



# GEMTEC

[www.gemtec.ca](http://www.gemtec.ca)

**Headwater Drainage Feature Assessment**  
**2822 Carp Road**  
**Ottawa, Ontario**



# GEMTEC

[www.gemtec.ca](http://www.gemtec.ca)

Submitted to:

Argue Construction Ltd.  
2900 Carp Road  
Carp, Ontario  
K0A 1L0

**Headwater Drainage Feature Assessment**  
**2822 Carp Road**  
Ottawa, Ontario

May 14, 2020  
Project: 61730.65

## TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
1.1	Purpose .....	1
1.2	Objective.....	1
2.0	METHODOLOGY.....	2
2.1	Desktop Review.....	2
2.2	Field Investigations .....	2
2.2.1	Headwater Drainage Feature Assessment.....	2
3.0	HEADWATER DRAINAGE FEATURES ASSESSMENT .....	3
3.1	Site Characteristics.....	3
3.1.1	HDF1 .....	4
4.0	CLASSIFICATION.....	6
5.0	MANAGEMENT RECOMMENDATIONS AND MITIGATION MEASURES .....	8
6.0	SUMMARY.....	8
7.0	LIMITATION OF LIABILITY .....	8
8.0	REFERENCES.....	9

## LIST OF TABLES

Table 2.1	Summary of Field Investigations .....	2
Table 3.1	Summary of Existing Conditions for HDF1 .....	5
Table 4.1	Summary of HDF Classification and Management recommendations.....	7

## LIST OF FIGURES

Figure 1	Flow Chart Providing Directions of Management Option's (TRCA/CVC, 2014).....	6
----------	--	---

## LIST OF APPENDICES

Appendix A	Report Figures
Appendix B	Site Photographs
Appendix C	Site Investigation Field Sheets
Appendix D	CVs for Key Personnel

## 1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by Argue Construction Ltd. to carry out a Headwater Drainage Feature Assessment (HDFA) for the property located at 2822 Carp Road, in the City of Ottawa, Ontario, hereafter referred to as the “subject property”. The site location is illustrated on Figure A.1 in Appendix A. This report provides the methodologies and results of the HDFA conducted at the subject property.

### 1.1 Purpose

The proponent is seeking to construct two multi-unit commercial buildings on the approximately 1.04-hectare (ha) site.

Based on correspondence with Mississippi Valley Conservation Authority (MVCA) staff on January 31, 2020, a Headwater Drainage Feature Assessment is required for the un-named watercourse located on-site to determine its conservation value, contributions to downstream fish habitat and local hydrology, prior to permitting any infilling or construction of any structures within 30 m of the watercourse.

### 1.2 Objective

Under Section 28(1) of the Conservation Authorities Act, conservation authorities have the ability to define the definition of a watercourse, which is defined under Section 28 (5) of the Act as “*An identifiable depression in the ground in which a flow of water regularly or continuously occurs*”. Headwater drainage features are defined as “*non-permanently flowing drainage features that may not have defined bed or banks; they are first-order and zero-order intermittent and ephemeral channels, swales and connected to headwater wetlands, but do not include rills or furrows*”. According to conservation authorities in Ontario, headwater drainage features meet the definition of a watercourse.

The objective of the work presented herein is twofold; 1) to identify headwater drainage features on the subject site and 2) to evaluate and classify any headwater drainage features on-site, in accordance with “*Evaluation, Classification and Management of Headwater Drainage Features Guidelines*” from the Toronto Region Conservation Authority and the Credit Valley Conservation (TRCA/CVC, 2014), and to recommend mitigation and conservation measures for headwater drainage features present on-site.

## 2.0 METHODOLOGY

### 2.1 Desktop Review

A desktop information gathering exercise was completed to aid in the scoping of field investigations and to gather background information relating to headwater drainage features on-site. Information relating to the presence and assessment of headwater drainage features on-site was obtained from the following sources:

- Evaluation, Classification and Management of Headwater Drainage Features Guidelines (TRCA/CVC, 2014);
- Ontario Stream Assessment Protocol, Section 4, Module 11 (OSAP, 2017);
- Land Information Ontario (OMNR, 2011);
- Mississippi Valley Conservation Authority Geoportal (MVCA, 2019); and
- Make a Map: Natural Heritage Areas (OMNRF, 2014).

### 2.2 Field Investigations

Two field investigations were undertaken to evaluate the headwater drainage feature identified on-site. Field investigations completed in support of this HDFA are outlined in Table 2.1 below.

**Table 2.1 Summary of Field Investigations**

Date	Time	Weather	Visit Number
March 31, 2020	10:00-11:30	2°C, overcast, no precipitation, Beaufort 4	1
April 27, 2020	12:20-1:00	11°C, partly cloudy, no precipitation, Beaufort 3	2

Site photographs taken during the field investigations are provided in Attachment A. Copies of field notes are provided in Attachment B.

#### 2.2.1 Headwater Drainage Feature Assessment

Field data collection of headwater drainage features on-site followed the protocol outlined in Section 4: Module 11, “Unconstrained Headwater Sampling” from the Ontario Stream Assessment Protocol (Stanfield, 2017).

Data collected during the site investigations included flow conditions, sediment transport, feature roughness, riparian and feature vegetation, as well as upstream and downstream site features. As outlined in the OSAP manual for assessing headwater drainage features, two to three site visits can be required to complete a HDFA. The first site visit is conducted within the short period following a major freshet event, in Ontario the first sampling event typically occurs between late March to mid-April. The second field event is conducted after the melt/thaw related flow has

ceased, typically late April to mid-May. When flow conditions are still observed during the second site investigation, a third site visit may be conducted in July to mid-September to further ascertain the importance of the HDF for seasonal use by fish and other biota.

Due to the stagnant and dry conditions observed during the second site investigation, described in Section 3, the importance of the HDF was able to be evaluated without completing a third site investigation.

Classification of the headwater drainage features on-site followed the protocols outlined in the Evaluation, Classification and Management of Headwater Drainage Features Guidelines manual (TRCA/CVC, 2014). Functions of the headwater drainage feature that were evaluated included hydrology, vegetation, fish and fish habitat, and terrestrial habitat.

### **3.0 HEADWATER DRAINAGE FEATURES ASSESSMENT**

#### **3.1 Site Characteristics**

The 1.04 ha site currently consists of cultural meadow habitat and existing development fronting to Carp Road. Based on aerial photographs reviewed, prior to 2014 the subject property contained a small forest parcel and between 2016 and 2017, the current on-site headwater drainage feature (HDF) was created by excavating a narrow channel onto the site from a drainage ditch on the adjacent south property.

Based on the desktop review and the site investigations, a single headwater drainage feature (HDF) occurs on-site and is identified as HDF1. HDF1 is illustrated on Figure A.2 in Appendix A.

HDF1 originates on-site and flows in a southeastern direction onto the neighbouring property addressed as 2826 Carp Road, before turning west and flowing into roadside ditches along Carp Road. The on-site portion of HDF1 is approximately 100 m in length. The watercourse is mapped as originating on neighbouring farm fields and flowing onto 2822 Carp Road, however based on observations during site investigations, the on-site portion of the watercourse is not connected to any upstream watercourses.

Once off-site, the HDF joins with an existing drainage ditch on the adjacent south property which conveys flows in an easterly direction from the west side of Carp Road. This unidentified tributary of Huntley Creek then flows in a south-south easterly direction for approximately 950 m prior to discharging to Huntley Creek.

According to the Aquatic Species at Risk map (DFO, 2018), no aquatic Species at Risk (SAR) or critical habitat for SAR occur within the subject area or the HDF present on-site.

### 3.1.1 HDF1

During the site investigation HDF1 was assessed in four segments, based on site break triggers, the segments are illustrated on Figure A.3 in Appendix A.

HDF1-1A is described as channelized, and had interstitial flow during the initial spring and was document as stagnant during late spring site investigation.

Segment HDF1-1B is described as no-defined feature and had a mix of interstitial flow and standing water during the initial spring investigation and standing water and dry conditions during the late spring visit.

Segment HDF1-1C is described as no-defined feature and had standing water conditions during the initial spring investigation and completely dry conditions during the second site investigation.

Segment HDF1-1D is described as no-defined feature with a mix of interstitial flow and standing water during the first investigation and standing water and dry conditions during the second investigation.

The riparian zone surrounding HDF1 is representative of a cultural meadow populated primarily by opportunistic woody and herbaceous species; the watercourse is primarily unvegetated within the channelized portions while the non-defined portions of the HDF consisted of cultural meadow vegetation as described above. Vegetation included reed canary grass, wild carrot, graminoids, red osier dogwood, slender willow and balsam poplar.

Substrates within HDF1 were primarily comprised of silty sand over bedrock or gravel.

Table 3.1 below summarizes the existing conditions and characteristics of HDF1 observed during the site investigation. During the site investigations, the HDF was assessed in four segments based on site break triggers as described above but the segments have been grouped for evaluation purposes.

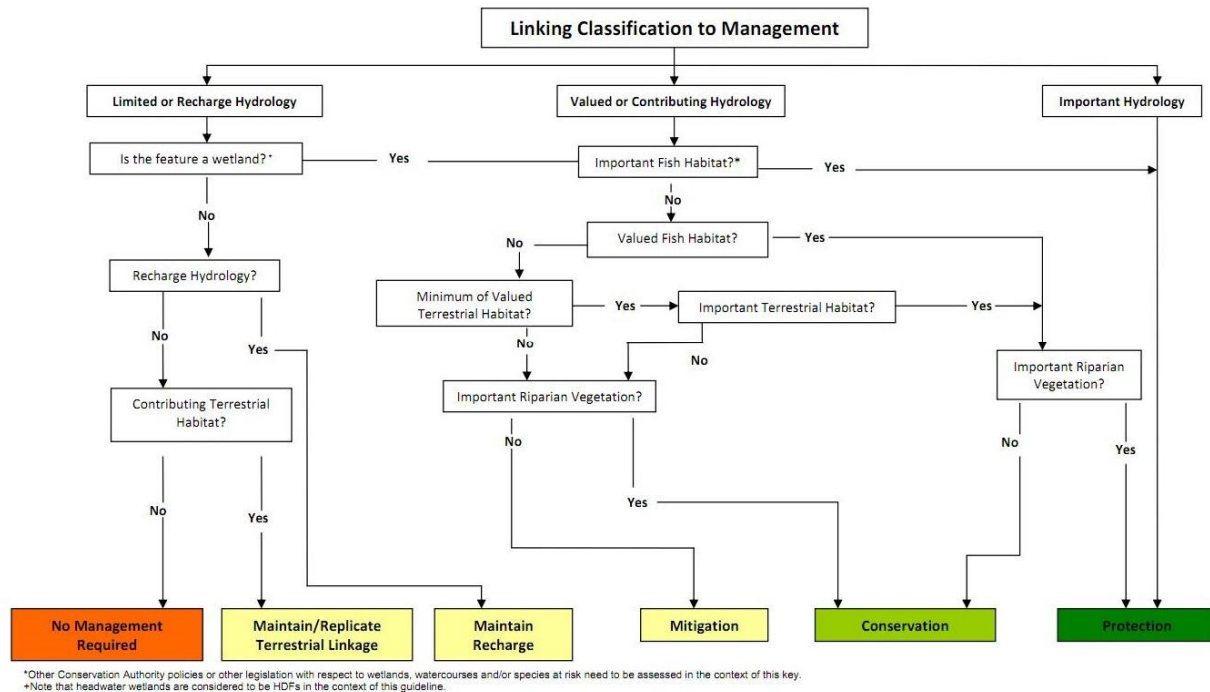
**Table 3.1 Summary of Existing Conditions for HDF1**

Site Visit	Hydrology		Vegetation Assessment		Channel Form		Sediment Transport				
	Flow Influence (FI)	Flow Condition (FC)	Feature Type (FT)	Feature	Riparian	Average Wetted Width (m)	Average Depth (range) (cm)	Average Bankfull Width (m)	Substrate	Sediment Transport	Sediment Dep.
1	Freshet (1)	Interstitial (3) and Standing (2)	Channelized (2)	Meadow (4)	Meadow (4)	4.4	17 (4-30)	4.7	Silty sand	None	None
2	Baseflow (3)	Standing (2) and Dry (1)	Channelized (2)	Meadow (4)	Meadow (4)	3.3	6.7 (4-12)	3.9	Silty Sand	None	None



## 4.0 CLASSIFICATION

HDF1 on-site was classified based on the information collected during the site investigations pertaining to hydrology, riparian habitat, fish and fish habitat and terrestrial components. Using the linking classification to management flow chart provided by the TRCA and CVC (2014), illustrated in Figure 1 below, the classification of HDF1 was used to determine management recommendations.



**Figure 1 Flow Chart Providing Directions of Management Option's (TRCA/CVC, 2014)**

HDF1 had interstitial flow in March and stagnant to dry conditions in April, which according to the Evaluation, Classification and Management of Headwater Drainage Features Guidelines (TRCA/CVC, 2014), provides contributing or valued function for hydrology. The HDF is connected to downstream fish habitat but is unlikely to contribute allochthonous transport due to the absence of flow nor is it likely to provide any critical life stage fish habitat. The adjacent terrestrial habitat is limited to a small parcel of cultural meadow adjacent to agricultural fields and commercial developments and is not connected to any adjacent natural features or corridors. As such, and in accordance the flow chart presented in Figure 1 above, the management recommendation for HDF1 is mitigation.

A summary of the classification and management recommendation for HDF1 is provided in Table 4.1 below

**Table 4.1 Summary of HDF Classification and Management recommendations**

Reach	Step 1		Step 2	Step 3	Step 4	Management Recommendation
	Hydrology	Modifiers	Riparian	Fish Habitat	Terrestrial Habitat	
1	Limited: provides only interstitial flow during spring freshet	No modifiers identified down stream	Limited – cultural meadow	Connectivity	Limited – channelized	Mitigation

## 5.0 MANAGEMENT RECOMMENDATIONS AND MITIGATION MEASURES

In accordance with the Evaluation, Classification and Management of Headwater Drainage Features Guidelines (TRCA/CVC, 2014), HDFs classified as 'valued' require mitigation. HDF1 has been field verified to provide contributing hydrology and connectivity to downstream fish habitat, and requires mitigation for any alterations to the watercourse. As outlined in the guidance document, mitigation management options for HDF1 on-site include:

- Replicate hydrologic functions through enhanced lot level conveyance measures, such as Low Impact Development stormwater options or well-vegetated swales connected to downstream;
- Consideration of using clean roof drainage directed to vegetated swales or bioswales to mitigate the loss of catchment area during potential future site redevelopment;
- All future development and construction activities within the study area, including ditching, culvert installation, erosion and sediment control and storm water management should be completed in accordance with Ontario Provincial Standard Specification 182 and OPSS 805; and
- No in-water work should occur between March 15 and June 30 of any year to protect downstream fish habitat. This in-water timing restriction is likely to result in any modification to the watercourse occurring 'in the dry'.

## 6.0 SUMMARY

A headwater drainage feature assessment was completed and one HDF was identified on-site, identified as HDF1. Mitigation was recommended for HDF1 based on flow conditions and functions contributing to downstream aquatic habitats. Mitigation should include maintaining the hydroperiod and connection with downstream features, as well as replicating hydrologic function.

## 7.0 CLOSURE

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

Sincerely,



Taylor Warrington, B. Sc.  
Biologist



Drew Paulusse, B.Sc.  
Senior Biologist

## 8.0 REFERENCES

Department of Fisheries and Oceans (DFO). 2019. Aquatic Species at Risk Map. Accessed: February 24, 2020. Available: <https://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html>

Ontario (Ontario). 1990. Conservation Authorities Act. R.S.O. 1990. Chapter C.27. Last amendment: 2019, c.9. Sched 2.

Ontario Ministry of Natural Resources (OMNR). 2011. Land Information Ontario (LIO).

Ontario Ministry of Natural Resources and Forestry (OMNRF). 2014. Make a Map: Natural Heritage Areas.

Mississippi Valley Conservation Authority (MVCA). 2019. Mississippi Valley Geoportal. Accessed: April 30, 2020. Available online: <http://camaps.maps.arcgis.com/apps/webappviewer/index.html?id=70831905961e470988262c7a703a56af>

Stanfield, L (Ed.). 2017. Ontario Stream Assessment Protocol. Version 10. Ontario, Canada.

Toronto Region Conservation Authority and Credit Valley Conservation (TRCA/CVC). 2014. Evaluation, Classification and management of Headwater Drainage Features Guidelines. TRCA Approval July 2013, Finalized January 2014.



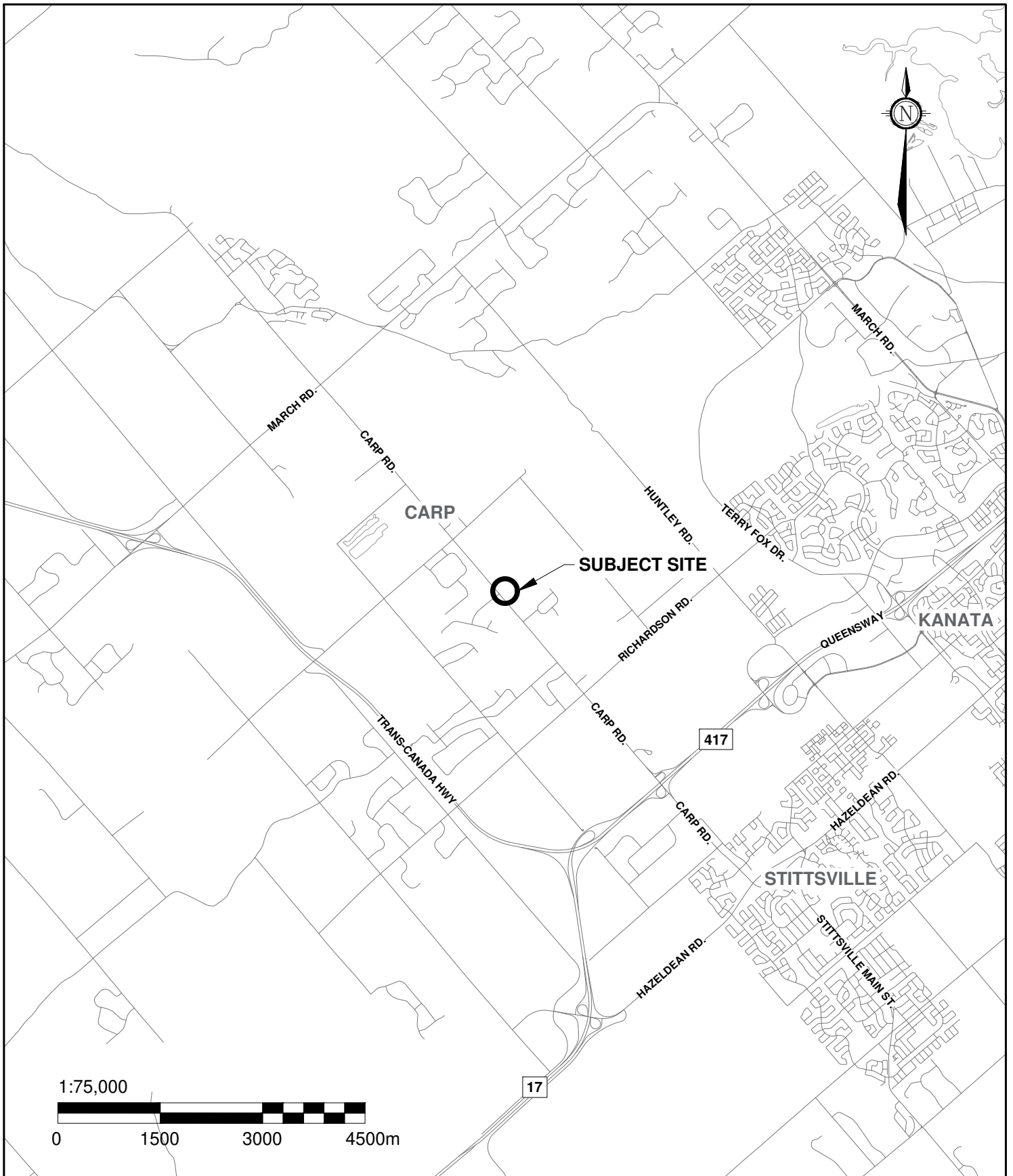
## **APPENDIX A**


Report Figures

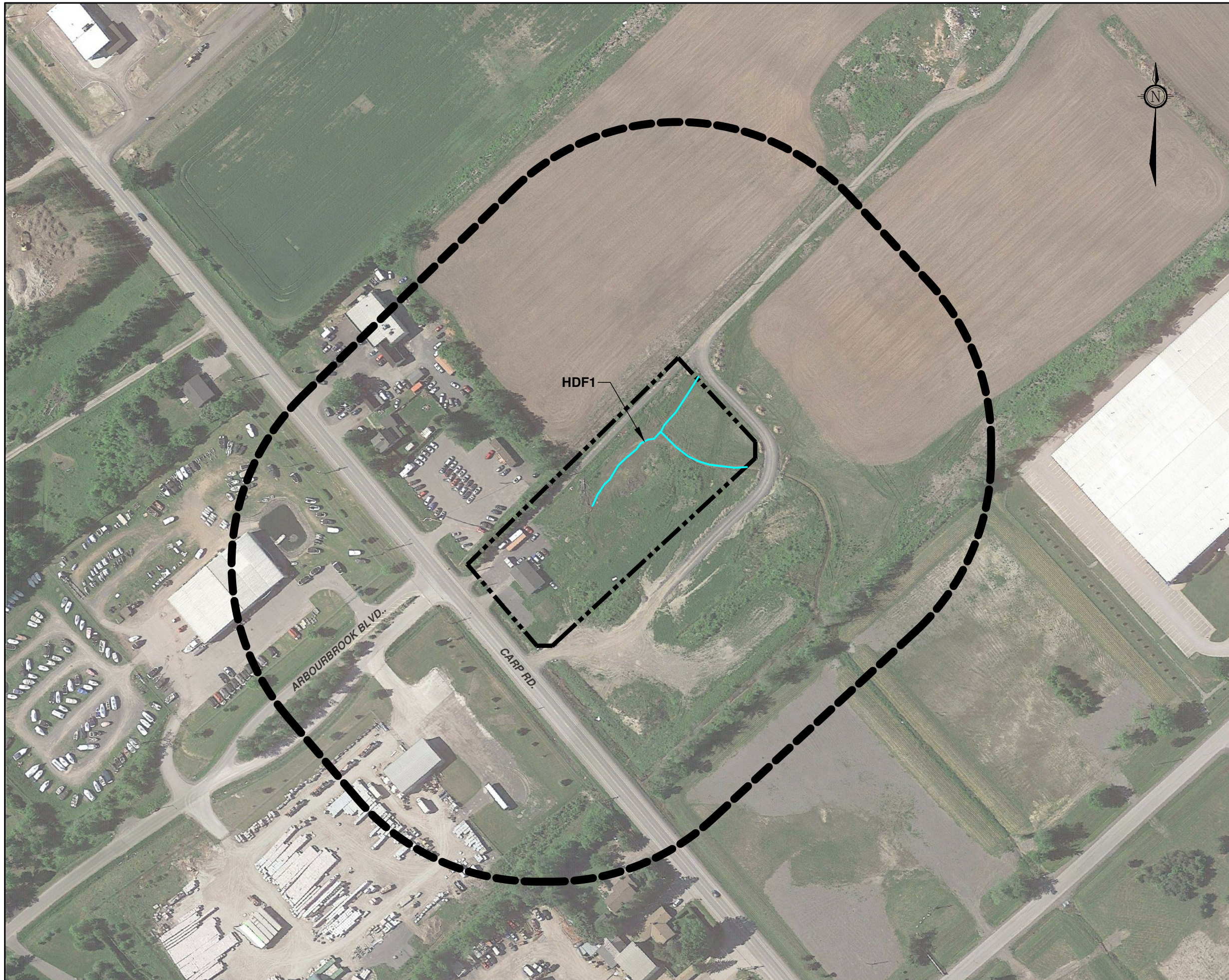
Figure A.1 – Site Location

Figure A.2 – Site Layout




Figure A.3 – HDF1 Segments



 <b>GEMTEC</b> CONSULTING ENGINEERS AND SCIENTISTS 32 Steacie Drive, Ottawa, ON K2K 2A9 T: (613) 836-1422   www.gemtec.ca   ottawa@gemtec.ca	Project HEADWATER DRAINAGE FEATURE ASSESSMENT 2822 CARP ROAD, OTTAWA, ONTARIO			Client ARGUE CONSTRUCTION LTD.		
	Drwn By P.C.	Chkd By T.W.	Date MAY 2020	Project No. 61730.65	Revision No. 0	<b>FIGURE A.1</b>



**LEGEND**

-  PROPERTY BOUNDARY
-  STUDY AREA  
120m AROUND PROPERTY BOUNDARY
-  HDF1




**GEMTEC**  
CONSULTING ENGINEERS  
AND SCIENTISTS

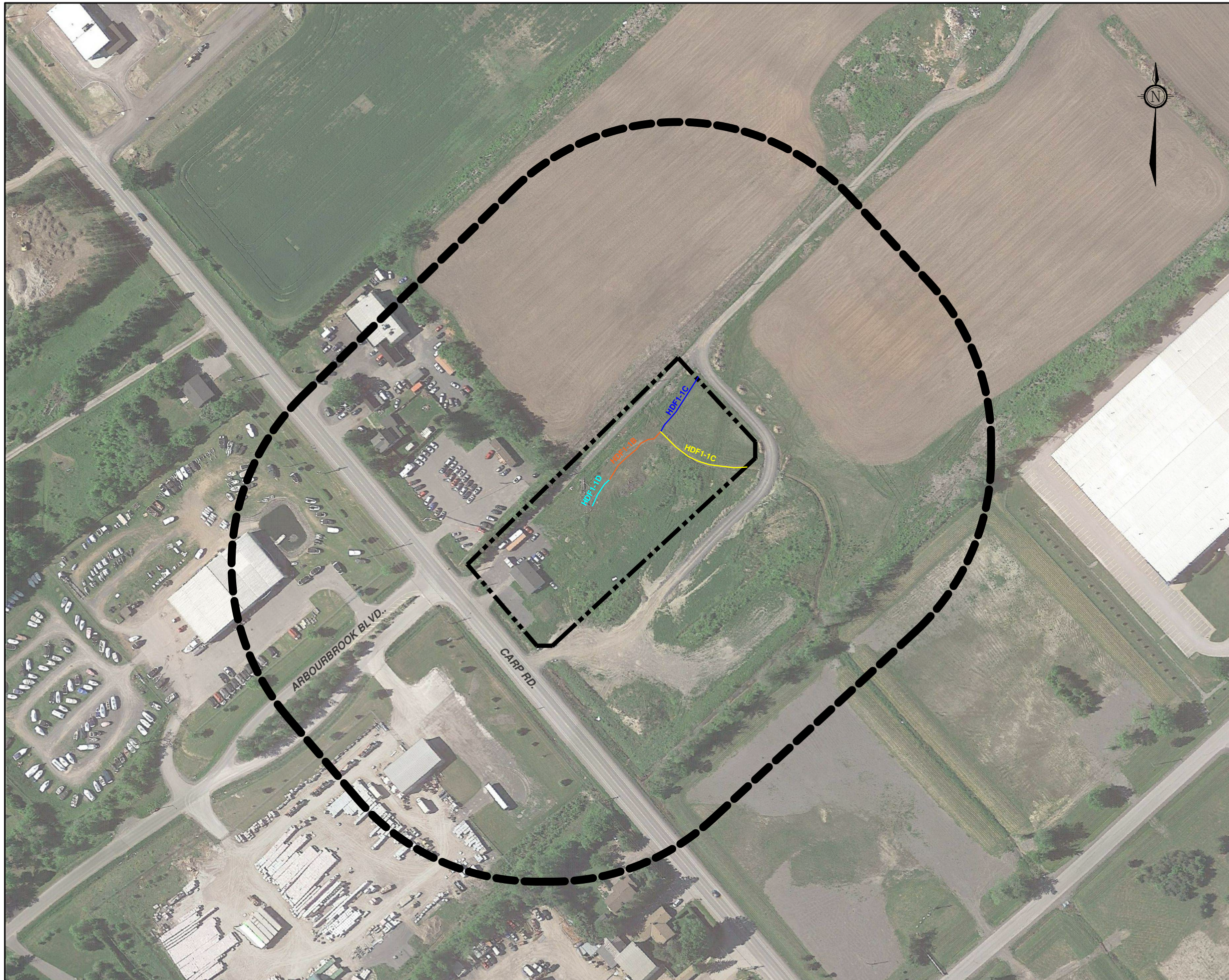
32 Steacie Drive  
Ottawa, ON K2K 2A9  
Tel: (613) 836-1422  
www.gemtec.ca  
ottawa@gemtec.ca

Drawing **SITE LAYOUT**

Client **ARGUE CONSTRUCTION LTD.**

Project 61730.65	HEADWATER DRAINAGE FEATURE ASESMENT 2822 CARP RD. OTTAWA, ONTARIO
Drwn by P.C.	
Chkd by T.W.	

Date MAY 2020	Rev. 0	<b>FIGURE A.2</b>
------------------	-----------	-------------------



**LEGEND**

- PROPERTY BOUNDARY
- STUDY AREA  
120m AROUND PROPERTY BOUNDARY



**GEMTEC**  
CONSULTING ENGINEERS  
AND SCIENTISTS

32 Steacie Drive  
Ottawa, ON K2K 2A9  
Tel: (613) 836-1422  
www.gemtec.ca  
ottawa@gemtec.ca

Drawing  
**HDF SEGEMENTS**

Client  
**ARGUE CONSTRUCTION LTD.**

Project 61730.65	HEADWATER DRAINAGE FEATURE ASESSMENT 2822 CARP RD. OTTAWA, ONTARIO
Drwn by P.C.	
Chkd by T.W.	

Date MAY 2020	Rev. 0	<b>FIGURE A.3</b>
------------------	-----------	-------------------





## **APPENDIX B**

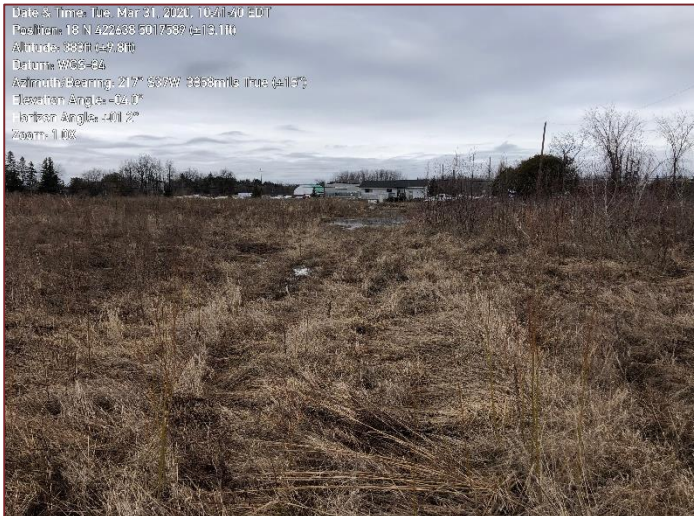
### Site Photographs



Site Photograph 1 – HDF1-1A looking downstream (March 31, 2020)



Site Photograph 2 – HDF1-1B looking upstream (March 31, 2020)



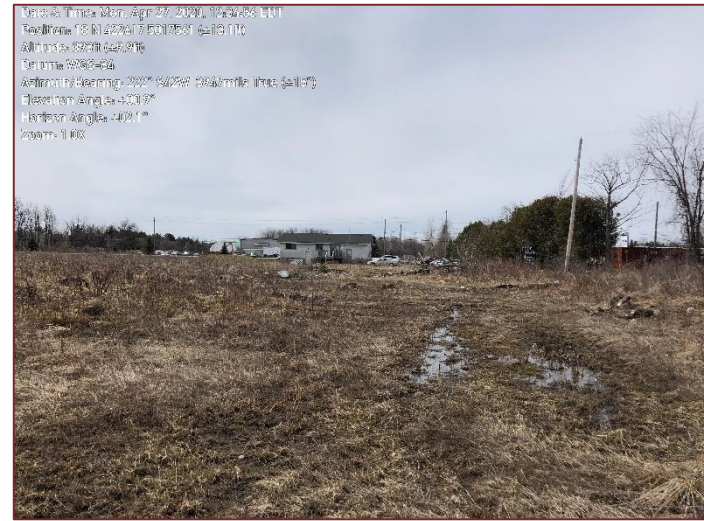
Site Photograph 3 – HDF1-1C looking downstream (March 31, 2020)



Site Photograph 4 – HDF1-1D looking upstream (March 31, 2020)



Site Photograph 5 – HDF1-1A looking downstream (April 27, 2020)



Site Photograph 6 – HDF1-1B looking upstream (April 27, 2020)



Site Photograph 7 – HDF1-1C looking downstream (April 27, 2020)



Site Photograph 8 – HDF1-1D looking upstream (April 27, 2020)



## **APPENDIX C**

### Site Investigation Field Notes

# Unconstrained Headwater Drainage Feature Assessment

Date: MAR 31/2020 Project #: 61730.65 Recorder/Crew: TW  
 Stream Name: HDFI Stream Code: HDFI-1 Site Code: HDFI-1A  
 Site Limits: Upstream WP# 45.307245 - 75.987050 Field Assessment:  Sample 1 Unconnected HDF:  Sample 2  Not connected  
 Downstream WP# 45.307110 - 75.984422  Sample 3 to downstream network  
 Direction of Assessment:  Upstream  Downstream

**Flow Influence**  Freshet (1)  Spate (2)  Baseflow (3)  
**Flow Condition**  Dry (1)  Interstitial Flow (3)  Substantial Flow (5)  
 Standing Water (2)  Minimal Flow (4)  
**Feature Type**  Defined Natural Channel (1)  No Defined Feature (4)  Swale (7)  
 Channelized or Constrained (2)  Tiled Feature (5)  Roadside Ditch (8)  
 Multi-thread (3)  Wetland (6)  Pond (9)

**Feature Vegetation**  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
*primrose, poplar, mullein, ash, rasp  
 -> loosestrife, grasses, goldenrod, willow, QAL, reed canary*

**Riparian Vegetation**  
 0 - 1.5 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 1.5 - 10 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 10 - 30 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Channel Gradient (S4.M7)**  Visual (1)  Clinometer (2)  Laser Level (3)  Survey Level (4)  Other (5)  LiDAR (6)

Distance (m): \_\_\_\_\_ Elevation (cm): \_\_\_\_\_ Gradient (°): \_\_\_\_\_

**Dominant Substrate (S2.M3)** Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock   
**Sub-Dominant Substrate (S2.M3)**

**Feature Roughness**  < 10% Minimal (1)  10 - 40% Moderate (2)  40 - 60% High (3)  > 60% Extreme (4)  
**Width Measurement**  Can't Measure (1)  Bankfull (2)  Mean Width (3)  Estimated (4)  GIS (5)  Measure/GIS (6)

**Channel Dimensions** Feature Width (m): 2.2m Bankfull Depth (mm) 50cm

**Entrenchment** Total:  > 40 m  < 40 m Left Bank \_\_\_\_\_ m Right Bank \_\_\_\_\_ m Total width \_\_\_\_\_ m

**Surface Flow Method**  Perched Culvert (1)  Hydraulic Head (2)  Distance by Time (3)  Estimated (4)  

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<u>2</u>	<u>30</u>	<u>26</u>	<u>29</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>

**Sediment Transport** Adjacent  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)  
 Feature  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

**Sediment Deposition** Measures (mm): \_\_\_\_\_  
 None (1)  Minimal: < 5 mm (2)  Moderate: 5-30 mm (3)  Substantial: 31-80 mm (4)  Extensive: > 80 mm (5)

# Unconstrained Headwater Drainage Feature Assessment

Pg. 2 of 2

Date: Mar 31/2020 Project #: 61730.65 Field Assessment:  Sample # 1  Sample # 2  Sample # 3

## POINT FEATURE DATA

Fish Barrier Measurements:	WP#	Perched Height (mm):	Jumping Height (mm):		
	WP#	Perched Height (mm):	Jumping Height (mm):		
Groundwater Indicators	<input checked="" type="checkbox"/> None	<input type="checkbox"/> Watercress	<input type="checkbox"/> Seepage	<input type="checkbox"/> Bubbling	<input type="checkbox"/> Stained
Fish Collection	<input checked="" type="checkbox"/> Absent	<input type="checkbox"/> Present	Comment: _____		

WP#	Photo #	Code	Category	Description

**Additional Notes:**

Site Break	<input checked="" type="checkbox"/> Feature Type	<input type="checkbox"/> Feature Modifier	<input type="checkbox"/> Flow Conditions	<input type="checkbox"/> Feature Vegetation	<input checked="" type="checkbox"/> Riparian Vegetation
Trigger	<input type="checkbox"/> Other: Comments _____				

Point Data	Ongoing and Active (1)	Historic Evidence (2)	Reported but No Evidence (3)
Category	No Evidence (4)	Unknown (5)	

- POINT DATA KEY:**
- A Spring/upwelling - estimate <0.5 l/sec or >0.5 l/sec; measure temp
  - B Seepage area - measure or estimate length of bank where seepage occurs
  - C Watercress - estimate total surface area occupied
  - D Outlet (tile or other) - record flow status as per feature flow. Estimate volume <0.5 l/sec or >0.5 l/sec. Measure temperature.
  - E Inlet (tile or other) - record flow status as per feature flow. Estimate volume to be <0.5 l/sec or >0.5 l/sec.
  - F Beaver dam - measure perched height and jumping height
  - G Manmade dam - measure perched height and jumping height
  - H Other barrier to fish movement
  - I Potential contamination source (storm sewer outlet or industrial discharge pipe).
  - J Channel hardening - indicated by rip-rap, armour stone, or gabion baskets.
  - K Culvert - note type, size and whether or not perched. If perched record perched height and jumping height.
  - L Flow transition point D/S - flow condition changes from dry to standing water, independent of segment break
  - M Flow transition point M/S - flow condition changes from minimal to substantial surface flow, independent of segment break
  - N Flow transition point D-S/IF - flow condition changes from dry/standing water to interstitial flow, independent of segment break
  - O Fish observed during non-fish sampling activities
  - P Potential nutrient source
  - Q Dredging of channel
  - R Offline pond
  - S Other

## Unconstrained Headwater Drainage Feature Assessment

Date: Mar 31/2020 Project #: 61730.65 Recorder/Crew: W  
 Stream Name: HDF1 Stream Code: HDF1-1 Site Code: HDF1-1B  
 Site Limits: Upstream WP# 45.307041 -75.987455 Field Assessment:  Sample 1 Unconnected HDF:  
 Downstream WP# 45.307245 -75.987050  Sample 2  Not connected  
 Direction of Assessment:  Upstream  Downstream  Sample 3 to downstream network

**Flow Influence**  Freshet (1)  Spate (2)  Baseflow (3)  
**Flow Condition**  Dry (1)  Interstitial Flow (3)  Substantial Flow (5)  
 Standing Water (2)  Minimal Flow (4)  
**Feature Type**  Defined Natural Channel (1)  No Defined Feature (4)  Swale (7)  
 Channelized or Constrained (2)  Tiled Feature (5)  Roadside Ditch (8)  
 Multi-thread (3)  Wetland (6)  Pond (9)

**Feature Vegetation**  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Riparian Vegetation**  
 0 - 1.5 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 1.5 - 10 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 10 - 30 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Channel Gradient (S4.M7)**  Visual (1)  Clinometer (2)  Laser Level (3)  Survey Level (4)  Other (5)  LiDAR (6)

Distance (m): \_\_\_\_\_ Elevation (cm): \_\_\_\_\_ Gradient (°): \_\_\_\_\_

**Dominant Substrate (S2.M3)** Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock   
**Sub-Dominant Substrate (S2.M3)**  Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock

**Feature Roughness**  < 10% Minimal (1)  10 - 40% Moderate (2)  40 - 60% High (3)  > 60% Extreme (4)

**Width Measurement**  Can't Measure (1)  Bankfull (2)  Mean Width (3)  Estimated (4)  GIS (5)  Measure/GIS (6)

**Channel Dimensions** Feature Width (m): 78.5m Bankfull Depth (mm) < 50cm

**Entrenchment** Total:  > 40 m  < 40 m Left Bank \_\_\_\_\_ m Right Bank \_\_\_\_\_ m Total width \_\_\_\_\_ m

**Surface Flow Method**  Perched Culvert (1)  Hydraulic Head (2)  Distance by Time (3)  Estimated (4)

Wetted Width (m)	Wetted Depth (mm)	Hydraulic head (mm)	Volume (L)	Distance (m)	Time (s)
<u>&gt; 8m</u>	<u>17 18</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>

**Sediment Transport**  
 Adjacent  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Feature  Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)  
 None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

**Sediment Deposition** Measures (mm):  
 None (1)  Minimal: < 5 mm (2)  Moderate: 5-30 mm (3)  Substantial: 31-80 mm (4)  Extensive: > 80 mm (5)

# Unconstrained Headwater Drainage Feature Assessment

Date: Mar 31/2000 Project #: 61730.65 Field Assessment:  Sample # 1  Sample # 2  Sample # 3

## POINT FEATURE DATA

Fish Barrier Measurements:	WP#	Perched Height (mm):	Jumping Height (mm):	
	WP#	Perched Height (mm):	Jumping Height (mm):	
Groundwater Indicators	<input checked="" type="checkbox"/> None	<input type="checkbox"/> Watercress	<input type="checkbox"/> Seepage	<input type="checkbox"/> Bubbling
Fish Collection	<input checked="" type="checkbox"/> Absent	<input type="checkbox"/> Present	<input type="checkbox"/> Stained	<input type="checkbox"/> Other: _____
		Comment:		

WP#	Photo #	Code	Category	Description

**Additional Notes:**

Site Break  
  Feature Type  
  Feature Modifier  
  Flow Conditions  
  Feature Vegetation  
  Riparian Vegetation  
 Trigger  
 Other: \_\_\_\_\_

**Point Data**                      Ongoing and Active (1)                      Historic Evidence (2)                      Reported but No Evidence (3)  
**Category**                              No Evidence (4)                              Unknown (5)

- POINT DATA KEY:**
- A Spring/upwelling - estimate <0.5 l/sec or >0.5 l/sec; measure temp
  - B Seepage area - measure or estimate length of bank where seepage occurs
  - C Watercress - estimate total surface area occupied
  - D Outlet (tile or other) - record flow status as per feature flow. Estimate volume <0.5 l/sec or >0.5 l/sec. Measure temperature.
  - E Inlet (tile or other) - record flow status as per feature flow. Estimate volume to be <0.5 l/sec or >0.5 l/sec.
  - F Beaver dam - measure perched height and jumping height
  - G Manmade dam - measure perched height and jumping height
  - H Other barrier to fish movement
  - I Potential contamination source (storm sewer outlet or industrial discharge pipe).
  - J Channel hardening - indicated by rip-rap, armour stone, or gabion baskets.
  - K Culvert - note type, size and whether or not perched. If perched record perched height and jumping height.
  - L Flow transition point D/S - flow condition changes from dry to standing water, independent of segment break
  - M Flow transition point M/S- flow condition changes from minimal to substantial surface flow, independent of segment break
  - N Flow transition point D-S/IF- flow condition changes from dry/standing water to interstitial flow, independent of segment break
  - O Fish observed during non-fish sampling activities
  - P Potential nutrient source
  - Q Dredging of channel
  - R Offline pond
  - S Other



## Unconstrained Headwater Drainage Feature Assessment

Date: Mar 31/2020 Project #: 61730.65 Recorder/Crew: TW  
 Stream Name: HDF1 Stream Code: HDF1-1 Site Code: HDF1-1C  
 Site Limits: Upstream WP# 45.307523 -75.986853 Field Assessment:  Sample 1 Unconnected HDF:  Not connected  
 Downstream WP# 45.307245 -75.987050  Sample 2  Sample 3 to downstream network  
 Direction of Assessment:  Upstream  Downstream

**Flow Influence**  Freshet (1)  Spate (2)  Baseflow (3)

**Flow Condition**  Dry (1)  Interstitial Flow (3)  Substantial Flow (5)  
 Standing Water (2)  Minimal Flow (4)

**Feature Type**  Defined Natural Channel (1)  No Defined Feature (4)  Swale (7)  
 Channelized or Constrained (2)  Tiled Feature (5)  Roadside Ditch (8)  
 Multi-thread (3)  Wetland (6)  Pond (9)

**Feature Vegetation**  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Riparian Vegetation**  
 0 - 1.5 m *same as HDF1-1A*  
 Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 1.5 - 10 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 10 - 30 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Channel Gradient (S4.M7)**  Visual (1)  Clinometer (2)  Laser Level (3)  Survey Level (4)  Other (5)  LiDAR (6)

Distance (m): \_\_\_\_\_ Elevation (cm): \_\_\_\_\_ Gradient (°): \_\_\_\_\_

**Dominant Substrate (S2.M3)** Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock   
**Sub-Dominant Substrate (S2.M3)**

**Feature Roughness**  < 10% Minimal (1)  10 - 40% Moderate (2)  40 - 60% High (3)  > 60% Extreme (4)

**Width Measurement**  Can't Measure (1)  Bankfull (2)  Mean Width (3)  Estimated (4)  GIS (5)  Measure/GIS (6)

**Channel Dimensions** Feature Width (m): < 1m Bankfull Depth (mm): < 10cm

**Entrenchment** Total:  > 40 m  < 40 m Left Bank \_\_\_\_\_ m Right Bank \_\_\_\_\_ m Total width \_\_\_\_\_ m

**Surface Flow Method**  Perched Culvert (1)  Hydraulic Head (2)  Distance by Time (3)  Estimated (4)

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<u>60cm</u>	<u>7</u>	<u>4</u>	<u>5</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>

**Sediment Transport**  
 Adjacent  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)  
 Feature  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

**Sediment Deposition** Measures (mm): \_\_\_\_\_  
 None (1)  Minimal: < 5 mm (2)  Moderate: 5-30 mm (3)  Substantial: 31-80 mm (4)  Extensive: > 80 mm (5)

# Unconstrained Headwater Drainage Feature Assessment

Date: Mar 31/2020 Project #: 6173065 Field Assessment:  Sample # 1  Sample # 2  Sample # 3

## POINT FEATURE DATA

Fish Barrier Measurements: WP# \_\_\_\_\_ Perched Height (mm): \_\_\_\_\_ Jumping Height (mm): \_\_\_\_\_  
 WP# \_\_\_\_\_ Perched Height (mm): \_\_\_\_\_ Jumping Height (mm): \_\_\_\_\_

Groundwater Indicators  None  Watercress  Seepage  Bubbling  Stained  Other: \_\_\_\_\_

Fish Collection  Absent  Present Comment: \_\_\_\_\_

WP#	Photo #	Code	Category	Description

**Additional Notes:**  
no flow from upstream (ie. watercourse onsite not connected to upstream network)

Site Break  Feature Type  Feature Modifier  Flow Conditions  Feature Vegetation  Riparian Vegetation

Trigger  Other: Comments \_\_\_\_\_

Point Data Ongoing and Active (1) Historic Evidence (2) Reported but No Evidence (3)  
 Category No Evidence (4) Unknown (5)

- POINT DATA KEY:**
- A Spring/upwelling - estimate <0.5 l/sec or >0.5 l/sec; measure temp
  - B Seepage area - measure or estimate length of bank where seepage occurs
  - C Watercress - estimate total surface area occupied
  - D Outlet (tile or other) - record flow status as per feature flow. Estimate volume <0.5 l/sec or >0.5 l/sec. Measure temperature.
  - E Inlet (tile or other) - record flow status as per feature flow. Estimate volume to be <0.5 l/sec or >0.5 l/sec.
  - F Beaver dam - measure perched height and jumping height
  - G Manmade dam - measure perched height and jumping height
  - H Other barrier to fish movement
  - I Potential contamination source (storm sewer outlet or industrial discharge pipe).
  - J Channel hardening - indicated by rip-rap, armour stone, or gabion baskets.
  - K Culvert - note type, size and whether or not perched. If perched record perched height and jumping height.
  - L Flow transition point D/S - flow condition changes from dry to standing water, independent of segment break
  - M Flow transition point M/S - flow condition changes from minimal to substantial surface flow, independent of segment break
  - N Flow transition point D-S/IF - flow condition changes from dry/standing water to interstitial flow, independent of segment break
  - O Fish observed during non-fish sampling activities
  - P Potential nutrient source
  - Q Dredging of channel
  - R Offline pond
  - S Other

# Unconstrained Headwater Drainage Feature Assessment

Date: Mar 31/2020 Project #: 61730.65 Recorder/Crew: TW  
 Stream Name: HDF1 Stream Code: HDF1-1 Site Code: HDF1-1D  
 Site Limits: Upstream WP# 45.306931 -75.987554 Field Assessment:  Sample 1 Unconnected HDF:  Not connected  
 Downstream WP# 45.307041 -75.987455  Sample 2  Not connected  
 Direction of Assessment:  Upstream  Downstream  Sample 3 to downstream network

**Flow Influence**  Freshet (1)  Spate (2)  Baseflow (3)

**Flow Condition**  Dry (1)  Interstitial Flow (3)  Substantial Flow (5)  
 Standing Water (2)  Minimal Flow (4)

**Feature Type**  Defined Natural Channel (1)  No Defined Feature (4)  Swale (7)  
 Channelized or Constrained (2)  Tiled Feature (5)  Roadside Ditch (8)  
 Multi-thread (3)  Wetland (6)  Pond (9)

**Feature Vegetation**  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
*Wcattails & reeds*

**Riparian Vegetation**  
 0 - 1.5 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

1.5 - 10 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

10 - 30 m Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Channel Gradient (S4.M7)**  Visual (1)  Clinometer (2)  Laser Level (3)  Survey Level (4)  Other (5)  LiDAR (6)

Distance (m): \_\_\_\_\_ Elevation (cm): \_\_\_\_\_ Gradient (°): \_\_\_\_\_

**Dominant Substrate (S2.M3)** Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock

**Sub-Dominant Substrate (S2.M3)** Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock

**Feature Roughness**  < 10% Minimal (1)  10 - 40% Moderate (2)  40 - 60% High (3)  > 60% Extreme (4)

**Width Measurement**  Can't Measure (1)  Bankfull (2)  Mean Width (3)  Estimated (4)  GIS (5)  Measure/GIS (6)

**Channel Dimensions** Feature Width (m): 7m Bankfull Depth (mm): <50cm

**Entrenchment** Total:  > 40 m  < 40 m Left Bank \_\_\_\_\_ m Right Bank \_\_\_\_\_ m Total width \_\_\_\_\_ m

**Surface Flow Method**  Perched Culvert (1)  Hydraulic Head (2)  Distance by Time (3)  Estimated (4)

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<u>7m</u>	<u>18</u>	<u>22</u>	<u>19</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>

**Sediment Transport** Adjacent  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

Feature  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

**Sediment Deposition** Measures (mm): \_\_\_\_\_  
 None (1)  Minimal: < 5 mm (2)  Moderate: 5-30 mm (3)  Substantial: 31-80 mm (4)  Extensive: > 80 mm (5)

# Unconstrained Headwater Drainage Feature Assessment

Date: Mar 31/2020 Project #: 61730.65 Recorder/Crew: TW  
 Stream Name: HDF1 Stream Code: HDF1-1 Site Code: HDF1-10  
 Site Limits: Upstream WP# 45.306931 -75.987554 Field Assessment:  Sample 1 Unconnected HDF:  Sample 2  Not connected  
 Downstream WP# 45.307041 -75.987455  Sample 3 to downstream network  
 Direction of Assessment:  Upstream  Downstream

**Flow Influence**  Freshet (1)  Spate (2)  Baseflow (3)  
**Flow Condition**  Dry (1)  Interstitial Flow (3)  Substantial Flow (5)  
 Standing Water (2)  Minimal Flow (4)  
**Feature Type**  Defined Natural Channel (1)  No Defined Feature (4)  Swale (7)  
 Channelized or Constrained (2)  Tiled Feature (5)  Roadside Ditch (8)  
 Multi-thread (3)  Wetland (6)  Pond (9)

**Feature Vegetation**  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
*Wcattails & reeds*

**Riparian Vegetation**  
**0 - 1.5 m** Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
**1.5 - 10 m** Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
**10 - 30 m** Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Channel Gradient (S4.M7)**  Visual (1)  Clinometer (2)  Laser Level (3)  Survey Level (4)  Other (5)  LiDAR (6)

Distance (m): \_\_\_\_\_ Elevation (cm): \_\_\_\_\_ Gradient (°): \_\_\_\_\_

**Dominant Substrate (S2.M3)** Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock   
**Sub-Dominant Substrate (S2.M3)** Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock

**Feature Roughness**  < 10% Minimal (1)  10 - 40% Moderate (2)  40 - 60% High (3)  > 60% Extreme (4)

**Width Measurement**  Can't Measure (1)  Bankfull (2)  Mean Width (3)  Estimated (4)  GIS (5)  Measure/GIS (6)

**Channel Dimensions** Feature Width (m): 7m Bankfull Depth (mm) <50cm

**Entrenchment** Total:  > 40 m  < 40 m Left Bank \_\_\_\_\_ m Right Bank \_\_\_\_\_ m Total width \_\_\_\_\_ m

**Surface Flow Method**  Perched Culvert (1)  Hydraulic Head (2)  Distance by Time (3)  Estimated (4)  

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<u>7m</u>	<u>18</u>	<u>22</u>	<u>19</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>

**Sediment Transport** Adjacent  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)  
 Feature  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

**Sediment Deposition** Measures (mm):  
 None (1)  Minimal: < 5 mm (2)  Moderate: 5-30 mm (3)  Substantial: 31-80 mm (4)  Extensive: > 80 mm (5)

## Unconstrained Headwater Drainage Feature Assessment

Date: APR 27/2020 Project #: 61730-65 Recorder/Crew: TW  
 Stream Name: HDFI-1 Stream Code: HDFI-1 Site Code: HDFI-1A  
 Site Limits: Upstream WP# 45.307245, -75.987050 Field Assessment:  Sample 1 Unconnected HDF:  
 Downstream WP# 45.307110, -75.986422  Sample 2  Not connected  
 Direction of Assessment:  Upstream  Downstream  Sample 3 to downstream network

**Flow Influence**  Freshet (1)  Spate (2)  Baseflow (3)

**Flow Condition**  Dry (1)  Interstitial Flow (3)  Substantial Flow (5)  
 Standing Water (2)  Minimal Flow (4)

**Feature Type**  Defined Natural Channel (1)  No Defined Feature (4)  Swale (7)  
 Channelized or Constrained (2)  Tiled Feature (5)  Roadside Ditch (8)  
 Multi-thread (3)  Wetland (6)  Pond (9)

**Feature Vegetation**  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Riparian Vegetation**

<b>0 - 1.5 m</b>	<b>Left Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
	<b>Right Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
<b>1.5 - 10 m</b>	<b>Left Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
	<b>Right Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
<b>10 - 30 m</b>	<b>Left Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
	<b>Right Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)

**Channel Gradient (S4.M7)**  Visual (1)  Clinometer (2)  Laser Level (3)  Survey Level (4)  Other (5)  LiDAR (6)

Distance (m): \_\_\_\_\_ Elevation (cm): \_\_\_\_\_ Gradient (°): \_\_\_\_\_

	Clay (Hard Pan)	Silt	Sand (0.06-2 mm)	Gravel (22-66 mm)	Cobble (67-249 mm)	Boulder (250 mm)	Bedrock
<b>Dominant Substrate (S2.M3)</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Sub-Dominant Substrate (S2.M3)</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Feature Roughness**  < 10% Minimal (1)  10 - 40% Moderate (2)  40 - 60% High (3)  > 60% Extreme (4)

**Width Measurement**  Can't Measure (1)  Bankfull (2)  Mean Width (3)  Estimated (4)  GIS (5)  Measure/GIS (6)

**Channel Dimensions** Feature Width (m): 2.2 Bankfull Depth (mm): 50 cm

**Entrenchment** Total:  > 40 m  < 40 m Left Bank \_\_\_\_\_ m Right Bank \_\_\_\_\_ m Total width \_\_\_\_\_ m

**Surface Flow Method**  Perched Culvert (1)  Hydraulic Head (2)  Distance by Time (3)  Estimated (4)

<b>Wetted Width (m)</b>	<b>Wetted Depth (mm)</b>	<b>Hydraulic head (mm)</b>	<b>Volume (L)</b>	<b>Distance (m)</b>	<b>Time (s)</b>
	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
<u>1.5 0.75 1.32</u>	<u>8 4 7</u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>

**Sediment Transport** Adjacent:  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

Feature:  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

**Sediment Deposition** Measures (mm): \_\_\_\_\_  
 None (1)  Minimal: < 5 mm (2)  Moderate: 5-30 mm (3)  Substantial: 31-80 mm (4)  Extensive: > 80 mm (5)

# Unconstrained Headwater Drainage Feature Assessment

Date: Apr 27/2022 Project #: 61730 65 Field Assessment:  Sample # 1  Sample # 2  Sample # 3

## POINT FEATURE DATA

Fish Barrier Measurements: WP# \_\_\_\_\_ Perched Height (mm): \_\_\_\_\_ Jumping Height (mm): \_\_\_\_\_  
 WP# \_\_\_\_\_ Perched Height (mm): \_\_\_\_\_ Jumping Height (mm): \_\_\_\_\_  
 Groundwater Indicators  None  Watercress  Seepage  Bubbling  Stained  Other: \_\_\_\_\_  
 Fish Collection  Absent  Present Comment: \_\_\_\_\_

WP#	Photo #	Code	Category	Description

**Additional Notes:**  
 \_\_\_\_\_  
 \_\_\_\_\_

Site Break  Feature Type  Feature Modifier  Flow Conditions  Feature Vegetation  Riparian Vegetation  
 Trigger  Other: Comments \_\_\_\_\_

Point Data	Ongoing and Active (1)	Historic Evidence (2)	Reported but No Evidence (3)
Category	No Evidence (4)	Unknown (5)	

- POINT DATA KEY:**
- A Spring/upwelling - estimate <0.5 l/sec or >0.5 l/sec; measure temp
  - B Seepage area - measure or estimate length of bank where seepage occurs
  - C Watercress - estimate total surface area occupied
  - D Outlet (tile or other) - record flow status as per feature flow. Estimate volume <0.5 l/sec or >0.5 l/sec. Measure temperature.
  - E Inlet (tile or other) - record flow status as per feature flow. Estimate volume to be <0.5 l/sec or >0.5 l/sec.
  - F Beaver dam - measure perched height and jumping height
  - G Manmade dam - measure perched height and jumping height
  - H Other barrier to fish movement
  - I Potential contamination source (storm sewer outlet or industrial discharge pipe).
  - J Channel hardening - indicated by rip-rap, armour stone, or gabion baskets.
  - K Culvert - note type, size and whether or not perched. If perched record perched height and jumping height.
  - L Flow transition point D/S - flow condition changes from dry to standing water, independent of segment break
  - M Flow transition point M/S - flow condition changes from minimal to substantial surface flow, independent of segment break
  - N Flow transition point D-S/IF - flow condition changes from dry/standing water to interstitial flow, independent of segment break
  - O Fish observed during non-fish sampling activities
  - P Potential nutrient source
  - Q Dredging of channel
  - R Offline pond
  - S Other

## Unconstrained Headwater Drainage Feature Assessment

Date: APR 27/2020 Project #: 61730.65 Recorder/Crew: TW  
 Stream Name: HDFI Stream Code: HDFI-1 Site Code: HDFI-1B  
 Site Limits: Upstream WP# 45.307041 - 75.987455 Field Assessment:  Sample 1 Unconnected HDF:  
 Downstream WP# 45.307245 - 75.987050  Sample 2  Not connected  
 Direction of Assessment:  Upstream  Downstream  Sample 3 to downstream network

**Flow Influence**  Freshet (1)  Spate (2)  Baseflow (3)

**Flow Condition**  Dry (1)  Interstitial Flow (3)  Substantial Flow (5)  
 Standing Water (2)  Minimal Flow (4)

**Feature Type**  Defined Natural Channel (1)  No Defined Feature (4)  Swale (7)  
 Channelized or Constrained (2)  Tiled Feature (5)  Roadside Ditch (8)  
 Multi-thread (3)  Wetland (6)  Pond (9)

**Feature Vegetation**  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland(6)  Forest (7)

**Riparian Vegetation**  
**0 - 1.5 m** Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
**1.5 - 10 m** Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
**10 - 30 m** Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Channel Gradient (S4.M7)**  Visual (1)  Clinometer (2)  Laser Level (3)  Survey Level (4)  Other (5)  LiDAR (6)

Distance (m): \_\_\_\_\_ Elevation (cm): \_\_\_\_\_ Gradient (°): \_\_\_\_\_

**Dominant Substrate (S2.M3)** Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock   
**Sub-Dominant Substrate (S2.M3)**

**Feature Roughness**  < 10% Minimal (1)  10 - 40% Moderate (2)  40 - 60% High (3)  > 60% Extreme (4)

**Width Measurement**  Can't Measure (1)  Bankfull (2)  Mean Width (3)  Estimated (4)  GIS (5)  Measure/GIS (6)

**Channel Dimensions** Feature Width (m): 8.5m Bankfull Depth (mm) < 50cm

**Entrenchment** Total:  > 40 m  < 40 m Left Bank \_\_\_\_\_ m Right Bank \_\_\_\_\_ m Total width \_\_\_\_\_ m

**Surface Flow Method**  Perched Culvert (1)  Hydraulic Head (2)  Distance by Time (3)  Estimated (4)

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<u>5-8m</u>	<u>9</u>	<u>5</u>	<u>4</u>												

**Sediment Transport** Adjacent  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)  
 Feature  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

**Sediment Deposition** Measures (mm): \_\_\_\_\_  
 None (1)  Minimal: < 5 mm (2)  Moderate: 5-30 mm (3)  Substantial: 31-80 mm (4)  Extensive: > 80 mm (5)

# Unconstrained Headwater Drainage Feature Assessment

Date: APR 27/2020 Project #: 61730 65 Field Assessment:  Sample # 1  Sample # 2  Sample # 3

## POINT FEATURE DATA

Fish Barrier Measurements: WP# \_\_\_\_\_ Perched Height (mm): \_\_\_\_\_ Jumping Height (mm): \_\_\_\_\_  
 WP# \_\_\_\_\_ Perched Height (mm): \_\_\_\_\_ Jumping Height (mm): \_\_\_\_\_

Groundwater Indicators  None  Watercress  Seepage  Bubbling  Stained  Other: \_\_\_\_\_

Fish Collection  Absent  Present Comment: \_\_\_\_\_

WP#	Photo #	Code	Category	Description

**Additional Notes:**  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Site Break  Feature Type  Feature Modifier  Flow Conditions  Feature Vegetation  Riparian Vegetation  
 Trigger  Other: \_\_\_\_\_ Comments: \_\_\_\_\_

Point Data	Ongoing and Active (1)	Historic Evidence (2)	Reported but No Evidence (3)
Category	No Evidence (4)	Unknown (5)	

- POINT DATA KEY:**
- A Spring/upwelling - estimate <0.5 l/sec or >0.5 l/sec; measure temp
  - B Seepage area - measure or estimate length of bank where seepage occurs
  - C Watercress - estimate total surface area occupied
  - D Outlet (tile or other) - record flow status as per feature flow. Estimate volume <0.5 l/sec or >0.5 l/sec. Measure temperature.
  - E Inlet (tile or other) - record flow status as per feature flow. Estimate volume to be <0.5 l/sec or >0.5 l/sec.
  - F Beaver dam - measure perched height and jumping height
  - G Manmade dam - measure perched height and jumping height
  - H Other barrier to fish movement
  - I Potential contamination source (storm sewer outlet or industrial discharge pipe).
  - J Channel hardening - indicated by rip-rap, armour stone, or gabion baskets.
  - K Culvert - note type, size and whether or not perched. If perched record perched height and jumping height.
  - L Flow transition point D/S - flow condition changes from dry to standing water, independent of segment break
  - M Flow transition point M/S - flow condition changes from minimal to substantial surface flow, independent of segment break
  - N Flow transition point D-S/IF - flow condition changes from dry/standing water to interstitial flow, independent of segment break
  - O Fish observed during non-fish sampling activities
  - P Potential nutrient source
  - Q Dredging of channel
  - R Offline pond
  - S Other



## Unconstrained Headwater Drainage Feature Assessment

Date: APR 27/2020 Project #: 61730.65 Recorder/Crew: TW  
 Stream Name: HDFI Stream Code: HDFI-1 Site Code: HDFI-1C  
 Site Limits: Upstream WP# 45.307523 -75.986853 Field Assessment:  Sample 1 Unconnected HDF:  
 Downstream WP# 45.307245 -75.987050  Sample 2  Not connected  
 Direction of Assessment:  Upstream  Downstream  Sample 3 to downstream network

**Flow Influence**  Freshet (1)  Spate (2)  Baseflow (3)

**Flow Condition**  Dry (1)  Interstitial Flow (3)  Substantial Flow (5)  
 Standing Water (2)  Minimal Flow (4)

**Feature Type**  Defined Natural Channel (1)  No Defined Feature (4)  Swale (7)  
 Channelized or Constrained (2)  Tiled Feature (5)  Roadside Ditch (8)  
 Multi-thread (3)  Wetland (6)  Pond (9)

**Feature Vegetation**  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland(6)  Forest (7)

**Riparian Vegetation**  
**0 - 1.5 m** Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
**1.5 - 10 m** Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
**10 - 30 m** Left Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)  
 Right Bank  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Channel Gradient (S4.M7)**  Visual (1)  Clinometer (2)  Laser Level (3)  Survey Level (4)  Other (5)  LiDAR (6)

Distance (m): \_\_\_\_\_ Elevation (cm) : \_\_\_\_\_ Gradient (°): \_\_\_\_\_

**Dominant Substrate (S2.M3)** Clay (Hard Pan)  Silt  Sand (0.06-2 mm)  Gravel (22-66 mm)  Cobble (67-249 mm)  Boulder (250 mm)  Bedrock   
**Sub-Dominant Substrate (S2.M3)**

**Feature Roughness**  < 10% Minimal (1)  10 - 40% Moderate (2)  40 - 60% High (3)  > 60% Extreme (4)

**Width Measurement**  Can't Measure (1)  Bankfull (2)  Mean Width (3)  Estimated (4)  GIS (5)  Measure/GIS (6)

**Channel Dimensions** Feature Width (m): < 1m Bankfull Depth (mm) < 10cm

**Entrenchment** Total:  > 40 m  < 40 m Left Bank \_\_\_\_\_ m Right Bank \_\_\_\_\_ m Total width \_\_\_\_\_ m

**Surface Flow Method**  Perched Culvert (1)  Hydraulic Head (2)  Distance by Time (3)  Estimated (4)

Wetted Width (m)	Wetted Depth (mm)			Hydraulic head (mm)			Volume (L)			Distance (m)			Time (s)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>	<u>          </u>

**Sediment Transport** Adjacent  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)  
 Feature  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

**Sediment Deposition** Measures (mm): \_\_\_\_\_  
 None (1)  Minimal: < 5 mm (2)  Moderate: 5-30 mm (3)  Substantial: 31-80 mm (4)  Extensive: > 80 mm (5)

Unconstrained Headwater Drainage Feature Assessment

Date: APR 27/2020 Project #: 61730.65 Field Assessment:  Sample # 1  Sample # 2  Sample # 3

POINT FEATURE DATA

Fish Barrier Measurements: WP# Perched Height (mm): Jumping Height (mm):  
WP# Perched Height (mm): Jumping Height (mm):  
Groundwater Indicators  None  Watercress  Seepage  Bubbling  Stained  Other: \_\_\_\_\_  
Fish Collection  Absent  Present Comment: \_\_\_\_\_

WP#	Photo #	Code	Category	Description

Additional Notes:  
no connection to upstream network

Site Break  Feature Type  Feature Modifier  Flow Conditions  Feature Vegetation  Riparian Vegetation  
Trigger  Other: Comments \_\_\_\_\_

Point Data Ongoing and Active (1) Historic Evidence (2) Reported but No Evidence (3)  
Category No Evidence (4) Unknown (5)

- POINT DATA KEY:
- A Spring/upwelling - estimate <0.5 l/sec or >0.5 l/sec; measure temp
  - B Seepage area - measure or estimate length of bank where seepage occurs
  - C Watercress - estimate total surface area occupied
  - D Outlet (tile or other) - record flow status as per feature flow. Estimate volume <0.5 l/sec or >0.5 l/sec. Measure temperature.
  - E Inlet (tile or other) - record flow status as per feature flow. Estimate volume to be <0.5 l/sec or >0.5 l/sec.
  - F Beaver dam - measure perched height and jumping height
  - G Manmade dam - measure perched height and jumping height
  - H Other barrier to fish movement
  - I Potential contamination source (storm sewer outlet or industrial discharge pipe).
  - J Channel hardening - indicated by rip-rap, armour stone, or gabion baskets.
  - K Culvert - note type, size and whether or not perched. If perched record perched height and jumping height.
  - L Flow transition point D/S - flow condition changes from dry to standing water, independent of segment break
  - M Flow transition point M/S - flow condition changes from minimal to substantial surface flow, independent of segment break
  - N Flow transition point D-S/IF - flow condition changes from dry/standing water to interstitial flow, independent of segment break
  - O Fish observed during non-fish sampling activities
  - P Potential nutrient source
  - Q Dredging of channel
  - R Offline pond
  - S Other

## Unconstrained Headwater Drainage Feature Assessment

Date: APR 27/2020 Project #: 61730.65 Recorder/Crew: TW  
 Stream Name: HDFI Stream Code: HDFI-1 Site Code: HDFI-1D  
 Site Limits: Upstream WP# 45.306931 - 75.987554 Field Assessment:  Sample 1 Unconnected HDF:  
 Downstream WP# 45.307041 - 75.987455  Sample 2  Not connected  
 Direction of Assessment:  Upstream  Downstream  Sample 3 to downstream network

**Flow Influence**  Freshet (1)  Spate (2)  Baseflow (3)

**Flow Condition**  Dry (1)  Interstitial Flow (3)  Substantial Flow (5)  
 Standing Water (2)  Minimal Flow (4)

**Feature Type**  Defined Natural Channel (1)  No Defined Feature (4)  Swale (7)  
 Channelized or Constrained (2)  Tiled Feature (5)  Roadside Ditch (8)  
 Multi-thread (3)  Wetland (6)  Pond (9)

**Feature Vegetation**  None (1)  Lawn (2)  Cropped (3)  Meadow (4)  Scrubland (5)  Wetland (6)  Forest (7)

**Riparian Vegetation**

<b>0 - 1.5 m</b>	<b>Left Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
	<b>Right Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
<b>1.5 - 10 m</b>	<b>Left Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input checked="" type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
	<b>Right Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
<b>10 - 30 m</b>	<b>Left Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input checked="" type="checkbox"/> Cropped (3)	<input type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)
	<b>Right Bank</b>	<input type="checkbox"/> None (1)	<input type="checkbox"/> Lawn (2)	<input type="checkbox"/> Cropped (3)	<input checked="" type="checkbox"/> Meadow (4)	<input type="checkbox"/> Scrubland (5)	<input type="checkbox"/> Wetland (6)	<input type="checkbox"/> Forest (7)

**Channel Gradient (S4.M7)**  Visual (1)  Clinometer (2)  Laser Level (3)  Survey Level (4)  Other (5)  LiDAR (6)

Distance (m): \_\_\_\_\_ Elevation (cm): \_\_\_\_\_ Gradient (°): \_\_\_\_\_

	Clay (Hard Pan)	Silt	Sand (0.06-2 mm)	Gravel (22-66 mm)	Cobble (67-249 mm)	Boulder (250 mm)	Bedrock
<b>Dominant Substrate (S2.M3)</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Sub-Dominant Substrate (S2.M3)</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Feature Roughness**  < 10% Minimal (1)  10 - 40% Moderate (2)  40 - 60% High (3)  > 60% Extreme (4)

**Width Measurement**  Can't Measure (1)  Bankfull (2)  Mean Width (3)  Estimated (4)  GIS (5)  Measure/GIS (6)

**Channel Dimensions** Feature Width (m): < 5 m Bankfull Depth (mm): < 50 cm

**Entrenchment** Total:  > 40 m  < 40 m Left Bank \_\_\_\_\_ m Right Bank \_\_\_\_\_ m Total width \_\_\_\_\_ m

**Surface Flow Method**  Perched Culvert (1)  Hydraulic Head (2)  Distance by Time (3)  Estimated (4)

<b>Wetted Width (m)</b>	<b>Wetted Depth (mm)</b>	<b>Hydraulic head (mm)</b>	<b>Volume (L)</b>	<b>Distance (m)</b>	<b>Time (s)</b>
	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
<u>1-3 m</u>	<u>4 12 8</u>	<u>/</u>	<u>/</u>	<u>/</u>	<u>/</u>

**Sediment Transport** Adjacent:  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

Feature:  None (1)  Rill (2)  Rill and Gully (3)  Gully (4)  Outlet Scour (5)  
 Sheet Erosion (6)  Instream Bank Erosion (7)  Other (8)

**Sediment Deposition** Measures (mm): \_\_\_\_\_

None (1)  Minimal: < 5 mm (2)  Moderate: 5-30 mm (3)  Substantial: 31-80 mm (4)  Extensive: > 80 mm (5)

*dry areas & pools*

**Unconstrained Headwater Drainage Feature Assessment**

Date: APR 27/2009 Project #: 61730-65 Field Assessment:  Sample # 1  Sample # 2  Sample # 3

**POINT FEATURE DATA**

Fish Barrier Measurements: WP# \_\_\_\_\_ Perched Height (mm): \_\_\_\_\_ Jumping Height (mm): \_\_\_\_\_  
 WP# \_\_\_\_\_ Perched Height (mm): \_\_\_\_\_ Jumping Height (mm): \_\_\_\_\_  
 Groundwater Indicators  None  Watercress  Seepage  Bubbling  Stained  Other: \_\_\_\_\_  
 Fish Collection  Absent  Present Comment: \_\_\_\_\_

WP#	Photo #	Code	Category	Description

**Additional Notes:**

Site Break  Feature Type  Feature Modifier  Flow Conditions  Feature Vegetation  Riparian Vegetation  
 Trigger  Other: \_\_\_\_\_

Point Data Ongoing and Active (1) Historic Evidence (2) Reported but No Evidence (3)  
 Category No Evidence (4) Unknown (5)

**POINT DATA KEY:**

- A Spring/upwelling - estimate <0.5 l/sec or >0.5 l/sec; measure temp
- B Seepage area - measure or estimate length of bank where seepage occurs
- C Watercress - estimate total surface area occupied
- D Outlet (tile or other) - record flow status as per feature flow. Estimate volume <0.5 l/sec or >0.5 l/sec. Measure temperature.
- E Inlet (tile or other) - record flow status as per feature flow. Estimate volume to be <0.5 l/sec or >0.5 l/sec.
- F Beaver dam - measure perched height and jumping height
- G Manmade dam - measure perched height and jumping height
- H Other barrier to fish movement
- I Potential contamination source (storm sewer outlet or industrial discharge pipe).
- J Channel hardening - indicated by rip-rap, armour stone, or gabion baskets.
- K Culvert - note type, size and whether or not perched. If perched record perched height and jumping height.
- L Flow transition point D/S - flow condition changes from dry to standing water, independent of segment break
- M Flow transition point M/S- flow condition changes from minimal to substantial surface flow, independent of segment break
- N Flow transition point D-S/IF- flow condition changes from dry/standing water to interstitial flow, independent of segment break
- O Fish observed during non-fish sampling activities
- P Potential nutrient source
- Q Dredging of channel
- R Offline pond
- S Other



## **APPENDIX D**

CVs for Key Personnel



# GEMTEC

## **Drew Paulusse, B.Sc.**

Senior Biologist / Manager of Environmental Services

---

Mr. Paulusse has over 12 years of experience in the environmental consulting industry, providing private industry and municipal and federal government clients with cost effective solutions to manage environmental constraints associated with land development proposals and infrastructure projects. Mr. Paulusse's expertise, as it relates to land development proposals and infrastructure projects is field assessment and regulatory permitting associated with species at risk, fish habitat and wetlands.

### **Education**

- B.Sc., Biology, Trent University, 2007
- Environmental Technician, Fleming College, 2004

### **Professional Experience**

<b>2018-date</b>	<b>GEMTEC Consulting Engineers and Scientists Limited</b> <i>Manager of Environmental Services</i>	<b>Ottawa, Ontario</b>
<b>2011-2018</b>	<b>Geofirma Engineering Limited</b> <i>Senior Biologist</i>	<b>Ottawa, Ontario</b>
<b>2007-2011</b>	<b>INTERA Engineering Limited</b> <i>Biologist</i>	<b>Ottawa, Ontario</b>
<b>2007</b>	<b>Canadian Wildlife Service, Environment Canada</b> <i>Wetland Conservation Officer</i>	<b>Burlington, Ontario</b>
<b>2005</b>	<b>Centre for Inland Waters, Environment Canada</b> <i>Junior Marine Technologist</i>	<b>Burlington, Ontario</b>

### **Professional Affiliations and Technical Training**

- Canadian Society of Environmental Biologists
- Ontario Association for Impact Assessment
- MTO/DFO/MNRF Protocol for Protecting Fish and Fish Habitat on Provincial Transportation Undertakings. Ministry of Transportation. 2018
- Ontario Wetland Evaluation System Certification Course. Ministry of Natural Resources and Forestry. 2017
- Headwater Drainage Feature Assessment Training Course. Rideau Valley Conservation Authority. 2017





# GEMTEC

- Ecological Land Classification System Certification Course. Ministry of Natural Resources and Forestry. 2015
- Ontario Benthic Biomonitoring Network Certification Course. Ministry of Environment, Conservation and Parks. 2011

## Project Highlights

- ***DFO Self-Assessment and Preparation of Tender Special Provisions, Osceola Culvert Replacement, County of Renfrew, Ontario (2019):*** Project manager and technical lead responsible for the evaluation of the significance of fish habitat and species at risk, and completion of a DFO self-assessment. Work included aquatic habitat assessments, pathway of effects evaluation, culvert design recommendations and reporting.
- ***Biological Inventory, Ontario Power Generation Incorporated, Bath, Ontario (2018):*** Project manager and technical lead responsible for conducting a three-season inventory of avian and amphibian species at the Lennox Provincially Significant Wetland. Work included conducting presence and abundance surveys following the Canadian Wildlife Service marsh monitoring protocol and Bird Studies Canada breeding bird surveys, statistical analysis of species data trends and reporting.
- ***Wetland Management Plan, Ontario Power Generation Incorporated, Bath, Ontario (2018):*** Project manager and technical lead responsible for the development of an adaptive wetland management plan for the Lennox Provincially Significant Wetland. Work included a synthesis of historical data, statistical analysis of data trends, vegetation assessment, air photo interpretation, development of short-term and long-term management objectives and development of a standardized monitoring program.
- ***Environmental Compliance Monitoring, Petrie Island Causeway Rehabilitation Project, Ottawa, Ontario (2018):*** Project manager and technical lead responsible for monitoring constructor compliance with various Department of Fisheries and Oceans, Ministry of Natural Resources and Conservation Authority permit conditions during the Petrie Island Causeway Rehabilitation Project within the Ottawa River. Work included species at risk surveys, fish salvage, exclusion fence inspection, monitoring of sediment and erosion control measures, turbidity monitoring, regulatory agency consultation and weekly reporting.
- ***Wetland Delineation and Wetland Function Assessment, National Capital Commission, Ottawa, Ontario (2018):*** Project manager and technical lead responsible for the delineation of wetland pockets within the LeBreton Flats Redevelopment Area and the assessment of wetland function for the purpose of evaluating compensation requirements. Work was completed following both the federal and provincial wetland evaluation frameworks.





# GEMTEC

- ***Environmental Impact Statement, Code Drive Development, Smiths Falls, Ontario (2018):*** Project manager and technical lead responsible for the completion of an Environmental Impact Statement in support of a severance application for the creation of eight residential lots within a significant woodland and adjacent to a large local wetland. Work included targeted surveys for species at risk, breeding amphibians and marsh birds, impact assessment, development of lot-specific mitigation measures and agency consultations.
- ***Tree Conservation Report, Royal LePage Team Realty, Ottawa, Ontario (2018):*** Mr. Paulusse completed an inventory of all trees located on an urban commercial lot for the purpose of identify significant retainable trees and trees in conflict with the proposed site redevelopment. Work included, site inventory, tree removal permit preparation and reporting.
- ***Environmental Compliance Monitoring, Airport Parkway Culvert Rehabilitation Project, Ottawa, Ontario (2018):*** Project manager and technical lead responsible for monitoring constructor compliance with Ministry of Natural Resources and Conservation Authority permit conditions. Work included species at risk surveys, exclusion fence inspection, monitoring of sediment and erosion control measures and weekly reporting.
- ***Tier I and II Natural Environment Report, Crain's Construction, Ottawa, Ontario (2018):*** Project manager and technical lead responsible for completing an inventory of site flora and fauna, completion of species at risk surveys, regulatory agency consultation, impact assessment and reporting.
- ***Species at Risk Assessment, National Capital Commission, Gatineau, Quebec (2018):*** Project manager responsible for the completion of avian species at risk surveys to determine the presence or absence of chimney swift and barn swallows at a contaminated site. Work was undertaken to support an Ecological Risk Assessment.
- ***Fish Habitat Assessment, Various Culvert Replacements, Ottawa, Ontario (2018):*** Project manager and technical lead responsible for the evaluation of the significance of fish habitat at three culvert crossings in rural Ottawa. Work included aquatic habitat assessments, pathway of effects evaluation, culvert design recommendations and reporting.
- ***Environment Effects Evaluation Assessment, Britannia Wall Rehabilitation Project, Ottawa, Ontario (2018):*** Project manager and technical lead responsible for completing a comprehensive tree inventory, wetland boundary delineation, significant wildlife habitat assessment and evaluation of effects associated with the rehabilitation of the Britannia Wall, a 600-metre-long community flood protection structure.
- ***Environmental Compliance Monitoring, Petrie Island Beach Head Rehabilitation Project, Ottawa, Ontario (2018):*** Project manager and technical lead responsible for monitoring constructor compliance with various Department of Fisheries and Oceans, Ministry of Natural Resources and Conservation Authority permit conditions during the Petrie Island







# GEMTEC

Beach Head Rehabilitation Project within the Ottawa River. Work included species at risk surveys, exclusion fence inspection, monitoring of sediment and erosion control measures, and reporting.

- ***Provincially Significant Wetland Boundary Evaluation and Mitigation Plan, Town and County Chrysler, Smiths Falls, Ontario (2018):*** Project manager and technical lead responsible for revising the wetland boundary associated with a provincially significant wetland and development of a mitigation plan to enable the redevelopment of an adjacent commercial lot. Work included wetland vegetation delineation, regulatory technical document submissions, agency consultations, mitigation measure development and reporting.
- ***Environmental Impact Statement and Headwater Drainage Feature Assessment, Swank Construction Limited, Morrisburg, Ontario (2017-2018):*** Project manager and technical lead responsible for the completion of an Environmental Impact Statement with Headwater Drainage Feature Assessment for a 100-lot residential subdivision. Work included ecological land classification, breeding bird surveys, impact assessment and a three season assessment of hydrological conditions and their contributions to downstream fish habitat.
- ***Natural Heritage Inventory and Environmental Impact Assessment, Combermere Lodge Limited, Barry's Bay, Ontario (2017-2018):*** Project manager and technical lead responsible for the completion of a Natural Heritage Inventory and Environmental Impact Assessment completed in support of a 54-lot condominium development located in an environmentally sensitive area. Work included wetland boundary delineation, identification of significant wildlife habitat, application of the significant wildlife habitat mitigation support tool, completion of a two-year survey of site flora and fauna, impact assessment and town hall presentations.
- ***Lake Capacity Assessment, Combermere Lodge Limited, Barry's Bay, Ontario (2017-2018):*** Project manager and technical lead responsible for the predictive assessment of septic effluent impacts relating to the operation of a 54-lot condominium development on three adjacent waterbodies. Work included limnological investigations over two seasons, application of the provincial lakeshore capacity model, hydrogeological investigations, mass flux analysis, mitigation measure development and reporting.
- ***Detailed Quantitative Ecological Risk Assessment, National Capital Commission, Gatineau, Quebec (2016 to 2018):*** Project manager and technical lead for the completion of a Detailed Quantitative Ecological Risk Assessment completed for a former landfill property located adjacent to the Ottawa River. Work included aquatic habitat assessment, benthic community characterization, species at risk surveys, terrestrial wildlife surveys and analysis of site-specific aquatic toxicity data.
- ***Environmental Compliance Monitoring, Carp Snow Dump, Ottawa, Ontario (2017):*** Project manager and technical lead responsible for monitoring constructor compliance with a Ministry of Natural Resources overall benefit permit for blanding's turtle associated with the





# GEMTEC

construction of the Carp Snow Dump. Work included weekly exclusion fence inspection and weekly reporting to the contract administrator.

- ***Fish Habitat Assessment, Little Bark Bay Properties, Barry's Bay, Ontario (2017):*** Project manager and technical lead responsible for the identification and evaluation of significance of fish habitat within and adjacent to a proposed plan of subdivision. Work included aquatic habitat assessments, pathway of effects evaluation, application of the Department of Fisheries and Oceans self-assessment process and reporting.
- ***Species at Risk and Migratory Bird Screening Assessment, City of Ottawa, New Edinburg Park Redevelopment Project, Ottawa, Ontario (2017):*** Project manager and technical lead responsible for the completion of a species at risk and migratory bird screening assessment to assist in bid tender package preparation for the re-development of New Edinburg Park. Work included a general habitat assessment, a probability of occurrence assessment, follow-up pre-construction surveys and reporting.
- ***Fish Habitat Assessment, Highway 417 Culvert Replacement Project, Ottawa, Ontario (2017):*** Project manager and technical lead responsible for the evaluation of the significance of fish habitat at two culvert crossings Ottawa. Work included aquatic habitat assessments, pathway of effects evaluation, application of the Department of Fisheries and Oceans self-assessment process and reporting.
- ***Fish Habitat and Headwater Drainage Feature Assessment, Private Landowner, Ottawa, Ontario (2017):*** Project manager and technical lead responsible for the completion of a two-season hydrological assessment of on-site water courses and assessment of fish habitat. Work completed in support of a permit required to develop an unopened road allowance.
- ***Environmental Impact Statement and Wetland Boundary Assessment, Town and Country RV, Perth, Ontario (2016-2017):*** Project manager and technical lead responsible for delineation of a provincially significant wetland and impact assessment associated with the expansion of an existing commercial enterprise. Work included ecological land classification, identification of significant wildlife habitat, species at risk surveys, wetland vegetation assessment, impact assessment and development of site-specific mitigation measures.
- ***Environmental Impact Statement, Blueberry Creek Veterinary Clinic, Perth, Ontario (2016):*** Project manager and technical lead responsible for delineation of a provincially significant wetland and impact assessment associated with the development of a commercial lot. Work included ecological land classification, identification of significant wildlife habitat, species at risk surveys, wetland vegetation assessment, impact assessment and development of site-specific mitigation measures.





# GEMTEC

## **Taylor Warrington, B.Sc.**

### **Biologist**

---

Ms. Warrington has 4 years of experience in the environmental consulting industry, providing private industry and municipal and federal government clients with cost effective solutions to manage environmental constraints associated with land development proposals and infrastructure projects.

### **Education**

- B.Sc., Life Sciences, McMaster University, 2015
- Graduate Certificate, Ecosystem Restoration, Niagara College, 2016

### **Professional Experience**

<b>2020-date</b>	<b>GEMTEC Consulting Engineers and Scientists Limited</b> <i>Biologist</i>	<b>Ottawa, Ontario</b>
<b>2019-2020</b>	<b>GEMTEC Consulting Engineers and Scientists Limited</b> <i>Junior Biologist</i>	<b>Ottawa, Ontario</b>
<b>2017-2019</b>	<b>Geofirma Engineering Limited</b> <i>Junior Biologist/Scientist</i>	<b>Ottawa, Ontario</b>
<b>2016</b>	<b>Dillon Consulting</b> <i>Junior Field Biologist</i>	<b>Little Current, Ontario</b>
<b>2014</b>	<b>McMaster University</b> <i>Laboratory-Research Assistant; URBAN Project Coordinator</i>	<b>Hamilton, Ontario</b>

### **Professional Affiliations and Technical Training**

- Ottawa Conservation Partners Workshop: How to Prepare and Environmental Impact Statement. 2020.
- Class 2 Backpack Electrofishing Crew Leader Certification Course. June, 2019.
- Ontario Reptile and Amphibian Survey Course. Blazing Star Environmental, Natural Resource Solutions Inc., and Ontario Nature. 2018
- Ontario Benthic Biomonitoring Network Certification Course. Ministry of Environment, Conservation and Parks. 2016

### **Project Highlights**

- ***Tier I and II Natural Environment Report, Crain's Construction, Lanark County, Ontario.*** Biologist responsible for completing on-going surveys in support of a proposed





# GEMTEC

quarry application. Surveys include winter mammal and ungulate use surveys, bat maternity roost surveys, ecological land classification, breeding bird surveys, turtle basking surveys, amphibian breeding surveys and targeted species at risk surveys for American ginseng and eastern whip-poor-will.

- ***Botanical Surveys, Ontario Power Generation Incorporated, Hydroelectric Generating Stations throughout Central and Eastern Ontario.*** Biologist responsible for completing on-going botanical surveys at 12 hydroelectric generating stations to update existing records. Botanical surveys will include a combination of field survey protocols including random meander, transects and quadrant sampling methods to identify vascular plant species present at each site.
- ***Foresters Falls Dam Removal, Renfrew County, Ontario.*** Biologist responsible for conducting a species at risk screening assessment to identify the presence of species at risk within the project area and evaluate the potential impacts on SAR and their habitat if the dam is removed. On-going surveys including targeted turtle basking surveys, and terrestrial wildlife and vegetation surveys.
- ***Environmental Impact Statement, Subdivision Development, Lanark County, Ontario.*** Biologist responsible for the completion of an Environmental Impact Statement for a proposed 25-lot subdivision application. Work included ecological land classification surveys, targeted surveys for species at risk, breeding amphibians and birds, basking turtle surveys, bat maternity roost surveys, headwater drainage feature assessment, butternut health assessment, impact assessment, development of lot-specific mitigation measures and agency consultation.
- ***Wetland Evaluation and Significant Wildlife Habitat Surveys, Ontario Power Generation Incorporated, Bath, Ontario (2019).*** Biologist responsible for conducting a wetland evaluation and significant wildlife habitat surveys at the Lennox Provincially Significant Wetland. Work included conducting turtle basking surveys, reptile hibernacula surveys, targeting species at risk surveys for Least Bittern and a wetland evaluation following the MNRF's Ontario Wetland Evaluation System.
- ***Environmental Impact Statement, Proposed Subdivision Development, Hawksbury, Ontario (2019).*** Biologist responsible for the completion of an Environmental Impact Statement in support of a proposed 272-lot subdivision application. Work included ecological land classification surveys, targeted surveys for breeding birds, bat maternity roost surveys, headwater drainage feature assessment, impact assessment and development of lot-specific mitigation measures.
- ***Surface Water Impact Assessment, Green Lake Development, Barry's Bay, Ontario (2019):*** Biologist responsible for the completion of a surface water impact assessment supporting two residential lot severances. Work included a review of existing data on Green





# GEMTEC

Lake, application of the provincial lakeshore capacity model, mitigation measure development and reporting.

- ***Biological Inventory, Ontario Power Generation Incorporated, Bath, Ontario (2018):*** Field Biologist responsible for conducting a three-season inventory of avian and amphibian species at the Lennox Provincially Significant Wetland. Work included conducting presence and abundance surveys following the Canadian Wildlife Service marsh monitoring protocol and Bird Studies Canada breeding bird surveys, statistical analysis of species data trends and reporting.
- ***Environmental Compliance Monitoring, Petrie Island Causeway Rehabilitation Project, Ottawa, Ontario (2018):*** Field biologist responsible for monitoring constructor compliance with various Department of Fisheries and Oceans, Ministry of Natural Resources and Conservation Authority permit conditions during the Petrie Island Causeway Rehabilitation Project within the Ottawa River. Work included species at risk surveys, fish salvage, exclusion fence inspection, monitoring of sediment and erosion control measures, turbidity monitoring, regulatory agency consultation and weekly reporting.
- ***Environmental Impact Statement, Code Drive Development, Smiths Falls, Ontario (2018):*** Field Biologist responsible for the completion of an Environmental Impact Statement in support of a severance application for the creation of eight residential lots within a significant woodland and adjacent to a large local wetland. Work included targeted surveys for species at risk, breeding amphibians and marsh birds, impact assessment, development of lot-specific mitigation measures and agency consultations.
- ***Tier I and II Natural Environment Report, Crain's Construction, Ottawa, Ontario (2018):*** Field biologist responsible for completing an inventory of site flora and fauna, completion of species at risk surveys, bat exit surveys, regulatory agency consultation, impact assessment and reporting.
- ***Species at Risk Assessment, National Capital Commission, Gatineau, Quebec (2018):*** Field biologist responsible for the completion of avian species at risk surveys to determine the presence or absence of chimney swift and barn swallows at a contaminated site. Work was undertaken to support an Ecological Risk Assessment.
- ***Environment Effects Evaluation Assessment, Britannia Wall Rehabilitation Project, Ottawa, Ontario (2018):*** Field Biologist responsible for completing a comprehensive tree inventory, wetland boundary delineation, significant wildlife habitat assessment and evaluation of effects associated with the rehabilitation of the Britannia Wall, a 600-metre-long community flood protection structure.
- ***Environmental Compliance Monitoring, Petrie Island Beach Head Rehabilitation Project, Ottawa, Ontario (2018):*** Field biologist responsible for monitoring constructor





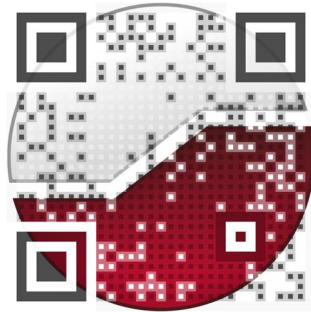
# GEMTEC

compliance with various Department of Fisheries and Oceans, Ministry of Natural Resources and Conservation Authority permit conditions during the Petrie Island Beach Head Rehabilitation Project within the Ottawa River. Work included species at risk surveys, exclusion fence inspection, monitoring of sediment and erosion control measures, and reporting.

- ***Natural Heritage Inventory and Environmental Impact Assessment, Combermere Lodge Limited, Barry's Bay, Ontario (2017-2018):*** Field biologist responsible for the completion of a Natural Heritage Inventory and Environmental Impact Assessment completed in support of a 54-lot condominium development located in an environmentally sensitive area. Work included wetland boundary delineation, identification of significant wildlife habitat, application of the significant wildlife habitat mitigation support tool, completion of a two-year survey of site flora and fauna, and impact assessments.
- ***Species at Risk and Migratory Bird Screening Assessment, City of Ottawa, New Edinburg Park Redevelopment Project, Ottawa, Ontario (2017):*** Field biologist responsible for the completion of a species at risk and migratory bird screening assessment to assist in bid tender package preparation for the re-development of New Edinburg Park. Work included a general habitat assessment, a probability of occurrence assessment, follow-up pre-construction surveys and reporting.
- ***Post-Construction Windfarm Monitoring for Wildlife Impacts, Little Current, Ontario (2016):*** Field biologist responsible for the completion of post-construction monitoring of a windfarm for avian and mammalian fatalities. Work included fatality surveys, vegetation surveys, and wildlife scavenger surveys.
- ***Long-term Changes in Ecosystem Health, Frenchman's Bay, Pickering, Ontario (2015):*** Field biologist responsible for evaluating the long-term changes in ecosystem health of Frenchman's Bay. Work included: data review, analysis of data trends, watershed and land-use mapping, digitization of wetland vegetation cover and analysis of changes over time, reporting and symposium presentation.



experience • knowledge • integrity



civil	civil
geotechnical	géotechnique
environmental	environnementale
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

expérience • connaissance • intégrité

