6939 King Street, Caledon
Meander Belt Study

DRAFT REPORT

Prepared for

Pinchin Ltd.
2470 Milltower Court
Mississauga, ON

October 1, 2020
Project No. P2020-469

Prepared by

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TECHNICAL MEMO

GeoProcess RESEARCH ASSOCIATES
Knowledge
Research
Consulting

October 1, 2020

Mr. Rocky Yao
Regional Practice Lead, Biologist, Environmental Science
Pinchin Ltd.
2470 Milltower Court
Mississauga, ON
L5N 7W5

Re: 6939 King Street, Caledon - Meander Belt Study

Dear Mr. Yao,

GeoProcess Research Associates Inc. (GRA) completed a meander belt study for a tributary of Lindsay Creek at 6939 King Street. The results presented in this memo can be used to support land-use planning decisions or as input to other constraints mapping. If you have any questions regarding this technical memo or the methods and rationale outlined herein, please do not hesitate to contact Chris McKie at 519-221-4111 or cmckie@geoprocess.com.

Regards,

GEOPROCESS RESEARCH ASSOCIATES INC

Chris McKie, MASc, P.Eng.
River Engineer

Ben Plumb, PhD, P.Eng.
River Engineer

Table of Contents

List of Figures

List of Tables

1. Introduction

GeoProcess Research Associates Inc. (GRA) was retained by Pinchin Ltd. to complete a meander belt study for a tributary to Lindsay Creek that passes adjacent to the study site at 6939 King Street, in Caledon, Ontario. The purpose of this study was to delineate the meander belt component of the erosion hazard setback, as defined by the Ministry of Natural Resources and Forestry (MNRF) technical guidelines for land-use planning as they relate to erosion hazards, a policy that is part of the Provincial Policy Statement (PPS) of the *Provincial Planning Act*, Section 3.1. This work has been undertaken to inform constraint mapping for a proposed development at 6939 King Street (the subject property). The study area covers approximately 388 m of channel length. This memo outlines the technical rationale and results of this assessment.

2. Background and Regulatory Context

The meander belt setback is a regulatory limit that establishes the erosion hazard for new developments, as defined by the MNRF. As a planning tool, the meander belt setback works with other erosion-related hazard allowances specific to watercourses, including the access, toe erosion and stable slope allowances (the latter, in cases where the watercourse flows coincident with the bottom of a valley wall). The geologic landform setting defines the applicability of these allowances to different stream and valley corridors, as illustrated in Figure 1, below.

In cases where the watercourse is not confined by a clear valley corridor, such that the erosion processes are dominated by "flat to gently rolling, glaciated plains", the governing erosion hazard allowance is the meander belt width, defined as the outer stream banks (illustrated in Figure 2) as determined by a study of historical mapping and aerial imagery. These conditions must consider the historic position of the watercourse to capture the dynamic nature of streams and rivers that migrate across a floodplain over time. The historic position of the watercourse is taken account by adding the calculated 100-year erosion rate to the belt width of the currently existing channel.

For cases where the watercourse is confined within a valley corridor, the valley walls act to constrain the meander belt width and the setback is adjusted accordingly. For cases where the watercourse is partially constrained by a valley wall, the confined condition applies to that portion of the watercourse and the outer banks to the unconfined portion.

The protocol recommended by the MNRF technical guidelines for delineation of the belt width for each of these geologic settings is the *Belt Width Delineation Procedures* (TRCA, 2001) document.

The valley setting within the study site was determined from topographic contours and cross-referenced with satellite imagery. Contour mapping (0.5 m resolution) were derived from the 2018 South Central Ontario Orthophotography Project, (SCOOP, 2018) raster. The study reach was identified to be unconfined. For unconfined systems, the meander belt limit is defined as the distance between lines tangential to the outside of extreme meander bends and in the direction of the meander axis (TRCA, 2001).

River and Stream Systems Landform Classification

	Confined	Unconfined
Watercourse Profile		
Typical Geologic Setting	Valley corridors	Glaciated plains, flat to gently rolling

Hazard Allowances	Confined	Unconfined
Stable Slope	Yes	No
Toe Erosion	Yes	No
Meander Belt	No	Yes
Access Allowance	Yes	Yes

Figure 1: River and stream systems landform classification and applicability of landform components to the hazard allowance designation (MNR Erosion Hazard - Technical Guidelines, 2002).

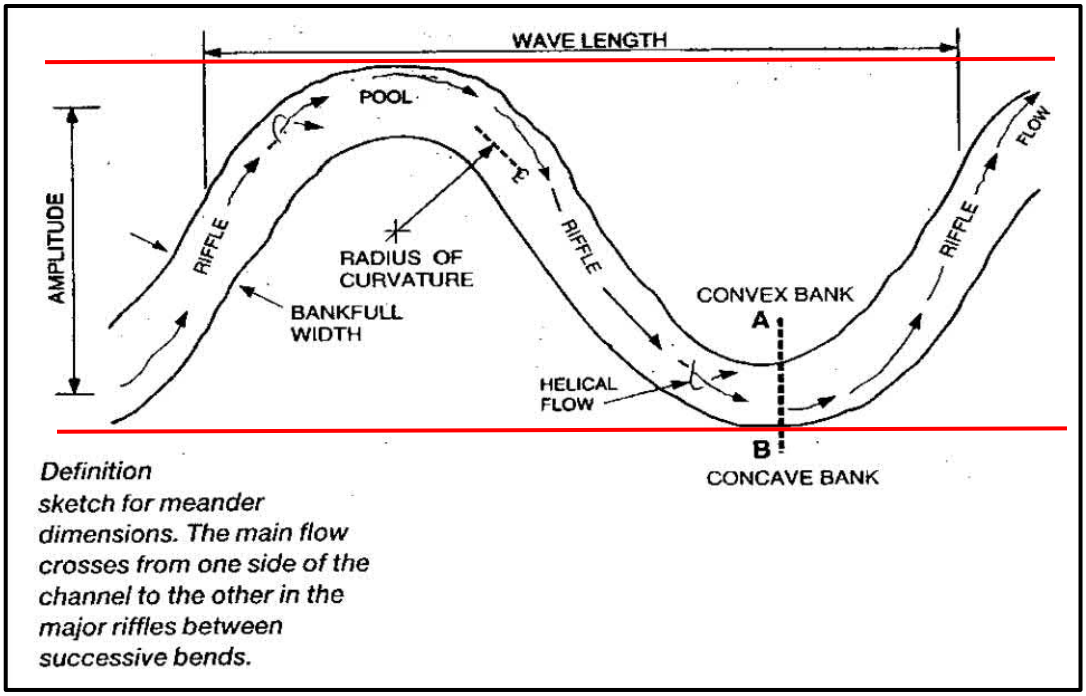


Figure 2: River planform dimensions and terminology (reproduced from the MNR Erosion Hazard Technical Guidelines, 2002). Meander belt limit for this schematic has been added as red lines.

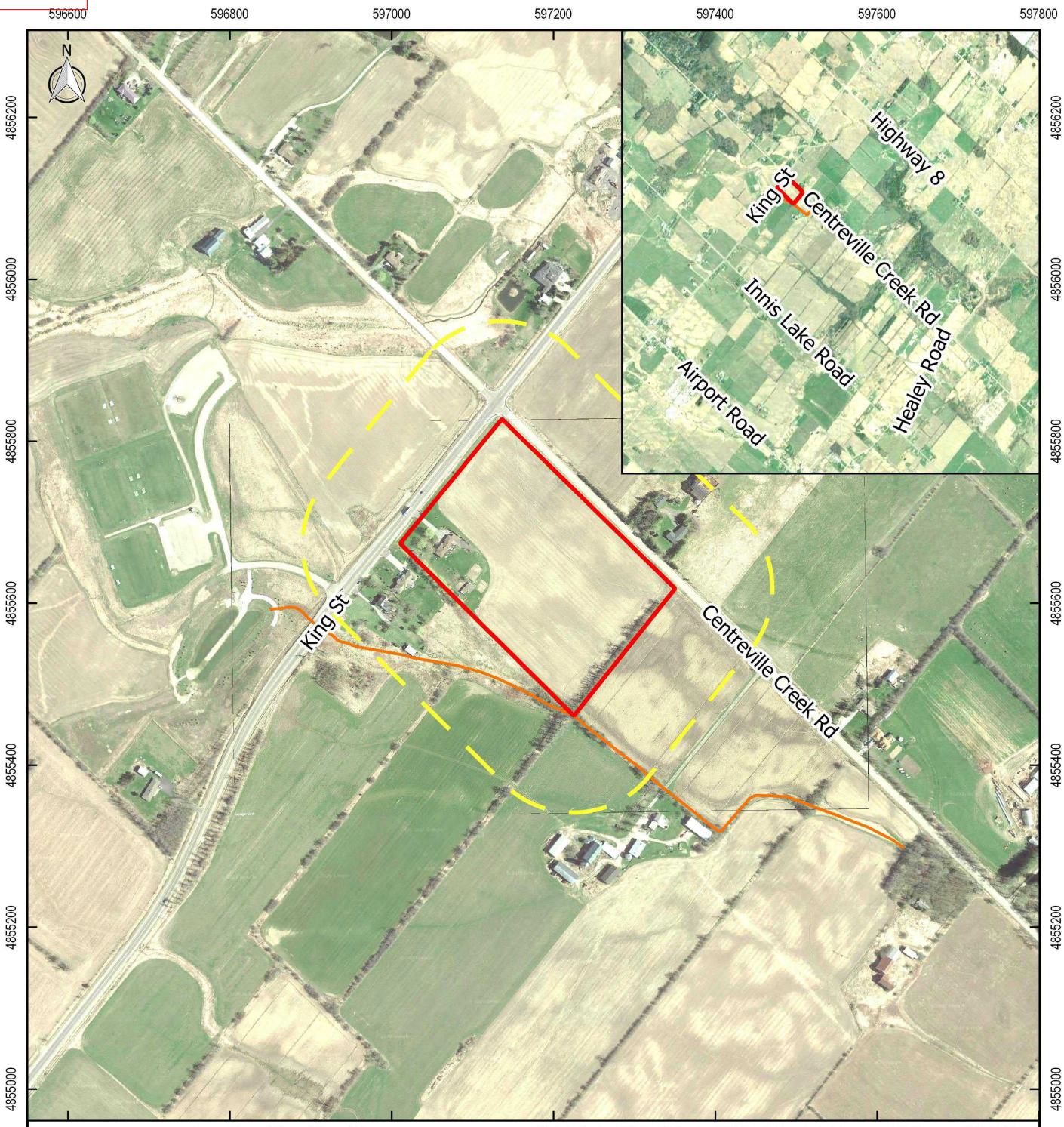
3. Existing Site Conditions

The watercourse of interest is a tributary to Lindsay Creek and within the Humber River Watershed. The study area (Figure 3) is adjacent to King Street and Centreville Creek Road. To gain an understanding of the natural system and the history of the site, historic aerial imagery was reviewed. The oldest available image year was 1978, with the most recent being 2018, providing a period of record of 40 years.

In 1978 the study area and neighbouring properties were predominantly agricultural, with the watercourse having riparian vegetation consisting of grasses and shrubs. Very little change in adjacent land-use and the channel corridor was noted in the 1999 aerial imagery. In the most recent (2018) aerial imagery, agriculture still dominated the surrounding land-use, however, a sports field complex is now immediately upstream of the study limits, and the channel appears to terminate at the upstream end at a SWM pond constructed as part of the sports field complex. Again, in 2018, the riparian corridor remains unchanged when compared to 1978 and 1999.

The channel very briefly intersects the southern corner of the site (6939 King Street) limits, however, approximately 388 m of the channel is contained within the expanded study limits. The study limits capture the channel between King Street (upstream limit) a residential driveway crossing (downstream limit). In the study area, the channel flows within an unconfined system. From aerial photo interpretation, the 1978 conditions indicate the channel was a straightened agricultural ditch. Since then, the channel has experienced minor adjustments in planform, however, this transformation has been occurring at a slow rate in localized areas. This adjustment was mainly observed as lateral migration and channel bifurcation (splitting into multiple flow paths) within the riparian corridor. Changes in channel width were difficult to assess as riparian vegetation obscured the channel banks.

Due to the uniformity of planform conditions (straightened channel), the channel is assessed as a singular reach. The meander belt width varies in width throughout this reach due to differences in meander axis alignment and slight differences in meander geometry, however, the 100-year erosion rate was assessed and applied to the entire reach based on reach-averaged erosion rates. The valley length within the study reach is 387 m, and in 2018, the channel length was measured to be 390 m, resulting in a sinuosity of 1.01, indicating near straight planform conditions and confirming visual observations.



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Oct 1, 2020

0 50 100 150 200 metres

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[Drawing by: CWM]

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LEGEND

- Property Line
- Channel Centreline
- Study Limits

Figure 3: Study Area Map

6939 King Street, Caledon, Ontario

4. Historic Site Context

To gain an understanding of the valley system and evolution of the channel within the study area, historic aerial imagery was reviewed. It was necessary to use imagery that was clear of vegetative cover to provide an unobstructed view of the channel. Imagery was obtained for 1978, 1999, and 2018, providing a period of record of approximately 40 years and covering three time periods, per the recommendations of the meander belt delineation protocol (TRCA, 2001). A summary of the data sources used and their corresponding interpretation is provided in Table 1. The aerial imagery and centreline delineations for different years are illustrated in Appendix A.

Table 1: Summary of historic observations of the watercourse within the study area.

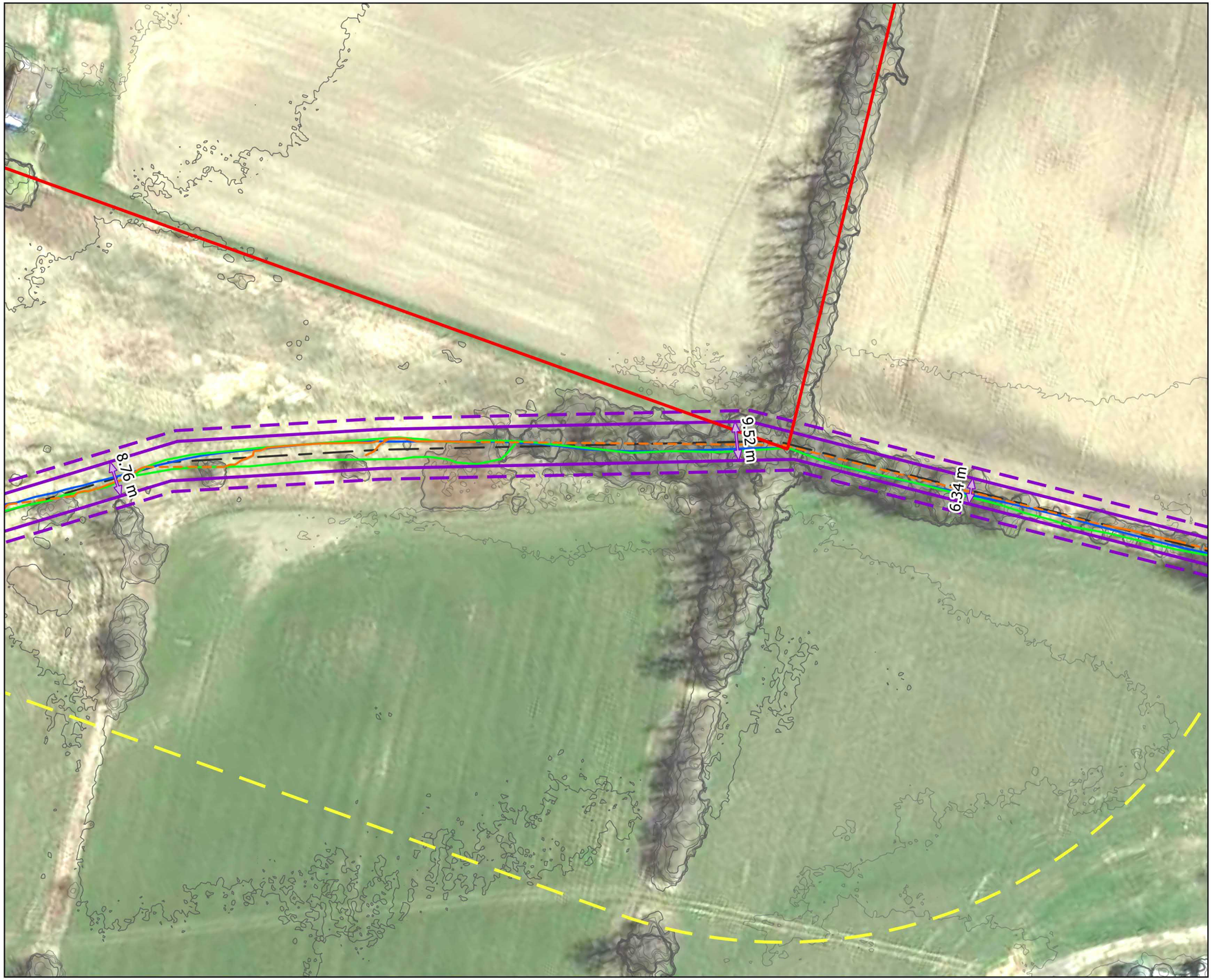
Year	Summary
1978	King Street and Centreville Creek Road were both paved roads. The surrounding land-use was predominantly agricultural, with intermittent farm structures and residences. A few minor exceptions were pockets of forested areas towards the north, northwest and east as well as some small pond features. The channel corridor does not appear to have any riparian vegetation except for some trees intermittently along the channel and possibly some grassy vegetation. The entire study reach appears to be a straightened agricultural ditch, possessing little-to-no lateral planform variability. Upstream of King Street, the channel becomes very poorly defined, appearing to be depressions that would convey overland flow through the agricultural field. Downstream of the study area, the channel appears to exhibit some planform variability until it crosses under Centreville Creek Road and joins with another tributary where it proceeds to run parallel to the road in a straight ditch for approximately 240 m.
1999	The surrounding land-use remains relatively unchanged from 1978, with only minor changes to the landscape. The only noticeable change was the removal and addition of several buildings adjacent to previously built residential and agricultural developments. The channel corridor remains in a similar alignment, with minor planform changes including the divergence of flow paths for approximately 80 m. The riparian vegetation consists of the same trees, with similar grassy vegetation. There is evidence of tracks from agricultural machinery crossing the channel corridor near the upstream end of the study area.
2018	Again, the surrounding land-use remains relatively unchanged from 1999 and 1978. The most notable change to the surrounding area is a new sports field complex upstream of the study area, north of King Street. The new facility is approximately 6 hectares and includes 5 sports fields, 2 parking areas and a SWM pond. It appears that the channel now originates from the SWM pond outlet. Previously, the channel originated from overland flow paths through the agricultural fields now occupied by the new complex. The riparian corridor of the channel through the study area contains the same trees as previous years, with some new tree and shrub growth within the corridor. The grassy vegetation persists adjacent to the channel. The channel exhibits some minor lateral migration, although due to the growth of the grassy vegetation, the alignment was difficult to delineate in some sections.

There was no historic aerial imagery available showing the natural, pre-channelized state of the studied channel. However, the channel within the study reach appears have been minimally altered (physically) since 1978 and, thus, provides good insight into the rate and modes of channel adjustments over a 40-year period.

5. Results

Meander belt widths for the study reaches were determined based on 1978, 1999, and 2018 aerial imagery. The meander belt width ranged from 6.34 m to 9.52 m within the study area, with a meander belt width of 9.52 m at the intersection with the project area. All years' imagery was considered in this assessment and all years were incorporated into the meander belt width delineation.

The lateral migration rate was also measured based on the historical aerial photos for the entire study reach. By comparing the migration of the outsides of meander bends from 1978 to 1999 as well as 1999 to 2018, the lateral migration rate was determined to be approximately 2.6 cm/year. As such, a 2.6 m erosion offset was added to the meander belt. The results of the analysis are shown in Figure 4.



Legend

- Study Limits
- Property Line
- Meander Belt
- Erosion Offset
- Meander Axis
- 2018 - Centreline
- 2018 - Centreline (Approximated)
- 1999 - Centreline
- 1978 - Centreline

Contours

- 5 m Contours
- 1 m Contours

N

0 25 50 75 metres

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Figure 4: Meander Belt Delineation

6939 King Street, Caledon, Ontario

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6. Conclusions

Following a desktop analysis, a meander belt width limit was delineated for a tributary to Lindsay Creek adjacent to 6939 King Street. This delineation is depicted in Figure 4 and has also been provided in digital format (SHP and DWG). The belt width lines can be used in subsequent land-use planning and constraint mapping. If you have any questions regarding this study, please do not hesitate to contact Chris McKie at 519-221-4111 or by email at cmckie@geoprocess.com.

Regards,

GeoProcess Research Associates Inc.

Chris McKie, MASc, P.Eng.
River Engineer

Ben Plumb, PhD, P.Eng.
River Engineer

Disclaimer

We certify that the services performed by GeoProcess Research Associates were conducted in a manner consistent with the level of care, skill and diligence to be reasonably exercised by members of the engineering and science professions.

Information obtained during the site investigations or received from third parties does not exhaustively cover all possible environmental conditions or circumstances that may exist in the study area. If a service is not expressly indicated, it should not be assumed that it was provided. Any discussion of the environmental conditions is based upon information provided and available at the time the conclusions were formulated.

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Project Number P2020-469

References

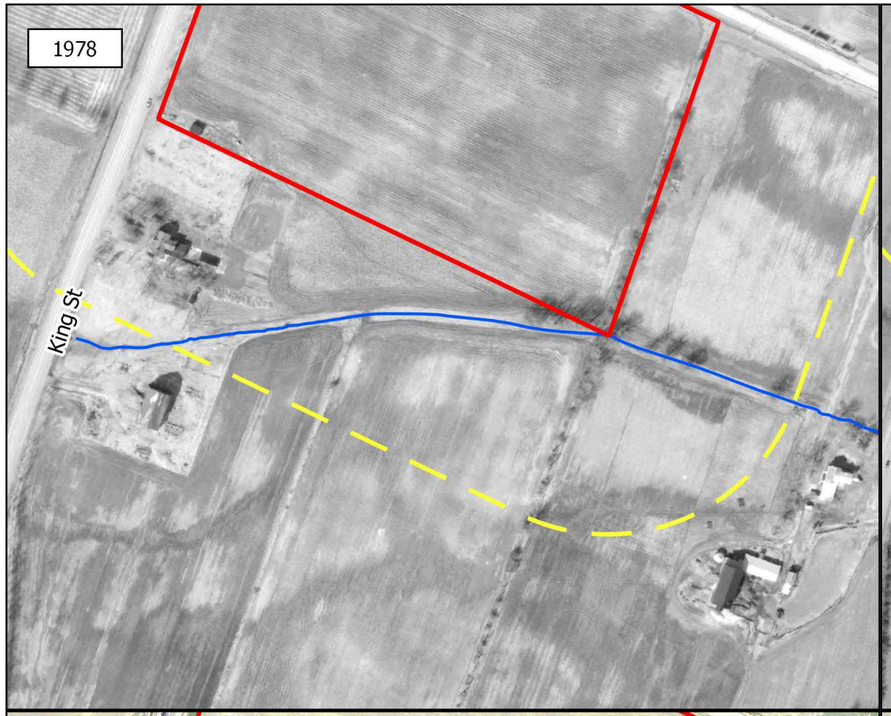
Toronto Region Conservation Authority (TRCA), 2001. Belt Width Delineation Procedures. Submitted by Parish Geomorphic. report no. 98-023.

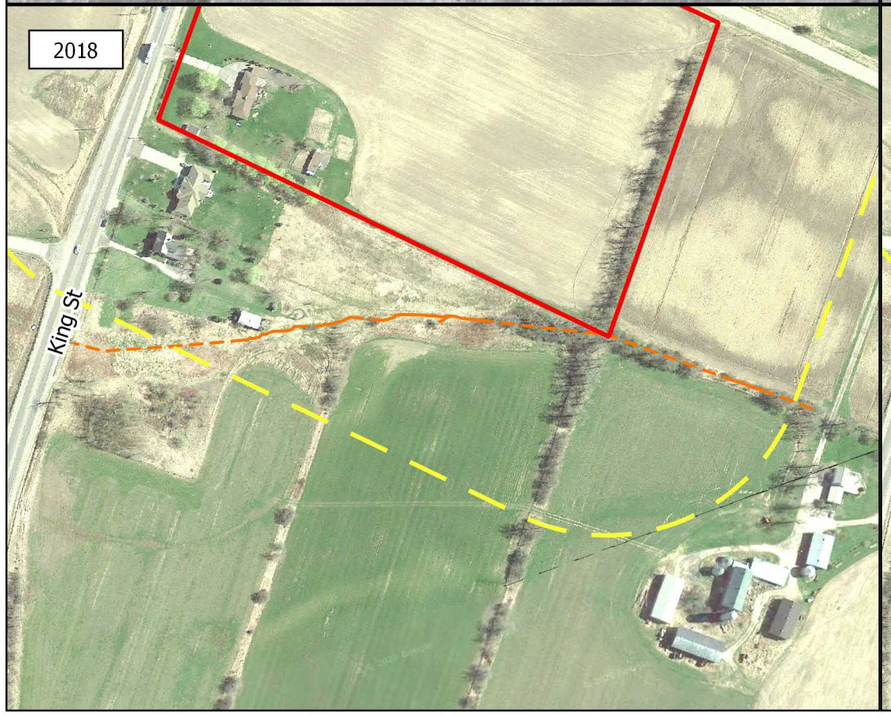
Ministry of Natural Resources (MNR), 2002. Technical Guide; River & Stream Systems: Erosion Hazard Limit. Prepared by Terraprobe Ltd. And Aqua Solutions.

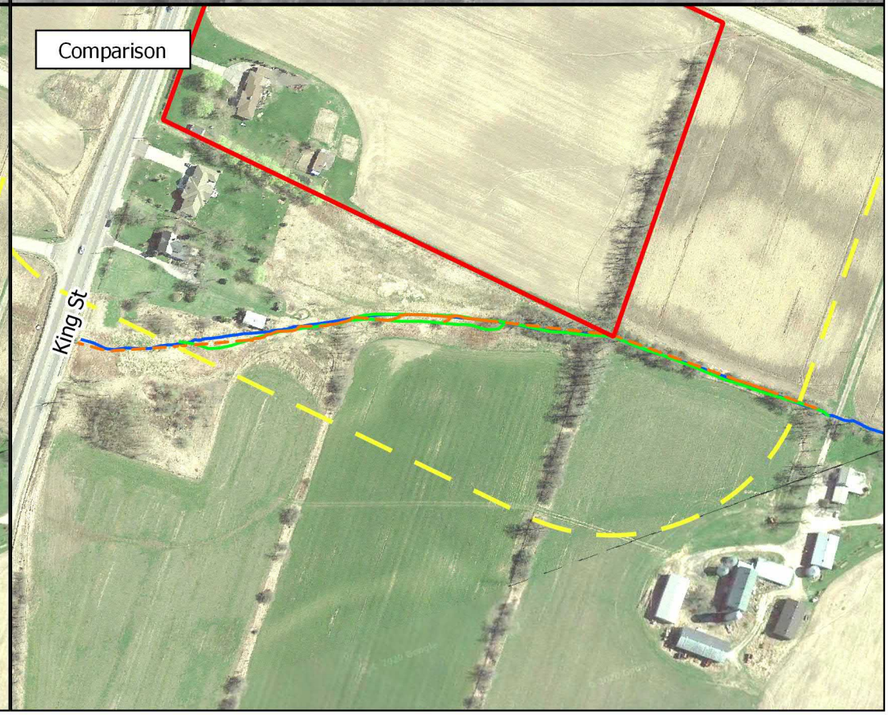
Land Information Ontario, Ministry of Natural Resources (LIO), 2019. South Central Ontario Orthophotography Project (SCOOP) 2018.

Appendix A

Historic Aerial Imagery and Centreline Delineation







Legend

- Property Line
- Study Limits
- 2018 - Centreline
- 2018 - Centreline (Approximated)
- 1999 - Centreline
- 1978 - Centreline

N

0 100 200 300 400 metres

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Coordinate System:
WGS 84 / UTM Zone 17 N

Historical Creek Delineation

6939 King Street, Caledon, Ontario

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