DRAFT

REPORT

HYDRAULIC AND FLUVIAL GEOMORPHIC HAZARD ASSESSMENT TO INFORM MITIGATION REQUIREMENTS FOR REGION OF PEEL STORMWATER SERVICING MASTER PLAN AT MULTIPLE SITES

Region of Peel, Ontario

Submitted to:

James Jorgensen, Infrastructure Planning, Partner

GM BluePlan Engineering Limited
Royal Centre
3300 Highway No. 7, Suite 402
Vaughan ON L4K 4M3

Submitted by:

Golder Associates Ltd.

6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada

+1 905 567 4444

19126124-3000

January 2022

Distribution List

PDF - GM BluePlan Engineering Limited

PDF - Golder Associates Ltd.

Table of Contents

1.0 INTRODUCTION 1

2.0 METHODS 1

3.0 RESULTS 1

4.0 RECOMMENDED NEXT STEPS 4

TABLES

Table 1: Results of Hydraulic and Geomorphic Analysis 2

FIGURES

Figure 1 - Derry Road near McLaughlin 8

Figure 2 - Mayfield Road east of Dixie Road 9

Figure 3 - Erin Mills south of Mississauga Road 10

Figure 4 - Erin Mills south of Highway 403 11

1.0 INTRODUCTION

Golder Associates Ltd. (Golder), a member of WSP, was retained by GM BluePlan Engineering Limited (GMBP) to complete a high-level desktop assessment of hydraulic and geomorphic hazard limits at four watercourse crossing locations in Mississauga and Brampton, Ontario. With reference to Figures 1 through 4, this includes crossing locations at Derry Road at McLaughlin Road, Erin Mills Parkway at Mississauga Road, Erin Mills Parkway south of Highway 403, and Mayfield Road east of Dixie Road. The results of the assessment were used to determine if planned stormwater works in the vicinity of each watercourse crossing (specifically Low Impact Development [LID] features that have been proposed as part of the Region of Peel Stormwater Servicing Master Plan) could be at risk of channel encroachment or migration, and, in turn, merit mitigation measures to minimize potential impacts.

This report presents the methods of the high-level hydraulic and geomorphic analysis, noting that the subject locations and associated planned LID measures are detailed in GMBP (2021).

2.0 METHODS

A cursory level analysis of maps and historical aerial photographs/orthoimagery was undertaken at each crossing location to examine changes in historical land use and channel patterns, and, in turn, to estimate the preliminary hydraulic and geomorphic hazard limits of the subject watercourses. This historical air photograph analysis considered the following background materials:

- Air photography or orthoimagery from all or a subset of 1966, 1977, 1989, 2000, 2005, 2010, and 2021 that was retrieved from the City of Mississauga and City of Brampton web map services (City of Mississauga, 2021; City of Brampton 2021).
- Mapped watercourse data that was obtained from the Ontario Flow Assessment Tool (OFAT, 2021).

The preliminary hydraulic and geomorphic hazard limit was derived by estimating the approximate meander amplitude (i.e., lateral span of the characteristic meander pattern of the channel) in the vicinity of the crossing location and multiplying by a factor of 1.5, noting that, in instances where active channel erosion appeared to be present, the approximate bankfull width of the channel was included as an added safety buffer. As a final step, the anticipated siting/location of the planned LID features was compared to the preliminary hydraulic and geomorphic hazard limit to determine the relative likelihood (low, moderate, or high) that the installations could be potentially impacted by channel encroachment or migration. This ranking was then used to inform possible mitigation measures.

3.0 RESULTS

The results from the high-level hydraulic and geomorphic analysis are presented in Table 1.

Table 1: Results of Hydraulic and Geomorphic Analysis

Crossing Location	Watercourse	Observed Evidence of Channel Migration, Active Erosion-Sedimentation, etc.	Preliminary Estimate of Hazard Limit (Centered Over Mid-Point of Channel)	Likelihood that Works will Require Installation within Hazard Limit and Associated Risk of Channel Encroachment/Migration on Works	Suggested Mitigation Measures
Derry Road near McLaughlin Road (Figure 1)	Unnamed Tributary of Fletcher's Creek – *Located approx. 220 m west of McLaughlin Road*	A review of available historical air photographs/imagery between 1966 and 2021 demonstrated the following: ▪ Land Use – Dominated by agricultural activities prior to 1997 followed by prominent urbanization since that time. ▪ Channel Change – Marked evidence of natural channel change prior to 2003 (i.e., channel migration of between 5 and 10 m at discrete meanders) followed by fairly stable channel conditions since that time.	Estimated to be 17.5 m based on: ▪ Meander amplitude with multiplier = 10 m x 1.5 = 15 m ▪ Channel width = 2.5 m	▪ Low to Moderate likelihood: Location of proposed outlets of LID features expected to be within the hazard limit, but channel appears to support stable conditions and risk of encroachment/migration likely further constrained by the lateral confinement of the channel between the existing subdivision developments (i.e., hard controls likely in place), as well as the presence of culvert crossing immediately upstream and a short distance downstream.	▪ Implementation of erosion protection (i.e., armour stone and targeted plantings) along the conveyance path between the outlet of the proposed discharge pipe and the receiving channel, as well as at the bank of the channel itself.
	Fletcher's Creek – *Located approx. 740 m east of McLaughlin Road*	A review of available historical air photographs/imagery between 1966 and 2021 demonstrated the following: ▪ Land Use – Dominated by agricultural activities or recreational facilities (golf course) prior to 2002 followed by prominent urbanization since that time. ▪ Channel Change – Moderate evidence of natural channel change prior to 1975 followed by channel alterations between 1975 and 1989 (i.e., straightening to support crossing structure installations) and then fairly stable channel conditions in the more recent period of record.	Estimated to be 31 m based on: ▪ Meander amplitude with multiplier = 17 m x 1.5 = 25.5 m ▪ Channel width = 5.5 m	▪ Moderate likelihood: Location of proposed outlets of LID features expected to be within the hazard limit, but channel appears to support relatively stable conditions.	▪ Implementation of erosion protection (i.e., armour stone and targeted plantings) along the conveyance path between the outlet of the proposed discharge pipe and the receiving channel, as well as at the bank of the channel itself. ▪ Installation of headwall at proposed outlet to reduce the risk of undercutting in the even of channel encroachment/migration.
Mayfield Road east of Dixie Road (Figure 2)	West Humber River – *Located approx. 660 m east of Dixie Road*	A review of available historical air photographs/imagery between 2000 and 2021 demonstrated the following: ▪ Land Use – Dominated by agricultural activities with some urban development over the most recent period of record. ▪ Channel Change – Moderate evidence of natural channel change prior to 2020 followed by channel alterations in the most recent period of record (i.e., straightening to support new crossing structure installations) and fairly stable channel conditions.	Estimated to be 46.5 m based on: ▪ Meander amplitude with multiplier = 31 m x 1.5 = 45.5 m ▪ Channel width = 1 m	▪ Low likelihood: Location of proposed outlets of LID features expected to be outside of the hazard limit.	▪ Implementation of erosion protection (i.e., armour stone and targeted plantings) along the conveyance path between the outlet of the proposed discharge pipe and the receiving channel.
	West Humber River – *Located approx. 1220 m east of Dixie Road*	A review of available historical air photographs/imagery between 2000 and 2021 demonstrated the following: ▪ Land Use – Dominated by agricultural activities with some light industry development over the most recent period of record. ▪ Channel Change – Moderate evidence of natural channel change prior to 2020 followed by channel alterations in the most recent period of record (i.e., straightening to support new crossing structure installations) and fairly stable channel conditions.	Estimated to be 12.5 m based on: ▪ Meander amplitude with multiplier = 7 m x 1.5 = 10.5 m ▪ Channel width = 2 m	▪ Low likelihood: Location of proposed outlets of LID features expected to be outside of the hazard limit, noting that channels appears to support stable conditions and risk of encroachment/migration likely further constrained by the lateral confinement of the channel on the right bank side by the existing subdivision developments (i.e., hard controls likely in place), as well as the presence of culvert crossing at Mayfield Road.	▪ Implementation of erosion protection (i.e., armour stone and targeted plantings) along the conveyance path between the outlet of the proposed discharge pipe and the receiving channel.

Crossing Location	Watercourse	Observed Evidence of Channel Migration, Active Erosion-Sedimentation, etc.	Preliminary Estimate of Hazard Limit (Centered Over Mid-Point of Channel)	Likelihood that Works will Require Installation within Hazard Limit and Associated Risk of Channel Encroachment/Migration on Works	Suggested Mitigation Measures
Erin Mills south of Mississauga Road (Figure 3)	Unnamed Tributary of Mullet Creek – *Located at intersection of Erin Mills Parkway and Erin Centre Boulevard*	A review of available historical air photographs/imagery between 1966 and 2021 demonstrated the following: ▪ Land Use – Dominated by mostly urban development ▪ Channel Change – Minor evidence of natural channel change prior to 1985 (noting the maintenance of a strong meander pattern) followed by channel alterations between 1985 and 1989 (i.e., straightening to support new crossing structure installations) and again between 2007 and 2008 (i.e., development of an online settling basin downstream of the crossing), with fairly stable channel conditions over the past 30 years of record.	Estimated to be 25.5 m based on: ▪ Meander amplitude with multiplier = 15 m x 1.5 = 22.5 m ▪ Channel width = 3 m	▪ Low likelihood: Location of proposed outlets of LID features expected to be outside of the hazard limit, noting that culvert crossing at Erin Mills Parkway likely serves as an added constraint on channel encroachment/migration.	▪ Implementation of erosion protection (i.e., armour stone and targeted plantings) along the conveyance path between the outlet of the proposed discharge pipe and the receiving channel.
Erin Mills south of Highway 403 (Figure 4)	Sawmill Creek – *Located approx. 80 m east of Burnhamthorpe Road West*	A review of available historical air photographs/imagery between 1966 and 2021 demonstrated the following: ▪ Dominated by agricultural activities prior to 1977 followed by incremental stages of urbanization since that time. ▪ Channel Change – Minor evidence of natural channel change prior to 1989 followed by fairly stable channel conditions since that time.	Estimated to be 14.5 m based on: ▪ Meander amplitude with multiplier = 7 m x 1.5 = 10.5 m ▪ Channel width = 4 m	▪ Low likelihood: Location of proposed outlets of LID features expected to be outside of the hazard limit, noting that culvert crossing at Erin Mills Parkway likely serves as an added constraint on channel encroachment/migration.	▪ Implementation of erosion protection (i.e., armour stone and targeted plantings) along the conveyance path between the outlet of the proposed discharge pipe and the receiving channel.

4.0 RECOMMENDED NEXT STEPS

The hydraulic and geomorphic analysis described herein involved a high-level assessment of channel change and hydraulics at each of the watercourse crossing locations. In light of this, the estimates of the hydraulic and geomorphic hazard limits at the crossing locations, and, by extension, the suggested mitigation measures at each site, are inherently preliminary and incorporate a heightened degree of conservatism. It is recommended that the assessment be refined through a comparatively detailed analysis. This would include the completion of a meander belt width assessment and 100-year erosion analysis at each of the watercourse crossing locations, with a plan to complete a ground-based field study to characterize existing channel morphology and stability at a site-specific level and to secure a broader set of air photographs/imagery. The results of the detailed analysis would allow for a more fulsome discussion of the potential risk of channel encroachment or migration at each of the planned LID measures, and, in turn, the need (if any) for mitigation.

Signature Page

Golder Associates Ltd.

DRAFT

Christopher Davidson, PEng
Surface Water Engineer

DRAFT

Andrew Forbes, MSc, PGeo
Senior Consultant and Associate

NA/CD/AF/ff/mp

https://golderassociates.sharepoint.com/sites/111670/project files/6 deliverables/hydraulic and fluvial geomorphic/rev b/19126124-3000-r-revb-hydraulic and fluvial geomorphic-24jan2022.docx

REFERENCES

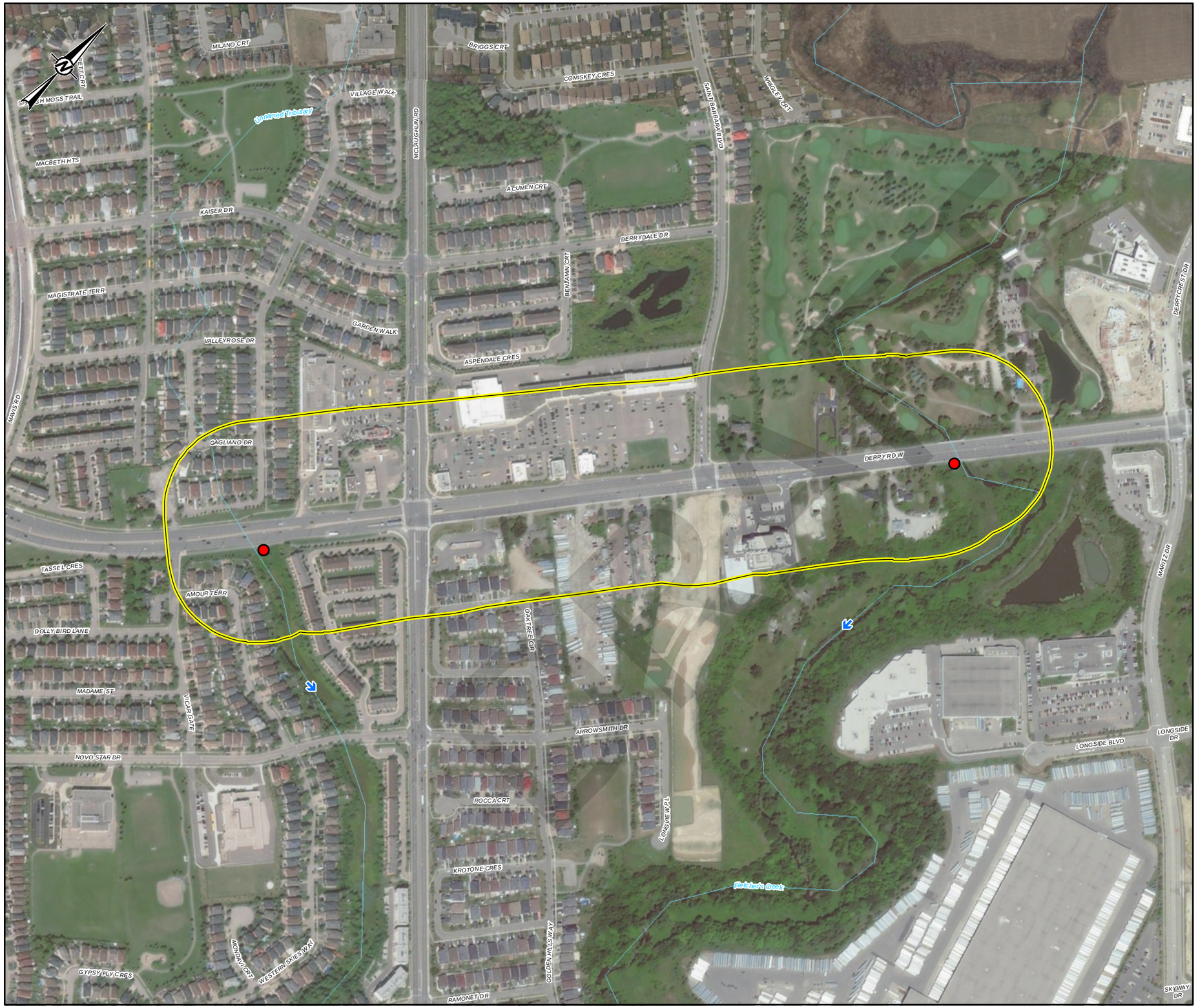
Brampton Maps, MyBrampton – City of Brampton, https://maps1.brampton.ca/mybrampton/, November 2021.

GM BluePlan Engineering Limited, LID Location Selections, Region of Peel, Stormwater Servicing Master Plan for Regional Road Infrastructure, July 2021.

Mississauga Maps, Mississauga Maps – City of Mississauga, http://www6.mississauga.ca/missmaps/, November 2021.

OFAT, Ontario Flow Assessment Tool (Ministry of Natural Resources and Forestry), https://www.lioapplications.lrc.gov.on.ca/OFAT/index.html?viewer=OFAT.OFAT&locale=en-ca, 2021.

FIGURES



LEGEND

- PROPOSED OUTLET LOCATION
- STREAM FLOW DIRECTION
- WATERCOURSE
- SITE AREA

0 100 200

1:5,219 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - MNRF LIO, 2020.
2. STORM WATER INFRASTRUCTURE PROVIDED BY GM BLUEPLAN AND REGION OF PEEL, MAY 2020
3. SURFICIAL GEOLOGY - MINISTRY OF NORTHERN DEVELOPMENT AND MINES, 1:250 000. SCALE SURFICIAL GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
GM BLUEPLAN ENGINEERING LIMITED

PROJECT
REGION OF PEEL STORMWATER SERVICING MASTER PLAN FOR REGIONAL ROADS

TITLE
HYDRAULIC AND FLUVIAL GEOMORPHIC - DERRY ROAD WEST AND MCLAUGHLIN ROAD (MISSISSAUGA)

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	JR
PREPARED	JR
REVIEWED	AF
APPROVED	---

PROJECT NO.	CONTROL	REV.	FIGURE
19126124	0007	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: S:\Clients\Region_of_Peel\Peel_Stormwater_Infrastructure\99_PROJECTS\19126124_GMBluePlan_PeelRegionStormwater\40_PRO\DWG\0007_Fluvial_Geomorphic\19126124-0007-CH-0002.mxd PRINTED ON: 2022-01-31 AT: 12:49:08 PM

LEGEND

- PROPOSED OUTLET LOCATION
- STREAM FLOW DIRECTION
- WATERCOURSE
- SITE AREA
- WATERBODY

0 100 200

1:6,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - MNRF LIO, 2020.
2. STORM WATER INFRASTRUCTURE PROVIDED BY GM BLUEPLAN AND REGION OF PEEL, MAY 2020
3. SURFICIAL GEOLOGY - MINISTRY OF NORTHERN DEVELOPMENT AND MINES, 1:250 000. SCALE SURFICIAL GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT

GM BLUEPLAN ENGINEERING LIMITED

PROJECT

REGION OF PEEL STORMWATER SERVICING MASTER PLAN FOR REGIONAL ROADS

TITLE

HYDRAULIC AND FLUVIAL GEOMORPHIC - MAYFIELD ROAD EAST OF DIXIE ROAD (MISSISSAUGA)

CONSULTANT

GOLDER
MEMBER OF WSP

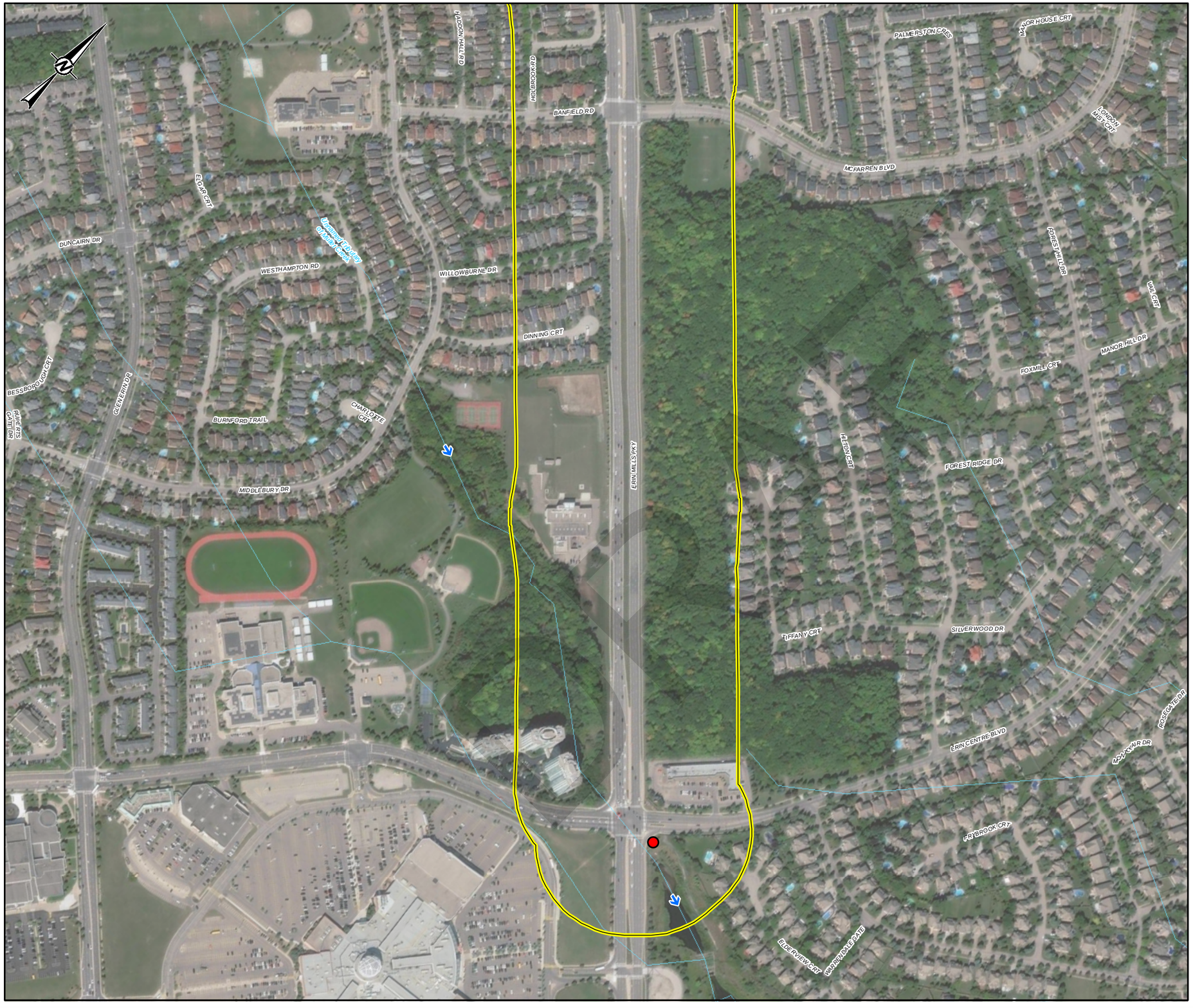
YYYY-MM-DD	2022-01-31
DESIGNED	JR
PREPARED	JR
REVIEWED	AF
APPROVED	---

PROJECT NO.	CONTROL	REV.	FIGURE
19126124	0007	A	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Region_of_Peel\Revit_Stormwater_Infrastructure\99_PROJ\19126124_GMBluePlan_PeelRegionStormwater\40_PRO\0007_Fluvial_Geomorph\c19126124-0007-CH-0003.mxd PRINTED ON: 2022-01-31 AT: 12:49:57 PM



LEGEND

- PROPOSED OUTLET LOCATION
- STREAM FLOW DIRECTION
- WATERCOURSE
- SITE AREA

0 100 200

1:5,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - MNRF LIO, 2020.
2. STORM WATER INFRASTRUCTURE PROVIDED BY GM BLUEPLAN AND REGION OF PEEL, MAY 2020
3. SURFICIAL GEOLOGY - MINISTRY OF NORTHERN DEVELOPMENT AND MINES, 1:250 000. SCALE SURFICIAL GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT

GM BLUEPLAN ENGINEERING LIMITED

PROJECT

REGION OF PEEL STORMWATER SERVICING MASTER PLAN FOR REGIONAL ROADS

TITLE

HYDRAULIC AND FLUVIAL GEOMORPHIC - ERIN MILLS SOUTH OF MISSISSAUGA ROAD (MISSISSAUGA)

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	JR
PREPARED	JR
REVIEWED	AF
APPROVED	---

PROJECT NO.	CONTROL	REV.	FIGURE
19126124	0007	A	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0

PATH: S:\Clients\Region_of_Peel\Peel_Stormwater_Infrastructure\09_PRO\19126124_GMBluePlan_PeelRegionStormwater\40_PRO\0007_Fluvial_Geomorph\s19126124-0007-CH-0004.mxd PRINTED ON: 2022-01-31 AT: 12:47:16 PM

LEGEND

- PROPOSED OUTLET LOCATION
- STREAM FLOW DIRECTION
- WATERCOURSE
- SITE AREA

0 100 200

1:5,000 METRES

NOTE(S)

REFERENCE(S)

1. BASE DATA - MNRF LIO, 2020.
2. STORM WATER INFRASTRUCTURE PROVIDED BY GM BLUEPLAN AND REGION OF PEEL, MAY 2020
3. SURFICIAL GEOLOGY - MINISTRY OF NORTHERN DEVELOPMENT AND MINES, 1:250 000. SCALE SURFICIAL GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
GM BLUEPLAN ENGINEERING LIMITED

PROJECT
REGION OF PEEL STORMWATER SERVICING MASTER PLAN FOR REGIONAL ROADS

TITLE
HYDRAULIC AND FLUVIAL GEOMORPHIC - ERIN MILLS SOUTH OF HIGHWAY 403 (MISSISSAUGA)

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	JR
PREPARED	JR
REVIEWED	AF
APPROVED	---

PROJECT NO.	CONTROL	REV.	FIGURE
19126124	0007	A	4

GOLDER
MEMBER OF WSP

golder.com