BEACON ENVIRONMENTAL

GUIDING SOLUTIONS IN THE NATURAL ENVIRONMENT

Geomorphic Assessment

230 Finch Ave, City of Pickering

Petticoat Creek Watershed

Prepared For:

Highglen Homes Ltd.

Prepared By:

Beacon Environmental Limited

Date:	*Project:*
April 2024	**220352**

Table of Contents

Figures

Tables

Appendices

1. Introduction

Beacon Environmental Limited (Beacon) was retained by Highglen Homes Ltd. to complete a geomorphic assessment in support of a proposed residential development of 230 Finch Avenue in the City of Pickering, Regional Municipality of Durham (**Figure 1**). These lands total an area of approximately 0.5 ha and will herein be referred to as the subject property. A portion of Petticoat Creek is located adjacent to the subject property and is located within the jurisdiction of the Toronto and Region Conservation Authority (TRCA).

The purpose of this study is to address the following comments issued by TRCA Water Resources Engineering staff (email dated February 27, 2023) requesting that a fluvial geomorphic assessment be submitted for the proposed development:

> *The fluvial geomorphology report should consist of desktop and field assessment and include the following:*
> - *A reach delineation is required as per the TRCA Belt Delineation Protocol (2004; link here:https://sustainabletechnologies.ca/app/uploads/2013/01/Belt-Width-Delineation-Procedures.pdf) to assess how much of the watercourse upstream and downstream of the proposed development should be included within the study to ensure an accurate fluvial geomorphology assessment.*
> - *Aerial photography analysis is required in accordance with the TRCA Belt Width Delineation Protocol (link above).*
> - *Field assessments including Rapid Geomorphic Assessment (GRA) and Rapid Stream Assessment Technique (RSAT) are required; please also provide geomorphic survey to detail and analyze cross-section, longitudinal slope and existing planform; and determine of key geomorphic characteristics using referenced methods; and includes final signed Fluvial Geomorphic report.*
> - *This study is required to inform the 100-year erosion limit that should be calculated using the 30-year interval preceding the most recent historic planform information that is available (based on reach delineation, aerial photographs analysis and field assessments as per above). The intent of this study is to ensure that within the next 100-years, the watercourse will not migrate into the proposed development by ensuring that the proposed development is appropriately set-back from the existing watercourse.*
>
> *We believe that requesting an assessment that only involves a rapid geomorphic assessment versus a detailed geomorphic assessment will assist in streamlining this requirement for your team.*

The purpose of this report is to address the TRCA comments. In accordance with the, TRCA (2004) *Belt Width Delineation Procedures* document (Section 5), the following tasks, were completed in support of the study:

- Background review of available materials including topographic mapping, aerial photography, pertinent studies;
- Delineation of watercourse reaches per the TRCA Belt Delineation Protocol (2004) to assess how much of the watercourse upstream and downstream of the proposed development should be included within the study to ensure an accurate fluvial geomorphology assessment;

- Historical assessment (aerial photography analysis) to determine current and past extents of the watercourse planform, as well as historical land-use changes that may have impacted the watercourse;
- Field investigation to characterize existing geomorphic conditions on a reach basis using standardized rapid assessment field methods, including Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment Technique (RSAT);
- Following applicable guidelines and TRCA (2004) procedures, delineation of the meander belt on a reach basis referencing recent aerial imagery, field observations and historic trends in channel planform; and
- Provision of a recommended toe erosion allowance to provide technical support to the determination of the long-term stable top of slope for the confined portions of the stream corridor.

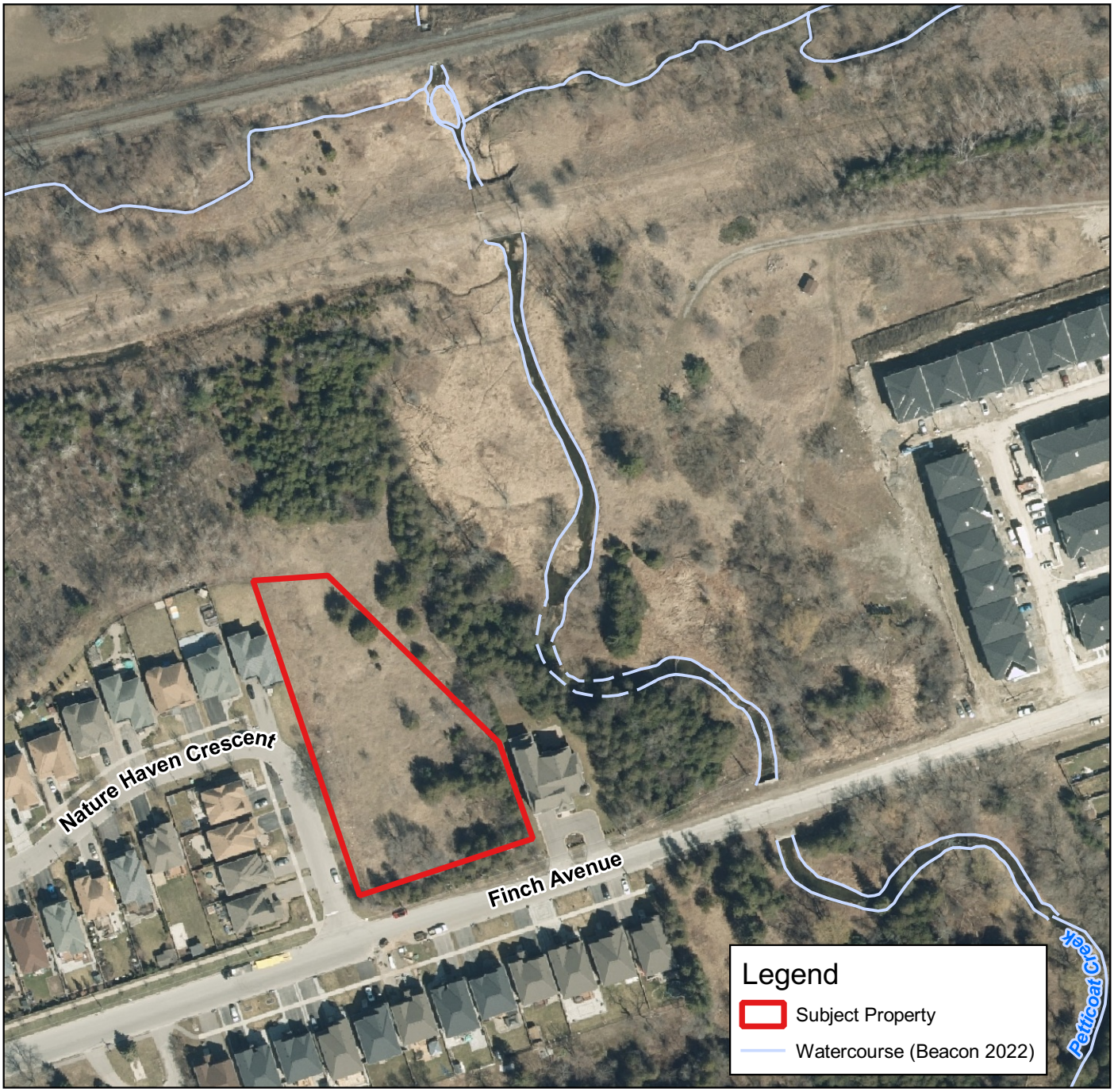
2. Policy Context

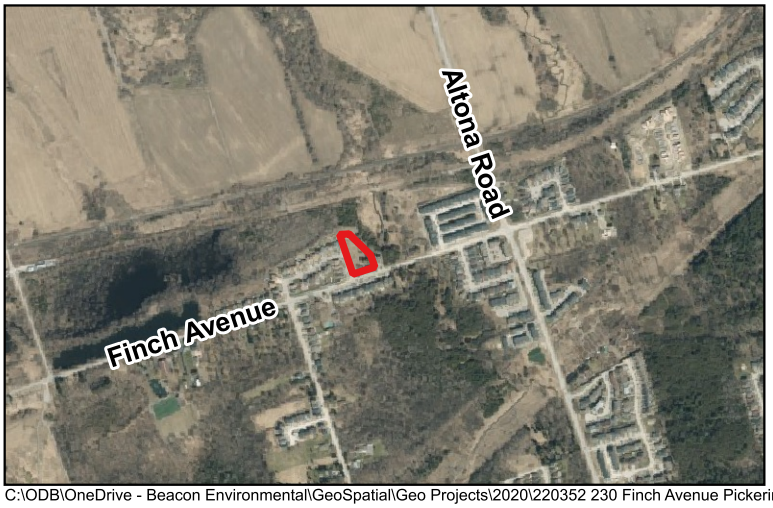
2.1 Provincial Policy Statement (2020)

The Provincial Policy Statement (MMAH 2020) issued under the *Planning Act* (1990) outlines areas of provincial interest with respect to natural hazards. In support of the Policy Statement, a Technical Guide - Rivers and Streams: Erosion Hazard Limit document was prepared by 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).

2.2 Durham Regional Official Plan – Office Consolidation (2020)

The Durham Regional Official Plan is a document that outlines the policies of the Regional Municipality of Durham to guide economic, environmental and community building decisions which inform the strategic decisions of Durham Region and benefit its residents. The basis of the natural environment protection system in Durham Region is the Greenlands System, which is comprised of Oak Ridges Moraine, Waterfronts and Major Open Space Areas as well as the Greenbelt Natural Heritage System and key natural heritage and hydrologic features. It also identifies hazard lands as being primarily located within the Greenlands System, stating that development on adjacent lands may be permitted only if the necessary measures to address and mitigate the known hazards are implemented.





Site Location	Figure 1
230 Finch Ave Geomorphic Assessment	
BEACON ENVIRONMENTAL	Project: 220352 Last Revised: July 2023
Client: Highglen Homes Limited	Prepared by: SZ Checked by: MA
N 1:2,000	Inset Map:1:20,000

C:\ODB\OneDrive - Beacon Environmental\GeoSpatial\Geo Projects\2020\220352 230 Finch Avenue Pickering\Q Project Files\2023-03-30_230FinchAvenuePickering_220352.qgz

2.3 City of Pickering Official Plan Office Consolidation (2022)

The City of Pickering published its latest Official Consolidated Plan (Edition 9) dated March 2022. It builds on the framework presented in the Region of Durham's Official Plan and protects natural heritage features through the Open Space System, which incorporates three types of natural areas: core areas, corridors and linkages. Schedule I – Land Use Structure identifies the subject property as Low Density Areas with Natural Areas to the north and east of the property.

Land uses for Natural Areas in the Open Space System are restricted and include conservation, environmental protection, restoration, education, passive recreation, existing residential and agricultural uses. The Open Space System recognizes a connected and integrated natural heritage system comprised of KNHF and KHF and includes minimum vegetation protection zones. KNHF and KHF for the City's Open Space System are consistent with those identified in the PPS and Region of Durham OP. Schedule III C identifies Key Natural Heritage Features/Key Hydrologic Features; Petticoat Creek adjacent to the subject property is mapped as Shorelines, Significant Valley Lands and Stream Corridors.

2.4 Toronto and Region Conservation Authority Regulations and Guidelines

2.4.1 Conservation Authorities Act (Ontario Regulation 166/06)

The Toronto and Region Conservation Authority (TRCA) regulates land use activities in and adjacent to wetlands, watercourses and valleylands under Ontario Regulation 166/06 (*Regulation for Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*) made under the *Conservation Authorities Act.*

Subject to conformity with the municipality's Official Plan, the completion of appropriate studies and application for Conservation Authority permits, The Authority may grant permission for development within these areas if it can be proven that control of flooding, erosion, pollution or the conservation of land will not be affected by the development.

2.4.2 The Living City Policies (2014)

The TRCA's Living City Policy was approved in November 2014 and replaces the Valley and Stream Corridor Management Program (1994). The Living City Policy document, among other matters, implements current federal, provincial and municipal legislation, policies and agreements affecting conservation authorities; and implements the policies for TRCA's updated section 28 of Ontario Regulation 166/06. For purposes of implementing TRCA's Environmental Management Policies:

- Confined River or Stream Valleys are considered **Valley Corridors**; and
- Unconfined River or Stream Valleys are considered **Stream Corridors**.

According to the Living City Policy, the boundaries of a valley or stream corridor generally require a minimum 10 m setback from the greater of:

- Physical top of the valley feature;

- Long term stable top of slope, where geotechnical concerns exist (which must be confirmed through an appropriate geotechnical analysis);
- Regulatory floodplain;
- Meander belt; and
- Limits of significant vegetation which is contiguous with the valley corridor.

It is the policy of TRCA:

> *That erosion hazard limits will be determined through site specific field investigations and technical reports where required, in accordance with the text of TRCA's Regulation and Provincial and TRCA standards. Where erosion hazard limits are required and not available, or where existing erosion hazard information does not meet current Provincial or TRCA standards, TRCA may require the erosion hazard to be determined by a qualified professional, at the expense of the proponent, to the satisfaction of TRCA.*

The Belt Width Delineation Procedures (TRCA 2004) document outlines standards for delineating the meander belt width in TRCA jurisdiction.

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 Toronto Buttonville Municipal Airport, located approximately 28 km west of the Study Area, averaged 27.7 mm, 59.9 mm, 79.3 mm and 72.3 mm for the winter, spring, summer, and fall months, respectively (Environment Canada 2023). The increase over the summer and fall 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 Watershed Conditions

The subject property is situated within the Petticoat Creek watershed. In 2012, the TRCA prepared a Watershed Action Plan for the Petticoat Creek Watershed as a reference document as part of a land use planning framework for within and adjacent to Petticoat Creek watershed. This report provided an overview of existing environmental conditions within the watershed, along with management and implementation strategies.

3.2.1 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 valley corridor. The 'dynamic equilibrium' of these inputs governs channel planform. These factors are influenced in smaller systems by physiography, riparian vegetation and land use. The subject property falls within the Lake Iroquois Plain

physiographic region dominated by lacustrine deposits from glacial Lake Iroquois or ancestral Lake Ontario (TRCA 2012). Surficial geology of the subject property is sand gravel and diamicton (TRCA 2012).

3.2.2 Fluvial Geomorphology

With it's headwaters located between Rouge River and Duffins Creek south of Oak Ridges Moraine and draining to Lake Ontario, the Petticoat Creek Watershed drains an area of roughly 27 km^2 and captures portions of the City of Pickering, City of Markham and City of Toronto (TRCA 2012). The upstream drainage area associated with the Petticoat Creek at the Finch Avenue crossing is 19 km^2; the mean slope for Petticoat Creek at this location is 3% (OWIT 2023).

3.2.3 Aquatic Habitat

Petticoat Creek is characterized as a warmwater system (TRCA 2012). The headwaters of Petticoat Creek contain small channels with an abundance of pools that support predominately baitfish communities. The schools of fish that are found in the upstream reaches include creek chub, fathead minnow, white sucker, common shiner, blacknose dace, longnose dace, Johnny darter and brook stickleback (TRCA 2012). In the downstream reaches, the thermal regime remains warmwater and support similar fish communities. A few species of coldwater fish, such as rainbow trout in spring and chinook in the fall have previously been observed, yet no evidence of a self-sustaining population has been identified (TRCA 2012).

3.3 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. Historical analyses provide insight into the scale of natural and human-induced changes within a watershed, particularly the degree to which channel planform adjustment and land use has changed over time. In support of the 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 1** provides a summary of specific observations regarding change in channel planform and land use based on available historical aerial imagery.

Table 1. Summary of Key Historical Observations

Year	Scale, Source	Observations
1972	1:12,000 Northway/Photomap/Remote Sensing Ltd.	Surrounding land use is predominantly agricultural, with low density residential development observed along Finch Avenue. Within the subject property, the parcel appears to be maintained, but buildings are not present. The existing residential home to the east can be observed. North of the subject property, the rail line has been constructed. Petticoat creek crosses under the rail line and flows east of the subject property to the Finch Avenue crossing, which appears to have been recently replaced.

Year	Scale, Source	Observations
		South of the rail crossing, two small tributaries that run along the rail embankment confluence with Petticoat Creek. Downstream of this confluence, the main branch channel appears have outflanked a culvert crossing, downstream of which a scour pool can be observed. Evidence of saturation, and potential historic channel activity, can be observed in the floodplain downstream of the scour pool. Further downstream, the channel is observed to have a highly sinuous channel planform.
1988	1:8,000 Northway/Photomap/Remote Sensing Ltd.	Land use surrounding the subject property remained largely agricultural, with the exception of increased farm structures observed immediately east of the creek. Land use within the subject property remains unchanged. An increase in tree cover along the valley slopes can be observed. Finch Avenue has been widened. South of the rail line, the outflanked culvert has been replaced by a larger crossing structure. South of this structure, Petticoat Creek has been straightened. Evidence of planform adjustment can be observed in the form of bank erosion and slumping along meander bends upstream and downstream of Finch Avenue.
2002	1:2,000 First Base Solutions	Surrounding land use remained largely agricultural with no change in land use within the subject property. An increase in tree cover within the valley can be observed. Evidence of bank erosion (slumping) can be observed within the channel immediately downstream of the rail crossing and along meander bends upstream and downstream of Finch Avenue.
2022	1:2,000 First Base Solutions	Land use north of the rail line remains mainly agricultural. Residential subdivisions have been construction immediately west and south of the subject property, as well as east of Petticoat Creek both north and south of Finch Avenue. Land use within the subject property remains unchanged. Evidence of bank erosion (slumping) can be observed along meander bends.

4. Existing Conditions

4.1 Reach Delineation

To facilitate a systematic evaluation of the relevant portions of Petticoat Creek, the watercourse was delineated into reaches. Reaches are homogenous sections of channel with regard to form and function and can, therefore, be expected to behave consistently along their length to changes in hydrology and sediment inputs, as well as to other modifying factors (Montgomery and Buffington, 1997; Richards et al., 1997).

For the purposes of this study, the portion of Petticoat Creek extending from the rail line to downstream of Finch Avenue (approximately 50 m) was delineated as a single reach (Reach PC-1, see **Figure 2**). The determination of reach extents was based on a desktop assessment of transitions in riparian vegetation, degree of valley confinement and meander geometry (channel planform) and the limit of existing residential development west of the creek based on available aerial imagery and topographic mapping. Field verification of reach extents was limited by property access/ownership.

PC-1

Nature Haven Crescent

Finch Avenue

Petticoat Creek

Legend

- Subject Property
- Reach Break
- Extent Assesseed
- Watercourse (Beacon 2022)
- Photo Locations

Reach and Photo Locations	**Figure 2**
230 Finch Ave Geomorphic Assessment	
BEACON ENVIRONMENTAL	Project: 220352 Last Revised: July 2023
Client: Highglen Homes Limited	Prepared by: SZ Checked by: MA
N 1:1,200	0 20 40 m

4.2 Rapid Assessments

4.2.1 Methods

In order to characterize existing geomorphic conditions along the relevant portion of Petticoat Creek, rapid field assessments were conducted on April 23, 2023. The following standardized rapid visual assessment methods were applied:

i. Rapid Geomorphic Assessment (RGA – MOE 2003)

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

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

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

iii. Downs Classification Method (Downs 1995)

The Downs (1995, 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.

4.2.2 Results

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

Within the extent assessed, Petticoat Creek was characterized as a historically modified (partially straightened), well-defined channel situated within a partially confined valley setting. The reach displayed a relatively low gradient with moderate sinuosity, and moderate entrenchment in the upstream portion of the reach, likely a result of previous modifications. Riparian vegetation was generally characterized as fragmented, extending one to more than five channel widths in dimension. Vegetation consisted of mainly grasses and herbaceous plants in the upstream reach extent with increased trees and shrubs in the downstream portion of the reach. Bank angles ranged between 30-90 degrees with 30-60% of banks identified as exhibiting evidence of erosion. Bank materials were predominantly comprised of clay/silt, sand and gravel underlain by till. Bankfull channel dimensions ranged from 5.3-5.9 m in width and 0.40-0.50 in depth. Riffle substrate consisted of sand, gravel, cobbles and boulders;

pool substrate consisted of sand, gravel and exposed till. Channel morphology was influenced locally by the rail line and Finch Avenue crossings. Valley wall contacts were observed in confined portions of the reach.

Rapid assessment results indicated that Reach PC-1 was in a state of transition (RGA score of 0.31). Widening was identified as the dominant mode of adjustment, with minor evidence of aggradation (accretion on point bars), degradation (exposed till) and planimetric form adjustment (chute formation and misaligned thalweg) also observed. Evidence of widening included leaning/fallen trees, occurrence of organic debris, exposed tree roots, fracture lines observed along top of bank/slumping, basal scour on inside meander bends, on both sides of channel through riffles, and extending greater than 50% of the reach length. An RSAT score of 26 indicated a 'good' degree of overall ecological health, with channel stability and riparian habitat conditions as the primary limiting factors. The Downs (1995) model reflected the RGA evaluation of this reach through a classification of U – 'undercutting' based on evidence of bank erosion on outside bend and deposition on inside bends with scoured bed.

Table 2. General Reach Characteristics – Petticoat Creek

Reach	Bankfull Width (m)	Bankfull Depth (m)	Riffle Substrate	Riparian Vegetation	Notes
PC-1	5.3-5.9	0.4-0.5	Sand, gravel, cobble and boulder	Shrubs and herbaceous	- Reworked gravel point bars with sand deposits - Valley wall contacts - Scour on inside meander bend - Exposed till along channel bed

Table 3. Rapid Assessment Results – Petticoat Creek

Reach	Rapid Geomorphic Assessment			Rapid Stream Assessment Technique			Downs Classification Method
	Score	Condition	Dominant Mode of Adjustment	Score	Condition	Limiting Feature	
PC-1	0.31	In Transition	Widening	26	Good	Channel stability; Riparian habitat conditions	U – 'undercutting'

5. Analysis

5.1 Meander Belt

The meander belt width is generally defined as the lateral extent that a meandering channel has historically occupied and will likely occupy in the future. Where the watercourse is confined, such as portions of Petticoat Creek adjacent to the subject property, the valley wall acts a constraint to channel

migration along portions of the corridor. According to the *Technical Guide – Rivers and Streams: Erosion Hazard Limit* document (MNR 2002), in the case of unconfined river systems, the meander belt width plus an erosion access allowance is defined to determine the erosion hazard limit. Conversely, in the case of confined valley systems, the erosion hazard is governed by geotechnical considerations, including the stable slope allowance and an applicable toe erosion allowance (i.e., channel migration component).

Following the TRCA (2004) *Belt Width Delineation Procedures* document, the meander belt was delineated for Reach PC-1 of Petticoat Creek based on the lateral extent of the outermost meander bends along the reach over the available historical record. The resultant 56 m dimension was then reviewed relative to available topographic mapping and field observations to ensure that it considered valley floor dimensions and was sufficient to capture the active (bankfull) channel as well as evidence of lateral occupation of the floodplain at the reach scale.

Due to the historically modified nature of the watercourse, a 10% factor of safety was applied to each side of the meander belt in lieu of calculating an annual recession rate (100-year migration rate), to account for potential changes in hydrologic regime (peak flow and frequency) as a result of future land use change. This resulted in a recommended meander belt dimension of 68 m (**Figure 3**) that should be considered in the evaluation of environmental constraints for any locations where Petticoat Creek where it is considered to be unconfined (stream corridor).

5.2 Toe Erosion Allowance

As Reach PC-1 adjacent to the subject property is situated within a partially confined valley system, where the valley wall is present it acts a constraint to channel migration. From a geomorphic perspective, technical support to geotechnical slope stability studies is typically provided through recommendation of a toe erosion allowance. A toe erosion allowance setback should be applied in the determination of the long-term stable slope at any location where the watercourse is within 15 metres of the base of the valley wall (MMAH 2020).

Results of this geomorphic assessment characterized the portion of the Petticoat Creek adjacent to the subject property as in a state of transition (RGA score of 0.31), with localized valley slope contact points with evidence of basal scour. Evidence of widening (e.g., bank erosion) and degradation (e.g., exposed till) were observed. Bankfull widths ranged from 5.3-5.9 m in width; boundary conditions within the bankfull channel were predominantly comprised of clay/silt, sand, gravel underlain by till. Referencing the MNR (2002) *Technical Guide - Rivers and Streams: Erosion Hazard Limit* (**Table 4**), a toe erosion allowance in the range of 5-8 m is considered appropriate based on these conditions. This allowance should be considered in the determination of the stable top of bank for any location where the watercourse bank is within 15 m of the toe of valley slope.

Table 4. 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

6. Policy Conformance

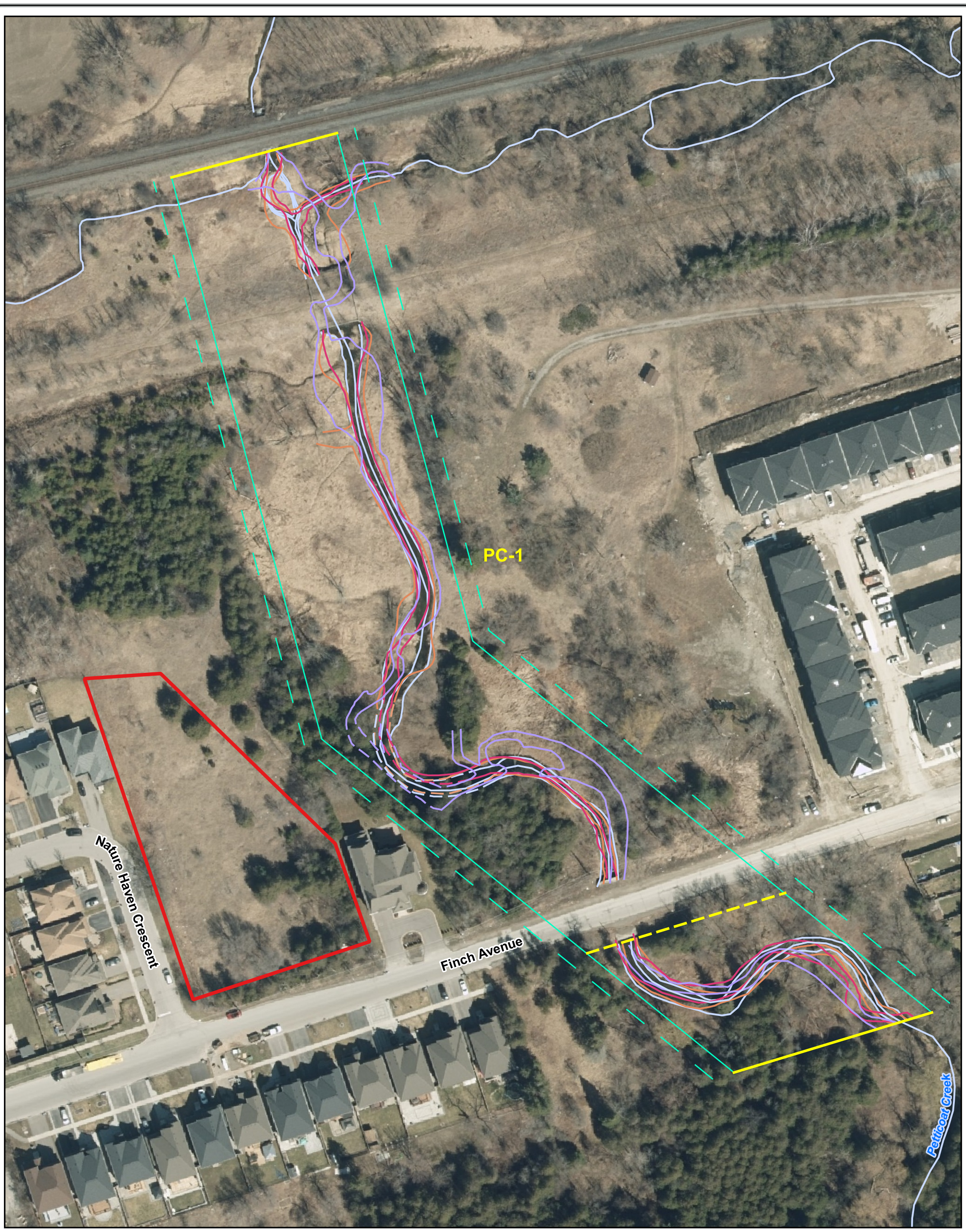
It is our opinion that the findings of this report are in conformance with the Provincial Policy Statement (2020), Ontario Regulation 166/06. It is also considered in conformance with the TRCA (2004) *Belt Width Delineation Procedures* (Secon 5) for accurate delineation of the meander belt, as the required steps (including a general field reconnaissance of the reach) were completed.

7. Conclusion

Beacon was retained by Highglen Homes Ltd. to complete a geomorphic assessment in support of proposed residential development of 230 Finch Avenue in the City of Pickering, Regional Municipality of Durham. The purpose of this study was to address comments issued by TRCA Water Resources Engineering staff (email dated February 27, 2023) requesting that a fluvial geomorphic assessment (meander belt study) be submitted for the proposed development.

The following points summarize the findings of this study:

- A review of available mapping indicated that Reach PC-1 consists of a well-defined, historically modified channel situated within a partially confined valley system;
- Rapid geomorphic assessment results identified the Reach PC-1 as being in a transitional state (RGA scores of 0.31) with observed evidence of widening;
- The RSAT assessment indicated that Reach PC-1 displayed a good degree of overall ecological health;
- In support of the determination of environmental constraints, a 68 m meander belt dimension (including factor of safety) was recommended for Reach PC-1, referencing the lateral extent of governing meander bends over the available historical record, in addition to valley floor dimensions and field observations. This meander belt should be applied in the determination of watercourse erosion hazard limits in any location where the valley is considered unconfined (stream corridor); and
- Where the valley is considered confined, a toe erosion allowance in the range of 5-8 m is recommended based on the scale of the watercourse, evidence of active erosion, and channel bank materials.



Legend

- Subject Property
- Reach Break
- Extent Assesseed
- Meander Belt (56 m)
- Meander Belt Width + FOS (68 m)

Historical Watercourse (Beacon 2022)

- 2022
- 2002
- 1988
- 1972

Meander Belt

Figure 3

230 Finch Ave Geomorphic Assessment

BEACON ENVIRONMENTAL

Project: 220352
Last Revised: July 2023

Client: Highglen Homes Limited

Prepared by: SZ
Checked by: MA

N

1:1,200

0 20 40 m

C:\ODB\OneDrive - Beacon Environmental\GeoSpatial\Geo Projects\2020\220352 230 Finch Avenue Pickering\Q Project Files\2023-03-30_230FinchAvenuePickering_220352.qgz

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

Report prepared by:
Beacon Environmental

Maureen Attard, M.Sc.
River Scientist

Report reviewed by:
Beacon Environmental

Shelley Gorenc, M.Sc., P.Geo.
Senior Geomorphologist

8. References

City of Pickering. 2022.
Office Consolidation of the Pickering Official Plan, March 2022. Edition 9.

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

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

Environment Canada. 2023.
Canadian Climate Normals 1981-2010 http://climate.weatheroffice.gc.ca/climate_normals/index_e.html. Accessed February 16, 2023.

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

Ministry of Environment. 2003.
Ontario Ministry of Environment. Stormwater Management Planning and Design Manual.

Ministry of Municipal Affairs and Housing (MMAH). 2020.
Provincial Policy Statement. Toronto, Ontario.

Ministry of Natural Resources (MNR). 2002.
Technical Guide: Rivers and Stream Systems: Erosion Hazard Limit.

Ministry of Natural Resources and Forestry (MNRF). 2022.
Ontario Watershed Information Tool (OWIT). King's Printer for Ontario.

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

Richards C, Haro RJ, Johnson LB, Host GE. 1997.
Catchment- and reach-scale properties as indicators of macroinvertebrate species traits. Freshw. Biol. 37:219–30

Toronto and Region Conservation Authority (TRCA). 2004.
Belt Width Delineation Procedures. Prepared by PARISH Geomorphic Ltd.

Toronto and Region Conservation Authority. 2006.
Ontario Regulation 166/06 - Regulation for Development, Interference with Wetlands and Alterations to Shorelines and Watercourses. May 4, 2006.

Toronto and Region Conservation Authority. 2012.
Petticoat Creek Watershed Action Plan.

Toronto and Region Conservation Authority. 2014.
The Living City Policies for Planning and Development in the Watersheds of the Toronto and Region Conservation Authority.

Appendix A

Historical Aerial Imagery

Legend

Subject Property

Historical Aerial Imagery	1972
230 Finch Ave Geomorphic Assessment	
BEACON ENVIRONMENTAL	Project: 220352 Last Revised: July 2023
Client: Highglen Homes Limited	Prepared by: SZ Checked by: MA
N 1:2,000	0 40 80 m

C:\ODB\OneDrive - Beacon Environmental\GeoSpatial\Geo Projects\2020\220352 230 Finch Avenue Pickering\Q Project Files\2023-03-30_230FinchAvenuePickering_220352.qgz

Legend

Subject Property

Historical Aerial Imagery	**1988**
230 Finch Ave Geomorphic Assessment	
BEACON ENVIRONMENTAL	Project: 220352 Last Revised: July 2023
Client: Highglen Homes Limited	Prepared by: SZ Checked by: MA
N 1:2,000	0 40 80 m

C:\ODB\OneDrive - Beacon Environmental\GeoSpatial\Geo Projects\2020\220352 230 Finch Avenue Pickering\Q Project Files\2023-03-30_230FinchAvenuePickering_220352.qgz

Legend

Subject Property

Historical Aerial Imagery	**2002**
230 Finch Ave Geomorphic Assessment	
BEACON ENVIRONMENTAL	Project: 220352 Last Revised: July 2023
Client: Highglen Homes Limited	Prepared by: SZ Checked by: MA
N	1:2,000 — 0 — 40 — 80 m

C:\ODB\OneDrive - Beacon Environmental\GeoSpatial\Geo Projects\2020\220352 230 Finch Avenue Pickering\Q Project Files\2023-03-30_230FinchAvenuePickering_220352.qgz

Legend

Subject Property

Historical Aerial Imagery	**2022**
230 Finch Ave Geomorphic Assessment	
BEACON ENVIRONMENTAL	Project: 220352 Last Revised: July 2023
Client: Highglen Homes Limited	Prepared by: SZ Checked by: MA
N 1:2,000	0 40 80 m

C:\ODB\OneDrive - Beacon Environmental\GeoSpatial\Geo Projects\2020\220352 230 Finch Avenue Pickering\Q Project Files\2023-03-30_230FinchAvenuePickering_220352.qgz

Appendix B

Photographic Record

Photograph 1. Location 1.
Reach PC-1 Petticoat Creek.
Downstream view of channel conditions from Finch Avenue crossing.

Photograph 2. Location 2.
Reach PC-1 Petticoat Creek.
Downstream view towards the Finch Avenue crossing. Stone bank protection observed on left bank.

Photograph 3. Location 3.
Reach PC-1 Petticoat Creek.
Upstream view of general conditions. Note exposed till on the channel bed in pool feature (arrow).

Photograph 4. Location 4.
Reach PC-1 Petticoat Creek.
Downstream view of riffle at valley wall contact (arrow). Note basal scour and fallen trees within channel.

Photograph 5. Location 4.
Reach PC-1 Petticoat Creek.
Upstream view of riffle at valley wall contact on right bank (photo left; arrow).

Photograph 6. Location 5.
Reach PC-1 Petticoat Creek.
Downstream view of meander bend at valley wall contact and leaning trees on right bank. Note scour on inside meander bend, with reworked gravel point bar (arrow).

Photograph 7. Location 6.
Reach PC-1 Petticoat Creek.
Downstream view of channel conditions. Note undercutting on left bank.

Photograph 8. Location 7.
Reach PC-1 Petticoat Creek.
Upstream view of channel conditions looking towards existing crossing structure south of rail line. Note channelized nature of creek and increase in entrenchment.