DELTINI COMMERCIAL DEVELOPMENTS INC.
181-01582-02

WATER BALANCE STUDY

636040 PRINCE OF WALES ROAD WEST, TOWNSHIP OF MULMUR, ONTARIO

JULY 13, 2021

CONFIDENTIAL

WATER BALANCE STUDY

636040 PRINCE OF WALES ROAD WEST, TOWNSHIP OF MULMUR, ONTARIO

DELTINI COMMERCIAL DEVELOPMENTS INC.

CONFIDENTIAL

PROJECT NO.: 181-01582-02
DATE: JULY 13, 2021

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July 13, 2021

DELTINI COMMERCIAL DEVELOPMENTS INC.
1350 Shawson Drive
Mississauga, Ontario
L4W 1C5

Attention: **Marika Zigon**

Re: Water Balance Study – 636040 Prince of Wales Road West, Township of Mulmur, ON

Dear Madam:

WSP Canada Inc. is pleased to present the Water Balance Study report for the above-noted project. This report documents relevant background information, results of our analyses, and provides findings and conclusions.

Please do not hesitate to contact the undersigned should you have any questions or require any further assistance.

Yours sincerely,

WSP Canada Inc.

Melanie Yuen, B.A.T.
Project Manager – Hydrogeology

Natalia Codoban, M. Eng., P.Eng.
Senior Hydrogeologist

WSP ref.: 181-01582-02

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SIGNATURES

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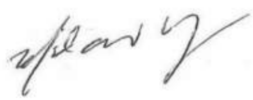
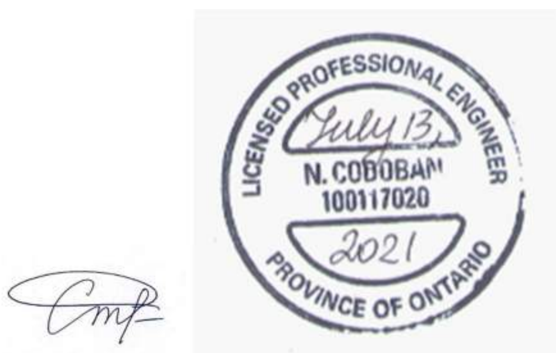


Melanie Yuen, B.A.T.
Project Manager

APPROVED BY



Natalia Codoban, M. Eng., P. Eng.
Senior Hydrogeologist

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1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by Deltini Commercial Developments Inc. to complete a water balance study for the proposed development at 6360101 Prince of Wales Road West, in the Township of Mulmur, Ontario, herein referred to as the "Site". The Site is a rectangular shaped parcel of land located north of Highway 89 and west of Prince of Wales Road (see **Figure 1**). Prince of Wales Road is also known as Dufferin County Road 19.

To evaluate regional hydrogeological conditions, a 500-m buffer zone (the "Study Area") was added around the Site. The purpose of this water balance study is to evaluate impacts the proposed development will have on infiltration and runoff volumes within the Site.

2 STUDY AREA CONDITIONS

2.1 PHYSIOGRAPHY AND DRAINAGE

The Site and the Study Area are located entirely within the physiographic region of Southern Ontario known as the Horseshoe Moraines (Chapman and Putnam, 1984; MNR, 1984). This physiographic region contains shallow ground moraine, scattered group drumlins, till ridges, kame moraines, and outwash plains. In this region, surficial soils were deposited as till and as sand and gravel associated with glacial fluvial processes and by meltwater discharged by glaciers (Singer et al, 2003). Available mapping indicates that the ground surface elevations range between 449 and 463 meters above the sea level (masl) across the Site.

The Study Area is located entirely within the Boyne River Sub-watershed of the Nottawasaga Valley watershed (NVCA, 2018). Boyne River is a tributary of the Nottawasaga River.

There is a wetland and woodland in the western portion of the Site, which are a part of a larger natural heritage system surrounding the Site (see **Figure 1**). Boyne Valley Provincial Park is located north of the Site and extends eastward. Tributaries of Primrose Creek flow through the western portion of the Site.

2.2 BEDROCK GEOLOGY

The bedrock in the Study Area is interpreted to be limestone and dolostone of the Amabel Formation (OGS, 1991). The bedrock formation is often fractured, with large open spaces and cracks, and can be a highly permeable, productive bedrock aquifer. However, the water-yielding capacity from the bedrock is highly variable due to the bedrock thickness and the degree of fracturing present (Singer et al., 2003).

2.3 SURFICIAL GEOLOGY

The occurrence and character of the overburden are a result of the repeated glacial advances and retreats that occurred in Southern Ontario. The surficial geology throughout most of the Site is comprised of sandy glaciofluvial deposits. Along the eastern portion of the Site, ice-contact stratified deposits are present, consisting of sand and gravel, with minor inclusions of silt, clay and till. There is a small pocket of organic peat deposits located towards the southwestern area of the Site. Within the Study Area, clay to silt-textured till and modern alluvial deposits can be found (OGS, 2010) in the northern portion of the Study Area. The surficial geology for the Site and Study Area is shown on **Figure 2.**

3 WATER BALANCE ASSESSMENT

A water balance assessment provides and accounting of the water inputs and water outputs within a defined area. In this case, the area of the proposed reconstruction project is used to estimate the water budgets in the existing condition (Pre-Development) and in the future condition (Post-Development).

The Thornthwaite water balance (Thornthwaite, 1948; Mather, 1978; 1979) is an accounting type method, used to analyze the allocation of water among various components of the hydrologic cycle. Inputs to the model are monthly temperature, precipitation and site latitude. Other factors that affect the water balance include, but may not be limited to, soil conditions, depth to water table, vegetation cover and topography. Outputs include monthly potential and actual evapotranspiration, evaporation, water surplus, infiltration and runoff. For ease of calculation, a spreadsheet model was used for the computation.

When precipitation (P) occurs, it can either runoff (R) through the surface water system, infiltrate (I) to the water table, or evapotranspire (ET) from the earth’s surface and vegetation. The sum of R and I is termed the water surplus (S). When long-term averages of P, R, I, and ET are used, there is no net change in groundwater storage (ST). Annually, however, there is a potential for small changes in ST.

The annual water budget can be stated as:

$$\mathbf{P = ET + R + I + ST}$$

The water balance assessment uses methods outlined in “Hydrogeological Technical Information Requirements for Land Development Applications” (MOEE, 1995).

3.1 CLIMATE AND PRECIPITATION

Climatic data for the Study Area was obtained from Environment Canada. The Canadian Climatic Normals 1981-2010 for the Ruskview Climate Station are considered representative of the climate (temperature and precipitation) in the area. **Table A-1 in Appendix A** presents the climate data for the climate station.

The climate station is at an elevation of 472.4 masl and is located about 15.5 km north of the Site. Based on data from the Ruskview Climate Station, the historical average annual precipitation for the area is approximately 995.8 mm and the average annual temperature is about 6.4ºC. Commonly, September and November are the wettest months and February and March are the driest.

3.2 LAND USE – EXISTING CONDITIONS

The total area for the proposed development is about 36.85 ha (368,500 m^2) and currently consists of natural environmental protection areas, agricultural fields, a couple of buildings, and some paved road areas. **Figure 3** presents a map of the existing pre-development land use cover. For the water balance assessment, the agricultural fields are assumed to be 100% pervious, based on comments received from the Jones Consulting Group Ltd., on May 17, 2021.

3.3 PROPOSED DEVELOPMENT

The western portion of the Site is an environmental protection area that will remain intact. The proposed development in the developable area will consist of three industrial blocks (Blocks 1 to 3), one stormwater management facility (Block 5), and a new road (Street 'A'). The proposed development areas are shown on **Figure 4.** The following post-development land uses were used in the water balance calculations:

- About 251,900 m^2 (68.1% of total area) will be industrial blocks;
- About 83,100 m^2 (22.5% of total area) will remain as the environmental protection area;
- About 21,000 m^2 (5.7% of total area) will be a stormwater management facility; and,
- About 13,800 m^2 (3.7% of total area) will be a road.

For the water balance calculations, the imperviousness for each Block in the proposed development was estimated based on comments from the Jones Consulting Group Ltd., (May 17, 2021).

3.4 PRE-DEVELOPMENT WATER BALANCE

To evaluate the background water balance that would naturally occur in the area, elements of the 30-year average weather data were used. The detailed calculations for the water balance are presented in **Appendix A, Table A-3** for this Site.

Precipitation (P)

Based on the 30-year average (1981-2010) for the Ruskview Climate Station, the average precipitation is about 995.8 mm/year. The monthly precipitation distribution is presented in **Appendix A, Table A-1**.

Storage (ST)

Groundwater storage (ST) of native soils for the existing Site was estimated using values of Water Holding Capacity (mm) of respective land use and soil types, identified in Table 3.1 of the Storm Water Management (SWM) Planning & Design Manual (MOE, March 2013). The land use, soil type and respective water holding capacities shown in **Table 1** were chosen to represent existing conditions and applied to March for monthly calculations.

Table 1: Existing Conditions – Water Holding Capacity of Native Soils

LAND USE	SOIL TYPE	WATER HOLDING CAPACITY (mm/year)
Urban Lawns/Shallow Rooted Crops	Fine Sandy Loam	75
Pasture and Shrubs	Fine Sandy Loam	150

Using the procedures outlined in the SWM Planning & Design Manual for the above land use and soil types, the annual change in storage is "0". Monthly changes in ST range from decreases of up to 43 mm in July, to increases of up to 48 mm in October. The monthly distribution of ST for each of the land use/soil types is presented in **Appendix A, Table A-2**.

Evapotranspiration (ET)

Monthly Potential Evapotranspiration (PET) is estimated using monthly temperature data and is defined as a water loss from a homogeneous vegetation-covered area that never lacks water (Thornthwaite, 1948; Mather, 1978).

In the Thornthwaite water balance model, PET is calculated using the Hamon equation (Hamon, 1961);

$$PET_{Hamon} = 13.97 * d * D^2 * W_t$$

Where:

d = the number of days in the month

D = the mean monthly hours of daylight in units of 12 hours

W_t = a saturated water vapour density term = $4.95 * e^{0.627}/100$

T = the monthly mean temperature in degrees Celsius

The calculated PET for the Study Area is 564 mm/year, or about 57% of the total precipitation. A comparison between PET and Precipitation (P) produces a soil moisture deficit in the order of 93 mm/year in the Study Area.

The calculated Actual Evapotranspiration (AET) is based on PET and changes in ST (ΔST). Where there is not enough P to satisfy PET, a reduction in ST occurs. As a result, volumes of AET are less than PET. The monthly distribution of ST at the Site produced unit area annual AET values between 509 and 535 mm/year, with an annual estimated volume of 187,853 m^3/yr. Detailed calculations and the monthly distribution of AET is presented in **Appendix A, Table A-2**.

Precipitation Surplus

Precipitation surplus (S) is calculated as P – ET. For all pervious areas, ET is considered to be AET and for impervious areas ET is potential evaporation (PE). The PE is assumed to be 15% of precipitation for flat roofs and impervious surfaces, and 10% for sloped roofs. For the existing conditions at the Site, precipitation surplus varies between 461 and 486 mm/yr. The total precipitation surplus volume calculated in the pre-development model is 179,613 m^3/year (S = P – AET – PE).

For pervious areas, precipitation surplus (S) has two components in the Thornthwaite model: a runoff component, which is the overland flow that occurs when soil moisture capacity is exceeded, and an infiltration component. For impervious areas, all surplus becomes runoff as there is no infiltration component. The accumulation of infiltration factors for topography, soil types and cover as prescribed in Table 3.1 of the SWM Planning & Design Manual give infiltration factors for existing conditions at the Site. Considering these factors, the total estimated volume of Infiltration (I) is 98,266 m^3/year and the total estimated volume of Runoff (R) is 81,347 m^3/yr. Detailed calculations are presented in **Appendix A, Table A-3**.

3.5 POST-DEVELOPMENT WATER BALANCE WITHOUT MITIGATION

To predict the post-development water balance, the same elements of the 30-year average climate data were used. Based on changes in land use, different factors of infiltration were used to anticipate changes in the water balance for the area as a result of the imported fill material. Detailed calculations are presented in **Appendix A, Table A-4.**

Precipitation (P)

Precipitation remains the same (i.e. the 30-year climate normal 1981-2010 for the Ruskview Climate Station). The long-term change in storage is 0.

Storage (ST)

Groundwater storage (ST) of soils at the Site will not change as a result of development. The land use, soil type and respective water holding capacities shown in **Table 2** were chosen to represent post-development conditions and applied to March for monthly calculations.

Table 2: Post-Development (without Mitigation) – Water Holding Capacity of Soils

LAND USE	SOIL TYPE	WATER HOLDING CAPACITY (mm/year)
Urban Lawns/Shallow Rooted Crops	Fine Sandy Loam	75
Pasture and Shrubs	Fine Sandy Loam	150

Similar to the pre-development conditions, using the procedures outlined in the SWM Planning & Design Manual for each of the above land uses, the annual change in storage is "0". The monthly distribution of ST for the land use/soil type is presented in **Appendix A, Table A-2**.

Evaporation/Evapotranspiration (ET)

In the post-development scenario, changes in land use results in 211,792 m^2 of impervious areas, primarily consisting of paved surfaces and buildings. Similar to the pre-development water balance, it is assumed that potential evaporation (PE) from flat roofs and impervious surfaces is about 15% of precipitation, and 10% of precipitation from sloped roofs. As a result, the total annual volume of evaporation is estimated at 31,635 m^3/year.

For post-development pervious areas, monthly PET is estimated using the same inputs and calculations described in the pre-development model. A decrease in pervious surface areas from 364,567 m^2 pre-development to 158,008 m^2 post-development means there is less area where evapotranspiration can occur. This results in a 56% decrease of total annual AET from pre-development volumes of 187,853 m^3/year to post-development volumes of 82,612 m^3/year. The monthly distribution of AET for each of the land use/soil types and detailed calculations are presented in **Appendix A, Tables A-2** and **A-4**.

Precipitation Surplus

Post-development precipitation surplus includes two components: one for pervious areas and one for impervious areas. For impervious areas, precipitation surplus is P – PE where PE is evaporation. For pervious areas, precipitation surplus is P – AET. Considering changes in land-use and its effect on AET, the estimated post-development total precipitation surplus volume is about 254,000 m^3/yr.

Based on the proposed development, it is estimated that about 43,018 m^3/year will infiltrate across the Site and about 210,982 m^3/year will be runoff. The calculations are shown in **Appendix A, Table A-4**.

4 WATER BALANCE IMPACT ASSESSMENT

With the inevitable changes in impervious areas and potential changes to groundwater quality and quantity, best management practices (BMP) that promote groundwater infiltration and recharge will make a significant contribution to mitigating the effects of development. Utilizing infiltration galleries and landscape features for diverted runoff are examples of BMPs that integrate SWM measures into open spaces to maximize soil moisture and promote infiltration.

4.1 CHANGES TO INFILTRATION AND RUNOFF

Based on the findings of the water balance assessments, without low impact development (LID) mitigation measures, the proposed development will result in a decrease in infiltration across the Site.

The infiltration in the post-development scenario is estimated to be 43,018 m^3/year, compared to pre-development estimate of 98,266 m^3/year, an infiltration deficit of 55,248 m^3/year (56% decrease). The calculated post-development runoff volume will increase by 129,635 m^3/year to 210,982 m^3/year compared to the pre-development runoff estimate of 81,347 m^3/year (159% increase).

A summary of calculations is shown in **Appendix A, Table A-5**.

4.2 INFILTRATION ENHANCEMENT

The proposed development should adopt an 'environment first' principle, which results in the integration of BMP/LID methods to maintain, as closely as practicable, pre-development groundwater conditions. Implementing mitigation measures such as infiltration galleries, increasing topsoil thickness, using permeable pavers, or redirecting roof runoff to pervious areas can help to maintain pre-development infiltration rates.

An infiltration study should be conducted to determine infiltration rates and other site-specific parameters. This will allow infiltration opportunities and limitations to be identified and better inform decisions regarding the types of LID mitigation measures that can be implemented and their effectiveness at maintaining infiltration volumes at pre-development levels.

5 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the hydrogeological investigation completed for the Site.

- It is understood that the proposed development of the Site will consist of the construction of three industrial blocks (Blocks 1 to 3), one stormwater management facility (Block 5), and a new road (Street "A") which will result in the following land uses:
  - ➔ About 251,900 m^2 (68.1% of total area) will be industrial blocks;
  - ➔ About 83,100 m^2 (22.5% of total area) will remain as the environmental protection area,
  - ➔ About 21,000 m^2 (5.7% of total area) will be a stormwater management facility; and,
  - ➔ About 13,800 m^2 (3.7% of total area) will be a road.
- Under the current (pre-development) site conditions, it is estimated that about 98,266 m^3/year of water infiltrates across the Site with 81,347 m^3/year as runoff.
- Under post-development conditions without mitigation, it is estimated that about 43,018 m^3/year of water will infiltrate across the Site and about 210,982 m^3/year will be runoff. This is an infiltration deficit of 55,248 m^3/year and 129,635 m^3/year additional runoff.
- An infiltration study should be conducted to determine site-specific opportunities and constraints regarding the types of LID mitigation measures that will be most effective at reducing the impacts to infiltration volumes at the Site.

6 STANDARD LIMITATIONS

WSP Canada Inc. prepared this report solely for the use of the intended recipient, Deltini Commercial Developments Inc., in accordance with the professional services agreement between the parties. In the event a contract has not been executed, the parties agree that the WSP General Terms for Consultant shall govern their business relationship which was provided to you prior to the preparation of this report.

The report is intended to be used in its entirety. No excerpts may be taken to be representative of the findings in the assessment.

The conclusions presented in this report are based on work performed by trained, professional and technical staff, in accordance with their reasonable interpretation of current and accepted engineering and scientific practices at the time the work was performed.

The content and opinions contained in the present report are based on the observations and/or information available to WSP at the time of preparation, using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by WSP and other engineering/scientific practitioners working under similar conditions, and subject to the same time, financial and physical constraints applicable to this project.

WSP disclaims any obligation to update this report if, after the date of this report, any conditions appear to differ significantly from those presented in this report; however, WSP reserves the right to amend or supplement this report based on additional information, documentation or evidence.

WSP makes no other representations whatsoever concerning the legal significance of its findings.

The intended recipient is solely responsible for the disclosure of any information contained in this report. Except for the City of Toronto, if a third party makes use of, relies on, or makes decisions in accordance with this report, said third party is solely responsible for such use, reliance or decisions. WSP does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken by said third party based on this report.

WSP has provided services to the intended recipient in accordance with the professional services agreement between the parties and in a manner consistent with that degree of care, skill and diligence normally provided by members of the same profession performing the same or comparable services in respect of projects of a similar nature in similar circumstances. It is understood and agreed by WSP and the recipient of this report that WSP provides no warranty, express or implied, of any kind. Without limiting the generality of the foregoing, it is agreed and understood by WSP and the recipient of this report that WSP makes no representation or warranty whatsoever as to the sufficiency of its scope of work for the purpose sought by the recipient of this report.

In preparing this report, WSP has relied in good faith on information provided by others, as noted in the report. WSP has reasonably assumed that the information provided is correct and WSP is not responsible for the accuracy or completeness of such information.

Benchmark and elevations used in this report are primarily to establish relative elevation differences between the specific testing and/or sampling locations and should not be used for other purposes, such as grading, excavating, construction, planning, development, etc.

WSP disclaims any responsibility for consequential financial effects on transactions or property values, or requirements for follow-up actions /or costs.

Design recommendations given in this report are applicable only to the project and areas as described in the text and then only if constructed in accordance with the details stated in this report. The comments made in this report on potential construction issues and possible methods are intended only for the guidance of the designer. The number of testing and/or sampling locations may not be sufficient to determine all the factors that may affect construction methods and costs. We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

Overall conditions can only be extrapolated to an undefined limited area around these testing and sampling locations. The conditions that WSP interprets to exist between testing and sampling points may differ from those that actually exist. The accuracy of any extrapolation and interpretation beyond the sampling locations will depend on natural conditions, the history of Site development and changes through construction and other activities. In addition, analysis has been carried out for the identified chemical and physical parameters only, and it should not be inferred that other chemical species or physical conditions are not present. WSP cannot warrant against undiscovered environmental liabilities or adverse impacts off-Site.

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This limitations statement is considered an integral part of this report.

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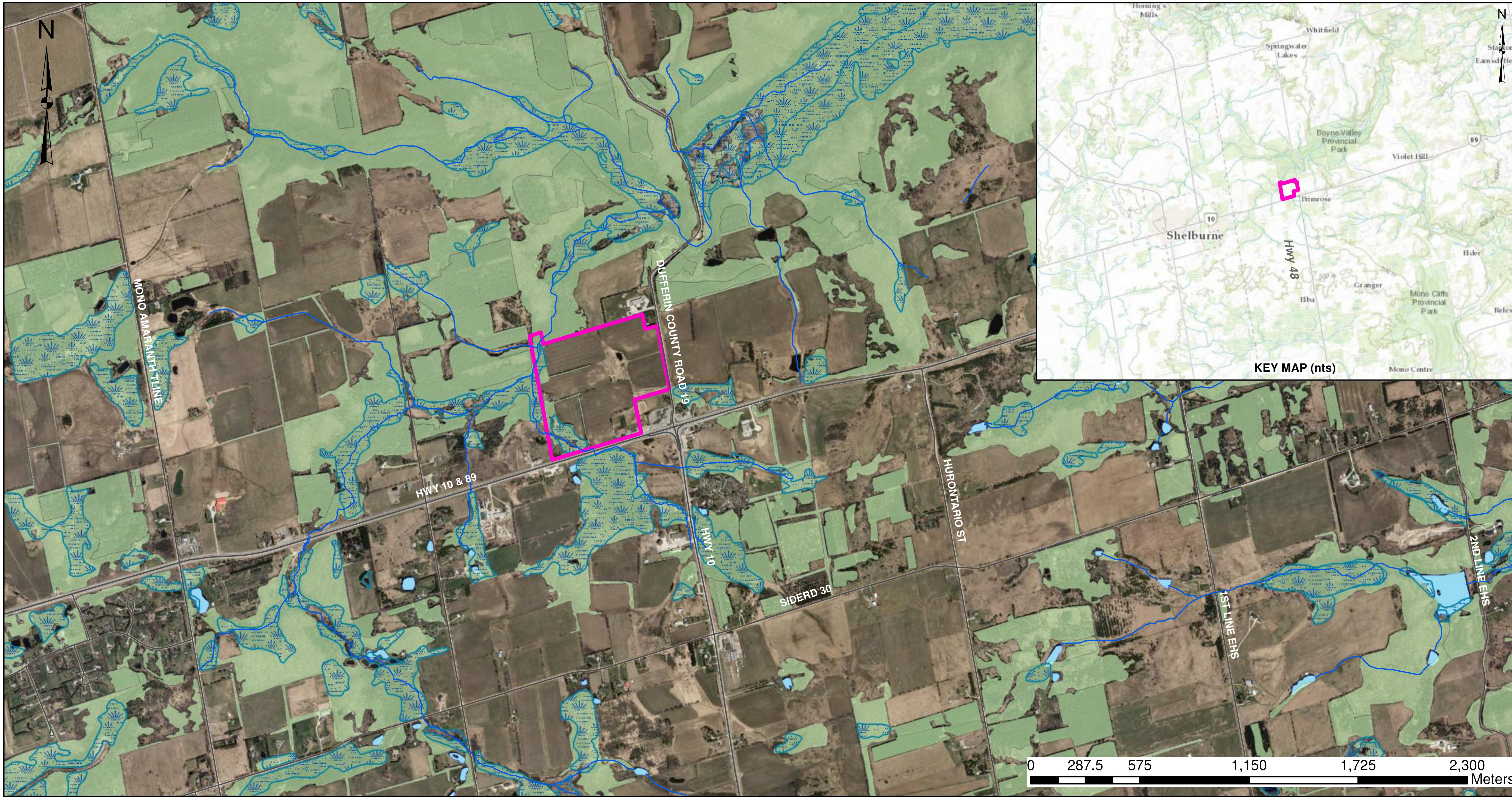
FIGURES



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community; Southern Ontario Base Mapping

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LEGEND

- Site
- 500m Study Area
- Watercourse
- Wooded Area
- Wetland

CLIENT: **Deltini Commercial Developments Inc.**

CLIENT REF. #

PROJECT: **WATER BALANCE STUDY**
636040 PRINCE OF WALES ROAD WEST
TOWNSHIP OF MULMUR, ONTARIO

PROJECT NO: 181-01582-02	DATE: July 2021
DESIGNED BY:	
DRAWN BY: NS	
CHECKED BY: MY	
FIGURE NO: 1	SCALE: As shown

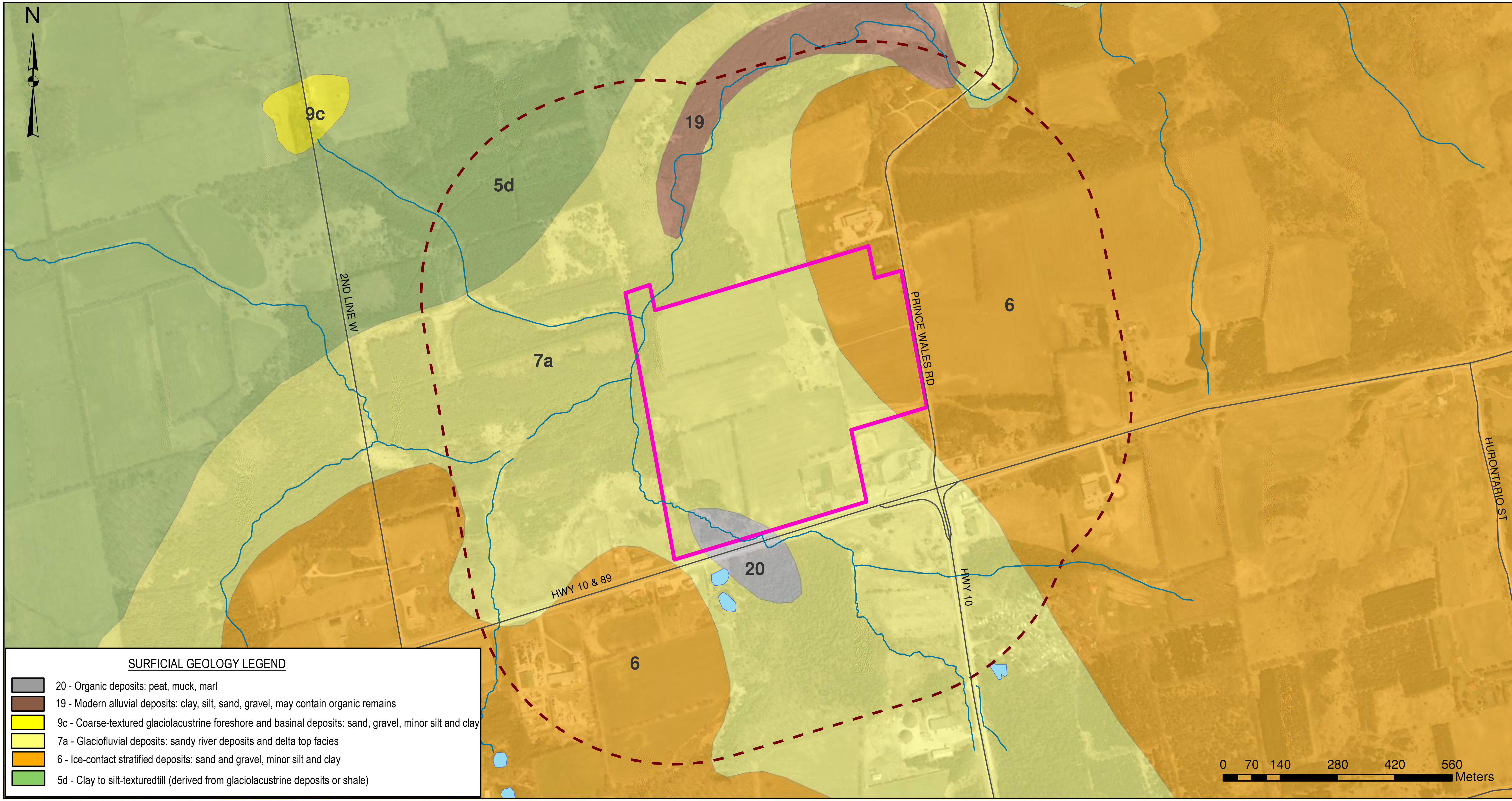
TITLE: **SITE LOCATION MAP**

DISCIPLINE: **ENVIRONMENT**

ISSUE:

RV.#: 0

DATE OF:



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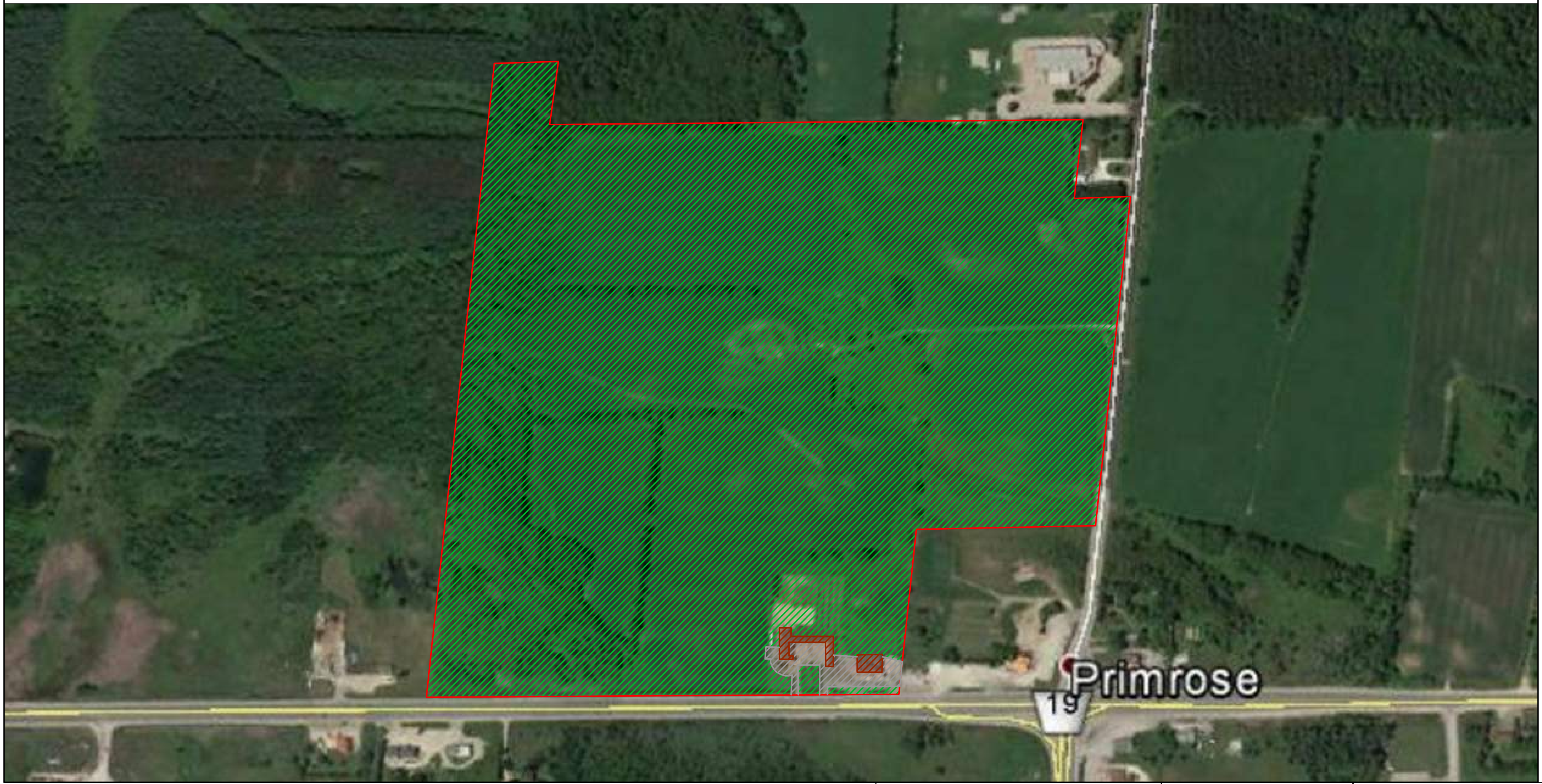
LEGEND
- Site
- 500m Study Area
- Watercourse

CLIENT:	Deltini Commercial Developments Inc.
CLIENT REF. #	
PROJECT:	WATER BALANCE STUDY 636040 PRINCE OF WALES ROAD WEST TOWNSHIP OF MULMUR, ONTARIO
PROJECT NO:	181-01582-02
DATE:	July 2021
DESIGNED BY:	
DRAWN BY:	NS
CHECKED BY:	MY
FIGURE NO:	2
SCALE:	As shown
TITLE:	SURFICIAL GEOLOGY
DISCIPLINE:	ENVIRONMENT
ISSUE:	
RV.#:	0
DATE OF:	

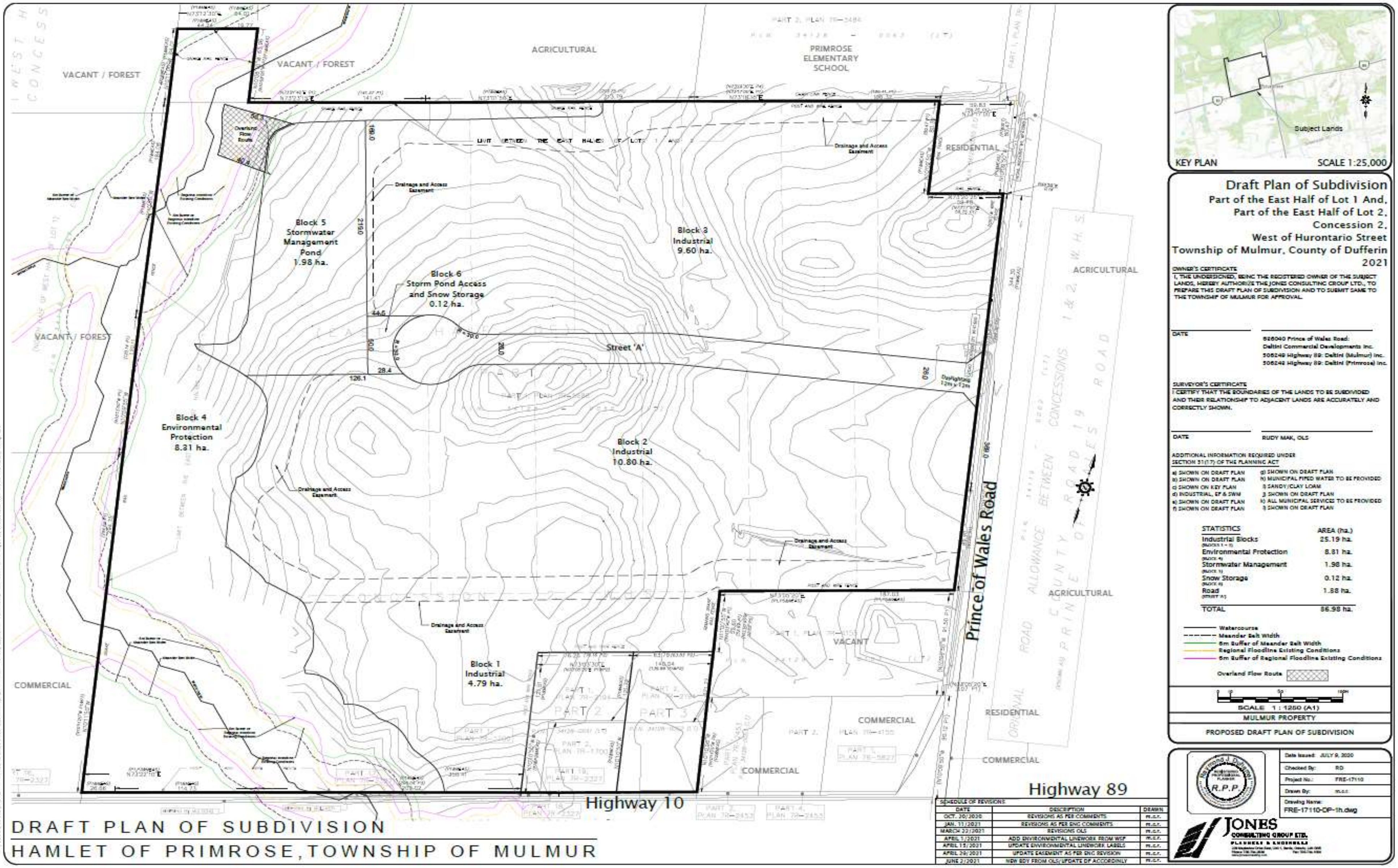
PRE-DEVELOPMENT



LEGEND:

- Property Boundary
- Buildings
- Paved Areas
- Lawn

Client: Deltini Commercial Developments Inc.		Project No.: 181-01582-02	Figure No.: 3
Drawn: MY	Approved: NC	Title: PRE-DEVELOPMENT LAND USE COVER	
Date: July 2021	Scale: na	Project: WATER BALANCE STUDY 636040 PRINCE OF WALES ROAD WEST, TOWNSHIP OF MULMUR, ONTARIO	
Original Size: Tabloid	Rev: 0	wsp 2 International Blvd., Suite 201 Toronto, ON M9W 1A2 T: 416-798-0065	



Client:	Deltini Commercial Developments Inc.			Project No:	181-01582-02	Drawing No:	4
Drawn:	MY	Approved:	NC	Title:	PROPOSED DEVELOPMENT PLAN		
Date:	JULY 2021	Scale:	N.T.S	Project:	WATER BALANCE STUDY 636040 PRINCE OF WALES ROAD WEST, TOWN OF MULMUR, ON		
Original Size:	Letter	Rev:	N/A		wsp	2 International Blvd. Toronto, Ontario M9W 1A2	

APPENDIX

A

WATER BALANCE ASSESSMENT

TABLE A-1

CLIMATE NORMALS 1981-2010 (Ruskview Climate Station)

636040 Prince of Wales Road West, Township of Mulmur, Ontario

	Thornthwaite (1948)					
Month	Mean Temperature (°C)	Heat Index	Potential Evapotranspiration (mm)	Daylight Correction Value	Adjusted Potential Evapotranspiration (mm)	Total Precipitation (mm)
January	-7.3	0.0	0.0	0.77	0.0	85.6
February	-6.8	0.0	0.0	0.87	0.0	69.8
March	-1.9	0.0	0.0	0.99	0.0	68.0
April	5.4	1.1	25.7	1.12	28.7	73.9
May	12.1	3.8	59.4	1.23	73.0	86.9
June	17.4	6.6	86.7	1.29	111.4	90.8
July	19.7	8.0	98.6	1.26	124.1	81.5
August	18.8	7.4	93.9	1.16	109.4	79.4
September	14.7	5.1	72.7	1.04	75.9	95.4
October	7.9	2.0	38.1	0.92	35.0	83.3
November	1.7	0.2	7.7	0.81	6.2	100.3
December	-4.3	0.0	0.0	0.75	0.0	80.9
TOTALS		**34.3**	**483.0**		**563.9**	**995.8**

NOTES:
1) Water budget adjusted for latitude and daylight.
2) (°C) – Represents calculated mean of avarage daily temperatures for the month.
3) Precipitation and Temperature data from Ruskview Climate Station located at latitude 44°14'00" N , longitude 80°08'00" W , elevation 472.40 m.
4) Total Water Surplus (Thornthwaite, 1948) is calculated as a total precipitation minus adjusted potential evapotranspiration.
5) Total Moisture Surplus (Thornthwaite and Mather, 1957) is calculated as total precipitation minus actual evapotranspiration.

TABLE A-2

Hydrologic Cycle Component Values

636040 Prince of Wales Road West, Township of Mulmur, Ontario

			Month												Total
			March	April	May	June	July	August	September	October	November	December	January	February	
PET - Adjusted Potential Evapotranspiration (mm)			0.0	28.7	73.0	111.4	124.1	109.4	75.9	35.0	6.2	0.0	0.0	0.0	**563.9**
P - Total Precipitation (mm)			68.0	73.9	86.9	90.8	81.5	79.4	95.4	83.3	100.3	80.9	85.6	69.8	**995.8**
P-PET (mm)			68.0	45.2	13.9	-20.6	-42.6	-30.0	19.5	48.3	94.1	80.9	85.6	69.8	-
Soil Moisture Deficit (mm)			0.0	0.0	0.0	-20.6	-63.3	-93.3	-73.8	-25.5	0.0	0.0	0.0	0.0	-
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)	Fine Sandy Loam, Clay	Δ ST (mm)	75.0	75.0	75.0	54.4	11.7	0.0	19.5	67.8	75.0	75.0	75.0	75.0	-
		AET (mm)	0.0	28.7	73.0	108.6	100.3	81.7	75.9	35.0	6.2	0.0	0.0	0.0	**509.5**
Pasture and Shrubs	Fine Sandy Loam	Δ ST (mm)	150.0	150.0	150.0	129.4	86.7	56.7	76.2	124.5	150.0	150.0	150.0	150.0	-
		AET (mm)	0.0	28.7	73.0	110.0	112.2	93.8	75.9	35.0	6.2	0.0	0.0	0.0	**534.9**

TABLE A-3

WATER BUDGET - PRE-DEVELOPMENT (Existing) CONDITIONS

636040 Prince of Wales Road West, Township of Mulmur, Ontario

Catchment Designation	Site			
	Environmental Protection (Block 4)	Agricultural Lands	Buildings/Paved Areas	Totals
Area (m^2)	83,100	281,467	5,233	**369,800**
Impervious Ratio	0.00	0.00	1.00	-
Pervious Area (m^2)	83,100	281,467	0	**364,567**
Impervious Area (m^2)	0	0	5,233	**5,233**
Infiltration Factors				
Topography Infiltration Factor	0.15	0.15	0.15	
Soil Infiltration Factor	0.30	0.30	0.30	
Land Cover Infiltration Factor	0.15	0.10	0.10	
MOECC Infiltration Factor	0.60	0.55	0.55	
Actual Infiltration Factor	0.60	0.55	0.55	
Run-Off Coefficient	0.40	0.45	0.45	
Run-Off from Impervious Surfaces*	0.85	0.85	0.85	
Inputs (per Unit Area)				
Precipitation (mm/yr)	996	996	996	
Run-On (mm/yr)	0	0	0	
Other Inputs (mm/yr)	0	0	0	
Outputs (per Unit Area)				
Precipitation Surplus for Pervious Areas (mm/yr)	461	486	486	
Net Surplus (mm/yr)	461	486	486	
Actual Evapotranspiration (mm/yr)	535	509	509	
Evaporation (mm/yr)	149	149	149	
Infiltration (mm/yr)	277	267	267	
Runoff Pervious Areas	184	219	219	
Runoff Impervious Areas	846	846	846	
Inputs (Volumes)				
Precipitation (m^3/yr)	82,751	280,285	5,211	**368,247**
Run-On (m^3/yr)	0	0	0	**0**
Other Inputs (m^3/yr)	0	0	0	**0**
Total Inputs (m^3/yr)	**82,751**	**280,285**	**5,211**	**368,247**
Outputs (Volumes)				
Precipitation Surplus for Pervious Areas (m^3/yr)	38,305	136,878	0	**175,183**
Precipitation Surplus for Impervious Areas (m^3/yr)	0	0	4,429	**4,429**
Net Surplus (m^3/yr)	38,305	136,878	4,429	**179,613**
Actual Evapotranspiration (m^3/yr)	44,446	143,406	0	**187,853**
Evaporation (mm/yr)	0	0	782	**782**
Infiltration (m^3/yr)	22,983	75,283	0	**98,266**
Total Infiltration (m^3/yr)	22,983	75,283	0	**98,266**
Runoff Pervious Areas (m^3/yr)	15,322	61,595	0	**76,917**
Runoff Impervious Areas (m^3/yr)	0	0	4,429	**4,429**
Total Runoff (m^3/yr)	15,322	61,595	4,429	**81,347**
Total Outputs (m^3/yr)	**82,751**	**280,285**	**5,211**	**368,247**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**

NOTES:

1) Evaporation from impervious areas are assumed to be 15% of precipitation for flat roofs and paved surfaces, 10% for sloped roofs
2) Impervious Ratio for Agricultural Lands from Preliminary Stormwater Management & Functional Servicing Report
2) Infiltration Factors taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003)
3) Total outputs is equal to the sum of evapotranspiration, evaporation, total infiltration, and total runoff

TABLE A-4

WATER BUDGET - POST-DEVELOPMENT CONDITIONS WITHOUT MITIGATION

636040 Prince of Wales Road West, Township of Mulmur, Ontario

Catchment Designation	Environmental Protection (Block 4)	Industrial Block (Block 1, 2, and 3)	Stormwater Management & Snow Storage (Block 5 & 6)	Roads (Street 'A')	Totals
Area (m^2)	83,100	251,900	21,000	13,800	**369,800**
Impervious Ratio	0.00	0.80	0.20	0.44	-
Pervious Area (m^2)	83,100	50,380	16,800	7,728	**158,008**
Impervious Area (m^2)	0	201,520	4,200	6,072	**211,792**
Infiltration Factors					
Topography Infiltration Factor	0.15	0.15	0.15	0.15	
Soil Infiltration Factor	0.30	0.30	0.30	0.30	
Land Cover Infiltration Factor	0.15	0.10	0.10	0.10	
MOE Infiltration Factor	0.60	0.55	0.55	0.55	
Actual Infiltration Factor	0.60	0.55	0.55	0.55	
Run-Off Coefficient	0.40	0.45	0.45	0.45	
Run-Off from Impervious Surfaces	0.85	0.85	0.85	0.85	
Inputs (per Unit Area)					
Precipitation (mm/yr)	996	996	996	996	
Run-On (mm/yr)	0	0	0	0	
Other Inputs (mm/yr)	0	0	0	0	
Outputs (per Unit Area)					
Precipitation Surplus for Pervious Areas (mm/yr)	461	486	486	486	
Net Surplus (mm/yr)	461	486	486	486	
Actual Evapotranspiration (mm/yr)	535	509	509	509	
Evaporation (mm/yr)	149	149	149	149	
Infiltration (mm/yr)	277	267	267	267	
Runoff Pervious Areas	184	219	219	219	
Runoff Impervious Areas	846	846	846	846	
Inputs (Volumes)					
Precipitation (m^3/yr)	82,751	250,842	20,912	13,742	**368,247**
Run-On (m^3/yr)	0	0	0	0	**0**
Other Inputs (m^3/yr)	0	0	0	0	**0**
Total Inputs (m^3/yr)	**82,751**	**250,842**	**20,912**	**13,742**	368,247
Outputs (Volumes)					
Precipitation Surplus for Pervious Areas (m^3/yr)	38,305	24,500	8,170	3,758	**74,733**
Precipitation Surplus for Impervious Areas (m^3/yr)	0	170,573	3,555	5,140	**179,267**
Net Surplus (m^3/yr)	38,305	195,073	11,725	8,898	**254,000**
Actual Evapotranspiration (m^3/yr)	44,446	25,668	8,560	3,937	**82,612**
Evaporation (m^3/yr)	0	30,101	627	907	**31,635**
Infiltration (m^3/yr)	22,983	13,475	4,493	2,067	**43,018**
Total Infiltration (m^3/yr)	22,983	13,475	4,493	2,067	**43,018**
Runoff Pervious Areas (m^3/yr)	15,322	11,025	3,676	1,691	**31,715**
Runoff Impervious Areas (m^3/yr)	0	170,573	3,555	5,140	**179,267**
Total Runoff (m^3/yr)	15,322	181,598	7,231	6,831	**210,982**
Total Outputs (m^3/yr)	**82,751**	**250,842**	**20,912**	**13,742**	**368,247**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**

NOTES:

1) Evaporation from impervious areas are assumed to be 15% of precipitation for flat and paved surfaces, 10% for sloped roofs
2) Impervious Ratio from Preliminary Stormwater Management & Functional Servicing Report
3) Infiltration Factors taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003)
4) Total outputs is equal to the sum of evapotransporation, evaporation, total infiltration, and total runoff

TABLE A-5
WATER BUDGET SUMMARY
636040 Prince of Wales Road West, Township of Mulmur, Ontario

Characteristic	Site			
	Pre-Development	Post-Development	Change (Pre- to Post-)	% Change (Pre- to Post-)
Inputs (Volumes)				
Precipitation (m^3/yr)	368,247	368,247	0	0%
Run-On (m^3/yr)	0	0	0	0%
Other Inputs (m^3/yr)	0	0	0	0%
Total Inputs (m^3/yr)	**368,247**	**368,247**	0	**0%**
Outputs (Volumes)				
Precipitation Surplus for Pervious Areas (m^3/yr)	175,183	74,733	-100,450	-57%
Precipitation Surplus for Impervious Areas (m^3/yr)	4,429	179,267	174,838	3947%
Net Surplus (m^3/yr)	179,613	254,000	74,387	41%
Actual Evapotranspiration (m^3/yr)	187,853	82,612	-105,241	-56%
Evaporation (m^3/yr)	782	31,635	30,854	3947%
Total Infiltration (m^3/yr)	98,266	43,018	-55,248	-56%
Runoff Pervious Areas (m^3/yr)	76,917	31,715	-45,203	-59%
Runoff Impervious Areas (m^3/yr)	4,429	179,267	174,838	3947%
Total Runoff (m^3/yr)	81,347	210,982	129,635	159%
Total Outputs (m^3/yr)	**368,247**	**368,247**	**0**	**0%**

NOTES:

1) Total Outputs is equal to the sum of evapotranspiration, evaporation, total infiltration, and total runoff