Water Balance – 309 Zephyr Road, Zephyr, Township of Uxbridge

July 7, 2025

Prepared for:
China Canada Jing Bei Xin Min International

In Association With:
EcoVue Consulting Services Inc.

Cambium Reference: 18619-003

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1.0 Introduction

EcoVue Consulting Services Inc. (EcoVue) on behalf of China Canada Jing Bei Xin Min Intl. (Client) retained Cambium Inc. to complete an updated catchment-based water balance for a proposed residential development at 309 Zephyr Road, in the Township of Uxbridge, Durham Region, Ontario (the Site). The proposed development has been split into a Phase 1 development and Phase 2 development. Phase 1 of the development will include building 7 single-family dwellings in the northwestern portion of the Site, while Phase 2 of the development will include building 17 single-family dwellings on the southwestern and central-western portions of the Site. The water balance calculations provided herein includes both development phases, along with a water balance comparison and a discussion of low impact development features for each development phase.

This water balance builds on an initial report prepared by Cambium entitled "*Hydrogeological Water Balance, Hidden Ridge Development, Uxbridge",* dated November 29, 2022 (Cambium, 2022). Both the Phase 1 and 2 developments constitute 'major developments' as per the Lake Simcoe Protection Plan (LSPP) (Lake Simcoe Region Conservation Authority, 2009) (i.e., as more than four residents are being constructed); therefore, catchment-based water balances are required for each development phase to demonstrate that changes in the water balances from pre- to post-development will be minimized as per Policy 4.8-DP of the LSPP.

The results of this updated water balance also support the hydrogeological assessment for private servicing of water and wastewater being prepared concurrently for the Phase 2 development of the Site by Cambium, in a document entitled, "*Hydrogeological Assessment – 309 Zephyr Road, Zephyr, Township of Uxbridge"* (Cambium, 2025a). Furthermore, reducing the difference between the pre- and post-development infiltration rate is particularly important as there are sensitive hydrological features on-site including a Provincially Significant Wetland, an Ecologically Significant Groundwater Recharge Area (ESGRA), and a Significant Groundwater Recharge Area (SGRA; see Cambium (2025a) for a complete discussion of these vulnerable areas).

Updates to Cambium's 2022 water balance report (Cambium, 2022) were required to address peer review comments provided by PGL Environmental Consultants (PGL) in a document entitled, "*Peer Review of the Hydrogeological Assessment, Hydrogeological Water Balance, And Natural Heritage Evaluation – 309 Zephyr Road, Zephyr, Township of Uxbridge, Durham Region, ON*", dated June 11, 2024 (PGL, 2024a). The comments from PGL that pertain to the Cambium's original 2022 water balance were as follows:

- *The Phase 1 northwest catchment landscaped area runoff rate changes between the pre- and post-development scenarios. It is unclear why the runoff rate changes though the areas remain the same.*
- *The Water Balance comparison provides infiltration and runoff rate differences based on the entire Site area, rather than just the Phase 2 area. This method of comparison does not effectively compare the actual changes that will be encountered in the Phase 2 area.*
- *The development proposal suggests that either roof runoff be captured and re-infiltrated through LID measures to address the infiltration deficit, or items including landscape measures, conveyance controls, or directing runoff through dry swales be implemented to improve infiltration efficiency and remove the need for further LID measures. However, no specific LID measures are proposed. As a result, PGL is unable to assess the appropriateness of the LID measures.*

This updated hydrogeological water balance assessment outlined herein is structured to be read as a stand-alone document, including information from both the original hydrogeological water balance (Cambium, 2022) and new data and analysis to address PGL's peer review comments. This updated water balance also uses recent information and Site plans provided in a storm water management report completed by Tatham Engineering Limited (Tatham) in a document entitled "*Hidden Ridge Subdivision – Stormwater Management Report*", dated May 16, 2025 (Tatham, 2025). The results of Cambium (2022) and Tatham (2025) are referenced herein, where applicable.

1.1 Site Description

The Site is part of Lots 24 and 25, Concession 3 in the Township of Uxbridge (Figure 1). The western portion of the property is a golf course and is accessed by Zephyr Road and Concession 3 Road. 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 coordinates of the Zephyr Road access to the Site are 638827 mE, 4895716 mN.

The total area of the property is approximately 40 ha; however, 22.2 hectares (ha) of the property are located within the PSW environmental protection area, with approximately 14.6 ha of the Site to be developed and the remainder of the Site reserved for setback areas. 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 2.

As seen in Figure 2, the proposed development area has been split into Phase 1 and Phase 2. The Phase 1 development area is located in the northwestern area of the Site and is approximately 3.4 ha. The Phase 1 development includes seven lots and an internal roadway. The Phase 2 development area is approximately 11.2 ha and is located south of Phase 1. Phase 1 includes the development of 7 lots and internal roadways, while Phase 2 includes the development of 17 lots and internal roadways. The PSW setback does not encroach on the lots or internal roadways in either the Phase 1 or 2 development areas.

A plan of the proposed development has been attached in Appendix A. The feasibility of on-site servicing for the Phase 2 development is assessed as part of Cambium's 2025 hydrogeological assessment for the Phase 2 development area (Cambium, 2025a).

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 & Putnam, 1984). The Site is located 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 257 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 238.0 masl at the southern border and 236.5 masl at the northern border of the property.

There are two main pre-development catchments identified within the development area based on the information provided by Tatham (2025), and as shown in Appendix A. The existing catchments are identified as the following:

- Northwest Catchment (referred to as the Outlet 1 Catchment by Tatham (2025))
- Primary Catchment (referred to as the Outlet 2 Catchment Tatham (2025)).

Cambium notes that the catchment and subcatchment outlines presented by Tatham (2025) do not strictly include the entire development area (e.g., the northeast corner of the Phase 1 development area is outside of Tatham's catchment, as seen in Appendix A). However, the remaining portions development area were confidently categorized herein as being in the Northwest Catchment or Primary Catchment based on the catchment outlines shown in Tatham (2025) and based on the local topography.

The pre-development Northwest Catchment is approximately 2.2 ha and includes small portions of the Phase 1 and Phase 2 development areas. According to Tatham (2025), the Northwest Catchment can be subdivided into two subcatchments, referred to as Catchments 101 and 103 in the stormwater management report. Catchment 101 is approximately 1.6 ha and consists of existing lawn areas and impervious surfaces. This catchment drains into the Zephyr Road south ditch on the northern boarder of the property. Catchment 103 is approximately 0.5 ha includes lawn and impervious surfaces and drains into the Dafoe Street Ditch on the western boarder of the property. The pre-development boundary of the Northwest Catchment encompasses portions of the Phase 1 and Phase 2 development areas.

The Primary Catchment is approximately 12.4 ha (referred to as Catchment 102 in the stormwater management report) and includes most of the Phase 1 and 2 development areas. The Primary Catchment consists mostly of landscaped and treed areas from the golf course. Runoff in the Primary Catchment is directed towards Zephyr Creek which runs north-south through the center of the Site, with Zephyr Creek subsequently flow north off-site towards the Black River and ultimately to Lake Simcoe.

According to Tatham (2025), the drainage divide between the Northwest and Primary Catchments will change post-development as the Site is re-graded. However, the orientation of the drainage divide will be minor and the location of the outlets for each catchment will remain unchanged; therefore, the post-development catchments are still referred to as the Northwest and Primary Catchments. Post-development, the footprint of the Northwest and Primary Catchments are expected to change to approximately 1.8 and 12.8 ha, respectively. The outlines of the Northwest and Primary Catchments for the pre- and post-development scenarios are shown in Appendix A.

3.0 Conceptual Water Balance

Cambium completed a conceptual, catchment-based water balance for the development area to assess the effects of the development on local groundwater and surface water resources. To assess the effects of the Phase 1 and 2 development areas separately, the water balance calculations were broken up by both by the catchment area (i.e., the Northwest and Primary Catchments) and by the development area (i.e., the Phase 1 and 2 development areas).

The pre- and post-development catchment boundaries are relatively similar. As such, the post-development runoff and infiltration rate calculations were based upon the post-development catchment boundaries and compared to the pre-development water balance results. Cambium notes that the water balance calculations described herein do not account for catchment areas outside of the Phase 1 and 2 development areas.

Generally, any property can be categorized into three broad types of areas: paved, roof, and landscape/vegetated. A breakdown of the pre-development plan as roofed, paved, and landscaped/vegetated areas for each of the catchment / development area combinations is presented in Table 1, while the breakdown for the post-development plan is presented in Table 2.

To complete the water balance assessment for each of the catchment / development area combination, the following equations were utilized:

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

Where:
- QI - Infiltration Volume (m^3/yr)
- A - Area (m^2)
- S - Water surplus (m/yr)
- I - Infiltration factor (dimensionless)

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

Where:
- QR - Runoff Volume (m^3/yr)
- A - Area (m^2)
- S - Water surplus (m/yr)
- I - Infiltration factor (dimensionless)

A detailed discussion of each component completed for the water balance assessment is provided in the following subsections.

Table 1 Pre-Development Statistics

Type of Land Coverage	Phase 1 Development Area		Phase 2 Development Area	
	Northwest Catchment	Primary Catchment	Northwest Catchment	Primary Catchment
Paved Area	719	0	1,435	0
Roofed Area	105	225	394	0
Landscape Area	12,478	20,314	6,382	103,801
Total (m^2)	**13,302**	**20,540**	**8,211**	**103,801**

Table 2 Post-Development Statistics

Type of Land Coverage	Phase 1 Development Area		Phase 2 Development Area	
	Northwest Catchment	Primary Catchment	Northwest Catchment	Primary Catchment
Paved Area	1,926	1,894	0	8,023
Roofed Area	389	972	0	3,304
Landscape Area	9,332	19,330	5,894	94,791
Total (m^2)	**11,646**	**22,195**	**5,894**	**106,118**

3.1 Water Surplus

Water surplus is calculated by determining the difference between precipitation and evapotranspiration (changes in soil water storage were 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 Climate Normals (1981-2010) for the Udora weather station (Environment Canada, 2028), 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, 2019). As outlined in Table 3, 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.

Table 3 Infiltration Factor

Category	Infiltration Factor
Topography	Hilly Land = 0.13
Soils	Silty Sand = 0.25
Cover	Cultivated Land = 0.1
Infiltration Factor	**0.48**

3.3 Pre-Development Water Balance

The water balance for the existing conditions of the Site is summarized in Table 4.

The Phase 1 pre-development infiltration rates for the Northwest and Primary Catchments were calculated to be approximately 2,144 and 3,491 m^3/yr, while the runoff rates were calculated to be approximately 2,980 and 3,961 m^3/yr, respectively.

The Phase 2 pre-development infiltration rates for the Northwest and Primary Catchments were calculated to be approximately 1,097 and 17,837 m^3/yr, while the runoff rates were calculated to be approximately 2,647 and 19,324 m^3/yr, respectively.

Considering the phases as a whole, the total infiltration rates for the Phase 1 and 2 developments pre-development were calculated to be 5,635 m^3/yr and 18,934 m^3/yr, respectively, while the runoff rates were calculated to be 3,961 and 19,324 m^3/yr, respectively.

Table 4 Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapo-transpiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Phase 1 Development Area						
Northwest Catchment	Paved Area	719	637	64	-	573
	Roofed Area	105	93	9	-	84
	Landscaped Area	12,478	11,055	6,588	2,144	2,323
	Total	***13,302***	***11,785***	***6,661***	***2,144***	***2,980***
Primary Catchment	Paved Area	-	-	-	-	-
	Roofed Area	225	199	20	-	180
	Landscaped Area	20,314	17,999	10,726	3,491	3,782
	Total	***20,540***	***18,198***	***10,746***	***3,491***	***3,961***
PHASE 1 TOTAL		**33,841**	**29,983**	**17,407**	**5,635**	**6,941**
Phase 2 Development Area						
Northwest Catchment	Paved Area	1,435	1,271	127	-	1,144
	Roofed Area	394	349	35	-	314
	Landscaped Area	6,382	5,654	3,370	1,097	1,188
	Total	***8,211***	***7,275***	***3,532***	***1,097***	***2,647***
Primary Catchment	Paved Area	-	-	-	-	-
	Roofed Area	-	-	-	-	-
	Landscaped Area	103,801	91,968	54,807	17,837	19,324
	Total	***103,801***	***91,968***	***54,807***	***17,837***	***19,324***
PHASE 2 TOTAL		**112,012**	**99,243**	**58,339**	**18,934**	**21,970**

3.4 Post-Development Water Balance

The water balance for the existing conditions of the Site is summarized in Table 5.

The Phase 1 post-development infiltration rates for the Northwest and Primary Catchments were calculated to be approximately 1,604 and 3,322 m^3/yr, while the runoff rates were calculated to be approximately 3,583 and 5,883 m^3/yr, respectively.

The Phase 2 post-development infiltration rates for the Northwest and Primary Catchments were calculated to be approximately 1,013 and 16,289 m^3/yr, while the runoff rates were calculated to be approximately 1,097 and 26,679 m^3/yr, respectively.

Considering the phases as a whole, the total infiltration rates for the Phase 1 and 2 developments post-development were calculated to be 4,925 m^3/yr and 17,302 m^3/yr, respectively, while the runoff rates were calculated to be 9,466 and 27,776 m^3/yr, respectively.

Table 5 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapo-transpiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Phase 1 Development Area						
Northwest Catchment	Paved Area	1,926	1,706	171	-	1,536
	Roofed Area	389	344	34	-	310
	Landscaped Area	9,332	8,268	4,927	1,604	1,737
	Total	***11,646***	***10,319***	***5,132***	***1,604***	***3,583***
Primary Catchment	Paved Area	1,894	1,678	168	-	1,510
	Roofed Area	972	861	86	-	775
	Landscaped Area	19,330	17,126	10,206	3,322	3,598
	Total	***22,195***	***19,665***	***10,460***	***3,322***	***5,883***
PHASE 1 TOTAL		**33,841**	**29,983**	**15,592**	**4,925**	**9,466**
Phase 2 Development Area						
Northwest Catchment	Paved Area	-	-	-	-	-
	Roofed Area	-	-	-	-	-
	Landscaped Area	5,894	5,222	3,112	1,013	1,097
	Total	***5,894***	***5,222***	***3,112***	***1,013***	***1,097***
Primary Catchment	Paved Area	8,023	7,108	711	-	6,397
	Roofed Area	3,304	2,928	293	-	2,635
	Landscaped Area	94,791	83,985	50,050	16,289	17,646
	Total	***106,118***	***94,021***	***51,053***	***16,289***	***26,679***
PHASE 2 TOTAL		**112,012**	**99,243**	**54,165**	**17,302**	**27,776**

3.5 Water Balance Comparison

The water balances of the pre-development and post-development scenarios are summarized below in Table 6.

Table 6 Water Balance Comparison

		QI (m^3/yr)	QI Difference from Pre Development Scenario (m^3/yr, % change)	QR (m^3/yr)	QR Difference From Pre-Development Scenario (m^3/yr, % change)
Phase 1 Development Area					
Northwest Catchment	Pre-Development	2,144		2,980	
	Post-Development	1,604	-541 m^3/yr, -25%	3,583	603 m^3/yr, +20%
Primary Catchment	Pre-Development	3,491		3,961	
	Post-Development	3,322	-169 m^3/yr, -5%	5,883	1,922 m^3/yr, +49%
Total	Pre-Development	5,635		6,941	
	Post-Development	4,925	-710 m^3/yr, -13%	9,367	2,525 m^3/yr, +36%
Phase 2 Development Area					
Northwest Catchment	Pre-Development	1,097		2,647	
	Post-Development	1,013	-84 m^3/yr, -8%	1,097	-1,549 m^3/yr, -59%
Primary Catchment	Pre-Development	17,837		19,324	
	Post-Development	16,289	-1,548 m^3/yr, -9%	26,679	7,355 m^3/yr, +38%
Total	Pre-Development	18,934		21,970	
	Post-Development	17,302	-1,632 m^3/yr, -9%	27,776	5,806 m^3/yr, +26%

3.5.1 Phase 1 Water Balance Comparison

For the Phase 1 development, the infiltration deficits for the Northwest and Primary Catchments were estimated to be 541 and 169 m^3/yr, respectively (a reduction of 25% and 5% of pre-development conditions). The runoff surpluses of the Phase 1 for the Northwest and Primary Catchments were estimated to be 603 and 1,922 m^3/yr, respectively (an increase of 20% and 49% of pre-development conditions). Considering the Phase 1 development area as a whole, the infiltration deficit and runoff surplus were calculated to be 710 m^3/yr and 2,525 m^3/yr, respectively (for a decrease in infiltration of 13% and an increase in runoff of 36% from pre-development conditions).

Regarding the Phase 1 development, a portion of the infiltration deficit in the Northwest catchment is the result of the Phase 1 Northwest Catchment decreasing in size from 13,302 m^2 to 11,646 m^2 from pre- to post-development (upon regrading of the Site during development). The remainder of the infiltration deficit in the Phase 1 Northwest Catchment is

the result of increases in the paved and roofed areas in the catchment from pre- to post-development. For the Phase 1 Primary Catchment, the infiltration deficit results entirely from increases in the paved and roofed areas post-development.

3.5.2 Phase 2 Water Balance Comparison

For the Phase 2 development, the infiltration deficits for the Northwest and Primary Catchments were estimated to be 84 and 1,548 m^3/yr (a reduction of 8% and 9% of pre-development conditions). The runoff rate of the Phase 2 post-development for the Northwest Catchment was estimated to be reduced by 1,549 m^3/yr (for a reduction of 59% from pre-development conditions), while the runoff rate for the Primary Catchment was estimated to increase by 7,335 m^3/yr (an increase of 38% from pre-development conditions).

Considering the Phase 2 development area as a whole, the calculated infiltration deficit and runoff surplus were calculated to be 1,632 m^3/yr and 5,806 m^3/yr, respectively (for a decrease in infiltration of 9% and an increase in runoff of 26% from pre-development conditions).

Regarding the Phase 2 development, the infiltration deficit for the Northwest Catchment is entirely the result of the Phase 2 Northwest Catchment decreasing in size from 8,211 m^2 to 5,894 m^2 from pre- to post-development, as the Phase 2 Northwest Catchment will be 100% landscaped post-development. While the Phase 2 Primary Catchment is expected to increase in size post-development from 103,801 m^2 to 106,118 m^2, the increase in area is only 1% relative to the pre-development Phase 2 Primary Catchment area. The impact of the increase in the Primary Catchment area from pre- to post-development on the water balance is considered to be negligible, as evidenced by the fact that the post-development infiltration deficit is 9% for both the Phase 2 Primary Catchment and when considering Phase 2 development area as a whole (where the area from pre- to post-development does not change). The runoff deficit of 84 m^3/yr for the Phase 2 Northwest Catchment is considered negligible relative the total infiltration rates for the Phase 2 development area.

3.5.3 Sensitive Areas

In terms of maintaining the pre-development infiltration rates, Cambium notes that the mapped SGRA onsite is within the Primary Catchment under pre-development conditions. Whereas the ESGRA is located within both the Northwest and Primary Catchments.

3.5.3.1 Sensitive Areas Water Balance Assessment Phase 1

It is recommended that the total pre-development infiltration rate within the Phase 1 development area be at least maintained upon development of the Site. As per Table 6, the projected infiltration deficit within the Phase 1 development area is 710 m³/year. At least this much water should be re-infiltrated on an annual basis with the use of Low Impact Development (LID) measures or similar. At least 169 m³/yr of re-infiltration should occur within the Primary Catchment to maintain infiltration. A best efforts approach should be made to maintain the predevelopment infiltration rate within the Northwest Catchment, however any part of the infiltration deficit that cannot be accounted for in the Northwest Catchment should be accounted for in the Primary Catchment with appropriate LID measures.

3.5.3.2 Sensitive Areas Water Balance Assessment Phase 2

It is recommended that the total pre-development infiltration rate within the Phase 2 development area be at least maintained upon development of the Site. As per Table 6, the projected infiltration deficit within the Phase 2 development area is 1,632 m³/year. At least this much water should be re-infiltrated on an annual basis with the use of LID measures. It is noted that the SGRA is located within the Primary Catchment of Phase 2, further all the impervious areas (paved and roofed areas) for the Phase 2 development will be located within the Primary Catchment. As such, it is considered most prudent that all LID measures be developed within the Phase 2 development area of the Primary Catchment.

The pre-development infiltration deficit of the Phase 2 Northwest Catchment cannot be maintained as the Phase 2 Northwest Catchment will be 100% landscaped post-development. So long as the infiltration deficit within the Northwest Catchment is maintained by re-infiltration

in the Primary catchment, then there is interpreted to be a negligible influence to the identified ESGRA.

3.6 Discussion on Low Impact Development Features

To protect sensitive hydrogeological systems, it is important to maintain the natural hydrologic cycle as much as possible because a decrease in infiltration can causes reductions in groundwater recharge and soil moisture replenishment. As mentioned in Section 3.5.3, efforts should be made within fully maintain the pre-development infiltration rates post-development.

In general, there are two primary types of LIDs. The first promotes the infiltration of stormwater run-off close to the source and are preferred when hydrogeological and physical conditions are optimal and allow for their emplacement. The second type of LID captures and slowly releases stormwater to the groundwater system through a process of storage and filtration.

Infiltration targets at the Site may be achieved through LIDs and incorporation of a variety of stormwater management techniques including reduced lot grading, roof downspout disconnection, roof leaders discharging to ponding areas or soak away pits, infiltration trenches, and grassed swales.

It is noted that a minimum vertical separation of 1.0 m is generally required between the maximum groundwater elevation and the bottom invert elevation of most proposed LID measures (except for LID measures like grass swales or reducing lot grading). Regular water level measurements have been made across both Phase 1 and Phase 2 of the proposed development areas (Cambium, 2025a) (Cambium, 2025b). The water level conditions outlined in these reports should be considered as part of any future LID design plan.

The runoff surplus for both the Phase 1 and Phase 2 development areas 355% greater than the projected infiltration deficit. As such, there is considered to be ample runoff water available for re-infiltration.

Cambium recommends that the Client retain a stormwater engineer to discuss options for maintaining the pre-development infiltration rate within the Phase 1 and 2 development areas.

4.0 Closing

Cambium completed a catchment-based water balance at 309 Zephyr Road in support of both the Phase 1 and 2 developments at the at the property.

The Phase 1 water balances indicates that the proposed development will induce infiltration reductions of 25% and 5% for the Phase 1 Northwest and Primary Catchments, respectively, when compared to pre-development conditions.

The Phase 2 Northwest and Primary Catchment water balances indicates that the proposed development will induce an infiltration reduction of 8% and 9% from pre-development conditions.

The pre-development infiltration rate should be at least maintained within the Phase 1 development area in order to mitigate influences to any sensitive areas. Similarly, pre-development infiltration conditions within Phase 2 should also be maintained, but focussed within the Primary Catchment Lands.

In summary, the proposed developments are considered feasible at the Site (with regards to the catchment-based water balance). LID measures should be implemented in both development phases to mitigate infiltration deficit concerns to within an acceptable range.

We trust that the information in this submission meets your current requirements. If you have any questions regarding the contents of this report, please contact the undersigned.

Respectfully submitted,

Cambium Inc.

Ben Didemus, M.Sc., GIT Project Coordinator	Cameron MacDougall, P.Geo. Project Manager

BD/CM/knh

\\cambiumincstorage.file.core.windows.net\projects\18600 to 18699\18619-003 EcoVue Consultin Services Inc - Water Well Survey and Additional HG\Deliverables\Water Balance Report\2025-07-07 - RPT - Updated Hidden Ridge Development Water Balance_v10.docx

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6.0 Standard Limitations

Limited Warranty

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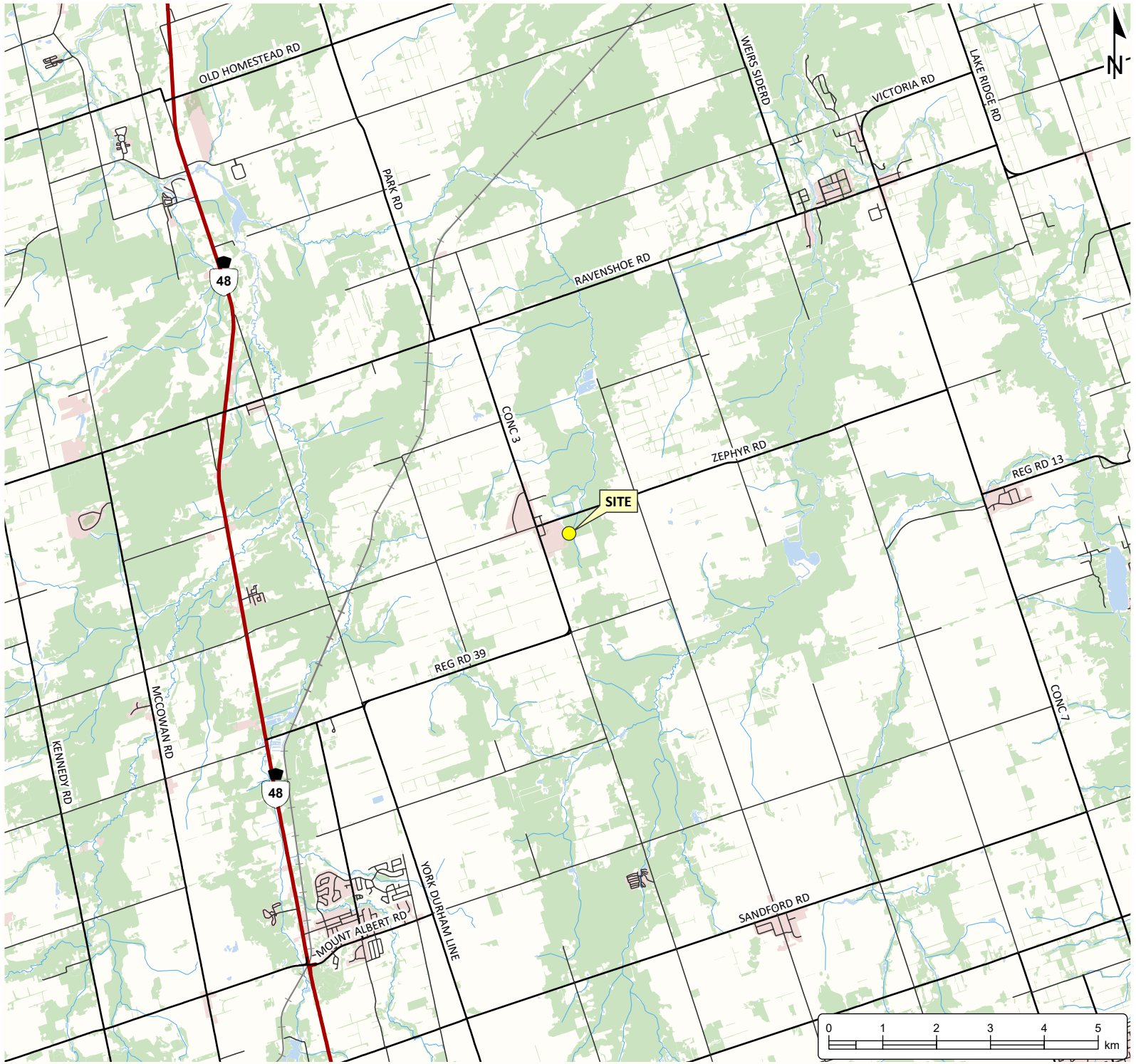
Appended Figures



HYDROGEOLOGICAL WATER BALANCE REPORT

CHINA CANADA JING XIN MIN INTL
309 Zephyr Road
Zephyr, Ontario

LEGEND

- Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Water Area
- Wooded Area
- Built Up Area

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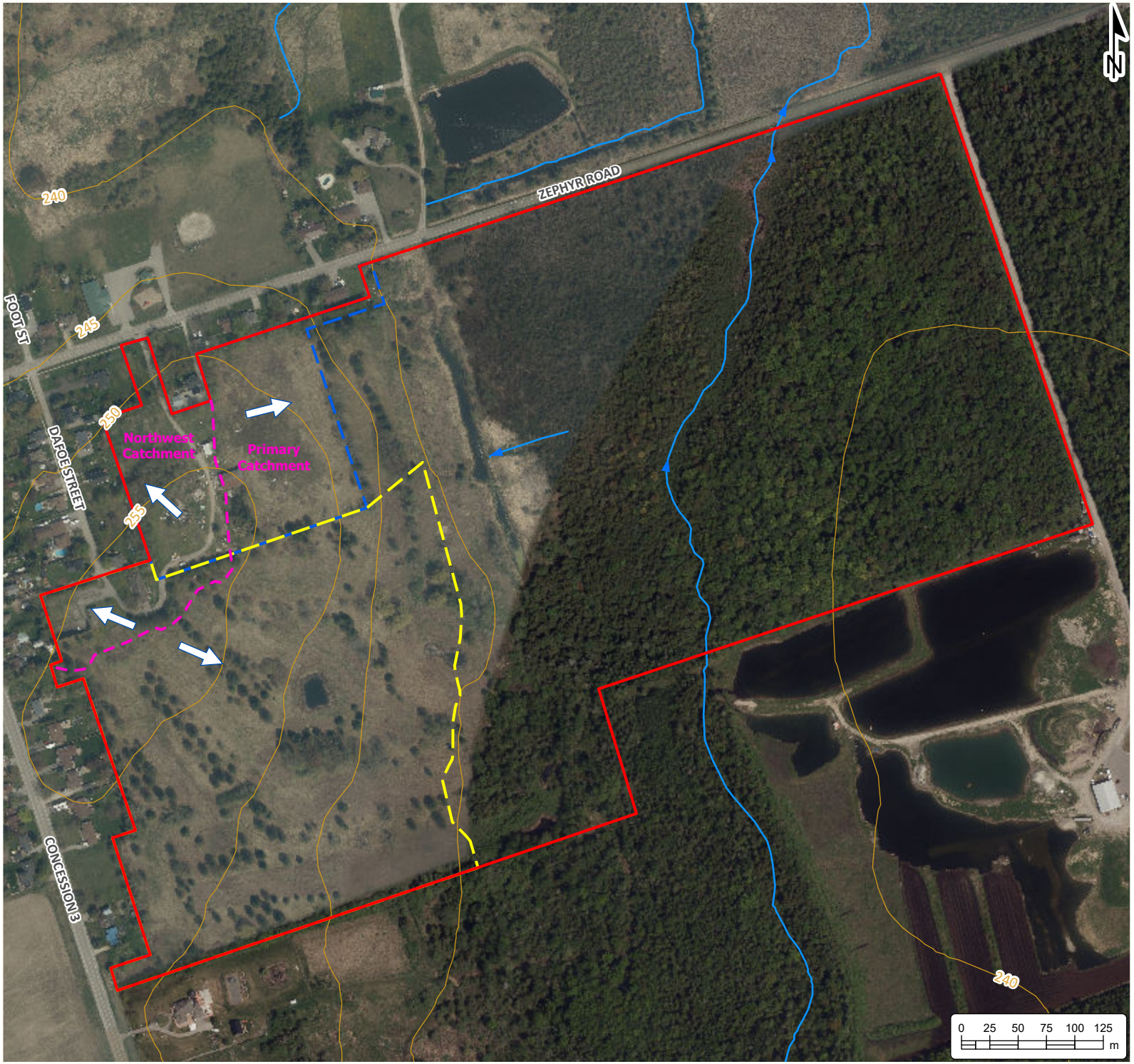
SITE LOCATION PLAN

Project No.:	Date:
18619-003	June 2025
Scale: 1:100,000	Projection: NAD 1983 UTM Zone 17N
Created by: LD	Checked by: CM
Figure: 1	

O:\GIS\MXDs\18600-18699\18619-003 EcoVue Consultin Services Inc - Water Well Survey and Additional HG\2025-06-16 HydroG 18619.aprx



HYDROGEOLOGICAL WATER BALANCE REPORT

CHINA CANADA JING XIN MIN INTL
309 Zephyr Road
Zephyr, Ontario

LEGEND

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

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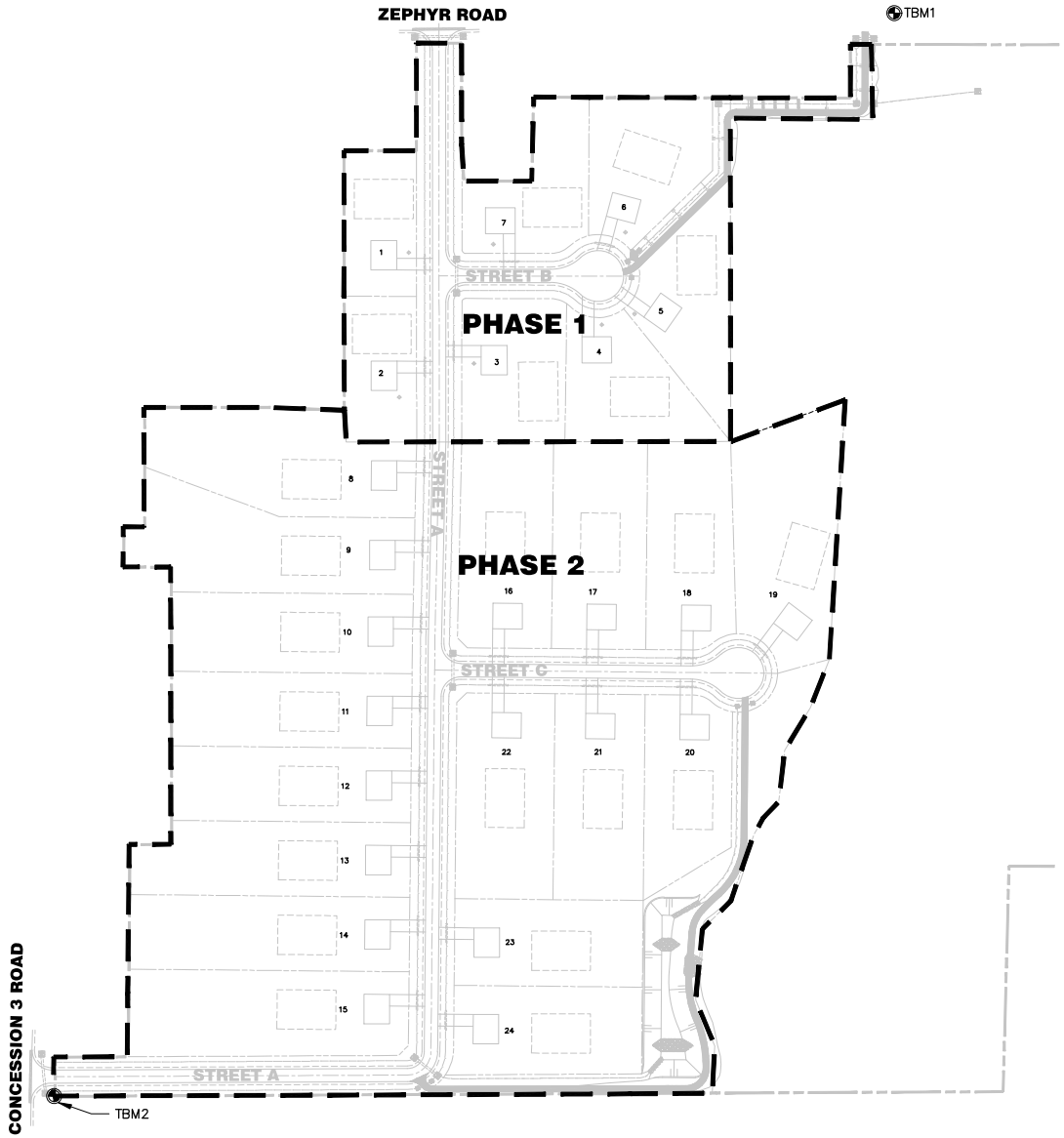
SITE PLAN

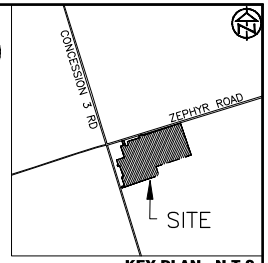
Project No.:	Date:
18619-003	July 2025
Scale: 1:4,750	Projection: NAD 1983 UTM Zone 17N
Created by: LD	Checked by: CM
Figure: 2	

O:\GIS\MXDs\18600-18699\18619-003 EcoVue Consultin Services Inc - Water Well Survey and Additional HG\2025-06-16 HydroG 18619.aprx

Appendix A

Proposed Development Plan





KEY PLAN - N.T.S.

LEGEND

PHASING BOUNDARY

Drawing Name: 516655-PH01.dwg, Plotted: May 16, 2025

TOPOGRAPHIC SURVEY COMPLETED BY A.R. (SANDY) WAKELING SURVEYING TECHNICAL SERVICES IN APRIL 18, 2017 AND RICHMOND SURVEYING INC. IN MARCH 28, 2024.

TBM1: SURVEY SPIKE ON SOUTHERLY FACE OF HYDRO POLE ON NORTH SIDE OF ZEPHYR ROAD, FIRST POLE WEST OF DRIVEWAY INTO 322 ZEPHYR ROAD. ELEVATION: 238.74.

TBM2: TOP OF STANDARD IRON BAR AT THE SOUTH WESTERLY CORNER OF PLAN PART 2 PLAN 40R-3497 ELEVATION: 250.59

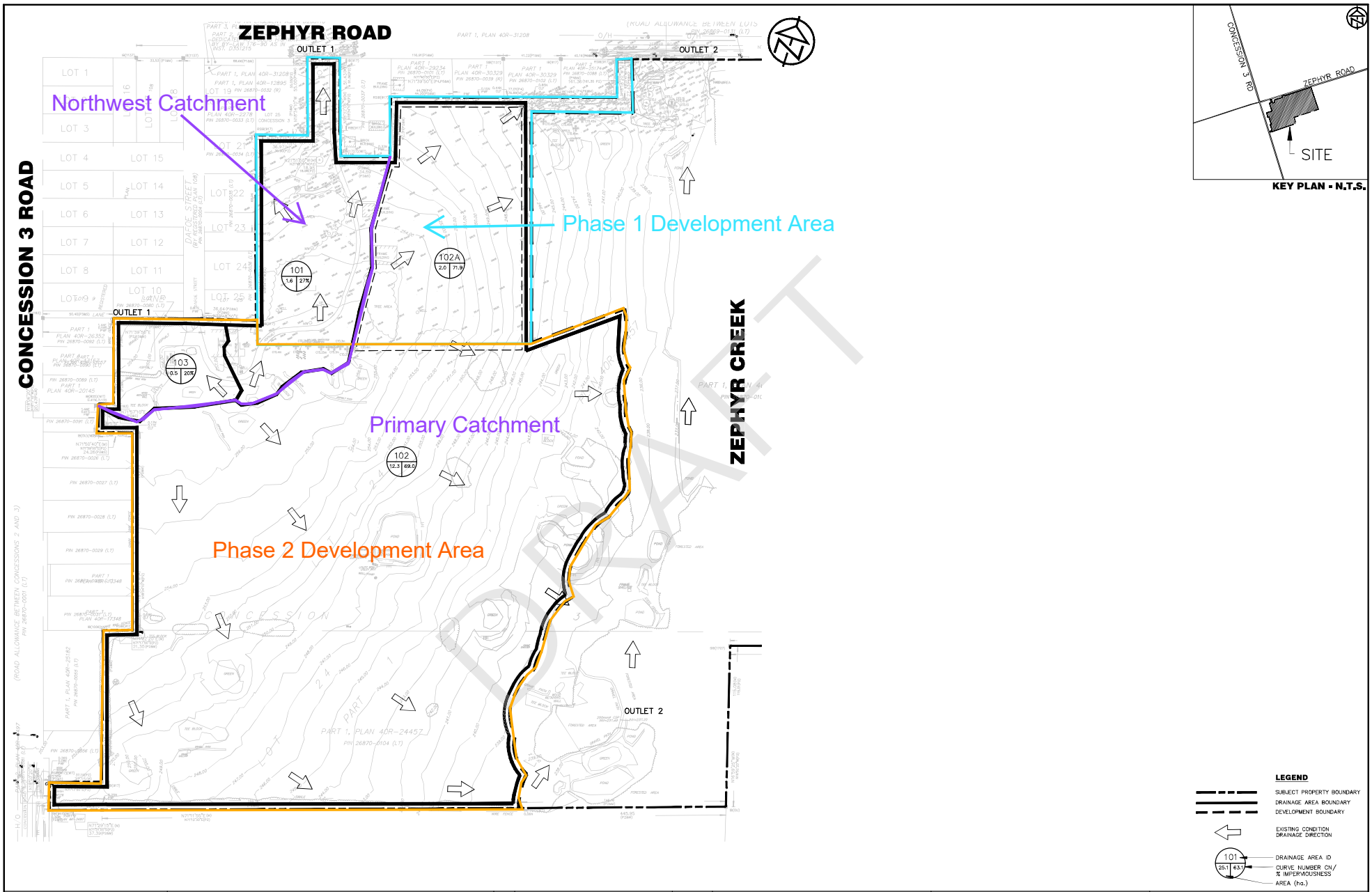
No.	REVISION DESCRIPTION	DATE	ENGINEER STAMP
1.	FIRST SUBMISSION FOR CLIENT REVIEW	MAY, 2025	

HIDDEN RIDGE SUBDIVISION
TOWNSHIP OF UXBRIDGE

TATHAM ENGINEERING

PHASING PLAN

DESIGN: HY	FILE: 516655	DWG:
DRAWN: HY	DATE: SEPT 2024	PH-1
CHECK: JA	SCALE: 1:750	



Drawing Name: 516655-DP01.dwg, Plotted: May 16, 2025

TOPOGRAPHIC SURVEY COMPLETED BY A.R. (SANDY) WAKELING SURVEYING TECHNICAL SERVICES IN APRIL 18, 2017 AND RICHMOND SURVEYING INC. IN MARCH 28, 2024.

TBM1: SURVEY SPIKE ON SOUTHERLY FACE OF HYDRO POLE ON NORTH SIDE OF ZEPHYR ROAD, FIRST POLE WEST OF DRIVEWAY INTO 322 ZEPHYR ROAD. ELEVATION: 238.74.

TBM2: TOP OF STANDARD IRON BAR AT THE SOUTH WESTERLY CORNER OF PLAN PART 2 PLAN 40R-3497 ELEVATION: 250.59

No.	REVISION DESCRIPTION	DATE	ENGINEER STAMP
1.	FIRST SUBMISSION FOR CLIENT REVIEW	MAY, 2025	

HIDDEN RIDGE SUBDIVISION
TOWNSHIP OF UXBRIDGE

EXISTING CONDITION DRAINAGE PLAN

TATHAM ENGINEERING

DESIGN: HY	FILE: 516655	DWG: DP-1
DRAWN: HY	DATE: SEPT 2024	
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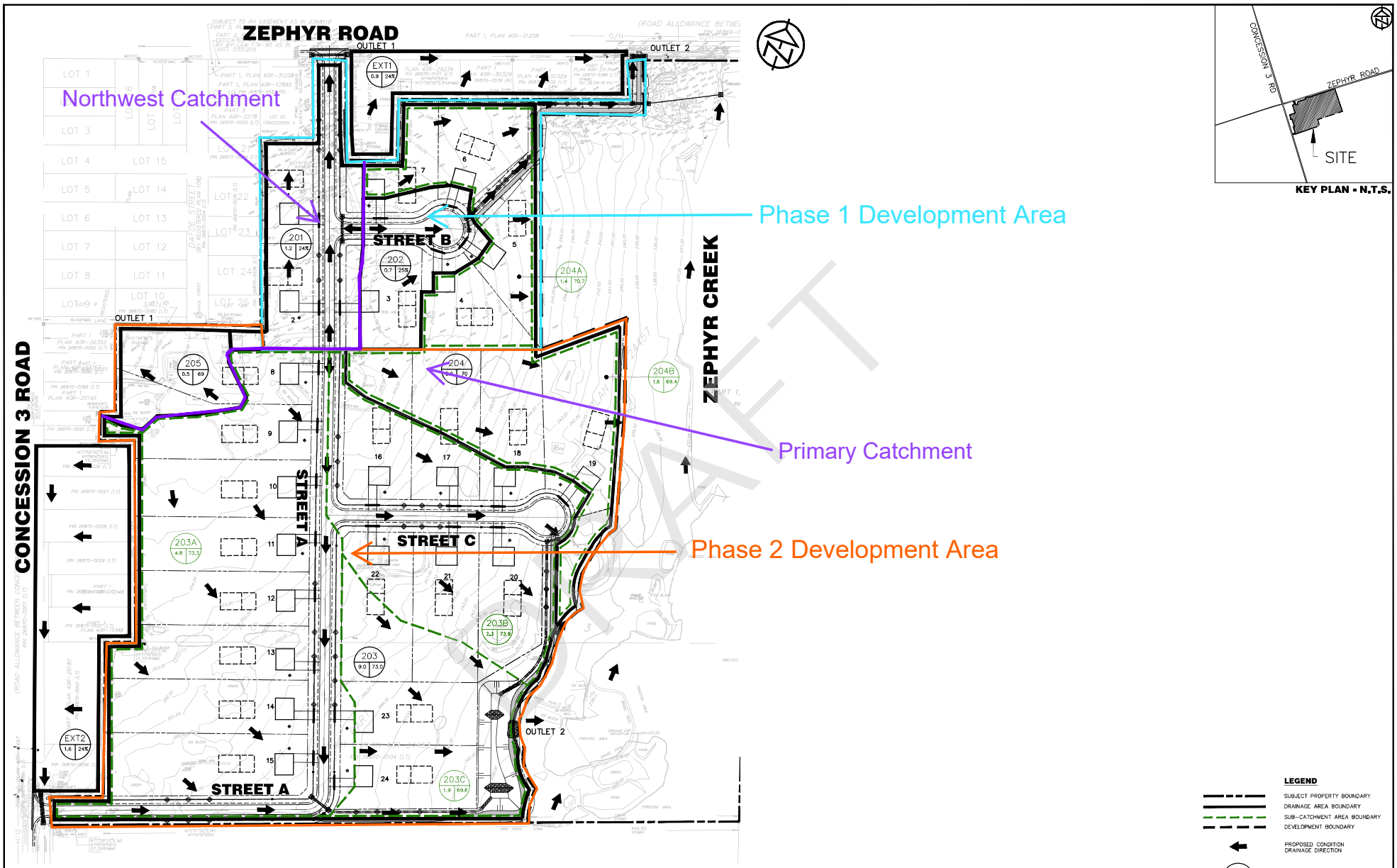

Drawing Name: 516655-DP02.dwg, Plotted: May 16, 2025

TOPOGRAPHIC SURVEY COMPLETED BY A.R. (SANDY) WAKELING SURVEYING TECHNICAL SERVICES IN APRIL 18, 2017 AND RICHMOND SURVEYING INC. IN MARCH 28, 2024.

TBM1: SURVEY SPIKE ON SOUTHERLY FACE OF HYDRO POLE ON NORTH SIDE OF ZEPHYR ROAD, FIRST POLE WEST OF DRIVEWAY INTO 322 ZEPHYR ROAD. ELEVATION: 238.74.

TBM2: TOP OF STANDARD IRON BAR AT THE SOUTH WESTERLY CORNER OF PLAN PART 2 PLAN 40R-3497 ELEVATION: 250.59

No.	REVISION DESCRIPTION	DATE	ENGINEER STAMP
1.	FIRST SUBMISSION FOR CLIENT REVIEW	MAY, 2025	

HIDDEN RIDGE SUBDIVISION
TOWNSHIP OF UXBRIDGE

PROPOSED CONDITION DRAINAGE PLAN

TATHAM ENGINEERING

DESIGN: HY	FILE: 516655	DWG: DP-2
DRAWN: HY	DATE: SEPT 2024	
CHECK: JA	SCALE: 1:1250	

Appendix B

Conceptual Water Balance Calculations

Water Balance Calculations

309 Zephyr Road, Zephyr, ON

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-DSOIL	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 Drive, Zephyr, ON

Phase 1 - Northwest Catchment Water Balance

1 Climate Information

Precipitation	886	mm/yr
Actual Evapotranspiration	528	mm/yr
Water Surplus	358	mm/yr

2 Infiltration Rates

Table 2 Approach - Infiltration factors	
Topography: Hilly	0.13
Soil Type: Silty Sand	0.25
Cover: Cultivated	0.1
Total Infiltration Factor	**0.48**

Infiltration (Water Surplus * Infiltration Factor)	**172**	mm/yr
Run-off (Water Surplus - Infiltration)	**186**	mm/yr

Table 3 Approach - Typical Recharge Rates		
Coarse Sand and Gravel	>250	mm/yr
Fine to medium sand	200-250	mm/yr
Silty sand to sandy silt	150-200	mm/yr
Silt	125-150	mm/yr
Clayey Silt	100- 125	mm/yr
Clay	<100	mm/yr

Site development area is underlain predominantly by sand and silty sand with gravel and trace clay.

Based on the above, the recharge rate is typically	200-250	mm/yr

3 Pre-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.07	719
Total Roof Area	0.01	105
Total Landscape Area	1.25	12,478
Total	**1.33**	**13,302**

4 Post-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.41	1,926
Total Roof Area	0.28	389
Total Landscape Area	0.31	9,332
Total	**1.01**	**11,646**

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 1 - Northwest Catchment Water Balance

5 Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	719	637	64	-	573
	Roof Area	105	93	9	-	84
Pervious Areas	Landscape Area	12,478	11,055	6,588	2,144	2,323
	Totals	13,302	11,785	6,661	2,144	2,980
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

6 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	1,926	1,706	171	-	1,536
	Roof Area	389	344	34	-	310
Pervious Areas	Landscape Area	9,332	8,268	4,927	1,604	1,737
	Totals	11,646	10,319	5,132	1,604	3,583
Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.						

7 Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	11,785	6,661	2,144	2,980
Post-Development	10,319	5,132	1,604	3,583
Change in Volume	- 1,467	- 1,529	- 541	603
Change in %	- 12	- 23	- 25	20

8 Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/yr)	2,144
Volume of Post-Development Infiltration (m^3/yr)	1,604
Deficit from Pre to Post Development Infiltration (m^3/yr)	541
Percentage of Roof Runoff required to match the pre-development infiltration (%)	174

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 1 - Primary Catchment Water Balance

1 Climate Information

Precipitation	886	mm/yr
Actual Evapotranspiration	528	mm/yr
Water Surplus	358	mm/yr

2 Infiltration Rates

Table 2 Approach - Infiltration factors	
Topography: Hilly	0.13
Soil Type: Silty Sand	0.25
Cover: Cultivated	0.1
Total Infiltration Factor	**0.48**

Infiltration (Water Surplus * Infiltration Factor)	**172**	mm/yr
Run-off (Water Surplus - Infiltration)	**186**	mm/yr

Table 3 Approach - Typical Recharge Rates		
Coarse Sand and Gravel	>250	mm/yr
Fine to medium sand	200-250	mm/yr
Silty sand to sandy silt	150-200	mm/yr
Silt	125-150	mm/yr
Clayey Silt	100- 125	mm/yr
Clay	<100	mm/yr

Site development area is underlain predominantly by sand and silty sand with gravel and trace clay.

Based on the above, the recharge rate is typically	200-250	mm/yr

3 Pre-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.00	0
Total Roof Area	0.02	225
Total Landscape Area	2.03	20,314
Total	**2.05**	**20,540**

4 Post-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.41	1,894
Total Roof Area	0.28	972
Total Landscape Area	0.31	19,330
Total	**1.01**	**22,195**

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 1 - Primary Catchment Water Balance

5 Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	-	-	-	-	-
	Roof Area	225	199	20	-	180
Pervious Areas	Landscape Area	20,314	17,999	10,726	3,491	3,782
	Totals	20,540	18,198	10,746	3,491	3,961

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

6 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	1,894	1,678	168	-	1,510
	Roof Area	972	861	86	-	775
Pervious Areas	Landscape Area	19,330	17,126	10,206	3,322	3,598
	Totals	22,195	19,665	10,460	3,322	5,883

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

7 Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	18,198	10,746	3,491	3,961
Post-Development	19,665	10,460	3,322	5,883
Change in Volume	1,467	- 286	- 169	1,922
Change in %	8	- 3	- 5	49

8 Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/yr)	3,491
Volume of Post-Development Infiltration (m^3/yr)	3,322
Deficit from Pre to Post Development Infiltration (m^3/yr)	169
Percentage of Roof Runoff required to match the pre-development infiltration (%)	22

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 2 - Northwest Catchment Water Balance

1 Climate Information

Precipitation	886	mm/yr
Actual Evapotranspiration	528	mm/yr
Water Surplus	358	mm/yr

2 Infiltration Rates

Table 2 Approach - Infiltration factors

Topography: Hilly	0.13
Soil Type: Silty Sand	0.25
Cover: Cultivated	0.1
Total Infiltration Factor	**0.48**

Infiltration (Water Surplus * Infiltration Factor)	**172**	mm/yr
Run-off (Water Surplus - Infiltration)	**186**	mm/yr

Table 3 Approach - Typical Recharge Rates

Coarse Sand and Gravel	>250	mm/yr
Fine to medium sand	200-250	mm/yr
Silty sand to sandy silt	150-200	mm/yr
Silt	125-150	mm/yr
Clayey Silt	100- 125	mm/yr
Clay	<100	mm/yr

Site development area is underlain predominantly by sand and silty sand with gravel and trace clay.

Based on the above, the recharge rate is typically	200-250	mm/yr

3 Pre-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.14	1,435
Total Roof Area	0.04	394
Total Landscape Area	0.64	6,382
Total	**0.82**	**8,211**

4 Post-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.41	0
Total Roof Area	0.28	0
Total Landscape Area	0.31	5,894
Total	**1.01**	**5,894**

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 2 - Northwest Catchment Water Balance

5 Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	1,435	1,271	127	-	1,144
	Roof Area	394	349	35	-	314
Pervious Areas	Landscape Area	6,382	5,654	3,370	1,097	1,188
	Totals	8,211	7,275	3,532	1,097	2,647

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

6 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	-	-	-	-	-
	Roof Area	-	-	-	-	-
Pervious Areas	Landscape Area	5,894	5,222	3,112	1,013	1,097
	Totals	5,894	5,222	3,112	1,013	1,097

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

7 Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	7,275	3,532	1,097	2,647
Post-Development	5,222	3,112	1,013	1,097
Change in Volume	- 2,053	- 420	- 84	- 1,549
Change in %	- 28	- 12	- 8	- 59

8 Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/yr)	1,097
Volume of Post-Development Infiltration (m^3/yr)	1,013
Deficit from Pre to Post Development Infiltration (m^3/yr)	84
Percentage of Roof Runoff required to match the pre-development infiltration (%)	N/A (no roof

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 2 - Primary Catchment Water Balance

1 Climate Information

Precipitation	886	mm/yr
Actual Evapotranspiration	528	mm/yr
Water Surplus	358	mm/yr

2 Infiltration Rates

Table 2 Approach - Infiltration factors

Topography: Hilly	0.13
Soil Type: Silty Sand	0.25
Cover: Cultivated	0.1
Total Infiltration Factor	**0.48**

Infiltration (Water Surplus * Infiltration Factor)	**172**	mm/yr
Run-off (Water Surplus - Infiltration)	**186**	mm/yr

Table 3 Approach - Typical Recharge Rates

Coarse Sand and Gravel	>250	mm/yr
Fine to medium sand	200-250	mm/yr
Silty sand to sandy silt	150-200	mm/yr
Silt	125-150	mm/yr
Clayey Silt	100- 125	mm/yr
Clay	<100	mm/yr

Site development area is underlain predominantly by sand and silty sand with gravel and trace clay.

Based on the above, the recharge rate is typically	200-250	mm/yr

3 Pre-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.00	0
Total Roof Area	0.00	0
Total Landscape Area	10.38	103,801
Total	**10.38**	**103,801**

4 Post-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.41	8,023
Total Roof Area	0.28	3,304
Total Landscape Area	0.31	94,791
Total	**1.01**	**106,118**

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 2 - Primary Catchment Water Balance

5 Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	-	-	-	-	-
	Roof Area	-	-	-	-	-
Pervious Areas	Landscape Area	103,801	91,968	54,807	17,837	19,324
	Totals	103,801	91,968	54,807	17,837	19,324

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

6 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	8,023	7,108	711	-	6,397
	Roof Area	3,304	2,928	293	-	2,635
Pervious Areas	Landscape Area	94,791	83,985	50,050	16,289	17,646
	Totals	106,118	94,021	51,053	16,289	26,679

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

7 Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	91,968	54,807	17,837	19,324
Post-Development	94,021	51,053	16,289	26,679
Change in Volume	2,053	- 3,754	- 1,548	7,355
Change in %	2	- 7	- 9	38

8 Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/yr)	17,837
Volume of Post-Development Infiltration (m^3/yr)	16,289
Deficit from Pre to Post Development Infiltration (m^3/yr)	1,548
Percentage of Roof Runoff required to match the pre-development infiltration (%)	59

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 1 - Combined Water Balance

1 Climate Information

Precipitation	886	mm/yr
Actual Evapotranspiration	528	mm/yr
Water Surplus	358	mm/yr

2 Infiltration Rates

Table 2 Approach - Infiltration factors	
Topography: Hilly	0.13
Soil Type: Silty Sand	0.25
Cover: Cultivated	0.1
Total Infiltration Factor	**0.48**

Infiltration (Water Surplus * Infiltration Factor)	**172**	mm/yr
Run-off (Water Surplus - Infiltration)	**186**	mm/yr

Table 3 Approach - Typical Recharge Rates		
Coarse Sand and Gravel	>250	mm/yr
Fine to medium sand	200-250	mm/yr
Silty sand to sandy silt	150-200	mm/yr
Silt	125-150	mm/yr
Clayey Silt	100- 125	mm/yr
Clay	<100	mm/yr

Site development area is underlain predominantly by sand and silty sand with gravel and trace clay.

Based on the above, the recharge rate is typically	200-250	mm/yr

3 Pre-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.07	719
Total Roof Area	0.03	330
Total Landscape Area	3.28	32,792
Total	**3.38**	**33,841**

4 Post-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.41	3,820
Total Roof Area	0.28	1,361
Total Landscape Area	0.31	28,661
Total	**1.01**	**33,841**

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 1 - Combined Water Balance

5 Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	719	637	64	-	573
	Roof Area	330	292	29	-	263
Pervious Areas	Landscape Area	32,792	29,054	17,314	5,635	6,105
	Totals	33,841	29,983	17,407	5,635	6,941

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

6 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	3,820	3,384	338	-	3,046
	Roof Area	1,361	1,206	121	-	1,085
Pervious Areas	Landscape Area	28,661	25,394	15,133	4,925	5,336
	Totals	33,841	29,983	15,592	4,925	9,466

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

7 Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	29,983	17,407	5,635	6,941
Post-Development	29,983	15,592	4,925	9,466
Change in Volume	-	- 1,815	- 710	2,525
Change in %	-	- 10	- 13	36

8 Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/yr)	5,635
Volume of Post-Development Infiltration (m^3/yr)	4,925
Deficit from Pre to Post Development Infiltration (m^3/yr)	710
Percentage of Roof Runoff required to match the pre-development infiltration (%)	65

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 2 - Combined Water Balance

1 Climate Information

Precipitation	886	mm/yr
Actual Evapotranspiration	528	mm/yr
Water Surplus	358	mm/yr

2 Infiltration Rates

Table 2 Approach - Infiltration factors	
Topography: Hilly	0.13
Soil Type: Silty Sand	0.25
Cover: Cultivated	0.1
Total Infiltration Factor	**0.48**

Infiltration (Water Surplus * Infiltration Factor)	**172**	mm/yr
Run-off (Water Surplus - Infiltration)	**186**	mm/yr

Table 3 Approach - Typical Recharge Rates		
Coarse Sand and Gravel	>250	mm/yr
Fine to medium sand	200-250	mm/yr
Silty sand to sandy silt	150-200	mm/yr
Silt	125-150	mm/yr
Clayey Silt	100- 125	mm/yr
Clay	<100	mm/yr

Site development area is underlain predominantly by sand and silty sand with gravel and trace clay.

Based on the above, the recharge rate is typically	200-250	mm/yr

3 Pre-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.14	1,435
Total Roof Area	0.04	394
Total Landscape Area	11.02	110,183
Total	**11.20**	**112,012**

4 Post-Development Property Statistics	**ha**	**m^2**
Total Paved Area	0.41	8,023
Total Roof Area	0.28	3,304
Total Landscape Area	0.31	100,685
Total	**1.01**	**112,012**

Pre- and Post-Development Water Balance Calculations

309 Zephyr Drive, Zephyr, ON

Phase 2 - Combined Water Balance

5 Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	1,435	1,271	127	-	1,144
	Roof Area	394	349	35	-	314
Pervious Areas	Landscape Area	110,183	97,622	58,177	18,934	20,512
	Totals	112,012	99,243	58,339	18,934	21,970

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

6 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	8,023	7,108	711	-	6,397
	Roof Area	3,304	2,928	293	-	2,635
Pervious Areas	Landscape Area	100,685	89,207	53,162	17,302	18,744
	Totals	112,012	99,243	54,165	17,302	27,776

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

7 Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	99,243	58,339	18,934	21,970
Post-Development	99,243	54,165	17,302	27,776
Change in Volume	-	- 4,173	- 1,632	5,806
Change in %	-	- 7	- 9	26

8 Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/yr)	18,934
Volume of Post-Development Infiltration (m^3/yr)	17,302
Deficit from Pre to Post Development Infiltration (m^3/yr)	1,632
Percentage of Roof Runoff required to match the pre-development infiltration (%)	62