next phase of their Cardinal Creek Village property, located at the corner of Old Montreal Road and Cox Country Road (Figure 1). It is part of Lot 25 and 26 in Concession 1 From the Ottawa River Cumberland Township. Bowfin Environmental Consulting (Bowfin) has been retained to provide the Headwater Drainage Feature Assessment Report.

The entire property is 50 ha, most of which is agricultural land. Corn was grown on the site in 2019 and soy in 2020. The area the to the west of the property has been disturbed as part of site preparation for urban residential development . An assessment of the fish habitat was completed in 2012 for the area surrounding, and including, this site. At that time, there was no Headwater Drainage Feature Assessment process. This report updates those results to this newer protocol. The South Tributary, which runs along the southern side of the property, was not assessed here since the watercourse, as well as its forested valley land, is scheduled to be protected and will not be directly impacted by this project. Further it is a permanent fish bearing waterbody (assessed in 2012).

Figure 1: General Location of Site

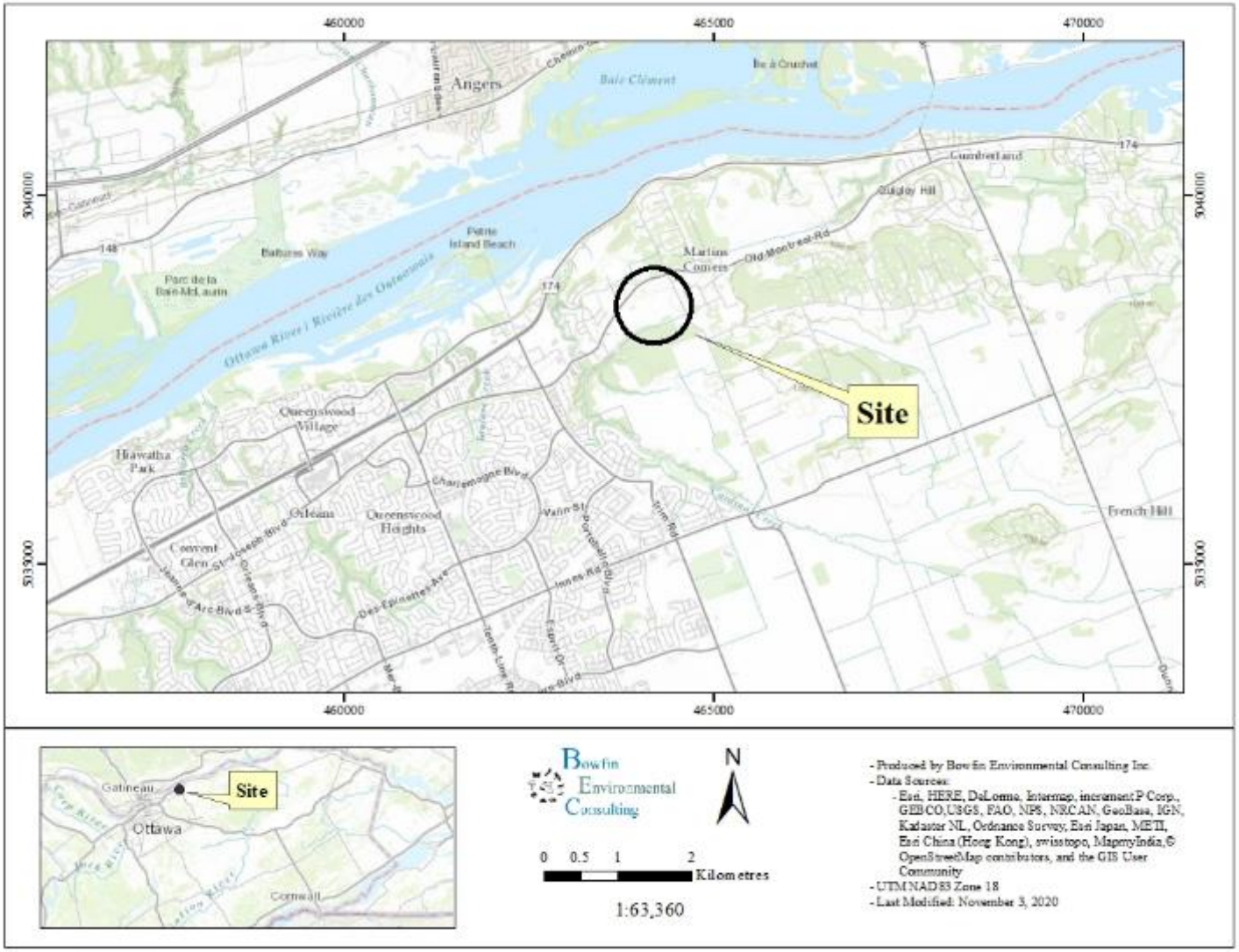
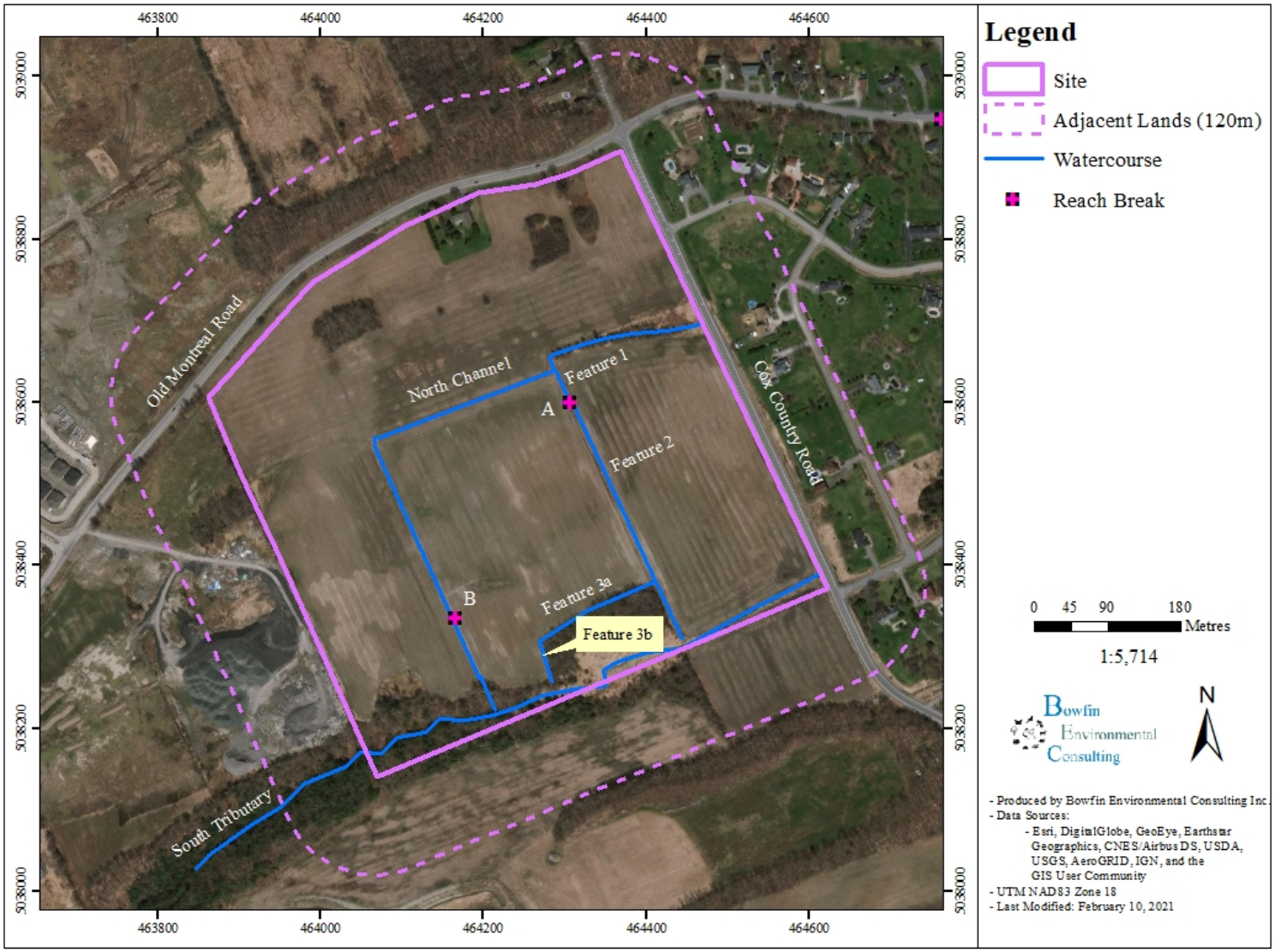


Figure 2: Location of Features and Watercourses.



v \

2.0 METHODOLOGY

The following is the Headwater Drainage Feature Assessment Report involves the evaluation of the site's headwater drainage features based on the guidelines outlined in the *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (here after referred to as the Guidelines) (prepared by Credit Valley Conservation Authority and Toronto and Region Conservation, revised July 2014). The Guideline is divided into three parts.

- Part 1 - Evaluation and various suggested study designs/methods
- Part 2 - Classification of features
- Part 3 - Management Recommendations.

As per the definition of the catchment area for a headwater in this guideline and the relevant *Ontario Stream Assessment Protocol* (OSAP) the catchment must be at least 2.5 ha and less than 1000 ha (or <10 km^2).

The evaluation of the features requires the collection of various data: habitat descriptions, fish community sampling and amphibian surveys. The methodologies for these are described below in Section 2. A brief outline of the habitats is provided in Section 3. The detailed descriptions of stations and fish community sampling results are in Appendix A.

The field work included habitat assessment, fish community sampling, amphibian surveys and headwater assessments completed from April to September 2020.

2.1 Habitat Description

The features within the study area were described based on the MTO *Environmental Guide for Fish and Fish Habitat October* (2006) and the *Ontario Stream Assessment Protocol* (2013). The channel morphology was described using evenly spaced transects upon which data was recorded from evenly spaced observation points. The data collected included: channel width, wetted width, bankfull depth, water depth, substrate size, morphological units, and in-stream cover. These results are provided in the Appendix A.

2.2 Fish Community Sampling

Fish community sampling was performed to document the use of the site by fish during the spring of 2020. The community was sampled using an electrofishing unit and dipnets.

2.3 Amphibian Surveys

Nighttime amphibian calling surveys were completed as per the *Environment Canada Marsh Monitoring Program* (MMP) guide. The protocol is summarized below:

- The surveys were completed 3 times during the spring, early summer, and during late summer (once during three survey periods to collect data on all species).
- Observations began 30 minutes after sunset and end before midnight.
- Each station was surveyed for 3 minutes during which time the species and the calling code were recorded for each of the following distances: 0-50m, 50-100m, and >100m. Additional notes were taken on whether amphibians were in the feature being assessed. The calling codes were recorded as one of:
    - Code 1: Calls not simultaneous, number of individuals can be accurately counted
    - Code 2: Some calls simultaneous, number of individuals can be reliably estimated
    - Code 3: Full chorus, calls continuous and overlapping, number of individuals cannot be reliably estimated
- Surveys were only conducted if the wind strength was Code 0, 1, 2 or 3 on the Beaufort Wind Scale.
- The MMP protocol calls for the stations to be separated by at least 500 m however, in this instance, the stations were positioned to capture the amphibian data on the various drainage features and as such, some stations were closer.

All surveys include the recording of the following information:

- Date
- Name of observer(s) conducting field work
- Time (start and end time, duration)
- Weather conditions (temperature, % cloud cover, wind)
- GPS location
- Species presence and abundance information

3.0 RESULTS

3.1 Site Investigations

3.1.2 Habitat and Fish Community Summary

Three drainage features were identified in the study area for this site, in addition to the North Channel. The sampling stations, descriptions and photographs are in Appendix A. All features are part of the Cardinal Creek Watershed and are agricultural ditches. All features begin on the site and either connect to the South Tributary or have standing water (that does not flow). This is due to gradient issues causing pooling instead of flowing towards South Tributary (even during the initial spring visit which occurred when snow was still present in the shaded areas).

North Channel

North Channel begins at a culvert under Cox Country Road and runs west for 440 m, in a windrow through an agricultural field. It then veers south for 360 m before flowing into South Tributary. There is a reach break (reach break "B") present near the downstream portion of the channel. Downstream of this break, there is much more erosion and the channel gets narrower and the banks taller. There is a fish barrier present in the form of a >2 m drop straight down the valley slope of the South Tributary, preventing the North Channel from being fish habitat (confirmed with sampling in 2012 and 2020).

Photo 1: North Channel through the windrow, looking upstream (April 6, 2020).

Photo 2: North Channel in the agricultural field (April 28, 2020)

Photo 3: North Channel, downstream of the reach break B (September 21, 2020)

Photo 4: Downstream portion of the North Channel showing the physical barrier (April 6, 2020)

Feature 1

Feature 1 is found on the east side of the site. It is a short feature (35 m) that is connected to the North Channel. This channel is inclined to the north and there was a gradient barrier between it and the Feature 2. This is compounded by a blocked culvert.

Photo 5: Feature 1 (April 6, 2020)

Feature 2

Feature 2 is situated along the same alignment as Feature 1 but is inclined to the south towards the South Tributary. Its total length is 330 m. There was no water present on the south (downstream) side during the initial visit (which took place early in the season, ice/snow was still present on the downstream end). Note that the water levels within the lower ±10 m are the result of the levels in the South Tributary. This lower section is not considered a part of Feature 2.

Photo 6: Feature 2, looking upstream from the center of the feature (April 6, 2020)

Feature 3

Feature 3 refers to the channel that is situated on the north and west sides of the forested area. This feature is connected to both Feature 2 and the South Tributary. Very little of this channel has any incline. The shading from the forest resulted in thick snow cover on April 6 and no flowing water was present anywhere. The feature was visited again on April 16 at which time there was standing water in the entire feature but there was no contributing water to Feature 2. Because of the strange alignment, this feature has been separated in two sections. The portion labelled as 3a is that along the north side of the forest and is 150 m long. The portion labelled as 3b is that along the west side of the forest and is 65 m. It is noted that there was no flowing water in all but the very southwest section (last few meters) which flowed down the valley bank of the South Tributary.

Photo 7: Feature 3a, looking upstream (April 28. 2020)

Photo 8: Feature 3b that is inclined and flows to South Tributary (April 28, 2020

3.1.1 Summary of Visits and Sampling Site Locations

Several visits were completed between April and September 2020. These included: flow visits, fish community sampling, fish habitat assessments, and amphibian surveys. Environmental conditions and the primary purpose for each visit are described in Table 1 below.

Table 1: Summary of Dates, Times of Site Investigations

Date	Time (h)	Staff	Air Temperature (Min-Max) °C	Cloud Cover (%) Beaufort Wind Scale [Descriptor (scale)]	Purpose
April 6, 2020	1030-1430	M. Lavictoire S. Lafrance	3.0 – 11.0 (-2.0-14.2)	Clear skies Wind: light air (1)	- Fish Community Sampling - Flow visit #1
April 16, 2020	1030-1245	M. Lavictoire C. Fontaine	3.0-15.0 (-5.4-5.8)	N/A	- Fish Habitat Description
April 28, 2020	1700-1800	S. Lafrance C. Fontaine	14.0 (-0.9-15.1)	10% cloud cover Wind: light air (1)	- Flow visit #2
April 29, 2020	2030-2100	M. Lavictoire	13.0 (3.0-16.2)	Overcast, light rain Wind: light breezes (2)	- Amphibian Survey #1
May 19, 2020	2215-2230	C. Fontaine A. Yates	16,0 (7.5-19.8)	Clear skies, Light air (1)	- Amphibian Survey #2
June 16, 2020	2145-2215	S. Lafrance A. Yates	21.0 (8.7-27.3)	Clear skies, calm (0)	- Amphibian Survey #3
July 27, 2020	1315-1400	C. Fontaine	30.0 (23.2-31.6)	Overcast, light breeze (2)	- Flow visit #3
September 21, 2020	0915-1115	M. Lavictoire	6.0 (0.1-17.8)	Clear skies, light air (1)	- Fish Habitat Description

M. Lavictoire – Michelle (Nunas) Lavictoire – B. Sc. Wildlife Resources and M.Sc. Natural Resources
S. Lafrance – Sophie Lafrance – B.Sc. Biology and Graduate Certificate in Ecological Restoration
C. Fontaine – Cody Fontaine - Fish and Wildlife Technologist
A. Yates – Abby Yates – B.Sc. Env. Ecology

*Min-Max Temp Taken From: Environment Canada. National Climate Data and Information Archive. Ottawa International Airport. Available http://climate.weatheroffice.gc.ca/ [November 3, 2020]

4.0 HEADWATER DRAINAGE FEATURES ASSESSMENT

4.1 Classification

The entire site is an agricultural field. All features have also been disturbed and have gradient issues affecting their ability to contribute flow to downstream waterbodies.

4.1.1 Step 1: Hydrology Classification

In Step 1 the flow is classified based on the amounts recorded during the three flow visits. These are summarized in Table 3 (as per OSAP S4.M10). There were no significant rainfall events in the week before any flow visit, however near 10 mm fell prior to the first two visits (Table 2). To further put the field work results into context of the conditions of 2020, the snowpack and water levels in the general area have been summarized. The winter of 2019-2020 was unusually mild, with lower than average snowfall (just under 200 cm by early April), resulting in a below-average snowpack. By early April, there was little amount of snowpack left in areas that were not shaded and all snow was gone by late April (personal observations). Rideau Valley Conservation Authority issued flood warning conditions from late March to early May. Water levels remained normal until June 4, 2020, when RVCA issued a minor low water status that lasted until July 15, 2020. From July 15 to August 5, 2020, the conservation authority issued a moderate low water status. A minor low water status was put back in place on August 5th until September 2, where water levels went back to normal.

Table 2: Summary of Rainfall for the 7 Days Preceding the Flow Visits

Dates	Total Rainfall (mm)
March 30- April 5	9.6
April 21 – April 27	8.5
July 20 – July 26	2.7

Total Rainfall taken from: Environment Canada. 2017. National Climate Data and Information Archive – Ottawa INTL. On-line (http://climate.weatheroffice.gc.ca) accessed November 4, 2020.

Table 3: Hydrology classification features using data from OSAP S4.

Features/ Channel	Definitions of Flow Influence	Flow Conditions	Feature Type Code	Comments	Hydrology Classification
North Channel	Spring Freshet	Standing Water (2) to Surface Flow substantial (5)	Channelized or constrained (2)	Gradient issues throughout resulted. in the upstream portion of the channel to have standing water. The flow in late April is created by the narrowing of the channel in certain areas and the large drop downstream, in the south tributary's valley.	Limited to Contributing
	Late April - May	Standing Water (2) to Surface Flow substantial (5)			
	July - August	Dry (1)			
Feature 1	Spring Freshet	Standing water (2)	Channelized or constrained (2)	Gradient issues keep this feature from flowing.	Limited
	Late April - May	Standing water (2)			
	July - August	Dry (1)			
Feature 2	Spring Freshet	Standing Water (2)	Channelized or constrained (2)	The first 20 meters found downstream of the feature had flowing water but are part of South Tributary due to backwater effects. The feature was standing	Limited
	Late April - May	Standing Water (2)			
	July - August	Dry (1)			

Features/ Channel	Definitions of Flow Influence	Flow Conditions	Feature Type Code	Comments	Hydrology Classification
				water due to gradient issues.	
Feature 3a	Spring Freshet	Standing water (2)	Channelized or constrained (2)	The area was covered in snow on April 6th. As such, another visit was done on April 16th. Gradient issues keep this feature from flowing. It was mostly dry in early April.	Limited
	Late April - May	Standing water (2)			
	July - August	Dry (1)			
Feature 3b	Spring Freshet	Standing water (2)	Channelized or constrained (2)	The area was covered in snow on April 6th. As such, another visit was done on April 16th. Gradient issues keep this feature from flowing. It was mostly dry in early April.	Limited
	Late April - May	Standing water (2)			
	July - August	Dry (1)			

Figure 3: Summary of Flow Conditions – Freshet Visit and Second Visit (April 6, 16 and 28, 2020)

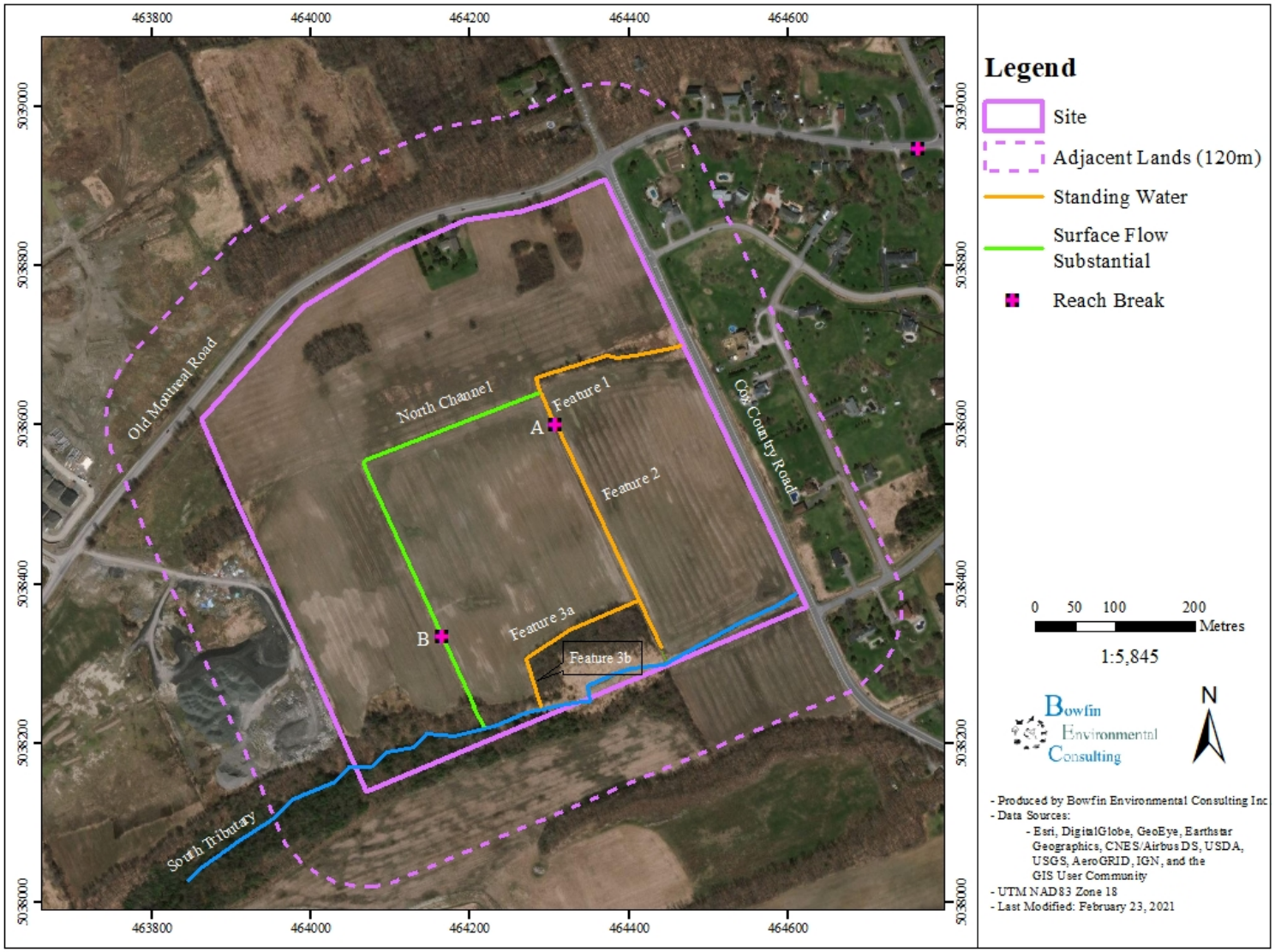
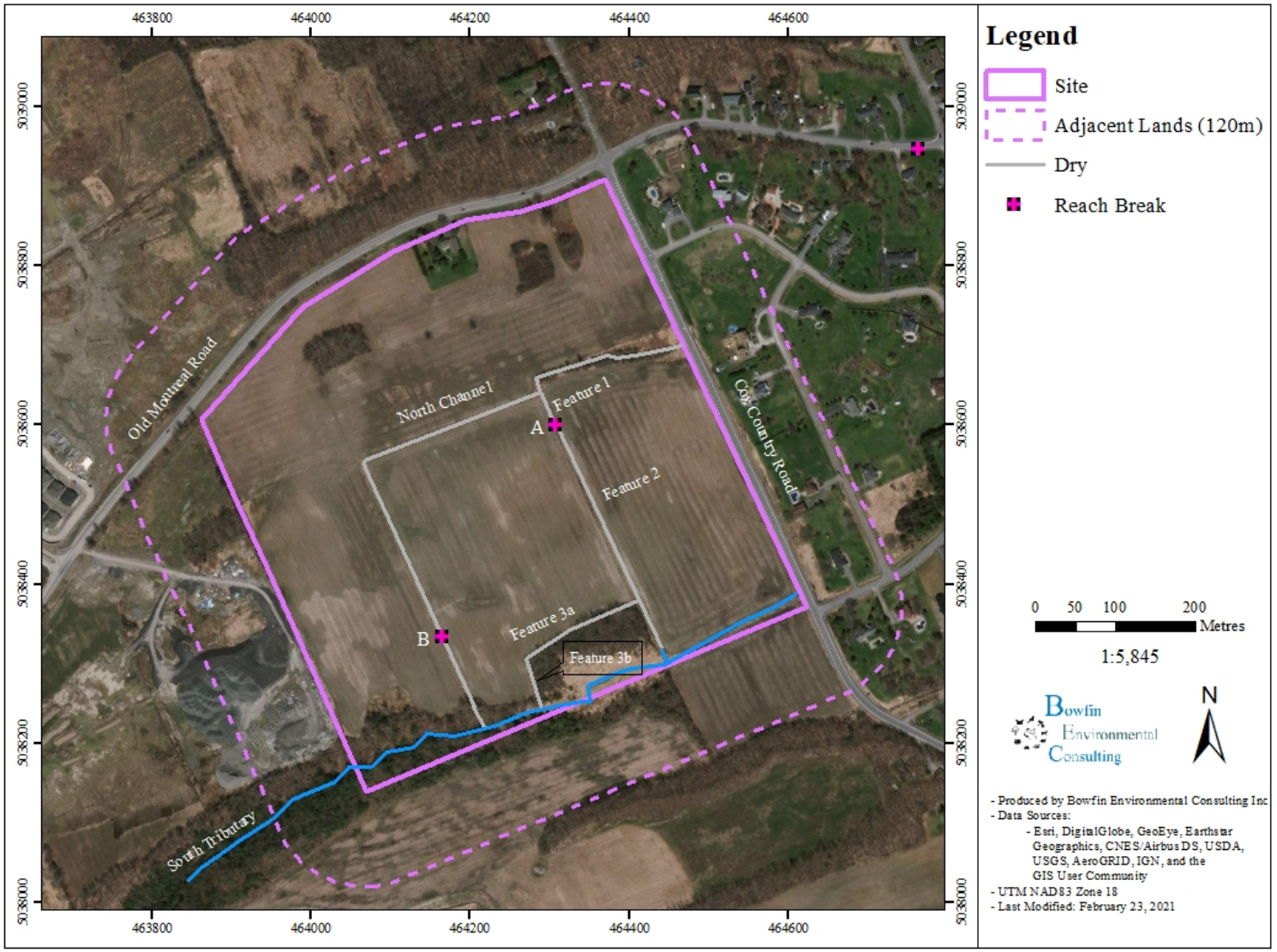


Figure 4: Summary of Flow Conditions – Summer Visit (July 27, 2020)



4.1.2 Step 2: Riparian Classification

In Step 2 the riparian habitat is classified based on the width and type of vegetation on the banks. These are summarized in Table 4.

Table 4: Riparian Classification

Features/ Channel	OSAP S4.M10 Riparian Code	Riparian Classification	Comments
North Channel	Cropped Land (3)	Limited	The feature is surrounded by agricultural land along most of its length. The upstream area is surrounded by a thin windrow. The downstream area is in the South Tributary valley, which is forested, but represents too small of a proportion to be considered in the classification for this feature.
Feature 1	Cropped Land (3)	Limited	The feature is surrounded by agricultural land along its entire length.
Feature 2	Cropped Land (3)	Limited to Important	The feature is surrounded by agricultural land along most of its length. The west bank's riparian area is forested at the downstream end, lifting part of the classification to important.
Feature 3a	Forest (6) Cropped Land (3)	Important	The north bank's riparian habitat is cropped land, but the south one is forested.
Feature 3b	Forest (6) Cropped Land (3)	Important	The west bank's riparian habitat is cropped land, but the east one is forested.

4.1.3 Step 3: Fish and Fish Habitat Classification

The fish habitat is classified based on fish sampling completed during the spring, all channels were dry by summer and as such do not provide year-round fish habitat. See Appendix A for the complete Fish Habitat and Community Descriptions.

Table 5: Fish and Fish Habitat Classification

Features/ Channel	Fish/Fish Habitat Classification	Comments
North Channel (Station 1, 2, and 3)	Contributing	No fish were captured or observed during the spring. The channel was dry in the summer. The large drop present downstream keep fish from getting into the channel. No fish were captured in 2012 either.
Feature 1	Contributing	No fish were captured or observed during the spring. The channel was dry in the summer.
Feature 2 (Station 4)	Contributing	No fish were captured or observed during the spring. The channel was dry in the summer.
Feature 3a (Station 5)	Contributing	The feature was not fish habitat, the area was mostly dry in April.
Feature 3b (Station 6)	Contributing	The feature was not fish habitat, the area was mostly dry in April. There was also a fish barrier present downstream.
Feature 4 (Station 3)	Contributing	No fish were captured or observed during spring and dry later.

4.1.4 Step 4: Terrestrial Habitat Classification

This step is more of a classification of amphibian habitat than of the terrestrial habitat. According to the guidelines, only those features considered wetland habitats can be considered Important or Valued. Features classed as Contributing are those that may or do provide a linkage between habitats for wildlife movement and Limited is given to those that do not meet any of the above criteria. OSAP guidelines indicate that three visits should be completed. These are summarized in Table 6.

Table 6: Terrestrial Habitat Classification

Features/ Channel	OSAP S4.M10 Feature Type Code	Marsh Monitoring Protocol Calling Code	Comments	Classification
North Channel	Channelized or constrained (2)	1	Three gray treefrogs were heard in the feature. However, since the feature does not act as a movement corridor for wetland habitats, it has limited classification.	Limited
Feature 1	Channelized or constrained (2)	1	Two gray treefrogs were heard in the feature. However, since the feature does not act as a movement corridor for wetland habitats, it has limited classification.	Limited
Feature 2	Channelized or constrained (2)	0	No calls within the feature.	Limited
Feature 3a	Channelized or constrained (2)	0	No calls within the feature.	Limited
Feature 3b	Channelized or constrained (2)	0	No calls within the feature.	Limited

4.2 Part 3 – Management Recommendations

The management recommendations are grouped into six categories: Protection, Conservation, Mitigation, Maintain Recharge, Maintain/ Replicate Terrestrial Linkage, and No Management Required. The key functions that determined the management recommendations for each feature or reach are highlighted in green in Table 7, it is these functions that should be managed.

No Management Required

The lack of water in Features 1, 2 and 3 is the main reason with they receive the No Management Required recommendation. This fits with the data collected during the site investigations. With the standing to dry conditions in early April, these channels were not contributing significant flow to downstream fish habitat and had little to no amphibian usage.

The only comment on these features is that the small length on the downstream end of Feature 2 was part of the South Tributary (backwater from South Tributary) and should be considered fish habitat. The setback from the South Tributary should be extended at this location to protect this little piece of habitat.

Mitigation

The North Channel comes out as Mitigation on its downstream side, where it experiences flowing water. This is restricted to the area that has eroded creating a narrower channel with an incline. Further upstream, the majority of the feature would come out as No Management Required because of the standing water.

On the very downstream end, the valley is treed. This treed valley of the South Tributary is to be protected (as part of the protection of the South Tributary itself). As such, no additional measures are needed on the North Channel.

The Guidelines indicate that Mitigation consists of:

- Replicating or enhancing the functions through lot level conveyance measures (i.e. vegetated swales, with vegetation including a mixture of herbaceous and woody vegetation).
- Natural channel design is not required but the Guidelines indicate that the feature is to remain open in some form, including vegetated swales. However, the approved Cardinal Creek Village Concept Plan and Master Servicing Study for the urban site did not include retention of these features.
- The hydroperiod is to be maintained.
- Flow is to be provided to the downstream connection.

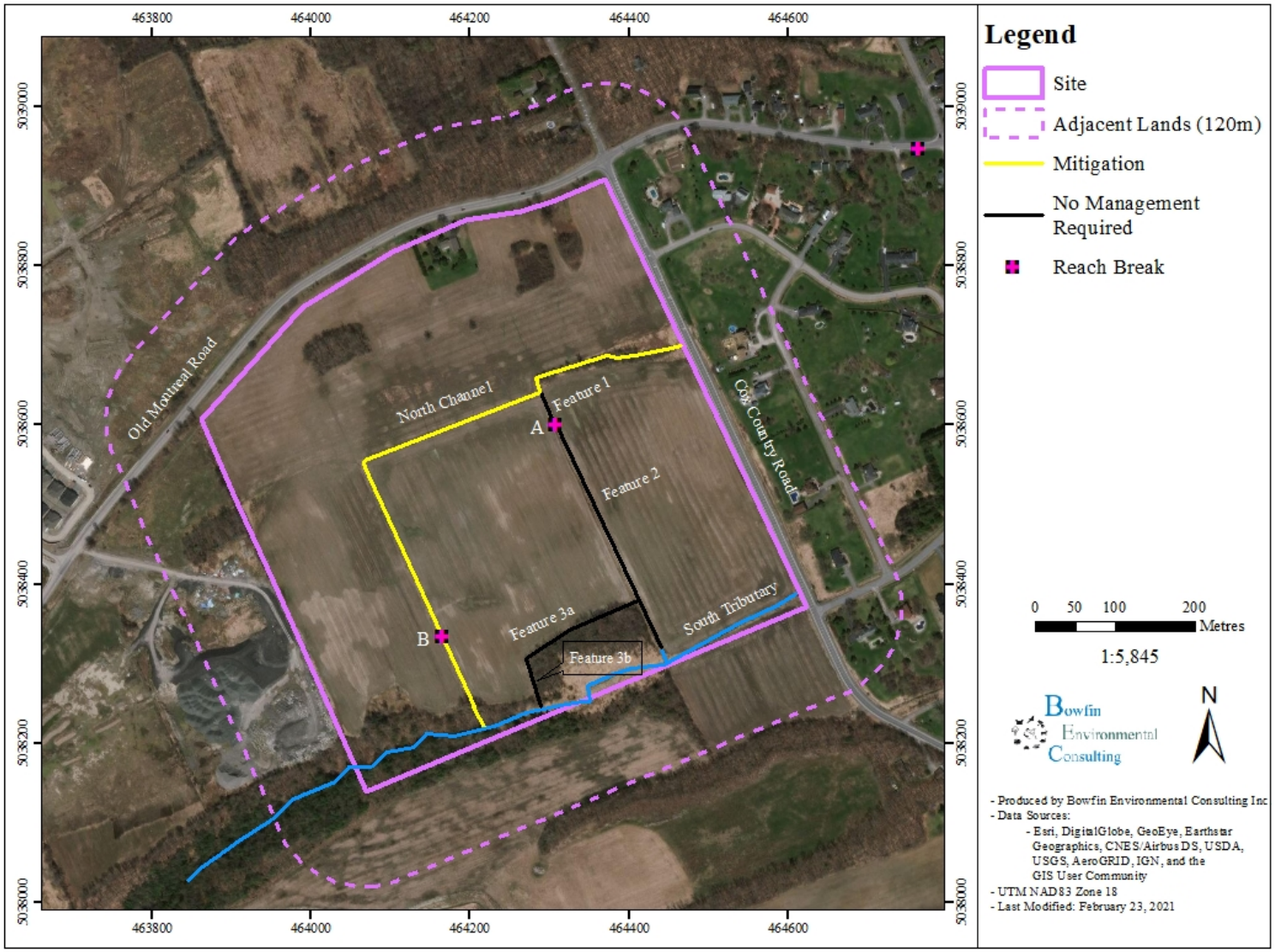
The field investigations found that this channel was not providing ecological functions (apart from a couple of tree frogs, not within wetland habitat and not sufficient to be significant). The flow was causing erosion and impacting the valley of South Tributary. It is recommended that this is considered during design and measures to prevent this erosion from continuing be implemented.

While the flow was classed as significant, this is a very low threshold to meet. It is recommended that the stormwater management of the site be designed to ensure that the water reaching the South Tributary is not negatively impacted in terms of quantity or quality.

Table 7: Evaluation, Classification and Management Summary

Features/ Channel	Hydrology Classification	Riparian Classification	Fish and Fish Habitat Classification	Terrestrial Habitat Classification	Management Recommendation
North Channel	**Contributing** (limited on upstream end)	Limited	Contributing	Limited	**Mitigation**
Feature 1	Limited	Limited	Contributing	Limited	No Management Required
Feature 2	Limited	Limited to Important	Contributing	Limited	No Management Required
Feature 3a	Limited	Important	Contributing	Limited	No Management Required
Feature 3b	Limited	Important	Contributing	Limited	No Management Required

Figure 5: Management Recommendations



5.0 REFERENCES

Bird Studies Canada, Environment Canada, and U.S. Environmental Protection Agency. (2008). Marsh Monitoring Program Participant's Handbook Surveying Amphibians. 20 pp.

Credit Valley Conservation, and Toronto Region Conservation Authority. (2014). Evaluation, Classification and Management of Headwater Drainage Features Guidelines. 26 pp.

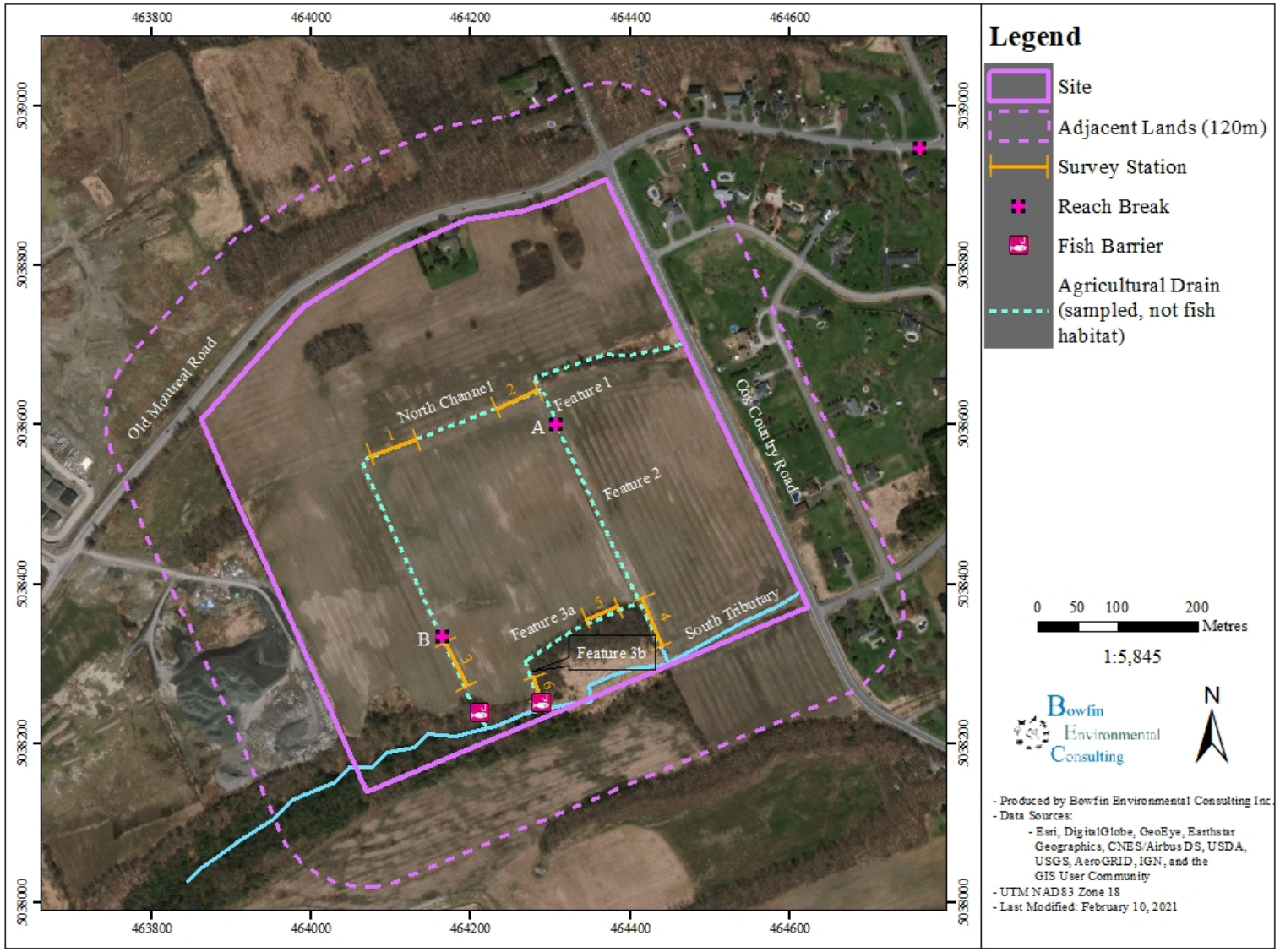
MTO (2006). *Environmental Guide for Fish and Fish Habitat, Section* 5: *Sensitivity of Fish and Fish Habitat*. Ministry of Transportation Ontario.

S Stanfield, L. (editor). (2013). *Ontario Stream Assessment Protocol*. Version 9.0. Fisheries Policy Section. Ontario Ministry of Natural Resources. Peterborough, Ontario. 505 pp

Appendix A: Habitat Description of Features

The entire site was flat, and some features did not flow, even during the early spring. All but the North Channel were poorly constructed resulting in gradient barriers. Six stations were established and are described below (Figure A).

Figure A: Fish Habitat and Sampling Stations



North Channel

North Channel begins at a culvert under Cox Country Road and runs west for 440 m, in a windrow through an agricultural field. It then veers south for 360 m before flowing into South Tributary. There is a reach break (reach break "B") present near the downstream portion of the channel. Downstream of B, there is much more erosion and the channel gets narrower and the banks are much taller. There is a fish barrier in the form as a large drop (>2 m tall straight down the valley bank of the South Tributary valley, preventing the North Channel from being fish habitat (confirmed with sampling in 2012 and 2020). Three stations (3) were established within the North Channel.

Station 1

This station was originally established in 2012 and was situated on the northwest corner of the feature, along the portion that had an east to west alignment. Station 1 was 60 m in length and was in the middle of the feature on site, just upstream of the bend. The average channel width was 1.8 m and the average bankfull height 13 cm. The average spring wetted width and depth were 0.9 m and 5 cm, respectively. The station was dry during the summer visit.

The substrate consisted entirely of fines and the stream morphology was a glide. The in-water cover throughout the station was provided by aquatic vegetation. Minor signs of erosion were noted on the left bank. The tops of the banks were partially vegetated (about 60%). There was also narrow-leaved cattail, manna grass, purple loosestrife, thistle, field horsetail, ragweed. The station had no canopy cover.

The station was electrofished during the spring of 2020. No fish were observed or captured. No sampling took place during the summer as the station was dry (July 27, 2020). No fish were observed or captured during the 2012 fish sampling either.

Photo 9: Station 1 looking upstream from downstream (April 6, 2020)

Photo 10: Station 1 looking upstream from downstream (September 21, 2020)

Station 2

Station 2 was a 2012 station placed roughly 90 m upstream of Station 1; also on the east to west portion of the feature. Station 2 was 50 m in length. The average channel width was 1.5 m and the average bankfull height 13 cm. The average spring wetted width and depth were 1.2 m and 5 cm, respectively. The station was dry during the summer visit.

The substrate consisted entirely of fines and the stream morphology was a glide. The in-water cover throughout the station was provided mostly by aquatic vegetation, including algae. Minor signs of erosion were noted on the left bank. The tops of the banks were mostly vegetated (about 80%). There was also narrow-leaved cattail, manna grass, purple loosestrife, knotweed, wild carrot, thistle, field horsetail and ragweed. The station had no canopy cover.

The station was electrofished during the spring 2020. No fish were observed or captured. No sampling took place during the summer as the station was dry (July 27, 2020). No fish were observed or captured during the 2012 fish sampling either.

Photo 11: Station 2 looking upstream from downstream (April 6, 2020)

Photo 12: Station 2 looking upstream from downstream (September 21, 2020)

Station 3

Station 3 was placed roughly 250 m downstream of station 1 on the south to north portion of the feature. This feature was 60 m in length. The average channel width was 1.6 m and the average bankfull height 13 cm. The average spring wetted width and depth were 0.4 m and 4 cm, respectively. The station was dry during the summer visit.

The substrate consisted entirely of fines and the stream morphology was a glide. The in-water cover throughout the station was provided of both terrestrial and aquatic vegetation, including common reed and purple loosestrife. Significant signs of erosion were noted on both banks. The tops of the banks were partially vegetated (about 40%). The most common species were reed-canary grass, dandelions, barley, pigweed, purple loosestrife, narrow-leaf cattails, broad-leaf cattail, and manna grass. The station had no canopy cover.

The station was electrofished during the spring 2020. No fish were observed or captured. No sampling took place during the summer as the station was dry (July 27, 2020).

Photo 13: Station 3 looking downstream from upstream (April 6, 2020)

Photo 14: Station 3 looking downstream from upstream (September 21, 2020)

Feature 1

Feature 1 is situated on the northeast side of the site. This feature was 35 m long and flowed into the North Channel. This feature receive water from the agricultural fields surrounding it and had a straight pattern. There is a blocked culvert (reach break "A") on its upstream end, separating it from feature 2. No station was established within the feature as it was connected to North Channel (which was sampled) and there was no potential for fish to reach this area from the South Tributary.

Photo 15: Feature 1 looking upstream from downstream (April 6, 2020)

Photo 16: Feature 1 looking upstream from downstream (September 21, 2020)

Feature 2

Feature 2 is situated on the east side of the site. Feature 2 was 320 m long and flowed in a north to south direction into South Tributary. This feature receives water from the agricultural fields surrounding it and had a straight pattern. There is a blocked culvert (reach break "A") on its upstream end, separating it from feature 2. Feature 2 end upstream of the backwater effect from South Tributary. One station (1) was established within Feature 2.

Station 4

Station 4 was 60 m in length and included just the upper portion of the area that was backwatered. The average channel width was 1.0 m and the average bankfull height 8 cm. The average spring wetted width and depth were 1.0 m and 3 cm, respectively. The station was dry during the summer visit.

The substrate consisted entirely of fines and the stream morphology was mostly composed of pools, due to the gradient issues. The in-water cover throughout the station was provided by both terrestrial and aquatic vegetation. No signs of erosion were noted. The tops of the banks were fully vegetated. The most common species were wild carrot, smartweed, white clover, vetch, purple aster and Virginia creeper. The left bank was forested on the downstream end, with green ash, sumac, and red osier dogwood. The station had no canopy cover.

The station was not fished as there was a fish barrier on the downstream end, in the form of vegetation and gradient issues, and is too densely vegetated to sample. No fish habitat was

present upstream of the portion that was backwatered from South Tributary. The entire feature was dry during the summer (July 27, 2020).

Photo 17: View of the fish barrier from downstream (April 6, 2020)

Photo 18: Station 4. looking downstream from the center of the feature (September 21, 2020)

Feature 3

Feature 3 is situated on the south side of the site. It was separated in two sections, 3a and 3b. Feature 3a was 150 m long. This flat channel was not well graded and with only standing water, did not provide contributing water to other features. This feature receive water from the agricultural field and the forested area surrounding it and had a straight pattern. Feature 3b was 60 m in length and, similarly to 3a had portions that were not graded, containing only standing water. But the lower portion did flow into South Tributary down the steep valley bank. This significant drop acted as a fish barrier. Two stations (2) were established within Feature 3, one in each section.

Station 5

Station 5 was 55 m in length and was located in the center of feature 3a. The average channel width was 0.8 m and the average bankfull height 6 cm. The area was still covered in snow and ice on April 6, 2020. The area was visited again on April 16. Although some of the feature was dry, the average wetted width and depth within the station were 0.7 m and 4 cm, respectively. The station was dry during the summer visit.

The substrate consisted entirely of fines and the stream morphology was mostly composed of pools, due to the gradient issues. There was little in-water cover present, with some overhanging vegetation. No signs of erosion were noted. The tops of the banks were mostly vegetated (about 80%). The most common species, other than agricultural species, were moss, red raspberry, reed-canary grass, goldenrod, white aster, poison ivy, dandelion, white clover, manna grass. The left bank was forested (American elm, green ash, and bur oak). There were some downed trees over the channel as well. The station little canopy cover (about 30%).

The station was not fished as it was only connected to feature 2, which was not fish habitat. No sampling took place during the summer either as the station was dry (July 27, 2020).

Photo 19: Station 5 looking upstream from the downstream end (April 16, 2020)

Photo 20: Station 5 looking upstream from the downstream end (September 21, 2020)

Station 6

Station 6 was 25 m in length. The average channel width was 1.1 m and the average bankfull height 6 cm. The area was still covered in snow and ice on April 6, 2020. Due to this, the area was visited again on April 16. Although some of the station was dry, the average wetted width and depth were 0.3 m and under 1 cm, respectively. The station was dry during the summer visit.

The substrate consisted entirely of fines and the stream morphology was mostly composed of pools, due to the gradient issues. There was little in-water cover present, with some overhanging vegetation (raspberry, colts' foot, and thimbleberry). No signs of erosion were noted. The tops of the banks were mostly vegetated (about 70%). The most common species, other than agricultural species, were dandelion, strawberry, vetch, yarrow, red raspberry, colts' foot, thimbleberry, and hickory.

The station was not fished as there was no fish habitat was present. No sampling took place during the summer either as the station was dry (July 27, 2020).

Photo 21: Station 6 looking downstream from the upstream end (April 16, 2020)

Photo 22: Station 6 looking downstream from the upstream end (September 21, 2020)

Appendix B: Amphibian Results Summary

Features	Amphibian Station	Visit 1 April 29, 2020 (Species, #)		Visit 2 May 19, 2020 (Species, #)		Visit 3 June 16, 2020 (Species, #)	
		In feature	In adjacent habitat	In feature	In adjacent habitat	In feature	In adjacent habitat
North Channel	**2/3**	NONE	NONE	NONE	AMTO, 1	GRTR, 3	NONE
Feature 1	**1/3**	NONE	NONE	NONE	NONE	GRTR, 2	NONE
Feature 2	**1**	NONE	NONE	NONE	NONE	NONE	GRTR, 1
Feature 3a	**1**	NONE	NONE	NONE	NONE	NONE	NONE
Feature 3b	**2**	NONE	NONE	NONE	NONE	NONE	NONE

AMTO – American Toad
GRTR – Gray Treefrog

Figure 6: Amphibian Survey Stations