Armstrong Estates

Mansfield, ON

Pine River Tributary Flood and Erosion Hazard Assessment

January 24, 2023

January 24, 2024
WE 21024

David Seaman
2735528 Ontario Inc.
12 Trotter Court
Barrie, ON
L4N 5S4

Attention: David Seaman

Re: Armstrong Estates - Mansfield, ON
Fluvial Geomorphological and Hazard Assessment

Water's Edge was authorized by David Seaman of 2735528 Ontario Inc. to conduct a Floodline and Fluvial Hazard Assessment on a tributary of the Pine River in Mansfield, ON. The Armstrong Estates is proposed to be developed on the subject property and the Nottawasaga Valley Conservation Authority requires assessments on the natural hazards associated with the Pine River tributary located there. As part of this assessment Water's Edge will analyze the historical trends of the Pine River tributary in the Study Area to determine the erosion hazard limits and ultimately determine the offset required. The existing and proposed floodlines will also be determined through hydrologic and hydraulic modelling.

Background information required to support the meander beltwidth assessment and floodline modelling include local physiography, river fluvial geomorphic characteristics, stream assessments, MNRF rainfall data, SWOOP DTM topography, and

Data sources for the analysis include:

- 2015 and 2018 Orthophotos (Dufferin County),
- Physiography of Southern Ontario by Chapman & Putnam (digital data from Ministry of Northern Development and Mines (MNDM)),
- SWOOP DTM topography,
- MNRF Rainfall Data,
- Ontario Soil Survey Data,
- Ontario Flow Assessment Tools III (OFAT III) (from MNRF) and,
- Site Inspections by Water's Edge staff.

A site inspection and geomorphic survey was completed by Water's Edge staff in August 2021. The initial site inspection was undertaken after review of the mapping and available literature was completed in order to confirm site and general system characteristics. Available historical air photos of the site were reviewed. The site is located in Mansfield, Ontario, **Figure 1** shows the site location.

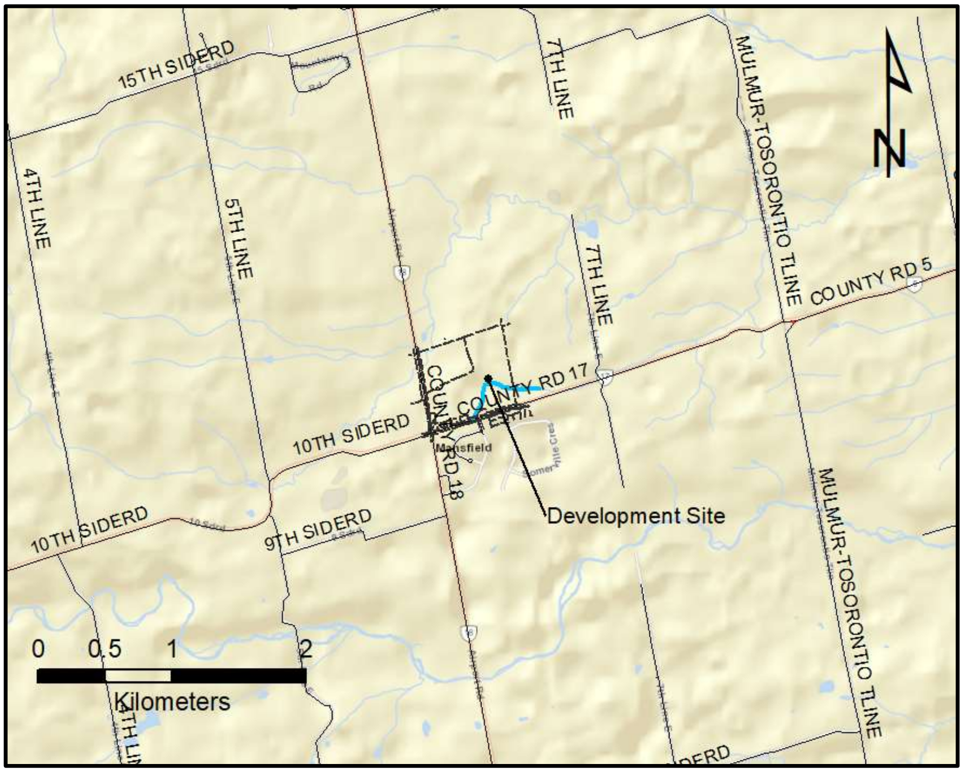


Figure 1: Armstrong Estates Development Study Area

1.0 EXISTING CONDITIONS

1.1 Geology & Physiography

Reviewing the site area's surficial materials is important to evaluate active channel processes and to understand the contributing sediment and substrate of the site. Stream channel form and sediment supply are controlled by the region's physiography and surficial geology. **Figure 2** shows the local physiography of the study area.

The study area, as shown in **Figure 2**, is located within the Horseshoe Moraines physiographic region. The surficial geology of the area is a glacial outwash which consists mostly of sand. No underlying materials were noted at the Study Site, due to the high amount of vegetation in the stream corridor and no apparent stream channel.

1.2 General Watershed Characteristics

The following data was acquired using the Ontario Flow Assessment Tool III (OFAT III). The landcover percentages are based on the subwatershed upstream of the study area. This tributary to the Pine River is likely an 2nd order stream that has a total drainage area of roughly 1.7 km^2 in size. The tributary originates to the southwest of the site where it drains a small residential area as well as roadside ditches. The major land cover/use for the tributary subwatershed is agricultural at 73% and community at 12% while the rest of the land cover is generally treed areas (OFAT III).

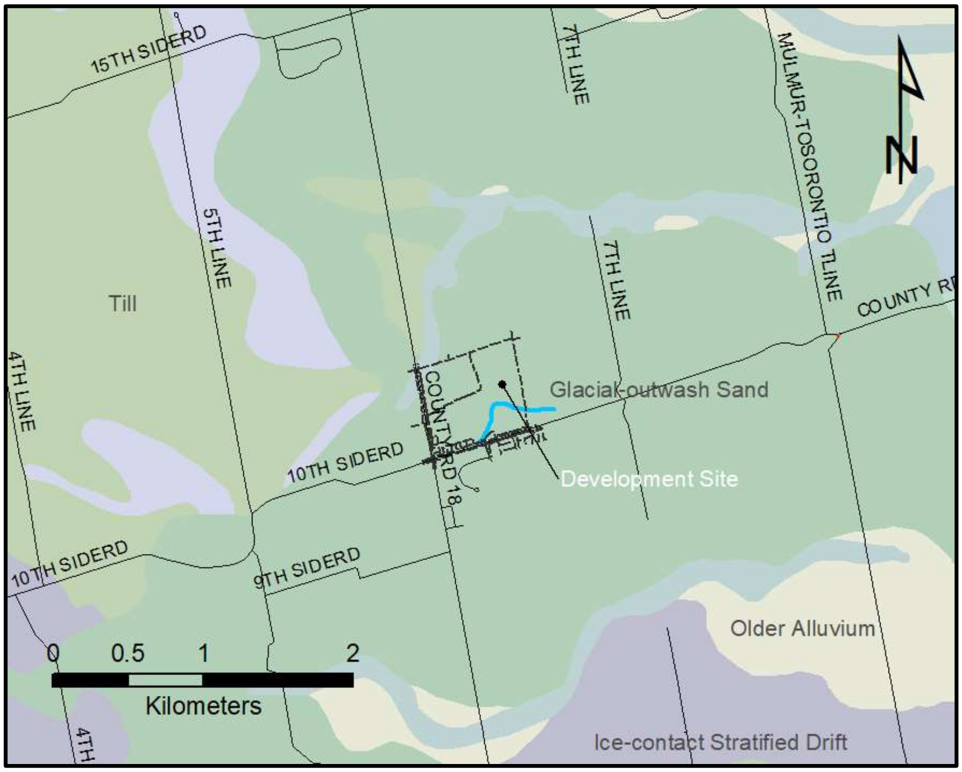


Figure 2: Local Physiography (data Ontario Geological Survey)

1.3.1 Reach Delineation

The tributary begins on the property at County Road 17 and flows for approximately 515 m northeast through the site. Channel morphology and substrate characteristics can change along a watercourse. Hence, it typically is important to account for these changes by delineating lengths of a watercourse that exhibit varying planform, sediment substrate, land use, local geology, valley confinement, hydrology, and slope. In this study the tributary exhibits the same characteristics throughout the Study Area. Within this Study Area there are only minor changes in slope and vegetation through the stream corridor and therefore no need to separate the channel into smaller reaches. Characteristics such as valley slope, substrate, and channel morphology all remain very similar throughout the site.

1.3.2 Geomorphic Characterization

Field investigations occurred during mid summer to assess the fluvial geomorphological characteristics of the Pine River tributary. It is noted that there was no flow present in the stream during the investigations, and that stream flow likley only occurs during periods of rain or during the spring melt. In addition, during the field investigations no distinct channel was observed through the majority of the Study Reach. Some low spots through the reach were noted to likely be locations of flow during rain events, however no continuously defined channel was noted. Through the majority of the Study Reach, particularly on downstream half, the corridor was a wetland feature rather than a concentrated channel. The wetland had some small, localized, pockets of standing water and large sections of cattails and other non-woody species typically found in wetlands. The channel/valley bottom was dominated with grasses, sedges, cattails, and other herbaceaus species. Small shrubs and trees lined the valley walls, shading the bottom of the valley for approximately 50% of the reach.

When visible, the substrate was limited to silty sand and organic material. The channel did not show any potential for moving larger particles such as gravel or cobbles. Similarly, the channel showed no evidence of erosion, whether it was bed scour or toe erosion along the valley walls.

Due to the lack of a defined channel no measurements were taken to characterize the tributary's geomorphological features. Additionally, no rapid assessments were completed for the tributary.

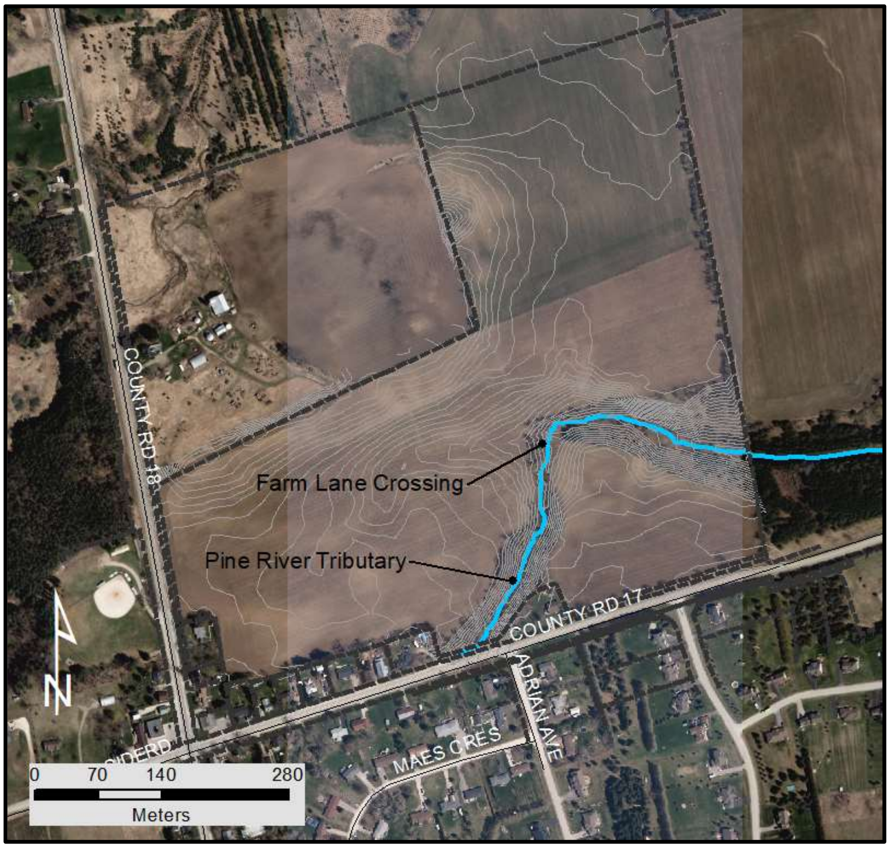


Figure 3: Subject Property (2018 Air Photo)

2.0 STREAM HAZARD OFFSET ASSESSMENT

2.1 Assessment Overview

The NVCA Planning and Regulation Guideline lays out the requirements for determining regulations limit for stream valleys. In particular the guideline defines specific criteria for determining the erosion hazard of a stream. As per the guideline, the extend of the erosion hazard is based on whether or not a valley is apparent (confined) or not apparent (unconfined) and whether or not the valley slopes are stable, unstable, and/or subject to toe erosion. As noted above the Pine River tributary through the subject property is a confined channel. This means that adjacent valley walls are close enough and steep enough that the channel cannot meander outside of them. In addition, the valley walls of the subject property are stable, which is noted in the geotechnical report prepared by Peto MacCallum Ltd.

The next criteria discussed in the guideline after channel confinement and slope stability is if the channel is subject to toe erosion. A fluvial geomorphological assessment of the tributary was conducted as part of this study, which investigated the fluvial processes of the tributary including erosional and depositional features and patterns in the stream. As noted, there was no apparent channel and also no signs of erosion throughout the entire Study Site. Therefore, the tributary through the subject property should be assigned the smallest possible offset in regards to erosion hazards.

The MNRF developed the River and Stream Systems: Erosion Hazard Limit in 2002 and it has been used by practitioners and agencies for guidance on natural hazards since then. Section 3.1 in the guide titled Toe Erosion Allowance provides specific advice on erosion hazard offsets. This includes a table which outlines a minimum toe erosion allowance for rivers within 15 m of a slope toe **(Table 3).** The table outlines three factors for deciding minimum erosion allowance: bank composition, bankfull width, and evidence of active erosion.

Bank composition for the Study Reach is comprised of the materials from the surficial geology, namely sands but also organic soils. The soils are cohesive but overall, they are moderately erodible. This classifies the native soil structure as the fourth group: Soft/Firm Cohesive Soil, loose granular, (sand, silt) Fill.

No evidence of erosion was noted during the site visits and there is no apparent bankfull channel. Without evidence of active erosion and a bankfull width less than 5 m, the MNRF recommends a minimum toe erosion allowance of 1 – 2 m.

Table 3: Determination of Toe Erosion Allowance

MINIMUM TOE EROSION ALLOWANCE - River Within 15 m of Slope Toe*

Type of Material Native Soil Structure	Evidence of Active Erosion** OR Bankfull Flow Velocity > Competent Flow Velocity***	No evidence of Active Erosion** OR Bankfull Flow Velocity <Competent Flow Velocity***		
	RANGE OF SUGGESTED TOE EROSION ALLOWANCES	Bankfull Width < 5m	5-30m	> 30m
1.Hard Rock (granite) *	0 - 2 m	0 m	0 m	1 m
2.Soft Rock (shale, limestone) Cobbles, Boulders *	2 - 5 m	0 m	1 m	2 m
3.Stiff/Hard Cohesive Soil (clays, clay silt), Coarse Granular (gravels) Tills *	5 - 8 m	1 m	2 m	4 m
4.Soft/Firm Cohesive Soil, loose granular, (sand, silt) Fill *	8 - 15 m	1-2 m	5 m	7 m

2.2 Application

Based on the toe erosion allowance the erosion hazard offset should be set back from the existing top of bank a minimum of 1 metre. This 1 m offset would be added on top of the stable slope and would not be included in the 6 m access allowance.

2.3 Aerial Photography Analysis

Air photos from 2015 and 2018 were reviewed to determine if any changes have occurred to the tributary over that time. Typically, a stream can be delineated and compared to previous years to determine changes in location of the channel. Measurements can also be made that would aid in determining the erosion potential of the stream. However, due to the size of the tributary and also the vegetation coverage, no useful information was gleaned from the aerial photography. It is noted that the photos were taken in the spring and locations of standing water were observed, however no consistent channel was distinguishable.

2.4 Crossing Discussion

One crossing of the tributary is proposed for the residential development site. There is an existing farm lane crossing on the property (**Figure 3**). Any flows from the tributary are conveyed through the crossing by a 300 mm pipe. It is recommended that the current location of the crossing be used for any future crossings of the tributary. In addition, the culvert at the crossing will be sized to include 1 metre offsets from the low flow channel in order to accommodate any future movement of the tributary. The culvert should also be embedded in the ground and include 100mm of stone substrate through it. The final culvert size will be determined by the hydraulic modelling but will ensure that the erosion offset from the channel is sufficient for the tributary.

3.0 MODELLING

3.1 Hydrologic Modelling

3.1.1 Methodology

An event-based hydrologic model was developed using HEC-HMS 4.11 to determine peak flows of 100-year Storm and Regional Storm (Timmins). GeoHUB 2022 LiDAR - derived Digital Terrain Model (DTM) was used for the terrain, Ontario Soil Survey data was used to define the hydrologic runoff conditions of the soil, and SOLRIS v3.0 was used to define the landuse in the existing conditions model. The SCS Curve Number Method was used to define runoff conditions based on the soil and landuse data. The Clark Unit Hydrograph was used to define the hydrograph transforms from the subcatchment headwaters to the outlet and is based on the physical characteristics of the subcatchment including the longest flowpath, channel length, slope, and roughness characteristics. The Muskingum-Cunge method was used for channel routing based on the slope, channel cross-section, and roughness for each reach. Below is the equation for Time of Concentration used for the model with units converted to imperial for calculation:

$$T_c = 2.2\left(\frac{L \times L_c}{\sqrt{Slope_{10-8}}}\right)^{0.3}$$

Where T_C= time of concentration (hrs); L= longest flow path (mi); L_c= Centroidal flow path (mi); $Slope_{10-85}$= average slope of the flow path represented by 10 to 85 percent of the longest flow path (ft/mi).

Subcatchments were delineated based on the DTM surface using HEC-HMS. Some subcatchments were manually divided so their outlets would match key locations in the proposed development and facilitate adjustments to represent proposed conditions. The delineated subcatchments and subcatchment areas are shown in **Figure 4**. Flows were modelled to the outlet of the model and were uncontrolled.

The 100-year storm used in the model was derived from observed precipitation records from the Egbert CS rainfall gauge about 21 km away. A 24-hour storm duration was selected as specified by NVCA. The SCS unit hydrograph was used to define the rainfall distribution.

For the Regional Storm, the Timmins Rainfall distribution from the MNRF was used. Due to the small size of the watershed, no real reduction was required. The Regional Storm also requires the use of wet antecedent moisture conditions in the model, so separate basin models representing AMC II (average) and AMC III (wet) conditions were used. AMC II conditions were used for modelling the 100-year Storm initially, but then AMC III conditions were used when trying to calibrate to the PEL modelled flows. Rainfall data was provided in an excel spreadsheet.

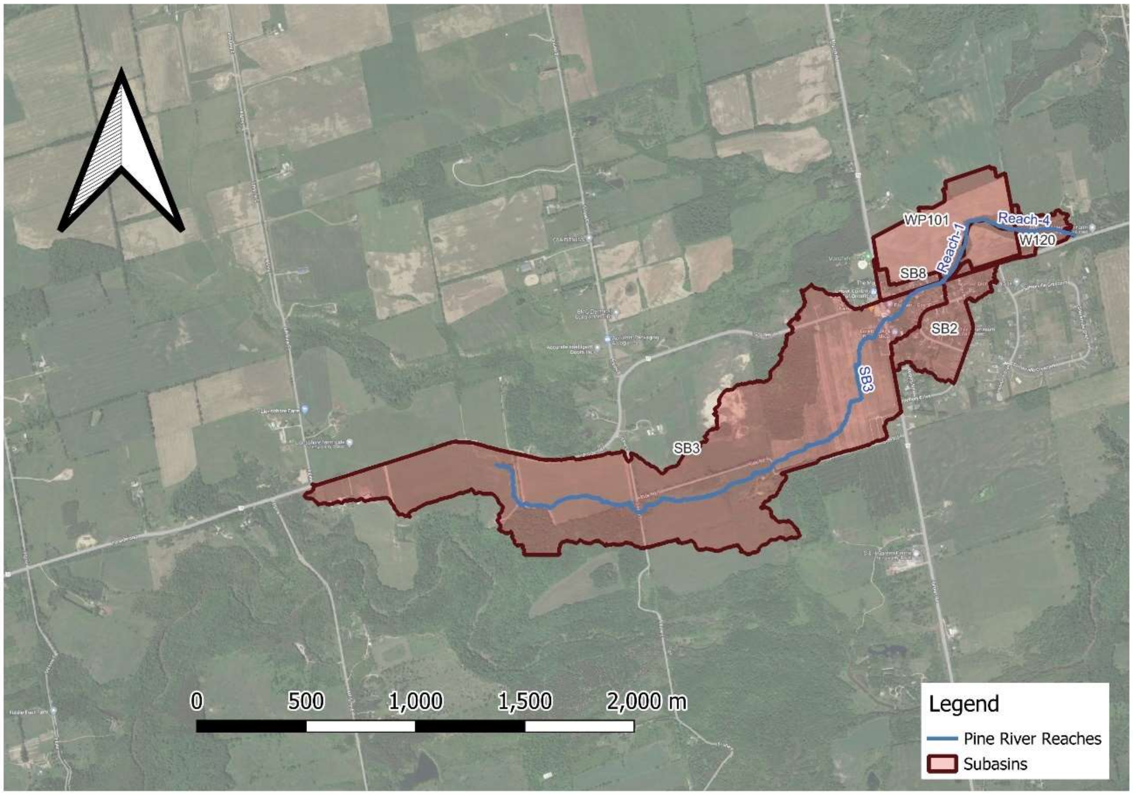


Figure 4: HEC-HMS Subcatchment Delineation

3.1.2 Results

The HEC-HMS model results showed that the peak flow of the Timmins Storm would be 4.11 m^3/s and the 100-year Storm would be 2.9 m^3/s at the downstream end of the site. The model was calibrated in to match PEL Drainage report from the previously modelled Vissual Otthymo SWM flows in Catchment WP101 and WP102. To calibrate the model to PEL's Otthymo model, CN numbers, % impervious, initial abstraction values were adjusted closely match their numbers as best as possible for existing and proposed conditions.

The drainage sizes of catchments were almost identical, and the same storms were used. The difference in numbers is due to different modelling software terrain detail. The differences would not affect the design of the culvert due to the factor of safety involved in the design and the chosen size of the culvert. The results are displayed below in **Table 1**, **Table 2**, and **Table 3**:

Table 1: North of Pine River Modelled Flows (m^3/s)

	HEC-HMS WP101	PEL 101 Existing	HEC-HMS Proposed WP101	PEL 101 Proposed
100yr24hr SCS	1.566	2.182	1.566	1.842
100yr4hr Chicago	1.680	0.975	1.680	0.925
Timmins	1.512	1.419	1.512	1.538

Table 2: South of Pine River Modelled Flows (m^3/s)

	HEC-HMS WP102 Existing	PEL 202 Existing	HEC-HMS Proposed WP102	PEL 202 & 204
100yr24hr SCS	0.395	0.646	0.395	0.646
100yr4hr Chicago	0.423	0.301	0.423	0.301
Timmins	0.379	0.408	0.379	0.408

Table 3: Outlet Flows (m^3/s)

	HEC-HMS Existing Outlet	HEC-HMS Proposed Outlet	MacLaren Outlet*
100yr24hr SCS	2.9	2.9	0.71
100yr4hr Chicago	2.8	2.8	N/A
Timmins	4.1	4.1	1.48

*Based on watershed of $1.6km^2$

These results vary from the NVCA *MacLaren Head Water's Study*. The Pine River data in the MacLaren Report was originally calibrated at 02ED014 Pine River near Everett. This gauge has since stopped modelling discharge due to unreliable data due to instability of the site. Additionally, the MacLaren report states a maximum daily average flow of $36.2m^3/s$ and an estimated maximum instantaneous peak flow of 53 m^3/s occurred at 02ED014. As a result, in a smaller watershed, the instantaneous flows on the pine river may be higher than the average flow. Waterway slopes were obtained from 1:50000 maps, whereas Water's Edge model calculated slopes using DEMs. Additionally, when the MacLaren study was being completed, there were no large storms on the Pine River to accurately monitor the flow. Furthermore, during the MacLaren study during the storm, the ground was dry during the storm event that did occur. This is different than a Timmins storm with assumed AMC III parameters. Lastly, the spring data from 1986 was not used for the Pine River in the study. All of these factors contribute to the fact that the Pine River study from MacLaren is not seen as accurate comparison for this model. Though it could be used as a baseline to generally estimate flows for the watershed, it clearly was not calibrated in a way to provide confidence in the model for substantial flooding.

3.2 Hydraulic Modelling

3.2.1 Methodology

A hydraulic model of the property was developed using HEC-RAS version 6.4.1. The 2022 LiDAR DTM to create a surface that extended downstream of the site to the next culvert crossing. The model included three crossings, the culvert crossing east of the subject property, the culvert crossing on the property (farm lane), and the County Rd 17 crossing at the upstream end of the property. Manning's roughness coefficient was set at 0.035 for the main channel and 0.05 for the overbank areas. The model was run using both the existing and proposed peak flows. The proposed condition flows were used to determine the culvert size that is necessary for the proposed crossing to avoid over-topping or increasing the flood risk upstream of the property.

3.2.2 Results

Under existing conditions, the water surface elevation (WSEL) immediately downstream of County Rd 17 is 306.98 for the Regional Storm. The Regional Storm WSELs are greater than the 100-year Storm in all areas. The water surface elevations at key locations under existing and proposed conditions are shown in **Table 4**. The existing crossing on the site has a 0.3 m culvert and an embankment height of 303.83 m. Various culvert sizes were modelled in order to determine a size that would not overtop the proposed road or increase the upstream flood risk. A concrete box culvert that is 3m wide and 2.4 m tall would be sufficient to achieve this. The culvert was embedded 10% to accommodate substrate within the structure. Under these proposed conditions, the road elevation will be 305.85m, which results in a 304.3 m Regional Storm elevation upstream of the proposed crossing. The water surface elevations at the downstream end of the property have not changed and remain at 300.19m. The Regional Storm floodplains under existing and proposed conditions are shown in **Figure 5** and full floodplain map are seen in **Appendix C**.

A sensitivity analysis was completed using 50% blocked culvert scenario. The resulting blockage resulted in 1.05m increase in WSELs upstream of the culvert for both the Timmins and 100-year storm respectively but did not change the WSEL at either ends of the property. There is a slight increase in the floodplain WSEL extents upstream of the proposed crossing extending to Sideroad 10, although the backwater area has no impact on the floodplain extents or elevations at either property boundary.

As per the NVCA guidelines safe access is required across the road for vehicles and pedestrians. This has been applied to the 50% blockage scenario, and the resultant water depth is lower than the road elevation. As a result, the average velocity and depth velocity product is not required. Therefore, at 50% blockage the crossing is deemed safe as per the NVCA guidelines. The Froude Number exceeds 1 at times. In general, it does not change between pre and post conditions and if there is a change it decreases, due to the larger culvert opening. Mixed flow regime was independently modelled, but the differences were negligible and the culvert was sufficiently large enough.

Table 4: Water Surface Elevations at Key Locations

	Water Surface Elevations (m)								
	D/S End of property (XS 357)			U/S Proposed Crossing (XS 551)			U/S End of Property (XS 804)		
Storm Event	**Ex.**	**Prop.**	**Prop. 50% block**	**Ex.**	**Prop.**	**Prop. 50% block**	**Ex.**	**Prop.**	**Prop. 50% block**
100-year	300.05	300.13	300.13	303.98	304.08	305.2	306.83	306.83	306.83
Timmins	300.19	300.19	300.19	304.12	304.3	305.41	306.98	306.98	306.98

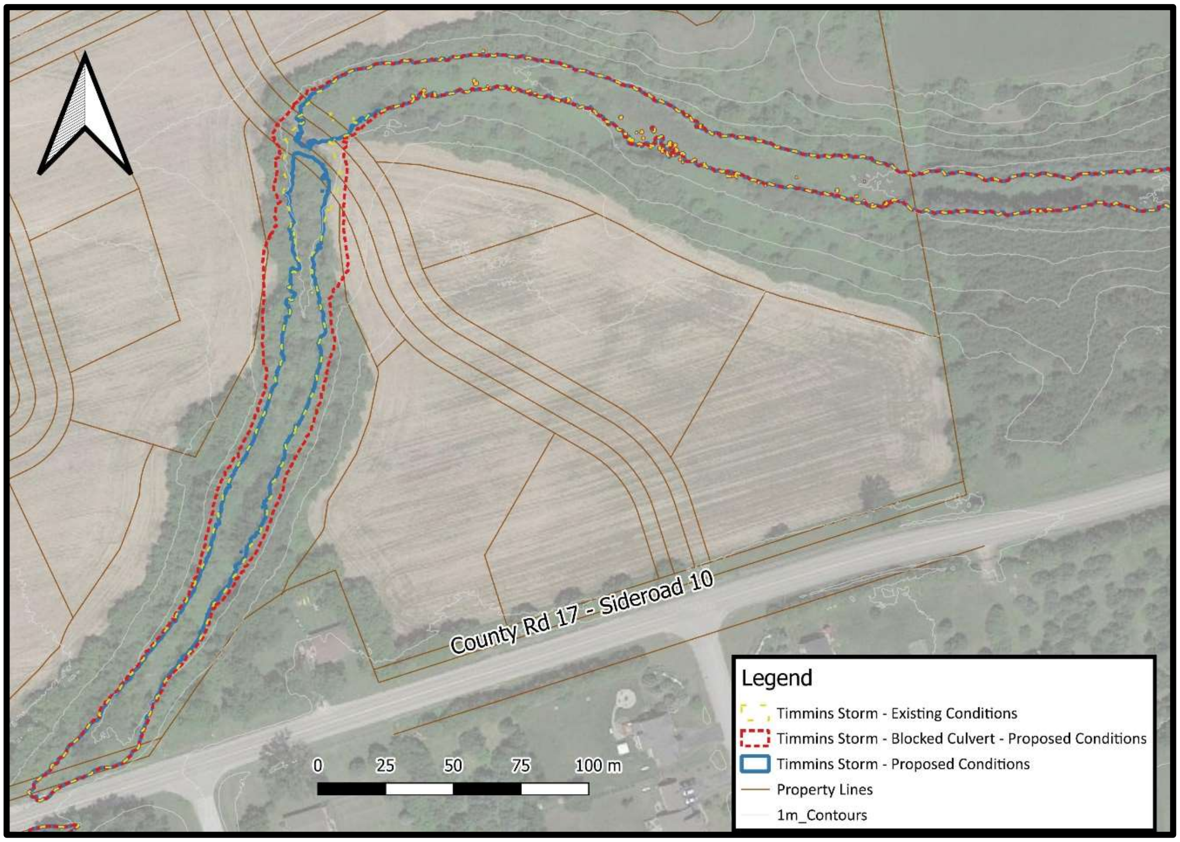


Figure 5: Floodplain Delineation

4.0 SUMMARY

Based on our field work and desktop analyses, we conclude the following:

1. The tributary is a small drainage feature that exhibits no defined or consistent stream features,
2. Under proposed conditions, the flood risk will not increase upstream of property during the Regional Storm, although a small increase in backwatering will occur on the property upstream of the proposed crossing,
3. No increase in the water surface elevations was present at the downstream end of the property, although it is primarily due to conservative estimates of post-development runoff leading to increased channel flows,
4. With an road height of 305.85 m and 0.24 m sediment depth, a concrete box culvert 3 m wide and 2.4 m tall are needed to avoid the Regional Storm overtopping the proposed crossing or increasing the flood risk outside of the subject property,
5. A 3 m wide culvert has sufficient width to include the 1 metre erosion offsets on a low flow channel,
6. The final erosion hazard and floodplain offsets submitted here do not include any additional erosion access allowances as required by the NVCA,
7. Photographs of typical creek features are shown in **Appendix A** and modelling results are in **Appendix B**.

Respectfully submitted,

Ed Gazendam, Ph.D., P. Eng.,
President, Sr. Water Resources Engineer
Water's Edge Environmental Solutions Team Ltd.

Nik Gazendam, C. Tech., CAN-CISEC
Sr. Fluvial Geomorphic Technician

Attachments:
Appendix A: Site Photos
Appendix B: Modelling Results
Appendix C Floodplain Map

References

Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines, 2022, Barrie, ON.

Chapman, L. J. and D. F. Putnam. 1984. The Physiography of Southern Ontario, Third Edition. Ontario Geological Survey, Special Volume 2, Ontario Ministry of Natural Resources, Toronto.

Galli, J. 1996, *Rapid Stream Assessment Technique (RSAT) field methods*. 36 pp. Metropolitan Washington Council of Governments, Department of Environmental Programs, Washington, DC.

Ministry of Natural Resources Ontario. 2002. Technical Guide River & Stream Systems: Erosion Hazard Limits.

Nottawasaga Valley Conservation Authority. 2009. Planning and Regulation Guidelines.

Toronto and Region Conservation Authority. 2004b. TRCA Belt Width Delineation Procedures. Prepared by Parish Geomorphic Ltd., Sept 27, 2001 (rev'd Jan 30, 2004).

APPENDIX A:

Photographs

PHOTOGRAPH NO.: 1
FROM: Immediately downstream of road, in channel.
LOOKING: At downstream end of HE Pipe. Note cattails and sediment.

PHOTOGRAPH NO.:2
FROM: In channel valley near upstream road crossing.
LOOKING: Upstream towards culvert (not visible)

PHOTOGRAPH NO.: 3
FROM: In channel valley.
LOOKING: Downstream through valley. No defined channel visible.

PHOTOGRAPH NO.: 4
FROM: Channel in upper middle part of site.
LOOKING: At potential flow path or low lying wet area in valley.

PHOTOGRAPH NO.: 5
FROM: Upper to middle of site.
LOOKING: Along valley corridor. Heavy grasses, no distinguishable channel.

PHOTOGRAPH NO.: 6
FROM: Upper to middle of site.
LOOKING: Along valley corridor. Heavy grasses, no distinguishable channel.

PHOTOGRAPH NO.: 7
FROM: Valley in middle of site.
LOOKING: Left (west) towards top of defined valley slope.

PHOTOGRAPH NO.: 8
FROM: Valley in middle of site.
LOOKING: Along valley corridor. Heavy grasses, no distinguishable channel.

PHOTOGRAPH NO.: 9
FROM: Upstream of farm lane crossing.
LOOKING: Towards farm lane crossing.

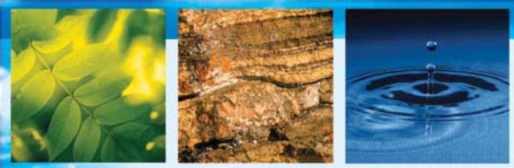
PHOTOGRAPH NO.: 10
FROM: Immediately upstream of farm lane crossing.
LOOKING: At small pipe (~300) that conveys flows through crossing.

PHOTOGRAPH NO.: 11
FROM: Farm lane crossing.
LOOKING: Downstream towards valley/channel.

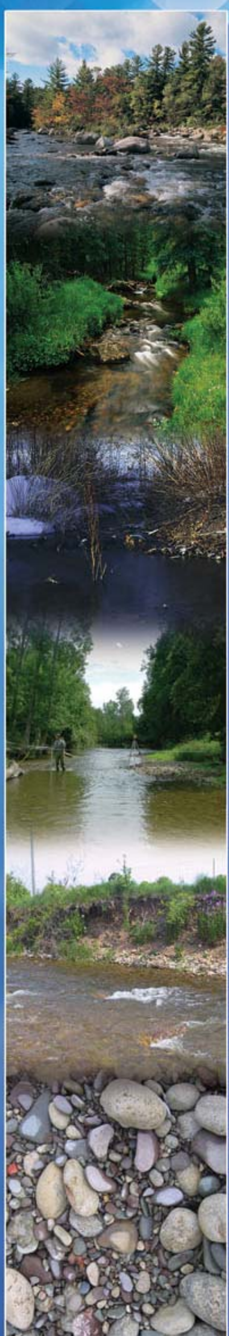
PHOTOGRAPH NO.: 12
FROM: Lower middle end of site in valley bottom near drainage path.
LOOKING: Along valley corridor. Heavy cattails and vegetation, area is damp.

PHOTOGRAPH NO.: 13
FROM: Lower middle end of site in valley bottom near drainage path.
LOOKING: Along valley corridor. Heavy cattails and vegetation, area is damp.

PHOTOGRAPH NO.: 14
FROM: Lower end of site in drainage path.
LOOKING: Along valley corridor and at the end of the property limits. Slope increase.



water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.



Fluvial Geomorphology

Natural Channel Design

Stream Restoration

Monitoring

Erosion Assessment

Sediment Transport

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APPENDIX B:

Modelling Results

Hec HMS Parameters

Reach Characteristics

Reach	Length (km)	Slope (m/m)	Relief (m)	Sinuosity	Mannings n	Index Method	Index Celerity (m/s)	Width(m)	Side Slope
Reach-1	0.28795	0.01466	4.22	1.122	0.035	Celerity	1.524	3	3
Reach-3	0.08566	0.01261	1.07999	1.37651	0.035	Celerity	1.524	3	3
Reach-4	0.44761	0.01363	6.10001	1.09453	0.035	Celerity	1.524	3	3
R1	0.04726	0.00825	0.38998	1.07348	0.035	Celerity	1.524	3	3

Subbasin Parameters

Subbasin	Time of Concentration (HR)	Storage Coefficient (HR)	Area (km^2)	Longest Flowpath (km)	Longest Flowpath Slope (m/m)	Centroidal Flowpath (km)	Centroidal Flowpath Slope (m/m)	10-85 Flowpath (km)	10-85 Flowpath slope (m/m)	Basin Slope (m/m)	Basin Relief (m)	Relief Ratio	Elongation Ratio	Drainage Density (km/km^2)
SB3	1.72	1.72	1.1751	4.7523	0.0191	2.1789	0.0085	3.5643	0.0157	0.0955	90.9500	0.0191	0.2574	3.0490
SB2	0.655	0.655	0.1155	0.8026	0.0075	0.3181	0.0124	0.6019	0.0059	0.0607	7.0800	0.0088	0.4777	0.0258
SB8	0.358	0.358	0.0241	0.3591	0.0182	0.1588	0.0197	0.2693	0.0165	0.0742	6.5000	0.0181	0.4883	0.9308
WP101	0.57	0.57	0.1730	0.8586	0.0154	0.2757	0.0172	0.6440	0.0128	0.0724	14.2990	0.0167	0.5467	2.6428
WP102	0.378	0.378	0.0433	0.3282	0.0324	0.2480	0.0393	0.2462	0.0236	0.0987	11.1600	0.0340	0.7154	1.9618
W120	0.355	0.355	0.0384	0.4736	0.0313	0.1740	0.0106	0.3552	0.0364	0.1737	14.9600	0.0316	0.4669	7.2581

Job no. 21024
Job Name: Mansfield FPM

HEC-RAS Model Output v. 6.4.1 Date 23-Jan-23

River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
828	Timmins	Ex. Cond.	2.94	307.81	308.12	308.12	308.18	0.024301	1.39	3.17	26.81	1.06
828	Timmins	Prop. Cond.	2.94	307.81	308.12	308.12	308.18	0.024301	1.39	3.17	26.81	1.06
828	Timmins	Pro. Cond. 50% Blocked Culv.	2.94	307.81	308.12	308.12	308.18	0.024301	1.39	3.17	26.81	1.06
828	100YR 24HR SCS	Ex. Cond.	1.01	307.81	308.04	308.04	308.08	0.020994	1.02	1.42	18.92	0.93
828	100 yr 24 hr SCS	Prop. Cond.	1.01	307.81	308.04	308.04	308.08	0.020868	1.02	1.42	18.96	0.93
828	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	1.01	307.81	308.04	308.04	308.08	0.020868	1.02	1.42	18.96	0.93
821	Timmins	Ex. Cond.	2.94	306.32	307.84	307.01	307.86	0.000405	0.55	5.32	23.81	0.17
821	Timmins	Prop. Cond.	2.94	306.32	307.84	307.01	307.86	0.000405	0.55	5.32	23.81	0.17
821	Timmins	Pro. Cond. 50% Blocked Culv.	2.94	306.32	307.84	307.01	307.86	0.000405	0.55	5.32	23.81	0.17
821	100YR 24HR SCS	Ex. Cond.	1.01	306.32	307.15	306.68	307.17	0.000974	0.51	1.97	4.02	0.23
821	100 yr 24 hr SCS	Prop. Cond.	1.01	306.32	307.15	306.68	307.17	0.000974	0.51	1.98	4.02	0.23
821	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	1.01	306.32	307.15	306.68	307.17	0.000974	0.51	1.98	4.02	0.23
812			Culvert									
804	Timmins	Ex. Cond.	2.94	306.48	306.98	306.98	307.12	0.01855	1.66	1.77	7.94	1
804	Timmins	Prop. Cond.	2.94	306.48	306.98	306.98	307.12	0.01855	1.66	1.77	7.94	1
804	Timmins	Pro. Cond. 50% Blocked Culv.	2.94	306.48	306.98	306.98	307.12	0.01855	1.66	1.77	7.94	1
804	100YR 24HR SCS	Ex. Cond.	1.01	306.48	306.83	306.83	306.9	0.024246	1.17	0.86	6.63	1.01
804	100 yr 24 hr SCS	Prop. Cond.	1.01	306.48	306.83	306.83	306.9	0.024031	1.17	0.86	6.64	1.01
804	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	1.01	306.48	306.83	306.83	306.9	0.024031	1.17	0.86	6.64	1.01
796	Timmins	Ex. Cond.	2.94	306.32	306.69	306.69	306.79	0.020686	1.42	2.08	10.18	1
796	Timmins	Prop. Cond.	2.94	306.32	306.7	306.69	306.79	0.017157	1.32	2.22	10.5	0.92
796	Timmins	Pro. Cond. 50% Blocked Culv.	2.94	306.32	306.69	306.69	306.79	0.020853	1.42	2.07	10.14	1.01
796	100YR 24HR SCS	Ex. Cond.	1.01	306.32	306.56	306.56	306.62	0.025819	1.09	0.93	7.97	1.02
796	100 yr 24 hr SCS	Prop. Cond.	1.01	306.32	306.58	306.56	306.62	0.013964	0.88	1.14	8.48	0.77
796	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	1.01	306.32	306.56	306.56	306.62	0.024853	1.08	0.94	8	1
713	Timmins	Ex. Cond.	4.09	304.86	305.31	305.27	305.41	0.013254	1.44	2.83	9.65	0.85
713	Timmins	Prop. Cond.	2.94	304.86	305.22	305.21	305.33	0.018579	1.45	2.02	8.8	0.97
713	Timmins	Pro. Cond. 50% Blocked Culv.	2.94	304.86	305.41		305.44	0.002696	0.75	3.9	10.64	0.4
713	100YR 24HR SCS	Ex. Cond.	1.34	304.86	305.16		305.2	0.007718	0.85	1.57	7.96	0.61
713	100 yr 24 hr SCS	Prop. Cond.	1.01	304.86	305.07	305.07	305.14	0.024289	1.15	0.88	6.68	1.01
713	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	1.01	304.86	305.2		305.21	0.002895	0.55	1.83	8.48	0.38
652	Timmins	Ex. Cond.	4.09	304.32	304.8		304.85	0.006391	1.02	4	13.28	0.6
652	Timmins	Prop. Cond.	2.94	304.32	304.76		304.8	0.004633	0.82	3.57	12.92	0.5
652	Timmins	Pro. Cond. 50% Blocked Culv.	2.94	304.32	305.42		305.42	0.00008	0.21	14.28	19.87	0.08
652	100YR 24HR SCS	Ex. Cond.	1.34	304.32	304.58		304.62	0.011581	0.88	1.52	9.89	0.72
652	100 yr 24 hr SCS	Prop. Cond.	1.01	304.32	304.66		304.67	0.00193	0.44	2.31	11.19	0.31
652	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	1.01	304.32	305.2		305.2	0.000025	0.1	10.26	17.61	0.04
610	Timmins	Ex. Cond.	4.09	304.04	304.68		304.71	0.001964	0.68	6.05	15.39	0.34
610	Timmins	Prop. Cond.	3.81	304.04	304.65		304.68	0.002137	0.68	5.59	14.98	0.36
610	Timmins	Pro. Cond. 50% Blocked Culv.	3.81	304.04	305.41		305.41	0.000043	0.19	21.78	27.07	0.06
610	100YR 24HR SCS	Ex. Cond.	1.34	304.04	304.45		304.46	0.001856	0.47	2.83	11.84	0.31
610	100 yr 24 hr SCS	Prop. Cond.	2.56	304.04	304.57		304.59	0.00194	0.58	4.42	14.08	0.33
610	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.56	304.04	305.2		305.2	0.000044	0.16	16.32	24.1	0.06
587	Timmins	Ex. Cond.	4.09	303.8	304.29	304.28	304.43	0.018783	1.65	2.47	8.94	1
587	Timmins	Prop. Cond.	3.81	303.8	304.31		304.41	0.012726	1.42	2.69	9.11	0.83
587	Timmins	Pro. Cond. 50% Blocked Culv.	3.81	303.8	305.41		305.41	0.000054	0.19	21.19	28.27	0.06
587	100YR 24HR SCS	Ex. Cond.	1.34	303.8	304.1	304.1	304.19	0.022322	1.3	1.03	6.04	1.01
587	100 yr 24 hr SCS	Prop. Cond.	2.56	303.8	304.2	304.2	304.31	0.020963	1.47	1.74	8.17	1.02
587	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.56	303.8	305.2		305.2	0.000054	0.17	15.6	23.87	0.06
583	Timmins	Ex. Cond.	4.09	303.59	304.12	304.12	304.33	0.018986	2.01	2.04	5.02	1.01
583	Timmins	Prop. Cond.	3.81	303.47	304.3	304	304.36	0.003889	1.12	3.42	6.04	0.47
583	Timmins	Pro. Cond. 50% Blocked Culv.	3.81	303.47	305.41	304	305.41	0.000045	0.17	23.68	31.8	0.06
583	100YR 24HR SCS	Ex. Cond.	1.34	303.59	303.98		304.03	0.005675	0.96	1.39	4.21	0.54
583	100 yr 24 hr SCS	Prop. Cond.	2.56	303.47	304.08	303.87	304.15	0.005504	1.14	2.23	4.89	0.54
583	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.56	303.47	305.2	303.87	305.2	0.000041	0.15	17.21	26.25	0.05
553	Timmins	Ex. Cond.	4.09	303.45	304.14		304.15	0.00079	0.45	9.18	22.12	0.22
553	100YR 24HR SCS	Ex. Cond.	1.34	303.45	303.99		303.99	0.000291	0.22	6	19.39	0.13
549	Timmins	Ex. Cond.	4.09	303.42	304.14	303.77	304.15	0.000708	0.42	9.62	22.92	0.21
549	100YR 24HR SCS	Ex. Cond.	1.34	303.42	303.99	303.77	303.99	0.000236	0.21	6.46	19.88	0.12
542			Culvert									
535	Timmins	Ex. Cond.	4.09	303.14	303.52	303.52	303.65	0.018533	1.63	2.5	18.27	1
535	100YR 24HR SCS	Ex. Cond.	1.34	303.14	303.38	303.38	303.44	0.023292	1.12	1.19	16.04	0.99
532	Timmins	Ex. Cond.	4.09	303.04	303.4	303.4	303.49	0.022633	1.33	3.08	17.88	1.02
532	100YR 24HR SCS	Ex. Cond.	1.34	303.04	303.29	303.29	303.34	0.028881	0.98	1.36	14.87	1.04
512.9853	Timmins	Ex. Cond.	4.09	302.69	303.15		303.19	0.005496	0.86	4.77	18.37	0.54
512.9853	Timmins	Prop. Cond.	4.09	302.69	303.16	303.05	303.2	0.005077	0.84	4.89	18.48	0.52
512.9853	Timmins	Pro. Cond. 50% Blocked Culv.	4.09	302.69	303.16	303.05	303.2	0.005077	0.84	4.89	18.48	0.52
512.9853	100YR 24HR SCS	Ex. Cond.	1.34	302.69	302.99		303.01	0.005654	0.64	2.07	12.54	0.51
512.9853	100 yr 24 hr SCS	Prop. Cond.	2.94	302.69	303.11	303	303.14	0.00523	0.75	3.91	17.62	0.51
512.9853	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.94	302.69	303.11	303	303.14	0.00523	0.75	3.91	17.62	0.51
496	Timmins	Ex. Cond.	4.09	302.44	302.9	302.9	303.01	0.020997	1.48	2.77	12.9	1.02
496	Timmins	Prop. Cond.	4.09	302.44	302.9	302.9	303.01	0.020997	1.48	2.77	12.9	1.02
496	Timmins	Pro. Cond. 50% Blocked Culv.	4.09	302.44	302.9	302.9	303.01	0.020997	1.48	2.77	12.9	1.02
496	100YR 24HR SCS	Ex. Cond.	1.34	302.44	302.74	302.74	302.82	0.022423	1.27	1.05	6.5	1
496	100 yr 24 hr SCS	Prop. Cond.	2.94	302.44	302.85	302.85	302.94	0.022304	1.37	2.15	11.79	1.02
496	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.94	302.44	302.85	302.85	302.94	0.022304	1.37	2.15	11.79	1.02
474	Timmins	Ex. Cond.	4.09	302.12	302.51		302.58	0.010479	1.23	3.34	12.24	0.75
474	Timmins	Prop. Cond.	4.09	302.12	302.51		302.58	0.010479	1.23	3.34	12.24	0.75

474	Timmins	Pro. Cond. 50% Blocked Culv.	4.09	302.12	302.51		302.58	0.010479	1.23	3.34	12.24	0.75
474	100YR 24HR SCS	Ex. Cond.	1.34	302.12	302.35	302.31	302.38	0.011746	0.87	1.54	10.31	0.72
474	100 yr 24 hr SCS	Prop. Cond.	2.94	302.12	302.45	302.4	302.51	0.010741	1.11	2.64	11.43	0.74
474	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.94	302.12	302.45	302.4	302.51	0.010741	1.11	2.64	11.43	0.74
437	Timmins	Ex. Cond.	4.09	301.66	302.11	302.06	302.19	0.010724	1.2	3.42	13.19	0.75
437	Timmins	Prop. Cond.	4.09	301.66	302.11	302.06	302.19	0.010724	1.2	3.42	13.19	0.75
437	Timmins	Pro. Cond. 50% Blocked Culv.	4.09	301.66	302.11	302.06	302.19	0.010724	1.2	3.42	13.19	0.75
437	100YR 24HR SCS	Ex. Cond.	1.34	301.66	301.96	301.91	301.99	0.009299	0.83	1.61	9.73	0.65
437	100 yr 24 hr SCS	Prop. Cond.	2.94	301.66	302.06	302.01	302.12	0.010116	1.06	2.76	12.18	0.71
437	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.94	301.66	302.06	302.01	302.12	0.010116	1.06	2.76	12.18	0.71
399	Timmins	Ex. Cond.	4.09	301.18	301.52	301.52	301.62	0.021273	1.36	3.02	16.16	1
399	Timmins	Prop. Cond.	4.09	301.18	301.52	301.52	301.62	0.021273	1.36	3.02	16.16	1
399	Timmins	Pro. Cond. 50% Blocked Culv.	4.09	301.18	301.52	301.52	301.62	0.021273	1.36	3.02	16.16	1
399	100YR 24HR SCS	Ex. Cond.	1.34	301.18	301.37	301.37	301.44	0.024968	1.11	1.21	9.89	1.01
399	100 yr 24 hr SCS	Prop. Cond.	2.94	301.18	301.47	301.47	301.56	0.02223	1.3	2.27	13.41	1.01
399	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.94	301.18	301.47	301.47	301.56	0.02223	1.3	2.27	13.41	1.01
357	Timmins	Ex. Cond.	4.09	300.47	300.86	300.79	300.92	0.009372	1.11	3.7	14.59	0.7
357	Timmins	Prop. Cond.	4.09	300.47	300.86	300.79	300.92	0.009372	1.11	3.7	14.59	0.7
357	Timmins	Pro. Cond. 50% Blocked Culv.	4.09	300.47	300.86	300.79	300.92	0.009372	1.11	3.7	14.59	0.7
357	100YR 24HR SCS	Ex. Cond.	1.34	300.47	300.72	300.67	300.75	0.008332	0.72	1.84	12.59	0.6
357	100 yr 24 hr SCS	Prop. Cond.	2.94	300.47	300.81		300.86	0.008876	0.97	3.03	13.9	0.67
357	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.94	300.47	300.81		300.86	0.008876	0.97	3.03	13.9	0.67
310	Timmins	Ex. Cond.	4.09	299.84	300.19	300.19	300.29	0.020543	1.4	2.92	14.48	1
310	Timmins	Prop. Cond.	4.09	299.84	300.19	300.19	300.29	0.020543	1.4	2.92	14.48	1
310	Timmins	Pro. Cond. 50% Blocked Culv.	4.09	299.84	300.19	300.19	300.29	0.020543	1.4	2.92	14.48	1
310	100YR 24HR SCS	Ex. Cond.	1.34	299.84	300.05	300.05	300.11	0.025577	1.08	1.24	10.72	1.02
310	100 yr 24 hr SCS	Prop. Cond.	2.94	299.84	300.13	300.13	300.22	0.022496	1.35	2.18	12.3	1.02
310	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.94	299.84	300.13	300.13	300.22	0.022496	1.35	2.18	12.3	1.02
276	Timmins	Ex. Cond.	4.11	298.88	299.31	299.31	299.43	0.020667	1.5	2.73	12.23	1.02
276	Timmins	Prop. Cond.	4.11	298.88	299.31	299.31	299.43	0.020667	1.5	2.73	12.23	1.02
276	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	298.88	299.31	299.31	299.43	0.020667	1.5	2.73	12.23	1.02
276	100YR 24HR SCS	Ex. Cond.	1.4	298.88	299.2	299.18	299.25	0.016302	0.97	1.45	10.51	0.83
276	100 yr 24 hr SCS	Prop. Cond.	2.92	298.88	299.26	299.26	299.36	0.022077	1.37	2.13	11.48	1.02
276	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	298.88	299.26	299.26	299.36	0.022077	1.37	2.13	11.48	1.02
253	Timmins	Ex. Cond.	4.11	298.43	298.92	298.88	299	0.013688	1.28	3.2	13.37	0.84
253	Timmins	Prop. Cond.	4.11	298.43	298.92	298.88	299	0.013688	1.28	3.2	13.37	0.84
253	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	298.43	298.92	298.88	299	0.013688	1.28	3.2	13.37	0.84
253	100YR 24HR SCS	Ex. Cond.	1.4	298.43	298.73	298.73	298.8	0.024048	1.2	1.16	8.16	1.02
253	100 yr 24 hr SCS	Prop. Cond.	2.92	298.43	298.86	298.83	298.93	0.013818	1.17	2.51	12.21	0.82
253	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	298.43	298.86	298.83	298.93	0.013818	1.17	2.51	12.21	0.82
232	Timmins	Ex. Cond.	4.11	298.16	298.53	298.53	298.65	0.01949	1.53	2.68	11.19	1
232	Timmins	Prop. Cond.	4.11	298.16	298.53	298.53	298.65	0.01949	1.53	2.68	11.19	1
232	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	298.16	298.53	298.53	298.65	0.01949	1.53	2.68	11.19	1
232	100YR 24HR SCS	Ex. Cond.	1.4	298.16	298.42	298.37	298.46	0.010768	0.92	1.52	8.72	0.71
232	100 yr 24 hr SCS	Prop. Cond.	2.92	298.16	298.48	298.48	298.58	0.020423	1.41	2.07	10.14	1
232	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	298.16	298.48	298.48	298.58	0.020423	1.41	2.07	10.14	1
204	Timmins	Ex. Cond.	4.11	297.82	298.17	298.12	298.24	0.009935	1.15	3.58	13.96	0.72
204	Timmins	Prop. Cond.	4.11	297.82	298.17	298.12	298.24	0.009935	1.15	3.58	13.96	0.72
204	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	297.82	298.17	298.12	298.24	0.009935	1.15	3.58	13.96	0.72
204	100YR 24HR SCS	Ex. Cond.	1.4	297.82	298.01	298	298.06	0.019405	0.97	1.44	11.86	0.89
204	100 yr 24 hr SCS	Prop. Cond.	2.92	297.82	298.13		298.18	0.009091	0.99	2.95	13.39	0.67
204	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	297.82	298.13		298.18	0.009091	0.99	2.95	13.39	0.67
173	Timmins	Ex. Cond.	4.11	297.4	297.7	297.7	297.79	0.022805	1.32	3.11	18.34	1.02
173	Timmins	Prop. Cond.	4.11	297.4	297.7	297.7	297.79	0.022805	1.32	3.11	18.34	1.02
173	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	297.4	297.7	297.7	297.79	0.022805	1.32	3.11	18.34	1.02
173	100YR 24HR SCS	Ex. Cond.	1.4	297.4	297.65		297.67	0.008424	0.65	2.16	17.68	0.59
173	100 yr 24 hr SCS	Prop. Cond.	2.92	297.4	297.67	297.67	297.74	0.024292	1.19	2.46	17.89	1.02
173	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	297.4	297.67	297.67	297.74	0.024292	1.19	2.46	17.89	1.02
121	Timmins	Ex. Cond.	4.11	296.72	297.58		297.58	0.000249	0.29	14.14	27.12	0.13
121	Timmins	Prop. Cond.	4.11	296.72	297.58		297.58	0.000249	0.29	14.14	27.12	0.13
121	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	296.72	297.58		297.58	0.000249	0.29	14.14	27.12	0.13
121	100YR 24HR SCS	Ex. Cond.	1.4	296.72	297.01		297.05	0.018425	0.87	1.61	15.15	0.85
121	100 yr 24 hr SCS	Prop. Cond.	2.92	296.72	297.53		297.53	0.000169	0.23	12.88	26.8	0.1
121	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	296.72	297.53		297.53	0.000169	0.23	12.88	26.8	0.1
73	Timmins	Ex. Cond.	4.11	296.22	297.58		297.58	0.000022	0.13	31.85	33.79	0.04
73	Timmins	Prop. Cond.	4.11	296.22	297.58		297.58	0.000022	0.13	31.85	33.79	0.04
73	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	296.22	297.58		297.58	0.000022	0.13	31.85	33.79	0.04
73	100YR 24HR SCS	Ex. Cond.	1.4	296.22	297.03		297.04	0.000021	0.09	15.51	26.98	0.04
73	100 yr 24 hr SCS	Prop. Cond.	2.92	296.22	297.53		297.53	0.000013	0.1	30.29	33.06	0.03
73	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	296.22	297.53		297.53	0.000013	0.1	30.29	33.06	0.03
37	Timmins	Ex. Cond.	4.11	296.05	297.58		297.58	0.000009	0.09	44.14	43.14	0.03
37	Timmins	Prop. Cond.	4.11	296.05	297.58		297.58	0.000009	0.09	44.14	43.14	0.03
37	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	296.05	297.58		297.58	0.000009	0.09	44.14	43.14	0.03
37	100YR 24HR SCS	Ex. Cond.	1.4	296.05	297.03		297.03	0.000009	0.06	22.64	36.75	0.03
37	100 yr 24 hr SCS	Prop. Cond.	2.92	296.05	297.53		297.53	0.000006	0.07	42.14	42.74	0.02
37	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	296.05	297.53		297.53	0.000006	0.07	42.14	42.74	0.02
26	Timmins	Ex. Cond.	4.11	295.9	297.58	296.37	297.58	0.000015	0.13	32.48	36.13	0.04
26	Timmins	Prop. Cond.	4.11	295.9	297.58	296.37	297.58	0.000015	0.13	32.48	36.13	0.04
26	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	295.9	297.58	296.37	297.58	0.000015	0.13	32.48	36.13	0.04
26	100YR 24HR SCS	Ex. Cond.	1.4	295.9	297.03	296.17	297.03	0.000069	0.24	5.75	30.46	0.08
26	100 yr 24 hr SCS	Prop. Cond.	2.92	295.9	297.53	296.29	297.53	0.000009	0.09	31.19	35.85	0.03
26	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	295.9	297.53	296.29	297.53	0.000009	0.09	31.19	35.85	0.03
19			Culvert									

12	Timmins	Ex. Cond.	4.11	296.07	296.93	296.93	297.29	0.013835	2.66	1.55	18.69	1
12	Timmins	Prop. Cond.	4.11	296.07	296.93	296.93	297.29	0.013835	2.66	1.55	18.69	1
12	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	296.07	296.93	296.93	297.29	0.013835	2.66	1.55	18.69	1
12	100YR 24HR SCS	Ex. Cond.	1.4	296.07	296.57	296.57	296.74	0.017359	1.85	0.76	15.77	1
12	100 yr 24 hr SCS	Prop. Cond.	2.92	296.07	296.79	296.79	297.07	0.014951	2.37	1.23	17.4	1
12	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	296.07	296.79	296.79	297.07	0.014951	2.37	1.23	17.4	1
5	Timmins	Ex. Cond.	4.11	295.59	295.94	295.89	295.99	0.01	1	4.09	19.54	0.7
5	Timmins	Prop. Cond.	4.11	295.59	295.94	295.89	295.99	0.01	1	4.09	19.54	0.7
5	Timmins	Pro. Cond. 50% Blocked Culv.	4.11	295.59	295.94	295.89	295.99	0.01	1	4.09	19.54	0.7
5	100YR 24HR SCS	Ex. Cond.	1.4	295.59	295.84	295.8	295.86	0.010013	0.67	2.09	18.39	0.63
5	100 yr 24 hr SCS	Prop. Cond.	2.92	295.59	295.9	295.86	295.94	0.010003	0.88	3.31	19.12	0.68
5	100 yr 24 hr SCS	Pro. Cond. 50% Blocked Culv.	2.92	295.59	295.9	295.86	295.94	0.010003	0.88	3.31	19.12	0.68

APPENDIX C:

Floodplain Map

Legend

- Cross Sections
- 1m_Contours

Timmins Storm - Proposed Conditions

- Timmins Storm - Existing Conditions
- Timmins Storm - Proposed Conditions

Timmins Storm - Proposed Conditions

- Property Lines

0 100 m

Scale: 1:1000

Projection: NAD83 (CRS) UTM Zone 17N
Datum: CGVD2013
Orthoimagery captured via Google Maps

River Station — 121
Existing Water Level — 297.58
Proposed Water Level — 297.58

water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.

Flood Hazard Mapping in Mansfield, ON

LICENSED PROFESSIONAL ENGINEER
E. GAZENDAM
January 24, 2024
PROVINCE OF ONTARIO

Pine River Headwaters

Date: 2024-01-25	Drawn By: TA Checked By: EG
File No.: WE21024	Map No.: 1