GEMTEC
www.gemtec.ca

Hydrologic Impact Statement
Proposed Subdivision Development
Part of Lot 17, Concession 10 (Ramsey)
Almonte, Ontario

GEMTEC Project: 100436.004

GEMTEC
www.gemtec.ca

Submitted to:

Menzie Almonte 2 Inc. (c/o Regional Group)
1737 Woodward Drive
Ottawa, Ontario
K2C 0P9

Hydrologic Impact Statement
Proposed Subdivision Development
Part of Lot 17, Concession 10 (Ramsey)
Almonte, Ontario

October 4, 2024
GEMTEC Project: 100436.004

experience • knowledge • integrity

GEMTEC Consulting Engineers and Scientists Limited
32 Steacie Drive
Ottawa, ON, Canada
K2K 2A9

October 4, 2024 File: 100436.004 – R1

Menzie Almonte 2 Inc. (c/o Regional Group)
1737 Woodward Drive
Ottawa, ON
K2C 0P9

Attention: Stefanie Kaminski, Project Manager, Land Development

Re: Hydrologic Impact Statement, Proposed Subdivision Development
Part of Lot 17, Concession 10 (Ramsey)
Almonte, Ontario

Please find enclosed the Hydrologic Impact Statement for Phases 7 and 8 of the proposed Mill Run Extension. This document has been prepared in response to a request by the Mississippi Valley Conservation Authority (MVCA) following review of preliminary development documents. If you have any questions or require clarification, please contact us at your convenience.

Sincerely,

Troy Poirier, P.Eng.

Hans Arisz, M.Sc.E., P.Eng.

N:\Projects\100400\100436.004\Deliverables\Hydrologic Impact Statement\100436.004_RPT_Hydrologic Impact Statement_Mill Run Ext_2024-10-03_Rev2A.docx

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by Menzie Almonte 2 Inc. (c/o Regional Group) to prepare an Hydrologic Impact Statement (HIS) the proposed residential subdivision development located on Lot 17, Concession 10 (Ramsey), collectively referred to as Mill Run Extension, in Almonte, Township Municipality of Mississippi Mills, Lanark County, Ontario. The HIS was requested by the Mississippi Valley Conservation Authority (MVCA) following review of preliminary development documents including the Environmental Impact Statement (EIS), Draft Plan of Subdivision and the Servicing and Stormwater Management Report.

1.1 Objective

The primary objectives of the HIS are to evaluate potential hydrologic impacts of the proposed development in accordance with MVCA Ontario Regulation 153/06, Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation. Regulation 153/06 prohibits development within wetlands, and areas that could interfere with the hydrologic function of wetlands and watercourses. The following three (3) areas of concerns were identified by MVCA:

- the larger off site portion of the 30 hectare local wetland,
- the Spring Creek Municipal Drain, and
- the adjacent lands.

These impacts have been evaluated in greater detail for this HIS, and to supplement the findings of the previously completed EIS and Stormwater Management reports.

2.0 POTENTIALLY IMPACTED COMPONENTS

The following paragraphs describe the three (3) areas MVCA requested be addressed by the HIS.

2.1 Local Unevaluated Wetland

The EIS identified a 3.42 hectare portion of a larger local wetland (30 hectares) is located within the footprint of the proposed development. During two years of site investigations, no direct surface water was observed within the on-site portions of the local wetland; however, based on dominant vegetation communities and the presence of organic soils, the ecological land classification system for Southern Ontario indicates the presence of wetland. It should be noted that the Natural Heritage Information System and Ontario Base Mapping also do not indicate the presence of local wetlands within the study area. Furthermore, Mississippi Valley Conservation Authority (MVCA) geoportal mapping indicates the presence of only 0.25 ha of local wetland within the northern portion of the site.

The local, unevaluated wetland is comprised of wet meadow, deciduous thickets, and open-water marsh communities. Air photo imagery (1985 to 2021) indicates the wetland extents and flooding regime are variable over time and appear to be significantly affected by beaver activity and drought conditions.

Review of LiDAR topographic data indicates zones within the 30 ha wetland. The upper zone is located in the northern portion of the wetland and is partially isolated from the rest of the wetland by a ridge with a drop of approximately 0.5 m to the south. This separation is likely the result of beaver activity, and results in discharge being directed west to Spring Creek (which is hydraulically connected to all portions of the wetland). Portions of the wetland south of the ridge discharge to the local watercourse and to the Spring Creek Municipal Drain. While the proposed development lands are at a lower elevation than the local watercourse, it is likely that only portions of the wetland on the east side of the watercourse would be impacted by the proposed changes to grading.

Figure 1 presents the topography of the local wetland, while Figure 2 presents the limits of its surface water catchment, which is approximately 10 times that of the wetland (304 ha vs 30 ha).

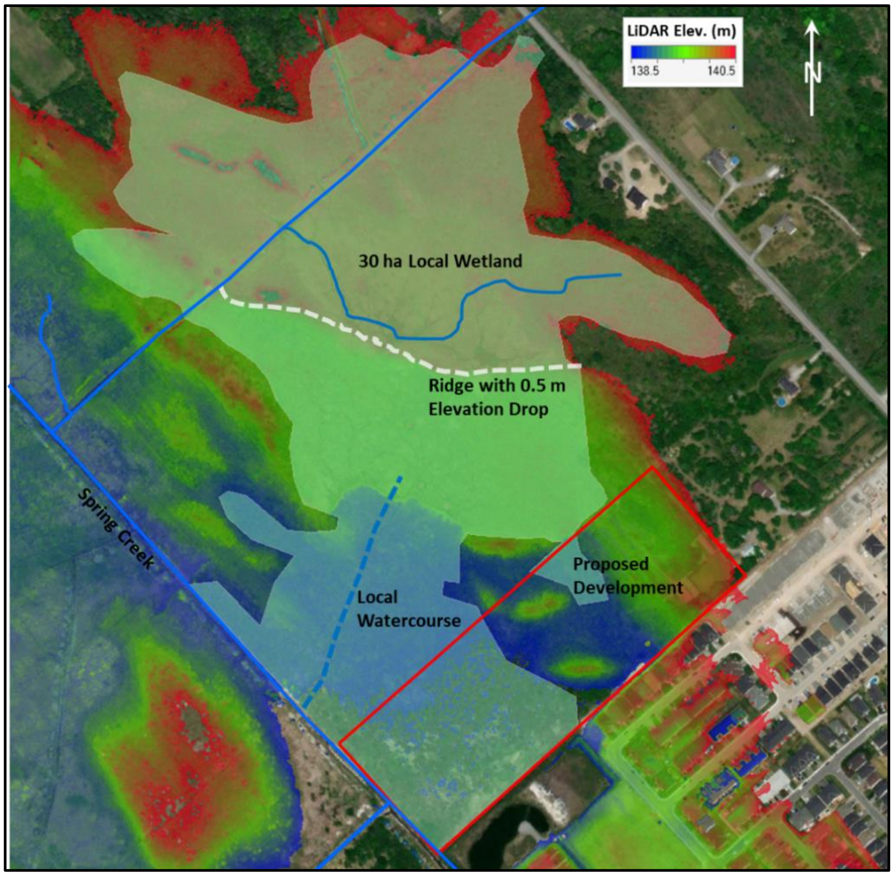


Figure 1. Topography of the Local Wetland

Figure 2. Local Wetland Contributing Catchment

2.2 Spring Creek Municipal Drain

Spring Creek is a municipal drain that runs along the west boundary of the property and receives runoff from upland drainage, the local wetland, and the proposed development (via the stormwater management facility (SWMF)). The SWMF was constructed during earlier phases of the subdivision development discharges at the west edge of the property to the Spring Creek Municipal Drain.

A fisheries assessment of Spring Creek was not conducted as part of the EIS. The watercourse, however, was observed to be flowing during field investigations and is assumed to provide direct fish habitat as well as contributing to downstream fish habitat. The Spring Creek Municipal Drain also runs through downstream residential development prior to discharging to the Mississippi River. As such, peak discharge rates from the proposed development should not increase peak flow rates nor the risk of downstream flooding. Figures 3 and 4 present the alignment of Spring Creek near the property as well as the contributing surface water catchment.

Figure 3. Location of Spring Creek near the Proposed Development

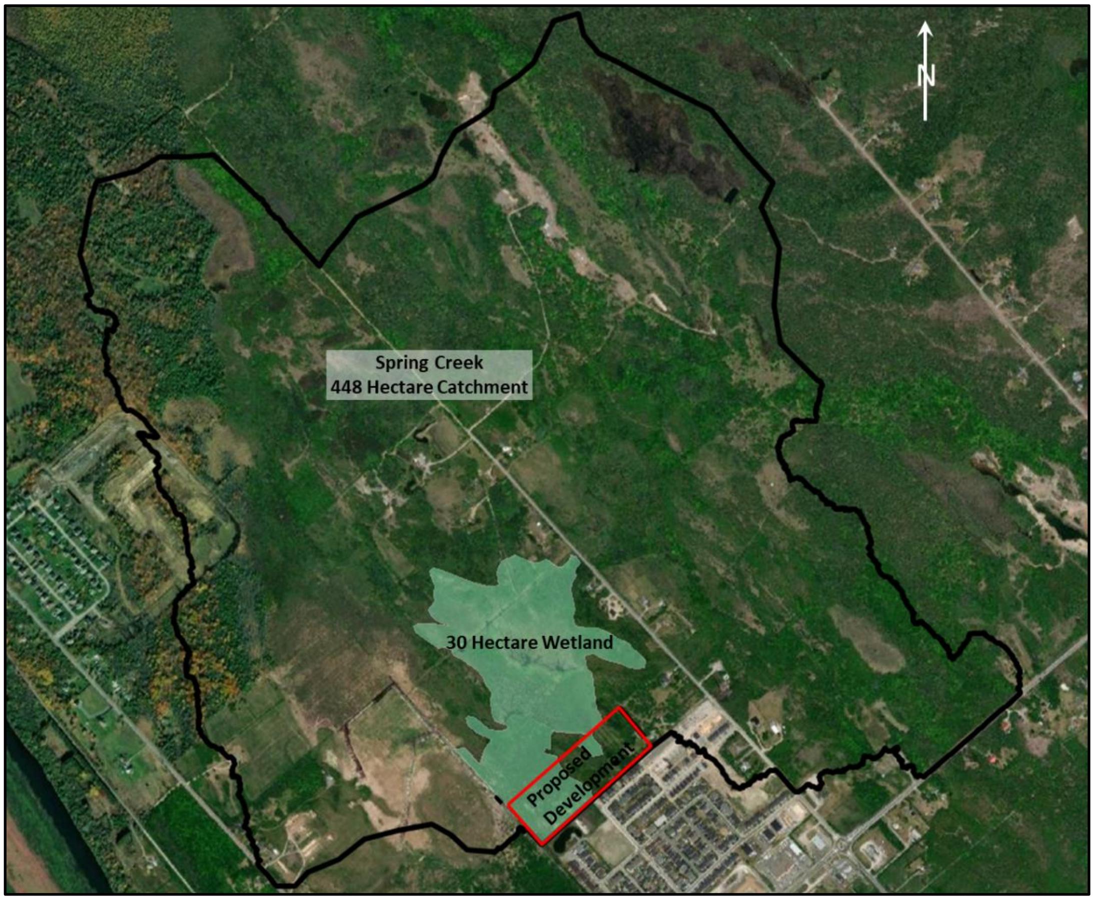


Figure 4. Spring Creek Contributing Catchment (near the Property)

2.3 Adjacent Lands

Existing residential development abuts the south and east sides of the proposed development, while the local wetland and Spring Creek Municipal Drain are located to the north and west. The stormwater management design for Phases 7 and 8 is intended to mitigate impacts of proposed development on these lands. A review of the site grading plan developed by Novatech (November 2023, Appendix A) indicates the existing SWMF will be expanded to accommodate the additional catchment area. Minor system drainage associated with the new development will discharge to the SWMF, as will major system runoff captured within the roadways. There may still be a slight volume of surface runoff from the rear of lots on the north and west sides of the proposed development that discharges to the local wetland and the Spring Creek Municipal Drain.

The other potential impact to adjacent lands is the loss of organic soils in the neighbouring unevaluated wetland. Geotechnical investigations discovered high groundwater elevations (0.1 m, 0.3 m, and 0.1 m below the surface) at test pit locations. This was associated with organic peat overlying soft grey silty clay and marl. Removal of peat and organic soil is often associated with lowering the water table and can have an adverse wetland impact.

3.0 ASSESSMENT OF HYDROLOGIC IMPACTS

The hydrologic impacts of the proposed development are discussed in the following sections. Design details for the grading plan, minor and major drainage systems as well as the SWMF have been previously presented by Novatech in the Mill Run Extension Phases 7 & 8 Servicing and Stormwater Management Report (November 10, 2023) and will only be reiterated as required in this analysis.

3.1 Impacts to Local Wetland

Grading changes associated with Phases 7 and 8 of the proposed development would eliminate 3.42 hectares of the 30 hectare local wetland. Infilling of the low-lying land associated with the wetland would reduce its footprint to 26.58 hectares, while grading changes would reduce its catchment area from 304 to 296. hectares. Hydrologic impacts to the local wetland can be determined by changes to the water balance (including hydroperiod), water quality and biodiversity. The water quantity and quality impacts are assessed in the following sections.

3.1.1 Hydrologic water balance

Water balance calculations for current and proposed post-development conditions were used to estimate changes to monthly and annual runoff volumes to the local wetland. These calculations are influenced by a few key factors including location, monthly temperature and precipitation, ground cover and land use, soil type, infiltration factors and evapotranspiration. The Thornthwaite and Mather water balance method (C.W. Thornthwaite and J.R. Mather, 1957) was used to incorporate these factors to allocate water for the various components of the hydrologic cycle. Monthly and annual water budgets were estimated for the following empirical relationship:

$P = ST + AET + I + R$

- Precipitation (P) – total monthly precipitation (rain and snow).

- Soil moisture storage (ST) – an accounting of water surplus or deficit within the soil water holding capacity (Table 5.1) based on values presented in the Storm Water Management (SWM) Planning & Design Manual (Table 3.1, Pg 3-4, MOECC, March 2003).

- Actual Evapotranspiration (AET) – actual evapotranspiration rates were calculated for each of the various catchment land cover types. AET is based on potential evapotranspiration rates and monthly changes to soil water storage (accounting for months with a soil moisture deficit, see tables in Appendix B).

- Infiltration (I) and Runoff (R) – where precipitation surplus occurs within the water budget calculations, it is distributed as either infiltration or runoff based on infiltration factors (Table 3.2) for the various groundcover/soil types. Infiltration factors are also based on values presented in the 2003 Storm Water Management (SWM) Planning & Design Manual.

Table 3.1 – Soil Moisture Storage Parameters

Land Cover	Water Holding Capacity (mm)
Wooded	400
Agriculture / Pasture	250
Wetland, Marsh & Swamp	200
Developed Lands	100

Table 3.2 – Soil Infiltration Factors for the Local Wetland Catchment

Land Cover	Topographic Factor	Soil Factor	Cover Factor	Total Infiltration Factor
Wooded	0.2	0.2	0.2	0.6
Agriculture / Pasture	0.1	0.2	0.2	0.5
Wetland, Marsh & Swamp	0.1	0.1	0.2	0.4
Developed Lands	0.1	0.1	0.1	0.3

3.1.1.1 Wetland Water Balance Current Conditions

A detailed water balance calculation table for current conditions is included in Appendix B. This includes calculations of soil moisture, actual evapotranspiration, precipitation surplus and infiltration/runoff volumes for the various land cover types within the local wetland catchment.

Average annual precipitation is 930 mm with a potential evapotranspiration depth of 679 mm (73% of precipitation). Actual evapotranspiration rates (AET) for the wooded, agriculture, wetland and developed land components were calculated as 653, 640, 632 and 602 mm/year, respectively. Between December and April, precipitation exceeds AET, generating monthly precipitation surpluses that result in net runoff and infiltration. AET exceeds precipitation between May and November resulting in monthly soil moisture deficits and no net runoff or infiltration.

Table 3.3 summarizes results of the annual water balance calculations for current conditions.

Table 3.3 – Annual Water Balance for Current Conditions – Local Wetland Catchment

Land Cover	Area (ha)	Actual ET (m^3/year)	Infiltration (m^3/year)	Runoff (m^3/year)
Wooded	121.6	793,732	202,216	134,811
Agriculture / Pasture	106.4	680,683	154,365	156,365
Wetlands, Marshes and Swamps	54.7	345,562	65,237	97,856
Developed Lands	21.3	128,171	20,969	48,929
Totals	**304**	**1,936,510**	**442,788**	**435,961**

3.1.1.2 Water Balance for Proposed Phases 7and 8 Development

Development of Phases 7 and 8 of the Mill Run lands will result in a loss of 7.2 hectares from the local wetland catchment, as runoff is diverted to the expanded SWMF. Table 3.4 summarizes the changes in the water balance, showing a slight decrease in annual runoff (-2.5%) to the wetland.

Table 3.4 – Annual Water Balance, Phase 7 & 8 Development – Local Wetland Catchment

Land Cover	Area (ha)	Actual ET (m^3/year)	Infiltration (m^3/year)	Runoff (m^3/year)
Wooded	119.0	776,761	197,892	131,928
Agriculture / Pasture	105.4	674,286	152,914	152,914
Wetlands, Marshes and Swamps	51.1	322,819	60,944	91,416
Developed Lands	21.3	128,171	20,969	48,929
Totals	**296.8**	**1,902,036**	**432,720**	**425,187**
Change from Current Conditions	**-7.2 ha (-2.4%)**	**-34,474 (-1.8%)**	**- 10,068 (-2.3%)**	**-10,774 (-2.5%)**

It should be noted the footprint of the local wetland would decrease by 3.42 hectares (11%) as a portion is infilled with the proposed development. This percentage decrease in footprint is greater than the calculated decrease in runoff to the wetland (2.5%). As such, slight water level increases could be expected for the remaining wetland. Review of monthly runoff volumes in Appendix B, indicate equivalent depths of runoff (volume divided by wetland footprint) would increase approximately 11% (between 22 mm and 38 mm) during the months with runoff.

In Section 2.2, it was noted the wetland has three partially separated zones: the upper zone and lower zones (east and west of the local watercourse). There are no changes to the levels of development and catchment areas for the upper and lower west zones. As such, little to no hydrologic impact is expected from the downgradient Mill Run Extension development. The lower east zone includes the proposed development, which will result in a loss of local wetland area and altered drainage patterns. This area would also be most susceptible to a wetland depth increase (up to 38 mm between December and April), however the actual impacts are likely to be smaller as runoff is discharged to the Spring Creek Municipal Drain during each month.

3.1.2 Wetland Water Quality

The Mill Run Extension would reduce the local wetland catchment area as runoff is redirected to the expanded SWMF (including runoff pollutants generated on the proposed development). As such, post-development wetland water quality is not expected to be negatively impacted by activities within the new development. Wetland water quality concerns would more likely be associated with the grade raise and construction activities. This will be addressed by a well-considered erosion and sediment control plan that mitigates the risk of sediment-laden runoff to the wetland. Erosion and sediment control measures to be implemented along the development/wetland boundary include but are not limited to the following (as noted in the Servicing and Stormwater Management Report).

- Heavy-duty sediment fencing will be positioned along the down gradient edge of construction adjacent to the wetland.
- Straw bale barriers will be installed in drainage ditches to mitigate the risk of sediment-laden runoff to the wetland and Spring Creek.
- Silt bags will be used for dewatering operations, with filtered water to be diverted from direct discharge to the wetland and Spring Creek, where possible.
- Straw and mulch are to be applied to disturbed soils for temporary erosion protection, prior to the application of topsoil and sod.
- Equipment maintenance and aggregate storage locations will have appropriate setback distances from the edge of the wetland (minimum 30 m and 40 m, respectively).
- Work will be scheduled to avoid wet, windy and rainy periods.

All erosion and sediment control measures are to be installed to the satisfaction of the engineer, the Municipality and the conservation authority prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and remain present during all phases of site preparation and construction. Progressive of disturbed areas along the wetland and Spring Creek boundaries will also mitigate the risk of water quality concerns.

3.1.3 Wetland Habitat

The proposed development is expected to result in the loss of 3.42 hectares of the local wetland and could include habitat for breeding wetland amphibians. Although surface water was not observed within the on-site portions of the wetland during 2 years of site investigations, dominant vegetation communities and the presence of organic soils indicate the presence of wetland.

To account for the loss of wetland, wetland habitat will be compensated off-site at a minimum of a 1:1 ratio. The wetland design will incorporate ecological design elements to support Blanding's turtle regulated habitat and general amphibian requirements. Habitat design and construction will be supervised by Ducks Unlimited, to be constructed on a Ducks Unlimited owned property. The findings of the EIS and discussions with the MECP indicate no significant residual negative impacts on the local, unevaluated wetland are anticipated if all mitigation measures detailed within are enacted, and best management practices are followed.

3.2 Impacts to Spring Creek

Located to the south of the proposed development, the existing Mill Run Subdivision SWMF provides quality and quantity control for Phases 1-6 of development before discharging to the Spring Creek Municipal Drain. To accommodate the Mill Run Extension Phases 7-9 (an additional 8.75 hectares), the permanent pool volume will increase from 4,214 m^3 to 6,786 m^3 while the active storage will increase from 8,620 m^3 to 11,259 m^3. Modelling completed by Novatech indicates peak runoff will be sufficiently controlled for the 5-year (602 L/s pre-development vs 596 L/s post development) and 100-year storm events (2,081 L/s pre-development vs 1,583 L/s post development).

Minor modifications are proposed for the original outlet structure, with no changes to the storm pipe outlet at Spring Creek. This will minimize disturbance to the Spring Creek Municipal Drain. The modified outlet structure will continue to provide quantity control for the Mill Run Phases 1-6 and Mill Run Extension Phases 7-9. The expanded SWMF design will provide pre-post development peak flow control as well as water quality protection at the "Enhanced" level (80% long-term TSS removal) prior to discharge to the Spring Creek Municipal Drain.

Drainage changes associated with the proposed development will not alter the catchment size for Spring Creek (448 hectares). Development would increase the level of imperviousness and local peak runoff rates, however, the expanded SWMF has been designed to accommodate these increases. As the proposed development lands already discharge southwest to the Spring Creek Municipal Drain, no significant changes to drainage patterns or downstream flow increases are expected.

3.3 Impacts to Adjacent Lands

3.3.1 Surface Drainage

The conceptual grading plan prepared by Novatech (November 2023) shows surface runoff is to be collected and discharged to the expanded SWMF via the minor (storm sewers) and major (overland) drainage systems. Although the SWMF is designed to accommodate all runoff from the expanded subdivision, there are portions of the property (e.g., rear lot drainage) that abut the Spring Creek Municipal Drain and the undeveloped lands to the north (the local wetland) that may receive uncontrolled runoff. This will not include captured runoff from impervious surfaces (roofs, driveways to be directed toward the road) and is expected to be similar to pre-development conditions (grass, planted trees).

The rear lot drainage from existing homes on Leishman Drive will continue to be collected and conveyed to the SWMF via the drainage swale between those properties and the Phase 7 development. Road and lot grading for Phase 7 is such that runoff from the northeast (future Phase 9 development) can continue in the current direction towards the Municipal Drain and will be collected in the Phase 7 major and minor drainage systems.

Based on the conceptual grading plan, no adverse hydrologic impacts are expected for the lands adjacent to the proposed development.

3.3.2 Loss of Organic Soils

The proposed development would result in loss of 3.64 hectares of unevaluated wetland including high-water content organic soils near the west portion of the site. These soils were identified as peat over-lying soft grey silty clay and marl. Organic soils such as peatlands have the ability to hold and release water through dry periods, recharge the groundwater system, and help to maintain surface water baseflows for biological communities. They also provide erosion control as wet weather flow is attenuated and slowly released.

The loss of organic soils would reduce baseflow to the unevaluated wetland and the Spring Creek Municipal Drain. The degree to which this impact occurs can be difficult to quantify. The expected area of organic soil loss is relatively small with a footprint that represents less than 1% of the catchments of the unevaluated wetland (304 hectares) and the Spring Creek Municipal Drain (448 hectares).

Hydrologic impacts of the loss of organic soils should also consider the following:

- The proposed reduction in unevaluated wetland footprint (12%) is less than the reduction in catchment area (2.5%) due to rerouting of runoff to the SWMF. This would result in a greater inflow per hectare to the remaining wetland portion to offset the water retention of the organic soils.

- The groundwater recharge function of the organic soils will be partially offset by groundwater recharge in the expanded SWMF, where ponded water in the permanent pool would drive sustained infiltration.
- Loss of the wet weather runoff storage and erosion control function of the organic soils will be offset by attenuation in the expanded SWMF.

The contribution to surface water baseflow provided by the organic soils in the wetland area may not be fully offset and could require monitoring dry-weather flow in the Spring Creek Municipal Drain to properly quantify. Monitoring pre- and post-construction discharge in the nearest culvert along the Spring Creek Municipal Drain (approximately 250 m downstream). Although monitoring could provide insight to the impacts to baseflow, possible limitations include:

- inability to isolate baseflow changes from the influence of upstream activities within the catchment, and
- the risk that impacts are too small to be evident in the monitoring data (due to the much larger Spring Creek catchment).

The expansion and naturalization of the Mill Run SWMF is expected to offset the flow attenuation and groundwater recharge functions of the organic soils, while providing habitat. In total, hydrologic impacts of the removal of organic soils on the unevaluated wetland and Spring Creek Municipal Drain are expected to be minor considering these offsetting functions.

4.0 CONCLUSIONS

The following conclusions are based on our review of the proposed Mill Run Extension (Phases 7 and 8) site grading plans, stormwater servicing plan and the hydrology of the adjacent lands.

- Grading changes associated with Phases 7 and 8 of the proposed development would infill 3.42 hectares of the 30 hectare local unevaluated wetland, while reducing its catchment area from 304 to 296.8 hectares.
  - The decrease in wetland footprint (11%) is greater than the decrease in contributing catchment area and runoff (approximately 2.5%). As such, slight increases water level (between 22 mm and 38 mm) could occur in the remaining wetland during the months with runoff. The actual magnitude of increases will likely be less as runoff is discharged to the Spring Creek Municipal Drain.
  - Impacts will likely be noticeable only in the portion of the wetland nearest the proposed development.
- Runoff from the Mill Run Extension will be redirected to the expanded Stormwater Management Facility where the wet pond will provide an “Enhanced” level (80% long-term TSS removal) of water quality prior to discharge to the Spring Creek Municipal Drain. This will mitigate the risk of water quality concerns for the local wetland and receiving Spring Creek Municipal Drain. The pond will discharge to the Spring Creek Municipal Drain, approximately 150 m downstream of the current wetland discharge location
- The off-site compensation of wetland habitat at a minimum ratio of 1:1 will off-set the loss of on-site wetlands. Detail design and ownership of the compensation habitat will be under the responsibility of Ducks Unlimited.
- .
- The catchment size for Spring Creek (448 hectares) will not be altered and the expanded SWMF has been designed to accommodate runoff increases associated with new development. As such, no increases in peak flow rate or flood risk are expected for the Spring Creek Municipal Drain.
- The stormwater servicing design accommodates all runoff from the proposed development, as well as drainage from the previously developed abutting lands mitigating the risk of hydrologic impacts are expected on the adjacent lands.
- Hydrologic impacts of the removal of organic soils on the unevaluated wetland and Spring Creek Municipal Drain are expected to be minor considering the offsetting functions of the expanded SWMF.

5.0 REFERENCES

GEMTEC. February 2023. Environmental Impact Statement, Proposed Subdivision Development, Part of Lot 17, Concession 10 (Ramsey), Almonte, Ontario.

Mississippi Valley Conservation Authority. April 2023. SWM Engineering Review, Re: Mill Run Extension Phase 7-8, Almonte, Mississippi Mills.

Mississippi Valley Conservation Authority. MVCA Portal, 2023. Available online: https://camaps.maps.arcgis.com/apps/webappviewer/index.html?id=70831905961e470988262c7a703a56af

Novatech. November 2023. Mill Run Extension Phases 7 & 8 Servicing and Stormwater Management Report.

Novatech. October 2023. Draft Plan of Subdivision.

Ontario Ministry of the Environment. March 2003. Stormwater Management Planning and Design Manual.

Ontario Ministry of Natural Resources (OMNR). 2011c. Land Information Ontario (LIO).

Paterson Group Inc. June 2021. Phase I - Environmental Site Assessment Part of 1825 Ramsay Concession 11A, Almonte, Ontario

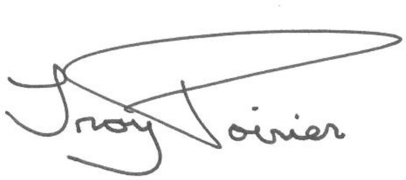
Paterson Group Inc. June 2021. Preliminary Geotechnical Investigation – Due Diligence, Proposed Residential Development, Ramsey Concession 11A – Mississippi Mills – Ontario.

Thornthwaite and Mather. 1957. Instructions and Tables for Computing Potential Evapotranspiration and Water Balance.

Toronto and Region Conservation Authority. November 2017. Wetland Water Balance Risk Evaluation.

6.0 CLOSING

We trust this report provides sufficient information to assess the potential hydrologic impacts associated with the development of the Mill Run Extension, Phases 7 and 8. If you have any questions concerning this report, please do not hesitate to contact our office.

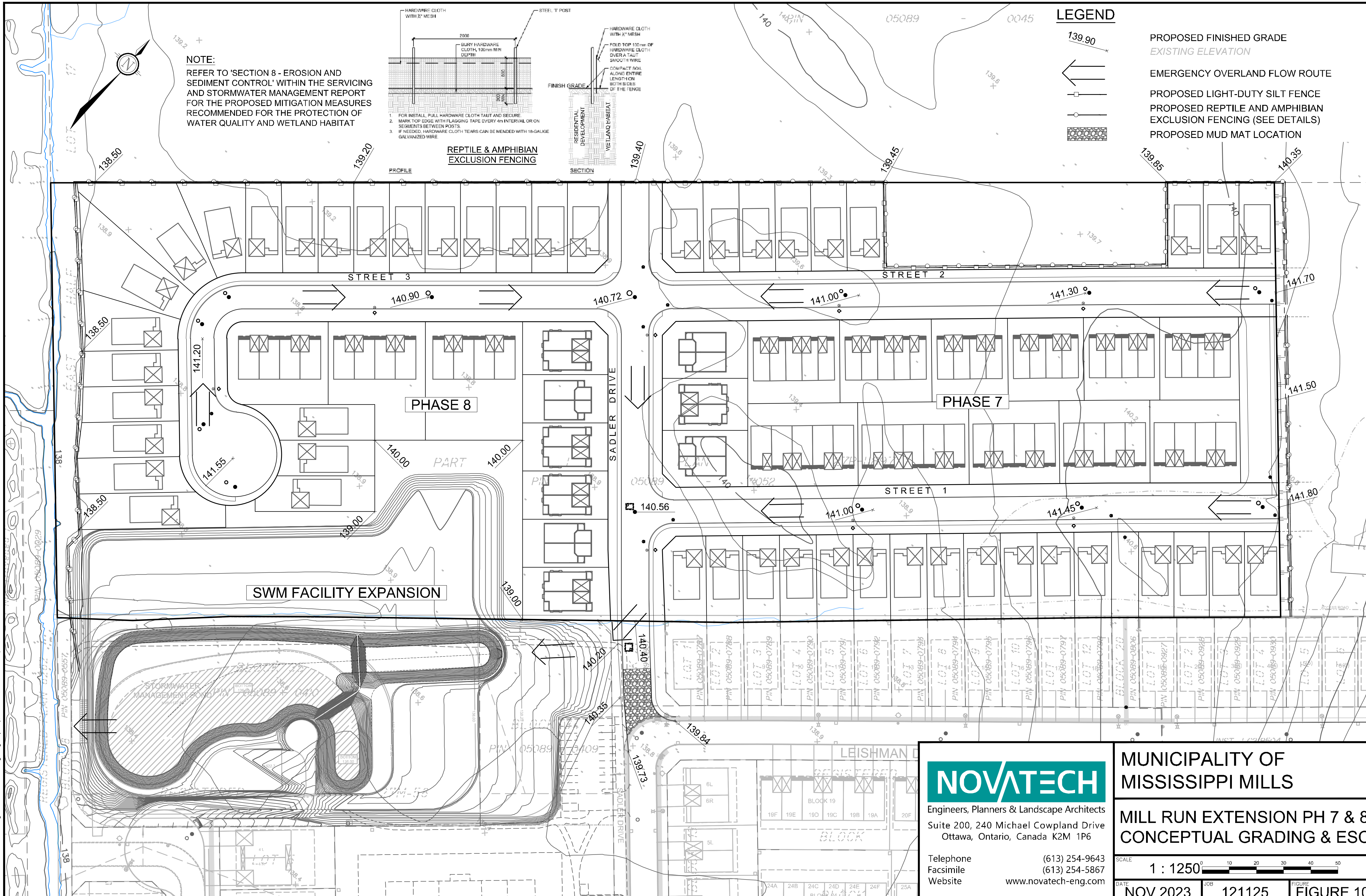


Troy Poirier, P.Eng.
Senior Hydrologist

Hans Arisz, M.Sc.E., P.Eng.
Manager of Water Resources

APPENDIX A

Mill Run Extension Phases 7 and 8
Conceptual Grading and Erosion and Sediment Control
Novatech, November 2023



MUNICIPALITY OF MISSISSIPPI MILLS

MILL RUN EXTENSION PH 7 & 8
CONCEPTUAL GRADING & ESC

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6

Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

SCALE 1 : 1250

DATE NOV 2023 | JOB 121125 | FIGURE FIGURE 10

M:\2021\121125\CAD\Design\121125-GR.dwg, Fig10(GR), Nov 21, 2023 - 1:39pm, smatthews

SHT11X17.DWG - 279mmX432mm

APPENDIX B

Wetland Water Balance Calculations

Report to: Menzie Almonte 2 Inc. (c/o Regional Group)
GEMTEC Project: 100436.004 (October 4, 2024)

Mill Run Extension - Local Wetland
Current Conditions Water Balance

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
	PET - Adjusted Potential Evapotranspiration (mm)	0.0	0.0	0.0	40.7	96.0	127.7	145.4	127.1	87.4	45.1	9.5	0.0	678.8 mm
	P - Total Precipitation (mm)	70.4	49.5	66.3	81.3	74.8	96.8	88.5	79.0	89.6	87.4	73.9	72.4	929.9 mm
	P-PET (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	2.2	42.3	64.4	72.4	
	Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	21.2	30.9	56.9	48.1	0.0	0.0	0.0	0.0	
	Total Moisture Deficit (mm)	0.0	0.0	0.0	0.0	21.2	52.1	109.0	157.1	0.0	0.0	0.0	0.0	
Wooded	Soil Moisture Retained (mm)	400.0	400.0	400.0	400.0	**379.0**	**352.0**	**303.0**	**269.0**	271.2	313.5	377.9	400.0	
	Change in Soil Moisture Retained (mm)	0.0	0.0	0.0	0.0	-21.0	-27.0	-49.0	-34.0	2.2	42.3	64.4	22.1	
121.6 ha	Actual Evapotranspiration (mm)	0.0	0.0	0.0	40.7	95.8	123.8	137.5	113.0	87.4	45.1	9.5	0.0	652.7 mm
	P-AET (mm)	70.4	49.5	66.3	40.6	-21.0	-27.0	-49.0	-34.0	2.2	42.3	64.4	72.4	
	Actual Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	-21.0	-48.0	-97.0	-131.0	-128.8	-86.5	-22.1	0.0	
	Change in Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	21.0	27.0	49.0	34.0	-2.2	-42.3	-64.4	-22.1	
	Precipitation Surplus (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.3	277.2 mm
	MOECC Infiltration Factor	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
	Runoff Coefficient	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
	Infiltration (mm)	42.2	29.7	39.8	24.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.2	166.3 mm
	Runoff (mm)	28.2	19.8	26.5	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.1	110.9 mm
	Infiltration (m^3)	51,364	36,115	48,372	29,636	-	-	-	-	-	-	-	36,728	202,216 m^3
	Runoff (m^3)	34,243	24,077	32,248	19,758	-	-	-	-	-	-	-	24,485	134,811 m^3
Agriculture/ Pasture	Soil Moisture Retained (mm)	250.0	250.0	250.0	250.0	**230.0**	**203.0**	**161.0**	**132.0**	134.2	176.5	240.9	250.0	
	Change in Soil Moisture Retained (mm)	0.0	0.0	0.0	0.0	-20.0	-27.0	-42.0	-29.0	2.2	42.3	64.4	9.1	
106.4 ha	Actual Evapotranspiration (mm)	0.0	0.0	0.0	40.7	94.8	123.8	130.5	108.0	87.4	45.1	9.5	0.0	639.7 mm
	P-AET (mm)	70.4	49.5	66.3	40.6	-20.0	-27.0	-42.0	-29.0	2.2	42.3	64.4	72.4	
	Actual Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	-20.0	-47.0	-89.0	-118.0	-115.8	-73.5	-9.1	0.0	
	Change in Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	20.0	27.0	42.0	29.0	-2.2	-42.3	-64.4	-9.1	
	Precipitation Surplus (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.3	290.2 mm
	MOECC Infiltration Factor	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
	Runoff Coefficient	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
	Infiltration (mm)	35.2	24.8	33.2	20.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.7	145.1 mm
	Runoff (mm)	35.2	24.8	33.2	20.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.7	145.1 mm
	Infiltration (m^3)	37,453	26,334	35,272	21,610	-	-	-	-	-	-	-	33,697	154,365 m^3
	Runoff (m^3)	37,453	26,334	35,272	21,610	-	-	-	-	-	-	-	33,697	154,365 m^3
Wetland, Marsh, Swamp	Soil Moisture Retained (mm)	200.0	200.0	200.0	200.0	**180.0**	**153.0**	**115.0**	**90.0**	92.2	134.5	198.9	200.0	
	Change in Soil Moisture Retained (mm)	0.0	0.0	0.0	0.0	-20.0	-27.0	-38.0	-25.0	2.2	42.3	64.4	1.1	
54.7 ha	Actual Evapotranspiration (mm)	0.0	0.0	0.0	40.7	94.8	123.8	126.5	104.0	87.4	45.1	9.5	0.0	631.7 mm
	P-AET (mm)	70.4	49.5	66.3	40.6	-20.0	-27.0	-38.0	-25.0	2.2	42.3	64.4	72.4	
	Actual Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	-20.0	-47.0	-85.0	-110.0	-107.8	-65.5	-1.1	0.0	
	Change in Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	20.0	27.0	38.0	25.0	-2.2	-42.3	-64.4	-1.1	
	Precipitation Surplus (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.3	298.2 mm
	MOECC Infiltration Factor	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
	Runoff Coefficient	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	
	Infiltration (mm)	28.2	19.8	26.5	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.5	119.3 mm
	Runoff (mm)	42.2	29.7	39.8	24.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.8	178.9 mm
	Infiltration (m^3)	15,404	10,831	14,506	8,888	-	-	-	-	-	-	-	15,609	**65,237** m^3
	Runoff (m^3)	23,105	16,246	21,760	13,331	-	-	-	-	-	-	-	23,414	**97,856** m^3
Developed Lands	Soil Moisture Retained (mm)	100.0	100.0	100.0	100.0	**81.0**	**56.0**	**33.0**	**20.0**	22.2	64.5	100.0	100.0	
	Change in Soil Moisture Retained (mm)	0.0	0.0	0.0	0.0	-19.0	-25.0	-23.0	-13.0	2.2	42.3	35.5	0.0	
21.3 ha	Actual Evapotranspiration (mm)	0.0	0.0	0.0	40.7	93.8	121.8	111.5	92.0	87.4	45.1	9.5	0.0	601.7 mm
	P-AET (mm)	70.4	49.5	66.3	40.6	-19.0	-25.0	-23.0	-13.0	2.2	42.3	64.4	72.4	
	Actual Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	-19.0	-44.0	-67.0	-80.0	-77.8	-35.5	28.9	0.0	
	Change in Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	19.0	25.0	23.0	13.0	-2.2	-42.3	-64.4	28.9	
	Precipitation Surplus (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.3	328.2 mm
	MOECC Infiltration Factor	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
	Runoff Coefficient	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
	Infiltration (mm)	21.1	14.9	19.9	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.4	98.4 mm
	Runoff (mm)	49.3	34.7	46.4	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.9	229.7 mm
	Infiltration (m^3)	4,499	3,163	4,237	2,596	-	-	-	-	-	-	-	6,476	**20,969** m^3
	Runoff (m^3)	10,497	7,380	9,885	6,056	-	-	-	-	-	-	-	15,110	**48,929** m^3
	Total Infiltration	108,719	76,443	102,387	62,729	-	-	-	-	-	-	-	92,510	442,788 m^3
	Total Runoff	105,297	74,037	99,165	60,755	-	-	-	-	-	-	-	96,706	435,961 m^3
Wetland Area (ha) 30	Equivalent Depth of Runoff to Wetland (mm)	350.99	246.79	330.55	202.52	-	-	-	-	-	-	-	322.35	

Mill Run Extension - Local Wetland
Post Development Water Balance

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
	PET - Adjusted Potential Evapotranspiration (mm)	0.0	0.0	0.0	40.7	96.0	127.7	145.4	127.1	87.4	45.1	9.5	0.0	678.8 mm
	P - Total Precipitation (mm)	70.4	49.5	66.3	81.3	74.8	96.8	88.5	79.0	89.6	87.4	73.9	72.4	929.9 mm
	P-PET (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	2.2	42.3	64.4	72.4	
	Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	21.2	30.9	56.9	48.1	0.0	0.0	0.0	0.0	
	Total Moisture Deficit (mm)	0.0	0.0	0.0	0.0	21.2	52.1	109.0	157.1	0.0	0.0	0.0	0.0	
Wooded Areas	Soil Moisture Retained (mm)	400.0	400.0	400.0	400.0	**379.0**	**352.0**	**303.0**	**269.0**	271.2	313.5	377.9	400.0	
	Change in Soil Moisture Retained (mm)	0.0	0.0	0.0	0.0	-21.0	-27.0	-49.0	-34.0	2.2	42.3	64.4	22.1	
119 ha	Actual Evapotranspiration (mm)	0.0	0.0	0.0	40.7	95.8	123.8	137.5	113.0	87.4	45.1	9.5	0.0	652.7 mm
	P-AET (mm)	70.4	49.5	66.3	40.6	-21.0	-27.0	-49.0	-34.0	2.2	42.3	64.4	72.4	
	Actual Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	-21.0	-48.0	-97.0	-131.0	-128.8	-86.5	-22.1	0.0	
	Change in Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	21.0	27.0	49.0	34.0	-2.2	-42.3	-64.4	-22.1	
	Precipitation Surplus (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.3	277.2 mm
	MOECC Infiltration Factor	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
	Runoff Coefficient	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
	Infiltration (mm)	42.2	29.7	39.8	24.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.2	166.3 mm
	Runoff (mm)	28.2	19.8	26.5	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.1	110.9 mm
	Infiltration (m^3)	50,266	35,343	47,338	29,003	-	-	-	-	-	-	-	35,943	197,892 m^3
	Runoff (m^3)	33,510	23,562	31,559	19,335	-	-	-	-	-	-	-	23,962	131,928 m^3
Agriculture/ Pasture	Soil Moisture Retained (mm)	250.0	250.0	250.0	250.0	**230.0**	**203.0**	**161.0**	**132.0**	134.2	176.5	240.9	250.0	
	Change in Soil Moisture Retained (mm)	0.0	0.0	0.0	0.0	-20.0	-27.0	-42.0	-29.0	2.2	42.3	64.4	9.1	
105.4 ha	Actual Evapotranspiration (mm)	0.0	0.0	0.0	40.7	94.8	123.8	130.5	108.0	87.4	45.1	9.5	0.0	639.7 mm
	P-AET (mm)	70.4	49.5	66.3	40.6	-20.0	-27.0	-42.0	-29.0	2.2	42.3	64.4	72.4	
	Actual Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	-20.0	-47.0	-89.0	-118.0	-115.8	-73.5	-9.1	0.0	
	Change in Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	20.0	27.0	42.0	29.0	-2.2	-42.3	-64.4	-9.1	
	Precipitation Surplus (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.3	290.2 mm
	MOECC Infiltration Factor	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
	Runoff Coefficient	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
	Infiltration (mm)	35.2	24.8	33.2	20.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.7	145.1 mm
	Runoff (mm)	35.2	24.8	33.2	20.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.7	145.1 mm
	Infiltration (m^3)	37,101	26,087	34,940	21,407	-	-	-	-	-	-	-	33,380	152,914 m^3
	Runoff (m^3)	37,101	26,087	34,940	21,407	-	-	-	-	-	-	-	33,380	152,914 m^3
Wetland, Marsh, Swamp	Soil Moisture Retained (mm)	200.0	200.0	200.0	200.0	**180.0**	**153.0**	**115.0**	**90.0**	92.2	134.5	198.9	200.0	
	Change in Soil Moisture Retained (mm)	0.0	0.0	0.0	0.0	-20.0	-27.0	-38.0	-25.0	2.2	42.3	64.4	1.1	
51.1 ha	Actual Evapotranspiration (mm)	0.0	0.0	0.0	40.7	94.8	123.8	126.5	104.0	87.4	45.1	9.5	0.0	631.7 mm
	P-AET (mm)	70.4	49.5	66.3	40.6	-20.0	-27.0	-38.0	-25.0	2.2	42.3	64.4	72.4	
	Actual Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	-20.0	-47.0	-85.0	-110.0	-107.8	-65.5	-1.1	0.0	
	Change in Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	20.0	27.0	38.0	25.0	-2.2	-42.3	-64.4	-1.1	
	Precipitation Surplus (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.3	298.2 mm
	MOECC Infiltration Factor	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
	Runoff Coefficient	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	
	Infiltration (mm)	28.2	19.8	26.5	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.5	119.3 mm
	Runoff (mm)	42.2	29.7	39.8	24.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.8	178.9 mm
	Infiltration (m^3)	14,390	10,118	13,552	8,303	-	-	-	-	-	-	-	14,582	**60,944** m^3
	Runoff (m^3)	21,585	15,177	20,328	12,454	-	-	-	-	-	-	-	21,873	**91,416** m^3
Developed Lands	Soil Moisture Retained (mm)	100.0	100.0	100.0	100.0	**81.0**	**56.0**	**33.0**	**20.0**	22.2	64.5	100.0	100.0	
	Change in Soil Moisture Retained (mm)	0.0	0.0	0.0	0.0	-19.0	-25.0	-23.0	-13.0	2.2	42.3	35.5	0.0	
21.3 ha	Actual Evapotranspiration (mm)	0.0	0.0	0.0	40.7	93.8	121.8	111.5	92.0	87.4	45.1	9.5	0.0	601.7 mm
	P-AET (mm)	70.4	49.5	66.3	40.6	-19.0	-25.0	-23.0	-13.0	2.2	42.3	64.4	72.4	
	Actual Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	-19.0	-44.0	-67.0	-80.0	-77.8	-35.5	28.9	0.0	
	Change in Soil Moisture Deficit (mm)	0.0	0.0	0.0	0.0	19.0	25.0	23.0	13.0	-2.2	-42.3	-64.4	28.9	
	Precipitation Surplus (mm)	70.4	49.5	66.3	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.3	328.2 mm
	MOECC Infiltration Factor	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
	Runoff Coefficient	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
	Infiltration (mm)	21.1	14.9	19.9	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.4	98.4 mm
	Runoff (mm)	49.3	34.7	46.4	28.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.9	229.7 mm
	Infiltration (m^3)	4,499	3,163	4,237	2,596	-	-	-	-	-	-	-	6,476	**20,969** m^3
	Runoff (m^3)	10,497	7,380	9,885	6,056	-	-	-	-	-	-	-	15,110	**48,929** m^3
	Total Infiltration	106,255	74,710	100,067	61,308	-	-	-	-	-	-	-	90,380	432,720 m^3
	Total Runoff	102,692	72,206	96,712	59,252	-	-	-	-	-	-	-	94,325	425,187 m^3
Wetland Area (ha) 26	Equivalent Depth of Runoff to Wetland (mm)	388.99	273.51	366.33	224.44	-	-	-	-	-	-	-	357.29	

Mill Run Extension Phases 7 and 8
Monthly Moisture Balance for the Project

Month	Temp deg. C	Heat Index	Daily Unadjusted PET mm	Monthly Correction Factors	Monthly Adjusted PET mm	Monthly Total Precip mm	Moisture Surplus mm	Moisture Deficit mm	Total Moisture Surplus mm
January	-10	0	0.0	24.0	0.0	70.4	70.4	0.0	70.4
February	-8.5	0	0.0	24.3	0.0	49.5	49.5	0.0	49.5
March	-2.4	0	0.0	30.6	0.0	66.3	66.3	0.0	66.3
April	5.9	1.29	1.2	33.9	40.7	81.3	40.6	0.0	40.6
May	13.6	4.55	2.5	38.4	96.0	74.8	0.0	21.2	-21.2
June	18.7	7.37	3.3	38.7	127.7	96.8	0.0	30.9	-30.9
July	21.2	8.91	3.7	39.3	145.4	88.5	0.0	56.9	-56.9
August	20.1	8.22	3.5	36.3	127.1	79.0	0.0	48.1	-48.1
September	15.3	5.44	2.8	31.2	87.4	89.6	2.2	0.0	2.2
October	8.2	2.12	1.6	28.2	45.1	87.4	42.3	0.0	42.3
November	1.7	0.2	0.4	23.7	9.5	73.9	64.4	0.0	64.4
December	-5.8	0	0.0	22.5	0.0	72.4	72.4	0.0	72.4
					678.8	929.9	408.2	157.1	**251.1**

PET - Potential Evapotranspiration
Latitude 45.2 deg

experience • knowledge • integrity

civil
geotechnical
environmental
structural
field services
materials testing

civil
géotechnique
environnement
structures
surveillance de chantier
service de laboratoire des matériaux

expérience • connaissance • intégrité