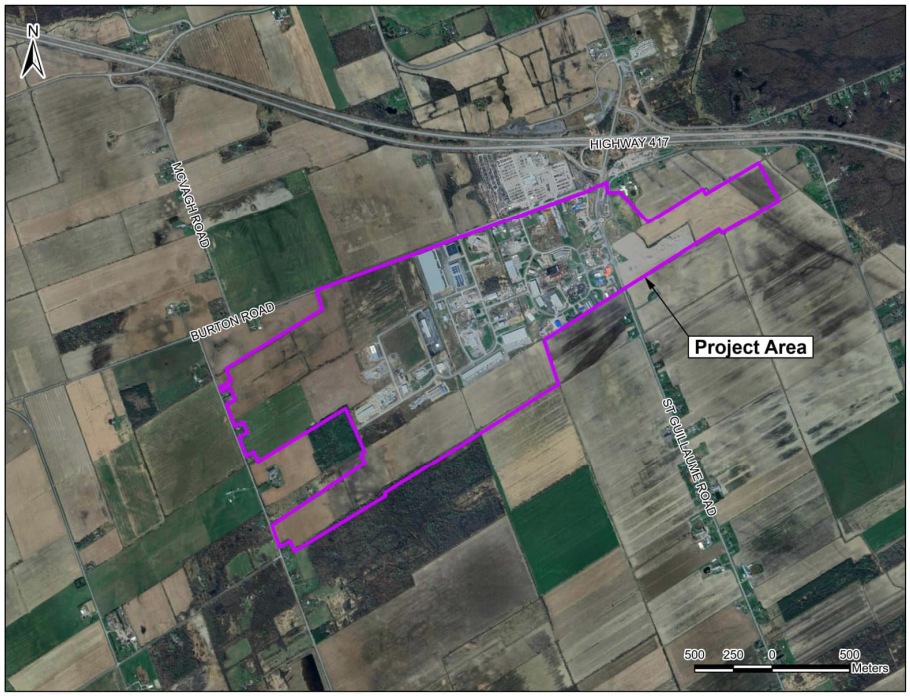
MEMORANDUM

To:	Russell Township
From:	Egis Canada Limited
Date:	April 1, 2025
Re:	Groundwater Recharge Impacts and Water Budget, Proposed Industrial Park Expansion Area

The Township of Russell is proposing the expansion of the 417 Industrial Park Area, hereinafter referred to as the "Project Area" or "Site". The proposed Project Area is centered around the intersection of Highway 417 and Highway 33 (Rockdale Road to the north, and St. Guillaume Road to the south), located within Vars, Ontario, and will be privately serviced. The approximate extents of the Project Area (in purple) are shown below.



Egis Canada Ltd. (Egis, formerly McIntosh Perry) has previously completed subsurface investigations and summarized hydrogeological characteristics of the Project Area in 2021. Based on these investigations and a review of salient resources, the following memo provides an overview of the hydrogeological characteristics of the Project Area, potential impacts to groundwater recharge, and key water balance figures for the Project Area.

1.1 Hydrogeological Characteristics

1.1.1 Soil and Groundwater

Based on boreholes constructed within the Project Area and a review of relevant online maps, the Project Area is predominantly located within Russell and Prescott Sand Plains (Ontario Geological Survey, 2021). The northeast and southwest portion of the Project Area consist of till plains (Ontario Geological Survey, 2021). Regional surficial geology at the Site consists of fine-textured glaciolacustrine deposits of silt and clay, with minor sand and gravel. The generalized stratigraphy at the Site, based on Egis' 2021 subsurface investigation, consists of a thin veneer of topsoil, asphalt, or granular fill, underlain by native overburden. Native overburden generally consists of near-surface fine-grained deposits of clay/silty clay or clayey silt, underlain by a till-like material (diamict, silty gravelly sand, traces of clay and gravel, cobbles and boulders), followed by inferred bedrock at an average depth of ~7.5 m bgs, or 67.95 m asl. The average overburden thickness across the Project Area is 7.17 m bgs. Bedrock consists of weathered limestone with interbedded shale (Egis, 2021).

Based on a review of the MECP Water Well Information System (WWIS), 172 Well Records were identified within a 1,000 m radius of the Site. Of these wells, 148 Records were listed for water supply purposes, 10 were listed as test/monitoring wells, 7 were listed as abandoned, and 7 records did not have any information. A majority of the wells in the area were listed for domestic purposes, and total depths range from 3.6 to 121.9 m. Static water levels ranged from 0.8 to 27.4 m below ground surface. Based on the Well Record data, a majority of these wells are completed deeper than 10 m below the ground surface (range from 3.6 to 121.9 m), and are completed within bedrock.

1.1.2 Hydraulic Conductivity and Proposed Groundwater Flow Rates

Based on water level measurements made within the Project Area in 2021, shallow groundwater flow is expected to be to the south/southeast, towards Castor River. Six (6) single well response tests were completed within the Project Area, which indicated hydraulic conductivities ranging from 1.7×10^{-7} to 1.2×10^{-5} m/s. Using these data, as well as assumptions regarding standardized excavation depths and lengths, a Finite Element Model (FEM) was generated to determine an average influx of groundwater flow from typical subsurface construction excavations. The FEM was generated under the assumption that either a trench box shoring system or permeable shoring would be utilized to maintain excavation stability. Trench excavations were modeled as 20 m long x 3 m wide x 3 m deep, and a standard building slab construction was modeled as 22 m long x 14 m wide x 5.6 m deep. The estimated short-term dewatering requirements (including safety factors and 2-year stormwater event) calculated with these data were as follows:

~*110,000 L/day for a typical trench* (20 m long x 3 m wide x 3 m deep); and

~*800,000 L/day for a typical building* (22 m long x 14 m wide x 5.6 m deep).

The estimated zone of dewatering influence from a typical trench and building excavation are estimated to range from 4.1 m (trench) to over 46 m (building) from the edge of excavation.

1.1.3 Intake Protection Zone (IPZ) 3

The Project Area is located within an Intake Protection Zone (IPZ) for the surface water intake located on the South Nation River at Casselman. The watercourses and drainage features within the Project Area are classified as being IPZ-3, which is the third and largest classified zone surrounding a surface water intake point. In an IPZ-3, certain activities have the potential to impact source water for human consumption or agricultural use. However, no policies are present within the Source Protection Plan that dictate restrictions around dewatering within the Project Area that may impact surface water.

1.1.4 Analysis

Given that a typical proposed construction within the Project Area has a maximum depth of 5 m below ground surface (or shallower; for example, the Geotechnical Investigation for the warehouse at 211 Corduroy Road indicated a footing foundation depth of 1.2 – 1.8 m below existing grade, and the Geotechnical Investigation for the industrial building at 101 Warehouse Street indicated a footing depth of a maximum of 1.2 m below the original ground surface), the potential dewatering which occurs within the overlying overburden aquifer is unlikely to impact water well supplies. Well users in the area rely upon the deeper bedrock aquifer (an average of greater than 10 m below ground surface) to supply groundwater.

Short-term dewatering within the stated theoretical zones of influence could potentially interfere with the local overburden aquifer and natural features. However, interference with nearby well users is not anticipated due to the short-term nature of dewatering, relatively shallow typical excavations expected for the Project Area, and low hydraulic conductivities of the soil and isolation of the deeper bedrock (supply) aquifer.

In order to adequately protect the underlying aquifer from surface contaminants, safe construction practices must be implemented to ensure the proper handling and storage of contaminants and/or hazardous wastes. The primary potential contaminants expected during the proposed industrial park expansion include fuels from heavy machinery and other equipment used. The proposed construction activities must ensure that minimal changes in Site grading or hydrology occur.

It is noted that if pumped groundwater during construction is to be returned to the natural environment, a detailed Environmental Management Plan must be prepared and implemented during construction phases. This Plan must include provisions for erosion and sediment control measures, regular testing of discharged water, and contingency measures. The exact design and implementation of the Environmental Management Plan will be the responsibility of the contractor on any given project. An Environmental Compliance Approval (ECA) may also be required.

1.2 Aquifer Protection

1.2.1 Vulnerability

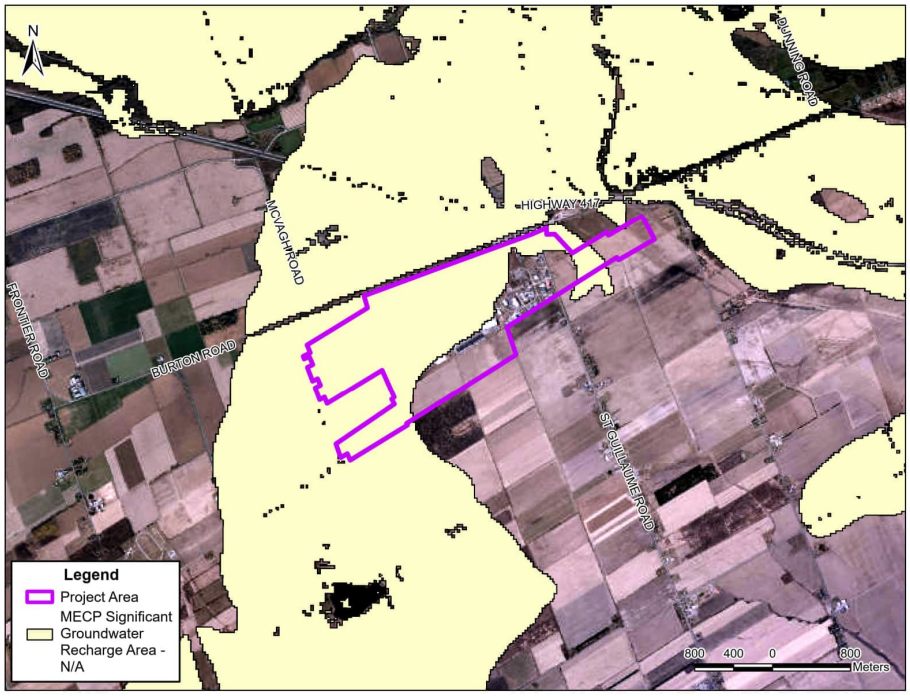
The Project Area is positioned within an a Highly Vulnerable Aquifer (HVA, risk score of 6). An HVA is an area where unconfined aquifer conditions are present and the aquifer is susceptible to contamination. Generally, when infiltrating water is able to rapidly flow through unsaturated layers to an aquifer, the aquifer is considered vulnerable to contamination. Based on a review of Well Records within the area, as well as previous subsurface

investigations completed, soils consist of a clay/silty clay, underlain by a till-like material (silty gravelly sand). These materials indicate adequate protection of underlying aquifers due to their low permeability (clay/silty clay and till-like material). The risk score of 6 is considered to be moderate.

1.2.2 Significant Groundwater Recharge Areas

The Project Area is located within a Significant Groundwater Recharge Area (SGRA). An SGRA is an area where water from precipitation provides significant recharge to the underlying aquifer. With the proposed industrial expansion changing the natural ground cover (creation of more hard, impermeable surfaces), natural aquifer recharge processes can be impacted. This impact is two-fold; the overall infiltration area is typically reduced by the development of hardscaped areas, and simultaneously where runoff is redirected to the remaining permeable areas (ditches, low-impact development infrastructure, etc.), the concentration of surficial contaminants is potentially higher. Based on groundwater samples obtained as part of the 2021 investigation, the natural shallow groundwater quality exceeded the Provincial Water Quality Objectives (PWQO) for various parameters associated with surface contamination, namely certain metals (boron, cobalt, copper) and polycyclic aromatic hydrocarbons (anthracene, fluoranthene, phenanthrene).

A SGRA comprises a majority of the Project Area. The north, east, south, and west portions of the Site are located within the SGRA, however the central/east/south portion of the 'Phase 1' portion of the Project Area are not located within the SGRA. Within the areas of the Project Area that are also located in the SGRA indicate overburden consisting of clay/silty clay, underlain by a till-like material (silty gravelly sand). No exposed bedrock was identified during previous subsurface investigations in 2020 and 2021. This information indicates that the Project Area is not located within a hydrogeologically sensitive area. A map of the extent of the SGRA is provided below.



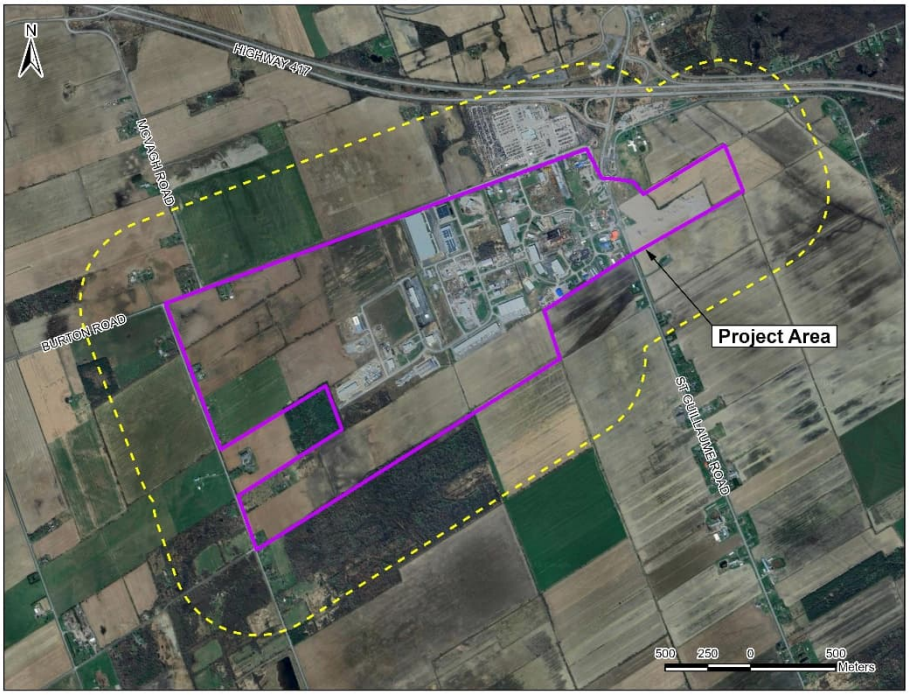
1.3 Water Balance

In order to provide a baseline for assessing impacts of proposed industrial developments within the Project Area, a water balance calculation was determined utilizing pre-development conditions. Site statistics were summarized using a combination of information made available from previous reports, as well as approximate estimations of land use areas using Google Earth. The total runoff value calculated for pre-existing development conditions is 680,286 m^3/year. The total pre-development infiltration was calculated as 77,049 m^3/year. The water balance calculations are attached.

1.4 Public Correspondence

Egis was involved in the initial public consultation process related to this project through the circulation of letters to residents in proximity to the proposed industrial development. Egis prepared a letter which provided notice of the proposed Industrial Park expansion, and outlined questions concerning their water well and groundwater usage. The goal of this letter campaign was to gain further information related to water wells that could be potentially affected by the industrial development, to understand how residents use groundwater, as well as to provide an opportunity for residents to communicate with Egis and the Township on any specific concerns they have with the proposed development.

Letters were delivered in December 2024 to residents within 500 m of the Project Area, as outlined below. Residents were given an original timeline of January 24, 2025, to respond to the letter, which was then extended to the end of February to ensure enough time was provided to review and answer the letter if desired.



Four (4) responses to this letter were received. Three (3) residents completed the questions concerning their well and well water usage, which indicated no yield issues. One individual described that a water softener and reverse osmosis system is in use to treat groundwater. The fourth response did not include answers to Egis' questionnaire, however the resident expressed concern regarding the depth of public consultation completed to-date, and the proposed industrial park expansion in general.

1.5 Recommendations

Egis has prepared the following high-level recommendations, which should be in place prior to any new development or construction as part of the proposed Industrial Park expansion. These recommendations are to be expanded upon in the Township's Official Plan, and are subject to municipal staff review and approval. The provided recommendations do not supersede other laws, bylaws, procedures, or guidelines which may be applicable to the Project Area and/or specific Zoning Bylaw Amendment (ZBA) or Site Plan Approval (SPA) processes. Recommendations covered by this memo generally fall into the following categories:

- Administrative Processes;
- Stormwater Quantity and Quality Management;
- Surface Water and Wetland Protection; and
- Aquifer Protection and Prohibited Land Uses.

1.5.1 Administrative Processes

- A Hydrogeological Assessment prepared by a qualified, third party Professional Geoscientist or Engineer must be provided by the proponent prior to development. This report must include, but not be limited to, the following:
    - Background Review and Existing Conditions: A summary must be provided of existing hydrogeological, hydrological, geological, and land use conditions in the vicinity of the proposed development. This should include a review of MECP Water Well Information System (WWIS) records, subsurface and hydrological mapping, and surrounding land use. An approximation of overburden (shallow) and bedrock (deeper) groundwater flow direction must be included, along with a discussion of site connectivity to surface watercourses/water bodies.
    - Groundwater Quantity and Quality Assessment: An on-site well must provide enough water to service the proposed development, and water quality and quantity must be shown to be suitable for servicing the proposed development. The proponent must demonstrate that the proposed development will not impact surrounding water wells or land uses, partly through the completion of a minimum 6-hr pumping test completed in accordance with MECP Procedure D-5-5 entitled Private Wells: Water Supply Assessment. (*MECP Procedure D-5-5*)
    - Terrain Evaluation: Where private a sewage system is proposed, a terrain assessment demonstrating that overburden and conceptual septic design are sufficient to treat discharged effluent must be provided. (*Ontario Building Code*, and MECP Procedure D-5-4 entitled Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment (*MECP Procedure D-5-4*))
    - Water Balance: A water balance following an accepted methodology must be provided. Further details are presented in S. 1.4.2 – Stormwater Quantity and Quality Management.

- Conclusions and Recommendations: The qualified Professional Geoscientist or Professional Engineer must provide a set of conclusions and recommendations based on the above analyses.

- It is recommended that all ZBA and SPA applications within the Project Area are subject to an initial pre-consultation with Township of Russell planning staff. It is recommended that any technical staff (e.g., peer reviewers) that will be representing the Township of Russell during the ZBA or SPA process be present at this pre-consultation as well. The purpose of the pre-consultation will be to address any site-specific concerns that the Township of Russell may have with the proposed development, and to outline technical submission requirements for the proponent.

1.5.2 Stormwater Quantity and Quality Management

In addition to any site-specific requirements set out at the pre-consultation, stormwater quantity and quality recommendations include the following:

- Stormwater Quantity Controls shall be provided to effectively attenuate the peak flow rates to match existing levels at all acceptable sufficient outlet locations for the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year design storm events. Applicable various synthetic events like Chicago Storm and SCS Type II events shall be considered for the design.
- Stormwater Quality Controls shall be provided to achieve the necessary "Enhance" level of protection, which corresponds to 80% long term average removal of Total Suspended Solids (TSS) as recommended in the MECP SWMMPD Manual, 2003.
- Applicable Low Impact developments (LIDs) shall be considered and incorporated into the SWM plan in a "treatment train" approach (lot-level, conveyance level, and end-of pipe level practices) to mimic the hydrologic cycle.
- A pre- and post-development annual water balance analyses shall be prepared by a qualified, third-party Professional Engineer or Professional Geoscientist, following an accepted methodology (e.g., Thornthwaite and Mather, 1955) or similar. The water balance model must consider the baseline conditions as set out in the water balance model appended to this document, as well as cumulative impacts from other developments within the Project Area. Mitigation strategies shall be explored in the SWM plan to minimize any adverse impacts and to maintain the annual infiltration targets.

    - Runoff from rooftop and landscaped areas shall be considered for the design of infiltration based Best Management Practices (BMP).
    - Possible High pollutant concentration areas such as parking lots and salt sand snow storage areas shall not be connected to the infiltration based BMPs to avoid any contamination.

- Applicable BMPs for temporary and permanent sediment and erosion controls shall be enforced to mitigate the migration of silt and sediment during and after construction. An Erosion and Sediment Control Plan shall be prepared and considered to be a living document, which gets amended as per applicable site conditions and constraints.
- Prioritization of the preservation of natural vegetation cover and landscaped areas, wherever possible.

1.5.3 Surface Water and Wetland Protection

Generally speaking, surface water and wetlands should not be degraded in any way by a proposed development, during the construction or built-out phase. Identification of pre-existing conditions, monitoring, and development of actionable contingency measures are essential in protecting surface water and wetlands in the vicinity of the Project Area.

- The proponent must submit a monitoring plan (to be in effect during construction) and contingency plan to address potential adverse impacts to surface water features, wetlands, or SGRA. A qualified Professional Geoscientist or Professional Engineer must make an assertion that they believe the plans are sufficiently designed to recognize and address any adverse impacts to surface water features, wetlands, or SGRA in the vicinity of the proposed development. If the proponent can demonstrate that no adverse impacts to surface water features, wetlands, and SGRA are reasonably expected, this requirement may be waived by the Township of Russell.
- The adverse impacts on the wetland (if any) due to the proposed development shall be quantified to sustain the hydrologic cycle of the wetland. Developed water balance model for the wetland shall be used to quantify the impacts and to propose mitigation measures.
- Collect a surface water sample from on-site or adjacent surface water features and wetlands, before and after construction, to ensure surface water quality is not impacted by development activities. The sample should be collected within two (2) weeks of the cessation of construction activity on any given project.
    - Should impacts be detected, the proponent's contingency plan must be put into action.
- Where surface water features, wetlands, or SGRA are present on-site or adjacent to the proposed development, appropriate erosion and sediment control (ESC) measures must be put in place to prevent impacts during construction.

1.5.4 Aquifer Protection and Prohibited Land Uses

Aquifer protection should be addressed primarily through the proponent's Hydrogeological Assessment, however the following specific recommendations should be considered.

- The proponent must submit a monitoring plan (to be in effect during construction) and contingency plan to address potential adverse impacts to shallow (overburden/weathered bedrock) and deeper (supply) groundwater aquifers. A qualified Professional Geoscientist or Professional Engineer must make an assertion that they believe the plans are sufficiently designed to recognize and address any adverse impacts to shallow and deep groundwater aquifers in the vicinity of the proposed development.
- A shallow groundwater level monitoring program should be in place throughout all stages of construction and at the end of the project to assess any impacts on shallow groundwater levels.
    - Should impacts be detected, the proponent's contingency plan must be put into action.

- The proponent shall collect a shallow groundwater sample from at least one monitoring well considered to be representative of the site, before and after construction, to ensure shallow groundwater quality is not impacted by development activities. The sample should be collected within two (2) weeks of the cessation of construction activity on any given project. Where existing residential, livestock, or irrigation water supply wells exist within 200 m of a proposed project, appropriate water samples should be collected in a similar manner to ensure water quality remains unaffected.
    - Should impacts be detected, the proponent's contingency plan must be put into action.
- Utilize trench plugs made of low-porosity materials (i.e., concrete or clay) for utility trenches to minimize the creation of preferential contaminant pathways.

A main goal of the proponent's Hydrogeological Assessment is to provide an assessment of how on-site activities will potentially impact the vulnerable aquifer and SGRA. It is recommended that the following land uses/activities not be permitted within the Project Area:

- Asphalt and bitumen manufacturing.
- Use of biodigesters.
- Coal gasification.
- Crude oil refining, processing, and bulk storage.
- Drum, barrel, or tank reconditioning and recycling.
- Fire retardant manufacturing, processing, and bulk storage, or any fire training. Fire training that is not permitted includes any fire training which uses liquid chemicals, in particular liquid chemicals containing PFAS.
- Paints manufacturing, processing, and bulk storage.
- Pharmaceutical manufacturing and processing.
- Solvent manufacturing and processing.
- Wood preservative treating.
- Commercial treatment, processing, or storage of any type of waste, contaminated water, sludge, effluent, or contaminated soil, fill, or crushed rock.
- Bulk storage or manufacturing of salt products, or import of salt-impacted material, such as snow or fill.
- Storage or use of chlorinated volatile organic compounds (cVOC), including but not limited to dry-cleaning chemicals and degreasing fluids that are more dense than water (e.g., perchloroethene (PCE), trichloroethene (TCE), and 1,1,1-trichloorethane (TCA)).
- Bulk storage of chemicals in underground storage tanks (UST). Above-ground storage tanks (AST) are permitted where appropriately designed secondary containment and surface protection are present.
- Large-scale refuelling of vehicles or equipment, unless performed in an area where appropriately designed secondary containment and surface protection are present.
- Any other land uses or activities that the Township of Russell deems to be a high-risk with regards to potential adverse impacts to the underlying aquifer(s) or SGRA.

Attachments:
Water Balance Calculation

Should you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

Rebecca Leduc, M.Sc.
Environmental Scientist
Rebecca.LEDUC@egis-group.com

Jordan Bowman, P.Geo.
Manager, Geosciences Group
Jordan.BOWMAN@egis-group.com

Amir Karim, P.Eng.
Project Manager, Environmental
Amir.KARIM@egis-group.com

Angela Gulley, P.Geo.
Senior Geoscientist
Angela.GULLEY@egis-group.com

Water Balance

Climate Data	
Precipitation (m/annum)	0.981
Evapotranspiration (m/annum)	0.603
Surplus Rate (m/annum)	0.378

Site Statistics - Pre-Development	
Area Covered by Hard Surfaces (m^2)	475,517
Area covered by SWMP (m^2)	3,410
Area Covered by Buildings (m^2)	149,202
Area Covered by Landscaped/Vegetation (m^2)	536,403
Total Site Area (m^2)	***1,164,532***

Table 2: Infiltration Factors (MOEE, 1995)	
Soil (Silty Clay tr sand, tr gravel)	0.15
*Slope (5.79 m/km)	0.18
Vegetation Cover (urban/cultivated)	0.05
Infiltration Factor	**0.38**
Runoff Factor	**0.62**
Infiltration Rate (m^3/annum)	**0.144**
Runoff Rate (m^3/annum)	**0.234**

Pre-Development Water Balance

Land Use Type	Land Use Area (m^2)	Precipitation (m^3/a)	Evapotranspiration (m^3/a)	Infiltration (m^3/a)	Runoff (m^3/a)
Area Covered by Hard Surfaces (m^2)	475,517	466,482	46,648	0	419,834
Area Covered by Buildings (m^2)	149,202	146,367	14,637	0	131,731
Area Covered by SWMP (m^2)	3,410	3,345	335	0	3,011
Area Covered by Landscaped/Vegetation (m^2)	536,403	526,212	323,451	77,049	125,711
Total	***1,164,532***	***1,142,406***	***385,071***	***77,049***	***680,286***

Impact Assessment & Mitigation	
Pre-Development Infiltration (m^3/a)	77,049