ASTRA REALTY MANAGEMENT INCORPORATED

STORMWATER MANAGEMENT FACILITY REPORT

1450 KING ROAD, BURLINGTON, ON

MAY 02, 2023



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ASTRA REALTY MANAGEMENT INCORPORATED

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1 INTRODUCTION AND SCOPE

WSP E&I Canada Limited (WSP; formerly Wood Environment & Infrastructure Solutions Canada Limited) has been retained by Astra Realty Management Incorporated (Astra; formerly Quantum Realty Management) to support the proposed re-development of its property located at 1450 King Road in the City of Burlington. The site is located at the north-west corner of King Road and the North Service Road, immediately north of Highway 403.

Currently, Astra owns a portion of the 1450 King Road site, while the balance is owned by the City of Burlington (City) and operated as a dual cell (dry/wet) stormwater management (SWM) facility, providing quantity and quality control for the upstream King Forest Phase 1 Business Park. Astra has previously engaged in discussions with City staff to support the proposed approach, which would involve re-locating the existing SWM facility (located in the south-east corner) to the northern portion of the site. This would allow the site to be re-developed for commercial purposes, such that the future proposed development can utilize the preferred frontage along North Service Road and King Road.

The re-located SWM facility (City-owned) is intended to provide quantity and quality control for the upstream King Forest Phase 1 Park only. Separate on-site controls (private) would be provided for any re-development of the balance of the 1450 King Road Site.

A preliminary SWM report was originally submitted to the City of Burlington for review in August 2015. A revised SWM report was subsequently submitted in October 2016. The proposed approach in that case involved an underground storage tank with a surface ponding feature. The underground storage chamber approach was ultimately not supported by City staff; it was understood that an open SWM facility (pond) would be required.

WSP subsequently prepared a number of alternative SWM facility concept designs for Astra in February 2017. The preferred approach was ultimately identified to be a dry pond facility. WSP developed a conceptual layout for Astra in April 2018. It is understood that this conceptual layout was presented to City staff by Astra as part of the overall discussions regarding the proposed SWM facility approach and associated land exchange. The preceding resulted in a development application pre-consultation meeting with City staff on April 30, 2021 (comments provided June 15 2021; a copy is included in Appendix E). An updated submission was issued February 22, 2022. The current version of the report is intended to build upon that submission and to address agency review comments.

It is understood that the required construction will need to be phased; the proposed approach has been structured accordingly. The new SWM facility would be constructed at the north of the site first, with the existing SWM facility remaining in place until formal acceptance and assumption by the City, and the completion of the associated land exchange with Astra. Following this, the existing SWM facility would be decommissioned.

It is the intent of the current SWM report to present the updated SWM design, and to demonstrate that the proposed revised stormwater management systems would address the most recent comments and requirements noted by regulators including the City, Conservation Halton (CH) and Ministry of Transportation (MTO).

It should be noted that the current report and associated drawings are intended to address the external SWM facility works only. Future re-development of the site (including buildings and amenity areas, servicing and grading, and private SWM measures) will be addressed through a separate future application and report.

2 BACKGROUND REVIEW

2.1 INFORMATION REVIEWED

The following information and data have been reviewed in the preparation of this preliminary SWM report:

Mapping and Base Data

- Current Aerial Photography
- Soil Mapping Reports from Agriculture Canada (Report Number 43: Soils of Halton County)
- Watercourses Mapping (Conservation Halton)
- Approximate Regulation Limit Mapping (Conservation Halton)
- Preliminary Proposed Design of the North Service Road and King Road Intersection (as supplied by the City of Burlington)

Topographic Surveys and Utilities

- Topographic Survey of Site, Millington and Associates (2015)
- Topographic Survey of Site and surrounding areas, Amec Foster Wheeler (August 2016)
- Topographic Survey of Site and surrounding areas, MMP (December 21,2017)
- Utility Locates of Site and surrounding areas (October – December, 2021)

Background Reports and Studies

- King Forest Business Park Phase 1 – Stormwater Management Report. Aquafor Beech Limited, May 1997 (Ref. 6799).
- CCTV Inspection Summary, Bob Robinson & Son Construction, February 2016.
- 1450 King Road – King Forest Phase 1 Business Park – Preliminary Stormwater Management Report. Amec Foster Wheeler, October 2016 (Project TP114058)
- Geotechnical Investigation Report – 1450 King Road, Wood, January 24, 2022 (Ref. WW21012079)
- Vibration Assessment, 1450 King Road, OZA Inspections Ltd., March 10, 2023.
- Topsoil Fertility Report, 1450 King Road SWM Facility Works, WSP, April 27, 2023.
- 1450 King Road SWM Facility Works – Hydrogeological Addendum, WSP, May 2, 2023.

Design Drawings

- King Forest Business Park Phase 1 – Storm Drainage Plan (Sheet MDR-247). Metropolitan Planning & Engineering Inc. Revised May 1997.
- King Forest Business Park Phase 1 – General Plan of Services (Sheet MSD-09/93). Metropolitan Planning & Engineering Inc. Revised June 1998
- King Forest Business Park Phase 1 – Storm Easement Block 2 (Sheet MEA-14). Metropolitan Planning & Engineering Inc. Revised March 1999.
- King Forest Business Park Phase 2/3 – Plan and Profile for North Service Road (Sta. 2+205 to Sta. 2+515). Metropolitan Planning & Engineering Inc. Revised February 2002.
- Various plan and profile drawings for North Service Road and King Road (City of Burlington).

Relevant findings, criteria, and direction from the previously noted reports and studies are referenced as required in subsequent sections of this design brief. Relevant background drawings and reports have been included in Appendix D.

2.2 SUMMARY OF PREVIOUS STORMWATER ANALYSES AND BACKGROUND MATERIAL

The design of the existing two-celled stormwater management facility on the site was documented in "King Forest Business Park Phase 1 Stormwater Management Report" (Aquafor Beech Limited, May 1997). A complete copy has been included in Appendix D for reference. As noted in that document, the stormwater management (SWM) facility on the current site (block south of 1450 King Road) was intended to provide both quantity and quality control for the full development of the King Forest Phase 1 Business Park to the north of 1450 King Road. In that report (Aquafor Beech, 1997), a maximum permissible lot coverage of 3.54 ha was documented, which has been assumed for the current assessment.

The 1997 SWM report indicates that Level 2 (Normal, or 70% average annual total suspended solids removal) quality control was applied. The wet pond feature was designed in accordance with this target and the 1994 MOECC (then the MOEE) Stormwater Management Planning and Design Manual.

Hydrologic modelling was completed using the 1993 OTTHYMO model developed by Aquafor Beech Limited for Indian Creek. The modelling was completed to ensure that the SWM facility would maintain peak flows at or below (then) pre-development levels, not only at the site level, but at other locations further downstream throughout the Indian Creek system. A 3-hour Chicago storm was used for the hydrologic modelling, with the 5-100 year storms (no 2-year) being simulated, along with two historically significant storm events (May 2 and August 27, 1992). Based on this assessment, peak flows from the site would be over-controlled compared to simulated pre-development values, in order to ensure no increase in simulated peak flows at any location. It has therefore been assumed that these discharge rates must be maintained for the proposed re-development. It should be noted however that there is no mention or assessment of the hydraulic capacity of the direct receiver in this case (a 500 mm diameter CSP); this should be accounted for as part of the current assessment.

The report indicates that a disk was supplied which contained the OTTHYMO hydrologic modelling files developed in support of the SWM report. However, this disk cannot be located by the City of Burlington.

Relevant data from the previously completed SWM analyses by WSP (October 2016 SWM report) have also been incorporated into the current reporting as required.

Based on information supplied by the City of Burlington, it is understood that improvements are currently being considered for the North Service Road and King Road intersection. A preliminary design drawing indicates that lanes would be expected to be widened on the west side of King Road (within the City's right-of-way), which would potentially impact the grading of the proposed site. In general, grading has been maintained at the site property line and also along the existing edge of road. This is discussed further in subsequent sections.

2.3 SETBACKS

Requirements for appropriate setbacks from the valley along the western side of the property have been previously identified by Conservation Halton. Both the dripline of the tree canopy and the top of bank were staked by CH staff (November 1, 2017) and have been included in the site survey by MMP (December 21, 2017).

In addition to the preceding, the calculated stable top of bank limit has been calculated through a geotechnical analysis (Wood, 2022). The detailed analyses are provided as part of the geotechnical investigation report included in Appendix F. The slope was divided into three (3) sub-sections. For two (2) of the sections the staked slope was found to coincide with the stable slope; however for one (1) section an additional setback to the calculated stable slope was required. The required setback has been calculated as the greater of:

- 10.0 m from the surveyed dripline
- 8.5 m from the surveyed top of bank (where stable)
- 15.5 m from the surveyed top of bank (where an additional setback is required)

The results, including the composite setback line, are presented in Drawing 1 (attached).

Additional planning setback lines as specified by the project planner (MHBC) have also been included for reference purposes.

Easements have also been included based on the information supplied by the survey (MMP, 2017) or as noted on record drawings. It is noted that there is currently an easement over the existing storm sewer through the 1450 King Road property; this has not been presented as it is understood this will be removed as part of the proposed re-development works.

2.4 UTILITIES

Based on a review of the remaining drawings for this area, a previous concern is that none of the drawings indicate to where the existing outlet (a 500 mm diameter CSP) drains. The majority of the drawings show only a stub running in an approximately south-east direction. To address this deficiency, a closed-circuit television (CCTV) inspection was previously coordinated by WSP.

A CCTV inspection of the existing 500 mm diameter CSP outlet and the downstream 1200 mm CSP culvert (east side of King Road) was conducted by Bob Robinson & Son Construction on February 29, 2016. This inspection was conducted both to confirm that the 1200 mm CSP culvert is the receiver of the outlet from the site (the 500 mm diameter CSP), and to verify the condition of both conduits.

A copy of the inspection report summary has been included in Appendix A for reference. It is noted that the site CSP is referred to as a 525 mm pipe, however based on in-field measurements and typical CSP sizes, this conduit is considered to be a 500 mm diameter pipe. The CCTV inspection confirmed that a 500 mm diameter CSP tap is present on the 1200 mm CSP culvert, which aligns with the 500 mm diameter CSP outlet from the site. As such, this branch of Indian Creek has been determined to be the receiver of drainage from the site. The CCTV inspection was unable to proceed through the 500 mm diameter CSP outlet, due to some ponding in the pipe. Some obstructions (tree branches) in the 1200 mm diameter CSP culvert also prevented a complete inspection of this conduit, however some deflections and warping in the pipe were noted.

The CCTV inspection confirms the drainage outlet for the study area. The CCTV inspection also indicates that some remediation work may be required to remove debris blockages from both pipes (likely by flushing), and potentially structural remediation to ensure that the full pipe capacity is available (likely by CIPP or other trenchless technologies). As per previous City comments, the proponent (i.e. Astra) would be responsible for conducting any works on the existing 500 mm diameter CSP outlet as part of the proposed development. Any works required to the downstream receiver (1200 mm diameter CSP) would however be assumed to be the responsibility of the City, Region of Halton, and the MTO. It is generally expected that outlet pipe rehabilitation will be completed as part of the second phase (decommissioning).

It is noted that the site survey indicated the culvert as a 0.7 m (700 mm) diameter pipe, however it is assumed that the measured sizing previously employed is correct. Modelling and sizing has continued to conservatively assume the 500 mm diameter sizing.

Utility locates were filed as part of the geotechnical investigation work; a second round of utility locates were also filed through Ontario OneCall for the roadway areas not included in the original geotechnical clearances. These utilities are presented in Drawing 2 (attached). The only utilities within the site are the existing storm sewers. Other utilities are noted along the site perimeter along the King Road and North Service Road right of ways and will be considered as part of the overall servicing and grading designs.

Daylighting of key utilities (i.e. at expected utility crossings) is planned to be undertaken using hydrovac excavation; this information will be incorporated into final design drawings as required.

2.5 FIELD RECONNAISSANCE

A brief field reconnaissance of the site was previously completed on July 17, 2015, in order to confirm the condition of the site and assess any other considerations with respect to stormwater management. A selected photo inventory has been included in Appendix A. No notable changes have occurred on site since that time, so the results of the field reconnaissance are still considered valid.

The steep topography of the site under existing conditions is evident from the attached photographs. This includes not only the two-celled stormwater management facility, and the secondary ponding area around the outlet, but also the side slopes adjacent to King Road, and the overall topography of the site from upstream to downstream. The proposed grading will therefore be challenging.

A number of utilities are evident parallel to King Road as shown on the plans received from the City, including a sanitary sewer, and other unknown utilities. These all appear to be located within the municipal right-of-way for King Road, as would be expected. However, these features will need to be accounted for as part of any grading modifications.

The existing stormwater quality facility is largely overgrown with vegetation – no permanent pool is evident from the top of the slope.

The outlet area (where both the stormwater quality and quantity facilities outlet via a concrete headwall) was pooled with water at the time of the field visit. This area was also found to be heavily vegetated with tall reeds, most likely phragmites (an invasive species). Proper handling will be required (as per relevant Provincial Guidelines) should these features be removed, in order to limit their spread.

The ultimate outlet (measured by WSP to be a 500 mm diameter CSP) was found to be partially obstructed by the vegetation, as well as by rocks and some geotextile fabric. The edges of the CSP were also noted to be partially crushed\bent. The interior of the existing CSP outlet (to the extent visible) is somewhat deteriorated, with corrosion and rust evident, along with some perforations. A build-up of sediment is also visible. As such, the outlet pipe will likely need to be flushed, and should be assessed in further detail to confirm its structural integrity. Pipe lining (using cured in place pipe or other methods) may also need to be undertaken.

The existing ditch along North Service Road also is heavily vegetated with tall reeds, again most likely phragmites. Should any future grading works be required in this area, proper handing will be required to minimize their spread.

Based on a review of current aerial photography and site reconnaissance, the upstream King Forest Phase 1 Business Park (located along King Forest Court) is now fully developed, with the construction of a paved parking area at 539 King Forest Court sometime in 2016 (not in place during the previously prepared SWM reporting).

3 HYDROLOGIC MODELLING AND QUANTITY CONTROL

3.1 GENERAL DESIGN CRITERIA

Based on the preceding background review, it has been assumed that peak flows under the proposed re-development must maintain the flow rates established by the originally approved stormwater management (SWM) report (i.e. 1997). No Certificate of Approval (C of A) or Environmental Compliance Approval (ECA) for the existing SWM facility has been provided; this should be confirmed with the City.

In addition to the preceding, the capacity of the outlet (conservatively assumed as a 500 mm diameter CSP) should be confirmed, in order to determine whether this capacity is critical and would govern in place of the previously noted flow rate targets.

3.2 HYDROLOGIC MODEL SETUP

In order to evaluate the site for stormwater management, it has been necessary to complete hydrologic modeling, in order to develop storm response hydrographs and associated peak flows under both existing and proposed conditions.

The previously completed hydrologic modelling for this area employed OTTHYMO. However, this modelling cannot be located by the City of Burlington. Further, OTTHYMO is no longer a directly supported hydrologic modelling program. Legacy OTTHYMO modelling files must either be imported into SWMHYMO, or into Visual OTTHYMO.

Given that the preceding modelling files cannot be located, and the age of the previously employed modelling program, we have conducted the current hydrologic modelling assessment using a different City-approved software platform. PCSWMM was employed for the previous (October 2016) SWM assessment and has been maintained for the current study. PCSWMM is a graphical user interface and pre-processor for the well-known US EPA-SWMM model. It is a combined hydrologic/hydraulic model which is capable of assessing complex hydraulic conditions, including dual drainage (minor/major system) and surcharge and reverse flow.

In order to determine appropriate infiltration parameters, a characterization of on-site soils is required. Based on available Ontario Soils Mapping for this area, the site itself consists of Oneida Loam, with an associated US SCS Soil Classification of “C”. The upstream limits of the site are classified as “Clay Pits”; a US SCS Soil Classification of “C” has also been assumed for these areas, which is suitable for clay, and is consistent with the balance of the drainage area under consideration.

A geotechnical investigation was completed in support of the current project (ref. Appendix F). That report indicates the surficial soils for the site itself consist of silty clays and silty clay tills. Hydraulic conductivity testing was also completed and yielded results of between 2.6 and 2.7 x 10^{-8} m/s (0.1 mm/hr) which indicates low permeability. The assumption of Class C soils is considered generally reasonable as an assumption for the overall study area.

Infiltration and runoff parameters have been based on the above soil classification assumption, different land uses evident within the drainage area in question, and typical literature values. Values are summarized in Table 3.1.

Infiltration modeling has applied the SCS Curve Number method, based on area-weighing and the standard values presented in Table 3.1. Initial abstractions have also been calculated based on areally-weighting the assumed values presented in Table 3.1.

Table 3.1. Assumed Runoff Parameters for Different Land Use Types

LAND USE	US SCS CN (AMC-II)	INITIAL ABSTRACTION (mm)
Forest	70	7
Grass/Meadow	74	5
Gravel	89	2
Rooftop/Paved	98	1

Other hydrologic parameters, such as length and slope, have generally been directly measured from the available mapping. Subcatchment length is a key parameter within PCSWMM, as it is used to represent sheet flow/overland flow, and accounts for the expected degree of attenuation (i.e. is a surrogate for time of concentration or time to peak used in unit hydrograph methodologies). As noted, where possible, subcatchment length has been directly measured, based on the expected length of sheet flow. For upstream subcatchments where a drainage channel is more well defined, the subcatchment length has been defined using generally accepted relationships between channel length and flow path length, such as the Proctor & Redfern method (Proctor and Redfern, Ltd. And MacLaren, J.F. Ltd, 1976, "Stormwater management model study – Vol 1". *Research Rep. No. 7,* Canada-Ontario Research Program, Environmental Protection Service, Ottawa), which indicated that the subcatchment width (width of the kinematic wave plane) should be 1.7 times the channel length. Thus subcatchment length is equal to the drainage area divided by 1.7 times the channel length.

3.3 RAINFALL AND DESIGN STORMS

As part of the hydrologic modeling process, rainfall input is required. As part of the previous (October 2016) SWM report, the 3-hour Chicago design storm (using the approved City IDF in place at the time of the 1997 reporting) was re-simulated; this design storm has been included as part of the verification for the current study as well.

The previous (October 2016) SWM report also considered a series of different design storm distributions based on a 2004 IDF update (not formally adopted by the City). The preceding confirmed that the SCS 24-hour Type II design storm was the governing design storm distribution; this design storm distribution has been maintained for the current updated assessment. The most current IDF (as per the City of Burlington's 2020 Stormwater Management Design Guidelines) have also been applied to generate updated design storms. Time series are included in Appendix B.

In addition to the preceding, the City's water quality storm event (25 mm, 4-Hour Chicago storm) has also been simulated, to assess extended detention functionality.

3.4 HYDROLOGIC MODELLING RESULTS (EXISTING CONDITIONS)

3.4.1 MODEL SETUP

Although simulated peak flow targets from the originally approved design are available, it is considered worthwhile to simulate existing (2023) land use condition, in order to provide a comparison to the proposed "post-development" results simulated in the original 1997 SWM report, particularly given that a different hydrologic modelling platform is being employed in the current assessment.

Drawing 3 (attached) indicates the limits of the contributing drainage areas north of the King Forest Phase 1 Business Park. These areas have been delineated based on the currently available 0.5 m elevation contours for the City of Burlington, as well as verified with a site reconnaissance to confirm drainage details within Bayview Park (which confirmed that the drainage limits do not extend as far north as an initial review of the elevation contours would suggest). These areas are generally consistent with what was delineated in the

original 1997 SWM report, with the same naming convention applied in the current modelling. Both areas EXT3 (3.46 ha) and EXT2 (1.57 ha) drain through a channel through the King Forest Phase 1 Business Park, and into ultimately into the existing SWM facility. EXT1 (1.38 ha) and EXT4 (0.44 ha) drain to the western ditch along King Road.

As evident from Drawing 3, drainage from the King Forest Phase 1 Business Park has been modeled to a relatively high degree of resolution, in order to properly account for minor (storm sewer) and major (overland and channel flow) drainage splits. A total of 21 subcatchments have been used to model the 4.72 ha area, ranging in size from 0.04 to 0.87 ha. Drainage boundaries have been delineated on the basis of the original SWM report and associated design drawings, topographic contours, topographic survey data, and field reconnaissance. Hydraulic conduits have also been added to this section of the model to represent channel, roadway, and sewer flow, along with orifices suitably sized to represent inlet capacity restrictions associated with observed catchbasins and ditch inlets.

Drawing 4 (attached) indicates the drainage boundaries for the site itself under existing conditions. EXT6 (0.20 ha) represents the balance of the drainage to the western ditch along King Road, which ultimately drains into the small ponding area beyond the SWM facility cell outlets, immediately upstream of the 500 mm diameter CSP outlet for the site. Sub-catchment 102 (0.15 ha) also drains directly into this area. EXT7 (0.12 ha) represents the portion of Municipal property along the slope that would also drain directly to this feature.

Sub-catchment 100 (1.43 ha) represents the overland drainage from the site which drains directly to the quantity control cell of the SWM facility, while sub-catchment 101 (1.10 ha) represents the overland drainage from the site which drains directly to the quality control cell of the SWM facility.

Sub-catchments 103 (0.16 ha) and 104 (0.38 ha) represent those portions of the site which would be expected to drain to the branch of Indian Creek immediately to the west of the site. Sub-catchment 103 would be expected to drain to the north ditch of the North Service Road, before draining westerly to the creek. Sub-catchment 104 represents direct sheet flow down the slope towards the creek. Drainage areas EXT8 (0.11 ha) and EXT9 (0.30 ha) represent drainage from King Road and the North Service Road which would also be expected to drain towards the north ditch of the North Service Road under existing conditions.

All of the above-noted sub-catchments have been parameterized in accordance with the methodology outlined in Section 3.2. Detailed calculations are included in Appendix B.

Previously, the King Forest Business Park was assumed at 75% imperviousness based on the original (1997) SWM report. Based on subsequent discussions with City staff (ref. Scott-Senior, October 20, 2022) should be assessed with an imperviousness of 85% in order to be consistent with the originally approved storm sewer design drawings which indicate a Rational Method Runoff Coefficient of 0.85. Refer to assumed values in Appendix B.

Additional hydraulic routing elements have also been included (beyond those for the King Forest Business Park to the north of the site) in order to account for flow routing effects, including the western ditch along King Road, and existing storm sewers within the site. The proposed 525 mm diameter storm sewer has been sized to covey the 100-year flow from the western ditch.

Although the existing SWM facility operates using two distinct cells (i.e. quantity and quality control), only a single combined facility rating curve is included in the previously completed (1997) SWM report. In order to more accurately represent the performance of the SWM facility, the two distinct cells have been modelled explicitly in PCSWMM. Stage-surface area functions for each of the two cells have been developed based on available topographic contours and the information included in the original SWM report. Storm sewer links, including the upstream flow splitter manhole, orifice restrictions, and overflow spillways have also been included explicitly to link the two cells. It should be noted that a discrepancy has been noted between the 1997 SWM Report and the as-constructed drawings for the water quality cell. The former indicates a 120 mm diameter orifice; the latter indicates a smaller 90 mm diameter orifice. It has been assumed that the latter (as-constructed drawings) are more correct, and the resulting more conservative flow rates used for this assessment.

In addition to the foregoing, a storage element has been included to represent the small ponding area between the SWM facility outlets and the ultimate 500 mm diameter CSP outlet. The stage-surface area relationship for this minor area has been developed based on the City's 0.5 m elevation contours. A section of

conduit has also been included to represent the 500 mm diameter CSP outlet, with a "normal" boundary condition. As noted previously, the details with respect to this outlet are unknown; as such a nominal 2% slope has been assumed for this conduit in the current modelling.

3.4.2 DESIGN STORM RESULTS (QUANTITY CONTROL)

As an initial comparison, the results for the original 3-hour Chicago storm distribution (with previous IDF) have been summarized in comparison to those from the original (1997) SWM report. This comparison is presented in Table 3.2. Discharge rates represent the total discharge to the 500 mm diameter CSP outlet (i.e. SWM facility discharge plus externally contributing drainage areas).

Table 3.2. Simulated Peak Flows to Primary Outlet and Maximum Simulated Storage Volumes under Existing (2023) Conditions with Assumed Full Build-Out of King Forest Phase 1 Business Park

SCENARIO	DRAINAGE AREA (ha)	PEAK FLOW (m^3/s) TO OUTLET FOR SIMULATED RETURN PERIOD (YEARS)		PEAK STORAGE (m^3) FOR COMBINED SWM FACILITY FOR SIMULATED RETURN PERIOD (YEARS)[1]	
		5	100	5	100
1997 SWM Report (Aquafor Beech)	NA	0.30	0.63	1,700	3,000
2023 SWM Report (WSP)	14.58	0.07	0.38	1,551 (1,550, 1)	2,331 (2,299, 38)

1. Bracketed values indicate the simulated peak storage volumes in the quality and quantity cells respectively.

Currently simulated peak flows are notably lower than previously reported results. Without having any details with respect to the originally completed modelling, the reason for the difference cannot be definitively stated. Notwithstanding, it is considered likely that this is attributable to differences in modelling software programs and modelling methodologies, as well as potentially some differences in parameterization. The original (1997) SWM report assumed a high impervious coverage of 75% for the King Forest Business Park, however as noted previously the current modelling reflects an assumed imperviousness of 85% for developed areas, or 70% overall when greenspace areas are included, which is slightly less (refer to Drawing 3). The current modelling also accounts for the minor storage feature downstream of the SWM facility cells, as well as tailwater and backwater impacts, which the original (1997) OTTHYMO modelling did not.

In general, maximum simulated storage volumes within the SWM facility are more consistent, albeit slightly lower with the current modelling for the reasons previously stated (including differences in the modelling of the SWM facility cells). The results indicate that SWM facility attenuation under the 3-hour Chicago storm distribution is attributable to the quality cell only, with the quantity cell providing minimal if any function.

The base existing conditions modelling has also been re-run using the City of Burlington's current (2020) IDF and SCS 24-hour Type II design storms as discussed in Section 3.1. The results are presented in Table 3.3.

Table 3.3. Simulated Performance of Existing SWM Facility

RETURN PERIOD (YEARS)	INFLOW TO SWMF[1] (m^3/s)	TOTAL STORAGE IN SWMF (m^3)	DISCHARGE FROM SWMF (m^3/s)	DISCHARGE TO CULVERT (m^3/s)
2	0.70	1,808	0.042	0.130
5	1.23	2,161	0.204	0.255
10	1.55	2,333	0.328	0.386
25	1.81	2,510	0.491	0.537
50	2.26	2,699	0.658	0.621
100	2.62	2,932	0.808	0.678

1. Pipe flow + overland flow + subcatchments 100 + 101

The modelling results indicate that under smaller storm events, the existing SWM facility greatly attenuates peak discharges, and that discharges to the culvert outlet are actually larger than discharges from the SWMF, due to additional inflows to the ditch and ponding area. Under larger storm event this difference gradually decreases, such that the discharges from the SWMF and to the downstream culvert are generally similar. For the 50 and 100-year storm events, the discharge from the SWMF are greater than the discharge from the 500 mm diameter CSP culvert. This reflects the impact of the additional ponding area at the outlet as well as the undersized 500 mm diameter CSP outlet culvert.

A maximum simulated depth of 2.57 m (115.57 m) is indicated for the 100-year storm event (24 hour SCS Type II distribution) at the additional informal ponding area immediately upstream of the 500 mm diameter CSP. This is generally equal to the peak water level in the quantity control cell (115.49 m) but much lower than that within the quality control cell (117.40 m) which is indicated as spilling via the overflow towards the outlet area. Given the simulated surcharging under the 100-year storm event, and that this is the primary drainage outlet, additional measures to prevent debris blockage should be considered as part of the proposed design.

The PCSWMM model results presented in Table 3.3 indicate that for the 10-year storm onwards, there is some negative flow from the quantity control cell outlet. This indicates that ponding in the downstream area upstream of the CSP outlet is pushing flow back into the quantity control pond. This again likely reflects the impact of the undersized 500 mm diameter CSP outlet which results in an upstream tailwater condition.

MTO reviewers requested a greater consideration of the degree of attenuation provided by the existing 500 mm diameter CSP culvert. To this end, a hypothetical scenario has been considered whereby the King Road culvert has been sized consistently with the inlet storm sewer piping, namely 975 mm diameter concrete piping. The results of this scenario are presented in Table 3.4.

Table 3.4. Assessment of Attenuation from King Road Culvert – Existing Conditions

RETURN PERIOD (YEARS)	DISCHARGE TO EXISTING 500 mm DIAMETER CULVERT (m^3/s)	DISCHARGE ASSUMING UPSIZED CULVERT (m^3/s)	DIFFERENCE (m^3/s)	DIFFERENCE (%)
2	0.130	0.134	+0.004	+3%
5	0.255	0.272	+0.017	+7%
10	0.386	0.523	+0.137	+35%
25	0.537	0.970	+0.433	+81%
50	0.621	1.270	+0.649	+105%
100	0.678	1.574	+0.896	+132%

The results presented in Table 3.4 indicate that with an upgraded culvert outlet at King Road, results would be generally similar for the 2 and 5-year storm events, but that increasing differences would be indicated for the 10-year storm event onwards. The results indicate that with an upgraded culvert, water would no longer pond upstream of the culvert and would not result in negative flows from the quantity control cells, resulting in a lesser degree of attenuation and storage, and greater discharges from the SWM facility. Discharges to the King Road ditch would also no longer be attenuated by the ponding area and limited culvert capacity.

It should be noted that the information provided in Table 3.4 is provided for information purposes only; ultimately the simulated discharges to the 500 mm CSP culvert under existing conditions should remain the target discharges for any proposed replacement SWM facility.

Overall, the quantity control cell provides much less storage than the quality control cell. For the 100-year storm event, the quality control pond provides 2,457 m^3 of storage (at a depth of 1.40 m) as compared to only 586 m^3 in the quantity control cell (at a depth of 2.37 m). This reflects the flow restrictions on the quality control cell as well as the larger overall area, and that all low flows are directed to this cell.

A rating curve comparison under existing conditions (actual existing conditions to the original 1997 design) is provided in Figure 3.1 Beyond the initial low flow portion, the rating curves are notably different. This in part may reflect the simplified assumptions in the original design report, which as per Table 3.2 from that

report assumed a constant 1,500 m^3 for storage from the quality control cell. The current results suggest that this cell actually stored a much greater volume of water. Conversely, the quantity control cell stores notably less (the design curve indicates 1,855 m^3 in the quantity control cell for the last ordinate). Overall, the current estimated rating curve is considered more representative and should be employed as the primary basis of comparison to proposed conditions.

Notwithstanding the preceding, the model results demonstrate that the 100-year discharges and storage volume using the more current (and longer) design storm distributions are actually generally similar to those from the original design, as per Table 3.2. This likely reflects the shorter and less intense storm events used in the original design.

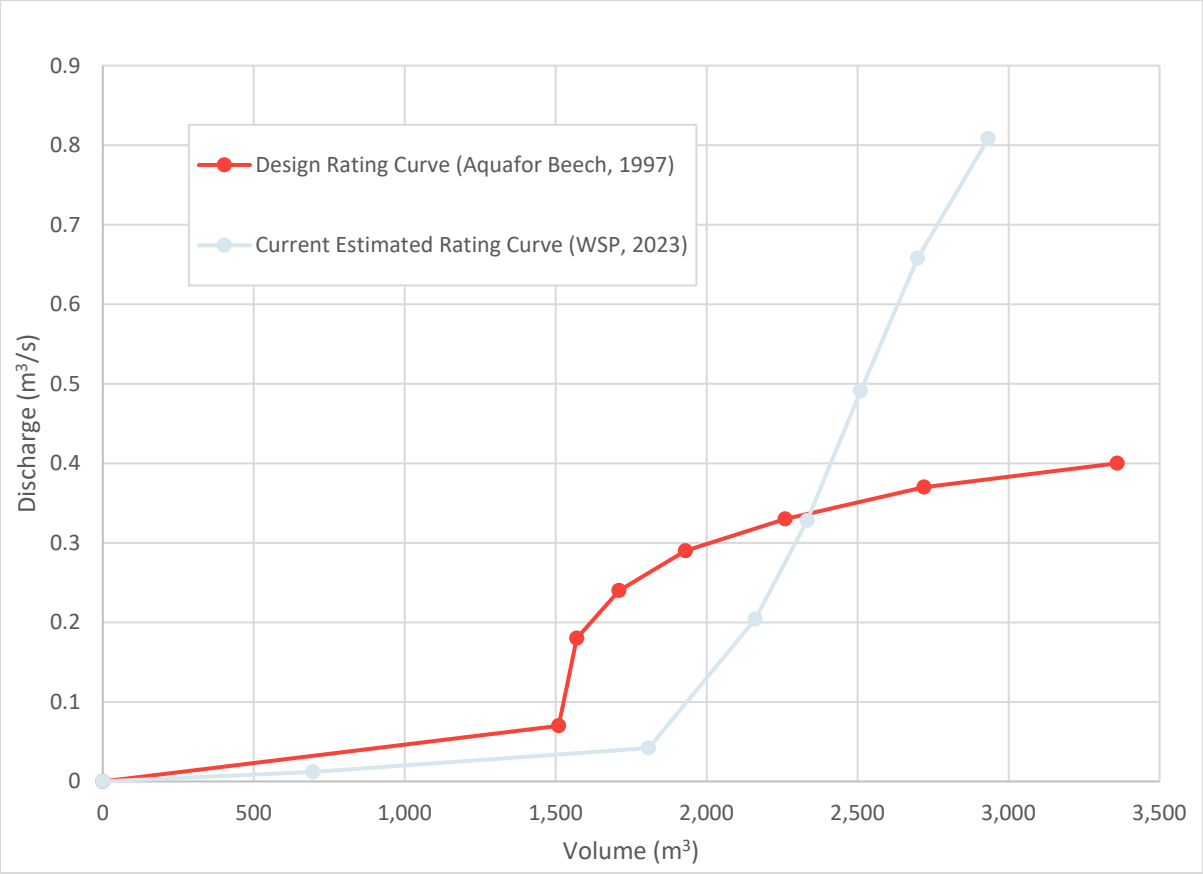


Figure 3.1. Existing SWMF Rating Curve Comparison

3.4.3 EXTENDED DETENTION AND EROSION

In addition to the preceding, the existing SWM facility has been assessed for the water quality storm event (25-mm, 4-hour Chicago storm) in order to assess the volume and duration of extended detention. The results are presented in Table 3.4.

The simulated results indicate that the existing SWM facility actually provides a much lower unitary extended detention than is stated in the original 1997 SWM Report. While it is considered that some of this is the results of differences in modelling methodology (as discussed previously), this alone is not considered to be significant enough to account for the difference presented in Table 3.5. The difference is also of note considering that the updated modelling uses an orifice size of 90 mm, while the original (1997) SWM report references an orifice size of 120 mm, which should in theory yield a lesser extended detention volume. Notwithstanding, the simulated extended detention of 44 m^3/ha slightly exceeds the typical minimum requirement of 40 m^3/ha.

Table 3.5. Simulated Extended Detention for Existing SWM Facility under Existing (2023) Conditions with Assumed Full Build-Out of King Forest Phase 1 Business Park

SCENARIO	DRAINAGE AREA TO SWM FACILITY (ha)	EXTENDED DETENTION VOLUME (m^3)	EXTENDED DETENTION (m^3/ha)	PEAK DISCHARGE (m^3/s)	DRAWDOWN TIME (HOURS)[2.]
1997 SWM Report (Aquafor Beech)	NA	NA	215[1.]	NA	12[1.]
2023 SWM Report (WSP)	12.17	696	57	0.012	32.5

1. As per Table 3.1 from the 1997 SWM Report.
2. Defined as the simulated duration where flows are greater than 0.001 m^3/s, to avoid excessively small values.

The simulated drawdown time of 32.5 hours exceeds the design time of 12 hours as stated in the original (1997) SWM report; this again may be attributable to differences in modelling methodology as well as the reduced orifice size.

3.5 HYDROLOGIC MODELLING RESULTS (INTERIM CONDITIONS)

3.5.1 DESIGN AND MODEL SETUP

Under interim conditions, a new stormwater management facility (SWMF) would be constructed along the north limits of the site. The proposed SWMF is a dry pond, designed to provide the required extended detention and quantity control function. The base of the pond would be graded toward the outfall; a rip-rap lined channel would be implemented to convey the primary inflow from the upstream storm sewer. A Hydroturf™ lined spillway is also proposed to facilitate overland flow from upstream areas into the proposed SWMF. Grading details are provided in Drawing 8 (attached). Flow control would be provided by a multi-stage orifice system located within MH#2. Details are provided on Drawing 9 (attached). Under interim conditions the proposed SWMF would outlet into the remaining portion of storm sewer and therefore into the existing SWMF.

Quality control would be provided through an oil/grit separator unit for primary treatment and an exfiltration trench for secondary treatment; this is reviewed further in Section 4. For modelling purposes any volume or peak flow reduction associated with the exfiltration trench has not been credited in order to be conservative.

Drawing 5 (attached) presents the proposed drainage boundaries under interim conditions. In order to construct the proposed SWMF, excavation is required. Excavation would generate approximately 10,434 m^3 of fill material. Under interim conditions, it is proposed to stockpile this material on the south site, such that it can be re-used under future decommissioned conditions (refer to Section 3.6) to fill the existing SWMF. Drainage boundaries have been developed based on this proposed approach and the proposed grading of the new SWMF. In addition to the preceding, it should be noted that the west King Road ditch (EXT1 and EXT4) have been re-directed into the proposed SWM facility. As the proposed SWMF has been re-located to the north half of the site, in order to ensure comparable flow attenuation, additional contributing drainage area is required. This diversion would also likely facilitate any future reconstruction of King Road, by avoiding the need to collect and covey this additional 1.82 ha area.

The existing conditions hydrologic/hydraulic PCSWMM modelling (discussed in Section 3.4) has been updated based on the preceding in order to represent the proposed drainage conditions noted previously. Subcatchments have been parameterized consistent with the methodology outlined in Section 3.2. Detailed calculations have been included in Appendix B.

3.5.2 DESIGN STORM RESULTS (QUANTITY CONTROL)

The results of the proposed conditions modelling with respect to design storms (2 through 100-year storm events) are presented in Table 3.6, along with a comparison to the simulated existing conditions values. The associated rating curve is presented in Figure 3.2. Discharges from the various outlets (as generated by the PCSWMM modelling) are also summarized in Appendix B as requested by City staff.

Table 3.6. Simulated Performance of Proposed SWM Facility (Interim)

PARAMETER	SCENARIO	VALUE FOR SPECIFIED RETURN PERIOD (YEARS)					
		2	5	10	25	50	100
Inflow to SWMF (m^3/s)	Existing	0.70	1.23	1.55	1.81	2.26	2.62
	Interim	0.78	1.36	1.71	1.99	2.50	2.84
	Difference	*+0.08*	*+0.13*	*+0.16*	*+0.18*	*+0.24*	*+0.22*
Peak WSE (m)	Interim	119.47	119.80	119.97	120.18	120.35	120.50
Storage in SWMF (m^3)	Existing	1,808	2,161	2,333	2,510	2,699	2,932
	Interim	1,346	2,170	2,650	3,281	3,821	4,360
	Difference	*-462*	*+9*	*+317*	*+771*	*+1,122*	*+1,428*
Discharge from SWMF[1] (m^3/s)	Existing	0.042	0.204	0.328	0.491	0.658	0.808
	Interim	0.103	0.174	0.257	0.364	0.430	0.474
	Difference	*+0.061*	*-0.030*	*-0.071*	*-0.127*	*-0.228*	*-0.334*
Discharge to Culvert (m^3/s)	Existing	0.130	0.255	0.386	0.537	0.621	0.678
	Interim	0.050	0.117	0.163	0.273	0.366	0.423
	Difference	*-0.080*	*-0.138*	*-0.223*	*-0.264*	*-0.255*	*-0.255*

1. Discharge from Existing SWM Facility under existing conditions; from proposed SWM facility under interim conditions.

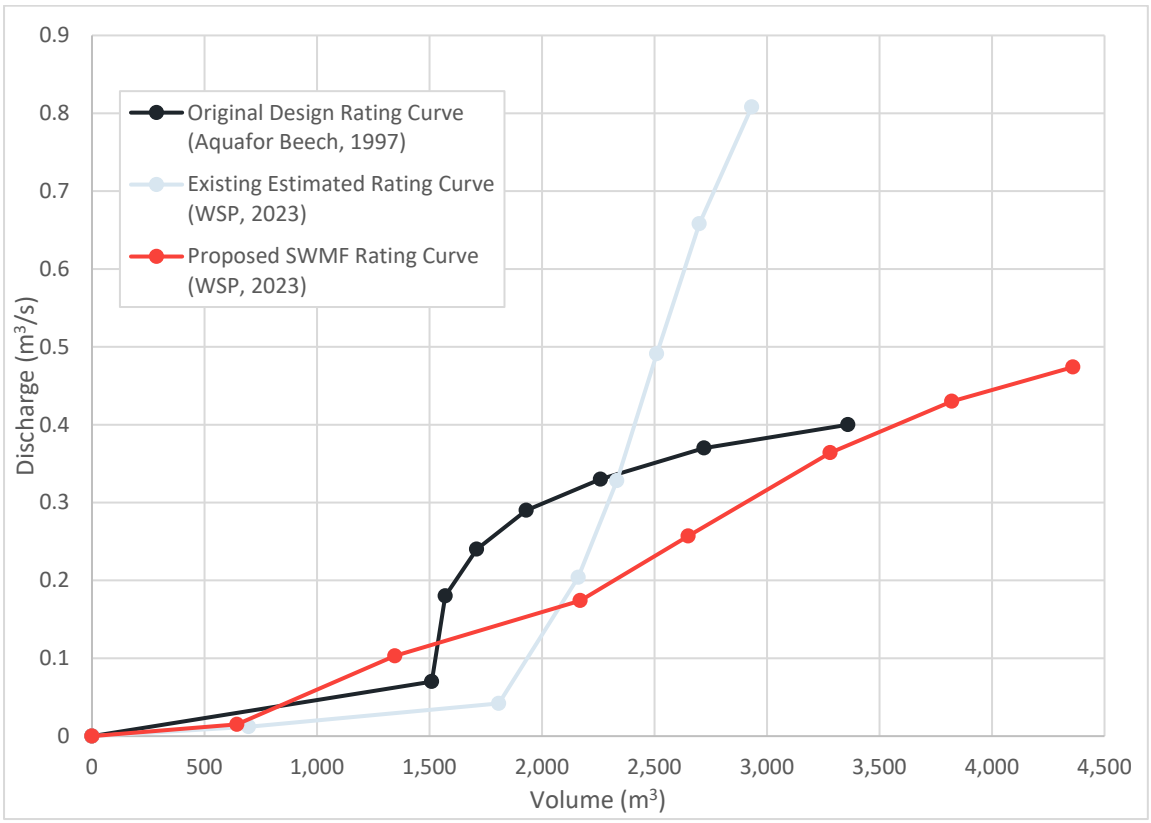


Figure 3.2. Proposed SWMF Rating Curve Comparison

The results indicate that under proposed conditions the inflow to the SWMF would be increased for all storm events. This is attributable to the diversion of inflows from the west King Road ditch, which is not present under existing conditions.

The proposed SWMF would provide slightly less storage as compared to the existing SWMF for the 2-year storm event only; for all other events a greater volume would be provided. This is also evident from **Figure 3.2**, which indicates that portion of the curve is above existing function. The discharge for the proposed SWMF for the 2-year storm event is greater than under existing conditions accordingly. However as noted previously the low flow control is already set at the minimum recommended size (75 mm diameter). The existing SWMF provides a greater surface area, and corresponding volume at lower depths, due to the form of the quality control cell (i.e. a wet pond, with a large flat surface and corresponding greater surface area). Dry ponds must be graded to ensure overland surface drainage, and thus have smaller surfaces areas (and thus volumes) at lower depths.

Table 3.6 confirms that for the 5-year storm event and above, under interim conditions, discharges from the SWMF are less than the existing discharges. As demonstrated further in Section 3.6, all targets at the ultimate outlet (culvert crossing of King Road) are achieved for all events, including the 2-year storm event. Due to the redundancy under interim conditions (i.e. existing SWMF is maintained until acceptance and transfer of the proposed SWMF) the proposed SWMF would discharge to the remaining portion of the inlet storm sewer to the existing SWMF. As such, discharges at the ultimate outlet (culvert crossing of King Road) are over-controlled well below existing condition targets.

Storage volumes for the proposed SWMF would be notably greater for the 10-year storm event and above, with an additional 1,428 m^3 provided for the 100-year storm event (49% above existing).

The proposed SWMF indicates a peak 100-year water level of 120.50 m. This also provides 0.5 m of freeboard relative to the top of the facility (121.0 m). An emergency overflow spillway has also been proposed to allow for the relief flow of any storm events greater than a 100-year storm event westerly towards the ravine system. As noted in discussion with MTO and CH (refer to Appendix E), this is consistent with where spill flow would be expected under current conditions (spill towards North Service Road, and then westerly to the ravine) and also eliminates the potential for spill or ponding on North Service Road and potentially towards Highway 403.

Proposed storm sewers have been designed and confirmed using the flows generated by the modelling. Refer to Appendix B for detailed storm sewer sizing sheets.

Although not presented in the summary results, other drainage areas would remain relatively consistent with existing conditions as well. Drainage towards the western valley would be slightly increased (0.43 ha as compared to 0.38 ha under existing conditions). Likewise, drainage to the North Service Road ditch would be almost identical (0.15 ha as compared to 0.16 ha under existing conditions). Given the slight changes in both cases no appreciable differences in peak flows to either location are expected.

3.5.3 EXTENDED DETENTION AND EROSION

In addition to the preceding, the existing and proposed interim SWMFs have been assessed for the water quality storm event (25-mm, 4-hour Chicago storm) in order to assess the volume and duration of extended detention. The results are presented in Table 3.7 in comparison to the previously simulated existing condition values as per Table 3.5.

Table 3.7. Simulated Extended Detention for Proposed and Existing SWMFs

SCENARIO	DRAINAGE AREA TO SWM FACILITY (ha)	SCENARIO	EXTENDED DETENTION VOLUME (m^3)	EXTENDED DETENTION (m^3/ha)	PEAK DISCHARGE (m^3/s)	DRAWDOWN TIME (hours)[2.]
2023 SWM Report (WSP)	12.17	Existing	696	57	0.012	32.5
	12.51	Interim	644	52	0.015	26.6
	+0.34	*Difference*	*-52*	*-5*	*+0.003*	*-5.9*

1. As per Table 3.1 from the 1997 SWM Report.
2. Defined as the simulated duration where flows are greater than 0.001 m^3/s, to avoid excessively small values.

The simulated results indicate that the proposed SWMF would have a slightly reduced extended detention volume as compared to the existing SWMF. Notwithstanding, the proposed SWMF would still achieve the MECP recommended 40 m^3/ha of extended detention volume.

A drawdown time of 26.6 hours is indicated for the proposed SWMF. This is slightly reduced as compared to the existing SWMF despite the smaller orifice (90 mm under existing conditions; 75 mm under proposed conditions) due to the larger flat surface area associated with the existing wet pond. The difference is considered slight however, and exceeds the MECP recommended 24-hour value (noting that the original SWMF was designed for a 12-hour drawdown only). Further, the calculated drawdown time of 26.6 hours is based on using a minimum flow of 0.001 m^3/s to avoid counting excessively small values. If no flow threshold were to be applied, the drawdown time would be greater.

As noted, the proposed SWMF includes a 75 mm diameter orifice, which is typically the smallest recommended orifice diameter. Orifices of a smaller size typically result in clogging and maintenance issues. Given that the minimum orifice size has been selected, and that the difference in extended detention and drawdown time is slight, the proposed SWMF is considered reasonably and essentially equivalent to the existing SWMF.

The extended detention volume also does not include the additional supplied volume in the proposed exfiltration trench (refer to Section 4 for further details), which would be expected to further detain flows within the overall SWMF system.

A peak water surface elevation of 119.15 m is indicated in the proposed dry pond by the modelling results for the water quality storm event. As per the grading plan (Drawing 8, attached), this would mean that the full base of the dry pond would be submerged for this event, with depths ranging from just 0.10 m at the west end to 0.35 m at the east end, and a depth of 0.70 m at the 900 mm diameter storm sewer headwall. The base of the dry pond SWMF should therefore be planted with wet-tolerant plant species. Sloped areas would experience water much less frequently and could therefore be landscaped differently.

3.6 HYDROLOGIC MODELLING RESULTS (DECOMMISSIONED CONDITIONS)

3.6.1 DESIGN AND MODEL SETUP

Following acceptance of the proposed SWMF by the City of Burlington, and agreement for the proposed land exchange with Astra Realty Management (Astra), the existing SWM facility would be decommissioned. Under decommissioned conditions the existing storm sewer outlet for the proposed SWMF would be extended to run along the King Road corridor, southerly to the connection to the 500 mm diameter CSP culvert crossing and outlet. As noted on Drawing 14 (attached) the exact location of the proposed storm sewer extension is to be determined with the City. Astra would prefer that the storm sewer be located off its property and within the King Road right-of-way, given the ultimate assumption and responsibility for this storm sewer by the City. Notwithstanding, existing utilities would need to be taken into consideration, as well as planned future roadway works on King Road.

The preliminary proposed storm sewer servicing approach would construct the outlet along the centreline of King Road, given the number of utilities present within the west ditch area. The section of storm sewer between MH#2 and MH#3 would need to be steepened from the upstream 0.8% to 2.0% to ensure that a minimum 0.5 m vertical separation between the proposed storm sewer and the existing sanitary sewer (the storm sewer would pass below the sanitary sewer). The proposed storm sewer would therefore be deep along King Road; MH#4 would be approximately 6.2 m deep, while MH#5 would be up to 8.3 m deep (actual depth will depend on the actual depth of the 500 mm diameter CSP culvert, since the slope is not known, given that it tees into the larger 1200 mm diameter CSP crossing of Highway 403). Appropriate shoring and trench protection would need to be considered as part of the associated design. Notwithstanding, it is again noted that the location of the storm sewer will require further review with City staff to confirm the preferred location.

Detailed storm sewer sizing calculations (as requested by City staff) have been included in Appendix B for reference purposes.

The fill pile generated under interim conditions would be used to fill the existing SWM facility as part of the decommissioning. The soft sediment within the wet pond quality control cell should however be removed and disposed of off-site (in accordance with O.Reg 406/19; Excess Soil Regulations) given that this material would be considered unsuitable for re-use. The proposed grading design (refer to Drawing 13, attached) would generally ensure a relatively consistent grade southerly, matching to existing grades on the east and west boundaries (generally 5% or less in a southerly direction). The design intent would be to capture as much on-site drainage as possible. A minor swale feature is proposed parallel to the North Service Road, draining towards the existing 500 mm diameter CSP culvert crossing. The grading in this corner would also be filled relative to existing conditions (culvert invert of 112.20 m; proposed surface grade of 115.50 m). DIMH #1 is proposed at this location to provide surface drainage and to connect to the 500 mm diameter CSP culvert, as per Drawing 14 (attached).

An overall cut-fill balance would be preferred under decommissioned conditions; notwithstanding based on the current results a minor fill pile would be generated (2,850 m^3 estimated). It is considered preferable to generate a net fill for the current grading design to avoid the need to remove material off-site. As part of future construction works minor grading adjustments may be necessary, provided that they maintain the overall intent of the proposed grading design (i.e. self-contained drainage for the site).

Drawing 10 (attached) presents the proposed drainage boundaries under decommissioned conditions, reflecting the preceding design notes. The existing conditions hydrologic/hydraulic PCSWMM modelling (discussed in Section 3.4) has been updated based on the preceding. Subcatchments have been parameterized consistent with the methodology outlined in Section 3.2. Detailed calculations have been included in Appendix B.

3.6.2 DESIGN STORM RESULTS (QUANTITY CONTROL)

The results of the proposed conditions modelling with respect to design storms (2 through 100-year storm events) are presented in Table 3.8, along with a comparison to the simulated existing conditions values. Note that the results are presented for the discharge to the ultimate receiver (500 mm diameter CSP culvert at King Road) only, as all other values would remain consistent with interim conditions (as per Table 3.5).

Similar to the quantity control function, the extended detention function of the proposed SWM facility under decommissioned conditions would be the same as under interim conditions (i.e. as per Section 3.5.3 and Table 3.6). As such, the results have not been re-presented.

Drainage to additional areas has also not been presented, given the nominal changes. Drainage towards the west creek valley under decommissioned conditions would be 0.45 ha, which is nearly identical to interim conditions (0.43 ha). Drainage to the North Service Road ditch would also be reduced (0.09 ha, as compared to 0.15 ha under interim conditions). Drainage to these areas would therefore be expected to remain essentially unchanged.

Table 3.8. Simulated Peak Flows under Decommissioned Conditions

PARAMETER	SCENARIO	VALUE FOR SPECIFIED RETURN PERIOD (YEARS)					
		2	5	10	25	50	100
Discharge from SWMF (m^3/s)	Decomm.	0.103	0.174	0.257	0.364	0.422	0.469
Discharge from Balance of Site and Ditches (m^3/s)	Decomm.	0.050	0.117	0.168	0.228	0.296	0.350
Combined Discharge to Culvert (m^3/s)	*Existing*	*0.130*	*0.255*	*0.386*	*0.537*	*0.621*	*0.678*
	Decomm	0.122	0.212	0.313	0.451	0.542	0.631
	Difference	*-0.008*	*-0.043*	*-0.073*	*-0.086*	*-0.079*	*-0.047*

The results presented in Table 3.8 indicate that under proposed decommissioned conditions, peak flows would be controlled for all storm events (2 through 100-year storms) to the receiver as required, confirming that the proposed SWMF would function as intended and would in fact reduce flows as compared to existing conditions for all storm events.

The simulated results indicate that the 500 mm diameter CSP outlet would be surcharged beginning with the 25-year storm event. Given the grade and elevations of the proposed 525 mm diameter storm sewer from the proposed SWM facility, no tailwater or other impacts are indicated for the proposed SWM facility or 525 mm storm sewer piping for any storm event up to and including the 100-year storm. The simulated surcharge is also not sufficient to result in any surface ponding or other impacts on the balance of the site but would need to be considered as part of any future drainage connections on that portion of the site.

It has been noted that the 500 mm diameter section of piping would require rehabilitation (CIPP lining or otherwise) to address issues noted in the CCTV inspection (as per Appendix B). It is understood that MTO, in conjunction with the City, are planning for a pipe replacement. MTO has noted that a similar pipe size would be implemented as per existing, as such it is generally expected that a 525 mm diameter concrete or PVC\HDPE pipe would be installed as a replacement, which would be expected to perform similarly to the existing crossing and outlet.

Although not considered as part of the current SWM report, it is acknowledged that as part of future projects, the south portion of the site will be developed, and will require separate, private on-site quantity controls. It is recommended that the PCSWMM modelling developed for the current assessment be applied for any such assessment to confirm specific storage and discharge requirements, such that the overall discharges for the 2 through 100-year storm events at the King Road culvert are less than or equal to the simulated existing condition values presented in Table 3.8 and in previous summaries. This would also consider any potential hydrograph timing impacts.

In addition, depending on the status of future works, the design of the on-site private SWM systems would need to consider the potential impact of tailwater/backwater from the King Road culvert during the 25 through 100-year storm events. This may result in grading revisions to locates these systems above the surcharge elevation, if feasible. If not feasible, additional storage requirements may be required.

4 STORMWATER QUALITY

In addition to providing stormwater quantity and erosion control, the proposed stormwater management strategy must address stormwater quality control.

The previously completed SWM report for the King Forest Phase 1 Business Park (Aquafor Beech Limited, 1997) designed the existing wet pond based on Level 2 (Normal) treatment as per the MOE"s 1994 criteria and subsequently released 2003 Stormwater Planning and Design Manual (i.e. 70% average annual total suspended soilds removal).

City staff have subsequently indicated (June 15, 2021 comments; refer to Appendix E) that Level 1 (Enhanced) treatment (i.e. 80% average annual TSS removal) will be required. Further, the City's current Stormwater Management Design Guidelines indicate a maximum credit of 50% TSS removal for oil/grit separators (OGS), and that sizing and units must follow the Canadian Environmental Technology Verification (ETV) approach.

Based on the preceding, a "treatment train" approach has been proposed to achieve the required 80% TSS removal. As per Drawing 9, initial treatment would be provided by an upstream OGS unit; secondary treatment would be provided by a downstream exfiltration trench.

A Hydrostorm HS8 unit (2400 mm inside diameter) has been proposed. The unit is ETV certified. Updated OGS sizing has been completed using the ETV particle size distribution (PSD). Detailed calculations are included in Appendix C. The results indicate the proposed unit would provide an annual TSS removal of 56%.

The proposed exfiltration trench design is presented on Drawing 9 (attached). The exfiltration trench would be constructed downstream of the OGS so that coarse particulate matter is removed in advance, limiting the potential for future clogging of the system. The inlet to the exfiltration pipe system would be located in MH#1. A 0.50 m deep sump would be generated, such that all inflows from the 975 mm diameter storm sewer would be directed to the sump and then into twin 200 mm perforated pipes. Stormwater would need to pond above the 0.5 m deep sump before being able to enter the dry pond SWMF.

The proposed exfiltration trench has been located easterly of MH#1 in order to maximize the available space, and to also locate it at a higher elevation given the potential for groundwater interaction if it were to be located within the footprint of the dry pond (refer to Appendix F for further details).

The proposed exfiltration trench would be 1.05 m high in total; 0.7 m below the twin 200 mm perforated pipes, and 0.15 m above, such that the top of the trench would be equal to the overflow elevation in MH#1. The proposed trench would have a width of 4.0 m (it is expected that a wider excavation would be required to construct the separate 525 mm diameter storm sewer above regardless). A total length of 65.0 m is proposed to maintain the feature entirely on the site property.

Assuming a porosity of 0.4, the proposed exfiltration trench would provide a total storage volume of 112 m^3. A scaled version of the water quality (extended detention) storm described in previous sections has been generated (5 mm rather than 25 mm over 4 hours using the same Chicago Distribution). The PCSWMM modelling indicates that this would generate a peak flow of 0.07 m^3/s and a total runoff volume of 110 m^3. Using a simple block-type storm distribution (5 mm over 2 hours) generates similar results; a lower peak inflow of 0.02 m^3/s but a consistent runoff volume of 109 m^3. Both simulations suggest that all inflow from the 5 mm storm would be retained and infiltrated by the exfiltration trench. The preceding has conservatively not been credited in the quantity control simulations described in Section 3.

The proposed exfiltration would promote stormwater retention, infiltration and most importantly additional settling of particulates within the MH#1 sump and the exfiltration trench itself, beyond the settling provided by the OGS. Estimated treatment levels (TSS reduction percentages) for such Low Impact Development (LID) measures vary, however general practice is to credit LID features with 60% TSS removal. Assuming this to be the case, the combined removal percentage of the OGS and exfiltration trench would be 82% (80% if the OGS is only credited for 50% removal). In both cases, the proposed treatment train approach should achieve the stormwater quality requirements of the City and should exceed the quality control provided by the existing SWMF.

5 OPERATIONS AND MAINTENANCE

5.1 OVERVIEW

As per City comments, it is understood that the requirements for Operations and Maintenance for the SWM facility should also be clarified. From an operational perspective, all components are designed to operate passively without any active management as is the case for the majority of stormwater management works. Periodic inspection and maintenance would however be required, as is the case with all infrastructure. Overall, there are three (3) different components which would require periodic inspection and maintenance, these include:

1. Oil/Grit Separator Unit
2. Exfiltration Trench
3. Dry Pond SWM Facility

The expected requirements for each are outlined in the subsequent sections.

5.2 INSPECTIONS

A visual inspection of all of the components noted previously should be completed at least once per year. Items to be reviewed should include at a minimum the following.

- **Oil/Grit Separator Unit**
  - Conform to all manufacturer recommendations for operations and maintenance.
  - Open the MH lid and note accumulation of trash, debris and floatables and whether removal is warranted.
  - Note presence of hydrocarbons or oils
  - Using suitable equipment, measure the depth of sediment accumulation within the unit and compare to the manufacturer's recommendations for removal.
  - Based on the preceding, determine whether or not any active maintenance is required
- **Exfiltration Trench**
  - Open lid of MH #1 and note any accumulation of debris, trash or floatables in the MH. Using suitable equipment, measure the depth of sediment accumulation within the MH sump and compare to invert elevations of exfiltration pipes to confirm whether sediment removal is warranted.
  - Open clean-out caps at the upstream end of the exfiltration trench and measure water level; compare to expected depths (in general, trench should be dry unless after a rainfall event). Note any other observations.
  - Confirm whether a camera inspection of the exfiltration pipes is warranted or not based on the preceding observations.
- **Dry Pond SWM Facility**
  - Inspect the primary inlet headwall and grate and remove any debris or vegetation if present.
  - Inspect the primary outlet headwall and grate and remove any debris or vegetation if present.
  - Review condition of rip-rap spillway and any signs of erosion or instability.
  - Review condition of dry pond base with respect to vegetation establishment, erosion, and any ponding.
  - Confirm facility is dry overall as intended and areas are draining towards outlet.
  - Review side slopes and access road for any rilling, rutting or erosion and whether remedial measures are required.
  - Open the lid to MH #2 and inspect the control structure. Confirm water is flowing (if present) and that concrete, and piping remain in good condition. Remove any debris if present.

5.3 MAINTENANCE

Potential maintenance requirements would depend on the findings of the annual inspections noted in Section 5.2. Typical maintenance works are as noted below.

- **Oil/Grit Separator Unit**
  - Remove trash\debris\floatables\oil using a hydrovac truck.
  - Remove accumulated sediment within the sump using a hydrovac truck.
- **Exfiltration Trench**
  - Remove accumulated sediment within the MH#1 sump using a hydrovac truck.
  - Flush exfiltration piping if indicated as warranted based on visual and camera inspections.
- **Dry Pond SWM Facility**
  - Remove trash and debris as required.
  - Restore rip-rap if erosion or displacement issues are noted.
  - Install additional erosion protection if warranted based on field observations to address erosion issues.
  - Re-seed bare areas if warranted using the application of terraseeding. Re-grade local low points if local ponding issues are noted to promote flow towards the outlet.
  - Restore granular material in cable concrete access road where necessary.

6 CONCLUSIONS AND RECOMMENDATIONS

Based on the foregoing, we have concluded that the proposed SWMF would generally equal or exceed the performance of the existing SWMF. The proposed SWMF would provide slightly less extended detention volume and drawdown time, however the minimum feasible orifice size (75 mm diameter) has been proposed; the difference is considered attributable to the flat surface area of the existing wet pond SWMF as compared to the grading required for the currently proposed SWMF) The proposed SWMF would reduce peak flows for the 2 through 100-year storm events inclusive, and provide a greater overall storage volume (49% increase for the 100-year storm event).

Stormwater quality treatment would meet the City's required 80% removal rate (Enhanced Treatment) through a "treatment train" approach of an upstream oil/grit separator and downstream exfiltration trench. The proposed exfiltration trench system would also benefit overall water balance and infiltration, by capturing and exfiltrating runoff from storms up to and including the 5 mm event.

It is expected that the proposed SWMF design will be further reviewed by City staff as well as other agencies (Conservation Halton and the Ministry of Transportation) to confirm adequacy. It is considered that confirmation on the preferred location for the proposed SWMF storm sewer outlet (i.e. along King Road) will be of primary interest, and will require consideration of any future municipally-planned road works in this area as well as existing utilities. The long-term plans for the rehabilitation of the existing 500 mm diameter CSP beneath King Road should also be confirmed, however it is generally understood that the MTO and City are working in partnership to replace this pipe with the nearest equivalent size (expected to be a 525 mm diameter concrete or PVC\HDPE pipe).

Following resolution of comments and design approval, an updated Environmental Compliance Approval (ECA) will be required from the Ministry of the Environment, Conservation and Parks (MECP). It is currently unknown whether or not an existing ECA is in place for the existing SWM facility. Regardless, it is generally expected that approvals would proceed under the recent Consolidated Linear Infrastructure (CLI-ECA) program given that the proposed SWM facility would ultimately be municipally owned and operated. Based on WSP's recent experience, MECP is deferring such approvals back to municipalities through this program.

A permit would be required from Conservation Halton for any works within a regulated area. As noted, a portion of the proposed overflow spillway would be located within the setback area; as such this may necessitate a permit application. Further review with CH may be required.

Following the preceding, Astra Realty Management (Astra) would proceed to tender the works outlined under the "interim" scenario for construction. Once constructed, the works would require confirmation and agreement with City staff; at which point the proposed land exchange between the City and Astra would occur. Following this, Astra would proceed with tendering and construction of the works noted on the "decommissioned" scenario plans, including abandoning of the existing SWMF, re-direction of the outlet to a new storm sewer on King Road, and final site grading, as indicated on the attached plans.

We trust the foregoing to be satisfactory. Please do not hesitate to contact our office should you wish to discuss further.

APPENDIX

A FIELD RECONNAISSANCE AND CCTV

Appendix A – Photo Reconnaissance



Looking north along King Road at existing roadside ditch.



Looking downstream at roadside ditch which drains through property.



Overview of subject site from north-east corner.



Overview of subject site from north-east corner.

Appendix A – Photo Reconnaissance



Looking north at roadside ditch which drains through subject property.



Sanitary Sewer parallel to King Road.



Looking north-west at quantity control cell of SWM facility.



Looking at SWM facility outlets and ponding area.
Note phragmites.

Appendix A – Photo Reconnaissance



Looking at SWM facility outlet ponding area and King Road/North Service Road intersection.



Headwall for SWM facility outlets. Note ponded water.



Existing 500 mm diameter CSP outlet. Note rock and vegetation obstruction.



Phragmites surrounding outlet.

Appendix A – Photo Reconnaissance



Interior of CSP outlet. Note corrosion and sediment accumulation.



Looking west from outlet along North service Road.
Note possible monitoring well.



View of quantity control cell of SWM facility from south.



View of quality control cell of SWM facility from east showing ditch inlet overflow.

Appendix A – Photo Reconnaissance



View of quality control cell of SWM facility from east.



Looking west along North Service Road ditch.
Note heavy phragmite accumulation.



Looking east along North Service Road.

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Amec Foster Wheeler

Client Address: 3215 North Service Road

Burlington, Ontario L7N 3G2

Contact: Richard McCabe

Project Name: Amec Foster Wheeler 525 Drainage Pipe

Types of Sewers in this Report: Storm

Inspections Performed By: BRC Devon Haluka

Video Format: DVD

Coding Type: PACP

Report Number	Date	Questions? Email us!
61012	29/02/2016	info@bobrobinsonconstruction.com

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Table of contents

Report No :		Date:		
61012		29/02/2016		

Profile Report 1

Inspection: 1

Section: 1, Ditch Outlet --- Unknown 2

Section: 2, Ditch Inlet --- Unknown 3

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/ Main sections

Report No	Project Name	Contact	Date
61012	**Amec Foster Wheeler 525 Drainage**	**Richard McCabe**	**29/02/2016**

No.	Start MH	End MH	Date	Street	Pipe Seg ID	Material	m	(m)
1	Ditch Outlet	Unknown	29/02/2016	King Road	1	Corrugated Metal Pipe	1.13	1.13

Pipe size: CIRCULAR 525 = 1.13 m (1.13 m)

No.	Start MH	End MH	Date	Street	Pipe Seg ID	Material	m	(m)
2	Ditch Inlet	Unknown	29/02/2016	King Road	2	Corrugated Metal Pipe	16.93	16.93

Pipe size: CIRCULAR 1230 = 16.93 m (16.93 m)

All sections = 18.06 m (18.06 m)

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Inspection Report

Inspection Number	Surveyor's Name	Surveyor's Certificate	Date	Time	Weather
1	**BRC Devon Haluka**	**07000419**	**29/02/2016**	**08:53:41**	**Dry**
City	Street Name and Number	Start MH	Finish MH	Direction of Survey	Sewer Use
Burlington	**King Road**	**Ditch Outlet**	**Unknown**	**Downstream**	**Stormwater**

U/S Rim to Invert	**0**	Pipe Diameter	**525 mm**	Upstream MH	**Ditch Outlet**
D/S Rim to Invert	**0**	Pipe Segment ID	**1**	Dowstream MH	**Unknown**
Pipe Material	**Corrugated Metal Pipe**	Pre-Cleaned	**No Pre-Cleaning**	Section Length	**1.13 m**
Pipe Shape	**Circular**	Report Number	**61012**	Survey Length	**1.13 m**

Location Details	**King Rd and North Service Rd**	Location Type	**Ditch**
		Purpose of Survey	**Maintenance Related**
Project Name	**Amec Foster Wheeler 525 Drainage Pipe**	Quick Maint Rate	**4100**
		Quick Structural Rate	**0000**

Add. Information : **MSA**

1:50	Position	Code	Observation	MPEG	Photo	Grade
Ditch Outlet						
	0.00	ADP	Discharge Point	00:00:23		
	0.00	MWL	Water Level, 90 %of cross sectional area	00:00:33		
	1.13	MCU	Camera Underwater	00:00:58		M 4
	1.13	MSA	Survey Abandoned / unsafe to proceed underwater	00:01:09		

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**4100**	**0**	**4**	**4**	**0**	**4**	**4**

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Inspection Report

Inspection Number	Surveyor's Name	Surveyor's Certificate	Date	Time	Weather
2	**BRC Devon Haluka**	**07000419**	**29/02/2016**	**09:59:46**	**Dry**
City	Street Name and Number	Start MH	Finish MH	Direction of Survey	Sewer Use
Burlington	**King Road**	**Ditch Inlet**	**Unknown**	**Downstream**	**Stormwater**

U/S Rim to Invert	**0**	Pipe Diameter	**1230 mm**	Upstream MH	**Ditch Inlet**
D/S Rim to Invert	**0**	Pipe Segment ID	**2**	Dowstream MH	**Unknown**
Pipe Material	**Corrugated Metal Pipe**	Pre-Cleaned	**No Pre-Cleaning**	Section Length	**16.93 m**
Pipe Shape	**Circular**	Report Number	**61012**	Survey Length	**16.93 m**

Location Details	**King Rd and North Service Rd**	Location Type	**Ditch**
		Purpose of Survey	**Maintenance Related**
Project Name	**Amec Foster Wheeler 525 Drainage Pipe**	Quick Maint Rate	**3121**
		Quick Structural Rate	**0000**

Add. Information : **Ditch Inlet on North Side of King Road**



1:140 Position		Code	Observation	MPEG	Photo	Grade
0.00		AMH	Manhole / Ditch Inlet	00:00:23		
0.00		MWL	Water Level, 5 %of cross sectional area	00:00:28		
5.90	**S1**	KW	Buckling Wall, from 12 to 03 o'clock, Start / 20% deflection	00:01:12	2_3A	
9.81		LL	Alignment Left, 10 %	00:01:40		M 1
13.27	**F1**	KW	Buckling Wall, from 12 to 03 o'clock, Finish	00:04:15		
13.28	**S2**	KW	Buckling Wall, from 10 to 04 o'clock, Start / 30% deflection	00:02:23	2_6A	
14.95		TB	Tap Break-In, at 10 o'clock, 200mm	00:02:23	2_5A	
16.49		TBD	Tap Break-In Defective, at 03 o'clock, 500mm, within 200mm of joint: YES / connection of interest	00:03:26	2_6A	M 3
16.49		KI	Inverse Curvature, at 12 o'clock, 10 % / at joint	00:03:26	2_9A	
16.49		OBC	Obstacles Thru Connection, 10 %of cross sectional area, from 04 to 07 o'clock / tree branches	00:04:15	2_10A	M 2
16.92	**F2**	KW	Buckling Wall, from 10 to 04 o'clock, Finish	00:04:15		
16.93		MSA	Survey Abandoned / cannot pass branches	00:04:15		

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**3121**	**0**	**6**	**6**	**0**	**2**	**2**

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E-mail: info@bobrobinsonconstruction.com

Inspection photos

City :	Street :	Date :	Pipe Segment ID :	Section No :
Burlington	**King Road**	**29/02/2016**	**2**	**2**

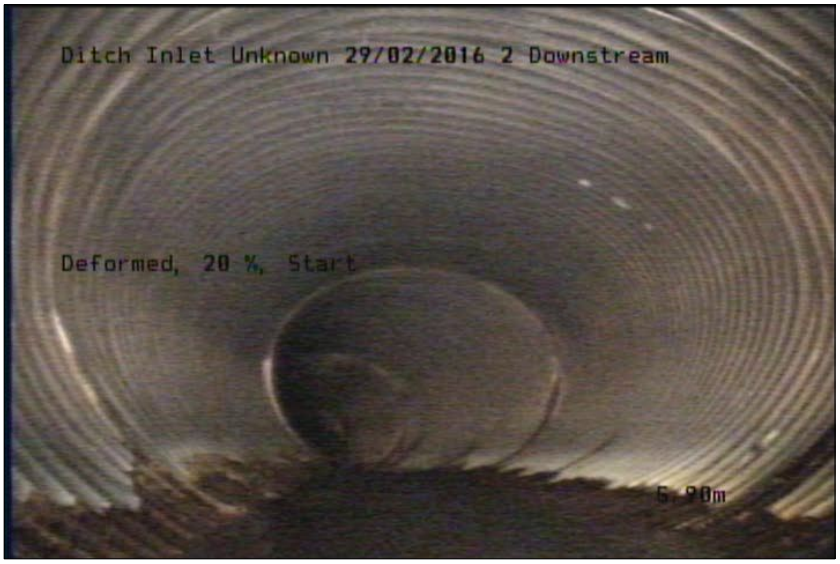


Photo: 2_3A, 00:01:12
5.9m, Buckling Wall, from 12 to 03 o'clock, Start / 20% deflection



Photo: 2_6A, 00:02:23
13.28m, Buckling Wall, from 10 to 04 o'clock, Start / 30% deflection

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Inspection photos

City :	Street :	Date :	Pipe Segment ID :	Section No :
Burlington	**King Road**	**29/02/2016**	**2**	**2**



Photo: 2_5A, 00:02:23
14.95m, Tap Break-In, at 10 o'clock, 200mm



Photo: 2_6A, 00:03:26
16.49m, Tap Break-In Defective, at 03 o'clock, 500mm, within 200mm of joint: YES / connection of interest

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Inspection photos

City :	Street :	Date :	Pipe Segment ID :	Section No :
Burlington	**King Road**	**29/02/2016**	**2**	**2**



Photo: 2_10A, 00:04:15
16.49m, Obstacles Thru Connection, 10 %of cross sectional area, from 04 to 07 o'clock / tree branches

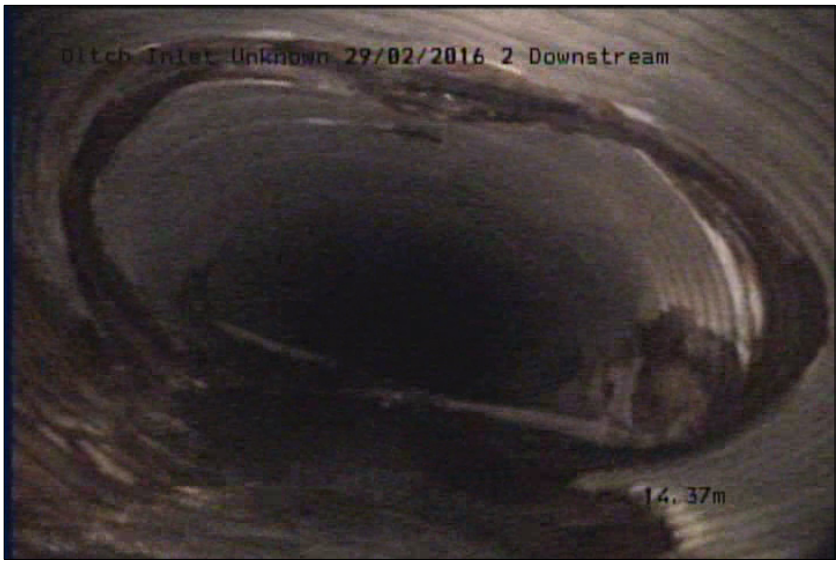
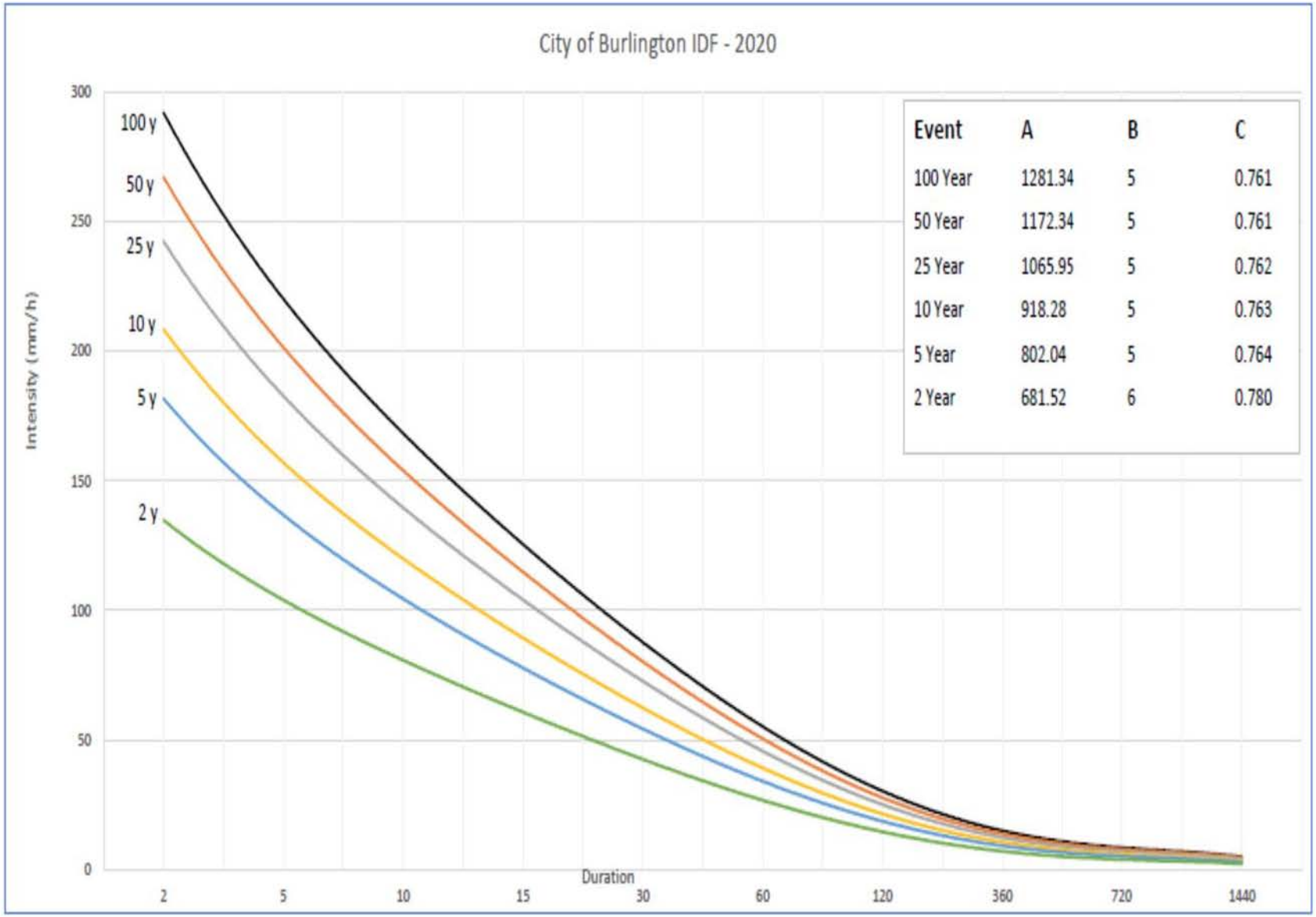


Photo: 2_9A, 00:03:26
16.49m, Inverse Curvature, at 12 o'clock, 10 % / at joint

APPENDIX

B HYDROLOGIC AND HYDRAULIC MODELLING PARAMETERS


City of Burlington IDF - 2020
Intensity (mm/h)
Duration
100 y
50 y
25 y
10 y
5 y
2 y
300
250
200
150
100
50
0
2
5
10
15
30
60
120
360
720
1440
Event A B C
100 Year 1281.34 5 0.761
50 Year 1172.34 5 0.761
25 Year 1065.95 5 0.762
10 Year 918.28 5 0.763
5 Year 802.04 5 0.764
2 Year 681.52 6 0.780

24 HOUR SCS II DESIGN STORM

	Total Depth		56.1	74.2	85.5	100.0	110.8	121.1
	*Time Ending	*% Inc	Depth/Increment 2	5	10	25	50	100
	0	0	0					
120	2	0.022	1.2336196	1.63189	1.882044	2.200652	2.437968	2.664642
240	4	0.026	1.4579141	1.928597	2.224234	2.600771	2.881235	3.149122
360	6	0.032	1.7943558	2.373658	2.737519	3.200949	3.546136	3.875843
420	7		0	0	0	0	0	0
480	8	0.04	2.2429447	2.967073	3.421899	4.001186	4.43267	4.844804
510	8.5		0	0	0	0	0	0
540	9	0.027	1.5139877	2.002774	2.309782	2.700801	2.992052	3.270242
570	9.5	0.016	0.8971779	1.186829	1.36876	1.600474	1.773068	1.937921
585	9.75		0	0	0	0	0	0
600	10	0.018	1.0093251	1.335183	1.539855	1.800534	1.994701	2.180162
630	10.5	0.023	1.2896932	1.706067	1.967592	2.300682	2.548785	2.785762
660	11	0.031	1.7382822	2.299482	2.651972	3.100919	3.435319	3.754723
690	11.5	0.048	2.6915337	3.560488	4.106279	4.801423	5.319204	5.813764
705	11.75	0.104	5.8316563	7.71439	8.896937	10.40308	11.52494	12.59649
720	12	0.276	15.476319	20.4728	23.6111	27.60819	30.58542	33.42915
750	12.5	0.072	4.0373005	5.340731	6.159418	7.202135	7.978806	8.720647
780	13	0.037	2.0747239	2.744542	3.165257	3.701097	4.10022	4.481443
810	13.5	0.007	0.3925153	0.519238	0.598832	0.700208	0.775717	0.847841
840	14	0.041	2.2990183	3.04125	3.507447	4.101216	4.543487	4.965924
960	16	0.06	3.3644171	4.450609	5.132849	6.001779	6.649005	7.267206
1200	20	0.072	4.0373005	5.340731	6.159418	7.202135	7.978806	8.720647
1440	24	0.048	2.6915337	3.560488	4.106279	4.801423	5.319204	5.813764

* ref Design Chart 1.05 MTO Drainage Manutal

UPDATED CITY OF BURLINGTON (2020) IDF DATA

a	681.52	802.04	918.28	1065.95	1172.34	1281.34
b	6	5	5	5	5	5
c	0.78	0.764	0.763	0.762	0.761	0.761
t	1440	1440	1440	1440	1440	1440
d (hrs)	24	24	24	24	24	24
i	2.3364007	3.090701	3.564478	4.167902	4.617364	5.046671
d	56.1	74.2	85.5	100.0	110.8	121.1

DESIGN STORM TIME SERIES

	Intensity (mm/hr)					
Time Step	2	5	10	25	50	100
10	0.62	0.82	0.94	1.10	1.22	1.33
20	0.62	0.82	0.94	1.10	1.22	1.33
30	0.62	0.82	0.94	1.10	1.22	1.33
40	0.62	0.82	0.94	1.10	1.22	1.33
50	0.62	0.82	0.94	1.10	1.22	1.33
60	0.62	0.82	0.94	1.10	1.22	1.33
70	0.62	0.82	0.94	1.10	1.22	1.33
80	0.62	0.82	0.94	1.10	1.22	1.33
90	0.62	0.82	0.94	1.10	1.22	1.33
100	0.62	0.82	0.94	1.10	1.22	1.33
110	0.62	0.82	0.94	1.10	1.22	1.33
120	0.62	0.82	0.94	1.10	1.22	1.33
130	0.73	0.96	1.11	1.30	1.44	1.57
140	0.73	0.96	1.11	1.30	1.44	1.57
150	0.73	0.96	1.11	1.30	1.44	1.57
160	0.73	0.96	1.11	1.30	1.44	1.57
170	0.73	0.96	1.11	1.30	1.44	1.57
180	0.73	0.96	1.11	1.30	1.44	1.57
190	0.73	0.96	1.11	1.30	1.44	1.57
200	0.73	0.96	1.11	1.30	1.44	1.57
210	0.73	0.96	1.11	1.30	1.44	1.57
220	0.73	0.96	1.11	1.30	1.44	1.57
230	0.73	0.96	1.11	1.30	1.44	1.57
240	0.73	0.96	1.11	1.30	1.44	1.57
250	0.90	1.19	1.37	1.60	1.77	1.94
260	0.90	1.19	1.37	1.60	1.77	1.94
270	0.90	1.19	1.37	1.60	1.77	1.94
280	0.90	1.19	1.37	1.60	1.77	1.94
290	0.90	1.19	1.37	1.60	1.77	1.94
300	0.90	1.19	1.37	1.60	1.77	1.94
310	0.90	1.19	1.37	1.60	1.77	1.94
320	0.90	1.19	1.37	1.60	1.77	1.94
330	0.90	1.19	1.37	1.60	1.77	1.94
340	0.90	1.19	1.37	1.60	1.77	1.94
350	0.90	1.19	1.37	1.60	1.77	1.94
360	0.90	1.19	1.37	1.60	1.77	1.94
370	1.12	1.48	1.71	2.00	2.22	2.42
380	1.12	1.48	1.71	2.00	2.22	2.42
390	1.12	1.48	1.71	2.00	2.22	2.42
400	1.12	1.48	1.71	2.00	2.22	2.42
410	1.12	1.48	1.71	2.00	2.22	2.42
420	1.12	1.48	1.71	2.00	2.22	2.42
430	1.12	1.48	1.71	2.00	2.22	2.42
440	1.12	1.48	1.71	2.00	2.22	2.42
450	1.12	1.48	1.71	2.00	2.22	2.42
460	1.12	1.48	1.71	2.00	2.22	2.42
470	1.12	1.48	1.71	2.00	2.22	2.42
480	1.12	1.48	1.71	2.00	2.22	2.42
490	1.51	2.00	2.31	2.70	2.99	3.27
500	1.51	2.00	2.31	2.70	2.99	3.27
510	1.51	2.00	2.31	2.70	2.99	3.27
520	1.51	2.00	2.31	2.70	2.99	3.27
530	1.51	2.00	2.31	2.70	2.99	3.27
540	1.51	2.00	2.31	2.70	2.99	3.27
550	1.79	2.37	2.74	3.20	3.55	3.88
560	1.79	2.37	2.74	3.20	3.55	3.88
570	1.79	2.37	2.74	3.20	3.55	3.88
580	2.02	2.67	3.08	3.60	3.99	4.36
590	2.02	2.67	3.08	3.60	3.99	4.36
600	2.02	2.67	3.08	3.60	3.99	4.36
610	2.58	3.41	3.94	4.60	5.10	5.57
620	2.58	3.41	3.94	4.60	5.10	5.57
630	2.58	3.41	3.94	4.60	5.10	5.57
640	3.48	4.60	5.30	6.20	6.87	7.51
650	3.48	4.60	5.30	6.20	6.87	7.51
660	3.48	4.60	5.30	6.20	6.87	7.51
670	5.38	7.12	8.21	9.60	10.64	11.63
680	5.38	7.12	8.21	9.60	10.64	11.63
690	5.38	7.12	8.21	9.60	10.64	11.63
700	23.33	30.86	35.59	41.61	46.10	50.39
710	42.62	56.37	65.02	76.02	84.22	92.05
720	61.91	81.89	94.44	110.43	122.34	133.72
730	8.07	10.68	12.32	14.40	15.96	17.44
740	8.07	10.68	12.32	14.40	15.96	17.44
750	8.07	10.68	12.32	14.40	15.96	17.44
760	4.15	5.49	6.33	7.40	8.20	8.96
770	4.15	5.49	6.33	7.40	8.20	8.96
780	4.15	5.49	6.33	7.40	8.20	8.96
790	0.79	1.04	1.20	1.40	1.55	1.70
800	0.79	1.04	1.20	1.40	1.55	1.70
810	0.79	1.04	1.20	1.40	1.55	1.70
820	4.60	6.08	7.01	8.20	9.09	9.93
830	4.60	6.08	7.01	8.20	9.09	9.93
840	4.60	6.08	7.01	8.20	9.09	9.93
850	1.68	2.23	2.57	3.00	3.32	3.63
860	1.68	2.23	2.57	3.00	3.32	3.63

24 HOUR SCS II DESIGN STORM

Total Depth	56.1	74.2	85.5	100.0	110.8	121.1

*Time Ending	*% Inc	Depth/Increment					
		2	5	10	25	50	100

DESIGN STORM TIME SERIES

	Intensity (mm/hr)					
Time Step	2	5	10	25	50	100
870	1.68	2.23	2.57	3.00	3.32	3.63
880	1.68	2.23	2.57	3.00	3.32	3.63
890	1.68	2.23	2.57	3.00	3.32	3.63
900	1.68	2.23	2.57	3.00	3.32	3.63
910	1.68	2.23	2.57	3.00	3.32	3.63
920	1.68	2.23	2.57	3.00	3.32	3.63
930	1.68	2.23	2.57	3.00	3.32	3.63
940	1.68	2.23	2.57	3.00	3.32	3.63
950	1.68	2.23	2.57	3.00	3.32	3.63
960	1.68	2.23	2.57	3.00	3.32	3.63
970	1.01	1.34	1.54	1.80	1.99	2.18
980	1.01	1.34	1.54	1.80	1.99	2.18
990	1.01	1.34	1.54	1.80	1.99	2.18
1000	1.01	1.34	1.54	1.80	1.99	2.18
1010	1.01	1.34	1.54	1.80	1.99	2.18
1020	1.01	1.34	1.54	1.80	1.99	2.18
1030	1.01	1.34	1.54	1.80	1.99	2.18
1040	1.01	1.34	1.54	1.80	1.99	2.18
1050	1.01	1.34	1.54	1.80	1.99	2.18
1060	1.01	1.34	1.54	1.80	1.99	2.18
1070	1.01	1.34	1.54	1.80	1.99	2.18
1080	1.01	1.34	1.54	1.80	1.99	2.18
1090	1.01	1.34	1.54	1.80	1.99	2.18
1100	1.01	1.34	1.54	1.80	1.99	2.18
1110	1.01	1.34	1.54	1.80	1.99	2.18
1120	1.01	1.34	1.54	1.80	1.99	2.18
1130	1.01	1.34	1.54	1.80	1.99	2.18
1140	1.01	1.34	1.54	1.80	1.99	2.18
1150	1.01	1.34	1.54	1.80	1.99	2.18
1160	1.01	1.34	1.54	1.80	1.99	2.18
1170	1.01	1.34	1.54	1.80	1.99	2.18
1180	1.01	1.34	1.54	1.80	1.99	2.18
1190	1.01	1.34	1.54	1.80	1.99	2.18
1200	1.01	1.34	1.54	1.80	1.99	2.18
1210	0.67	0.89	1.03	1.20	1.33	1.45
1220	0.67	0.89	1.03	1.20	1.33	1.45
1230	0.67	0.89	1.03	1.20	1.33	1.45
1240	0.67	0.89	1.03	1.20	1.33	1.45
1250	0.67	0.89	1.03	1.20	1.33	1.45
1260	0.67	0.89	1.03	1.20	1.33	1.45
1270	0.67	0.89	1.03	1.20	1.33	1.45
1280	0.67	0.89	1.03	1.20	1.33	1.45
1290	0.67	0.89	1.03	1.20	1.33	1.45
1300	0.67	0.89	1.03	1.20	1.33	1.45
1310	0.67	0.89	1.03	1.20	1.33	1.45
1320	0.67	0.89	1.03	1.20	1.33	1.45
1330	0.67	0.89	1.03	1.20	1.33	1.45
1340	0.67	0.89	1.03	1.20	1.33	1.45
1350	0.67	0.89	1.03	1.20	1.33	1.45
1360	0.67	0.89	1.03	1.20	1.33	1.45
1370	0.67	0.89	1.03	1.20	1.33	1.45
1380	0.67	0.89	1.03	1.20	1.33	1.45
1390	0.67	0.89	1.03	1.20	1.33	1.45
1400	0.67	0.89	1.03	1.20	1.33	1.45
1410	0.67	0.89	1.03	1.20	1.33	1.45
1420	0.67	0.89	1.03	1.20	1.33	1.45
1430	0.67	0.89	1.03	1.20	1.33	1.45
1440	0.67	0.89	1.03	1.20	1.33	1.45

TABLE B1 - BASE HYDROLOGIC PARAMETERIZATION

Land Use	CN (AMC-II)	Initial Abstraction (mm)
Forest	70	7
Grass/Meadow	74	5
Gravel	89	2
Rooftop/Paved	98	1

TABLE B2 - CALCULATION OF SCS CURVE NUMBER AND IMPERVIOUSNESS - EXISTING CONDITIONS

Land Use	Sub	Total Area (ha)	Forest (ha)	Grass/Meadow (ha)	Gravel (ha)	Rooftop/Paved - Disconnected (ha)	Rooftop/Paved - Connected (ha)	Imperviousness (%)	CN Pervious Area (AMC-II - Normal)	CN Pervious Area (AMC-III - Saturated)	IA Pervious Area (mm)
Common External Drainage Areas (Including Expected Full-Build Out of King Forest Business Park)	EXT1	1.38	0.98	0.12	0.00	0.28	0.00	0%	75.9	88.0	5.6
	EXT2	1.57	1.41	0.05	0.07	0.04	0.00	0%	71.7	86.0	6.6
	EXT3	3.46	1.09	2.05	0.22	0.10	0.00	0%	74.4	88.0	5.3
	EXT4	0.44	0.00	0.35	0.00	0.09	0.00	0%	79.0	90.0	4.2
	EXT5_300	0.04	0.03	0.01	0.00	0.00	0.00	0%	71.4	86.0	6.3
	EXT5_301	0.07	0.00	0.07	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT5_302	0.06	0.00	0.06	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT5_303	0.08	0.00	0.08	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT5_304	0.41						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_305	0.39						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_306	0.03	0.00	0.03	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT5_307	0.13						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_308	0.11	0.00	0.11	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT5_309	0.17						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_310	0.09						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_311	0.56						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_312	0.04	0.00	0.04	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT5_313	0.34						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_314	0.24	0.07	0.17	0.00	0.00	0.00	0%	72.8	87.0	5.6
	EXT5_315	0.08	0.00	0.08	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT5_316	0.07						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_317	0.09						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_318	0.12	0.00	0.12	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT5_319	0.87						**85%**	**74.0**	**87.0**	**5.0**
	EXT5_320	0.73						**85%**	**74.0**	**87.0**	**5.0**
Existing Site Conditions	100	1.43	0.00	1.43	0.00	0.00	0.00	0%	74.0	87.0	5.0
	101	1.10	0.00	1.10	0.00	0.00	0.00	0%	74.0	87.0	5.0
	102	0.15	0.00	0.15	0.00	0.00	0.00	0%	74.0	87.0	5.0
	103	0.16	0.00	0.16	0.00	0.00	0.00	0%	74.0	87.0	5.0
	104	0.38	0.00	0.38	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT6	0.20	0.00	0.15	0.00	0.05	0.00	0%	79.6	90.0	4.1
	EXT7	0.12	0.00	0.12	0.00	0.00	0.00	0%	74.0	87.0	5.0
	EXT8	0.11	0.00	0.00	0.00	0.00	0.11	100%	74.0	87.0	5.0
	EXT9	0.30	0.00	0.23	0.00	0.07	0.00	0%	79.8	90.0	4.0

***Highlighted values reflect assumed future imperviousness consistent with direction of City, based on original storm sewer design info (C=0.85 or 85% imperviousness)

TABLE B3 - CALCULATION OF OVERLAND FLOW LENGTH AND SLOPE - EXISTING CONDITIONS

Land Use	Sub	Total Area (ha)	Slope (%)	Channel Length (m)	Calculated Overland Flow Length (m)	Applied Overland Flow Length (m)
Common External Drainage Areas (Including Expected Full-Build Out of King Forest Business Park)	EXT1	1.38	4.8%	189	43	43
	EXT2	1.57	5.2%	154	60	60
	EXT3	3.46	6.1%	327	62	62
	EXT4	0.44	3.5%	230	11	15
	EXT5_300	0.04	2.0%	NA	NA	10
	EXT5_301	0.07	2.0%	65	6	10
	EXT5_302	0.06	2.0%	60	6	10
	EXT5_303	0.08	2.0%	NA	NA	15
	EXT5_304	0.41	2.0%	82	29	30
	EXT5_305	0.39	2.0%	NA	NA	35
	EXT5_306	0.03	2.0%	NA	NA	10
	EXT5_307	0.13	2.0%	50	15	15
	EXT5_308	0.11	2.0%	NA	NA	15
	EXT5_309	0.17	2.0%	85	12	15
	EXT5_310	0.09	2.0%	23	23	20
	EXT5_311	0.56	2.0%	NA	NA	30
	EXT5_312	0.04	2.0%	25	9	10
	EXT5_313	0.34	2.0%	NA	NA	30
	EXT5_314	0.24	2.0%	50	28	30
	EXT5_315	0.08	2.0%	36	13	15
	EXT5_316	0.07	2.0%	50	8	10
	EXT5_317	0.09	2.0%	NA	NA	20
	EXT5_318	0.12	2.0%	78	9	10
	EXT5_319	0.87	2.0%	115	45	40
	EXT5_320	0.73	2.0%	NA	NA	40
Existing Site Conditions	100	1.43	3.1%	NA	NA	60
	101	1.10	3.1%	NA	NA	60
	102	0.15	10.0%	NA	NA	10
	103	0.16	4.0%	NA	NA	15
	104	0.38	4.0%	NA	NA	20
	EXT6	0.20	4.4%	135	9	10
	EXT7	0.12	10.0%	NA	NA	15
	EXT8	0.11	2.0%	NA	NA	10
	EXT9	0.30	5.0%	125	14	14

TABLE B4 - CALCULATION OF SCS CURVE NUMBER AND IMPERVIOUSNESS - PROPOSED CONDITIONS

Land Use	Sub	Total Area (ha)	Forest (ha)	Grass/Meadow (ha)	Gravel (ha)	Rooftop/Paved - Disconnected (ha)	Rooftop/Paved - Connected (ha)	Imperviousness (%)	CN Pervious Area (AMC-II - Normal)	CN Pervious Area (AMC-III - Saturated)	IA Pervious Area (mm)
Proposed Interim Conditions	200	0.83	0.00	0.83	0.00	0.00	0.00	0%	74.0	87.0	5.0
	201	0.75	0.00	0.75	0.00	0.00	0.00	0%	74.0	87.0	5.0
	204	0.43	0.00	0.43	0.00	0.00	0.00	0%	74.0	87.0	5.0
	205	0.94	0.00	0.87	0.00	0.00	0.07	7%	74.0	87.0	5.0
	EXT10	0.18	0.00	0.18	0.00	0.00	0.00	0%	74.0	87.0	5.0
Proposed Decomm Conditions	301	1.75	0.00	1.75	0.00	0.00	0.00	0%	74.0	87.0	5.0
	303	0.09	0.00	0.09	0.00	0.00	0.00	0%	74.0	87.0	5.0
	304	0.45	0.00	0.45	0.00	0.00	0.00	0%	74.0	87.0	5.0

TABLE B5 - CALCULATION OF OVERLAND FLOW LENGTH AND SLOPE - PROPOSED CONDITIONS

Land Use	Sub	Total Area (ha)	Slope (%)	Channel Length (m)	Calculated Overland Flow Length (m)	Applied Overland Flow Length (m)
Proposed Interim Conditions	200	0.83	3.0%	60	NA	60
	201	0.75	3.0%	60	NA	60
	204	0.43	5.0%	30	NA	30
	205	0.94	10.0%	NA	NA	30
	EXT10	0.18	4.4%	120	9	10
Proposed Decomm Conditions	301	1.75	5%	100	NA	100
	303	0.09	5%	10	NA	10
	304	0.45	4%	20	NA	20

TABLE B6: OPERATION OF PROPOSED SWM FACILITY (INTERIM CONDITIONS)

Model output results from PCSWMM - orifices are explicity modeled

Storm	WSE (m)	Volume (m3)	Total Q (m3/s)	Low Orifice (m3/s)	Mid Orifice (m3/s)	High Orifice (m3/s)
25 mm	119.15	644	0.015	0.010	0.005	0.000
2	119.47	1,346	0.103	0.012	0.091	0.000
5	119.80	2,170	0.174	0.013	0.144	0.017
10	119.97	2,650	0.257	0.014	0.164	0.079
25	120.18	3,281	0.364	0.014	0.187	0.163
50	120.35	3,821	0.430	0.015	0.203	0.204
100	120.50	4,360	0.474	0.016	0.217	0.237

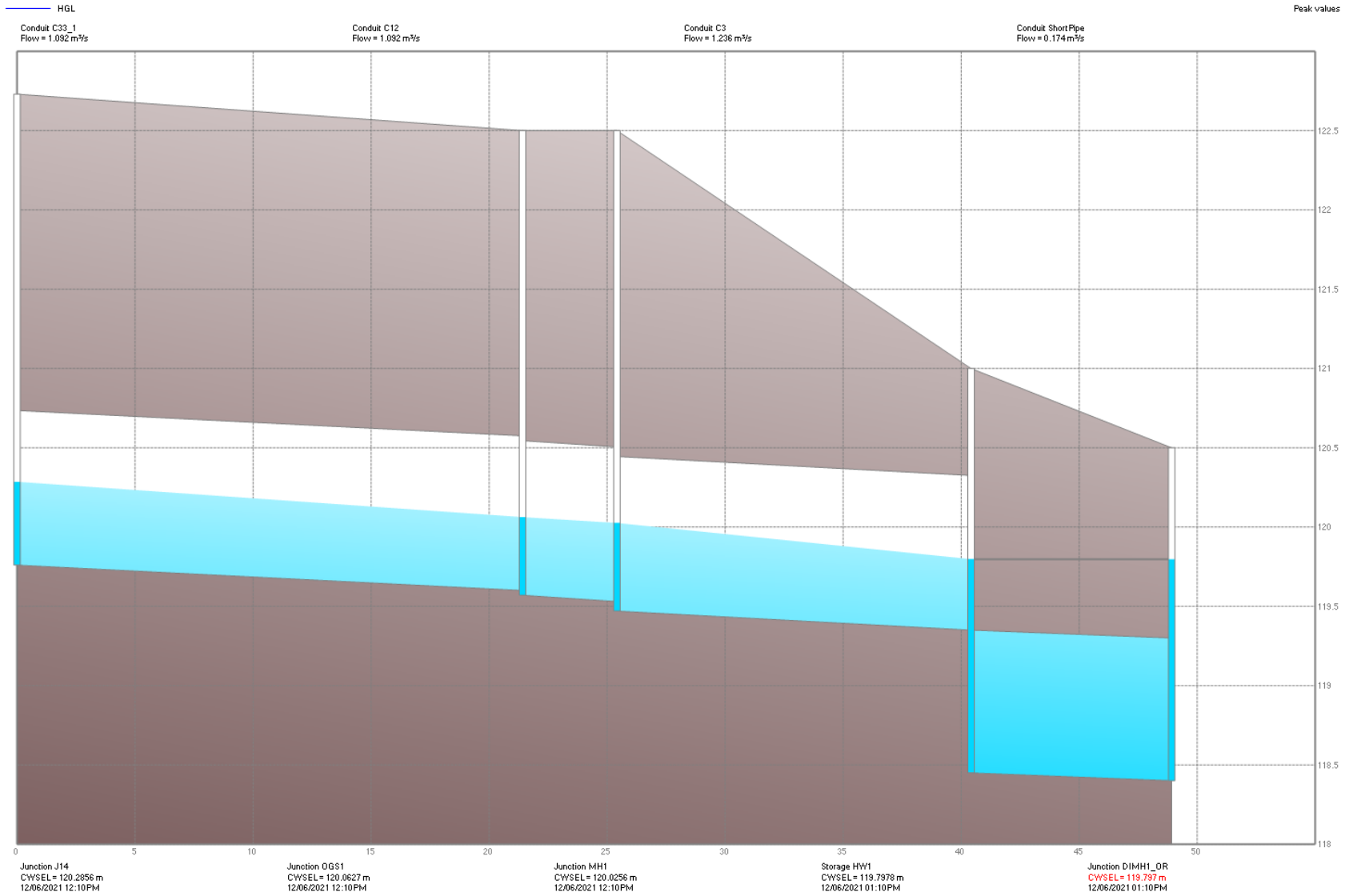


Figure B1: Inlet Piping to Dry Pond – Hydraulic Gradeline for Decommissioned Conditions (5-Year Storm)

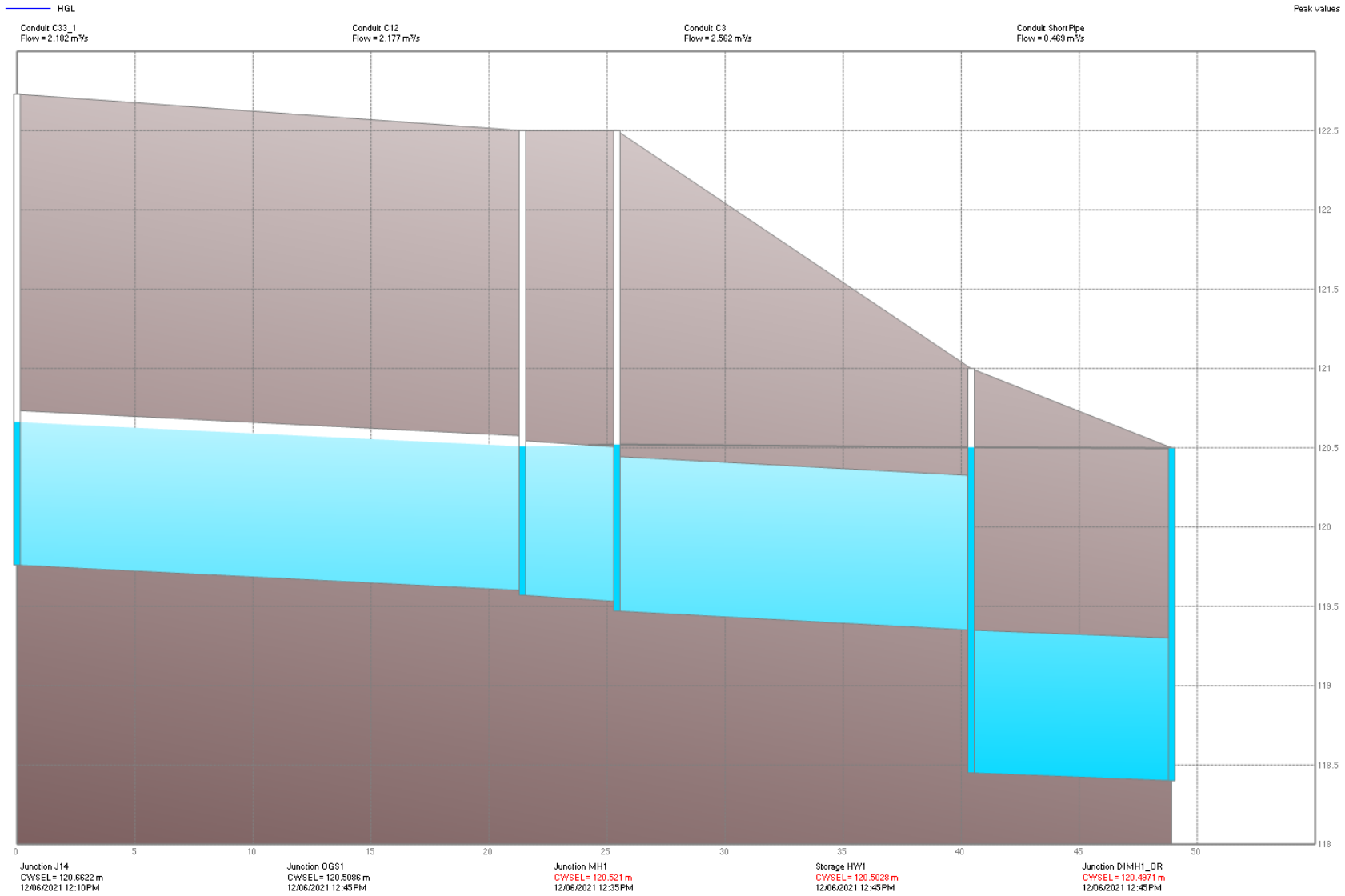


Figure B2: Inlet Piping to Dry Pond – Hydraulic Gradeline for Decommissioned Conditions (100-Year Storm)

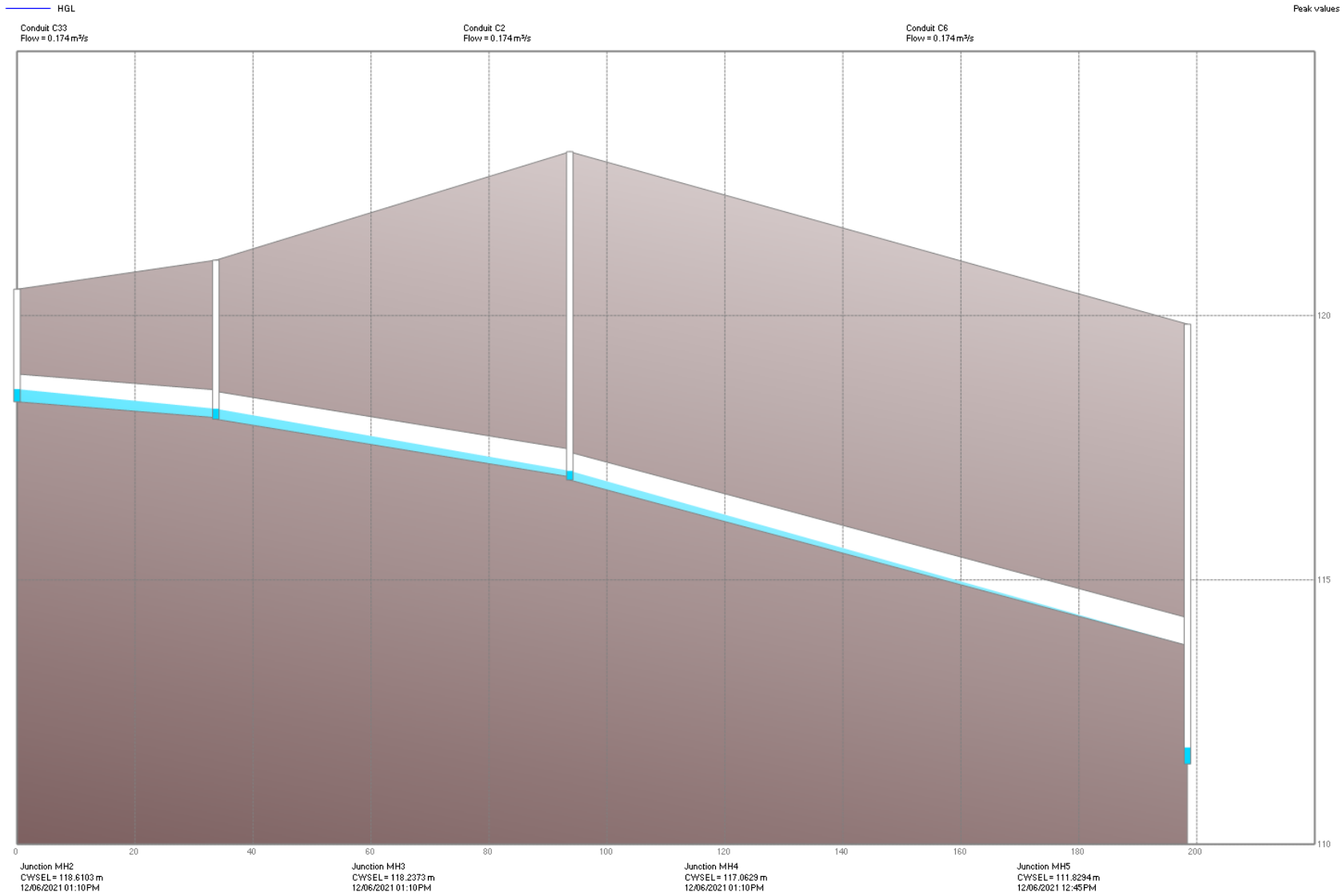


Figure B3: Outlet Piping from Dry Pond – Hydraulic Gradeline for Decommissioned Conditions (5-Year Storm)

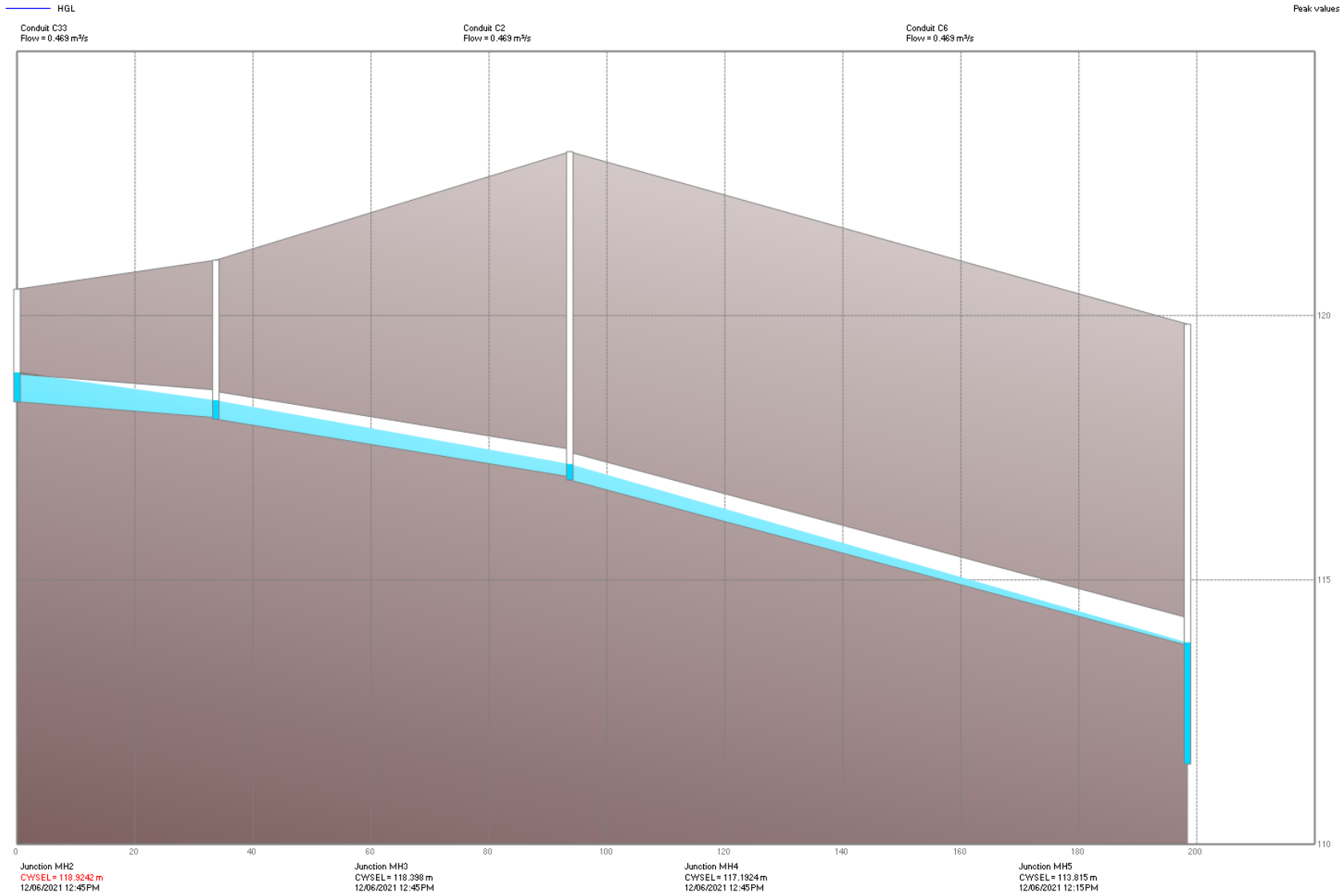


Figure B4: Outlet Piping from Dry Pond – Hydraulic Gradeline for Decommissioned Conditions (100-Year Storm)

STORM SEWER DESIGN CALCULATIONS (5-YEAR)

Flows as generated from PCSWMM Modelling for Decommissioned Conditions (2021 City IDF, 24H SCS design storm)

Project: **1450 King Road**

Manning's n = 0.013

Minimum acceptable velocity = 0.75 (m/s)

Job No.: WW21012079

Maximum acceptable velocity = 4.60 (m/s)

Date: 2-May-23

Designed by: Matt Senior

Drainage Area	STRUCTURE LOCATION		DRAINAGE AREA					RUNOFF			PIPE SELECTION							REMARKS
	From	To	A	Imp.	C	AC	Cumul. AC	Cumul. T_C	i	Q	Dia.	Pipe Slope	Actual Capacity (full)	Velocity (full)	Pipe Length	Time of Flow	% Full	
			ha	%					mm/hr	m^3/s	mm	%	m^3/s	m/s	m	min.		
Upstream site drainage	OGS1	MH#1	9.56	34.2%						1.092	975	1.00	2.241	3.00	6.0	0.03	48.7	NO SURCHARGE
Drainage from King Road ditch	DI#1	MH#1	1.94	0.0%						0.148	525	2.50	0.680	3.14	82.2	0.44	21.8	NO SURCHARGE
Discharge to dry pond	MH#1	HW#1	11.50	28.4%						1.236	975	0.80	2.004	2.68	14.0	0.09	61.7	NO SURCHARGE
Inlet to control structure	HW#2	MH#2	12.52	26.7%						0.174	900	0.60	1.402	2.20	8.5	0.06	12.4	NO SURCHARGE
Control structure discharge	MH#2	MH#3	12.52	26.7%						0.174	525	0.80	0.385	1.78	33.7	0.32	45.2	NO SURCHARGE
Conveyance to King Road	MH#3	MH#4	12.52	26.7%						0.174	525	2.00	0.608	2.81	60.0	0.36	28.6	NO SURCHARGE
King Road to existing culvert	MH#4	MH#5	12.52	26.7%						0.174	525	3.00	0.745	3.44	104.7	0.51	23.4	NO SURCHARGE

STORM SEWER DESIGN CALCULATIONS (100-YEAR)

Flows as generated from PCSWMM Modelling for Decommissioned Conditions (2021 City IDF, 24H SCS design storm)

Project: **1450 King Road**

Manning's n = 0.013

Minimum acceptable velocity = 0.75 (m/s)

Job No.: WW21012079

Maximum acceptable velocity = 4.60 (m/s)

Date: 2-May-23

Designed by: Matt Senior

Drainage Area	STRUCTURE LOCATION		DRAINAGE AREA					RUNOFF			PIPE SELECTION							REMARKS
	From	To	A	Imp.	C	AC	Cumul. AC	Cumul. T_C	i	Q	Dia.	Pipe Slope	Actual Capacity (full)	Velocity (full)	Pipe Length	Time of Flow	% Full	
			ha	%					mm/hr	m^3/s	mm	%	m^3/s	m/s	m	min.		
Upstream site drainage	OGS1	MH#1	9.56	34.2%						2.177	975	1.00	2.241	3.00	6.0	0.03	97.1	NO SURCHARGE
Drainage from King Road ditch	DI#1	MH#1	1.94	0.0%						0.405	525	2.50	0.680	3.14	82.2	0.44	59.6	NO SURCHARGE
Discharge to dry pond	MH#1	HW#1	11.50	28.4%						2.562	975	0.80	2.004	2.68	14.0	0.09	127.8	**SURCHARGE**
Inlet to control structure	HW#2	MH#2	12.52	26.7%						0.469	900	0.60	1.402	2.20	8.5	0.06	33.4	NO SURCHARGE
Control structure discharge	MH#2	MH#3	12.52	26.7%						0.469	525	0.80	0.385	1.78	33.7	0.32	121.9	**SURCHARGE**
Conveyance to King Road	MH#3	MH#4	12.52	26.7%						0.469	525	2.00	0.608	2.81	60.0	0.36	77.1	NO SURCHARGE
King Road to existing culvert	MH#4	MH#5	12.52	26.7%						0.469	525	3.00	0.745	3.44	104.7	0.51	63.0	NO SURCHARGE

APPENDIX

C WATER QUALITY MODELLING

Hydroworks Sizing Summary

King Road
Burlington, Ontario

12-03-2021

Recommended Size: HydroStorm HS 8

A HydroStorm HS 8 is recommended to provide 50 % annual TSS removal based on a drainage area of 9.57 (ha) with an imperviousness of 27 % and Hamilton Airport, Ontario rainfall for the ETV Canada particle size distribution.

The recommended HydroStorm HS 8 treats 96 % of the annual runoff and provides 56 % annual TSS removal for the Hamilton Airport rainfall records and ETV Canada particle size distribution.

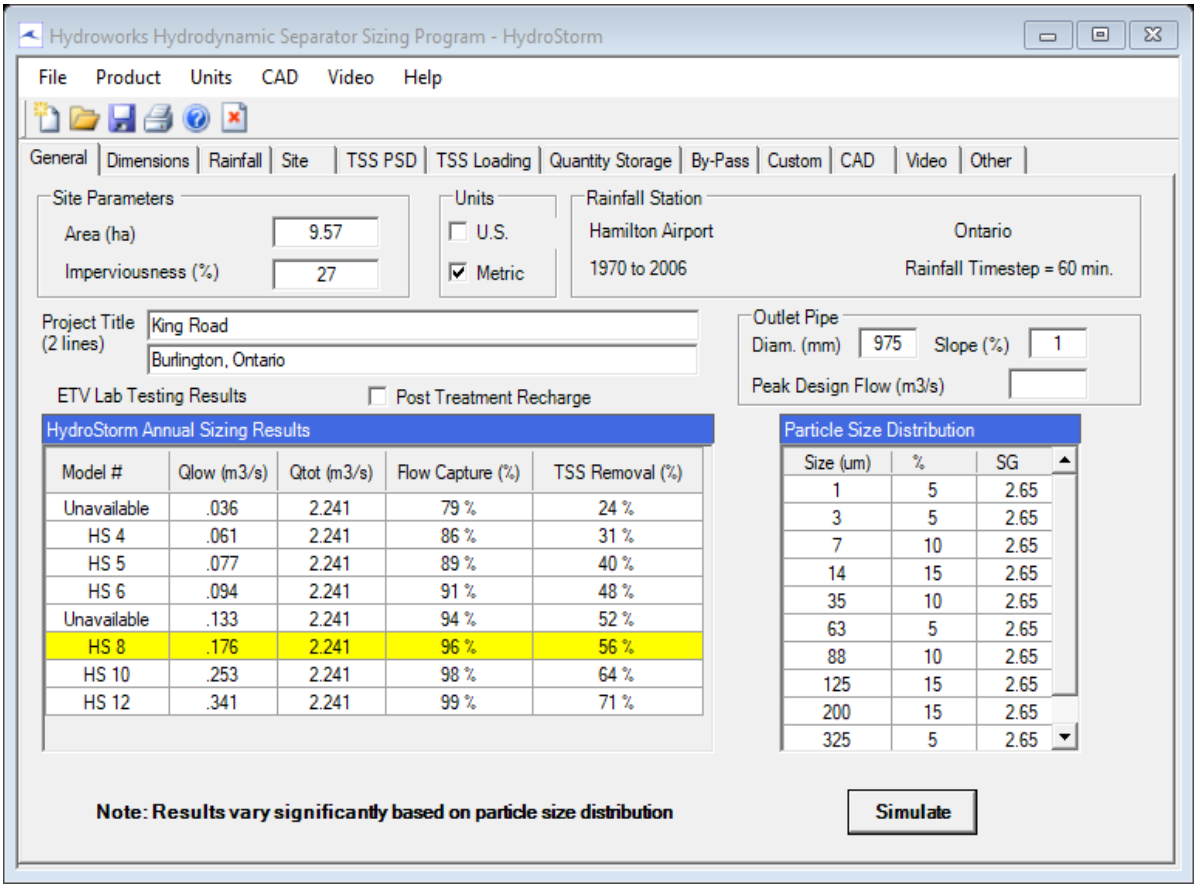
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of 2.24 (m3/s) for the given 975 (mm) pipe diameter at 1% slope. The headloss was calculated to be 478 (mm) based on a flow depth of 975 (mm) (full pipe flow).

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

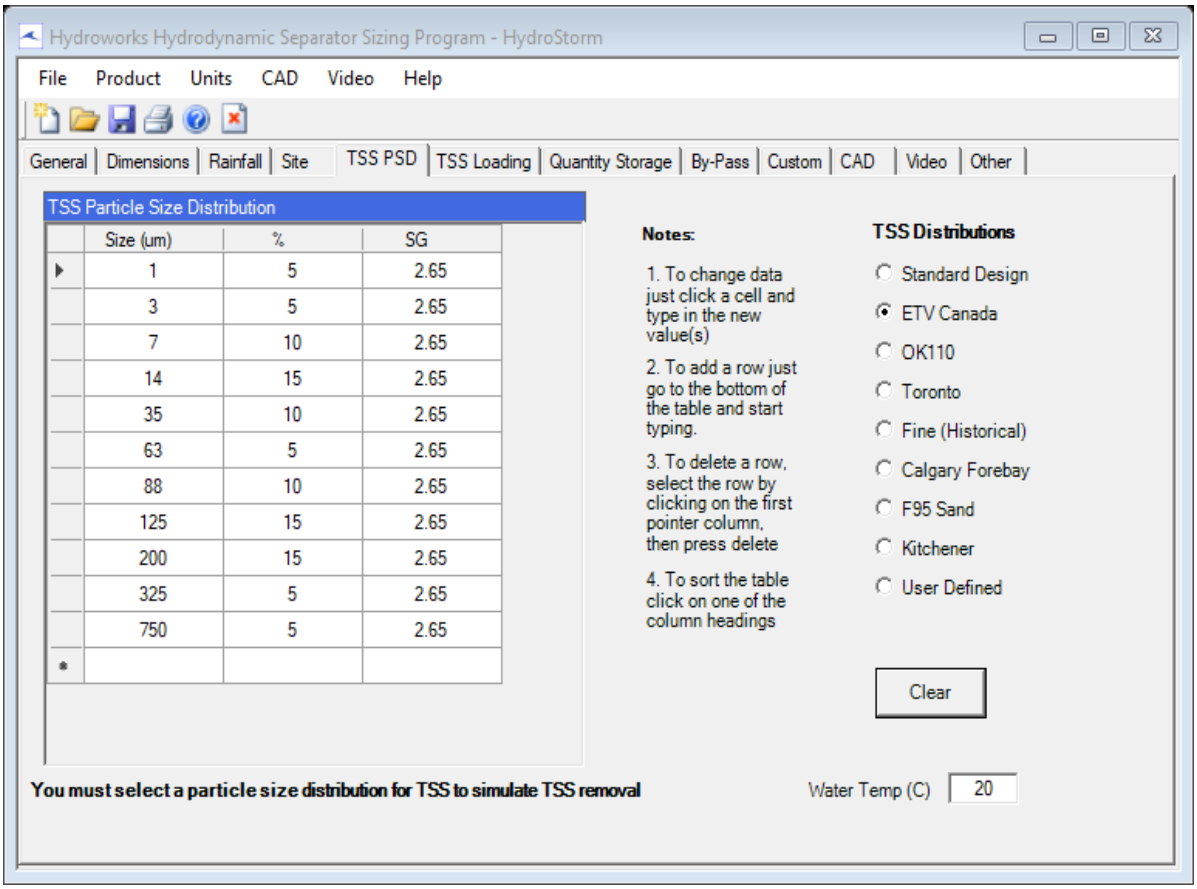
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroStorm . Design liability is only valid for lawsuits brought within the United States where Hydroworks has its corporate headquarters.

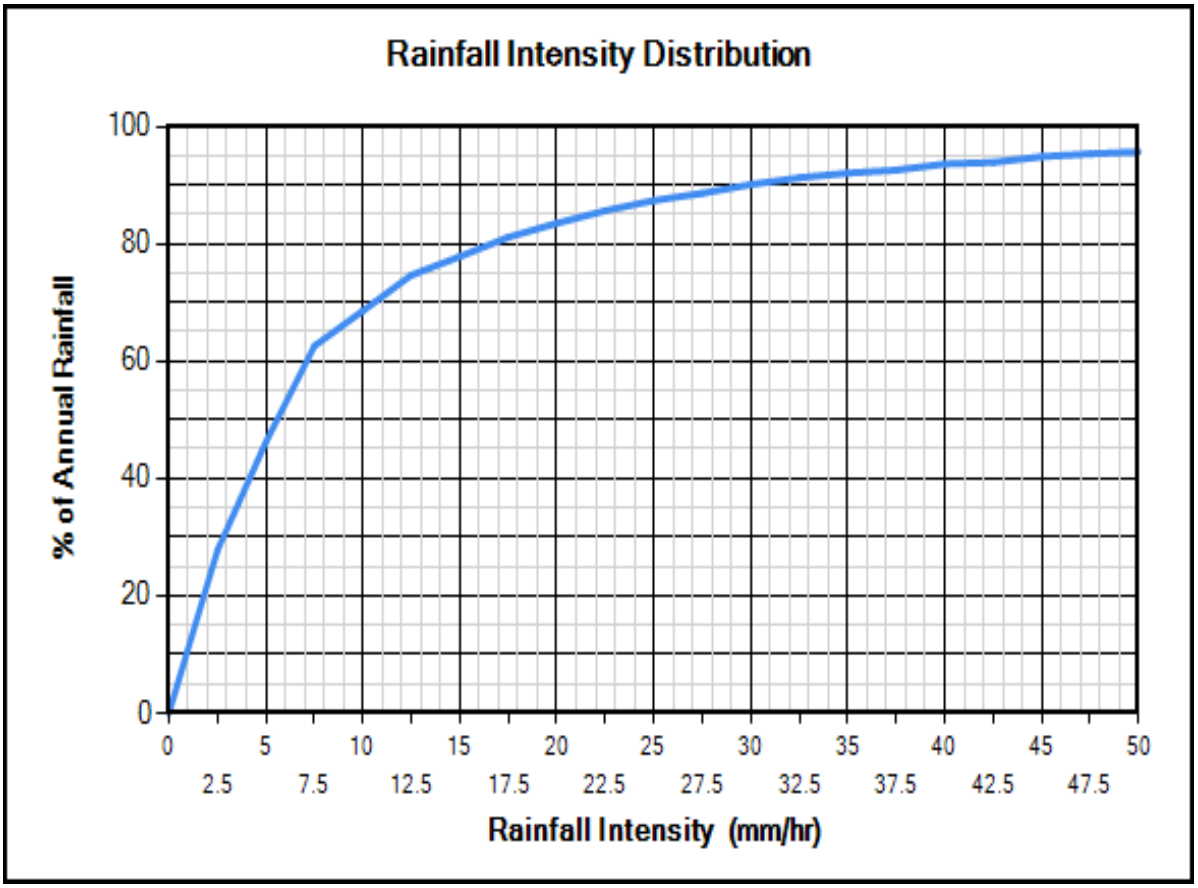
TSS Removal Sizing Summary



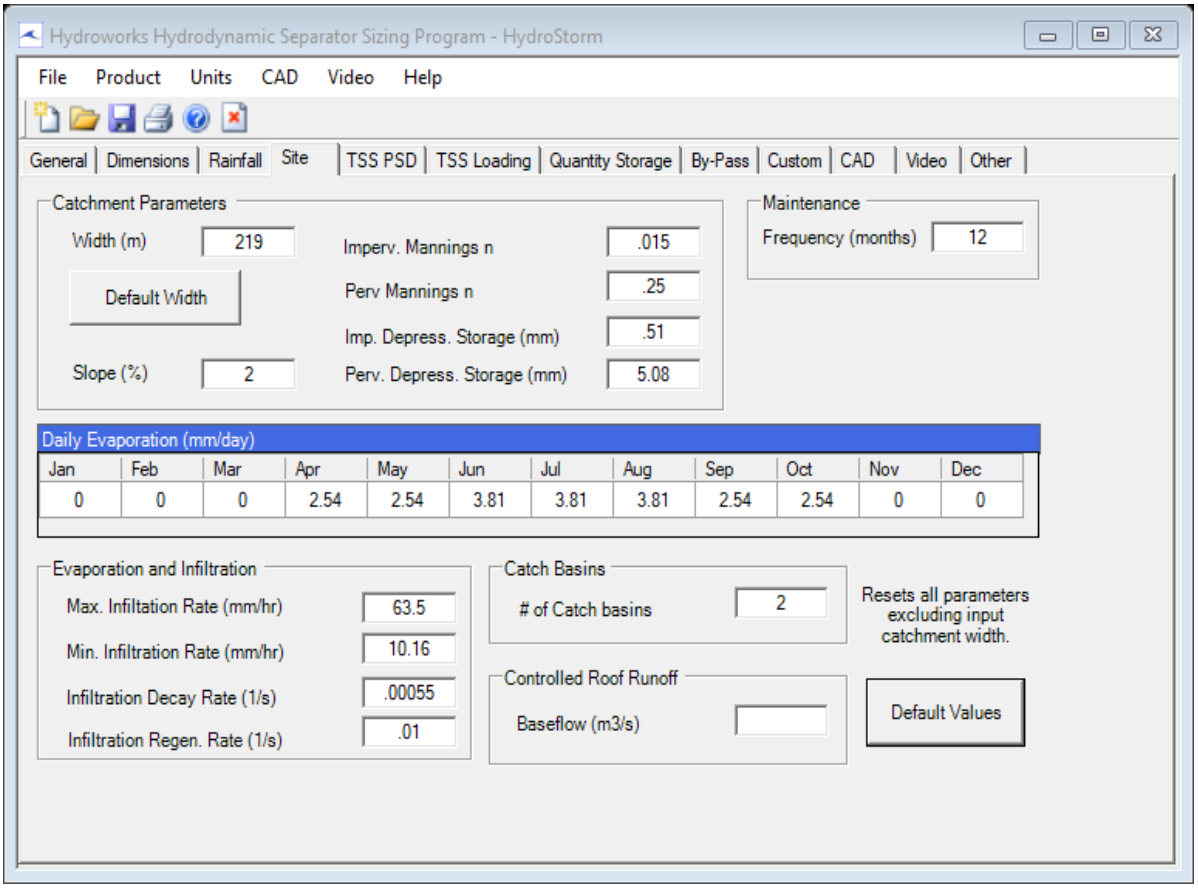
TSS Particle Size Distribution



Rainfall Station - Hamilton Airport, Ontario(1970 to 2006)



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Hydrodynamic Separator Sizing Program - HydroStorm

File Product Units CAD Video Help

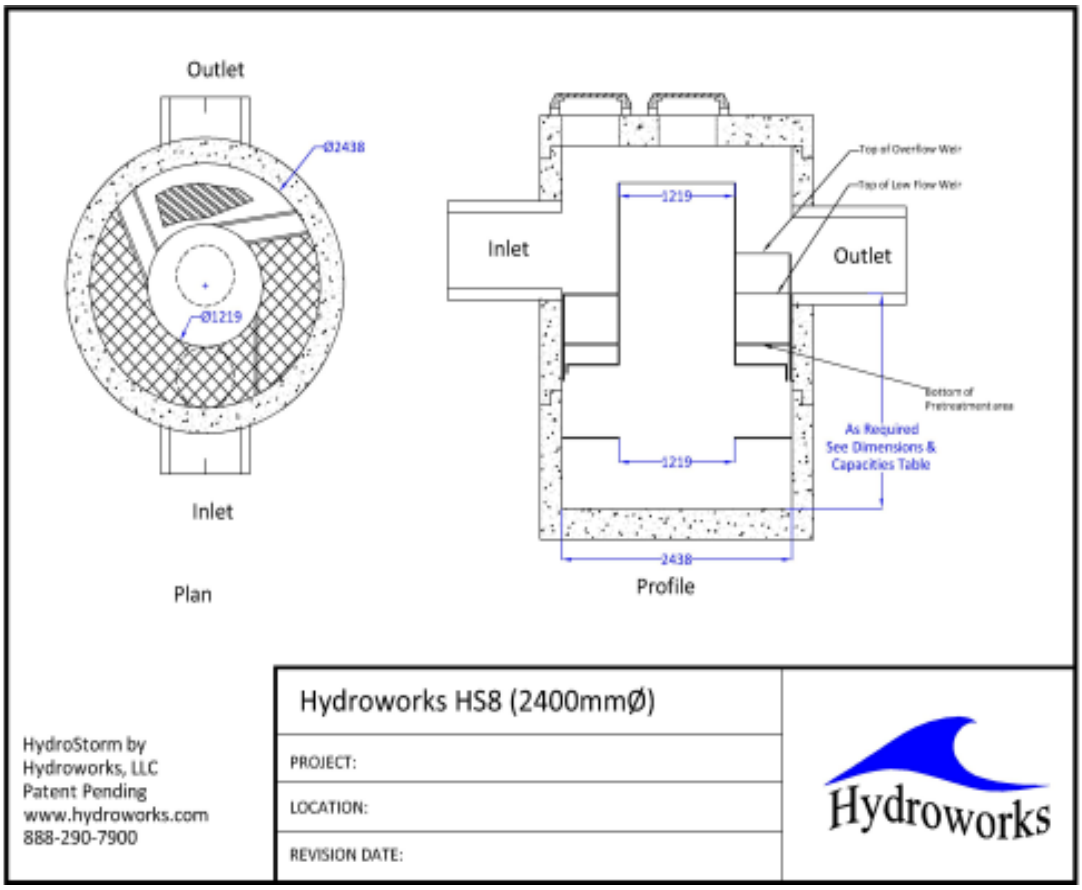
General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD | Video | Other

Dimensions and Capacities

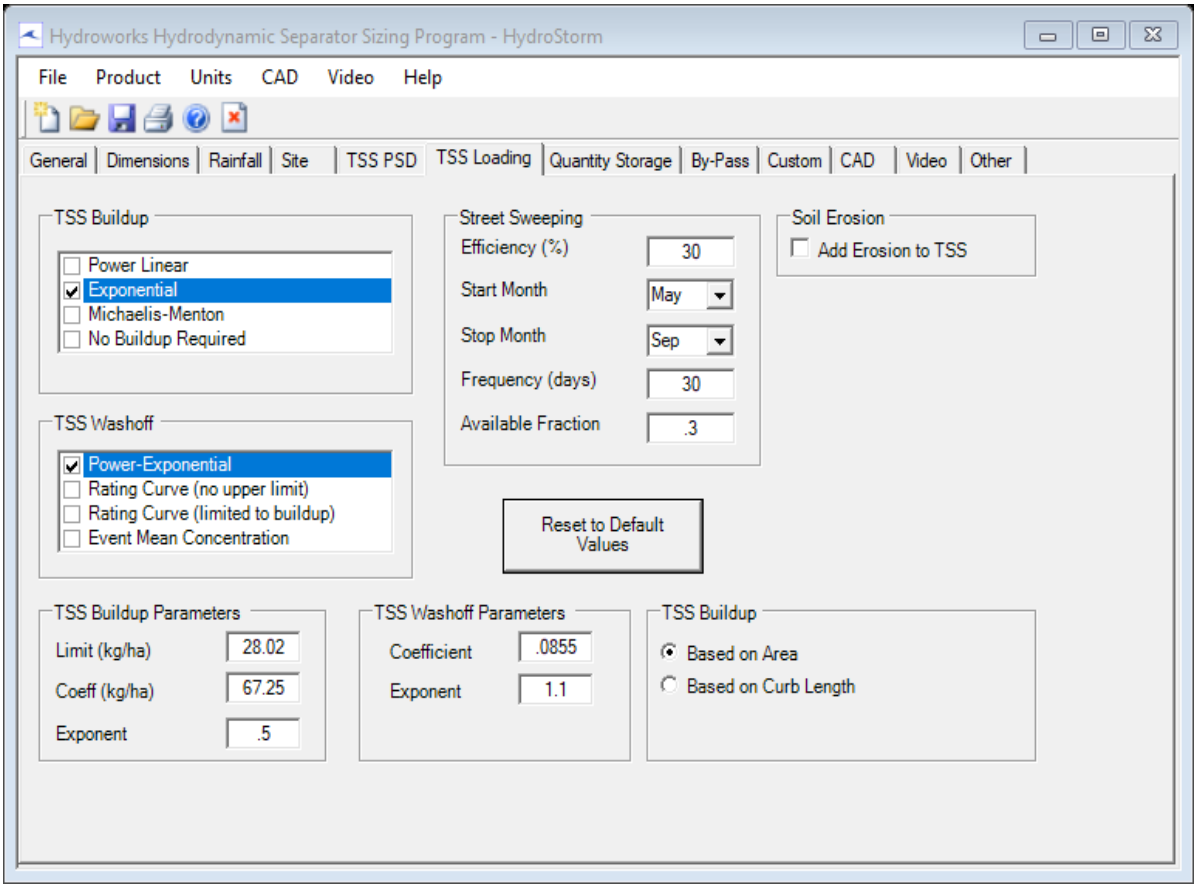
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 3	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

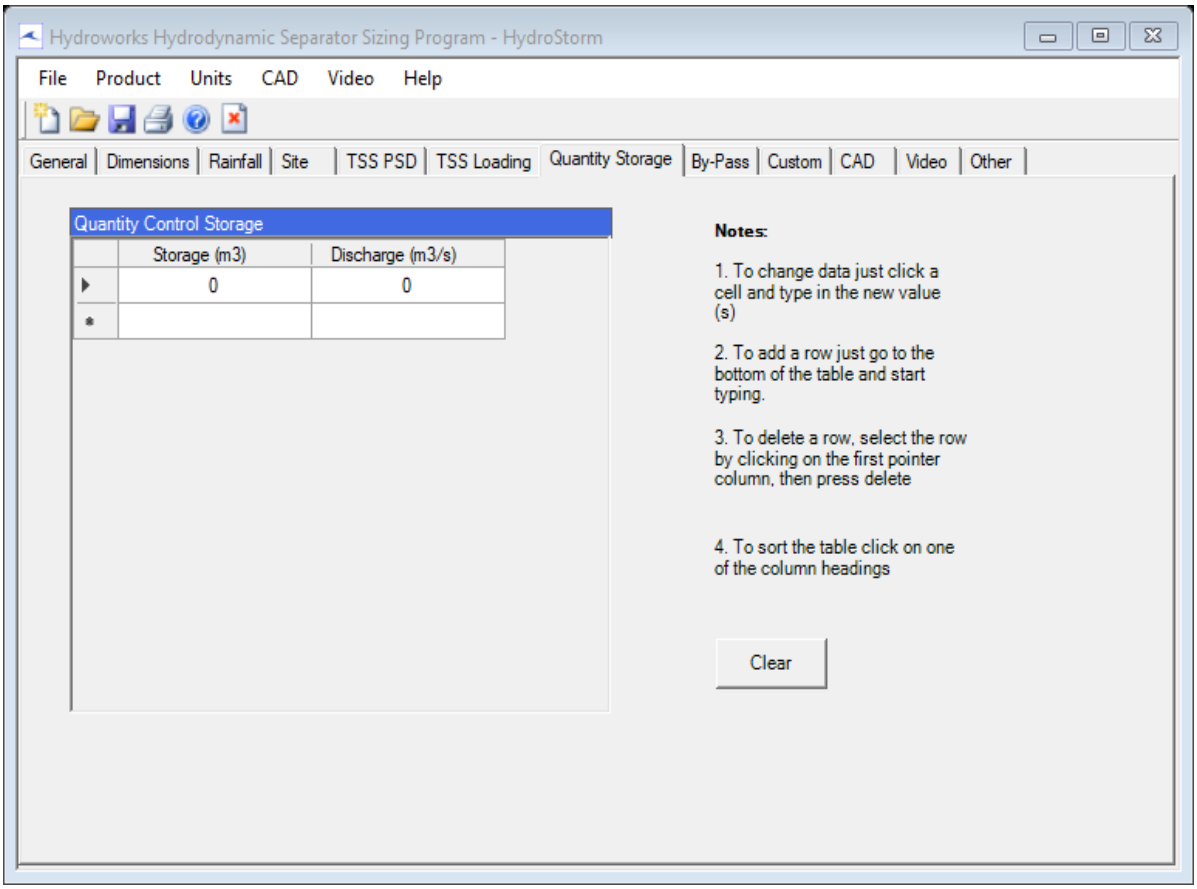
Generic HS 8 CAD Drawing



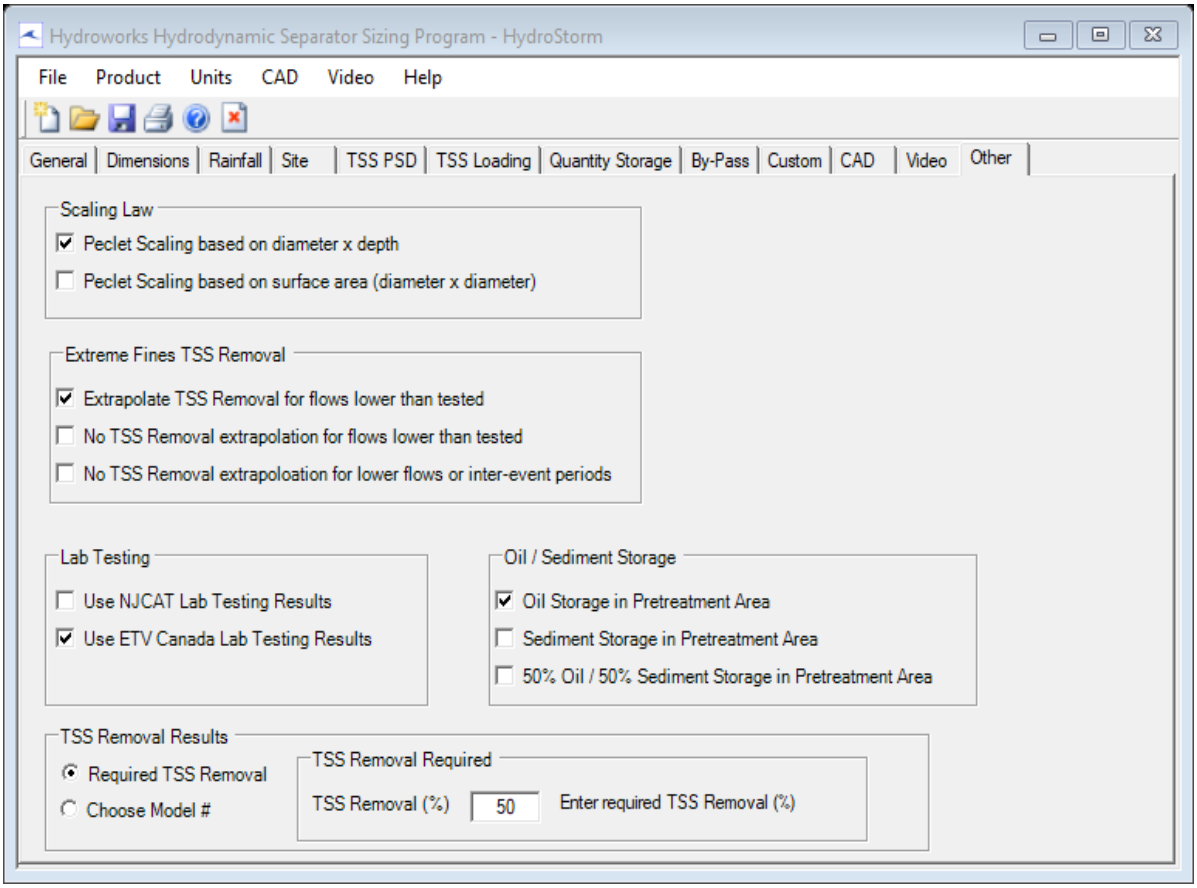
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Hydroworks Sizing Program - Version 5.0
Copyright Hydroworks, LLC, 2021

APPENDIX

D BACKGROUND INFORMATION

510-02. 9/97

KING FOREST BUSINESS PARK
PHASE 1

STORMWATER MANAGEMENT REPORT

A Final Report Prepared for:

Metropolitan Planning & Engineering Inc.
3370 South Service Road
Burlington, Ontario

Prepared by:

AQUAFOR BEECH LIMITED
14 Abacus Road
Brampton, Ontario
L6T 5B7

May 1997
Ref. 6799

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3.1 Characteristics of Proposed Water Quality / Erosion Control Facility

3.2 Stage Discharge Characteristics of Proposed Peak Flow Control Facility

3.3 Summary of Existing and Proposed Peak Flows - Indian Creek

1.0 INTRODUCTION

This report addresses stormwater management issues pertaining to Phase 1 of the King Forest Business Park. This King Forest Business Park is located on the north west corner of King Road and North Service Road, and Phase 1 is located at the eastern edge of the property.

A preliminary storm drainage report was submitted for the Business Park in 1993 which addressed water quality, erosion and peak flow control issues. Since the submission of the report the Ontario Ministry of Environment and Energy have released the Stormwater Management Practices Planning and Design Manual, (MOEE, June 1994). Accordingly, this submission incorporates the requirements of these two documents.

1.1 Response to HRCA and MNR 1994 Comments

As a condition of Site Plan approval the City of Burlington has advised that outstanding issues raised in earlier correspondence from the Halton Region Conservation Authority (HRCA) and Ministry of Natural Resources (MNR) must be addressed with this submission. Accordingly, the issues are addressed below and copies of the 1994 correspondence are enclosed in Appendix A for reference.

Ministry of Natural Resources Letter Dated November 26, 1993

Comments 1 and 2 - Since the 1993 report was prepared, and since the MNR letter, the Ontario Ministry of Environment and Energy (MOEE) has released the Stormwater Practices Planning and Design Manual. The guidelines in the 1994 MOEE document supersede the 13 mm and 25 mm water quality storms previously used. The new guidelines were used to develop water quality controls for Phase 1 (see Sections 3).

Third Comment - See response above with respect to comments 1 and 2. Further, note that Phase 1 uses an off-line facility in the table lands for water quality control. An erosion and sediment

control plan has been prepared by Metropolitan Planning & Engineering Inc. and is included on Sheet No. 15 of the subdivision drawings.

MNR Letter Dated 29 March 1994

Comment 1 - See response to comment 1 above.

Comment 2 - The second comment refers to the "dip in the land" in Phase 2 and approves in principal the use of the dip for water quantity control.

HRCA letter Dated February 8, 1994

The items below are numbered to correspond to HRCA's letter.

1. Approximately 6.27 ha of external land drains through Phase 1 of the King Forest Development. Flows from the most easterly swale (E1) are routed through a ditch on the west side of King Road. Flows from the center (E2) and westerly swale (E3) drain through an open channel located near the centre of Phase 1. Metropolitan Planning & Engineering Inc. is sizing the channel to ensure the 100 year flow can be conveyed safely through the site.

2. Figure 2.1 in the 1993 report illustrated land use in the vicinity of the King Forest Development. a) The landfill area is located north west of the King Forest Development. b) Submissions by Metropolitan Planning & Engineering Inc. include a site plan and topography.

3. Item 3 was a comment by HRCA.

4. This report addresses the amount of peak flow control required on Phase 1 to ensure that post development flows do not exceed pre-development levels.

5. Since the 1993 report was prepared, and since the HRCA letter, the Ontario Ministry of Environment and Energy (MOEE) has released the Stormwater Management Practices Planning and Design Manual (June 1994). The guidelines in the 1994 MOEE document supersede the 13 mm and 25 mm water quality storms previously used. The new guidelines were used to develop water quality controls for Phase 1 (see Sections 2 and 3).

6. Item 6 was an editorial request pertaining to water quality control. Water quality control is addressed in Sections 2 and 3.

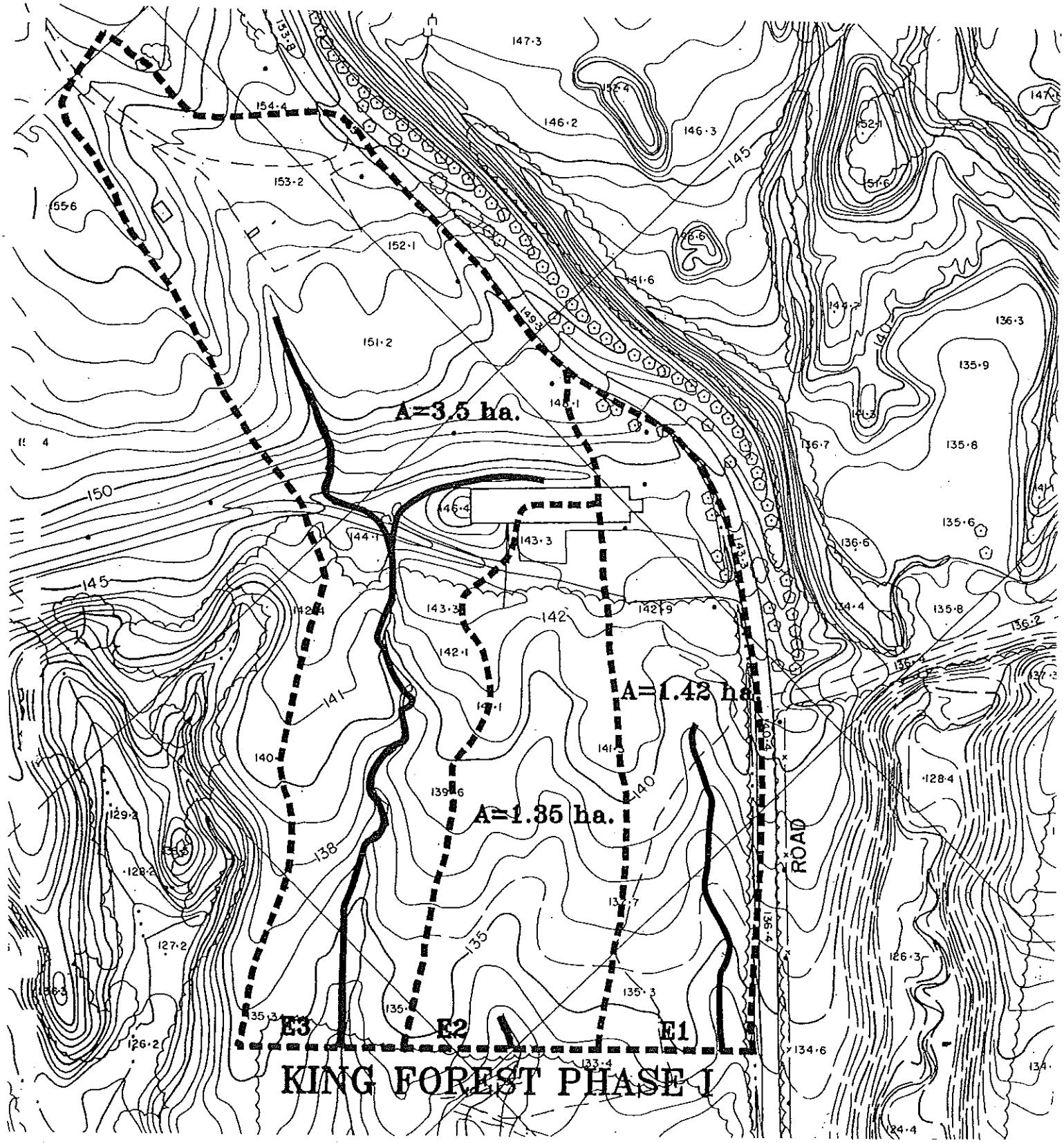
7. There are three external drainage areas to the Phase 1 property. The drainage areas, peak flows and inflow points to Phase 1 are illustrated on drawings prepared by Metropolitan Planning & Engineering. Further, the Figure 1.1 illustrates the areas.

8. The 1993 report was prepared assuming the maximum possible percent impervious for the King Forest Development to maximize stormwater runoff volumes and thereby to maximize the amount of land required for stormwater facilities. This submission assumes the maximum percent impervious (i.e. maximum lot coverages) as specified in site plan agreements for Phase 1. Section 2 provides further information with respect to this issue.

9. Item 9 pertains to Phases 2 and 3 of the King Forest Development and will be addressed in subsequent submissions.

EXTERNAL DRAINAGE AREAS TO KING FOREST PHASE I

FIGURE 1.1



2.0 BACKGROUND INFORMATION

2.1 Proposed Development

A prestige office / industrial development is proposed for the King Forest Business Park. Table 2.1 summarizes specifics with respect to the numerous Blocks in the King Forest Development. For Phase 1 (Blocks 1 to 7), the maximum permissible lot coverages (i.e. impervious area) totals 3.5 ha (381,300 square feet).

2.2 Proposed Drainage System

2.2.1 Minor Drainage System

The minor drainage system has been designed by Metropolitan Planning & Engineering Inc.. Sheet No. 10 of the construction drawings summarizes the design. No external flows are routed through the minor system.

2.2.2 Major Drainage System and External Flows

The major drainage system has been designed by Metropolitan Planning & Engineering Inc. The major drainage system:

- routes external flows from a swale located immediately west of King Road through the site in a ditch located on the west side of King Road.
- routes external flows from two swales located near the centre and west sides of Phase 1 through a north-south open channel located near the centre of Phase 1. These external flows are routed to the water quantity (peak flow) control pond as they mix with major system

TABLE 2.1

KING FOREST - PHASE 1
BLOCK CHARACTERISTICS

Block	Gross Coverage Permitted
1	135,137 sq ft
2	36,151 sq ft
3	40,832 sq ft
4	38,465 sq ft
5	32,708 sq ft
6	38,303 sq ft
7	59,768 sq ft
Total	381,380 sq ft. or 3.54 ha

flows from the development which must be attenuated prior to releasing to downstream lands.

- routes major system flows (i.e. flows with a return period greater than the two year event) from Phase 1 to the water quantity (peak flow) control facility.

Table 2.2 and Sheet 10 of the construction drawings summarize the major system flow capacities.

TABLE 2.2 - SUMMARY OF MAJOR SYSTEM FLOW CAPACITY

Channel / Ditch*	Description of cross-section	Capacity (m^3/s)	Expected flow (100 yr) (m^3/s)
A) BL.7	- 3.5 m wide; "V" shaped (3:1); grass lined at 4.6% - 5.0 m wide at 0.5%	≥ 0.344 ≥ 0.340	0.330
B) BL.6	- 5.0 m wide; "V" shaped (3:1); grass lined at min. 1.3%	≥ 0.819	0.814
C) East side of Cul-De-Sac	- 5.0 m wide; "V" shaped (3:1); grass lined at min. 1.6%	≥ 0.908	0.904
D) BL.2	- 5.0 m wide; "V" shaped (3:1); grass lined at min. 0.75%	≥ 1.526	1.496

*See sheet 10 of construction drawings

Table provided by Metropolitan Planning &Engineering Inc.

3.0 PROPOSED STORMWATER MANAGEMENT FACILITIES

3.1 Water Quality and Erosion Control Facility

The proposed water quality and erosion control facility is illustrated in Sheet No. 13 and 14 of the construction drawings. The facility was located on the table lands as preservation of the ravine and its vegetation is desired by HRCA and the City, and locating a water quality / erosion control facility in the ravine would require substantial clearing and grading in order to obtain gentle/safe slopes (i.e. 5H:1V) in the vicinity of the permanent water level, as current ravine slopes are generally at slopes of 3H:1V.

The proposed water quality and erosion control facility was designed in accordance with the guidelines in the MOEE Manual. As Indian Creek supports a warm water baitfish population, water quality controls must meet Level 2 requirements as a minimum (source: MOEE Manual, Section 4). A wet pond is proposed to provide water quality and erosion control based on a review of the MOEE manual and a discussions with the City of Burlington and HRCA staff.

Based on the MOEE Manual the target wet pond volume for this site is approximately 125 m^3/ha, of which 85 m^3/ha is the permanent pool volume and 40 m^3/ha is the extended detention volume. Features of the facility are as outlined below and as summarized on Table 3.1

- The facility consists of two cells, a sediment forebay and a second larger pool area.
- An emergency overflow from the pond is provided through the outlet control structure. Overflows through this structure are piped to the base of the ravine.
- Gravity drainage pipes are provided to simplify maintenance activities.

TABLE 3.1
WATER QUALITY / EROSION CONTROL POND CHARACTERISTICS

Item	Target	Actual & Comments
Total Volume for Water Quality Control	125 m^3/ha Level 2 - 66 % impervious	300+ m^3/ha Volume greater than target as pond also provides erosion control
Permanent Pool Volume	85 m^3/ha	92 m^3/ha
Extended Detention Volume	40 m^3/ha (water quality only)	215 m^3/ha Volume greater than target as pond also provides erosion control
Drainage Area	> 5 ha	5.3 ha
Length:Width Ratio	3:1 minimum	approximately 50m:14m or 3.6:1
Permanent Pool Depth	-1 to 2 metres average -3 metres maximum	Total surface area is 810 m^2 and total volume is 645 m^3, yielding an average depth of 0.8 m. Target depth is difficult to achieve in pond of this size. Depths of 1.0+ metres are provided and target volumes are met or exceeded. Maximum depth of 1.8 metres
Extended Detention Depth for Water Quality / Erosion	1 to 1.5 m	Permanent Pool at elevation 116.0 m, spill from pond at elevation 117.1 m, yielding an extended detention depth of 1.1 metres, and extended detention volume of approximately 1500 cubic metres
Grading at Edge of Permanent Pool	5H:1V or flatter for 3 metres both sides of water level	Provided
Orifice Size	≥ 75 mm	120 mm orifice provided in reverse slope pipe
Inlet Geometry		Inlet invert is 0.5 metres above permanent pool

Resuspension in Sediment Forebay		- Rip Rap pool provided at inlet to dissipate energy of incoming flows - 1.5 m deep areas in sediment forebay provided
Detention Time	24 hrs for areas $\geq$ 8 ha 12 hrs for areas < 8 ha	na 12 hr provided through 120 mm orifice
Maintenance & Access		Sediment forebay has hard lining and Access route provided to larger pool
Gravity Drained Maintenance Pipe	Desirable if grade permits	Gravity drain provided from sediment forebay and from larger pool. Flows are piped to ravine. Pipes area raised 0.5 or more above pond invert.
Forebay Berm	should be within 300 mm of permanent pool elevation	Proposed berm is 0.2 metres below the permanent pool elevation
Forebay Area	A $\leq$ 33 % of wet pond surface area	Forebay Area = 31 %

Erosion control is also required so that erosion potential downstream of the site does not increase as a result of development. The 1993 report concluded that 2-year post development flows from the site must be attenuated to at least 50 percent of predevelopment levels for erosion control. Further, the MOEE Manual (June 1994) suggests that in the abscence of a detailed subwatershed plan (as is the case here) that erosion control be provided for a 25 mm 4-hour Chicago event, and that erosion control can be provided in the extended detention storage of a wet pond. Accordingly, it is proposed that erosion control be provided in the extended detention area of the proposed wet pond. Flows in the extended detention area will be drawn down over several hours as they will drain through a 120 mm diametre orifice, and hence the flows will be attenuated by at least 50 percent, achieving the objective defined in the 1993 and current MOEE guidelines. Calculations in Appendix B illustrate that sufficient extended detention volume has been provided for erosion control. The volume required for erosion control exceeds the volume of extended detention required for water quality control (i.e. 40 m^3/ha).

3.1.1 Sediment Accumulation and Clean-out Frequency

To estimate the clean out frequency of the proposed wet pond reference was made to Figures 5.2 and 5.3 in the MOEE BMP manual (1994) which illustrate *Sediment Removal Interval (years) vs Storage Volume (m^3/ha)*. These figures suggest that with a total storage volume in the wet pond permanent pool of 116 m^3 / ha, that the estimated sediment removal interval is:

- 17.5 years for a development which is 55 percent impervious; and
- 12.5 years for a development which is 70 percent impervious.

As the percent impervious of the area draining to the wet pond has an upper limit of 66 percent impervious, the estimated clean out frequency is about 13 years, which meets the MOEE and City of Burlington guideline of a minimum 10 year cleanout frequency.

3.2 Peak Flow Control Facility

The Preliminary Storm Drainage Report (April 1993) concluded that peak flow control was required for the King Forest Business Park so that downstream reaches of Indian Creek would not be negatively impacted.

The proposed peak flow control facility is also illustrated on Sheet No. 13 and 14 of the construction drawings. The peak flow control facility was located in the ravine as doing so;

- helps to reduce the potential for resuspension of solids in the water quality / erosion control pond;

- minimizes the amount of table land required for stormwater management facilities;

Further, the peak flow control facility can be located in the ravine by constructing a berm and outlet structure at the extreme south east corner of the ravine. This allows most of the ravine to be preserved, as desired.

The components of the facility are as follows:

- a constructed berm to retain water in the ravine;

- an outlet structure to over-control post development flows, as outlined in the 1993 report;

- an overflow spillway in the event that the outlet pipe becomes clogged; and

- the existing topography of the ravine for storage of peak flows.

3.2.1 Peak Flows Downstream

To determine whether the proposed facility would maintain peak flows at or below pre-development levels, the proposed facility was modelled using the 1993 OTTHYMO model for Indian Creek which was prepared by Aquafor Beech Limited to model post development conditions. The 1993 model also includes peak flow control facilities for other areas in Indian Creek where future development is anticipated as per the City of Burlington's Official Plan.

During the analysis the impacts of peak flow attenuation within the water quality pond were modelled "indirectly" by increasing the available storage volume in the ravine by a portion of the available extended detention in the water quality / erosion control pond. In total 1500 cubic metres of the available 2000+ cubic metres of storage above the permanent pool was assumed to be available for peak flow control. Further, this volume was assumed to be available at the bottom of the ravine (i.e. below elevation 113.5m). The estimated stage discharge curve for the proposed facility is summarized in Table 3.2. Overall, this approach is conservative from a peak flow analysis perspective as the ravine pond (i.e. where the storage is modelled) has a higher discharge rate than the water quality pond (i.e. where the storage is). That is, the ravine has a 375 mm outlet while the water quality pond has a 120 mm orifice outlet. Therefore, the estimated peak flows will be overestimated slightly with the proposed approach.

The analysis considered the 5, 10, 25, 50 and 100 year design storms (3 hour Chicago), as well as two historic events which have caused high streamflows in the Burlington area - August 27, 1992 and May 2, 1992.

Table 3.3 summarizes existing and proposed peak flows at four key locations (see Figure 3.1) on Indian Creek. As all post development peak flows are less than or equal to existing peak flows, the proposed facility is appropriate.

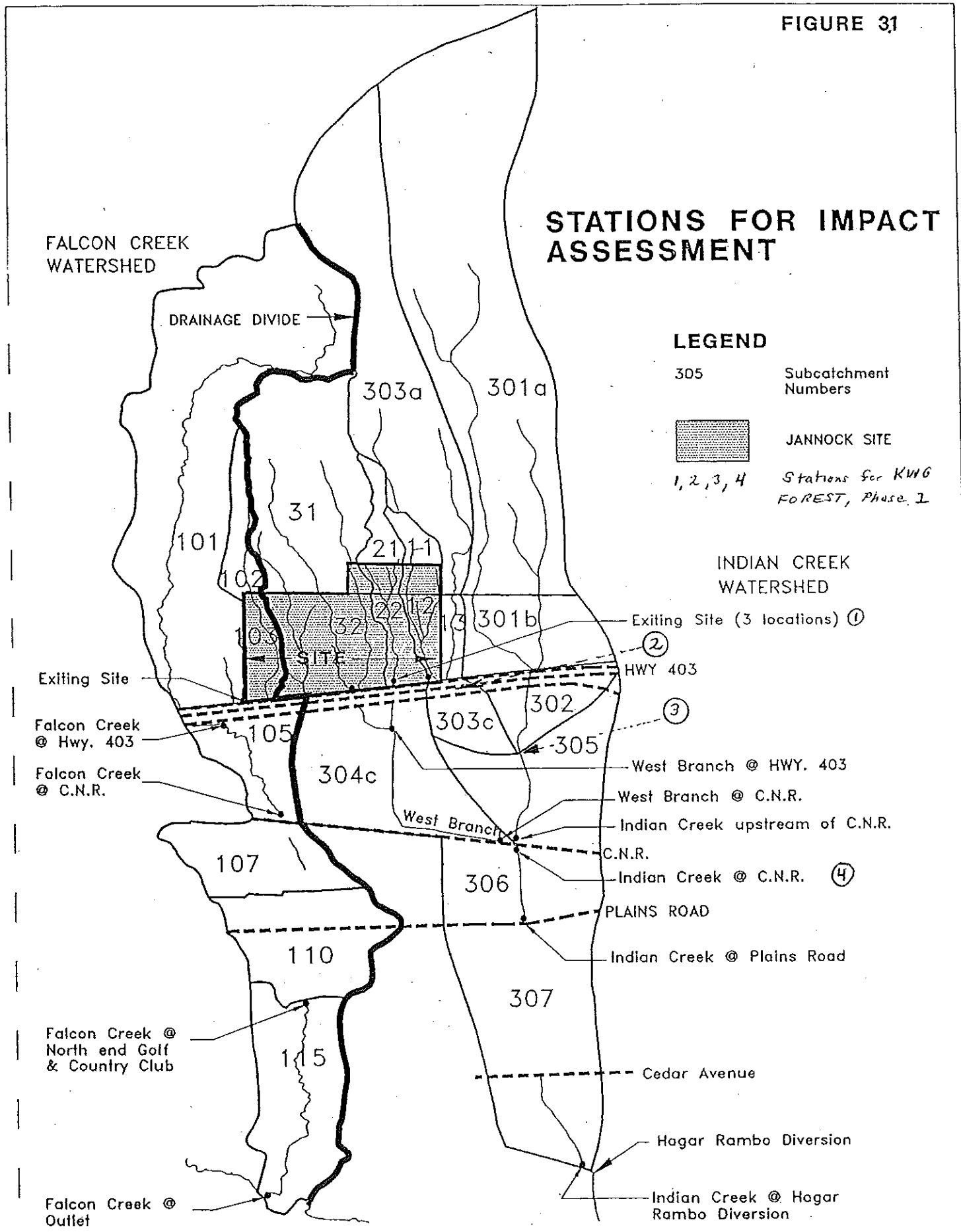
TABLE 3.2 - STAGE DISCHARGE CHARACTERISTICS OF PROPOSED PEAK FLOW CONTROL FACILITY

Elevation (m)	Area (m^2)	Average Area (m^2)	Distance Between Contours (m)	Volume (m^3)	Cumulative Volume (m^3)	Total Volume (ha-m)	Discharge (m^3/s)
113.3	00	-	-	-	-	-	0
113.5	47	24	0.5	12	12	0.151	0.07
114.0	188	118	0.5	59	71	0.157	0.18
114.5	356	272	0.5	136	207	0.171	0.24
115.0	539	448	0.5	224	431	0.193	0.29
115.5	777	658	0.5	329	760	0.226	0.33
116.0	1075	926	0.5	463	1223	0.272	0.37
116.5	1453	1264	0.5	632	1855	0.336	0.40+

Notes:

1) Total Volume: includes 1500 m^3 of extended detention storage from water quality pond
2) Discharge assumes 375 mm concrete outlet pipe as illustrated on construction drawings

FIGURE 3.1


STATIONS FOR IMPACT ASSESSMENT
FALCON CREEK WATERSHED
DRAINAGE DIVIDE
LEGEND
305 Subcatchment Numbers
JANNOCK SITE
1, 2, 3, 4 Stations for KWG FOREST, Phase 1
INDIAN CREEK WATERSHED
303a
301a
31
101
102
211
212
103
32
SITE
301b
Exiting Site (3 locations) ①
②
HWY 403
Exiting Site
Falcon Creek @ Hwy. 403
105
303c
302
③
305
West Branch @ HWY. 403
Falcon Creek @ C.N.R.
304c
West Branch @ C.N.R.
West Branch
Indian Creek upstream of C.N.R.
C.N.R.
107
306
Indian Creek @ C.N.R. ④
PLAINS ROAD
110
Indian Creek @ Plains Road
307
Falcon Creek @ North end Golf & Country Club
115
Cedar Avenue
Hagar Rambo Diversion
Falcon Creek @ Outlet
Indian Creek @ Hagar Rambo Diversion

ESTIMATED PEAK FLOWS FROM PHASE 1 AND IN INDIAN CREEK

TABLE 3.3

LOCATION AND ITEM	5 Year	10 Year	25 Year	50 Year	100 Year	Aug 27/92	May 2/92	Comments
1) Total Flow From Phase 1 and Area 11								
- Pre-development	0.54	0.71	0.94	1.13	1.31	0.65	0.66	Hydrograph 540
- With Proposed SWM Pond	0.30	0.40	0.50	0.57	0.63	0.51	0.32	
- Maximum total storage used (ha-m)	0.17	0.19			0.30	0.29	0.17	
2) Total Flow From Phase 1 & Areas 303a, 13 and 11								
- Pre-development	3.15	4.07	5.30	6.27	7.24	4.22	3.48	Hydrograph 992
- With Proposed SWM Pond	3.09	4.00	5.18	6.09	7.00	4.16	3.40	
3) Total Flow - Main Branch (Confluence at Areas 302 & 303c)								
- Pre-development	9.14	11.77	15.32	18.09	21.01	12.76	9.90	Hydrograph 119
- With Proposed SWM Pond	8.87	11.53	15.02	17.71	20.53	12.75	9.50	
4) Total Flow - Main Branch (At Confluence with West Branch)								
- Pre-development	13.84	17.9	23.34	27.52	31.95	19.60	14.75	Hydrograph 122
- With Proposed SWM Pond	13.15	17.2	22.41	26.43	30.6	19.56	13.80	

Note: See Figure 3.1 for locations

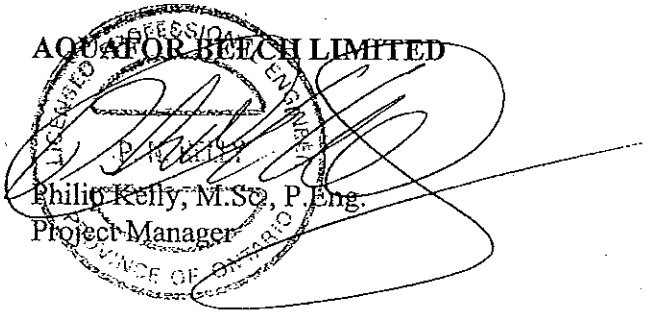
5.0 CONCLUSIONS

A stormwater management strategy for Phase 1 of the King Forest Business Park has been proposed which:

- provides water quality control and erosion control; and
- maintains post development flows at or below pre-development levels both exiting the site and further downstream in Indian Creek.

Respectfully submitted,

AQUAFOR BEECH LIMITED



Philip Kelly, M.Sc., P.Eng.
Project Manager

4.0 COMPUTER INPUT FILES

The OTTHYMO input files outlined below have been provided on disk.

KF_EX.IN - model used to estimate existing flows in Indian Creek

KF_PH_1.IN - represents post development conditions in Indian Creek
- includes proposed maximum coverages in King Forest Phase 1
- King Forest Phases 2 and 3 unchanged from 1993 analysis
- includes proposed ravine pond for peak flow control
- includes peak flow control ponds (from 1993 report) for other areas where future development is proposed

Model Schematics are included in Appendix C.

APPENDIX A

COPIES OF PREVIOUS CORRESPONDENCE FROM MNR AND HRCA

Ministry of Natural Resources
Ministère des Richesses naturelles
Ontario

FILE COPY

Ref: JAK.P

P. O. Box 7400
10401 Dufferin Street
Maple, Ontario
L6A 1S9

November 26, 1993.

May Pirie & Associates
Land Use Planning Consultants
3310 South Service Road
Burlington, Ontario
L7N 3M6

ATTENTION: J. Kenneth Dakin, B.E.S.

SUBJECT: Natural Environmental Study & Butterfly Report
Application by Jannock Properties
Request for Comments
City of Burlington.

Dear Mr. Dakin:

This letter is in response to the above submission. While the process of your study is a continual one, we wish to advise you comments and concerns that this Ministry staff have with this study. Our comments are as follows:

•Page 8. It is strongly suggested that regionally rare plant species should be incorporated into the natural landscape features of the site where ever possible.

•Unless that it can be demonstrated that the proposed managed habitat to the north will be utilized and will support Mottled Dusty Wings through its life cycle, it is recommended that the habitat on the side of the ravine from which the specimens have been collected be buffered from intrusion.

•The work for this study was done on the basis that the most environmentally significant habitat will be set aside from the development envelopes. We are encouraged to see this and further recommend that a buffer protecting the nectaring site of the Mottled Dusty Wing Butterfly also be included in this "no development" area.

•There is discussion about stormwater facilities and their geographic location within the site. Comments concerning this will be contained within our letter regarding the Preliminary Storm Drainage Report.

•Page 19. The second last paragraph claims that none of the watercorses contain fishery habitat. As such, we ask that this statement be edited from the report. The definition of fish habitat as per section 34 (1) of the Fisheries Act is as follows:

> "spawings grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly to carry out their life process".

•Lastly we want to confirm that there is at minimum a 15 metre buffer from the edge of the stream banks or top of bank which ever is greater. Our experience indicates that establishing a buffer strip of natural vegetation along the streambanks of the watercourse is essential for providing this protection. This area is to be maintained in a naturally vegetated, undisturbed state.

We also recommend that the creek(s) and vegetative buffer strips be placed in an Open Space block, outside private lot ownership to ensure maintenance of the environmental integrity of the vegetative buffer strip, and the sensitive slope.

Thank you for the opportunity to comment on this plan. Should you have any questions concerning these comments, please do not hesitate to contact me at this office at (416-832-7280).

Yours truly,

FILE COPY

Catherine Copelin
Resource Planner - Halton Area
Greater Toronto Area District.

cc.: Region of Halton, J. Blowers.
City of Burlington, A. Magi.
Halton Region Conservation Authority, B. Axon.

Ontario

Ministry of Natural Resources | Ministère des Richesses naturelles

P. O. Box 7400
10401 Dufferin Street
Maple, Ontario
L6A 1S9

Ref: JAK.P

March 29, 1994.

Aquafor Beech Ltd.
14 Abacus Road
Brampton, Ontario
L6T 5B7
Fax (905) 794-2338

ATTENTION: Philip Kelly, P.Eng

SUBJECT: Preliminary Storm Agreements
For the Jannock Properties Development
City of Burlington.

Dear Mr. Kelly:

This letter is in response your fax of March 16, 1994 with regard to stormwater management requirements for Ministry of Natural Resources. The following comments are for your information and consideration:

•The storage "sizing rule" required for post-development water quality control facilities for all fisheries resources should be based on runoff resulting from a 25 mm rainfall. This storage should be retained for a minimum of 24 hours. Water quality facilities should include a means of bypassing all flows in excess of the storage capacity to avoid re-suspension and flushing of accumulated pollutants during infrequent storm events.

•As agreed to, the "dip of the land" on the Jannok properties may be used for water quantity control.

I trust that this meets your requirements for the moment. Should you have any questions concerning these comments, please do not hesitate to contact me at this office at [(905)832-7280].

Yours truly,

C. Copelin

Catherine Copelin
Resource Planner - Halton Area
Greater Toronto Area District.

cc.: City of Burlington, A. Magi.
Halton Region Conservation Authority, B. Axon.

HALTON REGION
CONSERVATION AUTHORITY
2596 Britannia Road, West
R. R. #2, Milton, Ontario
L9T 2X6
(905) 336-1158 Fax (905) 336-7014

February 8, 1994

Mr. Phillip Kelly
Aquafor Engineering
14 Abacus Road
Brampton, Ontario
L6T 5B7

Dear Sir:

Re: Preliminary Storm Drainage Report
Jannock Brick
City of Burlington
File No.: 24T-93012/B, 510-02-9/93
520-02-1/92, 550-02-5/91

This letter is further to the Halton Region Conservation Authority reviewing the above referenced report dated April, 1993

Based upon a review of the above referenced report, Authority staff have determined that the report to be acceptable in principle. Notwithstanding this, Authority staff require the following changes/amendments be incorporated into the report.

1. Page 3. If there is the potential for flooding of a property where the external drainage area is less than 125 hectares, Authority staff will require that flood plain mapping be undertaken. As such please amend /delete the related section.

2. Please have the report include a) a plan showing the landfill and licensed quarry area and b) a site plan with topography.

3. Page 5. Please note that a new CNR culvert has been installed since the McLaren Report was completed. Flooding on Cedar Avenue to Plains Road will be more likely to occur since there is no attenuation at the CNR tracks.

4. Page 20. It is stated that in-line over-control may be required, yet no reference is made at the bottom of the page. Please clarify and to what level of over-control is necessary.

5. On several pages it refers to 13 mm of daily precipitation. Please remove the word daily. Also be advised that the Ministry of Natural Resources requires that ponds be designed to the 25mm storm and that this runoff be detained for 24-48 hours. Please amend accordingly.

6. Page 24. Please remove the last statement under the section entitled "Grass Filter Strips and Swales" since it is not accurate.

7. Table 5.1 Please add external drainage areas.

8. In consideration that the report was prepared in April, 1993 and the plans of subdivision have been revised several times, Authority staff are concerned that the % impervious as stated in the report does not reflect the plan. As such, please amend accordingly.

9. Please address the issue of constructing a separate weir for the quantity pond or utilizing the North Service Road as the weir. The Ministry of Natural Resources and the Conservation Authority are concerned with liability and ensuring the North Service Road remains as such.

We trust this is of assistance. Should you have any questions, please contact Robert Thun, Environmental Planner or the undersigned.

Your truly,

Brenda K. Axon
Manager, Resource Planning

RHT/rht
cc: Mr. G. Simon, City of Burlington, 426 Brant Street, Box 5013, Burlington, L7R 3Z6
Mr. A. Magi, City of Burlington, 426 Brant Street, Box 5013, Burlington, L7R 3Z6
Ms. C. Copeland, Ministry of Natural Resources, P.O. Box 7400, 10401 Dufferin St.
Maple, Ontario L6A 1S9

APPENDIX B

ESTIMATED EXTENDED DETENTION VOLUME FOR EROSION CONTROL FOR PHASE 1

Estimate the volume of extended detention required for erosion control

Rainfall volume	= 25 mm
Drainage Area to water quality / erosion control pond	= 7.0 ha
Volumetric Runoff Coefficient	= 0.65

(Note: volumetric runoff coefficient for 10 year event was 0.69 from OTTHYMO)

Estimated Runoff Volume from a 25 mm 4 hour storm event:

V = (drainage area) x (rainfall volume) x (volumetric runoff coefficient)
= (7.0 ha x 10,000 sq. m. / ha) x (0.025 m rainfall) x (0.65)
= 1140 cubic metres

Total volume of extended detention storage available above the permanent pool (i.e. elevation 116.0) and under the overflow spill elevation (elevation 117.1) is approximately 1500 cubic metres (Note; over 2000 cubic metres is available above the permanent pool and below the top of the water quality pond).

Conclusion: The proposed water quality / erosion control pond has sufficient volume for erosion control.

APPENDIX C

OTTHYMO MODEL SCHEMATICS

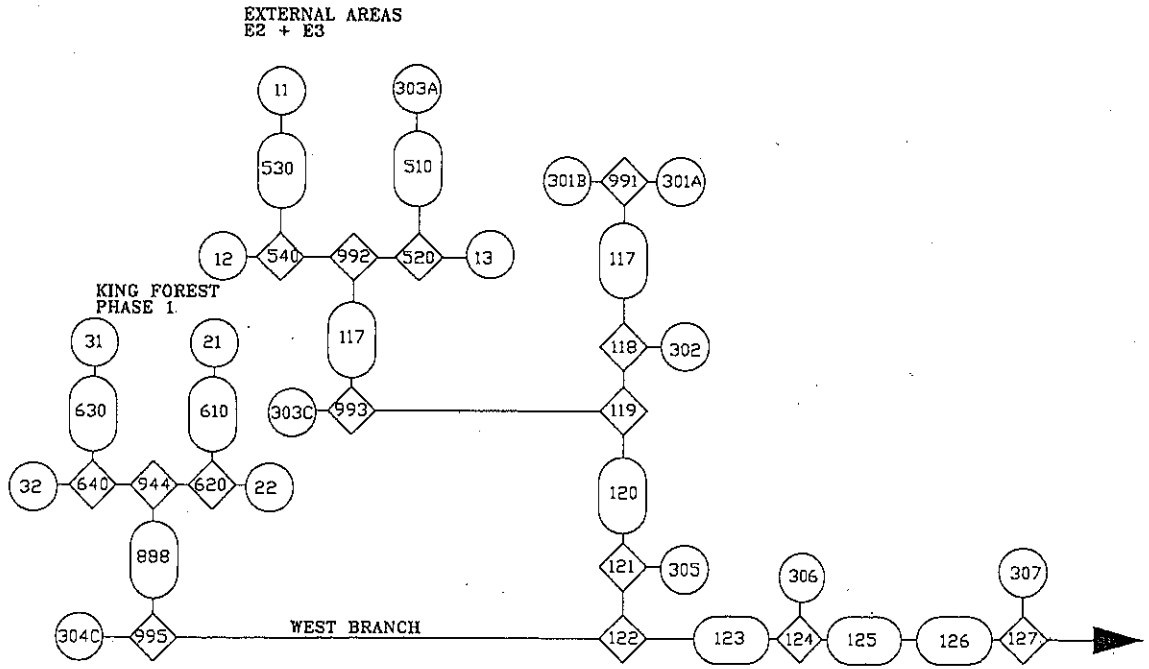
CLIENT:

JANNOCK PROPERTIES
KING FOREST
BUSINESS PARK

TITLE:

OTTHYMO MODEL SCHEMATIC
EXISTING CONDITIONS

Surveyed by:		File:	
Drawn by:	Chk'd by:	Drawing No.	Sheet No.
Designed by:	Chk'd by:		
Scale: N.T.S.	Date: APRIL 24, 1997		



Aquafor
Beech
Limited
CONSULTING ENGINEERS
14 ABACUS ROAD
BRAMPTON, ONTARIO L6T 5B7
905-794-2387

LEGEND

- ROUTING REACH
- 307 SUB-CATCHMENT No.
- HYDROGRAPH ADDED

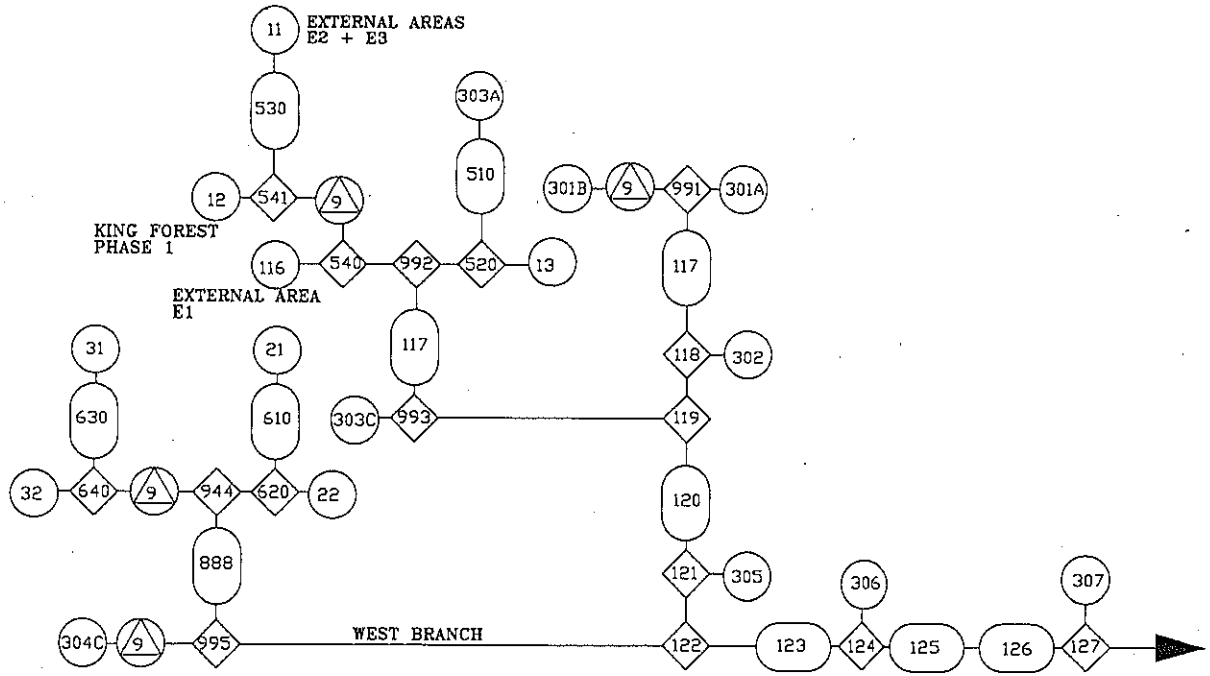
CLIENT:

JANNOCK PROPERTIES
KING FOREST
BUSINESS PARK

TITLE:

OTTHYMO MODEL SCHEMATIC
FUTURE CONDITIONS

Surveyed by:		File	
Drawn by:	Chk'd by:	Drawing No.	Sheet No.
Designed by:	Chk'd by:		
Scale: N.T.S.	Date:		



Aquafor
Beech
Limited
CONSULTING ENGINEERS
14 ABACUS ROAD
BRAMPTON, ONTARIO L6T 5G7
905-794-2367

LEGEND

- ROUTING REACH
- 307 SUB-CATCHMENT No.
- ROUTING RESERVOIR
- HYDROGRAPH ADDED

SEE SHEET 2

MH'10A'

10.2m–300mmø PVC. SAN. @ 0.50%

300mmøCSP

38.90m–450mmø H.D.P.E. SAN. @3.86%

MH'4'

58.80m– 200mmø SAN. @3.89%

MH'5'

RIP–RAP(MIN.200mmø) TREATMENT

100.00m– 200mmø SAN. @3.87%

10.0m–600mmøCSP CULVERT @ 3.0%

5.0m WIDE HYDRO EASEMENT

60.81m

N44°27'22"W

106.25m

N44°27'22"W

18.9m–200mmø SAN. @ 2.0%

MH'6AA' E.INV.=120.795 W.(BULK 150ø)=120.845

N23°37'44"W 55.35m

N47°07'12"W 39.00m

BLOCK 3

MH'6'

51.00m– 200mmø SAN. @2.78%

MH'7'

48.49m–200mmø SAN @ 3.43%

12.25° BEND

MATCH LINE STA. 0+220

SEE SHEET 5

GUARDRAIL

1.5m ASPH. S/W

VIT.CLAY SAN. @1.00%

BMH

BH# 1

HP

TEL

CONTROL MONUMENT 001 643 677

HYD&V

300mmø W\M PVC DR-18,CL.150, AWWA C900

3x300mmø VALVE CHAMBER #1(W2)

KING ROAD

81.6m

9.0m (typ.)

94.7m

10.6m

7.8m

HYD&V

5.0m MIN.

12.25° BEND

300mmø W\M PVC DR-18 CL.150,AWWA C900

1230mmøCSP

CB OUTLET

Indian Creek

FOR WATERMAIN AND FUNCTIONAL IMPROVEMENT OF INTERSECTION SEE SHEET 2

SEE SHEET 2

MH'1A'

A

B

C

D

FOR CROSS–SECTIONS OF 'A,B,C,D' SEE SHEET 8

KING ROAD

300mmø

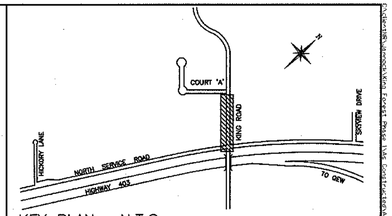
300mmø

300mmø

DETAIL OF CHAMBER #1

LEGEND:

- TOP OF BANK
- L.T. DITCH
- R.T. DITCH
- SHOULDER
- LT. DITCH



KEY PLAN: N.T.S.

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND ABOVE GROUND EXISTING UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL CONFIRM THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

VERTICAL CURVE DATA	
K=4.0 ; LVC=7.2m ; d=+0.016m	
BVC STA.0+002.4	El.=119.444
STA.0+005	El.=119.478
PVI STA.0+006	El.=119.480+d=119.496
STA.0+055	El.=121.050
EVC STA.0+009.6	El.=119.581
K=10.0 ; LVC=14.0m ; d=–0.025m	
BVC STA.0+043	El.=120.678
STA.0+045	El.=120.750
PVI STA.0+050	El.=120.937–d=120.912
STA.0+055	El.=121.050
EVC STA.0+057	El.=121.098
K=16.0 ; LVC=33.6m ; d=+0.042m	
BVC STA.0+083.2	El.=121.701
STA.0+085	El.=121.742
STA.0+090	El.=121.864
STA.0+095	El.=121.993
PVI STA.0+100	El.=122.087+d=122.129
STA.0+105	El.=122.328
STA.0+110	El.=122.534
STA.0+115	El.=122.747
EVC STA.0+116.8	El.=122.926

BENCH MARK – CITY OF BURLINGTON No. 286
BRASS CAP SET IN CONCRETE SIDEWALK 12.984m SOUTH OF THE NORTH END OF THE EASTERLY SIDEWALK 0.183m EAST OF THE WEST EDGE OF WALK ON KING ROAD ON HIGHWAY 403 OVERPASS JUST SOUTH OF THE NORTH SERVICE ROAD. HORIZONTAL CONTROL MONUMENT 001643677. ELEVATION 118.530m.

No	DATE	BY	REVISIONS
3	MAR/03	N.R.	AS–CONSTRUCTED – REVISED AS PER REGION COMMENTS
2	OCT./99	J.E.C.	AS–CONSTRUCTED – AS PER REGION COMMENTS
1	FEB./99	J.E.C.	AS–CONSTRUCTED FOR REGION

DESIGN	M.R.M.	CHECKED	R.A.	DATE	FEBRUARY 1997
DRAWN	M.R.M.	CHECKED	R.A.		
SCALE:	HORZ. 1:500			REFERENCES	
	VERT. 1:50				

APPROVALS

MUNICIPAL

ORGINAL SIGNED BY T. EICHENBAUM
DIRECTOR OF ENGINEERING

NOVEMBER 10, 1997
DATE

REGIONAL APPROVAL
REGIONAL DESIGN OF WATER &/OR WASTEWATER SERVICES APPROVED SUBJECT TO DETAIL CONSTRUCTION CONFORMING TO HALTON REGION STANDARDS & SPECIFICATIONS & LOCATION APPROVAL FROM AREA MUNICIPALITY.

ORGINAL SIGNED BY OCTOBER 27, 1997
SIGNED MARGARET SMITH DATED
PLANNING & PUBLIC WORKS DEPARTMENT

FIELD NOTES

BELL	GAS
HYDRO	CABLE

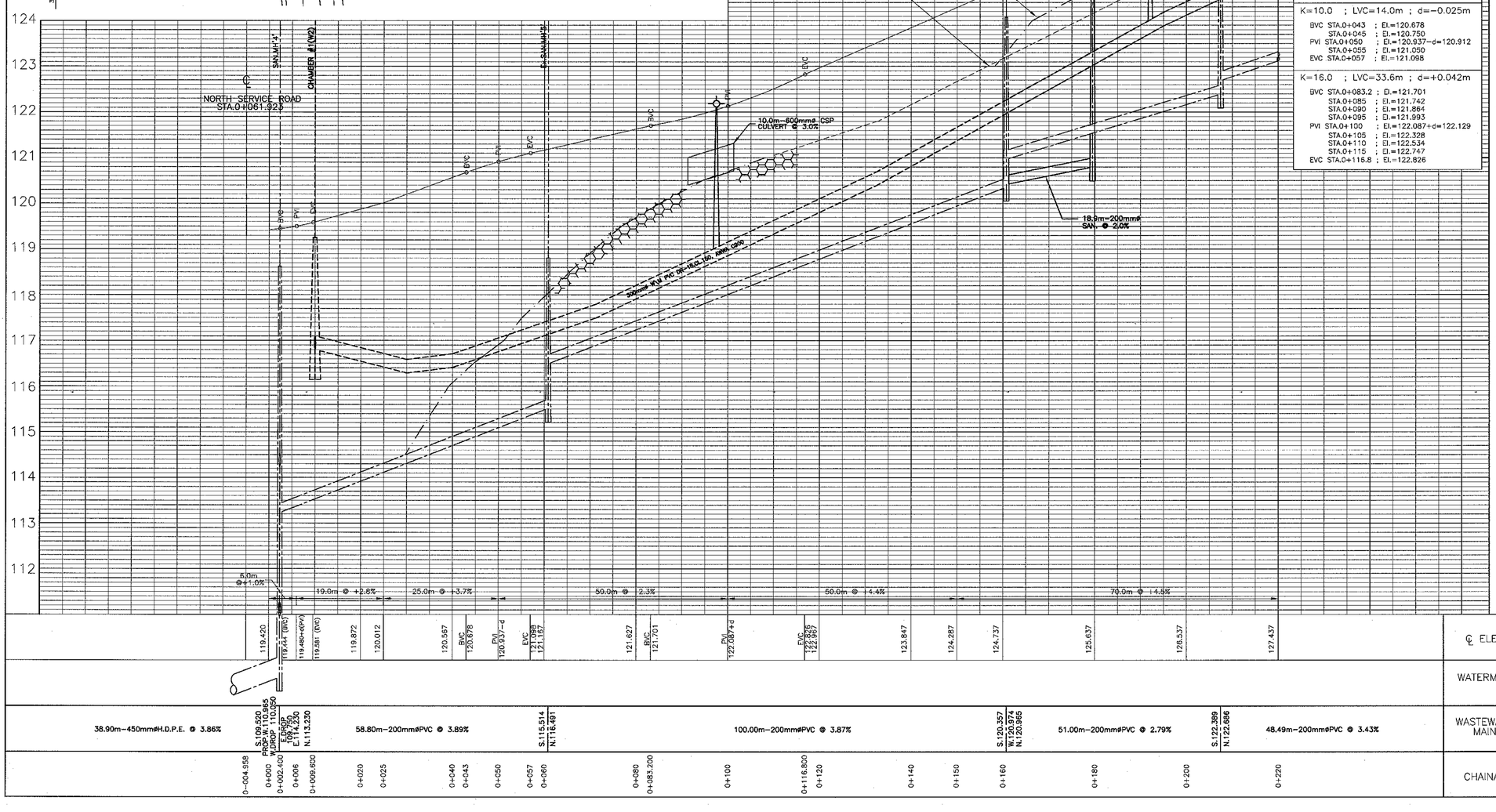
LICENSED PROFESSIONAL ENGINEER
C. C. POVELL
PROVINCE OF ONTARIO

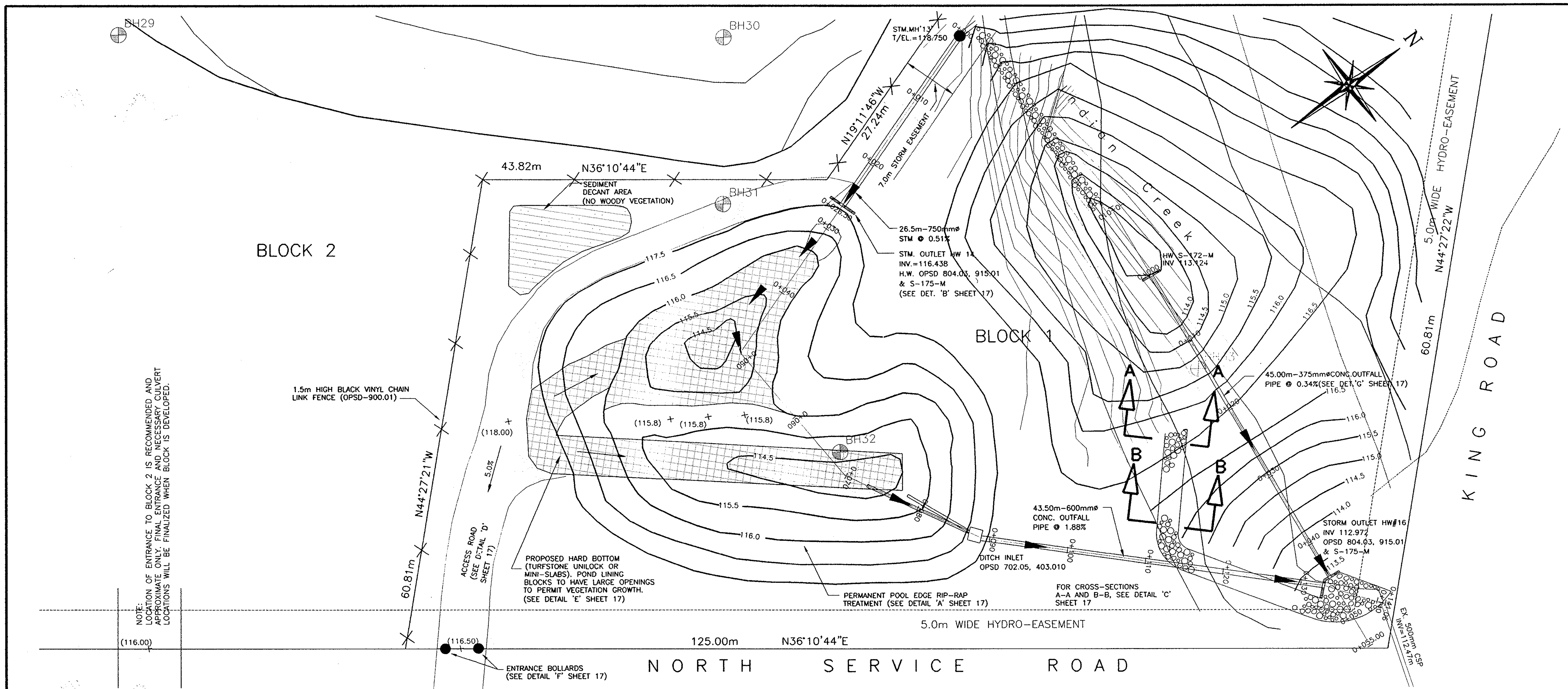
METROPOLITAN PLANNING AND ENGINEERING
2290 QUEENSWAY DRIVE
BURLINGTON, ONTARIO
L7R 3T2
TELEPHONE (905) 637–2926 FAX (905) 637–3268

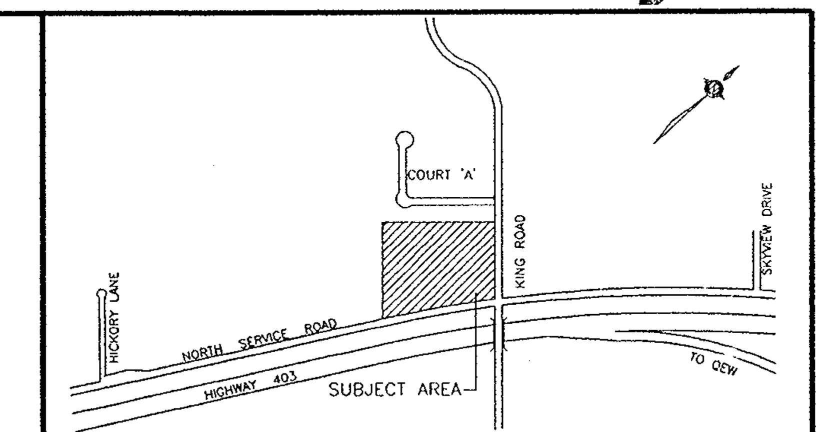
MUNICIPALITY
REGIONAL MUNICIPALITY OF HALTON
CITY OF BURLINGTON
Engineering Department

TITLE KING FOREST BUSINESS PARK Ph.1
WATERMAIN, SIDEWALK AND RESURFACING OF KING ROAD
STA. 0+000 TO 0+220

MUNICIPAL DWG. No.	REGIONAL DWG. No.
	B–7708
CONTRACT No. DB–405	SHEET 4 OF 26







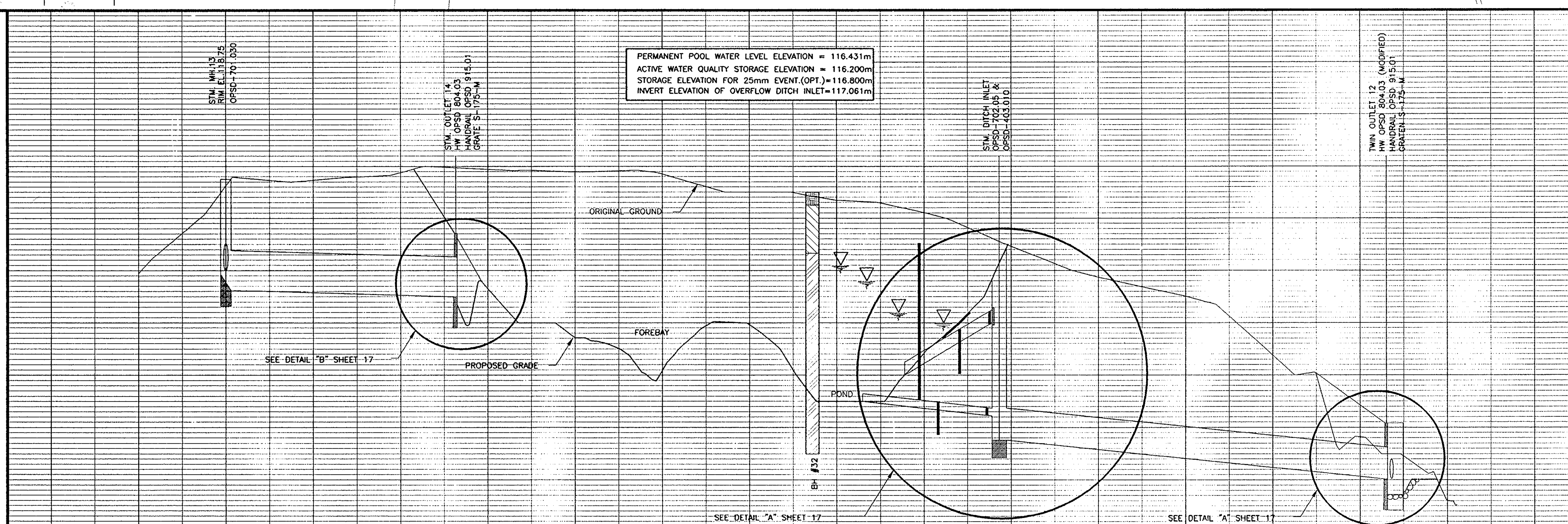
KEY PLAN: N.T.S.

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND ABOVE GROUND EXISTING UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL CONFIRM THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

LEGEND

- MAJOR OVERLAND FLOW ROUTE
- 129.5 EXISTING CONTOUR
- —129.5— PROPOSED CONTOUR
- STORM SEWER
- TOPSOIL
- SILTY CLAY
- SILTY CLAY TILL
- WEATHERED SHALE BEDROCK

BENCH MARK – CITY OF BURLINGTON No. 286
BRASS CAP SET IN CONCRETE SIDEWALK 12.984m SOUTH OF THE NORTH END OF THE EASTERLY SIDEWALK 0.183m EAST OF THE WEST EDGE OF WALK ON KING ROAD ON HIGHWAY 403 OVERPASS JUST SOUTH OF THE NORTH SERVICE ROAD. HORIZONTAL CONTROL MONUMENT 001643677. ELEVATION 118.530m.



℄ ELEVATION	118.62	118.88		118.89 / 115.72	118.50 / 115.96			118.10 / 115.42			116.87 / 116.53	115.37 / 114.65		112.60			℄ ELEVATION
STORM SEWER	E116.603 N116.948 S116.573	26.50m–750mmø STM. @ 0.51% CONC.CL.100-D	N116.438 OUTLET TO POND			N114.573	N115.00		S114.461 S116.431 N113.791	43.50m–600mmø CONC. OUTFALL PIPE @ 1.88% CONC.CL.100-D			N112.972 OUTLET TO INDIAN CREEK				STORM SEWER
CHAINAGE	0+000	0+020	0+026.50	0+040	0+060	0+072.93	0+077.77	0+080	0+088.63		0+100	0+120	0+132.74				CHAINAGE

No	DATE	BY	REVISIONS
1	FEB./99	J.E.C.	AS-CONSTRUCTED FOR CITY

DESIGN	P.K./M.R.M.	CHECKED	P.K./R.A.	DATE MAY 1997
DRAWN	M.R.M.	CHECKED	P.K./R.A.	

SCALE: 1:300

APPROVALS

MUNICIPAL
T. Eichentaw
DIRECTOR OF ENGINEERING
Nov. 10/97
DATE

REGIONAL
DESIGN OF WATER AND WASTEWATER SERVICES APPROVED SUBJECT TO DETAIL CONSTRUCTION CONFORMING TO HALTON STANDARDS AND SPECIFICATIONS AND LOCATION APPROVAL FROM AREA MUNICIPALITY.
SIGNED__________ DATED_______
PLANNING & PUBLIC WORKS HALTON REGION

STAMP: LICENSED PROFESSIONAL ENGINEER P. N. KELLY Oct 22/97 PROVINCE OF ONTARIO

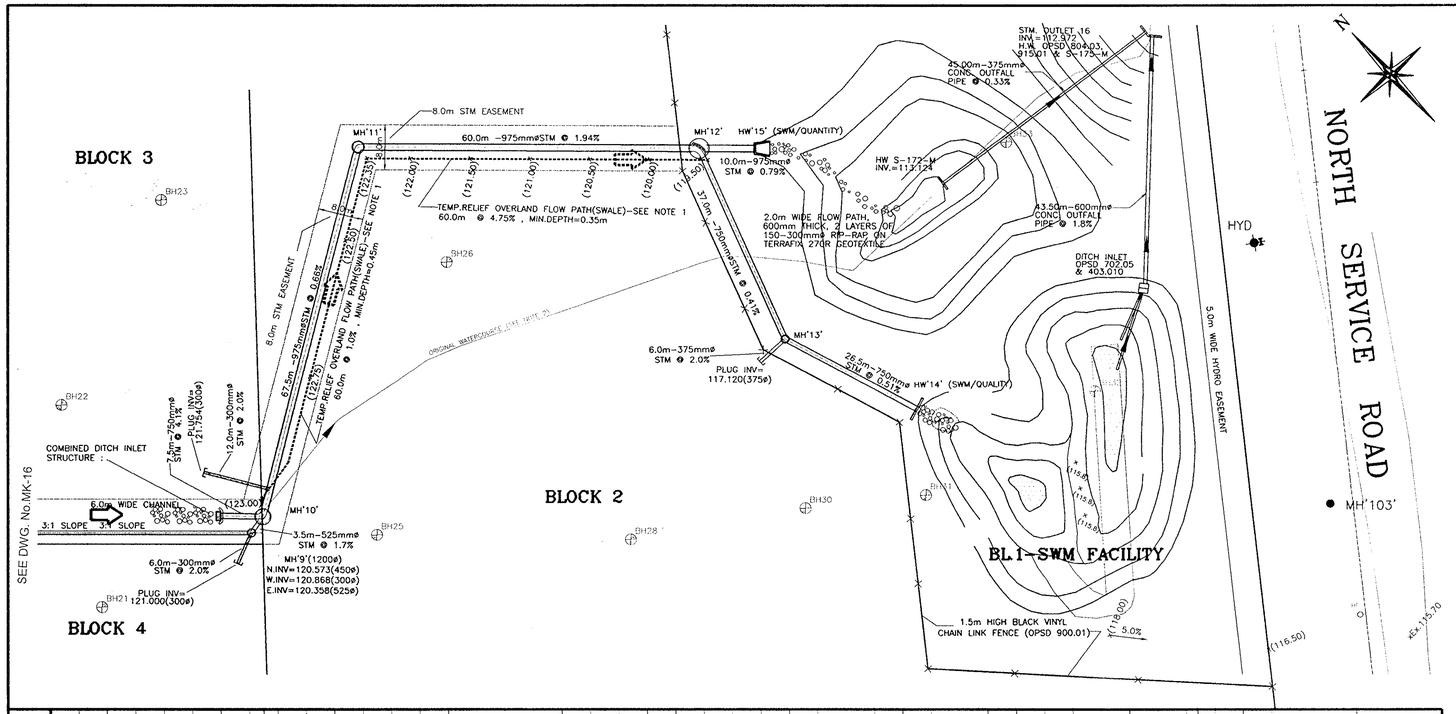
STAMP: LICENSED PROFESSIONAL ENGINEER R.D. ALDERSON Oct. 22/97 PROVINCE OF ONTARIO

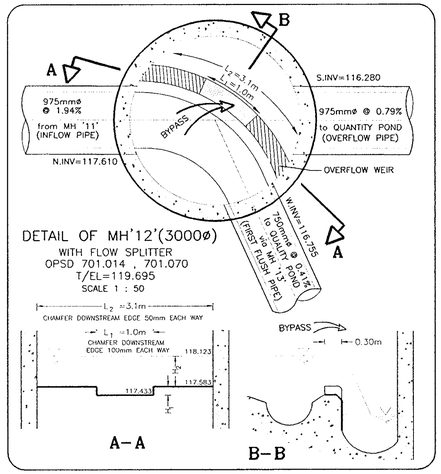
MP&E **METROPOLITAN** PLANNING AND ENGINEERING
2290 QUEENSWAY DRIVE
BURLINGTON, ONTARIO
L7R 3T2
TELEPHONE (905) 637-2926 FAX (905) 637-3268

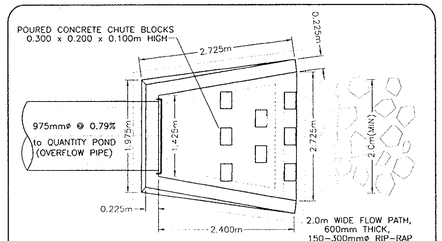
MUNICIPALITY
REGIONAL MUNICIPALITY OF HALTON
CITY OF BURLINGTON
Engineering Department

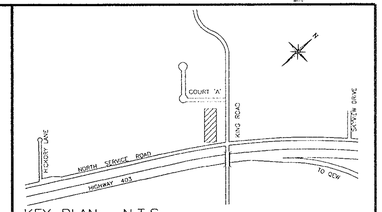
TITLE KING FOREST BUSINESS PARK Ph.1
SWM FACILITY–PLAN & PROFILE
STA. 0+000 TO 0+132.74

MUNICIPAL DWG. No. **MDR-247**
REGIONAL DWG. No.
CONTRACT No. DB–405
SH 3









KEY PLAN: N.T.S.

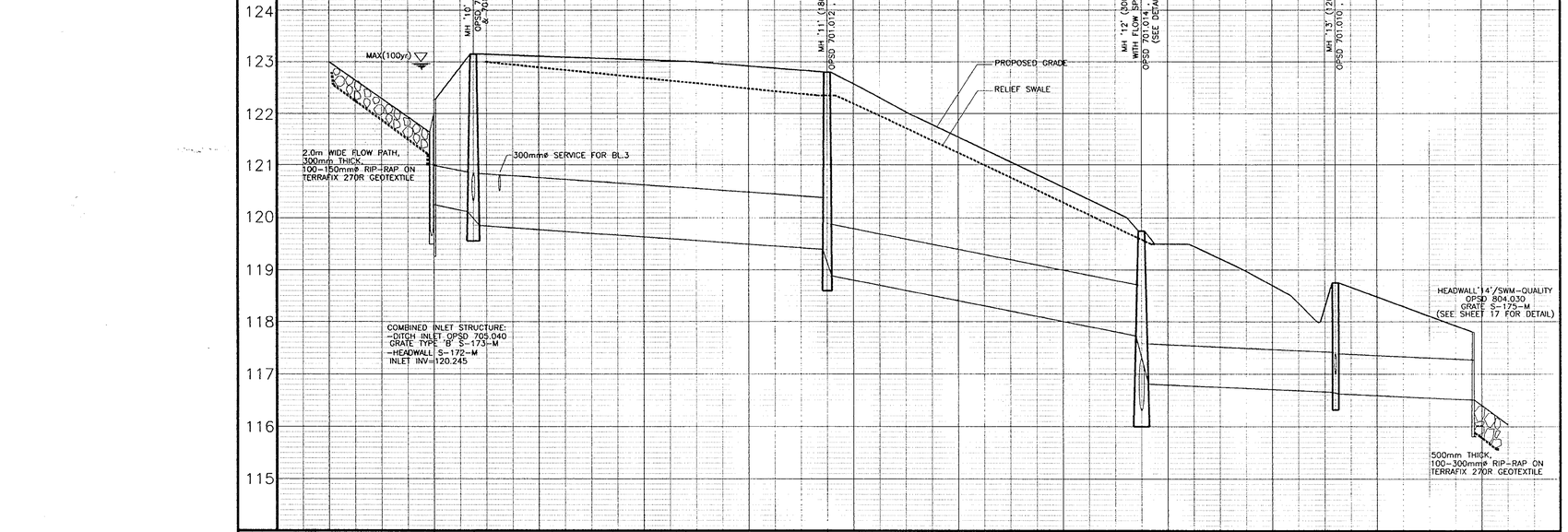
THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND ABOVE GROUND EXISTING UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL CONFIRM THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

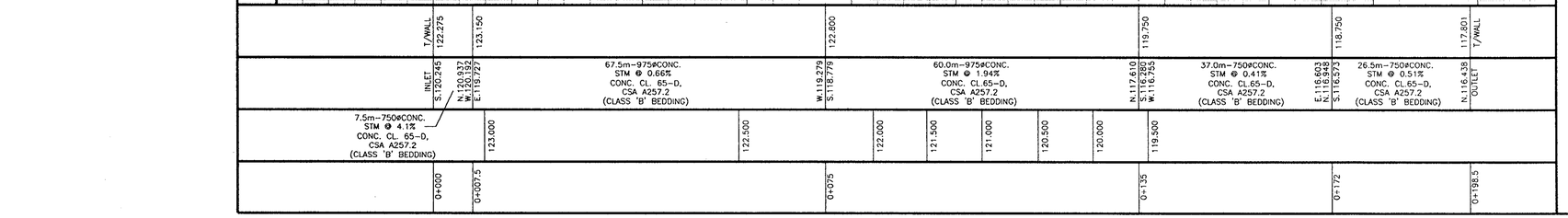
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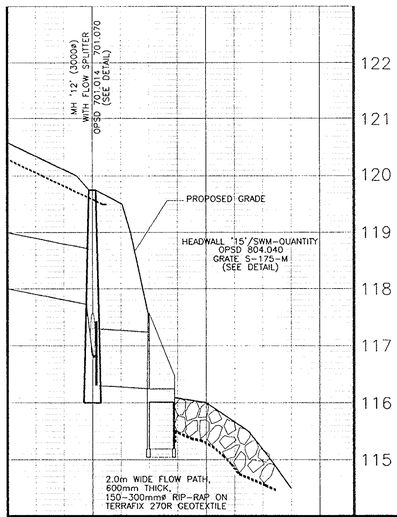
(121.50)x PROPOSED GRADE

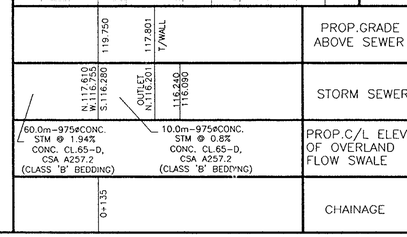
OVERLAND FLOW PATH / SWALE

BENCH MARK - CITY OF BURLINGTON No. 286
BRASS CAP SET IN CONCRETE SIDEWALK 12.984m SOUTH OF THE NORTH END OF THE EASTERLY SIDEWALK 0.183m EAST OF THE WEST EDGE OF WALK ON KING ROAD ON HIGHWAY 403 OVERPASS JUST SOUTH OF THE NORTH SERVICE ROAD HORIZONTAL CONTROL MONUMENT 001643677.
ELEVATION 118.530m.









No	DATE	BY	REVISIONS
1	MAR./99	J.E.C.	AS-CONSTRUCTED FOR CITY

DESIGN	M.R.M.	CHECKED	S.J.R.	DATE: JUNE 1998
DRAWN	M.R.M.	CHECKED	R.D.A.	REFERENCES
SCALE:	HORZ. 1:500			
	VERT. 1:50			

APPROVALS

MUNICIPAL

T. Eidenbaer
DIRECTOR OF ENGINEERING

NOV.10/97
DATE

REGIONAL
DESIGN OF WATER AND WASTEWATER SERVICES APPROVED SUBJECT TO DETAIL CONSTRUCTION CONFORMING TO HALTON STANDARDS AND SPECIFICATIONS AND LOCATION APPROVAL FROM AREA MUNICIPALITY

SIGNED _____ DATED Oct. 22, 1997
PLANNING & PUBLIC WORKS HALTON REGION

FIELD NOTES

BELL	GAS
HYDRO	CABLE

STAMP

R. D. ALTKINSON
Oct. 22/97
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METROPOLITAN PLANNING AND ENGINEERING
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MUNICIPALITY
REGIONAL MUNICIPALITY OF HALTON
CITY OF BURLINGTON
Engineering Department

TITLE KING FOREST BUSINESS PARK Ph.1
STORM EASEMENT-BLOCK 2

MUNICIPAL DWG. No.	REGIONAL DWG. No.
MEA-14	

CONTRACT No. DB- 405

SHEET

APPENDIX

E CORRESPONDENCE

SITE PLAN REVIEW COMMITTEE COMMENTS

Date:	**June 15, 2021**	**DC#:**	**DC15/21**
Planner:	**Andreas Houlios**	**Applicant:**	**Astra Capital Properties Inc.**
Site Address:	**1450 King Rd.**		
Heritage Inventory:	**No**		
SPRC Meeting Date:	**April 30, 2021**		

A preliminary review of your plans and has been completed and the committee has the following comments:

SITE PLANNING:

- The storm water management pond is not permitted to be located within the landscape area abutting King Road. The required landscape area abutting King Road is 30m, therefore this does not comply.
- Other Planning Approvals will be required to permit the storm water management pond to be located in the required landscape area.

Submission Requirements:

- Minor Site Plan Application required.
- Plan sets in metric scale, in accordance with submission matrix.
- All digital materials submitted using file transfer software with no password or account requirements.
- Completed Application Form – digital.
- Written response to this pre-consultation document
- Processing Fees – e-payment

Fees:

City of Burlington

- $1,685.00 (Minus one pre-consultation fee if applicable)

Region of Halton

- $727.71 (Contact Region of Halton for payment instructions)

Conservation Halton

- CH will confirm applicable review fees once the application has been formally circulated for review.

Reviewed by:
Andreas Houlios MCIP, RPP
andreas.houlios@burlington.ca

ZONING

Zoning Info:

The property is zoned BC2 and is in an area regulated by the MTO.

Zoning Comments:

- Zoning does not specifically regulate a dry storm water management pond.
- The storm water management pond is not permitted to be located within the landscape area abutting King Road. The required landscape area abutting King Road is 30m, therefore this does not comply.
- Other Planning Approvals will be required to permit the storm water management pond to be located in the required landscape area.

General Comments:

- Site Engineering is to confirm that King Road is at its deemed width at this location. If it is not, the deemed width is to be shown on a revised plan to confirm the location of the storm water management pond adjacent to King Rd.

Reviewed by:
Danielle Beck, Zoning Examiner
danielle.beck@burlington.ca

STORMWATER ENGINEERING:

1. The shape of the proposed SWM facility shown on the concept plan is not consistent with the outline of the facility shown on the Preliminary Stormwater Management Facility Layout Plan. Please maintain consistency across all plans.
2. Please confirm that the storage-discharge relationship for the new proposed SWM facility will match that of the existing pond.
3. A portion of the 5-meter wide spillway extends onto external lands. Please obtain written permission from the property owner.

4. Is one OGS unit sufficient for enhanced quality treatment of the lands to the north? To confirm, please provide preliminary sizing calculations of the proposed treatment device.
5. Please provide a conceptual stormwater management strategy for the development site to clarify whether it will have independent on-site quantity/quality controls, or the newly proposed SWM facility will service it.
6. If the new SWM facility receives and treats site runoff, its design must account for the extra runoff.
7. The post-development flows (discharge from the new SWM facility and the site runoff combined) must match the pre-development flows at the entrance to the culvert at King Road and North Service Road intersection.
8. Please show the conceptual location of the pond outlet.
9. What is the rationale behind splitting the flows at the maintenance hole downstream of the Oil Grit Separator?
10. Is grading proposed along the north perimeter of the new facility to direct major flows into the 5-meter side spillway?
11. The SWM facility Layout Plan shows a 525mm diameter storm pipe connected to a Ditch Inlet along King Road. Please indicate the flow route beyond the ditch inlet and confirm that the receiving conveyance feature has sufficient capacity.

Reviewed by:
Umar Malik, Stormwater Engineer
umar.malik@burlington.ca

CONSERVATION HALTON:

Conservation Halton (CH) staff have reviewed the pre-consultation application as per our responsibilities under *Ontario Regulation 162/06* and the Provincial Policy Statement 2020 (PPS) (delegated responsibility for comments relating to provincial interests under Sections 3.1.1-3.1.7 inclusive).

Ontario Regulation 162/06

CH regulates all watercourses, valleylands, wetlands, Lake Ontario and Hamilton Harbour shoreline and hazardous lands, as well as lands adjacent to these features. The subject property abuts Indian Creek and contains the erosion hazards associated with that watercourse. CH regulates a distance of 7.5 metres from the limit of the erosion hazard (Stable Top of Bank) for this particular site. Permission is required from CH prior to undertaking any development within CH's regulated area and must meet CH's *Policies and Guidelines for the Administration of Ontario Regulation 162/06* (https://conservationhalton.ca/policies-and-guidelines).

Proposed Development

As the subject property is vacant, all efforts should be made to locate new development outside of CH's regulated area. CH staff attended the site on November 1, 2017 to stake the physical top of bank.

CH discourages new stormwater outlets into creeks and therefore would prefer the proposed overflow spillway to valley be eliminated and overflow be routed through City services. Any proposed outlets will require justification and a CH Permit.

Erosion Hazard

Accurate delineation of the erosion hazard and 7.5 metre regulatory allowance is required. CH staff staked the physical top of bank on November 1, 2017. The stable top of bank needs to be determined through the submission of a geotechnical assessment which would need to be submitted to CH for review and approval.

Other Requirements:

- ESC plans
- Grading Plan
- Topographic survey
- A landscape buffer should be planted within the regulated area using native, non-invasive species. Please refer to CH's 'Landscaping and Tree Preservation Guidelines' available online.

Memorandum of Understanding (MOU)

Should this application move forward, staff provide the following comments under the MOU:

- CH will review stormwater management
    - CH to work with City staff in determining the SWM criteria
- CH will review and comment on the Environmental Impact Assessment (EIA) (lands contain Regional Natural Heritage System (NHS))
    - CH staff previously commented on a Draft Terms of Reference for an EIA (March 15, 2018) and recommend that the application further consult with Halton Region to determine if the draft EIA meets their requirements (CH staff will review/comment on revised TOR if requested)

Fees

CH will require circulation of the forthcoming application.

CH will confirm applicable review fees once the application has been formally circulated for review. Fees will apply based on the applicable fee schedule at the time of submission. CH's 2021 fee schedule is available online: https://conservationhalton.ca/plan-review-fees

Summary of Requirements:

- Detailed topographical survey
- Geotechnical report
- Landscape Plans including tree inventory and protection plans
- Grading Plan

- ESC plans
- Stormwater Management Report
- Environmental Impact Assessment
- Conservation Halton Permits for any works within regulated area.

Reviewed by:
Sean Stewart, Planning and Regulations Analyst
sstewart@hrca.on.ca

HALTON REGION:

Proposal:

The construction and commissioning of a new storm water management (SWM) facility, the decommissioning of the existing City of Burlington SWM facility located in the South-East corner of the site.

Designation: Urban Area (Built Boundary), Employment Areas – Overlay

- Conservation Halton staff provide technical review services to the Region with respect to the delineation and protection of watercourses, wetlands, fish habitat, natural hazards and related concerns. The applicant should have regard to any comments/concerns provided by Conservation Halton staff relating to these matters.

Infrastructure

- The property owner and their Civil Engineering Consulting firm should undertake to locate the size and location of all watermains, water services, property line water service valves, water meters, backflow prevention, fire hydrants, wastewater mains (sanitary sewers), wastewater (sanitary) services, wastewater sanitary manholes (including property line sanitary inspection manhole), stormwater mains and stormwater services that exist within the road right-of-ways, to the property and within the property and place them on an Existing Site Servicing Plan drawing. Public and private utility companies can be utilized for this purpose.
- At the time of future development of the property, a Functional Servicing Report will be required to be prepared by the developer's civil engineering consultant (watermains, water services, fire hydrants, sanitary sewer mains, sanitary sewer services, property line sanitary sewer inspection manholes, stormwater mains and stormwater services) to show options for how the property is proposed to be serviced according to City of Burlington and Halton Region standards. Local watermain and wastewater main (sanitary sewer) hydraulic analysis should be completed as well by the developer's consultant, for the local sewers and the drainage area down the to the nearest trunk sewer. The future FSR report should incorporate Fire Flow Rate Testing. The proponent should undertake fireflow rate testing of representative Regional fire hydrants in the area, with the proponent's fireflow contractor and Region forces present. Include within the Report a copy of the fireflow rate testing results, and the Fire Underwriters Survey (FUS) requirements for the development. This information will help to assist in informing the

watermain design and watermain hydraulic modelling analysis that is being undertaken by the proponent's consultants. The FSR should establish the fire flow requirement, for the proposed buildings and floor areas and property, according to the Fire Underwriters Survey (FUS). This area of Burlington in Halton Region is not a high fire flow rate area. The FSR will need to address any fire flow deficiency, and proposed mitigating measures, in order to meet these standards.

- The Region has a watermain replacement project forecast for the North Service Road in a future year. It is unknown at this time whether this project will impact the property. An example of possible impacts to the property, may be but not be limited to the following, the dedication of land or easements to the Region for infrastructure, site plan building and/or feature setbacks from Regional infrastructure, working easements for works projects, construction impacts, etc.
- Water and wastewater (sanitary) services are not permitted to cross lot lines for this or future Planning applications.

Submission requirements:

- Cover Letter
- Regional Review Fee
- Site Plan

Reviewed by:
James Yun, Intermediate Planner
james.yun@burlington.ca

Notes:
1. Pre-consultation does not imply or suggest any decision whatsoever on behalf of City staff or the Corporation of the City of Burlington to either support or refuse the application.
2. It may be determined during the review of the application that additional revisions, studies or information will be required as a result of issues arising during the processing of the application.

Senior, Matt

From: Malik, Umar <Umar.Malik@burlington.ca>
Sent: Tuesday, September 21, 2021 3:58 PM
To: Senior, Matt; Houlios, Andreas
Cc: Shaun Harcus; Ring, Thomas
Subject: RE: 1450 king road

CAUTION: External email. Please do not click on links/attachments unless you know the content is genuine and safe.

Thank you Matt. Please see my responses below in yellow highlight.

Umar

From: Senior, Matt <matt.senior@woodplc.com>
Sent: Wednesday, September 15, 2021 2:36 PM
To: Houlios, Andreas <Andreas.Houlios@burlington.ca>; Malik, Umar <Umar.Malik@burlington.ca>
Cc: Shaun Harcus <shaun.harcus@quantumrmi.com>; Ring, Thomas <thomas.ring@woodplc.com>
Subject: RE: 1450 king road

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi, just an update that drilling is not happening today (locates did not arrive in time) so will hopefully occur Friday. Some other comments/questions on the previous submission if you can review and advise.

With respect to the planning comments, not sure if that has been discussed/resolved but the comments say that the SWM facility "is not permitted to be located within the landscape area abutting King Road. The required landscape area abutting King Road is 30 m". Can you clarify how this is measured (i.e. from what point on King Road, and to what point in the SWM facility – top of active storage?). Obviously there would be an access road but assuming that does not count. Also do these requirements still apply given this will ultimately be a City-owned facility?

Also wondering if I can clarification on a few of the engineering comments from Umar further to my previous e-mail. Just to clarify in general, the intent is that the new pond is a replacement for the existing one and will provide treatment for external lands only. The site itself will have its own controls separate from the pond. Noted. A site servicing report will have to be submitted for City's review.

In comment 4, you questioned whether one OGS is enough for enhanced treatment (80% TSS removal). The intent of the previous concept was to match the performance of the existing pond, which was only designed to provide normal treatment (70%). The OGS design was also completed prior to the ETV certification approach, and the current City SWM guidelines, which only credit 50% TSS removal. Not sure if there are any "grandfathering" rules that allow us to proceed under the original intent? If not then we would look to incorporate some type of secondary treatment feature (infiltration likely) to ensure the combined treatment meets or exceeds 70% based on only crediting the OGS with 50%.

> I don't believe 70% TSS removal can be "grandfathered". The City would like the new facility to be built to the current standards - 80% TSS removal with a treatment approach where an ETV certified OGS is credited at 50% only.

Can you clarify what you mean in Comment 9? We were not intending to split anything – the outflows from the OGS combine with the flows from the King Road ditch inlet/525 mm storm sewer and that is what is directed into the dry pond.

The direction of flow in the 525mm pipe was not clear. If the flow direction is towards the pond from King Road, then no further action is needed. Thanks for the clarification.

For comment 11, we will re-confirm sizing but overland flow would continue to be south along King Road as it is right now. However the 525 mm pipe was designed for a 100-year flow capacity, so overland flow would not be an issue. Agreed, no further comments.

Let us know if a meeting/call is easier. Just better to confirm before we start preparing responses and updating the design. Thanks.

Matt Senior, MASc, PEng
Associate – Water Resources Engineer
Mobile: (905) 802-4706
www.woodplc.com

From: Senior, Matt
Sent: Tuesday, September 7, 2021 11:13 PM
To: andreas.houlios@burlington.ca; umar.malik@burlington.ca
Cc: Shaun Harcus <shaun.harcus@quantumrmi.com>; Ring, Thomas <thomas.ring@woodplc.com>
Subject: 1450 king road

Hi all. Just wanted to advise that we have been retained by Quantum to support the next steps for the 1450 King Road site. In order to satisfy CH requirements on the slope stability assessment we have booked a driller for September 15th and 17th to complete the supporting geotechnical investigation on site. Let us know if you need any further information. We will also likely be on site this week to complete a scoped topographic survey of the slope to confirm grades for the stability assessment.

Umar, I have done a cursory review of your comments with respect to SWM, will assemble my thoughts/questions and provide those to you shortly as well. Just want to confirm a few things before we prepare the updated response.

Thanks.

Matt Senior, MASc, PEng
Associate – Water Resources Engineer
Mobile: (905) 802-4706
www.woodplc.com

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Memo

To: Trevor Clark, Transportation Services, City of Burlington

From: Matt Senior, Wood

Date: July 12, 2022

File: WW22012079

cc: Tamara Tannis, MHBC Planning
Shaun Harcus, Quantum Real Estate Management

Re: **1450 King Road Site Plan Application (City File MM-01-22)**
Public Communication Plan

As required by the City of Burlington in its recent review comments, a public communication plan has been developed for the above-noted site. Reference is made to the Construction & Mobility Management Plans (CMMPs) for the proposed works in conjunction with the attached. The following shall be addressed with respect to public communication, prior, during and following the proposed construction works:

1. A preconstruction written notice shall be prepared (including contractor information under Item 2 below) and sent out to:
    a. Adjacent properties and along the construction access routes
        i. 598 King Forest Court (Keltech Ltd)
        ii. 578 King Forest Court (Gypsum Technologies Inc)
        iii. 521 North Service Road (Burlington Christian Academy)
        iv. 201 North Service Road (Ippolito)
        v. 151 North Service Road (CUMIS Services Incorporated)
    b. All Emergency agencies (fire, police, and ambulance)
    c. Burlington Transit (works are located along Route 87)
    d. Ward 1 Councillor (Kelvin Galbraith)
2. Sign boards shall be prepared and posted along both King Road and North Service Road sides of the site. Signs shall Include:
    a. Project Name
    b. Project Schedule\Duration and Working Hours
    c. Contractor Information (Company Name and website, and any social media links to provide construction updates and information where warranted)
    d. On site supervisor information (Phone number, e-mail, website) including an after hours contact if different from primary site supervisor

3450 Harvester Road
Burlington, ON L7N 3W5
+1 905 335 2353

Wood Environment & Infrastructure Solutions Canada Limited

3. 48 hours written notice shall be provided to adjacent properties should any construction operations produce impacts beyond the normal day-today operations of the site (including but not limited to excessive noise and/or vibration, unanticipated construction traffic including large-type deliveries, temporary road closures, any disruption to public transit, etc.).
4. A fulsome health and safety and emergency plan shall be developed by the contractor, including confirming evacuation and muster points on the site, key contacts and notifications, and all relevant requirements of the Ministry of Labour. All such information shall be available on site, and any relevant details included in the public communications noted previously.

Minutes

Date:	August 22, 2022
File #:	WW21012079
Meeting Date & Time:	August 18, 2022 9:00 AM
Meeting at:	Teleconference (MS Teams)
Subject:	1450 King Road Stormwater Management Facility (City File MM-01/22) Review of MTO Comments

Attendees:

Mark J. White (MTO)	Umar Malik, City of Burlington
Adam Cybart (MTO)	Shaun Harcus, Quantum Realty Management
Shahbaz Asif (MTO)	Tamara Tannis, MHBC
Graham Routledge (MTO)	Matt Senior, Wood

MATTERS DISCUSSED **ACTION BY:**

1. Introductions and Purpose

a) All present introduced themselves. From MTO, it was noted that Mark J. White is the planner for Halton Region, Shahbaz Asif is the Drainage Engineer, Adam Cybart is with the Project Delivery Office, and Graham Routledge is a Senior Project Manager with the Corridor Management group.

b) Matt Senior noted the purpose of the meeting was to review and discuss MTO's comments of May 4, 2022 in response to the minor modification application for the subject site. The application proposes to construct a new stormwater management (SWM) facility at the north limits of the site and ultimately to decommission the existing SWM facility at the south limits to satisfy conditions set out in a land exchange agreement between the City of Burlington and Astra Capital Properties\Quantum Realty Management. The proposed SWM facility would be constructed first to ensure acceptance and assumption by the City, prior to decommissioning the existing SWM facility as part of the land exchange.

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MATTERS DISCUSSED **ACTION BY:**

2. Comparison to Previous Design

a) Matt Senior noted that MTO Comments 1 and 2 both relate to MTO's requirement that the proposed pond match to the original 1997 SWM Report (Aquafor Beech), including comparisons to flows and volumes.
b) Matt Senior provided an overview of the hydrologic\hydraulic modelling (PCSWMM) completed by Wood which explicitly includes the storage and discharge characteristics of the quantity and quality control cells, as well as the constraint posed by the existing 500 mm diameter CSP outlet. He noted that the original 1997 SWM report provides limited information and calculations, and that the modelling files originally used are not available. Wood's SWM report included a comparison to the rating curve table in the 1997 report, however Wood is of the opinion that the detailed calculation method applied is much more representative of actual conditions.
c) Shahbaz Asif noted the explanation was appreciated and that based on its current understanding, MTO is in agreement with the modelling approach applied by Wood. Notwithstanding, Shahbaz requested additional detail on how the 500 mm diameter CSP outlet constrains flows. Matt Senior noted that as per Table 3.5 in the report, the culvert discharge is lower than the SWM facility discharge for the 100-year storm only, suggesting that crossing is only a constraint for larger flood events. However, Wood will review and update the report to provide a clearer summary of the attenuation posed by the existing 500 mm diameter CSP outlet. **Wood**

3. Emergency Overflow and Conveyance Piping

a) Matt Senior noted that MTO Comment 3 relate to the proposed larger diameter storm sewer piping (975 mm) between the proposed SWM facility and across King Road (including replacement of the existing 500 mm diameter CSP crossing).
b) Matt Senior clarified that the proposed upsized storm sewers are not related to the quantity control function of the proposed SWM facility, but would only be used in the event of an emergency overflow (i.e. storm > 100-year), and were sized to match the size of the storm sewers upstream of the SWM facility. He noted that Conservation Halton (CH) was also not generally supportive of an overflow spillway to the creek corridor to the west as suggested on the initial drawings.

MATTERS DISCUSSED **ACTION BY:**

c) Matt Senior noted that under existing conditions, any spill would be directed towards North Service Road, and due to the road grade would likely primarily drain west towards that tributary, which was the rationale for originally proposing a spillway in that direction.

d) Umar Malik re-affirmed that some type of emergency overflow is needed, and this overflow would only occur for events in excess of design capacity (i.e. > 100-year). He also noted that the City has robust maintenance activities for its SWM facilities to limit the risk of debris and vegetation blockage and other issues.

e) Shahbaz Asif noted that MTO would generally not be supportive of increasing any discharge (including emergency overflows) to the eastern crossing (east of King Road), if this is not the current overflow\spill direction. He noted that MTO would support advocation for a spillway to the west in discussions with CH as required, given that this is more consistent with existing conditions.

f) MTO staff noted conflicting information regarding the existing pond outlet piping, but that based on its CCTV review, the pipe size (500 mm diameter CSP) and alignment appears to be consistent with Wood's drawings. Matt Senior noted that the CCTV inspection completed included in the SWM report also confirms this.

g) MTO staff noted that there is an existing retainer in place for the design of the Highway 403 crossing of the eastern tributary (1200 mm +\- diameter CSP). The replacement design the culvert crossing of King Road would be completed as part of that. Matt Senior suggested a 525 mm diameter concrete or PVC pipe would be reasonable and consistent with the existing size; MTO staff noted this will be confirmed but this is likely reasonable. Construction was originally planned for 2023 but may be delayed by 1 year; MTO is confirming and can advise as part of its ongoing discussions with City staff. **MTO**

4. Next Steps

a) MHBC will co-ordinate a follow-up meeting with Conservation Halton to discuss the emergency overflow spillway from the proposed SWM facility. The need for any input from MTO will be confirmed thereafter. Wood to update the design following the discussion and any additional review comments. **MHBC**

Meeting Minutes prepared by:

Wood Environment & Infrastructure Solutions Canada Limited



Per: Matt Senior, M.A.Sc., P.Eng.
Associate, Senior Water Resources Engineer

MJS

MHBC
PLANNING
URBAN DESIGN
& LANDSCAPE
ARCHITECTURE

MINUTES

KITCHENER
WOODBRIDGE
LONDON
KINGSTON
BARRIE
BURLINGTON

Present:	**Shaun Harcus, Matt Senior, Ken Glasbergen, Jillian Sparrow, Tamara Tannis, Conservation Halton (Sean Stewart, Allan Newell, Karen Reis)**
Date:	**August 30, 2022**
File:	**1743D**
Subject:	**1450 King Road – SWM Pond**

DECISIONS / ACTIONS

- Conservation Action Items:
  - Sean Stewart – source available hydraulic modeling (HEC-RAS) for adjacent watercourses (tributaries of Indian Creek) for Matt Senior
  - Allan Newell – Confirm with team that CH will entertain the proposed spillway into the valley (western watercourse; tributary of Indian Creek)
  - Karen Reis – follow-up with Region regarding drip line. If required, arrange a meeting to discuss (Include Ken Glasbergen)
- Matt Senior:
  - Provide concept plans of proposed spillway to CH for review and discussion following confirmation that CH will consider this approach
- Ken Glasbergen:
  - Update to the EIA would be required to review the impacts of the proposed spillway
  - Prepare slope erosion analysis for a Regional storm event, both with and without vegetation.
  - Prepare a management and monitoring plan for invasive species.

TAKE AWAY

Based on our agenda, below is our take away from our meeting.

1. **SWM POND**
   a. Wet pond vs dry pond – Allan has confirmed that we can move forward with a Dry Pond. City has confirmed it supports a dry pond.

   b. Use of cable concrete ¼ pond bottom – Allan has requested that the cable concrete be naturalized at the bottom of the pond (topsoil and seed). The access road does not need to be naturalized (granular backfill).

c. Extreme Event Overflow spillway –

- Allan will discuss with his team to confirm that CH will entertain the proposed spill way.
- Allan will need to review a details of the proposed spillway. This can be provided outside of a formal resubmission.
- Allan generally does not have an issue with providing the spillway to the valley given its intended function as an emergency overflow for events greater than a 100-year event. Concerned that it might cause erosion at the top of bank, however, any damage could most likely be repaired.
- Karen advised that the Region will need to review as well given the proposed spillway would run through the wood lot. This may cause the need for additional studies.
- Karen advised that an updated environmental report would be required to review the impacts of the proposed spillway.
    - Matt/Ken advised that the intention is to provide for as natural a form as possible (including minimizing vegetation disturbance) and emphasized that this would only be used in extreme rain events.
- Karen suggested a meeting with the Region may be required to review the proposed spillway.
- Allan advised that it would be good to understand what would happen to the creek during a Regional event and what the pond would add
    - Ken advised that we could prepare a slope erosion analysis, both with and without vegetation.
    - It was suggested spillway function be assessed for a storm event greater than the 100-year event, such as the Regional Storm (Hurricane Hazel) to determine potential flows and velocities
- Sean will inquire about available hydraulic modeling (HEC-RAS) for adjacent watercourses (tributaries of Indian Creek) for Matt.

2. Dripline

a. 10 m buffer (woodland)

- Karen suggested this may require a meeting with the Region. Karen will reach out to the Region to discuss. Karen will include Ken should a meeting be required.
- Dripline may need to be re-staked.
    - Matt noted the only reason why we encroach is to enhance an existing spillway from sites to the north into the proposed SWM facility
    - Ken noted that we are not encroaching into the valleylands, we request that a 10m setback not be included on the finger

3. **EIA**
    a. Invasive Species – Common Reed (Invasive Species Plan)
        - Ken advised we can prepare a management and monitoring plan for invasive species. The City will ultimately be responsible for the maintenance of the site.
        - Intention would be to remove all phragmites from existing pond (to the extent possible) as part of second phase of construction (i.e. decommissioning of the existing SWM facility once the proposed SWM facility is constructed and assumed by the City)

APPENDIX

F GEOTECHNICAL INVESTIGATION REPORT

Geotechnical Investigation Report

1450 King Road, Burlington
WW21012079

Prepared for:

Quantum Realty Management, ATT: Shaun Harcus, Director, Facilities and Real Estate

2213 North Sheridan Way, Mississauga, ON, L5K 1A3

January 24, 2022

Geotechnical Investigation Report

1450 King Road, Burlington
WW21012079

Prepared for:

Quantum Realty Management, ATT: Shaun Harcus, Director, Facilities and Real Estate
2213 North Sheridan Way, Mississauga, ON, L5K 1A3

Prepared by:

Wood Environment & Infrastructure Solutions,
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January 24, 2022

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1.0 Introduction

Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited ("Wood") was retained by the Quantum Realty Management ("Client") to carry out a geotechnical investigation for the proposed re-design of the existing stormwater management facility and associated future re-development at 1450 King Road, located in the City of Burlington.

Currently, Quantum owns a portion of the 1450 King Road site. The balance is owned by the City of Burlington ("City") and operated as a dual cell (dry/wet) stormwater management (SWM) facility, providing quantity and quality control for the upstream King Forest Phase 1 Business Park. The proposed approach for the site would involve re-locating the SWM facility (located in the south-east corner) to the northern portion of the site, as part of the proposed development of the entire site, effectively exchanging the location of the SWM facility with potential development land in the north part of the site. This would allow the site to be re-developed so that the main building has frontage along North Service Road. Ultimately, the site is proposed to include a building, along with parking areas and two driveway accesses (both from North Service Road and King Road).

As per City's review comments dated June 15, 2021, Conservation Halton ("CH") requires "Accurate delineation of the erosion hazard and 7.5 metre regulatory allowance" and submission of a geotechnical assessment that determines the stable top of bank. In addition, a geotechnical exploration is required in order to support design of the proposed dry pond stormwater management facility (SWMF) and site grading in the development area.

The main purpose of this investigation is to provide geotechnical recommendations for design and construction of the proposed SWMF facility. In addition to the presenting the factual findings, this report outlines recommendations and discussion regarding; open-cut excavations, SWMF facility headwall structure, general backfill, lateral earth pressure coefficients, groundwater conditions, drainage and dewatering, and a slope assessment. A preliminary hydrogeological infiltration assessment is included.

The Client provided the following reports prepared for the subject site, and were reviewed for information when completing this report:

- McClymont and Rak Engineers Inc. (MRE) draft report titled "Geotechnical Investigation, Proposed Industrial Subdivision, King Forest Business Park - Ph 1, Burlington, Ontario", Report G1853, dated April 1997;
- Pinchin Environmental Ltd. (Pinchin) draft report titled "Phase I Environmental Site Assessment, 1450 King Road, Burlington, Ontario", Pinchin File: 95166, dated July 7, 2014; and
- EXP report titled "Phase I Environmental Site Assessment, 1450 King Road, Burlington, Ontario", Project Number HAM-00801175-A3, dated April 11, 2017.

In the 1997 MRE report, 33 boreholes were advanced to depths ranging between 2.0 to 5.0 m. Bedrock was encountered in sixteen boreholes at depths of 2.1 to 4.3 m. Bedrock was not encountered during the current investigation, with boreholes advanced to 5.2 m depth.

2.0 Authorization

Authorization to proceed with this investigation was received by Shaun Harcus of Quantum Realty Management on August 23, 2021. The scope of services authorized were as per the Wood proposal POGTW21642 Rev.1 revised August 23, 2021.

3.0 Terms of Reference

The findings of the investigation, together with Wood's comments and recommendations, are presented in this report. The anticipated construction conditions are also discussed but only to the extent that they may influence the design decisions. Any construction methods discussed express Wood's opinions only and are not intended to direct contractors on how to carry out the construction. Contractors should also be aware that the data and the interpretation presented in this report may not be sufficient to assess all the factors that may have an effect on construction.

This report was prepared with the assumption that the design will be in accordance with applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practices.

Further, the recommendations and opinions expressed in this report are only applicable to the proposed project as described above.

There should also be an ongoing liaison with Wood during both the design and construction phases of the project to ensure that the recommendations in this report have been interpreted and implemented correctly. Also, if any further clarification and/or elaboration are needed concerning the geotechnical aspects of this project, Wood should be contacted immediately.

4.0 Site Description and Geological Setting

The Site is at the north-west corner of North Service Road and King Road, in Burlington, Ontario. The northern and western portions are vacant, vegetated with grasses with a few trees and shrubs. The south-east section serves as an existing storm water pond. A tributary of Indian Creek flows along the west boundary with heavily treed valley slopes. Two earthen stockpiles are present in the southwest and northeast corners of the site. Overall, the Site slopes down towards the south.

Based on *Surficial Geology of Southern Ontario (MRD128)*, released by the Ontario Geologic Survey, 2010, the surficial soils generally consist of clay to silt-textured till (derived from glaciolacustrine deposits or shale) and Paleozoic bedrock.

Based on *Paleozoic Geology of Southern Ontario (MRD219),* published by the Ontario Geologic Survey, 2007, the bedrock in the area consists predominately of shale of the Queenston Formation.

5.0 Method of Investigation

The investigation obtained information about the subsurface conditions at the site by means of sampled boreholes. Based on site-specific findings, and the general knowledge of the area, Wood has provided geotechnical recommendations pertaining to this project.

5.1 General Description of Field Work

The fieldwork for this investigation was carried out on September 24 and September 28, 2021. It consisted of twelve (12) sampled boreholes, and installation of two (2) groundwater monitoring wells, as indicated on the Figure 2 - Borehole Location Plan.

The number of boreholes, their locations and depths are summarized in the table below.

Table 5-1: Borehole Summary

BH ID	Location - UTM Coordinates		Surface Elevation (geodetic datum, m)	Depth (mbgs)*
	Easting	Northing		
BH1	593674.3	4798114.6	123.6	5.2
BH2	593607.5	4798048.0	122.2	5.2
BH3	593617.4	4798048.0	121.5	5.2
BH/MW4	593585.6	4797995.4	121.8	5.2
BH/MW5	593657.0	4798076.9	121.1	5.2
BH6	593645.6	4798052.5	120.7	5.2
BH7	593624.7	4798007.4	121.0	5.2
BH8	593599.7	4797960.0	120.8	5.2
BH9	593702.3	4798068.8	120.2	5.2
BH10	593670.0	4797996.3	119.4	5.2
BH11	593660.5	4797924.4	118.5	5.2
BH12	593734.9	4798009.4	116.7	5.2

*mbgs = metre below ground surface

The ground surface elevations and co-ordinates at each borehole location were surveyed by Wood, using NAD83 horizontal datum and CGVD28:78 (1978) vertical datum.

Boreholes were advanced using a track mounted drilling rig. The drilling rig was outfitted with 150 millimetre ("mm") solid stem augers.

Prior to intrusive activities, proposed borehole locations were marked out and utility clearance requests submitted to Ontario One Call and a private utility locator. Boreholes were repositioned where required to avoid conflict with underground utilities.

The drilling, sampling, and testing operations were conducted by Davis Drilling Limited of Milton, Ontario under the direction of Wood personnel who logged the various soil strata. All soil samples and auger cuttings were visually examined and classified in the field. Groundwater and drilling conditions, as well as any pertinent subsurface observations, were also recorded during drilling progression.

Samples were obtained through the overburden, by driving a standard split spoon-sampling device in accordance with the requirements of the Standard Penetration Resistance Test (ASTM D1586). This consisted of freely dropping a 63.5 kg (140 lb) hammer for a vertical distance of 0.76 m (30 inches) to drive a 51 mm (2 inch) diameter O.D. split-barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m (12 inches) was recorded as SPT 'N' value of the soil which indicated the consistency of cohesive soils or the compactness of non-cohesive soils.

Upon completion, the boreholes were backfilled to grade with a bentonite and cutting mixture in accordance with the requirements of Ontario Regulation 903, as amended.

Detailed borehole logs summarizing the sampling, field testing, laboratory test results, and subsurface conditions encountered at the borehole locations are presented in Appendix B.

5.2 Soil Classification Tests

The soil samples collected were returned to a Wood's Burlington laboratory for visual examination and further classification. The moisture content of each sample was determined and is indicated on the Record of Borehole Logs (Appendix A). In addition to moisture contents (ASTM D2216), four soil samples were submitted for grain size distribution including hydrometer testing of fine-grained soils (ASTM D7928 and D6913), and four soil samples (BH3 SS4, BH/MW4 SS2, BH/MW5 SS3, BH10 SS2) were submitted for Atterberg Limits (ASTM D4318).

Laboratory testing results of these samples are attached in Appendix B, and summarized in the table below.

Table 5-2: Results of Soil Classification Tests

BH	Sample	Depth (m)	Particle Size Distribution				Atterberg Limits			USCS Modified Group Symbol
			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	
BH3	SS4	2.3-2.9	5	14	40	41	30	18	12	CI
BH/MW4	SS2	0.8-1.4	0	11	42	47	32	17	15	CI
BH/MW5	SS3	1.5-2.1	3	11	41	45	30	18	12	CI
BH10	SS2	0.8-1.4	1	10	39	50	34	18	16	CI

CI – Inorganic Clays of Medium Plasticity

All soil samples will be retained for three (3) months, and then disposed of unless a longer holding period is requested by the City.

6.0 General Subsurface Conditions

For a description of the soils and ground water conditions encountered at each borehole location during this investigation, reference should be made to the Record of Borehole Logs in Appendix A.

The following written descriptions are given to enhance the understanding of the individual sheets provided in Appendix A.

6.1 Topsoil/Surface Organics

Topsoil/ surface organics was encountered in all boreholes, with the exception of BH/MW4 and BH7. The measured topsoil thickness was measured 150 to 230 mm. It should be noted that testing for organic content was not carried out on the topsoil samples. Therefore, no commentary can be made as to the suitability of materials described as topsoil to support vegetation.

6.2 Fill

Silty clay, clayey silt and silt fill underlaid the topsoil/surface organics in all boreholes, except at boreholes BH/MW4 and BH10. The fill consisted of silty clay, clayey silt or silt. The fill layers extended to depths ranging from 0.2 to 3.7 m below existing ground surface (mbgs). The table below provides the fill depths and consistency or compactness at each location.

Table 6-1: Summary of Fill Material

BH #	Thickness (m)	Fill Base Elevation (geodetic datum / mbgs)	Fill Material	SPT 'N' Value (blows/0.3m)	Consistency/ Compactness
BH1	0.9	122.6 / 1.1	Silty Clay	10	Stiff
BH2	1.8	120.2 / 2.0	Clayey Silt	9,14,13	Stiff
BH3	0.5	120.9 / 0.7	Silt	7	Loose
BH/MW5	0.5	120.4 / 0.7	Clayey Silt	9	Stiff
BH6	0.5	120.1 / 0.7	Clayey Silt	7	Firm
BH7	0.2	120.8 / 0.2	Clayey Silt	N/A	N/A
BH8	0.1	120.5 / 0.3	Clayey Silt	11	Stiff
BH9	0.5	119.5 / 0.7	Clayey Silt	9	Stiff
BH11	0.5	117.8 / 0.7	Clayey Silt	7	Firm
BH12	3.5	113.0 / 3.7	Silty Clay	5, 6,13,16,8	Firm to Very Stiff

The fills are brown or grey in colouration and generally contained trace to some gravel, sand, clay and brick.

SPT testing yielded 'N' values ranging from 6 blows to 16 blows for 0.3 m of penetration. Natural moisture contents of the fills were between 4% and 26%.

6.3 Silty Clay

Native brown/mottled brown silty clay was encountered in boreholes BH2, BH3, BH/MW4, BH6 and BH11. Laboratory test results performed on one sample (BH/MW4 SS2) within this layer indicated silty clay with intermediate plasticity. Summaries of the results of the particle size analyses and Atterberg Limit determinations were presented in Table 5-2 of report Section 5.2.

The silty clay generally contained trace to some amounts of sand and trace gravel. The silty clay layers varied in thickness from 0.7 to 1.5 m.

SPT testing yielded 'N' values of 8 to 29 blows for 0.3 m of penetration, indicating firm to very stiff consistency. Natural moisture contents of the silty clay samples were between 14% and 25%.

6.4 Silty Clay Till

All boreholes were terminated in a deposit of native brown and/or grey silty clay till, which was encountered below the fill or silty clay. The silty clay till generally contained trace to some amounts of sand and trace gravel. The results of a particle size analysis carried out on three samples of silty clay till (BH3 SS4, BH5 SS3 and BH10 SS2) were presented in Table 5-2 of report Section 5.2.

SPT testing yielded 'N' values of 8 to 39 blows for 0.3 m of penetration, indicating firm to hard consistency. Natural moisture contents of the silty clay till samples were between 13% and 26%.

Although cobbles and boulders were not specifically encountered within the silty clay till, their presence should be anticipated based on the depositional history of these materials.

6.5 Groundwater Conditions

During and upon completion of drilling, observations were made including when water was encountered during sampling, water level upon completion, and whether any cave was present prior to backfilling. The following table summarizes these observations, along with water levels taken on October 27, 2021.

Table 6-2: Borehole Cave and Groundwater Observations

Location	Borehole Cave Depth Below Ground Surface / Elevation (mbgs) / (m)	Water Level Below Ground Surface / Elevation (mbgs) / (m)			
		Upon Completion*	October 27, 2021	November 2, 2021	November 5, 2021
BH1	open	dry	-	-	-
BH2	open	dry	-	-	-
BH3	open	dry	-	-	-
BH/MW4	open	dry	0.49/121.31	0.56/121.24	0.73/121.07
BH/MW5	open	dry	1.01/120.09	1.25/119.85	1.55/119.55
BH6	open	dry	-	-	-
BH7	open	dry	-	-	-
BH8	open	dry	-	-	-
BH9	open	dry	-	-	-
BH10	open	dry	-	-	-
BH11	open	dry	-	-	-
BH12	open	dry	-	-	-

Dry indicates an absence of visible seepage such that the groundwater level could not be established during the short time the borehole was open. The encountered groundwater levels are considered short-term and not indicative of stabilized or long-term readings. It should be noted that the groundwater conditions will vary subject to weather and seasonal fluctuations.

7 Slope Stability

7.1 Assessment of Existing Conditions -Visual Inspection

A visual inspection of the western limits of the site, which borders a tributary of Indian Creek, was conducted on August 27, 2021, by a Senior Geotechnical Engineer from Wood. The slope was inspected using the methodology from the Ministry of Natural Resources Technical Guide – River and Streams: Erosion Hazards Limits (2002). The slope was divided into three areas which had similar characteristics, denoted by A, B, and C as shown on the attached Figure 2.

The northern (Area A – adjacent the proposed stormwater management facility (SWMF)) and southern portions (Area C) of the slope were more gradual in nature compared to Area B. The slope of Area A and B was well vegetated and covered with either heavy scrub or forested with matured trees. No seepage or erosion features noted. The instability rating as per MNR Erosion Hazard Guide for Areas A and C is 'low'. No signs of slope instability were observed in the northern and southern portion. See slope stability rating in Appendix C.

The central part (Area B) of the slope along the SWMF appeared to be the steepest section. The slope was generally well vegetated and covered with either heavy shrubs or forested with mature trees. Localized areas were bare or lightly vegetated. No seepage areas were visible. Localized toe erosion features were observed. The instability rating as per MNR Erosion Hazard Guide for Area B is 'Slight'. See slope stability rating in Appendix C.

7.2 Slope Stability Analyses

The slope stability of two sections in the northern and central portions were analysed using SLOPE/W Version 8, a limiting equilibrium slope stability software with the GeoStudio 2016 package produced by Geoslope, a Seequent Solutions company. The slope geometry was modelled using cross section developed from the existing site survey used for Wood ProjectNo. TP110458 and conducted by MacKay, MacKay & Peters Limited (December 21, 2017). This survey was supplemented with LiDAR data obtained from Land Information Ontario's LiDAR DTM Halton 2018 Package B dataset. Deep-seated failures were examined using long-term (drained) analyses as it was found to be the most critical. Soil lithography was based on the nearest geotechnical boreholes (BH/MW-4 and BH-8). Soil parameters used for slope stability analysis were based on results of the geotechnical investigation and local experience.

A summary of the soil properties used in the analyses is provided in the following table.

Table 7-1: Geotechnical Parameters for Slope Stability Analyses – Existing Soils

Soil Type	Total Unit Weight, γ (kN/m^3)	Undrained Shear Strength, s_u (kPa)	Total Stress Friction Angle, ϕ_u (°)	Effective Stress Cohesion, c' (kPa)	Effective Stress Friction Angle, ϕ' (°)
V. Stiff Silty Clay Till	22	-	-	5	34

The Morgenstern-Price limit equilibrium method was used for the slope stability analyses. The slope stability models are provided in Appendix D.

The Ontario Ministry of Natural Resources (MNR) Technical Guide provides a minimum recommended design Factor of Safety for different land uses and associated risk to property and life. Based on the future land use (commercial building and storm water management facility), Category C 'Active Use' a design minimum factor of safety of 1.30 to 1.50 is recommended. A minimum 1.4 will be used as the criteria in this report.

Two sections were chosen for analysis as shown on Figure 2, 'A-A' and 'B-B'. These were selected as 'B-B' was the most adverse section, and 'A-A' as the transition between Area A and B. A summary of the slope results is listed in the table below.

Table 7-2: Slope Stability Analyses Results

Section	Condition	Factor of Safety Against Slope Instability	Figure
A-A	Existing	1.54	D.1
B-B	Existing	1.34	D.2

Based on the analysis, the existing slope at section A-A has the minimum required factor of safety against instability, while section B-B is marginally lower than the minimum required. Therefore, the physical top of slope is the long-term stable top of slope for at section A-A, while a section B-B a setback would be required to denote the long term stable top of slope.

In addition to the slope stability analysis, the MNR Guidelines requires consideration to toe erosion and an access allowance as this is considered a confined system. The overall "erosion hazard limit" is defined as the sum of:

"toe erosion allowance" + "allowance for stable slope" + "erosion access allowance".

The determinations of the respective allowances are described in the following paragraphs.

Toe Erosion Allowance

At Area A and C, the stream is shallow, narrow, slow flowing and at a distance less than 15 m from the slope toe. No evidence of active erosion was present along the slope toe from the creek. Based on the silty clay till soil type inferred to be in the stream bank and a bankfull width of less than 5 m, a toe erosion allowance of 1 m is conservatively applied as per Table 3 in MNR Technical Guide for Tills with no active erosion.

At Area B, the stream is shallow, narrow, slow flowing and at a distance less than 15 m from the slope toe. Localized toe erosion was observed. Based on the silty clay till soil type inferred to be in the stream bank, a toe erosion allowance of 5 m is conservatively applied as per Table 3 in MNR Technical Guide for Tills with active erosion.

Allowance for Stable Slope

The topography at cross section A-A was used to mode the most adverse condition within Area A and C. Based on the results of the slope stability analysis, the physical top of slope can be considered the long-term stable top of slope.

The topography at cross section B-B was used to model the most adverse condition within Area B. Based on the results of the slope stability analysis, an additional setback of 3 m is required as an allowance for stable slope. This setback was determined where the minimum factor of safety slip surface (of 1.4) would originate behind the physical top of slope.

Erosion Access Allowance

According to Conservation Halton requirements, the erosion access allowance is 7.5 m from the "Stable Top of Slope". Therefore, the required erosion hazard setback for Area A and C is 8.5 m, and for Area B, 15.5 m.

8 Discussion and Recommendations

It is understood, the major site works associated with construction of the storm water management facility will include excavating the dry pond, construction of a headwall at the north side of the pond, along with an oil/grit separator.

The field investigation consisted of sampled boreholes at 12 locations, installation of two monitoring wells, and infiltration testing at two (2) locations. A visual slope inspection and slope stability analyses of the existing conditions were also carried out.

The following subsections provide discussion and recommendations for anticipated works for use in design.

8.1 Foundations

Within and adjacent the dry pond potential structures include an oil/grit separator, a maintenance hole, concrete headwall, and stormwater management facility. As locations and founding elevations are not available, general foundation discussion will be provided.

Boreholes BH2, BH3, BH/MW4, BH/MW5, BH6, and BH7 were advanced within or in close proximity to the proposed storm water management facility. In general the soils consisted of topsoil at surface underlain by silty clay / clayey silt fill up to 2.0 m thick, but on average 0.5 m thick. Underlying the fill was firm to stiff native silty clay up to 1.4 m thick over firm to hard silty clay till. The topsoil and fills are not suitable materials to found upon. Foundations should be placed on native soils. Recommended bearing capacities for structures within or associated with the stormwater management facility, along with elevations encountered for the silty clay and silty clay till are provided per borehole in the table below. Wood should be consulted for site-specific foundation recommendations if other structures, including buildings, are to be erected on this site.

Table 8-1: Recommended Founding Grades and Geotechnical Resistances

BH#	Depth Below Existing Grade / Elevation (m)	Founding Stratum	Factored Ultimate Geotechnical Resistance at ULS (kPa)	Serviceability Geotechnical Resistance at SLS (kPa)
BH2	2 to 3 m / 120.2 to 119.2	Stiff silty clay	150	100
	3 to 4 m / 119.2 to 118.2	Very stiff silty clay till	300	200
BH3	1.2 to 2.2 m / 120.3 to 119.3	Very stiff silty clay	275	175
	2.2 to 4 m / 119.3 to 117.6	Hard silty clay till	300	200
BH4/MW	1.2 to 4 m / 120.6 to 117.9	Very stiff silty clay / very stiff to hard silty clay till	300	200
BH5/MW	1.2 to 4 m / 119.9 to 117.1	Very stiff to hard silty clay till	300	200
BH6	1.2 to 2.2 m / 119.5 to 118.5	Stiff silty clay to very stiff silty clay till	225	150
	2.2 m to 4 m / 118.5 to 116.7	Firm to stiff silty clay till	150	100
BH7	1.2 to 4 m / 119.8 to 117.0	Stiff to very stiff silty clay till	225	150

For founding depths below those provided in the table above, please consult with the geotechnical engineer to verify values. The geotechnical pressure values provided in the above noted table are intended to assess the feasibility and sizes of footings and are for vertical loads (no inclination) without load eccentricity. The ULS values will be less than those stated if inclined or eccentric loading conditions exist. The SLS value

provided should correspond to not more than 25 mm of total settlement with 10 mm to 15 mm of differential settlement.

The design frost depth penetration is 1.2 m below grade (OPSD 3090.101). All foundations should be covered by at least 1.2 m deep soil or equivalent synthetic thermal insulation.

8.1.1 Bedding for Appurtenances

It is anticipated that the headwall may be installed directly on the foundation soils without use of bedding. The maintenance hole is to be provided with 150 mm of granular bedding in accordance with OPSS 402. The bedding thickness for the oil/grit separator should be no less than 300 mm or as specified by the manufacturer/supplier. The bedding should comprise Granular 'A' (OPSS1010) compacted to 98% Standard Proctor Maximum Dry Density (SPMDD). The bedding material must extend beyond the footprint of the maintenance hole or oil/grit separator.

8.1.2 Lateral/Sliding Resistance

The resistance to sliding or horizontal/lateral resistance between the underside of the headwall footing, or base slabs of the oil/grit separator and maintenance hole should consider the appropriate interactions. In the case of cast-in-place (CIP) footings on native soil, the bond between the underside of the footing and the soil will be so rough that failure will occur in the soil beneath the footing. If a pre-cast foundation is used, the critical interaction will be the interface of the underside of the footing and the foundation soil, be it granular bedding or native soil. It is likely that the headwall, maintenance hole and oil/grit separator will all be pre-cast structures. The values in Table 8-2 assume that the foundation soils are not disturbed or loosened during excavation and footing construction.

Table 8-2: Summary of Parameters for Lateral Resistance

Interaction	Foundation Soil	Angle of Internal Friction, ϕ (°)	Angle of Interface Friction, δ (°)	Coefficient of Internal Friction, tan ϕ (°)	Coefficient of Interface Friction, tan δ (°)
CIP footing on native soil	Stiff to very stiff silty clay	28	-	0.53	-
	Stiff to hard silty clay till	30	-	0.58	-
Pre-cast footing on granular bedding	Granular A bedding	-	30	-	0.58
Pre-cast footing on native soil	Stiff to very stiff silty clay	-	26	-	0.49
	Stiff to hard silty clay till	-	28	-	0.53

Cohesion should be neglected in the calculation of lateral resistance.

8.2 Lateral Earth Pressure

Lateral earth pressures will be exerted on or by the backfill and soil adjacent to the walls of buried structures and retaining walls. Backfill placed behind buried structures and retaining walls should consist of free-

draining granular soil, compacted to a minimum of 98% of Standard Proctor Maximum Dry Density (ASTM D698). Backfill should be placed in loose lifts with a maximum thickness of 200 mm.

Based on a well compacted and drained backfill soil, the headwall and walls of any other buried structure should be designed to resist the horizontal pressure acting on the wall. The horizontal pressure P, at depth h, may be estimated using the following:

$$P = K(\gamma h + q)$$

Where:

K	=	Lateral Earth Pressure
γ	=	unit weight
h	=	depth below final grade (m)
q	=	surcharge load (kPa), if present, plus 12 kPa due to heavy compaction equipment

The following are the recommended values for various materials are presented in the table below.

Table 8-3: Recommended Material Properties / Parameters for Lateral Earth Pressure

Material	Angle of internal friction (Φ') (°)	Bulk Unit Weight* (kN/m^3)	Active earth coefficient (K_a)	Passive earth coefficient (K_p)	At rest earth coefficient (K_o)
Granular 'A'	35	22	0.27	3.7	0.43
Granular 'B' Type I	32	21	0.31	3.3	0.47
Granular 'B' Type II	35	22	0.27	3.7	0.43
Silty Clay	28	20	0.36	2.8	0.53
Silty Clay Till	30	21	0.33	3.0	0.50

*If below groundwater level, effective unit weight ($\gamma = \gamma_b - \gamma_w$).

8.3 Excavations

Excavations for the dry pond and any associated structures will encounter different soil types including topsoil, fills, native silty clay / clayey silt, and silty clay till.

Excavations are expected to proceed below the groundwater level for all site works. Additional details are provided in Section 8.4 and the Preliminary Hydrogeological Assessment (Section 9.0).

It is anticipated excavations within topsoil, fills, native silty clay / clayey silt, and silty clay till can be completed using conventional excavation equipment. The presence of cobbles and/or boulders within the silty clay till are possible although not encountered during the investigation.

All excavations must comply with the current Occupational Health & Safety Act and Regulations for Construction Projects (OHSARCP). The side slopes of any excavations through the overburden, deeper than 1.2 metres, must be sloped as outlined in the Act. Based on the criteria in the Act, all fills must be considered as Type 3 soils, and Type 4 if saturated. The native silty clay / clayey silt and silty clay till is considered to be Type 2. Excavations within Type 2 soils may be carried out with unsupported side slopes that are sloped to 1.2 m or less from its bottom with a slope no steeper than 1H (horizontal) to 1V (vertical). The walls of

excavations in Type 3 soils should be 1H:1V or flatter. Some flattening of excavation sides may be required if saturated fills are encountered. For Type 4 soils, temporary side slopes of 3H to 1V from the base of the excavation are required by the OHSARCP. The designation must be verified onsite by qualified personnel during excavation.

If there is insufficient space to accommodate proper sloping of the excavation temporary shoring may be employed and is to meet OHSARCP.

8.3.1 Reuse of Excavated Soils

Topsoil, and any zones in the fill with high organic content are not suitable for reuse as engineered fill.

The existing granular fill is too silty to be reused as structural backfill. It may be used for general backfill or grade changes but not to serve as a base under any structural element / footing, within the MSEW, or directly behind a retaining wall.

The silty clay / clayey silt and silty clay till is considered suitable for reuse as fill, provided it can be properly compacted. Generally, heavy compaction equipment must be used in order to break-up and thoroughly re-compact clayey soils to prevent post-construction settlement. The soils must also be at suitable moisture contents for re-compaction. Typically, the optimum moisture content for clayey soils for recompaction is about 18%. The moisture contents recorded for the silty clay / silty clay till within the expected excavation limits varies from 13 to 25%, therefore, some moisture conditioning maybe required.

It is generally difficult to adequately place and compact cohesive soils in small, confined areas such as trenches. It may be more practical to import a granular fill, such as Granular 'A' where fill is needed within trenches.

8.4 Groundwater Control During Construction

Surface water should be directed away from the excavations and areas of structure backfill at all times. If conditions are similar to those observed during drilling boreholes of site investigation, groundwater inflow into the excavations within 3 meters of ground surface are expected to be low. Monitoring wells indicate static water levels within this depth and there is a potential for a higher inflow if any silt or sand layers are encountered within the excavation depth. It is anticipated inflows can be handled with the use of properly filtered sumps placed strategically within excavations and outside the footprints of any foundations.

8.5 Pipe Bedding, Cover and Backfill

8.5.1 Standard Requirements

The bedding and backfill material should meet the manufacturer's specifications as well as the applicable Ontario Provincial Standard Specifications (OPSS) standards.

Applicable OPSS standards may include:

- OPSS.MUNI 401 "Construction Specifications for Trenching, Backfilling, and Compacting"
- OPSS.MUNI 410 "Construction Specifications for Pipe Sewer Installation in Open Cut"

8.5.2 Pipe Bedding and Cover

For open-cut installation, the depth of the pipe bedding should be a minimum of 150 mm, and the pipe cover should be completed to at least 300 mm above the pipe crown. All bedding, clearance and cover materials should consist of Granular 'A' (OPSS 1010) compacted to 95% SPMDD in accordance with the OPSS.MUNI 410 requirements.

Care should be exercised to avoid compaction methods that may damage the pipe. The placement and thickness of the granular bedding should meet the pipe manufacturer's specifications.

8.5.3 Trench Backfilling

Backfill material from 300 mm above the top of pipe to surface level can consist of compactable native silty clay / clayey silt or imported Granular 'A' or 'B' Type I, and placed in lifts not to exceed 200 mm and compacted to 98% SPMDD.

9 Preliminary Hydrogeological Assessment

A preliminary hydrogeological assessment has been conducted to assess the hydrogeological conditions at the site. This included the installation of monitoring wells for groundwater level monitoring and hydraulic conductivity testing. Two (2) infiltration tests were intended to be completed. However due to high groundwater levels, the results of the testing were not deemed to be representative.

9.1 Monitoring Well Construction

To provide hydrogeological information, monitoring wells were installed within BH/MW-04 and BH/MW-05. The monitoring wells were constructed within the open borehole at the completion of drilling to the borehole depth. A 0.05 m (2") inside diameter PVC riser pipe with a 3 m length of 10-slot screen was set to the bottom of the open hole. No. 2 Silica sand was poured into the borehole to fill the borehole's annulus from the bottom of the screen to approximately 0.3 m above the screen. Bentonite was then poured into the borehole to approximately 0.5 m below ground surface. The bentonite was hydrated to provide a seal from the ground surface. The monitoring wells were completed with lockable J-plug caps and protective stick-up steel casings embedded in concrete. The wells were tagged and labelled in accordance with Ontario Regulation 903 (O. Reg. 903) of the Ontario Water Resources Act by the well drillers and the water well records were submitted to the MECP by the drilling subcontractor.

9.2 Infiltration Testing

As part of the drilling program, two (2) shallow boreholes (BH4A, BH5A) were advanced on September 28, 2021 using a track mounted drill rig to a depth of approximately 3 m depth for the purposes of conducting infiltration testing. The depth was selected based on the maximum depth of the infiltration testing equipment and the approximate depth of the proposed dry pond. The boreholes were advanced directly adjacent to boreholes BH4 and BH5 as described in Section 5. The boreholes were approximately 10 cm in diameter.

Infiltration testing was conducted following the boreholes being drilled on September 28, 2021 in order to determine the field saturated hydraulic conductivity and an estimate of infiltrate rates. However the testing yielded low hydraulic conductivity results and subsequently upon obtaining stabilized groundwater levels in the monitoring wells at these locations, it was determined that the infiltration testing results were not representative as the depths tested were below the groundwater level.

9.3 Hydraulic Conductivity Testing

Hydraulic conductivity testing (single well response slug tests) was conducted within BH/MW4 and BH/MW5 on November 2, 2021. For each of the slug tests, a non-vented pressure transducer programmed to record pressure at 10 second intervals was placed in the monitoring well and recorded the water level recovery. Manual water levels were measured in the monitoring well at the beginning, during, and end of each slug test to corroborate the transducer's pressure data, which provided a continuous record of the water level in the monitoring well during the test.

The hydraulic conductivity testing consisted of completing a rising head test in BH/MW4 and BH/MW5. The rising head tests were conducted by removing a volume of water over a short time period using a Waterra® inertial lift pump and allowing the water level to recover back to natural equilibrium.

The recovery data were analyzed using the Bouwer-Rice method (Bouwer & Rice, 1976) in AQTESOLV version 4.5. The software incorporates water level data collected during the hydraulic conductivity testing as well as monitoring well construction details in the estimation of the hydraulic conductivity of the screened soils. The results of the hydraulic conductivity testing are presented in Table 9-1 below.

Table 9-1: Hydraulic Conductivity Testing Results

Borehole No.	Test Type	Hydraulic Conductivity (m/s)	Screened Soil[1]
BH/MW4	Rising Head	2.7×10^{-8}	Silty Clay Till
BH/MW5	Rising Head	2.6×10^{-8}	Silty Clay Till

Notes: [1] From borehole logs.

The hydraulic conductivities estimated are 2.7×10^{-8} m/s at BH/MW4, and 2.6×10^{-8} at BH/MW5. It is noted that this hydraulic conductivity would be a measure of horizontal hydraulic conductivity. The full results of the analysis are found in Appendix E. The hydraulic conductivity results are within expected ranges of hydraulic conductivity values for the testing completed in the described screened soil conditions. The hydraulic conductivities are representative of the screened clayey soils. It should be noted that more or less permeable soils may be encountered during construction.

9.4 Hydrogeological Considerations

The findings of the geotechnical investigation and preliminary hydrogeological assessment indicates that a high groundwater table exists on the site, however the soils are generally silty clay till soils which will act as an aquitard. The presence of this high-water table will restrict the potential for low impact development (LID) measures to be utilized on the site. It may be possible for limited infiltration to occur at areas of higher elevation, however this is limited by the low hydraulic conductivity and thus low infiltration rate that would be expected.

For any excavation, either temporary or permanent as in the proposed dry pond, these excavations will receive a low rate of seepage from groundwater. Overtime the excavation would fill up to the normal groundwater level if the excavation does not have a free draining outlet and or is not pumped out. This low rate of seepage would not likely affect the function of the dry pond as the pond's volume would be significantly larger and the outlet would allow water to exit the pond quicker than the groundwater would seep into the pond.

It is noted that the proposed dry pond would result in a slight lowering of the groundwater levels in the vicinity of the pond. However due to the low hydraulic conductivity of the soils, this reduction would be limited to an area several meters surrounding the pond and normal groundwater level would be expected elsewhere unless effected by other conditions on the site.

10 Closure

Attached in Appendix F is a document prepared by the Geo-Professional Business Association (GBA) that provides important information regarding studies of the type performed. Also included in Appendix F is our Standard Limitations to Geotechnical Reports which is intended to clarify the scope and assumptions used in the preparation of this study.

We trust that this report is complete within our present terms of reference. If you have any questions, please do not hesitate to contact our office.

Yours very truly,

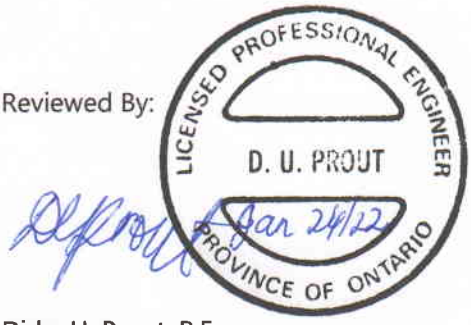
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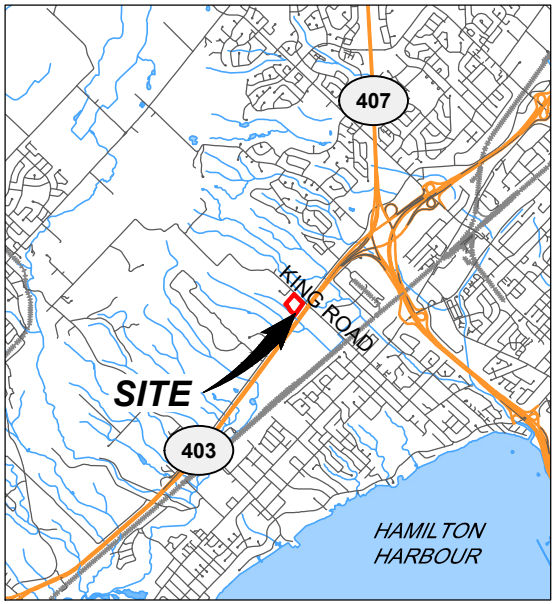
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Hydrogeologist-in-Training

SI/TW/TR/NS/DUP/si/tf/tr
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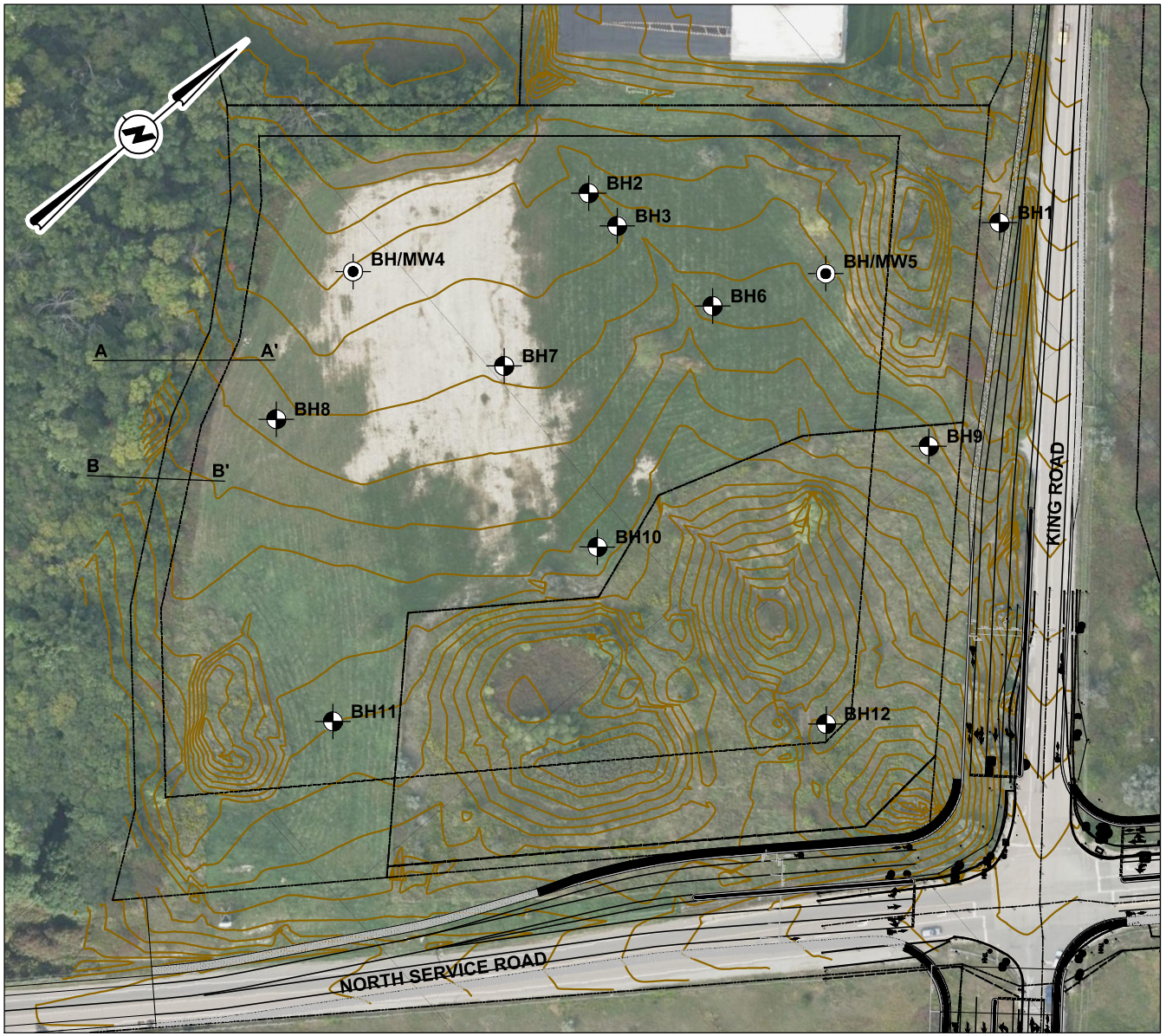
Figures



KEY PLAN

0 10 30 50m

SCALE 1:1,500



LEGEND:

- BOREHOLE LOCATION
- BOREHOLE/MONITORING WELL LOCATION

NOTES:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS REPORT No. WW21012079.

ALL LOCATIONS ARE APPROXIMATE ONLY.

REFERENCES:
BING IMAGERY AS OF NOVEMBER 22, 2021 (IMAGE DATE UNKNOWN), BING IMAGERY USED FOR ILLUSTRATION PURPOSES ONLY AND NOT TO BE USED FOR MEASUREMENTS.

CLIENT:
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DWN BY:	LMK
CHK'D BY:	TR
DATUM:	NAD83
PROJECTION:	UTM Zone 17
SCALE:	1:1,500

PROJECT:
SLOPE STABILITY
1450 KING ROAD
BURLINGTON, ONTARIO

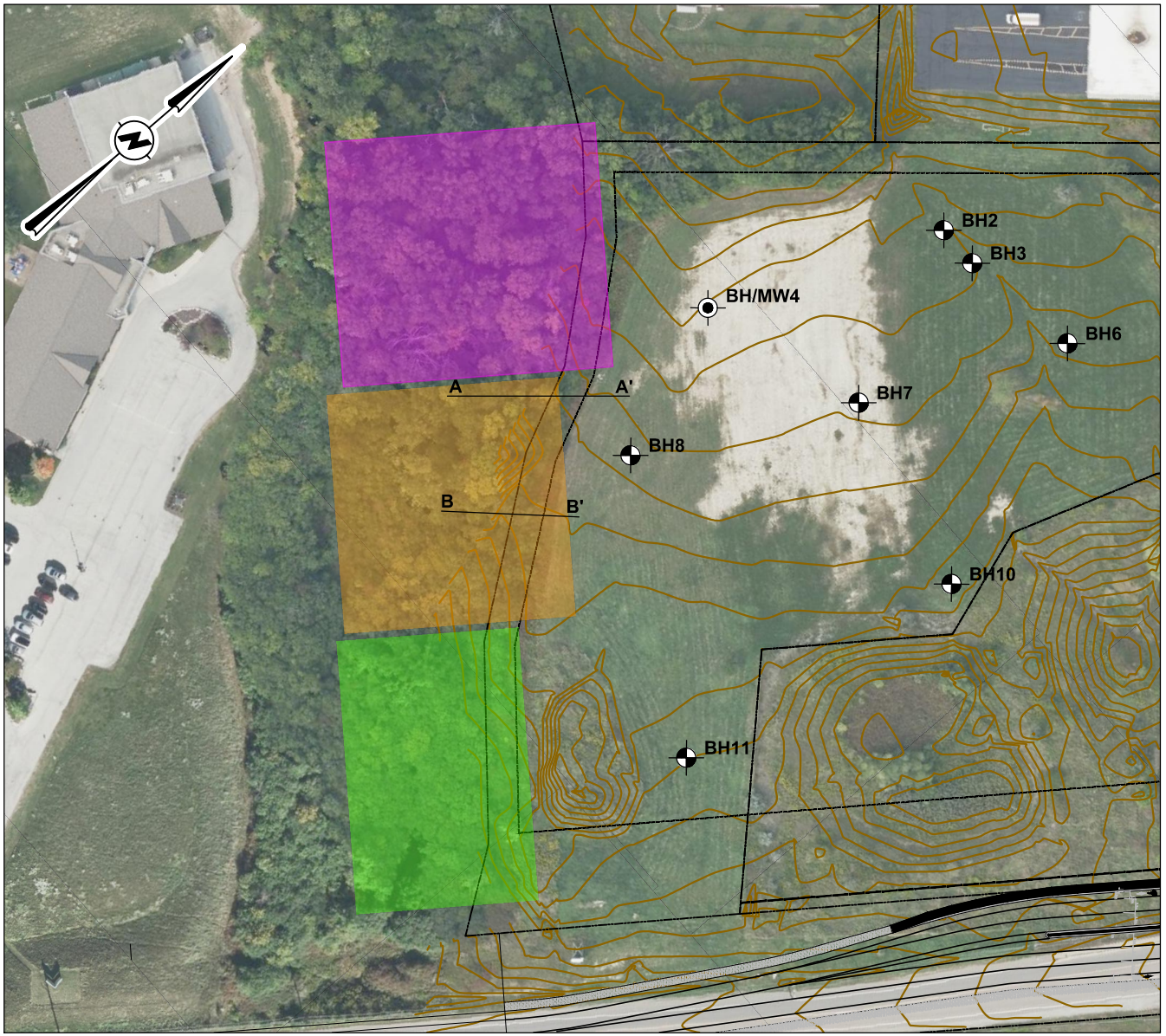
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BOREHOLE LOCATION PLAN

DATE:	NOV. 23, 2021
PROJECT No:	WW21012079
REV. No:	0
FIGURE No:	1

DATE PLOTTED: 11/23/2021 2:04:43 PM
FILE LOCATION: P:\2021\Projects\07 - GEOTECHNICAL\Other Offices\WW21012079.2\Drafting\AutoCAD\WW21012079.2-R01001.dwg

0 10 30 50m

SCALE 1:1,500



LEGEND:

- BOREHOLE LOCATION
- BOREHOLE/MONITORING WELL LOCATION
- AREA: A
- AREA: B
- AREA: C

NOTES:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS REPORT No. WW21012079.

ALL LOCATIONS ARE APPROXIMATE ONLY.

REFERENCES:
BING IMAGERY AS OF NOVEMBER 22, 2021 (IMAGE DATE UNKNOWN), BING IMAGERY USED FOR ILLUSTRATION PURPOSES ONLY AND NOT TO BE USED FOR MEASUREMENTS.

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DWN BY: LMK
CHK'D BY: TR
DATUM: NAD83
PROJECTION: UTM Zone 17
SCALE: 1:1500

PROJECT:
SLOPE STABILITY
1450 KING ROAD
BURLINGTON, ONTARIO

TITLE:
SLOPE STABILITY SECTION

DATE: NOV. 23, 2021
PROJECT No: WW21012079
REV. No: 0
FIGURE No: 2

DATE PLOTTED: 11/23/2021 1:58:05 PM
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Appendix A

EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

SOIL LITHOLOGY

Elevation and Depth

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

Lithology Plot

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

Description

This column gives a description of the soil stratums, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the *Modified Unified Soil Classification System* (modified slightly so that an inorganic clay of "medium plasticity" is recognized).

The compactness condition of cohesionless soils based on standard penetration testing (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows *(Ref. Canadian Foundation Engineering Manual, 4th Edition, 2006)*:

Compactness of Cohesionless Soils	SPT N-Value
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

Consistency of Cohesive Soils	Unconfined Compressive Strength	
	kPa	psf
Very Soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	> 200	> 4000

SOIL SAMPLING

Sample types are abbreviated as follows:

SS	Split Spoon	TW	Thin Walled Open (Pushed)	RC	Rock Core	GS	Grab Sample
AS	Auger Sample	TP	Thin Walled Piston (Pushed)	WS	Washed Sample	AR	Air Return Sample

Additional information provided in this section includes sample numbering, sample recovery (%) and numerical testing results (SPT).

FIELD AND LABORATORY SAMPLING

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

Definitions of Penetration Resistance

Standard penetration resistance 'N' – The number of blows required to advance a standard split spoon sampler 30 cm into the subsoil, driven by means of a 63.5 kg hammer falling freely a distance of 76 cm.

Dynamic penetration resistance – The number of blows required to advance a 50 mm, 60 degree cone, fitted to the end of drill rods, 30 cm into the subsoil, the driving energy being 474.5 Joules per blow.

INSTRUMENTATION INSTALLATION

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section.

WATER LEVEL

Water levels, if measured during fieldwork, are plotted in the depth/elevation column. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors. Other information includes the depth of borehole cave-in, if any. This information is also included in the borehole log footer.

COMMENTS

This column is used to describe non-standard situations or notes of interest.

MODIFIED* UNIFIED SOIL CLASSIFICATION SYSTEM

*The soil of each stratum is described using the Unified Soil Classification System (Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S Army. Vol. 1, March 1953) modified slightly so that an inorganic clay of "medium plasticity" is recognized.

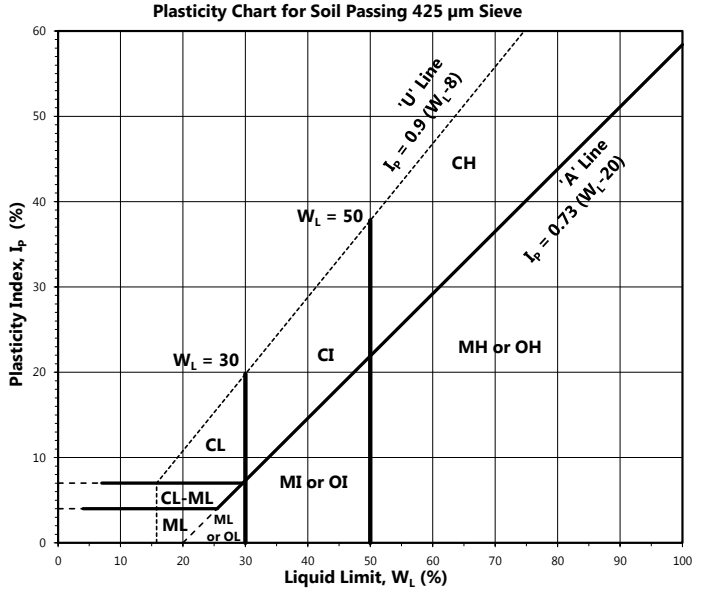
MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR I_P LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE OR I_P MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (TRACE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			SP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR I_P LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE OR I_P MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		W_L > 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 30%	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		30% < W_L < 50%	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		W_L > 50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SLTS & CLAYS BELOW "A" LINE	W_L < 50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", e.g. SF IS A MIXTURE OF SAND WITH SILT OR CLAY
		W_L > 50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGH ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE

SOIL COMPONENTS

FRACTION	U.S STANDARD SIEVE SIZE			DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		PASSING	RETAINED	PERCENT	DESCRIPTOR
GRAVEL	COARSE	75 mm	19 mm	35 - 50	AND
	FINE	19 mm	4.75 mm	20 - 35	Y/EY
SAND	COARSE	4.75 mm	2.00 mm	10 - 20	SOME
	MEDIUM	2.00 mm	425 µm	1 - 10	TRACE
	FINE	425 µm	75 µm		
FINES (SILT AND CLAY BASED ON PLASTICITY)		75 µm			

OVERSIZED MATERIAL

ROUNDED OR SUBROUNDED:	NOT ROUNDED:
COBBLES 75 mm to 300 mm	ROCK FRAGMENTS > 75 mm
BOULDERS > 300 mm	ROCKS > 0.76 CUBIC METRE IN VOLUME



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MODIFIED USCS

Note 1: Soils are classified and described according to their engineering properties and behaviour.
Note 2: The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual (4th Edition, Canadian Geotechnical Society, 2006.)

Rev Date: January 7, 2019

RECORD OF BOREHOLE No. BH1

Project Number: **WW21012079.2000**
Drilling Location: **E: 593674.3 N: 4798114.6**
Project Client: **Quantum Realty Management**
Drilling Method: **150 mm Solid Stem Augers**
Project Name: **1450 King Road Geotechnical Investigation**
Drilling Machine: **Track Mounted Drill**
Project Location: **1450 King Road, Burlington**
Date Started: **Sep 24, 21** Date Completed: **Sep 24, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 123.6 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT □ PPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading: □ COV (LEL) ■ TOV (LEL) 2 4 6 8; △ COV (ppm) ▲ TOV (ppm) 100 200 300 400; W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	GR SA SI CL
	TOPSOIL 150 mm	123.5 0.2										
	Light Brown Silty Clay **FILL** Trace sand, gravel & brick Moist		SS	1	0	10			○			
							1	123				
		122.6	SS	2	75	10			○	17		
	Brown **Silty Clay Till** Some sand, trace gravel Stiff to Hard DTPL	1.1						122				DTPL- Drier than plastic limit APL- Around plastic limit WTPL- Wetter than plastic limit
			SS	3	96	32	2		○	18		
			SS	4	92	39		121	○	19		
							3					
			SS	5	100	31			○	18		
								120				
			SS	6	100	37	4		○	15		
		119.1										
	Grey	4.5						119				
			SS	7	100	31	5		○	16		
		118.5										
	Borehole Terminated	5.2										

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH2

Project Number: **WW21012079.2000**
Drilling Location: **E: 593607.5 N: 4798048.0**
Project Client: **Quantum Realty Management**
Drilling Method: **150 mm Solid Stem Augers**
Project Name: **1450 King Road Geotechnical Investigation**
Drilling Machine: **Track Mounted Drill**
Project Location: **1450 King Road, Burlington**
Date Started: **Sep 28, 21** Date Completed: **Sep 28, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

Lithology Plot	DESCRIPTION (Geodetic Ground Surface Elevation: 122.2 m)	Elev.	Depth	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	Field Testing	Lab Testing	Instrumentation / Installation
	TOPSOIL 175 mm	122.0	0.0							
	Light Brown Clayey Silt **FILL** Trace sand & gravel Stiff Moist	121.8	0.2	SS	1	100	9		18	
				SS	2	100	14		13	
		120.2	2.0	SS	3	100	13		20	
	Mottled Brown **Silty Clay** Trace sand and gravel Stiff DTPL	119.2	3.0	SS	4	100	8		20	
	Brown **Silty Clay Till** Trace sand and gravel Very Stiff DTPL	118.4	3.7	SS	5	67	19		15	
	Hard	117.7	4.5	SS	6	100	32		16	
	Very Stiff	117.0	5.2	SS	7	100	27		13	
	Borehole Terminated									

Field Testing: Penetration Testing — ○ SPT □ PPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80

Lab Testing: Soil Vapour Reading — □ COV (LEL) ■ TOV (LEL) 2 4 6 8; △ COV (ppm) ▲ TOV (ppm) 100 200 300 400; W_P W W_L; Plastic Liquid; 20 40 60 80

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

DTPL- Drier than plastic limit
APL- Around plastic limit
WTPL- Wetter than plastic limit

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

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Scale: 1 : 47

RECORD OF BOREHOLE No. BH3

Project Number: **WW21012079.2000** Drilling Location: **E: 593617.4 N: 4798048.0**

Project Client: **Quantum Realty Management** Drilling Method: **150 mm Solid Stem Augers**

Project Name: **1450 King Road Geotechnical Investigation** Drilling Machine: **Track Mounted Drill**

Project Location: **1450 King Road, Burlington** Date Started: **Sep 28, 21** Date Completed: **Sep 28, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 121.5 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT □ PPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading: □ COV (LEL) ■ TOV (LEL) 2 4 6 8; △ COV (ppm) ▲ TOV (ppm) 100 200 300 400; W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	TOPSOIL 150 mm	121.4 0.2										
	Light Brown / Grey Silt **FILL** Some Clay & sand Moist	120.9	SS	1	100	7		121	○	○ 14		
	Mottled Brown **Silty Clay** Trace sand & gravel Very Stiff DTPL	0.7	SS	2	100	19	1		○	○ 17		
			SS	3	100	16	2	120	○	○ 25		DTPL- Drier than plastic limit APL- Around plastic limit WTPL- Wetter than plastic limit
	Brown **Silty Clay Till** Some sand, trace gravel Hard DTPL	119.3 2.2	SS	4	100	32		119	○	○ 14		GR 5 SA 14 SI 40 CL 41
			SS	5	100	30	3		○	○ 14		
	Very Stiff	117.8 3.7	SS	6	100	22	4	118	○	○ 15		
			SS	7	100	28	5	117	○	○ 16		
	Borehole Terminated	116.4 5.2										

▽ No freestanding groundwater observed in open borehole upon completion of drilling.

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Scale: 1 : 47

RECORD OF BOREHOLE No. BH4

Project Number:	WW21012079.2000	Drilling Location:	E: 593585.6 N: 4797995.4
Project Client:	Quantum Realty Management	Drilling Method:	150 mm Solid Stem Augers
Project Name:	1450 King Road Geotechnical Investigation	Drilling Machine:	Track Mounted Drill
Project Location:	1450 King Road, Burlington	Date Started: Sep 28, 21	Date Completed: Sep 28, 21

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LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 121.8 m	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing: SPT, PPT, DCPT; MTO Vane* Intact/Remould; Nilcon Vane* Intact/Remould; * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading: COV (LEL), TOV (LEL) 2 4 6 8; COV (ppm), TOV (ppm) 100 200 300 400; W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	GR	SA	SI	CL
	Brown **Silty Clay** Some sand, trace gravel Very Stiff DTPL	SS	1	96	23			16						
		SS	2	100	29	1	121	17			0	11	42	47
	120.4 Brown **Silty Clay Till** Some sand, trace gravel Hard DTPL	SS	3	100	34	2	120	16						
	119.6 Very Stiff	SS	4	100	25		119	20						
		SS	5	100	29	3		14						
		SS	6	100	23	4	118	15						
		SS	7	100	24	5	117	16						
	116.7 **Borehole Terminated** 5.2													

DTPL- Drier than plastic limit
APL- Around plastic limit
WTPL- Wetter than plastic limit

Water level measurements in 50 mm dia. deep monitoring well: (screen from 3.7 m to 5.2 m)

Date	Depth (m)	Elevation (m)
10/27/2021	0.5	121.3
11/02/2021	0.56	121.2
11/05/2021	0.73	121.1

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

▼ Groundwater depth observed on October 27, 2021 at a depth of: 0.5 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. BH5

Project Number:	WW21012079.2000	Drilling Location:	E: 593657.0 N: 4798076.9
Project Client:	Quantum Realty Management	Drilling Method:	150 mm Solid Stem Augers
Project Name:	1450 King Road Geotechnical Investigation	Drilling Machine:	Track Mounted Drill
Project Location:	1450 King Road, Burlington	Date Started: Sep 28, 21	Date Completed: Sep 28, 21

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Geodetic Ground Surface Elevation: 121.1 m

Depth (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	Elevation (m)	Field Testing (Penetration Testing: SPT, PPT, DCPT; MTO Vane* Intact/Remould; Nilcon Vane* Intact/Remould; * Undrained Shear Strength (kPa) 20 40 60 80)	Lab Testing (Soil Vapour Reading: COV (LEL), TOV (LEL); COV (ppm), TOV (ppm); W_P, W, W_L; Plastic, Liquid)	Instrumentation Installation	Comments & Grain Size Distribution (%) GR SA SI CL
	TOPSOIL 175 mm					120.9				
0.2	Reddish Brown Clayey Silt **FILL** Trace sand Moist	SS	1	75	9			22		
0.7	Brown **Silty Clay Till** Some sand, trace gravel Very Stiff DTPL	SS	2	92	22	120		18		DTPL- Drier than plastic limit APL- Around plastic limit WTPL- Wetter than plastic limit
1.4	Hard	SS	3	100	36	119		13		3 11 41 45
2.2	Very Stiff	SS	4	100	27			15		
		SS	5	100	25	118		15		
		SS	6	100	17	117		17		
4.5	Stiff APL	SS	7	100	14			17		
5.2	**Borehole Terminated**					116				

Water level measurements in 50 mm dia. deep monitoring well: (screen from 3.7 m to 5.2 m)

Date	Depth (m)	Elevation (m)
10/27/2021	1.0	120.1
11/02/2021	1.25	119.9
11/05/2021	1.55	119.6

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

▼ Groundwater depth observed on October 27, 2021 at a depth of: 1.0 m.

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RECORD OF BOREHOLE No. BH6

Project Number: **WW21012079.2000**
Drilling Location: **E: 593645.6 N: 4798052.5**
Project Client: **Quantum Realty Management**
Drilling Method: **150 mm Solid Stem Augers**
Project Name: **1450 King Road Geotechnical Investigation**
Drilling Machine: **Track Mounted Drill**
Project Location: **1450 King Road, Burlington**
Date Started: **Sep 28, 21** Date Completed: **Sep 28, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

Geodetic Ground Surface Elevation: 120.7 m

Lithology Plot	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Undrained Shear Strength (kPa)	LAB TESTING: Soil Vapour Reading / Plastic & Liquid	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	TOPSOIL 175 mm	120.6 / 0.2										GR SA SI CL
	Reddish Brown Clayey Silt **FILL** Trace sand Moist		SS	1	75	7				15		
		120.1 / 0.7						120				
	Brown **Silty Clay** Some sand, trace gravel Stiff DTPL		SS	2	100	12	1			16		
		119.3 / 1.4						119				DTPL- Drier than plastic limit APL- Around plastic limit WTPL- Wetter than plastic limit
	Brown **Silty Clay Till** Some sand, trace gravel Very Stiff DTPL		SS	3	75	17	2			17		
		118.5 / 2.2						118				
	Stiff		SS	4	83	8	3			18		
			SS	5	92	9		117		21		
		116.6 / 4.1					4					
	Very Stiff		SS	6	100	18	5	116		16		
		115.6 / 5.2										
	Borehole Terminated											

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

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RECORD OF BOREHOLE No. BH7

Project Number: **WW21012079.2000** Drilling Location: **E: 593624.7 N: 4798007.4**

Project Client: **Quantum Realty Management** Drilling Method: **150 mm Solid Stem Augers**

Project Name: **1450 King Road Geotechnical Investigation** Drilling Machine: **Track Mounted Drill**

Project Location: **1450 King Road, Burlington** Date Started: **Sep 24, 21** Date Completed: **Sep 24, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

Geodetic Ground Surface Elevation: 121.0 m

Depth (m)	Description	Elevation (m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	Field Testing: Penetration Testing (SPT ○ / PPT □ / DCPT ●)	Field Testing: MTO Vane* (△ Intact / ▲ Remould)	Field Testing: Nilcon Vane* (◇ Intact / ◆ Remould)	Lab Testing: Soil Vapour Reading COV (LEL) □ / TOV (LEL) ■	Lab Testing: COV (ppm) △ / TOV (ppm) ▲	Lab Testing: W_P / W / W_L (Plastic / Liquid)	Instrumentation Installation	Comments & Grain Size Distribution (%) GR SA SI CL
0.0	Brown Clayey Silt **FILL** Trace sand Moist	120.8												
0.2			SS	1	83	18						17		
	Brown **Silty Clay Till** Trace sand & gravel Very Stiff DTPL													
1		120	SS	2	88	29						16		
2		119	SS	3	100	28						22		DTPL- Drier than plastic limit APL- Around plastic limit WTPL- Wetter than plastic limit
			SS	4	100	16						22		
3.0	Stiff APL	118.0												
3		118	SS	5	100	13						26		
3.7	DTPL	117.2												
4		117	SS	6	100	13						14		
			SS	7	100	13						19		
5		116												
5.2	**Borehole Terminated**	115.8												

▽ No freestanding groundwater observed in open borehole upon completion of drilling.

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RECORD OF BOREHOLE No. BH8

Project Number: **WW21012079.2000** Drilling Location: **E: 593599.7 N: 4797960.0**

Project Client: **Quantum Realty Management** Drilling Method: **150 mm Solid Stem Augers**

Project Name: **1450 King Road Geotechnical Investigation** Drilling Machine: **Track Mounted Drill**

Project Location: **1450 King Road, Burlington** Date Started: **Sep 24, 21** Date Completed: **Sep 24, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 120.8 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT □ PPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading: □ COV (LEL) ■ TOV (LEL) 2 4 6 8; △ COV (ppm) ▲ TOV (ppm) 100 200 300 400; W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	GR SA SI CL
	TOPSOIL 175 mm	120.6 120.8										
	Brown Clayey Silt **FILL** Some rootlets, trace sand	0.3	SS	1	75	11			○	17		
	Brown **Silty Clay Till** Some sand, trace gravel Hard DTPL		SS	2	92	34	1	120	○	15		
			SS	3	100	37	2	119	○	15		DTPL- Drier than plastic limit APL- Around plastic limit WTPL- Wetter than plastic limit
			SS	4	100	32		118	○	20		
			SS	5	88	34	3		○	14		
			SS	6	100	30	4	117	○	15		
			SS	7	100	33	5	116	○	17		
	Borehole Terminated	115.6 5.2										

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

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RECORD OF BOREHOLE No. BH9

Project Number: **WW21012079.2000**
Drilling Location: **E: 593702.3 N: 4798068.8**
Project Client: **Quantum Realty Management**
Drilling Method: **150 mm Solid Stem Augers**
Project Name: **1450 King Road Geotechnical Investigation**
Drilling Machine: **Track Mounted Drill**
Project Location: **1450 King Road, Burlington**
Date Started: **Sep 24, 21** Date Completed: **Sep 24, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 120.2 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT □ PPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading: □ COV (LEL) ■ TOV (LEL) 2 4 6 8; △ COV (ppm) ▲ TOV (ppm) 100 200 300 400; W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	GR SA SI CL
	TOPSOIL 200 mm	120.0										
	Brown Clayey Silt **FILL** Trace sand & gravel Moist	0.2	SS	1	63	9		120	○	19		
		119.5										
	Brown **Silty Clay Till** Some sand, trace gravel Hard DTPL	0.7	SS	2	100	32	1	119	○	15		
		118.8										
	Hard to very Stiff	1.4	SS	3	83	30	2	118	○	15		DTPL- Drier than plastic limit APL- Around plastic limit WTPL- Wetter than plastic limit
			SS	4	100	24			○	14		
			SS	5	100	24	3	117	○	14		
		116.5										
	Grey	3.7	SS	6	63	21	4	116	○	13		
			SS	7	100	21	5		○	19		
		115.0										
	Borehole Terminated	5.2										

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

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RECORD OF BOREHOLE No. BH10

Project Number: **WW21012079.2000**
Drilling Location: **E: 593670.0 N: 4797996.4**
Project Client: **Quantum Realty Management**
Drilling Method: **150 mm Solid Stem Augers**
Project Name: **1450 King Road Geotechnical Investigation**
Drilling Machine: **Track Mounted Drill**
Project Location: **1450 King Road, Burlington**
Date Started: **Sep 24, 21** Date Completed: **Sep 24, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 119.4 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT □ PPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading: □ COV (LEL) ■ TOV (LEL) 2 4 6 8; △ COV (ppm) ▲ TOV (ppm) 100 200 300 400; W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	GR	SA	SI	CL
	TOPSOIL 230 mm	119.2													
	Brown **Silty Clay Till** Some sand, trace gravel	0.2	SS	1	75	8		119	○	17					
	DTPL	118.7													
	Hard	0.7	SS	2	92	35	1		○	17		1	10	39	50
		118.0						118							
	Very Stiff	1.4	SS	3	92	20	2		○	20					
			SS	4	100	22		117	○	15					
			SS	5	100	26	3	116	○	16					
			SS	6	100	21	4		○	14					
		114.9						115							
	Grey Stiff	4.5	SS	7	100	13	5		○	15					
		114.2													
	Borehole Terminated	5.2													

DTPL- Drier than plastic limit
APL- Around plastic limit
WTPL- Wetter than plastic limit

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

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RECORD OF BOREHOLE No. BH11

Project Number: **WW21012079.2000**
Drilling Location: **E: 593660.5 N: 4797924.4**
Project Client: **Quantum Realty Management**
Drilling Method: **150 mm Solid Stem Augers**
Project Name: **1450 King Road Geotechnical Investigation**
Drilling Machine: **Track Mounted Drill**
Project Location: **1450 King Road, Burlington**
Date Started: **Sep 24, 21** Date Completed: **Sep 24, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

LITHOLOGY PROFILE			SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION Geodetic Ground Surface Elevation: 118.5 m		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing: ○ SPT □ PPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading: □ COV (LEL) ■ TOV (LEL) 2 4 6 8; △ COV (ppm) ▲ TOV (ppm) 100 200 300 400; W_P W W_L Plastic Liquid 20 40 60 80	INSTRUMENTATION INSTALLATION	GR SA SI CL
	TOPSOIL 175 mm	118.4 0.2										
	Reddish Brown Clayey Silt **FILL** Trace sand, gravel Moist		SS	1	67	7			○	22		
		117.8						118				
	Mottled Brown **Silty Clay** Trace sand Very Stiff DTPL	0.7	SS	2	83	17	1		○	14		
		117.1						117				
	Brown **Silty Clay Till** Trace sand & gravel Very Stiff DTPL	1.4	SS	3	92	27	2		○	15		DTPL- Drier than plastic limit APL- Around plastic limit WTPL- Wetter than plastic limit
		116.3						116				
	Hard	2.2	SS	4	100	36			○	18		
		115.6					3					
	Very Stiff	3.0	SS	5	92	25		115	○	17		
		114.8										
	Grey	3.7	SS	6	100	22	4		○	14		
								114				
			SS	7	100	16	5		○	15		
		113.4										
	Borehole Terminated	5.2										

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

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RECORD OF BOREHOLE No. BH12

Project Number: **WW21012079.2000** Drilling Location: **E: 593734.9 N: 4798009.4**

Project Client: **Quantum Realty Management** Drilling Method: **150 mm Solid Stem Augers**

Project Name: **1450 King Road Geotechnical Investigation** Drilling Machine: **Track Mounted Drill**

Project Location: **1450 King Road, Burlington** Date Started: **Sep 24, 21** Date Completed: **Sep 24, 21**

Logged by: Compiled by: **TH** Reviewed by: **TR** Revision No.: **0, 12/3/21**

Geodetic Ground Surface Elevation: 116.7 m

Depth (m)	Description	Elevation (m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	Field Testing: Undrained Shear Strength (kPa)	Lab Testing: Plastic / Liquid
0.2	**TOPSOIL** 150 mm	116.5						
	Brown Silty Clay **FILL** Trace sand & gravel Firm to stiff DTPL		SS	1	63	5		26
1		116	SS	2	50	6		18
2		115	SS	3	71	13		17
2.2		114.5						
	Very Stiff		SS	4	83	16		4
3.0		113.7						
	Firm		SS	5	50	8		18
3.7		113.0						
	Brown **Silty Clay Till** Trace sand and gravel Very Stiff DTPL		SS	6	100	21		15
4		112	SS	7	100	23		15
5.2	**Borehole Terminated**	111.5						

DTPL- Drier than plastic limit
APL- Around plastic limit
WTPL- Wetter than plastic limit

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▽ No freestanding groundwater observed in open borehole upon completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying'Explanation of Borehole Log'.

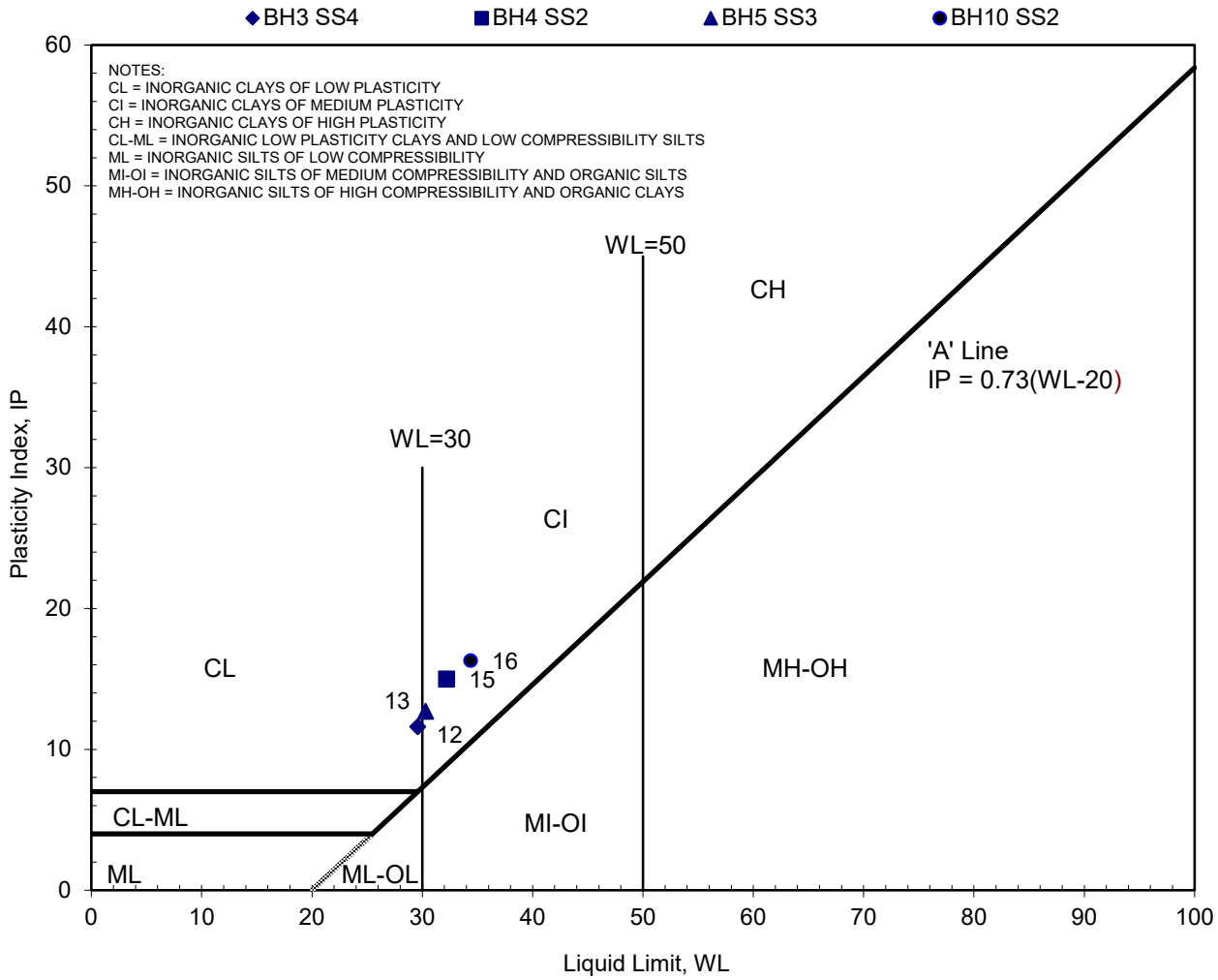
Appendix B

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOIL
LS 703/704

Client:	Quantum Realty Management	**Project No.:**	WW21012079
Sample Location:	1450 King Road, Burlington	**Date Tested:**	16-Oct-21
Sample Type:	Boreholes	**Tested By:**	KH

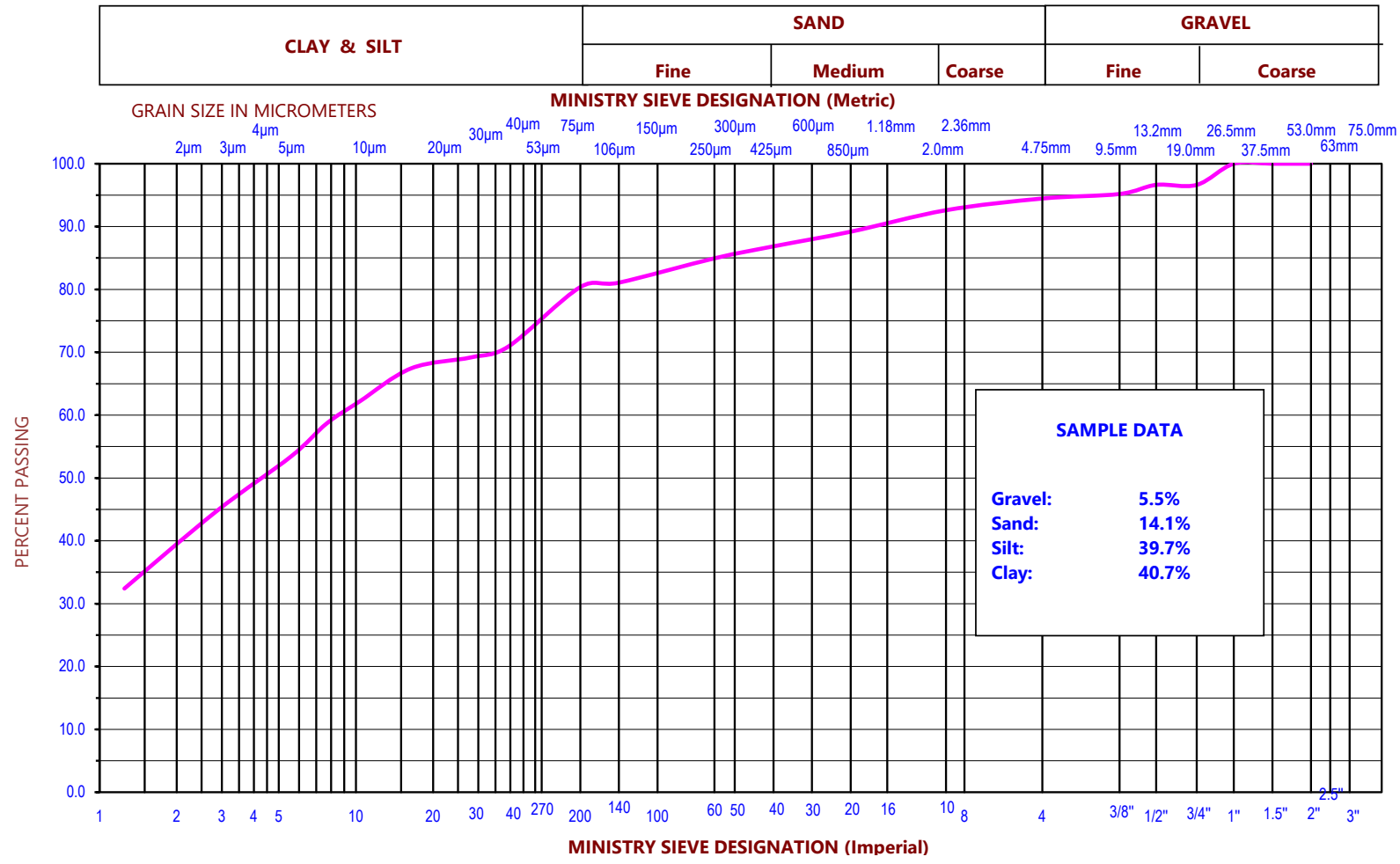
TEST RESULTS

Borehole No.	BH3	BH4	BH5	BH10
Sample No.	SS4	SS2	SS3	SS2
Depth				
Liquid Limit	30	32	30	34
Plastic Limit	18	17	18	18
Plasticity Index	12	15	13	16
Soil Classification	CI	CI	CI	CI
Natural Moiture Content %				



UNIFIED SOIL CLASSIFICATION SYSTEM

Determination of Particle Size Analysis of Soils LS 702

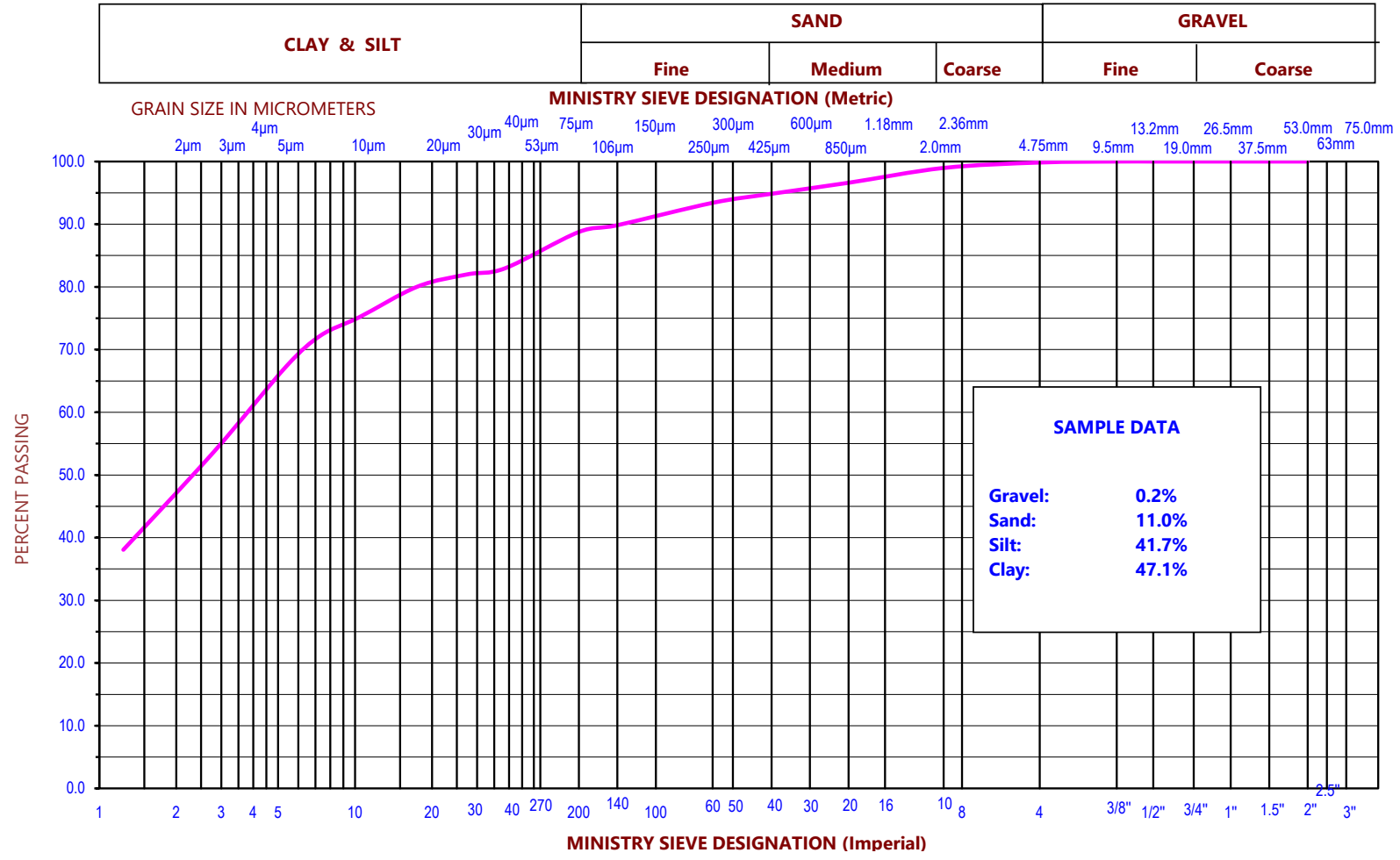


Sieve size (mm)	% Passing
53	100
37.5	100.0
26.5	100.0
19	96.6
13.2	96.6
9.5	95.2
4.75	94.5
2.00	92.6
0.85	89.2
0.425	86.9
0.250	84.9
0.106	81.1
0.075	80.4
0.0394	70.9
0.0282	69.2
0.0164	67.4
0.0103	62.2
0.0077	58.7
0.0056	53.4
0.0028	44.7
0.0013	32.4

Client:	Quantum Realty Management	**GRAIN SIZE DISTRIBUTION**	**Sample No.:**	S293-21
Job No.:	WW21012079	BH3 - SS4	**Tested By:**	HA
Date Received:	1 October 2021	**Silty Clay, some Sand, trace Gravel**	**Report Date:**	19 October 2021

UNIFIED SOIL CLASSIFICATION SYSTEM

Determination of Particle Size Analysis of Soils LS 702

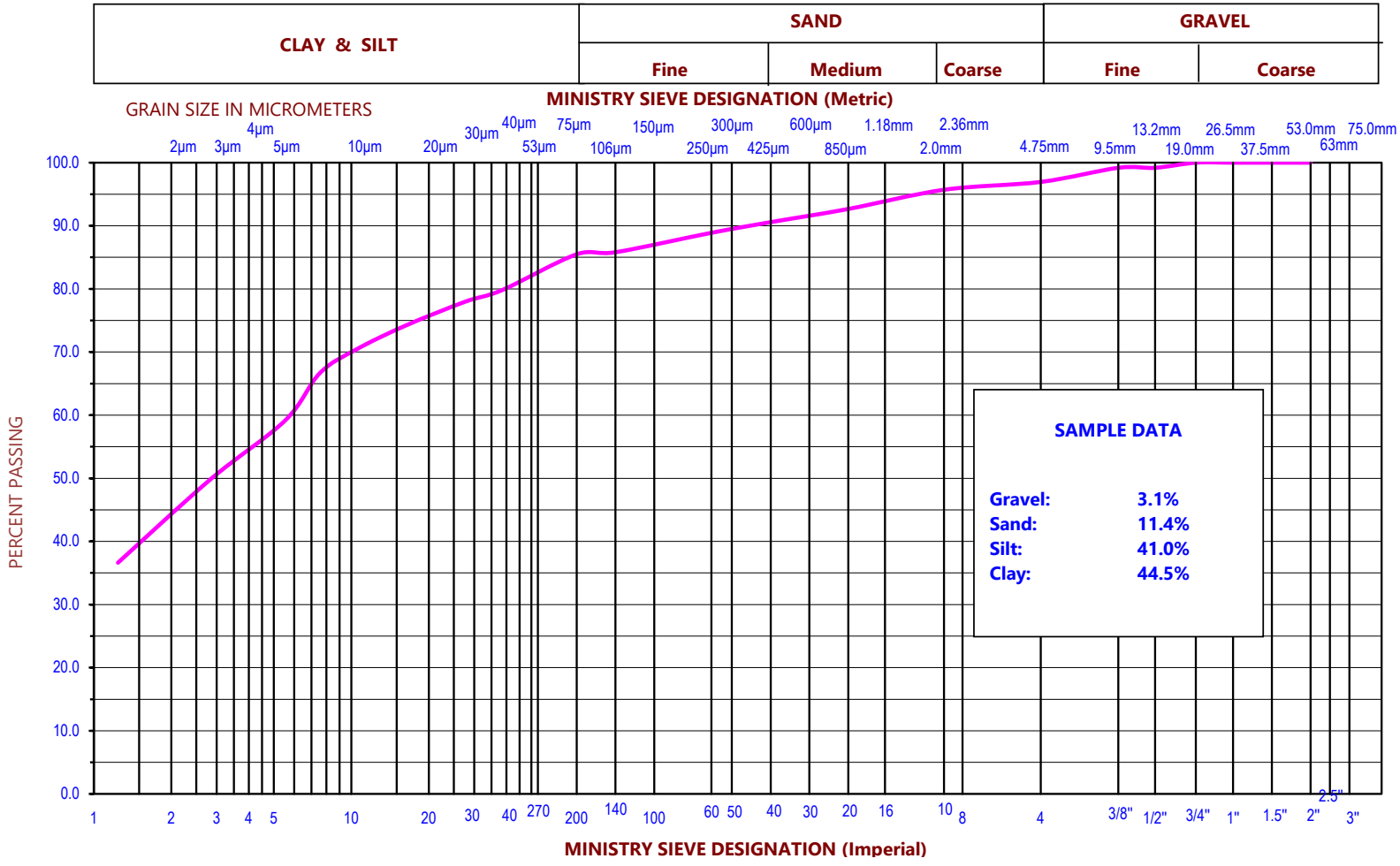


Sieve size (mm)	% Passing
53	100
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	99.8
2.00	99.0
0.85	96.6
0.425	94.9
0.250	93.4
0.106	89.8
0.075	88.8
0.0386	83.0
0.0274	82.0
0.0175	80.0
0.0104	75.2
0.0073	72.2
0.0054	67.4
0.0028	53.7
0.0012	38.1

Client:	Quantum Realty Management	**GRAIN SIZE DISTRIBUTION**	**Sample No.:**	S294-21
Job No.:	WW21012079	BH4 - SS2	**Tested By:**	HA
Date Received:	1 October 2021	**Silty Clay, some Sand, trace Gravel**	**Report Date:**	19 October 2021

UNIFIED SOIL CLASSIFICATION SYSTEM

Determination of Particle Size Analysis of Soils LS 702

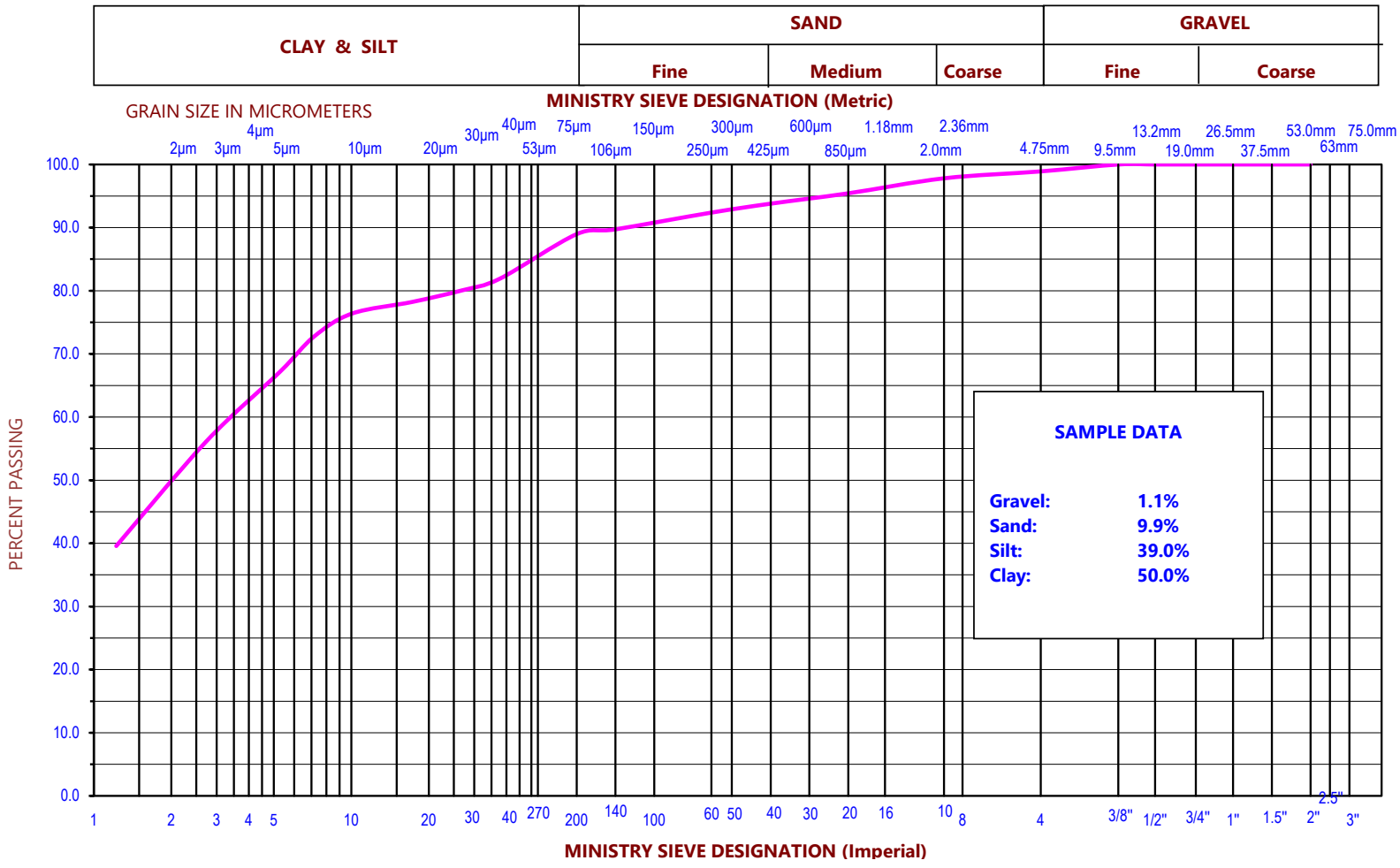


Sieve size (mm)	% Passing
53	100
37.5	100.0
26.5	100.0
19	100.0
13.2	99.2
9.5	99.2
4.75	96.9
2.00	95.7
0.85	92.7
0.425	90.6
0.250	88.9
0.106	85.8
0.075	85.5
0.0386	79.8
0.0276	77.9
0.0163	74.2
0.0105	70.4
0.0076	66.7
0.0055	59.2
0.0028	49.8
0.0012	36.6

Client:	Quantum Realty Management	**GRAIN SIZE DISTRIBUTION**	**Sample No.:**	S295-21
Job No.:	WW21012079	BH5-SS3	**Tested By:**	HA
Date Received:	1 October 2021	**Silty Clay, some Sand, trace Gravel**	**Report Date:**	19 October 2021

UNIFIED SOIL CLASSIFICATION SYSTEM

Determination of Particle Size Analysis of Soils LS 702



Sieve size (mm)	% Passing
53	100
37.5	100.0
26.5	100.0
19	100.0
13.2	100.0
9.5	100.0
4.75	98.9
2.00	97.8
0.85	95.4
0.425	93.8
0.250	92.4
0.106	89.7
0.075	89.0
0.0377	81.9
0.0270	80.1
0.0172	78.2
0.0101	76.4
0.0071	72.7
0.0053	67.2
0.0027	56.1
0.0012	39.6

Client:	Quantum Realty Management	**GRAIN SIZE DISTRIBUTION**	**Sample No.:**	S296-21
Job No.:	WW21012079	BH10 - SS2	**Tested By:**	HA
Date Received:	1 October 2021	**Silty Clay, trace Gravel & Sand**	**Report Date:**	19 October 2021

Appendix C

SLOPE STABILITY RATING CHART

Job Number:	WW21012079
Site Location:	1450 King Road - Area 'A' and 'C'
Property Owner:	Quantum Realty Management
Inspection By:	Thomas Ring
Inspection Date:	27-Aug-21
Weather:	Partly Cloudy, 23^{o}C

	RATING
1. SLOPE INCLINATION	
2H:1V to 3H:1V	6
2. SOIL STRATIGRAPHY	
Glacial Till	9
3. SEEPAGE FROM THE FACE	
None or Near bottom only	0
4. SLOPE HEIGHT	
2.1 to 5 m	2
5. VEGETATION COVER ON SLOPE FACE	
Well vegetated; heavy shrubs or forested with mature trees	0
6. TABLE LAND DRAINAGE	
Table land flat, no apparent drainage over slope	0
7. PROXIMITY OF WATERCOURSE TO SLOPE TOE	
Less than 15 metres from slope toe	6
8. PREVIOUS LANDSLIDE ACTIVITY	
No	0
Total	23

Rating	Instability Potential	Investigation Requirements
0-24	Low	Site inspection only, confirmation, report letter.
25-35	Slight	Site inspection and surveying, preliminary study, detailed report.
>35	Moderate	Boreholes, piezometers, lab tests, surveying, detailed report.

Additonal Remarks:
The instability rating for Areas 'A' and 'C' is low.
No further investigation is required beyond site inspection.

Rating as per Table 4.2 from the MNR Techncial Guide - River and Stream Systems: Erosion Hazard Limit (2002)

DRAFT

SLOPE STABILITY RATING CHART

Job Number:	WW21012079
Site Location:	1450 King Road - Area B
Property Owner:	Quantum Realty Management
Inspection By:	Thomas Ring
Inspection Date:	27-Aug-21
Weather:	Partly Cloudy, 23^{o}C

	RATING
1. SLOPE INCLINATION	
steeper than 2H:1V	16
2. SOIL STRATIGRAPHY	
Glacial Till	9
3. SEEPAGE FROM THE FACE	
None or Near bottom only	0
4. SLOPE HEIGHT	
5.1 to 10 m	4
5. VEGETATION COVER ON SLOPE FACE	
Well vegetated; heavy shrubs or forested with mature trees	0
6. TABLE LAND DRAINAGE	
Table land flat, no apparent drainage over slope	0
7. PROXIMITY OF WATERCOURSE TO SLOPE TOE	
Less than 15 metres from slope toe	6
8. PREVIOUS LANDSLIDE ACTIVITY	
No	0
Total	35

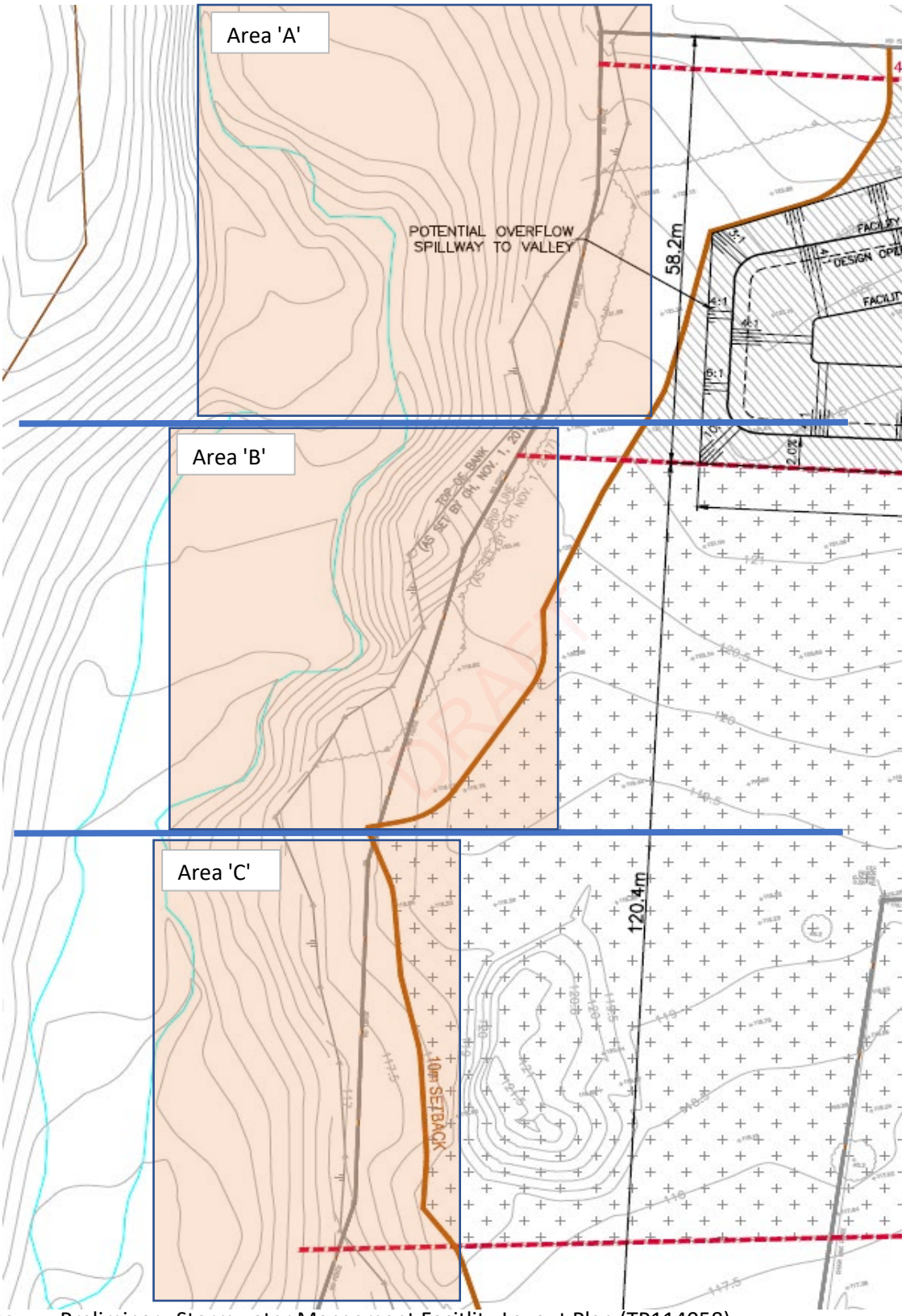
Rating	Instability Potential	Investigation Requirements
0-24	Low	Site inspection only, confirmation, report letter.
25-35	Slight	Site inspection and surveying, preliminary study, detailed report.
>35	Moderate	Boreholes, piezometers, lab tests, surveying, detailed report.

Additonal Remarks:
The instability potential for Area 'B' is slight.
In addition to the slope inspection, a survey and preliminary stability analysis is required.
Localized toe erosion was noted within Area 'B'

Rating as per Table 4.2 from the MNR Techncial Guide - River and Stream Systems: Erosion Hazard Limit (2002)

DRAFT

Topography



Source: Preliminary Stormwater Mangement Facitlity Layout Plan (TP114058)

Site Photo - Area A





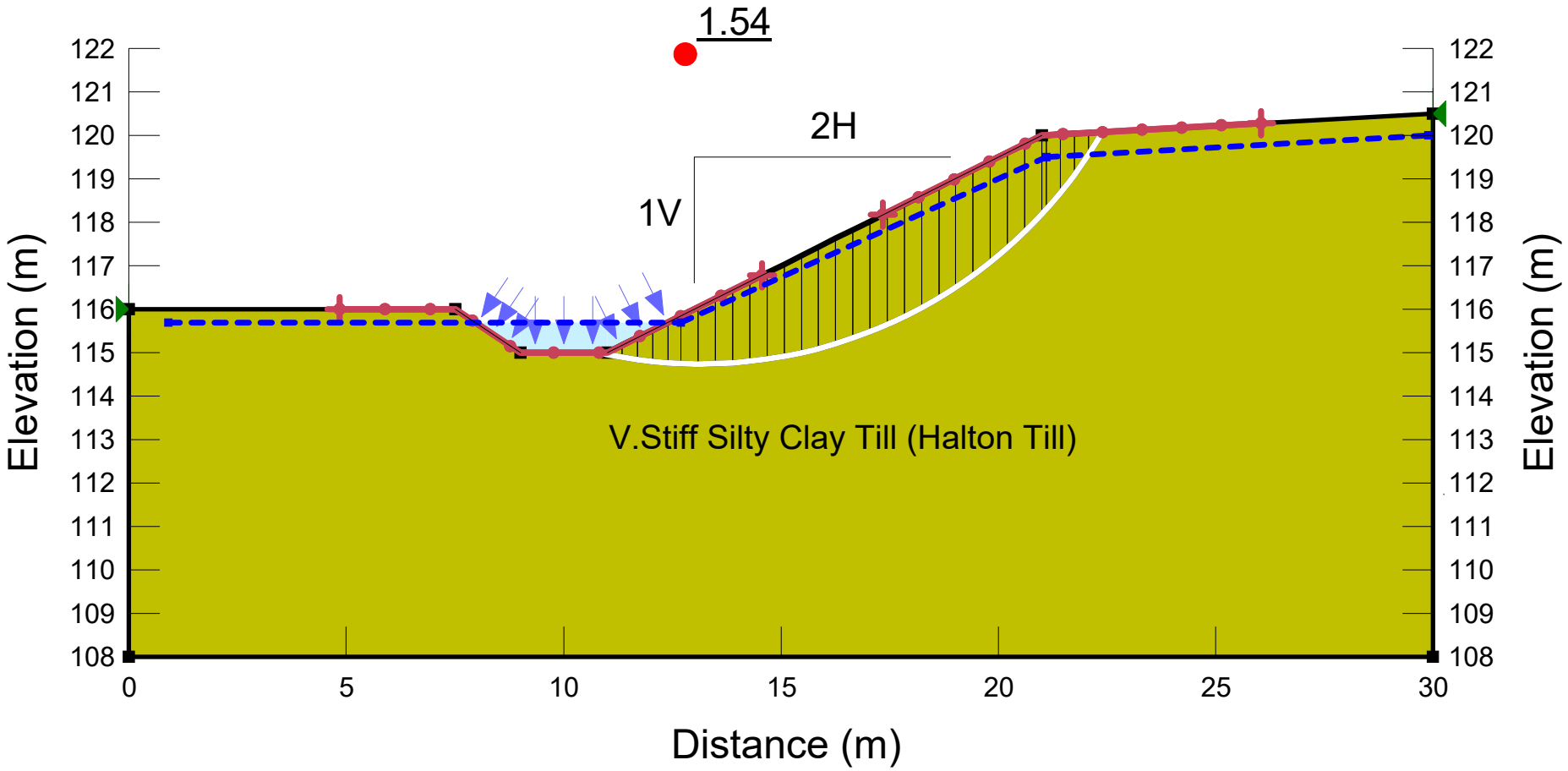
Site Photo - Area 'B'





Appendix D

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	V.Stiff Silty Clay Till (Halton Till)	22	5	34

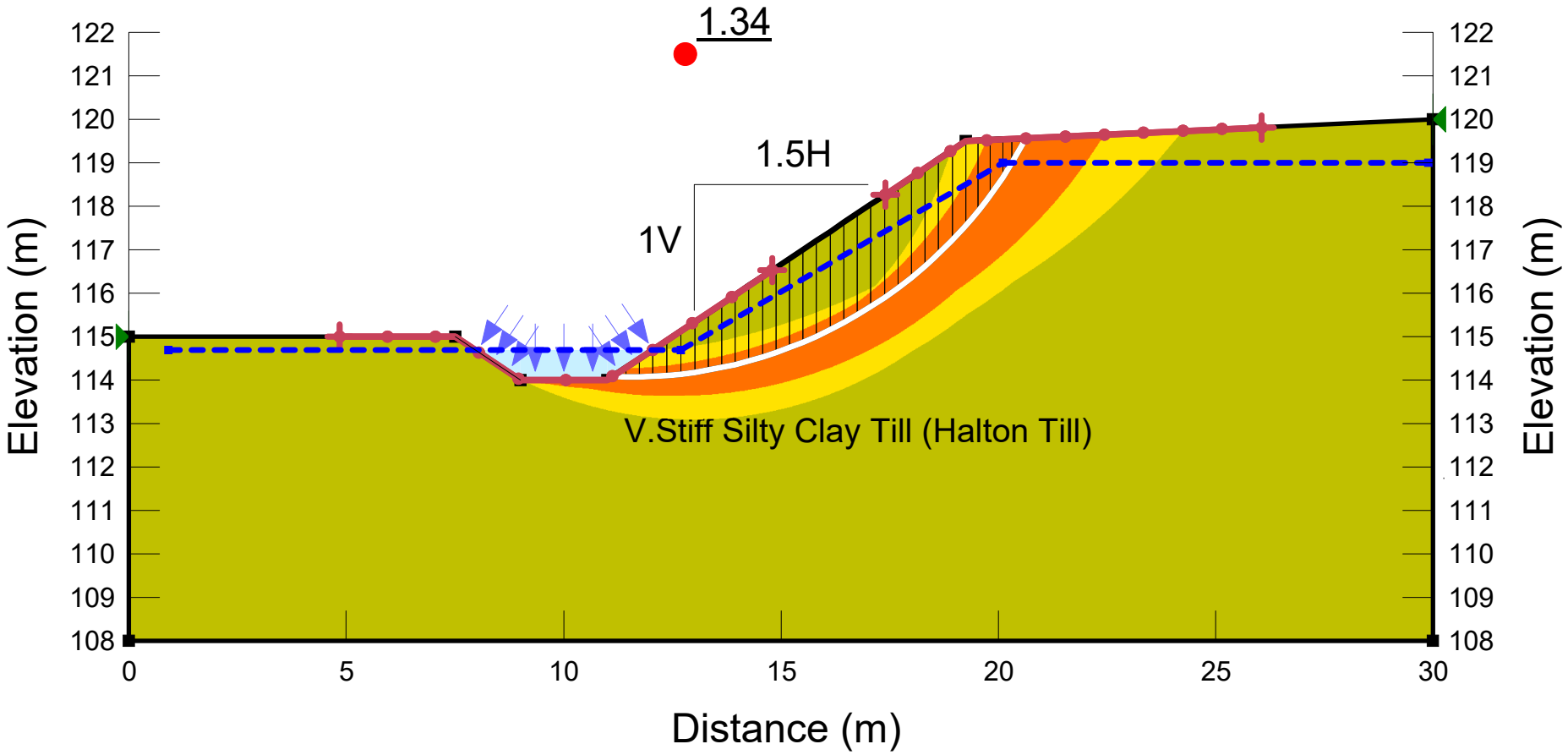


WW21012079 - 1450 King Road

Figure D.1: Area A - existing (long term)

Wood Environmental & Infrastructure Solutions, a Division of Wood Canada Limited

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	V.Stiff Silty ClayTill (Halton Till)	22	5	34



WW21012079 - 1450 King Road

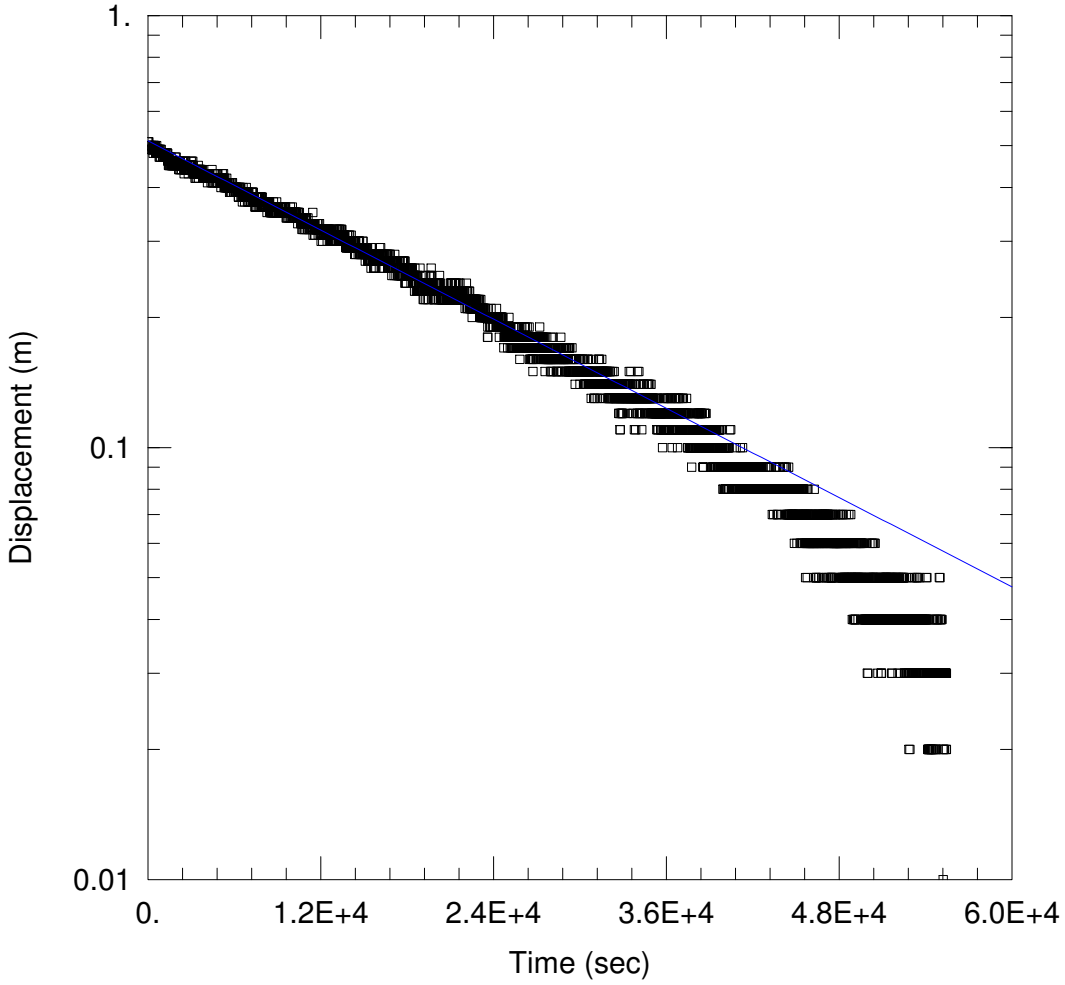
Figure D.2: Area B - existing (long term)

Wood Environmental & Infrastructure Solutions, a Division of Wood Canada Limited

WW21012079 Slope Stability Area B.gsz

1:147

Appendix E



WELL TEST ANALYSIS

Data Set: \...\BHMW4.aqt
Date: 11/26/21 Time: 09:45:19

PROJECT INFORMATION

Company: Wood
Client: Quantum Realty Management
Project: WW21012079
Location: Burlington
Test Well: BH/MW4
Test Date: November 3, 2021

AQUIFER DATA

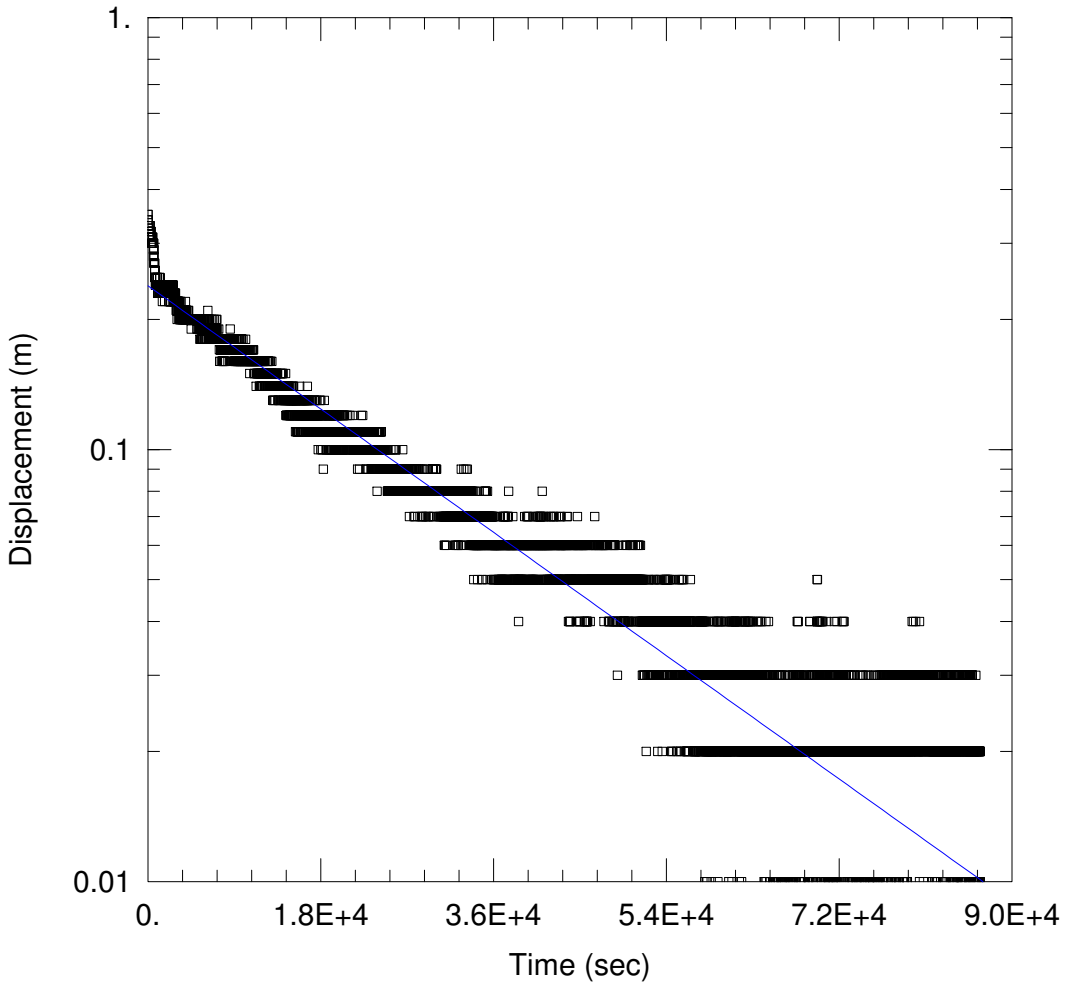
Saturated Thickness: 4.37 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH/MW4)

Initial Displacement: 0.51 m
Total Well Penetration Depth: 4.31 m
Casing Radius: 0.025 m
Static Water Column Height: 4.37 m
Screen Length: 1.5 m
Well Radius: 0.075 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.699E-8 m/sec
y0 = 0.5128 m



WELL TEST ANALYSIS

Data Set: \...\BHMW5.aqt
Date: 11/26/21 Time: 09:49:31

PROJECT INFORMATION

Company: Wood
Client: Quantum Realty Management
Project: WW21012079
Location: Burlington
Test Well: BH/MW5
Test Date: November 3, 2021

AQUIFER DATA

Saturated Thickness: 3.76 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH/MW5)

Initial Displacement: 0.35 m
Total Well Penetration Depth: 3.76 m
Casing Radius: 0.025 m
Static Water Column Height: 3.76 m
Screen Length: 1.5 m
Well Radius: 0.075 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.565E-8 m/sec y0 = 0.2394 m

Appendix F

LIMITATIONS TO GEOTECHNICAL REPORTS

1. The work performed in the preparation of this report and the conclusions presented herein are subject to the following:

    a) The contract between Wood and the Client, including any subsequent written amendment or Change Order dully signed by the parties (hereinafter together referred as the "Contract");

    b) Any and all time, budgetary, access and/or site disturbance, risk management preferences, constraints or restrictions as described in the contract, in this report, or in any subsequent communication sent by Wood to the Client in connection to the Contract; and

    c) The limitations stated herein.

2. **Standard of care:** Wood has prepared this report in a manner consistent with the level of skill and are ordinarily exercised by reputable members of Wood's profession, practicing in the same or similar locality at the time of performance, and subject to the time limits and physical constraints applicable to the scope of work, and terms and conditions for this assignment. No other warranty, guaranty, or representation, expressed or implied, is made or intended in this report, or in any other communication (oral or written) related to this project. The same are specifically disclaimed, including the implied warranties of merchantability and fitness for a particular purpose.

3. **Limited locations:** The information contained in this report is restricted to the site and structures evaluated by Wood and to the topics specifically discussed in it, and is not applicable to any other aspects, areas or locations.

4. **Information utilized:** The information, conclusions and estimates contained in this report are based exclusively on: i) information available at the time of preparation, ii) the accuracy and completeness of data supplied by the Client or by third parties as instructed by the Client, and iii) the assumptions, conditions and qualifications/limitations set forth in this report.

5. **Accuracy of information:** No attempt has been made to verify the accuracy of any information provided by the Client or third parties, except as specifically stated in this report (hereinafter "Supplied Data"). Wood cannot be held responsible for any loss or damage, of either contractual or extra-contractual nature, resulting from conclusions that are based upon reliance on the Supplied Data.

6. **Report interpretation:** This report must be read and interpreted in its entirety, as some sections could be inaccurately interpreted when taken individually or out-of-context. The contents of this report are based upon the conditions known and information provided as of the date of preparation. The text of the final version of this report supersedes any other previous versions produced by Wood.

7. **No legal representations:** Wood makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

8. **Decrease in property value:** Wood shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.

9. **No third party reliance:** This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or Contract. Any use or reproduction which any third party makes of the report, in whole or in part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. Wood does not represent or warrant the accuracy, completeness, merchantability, fitness for purpose or usefulness of this document, or any information contained in this

document, for use or consideration by any third party. Wood accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on this report or anything set out therein. including without limitation, any indirect, special, incidental, punitive or consequential loss, liability or damage of any kind.

10. **Assumptions**: Where design recommendations are given in this report, they apply only if the project contemplated by the Client is constructed substantially in accordance with the details stated in this report. It is the sole responsibility of the Client to provide to Wood changes made in the project, including but not limited to, details in the design, conditions, engineering or construction that could in any manner whatsoever impact the validity of the recommendations made in the report. Wood shall be entitled to additional compensation from Client to review and assess the effect of such changes to the project.

11. **Time dependence**: If the project contemplated by the Client is not undertaken within a period of 18 months following the submission of this report, or within the time frame understood by Wood to be contemplated by the Client at the commencement of Wood's assignment, and/or, if any changes are made, for example, to the elevation, design or nature of any development on the site, its size and configuration, the location of any development on the site and its orientation, the use of the site, performance criteria and the location of any physical infrastructure, the conclusions and recommendations presented herein should not be considered valid unless the impact of the said changes is evaluated by Wood, and the conclusions of the report are amended or are validated in writing accordingly.

    Advancements in the practice of geotechnical engineering, engineering geology and hydrogeology and changes in applicable regulations, standards, codes or criteria could impact the contents of the report, in which case, a supplementary report may be required. The requirements for such a review remain the sole responsibility of the Client or their agents.

    Wood will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

12. **Limitations of visual inspections:** Where conclusions and recommendations are given based on a visual inspection conducted by Wood, they relate only to the natural or man-made structures, slopes, etc. inspected at the time the site visit was performed. These conclusions cannot and are not extended to include those portions of the site or structures, which were not reasonably available, in Wood's opinion, for direct observation.

13. **Limitations of site investigations**: Site exploration identifies specific subsurface conditions only at those points from which samples have been taken and only at the time of the site investigation. Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite this investigation, conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

    Final sub-surface/bore/profile logs are developed by geotechnical engineers based upon their interpretation of field logs and laboratory evaluation of field samples. Customarily, only the final bore/profile logs are included in geotechnical engineering reports.

    Bedrock, soil properties and groundwater conditions can be significantly altered by environmental remediation and/or construction activities such as the use of heavy equipment or machinery, excavation, blasting, pile-driving

or draining or other activities conducted either directly on site or on adjacent terrain. These properties can also be indirectly affected by exposure to unfavorable natural events or weather conditions, including freezing, drought, precipitation and snowmelt.

During construction, excavation is frequently undertaken which exposes the actual subsurface and groundwater conditions between and beyond the test locations, which may differ from those encountered at the test locations. It is recommended practice that Wood be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered at the test locations, that construction work has no negative impact on the geotechnical aspects of the design, to adjust recommendations in accordance with conditions as additional site information is gained and to deal quickly with geotechnical considerations if they arise.

Interpretations and recommendations presented herein may not be valid if an adequate level of review or inspection by Wood is not provided during construction.

14. **Factors that may affect construction methods, costs and scheduling**: The performance of rock and soil materials during construction is greatly influenced by the means and methods of construction. Where comments are made relating to possible methods of construction, construction costs, construction techniques, sequencing, equipment or scheduling, they are intended only for the guidance of the project design professionals, and those responsible for construction monitoring. The number of test holes may not be sufficient to determine the local underground conditions between test locations that may affect construction costs, construction techniques, sequencing, equipment, scheduling, operational planning, etc.

    Any contractors bidding on or undertaking the works should draw their own conclusions as to how the subsurface and groundwater conditions may affect their work, based on their own investigations and interpretations of the factual soil data, groundwater observations, and other factual information.

15. **Groundwater and Dewatering**: Wood will accept no responsibility for the effects of drainage and/or dewatering measures if Wood has not been specifically consulted and involved in the design and monitoring of the drainage and/or dewatering system.

16. **Environmental and Hazardous Materials Aspects**: Unless otherwise stated, the information contained in this report in no way reflects on the environmental aspects of this project, since this aspect is beyond the Scope of Work and the Contract. Unless expressly included in the Scope of Work, this report specifically excludes the identification or interpretation of environmental conditions such as contamination, hazardous materials, wild life conditions, rare plants or archeology conditions that may affect use or design at the site. This report specifically excludes the investigation, detection, prevention or assessment of conditions that can contribute to moisture, mould or other microbial contaminant growth and/or other moisture related deterioration, such as corrosion, decay, rot in buildings or their surroundings. Any statements in this report or on the boring logs regarding odours, colours, and unusual or suspicious items or conditions are strictly for informational purposes

17. **Sample Disposal**: Wood will dispose of all uncontaminated soil and rock samples after 30 days following the release of the final geotechnical report. Should the Client request that the samples be retained for a longer time, the Client will be billed for such storage at an agreed upon rate. Contaminated samples of soil, rock or groundwater are the property of the Client, and the Client will be responsible for the proper disposal of these samples, unless previously arranged for with Wood or a third party.

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

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MEMO

TO: Ken Szekely

COMPANY: Quantum Realty Management

FROM: WSP E&I Canada Limited

DATE: May 2, 2023

PROJECT NO.: WW21012079

SUBJECT: 1450 King Road SWM Facility Works – Hydrogeological Addendum

WSP E&I Canada Limited (formerly Wood Environment & Infrastructure Solutions) was retained by Quantum Realty Management to complete an addendum to the Geotechnical Investigation for the re-design of the existing stormwater management facility (SWMF) and associated future re-development at 1450 King Road, located in the City of Burlington ("Site").

This report has been prepared as an addendum to the Geotechnical Investigation Report (Geotechnical Report) entitled *"Geotechnical Investigation Report, 1450 King Road, Burlington*" dated January 24, 2022 (Wood 2022, Project No. WW21012079) to supplement the information in the Geotechnical Report and should be read in conjunction with the Geotechnical Report. This report has been prepared to document the activities arising from the recommendations following the submission of the Geotechnical Report.

The Site is at the north-west corner of North Service Road and King Road, in Burlington, Ontario. The northern and western portions are vacant, vegetated with grasses with a few trees and shrubs. The southeast section serves as an existing storm water pond. A tributary of Indian Creek flows along the west boundary with heavily treed valley slopes. The topography within the Site slopes from the north-west to the south-east.

1 FIELD ACTIVITIES

1.1 GROUNDWATER MONITORING

WSP conducted groundwater level monitoring at the Site from March 1 to April 4, 2023 utilizing pressure transducers and manual water level measurements in groundwater monitoring wells. The monitoring occurred at MW4 and MW5 as shown in Figure 1. Pressure transducers were set to record readings at 15-minute intervals during the monitoring period. An additional pressure transducer was installed in MW4 above the groundwater level which was utilized to compensate for barometric pressure changes during the monitoring period. The manual levels were used to corroborate the pressure transducer data.

Groundwater elevations recorded during the monitoring period are shown in Figure 2. The groundwater levels from March to April 2023 in MW4 ranged from 121.33 to 121.81 metres above sea level (mASL). It is noted that this does not consider two decreases in water level that occurred on March 10 and March 14, 2023. The groundwater level decreases in MW4 on March 10, 2023, and March 14, 2023 represent purging of the monitoring well in preparation for groundwater sampling and subsequent groundwater quality sampling. The groundwater levels from March to April 2023 in MW5 ranged from 119.31 to 119.64 mASL. The groundwater level data indicates very little variation in the groundwater level during the monitoring period. The pressure transducers currently remain installed.

1.2 GROUNDWATER QUALITY SAMPLING

MW4 was purged on March 10, 2023 using a Waterra® inertial lift pump (i.e. foot valve) fitted with dedicated polyethylene tubing installed in the monitoring well. MW4 was purged dry to remove in preparation for groundwater sampling to remove fine particles from the sand filter pack and the soils immediately surrounding the well screen.

Groundwater samples were collected from MW4 on March 14, 2023 using low flow sampling techniques (peristaltic pump or bladder pump system) following stabilization of water quality parameters which include water temperature, electrical conductivity, dissolved oxygen, and pH. Groundwater samples were collected in lab supplied bottles for parameters listed in In Halton Region Sanitary Sewer Bylaw (2-03) and City of Burlington Storm Sewer Bylaw (059-2022), and for metals & inorganics, volatile organic compounds, polycyclic aromatic hydrocarbons, and polychlorinated biphenyls compared to the MECP Table 3 – Full Depth Generic Site Condition Standards in a Non-Potable ground Water Condition.

Laboratory chemical analyses were conducted by ALS Environmental, accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) in accordance with ISO/IEC 17025:1999 – General Requirements for the Competence of testing and Calibration laboratories for the tested parameters set out in the Soil, Ground and Sediment Standards document (MOE, 15 April 2011).

The certificates of analysis for the groundwater sample by ALS Environmental are provided in Appendix A on lab work order #WT2306151 and #WT2306162.

No exceedances were identified for any of the above listed guidelines or bylaws.

2 DEWATERING RATE ESTIMATION

2.1 EXCAVATION AND DEWATERING ASSUMPTIONS

For the construction of the proposed SWMF, it is expected that excavations will be below the groundwater level, and dewatering is expected to be needed to support the construction. Analytical equations have been used to estimate dewatering rates that may be required to support the construction of the stormwater management pond.

To provide a dewatering rate estimate, the following assumptions have been made, which are based on information provided and Site conditions encountered during the investigation.

The dewatering rates have been estimated using the estimated hydraulic conductivities from the two on-site monitoring wells tested on November 2, 2021. The details of the hydraulic conductivity testing are included in the Geotechnical Report. The dewatering rate has been selected based on the highest hydraulic conductivity as an input parameter. It has been assumed that this hydraulic conductivity value is representative of the entire excavation area, and that there will be negligible inflow along areas not considered in this analysis (e.g. utility trenches).

It is expected that open cut trench excavation will be used to construct the SWMF. Based on the Site layout plan (dated February 17, 2022), the dimensions of the SWMF are expected to be approximately 133 m by 35.5 m with a maximum expected excavation depth of 4.1 m. The base elevation of the SWMF is expected to be approximately 118.5 mASL. As the excavation for the SWMF is sloped towards the centre of the pond, two scenarios were considered for the dewatering estimations: 1) the maximum excavation depth of 4.1 m is applied through the excavation area and 2) the maximum excavation depth of 4.1 m is only applied to the area of maximum excavation

depth. Based on the Site layout plan, the area of maximum excavation depth is assumed to be approximately 101 m by 17.1 m.

For purposes of estimating the dewatering requirements and to conservatively account for seasonal water level changes, up to 1.0 m has been added to account for potential higher water table levels than encountered during the investigation. Where the water table is less than 1.0 m from the surface, water table has been increased to ground surface.

Estimated dewatering rates have been conservatively determined using unconfined homogenous hydrogeological conditions. This is a conservative simplification of the soils and heterogeneous and/or confined hydrogeological conditions may be encountered.

Additional higher inflow rates can be expected because of any or all of the following circumstances:

- Initial depletion of storage in the aquifer – this is a temporary response to dewatering and dewatering rates should fall to the expected volumes once equilibrium conditions are approached.
- Direct precipitation or runoff into an open excavation from precipitation events.

2.2 METHODOLOGY

To estimate the dewatering rates that would be required to support construction, analytical equations have been used.

For the SWMF, the amount of groundwater flow into an excavation that is trench shaped (where the length is a minimum of 1.5 times the width) under unconfined hydrogeological conditions were estimated using the following analytical expression (corrected from Powers et al., 2007):

$$Q = \pi K \frac{(H_0^2 - h_e^2)}{ln\left(\frac{2R_i + w}{w}\right)} + 2lK \frac{(H_0^2 - h_e^2)}{2R_i}$$

Where:

Q = groundwater flow rate (m^3/s).

K = hydraulic conductivity (m/s)

H_0 = static water table level (m above reference elevation) - [measured in the monitoring wells during the field investigation].

h_e = dewatered groundwater level at excavation (m above reference elevation) – [the reference elevation has been taken as 1.0 m below the proposed excavation depth. This assumes that there is no significant groundwater upflow from greater than 1.0 m below the excavation.

w = dewatering area width (m).

ℓ = dewatering area length (m).

R_i = radius of influence (m) – [estimated using Sichardt's Equation:

$$R_i = 3000(H_0 - h_e)\sqrt{K}$$

Dewatering rates with the assumptions listed above have been estimated and are provided in the Dewatering Rate Estimations found in Appendix B. The groundwater inflow (in m^3/day) estimated using the hydraulic conductivity value for each borehole location can be found in the far-right column. The maximum estimated groundwater inflow rate was multiplied by three (3) to determine a conservative dewatering rate to account for higher, short-term inflows and / or parameter uncertainty.

2.3 DEWATERING ESTIMATES

For the first scenario where the maximum excavation depth is applied across the entire excavation area, the estimated dewatering rates indicates that groundwater inflow rates of between approximately 5,400 L/day (5.4 m^3/day) and 5,500 L/day (5.5 m^3/day) may be expected. A three times factor of safety applied to the highest rate calculated has been determined to be approximately 16,600L/day (16.6 m^3/day).

For the second scenario where the minimum excavation area for the maximum excavation depth is used as the input for the excavation depth, the estimated dewatering rates indicates that groundwater inflow rates of between approximately 3,700 L/day (3.7 m^3/day) and 3,800 L/day (3,800 m^3/day) may be expected. A three times factor of safety applied to the highest rate calculated has been determined to be approximately 11,300 L/day (11.3 m^3/day).

The zone of influence (ZOI) has been estimated based on the Sichardt's equation (shown above) using information from the dewatering rate estimations found in Appendix B. The estimated ZOI is approximately 2.0 m. A safety factor has been applied by multiplying the hydraulic conductivity value by 3, and based on this the ZOI is approximately 3.5 m.

3 WATER TAKING PERMITTING RECOMMENDATION

Based on the dewatering rates provided above, water taking is expected to be below the threshold of 50,000 L/day, and as such an EASR is likely not required for the proposed construction activities.

4 GROUNDWATER MANAGEMENT

As excavations extend below the groundwater level temporary groundwater control may be required during construction. The method of groundwater control should be solely determined by the Project Contractor based on their own assessment of the Site-specific conditions, or by a specialist dewatering subcontractor retained by the Contractor, if required.

The groundwater sampling results are representative of the groundwater within the monitoring well sampled. However, groundwater quality may vary depending on location, time, meteorological conditions, and construction and dewatering methods utilized. The concentration of suspended solids in groundwater or water that must be removed from the construction area will impact the concentrations of many of the parameters tested for above, particularly metals.

Dewatering discharge and surface water runoff must be directed away from any open excavation. At a minimum, all dewatering operations should be in accordance with OPSS.MUNI 517 (Dewatering), OPSS.MUNI 518 (Control of Water), and OHSA. It is recommended that the discharge location is inspected daily to ensure the discharge is as intended. The discharge water should visually inspected daily to ensure that there is minimal turbidity, and that there is no visible hydrocarbon film or sheen present. If an increase in turbidity, any film or sheen is observed dewatering should cease until the source is identified.

The discharge of water, either groundwater or storm water encountered on the Site during construction will need to be considered and an approved discharge location determined and permitted as necessary prior to construction or discharge of any water.

5 CLOSURE

We trust the above is of assistance to you. The limitations of this report have been provided in Appendix C. If you would like to discuss any portion of the above, please do not hesitate to contact this office.

Yours very truly,

WSP E&I Canada Limited

Prepared by:



Jessica Pittman, B.Sc., P.Geo.
Hydrogeologist



Sarah Irvine, M.Sc., P.Geo.
Hydrogeologist

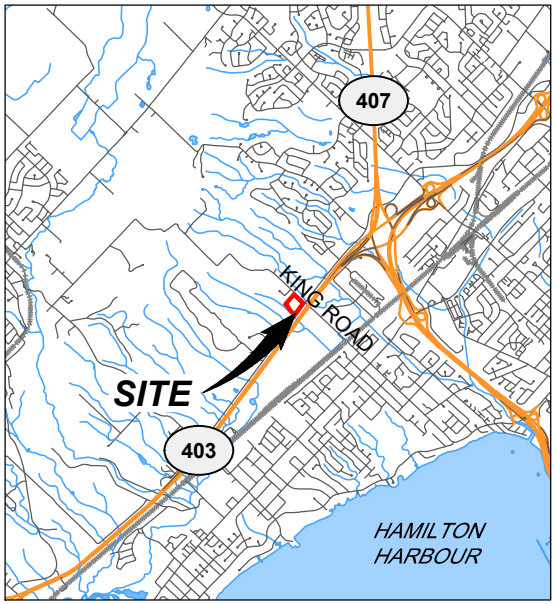


Reviewed by:



Simon Gautrey, M.Sc., MBA., P.Geo., F.G.C.,
Principal Hydrogeologist

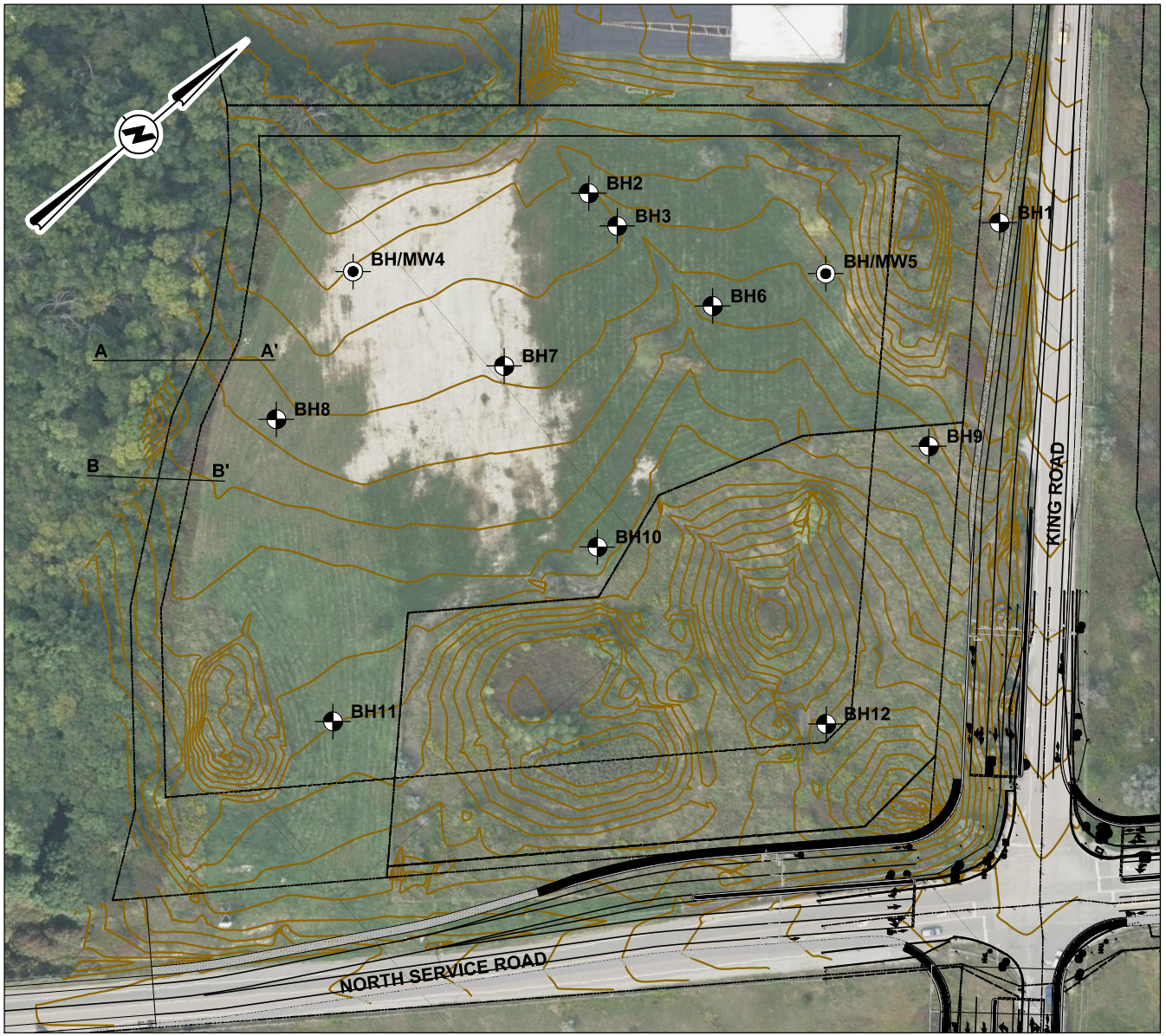
Figures



KEY PLAN

0 10 30 50m

SCALE 1:1,500



LEGEND:

- BOREHOLE LOCATION
- BOREHOLE/MONITORING WELL LOCATION

NOTES:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS REPORT No. WW21012079.

ALL LOCATIONS ARE APPROXIMATE ONLY.

REFERENCES:
BING IMAGERY AS OF NOVEMBER 22, 2021 (IMAGE DATE UNKNOWN), BING IMAGERY USED FOR ILLUSTRATION PURPOSES ONLY AND NOT TO BE USED FOR MEASUREMENTS.

CLIENT:
QUANTUM REALTY MANAGEMENT
2213 N SHERIDAN WAY
MISSISSAUGA, ONTARIO L5K 1A3

WSP E&I Canada Limited
3450 Harvester Road
Burlington, ON, L7N 3W5

DWN BY: LMK
CHK'D BY: TR
DATUM: NAD83
PROJECTION: UTM Zone 17
SCALE: 1:1,500

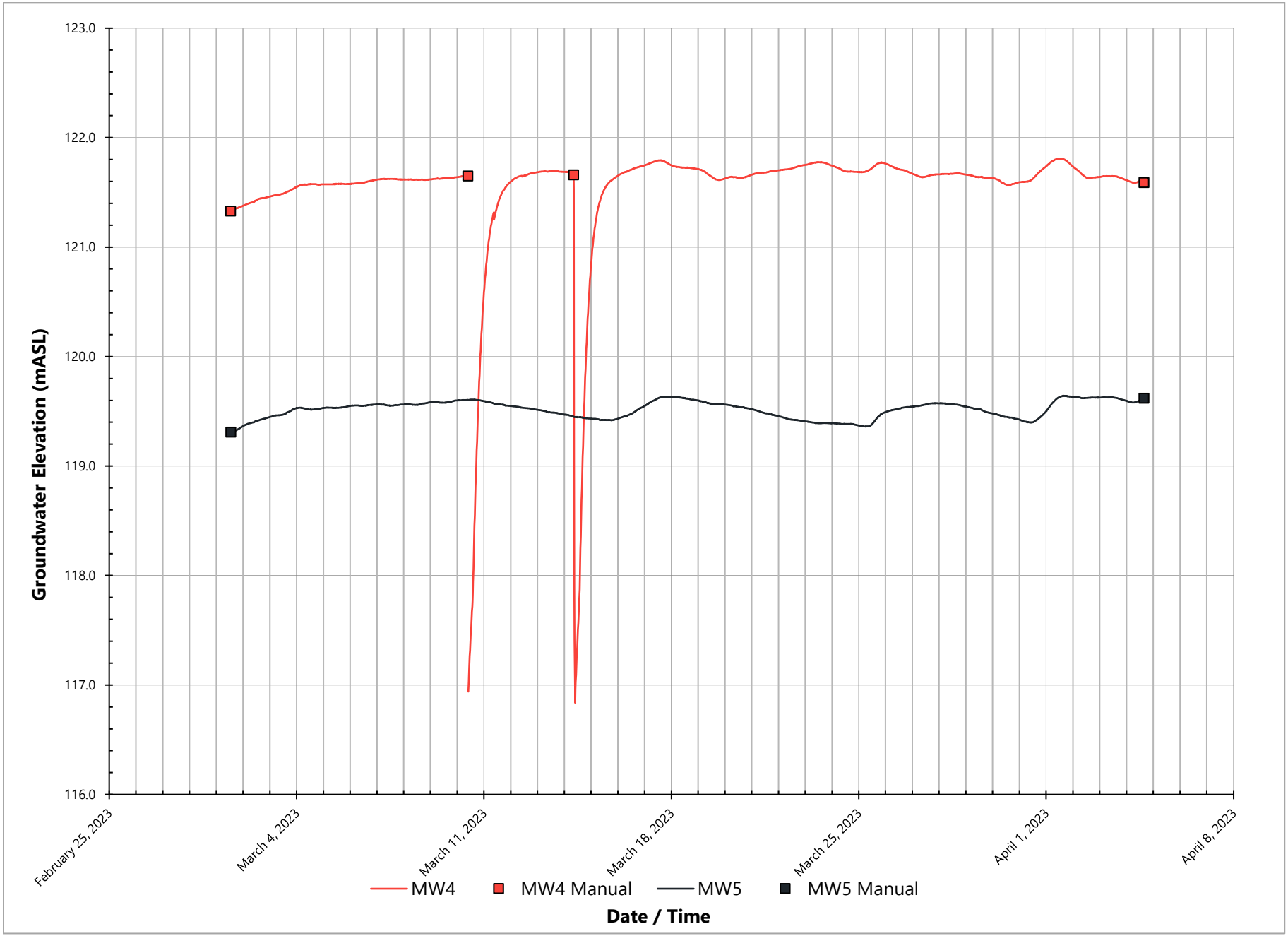
PROJECT:
SLOPE STABILITY
1450 KING ROAD
BURLINGTON, ONTARIO

TITLE:
BOREHOLE LOCATION PLAN

DATE: NOV. 23, 2021
PROJECT No: WW21012079
REV. No: 0
FIGURE No: 1

DATE PLOTTED: 11/23/2021 2:04:43 PM
FILE LOCATION: P:\2021\Projects\07 - GEOTECHNICAL\Other Offices\WW21012079.2\Drafting\AutoCAD\WW21012079.2-R01001.dwg

Figure 2 - Groundwater Monitoring



Appendix A

ALS Canada Ltd.

right solutions.
right partner.

CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2306151**	Page	: 1 of 12
Client	: **WSP E&I Canada Limited**	Laboratory	: Waterloo - Environmental
Contact	: Sarah Irvine	Account Manager	: Gayle Braun
Address	: 50 Vogel Road Unit 3 & 4 Richmond Hill ON Canada L4B 3K6	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: WW21012079.CO1P.****. 5120.573000	Date Samples Received	: 14-Mar-2023 15:40
PO	: ----	Date Analysis Commenced	: 14-Mar-2023
C-O-C number	: 20-1003332	Issue Date	: 21-Mar-2023 13:36
Sampler	: ----		
Site	:		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Microbiology, Waterloo, Ontario
Danielle Gravel	Supervisor - Semi-Volatile Instrumentation	Organics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Inorganics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Metals, Waterloo, Ontario
Joshua Stessun	Laboratory Analyst	Organics, Calgary, Alberta
Marsha Calero	Laboratory Assistant	Organics, Calgary, Alberta
Nguyen Tran	Laboratory Analyst	Organics, Calgary, Alberta
Sanja Risticevic	Department Manager - LCMS	LCMS, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	Organics, Waterloo, Ontario

No Breaches Found

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guidelines are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Key : LOR: Limit of Reporting (detection limit).

Unit	*Description*
µg/L	micrograms per litre
CFU/100mL	colony forming units per hundred millilitres
mg/L	milligrams per litre
pH units	pH units

>: greater than.
<: less than.
Red shading is applied where the result is greater than the Guideline Upper Limit or the result is lower than the Guideline Lower Limit.
For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit.

Qualifiers

Qualifier	Description
BODL	Limit of Reporting for BOD was increased to account for the largest volume of sample tested.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
SUR-ND	Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected.

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Unit	Client sample ID	BH4 Burlington	BH4 Halton	BH4-F	----	----	----	----
			Sampling date/time	14-Mar-2023 10:00	14-Mar-2023 10:00	14-Mar-2023 10:00	----	----	----	----
			Sub-Matrix	Groundwater	Groundwater	Groundwater	----	----	----	----
			WT2306151-001	WT2306151-002	WT2306151-003	--------	--------	--------	--------
Physical Tests										
pH	----	pH units	8.04	7.98	----	----	----	----	----
Solids, total suspended [TSS]	----	mg/L	8.5	7.9	----	----	----	----	----
Anions and Nutrients										
Fluoride	16984-48-8	mg/L	----	<0.200 DLDS	----	----	----	----	----
Kjeldahl nitrogen, total [TKN]	----	mg/L	----	<0.050	----	----	----	----	----
Phosphorus, total	7723-14-0	mg/L	0.0064	0.0059	----	----	----	----	----
Sulfate (as SO4)	14808-79-8	mg/L	----	57.5 DLDS	----	----	----	----	----
Cyanides										
Cyanide, strong acid dissociable (Total)	----	mg/L	<0.0020	<0.0020	----	----	----	----	----
Microbiological Tests										
Coliforms, Escherichia coli [E. coli]	----	CFU/100mL	Not Detected	----	----	----	----	----	----
Total Metals										
Aluminum, total	7429-90-5	mg/L	----	0.194 DLHC	<0.0300 DLHC	----	----	----	----
Antimony, total	7440-36-0	mg/L	----	<0.00100 DLHC	<0.00100 DLHC	----	----	----	----
Arsenic, total	7440-38-2	mg/L	<0.00100 DLHC	<0.00100 DLHC	<0.00100 DLHC	----	----	----	----
Beryllium, total	7440-41-7	mg/L	----	<0.000200 DLHC	----	----	----	----	----
Cadmium, total	7440-43-9	mg/L	<0.0000500 DLHC	<0.0000500 DLHC	<0.0000500 DLHC	----	----	----	----
Chromium, total	7440-47-3	mg/L	<0.00500 DLHC	<0.00500 DLHC	<0.00500 DLHC	----	----	----	----
Cobalt, total	7440-48-4	mg/L	----	<0.00100 DLHC	<0.00100 DLHC	----	----	----	----
Copper, total	7440-50-8	mg/L	<0.00500 DLHC	<0.00500 DLHC	<0.00500 DLHC	----	----	----	----
Iron, total	7439-89-6	mg/L	----	0.133 DLHC	----	----	----	----	----
Lead, total	7439-92-1	mg/L	<0.000500 DLHC	<0.000500 DLHC	<0.000500 DLHC	----	----	----	----
Manganese, total	7439-96-5	mg/L	0.00758 DLHC	0.0139 DLHC	0.00975 DLHC	----	----	----	----
Mercury, total	7439-97-6	mg/L	<0.0000050	<0.0000050	<0.0000050	----	----	----	----
Molybdenum, total	7439-98-7	mg/L	----	0.00135 DLHC	0.00137 DLHC	----	----	----	----
Nickel, total	7440-02-0	mg/L	<0.00500 DLHC	<0.00500 DLHC	<0.00500 DLHC	----	----	----	----
Selenium, total	7782-49-2	mg/L	0.000515 DLHC	<0.000500 DLHC	<0.000500 DLHC	----	----	----	----

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Unit	Client sample ID	BH4 Burlington	BH4 Halton	BH4-F	----	----	----	----
			Sampling date/time	14-Mar-2023 10:00	14-Mar-2023 10:00	14-Mar-2023 10:00	----	----	----	----
			Sub-Matrix	Groundwater	Groundwater	Groundwater	----	----	----	----
				WT2306151-001	WT2306151-002	WT2306151-003	--------	--------	--------	--------
Total Metals										
Silver, total	7440-22-4	mg/L		<0.000100 DLHC	<0.000100 DLHC	<0.000100 DLHC	----	----	----	----
Tin, total	7440-31-5	mg/L		----	<0.00100 DLHC	<0.00100 DLHC	----	----	----	----
Titanium, total	7440-32-6	mg/L		----	0.00413 DLHC	<0.00300 DLHC	----	----	----	----
Zinc, total	7440-66-6	mg/L		<0.0300 DLHC	<0.0300 DLHC	<0.0300 DLHC	----	----	----	----
Speciated Metals										
Chromium, hexavalent [Cr VI], total	18540-29-9	mg/L		<0.00050	----	<0.00050	----	----	----	----
Aggregate Organics										
Biochemical oxygen demand [BOD]	----	mg/L		<3.0 BODL	<3.0 BODL	----	----	----	----	----
Oil & grease (gravimetric)	----	mg/L		----	<5.0	----	----	----	----	----
Oil & grease, animal/vegetable (gravimetric)	----	mg/L		----	<5.0	----	----	----	----	----
Oil & grease, mineral (gravimetric)	----	mg/L		----	<5.0	----	----	----	----	----
Phenols, total (4AAP)	----	mg/L		<0.0010	<0.0010	----	----	----	----	----
Volatile Organic Compounds										
Benzene	71-43-2	µg/L		<0.50	----	----	----	----	----	----
Chloroform	67-66-3	µg/L		<0.50	----	----	----	----	----	----
Dichlorobenzene, 1,2-	95-50-1	µg/L		<0.50	----	----	----	----	----	----
Dichlorobenzene, 1,4-	106-46-7	µg/L		<0.50	----	----	----	----	----	----
Dichlorobenzene, 1,4-	106-46-7	µg/L		----	<0.50	----	----	----	----	----
Dichloroethylene, cis-1,2-	156-59-2	µg/L		<0.50	----	----	----	----	----	----
Dichloromethane	75-09-2	µg/L		<1.0	----	----	----	----	----	----
Dichloropropylene, trans-1,3-	10061-02-6	µg/L		<0.30	----	----	----	----	----	----
Ethylbenzene	100-41-4	µg/L		<0.50	----	----	----	----	----	----
Tetrachloroethane, 1,1,2,2-	79-34-5	µg/L		<0.50	----	----	----	----	----	----
Tetrachloroethylene	127-18-4	µg/L		<0.50	----	----	----	----	----	----
Toluene	108-88-3	µg/L		<0.50	----	----	----	----	----	----
Trichloroethylene	79-01-6	µg/L		<0.50	----	----	----	----	----	----
Xylene, m+p-	179601-23-1	µg/L		<0.40	----	----	----	----	----	----
Xylene, o-	95-47-6	µg/L		<0.30	----	----	----	----	----	----
Xylenes, total	1330-20-7	µg/L		<0.50	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Unit	Client sample ID: BH4 Burlington	BH4 Halton	BH4-F	----	----	----	----
			Sampling date/time: 14-Mar-2023 10:00	14-Mar-2023 10:00	14-Mar-2023 10:00	----	----	----	----
			Sub-Matrix: Groundwater	Groundwater	Groundwater	----	----	----	----
			WT2306151-001	WT2306151-002	WT2306151-003	--------	--------	--------	--------
Volatile Organic Compounds [Drycleaning]									
Dichloromethane	75-09-2	µg/L	----	<1.0	----	----	----	----	----
Tetrachloroethylene	127-18-4	µg/L	----	<0.50	----	----	----	----	----
Trichloroethylene	79-01-6	µg/L	----	<0.50	----	----	----	----	----
Volatile Organic Compounds [Fuels]									
Benzene	71-43-2	µg/L	----	<0.50	----	----	----	----	----
Ethylbenzene	100-41-4	µg/L	----	<0.50	----	----	----	----	----
Toluene	108-88-3	µg/L	----	<0.50	----	----	----	----	----
Volatile Organic Compounds [THMs]									
Chloroform	67-66-3	µg/L	----	<0.50	----	----	----	----	----
Volatile Organic Compounds Surrogates									
Bromofluorobenzene, 4-	460-00-4	%	84.3	----	----	----	----	----	----
Bromofluorobenzene, 4-	460-00-4	%	----	85.2	----	----	----	----	----
Difluorobenzene, 1,4-	540-36-3	%	91.4	----	----	----	----	----	----
Difluorobenzene, 1,4-	540-36-3	%	----	94.7	----	----	----	----	----
Polycyclic Aromatic Hydrocarbons									
Anthracene	120-12-7	mg/L	<0.000010	----	----	----	----	----	----
Benz(a)anthracene	56-55-3	mg/L	<0.000010	----	----	----	----	----	----
Benzo(a)pyrene	50-32-8	mg/L	<0.0000050	----	----	----	----	----	----
Benzo(b+j)fluoranthene	n/a	mg/L	<0.000010	----	----	----	----	----	----
Benzo(e)pyrene	192-97-2	mg/L	<0.000010	----	----	----	----	----	----
Benzo(g,h,i)perylene	191-24-2	mg/L	<0.000010	----	----	----	----	----	----
Benzo(k)fluoranthene	207-08-9	mg/L	<0.000010	----	----	----	----	----	----
Chrysene	218-01-9	mg/L	<0.000010	----	----	----	----	----	----
Dibenz(a,h)acridine	226-36-8	mg/L	<0.000050	----	----	----	----	----	----
Dibenz(a,h)anthracene	53-70-3	mg/L	<0.0000050	----	----	----	----	----	----
Dibenz(a,j)acridine	224-42-0	mg/L	<0.000050	----	----	----	----	----	----
Dibenzo(a,i)pyrene	189-55-9	mg/L	<0.000050	----	----	----	----	----	----
Dibenzo(c,g)carbazole, 7H-	194-59-2	mg/L	<0.000050	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Unit	Client sample ID	BH4 Burlington	BH4 Halton	BH4-F	----	----	----	----
			Sampling date/time	14-Mar-2023 10:00	14-Mar-2023 10:00	14-Mar-2023 10:00	----	----	----	----
			Sub-Matrix	Groundwater	Groundwater	Groundwater	----	----	----	----
				WT2306151-001	WT2306151-002	WT2306151-003	--------	--------	--------	--------
Polycyclic Aromatic Hydrocarbons										
Dinitropyrene, 1,3-	75321-20-9	mg/L		<0.0010	----	----	----	----	----	----
Dinitropyrene, 1,6-	42397-64-8	mg/L		<0.0010	----	----	----	----	----	----
Dinitropyrene, 1,8-	42397-65-9	mg/L		<0.0010	----	----	----	----	----	----
Fluoranthene	206-44-0	mg/L		<0.000010	----	----	----	----	----	----
Indeno(1,2,3-c,d)pyrene	193-39-5	mg/L		<0.000010	----	----	----	----	----	----
Methylcholanthrene, 3-	56-49-5	mg/L		<0.000050	----	----	----	----	----	----
Perylene	198-55-0	mg/L		<0.000010	----	----	----	----	----	----
Phenanthrene	85-01-8	mg/L		<0.000010	----	----	----	----	----	----
Pyrene	129-00-0	mg/L		<0.000010	----	----	----	----	----	----
PAHs, total (ON Sewer Use)	n/a	mg/L		<0.00175	----	----	----	----	----	----
Polycyclic Aromatic Hydrocarbons Surrogates										
Chrysene-d12	1719-03-5	%		88.2	----	----	----	----	----	----
Naphthalene-d8	1146-65-2	%		106	----	----	----	----	----	----
Phenanthrene-d10	1517-22-2	%		98.5	----	----	----	----	----	----
Terphenyl-d14, p-	1718-51-0	%		91.0	----	----	----	----	----	----
Phthalate Esters										
bis(2-Ethylhexyl) phthalate [DEHP]	117-81-7	µg/L		<2.0	----	----	----	----	----	----
Di-n-butyl phthalate	84-74-2	µg/L		<1.0	----	----	----	----	----	----
Semi-Volatile Organics										
Dichlorobenzidine, 3,3'-	91-94-1	µg/L		<0.40	----	----	----	----	----	----
Semi-Volatile Organics Surrogates										
Fluorobiphenyl, 2-	321-60-8	%		79.7	----	----	----	----	----	----
Terphenyl-d14, p-	1718-51-0	%		98.6	----	----	----	----	----	----
Chlorinated Phenolics										
Pentachlorophenol [PCP]	87-86-5	µg/L		<0.50	----	----	----	----	----	----
Phenolics Surrogates										
Tribromophenol, 2,4,6-	118-79-6	%		117	----	----	----	----	----	----
Nonylphenols										

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Unit	Client sample ID: BH4 Burlington	BH4 Halton	BH4-F	----	----	----	----
			Sampling date/time: 14-Mar-2023 10:00	14-Mar-2023 10:00	14-Mar-2023 10:00	----	----	----	----
			Sub-Matrix: Groundwater	Groundwater	Groundwater	----	----	----	----
			WT2306151-001	WT2306151-002	WT2306151-003	--------	--------	--------	--------
Nonylphenols									
Nonylphenol diethoxylates [NP2EO]	n/a	µg/L	<0.10	----	----	----	----	----	----
Nonylphenol ethoxylates, total	n/a	µg/L	<2.0	----	----	----	----	----	----
Nonylphenol monoethoxylates [NP1EO]	n/a	µg/L	<2.0	----	----	----	----	----	----
Nonylphenols [NP]	84852-15-3	µg/L	<1.0	----	----	----	----	----	----
Polychlorinated Biphenyls									
Aroclor 1016	12674-11-2	µg/L	<0.020	----	----	----	----	----	----
Aroclor 1221	11104-28-2	µg/L	<0.020	----	----	----	----	----	----
Aroclor 1232	11141-16-5	µg/L	<0.020	----	----	----	----	----	----
Aroclor 1242	53469-21-9	µg/L	<0.020	----	----	----	----	----	----
Aroclor 1248	12672-29-6	µg/L	<0.020	----	----	----	----	----	----
Aroclor 1254	11097-69-1	µg/L	<0.020	----	----	----	----	----	----
Aroclor 1260	11096-82-5	µg/L	<0.020	----	----	----	----	----	----
Aroclor 1262	37324-23-5	µg/L	<0.020	----	----	----	----	----	----
Aroclor 1268	11100-14-4	µg/L	<0.020	----	----	----	----	----	----
Polychlorinated biphenyls [PCBs], total	----	µg/L	<0.060	----	----	----	----	----	----
Polychlorinated Biphenyls Surrogates									
Decachlorobiphenyl	2051-24-3	%	142 SUR-ND	----	----	----	----	----	----
Tetrachloro-m-xylene	877-09-8	%	116	----	----	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

Summary of Guideline Limits

Analyte	CAS Number	Unit	BURSTM STM	HALSUB SAN					
Physical Tests									
pH	----	pH units	**6.5 - 8.5 pH units**	**6 - 10 pH units**					
Solids, total suspended [TSS]	----	mg/L	**15 mg/L**	**350 mg/L**					
Anions and Nutrients									
Fluoride	16984-48-8	mg/L		**10 mg/L**					
Kjeldahl nitrogen, total [TKN]	----	mg/L		**100 mg/L**					
Phosphorus, total	7723-14-0	mg/L	**0.4 mg/L**	**10 mg/L**					
Sulfate (as SO4)	14808-79-8	mg/L		**1500 mg/L**					
Cyanides									
Cyanide, strong acid dissociable (Total)	----	mg/L		**2 mg/L**					
Microbiological Tests									
Coliforms, Escherichia coli [E. coli]	----	CFU/100mL	**200 CFU/100mL**						
Total Metals									
Aluminum, total	7429-90-5	mg/L		**50 mg/L**					
Antimony, total	7440-36-0	mg/L		**5 mg/L**					
Arsenic, total	7440-38-2	mg/L	**0.02 mg/L**	**1 mg/L**					
Beryllium, total	7440-41-7	mg/L		**5 mg/L**					
Cadmium, total	7440-43-9	mg/L	**0.008 mg/L**	**1 mg/L**					
Chromium, total	7440-47-3	mg/L	**0.08 mg/L**	**3 mg/L**					
Cobalt, total	7440-48-4	mg/L		**5 mg/L**					
Copper, total	7440-50-8	mg/L	**0.04 mg/L**	**3 mg/L**					
Iron, total	7439-89-6	mg/L		**50 mg/L**					
Lead, total	7439-92-1	mg/L	**0.12 mg/L**	**3 mg/L**					
Manganese, total	7439-96-5	mg/L	**0.05 mg/L**	**5 mg/L**					
Mercury, total	7439-97-6	mg/L	**0.0004 mg/L**	**0.05 mg/L**					
Molybdenum, total	7439-98-7	mg/L		**5 mg/L**					
Nickel, total	7440-02-0	mg/L	**0.08 mg/L**	**3 mg/L**					
Selenium, total	7782-49-2	mg/L	**0.02 mg/L**	**5 mg/L**					
Silver, total	7440-22-4	mg/L	**0.12 mg/L**	**5 mg/L**					
Tin, total	7440-31-5	mg/L		**5 mg/L**					
Titanium, total	7440-32-6	mg/L		**5 mg/L**					
Zinc, total	7440-66-6	mg/L	**0.04 mg/L**	**3 mg/L**					
Speciated Metals									
Chromium, hexavalent [Cr VI], total	18540-29-9	mg/L	**0.04 mg/L**						
Aggregate Organics									
Biochemical oxygen demand [BOD]	----	mg/L	**15 mg/L**	**300 mg/L**					

Analyte	CAS Number	Unit	BURSTM STM	HALSUB SAN					
Aggregate Organics - Continued									
Oil & grease (gravimetric)	----	mg/L							
Oil & grease, animal/vegetable (gravimetric)	----	mg/L		**150 mg/L**					
Oil & grease, mineral (gravimetric)	----	mg/L		**15 mg/L**					
Phenols, total (4AAP)	----	mg/L	**0.008 mg/L**	**1 mg/L**					
Volatile Organic Compounds									
Benzene	71-43-2	µg/L	**2 µg/L**						
Chloroform	67-66-3	µg/L	**2 µg/L**						
Dichlorobenzene, 1,2-	95-50-1	µg/L	**5.6 µg/L**						
Dichlorobenzene, 1,4-	106-46-7	µg/L	**6.8 µg/L**	**80 µg/L**					
Dichloroethylene, cis-1,2-	156-59-2	µg/L	**5.6 µg/L**						
Dichloromethane	75-09-2	µg/L	**5.2 µg/L**						
Dichloropropylene, trans-1,3-	10061-02-6	µg/L	**5.6 µg/L**						
Ethylbenzene	100-41-4	µg/L	**2 µg/L**						
Tetrachloroethane, 1,1,2,2-	79-34-5	µg/L	**17 µg/L**						
Tetrachloroethylene	127-18-4	µg/L	**4.4 µg/L**						
Toluene	108-88-3	µg/L	**2 µg/L**						
Trichloroethylene	79-01-6	µg/L	**7.6 µg/L**						
Xylene, m+p-	179601-23-1	µg/L							
Xylene, o-	95-47-6	µg/L							
Xylenes, total	1330-20-7	µg/L	**4.4 µg/L**						
Dichloromethane	75-09-2	µg/L		**2000 µg/L**					
Tetrachloroethylene	127-18-4	µg/L		**1000 µg/L**					
Trichloroethylene	79-01-6	µg/L		**400 µg/L**					
Benzene	71-43-2	µg/L		**10 µg/L**					
Ethylbenzene	100-41-4	µg/L		**160 µg/L**					
Toluene	108-88-3	µg/L		**16 µg/L**					
Chloroform	67-66-3	µg/L		**40 µg/L**					
Polycyclic Aromatic Hydrocarbons									
Anthracene	120-12-7	mg/L							
Benz(a)anthracene	56-55-3	mg/L							
Benzo(a)pyrene	50-32-8	mg/L							
Benzo(b+j)fluoranthene	n/a	mg/L							
Benzo(e)pyrene	192-97-2	mg/L							
Benzo(g,h,i)perylene	191-24-2	mg/L							
Benzo(k)fluoranthene	207-08-9	mg/L							
Chrysene	218-01-9	mg/L							
Dibenz(a,h)acridine	226-36-8	mg/L							
Dibenz(a,h)anthracene	53-70-3	mg/L							
Dibenz(a,j)acridine	224-42-0	mg/L							

Analyte	CAS Number	Unit	BURSTM STM	HALSUB SAN					
Polycyclic Aromatic Hydrocarbons - Continued									
Dibenzo(a,i)pyrene	189-55-9	mg/L							
Dibenzo(c,g)carbazole, 7H-	194-59-2	mg/L							
Dinitropyrene, 1,3-	75321-20-9	mg/L							
Dinitropyrene, 1,6-	42397-64-8	mg/L							
Dinitropyrene, 1,8-	42397-65-9	mg/L							
Fluoranthene	206-44-0	mg/L							
Indeno(1,2,3-c,d)pyrene	193-39-5	mg/L							
Methylcholanthrene, 3-	56-49-5	mg/L							
PAHs, total (ON Sewer Use)	n/a	mg/L	**0.002 mg/L**						
Perylene	198-55-0	mg/L							
Phenanthrene	85-01-8	mg/L							
Pyrene	129-00-0	mg/L							
Phthalate Esters									
bis(2-Ethylhexyl) phthalate [DEHP]	117-81-7	µg/L	**8.8 µg/L**						
Di-n-butyl phthalate	84-74-2	µg/L	**15 µg/L**						
Semi-Volatile Organics									
Dichlorobenzidine, 3,3'-	91-94-1	µg/L	**0.8 µg/L**						
Chlorinated Phenolics									
Pentachlorophenol [PCP]	87-86-5	µg/L	**2 µg/L**						
Nonylphenols									
Nonylphenol diethoxylates [NP2EO]	n/a	µg/L							
Nonylphenol ethoxylates, total	n/a	µg/L	**10 µg/L**						
Nonylphenol monoethoxylates [NP1EO]	n/a	µg/L							
Nonylphenols [NP]	84852-15-3	µg/L	**1 µg/L**						
Polychlorinated Biphenyls									
Aroclor 1016	12674-11-2	µg/L							
Aroclor 1221	11104-28-2	µg/L							
Aroclor 1232	11141-16-5	µg/L							
Aroclor 1242	53469-21-9	µg/L							
Aroclor 1248	12672-29-6	µg/L							
Aroclor 1254	11097-69-1	µg/L							
Aroclor 1260	11096-82-5	µg/L							
Aroclor 1262	37324-23-5	µg/L							
Aroclor 1268	11100-14-4	µg/L							
Polychlorinated biphenyls [PCBs], total	----	µg/L	**0.4 µg/L**						

Please refer to the General Comments section for an explanation of any qualifiers detected.

Key:

BURSTM		Ontario Burlington Storm Sewer By-Law (59-2022)
	STM	Burlington Storm Sewer (59-2022)
HALSUB		Ontario Halton Sanitary Sewer By-law No. 02-03 (MAR, 2003)
	SAN	Halton Sanitary Sewer By-Law No. 02-03

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QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2306151**	Page	: 1 of 15
Client	: **WSP E&I Canada Limited**	Laboratory	: Waterloo - Environmental
Contact	: Sarah Irvine	Account Manager	: Gayle Braun
Address	: 50 Vogel Road Unit 3 & 4 Richmond Hill ON Canada L4B 3K6	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: WW21012079.CO1P.****. 5120.573000	Date Samples Received	: 14-Mar-2023 15:40
PO	: ----	Issue Date	: 21-Mar-2023 13:37
C-O-C number	: 20-1003332		
Sampler	: ----		
Site	:		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Matrix Spike outliers occur.
- Laboratory Control Sample (LCS) outliers occur - please see following pages for full details.
- Test sample Surrogate recovery outliers exist for all regular sample matrices - please see following pages for full details.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Water**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Laboratory Control Sample (LCS) Recoveries								
Polycyclic Aromatic Hydrocarbons	QC-865023-002	----	Methylcholanthrene, 3-	56-49-5	E642D	192 % LCS-H	60.0-130%	Recovery greater than upper control limit
Semi-Volatile Organics	QC-MRG4-8650170 02	----	Dichlorobenzidine, 3,3'-	91-94-1	E655F	37.1 % LCS-ND	50.0-140%	Recovery less than lower control limit

Result Qualifiers

Qualifier	Description
LCS-H	*Lab Control Sample recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.*
LCS-ND	*Lab Control Sample recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.*

Regular Sample Surrogates

Sub-Matrix: **Groundwater**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Result	Limits	Comment
Samples Submitted							
Polychlorinated Biphenyls Surrogates	WT2306151-001	BH4 Burlington	Decachlorobiphenyl	2051-24-3	142 %	50.0-140 %	Recovery greater than upper data quality objective

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT-4d]										
BH4 - Burlington	E550	14-Mar-2023	----	----	----		15-Mar-2023	4 days	1 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT-4d]										
BH4 - Halton	E550	14-Mar-2023	----	----	----		15-Mar-2023	4 days	1 days	✓
Aggregate Organics : Mineral Oil & Grease by Gravimetry										
Amber glass (hydrochloric acid)										
BH4 - Halton	E567SG	14-Mar-2023	16-Mar-2023	28 days	2 days	✓	17-Mar-2023	40 days	1 days	✓
Aggregate Organics : Oil & Grease by Gravimetry										
Amber glass (hydrochloric acid)										
BH4 - Halton	E567	14-Mar-2023	16-Mar-2023	28 days	2 days	✓	16-Mar-2023	40 days	0 days	✓
Aggregate Organics : Phenols (4AAP) in Water by Colorimetry										
Amber glass total (sulfuric acid) [ON MECP]										
BH4 - Burlington	E562	14-Mar-2023	15-Mar-2023	----	----		15-Mar-2023	28 days	1 days	✓
Aggregate Organics : Phenols (4AAP) in Water by Colorimetry										
Amber glass total (sulfuric acid) [ON MECP]										
BH4 - Halton	E562	14-Mar-2023	15-Mar-2023	----	----		15-Mar-2023	28 days	1 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [ON MECP]										
BH4 - Halton	E235.F	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	28 days	2 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Sulfate in Water by IC										
HDPE [ON MECP]										
BH4 - Halton	E235.SO4	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	28 days	2 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid) [ON MECP]										
BH4 - Halton	E318	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	28 days	2 days	✓
Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)										
Amber glass total (sulfuric acid) [ON MECP]										
BH4 - Burlington	E372-U	14-Mar-2023	15-Mar-2023	----	----		16-Mar-2023	28 days	2 days	✓
Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)										
Amber glass total (sulfuric acid) [ON MECP]										
BH4 - Halton	E372-U	14-Mar-2023	15-Mar-2023	----	----		16-Mar-2023	28 days	2 days	✓
Chlorinated Phenolics : BNA (Ontario Sanitary Sewer SVOC Target List) by GC-MS										
Amber glass/Teflon lined cap [ON MECP]										
BH4 - Burlington	E655F	14-Mar-2023	16-Mar-2023	14 days	2 days	✓	20-Mar-2023	40 days	4 days	✓
Cyanides : Total Cyanide										
UV-inhibited HDPE - total (sodium hydroxide)										
BH4 - Burlington	E333	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	14 days	2 days	✓
Cyanides : Total Cyanide										
UV-inhibited HDPE - total (sodium hydroxide)										
BH4 - Halton	E333	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	14 days	2 days	✓
Microbiological Tests : E. coli (MF-mFC-BCIG)										
Sterile HDPE (Sodium thiosulphate) [ON MECP]										
BH4 - Burlington	E012A.EC	14-Mar-2023	----	----	----		15-Mar-2023	48 hrs	27 hrs	✓
Nonylphenols : Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode										
Amber glass/Teflon lined cap - LCMS										
BH4 - Burlington	E749B	14-Mar-2023	14-Mar-2023	7 days	0 days	✓	14-Mar-2023	7 days	0 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Nonylphenols : Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode										
Amber glass/Teflon lined cap - LCMS										
BH4 - Burlington	E749A	14-Mar-2023	14-Mar-2023	7 days	0 days	✓	14-Mar-2023	7 days	0 days	✓
Phthalate Esters : BNA (Ontario Sanitary Sewer SVOC Target List) by GC-MS										
Amber glass/Teflon lined cap [ON MECP]										
BH4 - Burlington	E655F	14-Mar-2023	16-Mar-2023	14 days	2 days	✓	20-Mar-2023	40 days	4 days	✓
Physical Tests : pH by Meter										
HDPE [ON MECP]										
BH4 - Burlington	E108	14-Mar-2023	15-Mar-2023	----	----		16-Mar-2023	14 days	2 days	✓
Physical Tests : pH by Meter										
HDPE [ON MECP]										
BH4 - Halton	E108	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	14 days	2 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [ON MECP]										
BH4 - Burlington	E160	14-Mar-2023	----	----	----		15-Mar-2023	7 days	1 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [ON MECP]										
BH4 - Halton	E160	14-Mar-2023	----	----	----		15-Mar-2023	7 days	1 days	✓
Polychlorinated Biphenyls : PCB Aroclors by GC-MS										
Amber glass/Teflon lined cap [ON MECP]										
BH4 - Burlington	E687	14-Mar-2023	15-Mar-2023	14 days	1 days	✓	16-Mar-2023	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs (ON Special List) by GC-MS										
Amber glass/Teflon lined cap [ON MECP]										
BH4 - Burlington	E642D	14-Mar-2023	16-Mar-2023	14 days	2 days	✓	16-Mar-2023	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS (Low Level)										
Amber glass/Teflon lined cap (sodium bisulfate)										
BH4 - Burlington	E641A-L	14-Mar-2023	15-Mar-2023	14 days	1 days	✓	16-Mar-2023	40 days	1 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Semi-Volatile Organics : BNA (Ontario Sanitary Sewer SVOC Target List) by GC-MS										
Amber glass/Teflon lined cap [ON MECP]										
BH4 - Burlington	E655F	14-Mar-2023	16-Mar-2023	14 days	2 days	✓	20-Mar-2023	40 days	4 days	✓
Speciated Metals : Total Hexavalent Chromium (Cr VI) by IC										
HDPE - total (NaOH+Buf) [ON MECP]										
BH4 - Burlington	E532	14-Mar-2023	----	----	----		15-Mar-2023	28 days	1 days	✓
Speciated Metals : Total Hexavalent Chromium (Cr VI) by IC										
HDPE - total (NaOH+Buf) [ON MECP]										
BH4-F	E532	14-Mar-2023	----	----	----		15-Mar-2023	28 days	1 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid) [ON MECP]										
BH4 - Burlington	E508	14-Mar-2023	15-Mar-2023	----	----		15-Mar-2023	28 days	1 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid) [ON MECP]										
BH4-F	E508	14-Mar-2023	15-Mar-2023	----	----		15-Mar-2023	28 days	1 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid) [ON MECP]										
BH4 - Halton	E508	14-Mar-2023	15-Mar-2023	----	----		15-Mar-2023	28 days	1 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
BH4 - Burlington	E420	14-Mar-2023	14-Mar-2023	----	----		15-Mar-2023	180 days	2 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
BH4-F	E420	14-Mar-2023	14-Mar-2023	----	----		15-Mar-2023	180 days	2 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
BH4 - Halton	E420	14-Mar-2023	14-Mar-2023	----	----		15-Mar-2023	180 days	2 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Volatile Organic Compounds : VOCs (Eastern Canada List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
BH4 - Burlington	E611D	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	14 days	2 days	✓
Volatile Organic Compounds : VOCs (Full List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
BH4 - Halton	E611F	14-Mar-2023	17-Mar-2023	----	----		17-Mar-2023	14 days	3 days	✓
Volatile Organic Compounds [Drycleaning] : VOCs (Full List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
BH4 - Halton	E611F	14-Mar-2023	17-Mar-2023	----	----		17-Mar-2023	14 days	3 days	✓
Volatile Organic Compounds [Fuels] : VOCs (Full List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
BH4 - Halton	E611F	14-Mar-2023	17-Mar-2023	----	----		17-Mar-2023	14 days	3 days	✓
Volatile Organic Compounds [THMs] : VOCs (Full List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
BH4 - Halton	E611F	14-Mar-2023	17-Mar-2023	----	----		17-Mar-2023	14 days	3 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: ✗ = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Biochemical Oxygen Demand - 5 day	E550	863816	1	19	5.2	5.0	✓
E. coli (MF-mFC-BCIG)	E012A.EC	864123	0	9	0.0	5.0	✗
Fluoride in Water by IC	E235.F	865014	1	3	33.3	5.0	✓
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B	863310	1	18	5.5	5.0	✓
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A	863309	1	18	5.5	5.0	✓
pH by Meter	E108	864651	2	19	10.5	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	863563	1	14	7.1	5.0	✓
Sulfate in Water by IC	E235.SO4	865013	1	16	6.2	5.0	✓
Total Cyanide	E333	865831	1	20	5.0	5.0	✓
Total Hexavalent Chromium (Cr VI) by IC	E532	863582	1	13	7.6	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	863564	1	13	7.6	5.0	✓
Total Mercury in Water by CVAAS	E508	863570	1	10	10.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	863382	1	20	5.0	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	863561	1	19	5.2	5.0	✓
TSS by Gravimetry	E160	863863	1	19	5.2	4.7	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	866098	1	19	5.2	5.0	✓
VOCs (Full List) by Headspace GC-MS	E611F	867468	1	1	100.0	5.0	✓
Laboratory Control Samples (LCS)							
Biochemical Oxygen Demand - 5 day	E550	863816	1	19	5.2	5.0	✓
BNA (Ontario Sanitary Sewer SVOC Target List) by GC-MS	E655F	865018	1	4	25.0	5.0	✓
Fluoride in Water by IC	E235.F	865014	1	3	33.3	5.0	✓
Mineral Oil & Grease by Gravimetry	E567SG	865916	1	12	8.3	5.0	✓
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B	863310	1	18	5.5	5.0	✓
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A	863309	1	18	5.5	5.0	✓
Oil & Grease by Gravimetry	E567	865915	1	12	8.3	5.0	✓
PAHs (ON Special List) by GC-MS	E642D	865023	1	3	33.3	5.0	✓
PAHs by Hexane LVI GC-MS (Low Level)	E641A-L	863531	1	1	100.0	5.0	✓
PCB Aroclors by GC-MS	E687	863525	1	16	6.2	4.7	✓
pH by Meter	E108	864651	2	19	10.5	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	863563	1	14	7.1	5.0	✓
Sulfate in Water by IC	E235.SO4	865013	1	16	6.2	5.0	✓
Total Cyanide	E333	865831	1	20	5.0	5.0	✓
Total Hexavalent Chromium (Cr VI) by IC	E532	863582	1	13	7.6	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	863564	1	13	7.6	5.0	✓
Total Mercury in Water by CVAAS	E508	863570	1	10	10.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	863382	1	20	5.0	5.0	✓

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Control Samples (LCS) - Continued							
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	863561	1	19	5.2	5.0	✓
TSS by Gravimetry	E160	863863	1	19	5.2	4.7	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	866098	1	19	5.2	5.0	✓
VOCs (Full List) by Headspace GC-MS	E611F	867468	1	1	100.0	5.0	✓
Method Blanks (MB)							
Biochemical Oxygen Demand - 5 day	E550	863816	1	19	5.2	5.0	✓
BNA (Ontario Sanitary Sewer SVOC Target List) by GC-MS	E655F	865018	1	4	25.0	5.0	✓
E. coli (MF-mFC-BCIG)	E012A.EC	864123	1	9	11.1	5.0	✓
Fluoride in Water by IC	E235.F	865014	1	3	33.3	5.0	✓
Mineral Oil & Grease by Gravimetry	E567SG	865916	1	12	8.3	5.0	✓
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B	863310	1	18	5.5	5.0	✓
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A	863309	1	18	5.5	5.0	✓
Oil & Grease by Gravimetry	E567	865915	1	12	8.3	5.0	✓
PAHs (ON Special List) by GC-MS	E642D	865023	1	3	33.3	5.0	✓
PAHs by Hexane LVI GC-MS (Low Level)	E641A-L	863531	1	1	100.0	5.0	✓
PCB Aroclors by GC-MS	E687	863525	1	16	6.2	4.7	✓
Phenols (4AAP) in Water by Colorimetry	E562	863563	1	14	7.1	5.0	✓
Sulfate in Water by IC	E235.SO4	865013	1	16	6.2	5.0	✓
Total Cyanide	E333	865831	1	20	5.0	5.0	✓
Total Hexavalent Chromium (Cr VI) by IC	E532	863582	1	13	7.6	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	863564	1	13	7.6	5.0	✓
Total Mercury in Water by CVAAS	E508	863570	1	10	10.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	863382	1	20	5.0	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	863561	1	19	5.2	5.0	✓
TSS by Gravimetry	E160	863863	1	19	5.2	4.7	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	866098	1	19	5.2	5.0	✓
VOCs (Full List) by Headspace GC-MS	E611F	867468	1	1	100.0	5.0	✓
Matrix Spikes (MS)							
Fluoride in Water by IC	E235.F	865014	1	3	33.3	5.0	✓
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B	863310	1	18	5.5	5.0	✓
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A	863309	1	18	5.5	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	863563	1	14	7.1	5.0	✓
Sulfate in Water by IC	E235.SO4	865013	1	16	6.2	5.0	✓
Total Cyanide	E333	865831	1	20	5.0	5.0	✓
Total Hexavalent Chromium (Cr VI) by IC	E532	863582	1	13	7.6	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	863564	1	13	7.6	5.0	✓
Total Mercury in Water by CVAAS	E508	863570	1	10	10.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	863382	1	20	5.0	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	863561	1	19	5.2	5.0	✓

Matrix: **Water**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Matrix Spikes (MS) - Continued							
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	866098	1	19	5.2	5.0	✓
VOCs (Full List) by Headspace GC-MS	E611F	867468	1	1	100.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
E. coli (MF-mFC-BCIG)	E012A.EC Waterloo - Environmental	Water	ON E3433 (mod)	Following filtration (0.45 µm), and incubation at 44.5±0.2°C for 24 hours, colonies exhibiting characteristic morphology of the target organism are enumerated.
pH by Meter	E108 Waterloo - Environmental	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
TSS by Gravimetry	E160 Waterloo - Environmental	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at 104 ± 1°C, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
Fluoride in Water by IC	E235.F Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318 Waterloo - Environmental	Water	Method Fialab 100, 2018	TKN in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021).
Total Cyanide	E333 Waterloo - Environmental	Water	ISO 14403 (mod)	Total or Strong Acid Dissociable (SAD) Cyanide is determined by Continuous Flow Analyzer (CFA) with in-line UV digestion followed by colourmetric analysis. Method Limitation: High levels of thiocyanate (SCN) may cause positive interference (up to 0.5% of SCN concentration).
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U Waterloo - Environmental	Water	APHA 4500-P E (mod).	Total Phosphorus is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample.
Total metals in Water by CRC ICPMS	E420 Waterloo - Environmental	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total Mercury in Water by CVAAS	E508 Waterloo - Environmental	Water	EPA 1631E (mod)	Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS
Total Hexavalent Chromium (Cr VI) by IC	E532 Waterloo - Environmental	Water	APHA 3500-Cr C (Ion Chromatography)	Hexavalent Chromium is measured by Ion chromatography-Post column reaction and UV detection. Results are based on an un-filtered, field-preserved sample.
Biochemical Oxygen Demand - 5 day	E550 Waterloo - Environmental	Water	APHA 5210 B (mod)	Samples are diluted and incubated for a specified time period, after which the oxygen depletion is measured using a dissolved oxygen meter. Free chlorine is a negative interference in the BOD method; please advise ALS when free chlorine is present in samples.
Phenols (4AAP) in Water by Colorimetry	E562 Waterloo - Environmental	Water	EPA 9066	This automated method is based on the distillation of phenol and subsequent reaction of the distillate with alkaline ferricyanide ($K_3Fe(CN)_6$) and 4-amino-antipyrine (4-AAP) to form a red complex which is measured colorimetrically.
Oil & Grease by Gravimetry	E567 Calgary - Environmental	Water	BC MOE Lab Manual (Oil & Grease) (mod)	The entire water sample is extracted with hexane and the extract is evaporated to dryness. The residue is then weighed to determine Oil and Grease.
Mineral Oil & Grease by Gravimetry	E567SG Calgary - Environmental	Water	BC MOE Lab Manual (Oil & Grease) (mod)	The entire water sample is extracted with hexane, followed by silica gel treatment after which the extract is evaporated to dryness. The residue is then weighed to determine Mineral Oil and Grease.
VOCs (Eastern Canada List) by Headspace GC-MS	E611D Waterloo - Environmental	Water	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
VOCs (Full List) by Headspace GC-MS	E611F Waterloo - Environmental	Water	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PAHs by Hexane LVI GC-MS (Low Level)	E641A-L Waterloo - Environmental	Water	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by large volume injection (LVI) GC-MS.
PAHs (ON Special List) by GC-MS	E642D Waterloo - Environmental	Water	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by GC-MS.
BNA (Ontario Sanitary Sewer SVOC Target List) by GC-MS	E655F Waterloo - Environmental	Water	EPA 8270E (mod)	BNA are analyzed by GC-MS.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
PCB Aroclors by GC-MS	E687 Waterloo - Environmental	Water	EPA 8270E (mod)	PCB Aroclors are analyzed by GC-MS
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A Waterloo - Environmental	Water	J. Chrom A849 (1999) p.467-482	An aliquot of 5.0 ± 0.10 mL of filtered sample is spiked with Nonylphenol-D4, Nonylphenol Diethoxylate 13C6, and Bisphenol A 13C12 internal standards and analyzed by LC-MS/MS.
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B Waterloo - Environmental	Water	J. Chrom A849 (1999) p.467-482	Water samples are filtered and analyzed on LCMS/MS by direct injection.
Animal & Vegetable Oil & Grease by Gravimetry	EC567A.SG Calgary - Environmental	Water	APHA 5520 (mod)	Animal & vegetable oil and grease is calculated as follows: Oil & Grease (gravimetric) minus Mineral Oil & Grease (gravimetric)
Total PAH (Ontario Sewer Use Extended List)	EC640A Waterloo - Environmental	Water	Calculation (Sum of the Squares)	Total PAH (Ontario Sewer Use) is the sum of the following PAHs: anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b+j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, pyrene, benzo(e)pyrene, perylene, 3-methylcholanthrene, 1,3-dinitropyrene, 1,6-dinitropyrene, 1,8-dinitropyrene, 7H-dibenzo(c,g)carbazole, dibenzo(a,i)pyrene, dibenz(a,j)acridine, and dibenz(a,h)acridine. When the PAH is less than LOR, zero is used for calculation.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Digestion for TKN in water	EP318 Waterloo - Environmental	Water	APHA 4500-Norg D (mod)	Samples are digested at high temperature using Sulfuric Acid with Copper catalyst, which converts organic nitrogen sources to Ammonia, which is then quantified by the analytical method as TKN. This method is unsuitable for samples containing high levels of nitrate. If nitrate exceeds TKN concentration by ten times or more, results may be biased low.
Digestion for Total Phosphorus in water	EP372 Waterloo - Environmental	Water	APHA 4500-P E (mod).	Samples are heated with a persulfate digestion reagent.
Oil & Grease Extraction for Gravimetry	EP567 Calgary - Environmental	Water	BC MOE Lab Manual (Oil & Grease) (mod)	The entire water sample is extracted with hexane by liquid-liquid extraction.
VOCs Preparation for Headspace Analysis	EP581 Waterloo - Environmental	Water	EPA 5021A (mod)	Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler. An aliquot of the headspace is then injected into the GC/MS-FID system.
PHCs and PAHs Hexane Extraction	EP601 Waterloo - Environmental	Water	EPA 3511 (mod)	Petroleum Hydrocarbons (PHCs) and Polycyclic Aromatic Hydrocarbons (PAHs) are extracted using a hexane liquid-liquid extraction.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
PAHs DCM Extraction	EP642 Waterloo - Environmental	Water	EPA 3510C (mod)	PAH are extracted from aqueous sample using DCM liquid-liquid extraction.
BNA Extraction	EP655 Waterloo - Environmental	Water	EPA 3510C (mod)	SVOCs are extracted from aqueous sample using DCM liquid-liquid extraction.
Pesticides, PCB, and Neutral Extractable Chlorinated Hydrocarbons Extraction	EP660 Waterloo - Environmental	Water	EPA 3511 (mod)	Samples are extracted from aqueous sample using an organic solvent liquid-liquid extraction.
Preparation of Nonylphenol and Nonylphenol Ethoxylates	EP749 Waterloo - Environmental	Water	J. Chrom A849 (1999) p.467-482	An aliquot of 5.0 ± 0.10 mL of filtered sample is spiked with Nonylphenol-D4, Nonylphenol Diethoxylate 13C6, and Bisphenol A 13C12 internal standards and analyzed by LC-MS/MS.

QUALITY CONTROL REPORT

Work Order	: **WT2306151**	Page	: 1 of 16
Client	: WSP E&I Canada Limited	Laboratory	: Waterloo - Environmental
Contact	: Sarah Irvine	Account Manager	: Gayle Braun
Address	: 50 Vogel Road Unit 3 & 4 Richmond Hill ON Canada L4B 3K6	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: +1 519 886 6910
Project	: WW21012079.CO1P.****. 5120.573000	Date Samples Received	: 14-Mar-2023 15:40
PO	: ----	Date Analysis Commenced	: 14-Mar-2023
C-O-C number	: 20-1003332	Issue Date	: 21-Mar-2023 13:36
Sampler	: ---- ----		
Site	:		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Waterloo Microbiology, Waterloo, Ontario
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Greg Pokocky	Supervisor - Inorganic	Waterloo Inorganics, Waterloo, Ontario
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Marsha Calero	Laboratory Assistant	Calgary Organics, Calgary, Alberta
Nguyen Tran	Laboratory Analyst	Calgary Organics, Calgary, Alberta
Sanja Risticevic	Department Manager - LCMS	Waterloo LCMS, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	Waterloo Organics, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 863863)											
WT2306163-001	Anonymous	Solids, total suspended [TSS]	----	E160	150	mg/L	24200	25400	4.87%	20%	----
Physical Tests (QC Lot: 864651)											
WT2306084-009	Anonymous	pH	----	E108	0.10	pH units	7.86	7.89	0.381%	4%	----
Physical Tests (QC Lot: 865008)											
WT2306082-003	Anonymous	pH	----	E108	0.10	pH units	7.99	8.05	0.748%	4%	----
Anions and Nutrients (QC Lot: 863561)											
WT2306038-005	Anonymous	Phosphorus, total	7723-14-0	E372-U	0.0020	mg/L	0.0437	0.0438	0.388%	20%	----
Anions and Nutrients (QC Lot: 863564)											
WT2306041-002	Anonymous	Kjeldahl nitrogen, total [TKN]	----	E318	0.050	mg/L	0.100	0.090	0.010	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 865013)											
WT2306082-003	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	25.1	25.1	0.228%	20%	----
Anions and Nutrients (QC Lot: 865014)											
WT2306082-003	Anonymous	Fluoride	16984-48-8	E235.F	0.020	mg/L	0.581	0.587	1.16%	20%	----
Cyanides (QC Lot: 865831)											
CG2303021-001	Anonymous	Cyanide, strong acid dissociable (Total)	----	E333	0.200	mg/L	<0.200	<0.200	0	Diff <2x LOR	----
Total Metals (QC Lot: 863382)											
TY2301970-001	Anonymous	Aluminum, total	7429-90-5	E420	0.0030	mg/L	0.0048	0.0045	0.0003	Diff <2x LOR	----
		Antimony, total	7440-36-0	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00113	0.00113	0.0354%	20%	----
		Beryllium, total	7440-41-7	E420	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		Cadmium, total	7440-43-9	E420	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
		Chromium, total	7440-47-3	E420	0.00050	mg/L	0.00066	0.00057	0.00008	Diff <2x LOR	----
		Cobalt, total	7440-48-4	E420	0.00010	mg/L	0.00054	0.00055	0.000004	Diff <2x LOR	----
		Copper, total	7440-50-8	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Iron, total	7439-89-6	E420	0.010	mg/L	10.2	10.1	1.18%	20%	----
		Lead, total	7439-92-1	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Manganese, total	7439-96-5	E420	0.00010	mg/L	0.363	0.367	0.942%	20%	----
		Molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.00417	0.00388	7.38%	20%	----
		Nickel, total	7440-02-0	E420	0.00050	mg/L	0.00825	0.00837	1.48%	20%	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Total Metals (QC Lot: 863382) - continued											
TY2301970-001	Anonymous	Selenium, total	7782-49-2	E420	0.000050	mg/L	0.000052	<0.000050	0.000002	Diff <2x LOR	----
		Silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Tin, total	7440-31-5	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Titanium, total	7440-32-6	E420	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
		Zinc, total	7440-66-6	E420	0.0030	mg/L	<0.0030	<0.0030	0	Diff <2x LOR	----
Total Metals (QC Lot: 863570)											
TY2301993-002	Anonymous	Mercury, total	7439-97-6	E508	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
Speciated Metals (QC Lot: 863582)											
WT2305870-001	Anonymous	Chromium, hexavalent [Cr VI], total	18540-29-9	E532	0.00050	mg/L	0.0104	0.0105	0.950%	20%	----
Aggregate Organics (QC Lot: 863563)											
WT2305982-001	Anonymous	Phenols, total (4AAP)	----	E562	0.0010	mg/L	0.0051	0.0050	0.00008	Diff <2x LOR	----
Aggregate Organics (QC Lot: 863816)											
WT2306171-001	Anonymous	Biochemical oxygen demand [BOD]	----	E550	2.0	mg/L	5.5	5.3	3.9%	30%	----
Volatile Organic Compounds (QC Lot: 866098)											
WT2306113-001	Anonymous	Benzene	71-43-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Chloroform	67-66-3	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,2-	95-50-1	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,4-	106-46-7	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethylene, cis-1,2-	156-59-2	E611D	0.50	µg/L	399	389	2.53%	30%	----
		Dichloromethane	75-09-2	E611D	1.0	µg/L	<1.0	<1.0	0	Diff <2x LOR	----
		Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.30	µg/L	<0.30	<0.30	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E611D	0.50	µg/L	24.7	23.7	4.38%	30%	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tetrachloroethylene	127-18-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Toluene	108-88-3	E611D	0.50	µg/L	0.72	0.69	0.03	Diff <2x LOR	----
		Trichloroethylene	79-01-6	E611D	0.50	µg/L	382	367	3.89%	30%	----
		Xylene, m+p-	179601-23-1	E611D	0.40	µg/L	19.0	18.2	4.62%	30%	----
		Xylene, o-	95-47-6	E611D	0.30	µg/L	9.61	9.25	3.82%	30%	----
Volatile Organic Compounds (QC Lot: 867468)											
WT2306151-002	BH4 Halton	Benzene	71-43-2	E611F	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Chloroform	67-66-3	E611F	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,4-	106-46-7	E611F	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloromethane	75-09-2	E611F	1.0	µg/L	<1.0	<1.0	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E611F	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Volatile Organic Compounds (QC Lot: 867468) - continued											
WT2306151-002	BH4 Halton	Tetrachloroethylene	127-18-4	E611F	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Toluene	108-88-3	E611F	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichloroethylene	79-01-6	E611F	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
Nonylphenols (QC Lot: 863309)											
WT2305739-001	Anonymous	Nonylphenols [NP]	84852-15-3	E749A	1.0	µg/L	<1.0	<1.0	0	Diff <2x LOR	----
Nonylphenols (QC Lot: 863310)											
WT2305739-001	Anonymous	Nonylphenol diethoxylates [NP2EO]	n/a	E749B	0.10	µg/L	<0.10	<0.10	0	Diff <2x LOR	----
		Nonylphenol monoethoxylates [NP1EO]	n/a	E749B	2.0	µg/L	<2.0	<2.0	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 863863)						
Solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	----
Anions and Nutrients (QCLot: 863561)						
Phosphorus, total	7723-14-0	E372-U	0.002	mg/L	<0.0020	----
Anions and Nutrients (QCLot: 863564)						
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	<0.050	----
Anions and Nutrients (QCLot: 865013)						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 865014)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Cyanides (QCLot: 865831)						
Cyanide, strong acid dissociable (Total)	----	E333	0.002	mg/L	<0.0020	----
Microbiological Tests (QCLot: 864123)						
Coliforms, Escherichia coli [E. coli]	----	E012A.EC	1	CFU/100mL	<1	----
Total Metals (QCLot: 863382)						
Aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	----
Antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
Arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
Beryllium, total	7440-41-7	E420	0.00002	mg/L	<0.000020	----
Cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
Chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	----
Cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	----
Copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	----
Iron, total	7439-89-6	E420	0.01	mg/L	<0.010	----
Lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	----
Manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	----
Molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	----
Nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	----
Selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----
Silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
Tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----
Titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
Zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 863570)						
Mercury, total	7439-97-6	E508	0.000005	mg/L	<0.0000050	----
Speciated Metals (QCLot: 863582)						
Chromium, hexavalent [Cr VI], total	18540-29-9	E532	0.0005	mg/L	<0.00050	----
Aggregate Organics (QCLot: 863563)						
Phenols, total (4AAP)	----	E562	0.001	mg/L	<0.0010	----
Aggregate Organics (QCLot: 863816)						
Biochemical oxygen demand [BOD]	----	E550	2	mg/L	<2.0	----
Aggregate Organics (QCLot: 865915)						
Oil & grease (gravimetric)	----	E567	5	mg/L	<5.0	----
Aggregate Organics (QCLot: 865916)						
Oil & grease, mineral (gravimetric)	----	E567SG	5	mg/L	<5.0	----
Volatile Organic Compounds (QCLot: 866098)						
Benzene	71-43-2	E611D	0.5	µg/L	<0.50	----
Chloroform	67-66-3	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	<0.50	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	<0.50	----
Dichloromethane	75-09-2	E611D	1	µg/L	<1.0	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.3	µg/L	<0.30	----
Ethylbenzene	100-41-4	E611D	0.5	µg/L	<0.50	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.5	µg/L	<0.50	----
Tetrachloroethylene	127-18-4	E611D	0.5	µg/L	<0.50	----
Toluene	108-88-3	E611D	0.5	µg/L	<0.50	----
Trichloroethylene	79-01-6	E611D	0.5	µg/L	<0.50	----
Xylene, m+p-	179601-23-1	E611D	0.4	µg/L	<0.40	----
Xylene, o-	95-47-6	E611D	0.3	µg/L	<0.30	----
Volatile Organic Compounds (QCLot: 867468)						
Benzene	71-43-2	E611F	0.5	µg/L	<0.50	----
Chloroform	67-66-3	E611F	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,4-	106-46-7	E611F	0.5	µg/L	<0.50	----
Dichloromethane	75-09-2	E611F	1	µg/L	<1.0	----
Ethylbenzene	100-41-4	E611F	0.5	µg/L	<0.50	----
Tetrachloroethylene	127-18-4	E611F	0.5	µg/L	<0.50	----
Toluene	108-88-3	E611F	0.5	µg/L	<0.50	----
Trichloroethylene	79-01-6	E611F	0.5	µg/L	<0.50	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 863531)						
Anthracene	120-12-7	E641A-L	0.01	µg/L	<0.010	----
Benz(a)anthracene	56-55-3	E641A-L	0.01	µg/L	<0.010	----
Benzo(a)pyrene	50-32-8	E641A-L	0.005	µg/L	<0.0050	----
Benzo(b+j)fluoranthene	n/a	E641A-L	0.01	µg/L	<0.010	----
Benzo(e)pyrene	192-97-2	E641A-L	0.01	µg/L	<0.010	----
Benzo(g,h,i)perylene	191-24-2	E641A-L	0.01	µg/L	<0.010	----
Benzo(k)fluoranthene	207-08-9	E641A-L	0.01	µg/L	<0.010	----
Chrysene	218-01-9	E641A-L	0.01	µg/L	<0.010	----
Dibenz(a,h)anthracene	53-70-3	E641A-L	0.005	µg/L	<0.0050	----
Fluoranthene	206-44-0	E641A-L	0.01	µg/L	<0.010	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.01	µg/L	<0.010	----
Perylene	198-55-0	E641A-L	0.01	µg/L	<0.010	----
Phenanthrene	85-01-8	E641A-L	0.01	µg/L	<0.010	----
Pyrene	129-00-0	E641A-L	0.01	µg/L	<0.010	----
Polycyclic Aromatic Hydrocarbons (QCLot: 865023)						
Dibenz(a,h)acridine	226-36-8	E642D	0.05	µg/L	<0.050	----
Dibenz(a,j)acridine	224-42-0	E642D	0.05	µg/L	<0.050	----
Dibenzo(a,i)pyrene	189-55-9	E642D	0.05	µg/L	<0.050	----
Dibenzo(c,g)carbazole, 7H-	194-59-2	E642D	0.05	µg/L	<0.050	----
Dinitropyrene, 1,3-	75321-20-9	E642D	1	µg/L	<1.0	----
Dinitropyrene, 1,6-	42397-64-8	E642D	1	µg/L	<1.0	----
Dinitropyrene, 1,8-	42397-65-9	E642D	1	µg/L	<1.0	----
Methylcholanthrene, 3-	56-49-5	E642D	0.05	µg/L	<0.050	----
Phthalate Esters (QCLot: 865018)						
bis(2-Ethylhexyl) phthalate [DEHP]	117-81-7	E655F	2	µg/L	<2.0	----
Di-n-butyl phthalate	84-74-2	E655F	1	µg/L	<1.0	----
Semi-Volatile Organics (QCLot: 865018)						
Dichlorobenzidine, 3,3'-	91-94-1	E655F	0.4	µg/L	<0.40	----
Chlorinated Phenolics (QCLot: 865018)						
Pentachlorophenol [PCP]	87-86-5	E655F	0.5	µg/L	<0.50	----
Nonylphenols (QCLot: 863309)						
Nonylphenols [NP]	84852-15-3	E749A	1	µg/L	<1.0	----
Nonylphenols (QCLot: 863310)						
Nonylphenol diethoxylates [NP2EO]	n/a	E749B	0.1	µg/L	<0.10	----
Nonylphenol monoethoxylates [NP1EO]	n/a	E749B	2	µg/L	<2.0	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polychlorinated Biphenyls (QCLot: 863525)						
Aroclor 1016	12674-11-2	E687	0.02	µg/L	<0.020	----
Aroclor 1221	11104-28-2	E687	0.02	µg/L	<0.020	----
Aroclor 1232	11141-16-5	E687	0.02	µg/L	<0.020	----
Aroclor 1242	53469-21-9	E687	0.02	µg/L	<0.020	----
Aroclor 1248	12672-29-6	E687	0.02	µg/L	<0.020	----
Aroclor 1254	11097-69-1	E687	0.02	µg/L	<0.020	----
Aroclor 1260	11096-82-5	E687	0.02	µg/L	<0.020	----
Aroclor 1262	37324-23-5	E687	0.02	µg/L	<0.020	----
Aroclor 1268	11100-14-4	E687	0.02	µg/L	<0.020	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 863863)									
Solids, total suspended [TSS]	----	E160	3	mg/L	150 mg/L	87.8	85.0	115	----
Physical Tests (QCLot: 864651)									
pH	----	E108	----	pH units	7 pH units	101	98.0	102	----
Physical Tests (QCLot: 865008)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Anions and Nutrients (QCLot: 863561)									
Phosphorus, total	7723-14-0	E372-U	0.002	mg/L	0.845 mg/L	99.7	80.0	120	----
Anions and Nutrients (QCLot: 863564)									
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	4 mg/L	106	75.0	125	----
Anions and Nutrients (QCLot: 865013)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	98.0	90.0	110	----
Anions and Nutrients (QCLot: 865014)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	101	90.0	110	----
Cyanides (QCLot: 865831)									
Cyanide, strong acid dissociable (Total)	----	E333	0.002	mg/L	0.25 mg/L	88.6	80.0	120	----
Total Metals (QCLot: 863382)									
Aluminum, total	7429-90-5	E420	0.003	mg/L	0.1 mg/L	98.2	80.0	120	----
Antimony, total	7440-36-0	E420	0.0001	mg/L	0.05 mg/L	104	80.0	120	----
Arsenic, total	7440-38-2	E420	0.0001	mg/L	0.05 mg/L	103	80.0	120	----
Beryllium, total	7440-41-7	E420	0.00002	mg/L	0.005 mg/L	102	80.0	120	----
Cadmium, total	7440-43-9	E420	0.000005	mg/L	0.005 mg/L	102	80.0	120	----
Chromium, total	7440-47-3	E420	0.0005	mg/L	0.0125 mg/L	97.7	80.0	120	----
Cobalt, total	7440-48-4	E420	0.0001	mg/L	0.0125 mg/L	99.3	80.0	120	----
Copper, total	7440-50-8	E420	0.0005	mg/L	0.0125 mg/L	96.0	80.0	120	----
Iron, total	7439-89-6	E420	0.01	mg/L	0.05 mg/L	102	80.0	120	----
Lead, total	7439-92-1	E420	0.00005	mg/L	0.025 mg/L	103	80.0	120	----
Manganese, total	7439-96-5	E420	0.0001	mg/L	0.0125 mg/L	99.4	80.0	120	----
Molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.0125 mg/L	102	80.0	120	----
Nickel, total	7440-02-0	E420	0.0005	mg/L	0.025 mg/L	95.4	80.0	120	----
Selenium, total	7782-49-2	E420	0.00005	mg/L	0.05 mg/L	100	80.0	120	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report: Spike Concentration	Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Total Metals (QCLot: 863382) - continued									
Silver, total	7440-22-4	E420	0.00001	mg/L	0.005 mg/L	100	80.0	120	----
Tin, total	7440-31-5	E420	0.0001	mg/L	0.025 mg/L	102	80.0	120	----
Titanium, total	7440-32-6	E420	0.0003	mg/L	0.0125 mg/L	97.5	80.0	120	----
Zinc, total	7440-66-6	E420	0.003	mg/L	0.025 mg/L	99.2	80.0	120	----
Total Metals (QCLot: 863570)									
Mercury, total	7439-97-6	E508	0.000005	mg/L	0.0001 mg/L	91.3	80.0	120	----
Speciated Metals (QCLot: 863582)									
Chromium, hexavalent [Cr VI], total	18540-29-9	E532	0.0005	mg/L	0.025 mg/L	96.7	80.0	120	----
Aggregate Organics (QCLot: 863563)									
Phenols, total (4AAP)	----	E562	0.001	mg/L	0.02 mg/L	96.6	85.0	115	----
Aggregate Organics (QCLot: 863816)									
Biochemical oxygen demand [BOD]	----	E550	2	mg/L	198 mg/L	98.6	85.0	115	----
Aggregate Organics (QCLot: 865915)									
Oil & grease (gravimetric)	----	E567	5	mg/L	100 mg/L	70.4	70.0	130	----
Aggregate Organics (QCLot: 865916)									
Oil & grease, mineral (gravimetric)	----	E567SG	5	mg/L	50 mg/L	75.6	70.0	130	----
Volatile Organic Compounds (QCLot: 866098)									
Benzene	71-43-2	E611D	0.5	µg/L	100 µg/L	119	70.0	130	----
Chloroform	67-66-3	E611D	0.5	µg/L	100 µg/L	115	70.0	130	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	100 µg/L	111	70.0	130	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	100 µg/L	113	70.0	130	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	100 µg/L	112	70.0	130	----
Dichloromethane	75-09-2	E611D	1	µg/L	100 µg/L	124	70.0	130	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.3	µg/L	100 µg/L	75.9	70.0	130	----
Ethylbenzene	100-41-4	E611D	0.5	µg/L	100 µg/L	103	70.0	130	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.5	µg/L	100 µg/L	98.6	70.0	130	----
Tetrachloroethylene	127-18-4	E611D	0.5	µg/L	100 µg/L	117	70.0	130	----
Toluene	108-88-3	E611D	0.5	µg/L	100 µg/L	107	70.0	130	----
Trichloroethylene	79-01-6	E611D	0.5	µg/L	100 µg/L	125	70.0	130	----
Xylene, m+p-	179601-23-1	E611D	0.4	µg/L	200 µg/L	108	70.0	130	----
Xylene, o-	95-47-6	E611D	0.3	µg/L	100 µg/L	103	70.0	130	----
Volatile Organic Compounds (QCLot: 867468)									
Benzene	71-43-2	E611F	0.5	µg/L	100 µg/L	101	70.0	130	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 867468) - continued									
Chloroform	67-66-3	E611F	0.5	µg/L	100 µg/L	96.8	70.0	130	----
Dichlorobenzene, 1,4-	106-46-7	E611F	0.5	µg/L	100 µg/L	102	70.0	130	----
Dichloromethane	75-09-2	E611F	1	µg/L	100 µg/L	106	70.0	130	----
Ethylbenzene	100-41-4	E611F	0.5	µg/L	100 µg/L	88.1	70.0	130	----
Tetrachloroethylene	127-18-4	E611F	0.5	µg/L	100 µg/L	103	70.0	130	----
Toluene	108-88-3	E611F	0.5	µg/L	100 µg/L	91.5	70.0	130	----
Trichloroethylene	79-01-6	E611F	0.5	µg/L	100 µg/L	108	70.0	130	----
Polycyclic Aromatic Hydrocarbons (QCLot: 863531)									
Anthracene	120-12-7	E641A-L	0.01	µg/L	0.5263 µg/L	81.4	50.0	140	----
Benz(a)anthracene	56-55-3	E641A-L	0.01	µg/L	0.5263 µg/L	90.5	50.0	140	----
Benzo(a)pyrene	50-32-8	E641A-L	0.005	µg/L	0.5263 µg/L	77.0	50.0	140	----
Benzo(b+j)fluoranthene	n/a	E641A-L	0.01	µg/L	0.5263 µg/L	79.9	50.0	140	----
Benzo(e)pyrene	192-97-2	E641A-L	0.01	µg/L	0.5263 µg/L	93.6	50.0	140	----
Benzo(g,h,i)perylene	191-24-2	E641A-L	0.01	µg/L	0.5263 µg/L	92.9	50.0	140	----
Benzo(k)fluoranthene	207-08-9	E641A-L	0.01	µg/L	0.5263 µg/L	90.7	50.0	140	----
Chrysene	218-01-9	E641A-L	0.01	µg/L	0.5263 µg/L	102	50.0	140	----
Dibenz(a,h)anthracene	53-70-3	E641A-L	0.005	µg/L	0.5263 µg/L	81.6	50.0	140	----
Fluoranthene	206-44-0	E641A-L	0.01	µg/L	0.5263 µg/L	100	50.0	140	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.01	µg/L	0.5263 µg/L	98.6	50.0	140	----
Perylene	198-55-0	E641A-L	0.01	µg/L	0.5263 µg/L	96.2	50.0	140	----
Phenanthrene	85-01-8	E641A-L	0.01	µg/L	0.5263 µg/L	97.1	50.0	140	----
Pyrene	129-00-0	E641A-L	0.01	µg/L	0.5263 µg/L	100	50.0	140	----
Polycyclic Aromatic Hydrocarbons (QCLot: 865023)									
Dibenz(a,h)acridine	226-36-8	E642D	0.05	µg/L	1.6 µg/L	108	60.0	130	----
Dibenz(a,j)acridine	224-42-0	E642D	0.05	µg/L	1.6 µg/L	103	60.0	130	----
Dibenzo(a,i)pyrene	189-55-9	E642D	0.05	µg/L	1.6 µg/L	63.0	60.0	130	----
Dibenzo(c,g)carbazole, 7H-	194-59-2	E642D	0.05	µg/L	1.6 µg/L	112	60.0	130	----
Dinitropyrene, 1,3-	75321-20-9	E642D	1	µg/L	1.6 µg/L	120	60.0	130	----
Dinitropyrene, 1,6-	42397-64-8	E642D	1	µg/L	1.6 µg/L	66.3	60.0	130	----
Dinitropyrene, 1,8-	42397-65-9	E642D	1	µg/L	1.6 µg/L	94.9	60.0	130	----
Methylcholanthrene, 3-	56-49-5	E642D	0.05	µg/L	1.6 µg/L	# 192	60.0	130	LCS-H
Phthalate Esters (QCLot: 865018)									
bis(2-Ethylhexyl) phthalate [DEHP]	117-81-7	E655F	2	µg/L	6.4 µg/L	107	50.0	140	----
Di-n-butyl phthalate	84-74-2	E655F	1	µg/L	6.4 µg/L	108	50.0	140	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Semi-Volatile Organics (QCLot: 865018)									
Dichlorobenzidine, 3,3'-	91-94-1	E655F	0.4	µg/L	1.6 µg/L	# 37.1	50.0	140	LCS-ND
Chlorinated Phenolics (QCLot: 865018)									
Pentachlorophenol [PCP]	87-86-5	E655F	0.5	µg/L	4.8 µg/L	135	50.0	140	----
Nonylphenols (QCLot: 863309)									
Nonylphenols [NP]	84852-15-3	E749A	1	µg/L	10 µg/L	98.8	75.0	125	----
Nonylphenols (QCLot: 863310)									
Nonylphenol diethoxylates [NP2EO]	n/a	E749B	0.1	µg/L	1 µg/L	102	75.0	125	----
Nonylphenol monoethoxylates [NP1EO]	n/a	E749B	2	µg/L	20 µg/L	118	75.0	125	----
Polychlorinated Biphenyls (QCLot: 863525)									
Aroclor 1016	12674-11-2	E687	0.02	µg/L	0.2 µg/L	116	60.0	140	----
Aroclor 1221	11104-28-2	E687	0.02	µg/L	0.2 µg/L	116	60.0	140	----
Aroclor 1232	11141-16-5	E687	0.02	µg/L	0.2 µg/L	116	60.0	140	----
Aroclor 1242	53469-21-9	E687	0.02	µg/L	0.2 µg/L	116	60.0	140	----
Aroclor 1248	12672-29-6	E687	0.02	µg/L	0.2 µg/L	109	60.0	140	----
Aroclor 1254	11097-69-1	E687	0.02	µg/L	0.2 µg/L	83.5	60.0	140	----
Aroclor 1260	11096-82-5	E687	0.02	µg/L	0.2 µg/L	92.1	60.0	140	----
Aroclor 1262	37324-23-5	E687	0.02	µg/L	0.2 µg/L	92.1	60.0	140	----
Aroclor 1268	11100-14-4	E687	0.02	µg/L	0.2 µg/L	92.1	60.0	140	----

Qualifiers

Qualifier	Description
LCS-H	*Lab Control Sample recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.*
LCS-ND	*Lab Control Sample recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.*

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 863561)										
WT2306038-005	Anonymous	Phosphorus, total	7723-14-0	E372-U	0.0975 mg/L	0.1 mg/L	97.5	70.0	130	----
Anions and Nutrients (QCLot: 863564)										
WT2306041-002	Anonymous	Kjeldahl nitrogen, total [TKN]	----	E318	2.80 mg/L	2.5 mg/L	112	70.0	130	----
Anions and Nutrients (QCLot: 865013)										
WT2306082-003	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	97.9 mg/L	100 mg/L	97.9	75.0	125	----
Anions and Nutrients (QCLot: 865014)										
WT2306082-003	Anonymous	Fluoride	16984-48-8	E235.F	1.01 mg/L	1 mg/L	101	75.0	125	----
Cyanides (QCLot: 865831)										
CG2303021-001	Anonymous	Cyanide, strong acid dissociable (Total)	----	E333	0.233 mg/L	0.25 mg/L	93.3	75.0	125	----
Total Metals (QCLot: 863382)										
TY2301973-001	Anonymous	Aluminum, total	7429-90-5	E420	0.0964 mg/L	0.1 mg/L	96.4	70.0	130	----
		Antimony, total	7440-36-0	E420	0.0520 mg/L	0.05 mg/L	104	70.0	130	----
		Arsenic, total	7440-38-2	E420	0.0520 mg/L	0.05 mg/L	104	70.0	130	----
		Beryllium, total	7440-41-7	E420	0.00522 mg/L	0.005 mg/L	104	70.0	130	----
		Cadmium, total	7440-43-9	E420	0.00505 mg/L	0.005 mg/L	101	70.0	130	----
		Chromium, total	7440-47-3	E420	0.0124 mg/L	0.0125 mg/L	99.7	70.0	130	----
		Cobalt, total	7440-48-4	E420	0.0124 mg/L	0.0125 mg/L	99.3	70.0	130	----
		Copper, total	7440-50-8	E420	0.0122 mg/L	0.0125 mg/L	97.4	70.0	130	----
		Iron, total	7439-89-6	E420	ND mg/L	0.05 mg/L	ND	70.0	130	----
		Lead, total	7439-92-1	E420	0.0255 mg/L	0.025 mg/L	102	70.0	130	----
		Manganese, total	7439-96-5	E420	0.0122 mg/L	0.0125 mg/L	97.8	70.0	130	----
		Molybdenum, total	7439-98-7	E420	0.0127 mg/L	0.0125 mg/L	102	70.0	130	----
		Nickel, total	7440-02-0	E420	0.0240 mg/L	0.025 mg/L	96.2	70.0	130	----
		Selenium, total	7782-49-2	E420	0.0509 mg/L	0.05 mg/L	102	70.0	130	----
		Silver, total	7440-22-4	E420	0.00496 mg/L	0.005 mg/L	99.2	70.0	130	----
		Tin, total	7440-31-5	E420	0.0254 mg/L	0.025 mg/L	102	70.0	130	----
		Titanium, total	7440-32-6	E420	0.0122 mg/L	0.0125 mg/L	98.0	70.0	130	----
		Zinc, total	7440-66-6	E420	0.0244 mg/L	0.025 mg/L	97.4	70.0	130	----
Total Metals (QCLot: 863570)										
TY2301993-003	Anonymous	Mercury, total	7439-97-6	E508	0.000102 mg/L	0.0001 mg/L	102	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Speciated Metals (QCLot: 863582)										
WT2305870-001	Anonymous	Chromium, hexavalent [Cr VI], total	18540-29-9	E532	0.0389 mg/L	0.04 mg/L	97.4	70.0	130	----
Aggregate Organics (QCLot: 863563)										
WT2305982-001	Anonymous	Phenols, total (4AAP)	----	E562	0.0196 mg/L	0.02 mg/L	98.3	75.0	125	----
Volatile Organic Compounds (QCLot: 866098)										
WT2306113-001	Anonymous	Benzene	71-43-2	E611D	104 µg/L	100 µg/L	104	60.0	140	----
		Chloroform	67-66-3	E611D	102 µg/L	100 µg/L	102	60.0	140	----
		Dichlorobenzene, 1,2-	95-50-1	E611D	97.4 µg/L	100 µg/L	97.4	60.0	140	----
		Dichlorobenzene, 1,4-	106-46-7	E611D	99.7 µg/L	100 µg/L	99.7	60.0	140	----
		Dichloroethylene, cis-1,2-	156-59-2	E611D	ND µg/L	100 µg/L	ND	60.0	140	----
		Dichloromethane	75-09-2	E611D	108 µg/L	100 µg/L	108	60.0	140	----
		Dichloropropylene, trans-1,3-	10061-02-6	E611D	69.1 µg/L	100 µg/L	69.1	60.0	140	----
		Ethylbenzene	100-41-4	E611D	88.2 µg/L	100 µg/L	88.2	60.0	140	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	89.8 µg/L	100 µg/L	89.8	60.0	140	----
		Tetrachloroethylene	127-18-4	E611D	99.1 µg/L	100 µg/L	99.1	60.0	140	----
		Toluene	108-88-3	E611D	91.6 µg/L	100 µg/L	91.6	60.0	140	----
		Trichloroethylene	79-01-6	E611D	ND µg/L	100 µg/L	ND	60.0	140	----
		Xylene, m+p-	179601-23-1	E611D	187 µg/L	200 µg/L	93.6	60.0	140	----
		Xylene, o-	95-47-6	E611D	89.8 µg/L	100 µg/L	89.8	60.0	140	----
Volatile Organic Compounds (QCLot: 867468)										
WT2306151-002	BH4 Halton	Benzene	71-43-2	E611F	104 µg/L	100 µg/L	104	60.0	140	----
		Chloroform	67-66-3	E611F	101 µg/L	100 µg/L	101	60.0	140	----
		Dichlorobenzene, 1,4-	106-46-7	E611F	104 µg/L	100 µg/L	104	60.0	140	----
		Dichloromethane	75-09-2	E611F	109 µg/L	100 µg/L	109	60.0	140	----
		Ethylbenzene	100-41-4	E611F	91.2 µg/L	100 µg/L	91.2	60.0	140	----
		Tetrachloroethylene	127-18-4	E611F	105 µg/L	100 µg/L	105	60.0	140	----
		Toluene	108-88-3	E611F	94.4 µg/L	100 µg/L	94.4	60.0	140	----
		Trichloroethylene	79-01-6	E611F	112 µg/L	100 µg/L	112	60.0	140	----
Nonylphenols (QCLot: 863309)										
WT2305739-001	Anonymous	Nonylphenols [NP]	84852-15-3	E749A	13.4 µg/L	10 µg/L	134	60.0	140	----
Nonylphenols (QCLot: 863310)										
WT2305739-001	Anonymous	Nonylphenol diethoxylates [NP2EO]	n/a	E749B	0.85 µg/L	1 µg/L	85.1	60.0	140	----
		Nonylphenol monoethoxylates [NP1EO]	n/a	E749B	19.4 µg/L	20 µg/L	96.9	60.0	140	----

Chain of Custody (COC) / Analytical Request Form

ALS www.alsglobal.com

Canada Toll Free: 1 800 668 9878

COC Number: 20 - 1003332

Page of

JD

Report To (Contact and company name below will appear on the final report)
Company: WSP
Contact: Sarah Irvine
Phone:

(Company address below will appear on the final report)
Street: 3450 Harvester Rd
City/Province: Burlington ON
Postal Code: L7N 3W5

Invoice To
Same as Report To ☐ YES ☒ NO
Copy of Invoice with Report ☒ YES ☐ NO
Company: WSP
Contact: AP Invoice

Project Information
ALS Account # / Quote #:
Job #:
PO / AFE:
LSD:

Reports / Recipients
Select Report Format: ☐ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA ☒ YES ☐ NO ☐ N/A
☒ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: Sarah.irvine@wsp.com
Email 2: Jessica.Pitman@wsp.com
Email 3: ryan.phillips@wsp.com

Invoice Recipients
Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: APinvoice.Canada@wsp.com
Email 2:

Oil and Gas Required Fields (client use)
AFE/Cost Center: PO#
Major/Minor Code: Routing Code:
Requisitioner:
Location:

Turnaround Time (TAT) Requested
☒ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimu
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minim
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minim
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minim
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Ad
may apply to rush requests on weekends, statutory holidays and non-
Date and Time Required for all E&P TATs:
For all tests with rush TATs requested, pleas

Environmental Division
Waterloo
Work Order Reference
WT2306151

Telephone : +1 519 886 6910

ALS Lab Work Order # (ALS use only): WT2306151

ALS Contact: Sampler:

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Analysis Request: Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P)						SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see Special Instructions)
						Burlington Storm	Halton Sanitary	Total metals	Total mercury	Total chromium				
	BH 4	March 14,23	1000	GW	2	X	X							
	BH 4-F	March 14,23	1000	GW	3			X	X	X				

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System? ☐ YES ☒ NO
Are samples for human consumption/ use? ☐ YES ☒ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)
Compare BH-4-F directly to Sewer Bylaw metals
*Broke/missing BTEX Vial.

SAMPLE RECEIPT DETAILS (ALS use only)
Cooling Method: ☐ NONE ☐ ICE ☒ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED
Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO
Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
1.2°C			7.1		

SHIPMENT RELEASE (client use)
Released by: Ryan Phillips Date: March 14,23 Time: 3:00pm

INITIAL SHIPMENT RECEPTION (ALS use only)
Received by: JG Date: 3/14/2023 Time: 3:40pm

FINAL SHIPMENT RECEPTION (ALS use only)
Received by: FH Date: 2023-03-14 Time: 5:30PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Se-200 CN-EQL B-S25 L-416

ALS Canada Ltd.

right solutions.
right partner.

CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2306162**	Page	: 1 of 7
Client	: **WSP E&I Canada Limited**	Laboratory	: Waterloo - Environmental
Contact	: Sarah Irvine	Account Manager	: Gayle Braun
Address	: 100 - 3450 Harvester Road Burlington ON Canada L7N 3W5	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: WW21012079.CO1P.****. 5120.573000	Date Samples Received	: 14-Mar-2023 15:00
PO	: ----	Date Analysis Commenced	: 15-Mar-2023
C-O-C number	: 20-1003324	Issue Date	: 20-Mar-2023 15:03
Sampler	: ----		
Site	:		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Danielle Gravel	Supervisor - Semi-Volatile Instrumentation	Organics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Inorganics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Metals, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	Organics, Waterloo, Ontario

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guidelines are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Key : LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
µg/L	micrograms per litre
mg/L	milligrams per litre
mS/cm	millisiemens per centimetre
pH units	pH units

>: greater than.
<: less than.
Red shading is applied where the result is greater than the Guideline Upper Limit or the result is lower than the Guideline Lower Limit.
For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit .

Analytical Results

Sub-Matrix: **Water** (Matrix: **Water**)			Client sample ID	BH-4						
			Sampling date/time	14-Mar-2023 15:00						
Analyte	*Method*	*LOR*	*Unit*	WT2306162-001	**ON153/04 T3-NPGW-C-All**	**ON153/04 T3-NPGW-F-All**				
Physical Tests										
Conductivity	E100	0.0010	mS/cm	1.00	--	--	--	--	--	--
pH	E108	0.10	pH units	7.95	--	--	--	--	--	--
Anions and Nutrients										
Chloride	E235.Cl	0.50	mg/L	2.71	2300 mg/L	2300 mg/L	--	--	--	--
Cyanides										
Cyanide, weak acid dissociable	E336	2.0	µg/L	<2.0	66 µg/L	66 µg/L	--	--	--	--
Dissolved Metals										
Antimony, dissolved	E421	0.10	µg/L	<0.10	20000 µg/L	20000 µg/L	--	--	--	--
Arsenic, dissolved	E421	0.10	µg/L	0.22	1900 µg/L	1900 µg/L	--	--	--	--
Barium, dissolved	E421	0.10	µg/L	64.1	29000 µg/L	29000 µg/L	--	--	--	--
Beryllium, dissolved	E421	0.020	µg/L	<0.020	67 µg/L	67 µg/L	--	--	--	--
Boron, dissolved	E421	10	µg/L	124	45000 µg/L	45000 µg/L	--	--	--	--
Cadmium, dissolved	E421	0.0050	µg/L	<0.0050	2.7 µg/L	2.7 µg/L	--	--	--	--
Chromium, dissolved	E421	0.50	µg/L	<0.50	810 µg/L	810 µg/L	--	--	--	--
Cobalt, dissolved	E421	0.10	µg/L	<0.10	66 µg/L	66 µg/L	--	--	--	--
Copper, dissolved	E421	0.20	µg/L	0.33	87 µg/L	87 µg/L	--	--	--	--
Lead, dissolved	E421	0.050	µg/L	<0.050	25 µg/L	25 µg/L	--	--	--	--
Mercury, dissolved	E509	0.0050	µg/L	<0.0050	0.29 µg/L	2.8 µg/L	--	--	--	--
Molybdenum, dissolved	E421	0.050	µg/L	1.29	9200 µg/L	9200 µg/L	--	--	--	--
Nickel, dissolved	E421	0.50	µg/L	0.57	490 µg/L	490 µg/L	--	--	--	--
Selenium, dissolved	E421	0.050	µg/L	0.292	63 µg/L	63 µg/L	--	--	--	--
Silver, dissolved	E421	0.010	µg/L	<0.010	1.5 µg/L	1.5 µg/L	--	--	--	--
Sodium, dissolved	E421	50	µg/L	18500	2300000 µg/L	2300000 µg/L	--	--	--	--
Thallium, dissolved	E421	0.010	µg/L	0.028	510 µg/L	510 µg/L	--	--	--	--
Uranium, dissolved	E421	0.010	µg/L	6.68	420 µg/L	420 µg/L	--	--	--	--
Vanadium, dissolved	E421	0.50	µg/L	0.85	250 µg/L	250 µg/L	--	--	--	--
Zinc, dissolved	E421	1.0	µg/L	<1.0	1100 µg/L	1100 µg/L	--	--	--	--
Dissolved mercury filtration location	EP509		-	Field	--	--	--	--	--	--
Dissolved metals filtration location	EP421		-	Field	--	--	--	--	--	--

Analyte	Method	LOR	Unit	WT2306162-001 (Continued)	ON153/04 T3-NPGW-C-All	ON153/04 T3-NPGW-F-All				
Speciated Metals										
Chromium, hexavalent [Cr VI], dissolved	E532A	0.50	µg/L	<0.50	140 µg/L	140 µg/L	--	--	--	--
Volatile Organic Compounds										
Acetone	E611D	20	µg/L	<20	130000 µg/L	130000 µg/L	--	--	--	--
Benzene	E611D	0.50	µg/L	<0.50	44 µg/L	430 µg/L	--	--	--	--
Bromodichloromethane	E611D	0.50	µg/L	<0.50	85000 µg/L	85000 µg/L	--	--	--	--
Bromoform	E611D	0.50	µg/L	<0.50	380 µg/L	770 µg/L	--	--	--	--
Bromomethane	E611D	0.50	µg/L	<0.50	5.6 µg/L	56 µg/L	--	--	--	--
Carbon tetrachloride	E611D	0.20	µg/L	<0.20	0.79 µg/L	8.4 µg/L	--	--	--	--
Chlorobenzene	E611D	0.50	µg/L	<0.50	630 µg/L	630 µg/L	--	--	--	--
Chloroform	E611D	0.50	µg/L	<0.50	2.4 µg/L	22 µg/L	--	--	--	--
Dibromochloromethane	E611D	0.50	µg/L	<0.50	82000 µg/L	82000 µg/L	--	--	--	--
Dibromoethane, 1,2-	E611D	0.20	µg/L	<0.20	0.25 µg/L	0.83 µg/L	--	--	--	--
Dichlorobenzene, 1,2-	E611D	0.50	µg/L	<0.50	4600 µg/L	9600 µg/L	--	--	--	--
Dichlorobenzene, 1,3-	E611D	0.50	µg/L	<0.50	9600 µg/L	9600 µg/L	--	--	--	--
Dichlorobenzene, 1,4-	E611D	0.50	µg/L	<0.50	8 µg/L	67 µg/L	--	--	--	--
Dichlorodifluoromethane	E611D	0.50	µg/L	<0.50	4400 µg/L	4400 µg/L	--	--	--	--
Dichloroethane, 1,1-	E611D	0.50	µg/L	<0.50	320 µg/L	3100 µg/L	--	--	--	--
Dichloroethane, 1,2-	E611D	0.50	µg/L	<0.50	1.6 µg/L	12 µg/L	--	--	--	--
Dichloroethylene, 1,1-	E611D	0.50	µg/L	<0.50	1.6 µg/L	17 µg/L	--	--	--	--
Dichloroethylene, cis-1,2-	E611D	0.50	µg/L	<0.50	1.6 µg/L	17 µg/L	--	--	--	--
Dichloroethylene, trans-1,2-	E611D	0.50	µg/L	<0.50	1.6 µg/L	17 µg/L	--	--	--	--
Dichloromethane	E611D	1.0	µg/L	<1.0	610 µg/L	5500 µg/L	--	--	--	--
Dichloropropane, 1,2-	E611D	0.50	µg/L	<0.50	16 µg/L	140 µg/L	--	--	--	--
Dichloropropylene, cis+trans-1,3-	E611D	0.50	µg/L	<0.50	5.2 µg/L	45 µg/L	--	--	--	--
Dichloropropylene, cis-1,3-	E611D	0.30	µg/L	<0.30	--	--	--	--	--	--
Dichloropropylene, trans-1,3-	E611D	0.30	µg/L	<0.30	--	--	--	--	--	--
Ethylbenzene	E611D	0.50	µg/L	<0.50	2300 µg/L	2300 µg/L	--	--	--	--
Hexane, n-	E611D	0.50	µg/L	<0.50	51 µg/L	520 µg/L	--	--	--	--
Methyl ethyl ketone [MEK]	E611D	20	µg/L	<20	470000 µg/L	1500000 µg/L	--	--	--	--
Methyl isobutyl ketone [MIBK]	E611D	20	µg/L	<20	140000 µg/L	580000 µg/L	--	--	--	--
Methyl-tert-butyl ether [MTBE]	E611D	0.50	µg/L	<0.50	190 µg/L	1400 µg/L	--	--	--	--
Styrene	E611D	0.50	µg/L	<0.50	1300 µg/L	9100 µg/L	--	--	--	--
Tetrachloroethane, 1,1,1,2-	E611D	0.50	µg/L	<0.50	3.3 µg/L	28 µg/L	--	--	--	--

Analyte	Method	LOR	Unit	WT2306162-001 (Continued)	ON153/04 T3-NPGW-C-All	ON153/04 T3-NPGW-F-All				
Volatile Organic Compounds - Continued										
Tetrachloroethane, 1,1,2,2-	E611D	0.50	µg/L	<0.50	3.2 µg/L	15 µg/L	--	--	--	--
Tetrachloroethylene	E611D	0.50	µg/L	<0.50	1.6 µg/L	17 µg/L	--	--	--	--
Toluene	E611D	0.50	µg/L	<0.50	18000 µg/L	18000 µg/L	--	--	--	--
Trichloroethane, 1,1,1-	E611D	0.50	µg/L	<0.50	640 µg/L	6700 µg/L	--	--	--	--
Trichloroethane, 1,1,2-	E611D	0.50	µg/L	<0.50	4.7 µg/L	30 µg/L	--	--	--	--
Trichloroethylene	E611D	0.50	µg/L	<0.50	1.6 µg/L	17 µg/L	--	--	--	--
Trichlorofluoromethane	E611D	0.50	µg/L	<0.50	2500 µg/L	2500 µg/L	--	--	--	--
Vinyl chloride	E611D	0.50	µg/L	<0.50	0.5 µg/L	1.7 µg/L	--	--	--	--
Xylene, m+p-	E611D	0.40	µg/L	<0.40	--	--	--	--	--	--
Xylene, o-	E611D	0.30	µg/L	<0.30	--	--	--	--	--	--
Xylenes, total	E611D	0.50	µg/L	<0.50	4200 µg/L	4200 µg/L	--	--	--	--
BTEX, total	E611D	1.0	µg/L	<1.0	--	--	--	--	--	--
Hydrocarbons										
F1 (C6-C10)	E581.F1-L	25	µg/L	<25	750 µg/L	750 µg/L	--	--	--	--
F2 (C10-C16)	E601.SG	100	µg/L	<100	150 µg/L	150 µg/L	--	--	--	--
F2-Naphthalene	EC600SG	100	µg/L	<100	--	--	--	--	--	--
F3 (C16-C34)	E601.SG	250	µg/L	<250	500 µg/L	500 µg/L	--	--	--	--
F3-PAH	EC600SG	250	µg/L	<250	--	--	--	--	--	--
F4 (C34-C50)	E601.SG	250	µg/L	<250	500 µg/L	500 µg/L	--	--	--	--
F1-BTEX	EC580	25	µg/L	<25	750 µg/L	750 µg/L	--	--	--	--
Hydrocarbons, total (C6-C50)	EC581SG	240	µg/L	<370	--	--	--	--	--	--
Chromatogram to baseline at nC50	E601.SG		-	YES	--	--	--	--	--	--
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	E601.SG	1.0	%	84.3	--	--	--	--	--	--
Dichlorotoluene, 3,4-	E581.F1-L	1.0	%	75.8	--	--	--	--	--	--
Bromofluorobenzene, 4-	E611D	1.0	%	79.5	--	--	--	--	--	--
Difluorobenzene, 1,4-	E611D	1.0	%	96.4	--	--	--	--	--	--
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	E641A	0.010	µg/L	<0.010	600 µg/L	1700 µg/L	--	--	--	--
Acenaphthylene	E641A	0.010	µg/L	<0.010	1.8 µg/L	1.8 µg/L	--	--	--	--
Anthracene	E641A	0.010	µg/L	<0.010	2.4 µg/L	2.4 µg/L	--	--	--	--
Benz(a)anthracene	E641A	0.010	µg/L	<0.010	4.7 µg/L	4.7 µg/L	--	--	--	--
Benzo(a)pyrene	E641A	0.0050	µg/L	<0.0050	0.81 µg/L	0.81 µg/L	--	--	--	--
Benzo(b+j)fluoranthene	E641A	0.010	µg/L	<0.010	0.75 µg/L	0.75 µg/L	--	--	--	--

Analyte	Method	LOR	Unit	WT2306162-001 (Continued)	ON153/04 T3-NPGW-C-AII	ON153/04 T3-NPGW-F-AII				
Polycyclic Aromatic Hydrocarbons - Continued										
Benzo(g,h,i)perylene	E641A	0.010	µg/L	<0.010	0.2 µg/L	0.2 µg/L	--	--	--	--
Benzo(k)fluoranthene	E641A	0.010	µg/L	<0.010	0.4 µg/L	0.4 µg/L	--	--	--	--
Chrysene	E641A	0.010	µg/L	<0.010	1 µg/L	1 µg/L	--	--	--	--
Dibenz(a,h)anthracene	E641A	0.0050	µg/L	<0.0050	0.52 µg/L	0.52 µg/L	--	--	--	--
Fluoranthene	E641A	0.010	µg/L	<0.010	130 µg/L	130 µg/L	--	--	--	--
Fluorene	E641A	0.010	µg/L	<0.010	400 µg/L	400 µg/L	--	--	--	--
Indeno(1,2,3-c,d)pyrene	E641A	0.010	µg/L	<0.010	0.2 µg/L	0.2 µg/L	--	--	--	--
Methylnaphthalene, 1+2-	E641A	0.015	µg/L	<0.015	1800 µg/L	1800 µg/L	--	--	--	--
Methylnaphthalene, 1-	E641A	0.010	µg/L	<0.010	1800 µg/L	1800 µg/L	--	--	--	--
Methylnaphthalene, 2-	E641A	0.010	µg/L	<0.010	1800 µg/L	1800 µg/L	--	--	--	--
Naphthalene	E641A	0.050	µg/L	<0.050	1400 µg/L	6400 µg/L	--	--	--	--
Phenanthrene	E641A	0.020	µg/L	<0.020	580 µg/L	580 µg/L	--	--	--	--
Pyrene	E641A	0.010	µg/L	<0.010	68 µg/L	68 µg/L	--	--	--	--
Chrysene-d12	E641A	0.1	%	82.5	--	--	--	--	--	--
Naphthalene-d8	E641A	0.1	%	105	--	--	--	--	--	--
Phenanthrene-d10	E641A	0.1	%	97.4	--	--	--	--	--	--
Polychlorinated Biphenyls										
Aroclor 1016	E687	0.020	µg/L	<0.020	--	--	--	--	--	--
Aroclor 1221	E687	0.020	µg/L	<0.020	--	--	--	--	--	--
Aroclor 1232	E687	0.020	µg/L	<0.020	--	--	--	--	--	--
Aroclor 1242	E687	0.020	µg/L	<0.020	--	--	--	--	--	--
Aroclor 1248	E687	0.020	µg/L	<0.020	--	--	--	--	--	--
Aroclor 1254	E687	0.020	µg/L	<0.020	--	--	--	--	--	--
Aroclor 1260	E687	0.020	µg/L	<0.020	--	--	--	--	--	--
Aroclor 1262	E687	0.020	µg/L	<0.020	--	--	--	--	--	--
Aroclor 1268	E687	0.020	µg/L	<0.020	--	--	--	--	--	--
Polychlorinated biphenyls [PCBs], total	E687	0.060	µg/L	<0.060	7.8 µg/L	15 µg/L	--	--	--	--
Decachlorobiphenyl	E687	0.1	%	135	--	--	--	--	--	--
Tetrachloro-m-xylene	E687	0.1	%	97.1	--	--	--	--	--	--

Please refer to the General Comments section for an explanation of any qualifiers detected.

No Breaches Found

Key:

ON153/04	Ontario Regulation 153/04 - April 15, 2011 Standards (JUL, 2011)
T3-NPGW-C-All	153 T3-Non-Potable Ground Water-All Types of Property Uses (Coarse)
T3-NPGW-F-All	153 T3-Non-Potable Ground Water-All Types of Property Uses (Fine)

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QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2306162**	Page	: 1 of 9
Client	: **WSP E&I Canada Limited**	Laboratory	: Waterloo - Environmental
Contact	: Sarah Irvine	Account Manager	: Gayle Braun
Address	: 100 - 3450 Harvester Road Burlington ON Canada L7N 3W5	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: WW21012079.CO1P.****. 5120.573000	Date Samples Received	: 14-Mar-2023 15:00
PO	: ----	Issue Date	: 20-Mar-2023 15:03
C-O-C number	: 20-1003324		
Sampler	: ----		
Site	:		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Chloride in Water by IC										
HDPE [ON MECP]										
BH-4	E235.Cl	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	28 days	2 days	✓
Cyanides : WAD Cyanide										
UV-inhibited HDPE - total (sodium hydroxide)										
BH-4	E336	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	14 days	2 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
BH-4	E509	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	28 days	2 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid)										
BH-4	E421	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	180 days	2 days	✓
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID (Low Level)										
Glass vial (sodium bisulfate)										
BH-4	E581.F1-L	14-Mar-2023	17-Mar-2023	----	----		17-Mar-2023	14 days	3 days	✓
Hydrocarbons : Silica Gel Treated CCME PHCs - F2-F4sg by GC-FID										
Amber glass/Teflon lined cap [ON MECP]										
BH-4	E601.SG	14-Mar-2023	15-Mar-2023	7 days	1 days	✓	16-Mar-2023	40 days	1 days	✓
Physical Tests : Conductivity in Water										
HDPE [ON MECP]										
BH-4	E100	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	28 days	2 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : pH by Meter										
HDPE [ON MECP]										
BH-4	E108	14-Mar-2023	16-Mar-2023	----	----		16-Mar-2023	14 days	2 days	✓
Polychlorinated Biphenyls : PCB Aroclors by GC-MS										
Amber glass/Teflon lined cap [ON MECP]										
BH-4	E687	14-Mar-2023	15-Mar-2023	14 days	1 days	✓	16-Mar-2023	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs by Hexane LVI GC-MS										
Amber glass/Teflon lined cap [ON MECP]										
BH-4	E641A	14-Mar-2023	15-Mar-2023	14 days	1 days	✓	16-Mar-2023	40 days	1 days	✓
Speciated Metals : Dissolved Hexavalent Chromium (Cr VI) by IC										
HDPE - dissolved (NaOH+Buf) [ON MECP]										
BH-4	E532A	14-Mar-2023	----	----	----		17-Mar-2023	28 days	3 days	✓
Volatile Organic Compounds : VOCs (Eastern Canada List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
BH-4	E611D	14-Mar-2023	17-Mar-2023	----	----		17-Mar-2023	14 days	3 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L	866679	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	865015	1	17	5.8	5.0	✓
Conductivity in Water	E100	865010	1	9	11.1	5.0	✓
Dissolved Hexavalent Chromium (Cr VI) by IC	E532A	866920	1	10	10.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	865044	1	2	50.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	864845	1	12	8.3	5.0	✓
pH by Meter	E108	865008	1	15	6.6	5.0	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	866680	1	20	5.0	5.0	✓
WAD Cyanide	E336	865189	1	1	100.0	5.0	✓
Laboratory Control Samples (LCS)							
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L	866679	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	865015	1	17	5.8	5.0	✓
Conductivity in Water	E100	865010	1	9	11.1	5.0	✓
Dissolved Hexavalent Chromium (Cr VI) by IC	E532A	866920	1	10	10.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	865044	1	2	50.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	864845	1	12	8.3	5.0	✓
PAHs by Hexane LVI GC-MS	E641A	864051	1	1	100.0	5.0	✓
PCB Aroclors by GC-MS	E687	864122	1	7	14.2	4.7	✓
pH by Meter	E108	865008	1	15	6.6	5.0	✓
Silica Gel Treated CCME PHCs - F2-F4sg by GC-FID	E601.SG	864052	1	10	10.0	5.0	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	866680	1	20	5.0	5.0	✓
WAD Cyanide	E336	865189	1	1	100.0	5.0	✓
Method Blanks (MB)							
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L	866679	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	865015	1	17	5.8	5.0	✓
Conductivity in Water	E100	865010	1	9	11.1	5.0	✓
Dissolved Hexavalent Chromium (Cr VI) by IC	E532A	866920	1	10	10.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	865044	1	2	50.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	864845	1	12	8.3	5.0	✓
PAHs by Hexane LVI GC-MS	E641A	864051	1	1	100.0	5.0	✓
PCB Aroclors by GC-MS	E687	864122	1	7	14.2	4.7	✓
Silica Gel Treated CCME PHCs - F2-F4sg by GC-FID	E601.SG	864052	1	10	10.0	5.0	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	866680	1	20	5.0	5.0	✓
WAD Cyanide	E336	865189	1	1	100.0	5.0	✓
Matrix Spikes (MS)							

Matrix: **Water**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Matrix Spikes (MS) - Continued							
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L	866679	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	865015	1	17	5.8	5.0	✓
Dissolved Hexavalent Chromium (Cr VI) by IC	E532A	866920	1	10	10.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	865044	1	2	50.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	864845	1	12	8.3	5.0	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	866680	1	20	5.0	5.0	✓
WAD Cyanide	E336	865189	1	1	100.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 Waterloo - Environmental	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 Waterloo - Environmental	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
Chloride in Water by IC	E235.Cl Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
WAD Cyanide	E336 Waterloo - Environmental	Water	APHA 4500-CN I (mod)	Weak Acid Dissociable (WAD) cyanide is determined by Continuous Flow Analyzer (CFA) with in-line distillation followed by colourmetric analysis.
Dissolved Metals in Water by CRC ICPMS	E421 Waterloo - Environmental	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Mercury in Water by CVAAS	E509 Waterloo - Environmental	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.
Dissolved Hexavalent Chromium (Cr VI) by IC	E532A Waterloo - Environmental	Water	APHA 3500-Cr C (Ion Chromatography)	Hexavalent Chromium is measured by Ion chromatography-Post column reaction and UV detection. sample pretreatment involved field or lab filtration following by sample preservation.
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L Waterloo - Environmental	Water	CCME PHC in Soil - Tier 1	CCME Fraction 1 (F1) is analyzed by static headspace GC-FID. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
Silica Gel Treated CCME PHCs - F2-F4sg by GC-FID	E601.SG Waterloo - Environmental	Water	CCME PHC in Soil - Tier 1	Sample extracts are subjected to in-situ silica gel treatment prior to analysis by GC-FID for CCME hydrocarbon fractions (F2-F4).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
VOCs (Eastern Canada List) by Headspace GC-MS	E611D Waterloo - Environmental	Water	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
PAHs by Hexane LVI GC-MS	E641A Waterloo - Environmental	Water	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by large volume injection (LVI) GC-MS.
PCB Aroclors by GC-MS	E687 Waterloo - Environmental	Water	EPA 8270E (mod)	PCB Aroclors are analyzed by GC-MS
F1-BTEX	EC580 Waterloo - Environmental	Water	CCME PHC in Soil - Tier 1	F1-BTEX is calculated as follows: F1-BTEX = F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).
SUM F1 to F4 where F2-F4 is SG treated	EC581SG Waterloo - Environmental	Water	CCME PHC in Soil - Tier 1	Hydrocarbons, total (C6-C50) is the sum of CCME Fraction F1(C6-C10), F2(C10-C16), F3(C16-C34), and F4(C34-C50), where F2-F4 have been treated with silica gel. F4G-sg is not used within this calculation due to overlap with other fractions.
F2-F4 (sg) minus PAH	EC600SG Waterloo - Environmental	Water	CCME PHC in Soil - Tier 1	F2-F4 (sg) minus PAH is calculated as follows: F2-F4 minus PAH = Sum of CCME Fraction 2 (C10-C16), CCME Fraction 3 (C16-C34), and CCME Fraction 4 (C34-C50), minus select Polycyclic Aromatic Hydrocarbons (PAH).

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Dissolved Metals Water Filtration	EP421 Waterloo - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO3.
Dissolved Mercury Water Filtration	EP509 Waterloo - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HCl.
VOCs Preparation for Headspace Analysis	EP581 Waterloo - Environmental	Water	EPA 5021A (mod)	Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler. An aliquot of the headspace is then injected into the GC/MS-FID system.
PHCs and PAHs Hexane Extraction	EP601 Waterloo - Environmental	Water	EPA 3511 (mod)	Petroleum Hydrocarbons (PHCs) and Polycyclic Aromatic Hydrocarbons (PAHs) are extracted using a hexane liquid-liquid extraction.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Pesticides, PCB, and Neutral Extractable Chlorinated Hydrocarbons Extraction	EP660 Waterloo - Environmental	Water	EPA 3511 (mod)	Samples are extracted from aqueous sample using an organic solvent liquid-liquid extraction.

QUALITY CONTROL REPORT

Work Order	: **WT2306162**	Page	: 1 of 16
Client	: WSP E&I Canada Limited	Laboratory	: Waterloo - Environmental
Contact	: Sarah Irvine	Account Manager	: Gayle Braun
Address	: 100 - 3450 Harvester Road Burlington ON Canada L7N 3W5	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: +1 519 886 6910
Project	: WW21012079.CO1P.****. 5120.573000	Date Samples Received	: 14-Mar-2023 15:00
PO	: ----	Date Analysis Commenced	: 15-Mar-2023
C-O-C number	: 20-1003324	Issue Date	: 20-Mar-2023 15:03
Sampler	: ---- ----		
Site	:		
Quote number	: WOOD SOA 2022/23		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Danielle Gravel	Supervisor - Semi-Volatile Instrumentation	Waterloo Organics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Waterloo Inorganics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Waterloo Metals, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	Waterloo Organics, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 865008)											
WT2306082-003	Anonymous	pH	----	E108	0.10	pH units	7.99	8.05	0.748%	4%	----
Physical Tests (QC Lot: 865010)											
WT2306082-003	Anonymous	Conductivity	----	E100	1.0	µS/cm	316	318	0.631%	10%	----
Anions and Nutrients (QC Lot: 865015)											
WT2306082-003	Anonymous	Chloride	16887-00-6	E235.Cl	0.50	mg/L	30.6	30.5	0.208%	20%	----
Cyanides (QC Lot: 865189)											
WT2306162-001	BH-4	Cyanide, weak acid dissociable	----	E336	0.0020	mg/L	<2.0 µg/L	<0.0020	0	Diff <2x LOR	----
Dissolved Metals (QC Lot: 864845)											
WT2306162-001	BH-4	Antimony, dissolved	7440-36-0	E421	0.00010	mg/L	<0.10 µg/L	<0.00010	0	Diff <2x LOR	----
		Arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.22 µg/L	0.00022	0.000002	Diff <2x LOR	----
		Barium, dissolved	7440-39-3	E421	0.00010	mg/L	64.1 µg/L	0.0647	0.933%	20%	----
		Beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.020 µg/L	<0.000020	0	Diff <2x LOR	----
		Boron, dissolved	7440-42-8	E421	0.010	mg/L	124 µg/L	0.122	1.98%	20%	----
		Cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	<0.0050 µg/L	<0.0000050	0	Diff <2x LOR	----
		Chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.50 µg/L	<0.00050	0	Diff <2x LOR	----
		Cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.10 µg/L	<0.00010	0	Diff <2x LOR	----
		Copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.33 µg/L	0.00034	0.00001	Diff <2x LOR	----
		Lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.050 µg/L	<0.000050	0	Diff <2x LOR	----
		Molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	1.29 µg/L	0.00132	1.97%	20%	----
		Nickel, dissolved	7440-02-0	E421	0.00050	mg/L	0.57 µg/L	0.00057	0.000007	Diff <2x LOR	----
		Selenium, dissolved	7782-49-2	E421	0.000050	mg/L	0.292 µg/L	0.000281	0.000010	Diff <2x LOR	----
		Silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.010 µg/L	<0.000010	0	Diff <2x LOR	----
		Sodium, dissolved	7440-23-5	E421	0.050	mg/L	18500 µg/L	18.4	0.938%	20%	----
		Thallium, dissolved	7440-28-0	E421	0.000010	mg/L	0.028 µg/L	0.000027	0.0000009	Diff <2x LOR	----
		Uranium, dissolved	7440-61-1	E421	0.000010	mg/L	6.68 µg/L	0.00670	0.287%	20%	----
		Vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	0.85 µg/L	0.00085	0.000003	Diff <2x LOR	----
		Zinc, dissolved	7440-66-6	E421	0.0010	mg/L	<1.0 µg/L	0.0010	0.00003	Diff <2x LOR	----
Dissolved Metals (QC Lot: 865044)											
TY2302011-001	Anonymous	Mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
Speciated Metals (QC Lot: 866920)											

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Speciated Metals (QC Lot: 866920) - continued											
WT2306162-001	BH-4	Chromium, hexavalent [Cr VI], dissolved	18540-29-9	E532A	0.00050	mg/L	<0.50 µg/L	<0.00050	0	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 866680)											
WT2305685-001	Anonymous	Acetone	67-64-1	E611D	20	µg/L	<20	<20	0	Diff <2x LOR	----
		Benzene	71-43-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Bromodichloromethane	75-27-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Bromoform	75-25-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Bromomethane	74-83-9	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Carbon tetrachloride	56-23-5	E611D	0.20	µg/L	<0.20	<0.20	0	Diff <2x LOR	----
		Chlorobenzene	108-90-7	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Chloroform	67-66-3	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dibromochloromethane	124-48-1	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dibromoethane, 1,2-	106-93-4	E611D	0.20	µg/L	<0.20	<0.20	0	Diff <2x LOR	----
		Dichlorobenzene, 1,2-	95-50-1	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,3-	541-73-1	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,4-	106-46-7	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorodifluoromethane	75-71-8	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethane, 1,1-	75-34-3	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethane, 1,2-	107-06-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethylene, 1,1-	75-35-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethylene, cis-1,2-	156-59-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethylene, trans-1,2-	156-60-5	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloromethane	75-09-2	E611D	1.0	µg/L	<1.0	<1.0	0	Diff <2x LOR	----
		Dichloropropane, 1,2-	78-87-5	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloropropylene, cis-1,3-	10061-01-5	E611D	0.30	µg/L	<0.30	<0.30	0	Diff <2x LOR	----
		Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.30	µg/L	<0.30	<0.30	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Hexane, n-	110-54-3	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Methyl ethyl ketone [MEK]	78-93-3	E611D	20	µg/L	<20	<20	0	Diff <2x LOR	----
		Methyl isobutyl ketone [MIBK]	108-10-1	E611D	20	µg/L	<20	<20	0	Diff <2x LOR	----
		Methyl-tert-butyl ether [MTBE]	1634-04-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Styrene	100-42-5	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tetrachloroethane, 1,1,1,2-	630-20-6	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tetrachloroethylene	127-18-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Volatile Organic Compounds (QC Lot: 866680) - continued											
WT2305685-001	Anonymous	Toluene	108-88-3	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichloroethane, 1,1,1-	71-55-6	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichloroethane, 1,1,2-	79-00-5	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichloroethylene	79-01-6	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichlorofluoromethane	75-69-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Vinyl chloride	75-01-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Xylene, m+p-	179601-23-1	E611D	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	----
		Xylene, o-	95-47-6	E611D	0.30	µg/L	<0.30	<0.30	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 866679)											
WT2305685-001	Anonymous	F1 (C6-C10)	----	E581.F1-L	25	µg/L	<25	<25	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 865010)						
Conductivity	----	E100	1	µS/cm	<1.0	----
Anions and Nutrients (QCLot: 865015)						
Chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Cyanides (QCLot: 865189)						
Cyanide, weak acid dissociable	----	E336	0.002	mg/L	<0.0020	----
Dissolved Metals (QCLot: 864845)						
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
Dissolved Metals (QCLot: 865044)						
Mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	----
Speciated Metals (QCLot: 866920)						
Chromium, hexavalent [Cr VI], dissolved	18540-29-9	E532A	0.0005	mg/L	<0.00050	----
Volatile Organic Compounds (QCLot: 866680)						
Acetone	67-64-1	E611D	20	µg/L	<20	----
Benzene	71-43-2	E611D	0.5	µg/L	<0.50	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Volatile Organic Compounds (QCLot: 866680) - continued						
Bromodichloromethane	75-27-4	E611D	0.5	µg/L	<0.50	----
Bromoform	75-25-2	E611D	0.5	µg/L	<0.50	----
Bromomethane	74-83-9	E611D	0.5	µg/L	<0.50	----
Carbon tetrachloride	56-23-5	E611D	0.2	µg/L	<0.20	----
Chlorobenzene	108-90-7	E611D	0.5	µg/L	<0.50	----
Chloroform	67-66-3	E611D	0.5	µg/L	<0.50	----
Dibromochloromethane	124-48-1	E611D	0.5	µg/L	<0.50	----
Dibromoethane, 1,2-	106-93-4	E611D	0.2	µg/L	<0.20	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,3-	541-73-1	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	<0.50	----
Dichlorodifluoromethane	75-71-8	E611D	0.5	µg/L	<0.50	----
Dichloroethane, 1,1-	75-34-3	E611D	0.5	µg/L	<0.50	----
Dichloroethane, 1,2-	107-06-2	E611D	0.5	µg/L	<0.50	----
Dichloroethylene, 1,1-	75-35-4	E611D	0.5	µg/L	<0.50	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	<0.50	----
Dichloroethylene, trans-1,2-	156-60-5	E611D	0.5	µg/L	<0.50	----
Dichloromethane	75-09-2	E611D	1	µg/L	<1.0	----
Dichloropropane, 1,2-	78-87-5	E611D	0.5	µg/L	<0.50	----
Dichloropropylene, cis-1,3-	10061-01-5	E611D	0.3	µg/L	<0.30	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.3	µg/L	<0.30	----
Ethylbenzene	100-41-4	E611D	0.5	µg/L	<0.50	----
Hexane, n-	110-54-3	E611D	0.5	µg/L	<0.50	----
Methyl ethyl ketone [MEK]	78-93-3	E611D	20	µg/L	<20	----
Methyl isobutyl ketone [MIBK]	108-10-1	E611D	20	µg/L	<20	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E611D	0.5	µg/L	<0.50	----
Styrene	100-42-5	E611D	0.5	µg/L	<0.50	----
Tetrachloroethane, 1,1,1,2-	630-20-6	E611D	0.5	µg/L	<0.50	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.5	µg/L	<0.50	----
Tetrachloroethylene	127-18-4	E611D	0.5	µg/L	<0.50	----
Toluene	108-88-3	E611D	0.5	µg/L	<0.50	----
Trichloroethane, 1,1,1-	71-55-6	E611D	0.5	µg/L	<0.50	----
Trichloroethane, 1,1,2-	79-00-5	E611D	0.5	µg/L	<0.50	----
Trichloroethylene	79-01-6	E611D	0.5	µg/L	<0.50	----
Trichlorofluoromethane	75-69-4	E611D	0.5	µg/L	<0.50	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Volatile Organic Compounds (QCLot: 866680) - continued						
Vinyl chloride	75-01-4	E611D	0.5	µg/L	<0.50	----
Xylene, m+p-	179601-23-1	E611D	0.4	µg/L	<0.40	----
Xylene, o-	95-47-6	E611D	0.3	µg/L	<0.30	----
Hydrocarbons (QCLot: 864052)						
F2 (C10-C16)	----	E601.SG	100	µg/L	<100	----
F3 (C16-C34)	----	E601.SG	250	µg/L	<250	----
F4 (C34-C50)	----	E601.SG	250	µg/L	<250	----
Hydrocarbons (QCLot: 866679)						
F1 (C6-C10)	----	E581.F1-L	25	µg/L	<25	----
Polycyclic Aromatic Hydrocarbons (QCLot: 864051)						
Acenaphthene	83-32-9	E641A	0.01	µg/L	<0.010	----
Acenaphthylene	208-96-8	E641A	0.01	µg/L	<0.010	----
Anthracene	120-12-7	E641A	0.01	µg/L	<0.010	----
Benz(a)anthracene	56-55-3	E641A	0.01	µg/L	<0.010	----
Benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	<0.0050	----
Benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	<0.010	----
Benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	<0.010	----
Benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	<0.010	----
Chrysene	218-01-9	E641A	0.01	µg/L	<0.010	----
Dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	<0.0050	----
Fluoranthene	206-44-0	E641A	0.01	µg/L	<0.010	----
Fluorene	86-73-7	E641A	0.01	µg/L	<0.010	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	<0.010	----
Methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	<0.010	----
Methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	<0.010	----
Naphthalene	91-20-3	E641A	0.05	µg/L	<0.050	----
Phenanthrene	85-01-8	E641A	0.02	µg/L	<0.020	----
Pyrene	129-00-0	E641A	0.01	µg/L	<0.010	----
Polychlorinated Biphenyls (QCLot: 864122)						
Aroclor 1016	12674-11-2	E687	0.02	µg/L	<0.020	----
Aroclor 1221	11104-28-2	E687	0.02	µg/L	<0.020	----
Aroclor 1232	11141-16-5	E687	0.02	µg/L	<0.020	----
Aroclor 1242	53469-21-9	E687	0.02	µg/L	<0.020	----
Aroclor 1248	12672-29-6	E687	0.02	µg/L	<0.020	----
Aroclor 1254	11097-69-1	E687	0.02	µg/L	<0.020	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polychlorinated Biphenyls (QCLot: 864122) - continued						
Aroclor 1260	11096-82-5	E687	0.02	µg/L	<0.020	----
Aroclor 1262	37324-23-5	E687	0.02	µg/L	<0.020	----
Aroclor 1268	11100-14-4	E687	0.02	µg/L	<0.020	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 865008)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 865010)									
Conductivity	----	E100	1	µS/cm	1409 µS/cm	94.8	90.0	110	----
Anions and Nutrients (QCLot: 865015)									
Chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	99.9	90.0	110	----
Cyanides (QCLot: 865189)									
Cyanide, weak acid dissociable	----	E336	0.002	mg/L	0.125 mg/L	101	80.0	120	----
Dissolved Metals (QCLot: 864845)									
Antimony, dissolved	7440-36-0	E421	0.0001	mg/L	0.05 mg/L	105	80.0	120	----
Arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	0.05 mg/L	106	80.0	120	----
Barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.0125 mg/L	105	80.0	120	----
Beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.005 mg/L	104	80.0	120	----
Boron, dissolved	7440-42-8	E421	0.01	mg/L	0.05 mg/L	98.8	80.0	120	----
Cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.005 mg/L	101	80.0	120	----
Chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.0125 mg/L	103	80.0	120	----
Cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.0125 mg/L	102	80.0	120	----
Copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.0125 mg/L	100	80.0	120	----
Lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.025 mg/L	105	80.0	120	----
Molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.0125 mg/L	102	80.0	120	----
Nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.025 mg/L	101	80.0	120	----
Selenium, dissolved	7782-49-2	E421	0.00005	mg/L	0.05 mg/L	99.1	80.0	120	----
Silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.005 mg/L	102	80.0	120	----
Sodium, dissolved	7440-23-5	E421	0.05	mg/L	2.5 mg/L	106	80.0	120	----
Thallium, dissolved	7440-28-0	E421	0.00001	mg/L	0.05 mg/L	105	80.0	120	----
Uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.00025 mg/L	107	80.0	120	----
Vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.025 mg/L	104	80.0	120	----
Zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.025 mg/L	102	80.0	120	----
Mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0.0001 mg/L	98.9	80.0	120	----
Speciated Metals (QCLot: 866920)									

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Speciated Metals (QCLot: 866920) - continued									
Chromium, hexavalent [Cr VI], dissolved	18540-29-9	E532A	0.0005	mg/L	0.025 mg/L	101	80.0	120	----
Volatile Organic Compounds (QCLot: 866680)									
Acetone	67-64-1	E611D	20	µg/L	100 µg/L	127	70.0	130	----
Benzene	71-43-2	E611D	0.5	µg/L	100 µg/L	107	70.0	130	----
Bromodichloromethane	75-27-4	E611D	0.5	µg/L	100 µg/L	106	70.0	130	----
Bromoform	75-25-2	E611D	0.5	µg/L	100 µg/L	99.5	70.0	130	----
Bromomethane	74-83-9	E611D	0.5	µg/L	100 µg/L	107	60.0	140	----
Carbon tetrachloride	56-23-5	E611D	0.2	µg/L	100 µg/L	107	70.0	130	----
Chlorobenzene	108-90-7	E611D	0.5	µg/L	100 µg/L	104	70.0	130	----
Chloroform	67-66-3	E611D	0.5	µg/L	100 µg/L	110	70.0	130	----
Dibromochloromethane	124-48-1	E611D	0.5	µg/L	100 µg/L	100	70.0	130	----
Dibromoethane, 1,2-	106-93-4	E611D	0.2	µg/L	100 µg/L	103	70.0	130	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	100 µg/L	102	70.0	130	----
Dichlorobenzene, 1,3-	541-73-1	E611D	0.5	µg/L	100 µg/L	102	70.0	130	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	100 µg/L	104	70.0	130	----
Dichlorodifluoromethane	75-71-8	E611D	0.5	µg/L	100 µg/L	92.0	60.0	140	----
Dichloroethane, 1,1-	75-34-3	E611D	0.5	µg/L	100 µg/L	117	70.0	130	----
Dichloroethane, 1,2-	107-06-2	E611D	0.5	µg/L	100 µg/L	112	70.0	130	----
Dichloroethylene, 1,1-	75-35-4	E611D	0.5	µg/L	100 µg/L	104	70.0	130	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	100 µg/L	105	70.0	130	----
Dichloroethylene, trans-1,2-	156-60-5	E611D	0.5	µg/L	100 µg/L	112	70.0	130	----
Dichloromethane	75-09-2	E611D	1	µg/L	100 µg/L	113	70.0	130	----
Dichloropropane, 1,2-	78-87-5	E611D	0.5	µg/L	100 µg/L	107	70.0	130	----
Dichloropropylene, cis-1,3-	10061-01-5	E611D	0.3	µg/L	100 µg/L	104	70.0	130	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.3	µg/L	100 µg/L	108	70.0	130	----
Ethylbenzene	100-41-4	E611D	0.5	µg/L	100 µg/L	96.2	70.0	130	----
Hexane, n-	110-54-3	E611D	0.5	µg/L	100 µg/L	110	70.0	130	----
Methyl ethyl ketone [MEK]	78-93-3	E611D	20	µg/L	100 µg/L	114	70.0	130	----
Methyl isobutyl ketone [MIBK]	108-10-1	E611D	20	µg/L	100 µg/L	98.0	70.0	130	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E611D	0.5	µg/L	100 µg/L	108	70.0	130	----
Styrene	100-42-5	E611D	0.5	µg/L	100 µg/L	98.3	70.0	130	----
Tetrachloroethane, 1,1,1,2-	630-20-6	E611D	0.5	µg/L	100 µg/L	101	70.0	130	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.5	µg/L	100 µg/L	111	70.0	130	----
Tetrachloroethylene	127-18-4	E611D	0.5	µg/L	100 µg/L	90.5	70.0	130	----
Toluene	108-88-3	E611D	0.5	µg/L	100 µg/L	97.6	70.0	130	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 866680) - continued									
Trichloroethane, 1,1,1-	71-55-6	E611D	0.5	µg/L	100 µg/L	109	70.0	130	----
Trichloroethane, 1,1,2-	79-00-5	E611D	0.5	µg/L	100 µg/L	107	70.0	130	----
Trichloroethylene	79-01-6	E611D	0.5	µg/L	100 µg/L	99.4	70.0	130	----
Trichlorofluoromethane	75-69-4	E611D	0.5	µg/L	100 µg/L	103	60.0	140	----
Vinyl chloride	75-01-4	E611D	0.5	µg/L	100 µg/L	93.5	60.0	140	----
Xylene, m+p-	179601-23-1	E611D	0.4	µg/L	200 µg/L	100	70.0	130	----
Xylene, o-	95-47-6	E611D	0.3	µg/L	100 µg/L	97.3	70.0	130	----
Hydrocarbons (QCLot: 864052)									
F2 (C10-C16)	----	E601.SG	100	µg/L	4613.474 µg/L	99.4	70.0	130	----
F3 (C16-C34)	----	E601.SG	250	µg/L	6464.481 µg/L	101	70.0	130	----
F4 (C34-C50)	----	E601.SG	250	µg/L	4040.361 µg/L	104	70.0	130	----
Hydrocarbons (QCLot: 866679)									
F1 (C6-C10)	----	E581.F1-L	25	µg/L	2000 µg/L	99.7	80.0	120	----
Polycyclic Aromatic Hydrocarbons (QCLot: 864051)									
Acenaphthene	83-32-9	E641A	0.01	µg/L	0.5263 µg/L	96.2	50.0	140	----
Acenaphthylene	208-96-8	E641A	0.01	µg/L	0.5263 µg/L	93.3	50.0	140	----
Anthracene	120-12-7	E641A	0.01	µg/L	0.5263 µg/L	83.0	50.0	140	----
Benz(a)anthracene	56-55-3	E641A	0.01	µg/L	0.5263 µg/L	87.5	50.0	140	----
Benzo(a)pyrene	50-32-8	E641A	0.005	µg/L	0.5263 µg/L	78.7	50.0	140	----
Benzo(b+j)fluoranthene	n/a	E641A	0.01	µg/L	0.5263 µg/L	76.2	50.0	140	----
Benzo(g,h,i)perylene	191-24-2	E641A	0.01	µg/L	0.5263 µg/L	93.6	50.0	140	----
Benzo(k)fluoranthene	207-08-9	E641A	0.01	µg/L	0.5263 µg/L	82.4	50.0	140	----
Chrysene	218-01-9	E641A	0.01	µg/L	0.5263 µg/L	96.8	50.0	140	----
Dibenz(a,h)anthracene	53-70-3	E641A	0.005	µg/L	0.5263 µg/L	82.4	50.0	140	----
Fluoranthene	206-44-0	E641A	0.01	µg/L	0.5263 µg/L	100	50.0	140	----
Fluorene	86-73-7	E641A	0.01	µg/L	0.5263 µg/L	99.0	50.0	140	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A	0.01	µg/L	0.5263 µg/L	96.5	50.0	140	----
Methylnaphthalene, 1-	90-12-0	E641A	0.01	µg/L	0.5263 µg/L	95.6	50.0	140	----
Methylnaphthalene, 2-	91-57-6	E641A	0.01	µg/L	0.5263 µg/L	95.8	50.0	140	----
Naphthalene	91-20-3	E641A	0.05	µg/L	0.5263 µg/L	95.2	50.0	140	----
Phenanthrene	85-01-8	E641A	0.02	µg/L	0.5263 µg/L	98.0	50.0	140	----
Pyrene	129-00-0	E641A	0.01	µg/L	0.5263 µg/L	100	50.0	140	----
Polychlorinated Biphenyls (QCLot: 864122)									

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Polychlorinated Biphenyls (QCLot: 864122) - continued									
Aroclor 1016	12674-11-2	E687	0.02	µg/L	0.2 µg/L	107	60.0	140	----
Aroclor 1221	11104-28-2	E687	0.02	µg/L	0.2 µg/L	107	60.0	140	----
Aroclor 1232	11141-16-5	E687	0.02	µg/L	0.2 µg/L	107	60.0	140	----
Aroclor 1242	53469-21-9	E687	0.02	µg/L	0.2 µg/L	107	60.0	140	----
Aroclor 1248	12672-29-6	E687	0.02	µg/L	0.2 µg/L	94.7	60.0	140	----
Aroclor 1254	11097-69-1	E687	0.02	µg/L	0.2 µg/L	82.0	60.0	140	----
Aroclor 1260	11096-82-5	E687	0.02	µg/L	0.2 µg/L	92.3	60.0	140	----
Aroclor 1262	37324-23-5	E687	0.02	µg/L	0.2 µg/L	92.3	60.0	140	----
Aroclor 1268	11100-14-4	E687	0.02	µg/L	0.2 µg/L	92.3	60.0	140	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 865015)										
WT2306082-003	Anonymous	Chloride	16887-00-6	E235.Cl	99.4 mg/L	100 mg/L	99.4	75.0	125	----
Cyanides (QCLot: 865189)										
WT2306162-001	BH-4	Cyanide, weak acid dissociable	----	E336	0.123 mg/L	0.125 mg/L	98.3	75.0	125	----
Dissolved Metals (QCLot: 864845)										
WT2306248-001	Anonymous	Antimony, dissolved	7440-36-0	E421	0.0551 mg/L	0.05 mg/L	110	70.0	130	----
		Arsenic, dissolved	7440-38-2	E421	0.0565 mg/L	0.05 mg/L	113	70.0	130	----
		Barium, dissolved	7440-39-3	E421	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		Beryllium, dissolved	7440-41-7	E421	0.00528 mg/L	0.005 mg/L	106	70.0	130	----
		Boron, dissolved	7440-42-8	E421	0.048 mg/L	0.05 mg/L	97.0	70.0	130	----
		Cadmium, dissolved	7440-43-9	E421	0.00485 mg/L	0.005 mg/L	97.1	70.0	130	----
		Chromium, dissolved	7440-47-3	E421	0.0123 mg/L	0.0125 mg/L	98.2	70.0	130	----
		Cobalt, dissolved	7440-48-4	E421	0.0118 mg/L	0.0125 mg/L	94.4	70.0	130	----
		Copper, dissolved	7440-50-8	E421	0.0111 mg/L	0.0125 mg/L	88.9	70.0	130	----
		Lead, dissolved	7439-92-1	E421	0.0250 mg/L	0.025 mg/L	100	70.0	130	----
		Molybdenum, dissolved	7439-98-7	E421	0.0137 mg/L	0.0125 mg/L	110	70.0	130	----
		Nickel, dissolved	7440-02-0	E421	0.0224 mg/L	0.025 mg/L	89.6	70.0	130	----
		Selenium, dissolved	7782-49-2	E421	0.0573 mg/L	0.05 mg/L	115	70.0	130	----
		Silver, dissolved	7440-22-4	E421	0.00494 mg/L	0.005 mg/L	98.8	70.0	130	----
		Sodium, dissolved	7440-23-5	E421	ND mg/L	2.5 mg/L	ND	70.0	130	----
		Thallium, dissolved	7440-28-0	E421	0.0502 mg/L	0.05 mg/L	100	70.0	130	----
		Uranium, dissolved	7440-61-1	E421	ND mg/L	0.00025 mg/L	ND	70.0	130	----
		Vanadium, dissolved	7440-62-2	E421	0.0255 mg/L	0.025 mg/L	102	70.0	130	----
		Zinc, dissolved	7440-66-6	E421	0.0232 mg/L	0.025 mg/L	92.8	70.0	130	----
Dissolved Metals (QCLot: 865044)										
WT2306162-001	BH-4	Mercury, dissolved	7439-97-6	E509	0.0000899 mg/L	0.0001 mg/L	89.9	70.0	130	----
Speciated Metals (QCLot: 866920)										
WT2306162-001	BH-4	Chromium, hexavalent [Cr VI], dissolved	18540-29-9	E532A	0.0409 mg/L	0.04 mg/L	102	70.0	130	----
Volatile Organic Compounds (QCLot: 866680)										
WT2305685-001	Anonymous	Acetone	67-64-1	E611D	109 µg/L	100 µg/L	109	60.0	140	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 866680) - continued										
WT2305685-001	Anonymous	Benzene	71-43-2	E611D	100 µg/L	100 µg/L	100	60.0	140	----
		Bromodichloromethane	75-27-4	E611D	100 µg/L	100 µg/L	100	60.0	140	----
		Bromoform	75-25-2	E611D	92.1 µg/L	100 µg/L	92.1	60.0	140	----
		Bromomethane	74-83-9	E611D	97.3 µg/L	100 µg/L	97.3	60.0	140	----
		Carbon tetrachloride	56-23-5	E611D	99.5 µg/L	100 µg/L	99.5	60.0	140	----
		Chlorobenzene	108-90-7	E611D	97.4 µg/L	100 µg/L	97.4	60.0	140	----
		Chloroform	67-66-3	E611D	103 µg/L	100 µg/L	103	60.0	140	----
		Dibromochloromethane	124-48-1	E611D	93.1 µg/L	100 µg/L	93.1	60.0	140	----
		Dibromoethane, 1,2-	106-93-4	E611D	96.6 µg/L	100 µg/L	96.6	60.0	140	----
		Dichlorobenzene, 1,2-	95-50-1	E611D	95.2 µg/L	100 µg/L	95.2	60.0	140	----
		Dichlorobenzene, 1,3-	541-73-1	E611D	95.1 µg/L	100 µg/L	95.1	60.0	140	----
		Dichlorobenzene, 1,4-	106-46-7	E611D	96.6 µg/L	100 µg/L	96.6	60.0	140	----
		Dichlorodifluoromethane	75-71-8	E611D	77.9 µg/L	100 µg/L	77.9	60.0	140	----
		Dichloroethane, 1,1-	75-34-3	E611D	98.3 µg/L	100 µg/L	98.3	60.0	140	----
		Dichloroethane, 1,2-	107-06-2	E611D	106 µg/L	100 µg/L	106	60.0	140	----
		Dichloroethylene, 1,1-	75-35-4	E611D	94.7 µg/L	100 µg/L	94.7	60.0	140	----
		Dichloroethylene, cis-1,2-	156-59-2	E611D	97.9 µg/L	100 µg/L	97.9	60.0	140	----
		Dichloroethylene, trans-1,2-	156-60-5	E611D	102 µg/L	100 µg/L	102	60.0	140	----
		Dichloromethane	75-09-2	E611D	105 µg/L	100 µg/L	105	60.0	140	----
		Dichloropropane, 1,2-	78-87-5	E611D	100 µg/L	100 µg/L	100	60.0	140	----
		Dichloropropylene, cis-1,3-	10061-01-5	E611D	98.4 µg/L	100 µg/L	98.4	60.0	140	----
		Dichloropropylene, trans-1,3-	10061-02-6	E611D	100 µg/L	100 µg/L	100	60.0	140	----
		Ethylbenzene	100-41-4	E611D	88.3 µg/L	100 µg/L	88.3	60.0	140	----
		Hexane, n-	110-54-3	E611D	98.7 µg/L	100 µg/L	98.7	60.0	140	----
		Methyl ethyl ketone [MEK]	78-93-3	E611D	100 µg/L	100 µg/L	99.5	60.0	140	----
		Methyl isobutyl ketone [MIBK]	108-10-1	E611D	85 µg/L	100 µg/L	85.5	60.0	140	----
		Methyl-tert-butyl ether [MTBE]	1634-04-4	E611D	101 µg/L	100 µg/L	101	60.0	140	----
		Styrene	100-42-5	E611D	91.7 µg/L	100 µg/L	91.7	60.0	140	----
		Tetrachloroethane, 1,1,1,2-	630-20-6	E611D	94.1 µg/L	100 µg/L	94.1	60.0	140	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	102 µg/L	100 µg/L	102	60.0	140	----
		Tetrachloroethylene	127-18-4	E611D	82.2 µg/L	100 µg/L	82.2	60.0	140	----
		Toluene	108-88-3	E611D	90.0 µg/L	100 µg/L	90.0	60.0	140	----
		Trichloroethane, 1,1,1-	71-55-6	E611D	102 µg/L	100 µg/L	102	60.0	140	----
		Trichloroethane, 1,1,2-	79-00-5	E611D	101 µg/L	100 µg/L	101	60.0	140	----
		Trichloroethylene	79-01-6	E611D	92.3 µg/L	100 µg/L	92.3	60.0	140	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 866680) - continued										
WT2305685-001	Anonymous	Trichlorofluoromethane	75-69-4	E611D	93.1 µg/L	100 µg/L	93.1	60.0	140	----
		Vinyl chloride	75-01-4	E611D	81.7 µg/L	100 µg/L	81.7	60.0	140	----
		Xylene, m+p-	179601-23-1	E611D	185 µg/L	200 µg/L	92.6	60.0	140	----
		Xylene, o-	95-47-6	E611D	89.9 µg/L	100 µg/L	89.9	60.0	140	----
Hydrocarbons (QCLot: 866679)										
WT2305685-001	Anonymous	F1 (C6-C10)	----	E581.F1-L	1780 µg/L	2000 µg/L	89.2	60.0	140	----

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 - 1003324 RP

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Page of

Environmental Division Waterloo

Work Order Reference WT2306162

Telephone : +1 519 886 6910

Report To	Contact and company name below will appear on the final report
Company:	WSP
Contact:	Sarah Irvine
Phone:	
	Company address below will appear on the final report
Street:	3450 Harvester Rd
City/Province:	Burlington ON
Postal Code:	L7N 3W5
Invoice To	Same as Report To ☐ YES ☒ NO
	Copy of Invoice with Report ☒ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☒ YES ☐ NO ☐ N/A

☒ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: Sarah.irvine@wsp.com

Email 2: jessica.pitman@wsp.com

Email 3: ryan.phillips@wsp.com

Invoice Recipients

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: APInvoice.canada@wsp.com

Email 2:

Turnaround Time (TAT) Requested

☒ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional may apply to rush requests on weekends, statutory holidays and non-routine

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contac

Project Information

ALS Account # / Quote #:

Job #:

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (ALS use only): WT2306162 RP

ALS Contact: Sampler:

Analysis Reque

Indicate Filtered (F), Preserved (P) or Filtered and Pr

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Metals + Inorganics	VOCs	PAHs	PCBs	SAMPLES ON HOLD	EXTENDED STORAGE REQUI	SUSPECTED HAZARD (see no
	BH-4	March 14, 23	1000	GW	11	X	X	X	X			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☒ NO

Are samples for human consumption/ use? ☐ YES ☒ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

Standard filtration of metals

Compare to 153/04 Table 3

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
9.6				-1.9			

SHIPMENT RELEASE (client use)

Released by: Ryan Phillips Date: March 14, 23 Time: 3:00pm

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by: Date: Time:

FINAL SHIPMENT RECEPTION (ALS use only)

Received by: Date: Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

GCS21, KT VW169, OR374, SC249, CN575, MM703

Appendix B

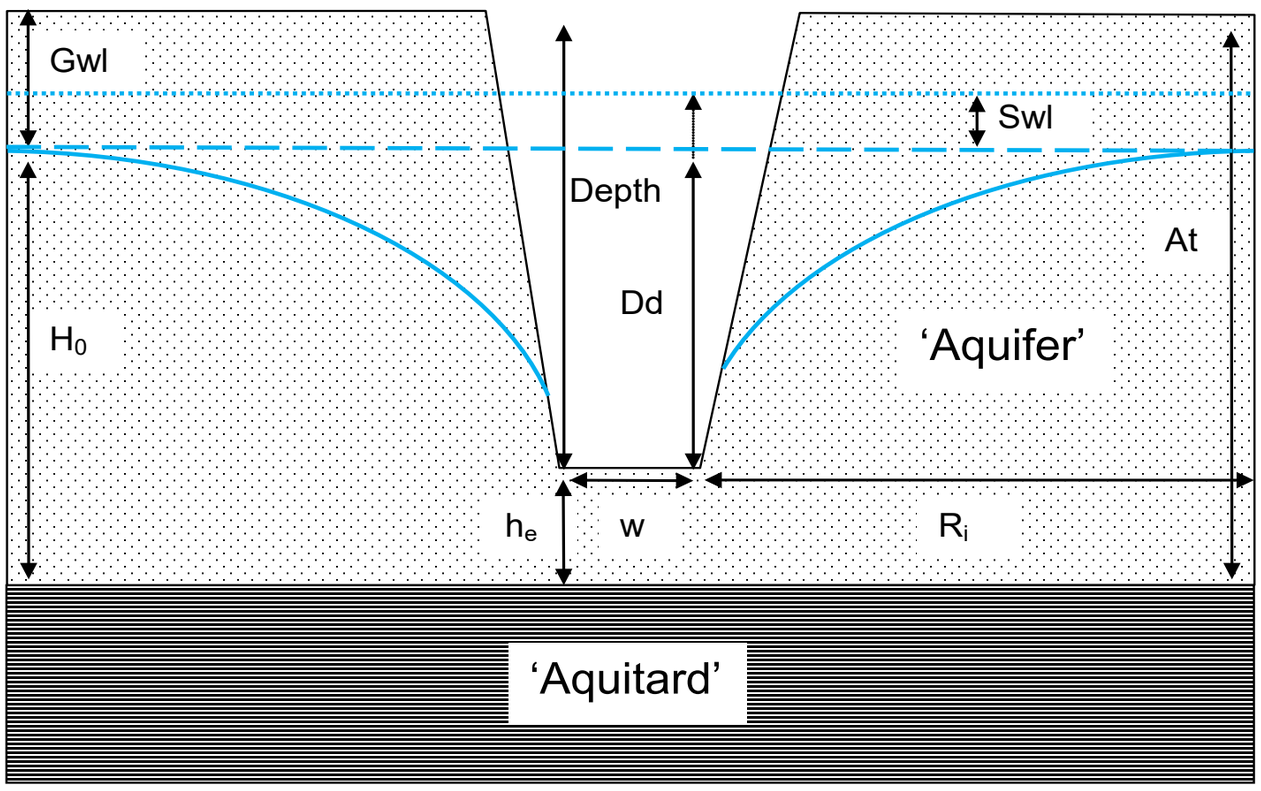
Dewatering Rate Estimation - Unconfined Trench

Project No.:	**WW21012079**
Project Name:	**1450 King Road SWM Facility Works**
Client:	**Quantum Realty Management**
Location:	**1450 King Road, Burlington, ON**
Description:	**Assume greatest excavation depth throughout entire excavation area**
Date:	**April 17, 2023**

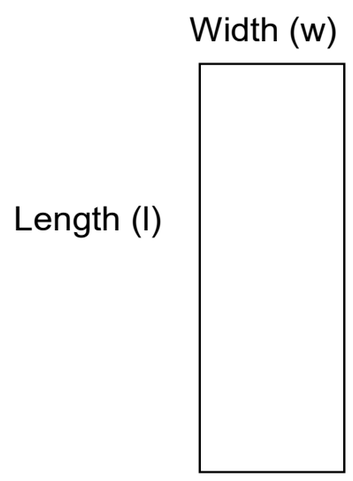
Performed by:	**JP**
Checked by:	**SI**

EXCAVATION INFO	
Length, l (m)	133.0
Width, w (m)	35.5
Depth (mbgs)	4.1

Cross Section



Plan View



Radius of Influence (R_i) calculated with the Sichardt equation $R_i = 3000(H_0 - h_e)\sqrt{K}$

Groundwater Inflow (Q) to the excavation calculated with the Dupuit solution combining:
1) radial steady-state for inflow to trench ends; and
2) linear steady-state for inflow to trench sides.

$$Q = \pi K \frac{(H_0^2 - h_e^2)}{\ln\left(\frac{2R_i + w}{w}\right)} + 2lK\frac{(H_0^2 - h_e^2)}{2R_i}$$

Bh	Gwl Measured Groundwater Level (mbgs)	Swl Estimated Seasonal Fluctuation above Gwl (m)	K Hydraulic Conductivity (m/s)	At 'Aquifer' Thickness (mbgs)	H_0 Ambient Head above 'Aquitard' (m)	h_e Head above 'Aquitard' at Excavation (m)	Dd Drawdown (m)	R_i Sichardt Calculation (m)	R_i User Defined (m)	Q Groundwater Inflow (m^3/d)
BH4	**0.47**	**0.47**	**2.7E-08**	**5.1**	5.1	1.0	4.1	2.0		5.5
BH5	**0.86**	**0.86**	**2.6E-08**	**5.1**	5.1	1.0	4.1	2.0		5.4
Maximum										5.5
K Geometric Mean			2.6E-08	5.10	5.10	1.00	4.10	2.0		5.5
K Arithmetic Mean			2.6E-08	5.10	5.10	1.00	4.10	2.0		5.5

Uncertainty Factor	*3*	**Maximum × SF**	**(K Geometric Mean) × SF**	**(K Arithmetic Mean) × SF**
Q Groundwater Inflow (m^3/d)		**16.6**	**16.4**	**16.4**
Uncertainty Factor	*3*	**S(Maximum K × SF)**	**S(K Geometric Mean × SF)**	**S(K Arithmetic Mean × SF)**
R_i Radius of Influence, Sichert (m)		**3.5**	**3.5**	**3.5**

Notes

1 mbgs = meters below ground surface
2 The user defined R_i is used for the calculation of groundwater inflow (Q) if specified
3 Geometric mean calculation is applied only to the hydraulic conductivity (K) - other input parameters for the Dupuit and Sichardt equation use the arithmetic average
4 The calculated groundwater inflows for the arithmetic and geometric mean both use the Sichardt R_i calculated from the respective mean K
5 If the depth of the excavation is below the base of the 'Aquifer' then the head at the excavation is set at the top of the 'Aquitard' (i.e. $h_e = 0$)

Comments

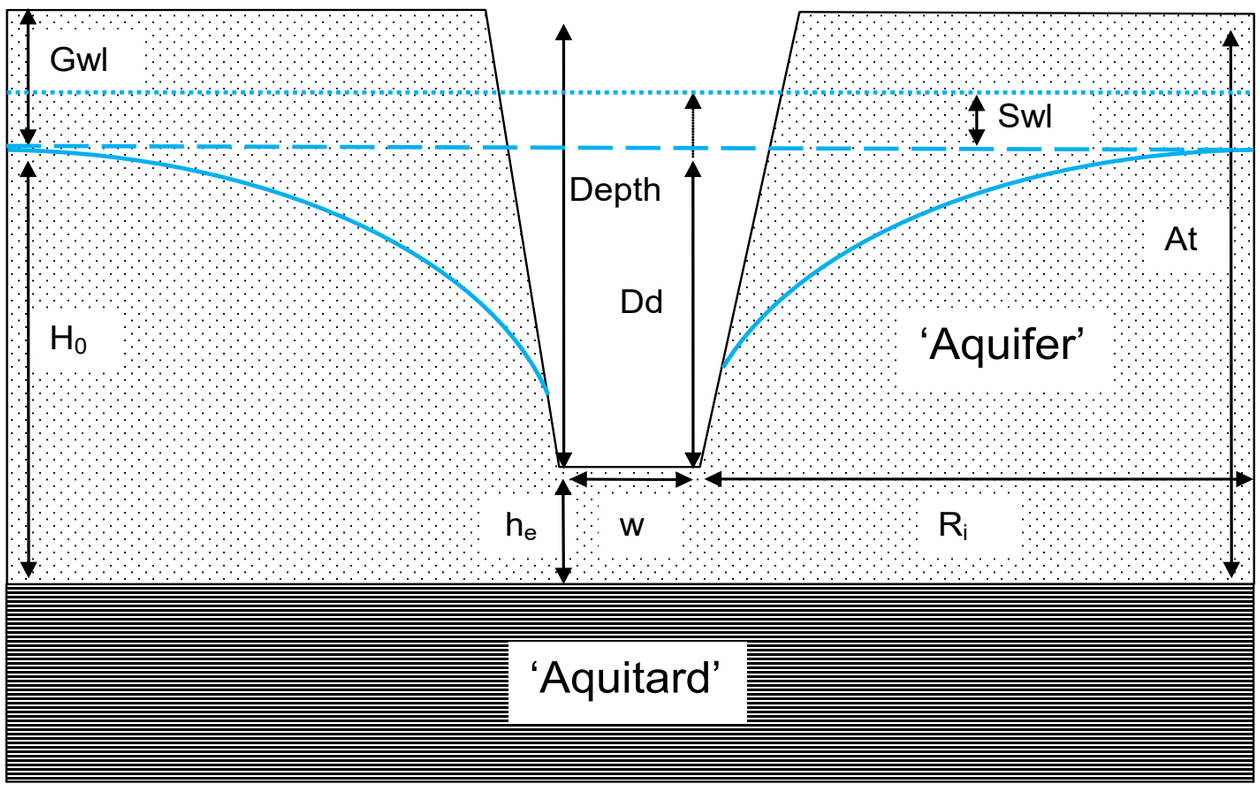
Dewatering Rate Estimation - Unconfined Trench

Project No.:	**WW21012079**
Project Name:	**1450 King Road SWM Facility Works**
Client:	**Quantum Realty Management**
Location:	**1450 King Road, Burlington, ON**
Description:	**Area of greatest excavation depth**
Date:	**April 17, 2023**

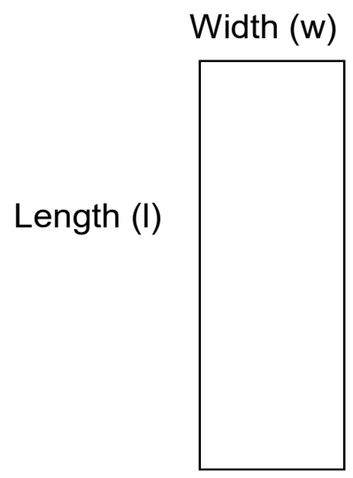
Performed by:	**JP**
Checked by:	**SI**

EXCAVATION INFO	
Length, l (m)	**101.0**
Width, w (m)	**17.1**
Depth (mbgs)	**4.1**

Cross Section



Plan View



Radius of Influence (R_i) calculated with the Sichardt equation $R_i = 3000(H_0 - h_e)\sqrt{K}$

Groundwater Inflow (Q) to the excavation calculated with the Dupuit solution combining:
1) radial steady-state for inflow to trench ends; and
2) linear steady-state for inflow to trench sides.

$$Q = \pi K \frac{(H_0^2 - h_e^2)}{\ln\left(\frac{2R_i + w}{w}\right)} + 2lK\frac{(H_0^2 - h_e^2)}{2R_i}$$

Bh	Gwl Measured Groundwater Level (mbgs)	Swl Estimated Seasonal Fluctuation above Gwl (m)	K Hydraulic Conductivity (m/s)	At 'Aquifer' Thickness (mbgs)	H_0 Ambient Head above 'Aquitard' (m)	h_e Head above 'Aquitard' at Excavation (m)	Dd Drawdown (m)	R_i Sichardt Calculation (m)	R_i User Defined (m)	Q Groundwater Inflow (m^3/d)
BH4	**0.47**	**0.47**	**2.7E-08**	**5.1**	5.1	1.0	4.1	2.0		3.8
BH5	**0.86**	**0.86**	**2.6E-08**	**5.1**	5.1	1.0	4.1	2.0		3.7
Maximum										3.8
K Geometric Mean			2.6E-08	5.10	5.10	1.00	4.10	2.0		3.7
K Arithmetic Mean			2.6E-08	5.10	5.10	1.00	4.10	2.0		3.7

Uncertainty Factor	*3*	**Maximum × SF**	**(K Geometric Mean) × SF**	**(K Arithmetic Mean) × SF**
Q Groundwater Inflow (m^3/d)		**11.3**	**11.2**	**11.2**
Uncertainty Factor	*3*	**S(Maximum K × SF)**	**S(K Geometric Mean × SF)**	**S(K Arithmetic Mean × SF)**
R_i Radius of Influence, Sichert (m)		**3.5**	**3.5**	**3.5**

Notes

1 mbgs = meters below ground surface
2 The user defined R_i is used for the calculation of groundwater inflow (Q) if specified
3 Geometric mean calculation is applied only to the hydraulic conductivity (K) - other input parameters for the Dupuit and Sichardt equation use the arithmetic average
4 The calculated groundwater inflows for the arithmetic and geometric mean both use the Sichardt R_i calculated from the respective mean K
5 If the depth of the excavation is below the base of the 'Aquifer' then the head at the excavation is set at the top of the 'Aquitard' (i.e. $h_e = 0$)

Comments

Appendix C

Limitations

1. The work performed in the preparation of this document and the data, interpretations and recommendations presented are subject to the following:

   (a) WSP's Standard Terms and Conditions;

   (b) The Scope of Services;

   (c) Time and Budgetary limitations as described in our Contract; and,

   (d) The Limitations stated herein.

2. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract.

3. This document was prepared with the assumption that the design and construction will be in accordance with all applicable standards, codes and regulations of authorities having jurisdiction, as well as good engineering practice. Further, the recommendations and opinions in this document are applicable only to the subject project described above. Contractors should be aware that the data and their interpretations presented in this report might not be sufficient to assess all factors that may have an impact on the construction process.

4. The conditions presented in this document were based, in part, on visual observations of the site and on subsurface investigation. The number of boreholes may not be sufficient to determine all of the factors that may affect construction methods and costs. Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations. Conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation.

5. Where testing was performed, it was carried out in accordance with the terms of our contract providing for testing. Other conditions may be present on site and may be revealed by different of other testing not provided for in our contract.

6. Because of the limitations referred to above, different conditions from those stated in our report may exist. There should be an ongoing liaison with WSP to ensure that the recommendations in this report have been interpreted and implemented as intended. In addition, if any further clarification and/or elaboration are needed, WSP should be contacted immediately.

7. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or in part, or any reliance thereon, or decisions made based on any information in the report, is the sole responsibility of such third party. WSP accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.

WSP E&I Canada Limited