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West Humber River Fluvial Geomorphological Assessment

12489 and 12861 Dixie Road Caledon, Ontario



Prepared for: QuadReal 199 Bay Street, Suite 4900 Toronto, Ontario M5L 1G2

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GEO Morphix Project No. 23012

GEO MORPHIX**

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Table of Contents

1	Intro	duction	3
2	Back	ground Review and Desktop Assessment3	3
	2.1	Background Information3	3
	2.2	Surficial Geology and Physiology4	ł
	2.3	Historical Assessment4	ł
3	Wate	rcourse Characteristics6	5
	3.1	Reach Delineation6	5
	3.2	General Reach Observations6	5
	3.3	Rapid Geomorphological Assessment Tools8	3
	3.4	Detailed Geomorphological Assessments10)
4	Erosi	on Threshold Analysis10)
5	Erosi	on Hazard Delineation13	
	5.1	Meander Belt Width13	3
6		ide Dace Habitat Delineation15	
7	Sum	mary and Recommendations15	5
8	Refer	-ences	7

List of Tables

Table 1: Historical assessment summary	4
Table 2: Reach characteristics summary	7
Table 3: Summary of rapid assessment results	9
Table 4: Detailed field assessment and erosion threshold analysis results	12
Table 5: Summary of meander belt widths	14

Appendices

- Appendix A Study Area Mapping
- Appendix B Historical Aerial Photographs
- Appendix C Photographic Record
- Appendix D Field Observations

1 Introduction

GEO Morphix Ltd. ("GEO Morphix") was retained to complete a fluvial geomorphological assessment for tributaries of the West Humber River in support of a development application for 12861 and 12489 Dixie Road ("Subject Lands"). The subject lands are generally situated east of Dixie Road and south of Old School Road in the Town of Caledon and fall within the jurisdictional area of the Toronto Region Conservation Authority (TRCA).

To support planning and development activities for the subject lands, a fluvial geomorphological assessment was completed to characterize watercourses on site and delineate the meander belt width associated with each watercourse feature. The meander belt width extent is used, in part, to support constraint delineation and the overall limit of development. Preliminary erosion threshold estimates were also completed to support initial stormwater management and erosion mitigation strategies for the site.

To complete the fluvial geomorphological assessment for watercourses on site, the following activities were completed:

- Review of available background reports and mapping (e.g., watershed/subwatershed reporting, geology, and topography) related to channel form and function and controlling factors related to fluvial geomorphology
- Watercourse reach delineation by desktop assessment and confirmed through field reconnaissance
- Review of recent and historical aerial photographs to understand historical changes in land use and channel form and function and to inform meander belt width delineation
- Complete field reconnaissance to understand general property and watercourse characteristics
- Delineate the erosion hazard (i.e., meander belt width) on a reach-by-reach basis based on results of the desktop and field assessments
- Complete detailed geomorphic field assessments to inform preliminary erosion threshold calculations
- Estimate preliminary erosion thresholds for watercourses potentially receiving stormwater discharge through field and desktop data analysis
- Provide recommendations and guidance to address erosion mitigation requirements for future design phases

2 Background Review and Desktop Assessment

2.1 Background Information

The subject section of West Humber River is situated within the Toronto and Region Conservation Authority (TRCA) jurisdiction as part of the Humber River watershed. The Humber River watershed originates in the Oak Ridges Moraine, outlets to Lake Ontario, and encompasses approximately 911 square kilometers (TRCA, 2021). The West Humber River specifically originates in Caledon (South Slope) and flows over 45 km (crossing Peel Plain) in Brampton prior to its confluence with the Main Humber River in Toronto (TRCA, 2021).

A small tributary of the West Humber River originates west of Dixie Road and flows roughly northwest to southeast along the eastern margin of Dixie Road through 12861 Dixie Road. The tributary drains to a larger branch of the West Humber River which bisects the central portion of the Subject Lands between 12861 and 12489 Dixie Road. The larger tributary is situated within the Greenbelt Plan Area.

A small section of Kilamanagh Creek (tributary to the West Humber River) also flows southwest to northeast through the southeastern corner of the subject lands through 12489 Dixie Road. Kilamanagh Creek is also situated within the Greenbelt Plan Area and is designated by the Ministry of the Environment, Conservation and Parks (MECP) as redside dace (*Clinostomus elongatus*) habitat. This has implications with respect to the limit of development in proximity to the creek, as redside dace and its

habitat are regulated under the provincial *Endangered Species Act, 2007 (ESA)* and the *Species at Risk Act, 2002 (SARA)*.

Additional drainage features on-site were observed through a desktop assessment of recent aerial imagery from Google Earth Pro. Recent aerial photographs indicate that there are small headwater drainage features on site that extend through existing agricultural fields. It should be noted that these features are only visible through aerial photograph interpretation and are not included in any available stream layer datasets reviewed through the desktop assessment. A headwater drainage feature assessment was completed by Stantec and is summarized in the Environmental Impact Study (EIS) for the subject lands (*12489 & 12861 Dixie Road, Caledon, Ontario – Draft Environmental Impact Study – Stantec File No. 160623114, 160623115 – November 2023*). A map of the subject lands and various drainage features is provided under **Appendix A**, for reference.

Based on plans developed by Stantec Consulting (2024), we understand that two stormwater management (SWM) ponds are proposed within the subject lands. One SWM pond is located east of the West Humber River tributary that runs north to south, parallel and east of Dixie Road. The Pond will ultimately discharge to the north-south tributary. The second SWM pond is further south on the east side of Dixie Road and will ultimately outlet to the Kilamanagh Creek branch in the southwest portion of the lands.

2.2 Surficial Geology and Physiology

Surficial geology and physiography act as constraints to channel development and tendency. These factors determine the nature and quantity of the availability and type of sediment. Secondary variables that affect the channel include land use and riparian vegetation. These factors are explored as they not only offer insight into existing conditions, but also potential changes that could be expected in the future as they relate to a proposed activity.

Within the subject property, the West Humber River and associated tributaries are dominated by the Till Plains (drumlinized) physiographic region of Ontario (Chapman and Putnam, 2007). In terms of surficial geology, the subject lands are characterized by till (OGS, 2010). Soils within these areas include clay to silt-textured clay derived from glaciolacustrine deposits or shale (OGS, 2010). Additionally, along the downstream extent of the northern tributary, soils were characterized by modern alluvial deposits, including clay, silt, sand, gravel, and organic remains (OGS, 2010).

2.3 Historical Assessment

A series of historical aerial photographs were reviewed to determine changes to the channel and surrounding land use and land cover. This information, in part, provides an understanding of the historical factors that have contributed to current channel morphodynamics. Specifically, an aerial photograph from 1974 (1:25,000) was obtained from the National Air Photo Library (NAPL), and recent Google Earth Pro imagery for the years 2004, 2009, 2015 and 2019 were reviewed to understand site history and inform the erosion hazard assessment. All aerial images are provided in **Appendix B** for reference. **Table 1** below summarizes historical changes in land use and land cover based on year and subwatershed.

Table 1: Historical assessment summary

	Tributaries of the West Humber River	Kilamanagh Creek
1974	 Land use was predominantly agricultural and rural residential Two tributaries of the West Humber River were visible, one flowing parallel to Dixie Road and into the larger main tributary that flows southwest to northeast 	 Land use was predominantly agricultural and rural residential Upstream of the subject lands the channel may have been straightened to facilitate agricultural practices Within the subject lands Kilamanagh Creek had a low sinuosity planform with few meanders

	Tributaries of the West Humber River	Kilamanagh Creek
	 Channel planform of the smaller tributary appeared to be previously straightened for agricultural purposes Large offline pond present adjacent to upstream extent of the small tributary Limited natural riparian vegetation present along the smaller tributary Channel planform of the main tributary appeared to be previously straightened for agricultural purposes along the upstream extent, meandering planform initiating near the downstream forested extent Natural riparian vegetation was limited to the section of channel in the northern portion of the subject lands for the main tributary Both tributaries likely received fine sediment inputs due to lack of riparian vegetation and adjacent farming activities Low order tributaries faintly visible but appeared cultivated 	 Limited natural riparian vegetation apparent along the channel Channel likely received fine sediment inputs due to lack natural of riparian vegetation along some sections of channel and adjacent farming activities
2004	 No significant changes to land use within the subject lands, a golf course was constructed northeast of the subject property Straightened channel planform of tributary parallel to Dixie Road readily apparent in imagery, a small headwater feature is visible flowing into the middle section of the small tributary Natural riparian vegetation was retained and matured along the main tributary within the subject lands Rural development had expanded when compared to 1974 	 Two large offline ponds were constructed adjacent to Kilamanagh Creek, one was located upstream of Dixie Road and the other was situated on the north side of the channel within the subject lands, during high water levels it is likely that the ponds overtop into the channel Channel planform had been modified to accommodate the pond and larger meanders observed in 1974 imagery are no longer apparent Riparian zone along the upstream portion of Kilamanagh Creek had naturalized with few mature trees, obscuring the channel planform Riparian vegetation along the downstream portion of the channel remained generally sparse, and the meandering planform appeared more sinuous when compared to 1974 Rural development had expanded when compared to 1974
2009	 No significant changes to land use or channel planform within and upstream of the subject lands Naturalization of woody vegetation along the main tributary channel banks within subject lands, which may have improved channel stability, coarse organic matter inputs and shade to the larger tributary 	 No significant changes to land use or channel planform within the subject lands Narrow band of vegetation permitted to naturalize along the channel, which likely improved channel stability, coarse organic matter inputs and shade to the channel

	Tributaries of the West Humber River	Kilamanagh Creek		
2019	 No significant changes to land use or channel planform within and upstream of the subject lands Woody riparian vegetation along the downstream portion of the main tributary was able to mature and obscures the channel planform 	 A large industrial building was constructed with two stormwater management ponds on the west side of Dixie Road, across from the channel. No significant changes to channel planform within the subject lands were observed Woody riparian buffer along Kilamanagh Creek has further naturalized and matured 		

3 Watercourse Characteristics

3.1 Reach Delineation

Reaches are homogeneous segments of channel used in geomorphological investigations. Reaches are divided as such because they are expected to have similar inputs and outputs in terms of sediment and discharge. They are also expected to react similarly to flow events and other stressors. They are studied semi-independently as each is expected to function in a manner that is at least slightly different from adjoining reaches. This allows for a meaningful characterization of a watercourse as the aggregate of reaches, or an understanding of a particular reach, for example, as it relates to a proposed activity.

Reaches are delineated based on changes in the following:

- Channel planform
- Channel gradient
- Physiography
- Land cover (land use or vegetation)
- Flow, due to tributary inputs
- Soil type and surficial geology
- Certain types of channel modifications by humans

This follows scientifically defensible methodology proposed by Montgomery and Buffington (1997), Richards et al. (1997), and the Toronto and Region Conservation Authority (2004). Reaches are first delineated as a desktop exercise using available data and information such as aerial photography, topographic maps, geology information and physiography maps. The results are then verified in the field.

Five (5) watercourse reaches were delineated within the subject property. **Reach 4a** and **Reach 4b** are situated along Kilamanagh Creek: **Reach 4b** extends from Dixie Road to the downstream extent of an offline pond and **Reach 4a** extends from the downstream extent of the offline pond to the eastern property boundary. **Reaches 7**, **8** and **8a** are associated with tributaries of the West Humber River through the central portion of the subject lands. **Reaches 7** and **8** flow northeast to southwest within the centre of the subject property. **Reach 8a** flows west to east parallel to Dixie Road and flows into **Reach 8**. The extent of each reach is shown in **Appendix A**.

3.2 General Reach Observations

Field investigations were completed along the reaches within the subject lands on June 13, 2023 and November 12, 2024. The following data were collected for all reaches assessed in the field:

- Descriptions of riparian conditions
- Estimates of bankfull channel dimensions
- Determination of bed and bank material composition and structure
- Observations of erosion, scour, or deposition

• Collection of photographs to document the watercourses, riparian areas and/or valley, surrounding land use, and channel disturbances such as crossing structures

These observations and measurements are summarized below. The field descriptions are supplemented with representative photographs, which are included in **Appendix C**. Field sheets, including those completed for rapid assessments, are provided in **Appendix D**. A summary of the general observations characterizing the delineated reach is presented in **Table 2**.

Reach Name	Avg. Bankfull Width (m)	Avg. Bankfull Depth (m)	Bed Substrate	Riffle Substrate	Dominant Riparian Condition	Notes
Reach 4a	3.36	0.65	Clay/silt, sand, gravel, and cobbles*		Continuous coverage of grasses	Partially confined system;
Reach 4b	3.25	0.66	Clay/silt, sand, gravel, and cobbles*		Continuous coverage of grasses and mature trees	Partially confined system, moderate bank erosion with valley wall contacts
Reach 7	7.17	0.85	Clay/silt, sand, and Sand, exposed gravel, and parent cobbles material		Continuous coverage of mature trees and grasses	Partially confined system; valley wall contacts, fallen trees common throughout channel
Reach 8	4.10	0.67	Clay/silt, sand Sand, gravel, and cobbles		Herbaceous species, with scattered shrubs and trees	Partially confined system, moderate density of woody debris
Reach 8a	4.59	0.79	Clay/silt, sand and gravel	Gravel and cobble	Continuous coverage of grasses	Partially confined system, evidence of erosion throughout the reach

Table 2: Reach characteristics summary

*Uniform bed morphology

Reach 4a was characterized as an irregularly meandering, moderate gradient channel situated within a partially confined valley. The riparian zone was dominated by a continuous coverage of grasses that heavily encroached the channel. The channel was dominated by runs with few pools; riffles were not observed along the reach. Bed substrate was comprised of clay/silt, sand, gravel, and cobbles. Bank angles ranged from 30° to 60° with undercuts measuring up to 0.80 m. Average bankfull width and depth were 3.36 m and 0.65 m, respectively.

Reach 4b was situated in a partially confined valley, adjacent to a large offline pond. The reach was characterized as irregularly meandering with a moderate gradient and perennial flow regime. The riparian zone was comprised of a continuous coverage of grasses and mature trees. Like **Reach 4a**, the channel was dominated by runs with few deep pools and no riffles present. Bed substrate was comprised of clay/silt, sand, gravel, and cobbles; bank substrate was composed of clay, silt, and sand. Average bankfull width and depth were 3.25 m and 0.66 m, respectively. Bank angles ranged from 30° to 60° with a moderate amount of bank erosion observed through undercutting, valley wall contacts and basal scour. A low density of woody debris was observed in the channel and cutbanks.

Reach 7 was characterized as an irregularly meandering, moderate gradient channel situated within a partially confined valley. The riparian zone was wide spanning greater than 10 channel widths and was dominated by a continuous coverage of mature trees and grasses. Riffle-pool morphology was present with bed substrate ranging from clay/silt to cobbles and exposed parent material (till). Average bankfull width and depth were 7.17 m and 0.85 m, respectively. Bank angles ranged from 60° to 90° and bank erosion was observed along 60% to 100% of the reach. Erosion was evident as undercutting, exposed tree roots and valley wall contacts. A low density of woody debris was present in the channel and cutbanks.



Reach 8 had an irregularly meandering planform and was a low gradient channel situated in a partially confined valley. The riparian zone was wide and dense, dominated by a continuous coverage of trees and shrubs. Riffle-pool morphology was observed with riffle substrate ranging from sand to cobbles and pool substrate ranging from clay/silt to sand. Rooted emergent aquatic vegetation was observed through 25% of the reach. Average bankfull width and depth were 4.10 m and 0.67 m, respectively. Bank angles ranged from 30° to 60° and the banks were moderately eroded. Evidence of erosion included exposed tree roots, undercuts and valley wall contacts. A moderate density of woody debris was present in the channel and cutbank.

Reach 8a was slightly sinuous and historically straightened to facilitate agricultural practices. The channel had a low gradient and was situated within a partially confined valley with valley walls at a significant distance from the centre of the channel. The floodplain adjacent to the channel is primarily used as pastured land. At the time of assessment, high flows were observed following a storm event, and much of the floodplain adjacent to the channel was inundated with water. Riparian vegetation in the corridor consisted of immature grasses with several mature trees. The riparian zone was greater than 10 channel widths wide with minimal encroachment on the channel. Aquatic vegetation including rooted emergent plants and attached algae covered approximately 45% of the reach. Riffle-pool geomorphic units were observed throughout the reach. The bed was noted to be predominantly sand and gravel with finer silts noted in pools and coarser cobbles noted in riffles. The banks of the stream consisted of clay, silt, and sand. Bank erosion was noted along 60% to 100% of the reach and was observed as bank slumps and undercutting. Bank angles were observed to be undercut or approximately 60° to 90° bank angle. Average bankfull width and depth was 4.59 m and 0.79 m, respectively.

3.3 Rapid Geomorphological Assessment Tools

Rapid assessments were completed to identify dominant geomorphic processes, document stream health, and to identify any areas of concern regarding erosion or instability. Channel instability was objectively quantified through the application of the Ontario Ministry of the Environment's (2003) Rapid Geomorphic Assessment (RGA). Observations were quantified using an index that identifies channel sensitivity based on evidence of aggradation, degradation, channel widening, and planimetric adjustment. The index produces values that indicate whether a channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40), or adjusting (score >0.41).

The Rapid Stream Assessment Technique (RSAT) was also employed to provide a broader view of the system as it considers the ecological function of the watercourse (Galli, 1996). Observations were made of channel stability, channel scouring or sediment deposition, instream and riparian habitats, and water quality. The RSAT score ranks the channel as maintaining a poor (<13), fair (13-24), good (25-34), or excellent (35-42) degree of stream health.

Reaches were also classified according to a modified Downs (1995) Channel Evolution Model. The Downs model describes successional stages of a channel because of a perturbation, namely hydromodification. Understanding the current stage of the system is beneficial as this allows one to predict how the channel will continue to evolve or respond to an alteration to the system. The results of these assessments are summarized below.

The River Styles Framework (Brierley and Fryirs, 2005) provides a geomorphic approach to examining river character, behaviour, condition and recovery potential through the identification of the Geomorphic Process Zone. Geomorphic attributes are assessed, larger scale interactions between zones are analyzed, and historical data are studied to understand the historical evolution and future trajectories of those reaches. This ultimately provides a physical template for river management. A modified classification approach was applied to the study reaches. A summary of the reach classifications and rapid assessment scores is provided in Error! Reference source not found.**3**.

	RGA (MOE, 2003)			RSAT (Galli, 1996)			Downs (1995)	River Styles Framework	
Reach	Score	Condition	Dominant Systematic Adjustment	Score	Condition	Limiting Feature(s)	Channel Evolution Model	(Bierley and Fyris, 2005)	
Reach 4a	0.21	In Transition/S tress	Evidence of Widening	23	Fair	Riparian Habitat Condition	E - Enlarging	Mixed load meandering	
Reach 4b	0.24	In Transition/S tress	Evidence of Widening	22	Fair	Riparian Habitat Condition	E - Enlarging	Mixed load meandering	
Reach 7	0.37	In Transition/S tress	Evidence of Widening	30	Good	Channel Stability	U - Undercutting	Mixed load meandering	
Reach 8	0.25	In Transition/S tress	Evidence of Planimetric Form Adjustment	25	Good	Riparian Habitat Condition	E - Enlarging	Mixed load meandering	
Reach 8a	0.17	In Regime	Evidence of Aggregation	23	Fair	Riparian Habitat Condition	E - Enlarging	Suspended load sinuous	

Table 3: Summary of rapid assessment results

Reach 4a was evaluated to be in transition/stress, with an RGA score of 0.21. The dominant systematic adjustment was evidence of widening. The channel contained basal scour on the inside of meander bends and both sides through the riffles. The reach was assigned an RSAT score of 23, indicating it was in fair condition. The limiting factor was riparian conditions. The Downs (1995) classification indicated that this reach was enlarging (E). The reach was a mixed load meandering channel under the River Styles Framework.

The RGA results for **Reach 4b** indicated that the reach was in transition/stress, with a score of 0.24. The dominant mode of systematic adjustment was evidence of widening. This was shown by occurrence of large organic debris, exposed tree roots, and basal scour. The RSAT indicated the reach was in fair condition with a score of 22. The limiting factor was riparian habitat condition. The riparian corridor was narrow with limited canopy coverage. Similar to **Reach 4b**, the Downs (2005) channel evolution model classified this reach as enlarging (E). The reach was a mixed load meandering channel under the River Styles Framework.

Reach 7 was assigned an RGA score of 0.37, indicating the reach was in transition/stress. The dominant systematic adjustment was evidence of widening. The channel had fallen/leaning trees, occurrence of organic debris and exposed tree roots. The RSAT resulted in a score of 30, or good. The limiting factor was channel stability due to undercutting, bank slumps, and valley wall contacts. **Reach 7** was characterized as an undercutting (U) channel under the Downs (1995) classification and a mixed load meandering channel under the River Style Framework.

The RGA results for **Reach 8** indicated the reach was in transition/stress, with a score of 0.25. The dominate mode of systematic adjustment was evidence of planimetric form adjustment. Formation of chutes, single thread to multiple channels and cut-off channels were observed. The RSAT indicated the reach was in good condition with a score of 25. The limiting factor was riparian habitat condition. The reach had a riparian zone consisting of grasses and herbaceous vegetation with few trees and limited canopy cover. The Downs (1995) classification indicated that the channel was enlarging (E), and the River Style Framework characterized the channel as mixed load meandering.

Reach 8a was evaluated to be in regime with an RGA score of 0.17. The dominant systematic adjustment was evidence of aggregation. Siltation in pools, coarse material embedded in riffles and poor longitudinal sorting of bed materials indicate aggradation of the channel. The RSAT resulted in a score of 23, or fair condition. The limiting factor was riparian habitat condition due to the lack of woody vegetation and limited canopy cover in the riparian buffer. The Downs (1995) classification indicated

that the channel was enlarging (E). The reach was a suspended load-dominated sinuous channel under the River Styles Framework.

3.4 Detailed Geomorphological Assessments

Detailed geomorphological assessments were completed in Fall 2024. These assessments provide bankfull channel characteristics, cross-sectional geometry, sediment characterization, and hydraulic information for use in defining appropriate erosion thresholds. Reaches were selected for assessment based on proximity to the zone of impact associated with their respective pond outlet. **. Reaches 7, 8a**, and **4a** were selected for detailed geomorphic assessments. A map with the locations of these assessments is provided in **Appendix A**.

Representative cross-sections were surveyed along each reach to characterize channel geometry, and a longitudinal bed survey was completed to measure the channel gradient. Detailed observations of bank conditions were collected at each cross section. A modified Wolman (1954) pebble count was completed, where applicable, to characterize the bed materials. Sediments sampled from bank and fine bed materials were collected for further review and laboratory grain size analysis to provide additional details regarding substrate composition and erosion sensitivity. For each assessed reach, a summary of measured and computed values is presented in **Table 4**.

4 Erosion Threshold Analysis

Erosion thresholds are used to determine the magnitude of flow required to potentially entrain and transport bed and/or bank material (Garcia, 2008; Villard and Parish, 2003). As such, they are used to inform erosion mitigation strategies in channels influenced by conceptual flow and stormwater management plans. Erosion thresholds were modelled from detailed field observations of **Reaches 7**, **8a**, and **4a**. These reaches were selected for the assessment, as they were determined to be the most erosion-sensitive reaches immediately downstream of the SWM outlets for the proposed development.

The erosion threshold is the theoretical point, typically expressed as a critical discharge or shear stress, at which entrainment of sediment would occur based on the morphology of the channel and characteristics of the bed and bank materials. Due to variability between bed and bank composition and structure, erosion thresholds are determined for both bed and bank materials. The lower of the bed and bank erosion thresholds is adopted, as it provides the more conservative and limiting estimate of erosion potential.

A theoretical erosion threshold is an inherently conservative value, as it represents the force required to initiate sediment motion rather than the force needed for systemic erosion. The methods applied also make assumptions necessary to adopt when the variability of a natural channel is reduced to variables in an equation, adding to the inherent conservatism. The shear acting on the bed material is assumed to be representative of the total shear in the hypothetical representative cross-section. At the same time, in a natural channel, there is additional resistance to erosion provided by vegetation and non-uniform channel bed geometry that dissipates a portion of the force. Subtracting the resistance from the total shear gives the effective shear, which is the force acting on the bed in a natural channel.

Erosion thresholds are determined using different methods that are dependent on channel and sediment characteristics. For example, thresholds for non-cohesive sediments are commonly estimated using a shear stress approach, similar to that of Miller et al. (1977), which is based on a modified Shield's curve. A velocity approach can also be applied. For cohesive materials, a method such as that described by Komar (1987), or empirically derived values such as those compiled by Fischenich (2001), Chow (1959) or Julien (1994), can be applied.

An erosion threshold, defined in terms of a critical discharge, is quantified based on the bed and bank materials and local channel geometry. Theoretically, above this discharge, entrainment and transport of sediment can occur. To determine this discharge, the velocity, U, or Shear Stress, t, is calculated at various depths for a representative cross section until the average velocity or shear stress in slightly exceeds the critical threshold of the bed material. The velocity is determined using a Manning's approach, where the Manning's n value is visually estimated through a method described by Acrement

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and Schneider (1989) or calculated using the Limerino (1970) approach. The velocity is mathematically represented as:

$$U = \frac{1}{n} d^{2/3} S^{1/2}$$
 [Eq. 1]

where, d is depth of water, S is channel slope, and n is the Manning's roughness.

The shear stress is determined using the depth-slope product, which can be applied to the bed of open channels containing fluid undergoing steady flows. The shear stress is mathematically represented as:

$$\tau = d\rho g S_{bed}$$

[Eq. 2]

Where, τ is shear stress, d is the water depth, ρ is water density, g is acceleration due to gravity, and S_{bed} is the channel bed slope.

Because only 75% of bed shear stress and velocities applies to channel banks in uniform cross sections (Chow, 1959), the erosion threshold is scaled appropriately for these materials.

The Ontario Soil Survey Complex identifies five soil types within the drainage areas upstream of and within the reaches: Chingacousy Clay Loam, Jeddo Clay Loam, Oneida Clay Loam, Bookton sandy loam, and Fox sandy loam (OMAFRA, 2024). The former three soils are calcareous fine-grained soils derived from Till diamicton parent materials, while the latter two soils are calcareous medium-grained sandy soils derived from sandy glacial moraine deposits overlying local clay till (Gillespie, Wicklund, and Miller, 1967). The banks within **Reaches 7** and **8a** were characterized as predominantly consisting of silt loam, based on the criteria of Fischenich (2001) as this soil type most closely matches observations made during field assessments. The banks within **Reach 4a** were characterized as predominantly consisting of sand loam, based on the criteria of Julien (1998) as this soil type most closely matches observations made during field assessments and the results of particle size analysis conducted on samples taken during the field assessment.

A critical velocity approach was taken using the criteria of Julien (1998) for the silt loam bank material in **Reaches 7** and **8a**, and for the sand loam bank materials in **Reach 4a**. These materials are estimated to have critical velocities of 0.53 m/s and 0.50 m/s, respectively, which were used to determine the threshold discharges for these reaches. Threshold discharge is an estimate of the discharge at which sediment entrainment begins to occur. Manning's roughness values were adopted for the critical discharge calculations for each reach, based on the framework described by Acrement and Schneider (1989). A value of n = 0.045 was adopted for **Reach 4a**.

Based on a critical velocity of 0.53 m/s, the critical discharge for the bank materials within **Reach 7** was predicted to be 0.998 m³/s. Using the same critical velocity, the critical discharge for the bank materials within **Reach 8a** was predicted to be 0.946 m³/s. Based on a critical velocity of 0.50 m/s, the critical discharge for the bank materials within **Reach 4a** was predicted to be 0.599 m³/s.

The beds within **Reaches 7**, **8a** and **4a** were characterized as predominantly consisting of sediments ranging in size from silt to cobble. Angular, sub-angular, and platy gravel to cobble sized sediments were observed at all cross-sections surveyed within these reaches during field assessments. These bed sediments were classified as graded silt to cobbles, based on the criteria of Julien (1994), as this most closely matches observations made during field assessments. This material is estimated to have a critical velocity of 1.14 m/s, which was used to determine the threshold discharges for these reaches. The same Manning's n values listed above were adopted for bed material calculations for the respective reaches.

Based on critical velocity of 1.14 m/s, the critical discharge for the bed materials within **Reach 7** was predicted to be 4.675 m³/s. Using the same critical velocity, the critical discharge for the bed materials within **Reach 8a** was predicted to be 6.772 m³/s. Based on critical velocity of 1.14 m/s, the critical discharge for the bed materials within **Reach 4a** was predicted to be 6.331 m³/s.

The results of the erosion threshold assessment are provided in **Table 4** below.

Table 4: Detailed field assessment and erosion threshold analysis results

Channel Parameter	R4a		R8a		R7			
Channel Characteristics								
Average bankfull width (m)	4.32		4.37		7.07			
Average bankfull depth (m)	0.	35	C).30	0.32			
Channel gradient (%)	0.	55	C).36	0	.66		
D ₅₀ (mm)	14	.6		2.8	1	1.0		
D ₈₄ (mm)	64	.0	1	9.0	6	5.0		
Manning's n roughness coefficient	0.0)45	0	.040	0.	045		
Average bankfull discharge (m ³ /s)	1.	21	1	34	1	.65		
Average bankfull velocity (m/s)	0.	76	C).77	0.82			
Drainage area* (h)	1194 847.20		17.20	970.05				
	E	rosion Thre	shold Analy	/sis				
	Bed	Banks	Bed	Banks	Bed	Banks		
Material	Silt to cobbles	Sandy Ioam	Graded loam to cobbles	Silty loam	Graded loam to cobbles	Silty loam		
Reference	Julien (1994)	Julien (1994)	Julien (1994)	Fischenich (2001)	Julien (1994)	Fischenich (2001)		
Critical velocity (m/s)	1.14	0.50	1.14	0.53	1.14	0.53		
Apparent shear stress (N/m ²)	35.18	15.59	19.08	9.46	24.57	11.68		
Critical depth (m)	0.65	0.29	0.71	0.36	0.50	0.24		
Critical discharge (m ³ /s)	6.331	0.599	6.772	0.946	4.675	0.998		
Unitary threshold (m ³ /s/ha)	0.0053	0.0005	0.0080	0.0013	0.0048	0.0010		
Limiting critical discharge (m ³ /s)	0.5	99	0.946 0.998		998			
Unitary threshold (m³/s/ha)	0.0	005	0.0013 0.0010		010			

* Drainage areas estimated using combination of the Ontario Watershed Information Tool (OWIT)

Drainage areas were estimated for **the above reaches** using the Ontario Watershed Information Tool (OWIT) to derive preliminary unitary erosion thresholds for comparison across similar watersheds. The drainage area of 1194 ha for **Reach 4a** resulted in a preliminary unitary erosion threshold of 0.0005 $m^3/s/ha$. A drainage area of approximately 847 ha was estimated for **Reach 8a**, resulting in a preliminary unitary erosion threshold of 0.0013 $m^3/s/ha$. A drainage area of approximately 970 ha was estimated for **Reach 7**, resulting in a preliminary unitary erosion threshold of 0.0013 $m^3/s/ha$.

These values are comparable to unitary erosion thresholds accepted for watercourses with similar characteristics, including other watercourses in the Humber River watershed and nearby watersheds within the TRCA as well as neighbouring conservation authority jurisdictions. Stormwater management and erosion mitigation strategies, such as low-impact development (LID), water detention, and water retention, for example, applied in similar and nearby watersheds are thus likely to be sufficient to

address downstream impacts associated with the proposed development. We recommend that the pond release rates be refined through detailed design and that a combination of onsite SWM detention and retention through LIDs be implemented.

5 Erosion Hazard Delineation

5.1 Meander Belt Width

Most watercourses in Ontario have a natural tendency to develop and maintain a meandering planform, provided there are no spatial constraints. A meander belt width assessment estimates the lateral extent that a meandering channel has historically occupied and will likely occupy in the future. This assessment is therefore useful for determining the potential erosion hazard to proposed activities adjacent to a given watercourse.

In unconfined systems, a meander belt width can be applied, at minimum, based on 20 times the bankfull channel width. Alternatively, the meander belt width can be determined through a detailed geomorphological study that examines the largest channel meanders observed through historical and recent aerial photograph interpretation. The meander belt width can then be graphically defined using orthorectified aerial imagery by determining the channel centerline and the channel's central tendency (i.e., meander belt axis). In cases where the channel is not discernible in aerial photographs or the channel has been substantially modified, empirical models can be used to estimate the meander belt width.

Partially confined systems are those where meander bends are adjacent to only one valley wall and the watercourse is therefore restricted in migration and floodplain occupation on one side of the valley system. Confined systems are those where the watercourse position is such that meander bends are adjacent to both valley walls and meander migration is restricted on both sides of the valley. The Ontario Ministry of Natural Resources (MNR) outlines an approach for establishing the erosion hazard where watercourses are confined by valley walls. This approach defines an appropriate erosion setback or toe erosion allowance from a channel bank where the creek is within 15 m of the toe of the valley slope. The toe erosion allowance is combined with a stable slope allowance to form the overall long-term stable slope (i.e., erosion hazard for confined valleys).

Based on field observations and available topographic data, **Reaches 4a**, **4b**, **7**, **8** and **8a** are partially confined. In this case, a meander belt width has been defined for each reach. In areas where the meander belt width extends beyond the valley wall, it has been truncated along the estimated toe of slope, which is the point where channel migration is impeded. If delineation of a long-term stable slope is required for any of the valley features on site, geomorphic confirmation will be required to define an appropriate toe erosion allowance. It should be noted that any stable slope allowance and final long-term stable slope line should be completed and delineated by a geotechnical engineer.

As meanders within the subject lands were not readily visible in aerial imagery due to the presence of woody vegetation and channel form, meander belt widths were calculated using an empirical modelling approach. The series of empirical models used to estimate meander belt widths are scientifically defensible and have been verified in past projects as suitable for use in southern Ontario.

A meander belt width was calculated based on TRCA's (2004) empirical model [Eq.1]:

$$B_w = -14.827 + 8.319 \ln (\rho g Q S * D A)$$

[Eq. 3]

where ρ is water density (1000 kg/m³), g is acceleration due to gravity (9.8 m/s²), Q is discharge (m³/s), S is channel slope (m/m), and DA is drainage area (km²). Drainage area values are based on information available through the Ontario Watershed Information Tool (OWIT).

In addition to the TRCA (2004) model described above, empirical relations such as those modified from Williams (1986) [Eqs. 3 and 4] were used to delineate the meander belt width, and includes the width of the channel as follows:

$$B_w = 18A^{0.65} + W_b$$
 [Eq. 4]

$$B_w = 4.3W_h^{-1.12} + W_h$$

where A is bankfull cross-sectional area (m^2) and W_b is average bankfull channel width (m). An additional 20% buffer was applied to the computed results as a factor of safety.

The Ward et al. (2002) model [Eq.5] was also used to determine meander belt widths (ft), B_w :

$$B_w = 6W_b^{1.12}$$

GFO

[Eq. 6]

[Eq. 5]

A 20% factor of safety was not applied to this value due to the approach used in the modelling (i.e., hazard envelope rather than a linear relationship). The results of the meander belt width assessment are provided in **Table 4.** Refer to **Appendix A** for the extent of the meander belt width along each reach.

			Recommended			
Reach	Valley Form	Williams (1986) Area*	Williams (1986) Width *	Ward et al. (2002) Width	TRCA (2004)**	Meander Belt Width (m)*
Reach 4a	Partially Confined	40	24	27	60	40
Reach 4b	Partially Confined	40	23	26	58	40
Reach 7	Partially Confined	78	56	63	59	78
Reach 8	Partially Confined	46	30	34	55	46
	Partially Confined		34	38	59	55

Table 5: Summary of meander belt widths

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* A 20% factor of safety is included

** 1 standard error (8.63 m) is included

The range of meander belt widths derived from the empirical modelling ranged from 30 m to 78 m for the reaches along the tributaries of the West Humber River. Meander belt width estimates were selected based on the Williams Area (1986) model. **Reach 7** was recommended as 78 m, **Reach 8** was recommended as 46 m, and **Reach 8a** was recommended at 55 m. These meander belt widths include a 20% factor of safety. Using the Williams Area (1986) model is considered a conservative estimate as it is slightly larger than meander belt width values for most of the reaches, it is also based on bankfull channel dimensions and is comparable to meander belt width values calculated using drainage area and 2-year discharge. The meander belt widths also generally fall within the extent of the valley bottom width, where the channel can realistically migrate.

The meander belt widths derived from the empirical modelling range from 24 m to 60 m for the reaches along Kilamanagh Creek. A meander belt width of 40 m is recommended based on the Willams Area (1986) model. A greater meander belt width such as 60 m would extend beyond the extent of defined slopes adjacent to the creek. The channel can not realistically migrate beyond the valley toe. The 40 m meander belt width is generally situated within the width of the valley floor, and as such, it is more appropriate and realistic.



Refer to **Appendix A** for mapping of the meander belt width extent along each reach. It should be noted that in areas where the meander belt width extended beyond the valley walls, the meander belt width has been truncated along the estimated valley toe of slope given that the valley will act to limit channel migration. As noted previously, if future long-term stable slope analysis is required, additional geomorphic analysis should be completed to confirm appropriate toe erosion allowance requirements. However, the final long-term stable slope would need to be completed and confirmed by a geotechnical engineer.

6 **Redside Dace Habitat Delineation**

Kilamanagh Creek within the subject lands is considered Redside Dace (*Clinostomus elongatus*) habitat by the Ontario Ministry of the Environment, Conservation and Parks (MECP). This has implications with respect to the limit of development in proximity to the creek, as Redside Dace and its habitat are regulated under the provincial *Endangered Species Act, 2007* (ESA) and the *Species at Risk Act, 2002*.

Ontario Regulation 832/21 under the ESA defines occupied and recovery Redside Dace habitat as the meander belt width and 30 m of vegetated riparian habitat along both sides of the meander belt. As the habitat regulation does not account for differences in valley setting, where the channel is confined or partially confined, the 30 m riparian area is applied from the toe of slope. This represents the extent that the channel can physically or effectively migrate. This approach has been accepted by the MECP elsewhere in the Greater Toronto Area. The extent of regulated habitat for Redside Dace is presented graphically in **Appendix A** along **Reach 4a** and **4b** in association with Kilamanagh Creek.

7 Summary and Recommendations

A fluvial geomorphological assessment was completed for the properties located at 12489 and 12861 Dixie Road to support development applications for future industrial properties. Several watercourses flow through the subject lands, including two tributaries of the West Humber River and a third tributary of the West Humber River named Kilamanagh Creek. The assessment included a review of historical aerial imagery, rapid and detailed field reconnaissance, meander belt width delineation, and preliminary erosion threshold analysis to support SWM and erosion mitigation strategies.

The meander belt widths were determined to be 40 m for **Reaches 4a** and **4b** along Kilamanagh Creek and 78 m for **Reach 7**, 46 m for **Reach 8** and 55 m for **Reach 8a** along the tributaries of the West Humber River. These meander belt width values include a 20% factor of safety. The reaches observed were also confined or partially confined by defined valley walls. Note that if delineation of a long-term stable slope is required in the future for any of the valley features on site, this work would need to be completed by a qualified geotechnical engineer. Although, it is recommended that geomorphic input be included in this type of study to define an appropriate toe erosion allowance.

Lastly, Kilamanagh Creek is considered redside dace habitat by the MECP. Occupied and recovery Redside Dace habitat is typically defined based on the meander belt width and a 30 m vegetated riparian habitat along both sides of the meander belt. As such, a 30 m buffer has been established beyond the meander belt width extent delineated here.

A preliminary erosion threshold, expressed as a critical discharge, was determined for both the bed and bank materials for each detailed geomorphic assessment field site. The more conservative of the two values was used to calculate unitary erosion thresholds using estimated drainage areas for each of the subject reaches. The unitary values were compared to those accepted for nearby watercourses to determine whether stormwater management and erosion mitigation strategies are likely to be sufficient to mitigate downstream impacts associated with the development. The unitary erosion thresholds outlined here are within the range of those successfully applied elsewhere in combination with Low Impact Development (LID) measures and stormwater management. We recommend that the pond release rates be refined through detailed design and that a combination of onsite SWM detention and retention through LIDs be implemented.



We trust this report meets your current requirements. Should you have any questions, please contact the undersigned.

Respectfully submitted,

Paul Villard, Ph.D., P.Geo., CAN-CISEC, EP, CERP Director, Principal Geomorphologist

Mort

Kat Woodrow, M.Sc. Manager of Watershed Studies

Jan Franssen, Ph.D. Senior Watershed Scientist

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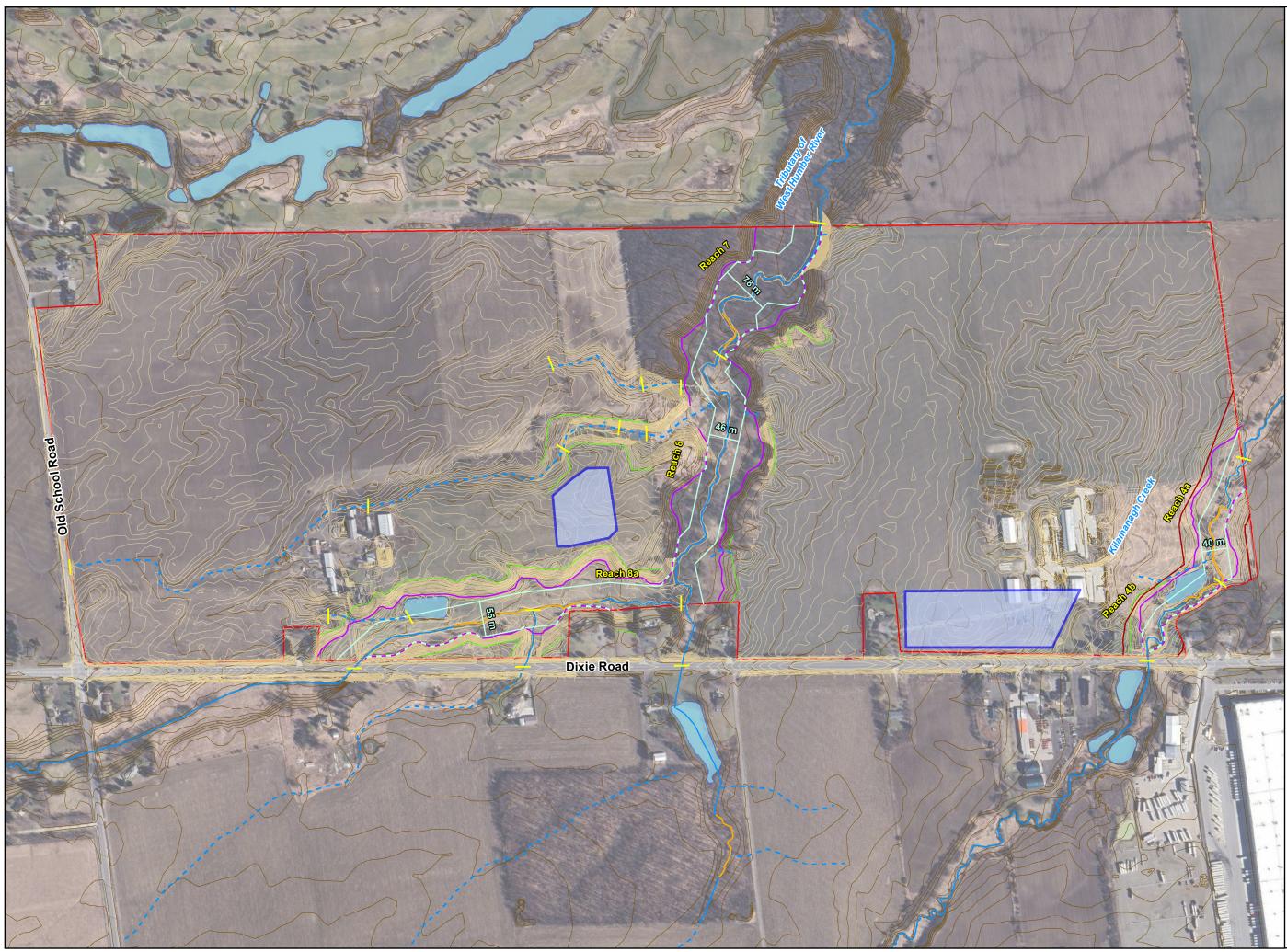
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Appendix A Study Area Mapping



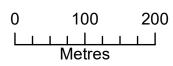
12489 and 12861 **Dixie Road**

Fluvial Geomorphic Assessment Caledon, Ontario

Legend

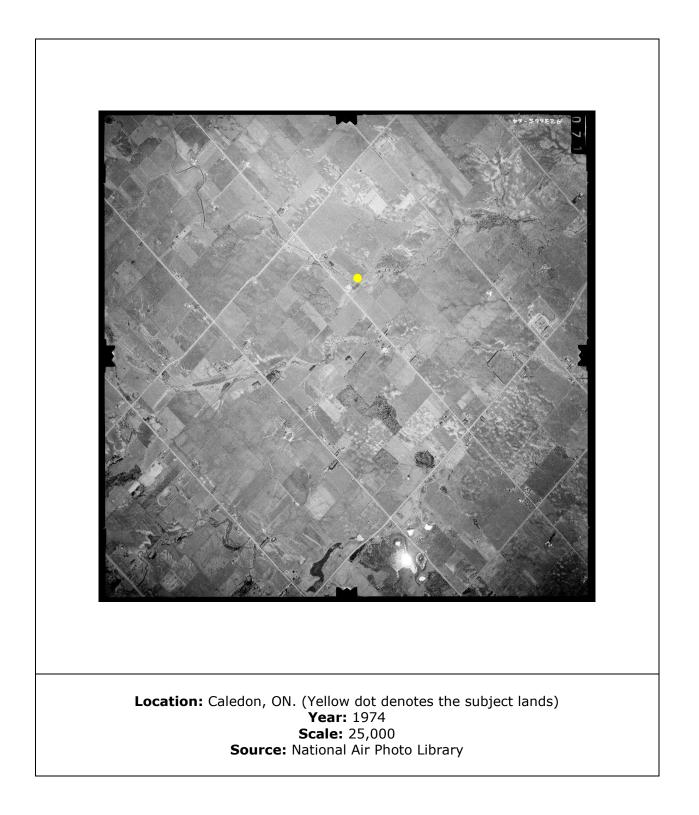
- Reach Break and ID
- →→→ Watercourse
- Headwater Drainage Feature
 - **Detailed Assessment** Location
 - 0.25 m Contour
- 1 m Contour
 - Estimated Toe of Slope
- Meander Belt Width
- Meander Belt Width Truncated at Toe of Slope
- Redside Dace Habitat Extent
- Staked Top of Slope
- Approximte Study Area
- Approximate SWM Pond Location
- OHN Waterbody

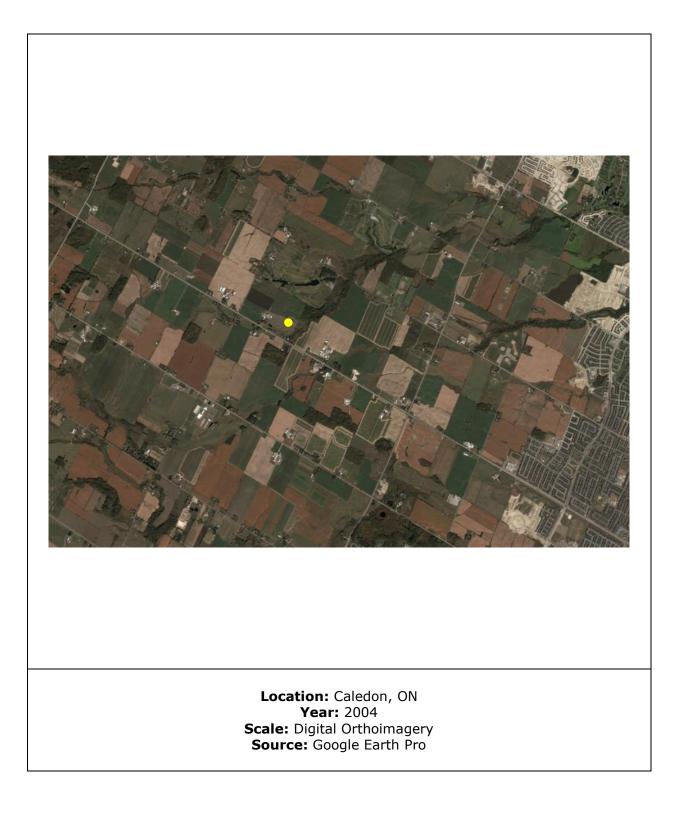


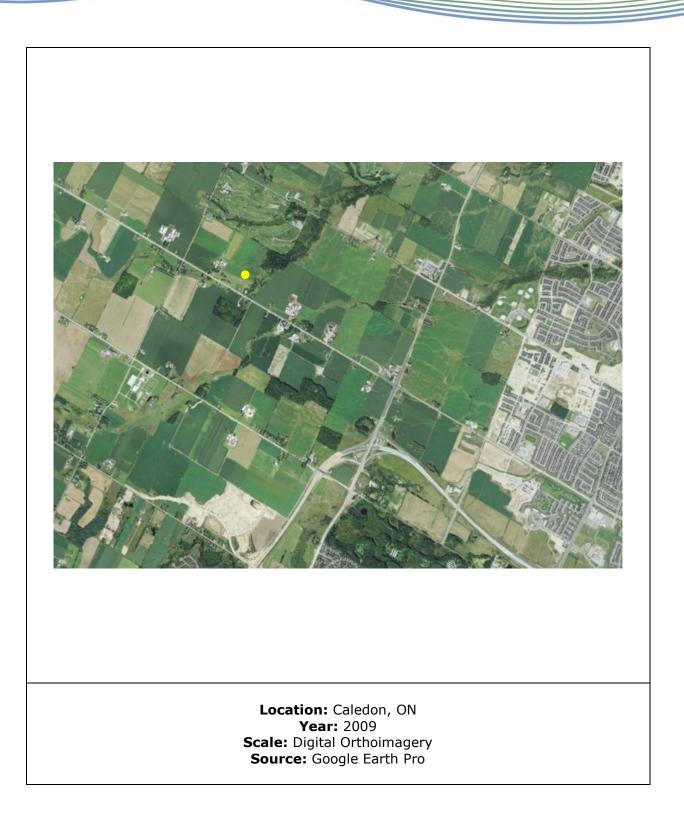


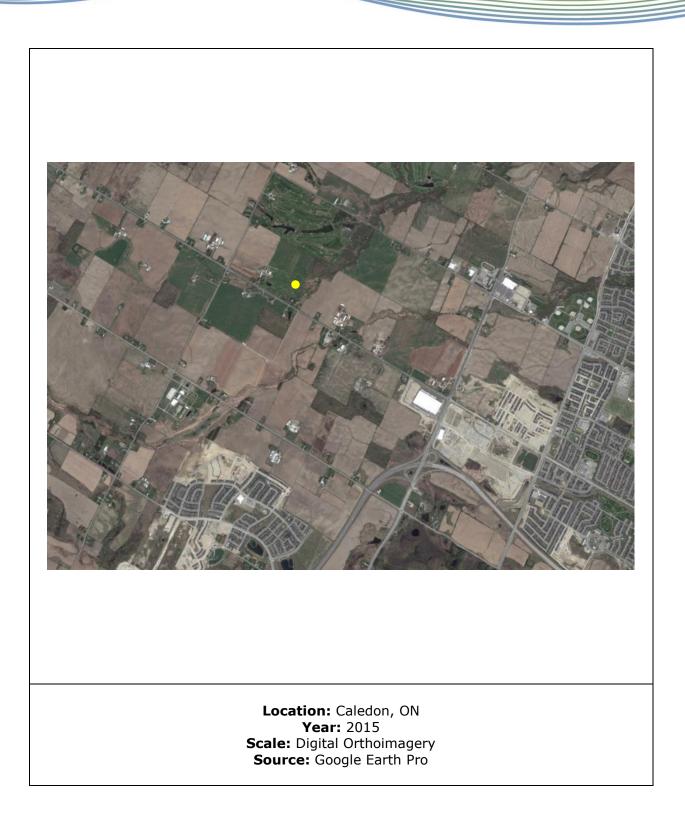
Imagery: Google Earth, 2023. Watercourse: Peel Region, 2021 / J.D. Barnes, 2022. 0.25 m Contour: J.D. Barnes, 2022. 1.0 m Region of Peel: 2020. Waterbody: MNR, 2020. Detailed Assessment Location: GEO Morphix Ltd., 2024. Staked Top of Bank: J.D. Barnes, 2023. Reach Break and ID, Approximate Study Area, Meander Belt Width, Redside Dace Habitat: GEO Morphix Ltd., 2023. Toe of Slope: GEO Morphix Ltd., 2023 (derived from J.D. Barnes Contour and Peel Region Contours). Headwater Drainage Features: Stantec, 2023. PN23012. Print Date: December 2024. Drawn By: M.O., K.W.

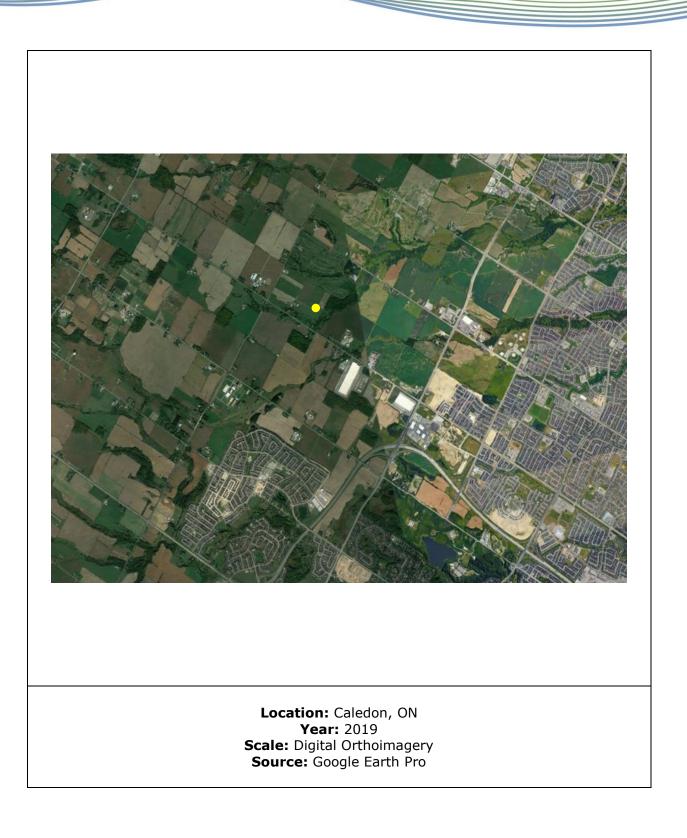
Appendix B Historical Aerial Photographs



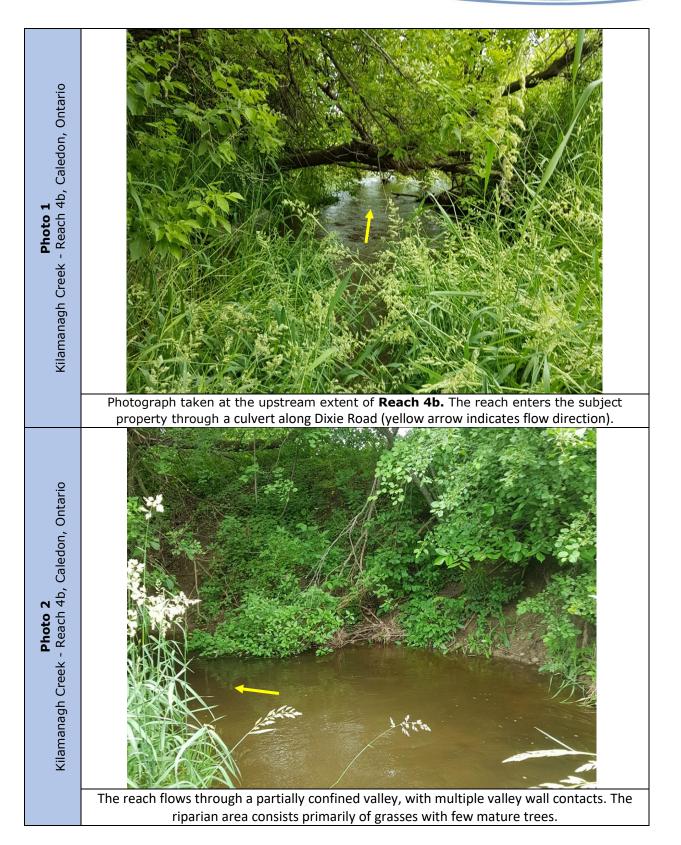


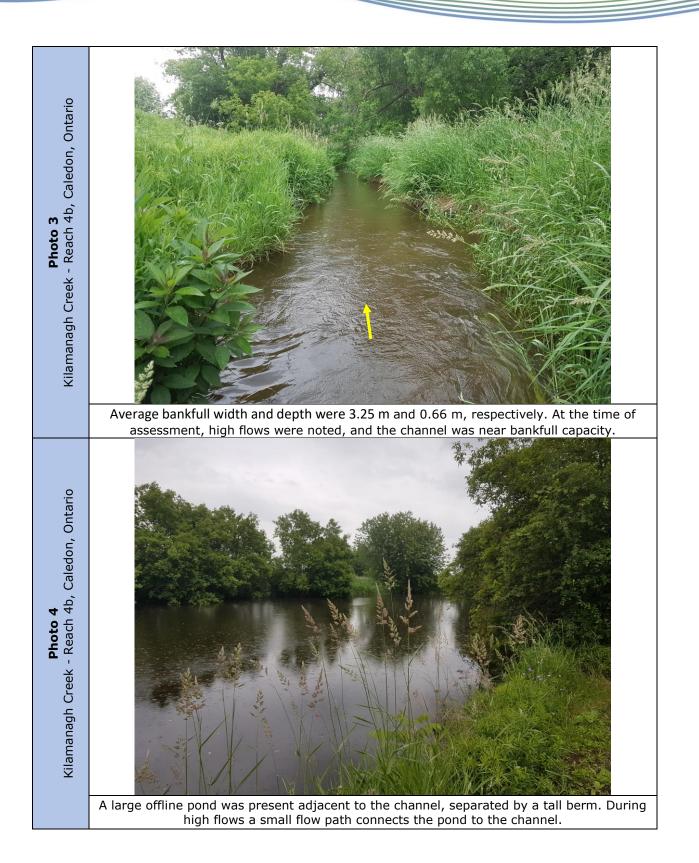


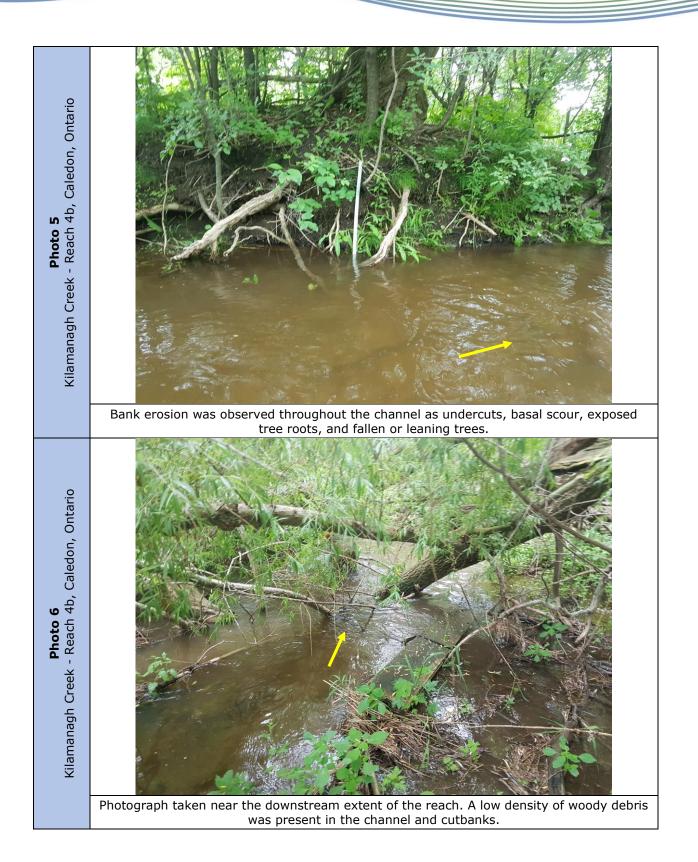


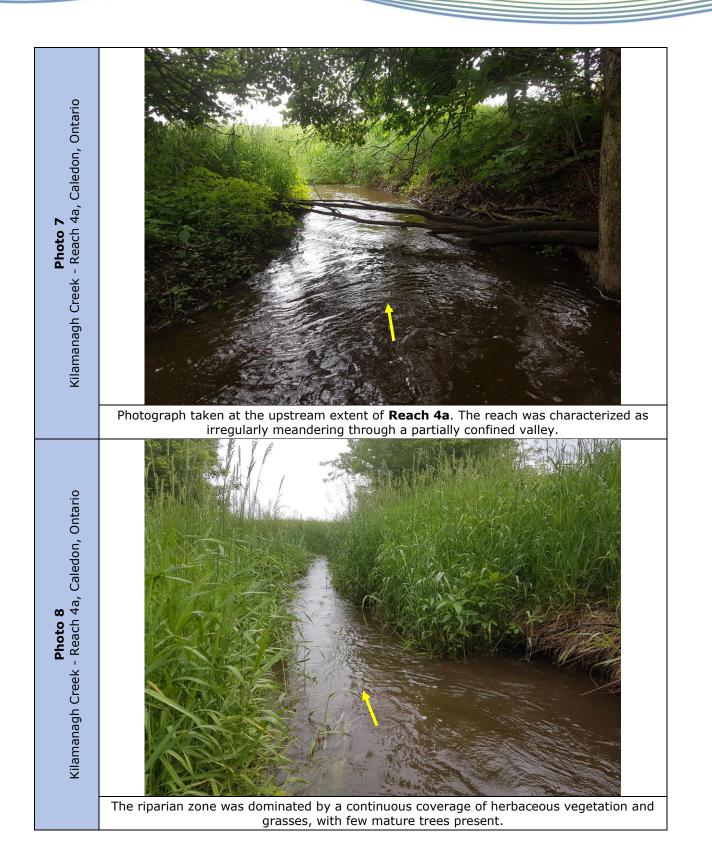


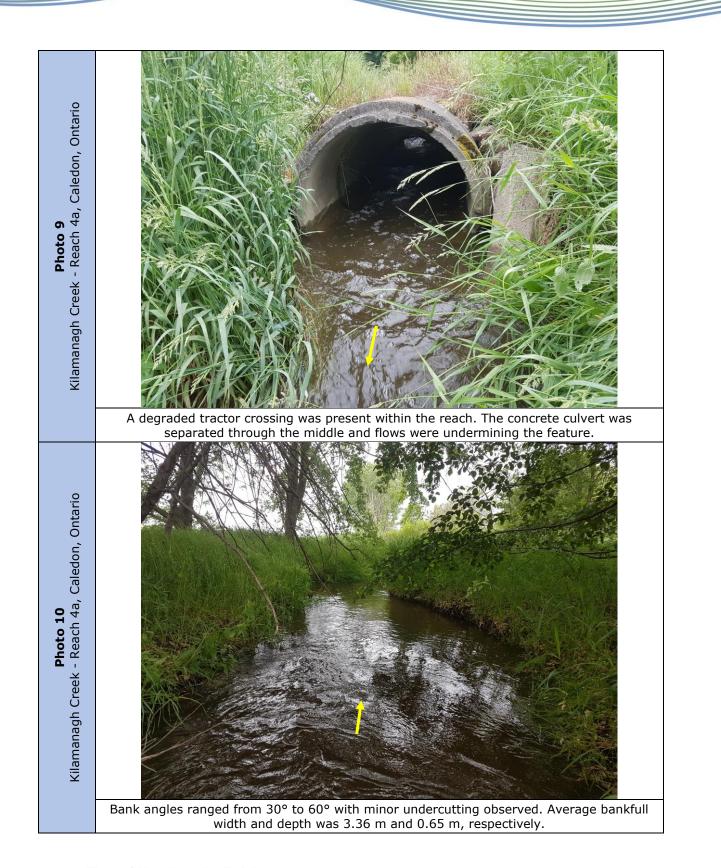
Appendix C Photographic Record



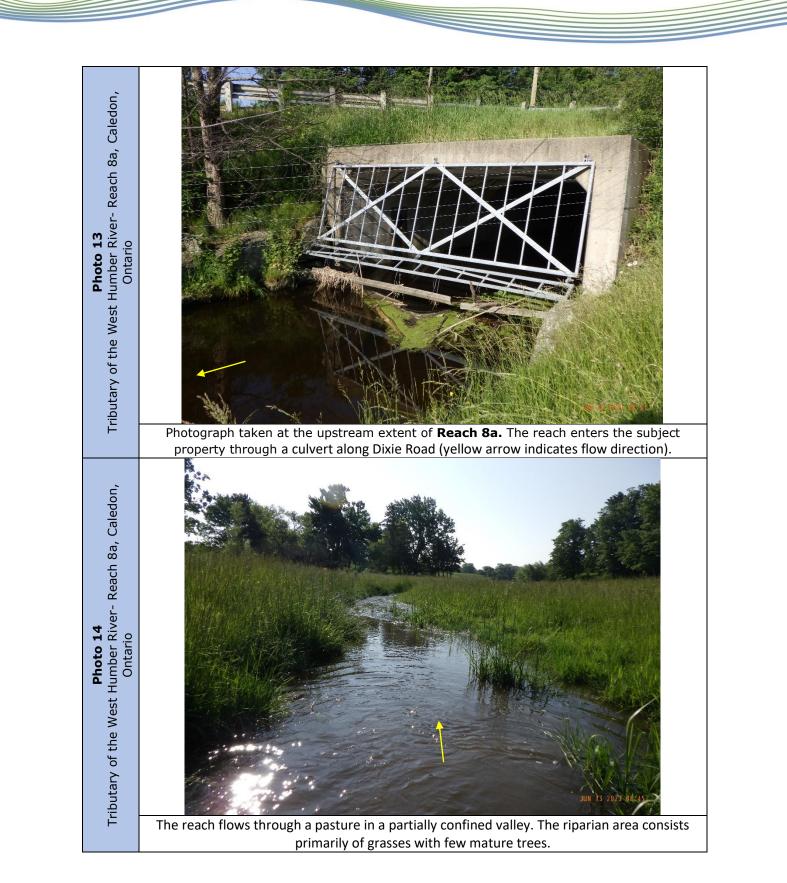


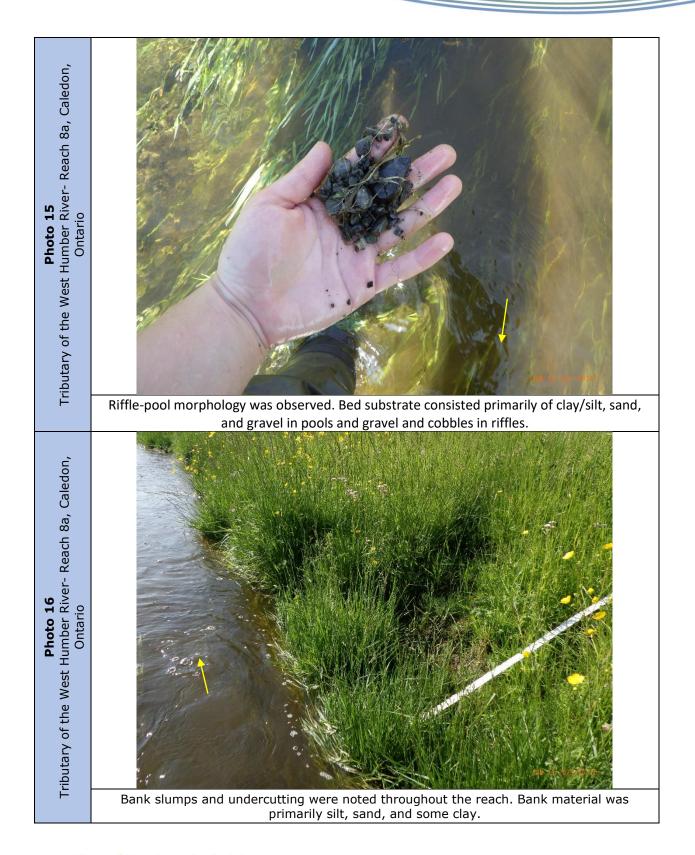


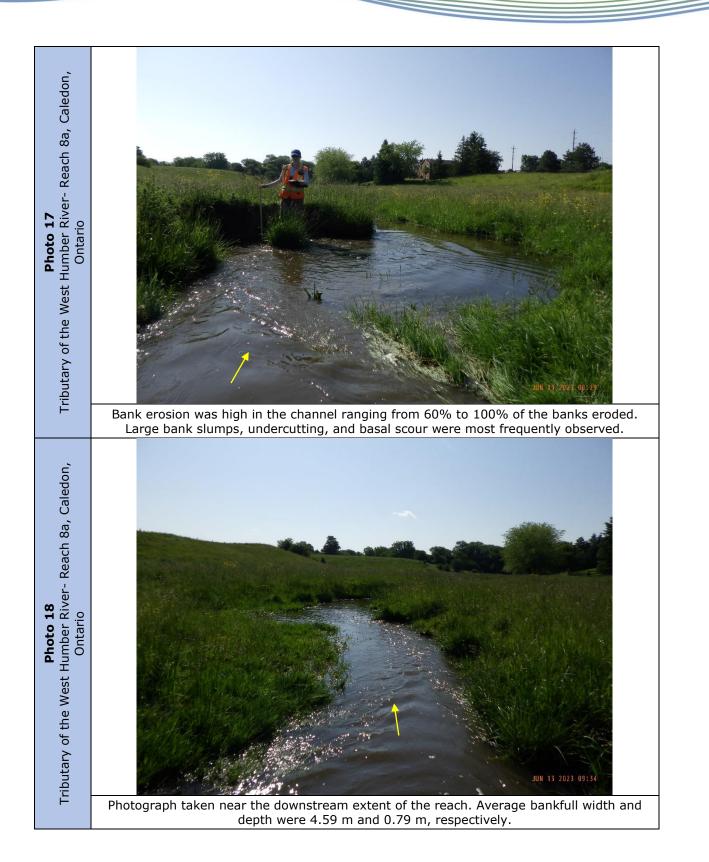


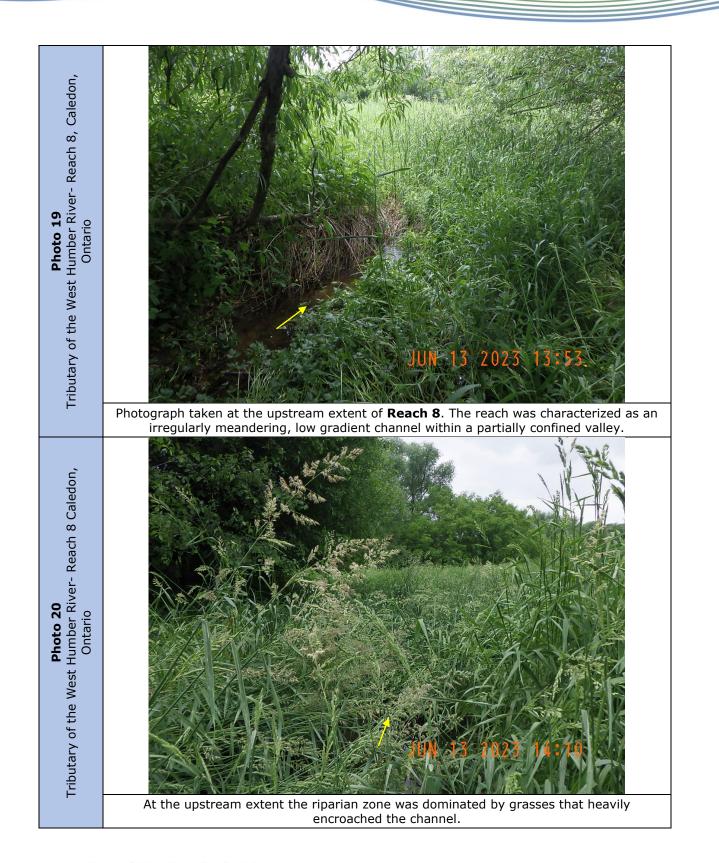


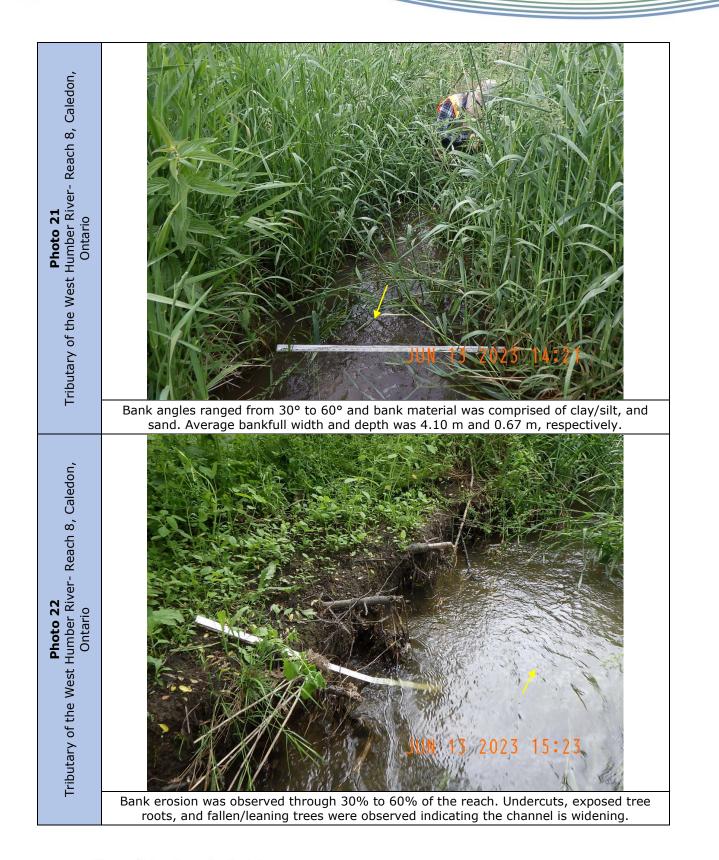


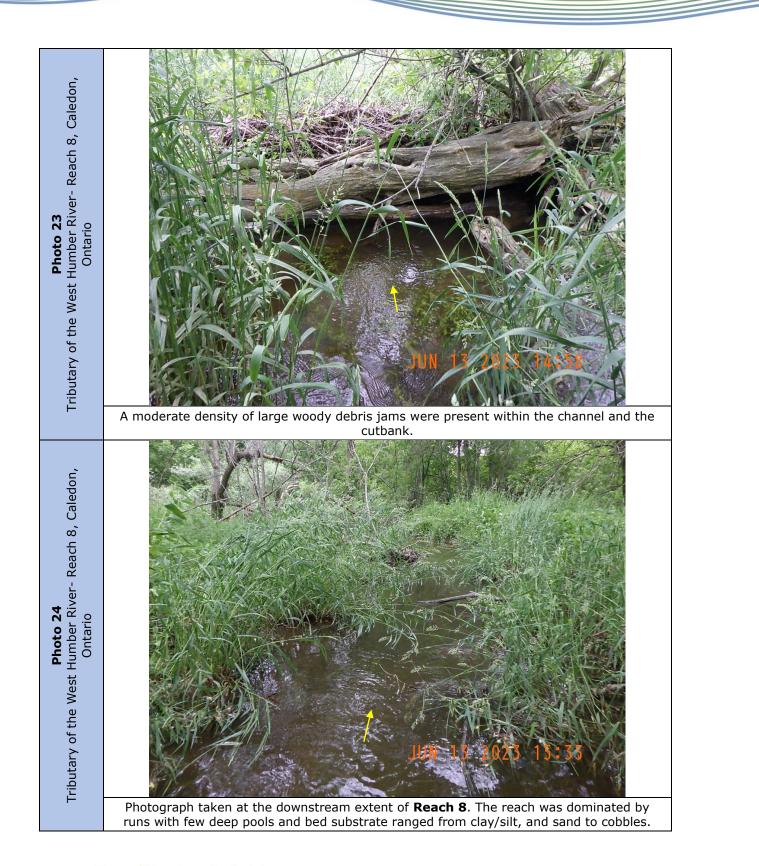


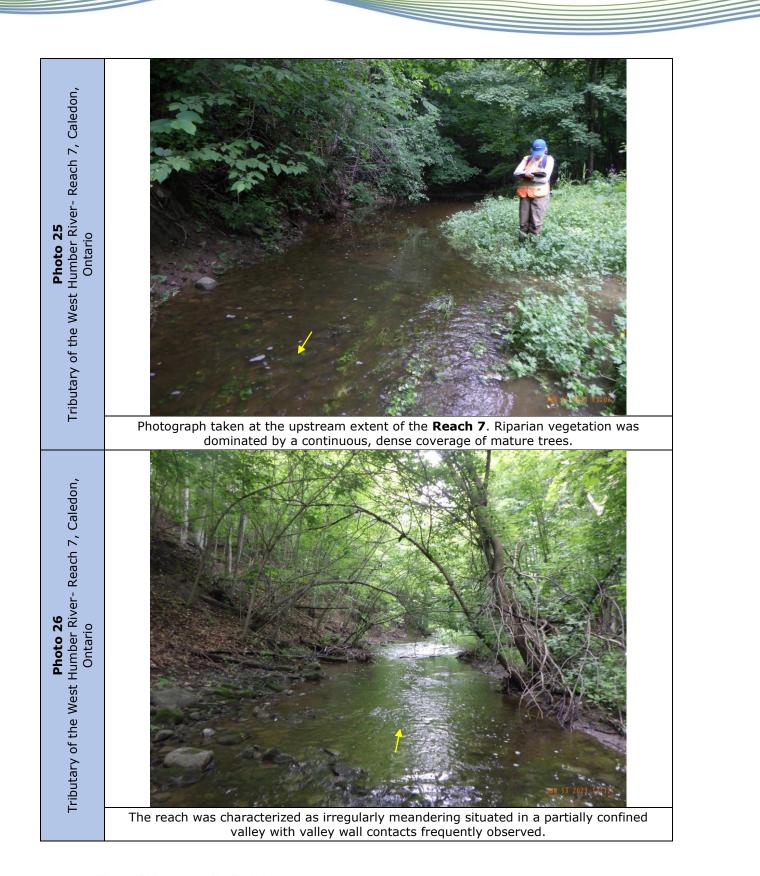


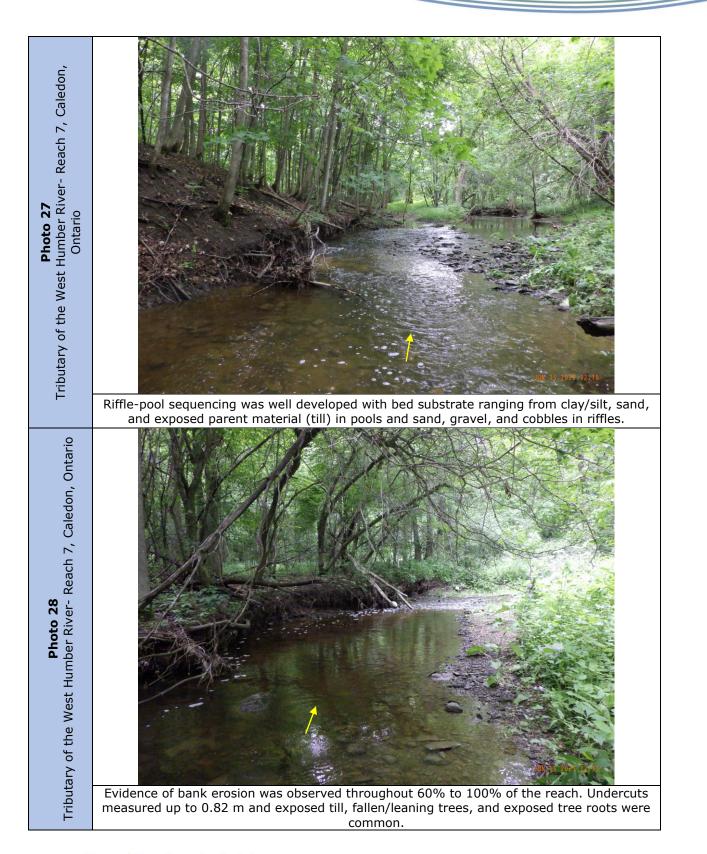


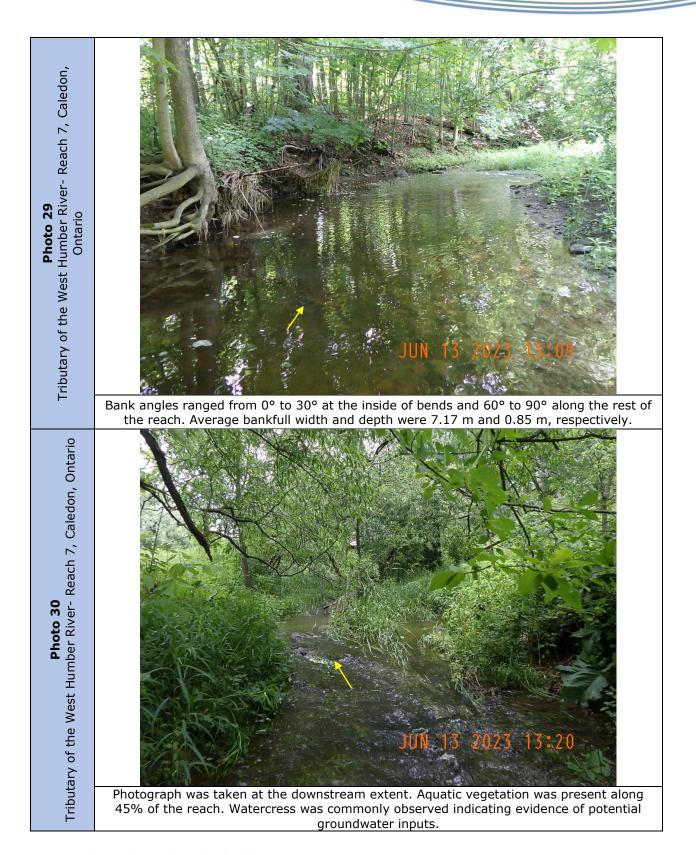












Appendix D Field Observations

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Version #4 Last edited: 21/02/2023

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____

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					1
-x-x Fence					V
Colvert/outfall	•			- 28m	1
Swakte/wetland				UNI/	- /
WW Grassás	1			V	5/
Q Na				P	11
1nstream log/tree					111
X 🛠 Woldy debris	3				VI
🚧 Beaver dam				V	10
S Vegetated island				10. 11	
avi Type			in a w	2 _ /	NI
NC Standing water H&		ater	low dro		IV
H2 Scarcely perceptible			20 mile	N.	
N3 Smooth surface flow A4 Upwelling	(d.			obed I Salt	1
14 Upwelling 15 Rippled			i	Lou Sul	)
15 Rippieg 16 Unbroken standing v	12W/A		V V V V V V V V V V V V V V V V V V V		
<ul> <li>Proken standing way</li> </ul>			· · · · · · · · · · · · · · · · · · ·	A) (1-51	
<ul> <li>Broken standing way</li> <li>Chute</li> </ul>		- Martin Carlo			. 1
	a≓ Dissipa	ites below free fall	V. 0.5	n I I I I	redeal
nstrato	· · · · · ·		1.	531	0-
st. Silt	<u>S6</u>	Small boulder	1/-1		
52 Sand	57	Large boulder	V	101-1	
S3 Gravel	<b>S</b> 8	Bimodał	$\neg \dot{c}$	X, K.	
S4 Small cobble	SØ	Bedrock/till	lan	HS Shight	
65 Large cobble			1010	· / //	Goda 1
tàsso.			alscord of	- V Soft	mil
M Benchmark	EP	Erosion pin	1 Nr	1	orodala m.13
s Backsight	RB	Kebar	my in		
6 Downstream	US	Upstream	63610	350,0,72m WE 73.98m	
IDJ Woody debris jam	TR	Terrace	5/11/0	BEL ) 3.08m	
WC Valley wall contact	FC	Flood chute		- WI OM	
OS Bottom of slope	FP	Flood plain	Photos:		
05 Top of slope	3CP2	Knick point	Notes: Nank clay	sad alt -	oools n

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Completed by: ____

Page 3 of 4

### General Site Characteristics

Project Number: PN 23013

Data		- A-	00-11-12		ject Numbe Stream:		1 marsh	1.	hun an
Date:		20	23-06-13.				III.G		hunder
Time:			1 4 - 42		Reach:		Reac		a 1 1
Weath	ner:	5	uniny 18°		Location:		Dixie Rd Caledor		
Field S	Staff:	A	SH'		Watershed/Su	ubwatershed:	W.	Hunt	per
Featur	es	Monito	ring	Sit	e Sketch				Compass
	Reach break Station location Cross-section Flow direction Riffle Pool Sediment bar Eroded bank/slope Undercut bank Bank stabilization Leaning tree Fence Culvert/outfall Swamp/wetland Grasses Tree Instream log/tree Woody debris Beaver dam		ring Long-profile Monumented XS Monumented photo direction Sediment sampling Erosion pins Scour chains Inal Symbols	Der	e Sketch 2 per ater 5.	More bar	vador Jestum	April A	$\frown$
Flow T	Vegetated island								w/wat
H1	Standing water H1	A Back	water				· · · · · · · · · · · · · · · · · · ·		
H2	Scarcely perceptible			_			1 1 1	roste 7 1	sheam
НЗ	Smooth surface flow			C	oncrete	A OF	- ibg /	0	sheam Lebris.
H4	Upwelling			SI	oncrete elbs m Creek	/	w.		
H5	Rippled				creet \	L V/			
H6	Unbroken standing	wave			1	N, M			
H7	Broken standing wa	ve				XI Lan	umping		
H8	Chute			0.7	12m /	Xigtsi			
H9		A Dissi	pates below free fall	0,1	-m	(V)			
Substr						V			
<b>S1</b>	Silt	<b>S6</b>	Small boulder	VI	X	X			
<b>S2</b>	Sand	<b>S7</b>	Large boulder	V	1 A	/ V			
<b>S</b> 3	Gravel	<b>S</b> 8	Bimodal	-	100				
<b>S4</b>	Small cobble	<b>S</b> 9	Bedrock/till		KX	hea	croach?		
S5	Large cobble				AN	pn	conchi	hont	
Other				N	531	V.	marchin	ments i	
BM	Benchmark	EP	Erosion pin	V	54	V			
BS	Backsight	RB	Rebar		1 - 1				
DS	Downstream	US	Upstream		M				
WDJ	Woody debris jam	TR	Terrace		IIN				
vwc	Valley wall contact	FC	Flood chute		1.				
BOS	Bottom of slope	FP	Flood plain	Pho	tos:				
TOS	Top of slope	KP	Knick point	Note					

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Page 4 of 4

GEO

YORPHIX"

# GEO

Rapid Geom	orph	ic Assessment	Project Numb	er: PN2	3013			МОКРНІХ™
Date:	20	23-06-13	Stream:		Trub (	S. F	rendo	r
Time:			Reach:		Reach 4a	a		
Weather:	Su	uny 18°	Location:		Cilvia I	0.1	Calas	laa.
Field Staff:	An	1 <1	Watershed/Subv	vatershed:	W Hum	heal	Cardel	News Pr
	/	V mort			AD TUNNAN			1
Process	No		omorphological Indicate	Dr			esent?	Factor Value
	No.	Description				Yes	No	Value
	1	Lobate bar		and an addition of the second data and the second	۵		V	
	2	Coarse materials in riffle	s empedded				-V	1/-
Evidence of	3	Siltation in pools					/ +	
Aggradation (AI)	4	Medial bars					V	. 1.0
	5	Accretion on point bars	- <b>6</b> h - d				V	0.145
	6	Poor longitudinal sorting						
		Deposition in the overba	rik zone		mofindicos	1		
l	1	1	-	51	m of indices =		6	T.
	1	Exposed bridge footing(s		4		/	112	
	2	Exposed sanitary / storm	*******	check				
	3	Elevated storm sewer ou						
Evidence of	4	Undermined gabion bask	· · · · · · · · · · · · · · · · · · ·				K	
Degradation	5	Scour pools downstream	of culverts / storm sew	er outlets				1/,
(DI)	6	Cut face on bar forms		1			V	10
	7	Head cutting due to knic				a a tra	V	
	8	Terrace cut through olde			R		V	0.1667
	9	Suspended armour layer			-			
	10	Channel worn into undis	curbed overburden / be		m of indices =		5	1
	1	Fallen / leaning trees / fe	ence posts / etc.			1		
	2	Occurrence of large orga	and the second				-V	
	3	Exposed tree roots						-
	4	Basal scour on inside me	./	V'				
Evidence of	5	Basal scour on both side	V		318			
Widening (WI)	6	Outflanked gabion baske	V		-10			
(****)	7	Length of basal scour >5				./	1	
	8	Exposed length of previo	V	-	0,375			
	9	Fracture lines along top	1		UISIN			
	10	Exposed building foundation	tion			5	e	
				Su	m of indices =	3	5	8
	1	Formation of chute(s)					1	
	2	Single thread channel to	multiple channel				1	-
Evidence of Planimetric	3	Evolution of pool-riffle fo		m				1
Form	4	Cut-off channel(s)		····			1	1/2
Adjustment	5	Formation of island(s)					1	T
(PI)	6	Thalweg alignment out o	f phase with meander f	orm			V.	0,143
	7	Bar forms poorly formed		and and a			$\overline{\mathbf{V}}$	01113
		1		Su	m of indices =		6	
Notes:				Stability Inde	ex (SI) = (AI	+DI+WI	+PI)/4 =	0,207
				In Regime	In Transi	tion/Str	ess In A	djustment
				0.00 - 0.2	20 🛛 0.2	21 - 0.40	C	0.41

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# Rapid Stream Assessment Technique Project Number: PN2303

Date:	2023-06-13	Stream:		Trib W.	Humber	
Time:	nag men	Reach:	uca.	Reach 4a	Calegory	
Weather:	Sunny 180	Location:		Dixie Rol Caledon.		
Field Staff:	AVISH	Watershed/Subwate	rshed:	W Humber		
Category	Poor	Fair	boo shood	Good	Excellent	
ant city and depth ant (ne., slow, and deep	<ul> <li>&lt; 50% of bank network stable</li> <li>Recent bank sloughing, slumping or failure frequently observed</li> </ul>	<ul> <li>50-70% of bank network stable</li> <li>Recent signs of bank sloughing, slumping or failure fairly common</li> </ul>	stable • Infrequ	6 of bank network ent signs of bank ng, slumping or	<ul> <li>&gt; 80% of bank network stable</li> <li>No evidence of bank sloughing, slumping or failure</li> </ul>	
Channel	<ul> <li>Stream bend areas highly unstable</li> <li>Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas)</li> <li>Bank overhang &gt; 0.8-1.0 m</li> </ul>	<ul> <li>Stream bend areas unstable</li> <li>Outer bank height 0.9- 1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas)</li> <li>Bank overhang 0.8-0.9m</li> </ul>	<ul> <li>Outer b m abov</li> <li>1.5 m a for larg</li> </ul>	bend areas stable bank height 0.6-0.9 ve stream bank (1.2- above stream bank e mainstem areas) verhang 0.6-0.8 m	<ul> <li>Stream bend areas very stable</li> <li>Height &lt; 0.6 m above stream (&lt; 1.2 m above stream bank for large mainstem areas)</li> <li>Bank overhang &lt; 0.6 m</li> </ul>	
Stability	<ul> <li>Young exposed tree roots abundant</li> <li>&gt; 6 recent large tree falls per stream mile</li> </ul>	<ul> <li>Young exposed tree roots common</li> <li>4-5 recent large tree falls per stream mile</li> </ul>	predom large, s scarce 2-3 rec	d tree roots ninantly old and smaller young roots ent large tree falls eam mile	<ul> <li>Exposed tree roots old, large and woody</li> <li>Generally 0-1 recent large tree falls per stream mile</li> </ul>	
	Bottom 1/3 of bank is highly erodible material     Plant/soil matrix severely compromised	<ul> <li>Bottom 1/3 of bank is generally highly erodible material</li> <li>Plant/soil matrix compromised</li> </ul>	genera	1/3 of bank is lly highly resistant oil matrix or material	<ul> <li>Bottom 1/3 of bank is generally highly resistant plant/soil matrix or materia</li> </ul>	
	<ul> <li>Channel cross-section is generally trapezoidally- shaped</li> </ul>	<ul> <li>Channel cross-section is generally trapezoidally- shaped</li> </ul>		el cross-section is lly V- or U-shaped	<ul> <li>Channel cross-section is generally V- or U-shaped</li> </ul>	
Point range		030405		6 0 7 0 8	□ 9 □ 10 □ 11	
D B uting level the [0-10%+2	<ul> <li>&gt; 75% embedded (&gt; 85% embedded for large mainstem areas)</li> </ul>	<ul> <li>50-75% embedded (60- 85% embedded for large mainstem areas)</li> </ul>	59% er	6 embedded (35- mbedded for large em areas)	Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas)	
	<ul> <li>Few, if any, deep pools</li> <li>Pool substrate composition &gt;81% sand- silt</li> </ul>	Low to moderate number of deep pools Pool substrate composition 60-80% sand-silt	pools Pool su 30-59%	ite number of deep bstrate composition 6 sand-silt	<ul> <li>High number of deep pools</li> <li>61 cm deep)</li> <li>122 cm deep for large mainstem areas)</li> <li>Pool substrate composition &lt;30% sand-silt</li> </ul>	
Channel Scouring/ Sediment Deposition	Streambed streak marks and/or "banana"-shaped sediment deposits common	<ul> <li>Streambed streak marks and/or "banana"-shaped sediment deposits common</li> </ul>	and/or	bed streak marks "banana" shaped nt deposits mon	<ul> <li>Streambed streak marks and/or "banana"-shaped sediment deposits absent</li> </ul>	
reges not a 20% for etc. a 60% for	<ul> <li>Fresh, large sand deposits very common in channel</li> <li>Moderate to heavy sand deposition along major portion of overbank area</li> </ul>	<ul> <li>Fresh, large sand deposits common in channel</li> <li>Small localized areas of fresh sand deposits along top of low banks</li> </ul>	uncomr Small lo fresh si	arge sand deposits mon in channel ocalized areas of and deposits along ow banks	<ul> <li>Fresh, large sand deposits rare or absent from channe</li> <li>No evidence of fresh sediment deposition on overbank</li> </ul>	
E1 7 Hent (~35)	<ul> <li>Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand</li> </ul>	Point bars common, moderate to large and unstable with high amount of fresh sand	Point bars small and stable, well-vegetated and/or armoured with little or no fresh sand		<ul> <li>Point bars few, small and stable, well-vegetated and/or armoured with little or no fresh sand</li> </ul>	
Point range				5 0 6	0708	

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# GEO MORPHIX"

Date: 20	)23-06-13	pn: 23013	Location: T	rib. W. Humber	
Category	Poor	Fair	Good	Excellent	
	• Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	Wetted perimeter 40- 60% of bottom channel width (45-65% for large mainstem areas)	<ul> <li>Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)</li> </ul>	Wetted perimeter > 85% of bottom channel width (> 90% for large mainstem areas)	
	<ul> <li>Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)</li> </ul>	<ul> <li>Few pools present, riffles and runs dominant.</li> <li>Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate)</li> </ul>	<ul> <li>Good mix between riffles, runs and pools</li> <li>Relatively diverse velocity and depth of flow</li> </ul>	<ul> <li>Riffles, runs and pool habitat present</li> <li>Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water)</li> </ul>	
Physical Instream	<ul> <li>Riffle substrate composition: predominantly gravel with high amount of sand</li> <li>&lt; 5% cobble</li> </ul>	<ul> <li>Riffle substrate composition: predominantly small cobble, gravel and sand 5-24% cobble</li> </ul>	<ul> <li>Riffle substrate composition: good mix of gravel, cobble, and rubble material</li> <li>25-49% cobble</li> </ul>	<ul> <li>Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand</li> <li>&gt; 50% cobble</li> </ul>	
Habitat	• Riffle depth < 10 cm for large mainstem areas	<ul> <li>Riffle depth 10-15 cm for large mainstem areas</li> </ul>	<ul> <li>Riffle depth 15-20 cm for iarge mainstem areas</li> </ul>	<ul> <li>Riffle depth &gt; 20 cm for large mainstem areas</li> </ul>	
	<ul> <li>Large pools generally &lt; 30 cm deep (&lt; 61 cm for large mainstem areas) and devoid of overhead cover/structure</li> </ul>	Large pools generally 30- 46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure	Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure	<ul> <li>Large pools generally &gt; 61</li> <li>cm deep (&gt; 122 cm for large mainstem areas) with good overhead cover/structure</li> </ul>	
	• Extensive channel alteration and/or point bar formation/enlargement	Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement	<ul> <li>Slight amount of channel alteration and/or slight increase in point bar formation/enlargement</li> </ul>	<ul> <li>No channel alteration or significant point bar formation/enlargement</li> </ul>	
	• Riffle/Pool ratio 0.49:1 ; ≥1.51:1	<ul> <li>Riffle/Pool ratio 0.5-</li> <li>0.69:1 ; 1.31-1.5:1</li> </ul>	<ul> <li>Riffle/Pool ratio 0.7-0.89:1</li> <li>; 1.11-1.3:1</li> </ul>	Riffle/Pool ratio 0.9-1.1:1	
n g a	<ul> <li>Summer afternoon water temperature &gt; 27°C</li> </ul>	<ul> <li>Summer afternoon water temperature 24-27°C</li> </ul>	Summer afternoon water temperature 20-24°C	<ul> <li>Summer afternoon water temperature &lt; 20°C</li> </ul>	
Point range	00102	0304	□ 5 □ 6	0708	
	Substrate fouling level: High (> 50%)	<ul> <li>Substrate fouling level: Moderate (21-50%)</li> </ul>	<ul> <li>Substrate fouling level: Very light (11-20%)</li> </ul>	• Substrate fouling level: Rock underside (0-10%)	
Water Quality	<ul> <li>Brown colour</li> <li>TDS: &gt; 150 mg/L</li> </ul>	<ul><li>Grey colour</li><li>TDS: 101-150 mg/L</li></ul>	<ul><li>Slightly grey colour</li><li>TDS: 50-100 mg/L</li></ul>	• Clear flow • TDS: < 50 mg/L	
Water Quality	Objects visible to depth     < 0.15m below surface	<ul> <li>Objects visible to depth 0.15-0.5m below surface</li> </ul>	Objects visible to depth     0.5-1.0m below surface	Objects visible to depth     > 1.0m below surface	
	Moderate to strong     organic odour	<ul> <li>Slight to moderate organic odour</li> </ul>	<ul> <li>Slight organic odour</li> </ul>	No odour	
Point range	0 0 1 0 2	0304	0506	2708	
Riparian Habitat	Narrow riparian area of mostly non-woody vegetation	<ul> <li>Riparian area predominantly wooded but with major localized gaps</li> </ul>	<ul> <li>Forested buffer generally</li> <li>&gt; 31 m wide along major portion of both banks</li> </ul>	<ul> <li>Wide (&gt; 60 m) mature forested buffer along both banks</li> </ul>	
Conditions	<ul> <li>Canopy coverage: &lt;50% shading (30% for large mainstem areas)</li> </ul>	Canopy coverage: 50- 60% shading (30-44% for large mainstem areas)	Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	<ul> <li>Canopy coverage: &gt;80% shading (&gt; 60% for large mainstem areas)</li> </ul>	
Point range	<b>D 0 D 1</b>	2 0 3	0405	<b>G G D 7</b>	

Reach Characte		iter i	V2301									MORPH
Date:	2023-06-	1	d Staff:	AV SH	5 L.L.	ler		rshed/Subwate	ershed:	WHU	mber	
Time:	Sunny (8	Stre		This u	J. MUM	108-9		(Upstream):				
Weather:		Rea		Reach 4a			UIM	(Downstream):				
Land Use(Table 1)	(Table 2)	Channel Type (Table 3)		annel Zone	(Table		1	Evidence of Gr				Photo:
Riparian Vegetati	on			Aquatic & I	nstream Ve	egetatio	on		Water	Quality		
Dominant Type (Table 6) Encroachment (Table 7)	□ None □ □ Fragmented		-	Type (Table 8) Reach Coverage %		Cutbank	WD Den Low Mod High	sity WDJ/50m:		Odour able 16)		Table 17)
Channel Characte	ristics			C. State of the second s								
Sinuosity Type (Table 9)			<b>ik Angle</b> – 30	Bank Erosion □ < 5%		le 19) <b>Bank</b>	Clay/Si	/	avel Cob		er Parent	Rootlet
Gradient	# of Channe		0 - 60	□ 5 - 30%		Riffle			][			
(Table 11)	(Table 1		0 - 90	30 - 60%		Pool						
(Table 13)	Bank Failu (Table 1		ndercut	□ 60 - 100%		Bed iffle-pool phology)	Ø		2 1			
Down's Model (Table 15)	Bankfull Indicato (Table 1			Bankfull Width (m)	4.2	2.8	0	୍ୟଞ୍ଚ Wetted V	Vidth (m)	4.2	2.8	3.08
Sed Sorting (Table 20)	Sediment Transpo Observed		] Not Visible	Bankfull Depth (m)	0.42	0.54		Wetted D	epth (m)	0.35	0,54	0.72
Transport Node (Table 21)	2 % of Bed Acti	ve	. Provide state of the state of	Undercuts (m)				Veloc	ity (m/s)		0,752	0,595
Geomorphic Jnits (Table 22)	Mass Moveme (Table 2	and a second		Pool Depth (m)	0.42	0,785		Velocity	/ Estimate Method		withe	will e
Riffle-Pool Spacing (m):	% Riffle	es: 🔿 % Po	ols: 20 I	Riffle Length (m)				Meander A	mplitude (m)	/	/	
otes:	size indicates	Saltahon	likely	- Hous	unlike	shy to	o jor	oduce				
E-best pos	sible choice	n Lackny	scour	m				· · · · · · · · · · · · · · · · · · ·				en e la provinsion angeler en
- 2001 PDS	since mance	- July	Ar a they		and an and the shares							
							An and a strength of the					
							-					
												ana da ata (
hotos:												

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### **General Site Characteristics**

Project Number: AN 2303

Date:	erar Site Cila		23-06-12		Stream:	T	Jaw, the	unde.
Time:		64	63 40 1.	2	Reach:	Por	ch 4b	
		C	nnu 180	1		Red		Caledon
Weath		au	nny io		Location:	- HV	SIG ER	
Field S	Staff:	A	VSR		Watershed/Subwatersh	ned: W	Humber	r
Featur	es	Monitor	ing	S	ite Sketch		C	ompass
E	Reach break		ong-profile					$\bigcirc$
<b>R</b>	Station location		Ionumented XS				(	R)
×	Cross-section	-	Ionumented photo				· · · · · · · · · · · · · · · · · · ·	$\mathbf{\mathbf{\mathcal{I}}}$
$\sim$	Flow direction Riffle		Ionumented photo lirection	-				
$\bigcirc$	Pool	-	Sediment sampling					
CEEDER OF	Sediment bar		rosion pins					
+++++++++++++++++++++++++++++++++++++++	Eroded bank/slope	0	Scour chains					
	Undercut bank	Addition	nal Symbols					
XXXXX	Bank stabilization							
	Leaning tree		×.,					
XX							1	/
	Culvert/outfall			-		S2 (s	guishy bank)	,
	Swamp/wetland			-			6	7/
WWW	Grasses			-			VM	/ V
	Tree							/ /
***	Instream log/tree Woody debris			-		11	1 / 1000	0.25m
*** *	Beaver dam					V	1 100.	or as m
A A A A A A A A A A A A A A A A A A A	Vegetated island			WE	:4.3m	1-1-1-4	1	
Flow T		I		WD	:0.56m	/		
H1	Standing water H1	A Back w	vater		0:6.81m	SI 152 I	celes.	
H2	Scarcely perceptible	flow			10: 4.3m	Silve I	AL.	
НЗ	Smooth surface flow				+ TIN31 -		£ /	
H4	Upwelling				alaybank		/ Xtx/	bank
H5	Rippled				3 ban	Kslump	1 lat	slump
H6 H7	Unbroken standing wave				N ST	\	) / W,	
H8	Chute			W	C. Ett	UC: 0.1m	TR? DA !	
H9		A Dissip	ates below free fall	0	1 6.61m	KX MU	C: 0,25m	1 Concret
Substr	ate			$\mathbb{R}$	X O.	33 3	0.42m	1 slabs
S1	Silt	<b>S6</b>	Small boulder	10 0		2 0 0 00	KII V	7 chan
S2	Sand	<b>S7</b>	Large boulder	EC.		1.0	SU M.	Ŧ
\$3	Gravel	<b>S</b> 8	Bimodal		81152/	undan	\$2152	
S4	Small cobble	<b>S9</b>	Bedrock/till		S4153 7	water	1-31	20
S5	Large cobble			4				
Other	Banahmark		Encolon ala		ATTA L hear	my grass	encreachme	af
BM BS	Benchmark Backsight	EP RB	Erosion pin Rebar		E	V		
DS	Downstream	US	Upstream	57	Sbiss Stamain	ing		
WDJ	Woody debris jam	TR	Terrace	5		11 .		
vwc	Valley wall contact	FC	Flood chute	MI	PIXIERA S2	altation	n	
BOS	Bottom of slope	FP	Flood plain	Ph	otos:			
TOS	Top of slope	КР	Knick point		tes: ended e	under	cul ba	ki
01.				J			1	
0010	77 7	rass	0 0 1	) Fr	and a second			munu
15/34	t- some	Gner	A COL	0 60		bank	breached	2
		anne		6	result of high			
Versio	on #4 edited: 21/02/2023		Senior staff sig	n-off (if	required): Checked	d by:	_ Completed by:	

Page _____ of _____

GEO MORPHIX*

General Site (C	haracteris	tics .	Project Number: PN23	
Şaka:		3-06-13	Aiream:	The W. Humbe
There:			· · · · · · · · · · · · · · · · · · ·	Reach 4b
W wat System	Sunn	y 18°	taxcation:	Dixie Rd Cale
Piedo Scaitt	All	1	Watershad/Subwatersha	1 1 11
7-92910-9203333:	<u> </u>	SH	13	
Penaliperes	Mentering		Site Sketch	Compass
Reach break	-0-0-0- Long			Mr. C
Station location	12 1	umented XS		9
<ul> <li>Cross-section</li> <li>How direction</li> </ul>	- Summer of	imented photo	1 1 1	
く 、 、 、 、 、 、 、 、 、 、 、 、 、	direc	umented photo		1 L
C Post	Sedi	ment sampling	1. 1. S.	fediment
Sediment bar	CECCE Eros		. 10 15 H	Fr -
栅栅栅 Eroded juank/sla	127	ir chains	12 B V	
Underout bank	Additional	Symbols		
CREAT Bank stabilizatio	they we assume the second seco		Und De arices De arices Universation	
->>> Leaning tree		2.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1	N 21-2 2	0.70m
x-x-x Fence			culla siin	0.
Culwert/cuttall			C X CX	
Soveriphietland			8-11(3(1)	
₩₩₩ Grasses			Ponol	D:0.395m
C3 Tese			A 1 A	NV 1007
1 Instreamleghtre				Suiszer WW. 3m
* * * Woody debris	· · · · · · · · · · · · · · · · · · ·	5		L bottom
Beaver dam			3 MHT	1 15M 1516
(如) Vegetated Island	1	1	N	squisty szisic
Them Type	Man Dealerset		The st	A / /
	HIA Back wate	۲ , , , , , ,	2 (1)/2 - 24	V: 0.588m
H2 Scarcely percep H3 Smooth surface				11,001 - 2 2m
H4 Vowelling			DUNC Company	WWW 72.2m BEW OUSM WD: 0.5 BED: 0.5
和5 私ippled			N S I V	WO: 05
:H6 Unbroken stand	ing wave		0811	X BED.
H7 Broken standing			La te	Slump G)
HS Chute			- (9)-	Train of the
H9 Free fall	H9A Dissipates	s.below free fall	12 5319	4.1
Substrate	مېرىمى بار بېرى بېرى بېرى بېرى بېرى بېرى بېرى بېر		X 12 12 5319	
S1 Silt		mail boulder	i lite	IK D
S2 Sand		arge boulder	SHIS	eluc W
- 53 Gravel		imodal	15	10.3~
\$4 Small cobble	<b>S9</b> B	edrock/țill	5 - anal 6.44	Cobele
35 Large cobble			0 7 armes 0,44	Cobble in Culvert,
Scher SM Benchmark	EP E	rosion pin		
BS Backsight		ebar	- PK	1. On.
S Downstream		pstream	(nord)	NI WIO.CMA
WD3 Woody debris ja		errace	( is	V D: 0. 30m 2 under ubler
WWC Valley wall cont		lood chute	6	
BOS Bottom of slope		lood plain	Photos:	
TOS Top of slope	KP K	nick point	Notes:	

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cked by: _____ Completed by: _____ Page 2__ of 2___

GEO

# GEO

Rapid Geom	orphi	ic Assessment	<b>Project Numb</b>	per: PN2	13013			MORPHIX"		
Date:	20	123-06-13	Stream:		Tribi	2.	Hum	ber		
Time:			Reach:		Reach 4b	)				
Weather:	Su	Inny 18°	Location:			N AI	edon			
Field Staff:	A	I SH	Watershed/Sub	watershed:		imp	£			
	1				101 (-11	· · · · · · · · · · · · · · · · · · ·	sent?			
Process	No.	Description	omorphological Indicat			Yes	No	Factor Value		
	1	Lobate bar	annaithe ann an ann an ann an ann an ann an ann an a			103	NO			
			anahaddad				V.	-		
	2	Coarse materials in riffles	sembedded					- 0/m		
Evidence of Aggradation	4	Siltation in pools Medial bars						- 1+		
(AI)	5	Accretion on point bars		ana ana ama ang ang ang ang ang ang ang ang ang an			V	-		
	6	Poor longitudinal sorting	of had materials		*		1 V	-		
	7	Deposition in the overbar								
		Deposition in the overbal		Si	m of indices =	0	2	0		
L		P	<u>\</u>							
	1	Exposed bridge footing(s					_			
	2	Exposed sanitary / storm		•		MI	_			
	3	Elevated storm sewer ou				Nr.	A	-		
Evidence of	4	Undermined gabion bask	and the state of the			N I	1	-0/2		
Degradation	5	Scour pools downstream	of culverts / storm sev	wer outlets				- / +		
(DI)	6	Cut face on bar forms	(noint migration					-		
	8	Head cutting due to knick Terrace cut through older						-		
	9	Suspended armour layer		Some clasy till	9			-		
	10	Channel worn into undist			-					
	1 - 10				um of indices =	Õ	F	0		
	1	Fallen / leaning trees / fe	ence posts / etc.				V			
	2	Occurrence of large orga	v							
	3	Exposed tree roots	V							
	4	Basal scour on inside me	V	North Contraction						
Evidence of Widening	5	Basal scour on both sides	V		-ba					
(WI)	6	Outflanked gabion baske	V							
	7	Length of basal scour >5	V							
	8	Exposed length of previo	. A.							
	9	Fracture lines along top of	of bank				V			
	10	Exposed building foundat	tion		and the state of the state	N	A			
				Su	um of indices =	6	9	0.667		
	1	Formation of chute(s)					1	1 20		
Evidence of	2	Single thread channel to	multiple channel			- 0		-		
Planimetric	3	Evolution of pool-riffle fo	rm to low bed relief fo	rm			~	10,		
Form	4	Cut-off channel(s)				V		147		
Adjustment	5	Formation of island(s)		~	1.					
(PI)	6	Thalweg alignment out of		V						
	7	Bar forms poorly formed	/ reworked / removed	form @ 1 seot			1			
	5			Su	im of indices =	2	17	0,286		
Notes:					ex (SI) = (AI					
				In Regime				Adjustment		
				0.00 - 0.2	20 🛛 0.2	21 - 0.40		0.41		

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# Rapid Stream Assessment Technique Project Number: PN 23013

Time: Weather: Field Staff:	2.15	Reach:		Inbw. mumber			
	10	Reach:		Reach 4b	Colegory		
Field Staff:	Sunny 18	Location:	renes bort	Pikie 20	Caledon		
	AV SH.	Watershed/Subwate	rshed:	W. Hum	her		
Category	Poor	Fair	Good		Excellent		
int City and depth of (Le., slow, and deep	<ul> <li>&lt; 50% of bank network stable</li> <li>Recent bank sloughing, slumping or failure frequently observed</li> </ul>	<ul> <li>50-70% of bank network stable</li> <li>Recent signs of bank sloughing, slumping or failure fairly common</li> </ul>	stable • Infreque	of bank network ent signs of bank g, slumping or	<ul> <li>&gt; 80% of bank network stable</li> <li>No evidence of bank sloughing, slumping or failure</li> </ul>		
sh alddog xim obluad ar Channol	<ul> <li>Stream bend areas highly unstable</li> <li>Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas)</li> <li>Bank overhang &gt; 0.8-1.0 m</li> </ul>	<ul> <li>Stream bend areas unstable</li> <li>Outer bank height 0.9- 1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas)</li> <li>Bank overhang 0.8-0.9m</li> </ul>	<ul> <li>Outer bandle</li> <li>m above</li> <li>1.5 m all</li> <li>for large</li> </ul>	bend areas stable ank height 0.6-0.9 e stream bank (1.2- bove stream bank e mainstem areas) erhang 0.6-0.8 m	<ul> <li>Stream bend areas very stable</li> <li>Height &lt; 0.6 m above stream (&lt; 1.2 m above stream bank for large mainstem areas)</li> <li>Bank overhang &lt; 0.6 m</li> </ul>		
Channel Stability	<ul> <li>Young exposed tree roots abundant</li> <li>&gt; 6 recent large tree falls per stream mile</li> </ul>	<ul> <li>Young exposed tree roots common</li> <li>4-5 recent large tree falls per stream mile</li> </ul>	predomi large, sr scarce	l tree roots nantly old and naller young roots ent large tree falls am mile	<ul> <li>Exposed tree roots old, large and woody</li> <li>Generally 0-1 recent large tree falls per stream mile</li> </ul>		
	Bottom 1/3 of bank is highly erodible material     Plant/soil matrix severely compromised	<ul> <li>Bottom 1/3 of bank is generally highly erodible material</li> <li>Plant/soil matrix compromised</li> </ul>	generall	1/3 of bank is y highly resistant il matrix or material	<ul> <li>Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material</li> </ul>		
tio 0.9-1.1:1	<ul> <li>Channel cross-section is generally trapezoidally- shaped</li> </ul>	Channel cross-section is generally trapezoidally- shaped	1	cross-section is y V- or U-shaped	<ul> <li>Channel cross-section is generally V- or U-shaped</li> </ul>		
Point range	0 0 1 0 2	3 0 4 0 5	<b>0</b> 6	0708	□ 9 □ 10 □ 11		
<b>B B</b> Jing Jévél de (0-10%a)	<ul> <li>&gt; 75% embedded (&gt; 85% embedded for large mainstem areas)</li> </ul>	<ul> <li>50-75% embedded (60- 85% embedded for large mainstem areas)</li> </ul>	59% em	embedded (35- ibedded for large m areas)	• Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas)		
	<ul> <li>Few, if any, deep pools</li> <li>Pool substrate composition &gt;81% sand- silt</li> </ul>	<ul> <li>Low to moderate number of deep pools</li> <li>Pool substrate composition 60-80% sand-silt</li> </ul>	• Pools	e number of deep strate composition sand-silt	High number of deep pools (> 61 cm deep) (> 122 cm deep for large mainstem areas) • Pool substrate composition <30% sand-silt		
Channel Scouring/ Sediment Deposition	Streambed streak marks and/or "banana"-shaped sediment deposits common	<ul> <li>Streambed streak marks and/or "banana"-shaped sediment deposits common</li> </ul>	and/or "	ed streak marks banana"-shaped t deposits oon	<ul> <li>Streambed streak marks and/or "banana"-shaped sediment deposits absent</li> </ul>		
ຍ rage: າg (> ສຍ% ໄດ ຫາ ນາຍລະ)	deposits very common in channel	<ul> <li>Fresh, large sand deposits common in channel</li> <li>Small localized areas of fresh sand deposits along top of low banks</li> </ul>	uncomm • Small lo	arge sand deposits ion in channel calized areas of nd deposits along w banks	<ul> <li>Fresh, large sand deposits rare or absent from channel</li> <li>No evidence of fresh sediment deposition on overbank</li> </ul>		
D 7	<ul> <li>Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand</li> </ul>	<ul> <li>Point bars common, moderate to large and unstable with high amount of fresh sand</li> </ul>	well-veg	rs small and stable, etated and/or d with little or no nd	<ul> <li>Point bars few, small and stable, well-vegetated and/or armoured with little or no fresh sand</li> </ul>		

Version #2 Last edited: 10/02/2023 Senior staff sign-off (if required): _____ Checked by: _____ Completed by: _____

# GEO

Date: 20	23-06-13	PN: 23613	Location:	aledon	
Category	Poor	Fair	Good	Excellent	
	Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	<ul> <li>Wetted perimeter 40- 60% of bottom channel width (45-65% for large mainstem areas)</li> </ul>	• Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	• Wetted perimeter > 85% of bottom channel width (> 90% for large mainstem areas)	
ettent unk network unner Cerl t deves vK	<ul> <li>Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)</li> </ul>	<ul> <li>Few pools present, riffles and runs dominant.</li> <li>Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate)</li> </ul>	<ul> <li>Good mix between riffles, runs and pools</li> <li>Relatively diverse velocity and depth of flow</li> </ul>	<ul> <li>Riffles, runs and pool habitat present</li> <li>Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water)</li> </ul>	
Physical Instream	<ul> <li>Riffle substrate composition: predominantly gravel with high amount of sand</li> <li>&lt; 5% cobble</li> </ul>	<ul> <li>Riffle substrate composition: predominantly small cobble, gravel and sand</li> <li>5-24% cobble</li> </ul>	<ul> <li>Riffle substrate composition: good mix of gravel, cobble, and rubble material</li> <li>25-49% cobble</li> </ul>	<ul> <li>Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand</li> <li>&gt; 50% cobble</li> </ul>	
Habitat	<ul> <li>Riffle depth &lt; 10 cm for large mainstem areas</li> </ul>	<ul> <li>Riffle depth 10-15 cm for large mainstem areas</li> </ul>	<ul> <li>Riffle depth 15-20 cm for large mainstem areas</li> </ul>	<ul> <li>Riffle depth &gt; 20 cm for large mainstem areas</li> </ul>	
	<ul> <li>Large pools generally &lt; 30 cm deep (&lt; 61 cm for large mainstem areas) and devoid of overhead cover/structure</li> </ul>	<ul> <li>Large pools generally 30- 46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure</li> </ul>	cm deep (91-122 cm for large mainstem areas) with some overhead	Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure	
	<ul> <li>Extensive channel alteration and/or point bar formation/enlargement</li> </ul>	Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement	Slight amount of channel alteration and/or slight increase in point bar formation/enlargement	<ul> <li>No channel alteration or significant point bar formation/enlargement</li> </ul>	
	• Riffle/Pool ratio 0.49:1 ; ≥1.51:1	<ul> <li>Riffle/Pool ratio 0.5- 0.69:1 ; 1.31-1.5:1</li> </ul>	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	• Riffle/Pool ratio 0.9-1.1:1	
11 - 01	Summer afternoon water temperature > 27°C	<ul> <li>Summer afternoon water temperature 24-27°C</li> </ul>	• Summer afternoon water temperature 20-24°C	Summer afternoon water temperature < 20°C	
Point range	0 0 1 0 2	□ 3 □ 4	5 0 6	0708	
	Substrate fouling level: High (> 50%)	<ul> <li>Substrate fouling level: Moderate (21-50%)</li> </ul>	• Substrate fouling level: Very light (11-20%)	Substrate fouling level: Rock underside (0-10%)	
Water Quality	<ul> <li>Brown colour</li> <li>TDS: &gt; 150 mg/L</li> </ul>	<ul><li>Grey colour</li><li>TDS: 101-150 mg/L</li></ul>	<ul> <li>Slightly grey colour</li> <li>TDS: 50-100 mg/L</li> </ul>	• Clear flow • TDS: < 50 mg/L	
water Quality	Objects visible to depth     < 0.15m below surface	<ul> <li>Objects visible to depth 0.15-0.5m below surface</li> </ul>	• Objects visible to depth 0.5-1.0m below surface	Objects visible to depth     > 1.0m below surface	
liter.	<ul> <li>Moderate to strong organic odour</li> </ul>	<ul> <li>Slight to moderate organic odour</li> </ul>	Slight organic odour	• No odour	
Point range	0 0 1 0 2	0304	0506	0708	
Riparian Habitat	<ul> <li>Narrow riparian area of mostly non-woody vegetation</li> </ul>	<ul> <li>Riparian area predominantly wooded but with major localized gaps</li> </ul>	<ul> <li>Forested buffer generally</li> <li>&gt; 31 m wide along major portion of both banks</li> </ul>	<ul> <li>Wide (&gt; 60 m) mature forested buffer along both banks</li> </ul>	
Conditions	Canopy coverage: <50% shading (30% for large mainstem areas)	Canopy coverage: 50- 60% shading (30-44% for large mainstem areas)	Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	Canopy coverage:     >80% shading (> 60% for     large mainstem areas)	
Point range			0405	0607	
otal overall s	score (0-42) =	Poor (<13)	Fair (13-24) Good (25-	34) Excellent (>35)	

Senior staff sign-off (if required): _____ Checked by: _____

14

___ Completed by: __

Date:	2022-06-	13	Field Staff:	AV S	7 =		Waters	hed/Subwate	rshed:	WH	umber	
Time:			Stream:	Tribu	3.4	under	UTM (U	pstream):				
Weather:	SUMAY 18		Reach:	Reach 4			UTM (D	ownstream):				
Land Use (Table 1)		<b>Channel Ty</b> (Table 3)		hannel Zone	2	Flow Type (Table 5)		Evidence of Gro	oundwater	Location:		Photo:
<b>Riparian Vegetation</b>	on , some			Aquatic &	Instrea	m Vegetati	on		Water	Quality		
Dominant Type (Table 6)	Coverage Channel	·4 ØI	<b>e (yrs)</b> mmature (<5) Established (5-30)	Type (Table 8)	2	Woody Debris	Low	y WDJ/50m:	(Tal	dour ble 16)		able 17)
Encroachment (Table 7)	Continuous />	10 🗆 N	nature (>30 tree	Reach Coverage %		□ Not Present						4
<b>Channel Characte</b>	ristics	ndside	2									
Sinuosity Type (Table 9) Z	Sinuosity Degree (Table 10)		Bank Angle □ 0 - 30	Bank Erosion □ < 5%		(Table 19) Bank	Clay/Silt	Sand Gra		e Boulde	er Parent	Root
Gradient (Table 11)	# of Channels (Table 12)		□ 30 - 60 □ 60 - 90	□ 5 - 30% □ 30 - 60%		Riffle						
Entrenchment (Table 13)	Bank Failure (Table 14)		Undercut	□ 60 - 100%	C. A	Bed (if no riffle-pool morphology)	Z	d d				C
Down's Model (Table 15)	Bankfull Indicators (Table 18)		V. high flo causing the	Bankfull Widtl	4.3	2.2		Wetted W	idth (m)	4.3	2.2	
(Table 20)	Sediment Transport Observed?		No 🗆 Not Visible	Bankfull Depti (m		0.5		Wetted De	epth (m)	0.56	0.5	
Transport Mode (Table 21)	% of Bed Active	0		Undercuts (m	0.10		0.2	Veloci	cy (m/s)	0.296	0,588	
Geomorphic Units (Table 22)	Mass Movement (Table 23)			Pool Depti (m		0.67	710	Velocity	Estimate Method	viffle	wille	
Riffle-Pool Spacing (m):	A % Riffles:	0	% Pools: 20	Riffle Length (m	)			Meander A	mplitude (m)	na na sana ang sana a		
Notes:									L	nable	to n	neade
NI				Anna an an Anna Anna an Anna An		en ageneration and a state of the state of t	1					
Photos:												

Version #4 Last edited: 04/04/2023

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GEC

GEO MORPHIX

General Site Characteristics Project Number: PN 23012

Date:		2023-00-13		Stream:	This W. Humber
Time:				Reach:	Reach 7
Weath	)er:	Sunny 180		Location:	Dixi C Rd Caledon
Field S	the second s				the start of the s
rieia :	50111:	AVSN		Watershed/Subwatershed:	W Humber
Featur	es	Monitoring	Site	Sketch	Compass
	Reach break	Long-profile			$\frown$
्र	Station location	Monumented XS		0	$\bigcirc$ $(\land)$
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Cross-section	Monumented photo		e.	
	Flow direction	Monumented photo		, the	
\sim	Riffle	▼ direction		tttit	1
	Pool	Sediment sampling		1 Xacu	
	Sediment bar	CIIII Erosion pins O Scour chains		X Dor	crash /
########	Eroded bank/slope	the second se	-	+51 %	553430
	Undercut bank	Additional Symbols		The inclosed	1 Bass
XXXXXX	Bank stabilization	F = exposed	59	Under 0,55	A Et cascade
\rightarrow	Leaning tree	1 (000		0.37	ALL EL CONCIL
XXX	Fence	ET = exposed		K ! P	
	Culvert/outfall	till		一、求一	0.66 HALLAND = 0.50
	Swamp/wetland			E photof 1	· · · · · · · · · · · · · · · · · · ·
vvv ©	Grasses			12 51 JA	ET+SI
	Tree			(E) (S)	
P ***	Instream log/tree			e internet	-poold= 0.43m (2)
* * *	Woody debris		6	To be an and the story ser	
A A A A A A A A A A A A A A A A A A A	Beaver dam		2	11/54/25	
	Vegetated island			1117	3 mature
Flow T H1	Standing water H1	A Back water	mat	se desert dit	@ mature forest
H2	Scarcely perceptible		for	et :0:50	forest
H3	Smooth surface flow	now			
H4	Upwelling			large moture # 14:56	F .
HS	Rippled			arge the	
HG	Unbroken standing v	ave	tr	ee 1005 \$ 12 56	
H7	Broken standing way		er	posed It (Ill the photo ZG
H8	Chute			Etuio.	All Istanding water, thou pa
H9	Free fall H9	A Dissipates below free fall	-	KAT (from torest
Substr	ate			XS I see The	V= 0.40mls
S1	Silt	S6 Small boulder		H I K	BFw= 10, 55m
S2	Sand	S7 Large boulder		H 154/52 50	5/ WW= 4,77~
S 3	Gravel	S8 Bimodal	ahoto 5	-7 22	wd = 0.24 m
S4	Small cobble	S9 Bedrock/till	T	1 F V	BFd= 0175m
S5	Large cobble		Likely?	52 10 55	
Other			the dra	a vinc in 2	
BM	Benchmark	EP Erosion pin	Qag X	11 14	
BS	Backsight	RB Rebar	large		
DS	Downstream	US Upstream	SUGF	rom Tob T	
WDJ	Woody debris jam	TR Terrace	field		itart os
VWC	Valley wall contact	FC Flood chute			DS
BOS	Bottom of slope	FP Flood plain	Photo		
ros	Top of slope	KP Knick point	Note	5: A aquatic veg (at	tacked energent)
Ou	inderest = 0.17	m to old + young exp	osed t	ree roots, leaning tro	1
(2)		annuler Substr		,	
#	and the second	, doing valley wall			
Versio				uired): Checked by:	Completed by SH
Last e	dited: 21/02/2023				8
Am	niner substa	rate fouring on sub	strate	tops	Page of
* N	ninnows in cl	ramel			
1.	l DS to US				

AN23012 **Project Number: General Site Characteristics** 2023-00-13 Stream: L.). Date: Trib TAULORI Reach 7 **Reach:** Time: Sunny B Location: P P Weather: SH Watershed/Subwatershed: **Field Staff:** in Compass Site Sketch Features Monitoring ------ Long-profile -Reach break F 只 Station location Monumented XS Cross-section Monumented photo 0 Flow direction Monumented photo 2+53 behind 605 Riffle direction erosion Sediment sampling Pool -vont LB. Sediment bar Erosion pins CTITIO 8 ####### Eroded bank/slope Scour chains ndercut = 0.82 Additional Symbols Undercut bank XXXXXX Bank stabilization SIS = cascade Leaning tree x----x---x Fence Culvert/outfall 1 53 Swamp/wetland \bigcirc 2.B = fres Grasses VVV 3 Tree e Instream log/tree * * * Woody debris SU -Beaver dam undesc VV Vegetated island **Flow Type** 02 0VW=~50m H1 Standing water H1A Back water H2 Scarcely perceptible flow НЗ Smooth surface flow SIY H4 Upwelling 53 H5 Rippled ascode d - 0,10m H6 Unbroken standing wave H7 Broken standing wave H8 Chute H9 Free fall H9A Dissipates below free fall Substrate **S1** Silt **S6** Small boulder 53 pool d= 0.53 **S2** Sand **S7** Large boulder **S**3 Gravel **S**8 Bimodal ET **S**4 Small cobble **S**9 Bedrock/till = 0.27mb **S**5 Large cobble Fresh BFd = 0.84Other 0Fw= 5.4m BM Benchmark EP Erosion pin Undered WW= 3.96-BS Backsight RB Rebar wd: 0,28 - 0 DS Downstream US Upstream WDJ Woody debris jam TR Terrace P.D. & good long, sorting vwc Valley wall contact FC Flood chute Bottom of slope BOS FP Flood plain Photos: TOS Top of slope KP Knick point Notes: - Cascade - pool sequence veg underwater but high flows - rooted submergent Version #4 Senior staff sign-off (if required): _____ Checked by: _____ Completed by: _____

Last edited: 21/02/2023

Page 2 of 3

1

Project Numbers 912202

Gene	eral Site Cha	racte	ristics	Project Number: 402	23012
Date:		20	23-06-13	Stream:	Trib W. Humber
Time:				Reach:	Reach 7
Weath	ner:	SU	iny 18°	Location:	Dixie Ld. Caledon
Field S	Staff:	A	HR V	Watershed/Subwatershe	
Fostur	10C	Monito	ring	Site Sketch	Compass
	Reach break Station location Cross-section Flow direction Riffle Pool Sediment bar Eroded bank/slope Undercut bank Bank stabilization Leaning tree Fence Culvert/outfall Swamp/wetland Grasses Tree Instream log/tree Woody debris		ring Long-profile Monumented XS Monumented photo direction Sediment sampling Erosion pins Scour chains nal Symbols	Site Sketch	H Site Sie
****	Beaver dam				
	Vegetated island	1		XS	950-096
Flow 1 H1	Standing water H:	A Back	water	3 KIL	BED = 0.95 V= 0.27m/s center: Cobbles
H2	Scarcely perceptible			T T	vie Dizimis center: cobbles vie Dizimis center: cobbles substrated ground substrate foulting pool d = 0.325
НЗ	Smooth surface flow			F, FW	stfle) l= 17.5m 0,
H4	Upwelling			Est.	- i cotvrated gravery
H5	Rippled			老了王	- Culton .
H6	Unbroken standing	wave		1 1 82 T	wetreste the
H7	Broken standing wa	ve		53+ eile 1830 +	SUBS
H8	Chute			out of t	apl d = 0.325
H9	Free fall HS	A Dissip	bates below free fall	woodes	L Port
Subst	rate				The wo.
S1	Silt	S6	Small boulder	So.	X
S2	Sand	S7	Large boulder	in the vegetated	1 det the
S 3	Gravel	S 8	Bimodal	martere vegetatal	TAY
S4	Small cobble	S 9	Bedrock/till	matere vegetares forest sediment	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
S5	Large cobble			there and	+ + + + + + + + + + + + + + + + + + + +
Other				Showt	* *
вм	Benchmark	EP	Erosion pin	ω	4 1
BS	Backsight	RB	Rebar	<u></u>	Vegetated island
DS	Downstream	US	Upstream	0 53	AND
WDJ	Woody debris jam	TR	Terrace		
vwc	Valley wall contact	FC	Flood chute	4	NE L
BOS	Bottom of slope	FP	Flood plain	Photos:	
TOS	Top of slope	KP	Knick point	Notes:	

Version #4 Last edited: 21/02/2023

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Page <u>3</u> of <u>3</u>

GEO

roject Number: PN23012

Rapid Geom	orph	ic Assessment	Project Number:	63016		·····	MORPHIX
Date:	20	23-06-13	Stream:	Thow	r. Inta	ana lae	4
lime:			Reach:	Reach 7			
Veather:	SI	anny 18°	Location:	Divie	Red	Cale	don
ield Staff:	A	USH	Watershed/Subwatershed:	Wiltu	mber	- Riv	2
	<u> </u>	Ge	eomorphological Indicator		Pres	sent?	Factor
Process	No.	Description			Yes	No	Value
	1	Lobate bar		- i			
	2	Coarse materials in riffle	s embedded				
Evidence of	3	Siltation in pools				1	
Aggradation	4	Medial bars				1	V1
(AI)	5	Accretion on point bars					· ·
	6	Poor longitudinal sorting	of bed materials			V.	
	7	Deposition in the overba				\checkmark	
	- I			Sum of indices =	١	6	0.143
	1	Exposed bridge footing(s)		N	A	
	2	Exposed sanitary / storn			N	A	
	3	Elevated storm sewer ou			N	A	
	4		<pre><ets aprons="" concrete="" etc.<="" pre=""></ets></pre>		N	A	
Evidence of	5		n of culverts / storm sewer outlets		Ń	A	1/
Degradation (DI)	6	Cut face on bar forms					1/5
	7	Head cutting due to knic	ckpoint migration			1	
	8	Terrace cut through olde					
	9	Suspended armour layer	an a			V	-
	10	Channel worn into undis	turbed overburden / bedrock				
				Sum of indices =		4	0.20
	1	Fallen / leaning trees / f	ence posts / etc.				
	2	Occurrence of large orga	anic debris Some *				
	3	Exposed tree roots			V		
	4	Basal scour on inside me	eander bends				5/7
Evidence of Widening	5		es of channel through riffle 🛶	- whe	1 mm		2/7
(WI)	6	Outflanked gabion baske	ets / concrete walls / etc.		N	A	
	7		50% through subject reach				
	8		ously buried pipe / cable / etc. 🛛 🕺		N	A	
	9	Fracture lines along top				~	-
	10	Exposed building founda	ition		N	A	
				Sum of indices =	5	2	0,714
	1	Formation of chute(s)					
Evidence of	2	Single thread channel to	multiple channel		1		1000
Planimetric	3	Evolution of pool-riffle for	orm to low bed relief form			V	
Form	4	Cut-off channel(s)		and the second	~		317
Adjustment (PI)	5	Formation of island(s)			V		-11
. ,	6	and the state of the second state of the secon	of phase with meander form			~	
	7	Bar forms poorly formed	l / reworked / removed			V	
				Sum of indices =	3	4	0.429
Notes:				ndex (SI) = (AI	****		
		anto net en en el este e ter este en engels en estas antes estas propositions e sobre en este	In Regi		******		djustment
			0.00 -	0.20 🗶 0.2	21 - 0.40	,C	0.41

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Rapid Stream Assessment Technique Project Number: PN23012

Date:	2023-06-13	Stream:		The Wi	Hunker		
Time:		Reach:	lat	Reach 7	4		
Weather:	Sunny 18	Location:	annag bari	Dixie Ro	Caledon.		
Field Staff:	AV SH	Watershed/Subwate	rshed:	W. Huml	er fiver		
Category	Poor	Fair		Good	Excellent		
	 < 50% of bank network stable Recent bank sloughing, slumping or failure frequently observed 	 50-70% of bank network stable Recent signs of bank sloughing, slumping or failure fairly common 	stable • Infreque	of bank network ent signs of bank ig, slumping or	 > 80% of bank network stable No evidence of bank sloughing, slumping or failure 		
Channel	 Stream bend areas highly unstable Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) Bank overhang > 0.8-1.0 m 	 Stream bend areas unstable Outer bank height 0.9- 1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) Bank overhang 0.8-0.9m 	 Outer bandle m above 1.5 m all for large 	bend areas stable ank height 0.6-0.9 e stream bank (1.2- bove stream bank e mainstem areas) erhang 0.6-0.8 m	 Stream bend areas very stable Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas) Bank overhang < 0.6 m 		
Stability	 Young exposed tree roots abundant > 6 recent large tree falls per stream mile 	 Young exposed tree roots common 4-5 recent large tree falls per stream mile 	predomi large, sr scarce	l tree roots nantly old and maller young roots ent large tree falls am mile	 Exposed tree roots old, large and woody Generally 0-1 recent large tree falls per stream mile 		
 Bottom 1/3 of bank is highly erodible material Plant/soil matrix severely compromised 		 Bottom 1/3 of benk is generally highly erodible material Plant/soil matrix compromised 	generall	1/3 of bank is y highly resistant Il matrix or material	 Bottom 1/3 of bank is generally highly resistant plant/soil matrix or material 		
1. fst-9.0 od	 Channel cross-section is generally trapezoidally- shaped 	 Channel cross-section is generally trapezoidally- shaped 		cross-section is y V- or U-shaped	 Channel cross-section is generally V- or U-shaped 		
Point range		030425	06	0708	□ 9 □ 10 □ 11		
Ti a sund level. Her (r -10%)	 > 75% embedded (> 85% embedded for large mainstem areas) 	 50-75% embedded (60- 85% embedded for large mainstem areas) 	59% em	embedded (35 bedded for large m areas)	 Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas) 		
	 Few, if any, deep pools Pool substrate composition >81% sand- silt 	 Low to moderate number of deep pools Pool substrate composition 60-80% sand-silt 	pools Pool sub	e number of deep strate composition sand-silt	 High number of deep pools 61 cm deep) 122 cm deep for large mainstem areas) Pool substrate composition <30% sand-silt 		
Channel Scouring/ Sediment Deposition	 Streambed streak marks and/or "banana"-shaped sediment deposits common 	 Streambed streak marks and/or "banana"-shaped sediment deposits common 	and/or "	oed streak marks banana"-shaped It deposits non	 Streambed streak marks and/or "banana"-shaped sediment deposits absent 		
arages ng (≻ 80% for en areas)	 Fresh, large sand deposits very common in channel Moderate to heavy sand deposition along major portion of overbank area 	 Fresh, large sand deposits common in channel Small localized areas of fresh sand deposits along top of low banks 	 uncomm Small log fresh sal 	arga sand deposits non in channel calized areas of nd deposits along w banks	 Fresh, large sand deposits rare or absent from channel No evidence of fresh sediment deposition on overbank 		
9 7 1000 (> 39)	 Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand 	 Point bars common, moderate to large and unstable with high amount of fresh sand 	well-veg	rs small and stable, etated and/or ed with little or no nd	 Point bars few, small and stable, well-vegetated and/or armoured with little or no fresh sand 		
Point range		0304		5 3 6	0708		

Version #2 Last edited: 10/02/2023 Senior staff sign-off (if required): _____ Checked by: _____ Completed by: _____

GEO MORPHIX

Date: 20	23-06-14	PN: 23012	Location:	sixie Road
Category	Poor	Fair	Good	Excellent
	• Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	 Wetted perimeter 40- 60% of bottom channel width (45-65% for large mainstem areas) 	Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	• Wetted perimeter > 85% or bottom channel width (> 90% for large mainstem areas)
	 Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low) 	 Few pools present, riffles and runs dominant. Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate) 	Good mix between riffles, runs and pools Relatively diverse velocity and depth of flow	 Riffles, runs and pool habitat present Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water)
Physical Instream	 Riffle substrate composition: predominantly gravel with high amount of sand < 5% cobble 	 Riffle substrate composition: predominantly small cobble, gravel and sand 5-24% cobble 	 Riffle substrate composition: good mix of gravel, cobble, and rubble material 25-49% cobble 	 Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand > 50% cobble
Habitat	Riffle depth < 10 cm for large mainstem areas	Riffle depth 10-15 cm for large mainstem areas	 Riffle depth 15-20 cm for large mainstem areas 	 Riffle depth > 20 cm for large mainstem areas
	 Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure 	• Large pools generally 30- 46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure	Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure	Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure
	 Extensive channel alteration and/or point bar formation/enlargement 	Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement	 Slight amount of channel alteration and/or slight increase in point bar formation/enlargement 	No channel alteration or significant point bar formation/enlargement
	• Riffle/Pool ratio 0.49:1 ; ≥1.51:1	• Riffle/Pool ratio 0.5- 0.69:1 ; 1.31-1.5:1	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	• Riffle/Pool ratio 0.9-1.1:1
10 11 14	 Summer afternoon water temperature > 27°C 	 Summer afternoon water temperature 24-27°C 	Summer afternoon water temperature 20-24°C	 Summer afternoon water temperature < 20°C
Point range		□ 3 □ 4	856	0708
agaista (aeb	• Substrate fouling level: High (> 50%)	Substrate fouling level: (Moderate (21-50%)	• Substrate fouling level: Very light (11-20%)	 Substrate fouling level: Rock underside (0-10%)
Water Quality	 Brown colour TDS: > 150 mg/L 	Grey colourTDS: 101-150 mg/L	Slightly grey colour TDS: 50-100 mg/L	Clear flow TDS: < 50 mg/L
Water Quarty	Objects visible to depth < 0.15m below surface	Objects visible to depth 0.15-0.5m below surface	• Objects visible to depth 0.5-1.0m below surface	Objects visible to depth > 1.0m below surface
10.	Moderate to strong organic odour	 Slight to moderate organic odour 	Slight organic odour	• No odour
Point range		0304	0506	
Riparian Habitat	 Narrow riparian area of mostly non-woody vegetation 	 Riparian area predominantly wooded but with major localized gaps 	 Forested buffer generally > 31 m wide along major portion of both banks 	• Wide (> 60 m) mature forested buffer along both banks
Conditions	Canopy coverage: <50% shading (30% for large mainstem areas)	Canopy coverage: 50- 60% shading (30-44% for large mainstem areas)	Canopy coverage: 60-79% shading (45-59% for large mainstem areas)	Canopy coverage: >80% shading (> 60% for large mainstem areas)
Point range	0 0 1		0405	6 6 7
Total overall s	score (0-42) =	Poor (<13) F	air (13-24) Good (25-	34) Excellent (>35)

																		GEO
Reach Charact	terist	ics P	Project	Number	PN.	230	12											MORPHIX
Date:		2023	- Olor 1	3	Field St		AV S				Wa	tershe	d/Subv	vatershed:	Wes	+ Hu	mbes	River
Time:					Stream	:	Tribu	3, 142	suns	er	UT	M (Ups	stream)	1				1
Weather:		Sunn	418	0	Reach:		☐Reach 7	7		542 12 ¹	UT	M (Dov	wnstrea	m):	1			
Land Use(Table 1)		illey Type able 2)	2	Channel (Table 3)		X	ble 4)	/	Flow (Table		1		vidence	of Groundwat	ter Loca	ation:	1	Photo:
Riparian Vegeta	ation	Sec. 8.				A. in	Aquatic &	Instrea	am Ve	getati	on			Wat	er Qua	ality		
Dominant Type (Table 6)	1/3	Coverage		4	Age (yrs) □ Immature		Type (Table 8)	1,2	In C	utbank	× Lo		WDJ/50n		Odou (Table 1			able 17)
Encroachment (Table 7)	١	Fragment Continuot			□ Established Mature (>:		Reach Coverage %	5		hannel Present			0.5					
Channel Charac	cterist	ics																
Sinuosity Type (Table 9)	2	Sinuos	ity Degro (Table 1		Bank A	ngle A	Bank Erosion □ < 5%		1.2	e 19) Bank		/Silt	Sand		bble	Boulder	Parent	Rootlets
Gradient (Table 11)	2	# o	f Channe (Table 1		□ 30 - ★60 -	60	□ 5 - 30% □ 30 - 60%			Riffle Pool								
Entrenchment (Table 13)	1	Ba	ank Failu (Table 1		Unde	Jatel	☎€0 - 100%		(if no rif morp	Bed fle-pool hology)	5]	Z	Z	2		Lytilli	-some sectio
Down's Model (Table 15)	U	Bankfull	Indicator (Table 18	1 01 1	valle	eg wit	Bankfull Widt (n		55	5.4		5.57	Wett	ed Width (m) 4.7	17	3.96	3.85
Sed Sorting (Table 20)	3	Sediment	Transpo Observed			t Visible	Bankfull Dept (n		5	0.84		0.95	Wett	ed Depth (m) 0.24	4	85,0	0.42
Transport Mode (Table 21)	3	% of	Bed Activ	ve O			Undercuts (m		0.55	0.50	0.21	0.37	0.2 V	elocity (m/s) 0,4	10	0.27	0.27
Geomorphic Units (Table 22)	215161	Mass	Moveme (Table 2				Pool Dept (n		3 0.33	0.66		0.53		ocity Estimat Metho	d w.w	ile 1	wiffle	wittle
Riffle-Pool Spacing (m):		*	% Riffle	s: 30	% Pools:	45	Riffle Length (m	1) 22	,0	17.5			Meand	er Amplitud (m				
Notes: Rif	2fles	ind	ide	Case	cdes													
															·····			
				1														
······																****		
Dhataa																		
Photos:			_															
			-															

Version #4 Last edited: 04/04/2023

Senior staff sign-off (if required): _____ Checked by: _____ Completed by: _____

Date:		20	23-06-13		Stream:		Thew	, kunder
Time:					Reach:		Reach 8	Α
Weath	ner:	R	inny 18°		Location:		Aixie Ro	1 Caledon
Field S	Staff:	A	VSA		Watershed/Su	bwatershed:	W Hum	
Featur	es	Monito	ring	Site	e Sketch		1	Compass
	Reach break Station location Cross-section Flow direction Riffle Pool Sediment bar Eroded bank/slope Undercut bank Bank stabilization Leaning tree		Long-profile Monumented XS Monumented photo direction Sediment sampling Erosion pins Scour chains mal Symbols			W D: O. Cloodin	>>	ww/87:3.0 * w0/87:3.0 * w0/85:0.7
***	Beaver dam				MULLIN	~ 11	2	Aload plene
V	Vegetated island					Selle WD: 0.	those (Flocol presid
Flow T	уре					WD: O.	54m HL	a converto
H1	Standing water H1	A Back	water				16	1 /meetin
H2	Scarcely perceptible							
H3	Smooth surface flow	r -						m
H4	Upwelling				N/			
H5	Rippled			>	11			VIC
H6	Unbroken standing v	vave		1.2.			/	2
H7	Broken standing way	/e		12.				ASWAS B
H8	Chute			J.				Vw:
H9	Free fall H9	A Dissip	ates below free fall					2HA 60m
Substr	ate			0.	uc.0.14	0	Kana 1º	Col com
S1	Silt	S6	Small boulder	d V'	100.00	DAN	KS2/SI/	N/ 7
S2	Sand	S7	Large boulder	N.	1			1. less define
S 3	Gravel	S 8	Bimodal		Jo- Clay	6001		AV/ bank
S 4	Small cobble	S 9	Bedrock/till	-			SILCIAN	m
S5	Large cobble						200	- ur
Other				orani	5121111		6	3
вм	Benchmark	EP	Erosion pin	100	[2]55	HIGH	NS	
BS	Backsight	RB	Rebar	SIL	NV	FLO		
DS	Downstream	US	Upstream		A NI	INTE	- Mahive	
WDJ	Woody debris jam	TR	Terrace	N	NVV	1 w	willow	
VWC	Valley wall contact	FC	Flood chute	D.	> the			
BOS	Bottom of slope	FP	Flood plain	Phote	os:			
	Top of slope	КР	Knick point	Note	s: channel	0 0	close to	BF

Version #4 Last edited: 21/02/2023

Senior staff sign-off (if required): _____ Checked by: _____ Completed by: _____

walked DS to US

Page _____ of _____

GEO MORPHIX

General Site Characteristics Project Number: 23012

Date:		202	3-06-13		Stream:	Tribof	W. Humbel Ri
Time:					Reach:	Reach 8	
Weatl	her:	5.	18°C		Location:	Dixie	Road
Field	Staff:	5	H AV		Watershed/Subwatershed:	and the second s	timber River
Featu	res	Monito	ring	Sit			· · · · · · · · · · · · · · · · · · ·
	Reach break Station location Cross-section Flow direction Riffle Pool Sediment bar		ring Long-profile Monumented XS Monumented photo direction Sediment sampling Erosion pins Scour chains nal Symbols	A C Weark the ly	Call		VW VW UD/SOM VW LOP T
Flow 7 H1 H2 H3 H4 H5	Beaver dam Vegetated island Type Standing water H1 Scarcely perceptible Smooth surface flow Upwelling Rippled	flow	vater		K willow	0,53r	grass field
H6 H7 H8 H9 Substr	Unbroken standing was Broken standing was Chute Free fall H9 rate	ve A Dissip	ates below free fall	300	X A ST KNW	willows /	
S1 S2 S3 S4 S5	Silt Sand Gravel Small cobble Large cobble	S6 S7 S8 S9	Small boulder Large boulder Bimodal Bedrock/till	Theeline	A Start	3 52 52	
Other BM BS DS WDJ VWC BOS	Benchmark Backsight Downstream Woody debris jam Valley wall contact Bottom of slope	EP RB US TR FC FP	Erosion pin Rebar Upstream Terrace Flood chute Flood plain	Phote	os:	54153	
TOS	Top of slope	KP	Knick point	Note		lessentiation experimentation and a second	

Version #4 Last edited: 21/02/2023

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Page _2_ of _5_



General Site Characteristics Project Number: 23012

Date:		20	23-06-13		Stream:		Trib of Wes	it Humber R
Time:					Reach:		Reach 8	E
Weath	er:	<	Varia IR'	C	Location:		Dixie Roa	e d
Field S		51	L JAIL		Watershed/Subwatershe	adı	W. Humbe	A
	puail,			· · · · · · · · · · · · · · · · · · ·	1 1		vv. Hv mpe	
Featur		Monitor		S	ite Sketch			Compass
	Reach break	1	ong-profile		p. 0.43m D V			\bigcirc
्र	Station location		Monumented XS	-	1.5		VW	$(\)$
~ ~	Cross-section	Concession of the local division of the loca	Monumented photo		13 40		115m	
200	Flow direction		Monumented photo	15	E. V		JV IN	
\bigcirc	Riffle Pool		Sediment sampling		IVAT	day	> 25	
CTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT	Sediment bar		Erosion pins	12		0	/ .	
	Eroded bank/slope	0	Scour chains	5	C3.		6	
	Undercut bank	C.C. C.C. C.C. C.C. C.C.	nal Symbols		****	0 /	3	
XXXXXX	Bank stabilization			0	VELLOL	X		
	Leaning tree			1.5	667000	11		
XX					() SI/52/	11		
	Culvert/outfall			0	0 1,5/			
	Swamp/wetland			15	1 2 Cin	AV)	1	
VVV	Grasses			V	VICIC	20.2	2	
G	Tree				121	18	m knich 1,	
	Instream log/tree				1016	1Y	3/ Knickpf by	
***	Woody debris				1 VE	/		
*	Beaver dam							
V	Vegetated island				NY K		Job	
Flow T	уре				her the	10.	wo+ rooks	
H1	Standing water H1	A Back v	vater		(0.)	le m		
H2	Scarcely perceptible	flow			K (Knr		2	
HЗ	Smooth surface flow				X IT			
H4	Upwelling		ſ		Nº 3 V			
H5	Rippled			1	Mr ftt			
H6	Unbroken standing v			-	0 1 1 10			
H7	Broken standing way	/e	ſ	X	no Stalla			
H8	Chute		the ball of the ball	m	1 KKK			
H9 Substr		A Dissip	ates below free fall	3 1.	X I I		V	
Substr S1	Silt	S 6	Small boulder	1	N AN			
S2	Sand	50 57	Large boulder	2				
S3 ·	Gravel	57	Bimodal	1	> MI	¥		
S4	Small cobble	50	Bedrock/till		X V			
S5	Large cobble	00	Ecchoory un		XX			
Other				2	a How X			
BM	Benchmark	EP	Erosion pin	2 cl	A TO No X			
BS	Backsight	RB	Rebar	4	An a V			
DS	Downstream	US	Upstream		1. 1			
WDJ	Woody debris jam	TR	Terrace		521551			
vwc	Valley wall contact	FC	Flood chute		1 sin 1			
BOS	Bottom of slope	FP	Flood plain	Ph	otos:			
TOS	Top of slope	КР	Knick point		tes:			
	ish of siche	NP	KIICK PUIIL	110				_

Version #4 Last edited: 21/02/2023

GEO MORPHIX

General Site Characteristics

Project Number: 23012

Apte:		20	23-06-13	Stypam:		Trib. of West	Humber Fiu
Time:				Reach:		Reach 8	
Weathe	.e.:	5	inny 18°C	Logation:		Dixie Road	l
Field St	aff:	SH		Watershed/Su	ubwatershed:	West Hum	A CONTRACTOR OF
Feature	<u>i</u>	Monitor		Site 6ketch			Compass
and the little and	Reach break		.ong-profile	- Charles			compass
Contraction)	Station location		Ionumented XS				$\langle \rangle$
	Cross-section	and the second line is	Aonumented photo				(\mathcal{I})
-tindlere &	Now direction	all the state of the	donumented photo	V/N/			
may 1	liffle		lirection				
C	Pépi		Sediment sampling	(\mathcal{Z})			
	Sediment bar		Frosion pins	WAR			
al antiti I	roded bank/slope	8 \$	Scour chains	were low	× 4.		
و به بوما سب	indercut bank	Additio	nał Symbols	15to			
SZUKEN I	Bank stabilization			14			
	Leaning tree			les y		V	
xx (Fençe			1 the) dien	Ne	
	Culvert/outfall			600	1 1005e 1 Som	Hear	
	Swamp/wetland			X	10050 dian	5	
	Gradela			1.2	i / ż	n	
	Tree			0.275m	YAX IG	2	
	Instream log/tree			UILIG	15.1	J	
	Hoody debris				A son Mil	141	
	sea∀er dam				X SAN	ter	
	Vegetated island				12 214	-solunated H1	
Flow Ty	and the second sec				1-314	7	
	Standing water H1		vater		VI LAT		
	Scarcely perceptible Smooth surface flow	· .	영약 이 사람이 많이 많이 많이 없다.		Va 111		
	Upwelling			· · · · · · · · · · · · · · · · · · ·	\ V/	1 Visson	
3.	Rippled			5	2461-	30.	
	Unbroken standing v	/ave		E C	NEHK		
	Broken standing way				nd vI	2	
	Chute			Ē	WIT WIT	Cartino les	
		A. Dissip	ates below free fail		1 wit in	regentives	
Substra	te				HEN	-12	
S1 5	Silt	<u>\$6</u>	Small boulder	3	m m	splend	
S2 5	Sand	S 7	Large boulder	a	XIO		
\$3 (Gravel	58	bimodal		St AK		
	Small cobble	S 9	Bedrock/till	1.1	Markel		
	Large cobble			20 12	ANA		
Other				2 21	(Set		
	Benchmark	EP	Erosion pin	201	Vi/		
,	Backsight	RB	Rebar	Sent.			
	Downstream	2.15	Upstream	- C Jak	1 SVS2		
	Woody debris jam	IH.	Terrace	207	o60 th	1-	
	Valley wali contact	FC	Flood chute	0.11	* Inpresse	ich ircheilig	reput 7
BOS E	Bottom of slope	FP	Flood plain	Photos:			
TOS T	Fop of slope	KP	Knick point	Notes: not exp	values acro		1

Version #4 L**as**t edited: 21/02/2023

Senior staff sign-off (if required): _____ Checked by: ____

Completed by: <u>AV</u> Page <u>4</u> of <u>5</u>

MORPHIX

Géneral Site Characteristics

Project Number: 23012

and the second s	20	23-06-13	Stream:	Trib. of West Hu	mbs
The and		an a	Reach	Reach 8	
La de la	S	nny 18°C	Location:	Dirie Road	e .
All he hashe	A	VELL	Watershed/Subw	and the second se	
1. 19 19 19 19 19 19 19 19 19 19 19 19 19	73	· 20			ani tra musi mini a data
Iddarbis	Monito		site steer A	Comp	a,95
Reach brea		Long-profile Monumented XS	40%		
Cross-seet	A	Monumented photo	571		1
> Flow direct	hoursenand	Monumented photo			see
· Ri∰e		direction	Site V	5 0	1
D Poel	G	Sediment sampling		A van x	V
Sediment I	bar 🛛 🖽 🖽	Erosion pins	AT 1	- And A A A A A A A A A A A A A A A A A A	
WHWHH Eroded bit	k/slope 8	Scour chains		A H X	-
Underdict b		hal-Symbols		J K-1	
EXXXX Bank statu				A LX	
Leaning the	se		1 F	1 the	
xxx Fenge	1.15		P	olay The I X	
L Cubiert/ou	and a the fit of the f		-	0 531	
Swajmp/we	stland			Q 52 X	
₩₩₩ Grasses					
C) Tree				hunted / the XI	INC
Tostream I * * x Woody det				Collenterproted Aler KK 14	23.5
K∦ χ Woqdy det ≰X₩ Beaver dat					× BFI
Vegetated				The street street	FL
Floy Type				in // etta	. w
	Her HIA Back	water		W () (M)	5
	erceptible flow	24 G		A NIL	ß
183 Smooth su	Pape flow			Co (400 A)	V:
H4 UpwellMg	S.			and they and	e ono
HS Rippied				w Krover	20
C Set a contract of the set of the	standing wave		INCI	25m B nor X with	-
	inding wave			11 0.5	
Hở Chute Hý Free fall	Mak Dicci	pates below free fall		25m B 0.32m White over with	
no metan	****** 1715S1		Nor Wards William	A CAN	
\$1 Silt	50	Sthall boulder	Ning Hour Hism		
\$2 Sand	57	Large boulder	N Los V	and a construction of the second seco	
93 Gravel	SB	Bimodal	2 con		
\$4 Small cobi		Bedrock/till	1 est Very	Que tack of I soule	
95 Large cobb	ole		Jow Acc	willow defined boule	
other			J.Y.T.		
Benchmari	<"	Erosion pin	Wierlan f W		
Backsight	RB	Rebar	m. F/		
DS Downstrea		Upstream	sta		
WDD Woody det	all the second sec	Terrace	W F	to the second se	
VWC Valley wall		Flood chute	R.		
BOS Bottom of		Flood plain	Photos:		
TOS Top of slop	ke KP	Knick point	Notes:		

Version #4 Last edited: 21/02/2023

Senior staff sign-off (if required): _____ Checked by: ____

____ Completed by: _____

Page 5 of S

GEO MORPHIX

.

Rapid Geomorphic Assessment Project Number: 23012

ate:	20	23.06-13	Stream:	T	rib of u	lest H	umber	River
ime:	Cont. No		Reach:		Reach 8	and the design of the second second		
Veather:	5	inn 18°C	Location:			i Ki e	Road	
ield Staff:	240	AU	Watershed/Subwate			mbes	Rine	
	2	H MV		cionedi (VEST TV			1
Process			eomorphological Indicator				sent?	_ Factor Value
	No.	Description	***			Yes	No	Value
	1	Lobate bar	×	and a state of the			V	4
	2	Coarse materials in riffle		IR	- 1/			
Evidence of	3	Siltation in pools				V		1/6
Aggradation (AI)	4	Medial bars	·				V	_
(,)	5	Accretion on point bars					V	0.166
	6	Poor longitudinal sorting				<u></u>		-
	7	Deposition in the overba	ink zone				V	,
				Sum	of indices =		5	6
	1	Exposed bridge footing(s)			1		
	2	Exposed sanitary / storr	n sewer / pipeline / etc.			/	-	
	3	Elevated storm sewer ou	utfall(s)			/		
- · · · · · · · · · · · · · · · · · · ·	4	Undermined gabion bas	<pre>kets / concrete aprons / etc</pre>		and the second se	1	Condesan and a condesan	
Evidence of Degradation	5	Scour pools downstream	n of culverts / storm sewer o	outlets				0.
(DI)	6	Cut face on bar forms					V	10
	7	Head cutting due to knic	kpoint migration		1. I.		~	10
	8	Terrace cut through olde	er bar material				~	0.00
	9	Suspended armour layer	r visible in bank					
	10	Channel worn into undis	turbed overburden / bedroc	:k			1	
				Sum	of indices =	0	S	0
	1	Fallen / leaning trees / f	ence posts / etc.			V		
	2	Occurrence of large orga	anic debris			1/		-
	3	Exposed tree roots				V		-
	4	Basal scour on inside me	eander bends					
Evidence of Widening	5	Basal scour on both side	es of channel through riffle				1	3/11
(WI)	6	Outflanked gabion baske	ets / concrete walls / etc.			/	-	_
	7	Length of basal scour >!	50% through subject reach				~	-
	8	Exposed length of previo	ously buried pipe / cable / e	tc.			~	0:273
	9	Fracture lines along top	of bank				V	
	10	Exposed building founda	tion			N	A	
				Sum	of indices =	3	B	11
	1	Formation of chute(s)				1./		
Evidence of	2	Single thread channel to	multiple channel			V		-
Planimetric	3		orm to low bed relief form				1	111
Form	4	Cut-off channel(s)			· · · · · · · · · · · · · · · · · · ·	/		14/7
Adjustment (PI)	5	Formation of island(s)				-		
(11)	6	Thalweg alignment out o	of phase with meander form				V.	0.57
	7	Bar forms poorly formed	/ reworked / removed				V	
				Sum	of indices =	Ц	3	Ŧ
otes:			St	ability Index	(SI) = (AI +	DI+WI	+PI)/4 =	0.75
				In Regime	In Transiti			Adjustmer
		and the first addition of the second s		0.00 - 0.20		- 0.40		0.41

Version #3 Last edited: 10/02/2023 Senior staff sign-off (if required): _____ Checked by: _____ Completed by: _____

Rapid Stream Assessment Technique Project Number: 23012

Date:	2023-06-13	Stream:		Trib of We	st Humber river	
Time:	10:3 bo	Reach:	e Sal M	Reach 8	Category	
Weather:	Sunny 182	Location:	Charles Les	12861 Dix	ie Road	
Field Staff:	SA AV	Watershed/Subwate	rshed:	West Hunni	per River	
Category	Poor	Fair	Good		Excellent	
ent oty and depth ent (Le., slow, and deep	 < 50% of bank network stable Recent bank sloughing, slumping or failure frequently observed 	 Š0-70% of bank network stable Recent signs of bank sloughing, slumping or failure fairly common 	stable • Infrequ	6 of bank network ent signs of bank ng, slumping or	 > 80% of bank network stable No evidence of bank sloughing, slumping or failure 	
Channel	 Stream bend areas highly unstable Outer bank height 1.2 m above stream bank (2.1 m above stream bank for large mainstem areas) Bank overhang > 0.8-1.0 m 	 Stream bend areas unstable Outer bank height 0.9- 1.2 m above stream bank (1.5-2.1 m above stream bank for large mainstem areas) Bank overhang 0.8-0.9m 	• Outer b m abov 1.5 m a for larg	bend areas stable bank height 0.6-0.9 e stream bank (1.2- above stream bank e mainstem areas) verhang 0.6-0.8 m	 Stream bend areas very stable Height < 0.6 m above stream (< 1.2 m above stream bank for large mainstem areas) Bank overhang < 0.6 m 	
Stability	 Young exposed tree roots abundant > 6 recent large tree falls per stream mile 	 Young exposed tree roots common 4-5 recent large tree falls per stream mile 	predom large, s scarce • 2-3 rec	d tree roots inantly old and smaller young roots ent large tree falls eam mile	 Exposed tree roots old, large and woody Generally 0-1 recent large tree falls per stream mile 	
	 Bottom 1/3 of bank is highly erodible material Plant/soil matrix severely compromised 	 Bottom 1/3 of bank is generally highly erodible material Plant/soil matrix compromised 	general	1)3 of bank is Ily highly resistant oil matrix or material	 Bottom 1/3 of bank is generally highly resistant plant/soil matrix or materia 	
	Channel cross-section is generally trapezoidally- shaped	 Channel cross-section is generally trapezoidally- shaped 	and the second second second	el cross-section is lly V- or U-shaped	 Channel cross-section is generally V- or U-shaped 	
Point range		030405	Re	5 0 7 0 8	□ 9 □ 10 □ 11	
및 회 ulting level: ide (0-19%)	 > 75% embedded (> 85% embedded for large mainstem areas) 	 50-75% embedded (60- 85% embedded for large mainstem areas) 	59% er	6 embedded (35- nbedded for large em areas)	 Riffle embeddedness < 25% sand-silt (< 35% embedded for large mainstem areas) 	
	 Few, if any, deep pools Pool substrate composition >81% sand- silt 	 Low to moderate number of deep pools Pool substrate composition 60-80% sand-silt 	pools Pool su 	te number of deep bstrate composition 6 sand-silt	 High number of deep pools 61 cm deep) 122 cm deep for large mainstem areas) Pool substrate composition <30% sand-silt 	
Channel Scouring/ Sediment Deposition	 Streambed streak marks and/or "banana"-shaped sediment deposits common 	 Streambed streak marks and/or "banana"-shaped sediment deposits common 	and/or	bed streak marks "banana <i>"-shaped</i> nt deposits non	 Streambed streak marks and/or "banana"-shaped sediment deposits absent 	
	 Fresh, large sand deposits very common in channel Moderate to heavy sand deposition along major portion of overbank area 	ry common in channel b heavy sand along major definition deposits common in channel • Small localized areas of fresh sand deposits along top of low banks		non in channel ocalized areas of and deposits along	 Fresh, large sand deposits rare or absent from channe No evidence of fresh sediment deposition on overbank 	
2 7 Skent (> 33)	 Point bars present at most stream bends, moderate to large and unstable with high amount of fresh sand 	Point bars common, moderate to large and unstable with high amount of fresh sand	well-ve	ars small and stable, getated and/or ed with little or no and	 Point bars few, small and stable, well-vegetated and/or armoured with little or no fresh sand 	
Point range		0304	2	3,506	0708	

GEO MORPHIX*

Date: 20	23-06-13	PN:	23012		069713	Location:	C	aledor	10100
Category	Poor	A	Fair		G	bod			Excellent
	Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas)	60% width	ed perimeter 40- of bottom chanr n (45-65% for lau stem areas)	nel	 Wetted perin of bottom ch (66-90% for mainstem an 	annel width large	/0	bottom	perimeter > 85% of channel width (> r large mainstem
	Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low)	and runs dominant.		5	 Good mix be runs and poor Relatively di and depth of 	ols verse velocity	al me	habitatDiverse of flow	runs and pool present velocity and depth present (i.e., slow, allow and deep
Physical Instream	 Riffle substrate composition: predominantly gravel with high amount of sand < 5% cobble 	comp prede cobb	substrate position: ominantly small le, gravel and sa % cobble	nd	 Riffle substrate composition: good mix of gravel, cobble, and rubble material 25-49% cobble 				ition: cobble, rubble, boulder mix le sand
Habitat	Riffle depth < 10 cm for large mainstem areas	And International Property in the In	depth 10-15 cm mainstem areas		 Riffle depth 15-20 cm for large mainstem areas 				epth > 20 cm for
	 Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure 	Large 46 cr for la areas	pools generally n deep (61-91 cr ge mainstem with little or no head cover/struct	30- m o	Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure			 large mainstem areas Large pools generally > 6 cm deep (> 122 cm for large mainstem areas) wil good overhead cover/structure 	
Extensive channel alteration and/or point bar formation/enlargement		chan mode point	erate amount of nel alteration and erate increase in bar ation/enlargemen		 Slight amour alteration an increase in p formation/er 	d/or slight oint bar		significa	nnel alteration or int point bar on/enlargement
	• Riffle/Pool ratio 0.49:1 ; ≥1.51:1		/Pool ratio 0.5- 1; 1.31-1.5:1		• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1		1	 Riffle/Pa 	ool ratio 0.9-1.1:1
	Summer afternoon water temperature > 27°C		mer afternoon wa erature 24-27°C		Summer afternoon water temperature 20-24°C				r afternoon water ature < 20°C
Point range	0 0 1 0 2	dime ».	3 2 4	isob.	□ 5	06	009	E	7 🗆 8
500) 1900)	 Substrate fouling level: High (> 50%) 		trate fouling leve trate (21-50%)	el:	• Substrate for Very light (1				te fouling level: derside (0-10%)
Water Quality	 Brown colour TDS: > 150 mg/L 	• Grey • TDS:	colour 101-150 mg/L		 Slightly grey TDS: 50-100 		(• Clear flo TDS: <	
Water Quality	 Objects visible to depth < 0.15m below surface 		cts visible to dep -0.5m below surf		Objects visib 0.5-1.0m be				visible to depth below surface
	Moderate to strong organic odour		t to moderate nic odour		 Slight organi 	c odour		• No odou	ır
Point range	0 0 1 0 2	n banao	0304	12 12	0 5	□ 6	5.7.6	K	7 0 8
Riparian	 Narrow riparian area of mostly non-woody vegetation 	predo	ian area ominantly wooded /ith major localized		 Forested buf > 31 m wide portion of bo 	along major			· 60 m) mature I buffer along both
Habitat Conditions	 Canopy coverage: <50% shading (30% for large mainstem areas) 	60%	py coverage: 50 shading (30-449 irge mainstem s)		Canopy coverage: 60-79% shading (45-59% for large mainstem areas)			>80% s	coverage: shading (> 60% for ainstem areas)
Point range	001		023		□ 4	□ 5	94		6 0 7
Total overall s	score (0-42) = 25	Po	oor (<13)	Fa	nir (13-24)	Good (2	25-3	4)	Excellent (>35)

ate:		2023-	06 -1	3	Field Sta	aff:	SH AV				Wa	tershe	d/Subv	watershed	1: Wa	:st H.	mber	Riner
ime:					Stream:		Tribiof1	Nest H	rumla	es river	UTI	M (Ups	stream)	:				
/eather:		Sunny	182	1	Reach:		Reach 8				UTI	M (Do	wnstrea	ım):				
and Use		alley Type able 2)		Channel Table 3)	1.4	1 1	hannel Zone	-1	low Table	Type 5)	1		vidence	of Groundw	ater Loc	ation:		Photo:
iparian Vege	tation						Aquatic & 1	nstrea	m Ve	getatio	on			Wa	ter Qu	ality		
ominant Type (Table 6) Encroachment (Table 7)	12	Coverage		4 C	Age (yrs) □ Immature (□ Established € Mature (>3	(5-30)	Type (Table 8) Reach Coverage %		In Cu In Ci	Debris utbank nannel Present		bc	WDJ/50r	n:	Odou (Table			Table 17)
hannel Chara	cterist	ics	/ -			<u>.</u>												
Sinuosity Type (Table 9)	2		ty Degree (Table 10)		Bank Ar		Bank Erosion □ < 5%		(Tabl	e 19) Bank	Clay		Sand	Gravel (Cobble	Boulder	Parent	Rootle
Gradient (Table 11)		# of	Channels (Table 12)		□ 30 - 6 □ 60 - 9		□ 5 - 30% 🗙 30 - 60%			Riffle Pool								
ntrenchment (Table 13)			nk Failure (Table 14)	1116	🗆 Under	cut	0 60 - 100%	4.1	(if no riff morph	Bed fle-pool hology)	_]		Z	R			
Down's Model (Table 15)	E	Bankfull I	ndicators (Table 18)	47			Bankfull Width (m)			3.70]	5.0	Wett	ed Width (i	m) 3.(60	3.70	3.3
Sed Sorting (Table 20)	4	Sediment 1 0	Fransport bserved?	🗆 Yes	No 🗆 Not	Visible	Bankfull Depth (m)			0.53		0.77	Wett	ed Depth (m) 👌	70	0,53	0.16
Transport ode (Table 21)	3-	% of B	ed Active	D		F	Undercuts (m)	-111	0,15	0.06		0.15	v	elocity (m/	's)		0.26	1.099
Geomorphic nits (Table 22)	5.6.8		lovement (Table 23)	1 1 1			Pool Depth (m)	0.54	032	0.47	0,49	0,415	Vel	ocity Estima Meth			wiffle	wiftle
Riffle-Pool Spacing (m):			% Riffles:		% Pools:	20	Riffle Length (m)						Meand	ler Amplitu (I	de m)			
tes:										u e a a a a a	*			1				

						·····												

Version #4 Last edited: 04/04/2023

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____

51

GEO MORPHIX"

General Site Characteristics Project Number: 23012

Date	:	2	023-06-13		Stream:		Tib Eul	() ()
Time					Reach:		Trib. of Wes.	t Humber Fire
Weat	ther:	6	1010		Location:		Reach 8a	
Field	Staff:		Whay 18'C		Watershed/Subwa			2 Road
			H AV			tersnea:	West Humber	River
Featu	Reach break	Monito		Site	Sketch	3		Compass
	Station location	-0-0-0-	Long-profile		/	11	d. u. w= 15mg	\cap
×>	Cross-section		Monumented XS Monumented photo		/		C. All	$(\land) \mid$
>	Flow direction	0			f pord f	3 ())		K /
~	Riffle	+	Monumented photo direction	11				
\square	Pool		Sediment sampling		/3	1. 1. 1	tw=10.62	
CONTROL OF	Sediment bar		Erosion pins	0		1:55	BF= 5.40.	
	Eroded bank/slope	8	Scour chains	1	Q Storp	HA!!	BFJ = 0.94	1/_/
	Undercut bank		onal Symbols		a stort	₹(\\\.	\$51.1 ww=4.3	
XXXXXX	Bank stabilization		Asola and			E 55/	a- wd=0.4	
	Leaning tree	d.v.	W: to valle well			614	distance to VIN30m	X
	Fence				M		- active d= 2.02m Floodplain	
	Culvert/outfall			I			V=0.25 V1	
0	Swamp/wetland					H54 /	mis	×
VVV	Grasses					2	V	
G	Tree				2. V. W= 50m	4		
	Instream log/tree			F	7	54 4		
***	Woody debris				Rz.	541/4		1 00
+98XXXQ#	Beaver dam				The W	27/14	(5)	8
(V)	Vegetated island				/	Λ /4	ME	1 K
Flow 1	Гуре	Strat 2.			/ (3)	·	X
H1	Standing water H1A	Back	water		SIX SH high embedded			6
H2	Scarcely perceptible f	low			She embedding		20	i ix
HЗ	Smooth surface flow					DI Floe	sed D	á
H4	Upwelling				A CORE IN IT	* 1: 50	545 0/	
H5	Rippled			16	CV. I	Two) -	/	\uparrow
H6	Unbroken standing wa	ave			53.	541 1 4	1	
H7	Broken standing wave	e			Riport 57		/	h.dro
H8	Chute				grassis (* Mile
H9		Dissip	ates below free fall		V H	()	1	The second
Substr						W		4
S1	Silt	S6	Small boulder			14 Lacto		
S2	Sand	S 7	Large boulder			1 51000 Shee	×	×
S3	Gravel	S8	Bimodal		\ v s	10/	liwn	1
S4	Small cobble	S9	Bedrock/till		× ·	H34	= 4-	
S5 Other	Large cobble					10		
BM	Benchmark				1. N vwn= V	V		\land
BS		ËP	Erosion pin		1.25m S	2+ #	1 -X-	
DS	Backsight Downstream	RB	Rebar			11 050-	k	
WDJ	Woody debris jam	US	Upstream		-/ - 1:	53- 0		
	Valley wall contact	TR	Terrace		1-1-	1	US	
BOS	Bottom of slope	FC	Flood chute			luest 1		
		FP	Flood plain	Photos	: taken US	to DS		
	Top of slope	КР	Knick point	Notes:	high wates	levels	after sign. r.	infall
A h	igh level of	substr	ate forling		A	Il slack	1 10	1
×	offesses alou	Nine.	instream,	455-125	1	9.1	the second se	surface
0	l= 0.45m, active	-		41001	001	50%	mocodedness	for
Version		10001		ff (if roat	rod).	un al la		S I.
Last ed	lited: 21/02/2023	B	R 21- cond	in (ii requi	red): Checl	ked by:	Completed by:	24
	iffle l= ~7m	0	Riffle -pool sp	" eug	4.40m		Page 1	of
3 00	ol d: 0.51m	0	pool d = 0.55					
	iffle 1 = 12,30 m	0	underest = 0,14	In	Walked	US to	DS	

GEO

General Site Characteristic

0

Date:	2	023-06-13	Stream:	Te	10. of west Humber river
Time:			Reach:		each 8a
Weather:	A State of State	Sunny 18°C	Location:		861 Dixie Road
Field Staff:		SH AV	Watershed/Subwa		lest Humber River
Features	Mon	itoring	Site Sketch		
Read		- Long-profile	Site Sketch	1 (56) +	Paxis 0.50 Compass
<mark>त्र</mark> Stati	on location	Monumented XS			r:fflel=5.59
× Cros	s-section 0	Monumented photo		1 H	
	direction	Monumented photo	×	1 0	- i Ball
∼∽ Riffle	*	direction	1	1 53 + I	pool d: 0.680
		Sediment sampling		W10.	140
		C Erosion pins		2	1141- 250 BFW2 3
####### Erod	ed bank/slope	Scour chains	VW2=15,	2 1 1	
	rcut bank Addi	tional Symbols	× ·	1	-X53) Tw=7.7
	stabilization			101	ww=21-7
	ng tree		large bank	# / / #	-pool 2 = 0,69m/ wd = 0.5
xxx Fence			large day :	Acil	BFd= D.
-	rt/outfall		K (small sond)	(43)	
	np/wetland		× Ksman	1. 1. 1	$(::::) \bigcirc /$
₩₩₩ Grass	es			in A	
C Tree			//	1 mil	flooded
	am log/tree		1/ 4	5/11/	
	y debris		4	(2))	M
	er dam		*/	,-' 52rti	
	ated island		1/ manet	1 12	- the willow
low Type			widening -	53+ 5	D large willow DCP BFw=5.60-
	ing water H1A Back	< water	(wide	1, 154 /2	20 BF. w= 5,60-
	ely perceptible flow		()	NA VA	
	th surface flow		X	X.	52 Fw= 9.90m d.V.W= 15.10 m ==
H4 Upwe	5 T		(WW= ~3.0~
· · · · · · · · · · · · · · · · · · ·	u ken standing wave		an hois	in Da	BFd = 0,80 m
	n standing wave		2 Poter Suiter		wd= 0.30m
H8 Chute	i standing wave		Couloss m	F. OI	V= 0. \$5m/5
H9 Free f	H9A Diss	ipates below free fall	(1005)0	1 53	
ubstrate			X		
S1 Silt	S6	Small boulder	Undered = 0124 m	-i W	
S2 Sand	S7		=015	INI	3 mature
S3 Grave	S8		Lup.	101	~ trees
S4 Small	cobble sg	Bedrock/till	1	10	
S5 Large	cobble		Oflow	1 2 1	G1V.W.
ther			1 W Dry	1 54	
M Bench	mark EP	Erosion pin	free.	17-51	W &
s Backsi	ght RB	Rebar	1 3 Q/X	1(1)	
s Downs	tream US	Upstream	0	1 ASH I	lel= 12,6
DJ Woody	debris jam TR	Terrace		1917 -	a stables 1
WC Valley	wall contact FC	Flood chute	(pond)	1- 56 T 1	e pictit
OS Botton	of slope FP	Flood plain	Photos:	1 41	MOST HO]
OS Top of	slope KP	Knick point	Notes:		
· · · · ·		· · · · · · · · · · · · · · · · · · ·			
gap in	bern at porel	wdry than path	to channel . Potentic	illy mannac	le drainage ditch
instres	n verit grad	sses + arrow	not talgare & roe	ted emes	sect + alas -
in low	flow channel	likely meanders	more U	(1 3
ersion #4		Senior staff sign-off	(if required): Chec	ked by:	Completed by: SH
ast edited: 2					

GEO

General Site Characteristics

Project Number: 23012

Date		20	23-06-13		Stream:		Trib.	of nus	it Humber	File
Time	:				Reach:		Reach			
Weat	ther:	S	Unny 18°C		Location:			Pixie	Road	
Field	Staff:		# AV		Watershed/Sub	watershed:	West	Humber	River	
Featu	ires	Monite	oring	Sit	e Sketch			10141505	Compass	
	Reach break		Long-profile						compass	-
<u>र</u>	Station location	I	Monumented XS						$\left(\right)$	
1	Cross-section	0	Monumented photo						(K)	
\sim	 Flow direction Riffle 	¥	Monumented photo direction						\bigcirc	
$ \bigcirc$	Pool		Sediment sampling							
CERED .			Erosion pins							
+++++++++++++++++++++++++++++++++++++++	Eroded bank/slope	8	Scour chains							
<u></u>	Undercut bank	Additio	onal Symbols							
XXXXX	Bank stabilization									(=
	Leaning tree									
xxx	Fence	-								
	Culvert/outfall									
	Swamp/wetland									
	Grasses	_								
G	Tree	_								75
	Instream log/tree									
***	Woody debris									
****	Beaver dam									
V	Vegetated island		v							
Flow 1										
H1	Standing water H1.		water							
H2	Scarcely perceptible	flow		_						
H3	Smooth surface flow									
H4	Upwelling									
H5 H6	Rippled Unbroken standing w									
H7	Broken standing wav									
H8	Chute	е								
H9	Free fall H9/	Discir	bates below free fall							
Substr		4 D1331	bates below free fall					_		
S1	Silt	S6	Small boulder						1	
S2	Sand	S7	Large boulder		duw= 25m			a	1/ 0	
S 3	Gravel	S 8	Bimodal	-	Y Y Y	1	1	4	*	road .
S 4	Small cobble	S 9	Bedrock/till		14	4 4		SIIS	2 11/	culut
S 5	Large cobble					\$ 521	5.3	2113	- VA	
Other					run d= 0,35 V= 0,23-15		+ +			-
BM	Benchmark	EP	Erosion pin		(un a	A M	1 martine	Case a	AN	
BS	Backsight	RB	Rebar		V=0.23-15		d=0.15 7	Irasses in	15X	
DS	Downstream	US	Upstream			()	uw=~2m		×	AVW=3m
WDJ	Woody debris jam	TR	Terrace		M	1 4				
vwc	Valley wall contact	FC	Flood chute			1			X	
BOS	Bottom of slope	FP	Flood plain	Photo	s:	4		<u>x</u>		
TOS	Top of slope	КР	Knick point	Notes	:					
L	bank has	more	bank slum	aine	than Rba	ok				
C.	stoff change	d k	ad cow-s	V J.						
			Contraction of the second seco							

Version #4 Last edited: 21/02/2023 Senior staff sign-off (if required): _____ Checked by: ____ Completed by: _____

Page 3_ of 4

General Site Characteristics Project Number: 23012

GEO MORPHIX

Date	:	20	23-06-13		Stream:	23012	- 1 ()	
Time	e:		2200 12		Reach:		Trib of W.	Humber river
Wea	ther:	<	ng 18.0			~	Reach 8a	X
Field	Staff:	St			Location:			xie Road
L					Watershed/Su	ibwatershed:	West Humb	er river
Featu	Reach break	Monito	ring Long-profile	Site	Sketch	-1x-0	2-X-W-	compass
못	Station location		Monumented XS	the			tow path	
×;	Cross-section		Monumented photo		wizium	162 DS	acourd in T	(7)
	Flow direction	-	Monumented photo	U.	d=0.22 W	Bridg	2 Willow	$\langle \rangle$
~	Riffle		direction		FJ: 4,20 /	tit .		
\bigcirc	> Pool	a s	Sediment sampling		XS	V	2	
CERED .	Sediment bar		Frosion pins	1	2/mt	W JUNE	m N	
+++++++++++++++++++++++++++++++++++++++	and barry brope		Scour chains		. / / ;	K JUNI		
XXXXXX	Under cut barrk	Additio	nal Symbols	- 1	11 41	1 ye Lencre	aved not at	
	Bank stabilization				14	il T	V entrend to	
	Fence					K Y spong	3/	electric
	Culvert/outfall				HOF?	x her	10-1-×1	K Fenere
0	Swamp/wetland			M	III A . John	Wor The	Bfw= 4,5	5
VVV					Red vegetat	684 173 -		= 55,80-
C	Tree				1 best	X		95m
	Instream log/tree			10	du) - ht -	SZ JU		n n
***	Woody debris			1 3	VW=40		Bfd= 0.5:	3~
-	Beaver dam				e mored deed	52 53 52	V: 0,45	
	Vegetated island					1.1	but welc	y electric
Flow T	and the second s				ates SI		1	
H1 H2	Standing water H14 Scarcely perceptible f		ater		underwater	1 55 1	X = 0	18mls
H3	Smooth surface flow	IOW		Va	CAP to 35	No.	BE.	
H4	Upwelling			W		133	BFw=	
H5	Rippled				embedded	1 25- 1 2		5,50
H6	Unbroken standing wa	ave			8 mbeer	× 534		3.20
H7	Broken standing wave	e		0	,	/		
H8	Chute			100	1	T ALE	ool d: 0.80m	
H9 Subatu		Dissipat	tes below free fall		V 3	K U W	11 de	wich: sandy + grand
Substr S1	Silt	66	C	/	1	XIVIW	bank more	The same day +
S2	Sand	S6 S7	Small boulder		undesc	211	2 molescut 0.	15m small cobble
S3	Gravel	S8	Large boulder Bimodal		0.00	I SIT	texposed	roots
S 4	Small cobble	S9	Bedrock/till	JUN=N	som ,	S2 1	*	
S 5	Large cobble]	1	DE- 1 54 1.2	31	
Other				1	=1			
BM	Benchmark	EP	Erosion pin		= lo loog	1-ICI	*	
	Backsight		Rebar		10.64	1 19531 1	BI, WW.	
DS	Downstream		Upstream		Some .	17 6:	*	
	Woody debris jam		Terrace	-		122/4	actite	
	Valley wall contact		Flood chute	1	ence to	- 11(*)T)/ SI	oodphin US	
	Bottom of slope		Flood plain	Photos				
	Top of slope	КР	Knick point	Notes:	H5 all	each		703
- I	nstream gra	55051	glace, aguar	· Son		11.1	hs (plats)	1 parts
-h	igh levels	70	sectimentati	0 0	0 1			her Two >
- pe	oth banks s	umpin		0 1	by still :		slumping	hen TWDR-26,
Version	n #4		Senior staff sign-	off (if requir	red):	Checked by:	Completed by:	. 5#
	lited: 21/02/2023							
	nows in ch	anned		+5-b	strate i m	one sound t	SIT Page 4	of
n nei	Shbour says ch	annel i	s dry in sua	nor than	TWOR-	4b, Some o	rand	
				1		Walke	al UD to C	20

MORPHIX

Rapid Geomorphic Assessment Project Number: 23012

Date:	20	23-06-13	Stream:		Trib of	Mort	Marin	L. D.
Time:			Reach:	Side Contraction	Reach 8a		TIUT.	ber k.
Weather:	SI	AN 18°C	Location:		1		-	
Field Staff:		SH AV		Subwatershed:			Rd	22
	1		I		Nest	MU	mber	River
Process	No		omorphological Ind	licator		Pr	esent?	Factor
	No.	Description				Yes	No	Value
	1	Lobate bar						
_	2	Coarse materials in riffle	s embedded			V		
Evidence of Aggradation	3	Siltation in pools						3/-
(AI)	4	Medial bars						
	5	Accretion on point bars					1	_
	6	Poor longitudinal sorting	And and a second s			~		
	7	Deposition in the overba	nk zone				-	
				S	um of indices =	3	4	0.42
	1	Exposed bridge footing(s					NIA	
	2	Exposed sanitary / storm		etc.			NIA	1
	3	Elevated storm sewer ou					NIA	1
Evidence of	4	Undermined gabion bask	the second se				NIA	0,
Degradation	5	Scour pools downstream	of culverts / storm	sewer outlets			NIA	1/5
(DI)	6	Cut face on bar forms					11	0
	7	Head cutting due to knick					W	
	8	Terrace cut through older					20	-
	9	Suspended armour layer					Sand .	1
	10	Channel worn into undist	urbed overburden /	bedrock			Ĩ.	
		T		Su	m of indices =	0	5	0.0
	1	Fallen / leaning trees / fe	nce posts / etc.				1	
	2	Occurrence of large organ	nic debris				1	1
	3	Exposed tree roots				V	W.	-
	4	Basal scour on inside mea	ander bends				1	1
Evidence of Widening	5	Basal scour on both sides		1	1			
(WI)	6	Outflanked gabion basket					- 1/	8
	7	Length of basal scour >50)% through subject	reach				
	8	Exposed length of previou	isly buried pipe / ca	ble / etc.				
	9	Fracture lines along top of	f bank		-			
	10	Exposed building foundati	on				NIA	
				Su	m of indices =	1	8	0.125
	1	Formation of chute(s)						
To date of	2	Single thread channel to r	nultiple channel					~
Evidence of Planimetric	3	Evolution of pool-riffle for		form			V	1
Form	4	Cut-off channel(s)					4	1
Adjustment	5	Formation of island(s)		V		6		
(PI)	6	Thalweg alignment out of	phase with meande	er form			V	
		Bar forms poorly formed /			3		V	
		, isonicu /	shorked / remove		n of indices =		V	6
otes:							Ce	0.143
				Stability Inde			1	0.174
				In Regime	In Transit		ss In Ac	ljustment
				0.00 - 0.20	0 0.21	- 0 40		0.41

Senior staff sign-off (if required): _____ Checked by: _____ Completed by: _____

high flows may / skew

GFO

MORPHIX

e: 202	3-06-13	PN: 23017	Location: 7	litie Road.	
Category	Poor	Fair	Good	Excellent	
•	 Wetted perimeter < 40% of bottom channel width (< 45% for large mainstem areas) 	 Wetted perimeter 40- 60% of bottom channel width (45-65% for large mainstem areas) 	Wetted perimeter 61-85% of bottom channel width (66-90% for large mainstem areas)	 Wetted perimeter > 85% of bottom channel width (> 90% for large mainstem areas) 	
•	 Dominated by one habitat type (usually runs) and by one velocity and depth condition (slow and shallow) (for large mainstem areas, few riffles present, runs and pools dominant, velocity and depth diversity low) 	 Few pools present, riffles and runs dominant. Velocity and depth generally slow and shallow (for large mainstem areas, runs and pools dominant, velocity and depth diversity intermediate) 	 Good mix between riffles, runs and pools Relatively diverse velocity and depth of flow 	 Riffles, runs and pool habitat present Diverse velocity and depth of flow present (i.e., slow, fast, shallow and deep water) 	
	 Riffle substrate composition: predominantly gravel with high amount of sand < 5% cobble 	 Riffle substrate composition: predominantly small cobble, gravel and sand 5-24% cobble 	 Riffle substrate composition: good mix of gravel, cobble, and rubble material 25-49% cobble 	 Riffle substrate composition: cobble, gravel, rubble, boulder mix with little sand > 50% cobble 	
Habitat	 Riffle depth < 10 cm for large mainstem areas 	Riffle depth 10-15 cm for large mainstem areas	Riffle depth 15-20 cm for large mainstem areas	Riffle depth > 20 cm for large mainstem areas	
•	 Large pools generally < 30 cm deep (< 61 cm for large mainstem areas) and devoid of overhead cover/structure 	 Large pools generally 30- 46 cm deep (61-91 cm for large mainstem areas) with little or no overhead cover/structure 	Large pools generally 46-61 cm deep (91-122 cm for large mainstem areas) with some overhead cover/structure	 Large pools generally > 61 cm deep (> 122 cm for large mainstem areas) with good overhead cover/structure 	
·	 Extensive channel alteration and/or point bar formation/enlargement 	 Moderate amount of channel alteration and/or moderate increase in point bar formation/enlargement 	 Slight amount of channel alteration and/or slight increase in point bar formation/enlargement 	 No channel alteration or significant point bar formation/enlargement 	
	• Riffle/Pool ratio 0.49:1 ; ≥1.51:1	 Riffle/Pool ratio 0.5- 0.69:1; 1.31-1.5:1 	• Riffle/Pool ratio 0.7-0.89:1 ; 1.11-1.3:1	Riffle/Pool ratio 0.9-1.1:1	
1 6 8	 Summer afternoon water temperature > 27°C 	Summer afternoon water temperature 24-27℃	Summer afternoon water temperature 20-24°C	 Summer afternoon water temperature < 20°C 	
int range		□ 3 □ 4	5 0 6	0708	
ŀ	Substrate fouling level: High (> 50%)	 Substrate fouling level: Moderate (21-50%) 	Substrate fouling level: Very light (11-20%)	 Substrate fouling level: Rock underside (0-10%) 	
er Ouality	Brown colour TDS: > 150 mg/L	Grey colourTDS: 101-150 mg/L	 Slightly grey colour TDS: 50-100 mg/L 	Rock underside (0-10%) • Clear flow • TDS: < 50 mg/L	
•	 Objects visible to depth < 0.15m below surface 	Objects visible to depth 0.15-0.5m below surface	Objects visible to depth 0.5-1.0m below surface	 Objects visible to depth > 1.0m below surface 	
•	 Moderate to strong organic odour 	 Slight to moderate organic odour 	 Slight organic odour 	• No odour	
int range	0 0 1 0 2	□ 3 □ 4	赵 5 🗆 6	0708	
liparian Habitat	 Narrow riparian area of mostly non-woody vegetation 	 Riparian area predominantly wooded but with major localized gaps 	 Forested buffer generally > 31 m wide along major portion of both banks 	 Wide (> 60 m) mature forested buffer along both banks 	
onditions •	 Canopy coverage: <50% shacing (30% for large mainstem areas) 	 Canopy coverage: 50- 60% shading (30-44% for large mainstem areas) 	 Canopy coverage: 60-79% shading (45-59% for large mainstem areas) 	 Canopy coverage: >80% shading (> 60% for large mainstem areas) 	
int range	口0風1		0405	0607	
		areas)		0405	

Senior staff sign-off (if required): _____ Checked by: ____ Completed by: ____

Date:	2023-06-13	Field Staff:	SH AV		Watershed/Subwatershed	MORI
'ime:		Stream:		lest Humber	UTM (Upstream):	West Humber river
Veather:	Sunny 18°C	Reach:	Reach 8a	Carl In Advance 1 of	UTM (Downstream):	
and Use			hannel Zone	7 Flow Type	orra (bownstream):	
			able 4)	2 (Table 5)	2 D Evidence of Groundwa	ater Location: Photo:
iparian Vegetation				nstream Vegetati		
ominant Type	Coverage Channel W	lidths Age (yrs)				ter Quality
(Table 6) 3	□ None □1-4		(Table 8)	16 Woody Debris	WD Density WDJ/50m:	Odour Turbidity
	\neg \Box Fragmented \Box 4 - 1				AS LOW	(Table 16) (Table 17)
(Table 7) 2	Continuous X> 10		Reach	In Channel	141 - 1	
		Mature (>30)	Coverage %	15 XNot Present	High	
hannel Characteris	tics					
Sinuosity Type	Sinuosity Degree	Bank Angle	Bank Erosion	(Table 19)	Clay/Silt Sand Gravel C	obble Boulder Parent Root
(Table 9)	(Table 10)	□ 0 - 30	□ < 5%	Bank	XXI	
Gradient	# of Channels	□ 30 - 60	□ 5 - 30%	Riffle		
(Table 11)	(Table 12)	X 60 - 90	□ 30 - 60%	Pool		
Entrenchment	Bank Failure	1/7. XUndercut	★ 60 - 100%	Bed		3
(Table 13)	(Table 14)			(if no riffle-pool morphology)		
(Table 15)	Bankfull Indicators	117	Bankfull Width	5.40 5.60	210	
	(Table 18)		(m)	5.40 5.60	3.60 Wetted Width (m	1) 4.5 ~3.0 2.7
Sed Sorting (Table 20)	Sediment Transport Observed?	🗆 Yes 🕱 No 🗆 Not Visible	Bankfull Depth	0.94 0.80	0,93 Wetted Depth (m	1) 0.41 0.30 0.56
			(m)	0.94 0.80		n) 0.41 0.30 0.56
Transport 3	% of Bed Active	0	Undercuts (m)	0.24 0.14	0.06 Velocity (m/s	s) 0.25 0.55 0.72
	here as			0		5) 0.25 0.55 0.23
Geomorphic hits (Table 22) 9/10	KMass Movement (Table 23)		Pool Depth (m)	0,69 0.55 0,68	0.51 Velocity Estimat	
			(111)	010	Metho	d a and
Spacing (m):	% Riffles:	25 % Pools: 35	Riffle Length (m)	12,6 5.50 Tm	12.3 Meander Amplitud	
tes: 🔺	Powns model				(m	
		i enlarging 1.	n sore		Bed not scourcel	through entire
	reach, Likely	experiencing	channel	- 3	in agent due to	a lack of
	<u>arora (a ca baacc</u> 1	the second			od.ble	
	Riffle not	visible due +	portion of	will but		
	1224 Porm	stren		VL DUT	sustrante aresent i	a some areas for
	substrates -	finet in	downst	reak Dor	tion of reach	
				1	UT ELVEN	