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February 7, 2024
File: 161413338

**Attention: Leah Lefler**
City of Guelph
Infrastructure, Development and Enterprise Services - Planning and Building Services
1 Carden Street
Guelph, ON N1H 3A1

Dear Leah,

**Reference: Revised Water Balance Calculations in Response to First and Second Submission Comments, Draft Plan Application - 220 Arkell Road, City of Guelph, Ontario (Third Submission)**

## 1.0 BACKGROUND

Stantec Consulting Limited (Stantec) prepared a Hydrogeological Assessment report (Stantec, 2019a[1]) on behalf of Rockpoint Properties Inc. for the lands located at 220 Arkell Road in the City of Guelph, Ontario (the Site) (Figure 1) in support of a Draft Plan Application. As a part of the assessment, a pre- and post-development water balance was completed for the Site. As provided in the City of Guelph's first submission comments memo dated November 10, 2020[2] and titled *220 Arkell Road Draft Plan of Subdivision and Zoning By-law Amendment Application*, Comment No. 67 states the following:

***Comment No. 67*** *– Monthly Water Balance calculations have been completed based on three subcatchments (A, B, and C). Pre-development conditions are compared to post-development conditions within these catchments on a monthly basis. This analysis does not enable a comparison of pre- to post-development conditions as the site, under pre-development conditions, has a drainage divide, with approximately 2/3rds drainage going to the wetland and 1/3 going to the woodland on the property to the east. To enable a proper assessment of impacts to wetland hydrology, compare post-development to pre-development conditions for the portion of the subject property located within the wetland's catchment.*

To address this previously mentioned comment, Stantec revised the monthly pre- to post-development water balance calculations to account for this drainage divide, utilizing the same Thornthwaite and Mather (1955[3]) methodology to perform the analysis as described in Stantec (2019a).

Based on the City's review of the second submission for this document, the City provided additional commentary on the water balance assessment, specifically Comment No.4 in their internal memo dated

[1] Stantec Consulting Limited. 2019a. Hydrogeological Assessment, 220 Arkell Road, Guelph, ON. May 28, 2019.
[2] City of Guelph Infrastructure, Development and Enterprise Services, Planning and Building Services. 2020. Internal Memo Re: 220 Arkell Road Draft Plan of Subdivision and Zoning By-law Amendment Application, November 10, 2020.
[3] Thornthwaite, C.W. and Mather, J.W. 1955. The water balance. Philadelphia, PA: Drexel Institute of Technology, Climatological Laboratory Publication No.8.

June 28, 2023[4] and titled *220 Arkell Road Draft Plan of Subdivision and Zoning By-law Amendment Application – 2nd Submission*:

***Comment No. 4*** *– The water balance prepared for the proposed development shows a 6,075 m3/yr increase in runoff directed to the Torrance Creek PSW. Hydrographs submitted in support of the water balance and EIS Addendum indicate a near tripling of runoff volume directed toward the wetland during summer months when swamps typically dry up. Trees that are located in a swamp are adapted to specific wetland hydroperiod. Changes to the hydroperiod of a wetland, such as a consistent increase in the monthly volume of runoff directed to a wetland, may result in negative impacts (e.g., death / dieback of trees located near SWM outlets).*

*a) Opportunities to reduce runoff directed to the wetland should be explored, including exploring the feasibility of maintaining the pre-construction volume of runoff directed via sheet flow toward the woodland located on the adjacent property to the east.*

To address this previously mentioned comment, Stantec performed additional revisions to the water balance calculations to achieve a further reduction in the projected runoff volume directed into the Torrance Creek Swamp from the proposed development under the post-development condition.

Figures and tables referenced in this letter report are presented in Attachments 1 and 2, respectively.

## 2.0 GROUNDWATER MONITORING NETWORK

### 2.1 SITE MONITORING WELLS

To better delineate high groundwater conditions throughout the Site, Stantec coordinated the installation of additional monitoring wells to complement the existing four monitoring wells (i.e., BH01-17 to BH04-17) constructed as part of the previous geotechnical investigation (Stantec, 2017[5]). Between March 10 and 11, 2022, Aardvark Drilling Inc. advanced a total of six boreholes in those areas of the Site where the construction of post-development infiltration facilities (e.g., infiltration galleries) are anticipated, with these boreholes being drilled to depths ranging from 6.1 to 9.4 m below ground surface (BGS) and each borehole being equipped with a single monitoring well (i.e., MW101-22 to MW106-22). Adhering to construction requirements outlined under Ontario Regulation 903 (O. Reg. 903) (MOE, 1990[6]), each monitoring well is constructed of 50 mm inside diameter, Schedule 40 polyvinyl chloride (PVC) pipe, having a No. 10 slot screen (0.01-inch slot) measuring 3.0 m in length. The backfilling of the screened interval consisted of silica sand to a height of approximately 0.3 m above the top of screen, followed by granular bentonite to ground surface to prevent a hydraulic connection from occurring between the screened formation and overlying soils. The completion of each monitoring well involved encasing the pipe stick-up within a lockable steel casing. The locations of the on-Site monitoring wells are presented on Figure 1.

[4] City of Guelph Infrastructure, Development and Enterprise Services, Planning and Building Services. 2023. Internal Memo Re: 220 Arkell Road Draft Plan of Subdivision and Zoning By-law Amendment Application – 2nd Submission, June 8, 2023.
[5] Stantec Consulting Ltd. (Stantec), 2017. Draft Report, Geotechnical Investigation, 220 Arkell Road Residential Site, Guelph, Ontario. October 23, 2017.
[6] Ministry of the Environment, Conservation and Parks (MECP) (formerly Ministry of the Environment). 1990. Wells. Regulation under the Ontario Water Resources Act. Regulation 903 of the Revised Regulations of Ontario, 1990.

**Reference:** **Revised Water Balance Calculations in Response to First and Second Submission Comments, Draft Plan Application - 220 Arkell Road, City of Guelph, Ontario (Third Submission)**

Following installation, Stantec personal developed and equipped each monitoring well with a Solinst® Levelogger®, which have been collecting continuous groundwater elevation measurements across the Site since April 2022. Data recorded by the Leveloggers installed in MW101-22 to MW106-22 for the period covering from March to November 2022 is presented on the hydrographs shown on Figure 2. Hydrographs presenting historical groundwater monitoring data collected from BH01-17 to BH04-17 (i.e., April 2017 to May 2018) together with data collected from March to November 2022 (except for BH01-17 and BH03-17, which are damaged / inaccessible) is shown on Figure 3. Groundwater elevation fluctuations at these previously mentioned wells are continuing to be collected and will be utilized by Stantec to assist with the designing of the post-development infiltration infrastructure as part of the detail design phases of the development.

### 2.2 WETLAND PIEZOMETERS

To better understand the pre-development hydroperiod for the portion of Torrance Creek Swamp that directly lies to the southwest of the Site, Stantec established a transect of three drive-point piezometers downgradient of the future outlet of the proposed stormwater management facility (SWMF) (i.e., DP101-22 to DP103-22) (Figure 4). These drive-point piezometers are designed to track the hydroperiod of the wetland following construction of the SWMF and assist in evaluating whether post-development stormwater discharge to the wetland could affect the long-term form and function of the wetland ecosystem. Following a walkthrough of the wetland by Stantec on April 1, 2022, the drive-point piezometers were installed in two topographically low areas where standing water was observed (i.e., DP101-22 and DP103-22) and in an area of higher ground containing no standing water (i.e., DP102-22).

Each drive-point piezometer is constructed of a 0.42 m long steel screen (19 mm diameter) that is connected to 25 mm diameter steel riser pipes. Stantec drove the drive-point piezometers into the substrate using a fence post driver. Following installation, Stantec developed and suspended a Solinst® Levelogger® in the pipe of each drive-point piezometer to continuously record groundwater elevation fluctuations. Concurrently, a Levelogger was secured to the exterior and at the base of each drive-point piezometer (i.e., pressure transducer resting upright upon the ground surface) to record depths of standing surface water. Data recorded by the Leveloggers installed in DP101-22 to DP103-22 for the period covering from May 25 to November 10, 2022, is presented on the hydrographs shown on Figure 5. Groundwater and surface water elevation fluctuations continue to be monitored at these drive-point piezometers at the issuing of this report.

## 3.0 WATER BALANCE ANALYSIS RESULTS

### 3.1 PRE-DEVELOPMENT

The pre-development water balance for the Site was split into two separate analyses to reflect the surface water divide that characterizes the property. Catchment 106 is analyzed as one land unit given that surface water runoff from this catchment is interpreted to flow in a south to southwest direction towards the Torrance Creek Swamp (Figure 1). Also included in the water balance calculations for Catchment 106 are Catchments 208-1 and 208-2, which are associated with the adjacent Arkell Meadows Subdivision to the south where runoff from these lands drain and flow into Torrance Creek Swamp. Similarly, Catchment 110 is analyzed as a separate land unit as surface water runoff is interpreted to flow in a north to northeast direction across this catchment towards an off-Site woodlot (Figure 1).

**Reference:** **Revised Water Balance Calculations in Response to First and Second Submission Comments, Draft Plan Application - 220 Arkell Road, City of Guelph, Ontario (Third Submission)**

The Site was broken down into a series of sub-areas based on topographic, soil type, and land cover characteristics. Figure 1 shows the distribution of the sub-areas used in the pre-development water balance analysis. As presented in Tables 1 and 2 (Attachment 2), the overall infiltration factor (IF) for a sub-area represents the sum of infiltration factors assigned to each of the sub-area characteristics (i.e., topography, soil type, land use) based on published values presented by the MECP (2003[7]). The IF is then multiplied against the water surplus (WS) calculated for a given sub-area to provide a calculated value of infiltration (INF). The sum of all sub-area INF volumes associated with each catchment then represents the overall annual pre-development infiltration volume for that catchment.

Topographic conditions across the Site are deemed to be rolling to hilly based on calculated slopes ranging from 0.5% to 15%, with the high point situated in the center of the Site (coinciding with the drainage divide). The two main soil types that characterize the Site include glaciofluvial sand and gravel or stone-poor, silty to sandy till (i.e., Port Stanley Till). Land cover throughout the Site based on the Ecological Land Classification (ELC) mapping prepared by Stantec (2019b[8]) consists of pasture/shrub lands and urban lawn (associated with the on-Site residence). Based on these parameters, infiltration factors ranged from 0.45 to 0.70 in the sub-areas (where a value of 1.00 indicates that the full WS volume infiltrates).

The Guelph Arboretum climate station provided long-term monthly average (1971-2000) air temperature and precipitation data for use in the water balance analysis. Located approximately five kilometers to the northwest of the Site, the assumption is that the monthly average precipitation and air temperatures recorded at the station is reflective of the precipitation and air temperature fluctuation trends that have historically occurred at the Site.

### 3.1.1 Surface Water Flows Westward to Torrance Creek Swamp

Based on the previously mentioned water balance components, the annual volume of infiltration occurring in Catchments 106, 208-1, and 208-2 (Figure 1) under the pre-development condition is calculated to be 10,246 $m^3$, equating to a rate of 225 mm/year (Table 1). This calculated infiltration rate falls within the range of infiltration rates reported for fine to medium sand by the MECP (1995[9]) and is considered an acceptable representation of the soils that form the subsurface of the Site. The annual volume of pre-development runoff is calculated at 8,706 $m^3$, equating to a rate of 191 mm/year (Table 1). A summary of the pre-development water balance components for Catchments 106, 208-1, and 208-2 is provided below.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pre-Development Infiltration (INF)** | 10,246 | $m^3$/yr | 225 | mm/yr | 0.3 | L/s |
| **Pre-Development Runoff (R)** | 8,706 | $m^3$/yr | 191 | mm/yr | 0.3 | L/s |
| **Pre-Development Evapotranspiration (ET)** | 23,098 | $m^3$/yr | 507 | mm/yr | 0.7 | L/s |
| **Total = INF + R + ET** | 42,050 | $m^3$/yr | 923 | mm/yr | 1.3 | L/s |
| **Precipitation** | 42,050 | $m^3$/yr | 923 | mm/yr | 1.3 | L/s |

[7] (MECP) Ministry of the Environment, Conservation and Parks (formerly Ministry of the Environment). 2003. Stormwater Management Planning and Design Manual. March 2003.
[8] Stantec Consulting Limited. 2019b. 220 Arkell Road - Guelph, ON, Environmental Impact Study. August 28, 2019.
[9] Ministry of Environment and Energy. 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

**Reference:** **Revised Water Balance Calculations in Response to First and Second Submission Comments, Draft Plan Application - 220 Arkell Road, City of Guelph, Ontario (Third Submission)**

As shown in Figure 4, infiltration occurring within Catchment 106 that recharges the groundwater system will flow to the south and southwest towards Torrance Creek Swamp. As documented in Appendix D of Stantec (2019a), downward vertical hydraulic gradients are mapped as occurring beneath Torrance Creek Swamp, which suggests that this wetland is a groundwater recharge feature.

### 3.1.2 Surface Water Flows Eastward to Off-Site Woodlot

Based on the previously mentioned water balance components, the annual volume of infiltration occurring in Catchment 110 (Figure 1) under the pre-development condition is calculated to be 5,294 m$^3$, equating to a rate of 214 mm/year (Table 2). The annual volume of pre-development runoff is calculated to be 4,035 m$^3$, equating to a rate of 163 mm/year (Table 1). A summary of the pre-development water balance components for Catchment 110 is provided below.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pre-Development Infiltration (INF)** | 5,294 | m$^3$/yr | 214 | mm/yr | 0.2 | L/s |
| **Pre-Development Runoff (R)** | 4,035 | m$^3$/yr | 163 | mm/yr | 0.1 | L/s |
| **Pre-Development Evapotranspiration (ET)** | 13,463 | m$^3$/yr | 545 | mm/yr | 0.4 | L/s |
| **Total = INF + R + ET** | 22,793 | m$^3$/yr | 923 | mm/yr | 0.7 | L/s |
| **Precipitation** | 22,793 | m$^3$/yr | 923 | mm/yr | 0.7 | L/s |

As shown in Figure 4, infiltration occurring in Catchment 110 that recharges the groundwater system is also interpreted to flow to the south and southwest towards Torrance Creek Swamp.

### 3.1.3 Site Infiltration

As previously mentioned, infiltration occurring across the Site under the pre-development condition (regardless of which surface water catchment that this infiltration occurs) that recharges the groundwater system is interpreted to flow to the south and southwest towards Torrance Creek Swamp. As such, the annual volume of infiltration occurring throughout the Site under the pre-development condition is 15,540 m$^3$ (i.e., 10,246 m$^3$ from Catchments 106, 208-1, and 208-2 (Section 3.1.1) + 5,294 m$^3$ from Catchment 110 (Section 3.1.2)), for an equivalent recharge rate of 221 mm/year.

## 3.2 POST-DEVELOPMENT (UNMITIGATED)

The projected post-development catchments for the Site are presented in Figure 6 and new sub-areas were derived accordingly based on topographic, soil type and land cover characteristics. For the analysis, the distribution of surficial soils found under the pre-development condition is assumed to remain relatively unchanged under the post-development condition, with the topography becoming less hilly and transitioning to predominantly rolling (due to grading) and the land cover becoming more representative of developed area having varying degrees of impervious surfaces (e.g., rooftops, concrete/asphalt roadways, and walkways) and urban vegetation cover (e.g., urban lawns). Under the post-development condition, a larger proportion of the Site (i.e., Catchment 200) will drain to the southwest and into the SWM facility (i.e., to Catchment 203), with this water then being slowly discharged to the Torrance Creek Swamp. Runoff occurring in Catchments 202, 204, 205-1/205-2, 206, 207A/B, and 209 (and off-Site Catchments 208-1 and 208-2) will flow overland and directly into the wetland (i.e., will not pass through the SWM facility). For Catchment 201A/B, runoff occurring in this portion of the Site will be directed northward towards the off-Site woodlot.

**Reference:** **Revised Water Balance Calculations in Response to First and Second Submission Comments, Draft Plan Application - 220 Arkell Road, City of Guelph, Ontario (Third Submission)**

Stantec has assumed that all infiltration occurring in the remaining pervious areas of the Site under the post-development condition that recharges the groundwater system will flow to the south and southwest towards Torrance Creek Swamp.

### 3.2.1 Surface Water Flows Westward to Torrance Creek Swamp

Based on the previously mentioned water balance components, the annual volume of infiltration occurring in combined Catchments 200, 202 to 204, 205-1/205-2, 206, 207A/B, 208-1/208-2, and 209 (Figure 6) under the post-development condition is calculated to be 8,937 m$^3$, equating to a rate of 152 mm/year (Table 3). The annual volume of surface water runoff projected to occur under the post-development condition in these combined catchments is 25,111 m$^3$ (427 mm/year) (Table 3). Overall, an infiltration deficit of 1,309 m$^3$ (i.e., from 10,246 m$^3$ to 8,937 m$^3$) is projected to occur in the previously mentioned catchment areas, with surface water runoff volumes increasing by 16,404 m$^3$ (i.e., from 8,706 m$^3$ to 25,111 m$^3$) in this same area (which will be directed to the Torrance Creek Swamp) from the pre- to post-development condition. A summary of the post-development water balance components for the flows moving towards Torrance Creek Swamp is provided below.

| **SUMMARY - WITH NO INFILTRATION AUGMENTATION / MITIGATION MEASURES** | | | | | | |
|---|---|---|---|---|---|---|
| **Post-Development Infiltration (INF)** | 8,937 | m$^3$/yr | 152 | mm/yr | 0.3 | L/s |
| **Post-Development Runoff (R)** | 25,111 | m$^3$/yr | 427 | mm/yr | 0.8 | L/s |
| **Post-Development Evapotranspiration (ET)** | 20,181 | m$^3$/yr | 344 | mm/yr | 0.6 | L/s |
| **Total = INF + R + ET** | 54,229 | m$^3$/yr | 923 | mm/yr | 1.7 | L/s |
| **Precipitation** | 54,229 | m$^3$/yr | 923 | mm/yr | 1.7 | L/s |

| | | |
|---|---|---|
| **Pre-Development Infiltration** | 10,246 | m$^3$/yr |
| **Infiltration Deficit** | **-1,309** | **m$^3$/yr** |
| **Pre-Development Runoff** | 8,706 | m$^3$/yr |
| **Runoff Surplus** | **16,404** | **m$^3$/yr** |

### 3.2.2 Surface Water Flows Eastward to Off-Site Woodlot

For Catchments 201A and 201B (Figure 6), the post-development annual volume of infiltration and surface water runoff occurring in these catchments is estimated at 2,743 m$^3$ (240 mm/year) and 1,590 m$^3$ (139 mm/year), respectively (Table 4). These volumes represent a 2,551 m$^3$ and 2,445 m$^3$ reduction in infiltration and surface water runoff volumes associated with the catchment areas that direct water to the off-Site woodlot to the northeast under the pre-development condition (i.e., Catchment 110). A summary of the post-development water balance components for the surface water flows moving east to the off-Site woodlot is provided below.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Post-Development Infiltration (INF)** | 2,743 | m$^3$/yr | 240 | mm/yr | 0.1 | L/s |
| **Post-Development Runoff (R)** | 1,590 | m$^3$/yr | 139 | mm/yr | 0.1 | L/s |
| **Post-Development Evapotranspiration (ET)** | 6,233 | m$^3$/yr | 544 | mm/yr | 0.2 | L/s |
| **Total = INF + R + ET** | 10,566 | m$^3$/yr | 923 | mm/yr | 0.3 | L/s |
| **Precipitation** | 10,566 | m$^3$/yr | 923 | mm/yr | 0.3 | L/s |

| | | |
|---|---|---|
| **Pre-Development Infiltration** | 5,294 | m$^3$/yr |
| **Infiltration Deficit** | **-2,551** | **m$^3$/yr** |
| **Pre-Development Runoff** | 4,035 | m$^3$/yr |
| **Runoff Deficit** | **-2,445** | **m$^3$/yr** |

### 3.2.3 Site Infiltration

All infiltration occurring across the Site that reaches the groundwater table as recharge under the post-development condition (whether occurring in the surface water catchment areas that direct runoff west towards Torrance Creek Swamp or east towards the off-site woodlot) will flow to the south and southwest through the groundwater system towards Torrance Creek Swamp. The combined total annual infiltration that occurs throughout the Site is calculated to be 11,680 $m^3$ (i.e., 8,937 $m^3$ from Catchments 200, 202 to 204, 205-1/205-2, 206, 207A/B, 208-1/208-2, and 209 (Section 3.2.1) + 2,743 $m^3$ from Catchment 201A/B (Section 3.2.2)), which will result in an annual infiltration deficit of 3,680 $m^3$ under the post-development condition (i.e., 11,680 $m^3$ - 15,540 $m^3$ [10,246 $m^3$ + 5,294 $m^3$] = 3,860 $m^3$).

## 3.3 POST-DEVELOPMENT (MITIGATED)

As shown in the above post-development scenario where no infiltration measures are in place, the Site will produce a large annual runoff surplus to Torrance Creek Swamp (i.e., 16,404 $m^3$) together with an overall infiltration deficit across the property (i.e., 3,860 $m^3$). Based on the results of the Geotechnical Investigation (Stantec 2019c[10]), the Site soils generally consist of a mix of glacial till to sand, which are both typically conducive to infiltration practices. The estimated infiltration rate for these soils ranges from 10 mm/hour to 28 mm/hour (Stantec, 2024a[11]), noting that these values are based on in-situ soil permeability testing conducted across the Site by Stantec using protocols presented in Appendix C of the Credit Valley Conservation (CVC) and Toronto and Region Conservation (TRCA) (2010[12]) *Low Impact Stormwater Management Planning and Design Guideline*. Since the Site soils appear to be conducive for infiltration, infiltration galleries are proposed throughout the Site at both lot level and end-of-pipe locations to mitigate the previously mentioned post-development infiltration deficit.

Infiltration galleries receiving rooftop runoff will be designed to infiltrate 25 mm precipitation events from the single-family lots and multi-residential block. In reviewing the proposed grading design in relation to the observed high groundwater elevations, Stantec estimates that using approximately 1.2 m of cover over a 0.5 m deep stone infiltration gallery will allow rooftop galleries to be constructed on each single-family lot (proposed gallery locations shown on Drawing C-100, Attachment 1). Although the location of the multi-residential block may change throughout the Site Plan process, the current location of this block was checked to determine the feasibility of accepting rooftop infiltration, with Stantec concluding that rooftop areas can be directed to this centralized infiltration gallery to infiltrate the 25 mm precipitation event. Similar to the single-family lots, the multi-residential block gallery is designed (i.e., 0.5 m height) to provide greater than 1.0 m of separation from the seasonal high groundwater elevation. The rooftop galleries proposed in the multi-residential block will be equipped with overflow pipes to permit overflow discharge to the local storm sewer system and/or adjacent open space lands if the galleries become full during a rain event.

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[10] Stantec Consulting Ltd. 2019c. Geotechnical Investigation Report, 220 Arkell Road Residential Site, Guelph, Ontario. June 11, 2019.
[11] Stantec Consulting Ltd. 2024a. Infiltration Testing Results in Response to Second Submission Comments and in Support of Third Draft Plan Submission – 220 Arkell Road, City of Guelph, Ontario. February 6, 2024.
[12] Credit Valley Conservation - Toronto and Region Conservation Authority (CVC-TRCA), 2010. Low Impact Development Stormwater Management Planning and Design Guide – Version 1.0.

**Reference:** **Revised Water Balance Calculations in Response to First and Second Submission Comments, Draft Plan Application - 220 Arkell Road, City of Guelph, Ontario (Third Submission)**

End-of-pipe (EOP) infiltration is also proposed for the on-Site stormwater management facility (SWMF) (i.e., Catchment 203) via an infiltration cell. The infiltration cell in the SWMF is sized to infiltrate the remaining 25 mm runoff volume from the Site after accounting for rooftop infiltration (i.e., runoff not being captured by the rooftops; that is, other on-Site impervious surfaces such as roadways and sidewalks).

The elevation of the infiltration cell for the SWMF will be 335.00 m above mean sea level (AMSL), which based on the seasonal high groundwater level recorded at MW106-22 of 333.69 m AMSL achieves a separation of 1.31 m between the base of the cell and high groundwater table. Based on the groundwater contours shown on Figure 4 and on the profile of the SWMF shown on Drawing C-410 (Attachment 1), groundwater levels increase moving from west to east away from the Torrance Creek Swamp. At the far east corner of the SWMF, there is a small portion of the facility that has slightly less than 1.0 m of separation to the high groundwater level with a distance of approximately 0.9 m. As most of the SWMF achieves greater than 1.0 m of separation from the high groundwater table, this small area on the eastern side is not a concern. This area of less than 1.0 m of separation will only occur temporarily during the spring and, subsequently, will not impact the overall infiltration function of the SWMF. Details on the infiltration system are included on Drawing C-410, with further details and discussion on the SWMF infiltration design found in Stantec (2024b[13]).

### 3.3.1 Surface Water Flows Westward to Torrance Creek Swamp

As discussed in Section 3.2.1, the annual unmitigated infiltration deficit for the catchment areas draining to the Torrance Creek Swamp (i.e., Catchments 200, 202 to 204, 205-1/205-2, 206, 207A/B, 208-1/208-2, and 209; Figure 3) is calculated at 1,309 m$^3$, with surface water runoff volumes increasing to 16,404 m$^3$ from the pre- to post-development condition (Table 3). With the implementation of the post-development infiltration augmentation measures discussed above (i.e., rooftop runoff from the single-family lots plus the multi-residential block directed to on-Site infiltration galleries, together with other impervious and pervious surface runoff directed to EOP infiltration SWMF), an additional 22,702 m$^3$ of stormwater will be annually returned to the subsurface across the Site (i.e., reducing the unmitigated runoff annual volume of 25,111 m$^3$ [Section 3.2.1] to a mitigated runoff volume of 11,346 m$^3$). Consequently, this additional infiltration will reduce the post-development annual runoff surplus to the Torrance Creek Swamp to **2,640 m$^3$** (i.e., 11,346 m$^3$ - 8,660 m$^3$). As shown in Figure 7, the greatest monthly runoff surpluses will occur during the winter/spring when the EOP infiltration will be offline, with the lowest runoff surpluses occurring in the late fall.

| **SUMMARY - WITH INFILTRATION AUGMENTATION / MITIGATION MEASURES** | | | | | | |
|---|---|---|---|---|---|---|
| **Post-Development Infiltration (INF)** | 22,702 | m$^3$/yr | 386 | mm/yr | 0.7 | L/s |
| **Post-Development Runoff (R)** | 11,346 | m$^3$/yr | 193 | mm/yr | 0.4 | L/s |
| **Post-Development Evapotranspiration (ET)** | 20,181 | m$^3$/yr | 344 | mm/yr | 0.6 | L/s |
| **Total = INF + R + ET** | 54,229 | m$^3$/yr | 923 | mm/yr | 1.7 | L/s |
| **Precipitation** | 54,229 | m$^3$/yr | 923 | mm/yr | 1.7 | L/s |

| | | |
|---|---|---|
| **Pre-Development Infiltration** | 10,246 | m$^3$/yr |
| **Infiltration Surplus** | **12,455** | **m$^3$/yr** |
| **Pre-Development Runoff** | 8,706 | m$^3$/yr |
| **Runoff Surplus** | **2,640** | **m$^3$/yr** |

[13] Stantec Consulting Limited. 2024b. 220 Arkell Road, Guelph, Revised Preliminary Servicing, Grading and Stormwater Management Report, Addendum No.1 – Section 5.0 Stormwater Management. February 2024.

**Reference: Revised Water Balance Calculations in Response to First and Second Submission Comments, Draft Plan Application - 220 Arkell Road, City of Guelph, Ontario (Third Submission)**

To assess the potential effects of the runoff surplus on the downstream system, an assessment of the potential increase in ponding depth within the Torrance Creek Swamp due to the maximum monthly surplus volume of runoff being discharged to this wetland was approximated. As shown on Figure 8, based on topographic contour data obtained from the GRCA (2021[14]), the portion of the Torrance Creek Swamp basin located downstream of the Site is relatively flat over a 24.3 hectare (ha) area (i.e., basin perimeter as defined by the 332.5 m AMSL contour) prior to discharging to a more defined and continuous watercourse downstream (i.e., Torrance Creek). Using the maximum monthly runoff surplus of 546 $m^3$ entering the Torrance Creek Swamp from the Site (greatest monthly surplus observed from pre- to post-development; that is, in August, Figure 7), this volume of discharge would result in surface water levels in the previously mentioned basin increasing by less than 3 mm (0.003 m). This rise in the surface water level also assumes that no infiltration is occurring in the wetland; however, this is a conservative assumption given that annual infiltration rates beneath the wetland are reported to range from 92 mm to 345 mm (Figure 9). In addition, although post-development runoff will be directed to the Torrance Creek Swamp during those months when runoff under the pre-development condition is low to absent (e.g., May to October), the groundwater table is typically at its lowest elevations during these months. Preliminary monitoring results from the wetland drive-point piezometers located downstream of the future SWMF outlet (Figure 1) support this assertion as surface water ponding has been absent with groundwater levels remaining below the wetland substrate (Figure 5). As such, the assumption is reasonable that any ponding of this runoff during these months (i.e., when the vegetation is not dormant) will be limited as infiltration will not be impeded by a high groundwater table beneath the wetland. Subsequently, this influx of post-development runoff to the wetland is not expected to detrimentally impact the long-term ecological form of this feature.

### 3.3.2 Surface Water Flows Eastward to Off-Site Woodlot

Since post-development infiltration augmentation measures are only proposed for construction in the catchments flowing westward towards the Torrance Creek Swamp, the water balance calculations for flows eastward to the woodlot remain unchanged from the unmitigated scenario as presented in Section 3.2.2.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Post-Development Infiltration (INF)** | 2,743 | $m^3$/yr | 240 | mm/yr | 0.1 | L/s |
| **Post-Development Runoff (R)** | 1,590 | $m^3$/yr | 139 | mm/yr | 0.1 | L/s |
| **Post-Development Evapotranspiration (ET)** | 6,233 | $m^3$/yr | 544 | mm/yr | 0.2 | L/s |
| **Total = INF + R + ET** | 10,566 | $m^3$/yr | 923 | mm/yr | 0.3 | L/s |
| **Precipitation** | 10,566 | $m^3$/yr | 923 | mm/yr | 0.3 | L/s |

| | | |
|---|---|---|
| **Pre-Development Infiltration** | 5,294 | $m^3$/yr |
| **Infiltration Deficit** | **-2,551** | **$m^3$/yr** |
| **Pre-Development Runoff** | 4,035 | $m^3$/yr |
| **Runoff Deficit** | **-2,445** | **$m^3$/yr** |

[14] Grand River Conservation Authority. 2021. Grand River Information Network (GRIN) - https://data.grandriver.ca/

### 3.3.3 Site Infiltration

All infiltration occurring across the Site that reaches the groundwater table as recharge under the post-development condition (whether occurring within that surface water catchment areas that direct runoff west towards Torrance Creek Swamp or east towards the off-site woodlot) will flow to the south and southwest through the groundwater system towards Torrance Creek Swamp. Under the post-development scenario where infiltration augmentation measures are employed, the combined total annual infiltration that will occur throughout the Site is calculated to be 25,445 $m^3$ (i.e., 22,702 $m^3$ from Catchments 200, 202 to 204, 205-1/205-2, 206, 207A/B, 208-1/208-2, and 209 (Section 3.3.1) + 2,743 $m^3$ from Catchment 201A/B (Section 3.2.2)), which will result in an annual infiltration surplus of 9,905 $m^3$ at the Site under the post-development condition (i.e., 25,445 $m^3$ - 15,540 $m^3$ [10,246 $m^3$ + 5,294 $m^3$] = 9,905 $m^3$).

## 4.0 CONCLUSIONS

Based on the material presented in this letter report, the following conclusions are provided:

1) Proposed on-Site infiltration augmentation measures will enhance groundwater recharge and reduce excess surface water runoff being discharged to the Torrance Creek Swamp. The proposed measures include rooftop infiltration galleries on all single-family lots and the multi-residential block units, which are sized for the 25 mm storm event and will receive rooftop runoff, as well as a SWMF end-of-pipe infiltration feature sized for the remaining 25 mm of runoff volume (from other on-Site impervious and pervious surfaces).

2) Lot level infiltration galleries throughout the Site have been designed to maintain greater than or equal to one meter of separation from seasonal high groundwater levels. The EOP infiltration basin also achieves greater than 1.0 m of separation from the seasonal high groundwater level.

3) The Site is projected to experience an annual infiltration volume surplus of 9,905 $m^3$ from the pre- to post-development condition, with annual runoff volumes to Torrance Creek Swamp increasing by 2,640 $m^3$ (from 8,706 $m^3$ to 11,346 $m^3$). Runoff volumes being directed northward to the off-Site woodlot will decrease by 2,445 $m^3$ (from 4,035 $m^3$ to 1,590 $m^3$).

4) The increase in post-development runoff discharged to the Torrance Creek Swamp is expected to raise surface water ponding within the wetland by no more than 0.003 m (3 mm) for a given month. This ponding is also expected to be temporary (i.e., not cumulative from month to month) as the Torrance Creek Swamp is identified to be a groundwater recharge feature (i.e., the runoff entering the wetland is expected to be infiltrated during those months when runoff under the pre-development condition is low to absent (e.g., May to October)). Preliminary monitoring results from the wetland drive-point piezometers located downstream of the future SWMF outlet (Figure 1) support this assertion as surface water ponding has been absent with groundwater levels remaining below the wetland substrate (Figure 5). As such, the assumption is reasonable that any ponding of this runoff during these months (i.e., when the vegetation is not dormant) will be limited as infiltration will not be impeded by a high groundwater table beneath the wetland.

**Reference: Revised Water Balance Calculations in Response to First and Second Submission Comments, Draft Plan Application - 220 Arkell Road, City of Guelph, Ontario (Third Submission)**

Regards,

**Stantec Consulting Ltd.**

Digitally signed by Whitehead, Grant
Date: 2024.02.07 15:44:54 -05'00'

PROFESSIONAL GEOSCIENTIST
LIMITED MEMBER
GRANT S. WHITEHEAD
1774
ONTARIO

Digitally signed by Weersink, Bryan
Date: 2024.02.07 16:10:53 -05'00'

**Grant Whitehead** MES, P.Geo. (Limited)
Senior Hydrogeologist
Mobile: (519) 502-8933
grant.whitehead@stantec.com

**Bryan Weersink** P.Eng.
Water Resources Engineer
Mobile: (519) 831-6554
bryan.weersink@stantec.com

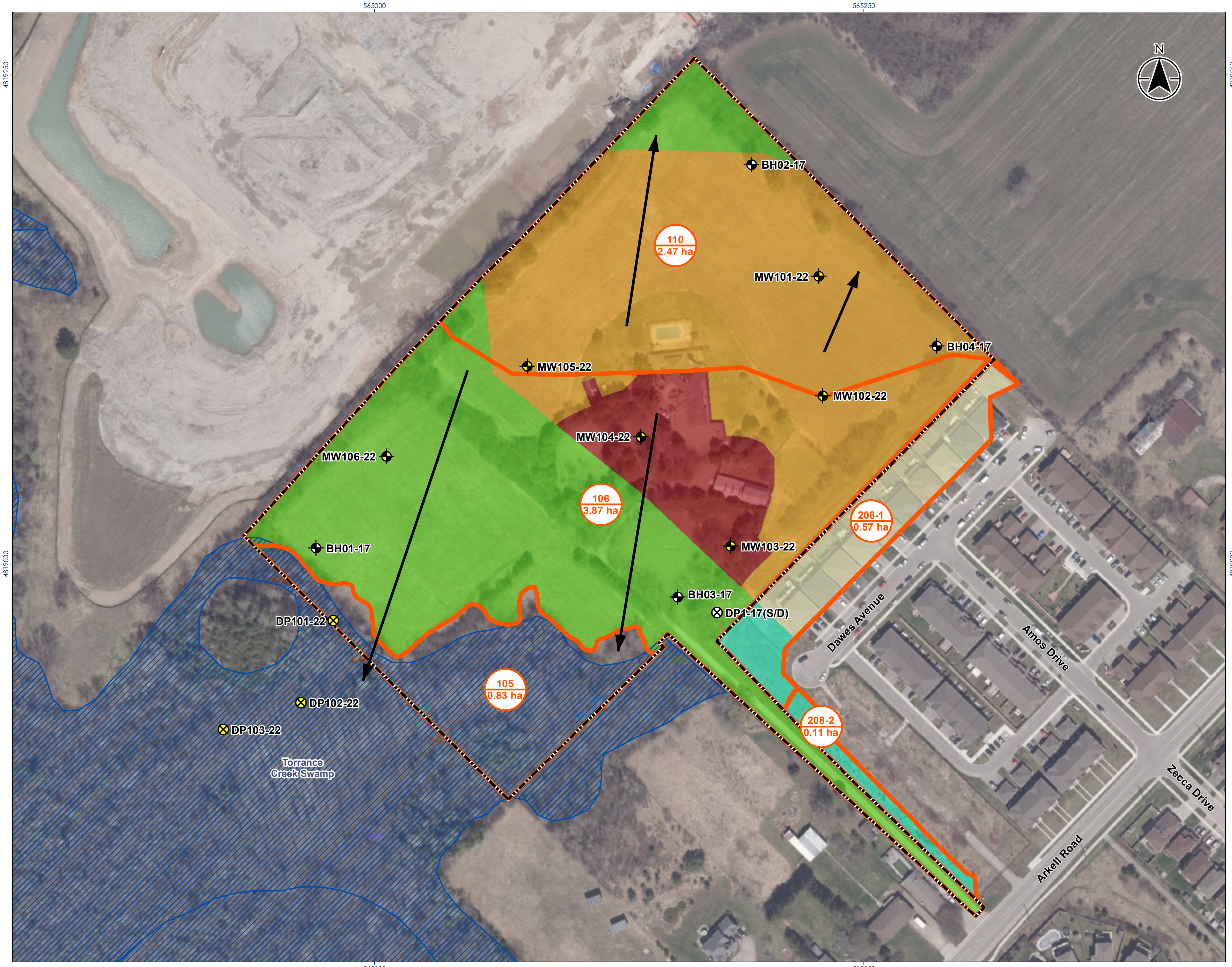
Attachment: Attachment 1: Figures
- Figure 1 - Pre-Development Water Balance
- Figure 2 - Hydrographs – MW101-22 to MW106-22
- Figure 3 - Hydrographs – BH01-17 to BH04-17 and DP1-17(S/D)
- Figure 4 - Groundwater Flow – March 2022
- Figure 5 – Hydrographs – DP101-22 to DP103-22
- Figure 6 - Post-Development Water Balance
- Figure 7 - Hydrograph – Monthly Pre- and Post-Development Runoff Flows Westward to Torrance Creek Swamp
- Figure 8 - Torrance Creek Swamp - Runoff Receiving Basin
- Figure 9 - Annual Recharge Rates (GRCA)
- Drawing C-100: Conceptual Servicing Plan
- Drawing C-410: Stormwater Management Facility Drawing

Attachment 2: Tables
- Table 1 – Pre-Development Monthly Water Balance Calculations – Lands Draining Westward to Torrance Creek Swamp
- Table 2 – Pre-Development Monthly Water Balance Calculations – Lands Draining Eastward to Woodlot
- Table 3 – Post-Development Monthly Water Balance Calculations – Lands Draining Westward to Torrance Creek Swamp
- Table 4 – Post-Development Monthly Water Balance Calculations – Lands Draining Eastward to Woodlot

c. Kevin Brousseau, Stantec Consulting Ltd.

wg \\cd1004-f01\01609\active\161413338\planning\report\hydrogeology\water_balance_memo\ver.3\ltr_20240406_220.arkell_water.balance_161423338_final_3rd.submission.docx

# Attachments A Figures




Stantec

Legend
- Site Boundary
- Monitoring Well (Stantec, 2022)
- Monitoring Well (Stantec, 2017)
- Drive-Point Piezometer (Stantec, 2022)
- Drive-Point Piezometer (Stantec, 2017)
- Overland Flow Direction
- Wetland - Evaluated (Provincial)
- Stormwater Catchment (Existing Conditions)

**Water Balance Sub-Areas**
- Sub-Area A - Rolling to Hilly, Silty Sand to Sand Till, Pasture and Shrubs, No Impervious Cover
- Sub-Area B - Rolling to Hilly, Silty Sand to Sand Till, Urban Lawn, No Impervious Cover
- Sub-Area C - Rolling to Hilly, Sand, Pasture and Shrubs, No Impervious Cover
- Sub-Area F - Rolling, Silty Sand to Sand Till, Urban Lawn, 40% Impervious
- Sub-Area G - Rolling, Sand, Urban Lawn, 40% Impervious

0 50 100 metres
1:2,000 (At original document size of 11x17)

**Notes**
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
3. Topographic contours presented on site as surveyed by Stantec (2017). Topographic data beyond the site boundaries should be considered approximate and for illustrative purposes only.
4. Orthoimagery © First Base Solutions, 2021. Imagery flown in 2020.

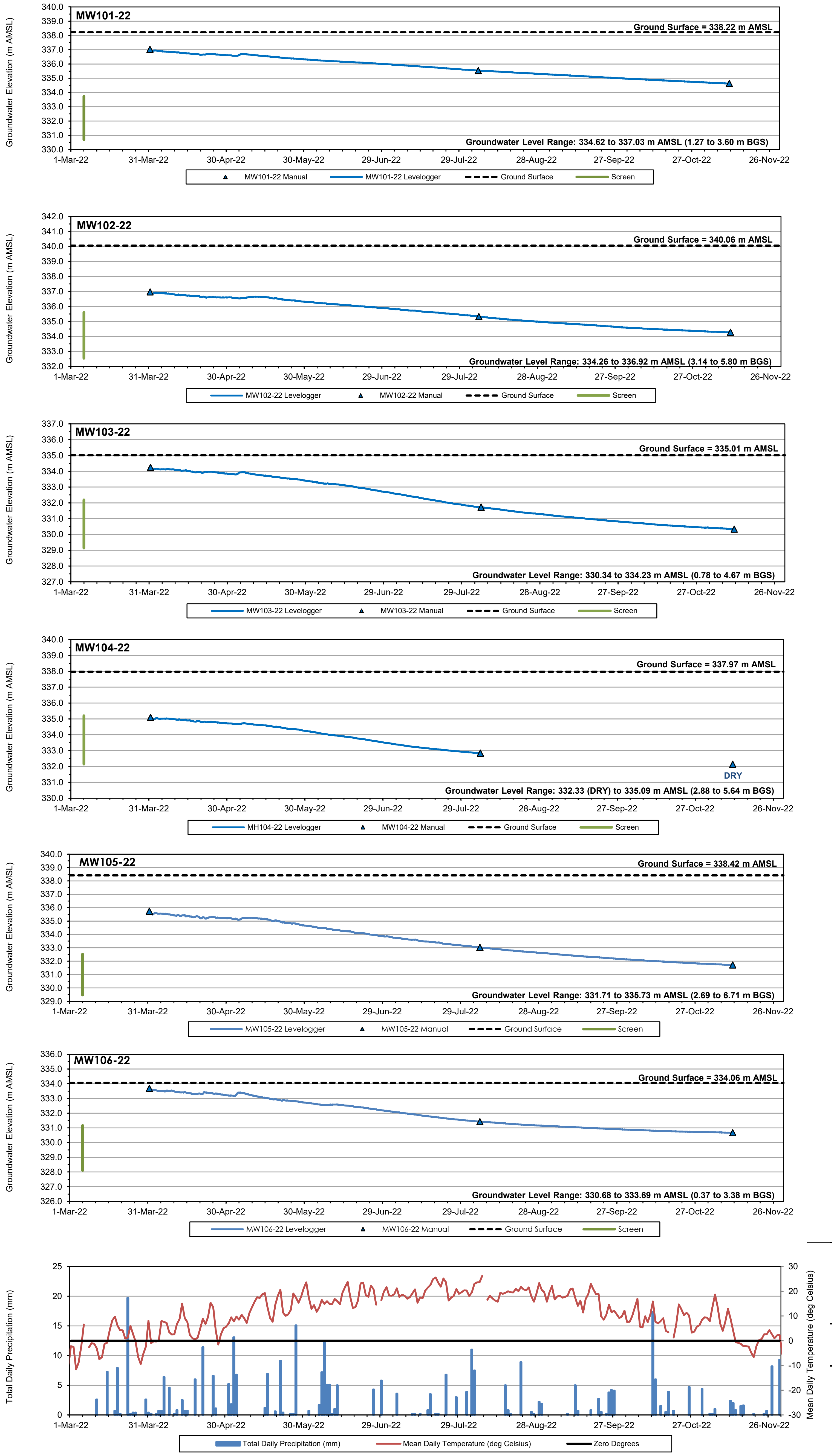

Project Location
Guelph, Ontario

161423338 REVA
Prepared by PRM on 2024-01-29
Technical Review by GW on 2024-01-29

Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
1

Title
**Pre-Development Water Balance**



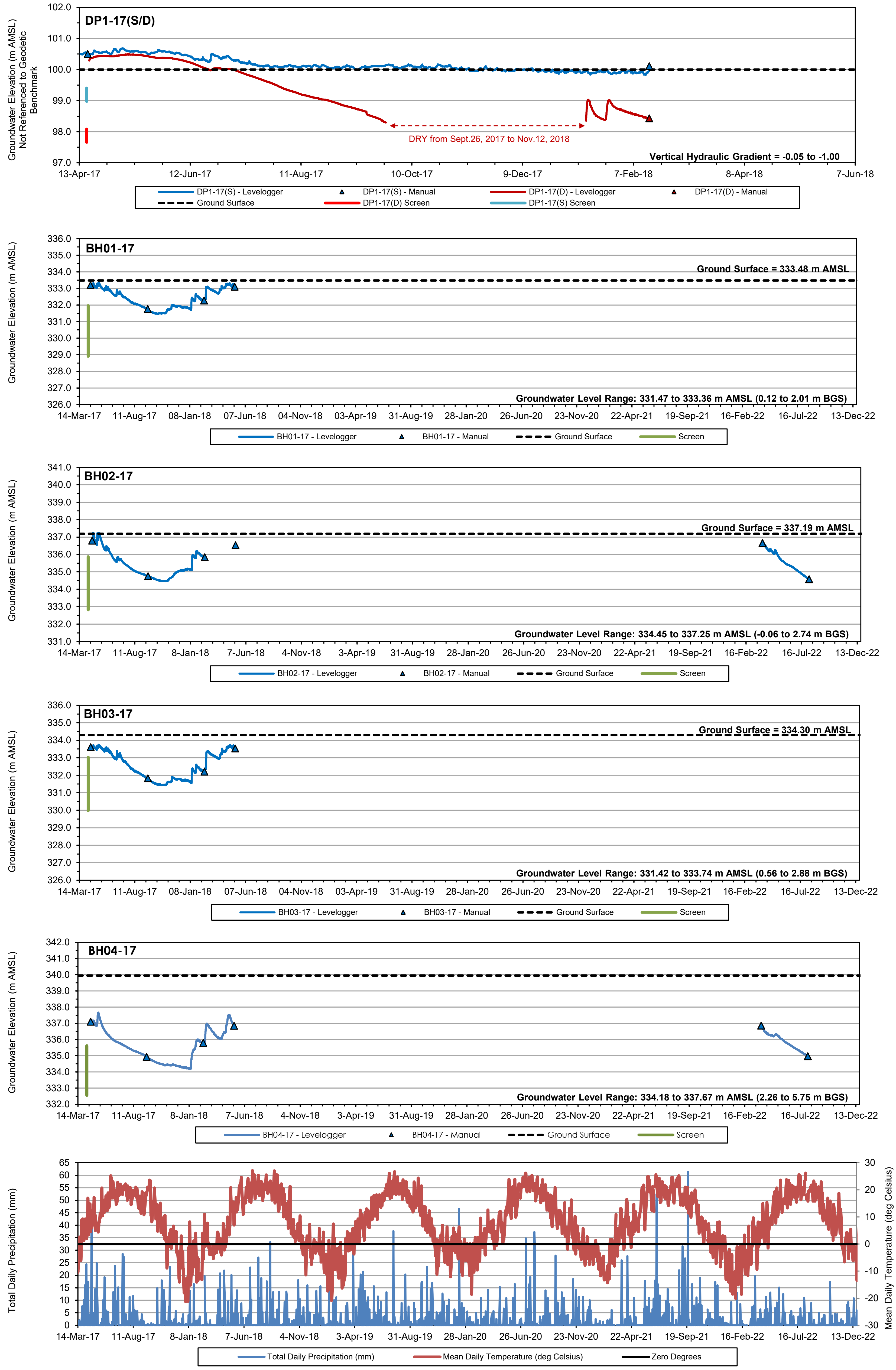

Client/Project

ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.

**2**

Title **HYDROGRAPHS**
**MW101-22 to MW106-22**




Client/Project

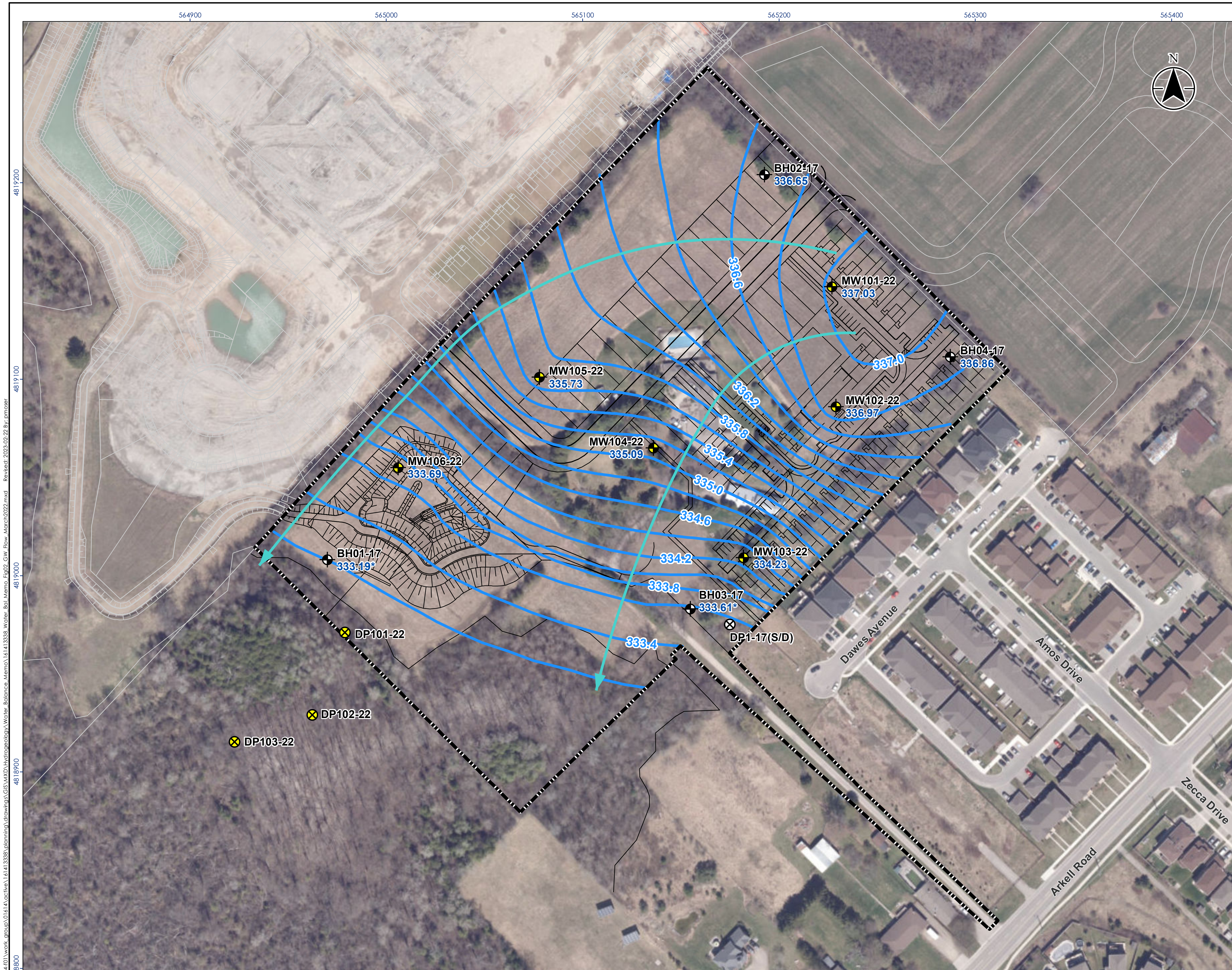
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.

**3**

Title **HYDROGRAPHS**
**BH01-17 to BH04-17 and DP1-17(S/D)**

Stantec




**Stantec**

- Site Boundary
- Monitoring Well (Stantec, 2022)
- Monitoring Well (Stantec, 2017)
- Drive-Point Piezometer (Stantec, 2022)
- Drive-Point Piezometer (Stantec, 2017)
- 337.10 Groundwater Elevation (mAMSL)
- * Groundwater Elevation (April, 2017)
- Proposed Subdivision
- Groundwater Contour (mAMSL)
- Interpreted Direction of Groundwater Flow

0 50 100 metres

1:2,000 (At original document size of 11x17)

**Notes**

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
3. Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
4. * - Groundwater Elevation (April 2017)

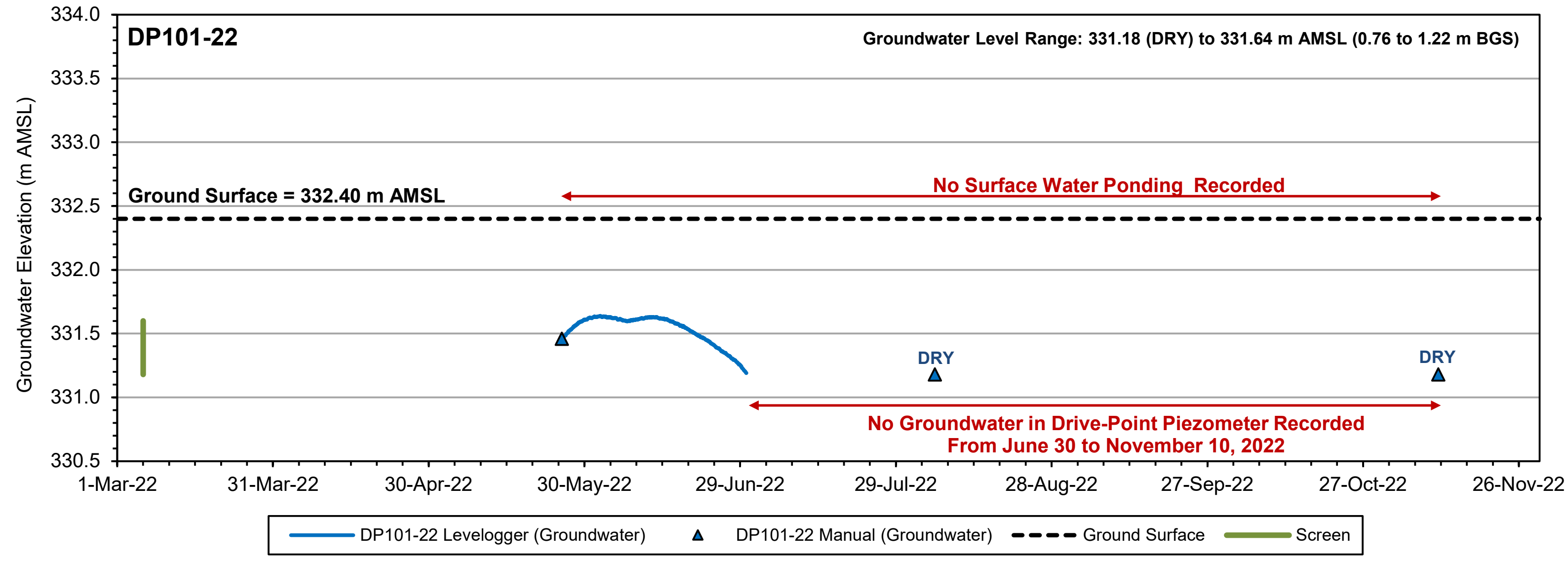

Project Location
Guelph, Ontario

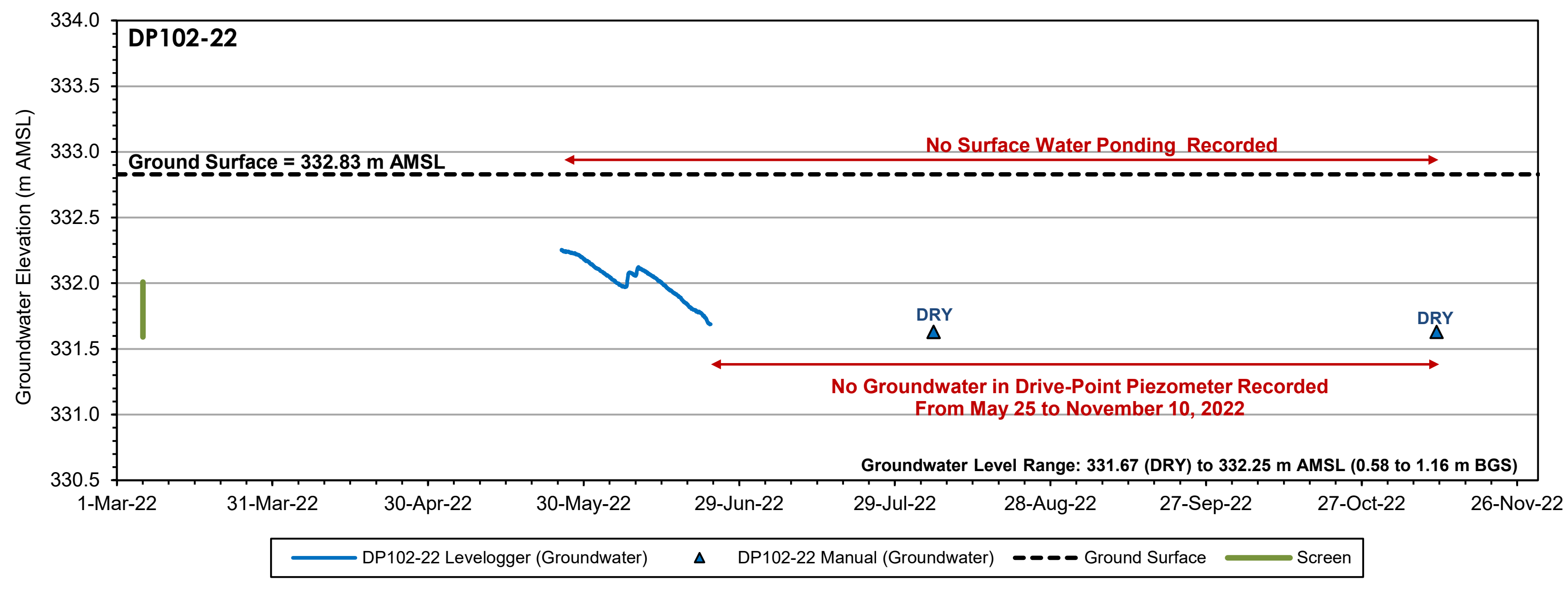
161413338 REVA
Prepared by PRM on 2023-02-22
Technical Review by GW on 2023-02-22

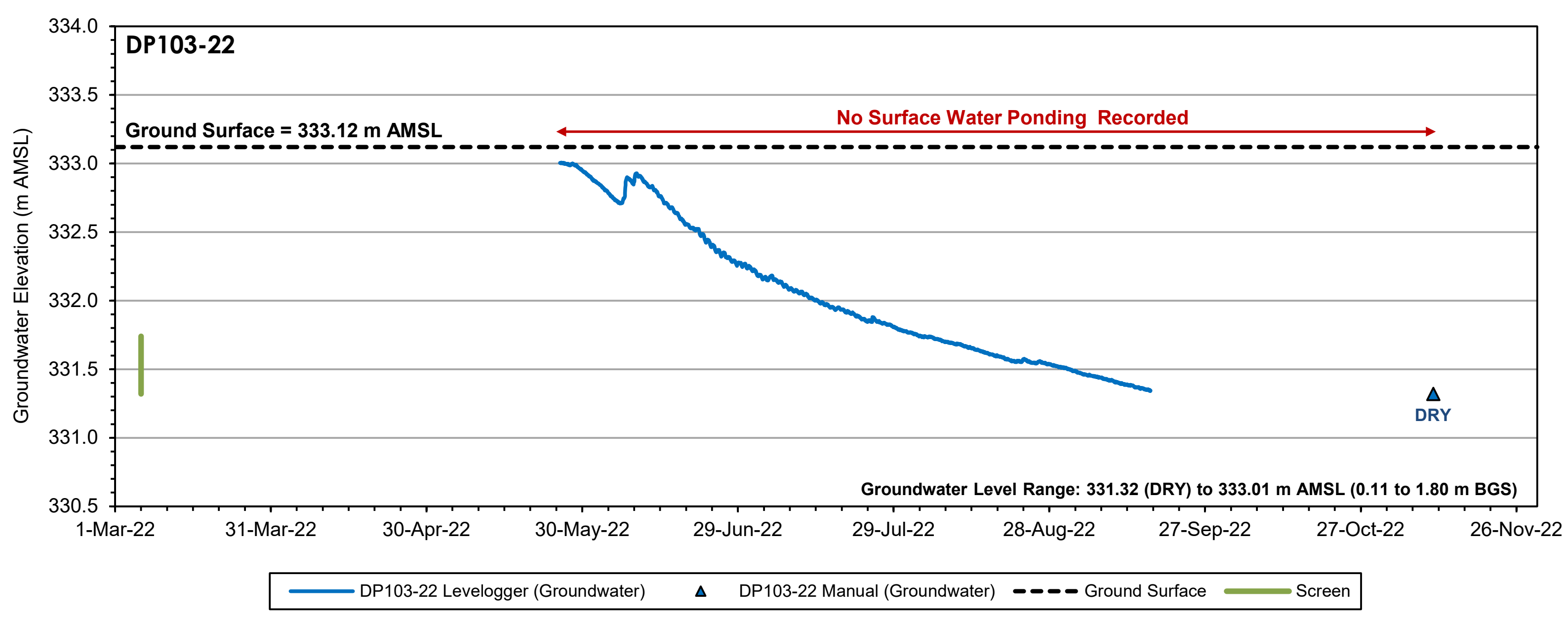
Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

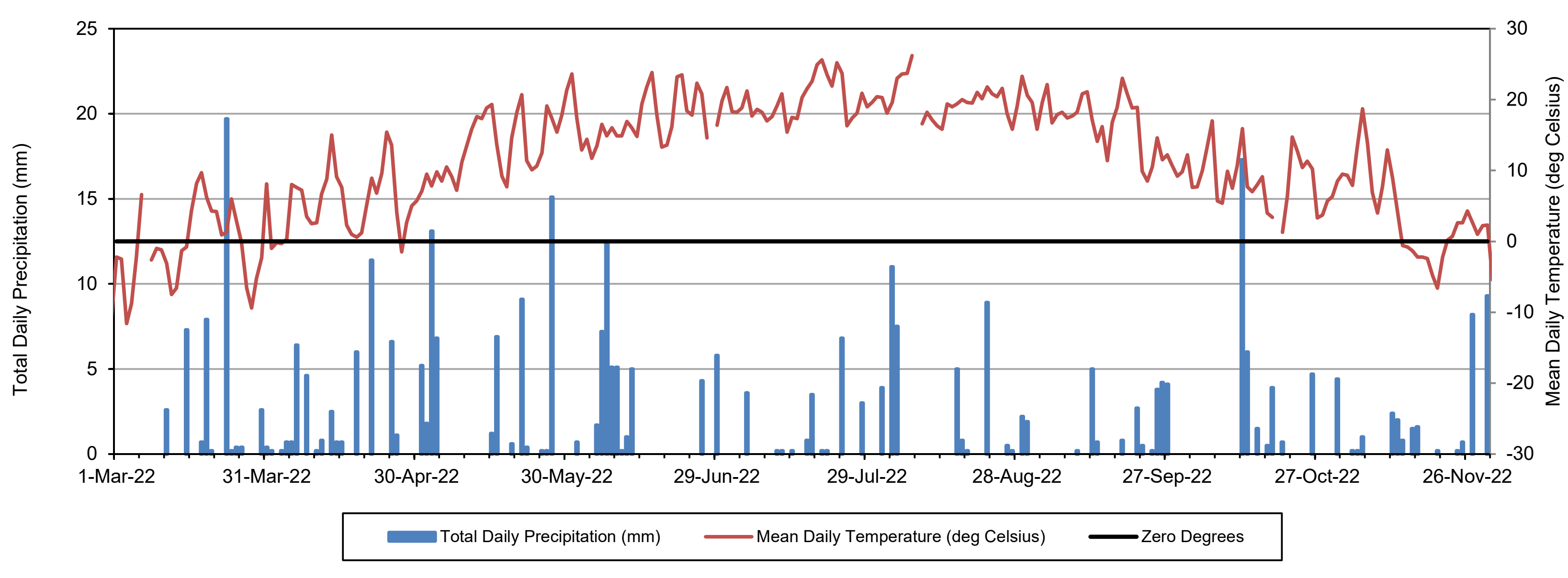
Figure No.
**4**

Title
**Groundwater Flow - March 2022**

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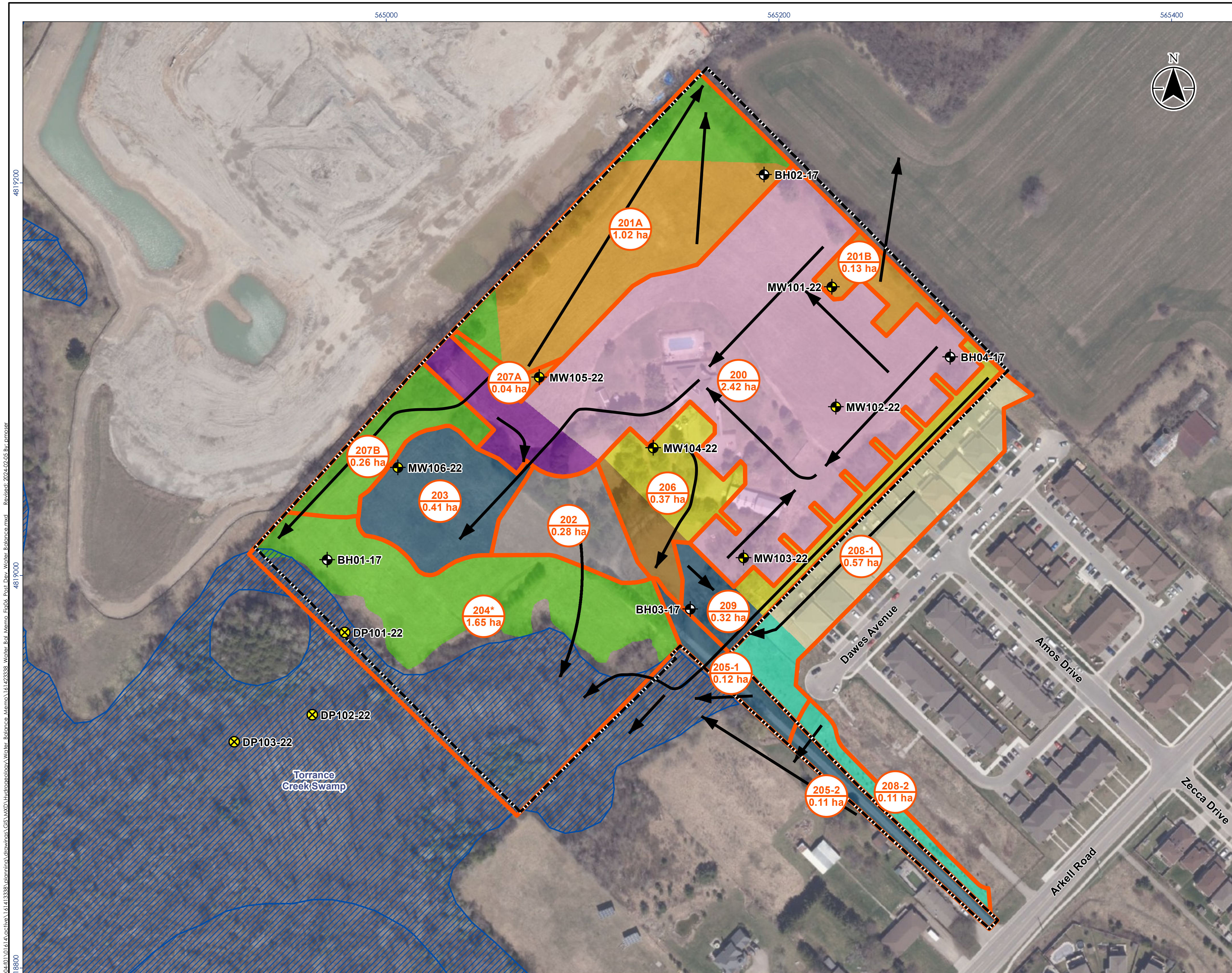
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.

**5**

Title

**HYDROGRAPHS**
**DP101-22 to DP103-22**




Stantec

Legend

- Site Boundary
- Monitoring Well (Stantec, 2022)
- Monitoring Well (Stantec, 2017)
- Drive-Point Piezometer (Stantec, 2022)
- Drive-Point Piezometer (Stantec, 2017)
- Overland Flow Direction
- Wetland - Evaluated (Provincial)
- Stormwater Catchment (Proposed Conditions)

**Water Balance Sub-Areas**

- Sub-Area A - Rolling, Silty Sand to Sand Till, Pasture and Shrubs, No Impervious Cover
- Sub-Area C - Rolling, Sand, Pasture and Shrubs, No Impervious Cover
- Sub-Area D - Rolling, Silty Sand to Sand Till, Urban Lawn, 65% Impervious
- Sub-Area E - Rolling, Sand, Urban Lawn, 65% Impervious
- Sub-Area F - Rolling, Silty Sand to Sand Till, Urban Lawn, 40% Impervious
- Sub-Area G - Rolling, Sand, Urban Lawn, 40% Impervious
- Sub-Area H - Rolling, Sand, Pasture and Shrubs, 15% Impervious
- Sub-Area I - Rolling, Silty Sand to Sand Till, Urban Lawn, 25% Impervious Cover
- Sub-Area J - Rolling, Sand, Urban Lawn, 25% Impervious Cover
- Sub-Area K - Rolling, Sand, Urban Lawn, 10% Impervious Cover

0 50 100 metres

1:2,000 (At original document size of 11x17)

**Notes**

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
3. Topographic contours presented on site as surveyed by Stantec (2017). Topographic data beyond the site boundaries should be considered approximate and for illustrative purposes only.
4. Orthoimagery © First Base Solutions, 2021. Imagery flown in 2020.
5. (*) Note that only the area of Sub-Area C in Catchment 204 is included in the

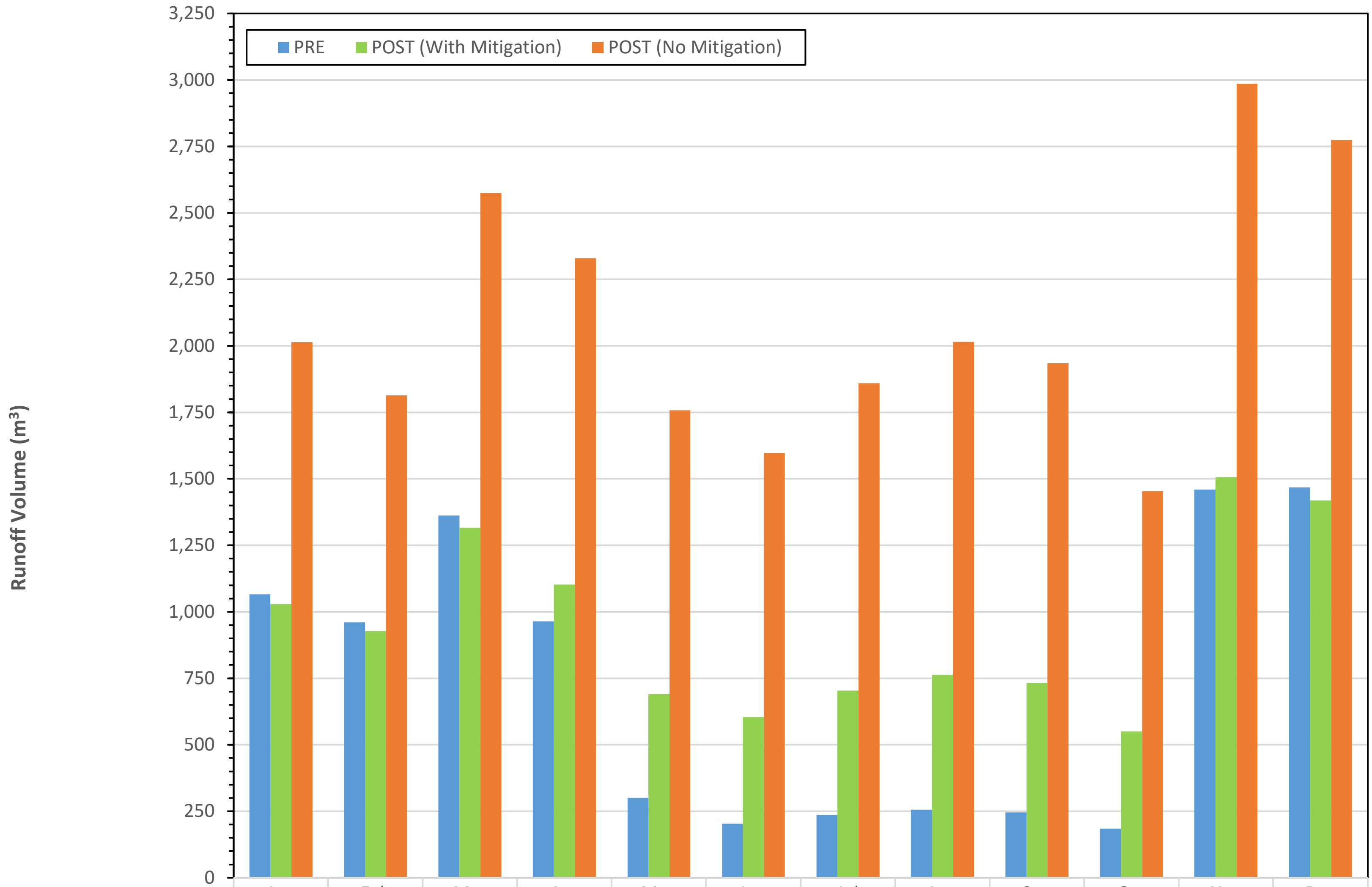
Project Location
Guelph, Ontario

161423338 REVA
Prepared by PRM on 2024-02-05
Technical Review by GW on 2024-02-05

Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
6

Title
**Post-Development Water Balance**



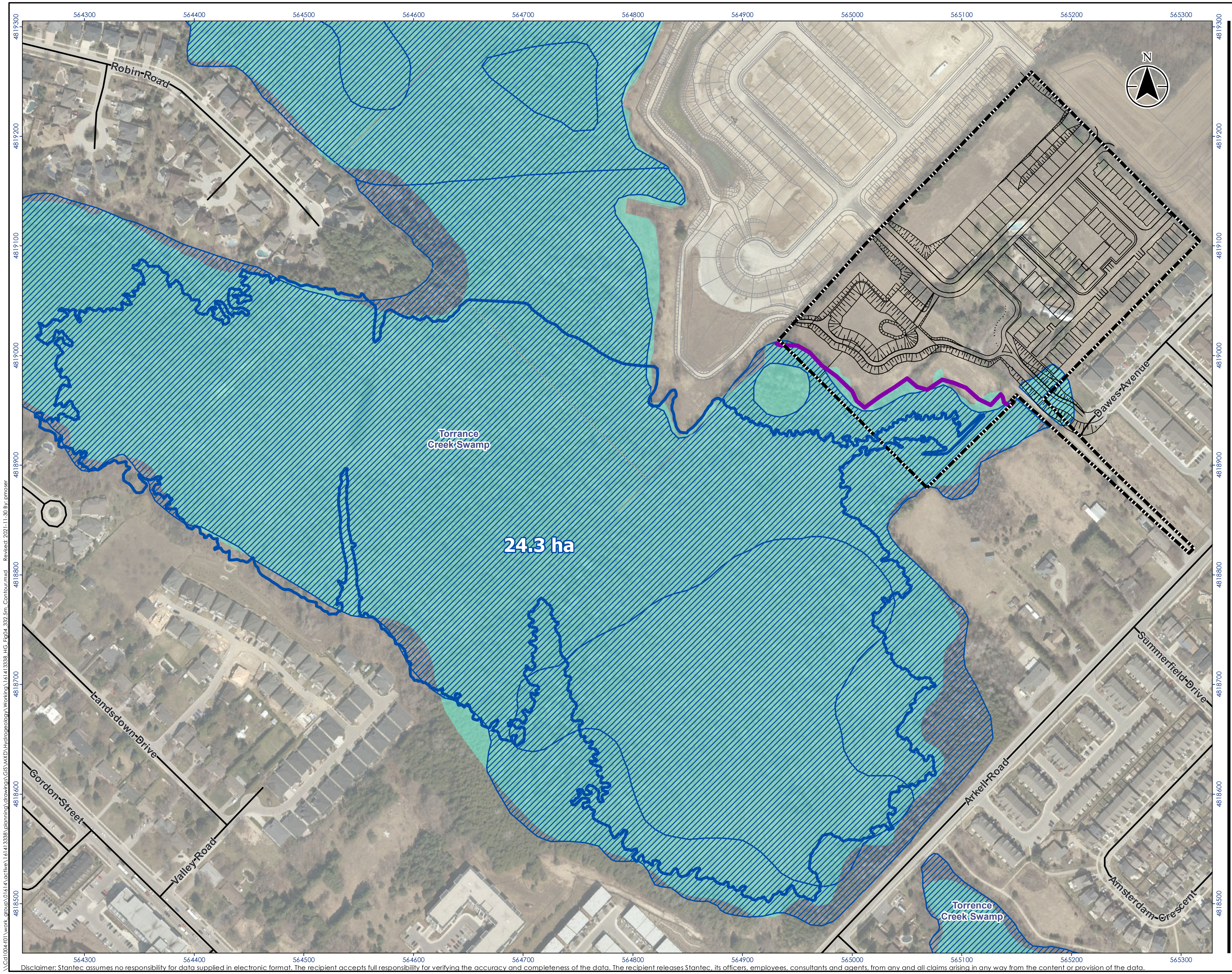

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRE | 1,066 | 960 | 1,362 | 965 | 300 | 203 | 236 | 256 | 246 | 185 | 1,460 | 1,468 |
| POST (With Mitigation) | 1,030 | 928 | 1,316 | 1,103 | 691 | 604 | 704 | 763 | 732 | 550 | 1,507 | 1,419 |
| POST (No Mitigation) | 2,014 | 1,814 | 2,575 | 2,330 | 1,758 | 1,597 | 1,859 | 2,015 | 1,935 | 1,454 | 2,986 | 2,775 |

Stantec

Project: HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure: **7**

Title: **Hydrograph - Monthly Pre- and Post-Development Runoff Flows Westward to Torrance Creek Swamp**

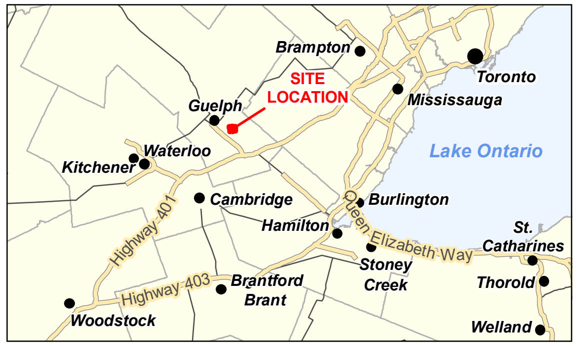



**Stantec**

- Site Boundary
- Proposed Subdivision
- Topographic Contour (5 meter Interval)
- Topographic Contour (1 meter Interval)
- Wetland Boundary (Stantec, June 2017)
- Wetland - Evaluated (Provincial)
- Wetland Boundary (GRCA)
- 332.5m Contour

0 50 100 metres
1:3,500 (At original document size of 11x17)

**Notes**
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2017.
3. Imagery © Firstbase Solutions 2021, Imagery date 2021.



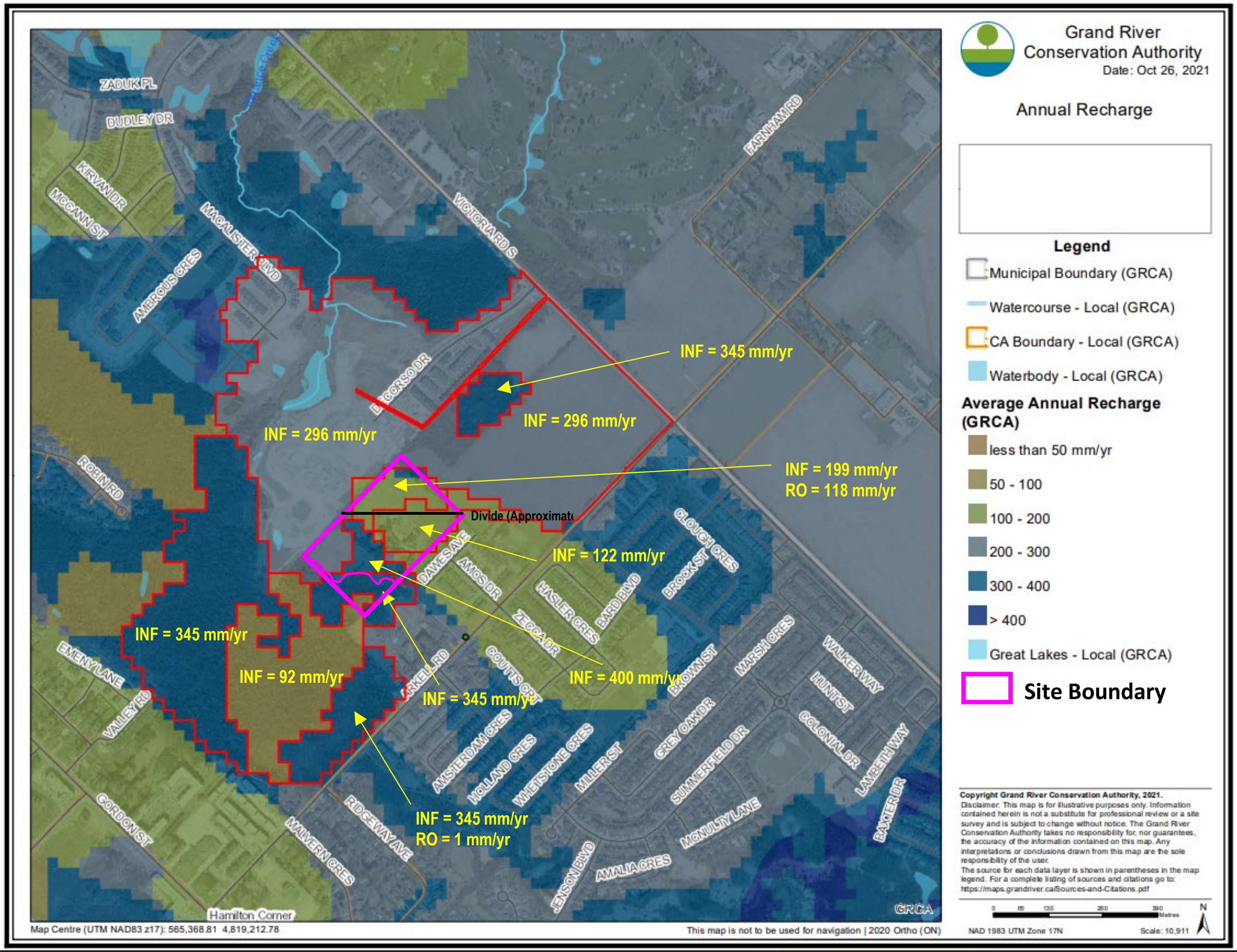

Project Location
Guelph, Ontario

161413338 REVA
Prepared by PRM on 2021-11-30
Technical Review by BW on 2021-11-30

Client/Project
ROCKPOINT PROPERTIES INC.
HYDROGEOLOGICAL ASSESSMENT
220 ARKELL ROAD, GUELPH, ONTARIO

Figure No.
8

Title
**Torrance Creek Swamp Runoff Receiving Basin**

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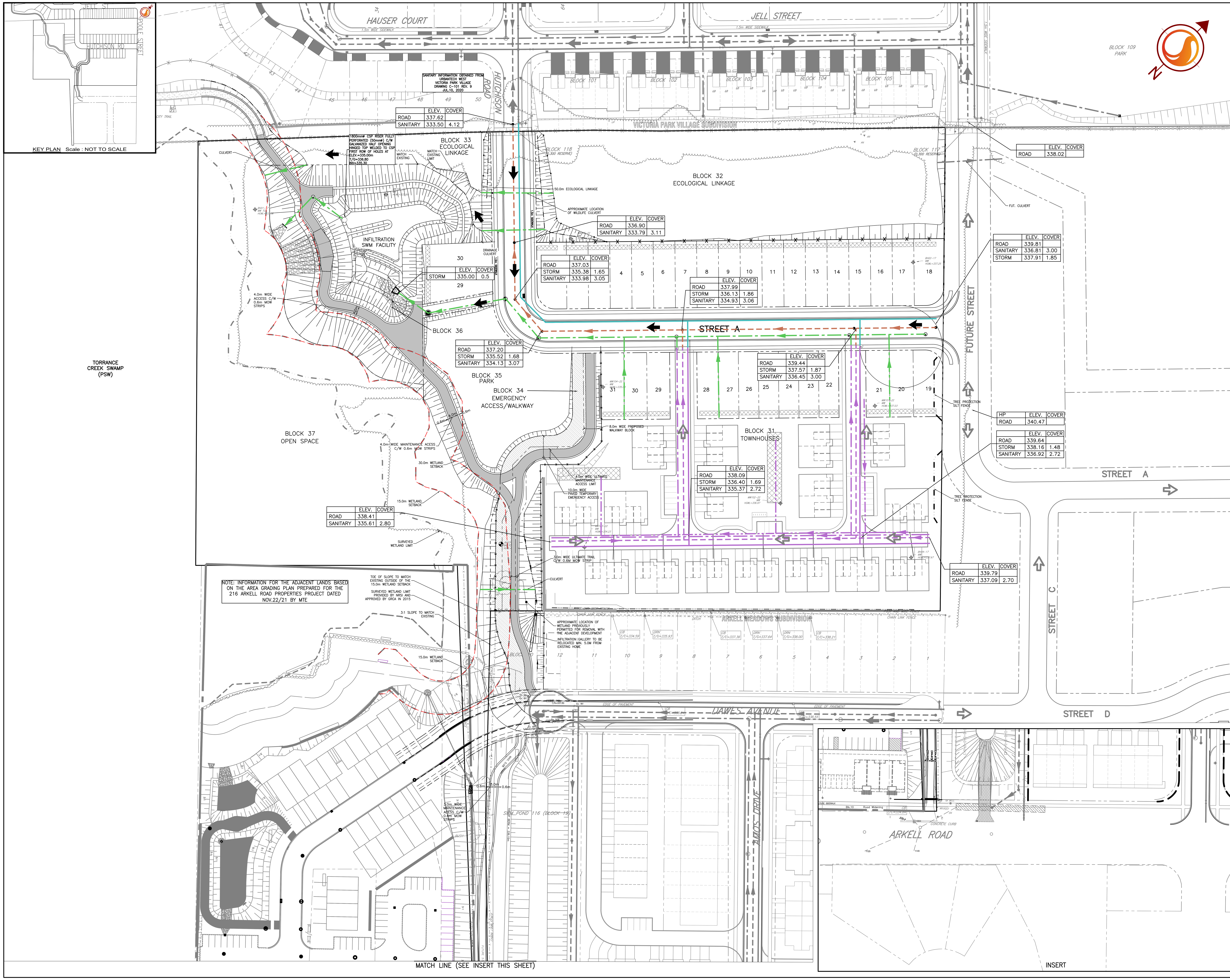
| | |
|---|---|
| Project: | HYDROGEOLOGICAL ASSESSMENT<br>220 ARKELL ROAD, GUELPH, ONTARIO |
| Figure: | **9** |
| Title: | **Annual Recharge Rates (GRCA)** |




Stantec

300 Hagey Blvd. Suite 100
Waterloo, ON, N2L 0A4
Tel. 519.579.4410
www.stantec.com



Notes

1. BENCHMARK:
   ND-27 RMW376 3
   GUELPH BENCHMARK #392. BENCHMARK PLATE ON TRAFFIC CONTROL BOX LOCATED ON SOUTH WEST CORNER OF THE INTERSECTION OF ARKELL ROAD AND VICTORIA ROAD.
   ELEVATION: 336.245m
2. TOPOGRAPHICAL SURVEY BY STANTEC CONSULTING LTD. DATED JULY 2017.
3. LEGAL PLAN PROVIDED BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED. DATED MARCH 2019.
4. DRAFT PLAN BY J.D. BARNES LIMITED DECEMBER 2023.

Legend

PROPOSED WATERMAIN
EXISTING WATERMAIN
FUTURE WATERMAIN
PROPOSED SANITARY SEWER
EXISTING SANITARY SEWER
FUTURE SANITARY SEWER
PROPOSED STORM SEWER
EXISTING STORM SEWER
FUTURE STORM SEWER
FUTURE INFILTRATION GALLERY PIPE
EXISTING OVERLAND FLOW DIRECTION
OVERLAND FLOW DIRECTION
FUTURE OVERLAND FLOW DIRECTION
ROAD STATUS (LP = LOW POINT, HP = HIGH POINT)
ROAD ELEVATION
COVER OVER SEWER
SEWER OBVERT ELEVATION
BH# BORE HOLE
HGWL GROUND WATER LEVEL
INFILTRATION GALLERY

| | | By | Appd. | YY.MM.DD |
|---|---|---|---|---|
| 2. | RESPONSE TO 2ND SUBMISSION COMMENTS | MALM | KRB | 23.12.20 |
| 1. | SECOND SUBMISSION | MALM | KRB | 23.03.03 |
| 0. | FIRST SUBMISSION | MHH | KRB | 19.05.30 |

Revision

File Name: 161413338_C-UC-Concept.dwg — 23.12.19
Dwn. Chkd. Dsgn. YY.MM.DD

Permit-Seal

Professional Engineers Ontario
**Licensed Engineering Technologist**
**Name:** J. R. K. BROUSSEAU
**Number:** 100227228
**Limitations:** Preparation of municipal servicing design and specifications for gravity sanitary sewer, storm sewer watermain layout, site grading, development erosion control and development of local roads.
**Association of Professional Engineers of Ontario**

**PRELIMINARY NOT FOR CONSTRUCTION**

Not for permits, pricing or other official purposes. This document has not been completed or checked and is for general information or comment only.

Client/Project

ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

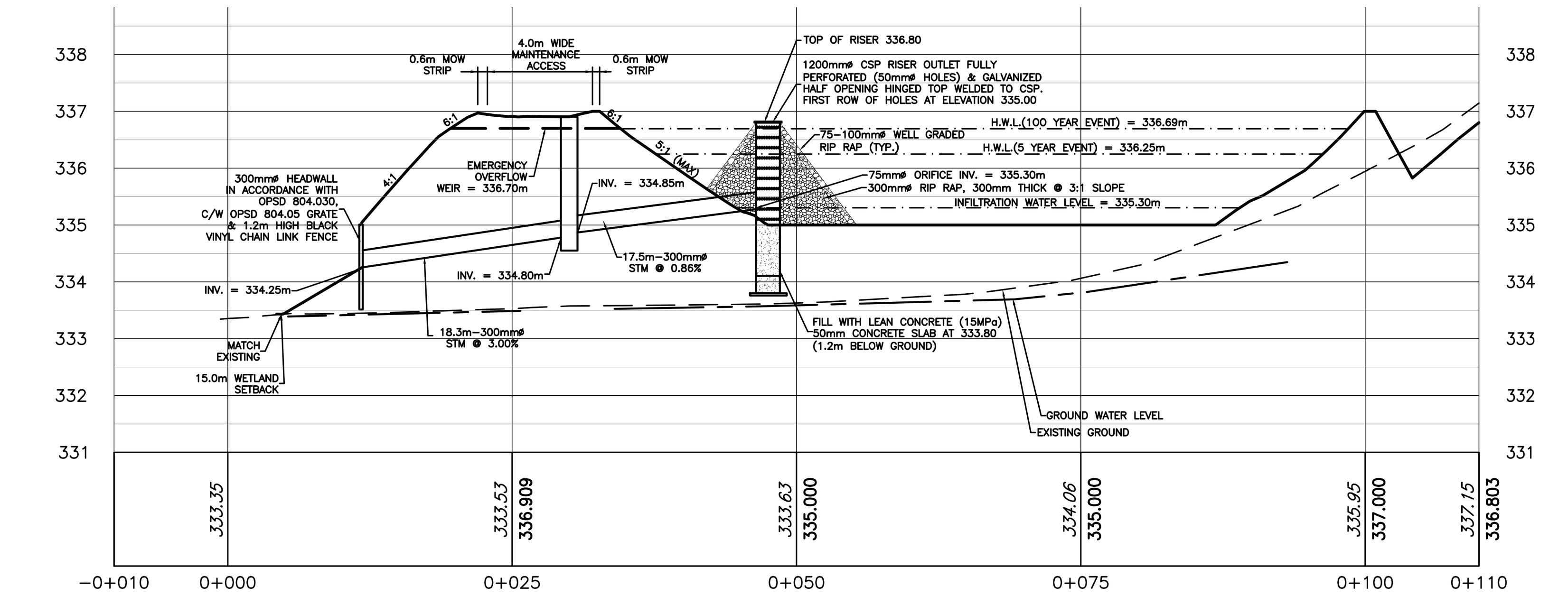
Guelph, ON

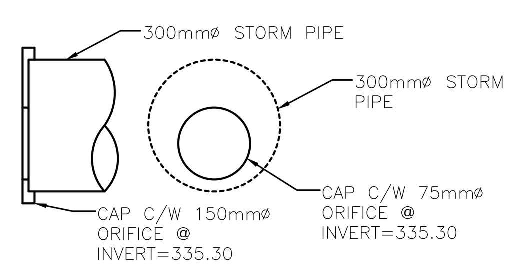
Title

CONCEPTUAL SERVICING PLAN

Project No. 161413338
Scale 1:750

Drawing No. C-100
Sheet 2
Revision 2



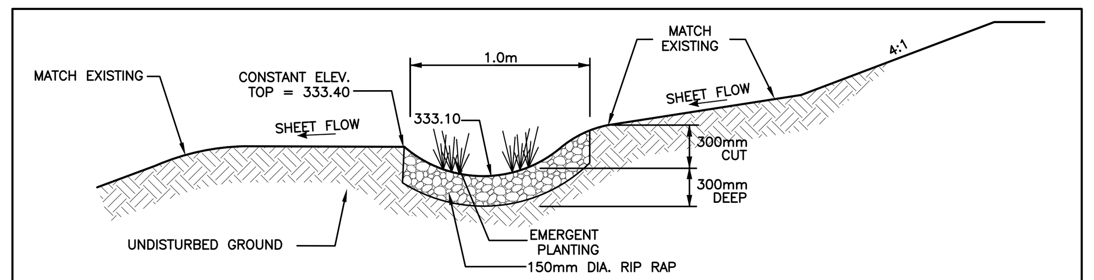




75mmø CAP DETAIL
NTS

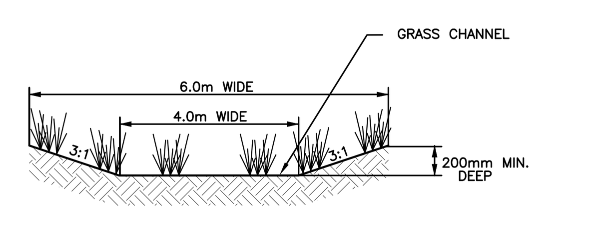
RIP–RAP GRADATION TABLE
100mm RIP–RAP 175mm THICK (MTO)
100% SMALLER THAN 150mm
AT LEAST 20% LARGER THAN 120mm
AT LEAST 50% LARGER THAN 100mm
AT LEAST 80% LARGER THAN 60mm

RIP–RAP GRADATION TABLE
300mm RIP–RAP 525mm THICK (MTO)
100% SMALLER THAN 500mm
AT LEAST 20% LARGER THAN 350mm
AT LEAST 50% LARGER THAN 300mm
AT LEAST 80% LARGER THAN 200mm

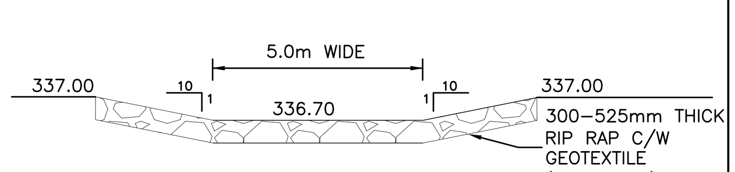
RIP–RAP DETAIL
NTS



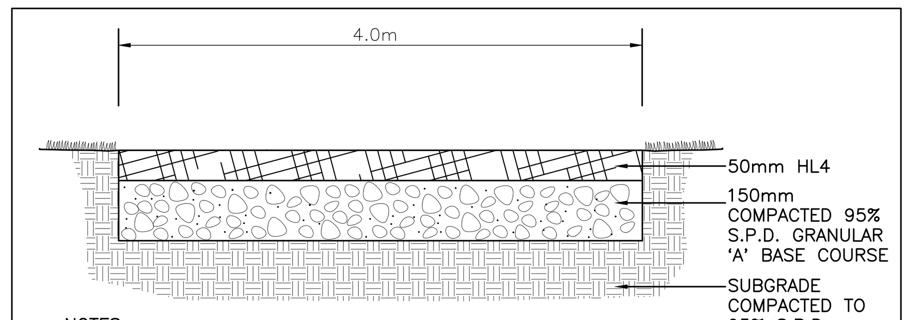

DETAIL OF SPREADER SWALE
NTS




SECTION A–A OVERLAND FLOW CHANNEL
NTS



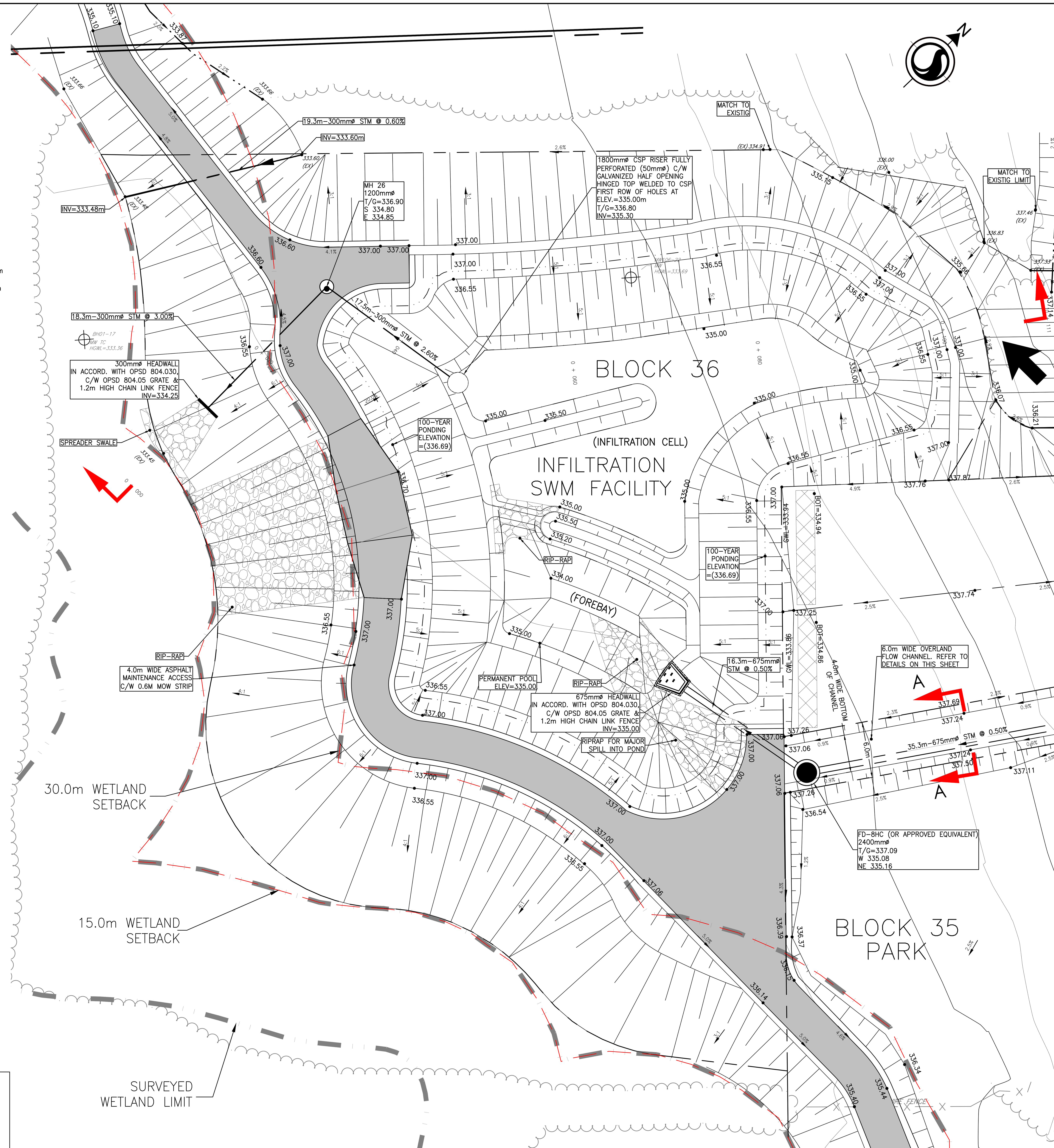

EMERGENCY WEIR DETAIL
NTS




NOTES:

1. COMPACT ASPHALT TO 97% MARSHALL MIX DESIGN BULK DENSITY.
2. TRAIL TO MATCH PROPOSED GRADES.
3. TRAIL SURFACE TO BE SMOOTH AND EVEN THROUGHOUT.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
5. DISTURBED AREAS ARE TO BE RESTORED C/W TOPSOIL AND SEED (TOWN AND COUNTRY PICKSEED). TOPSOIL IS TO BE FINE GRADED AND BOX SCRAPPED WITH ALL AREAS HAVING POSITIVE DRAINAGE.

ASPHALT MAINTENANCE ACCESS/WALKWAY DETAIL
NTS




NOTE:
POND SLOPES AND BOTTOM, FROM POND BOTTOM (334.00) TO 0.5m ABOVE PERMANENT POOL (335.00) TO ELEVATION 335.50 WITHIN THE FOREBAY LINED WITH 0.45m THICK ANTI SEEPAGE LINER. FINAL THICKNESS CONFIRMED FOLLOWING SOURCING AND TESTING OF MATERIAL BY GEOTECHNICAL CONSULTANT. ANY LOCALIZED SAND LAYERS CONTACTED ABOVE THE PERMANENT POOL WERE ALSO TO BE LINED.

# Stantec

300 Hagey Blvd. Suite 100
Waterloo, ON, N2L 0A4
Tel. 519.579.4410
www.stantec.com



Notes

1. BENCHMARK:
   ND-27 RMW376 3
   GUELPH BENCHMARK #392. BENCHMARK PLATE ON TRAFFIC CONTROL BOX LOCATED ON SOUTH WEST CORNER OF THE INTERSECTION OF ARKELL ROAD AND VICTORIA ROAD.
   ELEVATION: 336.245m
2. TOPOGRAPHICAL SURVEY BY STANTEC CONSULTING LTD. DATED JULY 2017.
3. LEGAL PLAN PROVIDED BY BLACK, SHOEMAKER, ROBINSON & DONALDSON LIMITED. DATED MARCH 2019.
4. DRAFT PLAN BY J.D. BARNES LIMITED DECEMBER 2023.

Legend

| Revision | By | Appd. | YY.MM.DD |
|---|---|---|---|
| 1. RESPONSE TO 2ND SUBMISSION COMMENTS | MALM | KRB | 23.12.20 |
| 0. SECOND SUBMISSION | MALM | KRB | 23.03.03 |

| File Name: 161413338_C-SWM.dwg | Dwn. | Chkd. | Dsgn. | YY.MM.DD |
|---|---|---|---|---|
| | | | | 23.12.19 |

Permit-Seal

Professional Engineers Ontario
**Licensed Engineering Technologist**
**Name:** J. R. K. BROUSSEAU
**Number:** 100227228
**Limitations:** Preparation of municipal servicing design and specifications for gravity sanitary sewer, storm sewer watermain layout, site grading, development erosion control and development of local roads.
**Association of Professional Engineers of Ontario**

**PRELIMINARY NOT FOR CONSTRUCTION**
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Client/Project

ROCKPOINT PROPERTIES INC.

220 ARKELL ROAD

Guelph, ON

Title

CONCEPTUAL STORMWATER MANAGEMENT PLAN

Project No. 161413338 | Scale 1:250

Drawing No. C-410 | Sheet | Revision 1

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ORIGINAL SHEET - ARCH D

# Attachments B Tables

# TABLE 1: PRE-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS
# CATCHMENTS 106, 208-1, AND 208-2 (LANDS DRAINING TO TORRANCE CREEK SWAMP)

**Pre-Development**

Model Type: Thornthwaite and Mather (1955)
Client: Rockpoint Properties Inc.
**Location 220 Arkell Road, Guelph, ON - Catchments 106, 208-1, and 208-2 (Lands Draining to Torrance Creek Swamp)**
Total Site Area (ha) 4.55

| **Land Description Factors (Sub-area descriptions provided below)** | **Sub-Area A** | **Sub-Area B** | **Sub-Area C** | **Sub-Area F** | **Sub-Area G** | **Total** |
|---|---|---|---|---|---|---|
| Topography | 0.15 | 0.15 | 0.15 | 0.20 | 0.20 | |
| Soils | 0.25 | 0.25 | 0.40 | 0.25 | 0.40 | |
| Cover | 0.15 | 0.05 | 0.15 | 0.05 | 0.05 | |
| Sum (Infiltration Factor / IF)† | 0.55 | 0.45 | 0.70 | 0.50 | 0.65 | |
| Soil Moisture Capacity (mm) | 150 | 75 | 100 | 75 | 50 | |
| Site area (ha) | 0.79 | 0.63 | 2.47 | 0.45 | 0.22 | 4.55 |
| Imperviousness Coefficient | 0.00 | 0.00 | 0.00 | 0.40 | 0.40 | |
| Impervious Area (ha) | 0.00 | 0.00 | 0.00 | 0.18 | 0.09 | 0.27 |
| Percentage of Total Site Area | 0.0% | 0.0% | 0.0% | 3.9% | 1.9% | 6% |
| Remaining Pervious Area (ha) | 0.79 | 0.63 | 2.47 | 0.27 | 0.13 | 4.29 |
| Total Pervious Site Area (ha) | 0.79 | 0.63 | 2.47 | 0.27 | 0.13 | 4.29 |
| Percentage of Total Site Area | 17.4% | 13.74% | 54.2% | 5.9% | 2.9% | 94% |

| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Data** (Guelph Arboretum Climate Normals, 1971 - 2000)‡ | | | | | | | | | | | | | |
| Average Daily Temperature (°C) | -7.6 | -6.9 | -1.3 | 5.9 | 12.3 | 16.9 | 19.7 | 18.6 | 14.1 | 7.9 | 2.4 | -4 | **6.5** |
| Precipitation (mm) | 56.4 | 50.8 | 72.1 | 78.3 | 79.9 | 76 | 88.5 | 95.9 | 92.1 | 69.2 | 86.3 | 77.7 | **923** |

| **Potential Evapotranspiration Analysis for Site** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat Index | 0.0 | 0.0 | 0.0 | 1.3 | 3.9 | 6.3 | 8.0 | 7.3 | 4.8 | 2.0 | 0.3 | 0.0 | **34** |
| Unadjusted Potential Evapotranspiration (mm) | 0.0 | 0.0 | 0.0 | 28.4 | 60.7 | 84.3 | 98.8 | 93.1 | 69.9 | 38.4 | 11.2 | 0.0 | **485** |
| Potential Evapotranspiration Adjusting Factor for Latitude* | 0.77 | 0.87 | 0.99 | 1.12 | 1.23 | 1.29 | 1.26 | 1.16 | 1.04 | 0.92 | 0.81 | 0.75 | |
| Adjusted Potential Evapotranspiration (PET)(mm) | 0 | 0 | 0 | 32 | 75 | 108 | 124 | 108 | 73 | 35 | 9 | 0 | **564** |
| Precipitation - PET (mm) | 56 | 51 | 72 | 47 | 5 | -32 | -36 | -12 | 19 | 34 | 77 | 78 | **359** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area A** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -51 | -9 | 0 | 0 | |
| Storage (S) | 150 | 150 | 150 | 150 | 150 | 121 | 95 | 88 | 107 | 141 | 150 | 150 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -29 | -26 | -8 | 19 | 34 | 9 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 105 | 114 | 104 | 73 | 35 | 9 | 0 | **546** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 68 | 78 | **377** |
| Potential Infiltration (I) | 31 | 28 | 40 | 26 | 3 | 0 | 0 | 0 | 0 | 0 | 37 | 43 | 207 |
| Potential Direct Surface Water Runoff (R) | 25 | 23 | 32 | 21 | 2 | 0 | 0 | 0 | 0 | 0 | 31 | 35 | 170 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 167 | 3 | 0 | 0 | 0 | 0 | 0 | 37 | 0 | 207 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 252 | 592 | 835 | 907 | 822 | 579 | 280 | 72 | 0 | 4,339 |
| **Pervious Runoff ($m^3$)** | 202 | 182 | 258 | 167 | 19 | 0 | 0 | 0 | 0 | 0 | 244 | 278 | **1,348** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 1327 | 23 | 0 | 0 | 0 | 0 | 0 | 298 | 0 | **1,648** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

## TABLE 1: PRE-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS
## CATCHMENTS 106, 208-1, AND 208-2 (LANDS DRAINING TO TORRANCE CREEK SWAMP)

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area B** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -39 | 4 | 0 | 0 | |
| Storage (S) | 75 | 75 | 75 | 75 | 75 | 49 | 30 | 26 | 45 | 79 | 75 | 75 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -26 | -18 | -5 | 19 | 34 | -4 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 102 | 107 | 101 | 73 | 35 | 9 | 0 | **533** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 81 | 78 | **390** |
| Potential Infiltration (I) | 25 | 23 | 32 | 21 | 2 | 0 | 0 | 0 | 0 | 0 | 37 | 35 | 176 |
| Potential Direct Surface Water Runoff (R) | 31 | 28 | 40 | 26 | 3 | 0 | 0 | 0 | 0 | 0 | 45 | 43 | 215 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 137 | 2 | 0 | 0 | 0 | 0 | 0 | 37 | 0 | 176 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 199 | 466 | 640 | 669 | 629 | 456 | 220 | 56 | 0 | 3,336 |
| **Pervious Runoff ($m^3$)** | 194 | 175 | 248 | 160 | 18 | 0 | 0 | 0 | 0 | 0 | 279 | 267 | **1,342** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 855 | 15 | 0 | 0 | 0 | 0 | 0 | 228 | 0 | **1,098** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area C** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -45 | -2 | 0 | 0 | |
| Storage (S) | 100 | 100 | 100 | 100 | 100 | 72 | 51 | 45 | 64 | 98 | 100 | 100 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -28 | -22 | -6 | 19 | 34 | 2 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 104 | 110 | 102 | 73 | 35 | 9 | 0 | **539** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 75 | 78 | **384** |
| Potential Infiltration (I) | 39 | 36 | 50 | 33 | 4 | 0 | 0 | 0 | 0 | 0 | 53 | 54 | 269 |
| Potential Direct Surface Water Runoff (R) | 17 | 15 | 22 | 14 | 2 | 0 | 0 | 0 | 0 | 0 | 23 | 23 | 115 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 212 | 4 | 0 | 0 | 0 | 0 | 0 | 53 | 0 | 269 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 783 | 1839 | 2557 | 2721 | 2512 | 1797 | 869 | 222 | 0 | 13,299 |
| **Pervious Runoff ($m^3$)** | 417 | 376 | 534 | 345 | 40 | 0 | 0 | 0 | 0 | 0 | 556 | 575 | **2,843** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 5242 | 93 | 0 | 0 | 0 | 0 | 0 | 1298 | 0 | **6,633** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area F** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -39 | 4 | 0 | 0 | |
| Storage (S) | 75 | 75 | 75 | 75 | 75 | 49 | 30 | 26 | 45 | 79 | 75 | 75 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -26 | -18 | -5 | 19 | 34 | -4 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 102 | 107 | 101 | 73 | 35 | 9 | 0 | **533** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 81 | 78 | **390** |
| Potential Infiltration (I) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Direct Surface Water Runoff (R) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 152 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 0 | 195 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 85 | 200 | 274 | 287 | 269 | 195 | 94 | 24 | 0 | 1,429 |
| **Pervious Runoff ($m^3$)** | 76 | 68 | 97 | 62 | 7 | 0 | 0 | 0 | 0 | 0 | 109 | 104 | **523** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 407 | 7 | 0 | 0 | 0 | 0 | 0 | 109 | 0 | **523** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 101 | 91 | 129 | 140 | 143 | 136 | 158 | 171 | 165 | 124 | 154 | 139 | **1,649** |

**TABLE 1: PRE-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS**
**CATCHMENTS 106, 208-1, AND 208-2 (LANDS DRAINING TO TORRANCE CREEK SWAMP)**

| Evapotranspiration Analysis | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area G** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -27 | 12 | 0 | 0 | |
| Storage (S) | 50 | 50 | 50 | 50 | 50 | 26 | 13 | 10 | 29 | 63 | 50 | 50 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -24 | -13 | -3 | 19 | 34 | -13 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 100 | 102 | 99 | 73 | 35 | 9 | 0 | **524** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 90 | 78 | **399** |
| Potential Infiltration (I) | 37 | 33 | 47 | 30 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 51 | 260 |
| Potential Direct Surface Water Runoff (R) | 20 | 18 | 25 | 16 | 2 | 0 | 0 | 0 | 0 | 0 | 32 | 27 | 140 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 197 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 0 | 260 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 42 | 99 | 132 | 135 | 131 | 97 | 47 | 12 | 0 | 694 |
| **Pervious Runoff ($m^3$)** | 26 | 24 | 33 | 22 | 2 | 0 | 0 | 0 | 0 | 0 | 42 | 36 | **185** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 262 | 5 | 0 | 0 | 0 | 0 | 0 | 78 | 0 | **344** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 50 | 45 | 64 | 69 | 71 | 67 | 78 | 85 | 81 | 61 | 76 | 69 | **816** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pre-Development Infiltration (INF)** | 10,246 | $m^3$/yr | 225 | mm/yr | 0.3 | L/s |
| **Pre-Development Runoff (R)** | 8,706 | $m^3$/yr | 191 | mm/yr | 0.3 | L/s |
| **Pre-Development Evapotranspiration (ET)** | 23,098 | $m^3$/yr | 507 | mm/yr | 0.7 | L/s |
| **Total = INF + R + ET** | 42,050 | $m^3$/yr | 923 | mm/yr | 1.3 | L/s |
| **Precipitation** | 42,050 | $m^3$/yr | 923 | mm/yr | 1.3 | L/s |

| Sub-Area Descriptions (topography, soils, cover) | |
|---|---|
| Sub-Area A | Rolling to Hilly, Silty Sand to Sand Till, Pasture and Shrubs |
| Sub-Area B | Rolling to Hilly, Silty Sand to Sand Till, Urban Lawn |
| Sub-Area C | Rolling to Hilly, Sand, Pasture and Shrubs |
| Sub-Area F | Rolling, Silty Sand to Sand Till, Urban Lawn, 40% Impervious |
| Sub-Area G | Rolling, Sand, Urban Lawn, 40% Impervious |

**Notes:**

† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2021. Canadian Climate Normals 1971-2000, Guelph Arboretum, Climate ID 6143069. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html. Accessed July 2021.

**Assumptions:**

[1] The monthly average precipitation collected at the Guelph Arboretum climate station is reflective of the precipitation trends that have historically occurred at the Site.
[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.
[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.
[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).
[5] Soil moisture capacity is at a maximum in April.

**TABLE 2: PRE-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS**
**CATCHMENT 110 (LANDS DRAINING EASTWARD TO WOODLOT)**

| | |
|---|---|
| | **Pre-Development** |
| Model Type: | Thornthwaite and Mather (1955) |
| Client: | Rockpoint Properties Inc. |
| **Location** | **220 Arkell Road, Guelph, ON - Catchment 110 (Lands Draining Eastward to Woodlot)** |
| Total Site Area (ha) | 2.47 |

| **Land Description Factors (Sub-area descriptions provided below)** | **Sub-Area A** | Sub-Area B | **Sub-Area C** | Sub-Area D | Sub-Area E | | | | | | | | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Topography | 0.15 | 0.15 | 0.15 | 0.00 | 0.00 | | | | | | | | |
| Soils | 0.25 | 0.30 | 0.40 | 0.00 | 0.00 | | | | | | | | |
| Cover | 0.15 | 0.05 | 0.15 | 0.00 | 0.00 | | | | | | | | |
| Sum (Infiltration Factor / IF)[†] | 0.55 | 0.50 | 0.70 | 0.00 | 0.00 | | | | | | | | |
| Soil Moisture Capacity (mm) | 150 | 75 | 100 | 0 | 0 | | | | | | | | |
| Site area (ha) | 2.19 | 0.00 | 0.28 | 0.00 | 0.00 | | | | | | | | 2.47 |
| Imperviousness Coefficient | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | |
| Impervious Area (ha) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | 0.00 |
| Percentage of Total Site Area | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | | | | | | | | 0% |
| Remaining Pervious Area (ha) | 2.19 | 0.00 | 0.28 | 0.00 | 0.00 | | | | | | | | 2.47 |
| Total Pervious Site Area (ha) | 2.19 | 0.00 | 0.28 | 0.00 | 0.00 | | | | | | | | 2.47 |
| Percentage of Total Site Area | 88.5% | 0.00% | 11.5% | 0.0% | 0.0% | | | | | | | | 100% |

| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Data** (Guelph Arboretum Climate Normals, 1971 - 2000)[‡] | | | | | | | | | | | | | |
| Average Daily Temperature (°C) | -7.6 | -6.9 | -1.3 | 5.9 | 12.3 | 16.9 | 19.7 | 18.6 | 14.1 | 7.9 | 2.4 | -4 | **6.5** |
| Precipitation (mm) | 56.4 | 50.8 | 72.1 | 78.3 | 79.9 | 76 | 88.5 | 95.9 | 92.1 | 69.2 | 86.3 | 77.7 | **923** |

| **Potential Evapotranspiration Analysis for Site** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat Index | 0.0 | 0.0 | 0.0 | 1.3 | 3.9 | 6.3 | 8.0 | 7.3 | 4.8 | 2.0 | 0.3 | 0.0 | **34** |
| Unadjusted Potential Evapotranspiration (mm) | 0.0 | 0.0 | 0.0 | 28.4 | 60.7 | 84.3 | 98.8 | 93.1 | 69.9 | 38.4 | 11.2 | 0.0 | **485** |
| Potential Evapotranspiration Adjusting Factor for Latitude* | 0.77 | 0.87 | 0.99 | 1.12 | 1.23 | 1.29 | 1.26 | 1.16 | 1.04 | 0.92 | 0.81 | 0.75 | |
| Adjusted Potential Evapotranspiration (PET)(mm) | 0 | 0 | 0 | 32 | 75 | 108 | 124 | 108 | 73 | 35 | 9 | 0 | **564** |
| Precipitation - PET (mm) | 56 | 51 | 72 | 47 | 5 | -32 | -36 | -12 | 19 | 34 | 77 | 78 | **359** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area A** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -51 | -9 | 0 | 0 | |
| Storage (S) | 150 | 150 | 150 | 150 | 150 | 121 | 95 | 88 | 107 | 141 | 150 | 150 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -29 | -26 | -8 | 19 | 34 | 9 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 105 | 114 | 104 | 73 | 35 | 9 | 0 | **546** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 68 | 78 | **377** |
| Potential Infiltration (I) | 31 | 28 | 40 | 26 | 3 | 0 | 0 | 0 | 0 | 0 | 37 | 43 | 207 |
| Potential Direct Surface Water Runoff (R) | 25 | 23 | 32 | 21 | 2 | 0 | 0 | 0 | 0 | 0 | 31 | 35 | 170 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 167 | 3 | 0 | 0 | 0 | 0 | 0 | 37 | 0 | 207 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 694 | 1629 | 2297 | 2496 | 2263 | 1592 | 770 | 197 | 0 | 11,938 |
| **Pervious Runoff ($m^3$)** | 555 | 500 | 709 | 458 | 53 | 0 | 0 | 0 | 0 | 0 | 670 | 764 | **3,709** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 3650 | 65 | 0 | 0 | 0 | 0 | 0 | 819 | 0 | **4,534** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

**TABLE 2: PRE-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS**
**CATCHMENT 110 (LANDS DRAINING EASTWARD TO WOODLOT)**

| Evapotranspiration Analysis | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area B** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -39 | 4 | 0 | 0 | |
| Storage (S) | 75 | 75 | 75 | 75 | 75 | 49 | 30 | 26 | 45 | 79 | 75 | 75 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -26 | -18 | -5 | 19 | 34 | -4 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 102 | 107 | 101 | 73 | 35 | 9 | 0 | **533** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 81 | 78 | **390** |
| Potential Infiltration (I) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Direct Surface Water Runoff (R) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 152 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 0 | 195 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Pervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

| Evapotranspiration Analysis | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area C** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -45 | -2 | 0 | 0 | |
| Storage (S) | 100 | 100 | 100 | 100 | 100 | 72 | 51 | 45 | 64 | 98 | 100 | 100 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -28 | -22 | -6 | 19 | 34 | 2 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 104 | 110 | 102 | 73 | 35 | 9 | 0 | **539** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 75 | 78 | **384** |
| Potential Infiltration (I) | 39 | 36 | 50 | 33 | 4 | 0 | 0 | 0 | 0 | 0 | 53 | 54 | 269 |
| Potential Direct Surface Water Runoff (R) | 17 | 15 | 22 | 14 | 2 | 0 | 0 | 0 | 0 | 0 | 23 | 23 | 115 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 212 | 4 | 0 | 0 | 0 | 0 | 0 | 53 | 0 | 269 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 90 | 211 | 293 | 312 | 288 | 206 | 100 | 26 | 0 | 1,525 |
| **Pervious Runoff ($m^3$)** | 48 | 43 | 61 | 40 | 5 | 0 | 0 | 0 | 0 | 0 | 64 | 66 | **326** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 601 | 11 | 0 | 0 | 0 | 0 | 0 | 149 | 0 | **761** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pre-Development Infiltration (INF)** | 5,294 | $m^3$/yr | 214 | mm/yr | 0.2 | L/s |
| **Pre-Development Runoff (R)** | 4,035 | $m^3$/yr | 163 | mm/yr | 0.1 | L/s |
| **Pre-Development Evapotranspiration (ET)** | 13,463 | $m^3$/yr | 545 | mm/yr | 0.4 | L/s |
| **Total = INF + R + ET** | 22,793 | $m^3$/yr | 923 | mm/yr | 0.7 | L/s |
| **Precipitation** | 22,793 | $m^3$/yr | 923 | mm/yr | 0.7 | L/s |

| **Sub-Area Descriptions (topography, soils, cover)** | |
|---|---|
| Sub-Area A | Rolling to Hilly, Silty Sand to Sand Till, Pasture and Shrubs |
| Sub-Area B | Rolling to Hilly, Silty Sand to Sand Till, Urban Lawn |
| Sub-Area C | Rolling to Hilly, Sand, Pasture and Shrubs |

**Notes:**
† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2021. Canadian Climate Normals 1971-2000, Guelph Arboretum, Climate ID 6143069. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html. Accessed July 2021.

## TABLE 2: PRE-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS
## CATCHMENT 110 (LANDS DRAINING EASTWARD TO WOODLOT)

**Assumptions:**

[1] The monthly average precipitation collected at the Guelph Arboretum climate station is reflective of the precipitation trends that have historically occurred at the Site.
[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.
[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.
[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).
[5] Soil moisture capacity is at a maximum in April.

**TABLE 3: POST-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS**
**CATCHMENTS 200 and 202 to 209 (LANDS DRAINING WESTWARD TO TORRANCE CREEK SWAMP)**

**Post-Development**
Model Type: Thornthwaite and Mather (1955)
Client: Rockpoint Properties Inc.
**Location** **220 Arkell Road - Former Catchment 106**
**Post-Development Catchments 200 and 202 to 209 (Lands Draining Westward to Torrance Creek Swamp)**

Total Site Area (ha) 5.87

| **Land Description Factors (Sub-area descriptions provided below)** | **Sub-Area A** | **Sub-Area C** | **Sub-Area D** | **Sub-Area E** | **Sub-Area F** | **Sub-Area G** | **Sub-Area H** | **Sub-Area I** | **Sub-Area J** | **Sub-Area K** | | | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Topography | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | | | |
| Soils | 0.25 | 0.40 | 0.25 | 0.40 | 0.25 | 0.40 | 0.25 | 0.25 | 0.40 | 0.40 | | | |
| Cover | 0.15 | 0.15 | 0.05 | 0.05 | 0.05 | 0.05 | 0.15 | 0.05 | 0.05 | 0.05 | | | |
| Sum (Infiltration Factor)† | 0.60 | 0.75 | 0.50 | 0.65 | 0.50 | 0.65 | 0.60 | 0.50 | 0.65 | 0.65 | | | |
| Soil Moisture Capacity (mm) | 150 | 100 | 75 | 50 | 75 | 50 | 100 | 75 | 50 | 50 | | | |
| Site area (ha) | 0.15 | 1.01 | 2.19 | 0.23 | 0.46 | 0.22 | 0.76 | 0.45 | 0.12 | 0.28 | | | 5.87 |
| Imperviousness Coefficient | 0.00 | 0.00 | 0.65 | 0.65 | 0.40 | 0.40 | 0.15 | 0.20 | 0.20 | 0.10 | | | |
| Impervious Area (ha) | 0.00 | 0.00 | 1.42 | 0.15 | 0.19 | 0.09 | 0.11 | 0.09 | 0.02 | 0.03 | | | 2.10 |
| Percentage of Total Site Area | 0.0% | 0.0% | 24.3% | 2.5% | 3.2% | 1.5% | 2.0% | 1.5% | 0.4% | 0.5% | | | 35.8% |
| Remaining Pervious Area (ha) | 0.15 | 1.01 | 0.77 | 0.08 | 0.28 | 0.13 | 0.65 | 0.36 | 0.10 | 0.25 | | | 3.77 |
| Total Pervious Site Area (ha) | 0.15 | 1.01 | 0.77 | 0.08 | 0.28 | 0.13 | 0.65 | 0.36 | 0.10 | 0.25 | | | 3.77 |
| Percentage of Total Site Area | 2.6% | 17.2% | 13.1% | 1.3% | 4.7% | 2.3% | 11.1% | 6.1% | 1.6% | 4.3% | | | 64.2% |
| Single-Family Rooftop Area (ha) | | | 0.36 | 0.04 | | | | | | | | | 0.37 (1) |
| Multiblock-Residential Rooftop Area (ha) | | | 0.44 | | | | | | | | | | 0.34 (2) |
| % of Sub-Area Runoff (non-rooftop) directed to SWMF | 0.0% | 0.0% | 100.0% | 100.0% | 0.0% | 0.0% | 53.1% | 0.0% | 0.0% | 0.0% | | | |

**Notes:**
[1] Total projected rooftop area in single-family lots (i.e., 33 units * 120 $m^2$ rooftop area per unit = 3,960 $m^2$ / 10,000 = 0.40 ha)
[2] Total projected rooftop area in multi-residential block (i.e., 16 buildings * 275 $m^2$ rooftop area per building = 4,400 $m^2$ / 10,000 = 0.44 ha)

| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Data** (Guelph Arboretum Climate Normals, 1971 - 2000)‡ | | | | | | | | | | | | | |
| Average Daily Temperature (°C) | -7.6 | -6.9 | -1.3 | 5.9 | 12.3 | 16.9 | 19.7 | 18.6 | 14.1 | 7.9 | 2.4 | -4 | **6.5** |
| Precipitation (mm) | 56.4 | 50.8 | 72.1 | 78.3 | 79.9 | 76 | 88.5 | 95.9 | 92.1 | 69.2 | 86.3 | 77.7 | **923** |

| **Potential Evapotranspiration Analysis for Site** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat Index | 0.0 | 0.0 | 0.0 | 1.3 | 3.9 | 6.3 | 8.0 | 7.3 | 4.8 | 2.0 | 0.3 | 0.0 | **34** |
| Unadjusted Potential Evapotranspiration (mm) | 0.0 | 0.0 | 0.0 | 28.4 | 60.7 | 84.3 | 98.8 | 93.1 | 69.9 | 38.4 | 11.2 | 0.0 | **485** |
| Potential Evapotranspiration Adjusting Factor for Latitude* | 0.77 | 0.87 | 0.99 | 1.12 | 1.23 | 1.29 | 1.26 | 1.16 | 1.04 | 0.92 | 0.81 | 0.75 | |
| Adjusted Potential Evapotranspiration (PET)(mm) | 0 | 0 | 0 | 32 | 75 | 108 | 124 | 108 | 73 | 35 | 9 | 0 | **564** |
| Precipitation - PET (mm) | 56 | 51 | 72 | 47 | 5 | -32 | -36 | -12 | 19 | 34 | 77 | 78 | **359** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area A** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -51 | -9 | 0 | 0 | |
| Storage (S) | 150 | 150 | 150 | 150 | 150 | 121 | 95 | 88 | 107 | 141 | 150 | 150 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -29 | -26 | -8 | 19 | 34 | 9 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 105 | 114 | 104 | 73 | 35 | 9 | 0 | **546** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 68 | 78 | **377** |
| Potential Infiltration (I) | 34 | 30 | 43 | 28 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 47 | 226 |
| Potential Direct Surface Water Runoff (R) | 23 | 20 | 29 | 19 | 2 | 0 | 0 | 0 | 0 | 0 | 27 | 31 | 151 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 182 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 0 | 226 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 48 | 113 | 160 | 173 | 157 | 111 | 53 | 14 | 0 | 829 |
| **Pervious Runoff ($m^3$)** | 34 | 31 | 44 | 28 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 47 | **229** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 277 | 5 | 0 | 0 | 0 | 0 | 0 | 62 | 0 | **343** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

**TABLE 3: POST-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS**
**CATCHMENTS 200 and 202 to 209 (LANDS DRAINING WESTWARD TO TORRANCE CREEK SWAMP)**

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area C** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -45 | -2 | 0 | 0 | |
| Storage (S) | 100 | 100 | 100 | 100 | 100 | 72 | 51 | 45 | 64 | 98 | 100 | 100 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -28 | -22 | -6 | 19 | 34 | 2 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 104 | 110 | 102 | 73 | 35 | 9 | 0 | **539** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 75 | 78 | **384** |
| Potential Infiltration (I) | 42 | 38 | 54 | 35 | 4 | 0 | 0 | 0 | 0 | 0 | 56 | 58 | 288 |
| Potential Direct Surface Water Runoff (R) | 14 | 13 | 18 | 12 | 1 | 0 | 0 | 0 | 0 | 0 | 19 | 19 | 96 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 228 | 4 | 0 | 0 | 0 | 0 | 0 | 56 | 0 | 288 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 320 | 753 | 1047 | 1114 | 1029 | 736 | 356 | 91 | 0 | 5,445 |
| **Pervious Runoff ($m^3$)** | 142 | 128 | 182 | 118 | 14 | 0 | 0 | 0 | 0 | 0 | 190 | 196 | **970** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 2300 | 41 | 0 | 0 | 0 | 0 | 0 | 569 | 0 | **2,910** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area D** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -39 | 4 | 0 | 0 | |
| Storage (S) | 75 | 75 | 75 | 75 | 75 | 49 | 30 | 26 | 45 | 79 | 75 | 75 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -26 | -18 | -5 | 19 | 34 | -4 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 102 | 107 | 101 | 73 | 35 | 9 | 0 | **533** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 81 | 78 | **390** |
| Potential Infiltration (I) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Direct Surface Water Runoff (R) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 152 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 0 | 195 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 243 | 572 | 785 | 821 | 771 | 559 | 270 | 69 | 0 | 4,090 |
| **Pervious Runoff ($m^3$)** | 216 | 195 | 277 | 179 | 21 | 0 | 0 | 0 | 0 | 0 | 311 | 298 | **1,496** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 1164 | 21 | 0 | 0 | 0 | 0 | 0 | 311 | 0 | **1,496** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 804 | 724 | 1027 | 1116 | 1138 | 1083 | 1261 | 1366 | 1312 | 986 | 1230 | 1107 | **13,154** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area E** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -27 | 12 | 0 | 0 | |
| Storage (S) | 50 | 50 | 50 | 50 | 50 | 26 | 13 | 10 | 29 | 63 | 50 | 50 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -24 | -13 | -3 | 19 | 34 | -13 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 100 | 102 | 99 | 73 | 35 | 9 | 0 | **524** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 90 | 78 | **399** |
| Potential Infiltration (I) | 37 | 33 | 47 | 30 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 51 | 260 |
| Potential Direct Surface Water Runoff (R) | 20 | 18 | 25 | 16 | 2 | 0 | 0 | 0 | 0 | 0 | 32 | 27 | 140 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 197 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 0 | 260 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 25 | 59 | 79 | 80 | 78 | 57 | 28 | 7 | 0 | 414 |
| **Pervious Runoff ($m^3$)** | 16 | 14 | 20 | 13 | 1 | 0 | 0 | 0 | 0 | 0 | 25 | 21 | **110** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 156 | 3 | 0 | 0 | 0 | 0 | 0 | 46 | 0 | **205** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 83 | 74 | 106 | 115 | 117 | 111 | 130 | 141 | 135 | 101 | 127 | 114 | **1,354** |

**TABLE 3: POST-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS**
**CATCHMENTS 200 and 202 to 209 (LANDS DRAINING WESTWARD TO TORRANCE CREEK SWAMP)**

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area F** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -39 | 4 | 0 | 0 | |
| Storage (S) | 75 | 75 | 75 | 75 | 75 | 49 | 30 | 26 | 45 | 79 | 75 | 75 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -26 | -18 | -5 | 19 | 34 | -4 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 102 | 107 | 101 | 73 | 35 | 9 | 0 | **533** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 81 | 78 | **390** |
| Potential Infiltration (I) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Direct Surface Water Runoff (R) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 152 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 0 | 195 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 88 | 207 | 284 | 297 | 279 | 202 | 98 | 25 | 0 | 1,481 |
| **Pervious Runoff ($m^3$)** | 78 | 71 | 100 | 65 | 7 | 0 | 0 | 0 | 0 | 0 | 113 | 108 | **542** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 422 | 7 | 0 | 0 | 0 | 0 | 0 | 113 | 0 | **542** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 104 | 94 | 134 | 145 | 148 | 141 | 164 | 178 | 171 | 128 | 160 | 144 | **1,710** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area G** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -27 | 12 | 0 | 0 | |
| Storage (S) | 50 | 50 | 50 | 50 | 50 | 26 | 13 | 10 | 29 | 63 | 50 | 50 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -24 | -13 | -3 | 19 | 34 | -13 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 100 | 102 | 99 | 73 | 35 | 9 | 0 | **524** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 90 | 78 | **399** |
| Potential Infiltration (I) | 37 | 33 | 47 | 30 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 51 | 260 |
| Potential Direct Surface Water Runoff (R) | 20 | 18 | 25 | 16 | 2 | 0 | 0 | 0 | 0 | 0 | 32 | 27 | 140 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 197 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 0 | 260 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 42 | 99 | 133 | 135 | 131 | 97 | 47 | 12 | 0 | 696 |
| **Pervious Runoff ($m^3$)** | 26 | 24 | 34 | 22 | 2 | 0 | 0 | 0 | 0 | 0 | 42 | 36 | **186** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 262 | 5 | 0 | 0 | 0 | 0 | 0 | 78 | 0 | **345** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 50 | 45 | 64 | 69 | 71 | 67 | 78 | 85 | 82 | 61 | 76 | 69 | **817** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area H** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -45 | -2 | 0 | 0 | |
| Storage (S) | 100 | 100 | 100 | 100 | 100 | 72 | 51 | 45 | 64 | 98 | 100 | 100 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -28 | -22 | -6 | 19 | 34 | 2 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 104 | 110 | 102 | 73 | 35 | 9 | 0 | **539** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 75 | 78 | **384** |
| Potential Infiltration (I) | 34 | 30 | 43 | 28 | 3 | 0 | 0 | 0 | 0 | 0 | 45 | 47 | 230 |
| Potential Direct Surface Water Runoff (R) | 23 | 20 | 29 | 19 | 2 | 0 | 0 | 0 | 0 | 0 | 30 | 31 | 154 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 182 | 3 | 0 | 0 | 0 | 0 | 0 | 45 | 0 | 230 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 206 | 484 | 673 | 717 | 662 | 473 | 229 | 59 | 0 | 3,503 |
| **Pervious Runoff ($m^3$)** | 147 | 132 | 187 | 121 | 14 | 0 | 0 | 0 | 0 | 0 | 195 | 202 | **998** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 1184 | 21 | 0 | 0 | 0 | 0 | 0 | 293 | 0 | **1,498** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 65 | 58 | 83 | 90 | 92 | 87 | 101 | 110 | 106 | 79 | 99 | 89 | **1,059** |

**TABLE 3: POST-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS**
**CATCHMENTS 200 and 202 to 209 (LANDS DRAINING WESTWARD TO TORRANCE CREEK SWAMP)**

| Evapotranspiration Analysis | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area I** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -39 | 4 | 0 | 0 | |
| Storage (S) | 75 | 75 | 75 | 75 | 75 | 49 | 30 | 26 | 45 | 79 | 75 | 75 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -26 | -18 | -5 | 19 | 34 | -4 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 102 | 107 | 101 | 73 | 35 | 9 | 0 | **533** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 81 | 78 | **390** |
| Potential Infiltration (I) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Direct Surface Water Runoff (R) | 28 | 25 | 36 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 39 | 195 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 152 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 0 | 195 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 113 | 266 | 365 | 382 | 359 | 260 | 126 | 32 | 0 | 1,903 |
| **Pervious Runoff ($m^3$)** | 101 | 91 | 129 | 83 | 10 | 0 | 0 | 0 | 0 | 0 | 145 | 139 | **696** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 542 | 10 | 0 | 0 | 0 | 0 | 0 | 145 | 0 | **696** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 50 | 45 | 64 | 70 | 71 | 68 | 79 | 86 | 82 | 62 | 77 | 69 | **824** |

| Evapotranspiration Analysis | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area J** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -27 | 12 | 0 | 0 | |
| Storage (S) | 50 | 50 | 50 | 50 | 50 | 26 | 13 | 10 | 29 | 63 | 50 | 50 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -24 | -13 | -3 | 19 | 34 | -13 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 100 | 102 | 99 | 73 | 35 | 9 | 0 | **524** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 90 | 78 | **399** |
| Potential Infiltration (I) | 37 | 33 | 47 | 30 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 51 | 260 |
| Potential Direct Surface Water Runoff (R) | 20 | 18 | 25 | 16 | 2 | 0 | 0 | 0 | 0 | 0 | 32 | 27 | 140 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 197 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 0 | 260 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 31 | 72 | 97 | 99 | 96 | 70 | 34 | 9 | 0 | 507 |
| **Pervious Runoff ($m^3$)** | 19 | 17 | 24 | 16 | 2 | 0 | 0 | 0 | 0 | 0 | 31 | 26 | **135** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 191 | 3 | 0 | 0 | 0 | 0 | 0 | 57 | 0 | **251** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 14 | 12 | 17 | 19 | 19 | 18 | 21 | 23 | 22 | 17 | 21 | 19 | **223** |

| Evapotranspiration Analysis | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area K** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -27 | 12 | 0 | 0 | |
| Storage (S) | 50 | 50 | 50 | 50 | 50 | 26 | 13 | 10 | 29 | 63 | 50 | 50 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -24 | -13 | -3 | 19 | 34 | -13 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 100 | 102 | 99 | 73 | 35 | 9 | 0 | **524** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 90 | 78 | **399** |
| Potential Infiltration (I) | 37 | 33 | 47 | 30 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 51 | 260 |
| Potential Direct Surface Water Runoff (R) | 20 | 18 | 25 | 16 | 2 | 0 | 0 | 0 | 0 | 0 | 32 | 27 | 140 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 197 | 3 | 0 | 0 | 0 | 0 | 0 | 59 | 0 | 260 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 80 | 187 | 251 | 256 | 248 | 183 | 88 | 23 | 0 | 1,314 |
| **Pervious Runoff ($m^3$)** | 50 | 45 | 63 | 41 | 5 | 0 | 0 | 0 | 0 | 0 | 79 | 68 | **351** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 495 | 9 | 0 | 0 | 0 | 0 | 0 | 148 | 0 | **652** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 16 | 14 | 20 | 22 | 22 | 21 | 25 | 27 | 26 | 19 | 24 | 22 | **257** |

**TABLE 3: POST-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS**
**CATCHMENTS 200 and 202 to 209 (LANDS DRAINING WESTWARD TO TORRANCE CREEK SWAMP)**

## POST-DEVELOPMENT - WITH NO INFILTRATION AUGMENTATION / MITIGATION MEASURES

**PRE-DEVELOPMENT**

**Catchments 106, 208-1, and 208-2 (Lands Draining to Torrance Creek Swamp) (1)** **Area = 4.52 ha**

| Monthly Summary ($m^3$) (2) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-Development Infiltration (INF) | 0 | 0 | 0 | 8,092 | 143 | 0 | 0 | 0 | 0 | 0 | 2,011 | 0 | 10,246 |
| Pre-Development Runoff (R) | 1,066 | 960 | 1,362 | 965 | 300 | 203 | 236 | 256 | 246 | 185 | 1,460 | 1,468 | 8,706 |
| Pre-Development Evapotranspiration (ET) | 0 | 0 | 0 | 1,361 | 3,196 | 4,438 | 4,719 | 4,364 | 3,123 | 1,511 | 387 | 0 | 23,098 |
| Total = INF + R + ET | 1,066 | 960 | 1,362 | 10,417 | 3,639 | 4,641 | 4,955 | 4,620 | 3,369 | 1,696 | 3,858 | 1,468 | 42,050 |

**Notes:**

[1] Refer to Figure 1 (Attachment 1) for delineation of catchments and sub-areas.

[2] Monthly pre-development volume sum for each of Infiltration, Runoff, and Evapotranspiration from Sub-Areas A, B, C, F, and G as calculated in Table 1 (Attachment 2).

**POST-DEVELOPMENT**

**Catchments 200 and 202 to 209 (Lands Draining Westward to Torrance Creek Swamp) (3)** **Area = 5.86 ha**

| Monthly Summary - No Augmentation ($m^3$) (4) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Post-Development Infiltration (INF) | 0 | 0 | 0 | 6,991 | 124 | 0 | 0 | 0 | 0 | 0 | 1,822 | 0 | 8,937 |
| Post-Development Runoff (R) | 2,014 | 1,814 | 2,575 | 2,330 | 1,758 | 1,597 | 1,859 | 2,015 | 1,935 | 1,454 | 2,986 | 2,775 | 25,111 |
| Post-Development Evapotranspiration (ET) | 0 | 0 | 0 | 1,197 | 2,812 | 3,872 | 4,074 | 3,809 | 2,748 | 1,329 | 340 | 0 | 20,181 |
| Total = INF + R + ET | 2,014 | 1,814 | 2,575 | 10,518 | 4,693 | 5,469 | 5,933 | 5,824 | 4,683 | 2,783 | 5,148 | 2,775 | 54,229 |

**Notes:**

[3] Refer to Figure 3 (Attachment 1) for delineation of catchments and sub-areas.

[4] Monthly post-development volume sum for each of Infiltration, Runoff, and Evapotranspiration from Sub-Areas A and C to K as calculated in this table (Table 3, Attachment 2).

**SUMMARY - WITH NO INFILTRATION AUGMENTATION / MITIGATION MEASURES**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Post-Development Infiltration (INF)** | 8,937 | $m^3$/yr | 152 | mm/yr | 0.3 | L/s |
| **Post-Development Runoff (R)** | 25,111 | $m^3$/yr | 427 | mm/yr | 0.8 | L/s |
| **Post-Development Evapotranspiration (ET)** | 20,181 | $m^3$/yr | 344 | mm/yr | 0.6 | L/s |
| **Total = INF + R + ET** | 54,229 | $m^3$/yr | 923 | mm/yr | 1.7 | L/s |
| **Precipitation** | 54,229 | $m^3$/yr | 923 | mm/yr | 1.7 | L/s |

| | | |
|---|---|---|
| **Pre-Development Infiltration** | 10,246 | $m^3$/yr |
| **Infiltration Deficit** | **-1,309** | **$m^3$/yr** |
| **Pre-Development Runoff** | 8,706 | $m^3$/yr |
| **Runoff Surplus** | **16,404** | **$m^3$/yr** |

| **Sub-Area Descriptions (topography, soils, cover)** | |
|---|---|
| Sub-Area A | Rolling, Silty Sand to Sand Till, Pasture and Shrubs, No Impervious Cover |
| Sub-Area C | Rolling, Sand, Pasture and Shrubs, No Impervious Cover |
| Sub-Area D | Rolling, Silty Sand to Sand Till, Urban Lawn, 65% Impervious |
| Sub-Area E | Rolling, Sand, Urban Lawn, 65% Impervious |
| Sub-Area F | Rolling, Silty Sand to Sand Till, Urban Lawn, 40% Impervious |
| Sub-Area G | Rolling, Sand, Urban Lawn, 40% Impervious |
| Sub-Area H | Rolling, Sand, Pasture and Shrubs, 15% Impervious |
| Sub-Area I | Rolling, Silty Sand to Sand Till, Urban Lawn, 20% Impervious |
| Sub-Area J | Rolling, Sand, Urban Lawn, 20% Impervious Cover |
| Sub-Area K | Rolling, Sand, Urban Lawn, 10% Impervious Cover |

**TABLE 3: POST-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS**
**CATCHMENTS 200 and 202 to 209 (LANDS DRAINING WESTWARD TO TORRANCE CREEK SWAMP)**

## POST-DEVELOPMENT - WITH INFILTRATION AUGMENTATION / MITIGATION MEASURES

| Infiltration Augmentation Sources ($m^3$) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Rooftop Runoff - Singles ($m^3$) *(Note A)*** | 179 | 161 | 228 | 248 | 253 | 241 | 280 | 304 | 292 | 219 | 273 | 246 | **2,925** |
| **Rooftop Runoff - Multiblock ($m^3$) *(Note B)*** | 199 | 179 | 254 | 276 | 281 | 268 | 312 | 338 | 324 | 244 | 304 | 274 | **3,250** |
| **SWMF Recharge ($m^3$) *(Note C)*** | 607 | 547 | 776 | 703 | 533 | 484 | 564 | 611 | 587 | 441 | 902 | 836 | **7,590** |
| | | | | | | | | | | | | **Total Stormwater Volume Directed to Post-Development LID Infiltration Facilities =** | **13,764** |

Notes:
(A) 80% of precipitation captured by single-family rooftops that is directed to lot infiltration galleries (sized for 25 mm precipitation event).
(B) 80% of precipitation captured by multi-residential block rooftops that is directed to centralized infiltration gallery (sized for 25 mm precipitation event).
(C) Remaining impervious area (minus rooftops) runoff directed to SWMF, sized for 25mm event, which is approximately 80% of annual precipitation events.

**POST-DEVELOPMENT**
**Catchments 200 and 202 to 209 (Lands Draining Westward to Torrance Creek Swamp)** **Area = 5.86 ha**

| Monthly Summary - With Augmentation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Post-Development Infiltration (INF) ($m^3$)** | | | | | | | | | | | | | |
| Remaining Pervious Areas | 0 | 0 | 0 | 6,991 | 124 | 0 | 0 | 0 | 0 | 0 | 1,822 | 0 | 8,937 |
| Rooftop Runoff from Single-Family Lots | 179 | 161 | 228 | 248 | 253 | 241 | 280 | 304 | 292 | 219 | 273 | 246 | 2,925 |
| Rooftop Runoff from Multiblock-Residential Block | 199 | 179 | 254 | 276 | 281 | 268 | 312 | 338 | 324 | 244 | 304 | 274 | 3,250 |
| Remaining Impervious Runoff to SWMF | 607 | 547 | 776 | 703 | 533 | 484 | 564 | 611 | 587 | 441 | 902 | 836 | 7,590 |
| **Total =** | **984** | **887** | **1,258** | **8,218** | **1,191** | **992** | **1,156** | **1,252** | **1,203** | **904** | **3,301** | **1,356** | **22,702** |
| | | | | | | | | | | | | | |
| **Post-Development Runoff (R) ($m^3$)** | | | | | | | | | | | | | |
| In Absence of Infiltration Augmentation Sources | 2,014 | 1,814 | 2,575 | 2,330 | 1,758 | 1,597 | 1,859 | 2,015 | 1,935 | 1,454 | 2,986 | 2,775 | 25,111 |
| *Runoff Captured by Single-Family Rooftops* | *179* | *161* | *228* | *248* | *253* | *241* | *280* | *304* | *292* | *219* | *273* | *246* | *2,925* |
| *Runoff Captured by Multiblock-Residential Rooftops* | *199* | *179* | *254* | *276* | *281* | *268* | *312* | *338* | *324* | *244* | *304* | *274* | *3,250* |
| *Runoff Captured by Impervious Surfaces to SWMF* | *607* | *547* | *776* | *703* | *533* | *484* | *564* | *611* | *587* | *441* | *902* | *836* | *7,590* |
| **Total Adjusted Runoff =** | **1,030** | **928** | **1,316** | **1,103** | **691** | **604** | **704** | **763** | **732** | **550** | **1,507** | **1,419** | **11,346** |
| | | | | | | | | | | | | | |
| Post-Development Evapotranspiration (ET) ($m^3$) | 0 | 0 | 0 | 1,197 | 2,812 | 3,872 | 4,074 | 3,809 | 2,748 | 1,329 | 340 | 0 | 20,181 |
| Total = INF + R + ET | 2,014 | 1,814 | 2,575 | 10,518 | 4,693 | 5,469 | 5,933 | 5,824 | 4,683 | 2,783 | 5,148 | 2,775 | 54,229 |

**SUMMARY - WITH INFILTRATION AUGMENTATION / MITIGATION MEASURES**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Post-Development Infiltration (INF)** | 22,702 | $m^3$/yr | 386 | mm/yr | 0.7 | L/s | **Pre-Development Infiltration** | 10,246 | $m^3$/yr |
| **Post-Development Runoff (R)** | 11,346 | $m^3$/yr | 193 | mm/yr | 0.4 | L/s | **Infiltration Surplus** | **12,455** | **$m^3$/yr** |
| **Post-Development Evapotranspiration (ET)** | 20,181 | $m^3$/yr | 344 | mm/yr | 0.6 | L/s | **Pre-Development Runoff** | 8,706 | $m^3$/yr |
| **Total = INF + R + ET** | 54,229 | $m^3$/yr | 923 | mm/yr | 1.7 | L/s | **Runoff Surplus** | **2,640** | **$m^3$/yr** |
| **Precipitation** | 54,229 | $m^3$/yr | 923 | mm/yr | 1.7 | L/s | | | |

**Notes:**

† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2021. Canadian Climate Normals 1971-2000, Guelph Arboretum, Climate ID 6143069. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html. Accessed July 2021.

Assumptions:

[1] The monthly average precipitation collected at the Guelph Arboretum climate station is reflective of the precipitation trends that have historically occurred at the Site.

[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.

[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.

[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).

[5] Soil moisture capacity is at a maximum in April.

[6] Rooftop and EOP infiltration galleries sized for 25mm rainfall event, which corresponds to approximately 80% of annual precipitation.

## TABLE 4: POST-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS
## CATCHMENT 201A/B (LANDS DRAINING EASTWARD TO WOODLOT)

**Post-Development**

Model Type: Thornthwaite and Mather (1955)
Client: Rockpoint Properties Inc.
**Location 220 Arkell Road - Former Catchment 110**
**Post-Development Catchment 201A/B (Lands Draining Eastward to Woodlot)**
Total Site Area (ha) 1.15

| **Land Description Factors (Sub-area descriptions provided below)** | **Sub-Area A** | **Sub-Area C** | Sub-Area D | Sub-Area E | Sub-Area F | Sub-Area G | Sub-Area H | Sub-Area I | Sub-Area J | | | | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Topography | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.00 | 0.00 | | | | |
| Soils | 0.25 | 0.40 | 0.25 | 0.40 | 0.25 | 0.40 | 0.25 | 0.00 | 0.00 | | | | |
| Cover | 0.15 | 0.15 | 0.05 | 0.05 | 0.05 | 0.05 | 0.15 | 0.00 | 0.00 | | | | |
| Sum (Infiltration Factor)† | 0.60 | 0.75 | 0.50 | 0.65 | 0.50 | 0.65 | 0.60 | 0.00 | 0.00 | | | | |
| Soil Moisture Capacity (mm) | 150 | 100 | 75 | 50 | 75 | 50 | 100 | 0 | 0 | | | | |
| Site area (ha) | 0.90 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | 1.14 |
| Imperviousness Coefficient | 0.00 | 0.00 | 0.65 | 0.65 | 0.40 | 0.40 | 0.15 | 0.00 | 0.00 | | | | |
| Impervious Area (ha) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | 0.00 |
| Percentage of Total Site Area | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | | | | 0.0% |
| Remaining Pervious Area (ha) | 0.90 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | 1.14 |
| Total Pervious Site Area (ha) | 0.90 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | 1.14 |
| Percentage of Total Site Area | 78.3% | 21.7% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | | | | 100.0% |

| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Data** (Guelph Arboretum Climate Normals, 1971 - 2000)‡ | | | | | | | | | | | | | |
| Average Daily Temperature (°C) | -7.6 | -6.9 | -1.3 | 5.9 | 12.3 | 16.9 | 19.7 | 18.6 | 14.1 | 7.9 | 2.4 | -4 | **6.5** |
| Precipitation (mm) | 56.4 | 50.8 | 72.1 | 78.3 | 79.9 | 76 | 88.5 | 95.9 | 92.1 | 69.2 | 86.3 | 77.7 | **923** |

| **Potential Evapotranspiration Analysis for Site** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat Index | 0.0 | 0.0 | 0.0 | 1.3 | 3.9 | 6.3 | 8.0 | 7.3 | 4.8 | 2.0 | 0.3 | 0.0 | **34** |
| Unadjusted Potential Evapotranspiration (mm) | 0.0 | 0.0 | 0.0 | 28.4 | 60.7 | 84.3 | 98.8 | 93.1 | 69.9 | 38.4 | 11.2 | 0.0 | **485** |
| Potential Evapotranspiration Adjusting Factor for Latitude* | 0.77 | 0.87 | 0.99 | 1.12 | 1.23 | 1.29 | 1.26 | 1.16 | 1.04 | 0.92 | 0.81 | 0.75 | |
| Adjusted Potential Evapotranspiration (PET)(mm) | 0 | 0 | 0 | 32 | 75 | 108 | 124 | 108 | 73 | 35 | 9 | 0 | **564** |
| Precipitation - PET (mm) | 56 | 51 | 72 | 47 | 5 | -32 | -36 | -12 | 19 | 34 | 77 | 78 | **359** |

| **Evapotranspiration Analysis** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area A** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -51 | -9 | 0 | 0 | |
| Storage (S) | 150 | 150 | 150 | 150 | 150 | 121 | 95 | 88 | 107 | 141 | 150 | 150 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -29 | -26 | -8 | 19 | 34 | 9 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 105 | 114 | 104 | 73 | 35 | 9 | 0 | **546** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 68 | 78 | **377** |
| Potential Infiltration (I) | 34 | 30 | 43 | 28 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 47 | 226 |
| Potential Direct Surface Water Runoff (R) | 23 | 20 | 29 | 19 | 2 | 0 | 0 | 0 | 0 | 0 | 27 | 31 | 151 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 182 | 3 | 0 | 0 | 0 | 0 | 0 | 41 | 0 | 226 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 284 | 668 | 942 | 1023 | 928 | 653 | 316 | 81 | 0 | 4,896 |
| **Pervious Runoff ($m^3$)** | 202 | 182 | 259 | 167 | 19 | 0 | 0 | 0 | 0 | 0 | 244 | 279 | **1,352** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 1633 | 29 | 0 | 0 | 0 | 0 | 0 | 367 | 0 | **2,028** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

## TABLE 4: POST-DEVELOPMENT MONTHLY WATER BALANCE CALCULATIONS
## CATCHMENT 201A/B (LANDS DRAINING EASTWARD TO WOODLOT)

| Evapotranspiration Analysis | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-Area C** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| Accumulated Potential Water Loss (APWL) | 0 | 0 | 0 | 0 | 0 | -32 | -68 | -81 | -45 | -2 | 0 | 0 | |
| Storage (S) | 100 | 100 | 100 | 100 | 100 | 72 | 51 | 45 | 64 | 98 | 100 | 100 | |
| Change in Storage | 0 | 0 | 0 | 0 | 0 | -28 | -22 | -6 | 19 | 34 | 2 | 0 | |
| **Actual Evapotranspiration (mm)** | 0 | 0 | 0 | 32 | 75 | 104 | 110 | 102 | 73 | 35 | 9 | 0 | **539** |
| **Recharge/Runoff Analysis** | | | | | | | | | | | | | |
| **Water Surplus (mm)** | 56 | 51 | 72 | 47 | 5 | 0 | 0 | 0 | 0 | 0 | 75 | 78 | **384** |
| Potential Infiltration (I) | 42 | 38 | 54 | 35 | 4 | 0 | 0 | 0 | 0 | 0 | 56 | 58 | 288 |
| Potential Direct Surface Water Runoff (R) | 14 | 13 | 18 | 12 | 1 | 0 | 0 | 0 | 0 | 0 | 19 | 19 | 96 |
| Potential Infiltration (mm) | 0 | 0 | 0 | 228 | 4 | 0 | 0 | 0 | 0 | 0 | 56 | 0 | 288 |
| Pervious Evapotranspiration ($m^3$) | 0 | 0 | 0 | 79 | 185 | 257 | 274 | 253 | 181 | 87 | 22 | 0 | 1,337 |
| **Pervious Runoff ($m^3$)** | 35 | 32 | 45 | 29 | 3 | 0 | 0 | 0 | 0 | 0 | 47 | 48 | **238** |
| **Pervious Infiltration ($m^3$)** | 0 | 0 | 0 | 565 | 10 | 0 | 0 | 0 | 0 | 0 | 140 | 0 | **715** |
| Potential Impervious Evaporation (mm) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential Impervious Runoff (mm) | 56 | 51 | 72 | 78 | 80 | 76 | 89 | 96 | 92 | 69 | 86 | 78 | 923 |
| **Impervious Runoff ($m^3$)** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

**Post-Development Catchment 201A/B (Lands Draining Eastward to Woodlot)**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Post-Development Infiltration (INF)** | 2,743 | $m^3$/yr | 240 | mm/yr | 0.1 | L/s |
| **Post-Development Runoff (R)** | 1,590 | $m^3$/yr | 139 | mm/yr | 0.1 | L/s |
| **Post-Development Evapotranspiration (ET)** | 6,233 | $m^3$/yr | 544 | mm/yr | 0.2 | L/s |
| **Total = INF + R + ET** | 10,566 | $m^3$/yr | 923 | mm/yr | 0.3 | L/s |
| **Precipitation** | 10,566 | $m^3$/yr | 923 | mm/yr | 0.3 | L/s |

| | | |
|---|---|---|
| **Pre-Development Infiltration** | 5,294 | $m^3$/yr |
| **Infiltration Deficit** | **-2,551** | **$m^3$/yr** |
| **Pre-Development Runoff** | 4,035 | $m^3$/yr |
| **Runoff Deficit** | **-2,445** | **$m^3$/yr** |

| **Sub-Area Descriptions (topography, soils, cover)** | |
|---|---|
| Sub-Area A | Rolling, Silty Sand to Sand Till, Pasture and Shrubs, No Impervious Cover |
| Sub-Area C | Rolling, Sand, Pasture and Shrubs, No Impervious Cover |

**Notes:**

† Infiltration factors after Ontario Ministry of the Environment, 2003. Stormwater Management Planning and Design Manual. March 2003.; and Ontario Ministry of Environment and Energy (MOEE). 1995. MOEE Hydrogeological Technical Information Requirements for Land Development Applications. April 1995.

* PET adjustment factors after Thornthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration and the water balance. Drexel Institute of Technology, Laboratory of Climatology, Publications in Climatology, Volume X, No. 3. Centerton, New Jersey.

‡ Climate Data after Environment Canada, 2021. Canadian Climate Normals 1971-2000, Guelph Arboretum, Climate ID 6143069. [Online] http://climate.weather.gc.ca/climate_normals/index_e.html. Accessed August 2022.

Assumptions:

[1] The monthly average precipitation collected at the Guelph Arboretum climate station is reflective of the precipitation trends that have historically occurred at the Site.

[2] Surplus water is not available for runoff and recharge during months where water losses from actual evapotranspiration exceed precipitation inputs.

[3] Runoff, infiltration and evapotranspiration do not occur in months where the average daily temperature is below 0°C, which is the case for the months of December through March at the Site.

[4] Precipitation during freezing months (i.e., December to March) is assumed to accumulate as snow and result in additional precipitation in the first month thereafter where the average temperature is greater than 0°C (i.e., April).

[5] Soil moisture capacity is at a maximum in April.