BEACON ENVIRONMENTAL

GUIDING SOLUTIONS IN THE NATURAL ENVIRONMENT

Geomorphic Assessment

51 & 57 Tannery Street & 208 Emby Drive

Mullet Creek Watershed

City of Mississauga

Prepared For:

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Prepared By:

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Date: *Project:*

May 2019 **217069.1**

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1. Introduction

Beacon Environmental Limited (Beacon) was retained by Nyx Development Corp. to prepare a geomorphic assessment for three adjoining properties located at 55 and 57 Tannery Street and 208 Emby Drive in the City of Mississauga, hereafter referred to as the subject property (**Figure 1**). A portion of Mullet Creek traverses the western limit of the subject property, which is located within the jurisdiction of the Credit Valley Conservation Authority (CVC).

Presently, the subject property supports a mix of commercial and industrial land use. It is our understanding that redevelopment of the subject property is proposed to accommodate 155 residential townhouse units. In support of the proposed development, an Official Plan Amendment (OPA), Zoning By-law Amendment (ZBLA), and Draft Plan of Condominium application, including an Environmental Impact Assessment (EIS) completed by Beacon was made to the City of Mississauga in 2018.

The purpose of this assessment is to provide technical support to the Geotechnical Investigation, and to address the following comment issued in the November 11, 2018 Application Status Report (ASR) regarding the development application:

> *Slope Stability: Oct 2018- Based on previously completed slope stability assessments surrounding the study area, there is evidence of active erosion at the toe of slope. Please provide additional justification for the 4m toe erosion component used in determining the LTSSL and how the 4m erosion component was derived. Please note that CVC staff also noticed active toe erosion within and around the study area. If there is a dispute as to whether active erosion is occurring, confirmation from a qualified fluvial geomorphologist is required.*

In support of this geomorphic assessment the following tasks were undertaken:

- Background review of available mapping, recent and historic aerial imagery, and the Geotechnical Investigation completed by Patriot Engineering Ltd. (2017);
- Field confirmation of existing geomorphic conditions along the relevant reach of Mullet Creek; and
- Referencing Provincial Policy and the CVC (2014) Slope Stability Definition & Determination Guideline, provide a recommended design toe erosion allowance.

2. Policy Context

2.1 Provincial Policy Statement (2014)

The Provincial Policy Statement (MNRF 2014) issued under the Planning Act (1990) outlines areas of provincial interest with respect to natural hazards. In support of the Policy Statement, a Technical Guide - Rivers and Streams: Erosion Hazard Limit document was prepared (MNR 2002) to outline standardized procedures for the delineation and management of riverine erosion hazards in the Province of Ontario. The guide presents erosion hazard protocols based on two generalized landform

systems through which watercourses flow: confined and unconfined valley systems. Through this approach, the meander belt width plus an erosion access allowance is defined to determine the erosion hazard limit of an unconfined valley system. For confined valley systems, the erosion hazard limit is governed by geotechnical considerations, including the stable slope allowance and an applicable toe erosion allowance (i.e., channel migration component).

The intent of the toe erosion allowance is to mitigate risk to the adjacent tablelands by accounting for the potential of the stream to migrate laterally into the valley wall and erode the toe of slope. This process can result in subsequent slope adjustments or failure and cause the loss of property or pose a risk to human life. Policy dictates that, for confined valley systems, an initial screening must be undertaken to determine whether the valley wall is less than 15 m from the watercourse. Where soil conditions are not known, a 15 m toe erosion allowance is recommended. Based on a more detailed evaluation, the Technical Guide provides recommendations for the toe erosion allowance referencing existing soil structure and channel stability conditions (**Table 1**).

Table 1. Minimum Toe Erosion Allowance based on Existing Conditions (MNR 2002).

Type of Material Native Soil Structure	Evidence of Active Erosion or where the Bankfull Flow Velocity is Greater than Competent Flow Velocity	No Evidence of Active Erosion		
		Bankfull Width		
		<5m	5-30m	>30m
Hard Rock (e.g. granite)	0-2 m	0 m	0 m	1 m
Soft Rock (shale, limestone), cobbles, boulders	2-5 m	0 m	1 m	2 m
Clays, clay-silt, gravels	5-8 m	1 m	2 m	4 m
Sand, silt	8-15 m	1-2 m	5 m	7 m

2.2 Region Municipality of Peel Official Plan (2016)

Section 2.4 of the Region of Peel Official Plan deals with the policies applied to natural hazards. Specific sections deal with ravine, valley and stream corridors, and riverine floodplains. These policies commit the Region to work in conjunction with area municipalities and Conservation Authorities towards the following three objectives:

1. To ensure that development and site alterations are not permitted in areas where site conditions or location may pose a danger to public safety, public health or result in property damage.
2. To encourage a coordinated approach to the use of land and the management of water in areas subject to flooding in order to minimize social disruption.
3. To ensure that methods used to protect existing development at risk from natural hazards do not negatively impact the integrity of the ecosystem.

Site Location and Reach Delineation	Figure 1
Environmental Impact Study 51 & 57 Tannery Street & 208 Emby Drive, Mississauga	
BEACON ENVIRONMENTAL	Project: 217069.1 Last Revised: May, 2019
Client: NYX Captial Corp.	Prepared by: DU Checked by: SG
N 1:2,000	Inset Map:1:30,000
Contains information licensed under the Open Government License–Ontario Orthoimagery Baselayer: FBS Peel 2018	

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2.3 City of Mississauga Official Plan (2017)

Section 6.3 of the MOP contains policies pertaining to the protection of the Green System. The Green System is composed of 1) the Natural Heritage System, 2) the Urban Forest, 3) Natural Hazard Lands; and 4) Parks and Open Spaces. The Natural Heritage System is conceptually illustrated on Schedule 3 of the MOP.

Components of the Green System that overlap with the subject property include the Natural Heritage System, Natural Hazard Lands, and the Urban Forest. Policies pertaining to the Natural Hazard Lands are discussed below.

2.3.1 Natural Hazard Lands

Natural Hazard Lands are associated with valley and watercourse corridors and the Lake Ontario shoreline. These areas are prone to flooding and erosion and are generally unsuitable for development.

With respect to valleylands, it is the policy of the City that *development adjacent to valleylands and watercourse features must incorporate measures to ensure public health and safety; protection of life and property; as well as enhancements and restoration of the Natural Heritage System*.

Policy 6.3.47 states:

> *Development and site alteration will not be permitted within erosion hazards associated with valleyland and watercourse features. In addition, development and site alteration must provide appropriate buffer to erosion hazards, as established to the satisfaction of the City and appropriate conservation authority.*

Policy 6.3.48 states:

> *Development adjacent to valleyland and watercourse features may be required to be supported by detailed slope stability and stream erosion studies, where appropriate.*

With respect to flood plains, it is the policy of the City that:

> L*ands subject to flooding are a danger to life and property and, as such, development is generally prohibited. However, it is recognized that some historic development has occurred within flood plains and may be subject to special flood plain policy consideration.*

Policy 6.3.51 states:

> *Development and site alteration is generally prohibited on lands subject to flooding.*

Policy 6.3.52 states:

> *Where historic development has occurred in the flood plain, minor works may be permitted subject to detailed studies to the satisfaction of the City and appropriate conservation authority.*

Policy 6.3.53 states:

> *The construction of buildings or structures permitted in or adjacent to the flood plain will be protected to the elevation of the Regulatory Flood and will not impact upstream or downstream properties. Additional flood protection measures to be implemented relative to individual development applications will be determined by the City and the appropriate conservation authority.*

Policy 6.3.54 states:

> *Access for development adjacent to or within the flood plain will be subject to appropriate conservation authority policies and the policies of the City.*

2.4 Credit Valley Conservation Authority Policies and Regulations

2.4.1 Ontario Regulation 168/06

The Credit Valley Conservation Authority (CVC) regulates activities within and adjacent to wetlands, watercourses and hazard lands under *Ontario Regulation 168/06 - Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* under Section 28 of the *Conservation Authorities Act*. *Regulation 168/06* is implemented by Credit Valley Conservation (CVC) according to their *Watershed Planning and Regulation Policies* (CVC 2010).

2.4.2 Slope Stability Definition and Determination Guideline (CVC 2014)

The CVC (2014) Slope Stability Definition and Determination Guideline defines the Long Term Stable Slope Line as consisting of a Stability Component and the Erosion Component. The Erosion Component is further defined as:

> *The regression of the slope toe/channel bank due to erosion over the design life of the structure at the crest of the slope and is measured as a horizontal distance.*

Factors for identified within the Guideline for consideration in the determination of the Erosion Component include:

- Proximity of the slope toe to the watercourse;
- Sediment load carried by the watercourse;
- Average and peak flow rates and velocities of the watercourse;
- Fluvial geomorphological processes affecting the reach within which the site is located;
- Susceptibility of the soils to erosion;

- Increases in surface runoff over the slope;
- Type and extent of vegetation; and
- Weathering of slope face.

As illustrated in Figure 4a of the Guideline, delineation of the Erosion Component consists of two separate factors:

1. Determination of the distance from the toe of the valley wall to the watercourse channel bank; and
2. Determination of the design toe erosion allowance.

The design toe erosion allowance can either be calculated based on historical records for the site or based on suggested allowances as identified in the guideline (**Table 2**).

Table 2. Suggested Design Toe Erosion Allowance (CVC 2014).

Material at Channel Bank or Bankfull	Bank Condition		
	Active Erosion of Bank	Erosion Not Currently Evident	Existing Bank Protection in Place and Maintained Along Bank
Limestone/Dolostone	2 m	1 m	0 m
Shale	5 m	2 m	0 m
Cohesive Soils (Silty Clays, Clayey Silts)	8 m	4 m	0 m
Cohesionless Soils (Silts, Sands)	15 m	7 m	0 m

3. Background Review

3.1 Climate

Climate provides the driving energy for a fluvial system and directly influences basin hydrology and rates of channel erosion, particularly through precipitation. Precipitation records obtained from climate normals (1981-2010) recorded at Oakville Southeast WPCP, south of the subject lands, averaged 61 mm per month in winter (November through February), and 77 mm in summer (July and August; Environment Canada 2018). This increase over the summer months is likely a result of convective thunderstorms. While total precipitation amounts are greater during the summer months, snowmelt and rain-on-snow events tend to produce the highest flows within a watershed.

3.2 Geology

The planimetric form of a watercourse is fundamentally a product of the channel flow regime and the availability of sediments (i.e., surficial geology) within the stream corridor. The 'dynamic equilibrium' of these inputs governs channel planform. These factors are influenced in smaller systems by

physiography, riparian vegetation, and land use. The subject property is located on the South Slope physiographic region, which is the southern slope of the Oak Ridges Moraine dominated by till moraines (Chapman and Putnam 1984).

3.3 Geotechnical Investigation (Patriot Engineering Ltd.)

Patriot Engineering Ltd. (2017) carried out a geotechnical investigation to determine soil and groundwater conditions within the subject property. The purpose of the investigation was to perform slope stability analysis in order to provide geotechnical comments on the long term stability of the existing slope for the proposed development.

The study included a site visit (conducted on March 1, 2017) and consisted of drilling four boreholes (BH201 to BH204). A survey of the borehole locations, along with surface elevations at the time of drilling was also undertaken using tape and level methods. A review of the slope was completed to determine the setback distances to be applied to the predicted stable slope crest based on the predicted erosion over a 100 year period.

Slope conditions and recommendations relevant to this assessment were reported as follows:

- *All boreholes with the exception of Borehole 202, were drilled from above a granular fill covered area and initially advanced through a 50mm thick layer of compact, brown, moist to very moist, crusher run limestone.*
- *Beneath this layer, earth fill materials were present in all boreholes. In Boreholes 202 and 204, the earth fill material was composed of loose to compact, brown, moist to very moist, sand silt fill. This material also contained some clay, along with traces of gravel, cobbles, topsoil, rootlets and asphalt fragments.*
- *Below the sandy silt fill layer, a second fill layer was present in the same Boreholes 202 and 204 and consisted of firm to very stiff, brown and/or reddish brown, and/or dark brown, and/or grey, slightly moist to very moist clayey silt fill. This fill material was also present in Boreholes 201 and 203, below the surficial granular cover materials.*
- *The depth of fill layers inside the boreholes extended to depths that varied from 4.0m to 4.9m below existing grade.*
- *Underlying the fill layers, native compact to very dense, grey, and/or brown, moist to slightly moist, sandy silt till layer was encountered in all boreholes. Some clay, plus traces of gravel, cobbles and shale fragments, as well as, isolated wet sand seams were also observed within this material.*
- *Below the overburden soil, all boreholes then encountered shale bedrock. These boreholes penetrated the shale bedrock to depths ranging from approximately 0.6m to 2.8m. Based on the geology of the area, the shale is of the Georgian Bay formation, which is usually grey and mainly weathered on the upper strata.*
- *The slope is in close proximity to Mullet Creek. Based on site measurements it is noted that at all four sections, the distance from the toe of the slope to the edge of Mullet Creek is less than 15m.*

- *The Credit Valley Conservation guidelines state that if the above mentioned distance is less than 15m, then to use a 4m setback distance for the 100 year erosion component.*

4. Historical Assessment

The following section presents an overview of historical conditions in the vicinity of the subject property with respect to land use, land cover, and channel conditions. The scale of these natural and human induced changes can provide insight into the degree to which channel planform adjustment has occurred over time.

In support of the historical assessment, black and white aerial photographs and digital colour imagery were analysed and compared to obtain a simple, qualitative assessment of the degree of land use and channel planform change over time (**Appendix A**). **Table 3** provides a summary of specific observations regarding change in channel planform and land use based on available historical aerial imagery. **Figure 2** illustrates an overlay of Mullet Creek centreline tracings between 1983 and 2018.

Table 3. Historical Observations - Mullet Creek

Time Period	Scale, Source	Observations
1963	1:12,000 Northway/Photomap/Remote Sensing Ltd. .	Land use consists of a mixture of low density residential and commercial development. Tannery Street and the bridge crossing of Mullet Creek have been constructed. The rail line east of the subject property can be observed. Lands immediately to the west of Mullet Creek, south of Tannery Street are vacant. Between Tannery Street and Thomas Street, mature tree cover is limited to localized groupings within the residential lots.
		Mullet Creek can be observed as a well defined watercourse with a sinuous planform along the western property boundary. Evidence of active geomorphic processes observed along Mullet Creek include the presence of vegetated bar formations and slumping banks. Downstream of the subject property, and through the Thomas Street crossing, Mullet Creek appears to have been channelized.
1983	1:8,000 Northway/Photomap/Remote Sensing Ltd.	Land use within the subject property has transitioned to include commercial use. West of Mullet Creek, the vacant lots have transitioned to commercial development. Two additional commercial buildings were constructed on the subject property.
		The portion of Mullet Creek adjacent to the commercial development within the subject property and downstream to Thomas Street has been channelized; other modifications include an informal crossing of the creek approximately 60 m downstream of Tannery Street. Fill within the valley corridor appears to have taken place, resulting in a narrowed dimension.
1995	1:6,000	Land use within and adjacent to the subject property remains unchanged.

Time Period	Scale, Source	Observations
	Northway/Photomap/Remote Sensing Ltd.	Increased riparian vegetation can be observed along the valley corridor. An informal crossing of Mullet Creek can be observed upstream of the Tannery Street crossing.
2008	Digital Image First Base Solutions	Land use within and adjacent to the subject property remains unchanged.
		Increased riparian vegetation, including mature trees, can be observed along the valley corridor. Storage containers for the commercial development can be observed along the top of slope within the subject property.
2014	Digital Image First Base Solutions	Land use within and adjacent to the subject property remains unchanged.
		The channel planform appears unchanged.
2018	Digital Image First Base Solutions	There was no noticeable change in land use or channel planform from 2014.

5. Existing Conditions

5.1 Reach Delineation

Reaches are homogeneous sections of channel with regard to form and function and can, therefore, be expected to behave consistently along their length to changes in hydrology and sediment inputs, as well as to other modifying factors (Montgomery and Buffington 1997; Richards et al. 1997). For the purposes of this study the portion of Mullet Creek between Tannery Street and Emby Drive was delineated as a single reach (refer to **Figure 1**, Reach MC-1) based on degree of valley confinement, land use and valley form**.**

5.2 Rapid Assessments

5.2.1 Methods

In order to confirm existing geomorphic conditions along the portion of Mullet Creek within the subject property, field investigations were conducted on December 19, 2018. The following standardized rapid visual assessment methods were applied:

i. Rapid Geomorphic Assessment (RGA – MOE 2003)

The RGA documents observe indicators of channel instability by quantifying observations using an index that identifies channel sensitivity. Sensitivity is based on evidence of aggradation, degradation, channel widening and planimetric form adjustment. The index produces values that indicate whether

Historical Assessment	Figure 2

Geomorphic Assessment
51-57 Tannery Street & 208 Emby Drive
Mississauga

Legend

- Subject Property
- Reach Breaks

Watercourse Centreline

- 1983
- 1995
- 2008
- 2014
- 2018

Beacon 2018: Reach Breaks, Watercourse Centreline

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Last Revised: May, 2019

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the channel is stable/in regime (score <0.20), stressed/transitional (score 0.21-0.40) or in adjustment (score >0.41).

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

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

iii. Downs Classification Method (Downs 1995)

The Downs (1995, outlined in Thorne et al. 1997) classification method infers present and future potential adjustments based on physical observations, which indicate the stage of evolution, and type of adjustments that can be anticipated based on the channel evolution model. The resultant index classifies streams as stable, laterally migrating, enlarging, undercutting, aggrading, or recovering.

In addition to the application of rapid assessment techniques, site-specific observations regarding channel dimensions and evidence of toe erosion were documented at each of the four slope profiles referenced in the Geotechnical Investigation (Patriot Engineering Ltd. 2017).

5.2.2 Results

Results of the rapid assessments are summarized in **Table 4** and **Table 5** below. A photographic record of site conditions at the time of the assessment is provided in **Appendix B.** Photo locations and extent assessed through the field investigation are identified on **Figure 3**.

5.2.2.1 Mullet Creek Reach MC-1

Reach MC-1 was characterized as a heavily modified channel situated within a narrow, confined valley setting. The channel maintained a moderate gradient, with minimal sinuosity, and a moderate degree of entrenchment. Riparian vegetation was fragmented, varying between <1-5 channel widths laterally. Riparian vegetation dominated by deciduous trees with shrubs, grasses, and herbaceous plants also present. Bank angles ranged between 60-90 degrees with evidence of erosion along 60-100% of the reach. Banks were composed of clay/silt and sand with extraneous concrete blocks and urban debris observed throughout the reach. Riffle substrate was composed of clay/silt, sand, gravel, and boulders. Pool substrate was composed of clay/silt, sand, gravel, and cobble. Bankfull widths and depths were between 5.6-8.2 m and 0.6-0.8 m, respectively. Moderate quantities of woody debris were observed in the channel.

RGA results indicated that Reach MC-1 was 'in adjustment', with a score of 0.41. Channel widening was identified as the dominant mode of adjustment, as noted through the presence of fallen trees, basal scour and slumping along channel banks. Degradation was identified as a secondary process, as noted through the presence of exposed bedrock, undermined bank protection measures, and scour pool

formations in association with stormwater outlets. An RSAT score of 16 indicated a 'fair' degree of overall ecological health with riparian habitat conditions acting as the primary limiting factor. The Downs model confirmed the findings of the RGA with a classification of e – 'enlarging'.

Table 4. Mullet Creek - General Reach Characteristics

Reach	Bankfull Width (m)	Bankfull Depth (m)	Riffle Substrate	Riparian Vegetation	Notes
MC-1	5.6-8.2	0.6-0.8	Clay/silt, sand, gravel, cobble, boulder	Deciduous trees, shrubs, grasses, herbaceous plants	• Basal scour • Fallen and leaning trees • Concrete and urban debris on banks

Table 5. Mullet Creek - Rapid Assessment Results

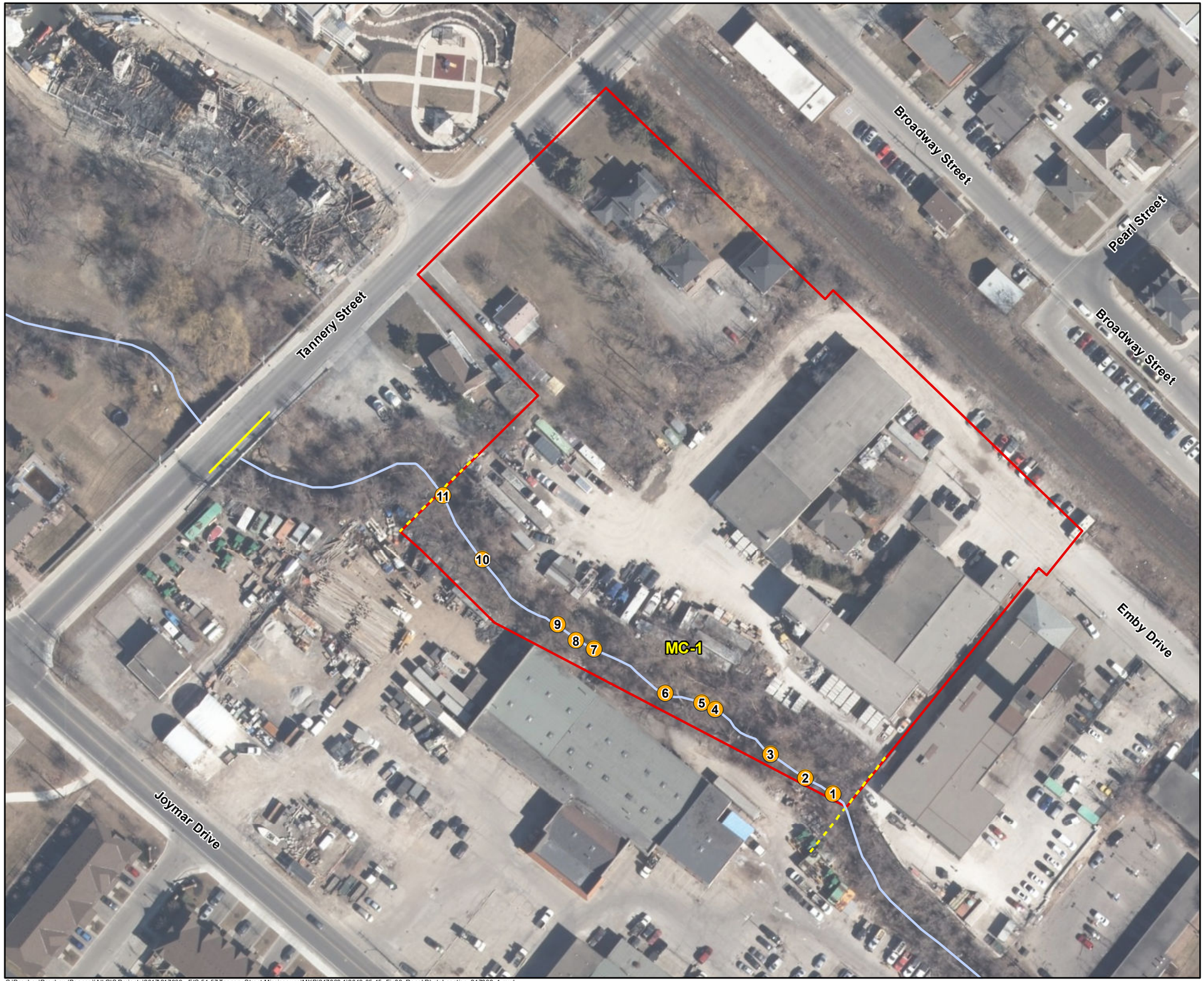
Reach	Rapid Geomorphic Assessment (RGA)			Rapid Stream Assessment Technique (RSAT)			Downs Classification Method
	Score	Condition	Dominant Mode of Adjustment	Score	Condition	Limiting Feature	
MC-1	0.41	In Adjustment	Widening	16	Fair	Riparian Habitat Conditions	e – 'enlarging'

Site-specific observations at the four slope profile locations referenced in the Geotechnical Investigation (Patriot Engineering Ltd. 2017) identified evidence of active toe erosion (undercutting, vertical banks, or exposed tree roots) at all four sections (**Appendix B**). In general, the valley toe of slope was deemed to be at, or in close proximity to, the watercourse along the entire extent assessed.

6. Analysis

6.1 Lateral Migration Analysis

In conformance with the CVC (2014) Slope Stability Definition and Determination Guideline, a detailed analysis of historical planform characteristics and trends in lateral migration was undertaken for the portion of Reach MC-1 within the subject property. **Figure 4** illustrates the findings of this analysis, which referenced aerial imagery from 1983 and 2014 (**Appendix A**). These aerial images were selected as they were subsequent to anthropogenic modifications (channelization and fill) of the valley corridor (refer to **Table 3**). Additionally, given the degree of riparian vegetative cover, only selected years supported the most accurate delineation of the channel banks. Digitized channel banks for the 2014 aerial image were also cross-referenced with field-based measurements of bankfull width documented through the field investigation to ensure that the dimensions were comparable.



Extent Assessed and Photo Locations

Figure 3

Geomorphic Assessment
51-57 Tannery Street & 208 Emby Drive, Mississauga

Legend

- Subject Property
- Reach Breaks
- Extent Assessed
- Watercourse
- Photo Locations

Beacon 2018: Extent Assessed, Reach Breaks, Photo Locations, Watercourse

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Last Revised: May, 2019

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Prepared by: DU
Checked by: IK

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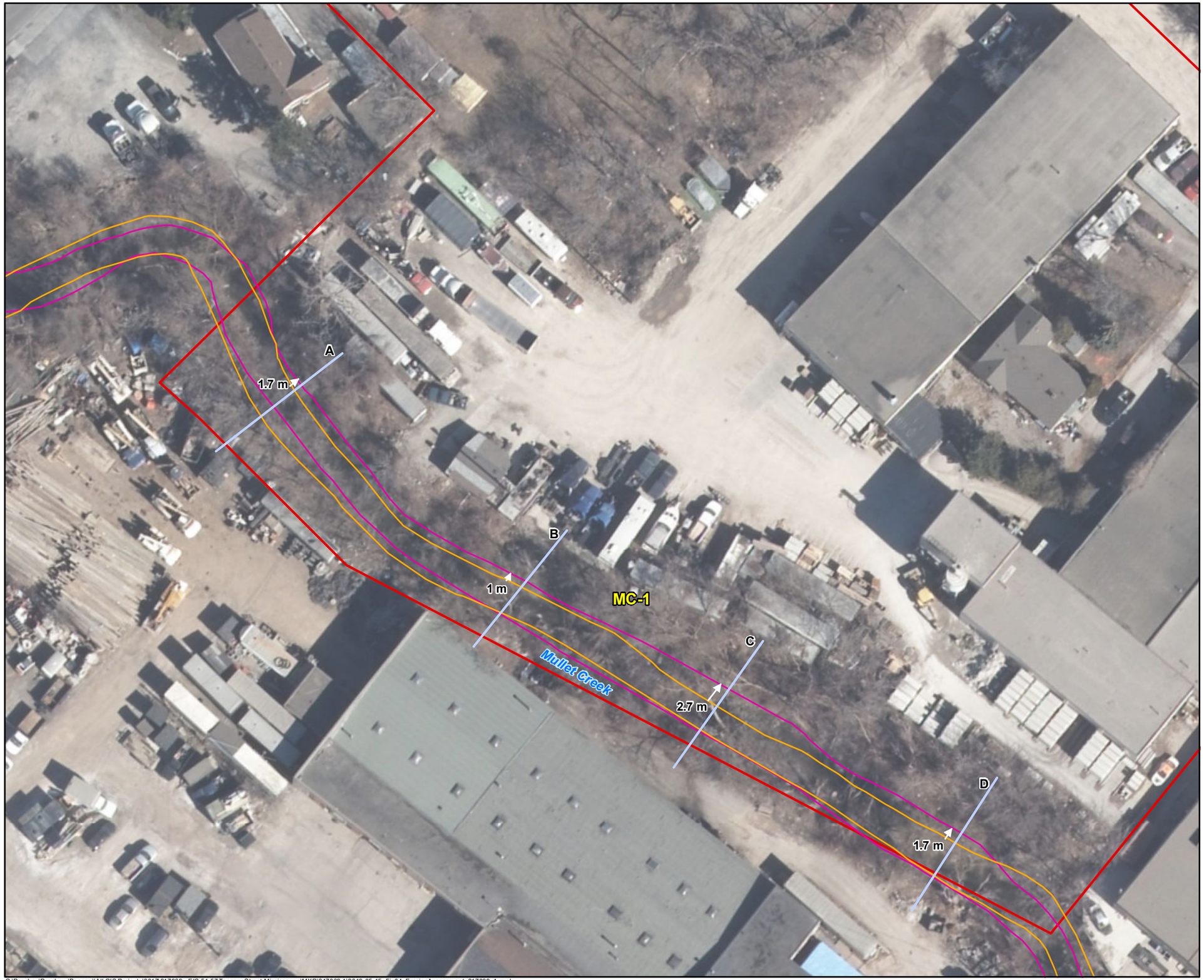

Erosion Assessment	Figure 4

Geomorphic Assessment
51-57 Tannery Street & 208 Emby Drive,
Mississauga

Legend

- Subject Property
- Geotechnical Cross-Section Locations
- 1983 Channel Banks
- 2014 Channel Banks
- Lateral Migration (Approximate)

Beacon 2018: 1983 & 2014 Channel Banks, Lateral Migration; Patriot Engineering Ltd. 2018: Geotechnical Cross-Section Locations

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The determination of lateral migration rates focussed on the four slope profile locations referenced in the Geotechnical Investigation (Patriot Engineering Ltd. 2017). These locations were deemed to provide representative spatial coverage of Reach MC-1 within the subject property. The use of several points of reference for the lateral migration analysis also account for potential errors involved in georeferencing and provide more accurate analyses of lateral migration between historical aerial images. Results of the lateral migration analysis indicate an average dimension of approximately 1.8 m over the assessed historical record of 31 years (**Figure 4**):

Average Lateral Migration = (1.7 m + 1 m +2.7 m + 1.7 m) = 1.8 m

Within the extent assessed, the overall trend in migration was noted to be in the direction of the valley slope and subject property. These results are consistent with the findings of the field investigation.

6.2 Toe Erosion Allowance

The intent of the toe erosion allowance is to mitigate risk to the adjacent tablelands by accounting for the potential of the stream to migrate laterally into the valley wall and erode the toe of slope. This process can result in subsequent slope adjustments or failure and cause the loss of property or pose a risk to human life. For confined valley systems, an initial screening must be undertaken to determine whether the valley wall is less than 15 m from the watercourse bank. The CVC (2014) Slope Stability Definition and Determination Guideline identifies suggested design toe erosion allowance values, based on bank materials and channel conditions for those locations where the watercourse is within 15 m from the toe of valley slope.

Results of the geomorphic field investigation characterized the portion of Mullet Creek within the subject property as being in an active state of adjustment, with planform adjustment and widening flagged as the dominant modes of adjustment. Site-specific observations at the four slope profile locations referenced in the Geotechnical Investigation (Patriot Engineering Ltd. 2017) noted evidence of active bank erosion.

In consideration of the lateral migration analysis, a 6 m design toe erosion allowance is recommended. This allowance was calculated as follows (reference **Figure 4**):

100-year Design Toe Erosion Allowance = (1.8 m/31 years)*100 = 5.8 m

Per the CVC (2014) Guideline, this allowance represents the calculated design toe erosion allowance and should be applied in the determination of the Long Term Stable Slope Line for any location where the watercourse bank is within 15 m of the toe of valley slope.

7. Policy Conformance

It is our opinion that the findings of this report are in conformance with the Provincial Policy Statement (2014), the Peel Region Official Plan (2016), the City of Mississauga Official Plan (2017), and the CVC (2014) Slope Stability Definition and Determination Guideline.

8. Summary

Beacon Environmental was retained by Nyx Development Corp. to undertake a geomorphic assessment for the subject property located at 55 and 57 Tannery Street and 208 Emby Drive in the City of Mississauga. The purpose of this assessment was to provide technical support to the Geotechnical Investigation undertaken by Patriot Engineering Ltd. (2017) and address comments issued in the November 11, 2018 ASR Report. The following points summarize the findings of this study:

- Reach MC-1 of Mullet Creek was characterized as a heavily modified (channelized) watercourse situated within a narrow, confined valley.
- Rapid assessment results indicated Reach MC-1 of Mullet Creek was 'in-adjustment' (RGA score of 0.41), with planform adjustment and widening identified as the dominant modes of adjustment.
- Site-specific field observation at the four slope profile locations referenced in the Geotechnical Investigation (Patriot Engineering Ltd. 2017) noted evidence of active bank erosion at each section.
- In accordance with the CVC (2014) Slope Stability Definition and Determination Guideline, a calculated design toe erosion allowance of 6 m is recommended based on a detailed analysis of historical planform characteristics and trends in lateral migration between 1983 and 2014 (31-year record).
- This design toe erosion allowance should be applied in the determination of the Long Term Stable Slope Line for any location where the watercourse bank is within 15 m of the toe of valley slope.

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9. References

Beacon Environmental. 2018.
Environmental Impact Study: 51 & 57 Tannery Street & 208 Emby Drive, Mississauaga.

Chapman, L.J. and D.F. Putnam. 1984.
Physiography of Southern Ontario. 1973. Special Volume No. 2. Toronto, Ontario: Ontario Geological Survey. 270 p.

City of Mississauga. 2017.
City of Mississauga Official Plan – August 2, 2017 Consolidation.

Credit Valley Conservation. 2005.
Credit Valley Conservation Watershed Report Card.

Credit Valley Conservation. 2010.
Watershed Planning and Regulation Policies. April 9, 2010.

Downs, P.W. 1995.
Estimating the probability of river channel adjustment. Earth Surface Processes and Landforms. 20: 687-705.

Downs, P.W. and K.J. Gregory. 2004.
River Channel Management: Towards Sustainable Catchment Hydrosystems. Oxford University Press Inc., New York, New York.

Environment Canada. 2018.
Canadian Climate Normals 1981-2010
http://climate.weatheroffice.gc.ca/climate_normals/index_e.html. Accessed January 16, 2019.

Galli, J. 1996.
Rapid stream assessment technique, field methods. Metropolitan Washington Council of Governments. 36pp.

Montgomery, D.R and J.M. Buffington. 1997.
Channel-reach morphology in mountain drainage basins. Geological Society of America Bulletin 109 (5): 596-611.

Ontario Ministry of the Environment. 2003.
Stormwater Management Planning and Design Manual. Document # 4329e. Queen's Printer for Ontario, Ontario, Canada.

Ontario Ministry of Natural Resources. 2002.
Technical Guide: River and Stream Systems: Erosion Hazard Limit.

Ontario Ministry of Municipal Affairs and Housing. 2014.
Provincial Policy Statement (Policy 3.1: Natural Hazards).

Patriot Engineering Ltd. 2017.
Geotechnical Investigation for Performing Slope Stability Analysis. Proposed Development – 51 Tannery Street, Mississauga, ON.

Region of Peel. 2016.
Peel Region Official Plan – December 2016 Consolidation.

Richards, C., R.J. Haro, L.B. Johnson, and G.E. Host. 1997.
Catchment and reach-scale properties as indicators of macroinvertebrate species traits. Freshwater Biology 37: 219-230.

Ward, A. D. Mecklenberg, J. Mathews, and D. Farver. 2002.
Sizing Stream Setbacks to Help Maintain Stream Stability. 2002 ASAE International Meeting, Chicago, IL. July 28-21, 2002. Paper Number 0222239.

Williams, G.P. 1986.
River meanders and channel size. Journal of Hydrology, 88: 147-164.

Appendix A

Historical Aerial Imagery

Historic Assessment	1963

Geomorphic Assessment
51-57 Tannery Street & 208 Emby Drive
Mississauga

Legend

Subject Property

BEACON ENVIRONMENTAL

Project: 217069.1
Last Revised: January, 2019

Client: NYX Tannery LP

Prepared by: DU
Checked by: IK

N

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Historic Assessment	1983

Geomorphic Assessment
51-57 Tannery Street & 208 Emby Drive
Mississauga

Legend

Subject Property

BEACON ENVIRONMENTAL

Project: 217069.1
Last Revised: January, 2019

Client: NYX Tannery LP	Prepared by: DU Checked by: IK

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Historic Assessment	1995

Geomorphic Assessment
51-57 Tannery Street & 208 Emby Drive
Mississauga

Legend

Subject Property

BEACON ENVIRONMENTAL

Project: 217069.1
Last Revised: January, 2019

Client: NYX Tannery LP	Prepared by: DU Checked by: IK

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Historic Assessment	2008

Geomorphic Assessment
51-57 Tannery Street & 208 Emby Drive
Mississauga

Legend

Subject Property

BEACON ENVIRONMENTAL

Project: 217069.1
Last Revised: January, 2019

Client: NYX Tannery LP

Prepared by: DU
Checked by: IK

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Historic Assessment	2014

Geomorphic Assessment
51-57 Tannery Street & 208 Emby Drive
Mississauga

Legend

Subject Property

BEACON ENVIRONMENTAL

Project: 217069.1
Last Revised: January, 2019

Client: NYX Tannery LP	Prepared by: DU Checked by: IK

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Historic Assessment	2018

Geomorphic Assessment
51-57 Tannery Street & 208 Emby Drive
Mississauga

Legend

Subject Property

BEACON ENVIRONMENTAL

Project: 217069.1
Last Revised: January, 2019

Client: NYX Tannery LP	Prepared by: DU Checked by: IK

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Appendix B

Photographic Record

Photo 1 (Photo Location 1)
Upstream view of Reach MC-1 from property limit.

Photo 2 (Photo Location 2)
Upstream view of wood and urban debris within channel.

Photo 3 (Photo Location 3)
Channel bank and toe of slope conditions at geotechnical section DD.

Photo 4 (Photo Location 3)
Upstream view of general conditions at geotechnical section DD.

Photo 5 (Photo Location 4)
Upstream view of wood debris jam.

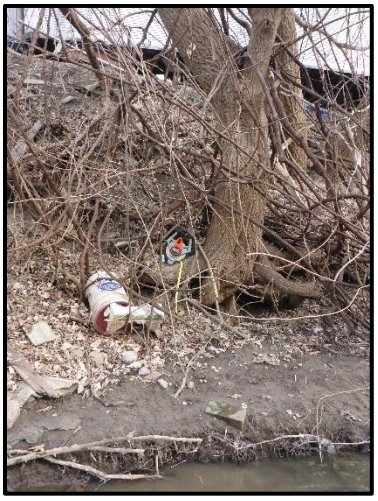

Photo 6 (Photo Location 5)
Evidence of bank erosion and slope conditions along subject property.

Photo 7 (Photo Location 6)
Downstream view of general conditions at geotechnical section CC.

Photo 8 (Photo Location 7)
Existing 1000 mm CSP outlet and debris along valley slope.

Photo 9 (Photo Location 7)
Downstream view of general conditions and wood debris jam.

Photo 10 (Photo Location 8)
Existing 500 mm CSP outlet to valley slope.

Photo 11 (Photo Location 9)
Upstream view of channel conditions at geotechnical section BB.

Photo 12 (Photo Location 9)
Toe of slope at geotechnical section BB.

Photo 13 (Photo Location 10)
Downstream view of channel conditions at geotechnical section AA.

Photo 14 (Photo Location 10)
Toe of slope at geotechnical section AA.

Photo 15 (Photo Location 11)
Downstream view of general conditions at property limt.

Photo 16 (Photo Location 11)
Toe of slope at property boundary.