Hydrogeological Water Balance, Hidden Ridge Development, Uxbridge

November 29, 2022

Prepared for:
China Canada Jing Bei Xin Min International

Cambium Reference: 6199-003

CAMBIUM INC.

866.217.7900

cambium-inc.com

Peterborough | Barrie | Oshawa | Kingston | Calgary

Table of Contents

List of Appended Figures

List of Tables

List of Appendices

1.0 Introduction

Cambium Inc. was retained by China Canada Jing Bei Xin Min Intl. (Client) to complete a catchment based water balance for a proposed development of 17 residential lots located at 309 Zephyr Road (the Site) in the Township of Uxbridge, Durham Region, Ontario.
There are sensitive hydrological features on-site, as per the Lake Simcoe Protection Plan (LSPP) (Lake Simcoe Region Conservation Authority, 2009) a catchment based water balance is required to demonstrate that water balance inputs to those features will be maintained upon development of the Site.

Cambium previously completed a soils investigation (Cambium Inc., 2019) and a hydrogeological assessment (Cambium Inc., 2018). A functional servicing and preliminary stormwater management report was prepared by Tatham Engineering (Tatham Engineering, 2020). These reports are refenced herein when appropriate.

1.1 Site Description

The Site is part of Lots 24 and 25, Concession 3 in the Township of Uxbridge. The western portion of the property is a golf course and is accessed by Zephyr Road and Concession Road 3. The Zephyr-Egypt Provincially Significant Wetland Complex (PSW) occupies the eastern portion of the property. The Site consists of rolling and hilly topography that generally slopes towards the southeast towards the PSW. Residential land use surrounds the Site to the north, west and south. The Universal Transverse Mercator (UTM) coordinate of the Zephyr Road access to the Site is 638827 mE, 4895716 mN.
The proposed development will occur wholly within the western portion of the property. This portion of the property will hereafter be referred to as the development area and is outlined in Figure 1. The total area of the property is approximately 40 ha; however, 22.2 hectares of the property are located within the PSW environmental protection area.
The proposed development has been split into Phase 1 and Phase 2. Phase 1 is located in the northwestern area of the Site and is approximately 5.1 ha. The Phase 1 development includes

seven lots and an internal roadway. A 30 m setback from the PSW encroaches into the Phase 1 development area.

Phase 2 is approximately 12.7 ha and is located south of Phase 1. Phase 2 includes the development of 17 lots and internal roadways. The PSW setback does not encroach onto the Phase 2 development area.

The total area of the proposed development area (i.e., Phase 1 and 2) is approximately 17.8 ha. The proposed development will be provided water and wastewater servicing by on-site systems.

A plan of the proposed development has been attached in Appendix A. The feasibility of on-site servicing has been assessed as part of previous work programs at the Site (Cambium Inc., 2018) (Tatham Engineering, 2020).

The catchment-based water balance outlined herein focusses on Phase 2 of the development. It is assumed herein that Phase 1 exists as part of the pre-development conditions at the Site.

2.0 Geological and Hydrogeological Setting

The Site is primarily located within the physiographic region known as the Simcoe Lowlands. The Simcoe Lowlands physiographic region extends from Lake Couchiching, southward along the western edge of Lake Simcoe continuing southward toward the community of Bolton. Morphologically, this region is characterised by flat, low-lying plains composed of silts, clays and fine to medium grained sands deposited within glacial Lake Algonquin. Evidence of glacial Lake Algonquin and its successors is provided by numerous shorelines, wave-cut notches, terraces and beach ridges located throughout the study area. (Chapman, L.J. and D.F. Putnam, 1984).

The Site is located just within the eastern boundary of the Black River subwatershed. The Black River subwatershed is approximately 375 km² and drains northwards to Lake Simcoe (Lake Simcoe Region Conservation Authority, 2010).

The central west area of the Site occupies a local topographic high that exhibits a maximum elevation of approximately 256.5 metres above sea level (masl). Ground surface topography lowers extending north, east and south away from the central west area of the property. The eastern area of the property is relatively flat and ranges in elevation between approximately 240 and 245 masl. The Zephyr-Egypt PSW occupies the eastern portion of the property.

The lowest area the Site is oriented north-south across the Site and forms the border between the western area of the property (the development area) and the flatter areas in the eastern area of the property (generally the PSW). The lowest elevations at the Site range between approximately 238.5 masl at the southern border and 237.5 masl at the northern border of the property. Drainage generated from most of the Site is directed towards the central area of the property, where is it then routed northwards, off-site.

There are two catchments identified on-site as part of existing conditions mapping provided by the Client and information provided by Tatham (Appendix A). The existing catchments have been identified as the following:

- Primary Catchment
- Northwest Catchment

The Primary Catchment is approximately 389,912 m^2 and includes the PSW, most of Phase 1 and 2. Runoff generated within the Primary catchment is routed to the low-lying area centrally located within the property, then flows north off-site. Note, the surface water drainage features of the PSW were not explored as part of this assessment. It is assumed herein that all runoff generated from the PSW is directed to the central drainage feature, then northwards, off-site. The Primary Catchment includes pre-development catchments 102 and 103 outlined in the stormwater management plan (Tatham Engineering, 2020). It is noted that the stormwater management plan does not include catchment information for the environmental protection area and Phase 1 of the proposed development.

The Northwest Catchment is approximately 10,345 m^2 and includes small portions of the Phase 1 and Phase 2 areas. Runoff generated within the Northwest Catchment flows to the northwest, off-site, as sheet flow. It is noted that the Northwest Catchment is comprised of two smaller, adjacent catchments which both drain north/northwest. The Northwest Catchment includes pre-development catchment 101 of the stormwater management plan (Tatham Engineering, 2020).

The approximate drainage divide between the Primary and Northwest Catchments is outlined on Figure 1 and was based on the stormwater management plan (Tatham Engineering, 2020) available topographic mapping.

3.0 Conceptual Water Balance

Cambium completed a conceptual catchment-based water balance for the catchments identified on-site to assess the potential impact of the development on local groundwater and surface water resources. Specifically, the Primary Catchment includes the PSW. The PSW is the feature of concern on-site. The results of the catchment-based water balance focus on the Primary Catchment and post-development mitigation measures therein.

To complete the assessment the following equations were utilized:

$$QI = A \times S \times I$$

Where:
- QI - Infiltration Volume (m³/yr)
- A - Area (m²)
- S - Water surplus (m/yr)
- I - Infiltration factor (dimensionless)

$$QR = A \times S \times (1-I)$$

Where:
- QR - Runoff Volume (m³/yr)
- A - Area (m²)
- S - Water surplus (m/yr)
- I - Infiltration factor (dimensionless)

It is noted that the water balance described herein does not account for catchment areas that extend off-site. The calculations compare the pre- and post-development water balance changes within the Site boundaries (and conceptually determine if changes in groundwater infiltration can be mitigated wholly by on-site Low Impact Development (LID) measures).

The total area of the Site is 400,257 m². The total area of the Primary Catchment is 389,912 m². The pre-development conditions of the Primary Catchment include the following surfaces:

- Environmental Protection Area: 221,838 m²
- Phase 1 Areas:
  - Paved areas: 3,088 m² – includes 5 driveways (80 m² each) and 2,688 m² of roadway.
  - Roof areas: 1,000 m² – includes 5 rooftops, assumed to be 200 m² each
  - Landscaped Areas: 41,764 m²
- Phase 2 Areas: 122,222 m² of golf course, considered to be landscaped areas

The total area of the Northwest Catchment is 10,345 m². The pre-development conditions of the Northwest Catchment include the following surfaces:

- Phase 1 Areas:
    - Paved areas: 1,960 m² – includes 2 driveways (80 m² each) and 1,800 m² of roadway.
    - Roof areas: 400 m² – includes 2 rooftops, assumed to be 200 m² each
    - Landscaped Areas: 2,985 m²
- Phase 2 Areas: 5,000 m² of golf course, considered to be landscaped areas

The proposed development in Phase 2 includes internal roadways, dwellings and landscaped areas. Within Phase 2 there will be approximately 7,300 m² of paved surfaces (i.e., internal roadways and 17 driveways (each 80 m² each), 3,400 m² of roof areas (i.e., 17 dwellings each with 200 m² of roof area) and 116,522 m² of landscaped areas. As outlined in the following sections, the proposed development surfaces are split between the Primary and Northwest Catchments. The pre-development conditions in Phase 1 and the environmental protection area will not change upon development of the Site.

Supporting information referenced herein (including detailed water balance calculations) is attached in Appendix B.

3.1 Water Surplus

Water surplus is calculated by determining the difference between precipitation and evapotranspiration (changes in soil water storage was assumed to be negligible over the course of a year). The volume of water surplus is further sub-divided into portions that infiltrate the on-site soils and that are directed off-site as runoff.

According to the Environment Canada Climatic Normals (1981-2010) for the Udora weather station (Environment Canada, 2022), the average annual precipitation is 886 mm/year. The Thornthwaite method was used to determine the amount of evapotranspiration that will occur at the Site (Dingman, 2008). The calculated depth of evapotranspiration was 528 mm/year. The evapotranspiration calculations are included in Appendix B. The water surplus of the Site was calculated to be 358 mm/yr from pre-development surfaces and landscaped areas.

Evapotranspiration does not occur from structures, paved areas or gravel surfaces. It was assumed that 10% of precipitation falling on these surfaces is lost directly to evaporation. The remaining depth (i.e., 90% of precipitation) was considered surplus and converted to infiltration and/or runoff.

3.2 Infiltration Rates

The volume of surplus water that infiltrates through pervious surfaces on-site was determined by applying an infiltration factor to the surplus depth. The surplus water that does not infiltrate into pervious surfaces will leave the Site as surface water runoff. The infiltration factor varies from 0 to 1 and is estimated based on topography, soils, and vegetation cover as per the *Stormwater Management Planning and Design Manual* (Ministry of the Environment, 2003).

The Site is hilly with slopes around 35 m/km, and the mineral soils are mainly silty sand based on the soil characterization report (Cambium Inc., 2019). The infiltration factor for pre-development landscaped and golf course areas was 0.48. An infiltration factor of 0 was applied to roof surfaces and paved areas. The environmental protection area was assumed to have an infiltration factor of 0 since it is designated as a wetland.

The landscaped areas included post-development were assumed to have an infiltration factor of 0 (however evapotranspiration occurs from the wetland areas).

3.3 Pre-Development Water Balance

The water balance for the existing conditions of the Site is summarized in Table 1. The pre-development infiltration rate for the Primary Catchment was calculated to be 28,179 m³/yr and the runoff rate was 113,205 m³/yr.

The pre-development infiltration rate for the Northwest Catchment was calculated to be 1,372 m³/yr and the runoff rate was 3,368 m³/yr.

The site infiltration rate under pre-development conditions was calculated to be 29,552 m³/yr and the runoff rate as 116,574 m³/yr.

Table 1 Pre-Development Water Balance

Land Use		Area (m^2)	Infiltration Rate (QI) (m^3/yr)	Runoff Rate (QR) (m^3/yr)
PRIMARY CATCHMENT				
Environmental Protection		**221,838**	**-**	**79,418**
Phase 1	Paved Area	**3,088**	**-**	**2,462**
	Roof Area	**1,000**	**-**	**797**
	Landscape Area	**41,764**	**7,177**	**7,775**
Phase 2	Landscape Area	**122,222**	**21,003**	**22,753**
Totals		**389,912**	**28,179**	**113,205**
NORTHWEST CATCHMENT				
Phase 1	Paved Area	**1,960**	**-**	**1,563**
	Roof Area	**400**	**-**	**319**
	Landscape Area	**2,985**	**513**	**247**
Phase 2	Landscape Area	**5,000**	**859**	**931**
Totals		**10,345**	**1,372**	**3,368**
SITE TOTAL		**400,257**	**29,552**	**116,574**
Sum of QI and QR (m^3/yr)				**146,125**

3.4 Post-Development Water Balance

The post-development water balance is summarized in Table 2. The post-development infiltration rate for the Primary Catchment was calculated to be 26,389 m^3/yr and the runoff rate was 119,575 m^3/yr. The post-development infiltration rate for the northwest catchment was calculated to be 1,324 m^3/yr and the runoff rate was 3,536 m^3/yr.

Table 2 Post-Development Water Balance

Land Use		Area (m²)	Infiltration Rate (QI) (m³/yr)	Runoff Rate (QR) (m³/yr)
PRIMARY CATCHMENT				
Environmental Protection		**221,838**	**-**	**79,418**
Phase 1	Paved Area	**3,088**	**-**	**2,462**
	Roof Area	**1,000**	-	**797**
	Landscape Area	**41,764**	**7,177**	**7,775**
Phase 2	Paved Area	**7,220**	**-**	**5,757**
	Roof Area	**3,200**	**-**	**2,552**
	Landscape Area	**111,802**	**19,212**	**20,813**
Totals		**389,912**	**26,389**	**119,575**
NORTHWEST CATCHMENT				
Phase 1	Paved Area	**1,960**	**-**	**1,563**
	Roof Area	**400**	**-**	**319**
	Landscape Area	**2,985**	**513**	**556**
Phase 2	Paved Area	**80**	**-**	**63**
	Roof Area	**200**		**157**
	Landscape Area	**4,720**	**811**	**879**
Totals		**10,345**	**1,324**	**3,536**
SITE TOTAL		**400,257**	**27,713**	**123,111**
Sum of QI and QR (m³/yr)				**150,824**

3.5 Water Balance Comparison

The water balances of the pre-development and post-development scenarios are summarized below in Table 3.

Table 3 Water Balance Comparison

Scenario	QI (m³/yr)	QI Difference From Pre-Development Scenario (m³/yr, % change)	QR (m³/yr)	QR Difference From Pre-Development Scenario (m³/yr, % change)
PRIMARY CATCHMENT				
Pre-Development	28,179	-	113,205	-
Post-Development	26,389	(-1,791 m³/yr, -6%)	119,575	(+6,369 m³/yr, +6%)
NORTHWEST CATCHMENT				
Pre-Development	1,372	-	3,368	-
Post-Development	1,324	(-48 m³/yr, -4%)	3,536	(+168 m³/yr, +5%)

The infiltration deficit of the post-development water balance for the Primary Catchment was estimated to be 1,791 m³/yr (a reduction of 6% of pre-development conditions). The runoff

surplus of the post-development water balance for the Primary Catchment was estimated to be 6,369 m^3/yr (an increase of 6% of pre-development conditions).

The infiltration deficit of the post-development water balance for the Northwest Catchment was estimated to be 48 m^3/yr (a reduction of 4% of pre-development conditions). The runoff surplus of the post-development water balance for the Northwest catchment was estimated to be 168 m3/yr (an increase of 5% of pre-development conditions).

3.6 Water Balance Mitigation Measures

The Primary Catchment is interpreted to be hydraulically connected to the PSW located on-site. As such, mitigation measures outlined herein will be focussed within the Primary Catchment.

The post-development water balance conditions within the Primary Catchment result in a 6% (1,791 m^3/year) decrease of infiltration and a 6% (6,369 m^3/year) increase in runoff when compared to pre-development conditions. In order maintain pre-development infiltration conditions within the Primary Catchment roof runoff generated from the dwellings should be re-infiltrated on-site.

Table 2 indicates that roof surfaces included in Phase 2 will generate 2,552 m^3/year of runoff within the Primary Catchment, therefore there is a sufficient volume of clean water available for re-infiltration to account for the infiltration deficit. The actual amount of runoff re-infiltrated will depend on the Low Impact Development (LID) features implemented at the Site.

If runoff from roof surfaces in Phase 2 (within the Primary Catchment) is directed to permeable areas within each lot then then infiltration efficiency could range between 25% and 50% (Credit Valley Conservation, 2010). However, including other landscape measures (such as levelling lots to promote infiltration and/or directing runoff through dry swales) could increase the infiltration efficiency of roof runoff to greater than 50%.

If roof runoff within the Primary Catchment is re-infiltrated on-site with an efficiency of greater than 50%, then the post-development infiltration deficit will be less than 1,276 m^3/year (which equates to an infiltration deficit of less than 5%, when compared to pre-development

conditions). An infiltration deficit within the Primary Catchment of less than 5% is considered a negligible deviation from pre-development conditions.

The stormwater management plan references infiltration of roof runoff and other landscape/conveyance controls as possible LID measures to promote infiltration at the Site (Tatham Engineering, 2020).

There will be a runoff surplus within the Primary Catchment, even if roof runoff within Phase 2 is captured and re-infiltrated. The magnitude of the runoff surplus will be dependant on the efficiency of the LID measures used to re-infiltrate runoff. If it is assumed that 50% of roof runoff within Phase 2 is re-infiltrated, then the runoff surplus within the Primary Catchment will be 118,299 m³/year (i.e., a 5% increase compared to pre-development conditions). The stormwater management plan will account for runoff flow mitigation.

The infiltration deficit and runoff surplus within the Northwest Catchment are considered negligible deviation from pre-development conditions. As such, specific LID measures for the Northwest Catchment were not considered herein.

4.0 Closing

Cambium completed a catchment-based water balance at 309 Zephyr Road in support of proposed development at that property. The catchment-based water balance focussed on Phase 2 of the proposed development. It was assumed that Phase 1 of the proposed development was included in the pre-development conditions.

The Primary Catchment water balance indicates that the proposed development will induce an infiltration deficit of 6%, and a runoff surplus of 6% when compared to pre-development conditions. If roof runoff is captured and re-infiltrated (in addition to other LID measures), then the infiltration deficit can be reduced to less than 5% depending on how LID measures are implemented. Runoff surplus concerns should be addressed as part of the stormwater management plan.

The pre- and post-development water balance conditions within the Northwest Catchment were similar (but of a smaller magnitude) than the Primary Catchment (i.e., an infiltration deficit and runoff surplus of -4% and +5%, respectively). The infiltration deficit and runoff surplus within the Northwest Catchment are considered negligible deviation from pre-development conditions. Specific LID measures for the Northwest Catchment were not referenced as part of this water balance.

In summary, the proposed development is considered feasible at the Site (with regards to the catchment-based water balance). There are LID measures that can be implemented that will mitigate infiltration deficit concerns to within an acceptable range.

4.1 Respectfully submitted,

Cambium Inc.

Cameron MacDougall, P.Geo.
Project Manager

P:\6100 to 6199\6199-003 EcoVue - Catchment Based Water Balance - Hidden Ridge Development\Deliverables\REPORT - Hydro G Water Balance\Final\2022-11-29 - RPT - Hidden Ridge Development Water Balance.docx

5.0 References

Cambium Inc. (2018). *Hydrogeological Assessment - 309 Zephyr Road.* Peterborough.

Cambium Inc. (2019). *Hidden Ridge Development - Soil Characterization (6199-002).* Peterborough.

Chapman, L.J. and D.F. Putnam. (1984). *The Physiography of Southern Ontario: Ontario Geological Survey, Special Volume 2.*

Credit Valley Conservation. (2010). *Low Impact Development Stormwater Management Planning and Design Guide.*

Dingman, S. L. (2008). *Physical Hydrology, Second Edition.*

Environment Canada. (2022, August 8). *https://weather.gc.ca/*.

Lake Simcoe Region Conservation Authority. (2009). *Lake Simcoe Protection Plan.*

Lake Simcoe Region Conservation Authority. (2010). *Black River Subwatershed Plan.*

Lake Simcoe Region Conservation Authority. (2015). *Lake Simcoe and Couchiching-Black River SPA.*

Ministry of the Environment. (2003). *Stormwater Management Planning and Design Manual .*

Tatham Engineering. (2020). *Hidden Ridge Subdivision Phase 2 Funtional Servicing and Prelimiary Stormwater Management Report.*

6.0 Standard Limitations

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

Reliance on Materials and Information

The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work or reports.

Facts, conditions, information and circumstances may vary with time and locations and Cambium's work is based on a review of such matters as they existed at the particular time and location indicated in its reports. No assurance is made by Cambium that the facts, conditions, information, circumstances or any underlying assumptions made by Cambium in connection with the work performed will not change after the work is completed and a report is submitted. If any such changes occur or additional information is obtained, Cambium should be advised and requested to consider if the changes or additional information affect its findings or results.

When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

Reliance

Cambium's services, work and reports may be relied on by the client and its corporate directors and officers, employees, and professional advisors. Cambium is not responsible for the use of its work or reports by any other party, or for the reliance on, or for any decision which is made by any party using the services or work performed by or a report prepared by Cambium without Cambium's express written consent. Any party that relies on services or work performed by Cambium or a report prepared by Cambium without Cambium's express written consent, does so at its own risk. No report of Cambium may be disclosed or referred to in any public document without Cambium's express prior written consent. Cambium specifically disclaims any liability or responsibility to any such party for any loss, damage, expense, fine, penalty or other such thing which may arise or result from the use of any information, recommendation or other matter arising from the services, work or reports provided by Cambium.

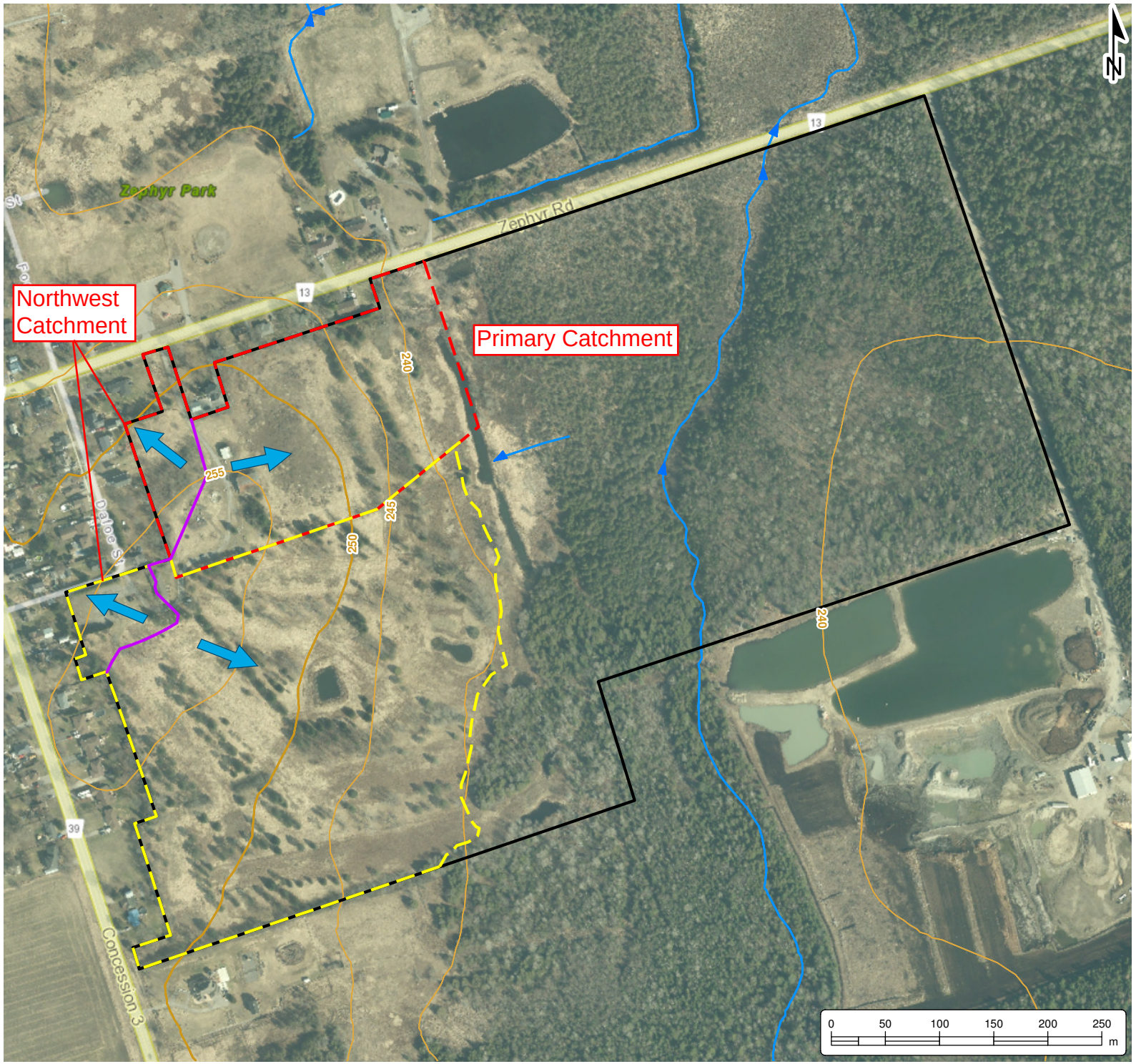
Limitation of Liability

Potential liability to the client arising out of the report is limited to the amount of Cambium's professional liability insurance coverage. Cambium shall only be liable for direct damages to the extent caused by Cambium's negligence and/or breach of contract. Cambium shall not be liable for consequential damages.

Personal Liability

The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.

Appended Figures



HIDDEN RIDGE DEVELOPMENT WATER BALANCE

ECOVUE CONSULTING
309 Zephyr Road,
Uxbridge, Ontario

LEGEND

- Approximate Catchment Boundary
- Watercourse, Permanent
- Contour 5m Interval (Major)
- Contour 5m Interval (Minor)
- Phase 1 Development
- Phase 2 Development
- Subject Property (approximate)
- Surface Water Drainage

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

CAMBIUM
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

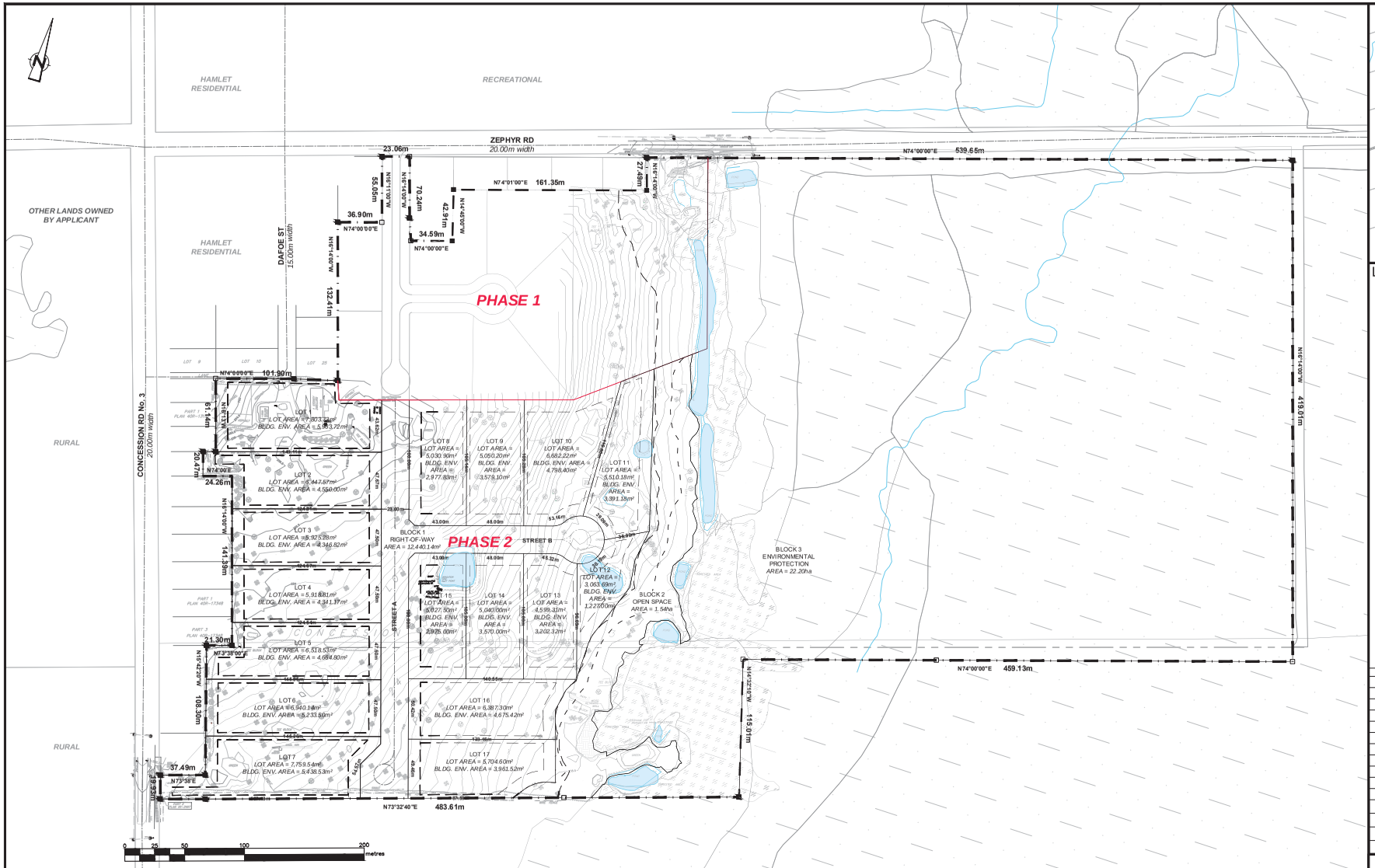
SITE LOCATION MAP

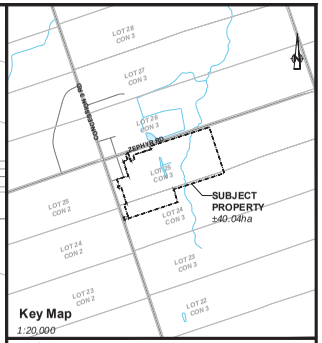
Project No.:	6199-003	Date:	August 2022
		Rev.:	
Scale:	1:5,000	Projection:	NAD 1983 UTM Zone 17N
Created by:	ACS	Checked by:	SNR
Figure:	1		

O:\GIS\MXDs\6100-6199\6199-003 EcoVue - Catchment Based Water Balance - Hidden Ridge Development\2022-08-10 FIG 1 - Site Plan.mxd

Appendix A

Proposed Development Plan





LEGEND

- SUBJECT BOUNDARY
- EXISTING PARCEL
- PROPOSED LOT LINE
- EXISTING BUILDING
- WATERBODY / WATERCOURSE
- EXISTING ENVIRONMENTAL PROTECTION AREA
- EP BUFFER *(30m)*
- EXISTING WETLAND COMMUNITY
- WETLAND BUFFER *(30m)*
- EXISTING FOREST COMMUNITY
- BUILDING ENVELOPE *as per Hamlet Residential (HR) Zone*
  Front Yard: 10m, Ext. Side Yard: 10m, Int. Side Yard: 3m, Rear Yard: 10m

OWNER'S CERTIFICATE
I hereby authorize EcoVue Consulting Services Inc. to prepare and submit this plan to the Region of Durham

Date

SURVEYOR'S CERTIFICATE
This Draft Plan accurately shows the boundaries of all lands proposed to be subdivided.
Certified by:

Date
Ontario Land Surveyor

REVISIONS

DATE	DESCRIPTION
2021-10-01	NHE mapping addition and lot revisions

NOTES:
1. Property boundaries are approximate and based on Plan of Survey 40R-24457.
2. Survey monuments shown on this plan have not been verified.
3. Topographic survey was done by EcoVue Consulting Services Inc. on April 18th, 2017.
4. Temporary benchmarks
   - 4.1. TBM 1: Set survey spike on southerly face of hydro pole on north side of Zephyr Rd, first pole west of driveway into No. 322. Elevation = 238.74
   - 4.2. TBM 2: Top of standard iron bar at the south westerly corner of plan part 2 plan 40R-3497. Elevation = 250.59.
5. Elevations shown here are referenced to G.P.S. observations on the power net GPS Real Time Network, U.T.M. Zone 17, NAD83.
6. Natural Heritage Evaluation mapping provided by GHD, project no. 12562874.

Submission Requirements

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51-17 (a-l) THE PLANNING ACT
a) As shown on this Draft Plan
b) As shown on this Draft Plan
c) As shown on this Draft Plan
d) As shown on this Draft Plan
e) As shown on this Draft Plan
f) As shown on this Draft Plan
g) As shown on this Draft Plan
h)
i)
j) As shown on this Draft Plan
k)
l)

SITE STATISTICS

LOT/BLOCK No.	PROPOSED USE	PROPOSED USE AREA (sq. m)	PROPOSED USE AREA (ha)	PROPOSED USE FRONTAGE (m)	PROPOSED USE PERCENTAGE (%)	PROPOSED UNITS	UNITS/NET ha
	PHASE 1 LANDS	51,197.12	5.12		12.79%		
LOT 1-17	RESIDENTIAL (SINGLE DETACHED)	99,349.73	9.93	811.22	24.83%	17	0.95
BLOCK 1	RIGHT-OF-WAY	12,440.14	1.24		3.11%	0	
BLOCK 2	OPEN SPACE	15,372.77	1.54		3.84%	0	
BLOCK 3	ENVIRONMENTAL PROTECTION	221,837.81	22.18		55.43%	0	
	GROSS SITE AREA	400,197.99	40.02				
	NET SITE AREA (GSA - BLOCK 3)	178,360.18	17.84				
	TOTAL			811.22	100.00%	17	0.95

EcoVue Consulting Services Inc.
311 George St. N., Suite 200
Peterborough ON K9J 3H3
Tel: 705-876-8340 Fax: 705-742-8343
www.ecovueconsulting.com

DRAWN BY: TB	PROJECT No.: 17-1672
APPROVED BY:	HORIZ. SCALE: 1:1,500
REVISION DATE: OCTOBER 1, 2021	PLOT DATE: OCTOBER 1, 2021

HIDDEN RIDGE GOLF COURSE
CHINA CANADA JING BEI XIN MIN INTERNATIONAL CO. LTD.
300 ZEPHYR RD
PART OF LOT 24 & 25, CONCESSION 3
GEOG. TWP. OF SCOTT
TOWNSHIP OF FUSBRIDGE | REGION OF DURHAM

DRAFT PLAN OF SUBDIVISION | DP1

Appendix B

Conceptual Water Balance Calculations

Climate Normals 1981-2010 Station Data

Metadata including Station Name, Province or Territory, Latitude, Longitude, Elevation, Climate ID, WMO ID, TC ID

STATION_I	PROVINCE	LATITUDE	LONGITUD	ELEVATION	CLIMATE_I	WMO_ID	TC_ID
UDORA	ON	44°15'45.(	79°09'41.(	262.0 m	6119055		

Legend

A = WMO "3 and 5 rule" (i.e. no more than 3 consecutive and no more than 5 total missing for either temperature or precipitation)
B = At least 25 years
C = At least 20 years
D = At least 15 years

1981 to 2010 Canadian Climate Normals station data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Temperature														
Daily Aver:	-7	-6.6	-1.3	5.7	12.2	18	19.9	19.3	15.1	8.6	2.4	-4	6.9	D
Standard D	3.5	2.7	2	1.5	2	1.5	1.2	1.2	1.6	1.1	1.7	3	1.5	D
Daily Maxi	-2.7	-1.8	3.5	11.2	18.2	23.9	25.7	25.3	20.7	13.4	6.2	-0.2	12	D
Daily Mini	-11.4	-11.4	-6.2	0.2	6.2	12	14	13.3	9.3	3.8	-1.4	-7.8	1.7	D
Extreme M	14	14	25.5	30	34	34	34.5	36	33.5	29	21.5	16.5		
Date (yyyy	2005/13	2000/26	1998/30	2002/16	2006/30	2003/26	2005/13	01-Aug	02-Sep	02-Jan	Mar-90	01-May		
Extreme M	-34	-29	-33	-15	-5	1	5	3.5	-2.5	-7	-18	-33		
Date (yyyy	1994/16	03-Nov	03-Mar	03-Jun	Feb-97	Apr-98	1992/22	Jun-97	2000/28	2002/24	2000/23	2004/20		
Precipitation														
Rainfall (m	25.7	18.3	27.2	58.9	82.1	106.6	86.4	73.9	87.3	72.9	64.8	24.6	728.7	D
Snowfall (c	39.3	27.7	25.8	9.1	0	0	0	0	0	2	18.4	35.4	157.6	D
Precipitati	64.9	45.9	53.1	67.9	82.1	106.6	86.4	73.9	87.3	74.9	83.2	60	886.3	D
Extreme D	38.1	32.2	40	38.2	65.4	121	58.2	60	79.8	42.2	71	24.4		
Date (yyyy	1995/14	1997/21	Nov-90	1998/16	2002/30	1998/25	Mar-99	1995/31	2006/13	May-95	Feb-99	2005/28		
Extreme D	18	25	25	15	0	0	0	0	0	15	19	30		
Date (yyyy	03-Oct	1993/21	1996/19	03-Mar	Oct-90	Jan-90	Jan-90	Jan-90	Jan-89	1997/26	Mar-99	Oct-92		
Extreme D	38.1	33.2	40	38.2	65.4	121	58.2	60	79.8	42.2	71	30		
Date (yyyy	1995/14	1997/21	Nov-90	1998/16	2002/30	1998/25	Mar-99	1995/31	2006/13	May-95	Feb-99	Oct-92		
Extreme Sı	44	52	48	15	1	0	0	0	0	12	18	40		
Date (yyyy	1999/16	01-Sep	03-May	03-Apr	02-Mar	Jan-91	1991/31	Jan-91	1991/30	1997/27	Apr-99	Dec-92		
Days with Rainfall														
>= 0.2 mm	4.3	3.5	6.1	10.2	12.2	10.8	11.4	9.7	11.4	14.4	10.4	5.1	109.5	D
>= 5 mm	1.4	1.4	2.1	4	5.2	5.5	5.5	4.6	4.7	4.6	4.5	1.5	45	D
>= 10 mm	0.81	0.56	0.59	1.4	2.9	3.1	3.4	2.7	3.2	2.4	2.3	0.72	24	D
>= 25 mm	0.13	0.06	0.06	0.24	0.47	1.2	0.59	0.47	0.5	0.44	0.22	0	4.4	D
Days With Snowfall														
>= 0.2 cm	10.4	7.7	6.7	2.5	0	0	0	0	0	0.44	4.6	8.1	40.4	D
>= 5 cm	2.9	1.8	1.7	0.53	0	0	0	0	0	0.11	1.3	2.5	10.7	D
>= 10 cm	1	0.44	0.76	0.35	0	0	0	0	0	0.11	0.44	0.94	4	D
>= 25 cm	0	0.06	0.06	0	0	0	0	0	0	0	0	0.11	0.23	D
Days with Precipitation														
>= 0.2 mm	13.8	9.9	11.5	11.4	12.2	10.8	11.4	9.7	11.4	14.5	14.1	12.5	143.1	D
>= 5 mm	4.4	3.1	3.9	4.5	5.2	5.5	5.5	4.6	4.7	4.7	5.8	4.2	56	D
>= 10 mm	2	1.1	1.4	1.9	2.9	3.1	3.4	2.7	3.2	2.5	2.8	1.7	28.5	D
>= 25 mm	0.13	0.25	0.12	0.29	0.47	1.2	0.59	0.47	0.5	0.5	0.28	0.11	4.9	D

Water Balance Calculations

Hidden Ridge Development, Zephyr, Ontario

THORNTHWAITE-TYPE MONTHLY WATER-BALANCE MODEL

modified from Dingman 2015: Box 6-8 (pg 299) using ET model of Hamon (1963)

		Input Data				Computed Values							
											Surplus	358	mm/yr
Weather Station Location:	**Udora, ON**					**Latitude:**	**44.2**	**degree**					
Solar Declination (degree)	-20.6	-12.6	-1.5	10.0	19.0	23.1	21.0	13.4	2.6	-9.0	-18.5	-23.0	
DayLength (hr)*	9.1	10.3	11.8	13.3	14.6	15.3	14.9	13.8	12.3	10.8	9.5	8.7	
Available Water Storage Capacity	0.18	m/m		**Root Depth**	500	mm		**SOILmax**	90.0	mm			

MONTHLY WATER BALANCE DATA

Temperatures in C, water-balance terms in mm.

Month:	J	F	M	A	M	J	J	A	S	O	N	D	Year
TEMPERATURE (T)	-7.0	-6.6	-1.3	5.7	12.2	18.0	19.9	19.3	15.1	8.6	2.4	-4.0	
PRECIPITATION (P)	64.9	45.9	53.1	67.9	82.1	106.6	86.4	73.9	87.3	74.9	83.2	60.0	886
RAIN	25.7	18.3	27.2	58.9	82.1	106.6	86.4	73.9	87.3	72.9	64.8	24.6	729
SNOW	39	28	26	9	0	0	0	0	0	2	18	35	158
MELT FACTOR (F)	0.00	0.00	0.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	0.40	0.00	
PACK	86	113	139	7	0	0	0	0	0	0	11	46	
MELT	0	0	0	141	7	0	0	0	0	2	7	0	158
INPUT (W)	26	18	27	200	90	107	86	74	87	75	72	25	886
POTENTIAL ET (PET)	0	0	0	39	67	97	110	98	66	40	22	0	539
NET INPUT (ΔW)	26	18	27	160	22	10	-23	-24	21	35	50	25	
SOIL MOISTURE (SOIL)	90	90	90	90	90	90	70	53	75	90	90	90	
ΔSOIL	0	0	0	0	0	0	-20	-16	21	15	0	0	0
ET	0	0	0	39	67	97	107	90	66	40	22	0	528
SURPLUS=W-ET-Δ SOIL	26	18	27	160	22	10	0	0	0	20	50	25	358

Notes:

Precipitation, Rain, Temperature, and Latitude are inputted parameters

SOILmax = available water storage capacity * root depth

m = month

D = Day length (hrs) $=2*\cos^{-1}(-\tan(\text{Latitude})*\tan(\text{Declination}))/0.2618$ [calculation is in radians]

$SNOW_m = P_m - RAIN_m$

$F_m = 0$ if $T_m <= 0^oC$; $F_m = 0.167*T_m$ if $0^oC<T_m<6^oC$; $F_m = 1$ if $T_m>=6^oC$

$PACK_m = (1-F_m)*(SNOW_m+PACK_{m-1})$

$MELT = F_m*(SNOW_m+PACK_{m-1})$

$W_m = RAIN_m+MELT_m$.

PET = 0 if $T_m<0$; otherwise $PET = 2.98*0.611*\exp(17.3*T_m/(T_m+237))/(T_m+237.2)*$Number of days in month [Hamon ET model (1963)]

$\Delta W_m = W_m - PET_m$

$SOIL = \min\{[\Delta W_m+SOIL_{m-1}], SOILmax\}$, if $\Delta Wm>0$; otherwise $SOIL = SOIL_{m-1}* \exp(\Delta W/SOILmax)$

$\Delta SOIL = SOIL_{m-1}-SOIL_m$

ET = PET if W_m > PET; otherwise, $ET=W_m-\Delta SOIL$

Pre- and Post-Development Water Balance Calculations

309 Zephyr Road, Township of Uxbridge, ON

Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration/Evaporation (m^3)	Infiltration (m^3)	Run-off (m^3)
PRIMARY CATCHMENT / OUTLET 2						
Environmental Protection		221,838	196,548	117,130	-	79,418
Phase 1	Paved Area	3,088	2,736	274	-	2,462
	Roof Area	1,000	886	89	-	797
	Landscape Area	41,764	37,003	22,051	7,177	7,775
	Sum	45,852				
Phase 2	Landscape Area	122,222	108,289	64,533	21,003	22,753
	Totals	389,912	345,462	204,077	28,179	113,205
NORTHWEST CATCHMENT / OUTLET 1						
Phase 1	Paved Area	1,960	1,737	174	-	1,563
	Roof Area	400	354	35	-	319
	Landscape Area	2,985	2,645	1,576	513	556
	Sum	5,345				
Phase 2	Landscape Area	5,000	4,430	2,640	859	931
	Totals	10,345	9,166	4,425	1,372	3,368
TOTAL		400,257	354,628	208,503	29,552	116,574

Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.

Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
PRIMARY CATCHMENT / OUTLET 2						
Environmental Protection		221,838	196,548	117,130	-	79,418
Phase 1	Paved Area	3,088	2,736	274	-	2,462
	Roof Area	1,000	886	89	-	797
	Landscape Area	41,764	37,003	22,051	7,177	7,775
Phase 2	Paved Area	7,220	6,397	640	-	5,757
	Roof Area	3,200	2,835	284	-	2,552
	Landscape Area	111,802	99,057	59,032	19,212	20,813
	Totals	389,912	345,462	199,499	26,389	119,575
NORTHWEST CATCHMENT / OUTLET 1						
Phase 1	Paved Area	1,960	1,737	174	-	1,563
	Roof Area	400	354	35	-	319
	Landscape Area	2,985	2,645	1,576	513	556
Phase 2	Paved Area	80	71	8	-	63
	Roof Area	200	177	20	-	157
	Landscape Area	4,720	4,182	2,492	811	879
	Totals	10,345	9,166	4,305	1,324	3,536
TOTAL		400,257	354,628	203,804	27,713	123,111

Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.

Pre- and Post-Development Water Balance Calculations

309 Zephyr Road, Township of Uxbridge, ON

Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
PRIMARY CATCHMENT / OUTLET 2				
Pre-Development	345,462	204,077	28,179	113,205
Post-Development	345,462	199,499	26,389	119,575
Change in Volume	-	- 4,579	- 1,791	6,369
Change in %	-	- 2	- 6	6
NORTHWEST CATCHMENT / OUTLET 1				
Pre-Development	9,166	4,425	1,372	3,368
Post-Development	9,166	4,305	1,324	3,536
Change in Volume	-	- 120	- 48	168
Change in %	-	- 3	- 4	5