



APPENDIX D

Floodplain Analysis



MEMO

TO: Albert Zhuge, P.Eng.
FROM: Xiaoxu (Iris) Qu, P.Eng.
SUBJECT: **Bartley Smith Greenway Trail Gap Feasibility Study: Hydraulic Memo**
DATE: **October 29, 2021**

1. Introduction

WSP is retained by the City of Vaughan to complete a feasibility study and 30% design to fill critical gaps in the Bartley Smith Greenway (BSG) Trail along a 3 km segment in the Upper West Don River Corridor between McNaughton Avenue to Keel Street. The study area is situated within the Don River watershed, which falls in the Toronto and Region Conservation Authority (TRCA) jurisdiction. The TRCA completed the Don River Flood Mapping Phase II Study in 2020, which included a HEC-RAS hydraulic model and Regulatory floodplain map for the existing conditions.

2. Background Information

The current Don River Phase II HEC-RAS model and two floodplain map sheets that cover the study area were provided by the TRCA in September 2021. The model and floodplain map were reviewed by the water resources staff.

3. TRCA Criteria

In order to fully understand the TRCA's criteria/expectation related to the locations of the trail alignments and water crossings, the water resources staff consulted the TRCA on September 13, 2021. The TRCA provided general criteria for the development and additional criteria on September 14, 2021 by email, as shown below:

General Criteria

- Where the development is within the Regulatory floodplain, TRCA requires to demonstrate no loss to the floodplain storage and a hydraulic impact analysis.

Additional Criteria

- For Water Crossing(s):
 - Minimize fill placement within the Regulatory floodplain.
 - If possible, reduce the number of crossings (limit to one).
 - Clearly show the top of bank on the drawings and the location of the erosion and sediment control features. This is necessary to show that silt fencing will be placed outside of the channel.
 - If it is a new bridge or a replacement bridge with different geometry, a HEC-RAS model for 2 – 100 year and Regional storm is required to demonstrate no adverse impacts to the local floodplain.



- Stone sizing should be provided based on the anticipated velocities through the channel. Supporting calculations should be provided and sizing details should be included on the drawings.
- Fluvial geomorphological analysis is required to support the proposed study, e.g., meander belt, 25/50 year channel migration, 25yr and/or 50yr erosion limit, etc.
- For the Trail:
 - Minimize fill placement within the Regulatory floodplain.
 - Update the HEC-RAS model with the proposed changes to the geometry and show no impacts for the 2-100 year and regional storm events.
 - Less intrusive trail design should be favored over impactful design such as pavement. It is recommended to reduce the number of impervious surfaces as much as possible.
 - The trail should be set outside of the 25/50 year channel migration to prevent hardening the creek in the future to protect the trail.
 - Address the sediment and erosion control measures proposed for the site and ensure the details are shown on the drawings.

The TRCA's email is enclosed to the end of this memo.

4. Next Steps

Upon preferred trail alignments and water crossings are determined, the water resources staff will update the HEC-RAS hydraulic model and simulate the 2 – 100 year and Regional storm for the proposed conditions. We will ensure they will meet the TRCA's criteria stated above and to demonstrate no negative impacts to the existing floodplain.

Fluvial geomorphological analysis will be required to support the location of the preferred trail alignment, crossing location, span and stream bank / abutment erosion protection requirements. This will be accomplished through the determination of stream meander belt widths and 25yr and/or 50yr stream erosion limits.

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MEMO

TO: City of Vaughan
FROM: Xiaoxu (Iris) Qu, P.Eng., Albert Zhuge, P.Eng.
SUBJECT: **Bartley Smith Greenway Trail Gap Feasibility Study: Floodplain Analysis**
DATE: **July 29, 2022**

1. Introduction

WSP is retained by the City of Vaughan to complete a feasibility study and 30% design to fill critical gaps in the Bartley Smith Greenway (BSG) Trail along a 3 km segment in the Upper West Don River Corridor between McNaughton Avenue to Keel Street. The study area is situated within the Don River watershed, which falls in the Toronto and Region Conservation Authority (TRCA) jurisdiction. The TRCA completed the Don River Flood Mapping Phase II Study in 2020, which included a HEC-RAS hydraulic model and Regulatory floodplain map for the section of Don River associated with the subject site.

2. Background Information

The current Don River Phase II HEC-RAS model and two floodplain map sheets (Don # 08 and Don # 09) that cover the study area were provided by the TRCA in September 2021, and reviewed by WSP. The TRCA Regulatory floodlines are illustrated in **Figure 1**.

3. TRCA Criteria

In order to fully understand the TRCA's criteria/expectation related to the locations of the trail alignments and water crossings, the water resources staff consulted the TRCA on September 13, 2021. The TRCA provided general criteria for the development and additional criteria on September 14, 2021 by email, as shown below:

General Criteria

- Where the development is within the Regulatory floodplain, TRCA requires to demonstrate no loss to the floodplain storage and a hydraulic impact analysis.

Additional Criteria

- For Water Crossing(s):
 - Minimize fill placement within the Regulatory floodplain.
 - If possible, reduce the number of crossings (limit to one).
 - Clearly show the top of bank on the drawings and the location of the erosion and sediment control features. This is necessary to show that silt fencing will be placed outside of the channel.

- If it is a new bridge or a replacement bridge with different geometry, a HEC-RAS model for 2 – 100 year and Regional storm is required to demonstrate no adverse impacts to the local floodplain.
 - Stone sizing should be provided based on the anticipated velocities through the channel. Supporting calculations should be provided and sizing details should be included on the drawings.
 - Fluvial geomorphological analysis is required to support the proposed study, e.g., meander belt, 25/50 year channel migration, 25yr and/or 50yr erosion limit, etc.
- For the Trail:
 - Minimize fill placement within the Regulatory floodplain.
 - Update the HEC-RAS model with the proposed changes to the geometry and show no impacts for the 2-100 year and regional storm events.
 - Less intrusive trail design should be favored over impactful design such as pavement. It is recommended to reduce the number of impervious surfaces as much as possible.
 - The trail should be set outside of the 25/50 year channel migration to prevent hardening the creek in the future to protect the trail.
 - Address the sediment and erosion control measures proposed for the site and ensure the details are shown on the drawings.

The TRCA’s email is provided in **Appendix A**.

4. Floodplain Analysis

4.1 Preferred Trail Alignments and Watercourse Crossing

For the subject feasibility study and 30% design completion, the preferred trail alignment was completed in June, 2022, as shown in **Figure 1**. One watercourse crossing is proposed approximately 1 km south of Major Mackenzie Drive West. The River ID (West Don Reach 18) and Cross Sections from the TRCA existing HEC-RAS Don River model are also illustrated in **Figure 1**. As shown in **Figure 1**, portions of the proposed trail are located outside the Regulatory floodlines.

4.2 Potential Hydraulic Impacts

Proposed Trail

To examine the potential hydraulic impacts of the proposed trail, the cross sections that show the elevation of both the existing ground and the proposed trail were generated with a space of approximately 25 m along the trail alignment. As indicated, the proposed trail elevations generally remain unchanged at the existing ground elevations. Therefore, there would be no impacts to the existing Regulatory floodlines. The layout (**Figure 2**) and plots of the cross sections are provided in **Appendix B**. Note that the cross sections with the proposed trail outside the Regulatory floodlines are marked as “O_F”. Two examples of the cross sections are shown in **Exhibit 1**.

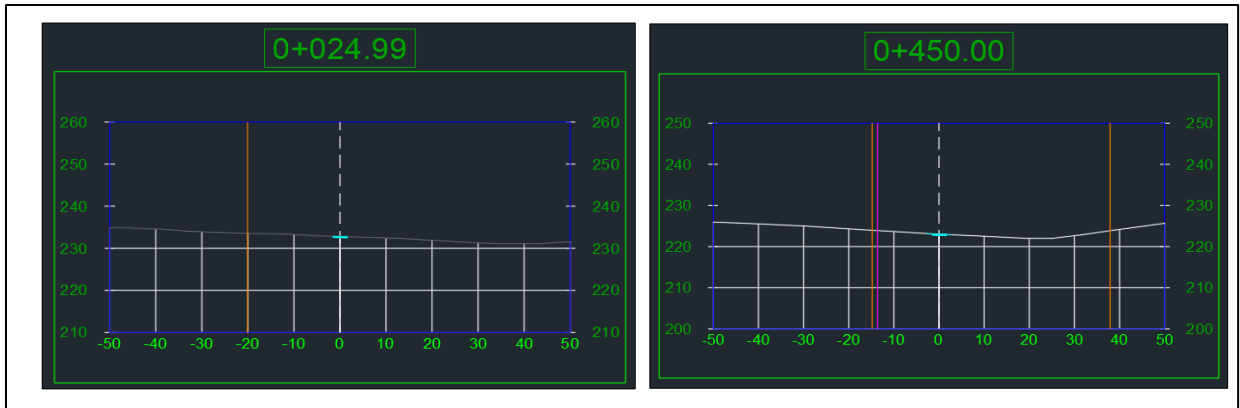


Exhibit 1 Cross Section Samples

Proposed Bridge

As stated above, there is a proposed 33 m bridge located approximately 1 km south of Major Mackenzie Drive West. The layout of this bridge is presented in the drawing L306. As shown in this drawing, the abutments of the proposed bridge are situated outside of the TRCA Regulatory floodlines. As such, there would be no impacts to the existing Regulatory floodlines.

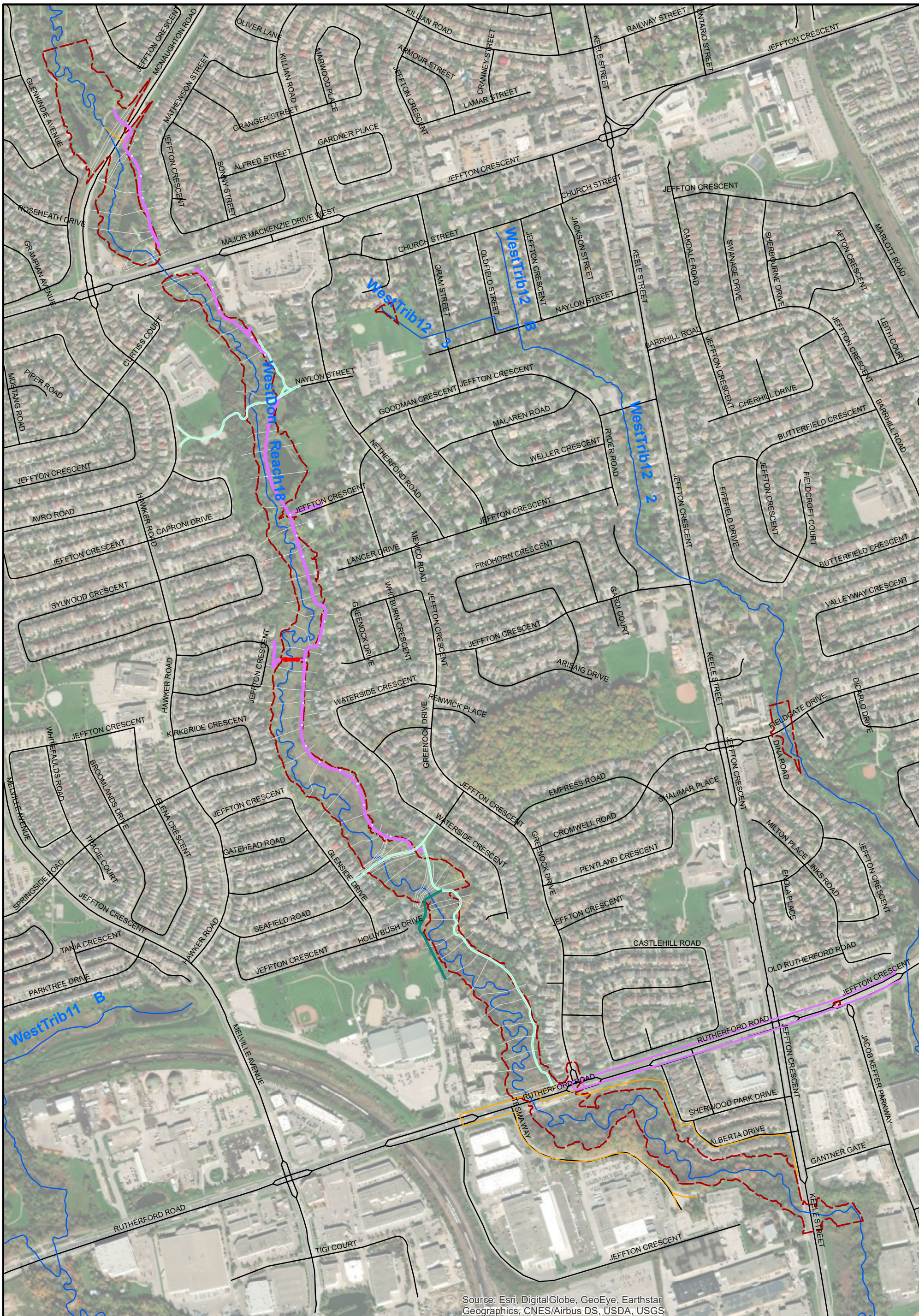
5. Conclusion

The preferred trail alignment was completed in June, 2022. A 33 m bridge is proposed approximately 1 km south of Major Mackenzie Drive West. To examine the potential hydraulic impacts, the cross sections were generated at a space of approximately 25 m along the proposed trail to compare the elevations between the existing ground and proposed trail. Since the proposed trail is generally at the existing ground elevations, there would be no negative impacts to the existing Regulatory floodlines.

The abutments of the proposed bridge are located outside of the TRCA Regulatory floodlines. As such, there would be no impacts to the existing Regulatory floodlines.



FIGURE AND DRAWING



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics; CNES/Airbus DS, USDA, USGS

Legend

- Existing Asphalt
- Proposed BSG Trail
- Proposed Watercourse Crossing
- Proposed BSG Trail_Future
- Proposed BSG Trail_Alternative
- - - TRCA Regulatory Floodline
- - - TRCA Model Cross Section
- TRCA Model Don River

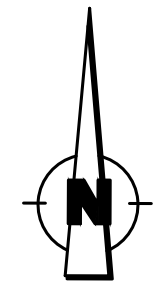
CLIENT
CITY OF VAUGHAN

TITLE
BARTLEY SMITH GREENWAY TRAIL
GAP FEASIBILITY STUDY

FLOODPLAIN ANALYSIS



Checked	I.Q	Drawn	J.C
Date	July 2022	Proj. No.	211-07301-00
Scale	1:8,000	Figure No.	1



PROPOSED
RETAINING WALL

(SIDEWALK
ENDS- SITE GPS)

ROUTE EXPLORED - LONG
TERM CONSIDERATION

PROPOSED 33m BRIDGE STRUCTURE (ROUTE
EXPLORED - LONG TERM CONSIDERATION)

(POTENTIAL ABUTMENT
LOCATION- SITE GPS)

ALTERNATE 60m BRIDGE CROSSING LOCATION
(NEED TO BE CONFIRMED BY GEOMORPHOLOGY MEMBERS)

5.7m BETWEEN THE EDGE OF TRAIL
AND STREAM

(POTENTIAL ABUTMENT
LOCATION- SITE GPS)

ORIGINAL TRAIL LOCATION (RESIDENTIAL
CONCERNS ABOUT TRAIL LOCATED CLOSE TO
BACKYARDS)

ALTERNATE TRAIL LOCATION RESPONDING TO RESIDENTIAL CONCERNS (LOCATION
TO BE EXPLORED FURTHER, FURTHER CONSULTATION WITH THE CITY, TRCA, MECP
REGARDING HABITAT AND ECOLOGICAL CONCERNS IN THE SUBJECT AREA)

R19.00

0+549.90

0+574.90

0+599.90

0+649.73

0+624.90

0+674.72

0+699.72

0+724.72

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0+774.72

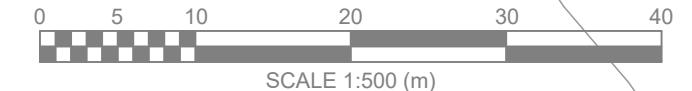
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0+824.72

0+849.72

0+874.72

TRCA Regulatory Floodlines



KEY MAP

LEGEND

BENCHMARK INFORMATION

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ELEVATION = XXX.XX

SURVEY - DRAWING REF #: XXX-XXX-XX-XXX
BY: DATE:

NO	DATE	REVISION/ISSUED	BY	APPD



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Kitchener, ON N2K 1M3
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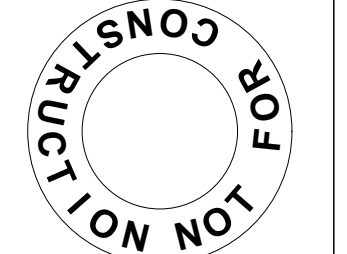
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CITY OF VAUGHAN
2141 Major MacKenzie Dr W, Maple, ON L6A 1T1

PROJECT TITLE:
BARTLEY SMITH GREENWAY TRAIL
TRAIL ALIGNMENT
SP #

SITE ADDRESS:
MCNAUGHTON RD. & MAJOR MACKENZIE DR.

DRAWING TITLE:
LAYOUT PLAN

STAMP



STAMP

DESIGNED	WL	DRAWN	WL	CHECKED	##
SCALE	1:500	DATE	DEC 10 2021	PROJECT NUMBER	DWG. NUMBER
211-07301-00					L-306

APPENDIX

A TRCA EMAIL



From: Shilla Shahlaee <Shilla.Shahlaee@trca.ca>

Sent: Tuesday, September 14, 2021 11:25 AM

To: Zhuge, Albert <Albert.Zhuge@wsp.com>

Cc: Manirul Islam <manirul.islam@trca.ca>

Subject: TRCA's Water Resources Requirements for Bartley Smith Trail Feasibility Study

Hello Albert,

Thank you for your email.

In your email to Manirul you mentioned that some sections of the trail system such as water crossings will be within the regulatory flood plain. In such cases where the development is within a floodplain, TRCA requires the proponent to demonstrate no loss to the floodplain storage and a hydraulic impact analysis. As such, the approach you mentioned is acceptable, however, we also require for additional info that I have listed below for your reference:

For Water Crossing(s):

1. Please ensure that fill placement within the regulatory floodplain is minimized.
2. If possible, please reduce the number of crossings (limit to one).
3. A letter report/design brief should be provided that speaks to the fluvial geomorphological condition of the watercourse (including channel stability, erosion rate, design flows and velocities) and the recommendations for the crossing at this location with regards to crossing on a straight stretch of the watercourse, at a perpendicular angle, etc. It is recommended to include an overview of the channel (at the upstream and downstream of the proposed crossing, at least 200m or whatever length necessary to show at least two major meanders). Please note, TRCA typically requires a pedestrian bridge to span the 25yr and/or 50yr erosion limit.
4. Please clearly show the top of bank on the drawings and the location of the erosion and sediment control features. This is necessary to show that silt fencing will be placed outside of the channel.
5. If it is a new bridge, or a replacement bridge with different geometry, then the bridge should be modelled in HEC-RAS for 2-100 year and Regional storm events to demonstrate no adverse impacts to the local floodplain. The railings should be modelled as blocked as it is to be assumed that railings will catch debris. This design report and model needs to be stamped by a P. Eng.
6. Stone sizing should be provided based on the anticipated velocities through the channel. Supporting calculations should be provided and sizing details should be included on the drawings.

For the Trail:

7. Please ensure that the fill placement within the regulatory floodplain is minimized.

8. Please update the HEC-RAS model with the proposed changes to the geometry and show no impacts for the 2-100 year and regional storm events.
9. Less intrusive trail design should be favored over impactful design such as pavement. It is recommended to reduce the number of impervious surfaces as much as possible.
10. Please ensure the trail is set outside of the 25/50 year channel migration. This is to prevent hardening the creek in the future to protect the trail.
11. Please address the sediment and erosion control measures proposed for the site and ensure the details are shown on the drawings.

I hope the information provided above is helpful. Should you have any additional questions, please don't hesitate to email me.

Kind Regards,

Shilla Shahlaee, M.S.c., E.I.T.

Technologist, Water Resources Engineering
Engineering Services | Development and Engineering Services

T: (416) 661-6600 ext. 6490

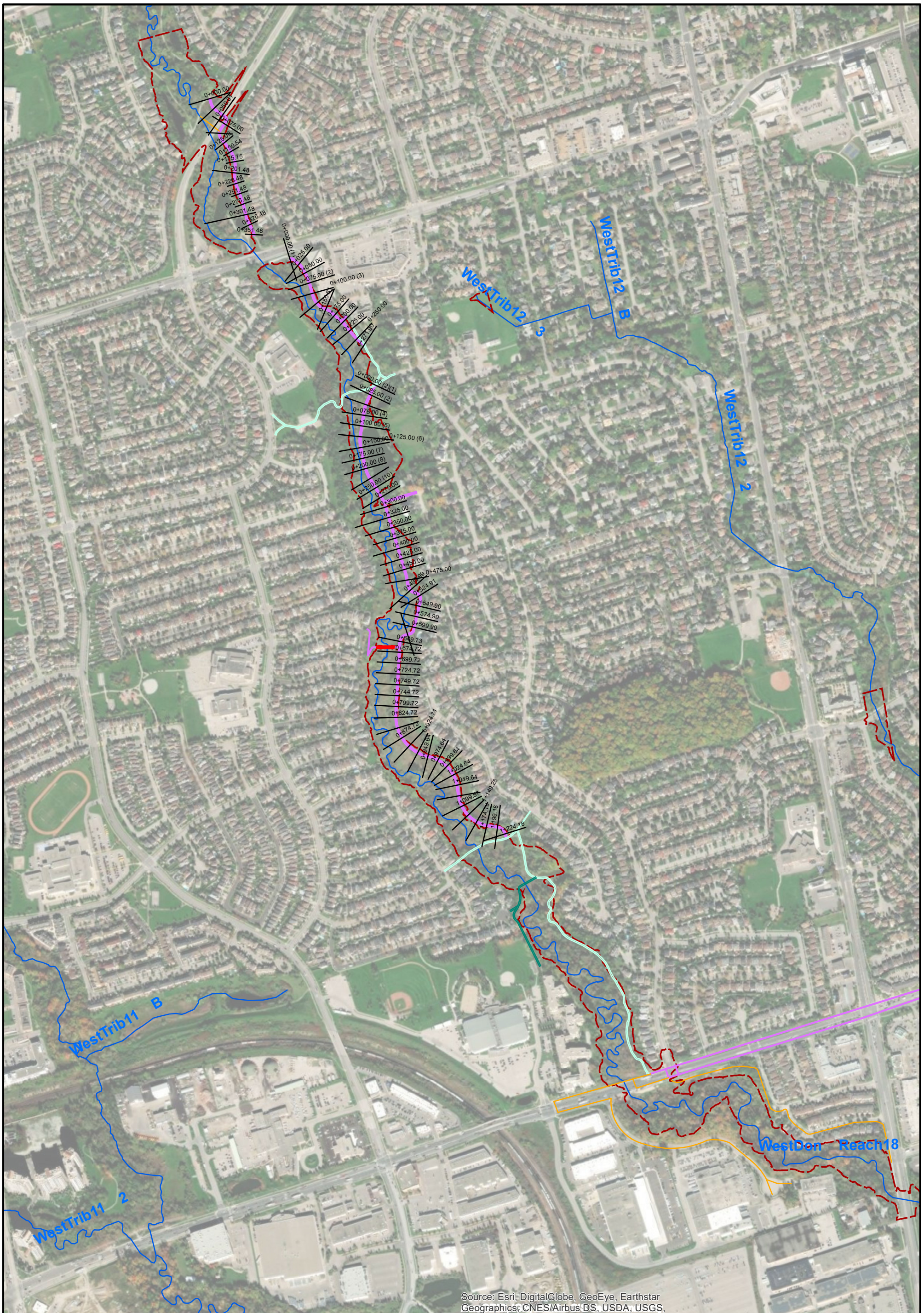
E: shilla.shahlaee@trca.ca

A: [101 Exchange Avenue, Vaughan, ON, L4K 5R6](#) | trca.ca



APPENDIX


B CROSS SECTION LAY- OUT AND CROSS SEC- TIONS

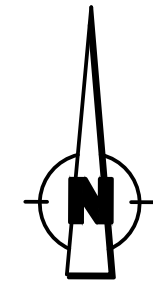


Source: Esri; DigitalGlobe, GeoEye, Earthstar Geographics; CNES/Airbus DS, USDA, USGS,

Legend	
— TRCA Model Don River	— Proposed BSG Trail_Future
— TRCA Regulatory Floodline	— Proposed BSG Trail_Alternative
— Existing	— Cross Section_Sample Line
— Proposed BSG Trail	■ Proposed Watercourse Crossing

CLIENT	CITY OF VAUGHAN
TITLE	BARTLEY SMITH GREENWAY TRAIL GAP FEASIBILITY STUDY
Cross Section - Sample Lines	

			
Checked	I.Q	Drawn	J.C
Date	July 2022	Proj. No.	211-07301-00
Scale	1:8,000	Figure No.	2



KEY MAP

LEGEND

- PROPOSED RECOMMENDED ALIGNMENT
- PROPOSED ALTERNATIVE ALIGNMENT
- EXISTING TRAIL PROPOSED FOR RE-PAVING
- EXISTING TRAIL
- PROPOSED TRAIL (OUT OF PROJECT SCOPE)
- ALIGNMENT EXPLORED BUT NO LONGER PURSUED
- ALIGNMENT EXPLORED AND RECOMMENDED FOR FUTURE PHASE
- PREFERRED ALIGNMENT EXPLORED AND RECOMMENDED FOR FUTURE PHASE
- PROPOSED BRIDGE
- PROPOSED BENCH PAD
- PROPOSED RETAINING WALL
- DON RIVER WEST BRANCH
- 20m OFFSET FROM THE DON VALLEY WEST BRANCH
- 10m OFFSET FROM THE TRCA 100 YEAR FLOODLINE
- TRCA 100 YEAR FLOODLINE
- PROPOSED PLANTING - TYPE A (LIGHT BUFFER)
- PROPOSED PLANTING - TYPE B (MEDIUM BUFFER)
- PROPOSED PLANTING - TYPE C (ROBUST BUFFER)

BENCHMARK INFORMATION

ELEVATIONS ARE IN METRES AND ARE DERIVED FROM
 BENCHMARK No: XXXXXXXXX,
 ELEVATION = XXX.XX
 SURVEY - DRAWING REF #: XXX-XXX-XX-XXX
 BY: _____ DATE: _____

NO	DATE	REVISION/ISSUED	BY	APPD

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 582 Lancaster Street West
 Kitchener, ON N2K 1M3
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 SP #

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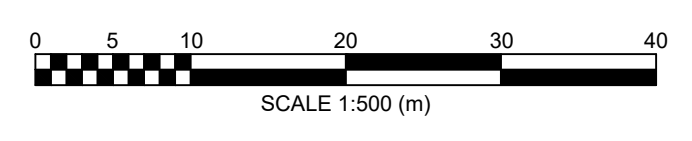
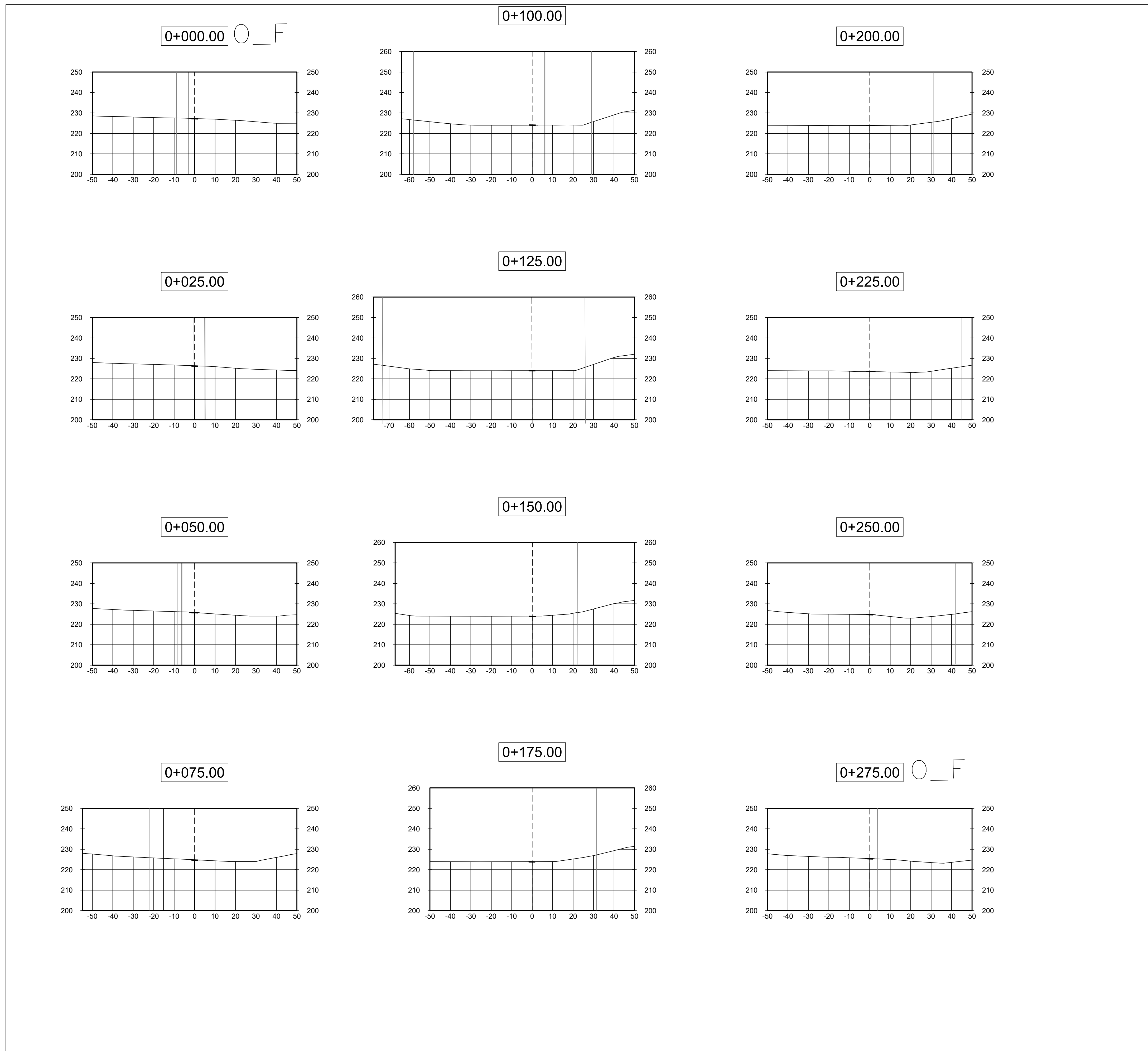
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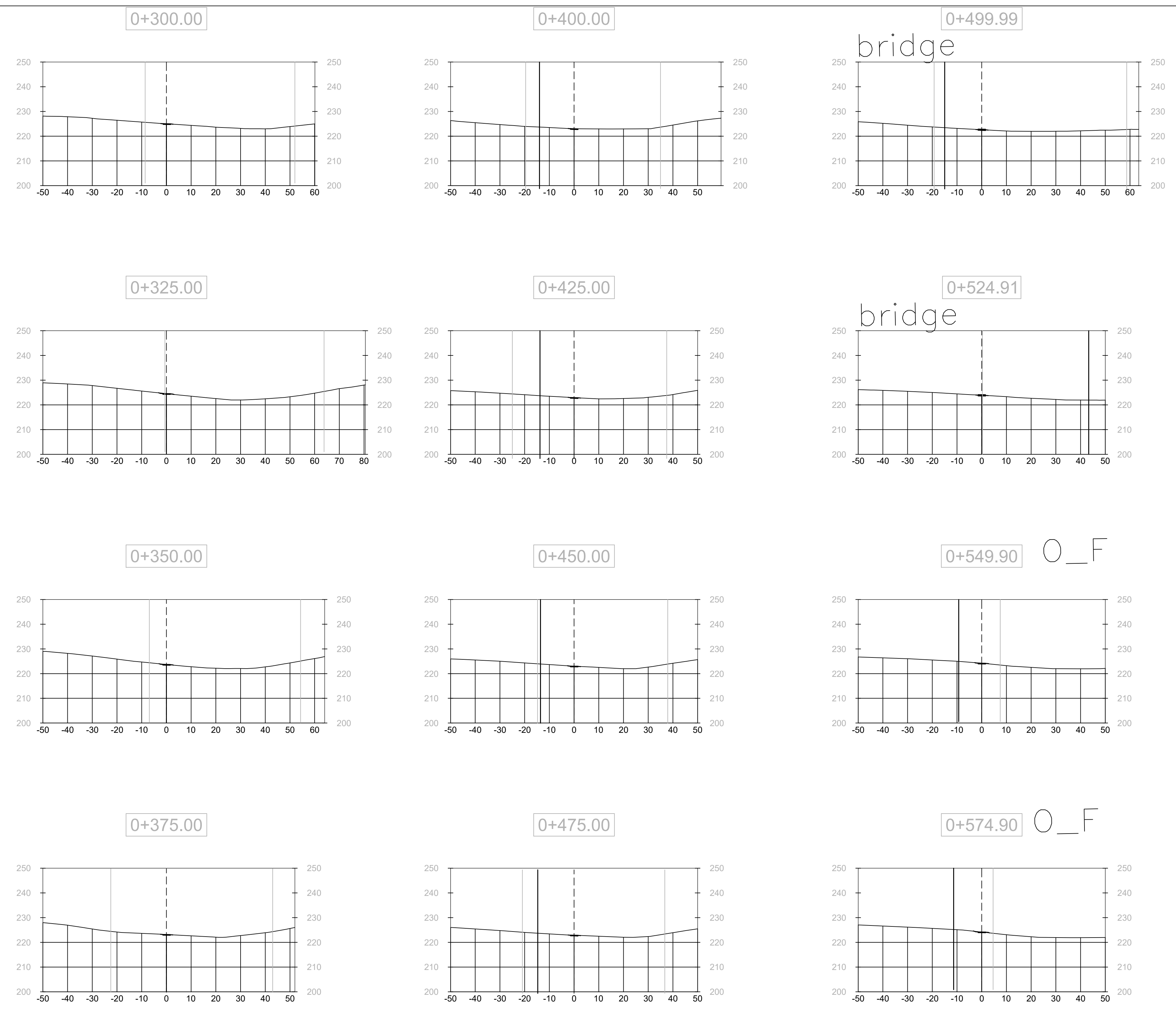
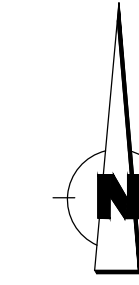
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211-07301-00 L-301



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KEY MAP

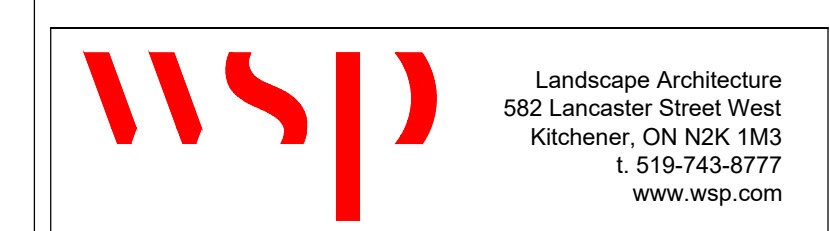
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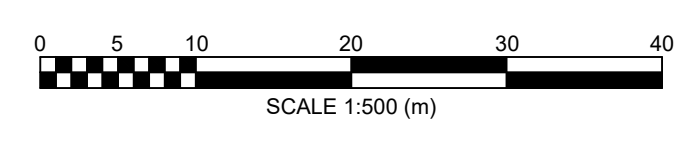
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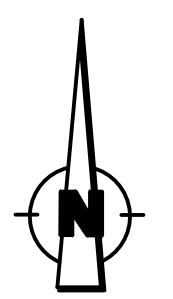
PROJECT TITLE:
BARTLEY SMITH GREENWAY TRAIL
 TRAIL ALIGNMENT
 SP # _____

SITE ADDRESS:
 MCNAUGHTON RD. & MAJOR MACKENZIE DR.

DRAWING TITLE:
LAYOUT PLAN

DESIGNED WL	DRAWN WL	CHECKED ##
SCALE 1:500	DATE DEC 10 2021	
PROJECT NUMBER 211-07301-00	DWG. NUMBER L-301	





KEY MAP

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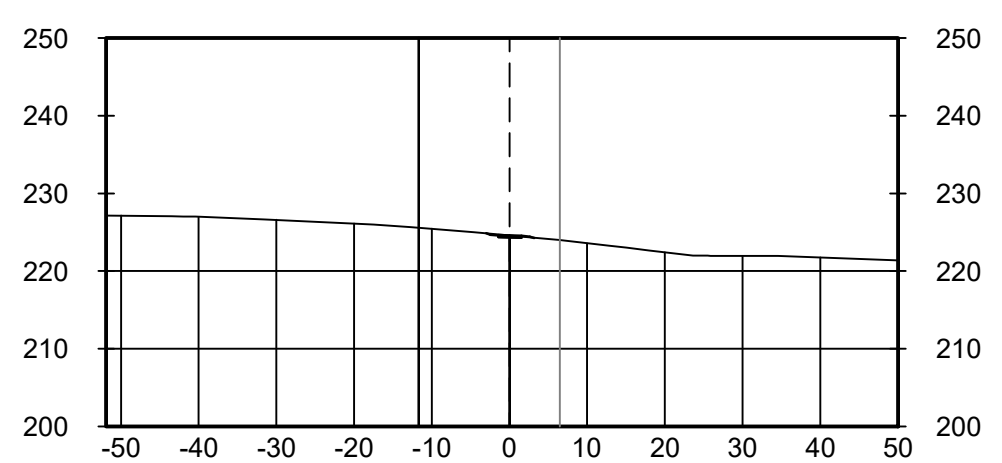
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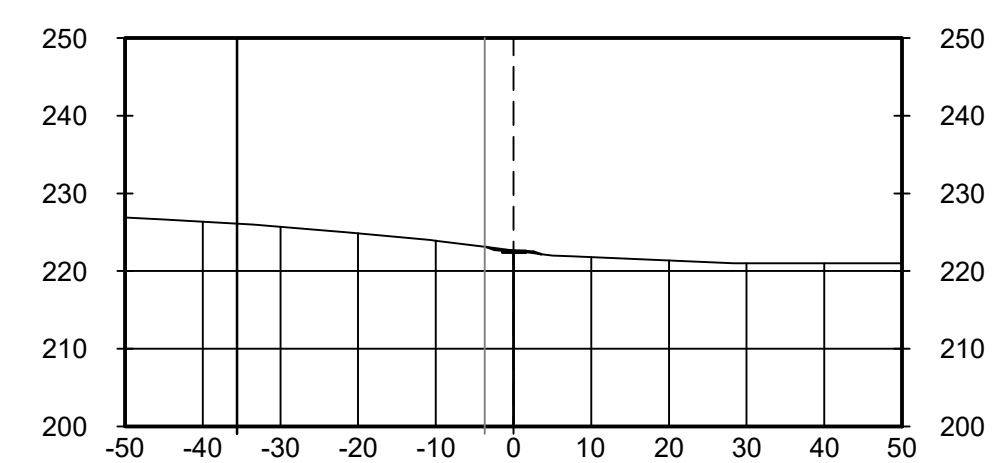
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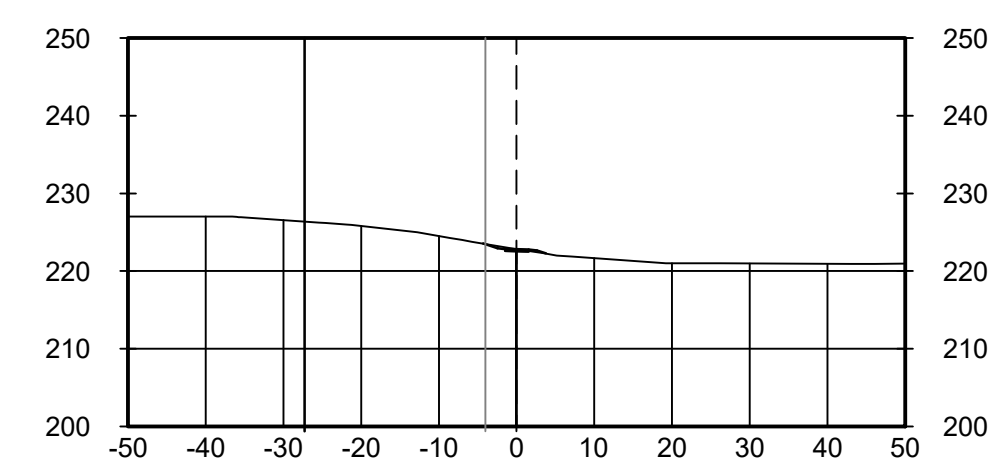
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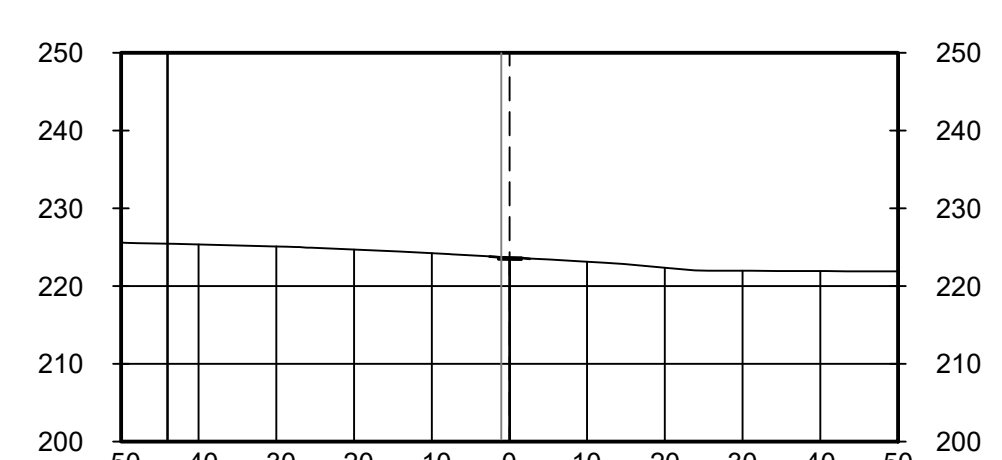
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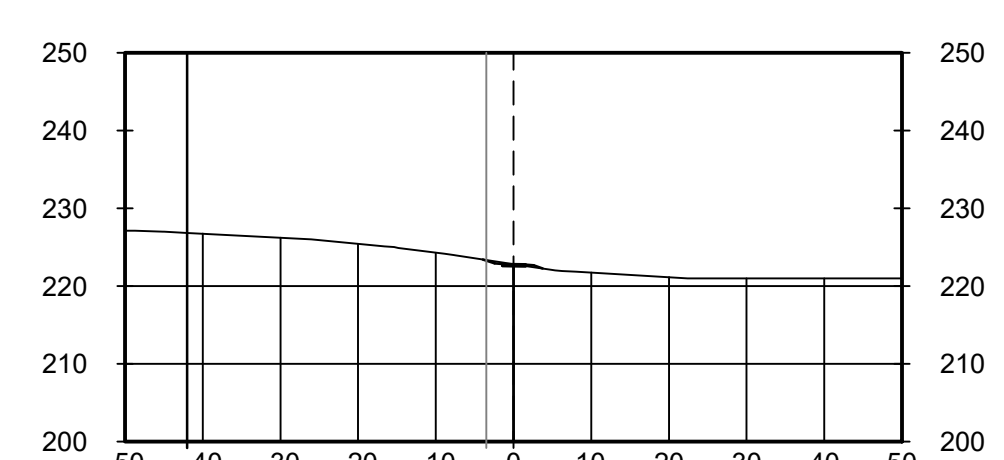
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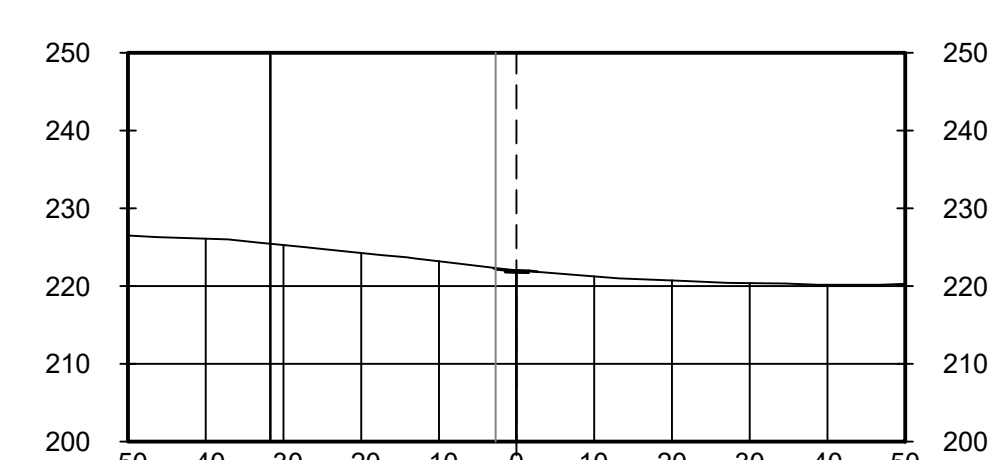
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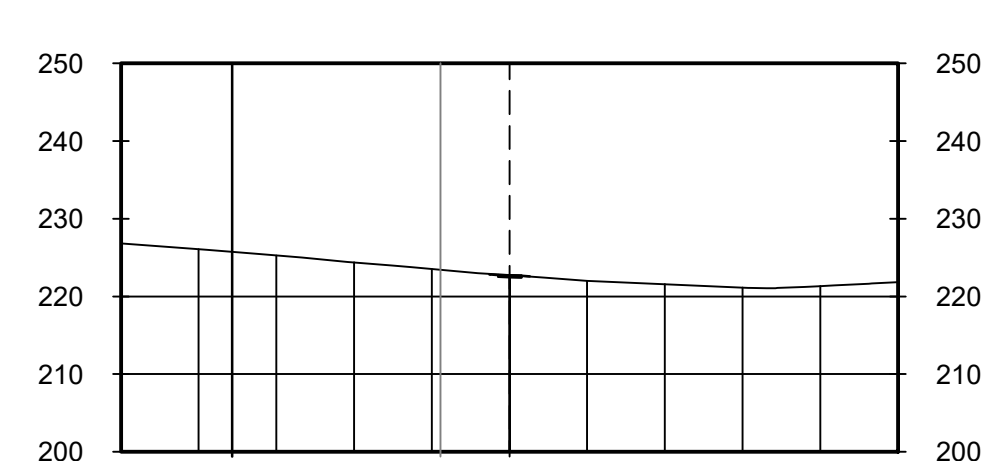
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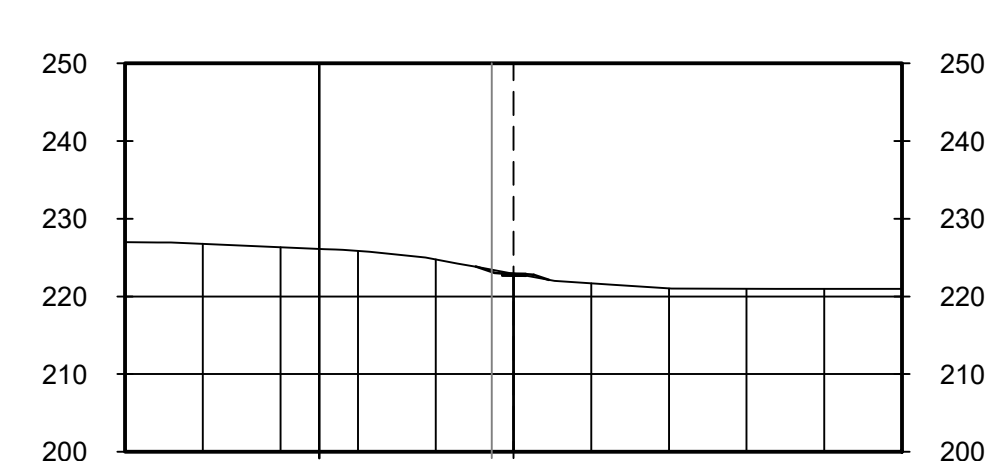
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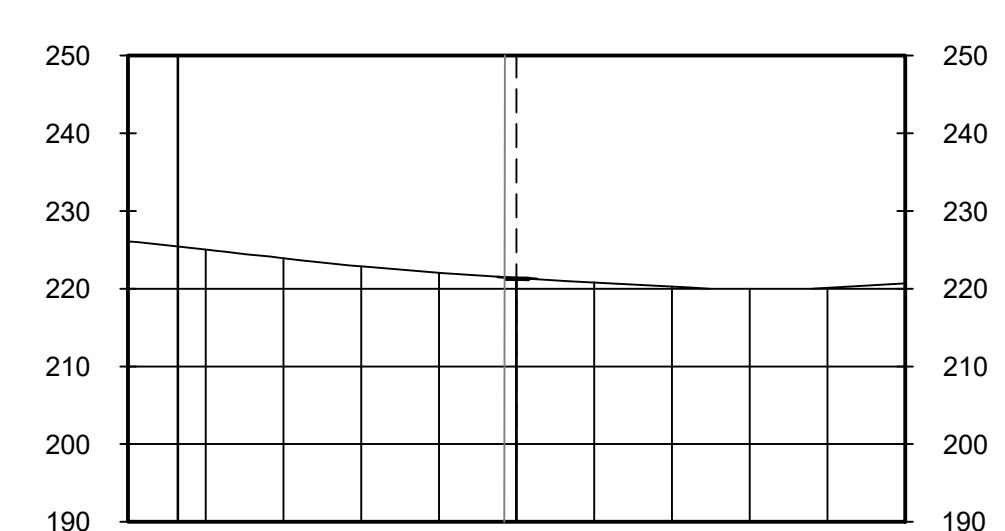
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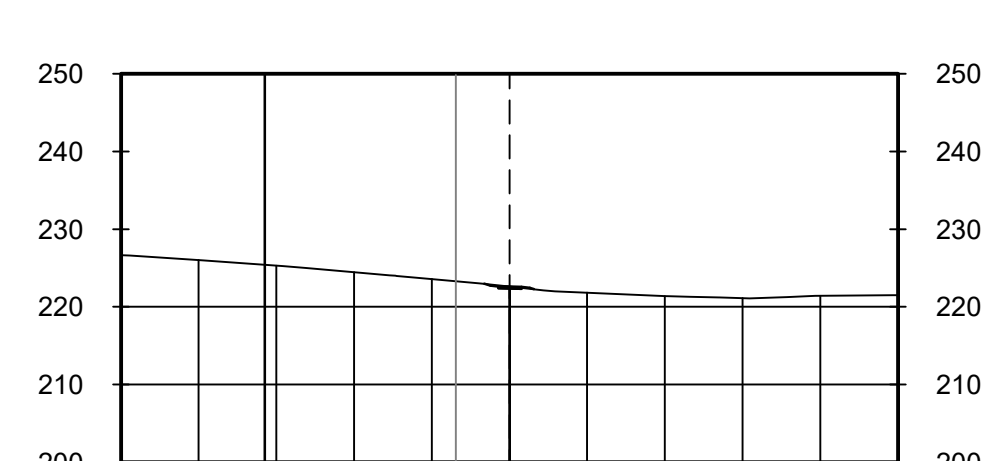
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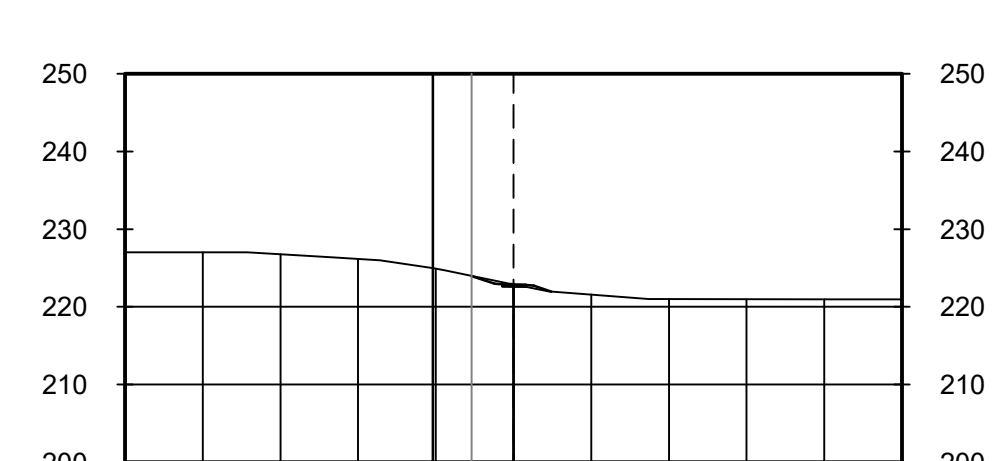
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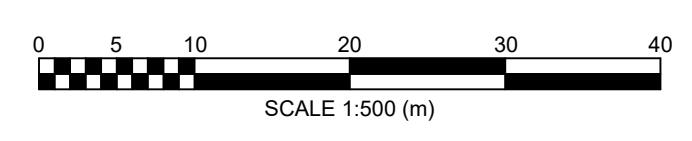
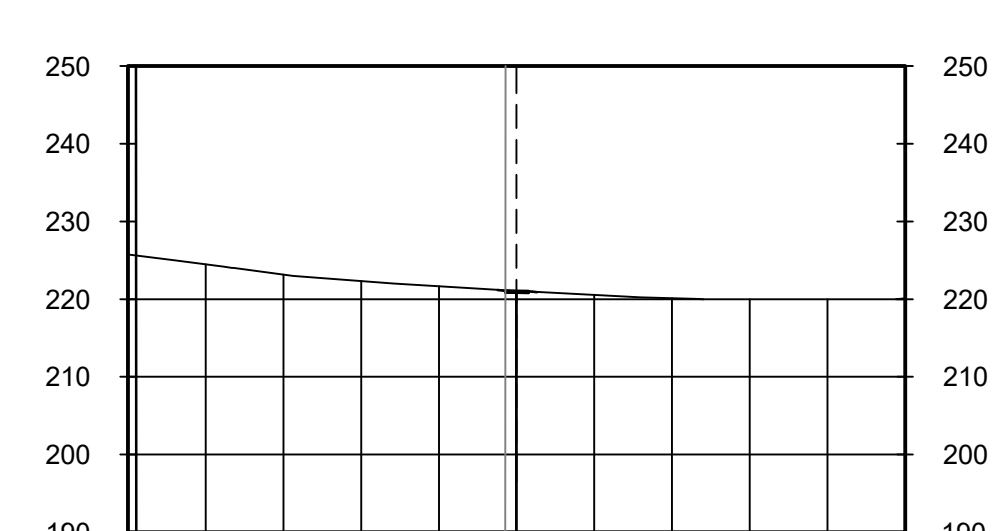
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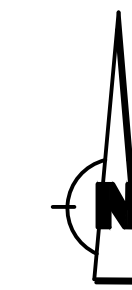
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KEY MAP

LEGEND

- PROPOSED RECOMMENDED ALIGNMENT
- PROPOSED ALTERNATIVE ALIGNMENT
- EXISTING TRAIL PROPOSED FOR RE-PAVING
- · — EXISTING TRAIL
- · — PROPOSED TRAIL (OUT OF PROJECT SCOPE)
- - - - - ALIGNMENT EXPLORED BUT NO LONGER PURSUED
- · — ALIGNMENT EXPLORED AND RECOMMENDED FOR FUTURE PHASE
- - - - - PREFERRED ALIGNMENT EXPLORED AND RECOMMENDED FOR FUTURE PHASE
- ▭ PROPOSED BRIDGE
- PROPOSED BENCH PAD
- PROPOSED RETAINING WALL
- DON RIVER WEST BRANCH
- 20m OFFSET FROM THE DON VALLEY WEST BRANCH
- 10m OFFSET FROM THE TRCA 100 YEAR FLOODLINE
- TRCA 100 YEAR FLOODLINE
- PROPOSED PLANTING - TYPE A (LIGHT BUFFER)
- PROPOSED PLANTING - TYPE B (MEDIUM BUFFER)
- PROPOSED PLANTING - TYPE C (ROBUST BUFFER)

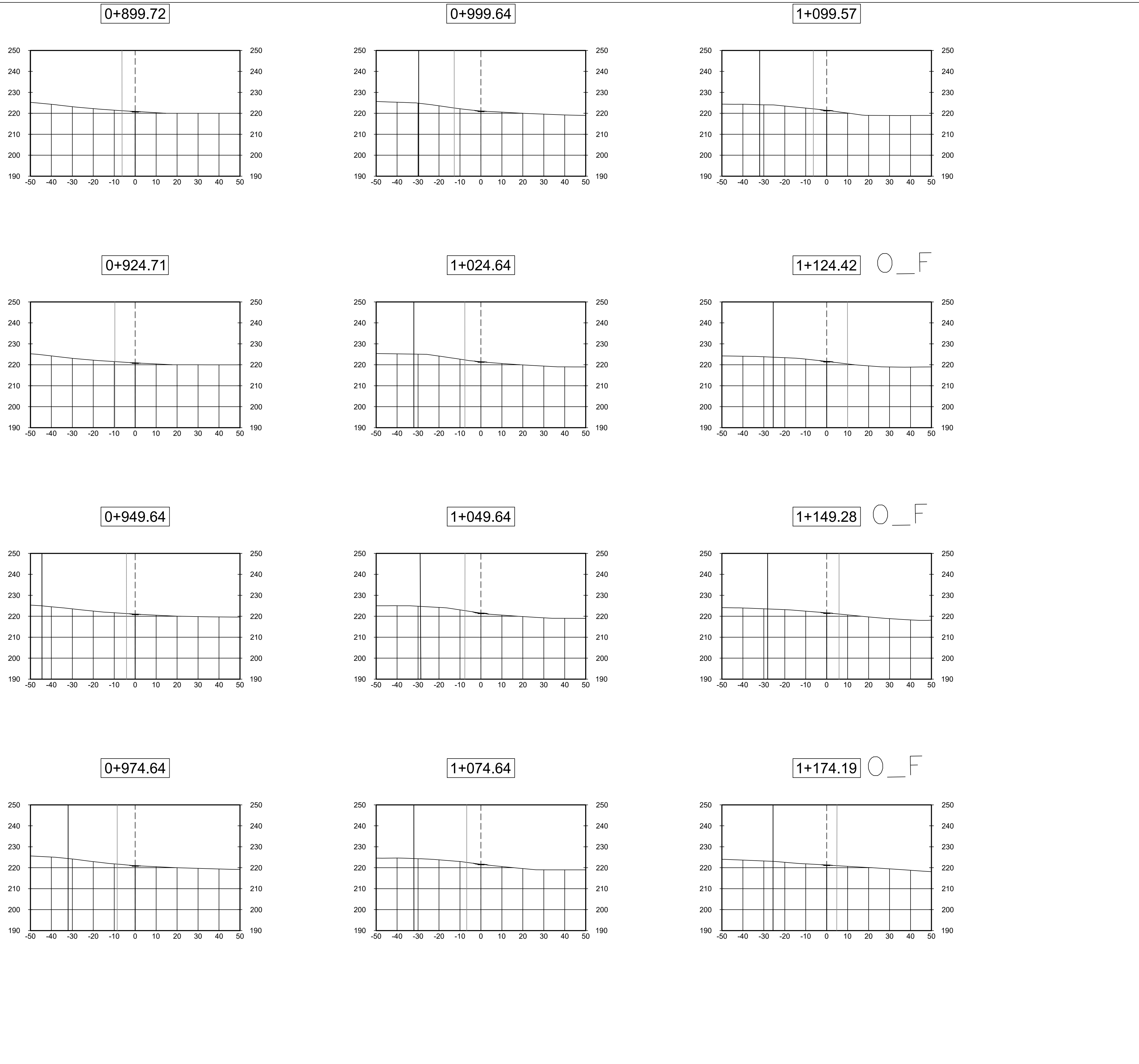
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ELEVATION = XXXXX

SURVEY - DRAWING REF # XXX-XXX-XX-XXX

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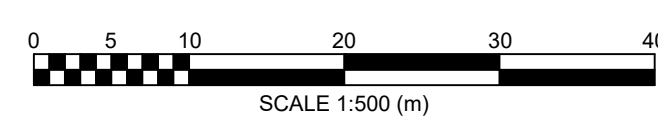
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PROJECT TITLE:
BARTLEY SMITH GREENWAY TRAIL
TRAIL ALIGNMENT
SP #

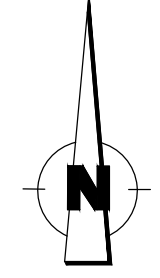
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SCALE 1:500	DATE DEC 10 2021
PROJECT NUMBER 211-07301-00	DWG. NUMBER L-301



KEY MAP



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SURVEY - DRAWING REF # XXX-XXX-XX-XXX
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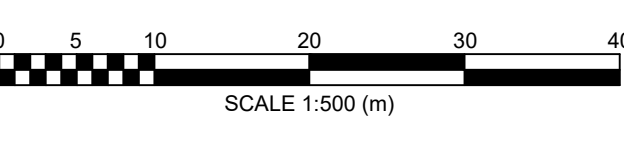
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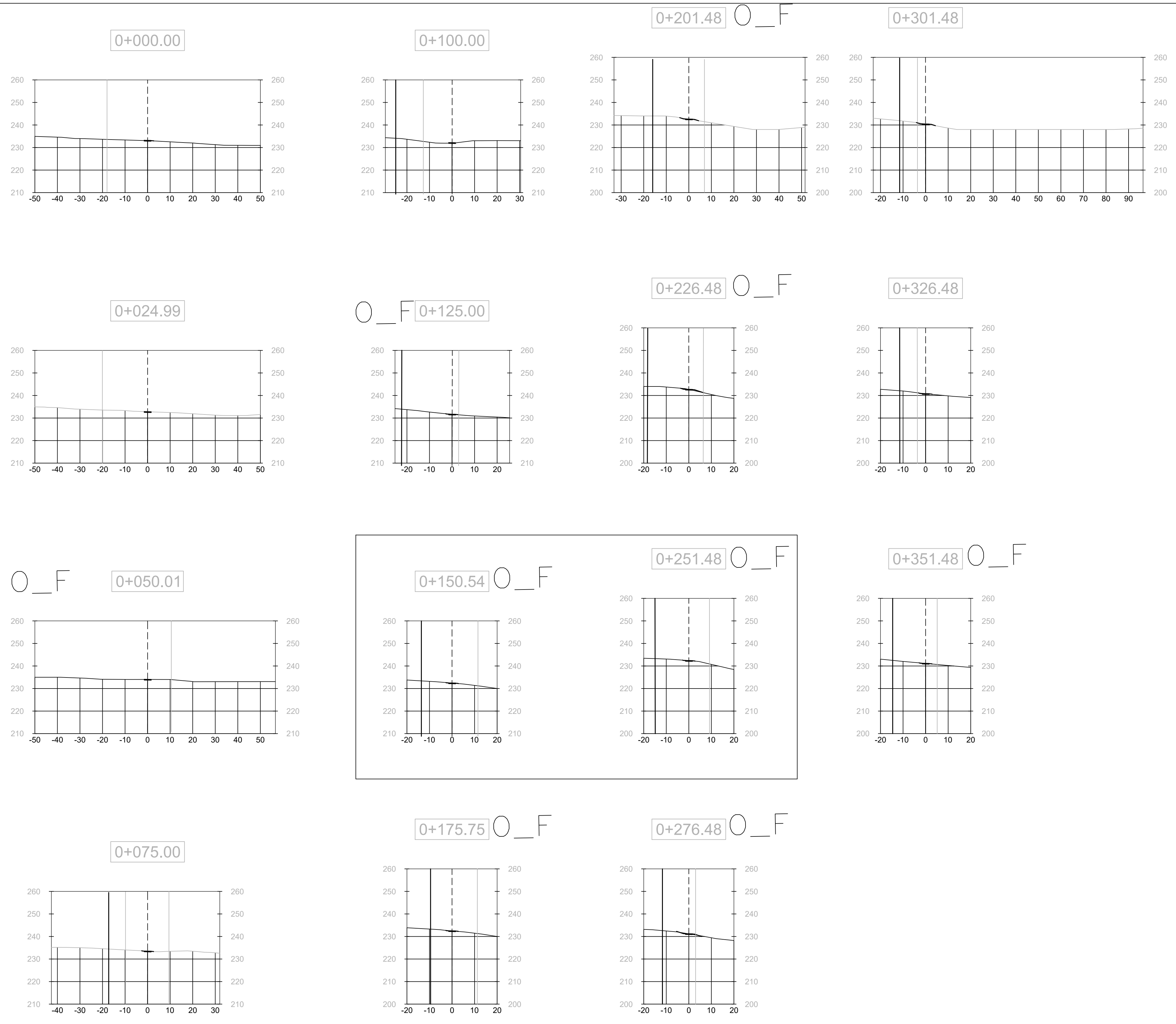
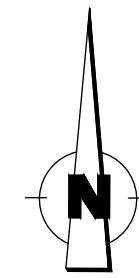
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SCALE 1:500 DATE **DEC 10 2021**

PROJECT NUMBER **211-07301-00** DWG. NUMBER **L-301**





KEY MAP

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 ELEVATION = XXX.XX
 SURVEY - DRAWING REF #: XXX-XXX-XX-XXX
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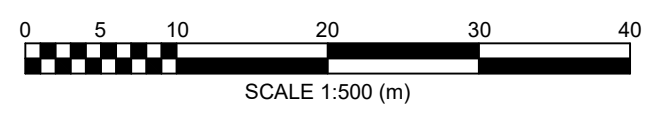
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BARTLEY SMITH GREENWAY TRAIL
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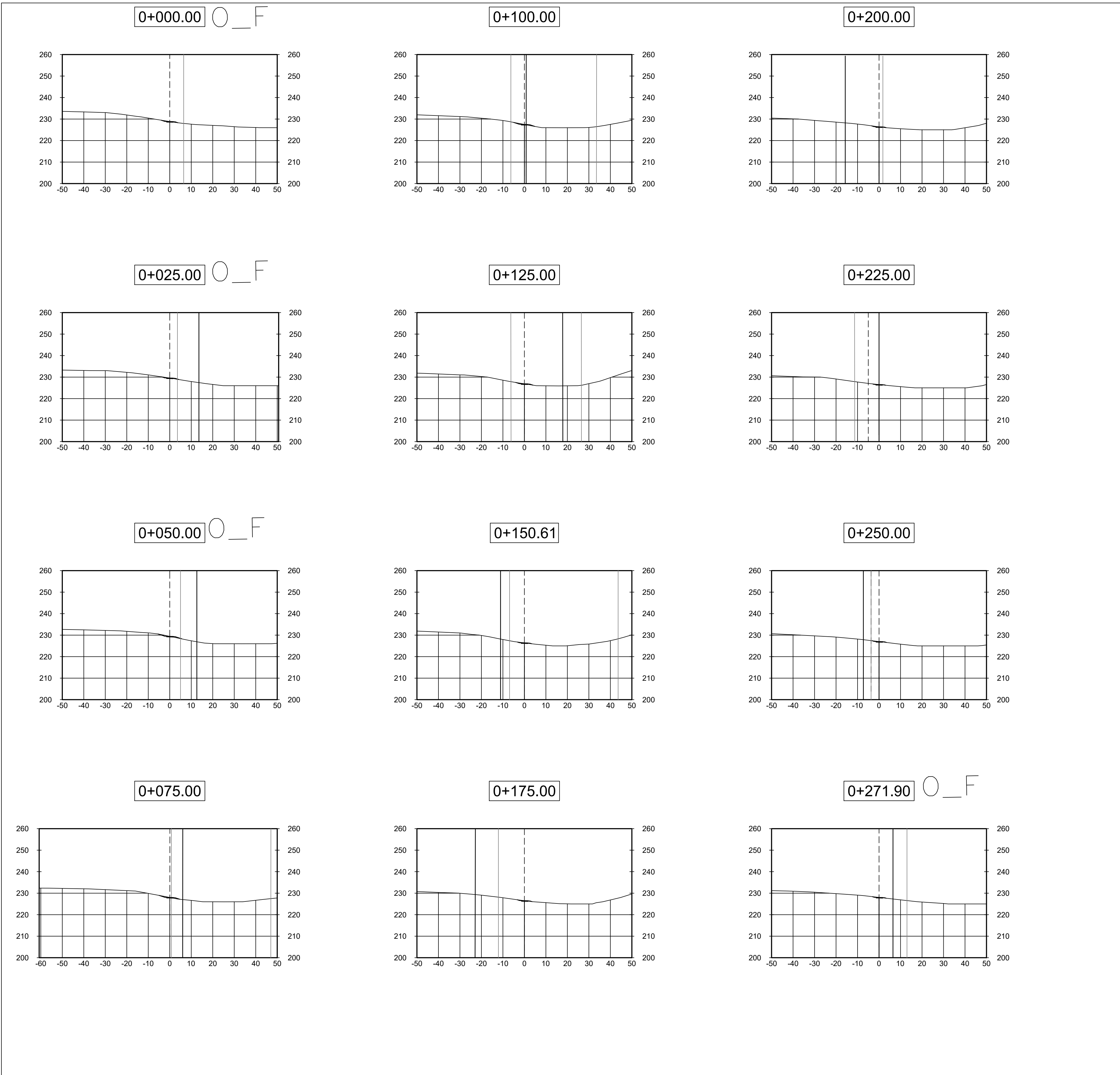
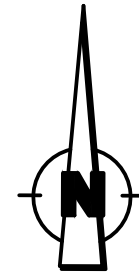
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SCALE 1:500	PROJECT NUMBER 211-07301-00	DATE DEC 10 2021	DWG. NUMBER L-301





KEY MAP

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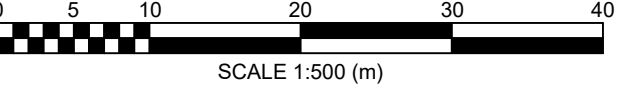
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MEMO

TO: Amanda Gebhardt, WSP
FROM: Peter Hayes, P.Geo., WSP
SUBJECT: Bartley Smith Trail Preliminary Design City of Vaughan, Ontario – Desktop Fluvial Geomorphology Assessment
DATE: September 26, 2022
Project No.: 211-07301-00

This memo presents the desktop fluvial geomorphological assessment of the subject watercourse (Don River West Branch) channel located along the Bartley Smith Trail Preliminary Design City of Vaughan, Ontario. The site location is shown on attached **Figure 9**.

BACKGROUND

The site is located in an urban setting within the City of Vaughan with primarily residential commercial, and natural land uses surrounding the site. The site is located in the South Slope and Peel Plain physiographic regions as per Chapman and Putman (1984). Quaternary mapping of the area shows the geology consists of silt/silty clay (Halton Till) and silt and clay as per Ontario Geological Survey (2000).

APPROACH

WSP's approach for the desktop fluvial geomorphology assessment was as follows:

- Obtaining historical aerials;
- Adding watercourse alignments on historical aerials;
- Reviewing relevant TRCA guidance documents;
- Assessing historical aerials, including a composite figure; and
- Finally making recommendations for the site based on the findings, including a proposed set back.

HISTORICAL AERIAL IMAGES

As a part of the desktop fluvial geomorphology assessment WSP retrieved aerial imagery of the site, as far back as available (1946, 1954, 1960, 1970, 1988, 1999, 2005, 2014 and 2020). The individual historical aerial images are provided on **Figures 1 to 9**.

Watercourse alignments are shown on individual aerials, it is noted that various colours were used such the specific historical aerial watercourse alignments could easily be identified on the composite figure (**Figure 10**).

1946, 1954, 1960 AND 1970

In 1946, 1954, 1960 and 1970 (**Figures 1, 2, 3 and 4**) the area was mostly rural, with agricultural fields and residences and natural areas. Urban developments (residential) started to appear in the southwest corner of Major Mackenzie Drive West and Keele Street in 1954 (roads) (**Figure 2**) by 1960 (**Figure 3**) houses had been constructed along the roads and the development had expand to the south. Additionally there appears to have been a landing strip of airplanes to the west of watercourse just south of Major Mackenzie Drive West. By 1970 (**Figure 4**) more houses had been built and a rail line was constructed in the northeast corner of Jane Street and Rutherford Road.

1988, 1999 AND 2005

In 1988, 1999 and 2005 (**Figures 5, 6 and 7**) the area was continually developed, becoming almost entirely urban by 2005 (**Figure 7**). By 1988 (**Figure 5**) residential developments had expanded to east of Keele Street, north of Major Mackenzie Drive West and in the northwest corner of Rutherford Road and Keele Street. By 1999 (**Figure 6**) residential developments had grown to west of the watercourse with almost the entire area east of the watercourse having been developed. By 2005 (**Figure 7**) the area was entirely urban with development having extended west of the watercourse.

2014 AND 2020

In 2014 and 2020 (**Figures 8 and 9**) the site was urban. There were some developments in 2014 (**Figure 8**) on the outside edge of the site.

ASSESSMENT

Based on the historical aerials the area was developed from a rural setting to an urban gradually between 1954 (**Figure 2**) and 2005 (**Figure 7**).

WSP approximated the watercourse channel for each historical aerial photograph and compiled the approximated watercourse channels onto one figure to highlight the historical variations of the watercourse over the 74 year timeframe, 1946 to 2020 (**Figure 10**). As noted previously watercourse alignments have various colours for individual historical aerial watercourse alignments such that each can be easily identified on the composite figure (**Figure 10**).

Based on **Figure 10** it is interpreted that this watercourse channel has followed the same alignment with minor fluctuations over the 74 year assessment timeframe. The watercourse has shifted an approximate maximum 15 m in select locations since 1988; however, the watercourse channel has generally remained quite consistent with no significant channel shifts in most areas; however, there are some areas where there was channel migration of 10m since 1988.

WSP completed an estimation of lateral 100-year erosion rates based on the TRCA (2015) *Crossing Guidelines for Valley and Corridors (Appendix 2.A)*. This method is for a proposed crossing and involves measurements at two meanders upstream and downstream of the crossing. However, as this rate was requested for the entire watercourse alignment at the site, WSP measured meander extension (lateral migration) for seventeen meanders generally between 2020 and 1988 along the alignment. A value

of 0.5m was assumed for 4 meanders that were selected for the assessment and had shifts too small to measure. Overall the meander extension (lateral migration) ranged from 8.84 m to 0.5 m with an average of 4 m.

CONCLUSIONS AND RECOMMENDATIONS

Based on the desktop fluvial geomorphology assessment the following conclusions and recommendations were determined:

- 1 Based on the historical aerials, the area was historically rural and is now urban, having been developed gradually between 1954 and 2005.
- 2 Based on the historical aerials, the watercourse channel has generally remained within a narrow band for approximately for 74 years with some minor fluctuations.
- 3 Based on the TRCA (2015) *Crossing Guidelines for Valley and Corridors (Appendix 2.A)* the 100-year erosion rates for this reach were estimated as 4 m.
- 4 As per TRCA (2014) *The Living City Polices for Planning and Development in the Watersheds of the Toronto and Region Conservation Authority (Section 7.4.5.1.(h) and 8.10.5)* WSP considers the appropriate set back limit for the trail from the edge of the existing watercourse is 4 m as shown on attached **Figure 9** (2020 aerial).

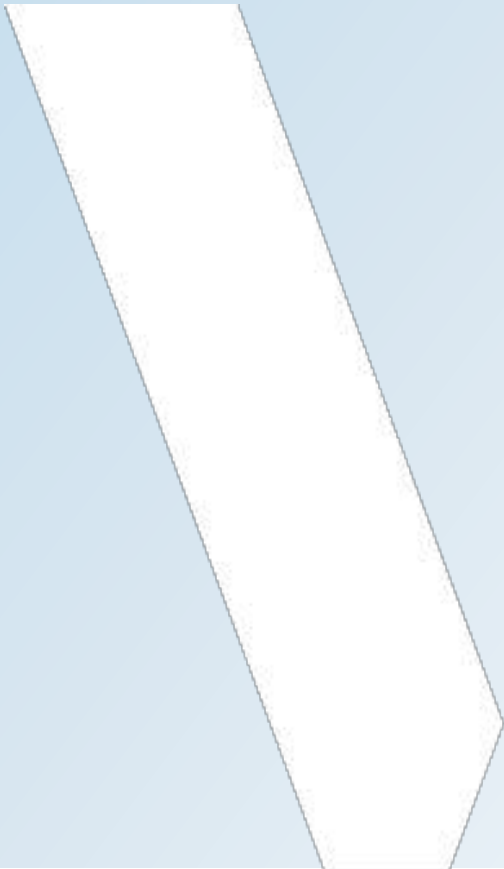
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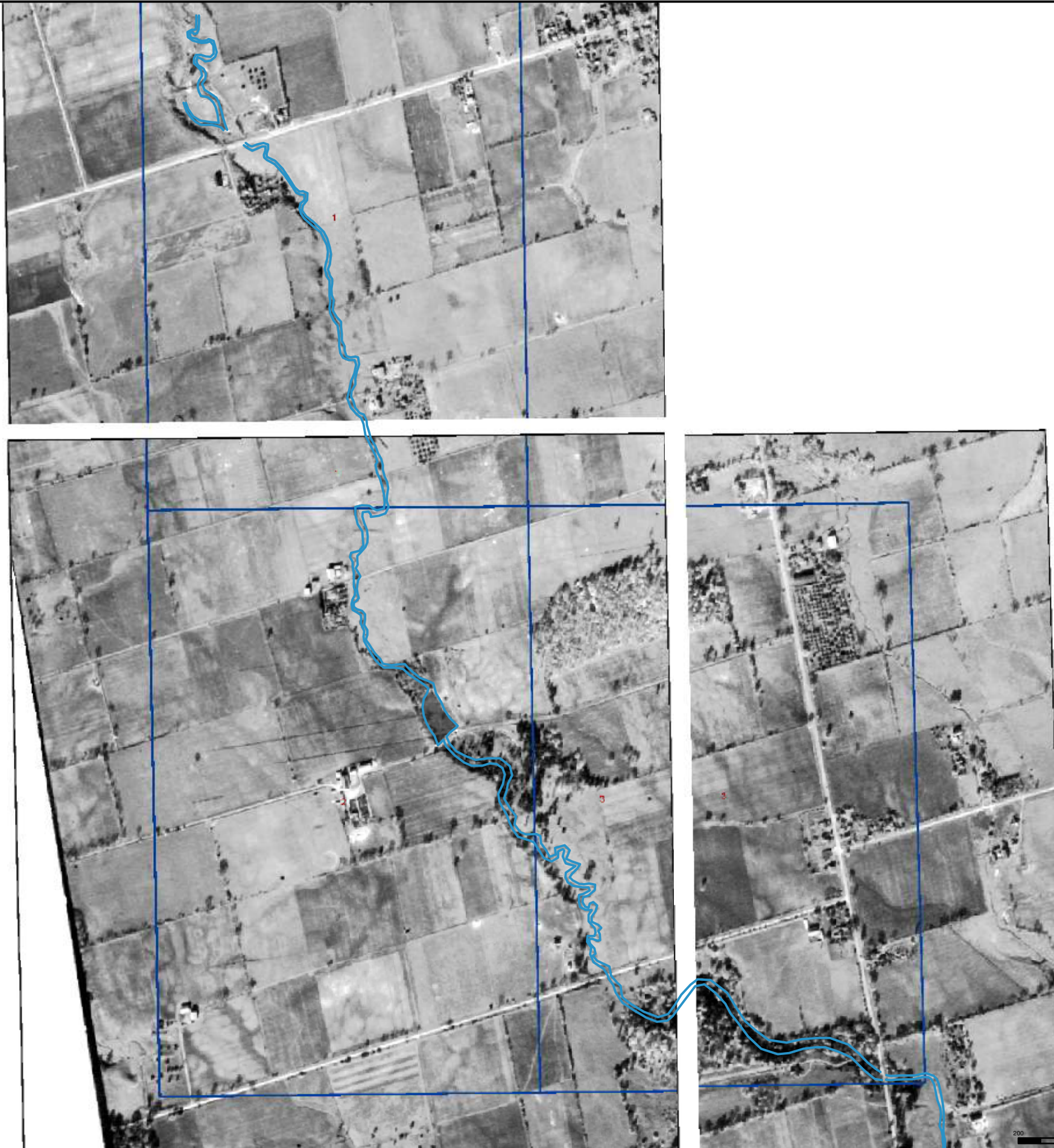
- Chapman, L.J. and Putnam, D.F., 1984. The Physiography of Southern Ontario, Ontario Geological Survey Special Volume 2.
- Ontario Geological Survey, 2000. Quaternary geology, seamless coverage of the Province of Ontario; Ontario Geological Survey, Data Set 14---Revised.
- Toronto and Region Conservation Authority, 2015. Crossing Guidelines for Valley and Corridors.
- Toronto and Region Conservation Authority, 2012. The Living City Polices for Planning and Development in the Watersheds of the Toronto and Region Conservation Authority.

ATTACHMENTS:

Figures 1 to 9: Individual Historical Aerials
Figure 10: Composite Historical Watercourse

FIGURES

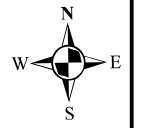




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LEGEND

— 1946 WATERCOURSE



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PROJECT NO:
 211-07301-00

DATE:
 MAY 2022

DESIGNED BY:
 -

DRAWN BY:
 LT

CHECKED BY:
 -

FIGURE NO:
 1

SCALE:
 1:10,500

TITLE:

1946 AERIAL PHOTOGRAPH

DISCIPLINE:

ENVIRONMENT

ISSUE:
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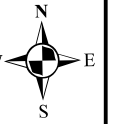




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LEGEND

— 1954 WATERCOURSE



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FIGURE NO:
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SCALE:
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1954 AERIAL PHOTOGRAPH

DISCIPLINE:

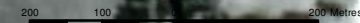
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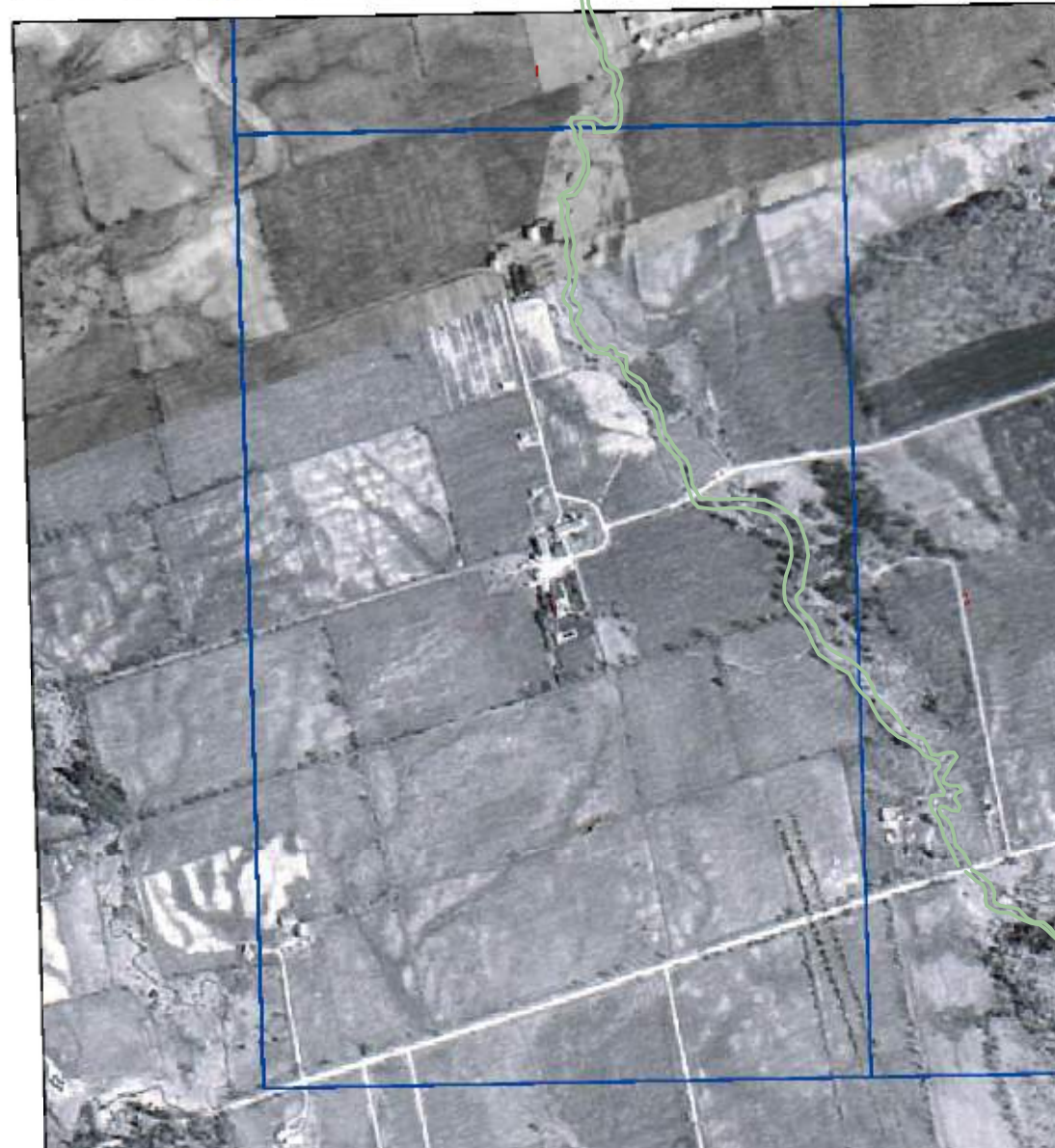
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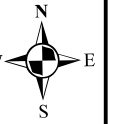




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LEGEND

— 1960 WATERCOURSE



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FIGURE NO:
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SCALE:
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TITLE:

1960 AERIAL PHOTOGRAPH

DISCIPLINE:

ENVIRONMENT

ISSUE:

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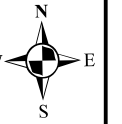




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LEGEND

— 1970 WATERCOURSE



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FIGURE NO:
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SCALE:
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TITLE:

1970 AERIAL PHOTOGRAPH

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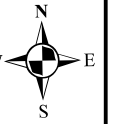
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LEGEND

— 1988 WATERCOURSE



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FIGURE NO:

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1988 AERIAL PHOTOGRAPH

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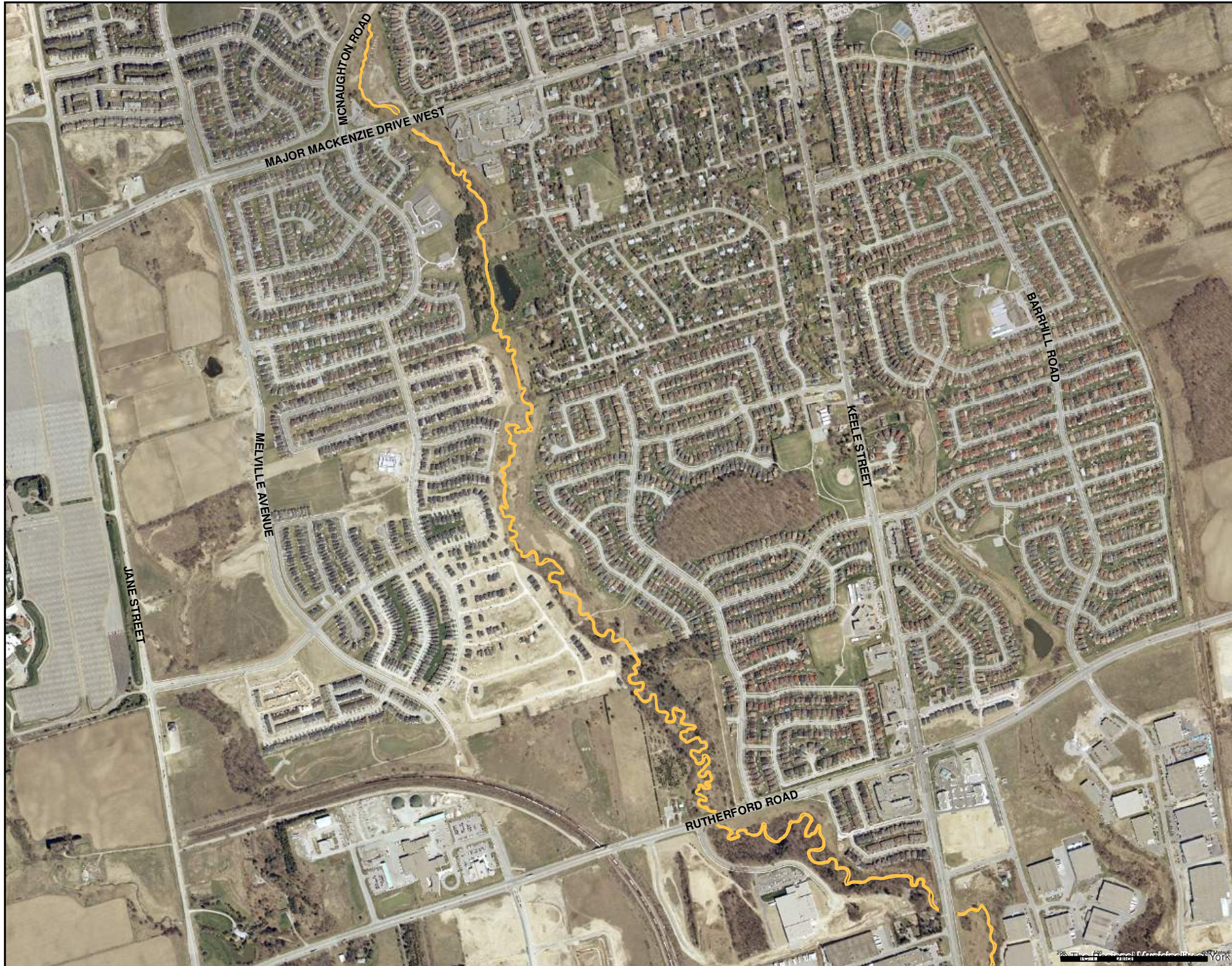
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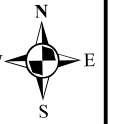
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LEGEND

— 1999 WATERCOURSE



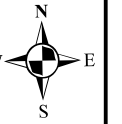
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LEGEND

— 2005 WATERCOURSE



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DRAWN BY:

LT

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FIGURE NO:

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SCALE:

1:10,500

TITLE:

2005 AERIAL PHOTOGRAPH

DISCIPLINE:

ENVIRONMENT

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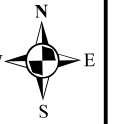
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LEGEND

— 2014 WATERCOURSE



CLIENT:
 CITY OF VAUGHAN

PROJECT:
 BARTLEY SMITH TRAIL PRELIMINARY DESIGN
 CITY OF VAUGHAN

PROJECT NO: 211-07301-00	DATE: MAY 2022
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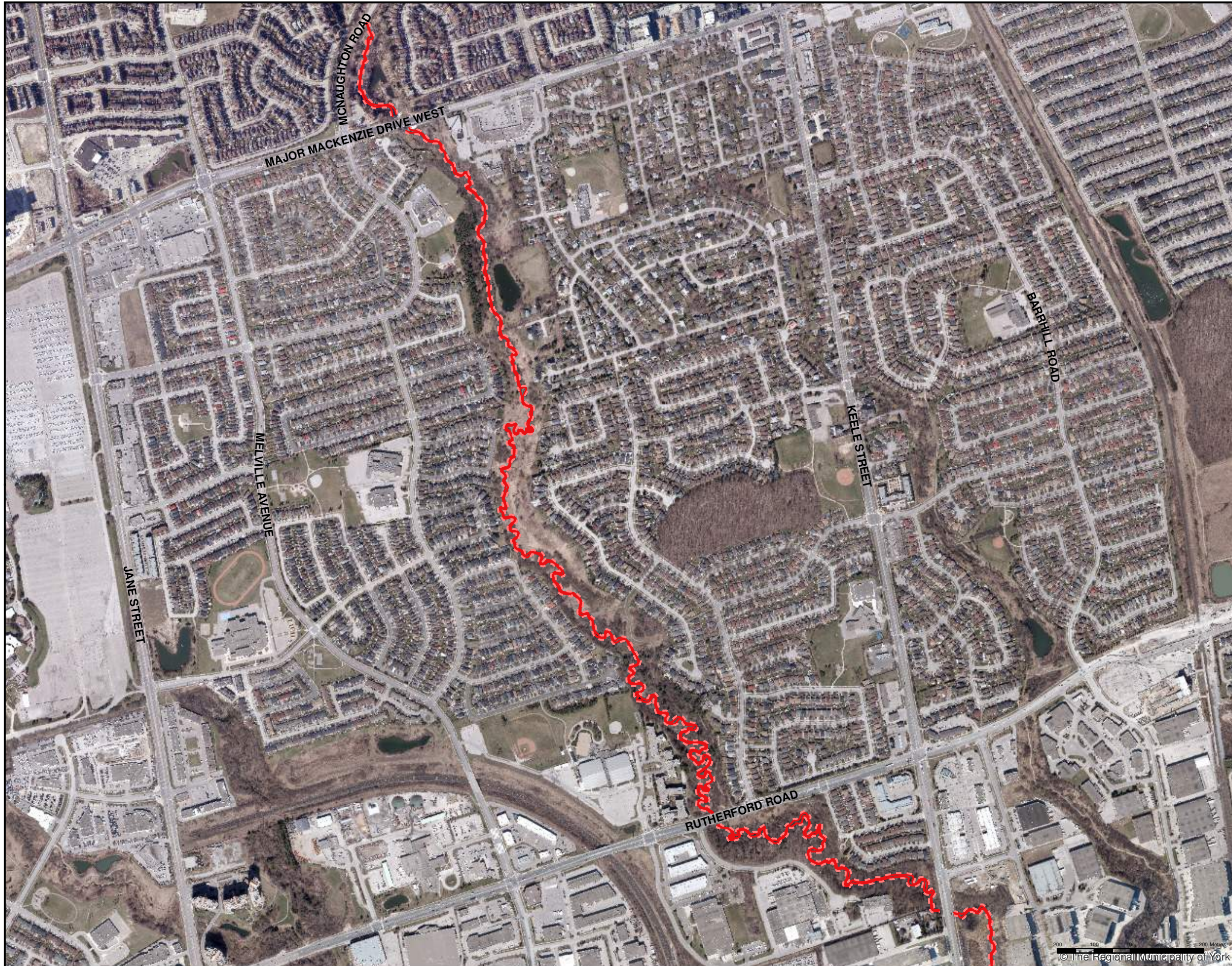
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TITLE:
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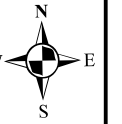
ISSUE: -	REV.: -
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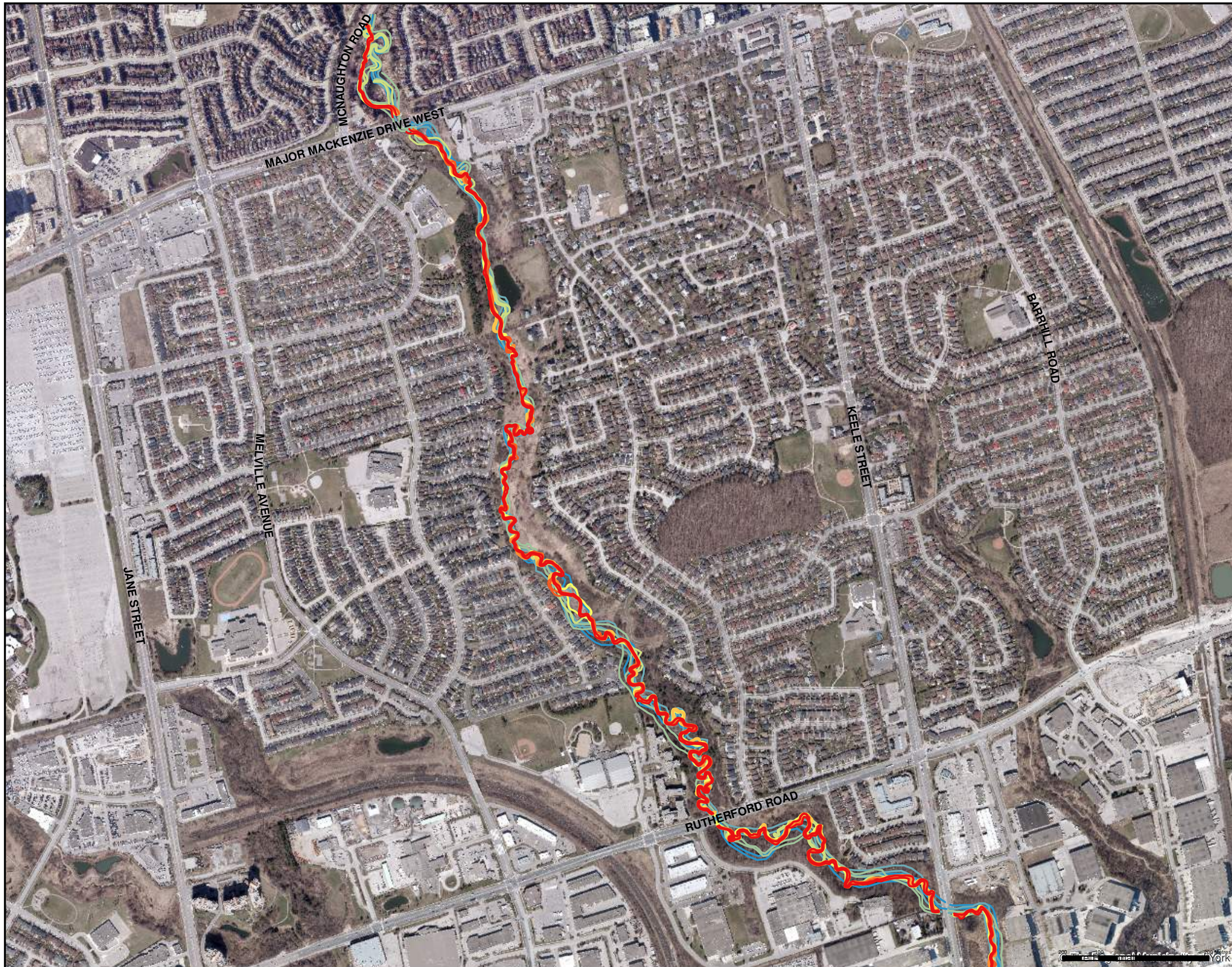
126 DON HILLOCK DRIVE, UNIT 2
 AURORA, ONTARIO CANADA L4G 0G9
 TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM

LEGEND

- 2020 WATERCOURSE
- - - 4 m WATERCOURSE SETBACK



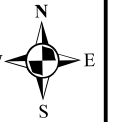
CLIENT:		CITY OF VAUGHAN	
PROJECT:		BARTLEY SMITH TRAIL PRELIMINARY DESIGN CITY OF VAUGHAN	
PROJECT NO: 211-07301-00	DATE: SEPTEMBER 2022		
DESIGNED BY: -			
DRAWN BY: LT			
CHECKED BY: -			
FIGURE NO: 9	SCALE: 1:10,500		
TITLE: 2020 AERIAL PHOTOGRAPH			
DISCIPLINE: ENVIRONMENT			
ISSUE: -	REV.: -		



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LEGEND

- 1946 WATERCOURSE
- 1954 WATERCOURSE
- 1960 WATERCOURSE
- 1970 WATERCOURSE
- 1988 WATERCOURSE
- 1999 WATERCOURSE
- 2005 WATERCOURSE
- 2014 WATERCOURSE
- 2020 WATERCOURSE



CLIENT:
 CITY OF VAUGHAN

PROJECT:
 BARTLEY SMITH TRAIL PRELIMINARY DESIGN
 CITY OF VAUGHAN

PROJECT NO: 211-07301-00	DATE: MAY 2022
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DESIGNED BY:
 -

DRAWN BY:
 LT

CHECKED BY:
 -

FIGURE NO: 10	SCALE: 1:10,500
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TITLE:
 COMBINED HISTORICAL WATERCOURSES

DISCIPLINE:
 ENVIRONMENT

ISSUE: -	REV.: -
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