Mount Hope Road Lands

Fluvial Geomorphic Characterization of Cold Creek

Bolton, Caledon, Ontario

Submitted to:
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Statement of Conditions

This Report / Study (the “Work”) has been prepared at the request of, and for the exclusive use of, the Owner / Client, Municipality and its affiliates (the “Intended User”). No one other than the Intended User has the right to use and rely on the Work without first obtaining the written authorization of GEI Consultants Ltd. and its Owner. GEI Consultants Ltd. expressly excludes liability to any party except the Intended User for any use of, and/or reliance upon, the work.

Table of Contents

Tables

Appendices

1. Introduction

GEI Consultants Ltd. (GEI) has been retained by United Holdings Inc. to complete a geomorphic assessment within the Mount Hope West Secondary Plan Area, located west of Mount Hope Road, east of Highway 50, and north of Columbia Way (herein referred to as the Subject Lands; **Figure 1, Appendix A**). The Subject Lands are located in Bolton, a community within the Town of Caledon, Ontario. Two first-order tributaries of Cold Creek, itself a third-order tributary of the Humber River, traverse a portion of the property. This watercourse falls under the jurisdiction of the Toronto and Region Conservation Authority (TRCA).

Presently, land use within the Subject Lands consists of agricultural fields with some forested areas. Columbia Way separates the Subject Lands from a large residential area to the south, while agricultural fields extend far beyond the Subject Land's northern boundary. The western portion of the Subject Lands is located within the Greenbelt boundary and designated as part of the Protected Countryside and Natural Heritage System, while the eastern portion is delineated as Urban Area and designated as New Community Area in the council-adopted Town of Caledon Official Plan (2024a) and the Region of Peel's Official Plan (2022a). The southern boundary of the Oak Ridges Moraine is located 1.5 km to the north of the Subject Lands (ORM). The watercourse to the south of Columbia Way is classified as an Urban River Valley (URV).

It is understood that United Holdings Inc. would like to develop the portion of the Subject Lands designated as Urban and Settlement Areas within the Region of Peel and council-adopted Town of Caledon Official Plans. As part of the development, it is proposed that the reach of Cold Creek located in the Subject Lands will be relocated to the existing Greenbelt NHS area to the west of the current watercourse.

In accordance with the study requirements of Phase 1 of a Subwatershed Study, as outlined in Section 2.2.3 of the Terms of Reference for Subwatershed Studies in the Town of Caledon Terms of Reference for a Local Subwatershed Study (Town of Caledon, 2024b), GEI completed a preliminary watercourse characterization for the watercourses within the Subject Lands and along tributaries downstream that may receive stormwater discharge. This assessment is intended to establish existing conditions, and to provide input for the sizing of an appropriate natural channel corridor, incorporating geomorphic considerations. As the watercourses downstream of the Subject Lands are anticipated to receive stormwater flows under proposed conditions, a sensitivity analysis was completed to inform the potential for erosion and extents of erosion mitigation to be applied. If required as part of future submissions, these results will enable GEI to perform an erosion analysis, in support of future phases within the Subject Lands.

The following tasks were completed for this study:

- Background review of available materials, including topographic, soil, and geology mapping, as well as a review of pertinent watershed reports, and historic aerial imagery;
- A desktop approach to delineating reaches based on geomorphic form and processes;
- A historic assessment to provide insight into past channel adjustments and modifications;

- A field assessment to confirm the results of the desktop assessment, as well as to characterize existing conditions and document active channel processes;
- Delineate the meander belt widths on a reach basis where applicable, following relevant policies and guidelines.

2. Natural Heritage Planning Considerations

2.1 Provincial Planning Statement

The new Provincial Planning Statement (PPS) (MMAH 2024) came into effect on October 20, 2024. This document replaces the previous Provincial Policy Statement (2020) and A Place to Grow: Growth Plan for the Greater Golden Horseshoe (2020). Many of the Natural Heritage considerations remain the same. One principle behind the planning statement is the reduction of public cost and risk to Ontario's residents by directing development away from areas where there is a risk to public health or safety or risk of property damage. The *Technical Guide – Rivers and Streams: Erosion Hazard Limit* (MNR 2002) was developed in support of the PPS, to assist members of the public and planning authorities in understanding the PPS, particularly, Section 3.1, relating to natural hazards. The guide is based on a standard and simplistic methodology, intended to be applied to two generalized landform systems through which river and stream systems flow: confined and unconfined systems. In the case of unconfined systems, the erosion hazard allowance consists of the meander belt and an access allowance. In the case of confined systems, the erosion hazard allowance consists of the stable slope allowance, toe erosion allowance, in addition to the access allowance.

2.2 Town of Caledon Official Plan (Council-adopted March 26, 2024)

New development is prohibited within areas designated as part of the NHS. Proposed new development or site alterations to an NHS will be required to complete an Environmental Impact Assessment (EIA) to the satisfaction of the Town and other relevant agencies. The Subject Lands is designated within the Prime Agricultural Area of the Town of Caledon Official Plan, Schedule C (OP; Town of Caledon 2018). In the council-adopted draft Town of Caledon Official Plan (2024), the portion of the site is now delineated as Urban Area on Schedule B1 and designated as New Community Area on Schedule B4.

The area surrounding the Cold Creek tributaries in the Subject Lands is designated as an Environmental Policy Area (EPA) (Schedule A; Land Use Plan). As discussed within section 5.7 of the Town of Caledon OP, EPAs are all Natural Core Areas and Natural Corridors, including:

- All Woodland Core Areas;
- All Wetland Core Areas;
- All Niagara Escarpment Natural Areas;
- Oak Ridges Moraine Key Natural Heritage Features (as defined by the Oak Ridges Moraine Conservation Plan (ORMCP));
- Oak Ridges Moraine Hydrologically Sensitive Features (as defined by the ORMCP);
- Greenbelt Key Natural Heritage Features (as defined by the Greenbelt Plan);
- Greenbelt Key Hydrologic Features (as defined by the Greenbelt Plan);
- All Environmentally Significant Areas;
- All Life Science Areas of Natural and Scientific Interest (ANSIs);
- All Significant Habitats of Threatened and Endangered Species;
- All Significant Wildlife Habitat;
- All Core Fishery Resource Areas; and
- All Valley and Stream Corridors.

New development is prohibited within areas designated EPA. Proposed new development adjacent to an EPA will be required to complete a Comprehensive Environmental Impact Study and Management Plan to the satisfaction of the Town and other relevant agencies.

2.3 Peel Region Official Plan

In November of 2022 the Region of Peel approved the new Peel Official Plan (Region of Peel 2022a). The plan included changes brought about by Provincial Bill 22 (More Homes Built Faster Act, 2022) and Provincial Bill 185 (Cutting Red Tape to Build More Homes Act, 2024). Like the Town of Caledon OP, the Region of Peel OP has certain policies and designations that can affect land-uses permitted within the Subject Land boundaries (Peel Region 2024).

The Official Plan designates the eastern portion of the Subject Lands as 2051 New Urban Area under Schedule E-1 (Regional Structure) in the Peel Region OP. The western portion of the Subject Lands is designated as Rural Land under Schedule D-1 (Rural System) in the Peel Region OP.

The Cold Creek tributary that traverses the site is delineated as a Significant Groundwater Recharge Area on Schedule A-3 (Significant Groundwater Recharge Areas in Peel). Additionally, the Cold Creek tributary is delineated as a Core Area of the Greenlands System on Schedule C-2 (Core Areas of the Greenlands System in Peel). The Greenland System consists of Core Areas, Natural Areas and Corridors, and includes similar natural heritage feature types as the Town of Caledon OP Environmental Policy Areas (e.g., ANSIs, Environmentally Significant Areas, fish and wildlife habitat, wetlands, etc.).

The municipalities are directed to adopt appropriate policies to demonstrate that development or site alteration is directed away from the Core Area features, any impact is minimized and if its functions cannot be avoided then mitigation through restoration and enhancement is done to the greatest extent possible.

2.4 Mount Hope West Secondary Plan Zoning

In June of 2024, the Town of Caledon passed by-law No. 2024-057, which rezones the Mount Hope Urban Area as a New Community Area to provide a range of housing and land uses that aim to advance Caledon's Housing Pledge and the prescribed provincial priority of building 1.5 million new residential units by December of 2031. The by-law rezones the Mount Hope Urban Area such that various residential and commercial developments are permitted. Schedule A from by-law 2024-57 shows the new zones, and is attached in **Appendix E.**

2.5 Toronto and Region Conservation Authority

The Toronto and Region Conservation Authority (TRCA) conducts reviews of planning processes associated with future development of properties within its jurisdictional boundaries. TRCA provides planning and technical advice to planning authorities to assist them in fulfilling their responsibilities regarding natural hazards other relevant policy areas pursuant to the Planning Act. In addition to their regulatory responsibilities, TRCA provides advice as both a watershed-based resource management agency and through planning advisory services.

Effective April 1, 2024, Ontario Regulation (O. Reg.) 41/24: Prohibited Activities, Exemptions and Permits has come into force, replacing the former O.Reg. 166/06: Toronto and Region

Conservation Authority: Development, Interference with Wetlands, Alterations to Shorelines and Watercourses Regulation. O. Reg. 41/24 allows Conservation Authorities to implement Section 28 of the Conservation Authorities Act, 1990 (amended 2024), allowing the TRCA to:

- Prohibit, regulate, or provide permission for straightening, changing, diverting or interfering in any way with the existing channel of a river, creek, stream, watercourse or changing or interfering with a wetland; and
- Prohibit, regulate, or provide permission for development if the control of flooding, erosion, dynamic beaches, pollution or the conservation of land may be affected by the development.

The Regulation Limit delineates hazardous lands, wetlands, shorelines and areas susceptible to flooding and associated allowances. A higher order tributary of the Main Humber River is found on the Subject Lands and is identified by the TRCA as a regulated area. The regulated area also contains unevaluated wetlands, locally significant wetlands, meander belt, flooding hazards and crest of slope.

Pursuant to the Prohibited Activities, Exemptions and Permits Regulation (TRCA; O. Reg. 41/24), any development in or on areas defined in the Regulation (e.g., river or stream valleys, hazardous land, wetlands) requires permission from the Conservation Authority. The Conservation Authority may grant permission for development in or on these areas if, in its opinion, the control of flooding, erosion, dynamic beaches, pollution or the conservation of land will not be affected by the development.

The TRCA's Living Cities Policies (2014) contains the principles, goals, objectives, and policies approved by the TRCA for their planning and development approvals process. This document outlines policies related to the determination of the Natural System and recommends buffer widths for natural heritage features such as woodlands, wetlands, and valley and stream corridors.

The erosion hazard within River or Stream Valleys includes both the erosion potential of the actual river or stream bank, as well as the potential for erosion or slope stability issues associated with the valley walls. Ultimately, the identification of the hazard depends on whether there is a well-defined valley corridor that is part of a confined system or a relatively flat landscape that is not bounded by valley walls and is part of an unconfined system.

The TRCA's Living Cities Policies (2014) document states that for purposes of implementing TRCA's Environmental Planning policies:

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

The limits of Valley and Stream Corridors shall be defined by the greater of the long-term stable top of slope/bank, toe of slope, Regulatory flood plain, meander belt, and any contiguous natural features and areas plus an applicable buffer. Development within a regulated area shall be set back a further 10 m from this limit of Valley and Stream Corridor.

3. Background Review

A background review was completed for the Subject Lands to gain an understanding of the watercourse in the Subject Lands and a general context of the Subject Lands. Under existing conditions, land use generally consists of agricultural lands with some isolated woodlots.

3.1 Watershed Characteristics

Several Cold Creek tributaries that flow across and around the property eventually feed into the West Humber River. The West Humber River discharges into the main branch of the river approximately 5 km downstream, before flowing into Lake Ontario (TRCA 2023). The Humber River watershed is situated in the TRCA's jurisdiction, spanning 900 km^2 of land that includes portions of local municipalities of Caledon, King, Brampton, Mississauga, and Toronto (TRCA2023).

Climate and geology play an important role to influence the form and processes of the watercourse. Geological influences on patterns and rates of river change include landscape configuration, material availability, and erodibility of the substrate. Climatic fluctuations influence water balance and vegetation patterns, which impact flow regimes and the production, supply, and transport of sediment. The following sections provide an understanding of the physical setting of the Cold Creek tributary and provide context to the active fluvial geomorphological processes in the Subject Lands.

3.1.1 Geology

The Subject Lands lies within the South Slope physiographic region (Chapman & Putnam 2007). This is a sloping plain that extends from the boundary with the Oak Ridges Moraine, southwards, and is underlain by glacial till. Bedrock in this region consists of shale, limestone, dolostone, and siltstone. The soil types in this physiographic region are predominantly clay with some clay loam, and loam. The topography is relatively smooth, and infiltration is low due to the clay content. As a result, runoff rates are high. Surficial geology consists of clay to silt-textured till (OGS 2010).

3.1.2 Climate

Precipitation was calculated from climate normals (1981-2010) recorded at the Albion Field Centre (Environment Canada Climate ID 6150103), approximately 9 km west of the Subject Lands. Precipitation averaged 63 mm in the winter (November to February, inclusive) and 78 mm in summer (June to August, inclusive; Environment Canada 2023). For most streams in Southern Ontario, the highest instream flows typically occur during the spring freshet due to snowmelt, as well as rain-on-snow events. Convective thunderstorms are likely to be the cause of higher amounts of precipitation in the summer. Typically, these events do not result in extreme flow events, unless when sustained intense rainstorms occur.

3.2 Summary of Relevant Studies

TRCA Humber River Watershed Report Card

The watercourses in the Subject Lands were classified as fourth and third-order streams with respect to the Main Humber River branch. The TRCA released a Watershed Report Card (TRCA 2018) for the Humber River watershed. The Main Humber subwatershed, of which the tributary traversing the Subject Lands is a part of, received a grade of 'C', or 'fair', with respect to both surface water quality and forest conditions.

Humber River Fisheries Management Plan

A Humber River Fisheries Management Plan was developed by the Ontario Ministry of Natural Resources and TRCA (2005) and was intended to characterize the existing conditions of seven aquatic habitat types found in the watershed and assess their habitat potential. Specific management directions and rehabilitation priorities are provided for the five subwatersheds. The Humber River Fisheries Management Plan identifies target fish species for management: Brook Trout, Redside Dace, Rainbow Trout, Brown Trout, Atlantic Salmon, and Darters. Management in support of these species will provide conditions that are suitable for other species that require stable, cold, or cool water habitats (TRCA 2023).

The TRCA delineated twelve Fish Management Zones (FMZs) within the Humber River watershed, evaluating fish communities in the context of a river continuum, where similar physiographic and hydrologic conditions give rise to habitats that support similar fish communities in a specific zone. The Subject Lands falls within Fish Management Zone 2, where target species are Brook Trout and Atlantic Salmon (TRCA 2023).

Scoped Subwatershed Study and SABE

In 2022, the Regional Municipality of Peel released a Scoped Subwatershed Study to provide natural heritage context for the Settlement Area Boundary Expansion (SABE) report. The SABE's objective includes the definition of areas of potential urban development to take place before 2051 (Peel Region 2022b). The features were given a classification of high, medium, and low geomorphic constraint. High constraint features attract Conservation Authority regulation and must not be relocated or altered in a post development scenario. Medium constraint features have attributes in common with high constraint features, but are typically highly impacted or unstable, warranting potential realignment. Low constraint features are ephemeral in nature, and are typically poorly defined, yet must still be treated as watercourses prior to further analysis. As reaches had been previously delineated as part of the Scoped Subwatershed Study, the same reach delineation shall be adopted in this study.

3.3 Historical Assessment

Historical aerial photographs of the watercourse in the vicinity of the Subject Lands were reviewed, to determine changes to the channel and surrounding land use and land cover. Historic analyses provide insight into how past channel adjustments and modifications have contributed to current channel form and processes.

Aerial photographs from 1946, 1969, 1974, and 1988 obtained from the National Air Photo Library and an image from 1954 obtained from the University of Toronto's Map Library, were compared with more recent imagery from 2002, 2011, and 2022, retrieved from First Base Solutions Inc. A historical record displaying the imagery used is shown in **Appendix B**.

In 1946, the surrounding land use was mainly agricultural. Properties, separated by hedgerows, consisted of agricultural fields, small wood lots, and residential dwellings. The southern portion of the site consisted of an agricultural field, a residential dwelling, and a small driveway connecting the residence with Columbia Way. The residence was made up of several structures, including a barn and two smaller houses. The driveway continued to the northwest, past the residence, leading to another dwelling to the north of the Subject Lands. The northern portion of the Subject Lands consisted of a small woodlot, through which the watercourse in question flowed. A small circular pond was located on the eastern side of the Subject Lands.

By 1954, a 90-degree bend in Columbia Way, to the south of the Subject Lands, was realigned to a 45-degree bend, encroaching slightly onto the Subject Lands. Apart from this change, no notable developments were observed. At this time, the stream flowed adjacent to the boundary between the agricultural field and the woodlot.

Between 1954 and 1969, some tilling operations had been performed in the southern portion of the site, to the southwest of the residence. The flow path remained in the same location as in previous years. Some new residential dwellings had been constructed in the vicinity of the Subject Lands.

Apart from agricultural practices, no notable changes were observed in the Subject Lands's land use between 1966 and 1974. However, the stream had developed multiple flow paths, the newer one flowing through the woodlot. The old flow path between the boundary of the agricultural field and the woodlot still existed in a less defined manner than the new flow path.

Significant changes occurred in the vicinity of the site between 1974 and 1988. Columbia Way was realigned once again, this time encroaching more significantly onto the Subject Lands. A larger, two-lane roadway, initiating from the intersection located at the southeast corner of the site, extended towards the east, intersecting the historical location of the residential dwelling. A large suburban development was constructed on the southern side of Columbia way, across from the Subject Lands. Additionally, the channel was observed to flow exclusively through the woodlot. However, a new flow path formed in the lower regions of the watercourse, crossing the roadway to the east of the other, still existent crossing.

By 2002, an additional townhouse complex was in the midst of development to the northeast of the previous suburban development. Additionally, some other small properties in the vicinity of the Subject Lands had been constructed in the previous decade. A slow transition from forest to meadow marsh was also noted in the Subject Lands's woodlot, encompassing a small portion of the stream.

By 2011, St. Michael's Catholic Secondary School was constructed to the west of the Subject Lands and consisted of a large structure and an athletic field. On the subject lands, the lower portion of the agricultural fields had been altered once again by tilling operations. However, the position of the watercourse in question remained clear, with several small tributaries draining water into the channel.

Limited changes were noted between 2011 and 2022. The watercourses running through the southerly agricultural field were slightly less defined than in previous years, but the position of the watercourse did not change significantly in the previous 20 years.

4. Existing Conditions

4.1 Reach Delineation

Reaches are defined as sections of river along which boundary conditions are sufficiently uniform such that the river maintains a near consistent structure (Brierley and Fryirs, 2005). Reaches are typically delineated based on changes in channel planform, gradient, valley form, physiography, land cover, flow inputs, channel disturbances, and past channel modifications. Due to spatial variability in the modifying and controlling influences of channel form, two reaches situated immediately upstream or downstream of each other could show a marked difference in planform (TRCA 2004).

Reach delineation and nomenclature were adopted from the SABE (Peel Region 2022b). While the reaches delineated as part of the SABE were maintained for the most part, reach TCC(1) was split into two sub-reaches, namely TCC(1)-1 and TCC(1)-2, following a detailed desktop assessment and confirmation through the field investigation. Additionally, the portion of the watercourse south of Columbia Way, not part of the SABE, but which will receive flows from the proposed development was delineated into reaches, namely TCC(0)-1 and TCC(0)-2.

Reach TCC(1)-1 in the centre of the Subject Lands initiates in a grassy, agricultural patch of land surrounded by trees. Upon exiting the woodlot, the watercourse continued to the south towards Columbia Way. As such, a reach break was placed at the terminus of the woodlot, identifying the initiation of reach TCC(1)-2. After the feature is conveyed off the Subject Lands to the south, under Columbia Way, it flows into a large stormwater pond situated in a residential area. The pond outlets into a watercourse situated within a confined valley, which continues to the south until crossing under Kingsview Drive. The ponded portion of this feature was named TCC(0)-1, while the defined section downstream of the pond was named TCC(0)-1.

Reach TCC(8)1-1b within the Bolton North Hill Secondary Plan Area to the east of the Subject Lands, receives flow from the eastern boundary of the Subject Lands, conveying water to the east before joining with another tributary of Cold Creek (Reach TCC(8)). The relevant reaches in and around the Subject Lands are shown in **Figure 2, Appendix A**.

The reach delineation was subsequently verified during three separate field investigations (noted below). Results from the field investigations differed significantly from the desktop assessment due to the fact that TCC(1)-2 no longer existed, as the grassy field observed during the desktop assessment had been tilled over.

4.2 Field Investigation

4.2.1 Methods

Field assessments were completed for reaches TCC(1)-1 and TCC(1)-2 on November 30, 2023, and for TCC(0)-2 on December 11, 2024 by GEI. An additional field assessment was completed for reach TCC(8)1-1b east of the Mount Hope West Secondary Plan Area in late April by GEO Morphix Ltd. (GEO Morphix). The findings of the GEO Morphix assessment are

summarized below, and additional details contained within the associated letter can be found in **Appendix D**.

Both assessments consisted of a Rapid Geomorphic Assessment (RGA), while GEI's assessments also included a modified Rapid Stream Assessment Technique (RSAT) and classification of the reach using the Downs method.

The RGA (MOE, 2003) documents observed indicators of channel instability. Observations made during the field investigation are quantified using an index that identifies channel sensitivity based on evidence of aggradation, degradation, channel widening, and planform 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 adjusting (score >0.41).

The RSAT (Galli, 1996) provides an assessment of the channel by also considering the ecological function of the stream. Observations under the modified RSAT include channel stability, channel scouring/sediment deposition, physical instream habitat, water quality, and riparian habitat condition. The RSAT scores rank the channel as maintaining a poor (<13), fair (13-24), good (25-34), or excellent (35-42) degree of stream health.

The Downs method, as outlined in Thorne et al. (1997), was developed based on adjustment processes and trends of channel change and links these processes and trends to the fluvial and sediment processes responsible for driving channel change. This system classifies streams as stable, depositional, laterally migrating, enlarging, compound, recovering, or undercutting.

4.2.2 Results

Reach TCC(1)-1

The upstream extent of TCC(1)-1 exists as a vegetated, swale-like feature that juts into an open field. The swale slowly transitions into an entrenched ditch until it reaches the woodlot, at which point it widens and dissipates into a pond. It is unclear whether the pond, approximately 20 m in width, exists as a permanent feature. The downstream end of the pond gradually transitions into a channel flanked by mature trees on both banks. Instream vegetation was not observed, although grassy debris was noted in the un-moving water. Woody debris, tree falls, and exposed roots were observed along the length of the reach. Riparian vegetation consisted mainly of trees, grasses, and herbaceous species. The riparian buffer extended >5 channel widths in dimension on either side. The reach continued through the forested area before terminating at the extent of the woodlot, at which point the bed of the channel rose to meet existing ground. No defined channel existed past this point.

Distinct pools and riffles could not be discerned, and the dominant habitat type consisted of runs. The feature was relatively uniform in width and depth before ending. Riffles were unclear and rare. Where defined, bankfull widths ranged between 1.5 m in the upstream swale area and 5.0 m in the downstream, forested region of TCC(1)-1. Bankfull depths ranged between 0.3 in the upstream region and 2 in the downstream forested region. Observed bank materials consisted of clay, silt and sand. Pool substrate was composed of clay, silt, and sand. Bank angles were medium, ranging between 30 – 60° and erosion was noted on approximately 5 – 30% of banks.

The RGA produced a score of 0.28, which indicated that the reach was in transition / stressed. The RSAT score of 21 indicated that this reach was in a fair state of ecological health. The dominant process observed in the channel was planimetric form adjustment. Physical

instream habitat conditions were noted to be the main limiting factor, due to the absence of hydraulic variability. The Downs method classified this reach as m – lateral migration, which is characterized by erosion on one bank and deposition on the other.

Reach TCC(1)-2

A rapid assessment could not be performed on reach TCC(1)-2, as it had been ploughed through, removing bed and bank variability. The channel was identified in historical imagery as a small, entrenched feature flowing through a field of shrubs and grasses. However, during the field assessment it was established that the downstream extent of TCC(1)-1, located at the boundary of the woodlot, was also the terminus of the channel. This resulted in a stagnation of water in reach TCC(1)-1. Photos showing the feature's terminus, as well as the tilled field, are included in the photographic record.

Reach TCC(0)-1

A rapid assessment was not performed on reach TCC(0)-1, as it exists as a pond.

Reach TCC(0)-2

The upstream extent of TCC(0)-2 receives flow from TCC(0)-1 via a circular CSP culvert before continuing south through a confined valley. The bottom of the valley was found to be densely vegetated with trees, grasses, shrubs, and herbaceous species. Shortly upstream of the reach break, the watercourse flows through a clearing with limited trees. Instream vegetation was observed in the form of watercress, especially on point bars, indicating groundwater exchange. Woody debris, tree falls, and exposed roots were observed along the length of the reach. The riparian buffer extended >5 channel widths in dimension on either side.

Distinct pools and riffles existed throughout the reach. The feature was relatively uniform in width and depth becoming more entrenched upon exiting the woodlot. Where defined, bankfull widths ranged between 1.5 – 2.6 m. Bankfull depths ranged between 0.4 – 0.6 m. Observed bank materials consisted of sandy loam, with some silt. Pool substrate was composed of silt, and sand. Bank angles were steep, ranging between 60 – 90° and erosion was noted on approximately 60 – 90% of banks.

The RGA produced a score of 0.19, which indicated that the reach was in regime. The dominant process observed in the channel was widening. The RSAT score of 25 indicated that this reach was in a good state of ecological health. Channel stability was noted to be the main limiting factor, due to lack of integrity n the bank network. The Downs method classified this reach as e - enlarging, which is characterized by erosion along both banks as well as the bed.

Reach TCC(8)1-1b

Reach TCC(8)1-1b (referred to as THR1 in the appended GEO Morphix letter) extends from Mount Hope Road to the downstream confluence and is approximately 455 m in length. The reach was characterized as a single channel flowing through a defined valley. It was moderately entrenched and had a moderate gradient. At the time of assessment, only intermittent pools of standing water were observed (i.e., no flow), ranging in depth from 0.09 m to 0.18 m. Riparian vegetation consisted of a wide, continuous buffer of mature trees and shrubs. Active bank erosion was documented along the reach, with fallen trees and bank slumping common. Undercuts measured between 0.3 m and 0.48 m. In addition, two knickpoints were observed. Riffle substrate consisted of largely gravel, while pool substrate

consisted of clay/silt and sand. Bank materials were comprised of clay/silt and gravel. Average bankfull channel width and depth were 1.9 m and 0.64 m, respectively.

The RGA produced a score of 0.33, indicating that the reach is in transition/stress. The dominant mode of systematic adjustment was evidence of widening due to the presence of fallen trees, large organic debris, exposed tree roots and basal scour. Evidence of aggradation was also noted due to accretion on point bars, siltation in pools, and riffle embeddedness.

Summary

Rapid assessment results are summarized in **Table 1** below. The photographic record of existing conditions is provided in **Appendix C**.

Table 1 – Summary of Rapid Assessment Results for the Tributaries of Cold Creek

Reach	RGA Score and Condition	Dominant Mode of Adjustment	RSAT Score and Condition	Limiting Factor	Downs Method
TCC(1)-1	0.28 In Transition / Stressed	Planimetric Form Adjustment	23 Fair	Physical Instream Habitat Conditions	m – lateral migration
TCC(1)-2	-	-	-	-	-
TCC(0)-1	-	-	-	-	-
TCC(0)-2	0.19 In Regime	Widening	25 Good	Channel Stability	e - enlarging
TCC(8)1-1b*	0.33 In Transition / Stressed	Widening	-	-	-

* Completed by GEO Morphix Ltd.

5. Meander Belt Delineation

Streams and rivers are dynamic features on the landscape, and their configuration and position on the floodplain changes as part of meander evolution, development and migration processes. When development or other activities are contemplated near a watercourse, it is desirable to designate a corridor that is intended to contain all natural meander and migration tendencies. The space that a meandering watercourse occupies on its floodplain, and in which all of these natural processes occur, is referred to as the meander belt (TRCA 2004). In the case of unconfined systems, the erosion hazard allowance consists of the meander belt and an access allowance. In the case of confined systems, the erosion hazard allowance consists of the stable slope allowance and toe erosion allowance, in addition to the access allowance.

As the Cold Creek tributary traversing the Subject Lands was situated in an unconfined valley, a meander belt width was delineated for reaches TCC(1)-1 and TCC(1)-2. The TRCA (2004) *Belt Width Delineation Procedures* document was created to recommend a protocol for delineation of meander belt for river systems within the TRCA's jurisdiction but is accepted by Conservation Authorities throughout Ontario as a primary method for delineating the belt width. The method involves drawing lines tangential to the outside meander bends of the planform, including the historical position of the watercourse. The perpendicular distance between these two lines represents the meander belt width. The meander belt was found to be 33 m for TCC(1)-1, and 18 m for TCC(1)-2.

For comparison, an empirical modelling approach was also employed. There are a variety of empirical models available, which use simple power functions based on field-based measurements of average channel dimensions. The methods include those outlined by Williams involving bankfull width (W_b) (1986 – equation 1), Ward et al. involving bankfull width (2002 – equation 2), Lorenz et al. (1985 – equation 3 below), and a linear model presented by Howett (2017 – equation 4).

$$B_w = 4.3 \times {W_b}^{1.12} \quad \text{[Eq. 1]}$$
$$B_w = 6 \times {W_b}^{1.12} \quad \text{[Eq. 2]}$$
$$B_w = 7.53 \times {W_b}^{1.01} \quad \text{[Eq. 3]}$$
$$B_w = 6.89 \times W_b \quad \text{[Eq. 4]}$$

After determining the belt width using these relations, the channel width was added. For the Williams relations, a 20% factor of safety was also added to the initial belt width. The inputs used in the Ward equations are in imperial units. Results from the empirical analysis are presented in **Table 2** below. As TCC(1)-2 had been ploughed through, an empirical analysis could not be performed.

Table 2 – Meander Belt Widths for the Tributaries of Cold Creek

Reach	Empirical Approaches					Desktop Approach (m)	Recommended Belt Width (m)
	Williams – 1986 (m)	Ward et al. – 2002 (m)	Lorenz et al. – 1985 (m)	Howett – 2017 (m)	Average (m)		
TCC(1)-1	21	26	25	23	23	33	33
TCC(1)-2	-	-	-	-	-	18	18

The limits of the meander belt are shown in **Figure 3, Appendix A**.

6. Conclusions and Recommendations

GEI Consultants Ltd. (GEI) has been retained by United Holdings Inc. to complete a geomorphic assessment for the Mount Hope West Secondary Plan Area, located west of Mount Hope Road, east of Highway 50, and north of Columbia Way. The assessment is in support of developments proposed within the portion of the Subject Lands delineated as Urban Area on Schedule B1 and designated as New Community Area on Schedule B4 under the council-adopted Town of Caledon Official Plan (Town of Caledon, 2024a). The Subject Lands is located within the Bolton community, Town of Caledon, Ontario. Two first-order tributaries of Cold Creek, which is a third-order tributary of Humber River, traverse the property. This watercourse falls under the jurisdiction of the Toronto and Region Conservation Authority (TRCA). This assessment was supplemented by a field investigation performed on a Cold Creek tributary to the east of Mount Hope Road, by GEO Morphix Ltd.

The purpose of the geomorphic assessment was to characterize the watercourses in and around the Subject Lands, and to assist the development of environmental constraint limits, through the delineation of the meander belt. As such, a meander belt was delineated for the watercourses within the Subject Lands. Results from the Meander Belt Delineation will aid in determining the allowable extent of development as well as the location of the future channel realignment. The following summarizes the key findings:

- Reach TCC(1)-1 was characterized as a perennially defined channel situated within an unconfined valley setting. Channel geometry was found to vary within the reach, which initiates as a drainage feature in the north of the site before entering the large central woodlot. At this point, the reach widens into a pond-like feature before transitioning into a watercourse with an average bankfull width of 3 m. The RGA produced a score of 0.28 for the reach, indicating that the reach is in transition / stressed. A meander belt width of 33 m. The watercourse terminates at the extent of TCC(1)-1.
- Reach TCC(1)-2 could not be investigated as part of the field assessment as the grassy field, including TCC(1)-2, had been tilled over as part of an agricultural operation, thereby removing the defined bed and banks. However, the historical location of the channel (up until 2022) could be determined based off the desktop assessment, allowing for the delineation of a meander belt of 18 m.
- Reach TCC(0)-1 was not investigated, as it exists in the form of a pond.
- Reach TCC(0)-2 was characterized as a perennially defined channel situated within a confined valley setting. The watercourse receives flow from the outlet of Reach TCC(0)-1 via a circular CSP culvert. The feature continues through a treed area with an average bankfull width and depth of 2.3 m and 0.3 m respectively. The RGA produced a score of 0.19, indicating that the reach in in regime.
- Reach TCC(8)1-1b was characterized as an intermittently flowing channel situated in a moderately steep, relatively confined valley setting. The reach receives flow from the Subject Lands to the west via a culvert underneath Mount Hope Road, continuing through a densely wooded area to the east. The average bankfull width and depth of the channel was measured to be 1.9 m and 0.64 m respectively. The RGA produced a score of 0.33, indicating that the reach is in transition / stressed.
- Based on the existing meander geometry of the tributaries of Cold Creek, aerial photographic interpretation of evidence of historical channel activity within the floodplain, and valley floor dimensions, a meander belt width of 33 m and 18 m were recommended for reaches TCC(1)-1 and TCC(1)-2 within the study area, respectively.

Yours truly,

GEI Consultants

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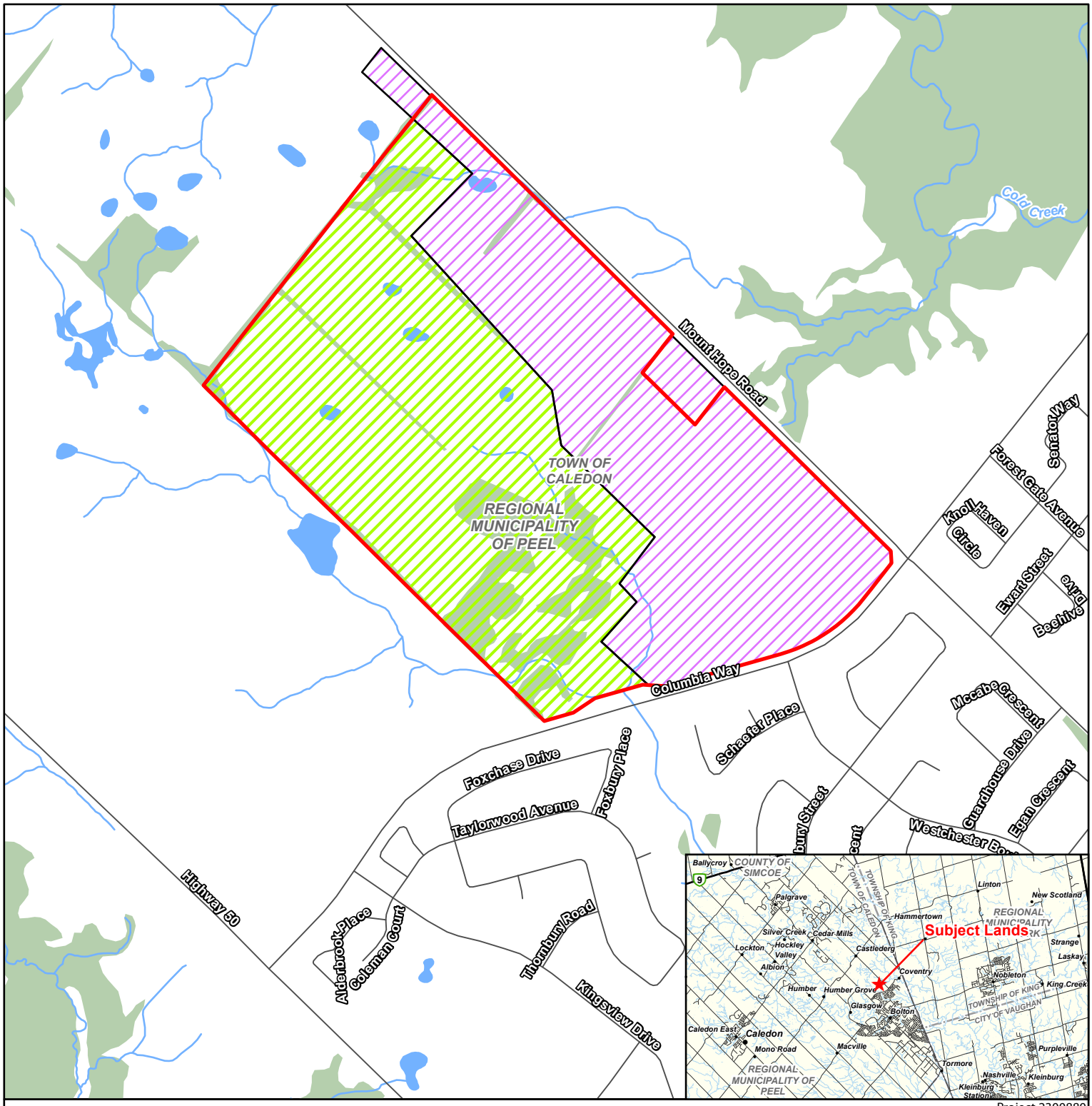
Appendix A

Figures



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2025.

Legend
- Watercourse
- Waterbody
- Wooded Area
- Road
- Subject Lands
- Greenbelt Lands
- Urban Area

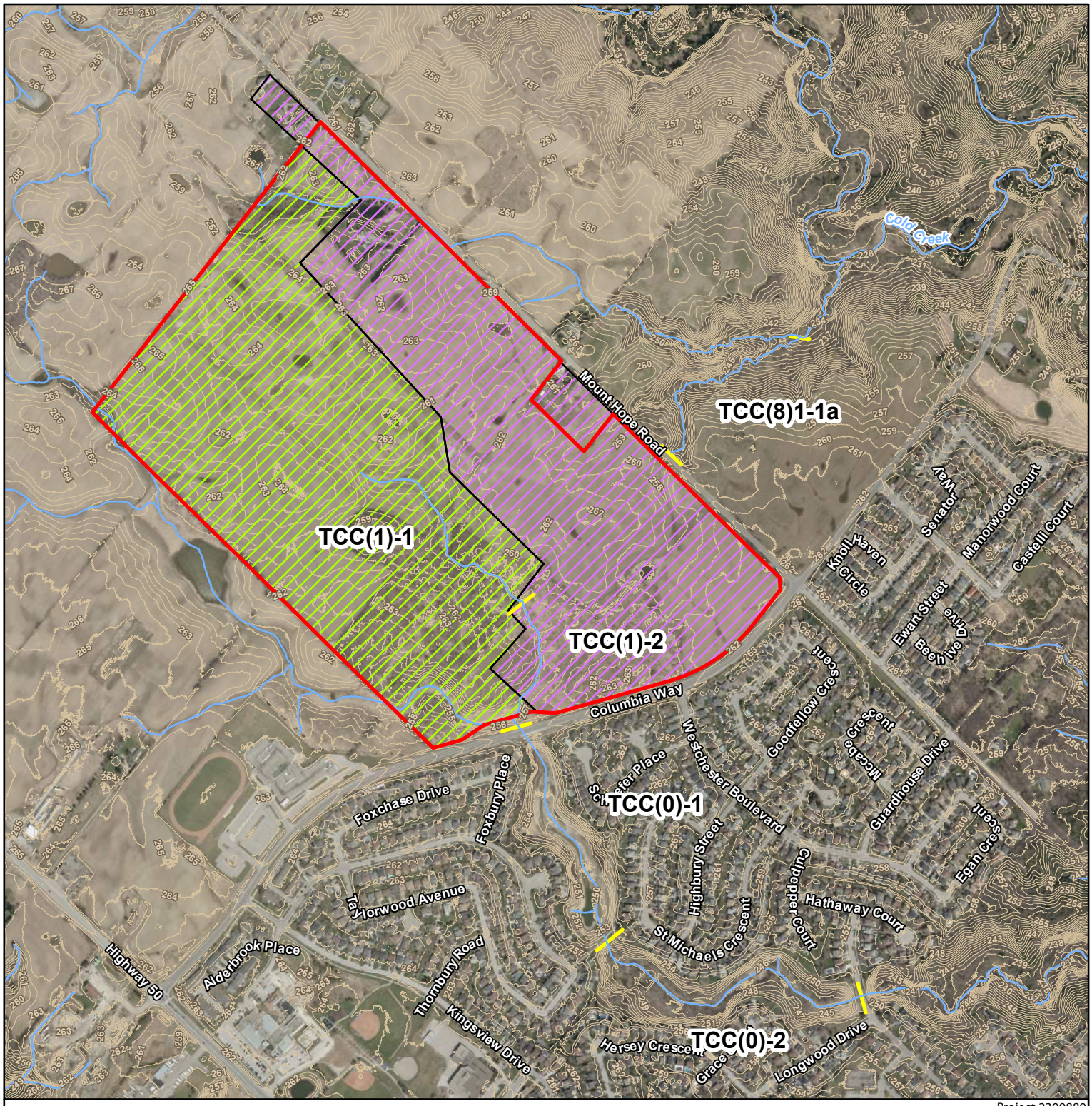
Project 2300880

Mount Hope Road Lands, Bolton
Environmental Impact Study
United Holdings Inc.

Figure 1
Location of Subject Lands

0 200 m
1:10,000
N

GEI Consultants



Project 2300880

NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
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3. Orthoimagery © First Base Solutions, 2025. Imagery taken in 2022.

Legend
- Subject Lands
- Watercourse
- Greenbelt Lands
- Urban_Area
- Reach Break

Mount Hope Road Lands, Bolton
United Holdings Inc.

Figure 2
Reach Delineation

0 100 m
1:10,000

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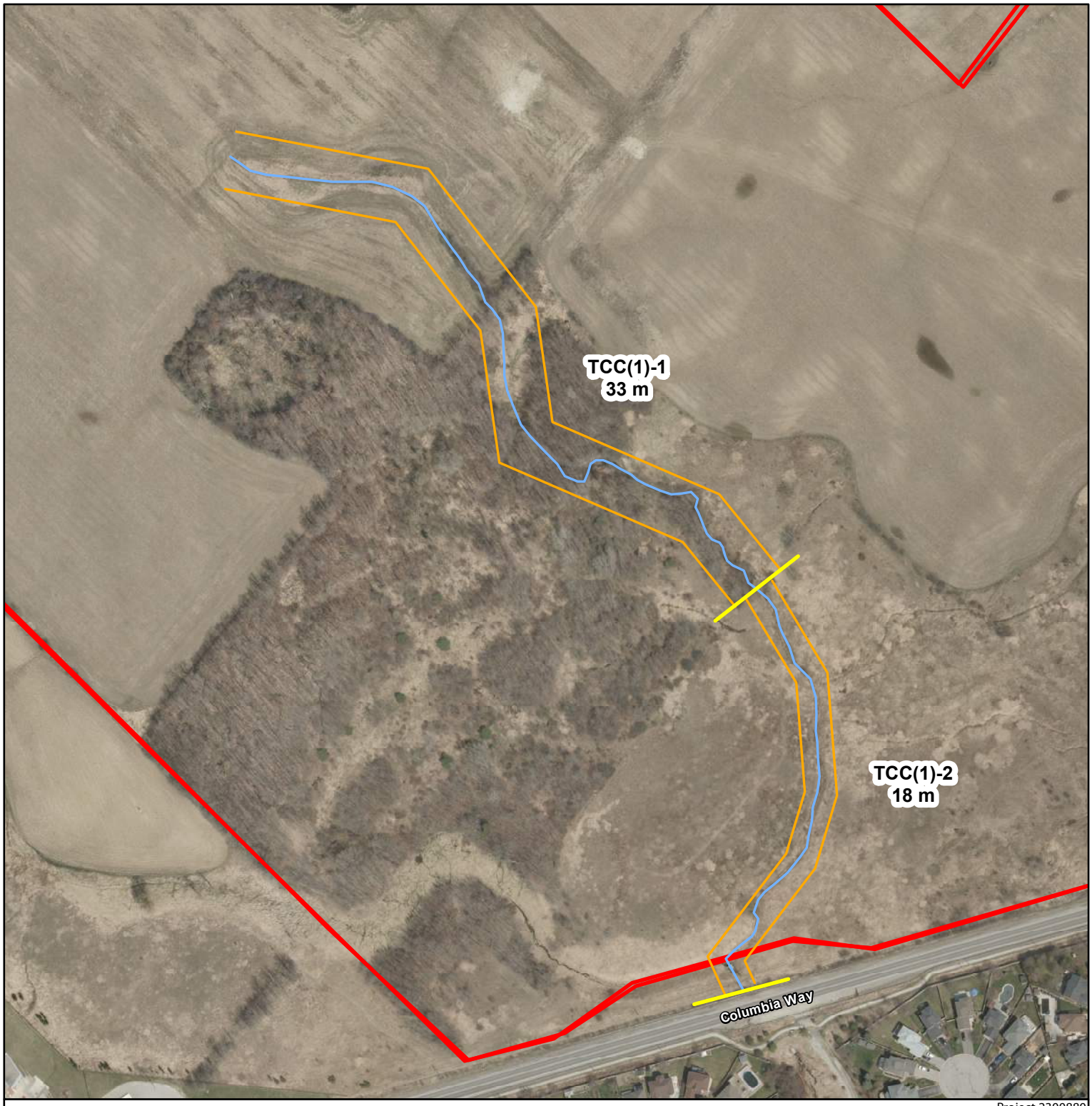
GEI Consultants



Project 2300880

NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2024.
3. Orthoimagery © First Base Solutions, 2024. Imagery taken in 2022.

Legend
- Subject Lands
- Watercourse Trace (2022)
- Meander Belt
- Reach Break

Mount Hope Road Lands, Bolton
United Holdings Inc.

Figure 3
Meander Belt

0 10 20 30 40 50 m
1:3,049

N

GEI Consultants

Appendix B

Historical Aerial Imagery

Project 2300880

NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Airphoto Source: National Air Photo Library

Legend

Subject Lands

United Holdings Inc.
Fluvial Geomorphic Characterization Report for the Mount Hope Lands
Bolton, Ontario

1946 AERIAL PHOTOGRAPH

0 50 100 150 200 m

1:7,310

GEI Consultants

NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Airphoto Source: University of Toronto Aerial Imagery Database

Legend

Subject Lands

Project 2300880

United Holdings Inc.
Fluvial Geomorphic Characterization Report for the Mount Hope Lands
Bolton, Ontario

1954 AERIAL PHOTOGRAPH

0 50 100 150 200 m

1:7,310

GEI Consultants

Project 2300880

NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Airphoto Source: National Air Photo Library

Legend

Subject Lands

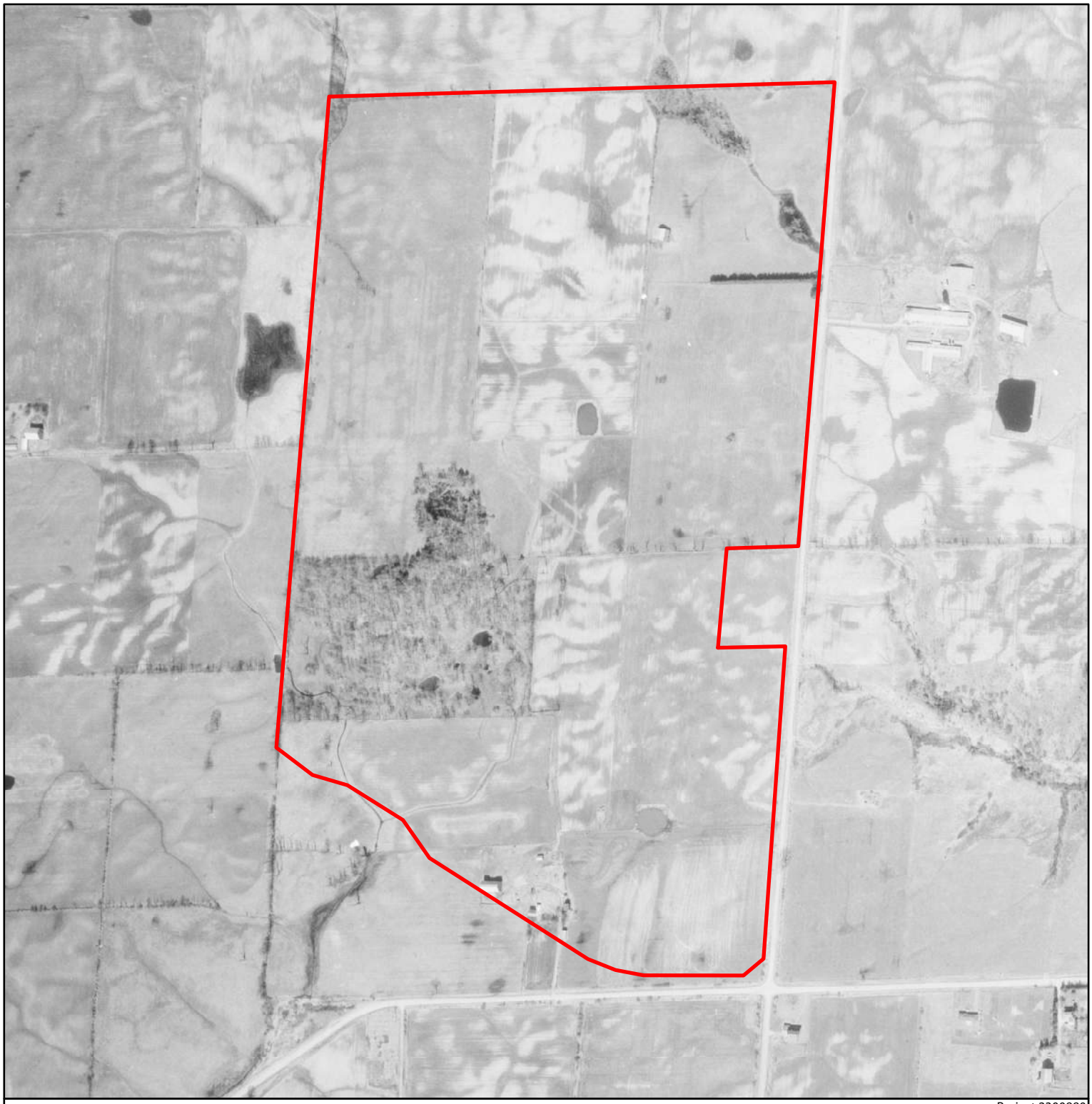
United Holdings Inc.
Fluvial Geomorphic Characterization Report for the Mount Hope Lands
Bolton, Ontario

1969 AERIAL PHOTOGRAPH

0 50 100 150 200 m

1:7,310

GEI Consultants



Project 2300880

NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Airphoto Source: National Air Photo Library

Legend

Subject Lands

United Holdings Inc.
Fluvial Geomorphic Characterization Report for the Mount Hope Lands
Bolton, Ontario

1974 AERIAL PHOTOGRAPH

0 50 100 150 200 m

1:7,310

N

GEI Consultants

Project 2300880

NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Airphoto Source: National Air Photo Library

Legend

Subject Lands

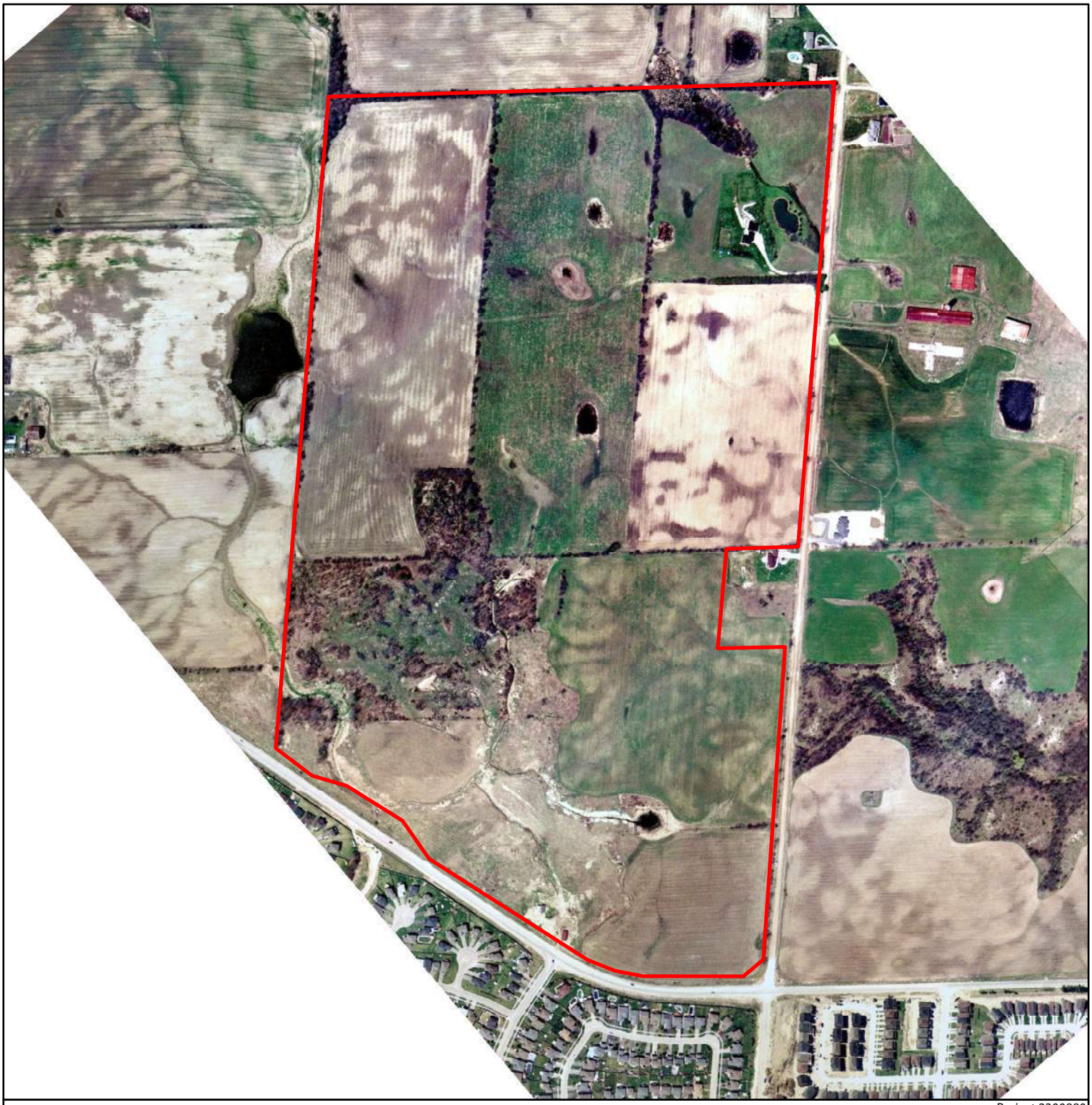
United Holdings Inc.
Fluvial Geomorphic Characterization Report for the Mount Hope Lands
Bolton, Ontario

1988 AERIAL PHOTOGRAPH

0 50 100 150 200 m

1:7,310

GEI Consultants



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Airphoto Source: First Base Solutions Inc

Legend

Subject Lands

Project 2300880

United Holdings Inc.
Fluvial Geomorphic Characterization Report for the Mount Hope Lands
Bolton, Ontario

2002 AERIAL PHOTOGRAPH

0 50 100 150 200 m

1:7,310

N

GEI Consultants

NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Airphoto Source: First Base Solutions Inc

Legend

Subject Lands

Project 2300880

United Holdings Inc.
Fluvial Geomorphic Characterization Report for the Mount Hope Lands
Bolton, Ontario

2011 AERIAL PHOTOGRAPH

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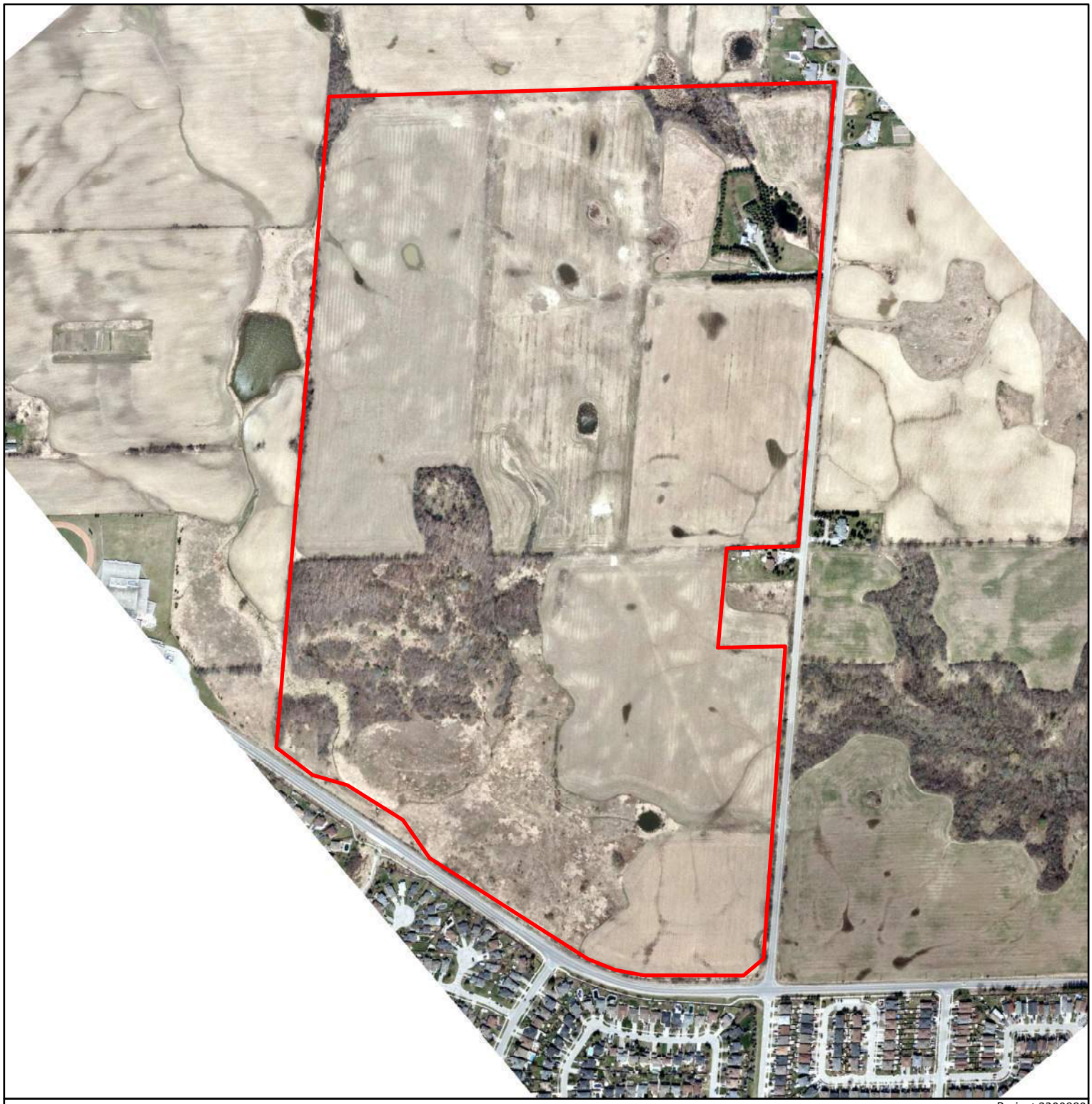
1:7,310

GEI Consultants



Project 2300880

NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Airphoto Source: First Base Solutions Inc

Legend

Subject Lands

United Holdings Inc.
Fluvial Geomorphic Characterization Report for the Mount Hope Lands
Bolton, Ontario

2022 AERIAL PHOTOGRAPH

0 50 100 150 200 m

1:7,310

GEI Consultants

Appendix C

Photographic Record

Photographic Record

Photo 1 – Downstream view from TCC(1)-1's upstream extent. Draining into woodlot.

Photo 2 – Downstream view of treed ditch-like portion of TCC(1)-1, draining into pond.

Photo 3 – Pond splitting TCC(1)-1 into two portions. Wetland-like vegetation is prevalent.

Photo 4 – Downstream view of TCC(1)-1. Watercourse drains water from pond towards TCC(1)-2.

APPENDIX C

Fluvial Geomorphic Assessment of Cold Creek Tributaries.

Mount Hope

Reach TCC(1)-1

PHOTOGRAPHIC RECORD

GEI Consultants

Photo 1 – Downstream view of TCC(1)-2's upstream extent. TCC(1)-1 rises to meet existing ground.

Photo 2 – Downstream view of where TCC(1)-2 exists in historical imagery. Previously drained into agricultural field

Photo 4 – Previous location of TCC(1)-2, likely removed during agricultural tilling operation. See arrows for locations.

Photo 4 – Previous location of TCC(1)-2, leading to downstream culvert.

APPENDIX C

Fluvial Geomorphic Assessment of Cold Creek Tributaries

Mount Hope

Reach TCC(1)-2

PHOTOGRAPHIC RECORD

GEI Consultants

Photo 1 – Upstream view of TCC(0)-2's upstream extent. Undercutting along outside of meander bend was observed.

Photo 2 – Downstream view of TCC(0)-2's upstream extent, as it exits the woodlot.

Photo 4 – Downstream view of TCC(0)-2's downstream portion, flowing into the culvert at Kingsview Drive.

Photo 4 – Upstream view at TCC(0)-2's downstream extent, at Kingsview Drive.

APPENDIX C

Fluvial Geomorphic Assessment of Cold Creek Tributaries

Mount Hope

Reach TCC(0)-2

PHOTOGRAPHIC RECORD

GEI Consultants

Appendix D

GEO Morphix Letter

December 11, 2024

GEI Consultants
650 Woodlawn Road West, Block C, Unit 2
Guelph, ON N1K 1B8

Attn: **Agneta Szabo, M.Env.Sc.**
Ecologist

Re: **Fluvial Geomorphology Assessment**
Cold Creek Reach THR1
Mount Hope Secondary Plan Area
Town of Caledon
GEO Morphix Project Number 24084

GEO Morphix Ltd (GEO Morphix) is undertaking characterization work for tributaries that are proposed to receive stormwater discharge from the Bolton North Hill and Mount Hope Secondary Plan Areas in support of a Local Subwatershed Study, which is to be submitted in 2025. It is understood that GEI is preparing an independent submission in support of the Mount Hope Secondary Plan Area, which will be submitted to review agencies in 2024.

In late April 2024, GEO Morphix completed rapid field reconnaissance along **Reach THR1**, which is located east of Mount Hope Road and is proposed to receive stormwater discharge from the Mount Hope Secondary Plan Area. The field investigation included the following reach observations:

- Descriptions of riparian conditions
- Estimates of bankfull channel dimensions
- Characterization 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

In addition to the above, the rapid geomorphic assessment (RGA) (MOE, 2003) tool was applied to evaluate channel stability and identify dominant systematic adjustments. A brief summary of our observations is provided below. Note that due to an absence of flowing water at the time of assessment, the rapid stream assessment technique (RSAT) (Galli, 1996) was not applied.

Reach THR1 extends from Mount Hope Road to the downstream confluence and is approximately 455 m in length. The reach was characterized as a single channel flowing through a defined valley. It was moderately entrenched and had a moderate gradient. At the time of assessment, only intermittent pools of standing water were observed (i.e., no flow), ranging in depth from 0.09 m to 0.18 m. Riparian vegetation consisted of a wide, continuous buffer of mature trees and shrubs. Active bank erosion was documented along the reach, with fallen trees and bank slumping common. Undercuts measured between 0.3 m and 0.48 m. In addition, two knickpoints were observed. Riffle substrate consisted of largely gravel, while pool substrate consisted of clay/silt and sand. Bank materials were comprised of clay/silt and gravel. Average bankfull channel width and depth were 1.9 m and 0.64 m, respectively.

Reach THR1 had an RGA score of 0.33, indicating that the reach is in transition/stress. The dominant mode of systematic adjustment was evidence of widening due to the presence of fallen trees, large organic debris, exposed tree roots and basal scour. Evidence of aggradation was also noted due to accretion on point bars, siltation in pools, and riffle embeddedness.

Representative photographs of reach conditions are provided below for reference.

	
Photo 1: In the upstream portion of the reach bank erosion and undercutting were observed.	**Photo 2**: Two knickpoints were present, indicating channel adjustment.
	
Photo 3: The channel was moderately entrenched and had a moderate channel gradient.	**Photo 4**: Woody debris, leaning and fallen trees and exposed tree roots were common.

A detailed geomorphological assessment was completed along **Reach THR1** in late November 2024 and results will be made available to the GEI in support of future submissions. The average bankfull dimensions provided above are subject to refinement based on the forthcoming detailed geomorphological assessment results.

We trust the above summary satisfies your requirements at this time. Should you have any questions or concerns, please contact the undersigned.

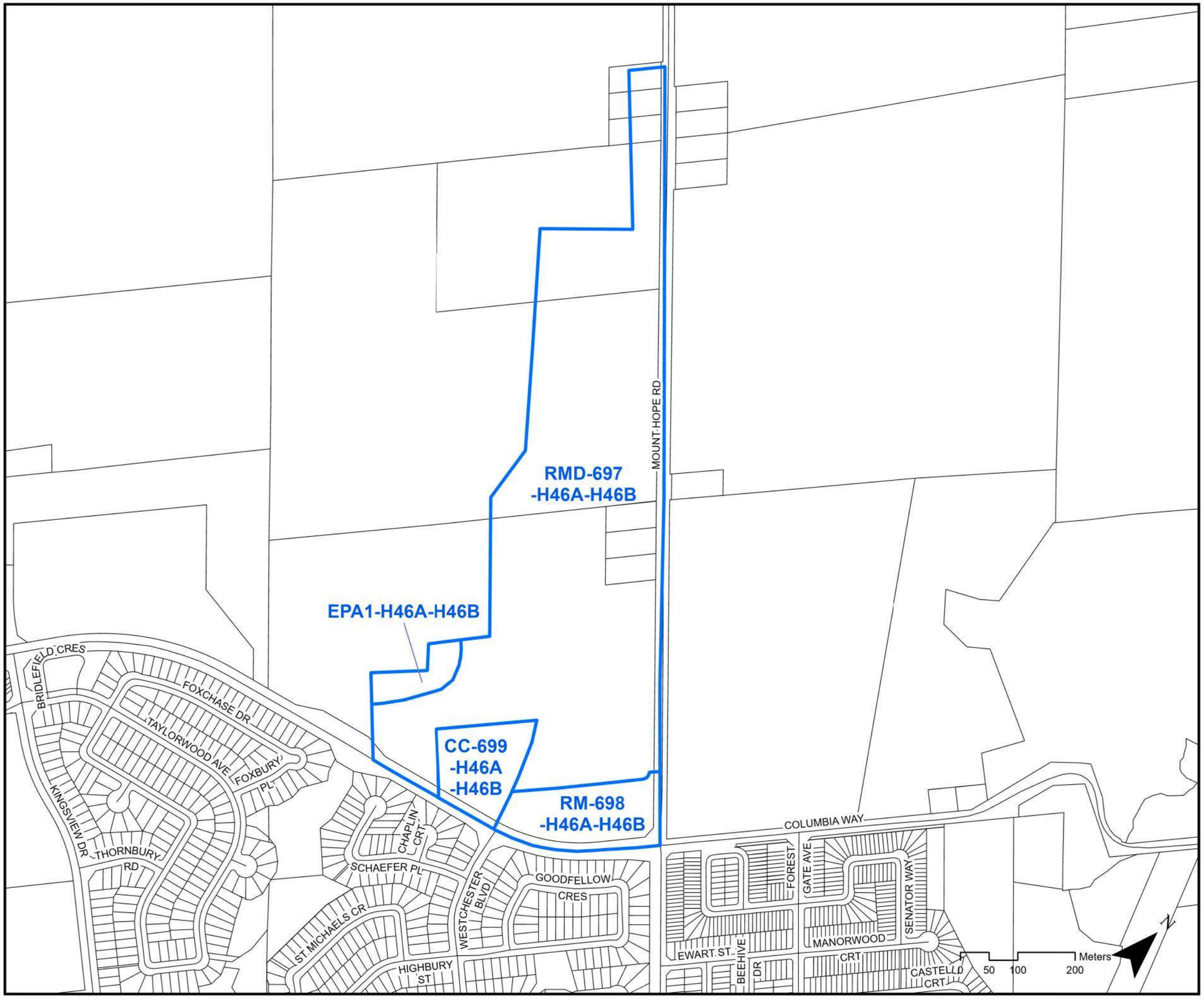
Respectfully submitted,

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

Suzanne St Onge
Senior Environmental Scientist

Appendix E

Schedule A – By-law 2024-57



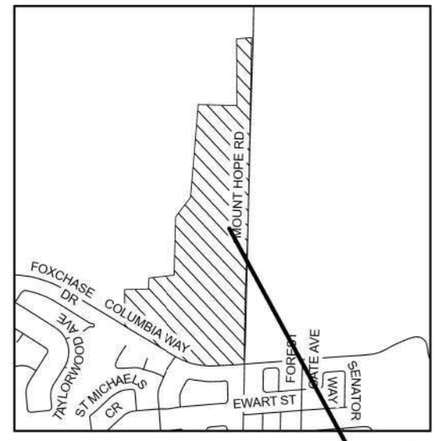
Schedule A
By-law 2024-57

Part 1 Plan 43R-37026, Part 1 Plan 43R-37027,
Part 1 Plan 43R 4880, Part 1 Plan 43R-18117,
Parts 1, 2, 3 & 4 on Plan 43R-17592 and
Parts 1 & 2 on Plan 43R-22592, Parts 1, 2 & 3
on Plan 43R-7218, Parts 4 & 5 on Plan 43R- 7218
Town of Caledon,
Regional Municipality of Peel

Legend

Lands to be rezoned to the zones identified on this Schedule

Key Map



Date: June 18, 2024

File: ZB 2024-0006