National Bahá'í Centre of Canada and Canadian National Temple, City of Markham

Functional Servicing and Stormwater Management Report

January 2024

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Submission History

Submission	Date	In Support Of	Distributed To
1st	October 2022	Official Plan Amendment and Re-Zoning Application	City of Markham, Toronto & Region Conservation Authority
2nd	January 2024	Official Plan Amendment and Re-Zoning Application	City of Markham, Toronto & Region Conservation Authority

1.0 Introduction

SCS Consulting Group Ltd. has been retained by Hariri Pontarini Architects to prepare a Functional Servicing and Stormwater Management Report for the restoration and parking lot improvement at 7015 Leslie Street, a proposed Temple and National Centre building located at 7200 and 7290 Leslie Street respectively in the City of Markham of the Regional Municipality of York.

The National Spiritual Assembly of the Bahá'ís of Canada and the Association for Bahá'í Studies ("NSA Bahá'ís") own three properties on Leslie Street, north of Steeles Avenue and south of John Street, in the City of Markham. These properties are municipally known as 7200, 7290 and 7015 Leslie Street ("Subject Lands") and the subject of applications for Official Plan and Zoning By-law Amendments with the City of Markham.

The NSA Bahá'ís is proposing to construct a new National Bahá'í Centre of Canada ("BNC") to replace the existing National Centre building at 7200 Leslie Street and have selected their property in Markham to raise up a national Bahá'í House of Worship ("Canadian National Temple" or "Temple"). The new BNC will provide for expanded administrative and institutional functions that include administrative offices, meeting rooms, multi-purpose educational and assembly facilities, and lodging rooms. The Temple will be designed to the highest standard, as reflected in the great Bahá'í Temples constructed around the world. The proposal will support the institute's growing functions and support the construction of the Temple in accordance with the Conceptual Master Plan. Detailed technical studies and design exercises have illustrated that the Subject Lands can accommodate the proposed design without impacts on the adjacent lands and natural heritage network.

7015 Leslie Street is currently used by the Bahá'í Community for the Don Valley Education Centre for their programming such as plenary sessions, small group studies, educational and service events, and other community outreach programs such as youth day camps, arts and craft activities, outdoor play and recreation. This property and existing buildings also provide space for other gatherings and meetings organized by the Bahá'í Community such as holy day celebrations, community and administrative meetings, conferences, and storage of educational books and materials. 7015 Leslie Street was added to the zoning application to ensure that these existing uses are properly enshrined in the zoning by-law.

The Subject Lands are designated "Greenway" and "Residential Low Rise" under the City of Markham Official Plan 2014 ("MOP"). Place of Worship are permitted in all land use designations in the MOP to the discretion of Council and in consideration of the criteria in policy 8.13.7.1 when in a Residential designation. The Proposed OPA will refine the extent of the "Greenway" designation to better reflect the extent of the key natural heritage features as delineated through an environmental impact study. The Proposed OPA also includes site-specific policy under Section 9.18 to clarify the permitted uses

related to the existing place of worship and the BNC as the place of worship administrative headquarters as well as details regarding the application of minimum vegetation protection zones, trails within the Greenway, and restoration commitments.

7200 and 7290 Leslie Street are currently zoned "Special Residential 3 Zone (SR3)" under Zoning By-law 1767, as amended. Places of Worship, specifically churches or religious institutions, are currently permitted uses. A Zoning By-law Amendment ("ZBA") is proposed to bring the zoning into conformity with the MOP (zone lands Greenway which have been identified for protection) and update the zone standards. The Proposed ZBA updates the "out-of-date" in-force By-laws and standards to be generally consistent with current standards in Zoning By-law 177-96 and the proposed Comprehensive Zoning By-law.

1.1 Purpose of the Report

The Functional Servicing and SWM Report has been prepared in support of the Re-Zoning Application and Official Plan Amendment for the proposed development. The Concept Plan is provided in **Appendix A**.

The purpose of this report is to demonstrate that the proposed development can be accommodated by existing external storm, sanitary and water infrastructure and to establish servicing, grading and stormwater management expectations for the future site plan application in accordance with the City of Markham, Toronto & Region Conservation Authority (TRCA), the Ontario Building Code, and the Ministry of Environment, Conservation and Parks (MECP) design criteria.

1.2 Study Area

The proposed development is approximately 5.37 ha in size and consists of a restored and improved parking lot, new National Centre Building for the National Spiritual Assembly of the Bahá'ís of Canada, a National Temple for the Bahá'i Faith, several small ancillary structures, a private driveway shared with the adjacent golf club located on the Golf Course Lands, and parking lot, all located within the German Mills Creek subwatershed of the Don River Watershed in the City of Markham. Access to the proposed development is proposed from Leslie Street. As shown on **Figure 1.1**, the study area is bound by:

- Existing Park space and woodland to the north;
- Waterloo Court to the south;
- Existing Park space and woodland to the east; and
- Existing Bayview Golf and Country Club to the west.

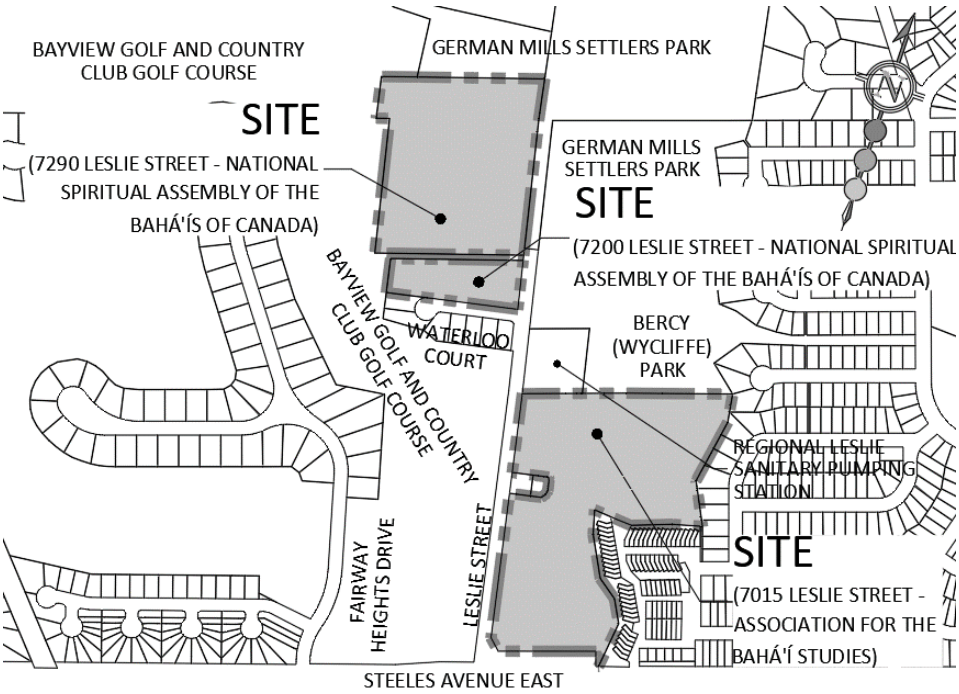

Figure 1.1: Site Location Plan

1.3 Background Servicing Information

The following design guidelines and standards have been referred to with regard to the site servicing, grading, and stormwater management for the proposed development (relevant excerpts are included in **Appendix B**):

- Stormwater Management Criteria by Toronto and Region Conservation Authority (August 2012);

- Low Impact Development Stormwater Management Planning and Design Guide by Sustainable Technologies Evaluation Program, (January 2024), [https://wiki.sustainabletechnologies.ca/wiki/Main_Page];
- Design Criteria by City of Markham Engineering Department (July 2019); and
- MECP Stormwater Management Planning and Design Manual (2003).

The site servicing and SWM strategies in this report are based on the following approved reports & drawings:

- York-Durham Sewage System (Leslie Street Forcemain) – Contract Drawing Set, Gore & Storrie Ltd. Consulting Engineers (March 1995);
- York-Durham Sewage System (Leslie Street Forcemain-South) – Contract Drawing Set, Gore & Storrie Ltd. Consulting Engineers (May 1979);
- York-Durham Sewage System (Leslie Street Forcemain-Central) – Contract Drawing Set, Gore & Storrie Ltd. Consulting Engineers (November 1979);
- Waterloo Court Subdivision – As Constructed Engineering Drawings Set, Fred Schaeffer & Associates Inc (August 1981);
- South-West Collector Sewer Drawing, Gore & Storrie Ltd. Consulting Engineers (December 1978);
- Don River Floodplain Mapping Updated (Phase I) and G. Ross Lord Dam's Operation Rule Optimization and Risks Study – Phase I Report, prepared by KGS Group Inc., dated April 2020; and
- Don River Floodplain Mapping Phase II Report, prepared by WSP Global Inc., dated August 2020.
- Technical Guide, River & Stream Systems: Floodplain Hazard Limit, Appendix 26, Section (1) Flooding as a Threat to Life, prepared by Ontario Ministry of Natural Resources, dated 2002

The site servicing and SWM strategies in this report are also based on the following reports:

- Scoped Environmental Impact Study for the Bahá'í National Centre and Temple, prepared by GEI Consultants Ltd. (October 2022);
- 7015-7200 Leslie Street Development Watermain Analysis, prepared by Municipal Engineering Solutions. (August 2022); and
- Hydrogeological Study for the Bahá'í National Centre Site, prepared by Terraprobe Inc. (December 2023).

Relevant excerpts from the above listed documents are provided in **Appendix B**.

2.0 Storm Servicing

2.1 Existing Storm Sewer System

As indicated in the record drawings (**Appendix B**), the sizes and locations of the existing storm sewers surrounding the existing site are:

- 300 mm – 375 mm diameter storm sewers from Waterloo Court flowing east across Leslie Street and outletting to an existing headwall to German Mills Creek.

The existing site is currently draining via overland flow towards the woodland and German Mills Creek to the east. There are no existing storm sewers servicing the site.

2.2 Proposed Storm Sewer System

The private storm sewer system for the proposed development (**Figure 2.1**) will be designed to capture the 100 year return storm per the City of Markham Design Standards and released via control structure to restrict the flow to the capacity of the existing infrastructure (further discussed in Section 3.2 of this report). The storm sewer system will be designed in accordance with the City of Markham, Ontario Building Code and MECP guidelines, including the following:

- Pipes to be sized to accommodate runoff from a 100 year storm event;
- Minimum Pipe Size: 300 mm diameter;
- Maximum Flow Velocity: 3.7 m/s;
- Minimum Flow Velocity: 0.6 m/s; and
- Minimum Pipe Depth: 1.2 m to obvert (frost cover).

As requested by the City and TRCA, a connection is proposed to the existing stormwater infrastructure so an additional headwall is not required to German Mills Creek. As such, a downstream capacity analysis (**Appendix C**) was prepared to evaluate the residual capacity of the existing storm sewer on Waterloo Court. As shown by the analysis, the residual capacity by gravity within the existing sewer is 37.0 L/s. A hydraulic grade line (HGL) analysis was conducted to identify if any additional flow can be added to the existing infrastructure without creating adverse impact. This analysis concludes that the existing system at Ex. STM.MH.3 at the intersection of Leslie Street and Waterloo Court can accommodate a flow of 213.2 L/s without impacting the HGL between STM.MH.3 and STM.MH.2 on waterloo court where there are catchbasins and service connections to the existing infrastructure. For this reason, the storm sewer system is proposed to connect to the existing infrastructure at the intersection of Leslie Street and Waterloo Court to outlet to German Mills Creek via the existing headwall within the valley, as shown on **Figure 2.1**. The exact size and location of the proposed private storm sewer system for the proposed development will be determined in support of the Site Plan application.

3.0 Stormwater Management

3.1 Existing Drainage

The existing site is located within the German Mills Creek Subwatershed of the Don River Watershed. German Mills Creek flows southerly east of the existing site. The runoff from the existing site (5.37 ha) drains easterly via overland flow into German Mills Creek.

3.2 Stormwater Runoff Control Criteria

The following stormwater runoff control criteria have been established based on the City of Markham design criteria (July 2019), the Toronto & Region Conversation Authority SWM Criteria (August 2012), and the MECP Stormwater Management Planning and Design Manual (2003). The stormwater runoff criteria are summarized below in **Table 3-1**.

Table 3-1: Stormwater Runoff Control Criteria

Criteria	Control Measure
Quantity Control	The release rate to German Mills Creek will be the existing 2 – 100 peak flows per Don River Criteria. For flows directed to existing infrastructure the release rate will be the lesser of existing peak or the capacity of the existing infrastructure to prevent the construction of an additional outlet headwall in the valley.
Quality Control	Provide MECP Enhanced (Level 1) Protection for 80% TSS Removal.
Erosion Control	Retention of the 5 mm rainfall runoff on-site.
Water Budget	As the majority of the existing site does not lie within a Wellhead Protection Area (WHPA), High Volume Recharge Area (HVRA), or Ecologically Significant Groundwater Recharge Area (ESGRA), the water budget criteria will be achieved via the retention of the equivalent of 5 mm of rainfall over the development area. The western portion of the site falls within a Highly Vulnerable Aquifer (HVA) with a Vulnerability Score of 6.

3.3 Allowable Release Rate

The target release rates for the proposed development are the existing 2 – 100 year peak runoff rates for the portion of the existing site that are tributary to German Mills Creek (Catchments 101, 102 & 103, **Figures 3.2 & 3.3**). The allowable release rate for the proposed development that is tributary to the existing storm infrastructure on Waterloo Court (Catchment 104, **Figure 3.1**) was determined based on the hydraulic gradeline assessment performed on the existing infrastructure from Waterloo Court to the existing headwall (**Section 2.2**). The design sheets and hydraulic grade line analysis is

provided in **Appendix C**. The existing storm drainage areas are shown on **Figures 3.1**, **3.2**, and **3.3**.

The rational method was used to determine the target release rates from the site based on Intensity-Duration-Frequency (IDF) rainfall curves from the City of Markham Design Standards.

The allowable release rate calculation for the proposed redevelopment is summarized in **Table 3-2** below, further detail on the calculations is available in **Appendix C**.

Table 3-2: Allowable Release Rate Summary

Return Period Storm	Leslie Street Outlet Sewer (L/s)	German Mills Creek (L/s)	Total Release Rate to German Mills Creek (L/s)
2 Year	95.7	253.4	349.2
5 Year	132.8	351.6	484.4
10 Year	161.4	427.2	588.6
25 Year	192.5	560.7	753.2
50 Year	211.4	671.8	883.2
100 Year	213.2[†]	789.1	1087.2

Note[†]: The allowable release rate reflects residual capacity available in this existing system without impacting the upstream infrastructure (213.2 L/s), which is less than existing.

3.4 Stormwater Best Management Practices Selection

In accordance with the Ministry of Environment Stormwater Management Planning and Design Manual (2003), a review of stormwater management best practices was completed using a treatment train approach, which evaluated at-source, conveyance system, and end-of-pipe alternatives. The potential best management practices were evaluated based on the stormwater management objectives listed in **Table 3-1** and selected for feasibility and applicability in the proposed development. The proposed low-impact development (LID) measures are subject to further evaluation at the SPA stage when more detailed site data are available and the site plan is finalized.

The following site characteristics were taken into consideration:

- Developable area of 2.48 ha west of Leslie Street, consisting of new development;
- The 7015 Leslie Street Property (on the east side of Leslie) has not been considered in the stormwater management analysis as the works proposed in this site and restoration, regarding and parking spot line painting, there is to be no additional impervious area or change to any servicing for this property;
- The receiving watercourse is German Mills Creek in the Don River watershed;
- The site is underlain with Clayey Silt to Silt and Clay Till; and groundwater encountered on-site ranges from 3.1 metres below ground surface (mbgs) at the shallowest to 10.7 mbgs.

The following are examples of at-source, conveyance and end-of-pipe controls that were evaluated for use in the proposed development. While evaluating the following controls, cost, feasibility, groundwater and grading constraints were taken into consideration.

At-Source Controls

At-source controls are at-source measures that reduce runoff prior to stormwater entering the conveyance system, such as:

- Increased topsoil depth;
- Passive Landscaping;
- Roof runoff to soak-away pits;
- Roof runoff to retention cisterns/rainwater harvesting;
- Roof downspout disconnection to grassed areas;
- Green Roofs; and
- Pervious pavements.

Conveyance Controls

Conveyance controls provide treatment of stormwater during the transport of runoff from individual lots to the receiving watercourse or end-of-pipe facility. Examples of conveyance controls include:

- Grassed Swales; and
- Pervious pipe system.

End-of-Pipe Controls

End-of-pipe stormwater management facilities receive stormwater flows from a conveyance system (i.e., storm sewers or ditches) and provide treatment of stormwater prior to discharging flows to the receiving watercourse. Typical end-of-pipe controls include:

- Wet ponds;
- Wetlands;
- Dry ponds;
- Infiltration basins;
- Manufactured Treatment Device;
- Underground storage.

3.4.1 At-Source Controls Evaluation

It is noted these controls are proposed on private properties. Incorporating controls that require minimal routine maintenance can be an effective method in the treatment train approach to SWM. The following controls have been evaluated for use in the proposed development:

Increased Topsoil Depth

An increase in the proposed topsoil depth is recommended to promote at source infiltration (minimum 0.3 m depth). Increased topsoil depth will also contribute to at source quality and quantity control and will contribute to groundwater recharge. A topsoil depth of 0.30 m is proposed.

Passive Landscaping

Planting of gardens and other vegetation designed to minimize local runoff or use rainwater as a watering source can be used to reduce rainwater runoff by increasing evaporation, transpiration, infiltration and contribute to groundwater recharge. Homeowner education should be encouraged to use passive landscaping practices as part of the homeowner turnover package of information. By promoting infiltration through passive landscaping, water quality and quantity control is provided for the volume of water infiltrated. Passive landscaping can provide significant stormwater management benefits as part of the overall treatment train approach for the proposed development.

Roof Runoff to Soak-away Pits

Directing roof runoff to subsurface soak-away pits can be used to promote infiltration. By promoting infiltration water quality and quantity controls are provided for the volume of water retained. Infiltration of roof runoff can provide significant SWM

benefits as part of the overall treatment train approach for the proposed development. Within the extents of the proposed underground parking garage a soak-away pit is not feasible.

Roof Runoff to Retention Cisterns/Rainwater Harvesting

Directing roof runoff to rainwater retention cisterns (i.e. rain barrels or greywater re-use tank) will contribute to water quality and water balance control. The retained rainwater can be harvested for re-use such as mechanical cooling, irrigation and/or greywater use. A retention cistern is proposed for this application as part of the active stormwater storage tank within the proposed parking garage.

Roof Downspout Disconnection to Grassed Areas

Directing roof leaders to grassed areas will contribute to water quality and water balance control by encouraging stormwater retention. Roof leaders are to be disconnected and directed to grassed areas. As the site is comprised of mid-high-rise buildings there are no downspouts therefore this LID is not applicable for this development.

Green Roofs

Best suited for flat roofs, green roofs provide rainwater retention in the growing medium where it is evaporated, evapo-transpired, or slowly drains away after the rainfall event. Although the proposed development consists of mid-rise to high-rise buildings, the roof plans do not reflect opportunities for green roof technology.

Pervious Pavement

By encouraging infiltration and filtration, pervious pavement can contribute to water quality, balance and erosion control. This technology is recommended as a feasible solution to provide infiltration, this is proposed in the visitor parking areas as it is less effective in heavily trafficked areas.

An evaluation of the suitability of potential lot level controls for the proposed development is provided in **Table 3.3**.

3.4.2 Conveyance Controls Evaluation

Conveyance controls provide treatment of stormwater during the transport of runoff from individual lots to the receiving watercourse or end-of-pipe facility. The following conveyance controls have been evaluated for use in the proposed development:

Enhanced Grassed Swales

Grassed swales conveying runoff promote infiltration, filtration, and evapotranspiration, contributing to water quality and quantity control, and contribute to groundwater recharge. It is recommended to use enhanced grass swales for this site, specifically to direct runoff from the undistributed area in between the temple and parking area as well as at the eastern parking lot overland flow outlet.

Perforated Pipe System – A perforated pipe system promotes infiltration of stormwater runoff. As the majority of the proposed storm sewers are adjacent to the proposed underground parking garage or located within the municipal right-of-way, a perforated pipe system is not recommended.

An evaluation of the suitability of potential conveyance BMPs is provided in **Table 3-3**.

3.4.3 Proposed End-of-Pipe Controls

While at-source and conveyance system controls are valuable components of the overall SWM plan, on their own they are not sufficient to meet the quantity and quality control objectives for the proposed development. End-of-pipe stormwater management facilities receive stormwater flows from a conveyance system (i.e., storm sewers or ditches) and provide treatment of stormwater prior to discharging flows to the receiving outlet. Accordingly, the following end-of-pipe controls have been evaluated for use in the proposed development:

Wet Ponds, Wetlands, Dry Ponds

Sized following the MECP criteria, these end of pipe facilities can provide water quality, quantity, and erosion control treatment. Due to the size of the proposed development and the presence of the underground parking level, a stormwater detention facility is not proposed.

Manufactured Treatment Device

A properly sized manufactured treatment device (MTD) can assist in providing MECP Enhanced (Level 1) treatment and can contribute to the treatment train approach for water quality control. The MTD unit specified shall be Environmental Technology Verification (ETV) certified, to provide 80% TSS removal. A MTD has been incorporated into the proposed stormwater treatment train.

Underground Storage

To meet quantity control targets, flow restrictors can be used to control stormwater release rates. To accommodate the reduced release rate, stormwater detention facilities are required to store stormwater runoff. Stormwater storage is proposed to be provided

by on-site underground storage chambers (e.g., CULTEC or approved equivalent) and/or underground storage tank (i.e. cast-in-place concrete tank) within the proposed development.

An evaluation of the suitability of potential conveyance BMPs is provided in **Table 3-3**.

3.4.4 Selection of Best Management Practices (BMPs)

Table 3-3 evaluates the suitability of the various stormwater management controls identified for the proposed development.

Table 3-3: Evaluation of Stormwater Best Management Practices (BMPs)

BEST MANAGEMENT PRACTICE	FEASIBLE (Yes/No)	RECOMMENDED (Yes/No)
Increased Topsoil Depth	Yes	Yes
Passive Landscaping	Yes	Yes
Roof Runoff to Soak-away Pits	Yes	No
Roof Runoff to Retention Cisterns/Rainwater Harvesting	Yes	Yes
Roof Downspout Disconnection to Grassed Areas	No	No
Green Roofs	Yes	No
Pervious Pavement	Yes	Yes
Enhanced Grassed Swales	Yes	Yes
Perforated Pipe System	No	No
Wet Ponds, Wetlands, Dry Ponds	No	No
Manufactured Treatment Device	Yes	Yes
Underground Storage	Yes	Yes

Table 3-4 below summarizes the recommended stormwater management Best Management Practices (BMPs) for the proposed development. These practices are subject to further evaluation at the SPA stage.

Table 3-4: Summary of the Recommended Best Management Practices (BMPs)

Stormwater Management Control	Recommended BMP
At-Source Controls	Increased Topsoil Depth
	Passive Landscaping
	Roof Runoff to Retention Cisterns/Rainwater Harvesting
	Pervious Pavement
Conveyance System Controls	Enhanced Grassed Swales
End-Of-Pipe Controls	Underground Stormwater Detention System
	Manufactured Treatment Device

3.5 Proposed Storm Drainage

The proposed major and minor system flow patterns and drainage areas are shown on **Figures 3.4** & **3.5**. As illustrated, the proposed development will convey runoff to one of two outlet locations; the existing storm sewer infrastructure on Waterloo Court, and via overland flow to German Mills Creek. Major system flow from northern area of the site will continue to flow eastward to German Mills Creek, the minor system flows will be captured and conveyed through proposed storm sewers to the existing storm outfall east of Waterloo Court (Catchment 201, 202, & 204, **Figure 3.4 & 3.5**). The major and minor flows from the National Centre (7200 Leslie) will be captured via a proposed internal storm sewer system (Catchment 203, **Figure 3.4**) and detained on-site in an underground storage system and discharged into proposed MH4.

3.6 Quantity Control

Quantity control for the proposed development is required to control the proposed runoff to the allowable release rates as described in **Section 3.2.** The allowable release rates are to be achieved through proposed on-site underground storage via a cast-in-place stormwater management tank in the National Centre underground parking level.

Table 3-5, presents a summary of the release rates and storage requirements for each of the catchment areas shown in **Figures 3.4** & **3.5**.

Table 3-5: Summary of 100 Year Release Rates and Storage to the Leslie Street Outlet

Catchment	100 Year Allowable Release Rate (L/s)	100 Year Proposed Release Rate (L/s)	Storage Required (m^3)
202	213.2	35	--
203		103.3	225.7

Table 3-6: Proposed Release Rate Summary

Return Period Storm	Allowable Release Rate to the Leslie Street Outlet† (L/s)	Proposed Release Rate to the Leslie Street Outlet (L/s)	Total Allowable Release Rate to German Mills Creek† (L/s)	Proposed Release Rate to German Mills Creek (L/s)
2 Year	95.7	85.0	349.2	349.1
5 Year	132.8	98.4	484.4	478.4
10 Year	161.4	108.0	588.6	577.2
25 Year	192.5	122.6	753.2	749.4
50 Year	211.4	130.1	883.2	871.7
100 Year	213.2	138.3	1087.2	1002.2

Note: †Per **Table 3.2**

For further detail on the quantity control measures, please refer to the detailed calculations provided in **Appendix C**.

3.7 Quality Control

Quality control will be provided by a treatment train of Low Impact Development (LID) techniques which will include a manufactured treatment device (MTD) located downstream of the Temple & National Centre (**Figure 2.1**), enhanced grassed swales with an infiltration component and permeable pavers, illustrated on **Figures 3.4** & **3.5**.

The MTD is to be sized for a minimum of 80% TSS removal. A HydroDome unit or approved equivalent with ETV Certification for 80% TSS removal is to be utilized and detailed through the SPA Stage.

The proposed enhanced swale, as shown on **Figure 3.5** will collect runoff from the eastern parking area via overland flow. To achieve the quality control objectives, the enhanced grassed swale has a flow depth less than 0.10 m and a velocity less than 0.5 m/s in the 25 mm 4-hour storm event. The calculations for the proposed enhanced grassed swale, ensuring that quality control is achieved is provided in **Appendix C**. Calculations to illustrate the infiltration volumes required to meet the MECP quality control objectives in the permeable pavers are provided in **Appendix C**.

3.8 Erosion & Volume Control

As outlined in **Table 3-1**, erosion control is required in the form of the retention of the first 5 mm of rainfall on-site. The erosion control criterion for the entire development (the National Centre and Temple (7200 & 7290) is proposed to be achieved through the use of permeable pavers across the eastern parking lot and infiltration via the enhanced grassed swale at the outlet of the eastern parking area, as well as a water re-use chamber in the underground storage tank of the National Centre. The required volume to achieve the 5 mm retention requirement across the development is 45.7 m^3. The permeable pavers proposed offer 73.3 m^3 of storage in the clear stone base, exceeding the required retention volume. In addition to the proposed permeable pavers, a water re-use chamber below the outlet invert of the underground storage tank of the National Centre noted in *Section 3.6* above, as well as an enhanced grassed swale with an infiltration component on the eastern overland outlet from the parking lot are proposed. These LIDs are to be further refined at the detailed design stage. Supporting calculations are provided in **Appendix C**.

It is noted that permeable pavers or approved equivalent are only proposed in the parking spots of the parking area. Due to the challenges to maintain the permeability of the material in a high traffic area, we do not recommend the installation of permeable material in either the driveways or laneways. The visitor parking spaces offer a lower traffic area where vehicle turning is limited and the area can be easily barricaded for maintenance purposes.

3.9 Water Balance

As noted in **Table 3.1**, the subject site does not fall within a WHPA-Q source protection area, therefore, the existing annual infiltration volume is not required to be maintained in the post-development condition.

The equivalent of the 5 mm rainfall event is required to be retained on-site in accordance with the TRCA's erosion control and water balance criteria. As discussed in **Section 3.8**, the required 5 mm retention volume is exceeded through the use of permeable pavement, an enhanced grassed swale, and a re-use chamber below the outlet invert of the proposed underground storage tank of the National Centre. Water re-use in this chamber is to be utilized through mechanical cooling and irrigation.

The Hydrogeological Assessment (Terraprobe, December 2023) details the water balance calculations and is submitted under separate cover for review, however, relevant excerpts are provided in **Appendix B**.

4.0 Sanitary Servicing

4.1 Existing Sanitary Servicing

As indicated in the record drawings received from the City of Markham (**Appendix B**), the sizes and locations of the existing sanitary sewers surrounding the site are:

- A regional twin 1200 mm diameter concrete sanitary forcemain sewer on Leslie Street flowing north; and
- A municipal 200 mm diameter PVC sanitary sewer on Waterloo Court flowing east across Leslie Street and under German Mills Creek, where it connects to the existing municipal 750 mm diameter trunk sewer.

The Regional Leslie Sanitary Pumping Station is located south of the site, on the east side of Leslie Street.

4.2 Proposed Sanitary Servicing

Based on City of Markham design criteria, the proposed ancillary structures and washrooms, the proposed temple, and the new National Centre will generate a total sanitary flow of 2.2 L/s. This is based on the proposed development's site areas and City of Markham's Sanitary Sewer Design and Design Flow Calculation criteria (refer to City of Markham Engineering Design Criteria, Section – D, Subsection D2.2), as shown on **Figure 4.2** and the Sanitary Design Sheet included in **Appendix D**. The private sanitary servicing system from the proposed development is proposed to connect to the existing municipal 200 mm diameter PVC sanitary sewer on Waterloo Court via a new manhole at the intersection of Waterloo Court and Leslie Street, as shown on **Figure 4.1**. Per the Waterloo Court plan and profile (provided in **Appendix B** for reference), the proposed sanitary sewer has approximately 3.20 m of cover at the proposed service connection, which is sufficient to service the majority of the proposed development with a gravity connection. At the SPA stage, local sanitary pumping solutions for lower areas of the proposed development (i.e. underground parking) will be investigated.

A downstream sanitary sewer capacity analysis has been completed to evaluate the residual capacity of the downstream sewers up to the existing 750 mm diameter sanitary trunk sewer under German Mills Creek. Based on the result of this analysis, the downstream sanitary sewer has sufficient capacity to accommodate the proposed development. A preliminary sanitary drainage scheme is presented in **Figure 4.2** and the accompanying design sheets are included in **Appendix D** for reference.

The private sanitary sewers within the site will have slopes ranging between 0.5% and 2% (typically) and will be provided at 2 m to 5 m deep.

The sanitary servicing system will be designed in accordance with the City of Markham and MECP criteria, including but not limited to:

- Residential Sanitary Generation Rate: 365 l/c/d
- Institutional Population Density: 60 people/ha of GFA
- Parks and Recreation Density: 60 people/ha gross land area
- Existing Residential Population Density: 4.0 people/unit
- Peaking Factor: Harmon (Max. 4.0, Min. 1.5)
- Infiltration Rate: 0.26 L/s/ha
- Minimum Pipe Size: 200 mm diameter
- Minimum Pipe Cover: 2.75 m
- Minimum Full-Flow Velocity: 0.75 m/s
- Maximum Full-Flow Velocity: 3.65 m/s

5.0 Water Servicing

5.1 Existing Water Servicing

As indicated in the record drawings received from the City of Markham (**Appendix B**), the following existing watermains surround the site:

- A municipal 300 mm diameter watermain on the west side of Leslie Street fronting the development and continuing south along Leslie to Steeles Avenue and north to the end of the existing driveway elbow; and
- A municipal 150 mm diameter ductile iron watermain on the north side of Waterloo Court.

According to record drawings, the existing building is being serviced by an existing 25mm water service connection on Leslie Street, approximately 26.0m south of an existing fire hydrant, directly fronting the site. This existing 25mm water service connection shall be removed. A hydrant flow test was completed on August 3, 2022 to determine existing flows and pressures for the Leslie Street and Waterloo Court watermain systems. According to the hydrant flow test, the available flow at 20 psi is 281 L/s. The hydrant flow test results are included in **Appendix E** for reference.

5.2 Proposed Water Servicing

The water supply for the proposed development and ancillary structures will be provided from the existing 300 mm diameter watermain on Leslie Street. A water meter and backflow preventer for the proposed development will be located in underground chambers behind Leslie Street property line. Preliminary layout for the proposed watermain system is provided on **Figure 5.1**.

A water distribution analysis was completed by Municipal Engineering Solutions (MES) (**Appendix E**) and was designed in accordance with the City of Markham and Ontario Building Code criteria including:

- Residential water usage rate: 365 l/c/d
- Minimum Pipe Size: 150 mm diameter
- Minimum Pipe Depth: 1.75 m
- Maximum Hydrant Spacing: 90 m

The water demand calculations have been provided by Municipal Engineering Solutions (MES) and are provided in **Appendix E**. Based on the population and demand data above, the maximum day demand is 2.94 L/s and the peak hour demand is 5.90 L/s. The fire demand has been calculated to be 117 L/s for the temple, 117 L/s for the national centre, 133 L/s for the welcome center, and 117 L/s for the log cabin/visitor center based on the FUS criteria.

According to the water model completed by MES, using the hydrant flow test results as boundary conditions to calibrate the model, the available fire flow meets or exceeds the minimum fire demands at the minimum pressure of 140 kPa. For further detail on the hydraulic modelling assumptions and results, please refer to the MES report provided in **Appendix E**.

6.0 Grading

6.1 Existing Grading Conditions

The existing topography has slopes in the range of 0.5% to 50%. The ground surface elevations through the study area range from approximately 153.93 m in the east side of the site to approximately 184.37 m in the northwest corner.

6.2 Proposed Grading Concept

In general, the proposed development will be graded in a manner which satisfies the following goals:

Satisfy the City of Markham lot and road grading criteria, create required depth for sanitary sewer, as well as provision of an efficient earthworks program, including:

- Minimum Road Grade: 0.7%
- Maximum Road Grade: 6.0%
- Minimum Driveway Grade: 2%
- Maximum Driveway Grade: 8%
- Minimize the need for retaining walls
- Minimize the volume of earth to be moved and minimize cut/fill differentials
- Achieve the stormwater management objectives required for the proposed development.

A preliminary grading plan is provided on **Figure 6.1**. At the site plan application stage, the preliminary grading will be subject to a more in-depth analysis in an attempt to balance the cut and fill volumes and minimize slopes and retaining walls.

7.0 Leslie Street Modifications

7.1 Existing Conditions

The floodplain for German Mills Creek currently encompasses a portion of the Leslie Street Right-of-way. Based on the Regional Storm depth and velocity at cross section 538.98 in the TRCA's Don River Hydraulic Model for German Mills Creek Reach 3, it creates an unsafe ingress/egress condition for the proposed development, as well as for the Regional sanitary pumping station and the existing residential units on Waterloo Court.

Table 7-1: Existing Conditions – Leslie Flood Spill

Storm Event	Flood Elevation	Velocity Right Bank (m/s)	Leslie Street Low Point (m)	Depth (m)	Depth*Velocity (m^2/s)
Regulatory	152.25	1.52	151.08	1.17	1.78

As demonstrated in **Table 7-1** above, the Depth*Velocity is > 0.8 m2/s which fails the Ontario Ministry of Natural Resources & Forestry (MNRF) safety guidelines discussed in the "Technical Guide – River and Strem Systems: Flooding Hazard Limit" (2002). The flooding depth is in excess of 0.98 m, a threshold sufficient to float young school children. As the depth > 0.3 m, this location is not safe for the passage of cars, but as the depth is < 1.2 m, it is safe for emergency fire vehicles, furthermore as the velocity is < 4.5 m/s, this is acceptable for emergency fire vehicles.

The existing flood plain is shown on **Figure 7.1** and **Figure 7.2**.

7.2 Proposed Conditions

In order to provide safe ingress/egress access for the proposed development and the surrounding neighbourhood during regional flood events, the portion of Leslie Street below the regional floodline will be raised 0.30 m above the regional flood elevation of 152.25 m, to a minimum elevation of 152.55 m. Leslie Street will also be redesigned to include lay—by parking in appropriate areas and a multi-use path linking the lake to lake trail to Steeles Ave. Pavement improvements to meet municipal road standards will also be incorporated. During the SPA stage of the project, a more detailed road design and an updated floodplain model will be prepared in support of the new Leslie Street alignment. The existing adjacent parking lot to the east is being revised to conform with the latest Leslie Street design & configuration including shifting the entrance north. The preliminary layout of the Leslie Street redesign and grading is shown on **Figure 7.3.**

8.0 Erosion and Sediment Control During Construction

During the detailed design stage in support of Site Plan approval, erosion and sediment control measures will be designed with a focus on erosion control practices (such as stabilization, track walking, staged earthworks, etc.) as well as sediment controls (such as temporary fencing, mud mats, catchbasin sediment control devices, check dams, etc.). These measures will be designed and constructed as per the Erosion and Sediment Control Guide for Urban Construction document (TRCA, 2019). A detailed erosion and sediment control plan will be prepared for review and approval by the City of Markham and TRCA prior to any proposed grading being undertaken. This plan will address phasing, inspection and monitoring aspects of erosion and sediment control. All reasonable measures will be taken to ensure sediment loading to the adjacent watercourse and properties are minimized both during and following construction.

9.0 Summary

This Functional Servicing and Stormwater Management Report has outlined the means by which:

- The site can be serviced by full municipal services (storm, sanitary and water);
- The Stormwater Management Criteria can be achieved and has been noted to which the site plan shall conform to during detailed design;
  - *Quantity Control:* Quantity control will be provided via a cast-in-place underground storage tank in the National Centre underground parking level to control proposed runoff rates in the 2 through 100 year storm events to the allowable levels;
  - *Quality Control:* MECP Enhanced (Level 1) water quality protection is provided through the use of an MTD, Permeable Pavers & an Enhanced Grassed Swale.
  - *Erosion/Volume Control:* The required volume to achieve the 5 mm retention requirement across the development is proposed to be achieved via permeable pavers, a water re-use chamber in the National Centre, as well as an enhanced grassed swale with an infiltration component on the eastern overland outlet from the parking lot; and
  - *Water Budget:* 5mm retention is provided as noted above.
- A safe ingress/egress condition to the proposed development can be provided by raising the Leslie Street elevation above the Regional Flood level and will be further detailed during SPA application.

Respectfully Submitted:

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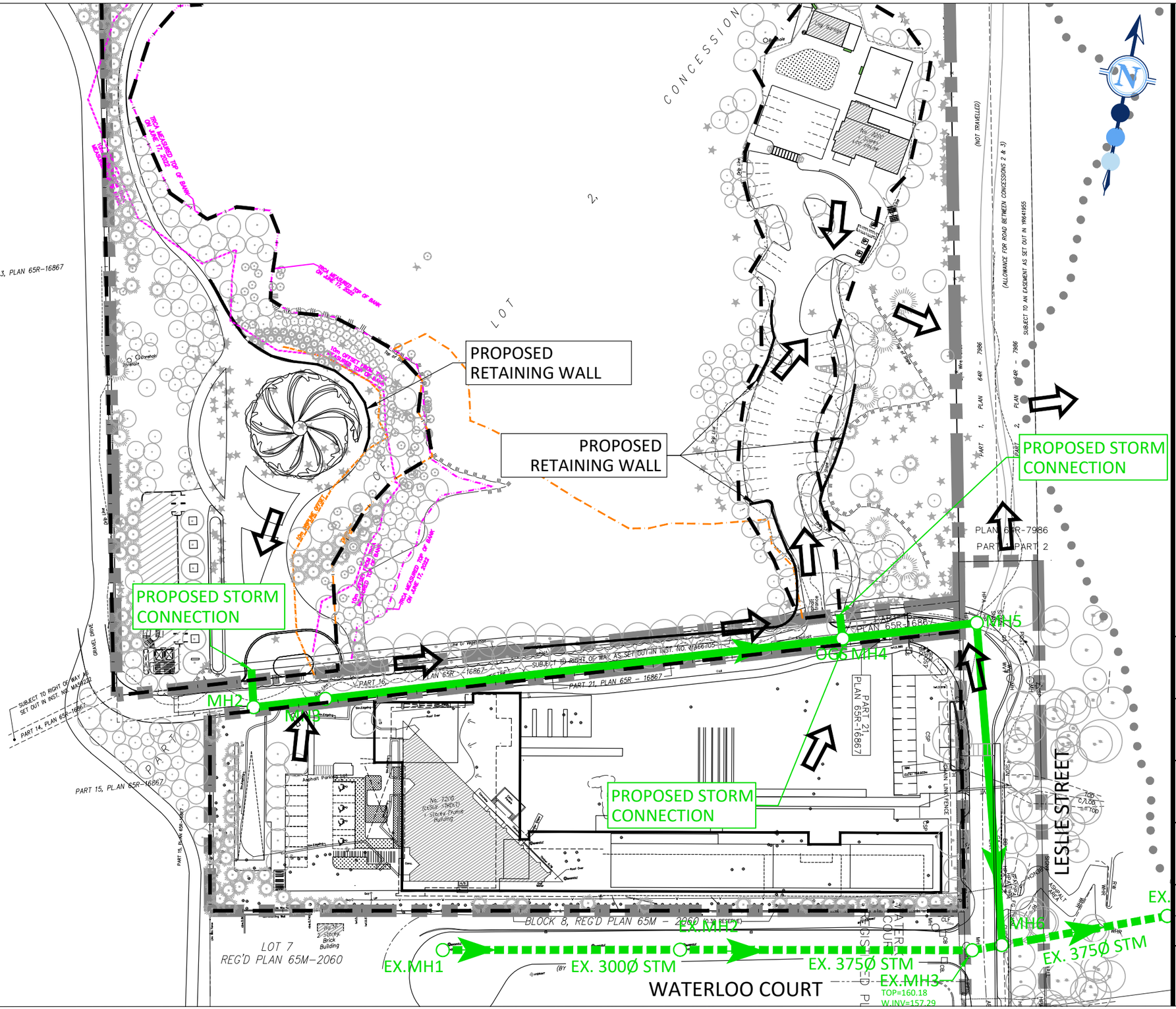
Michael Ventresca, P. Eng.,
mventresca@scsconsultinggroup.com

P:\2004 Bahai National Centre\Design\Reports\FSP\2004P-FSR (Site Plan).docx



LEGEND:

- LIMIT OF PROPERTY
- DEVELOPABLE AREA
- DRIPLINE
- 10m DRIPLINE OFFSET
- TRCA MEASURED TOP OF BANK (JUNE 17, 2022)
- 10m TRCA MEASURED TOP OF BANK OFFSET (JUNE 17, 2022)
- PROPOSED STORM SEWER AND MANHOLE
- EXISTING STORM SEWER AND MANHOLE
- EXISTING REGULATORY FLOODPLAIN
- OVERLAND FLOW DIRECTION

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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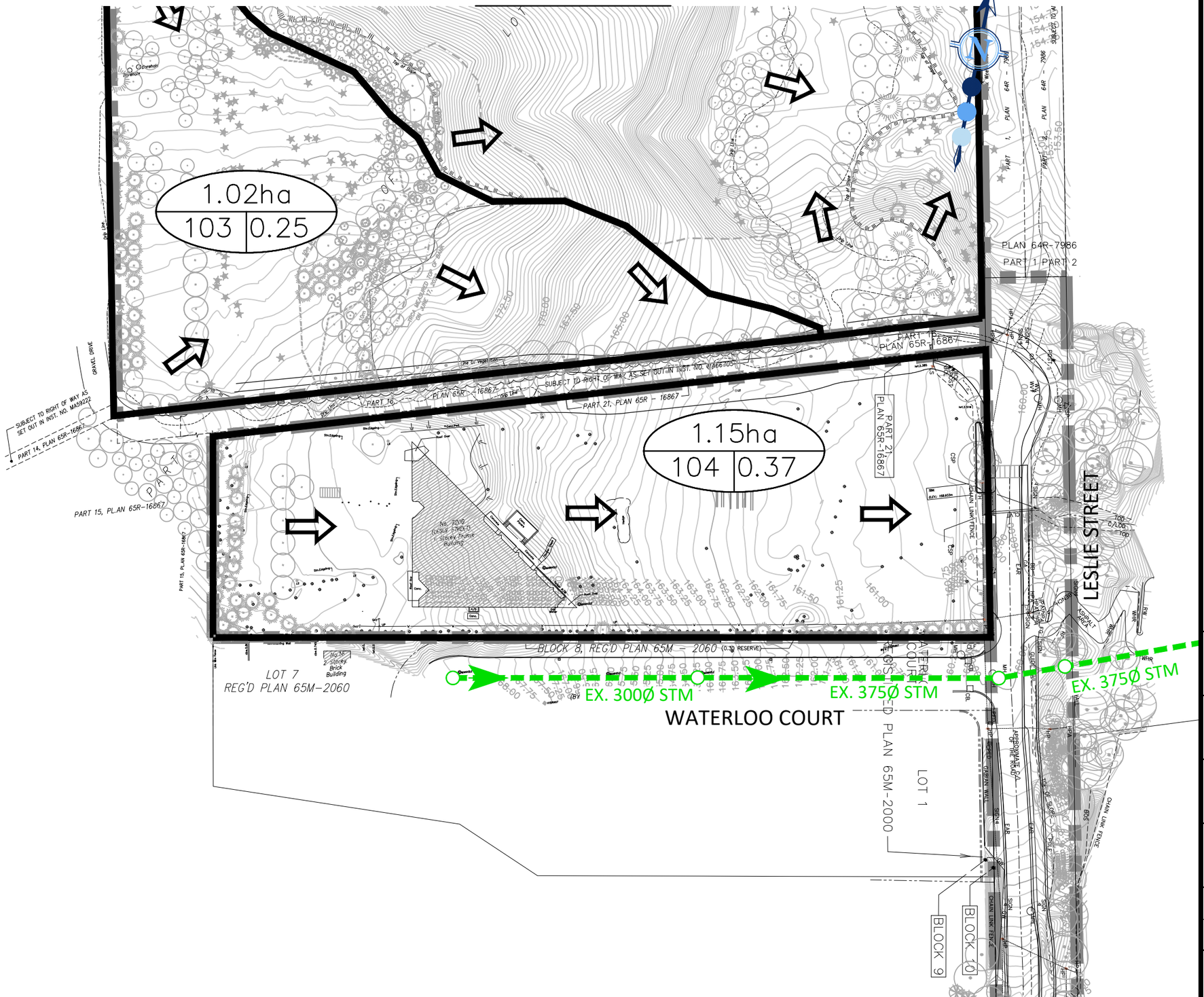
NATIONAL BAHÁ'Í CENTRE OF CANADA

FUNCTIONAL STORM SERVICING PLAN

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	2.1

File: P:\2004 Bahai National Centre\Drawings\FSP\Fig\Report Figures\2004P-2.1-SERV-STRM.dwg – Revised by <JLIM> : Wed, Jan 31 2024 – 6:43pm

SEE FIGURE 3.2



LEGEND:

- LIMIT OF DEVELOPMENT
- MAJOR SYSTEM - OVERLAND FLOW
- MINOR SYSTEM - STORM SEWER
- STORM DRAINAGE BOUNDARY
- EXTERNAL STORM DRAINAGE BOUNDARY
- 0.04ha / 104 | 79% — DRAINAGE AREA (HECTARES); PERCENT (%) IMPERVIOUS; CATCHMENT ID
- EXISTING STORM SEWER AND MANHOLE

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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EXISTING STORM DRAINAGE FIGURE 1

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	3.1

File: P:\2004 Bahai National Centre\Drawings\FSP\Fig\Report Figures\2004P-3.1-3.3-EXST.dwg – Revised by <JLIM> : Wed, Jan 31 2024 – 6:45pm

SEE FIGURE 3.3

SEE FIGURE 3.1

LEGEND:

- LIMIT OF DEVELOPMENT
- MAJOR SYSTEM - OVERLAND FLOW
- MINOR SYSTEM - STORM SEWER
- STORM DRAINAGE BOUNDARY
- EXTERNAL STORM DRAINAGE BOUNDARY
- 0.04ha / 104 | 79% — DRAINAGE AREA (HECTARES); PERCENT (%) IMPERVIOUS; CATCHMENT ID
- EXISTING STORM SEWER AND MANHOLE

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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NATIONAL BAHÁ'Í CENTRE OF CANADA

EXISTING STORM DRAINAGE FIGURE 2

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	3.2

File: P:\2004 Bahai National Centre\Drawings\FSP\Fig\Report Figures\2004P-3.1-3.3-EXST.dwg – Revised by <JLIM> : Wed, Jan 31 2024 – 6:45pm

LEGEND:

- LIMIT OF DEVELOPMENT
- MAJOR SYSTEM - OVERLAND FLOW
- MINOR SYSTEM - STORM SEWER
- STORM DRAINAGE BOUNDARY
- EXTERNAL STORM DRAINAGE BOUNDARY
- 0.04ha / 104 | 79% — DRAINAGE AREA (HECTARES); PERCENT (%) IMPERVIOUS; CATCHMENT ID
- EXISTING STORM SEWER AND MANHOLE

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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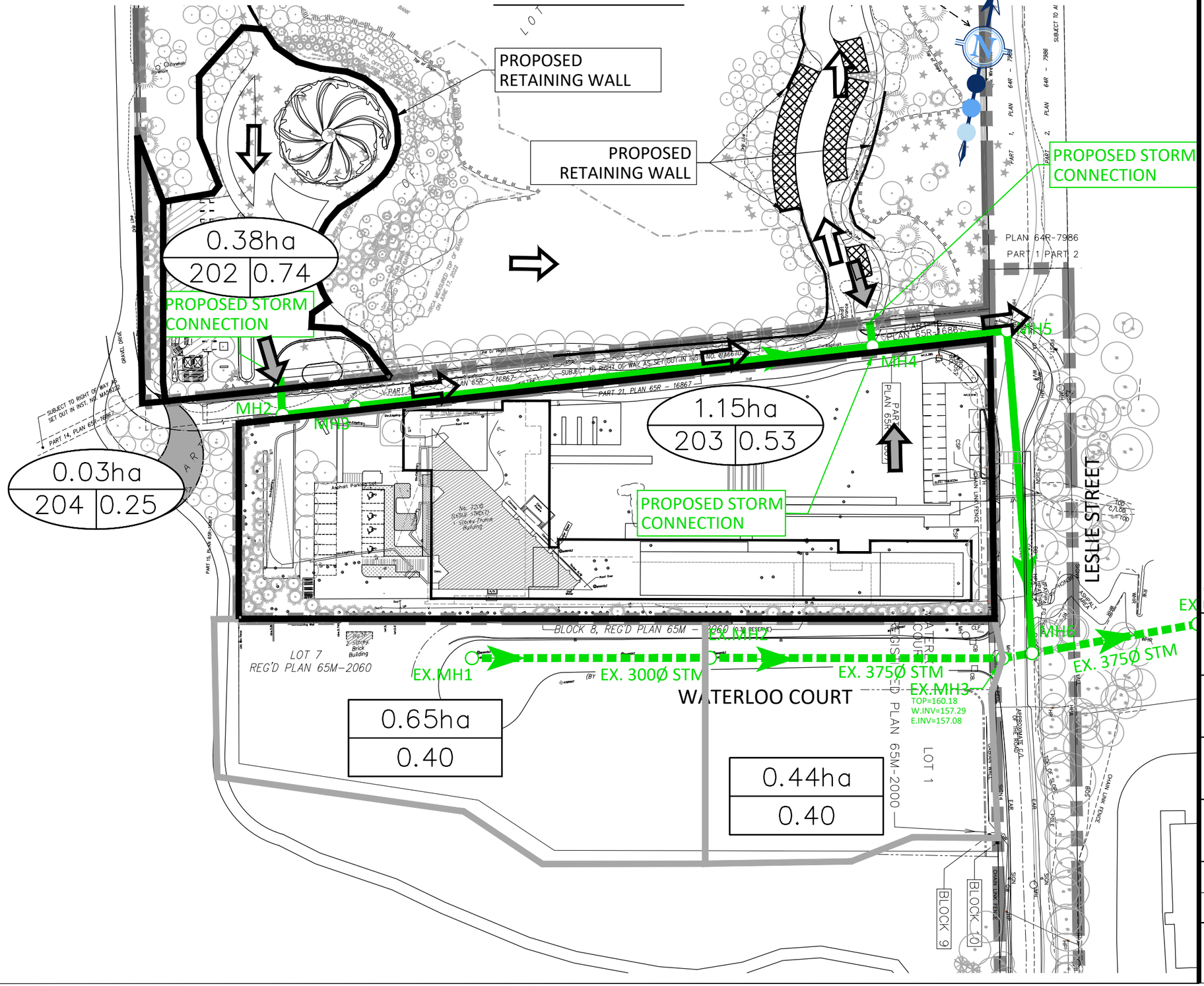
EXISTING STORM DRAINAGE FIGURE 3

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	3.3

SEE FIGURE 3.5



LEGEND:

- LIMIT OF DEVELOPMENT
- MAJOR SYSTEM - OVERLAND FLOW
- MINOR SYSTEM - STORM SEWER
- STORM DRAINAGE BOUNDARY
- EXTERNAL STORM DRAINAGE BOUNDARY
- 0.52ha / 202 | 0.74 — DRAINAGE AREA (HECTARES); PERCENT (%) IMPERVIOUS; CATCHMENT ID
- 1.08ha / 0.40 — DRAINAGE AREA (HECTARES); RUNOFF COEFFICIENT
- EXISTING STORM SEWER AND MANHOLE
- PROPOSED STORM SEWER AND MANHOLE
- PROPOSED PERMEABLE PAVEMENT
- PROPOSED ENHANCED GRASS SWALE

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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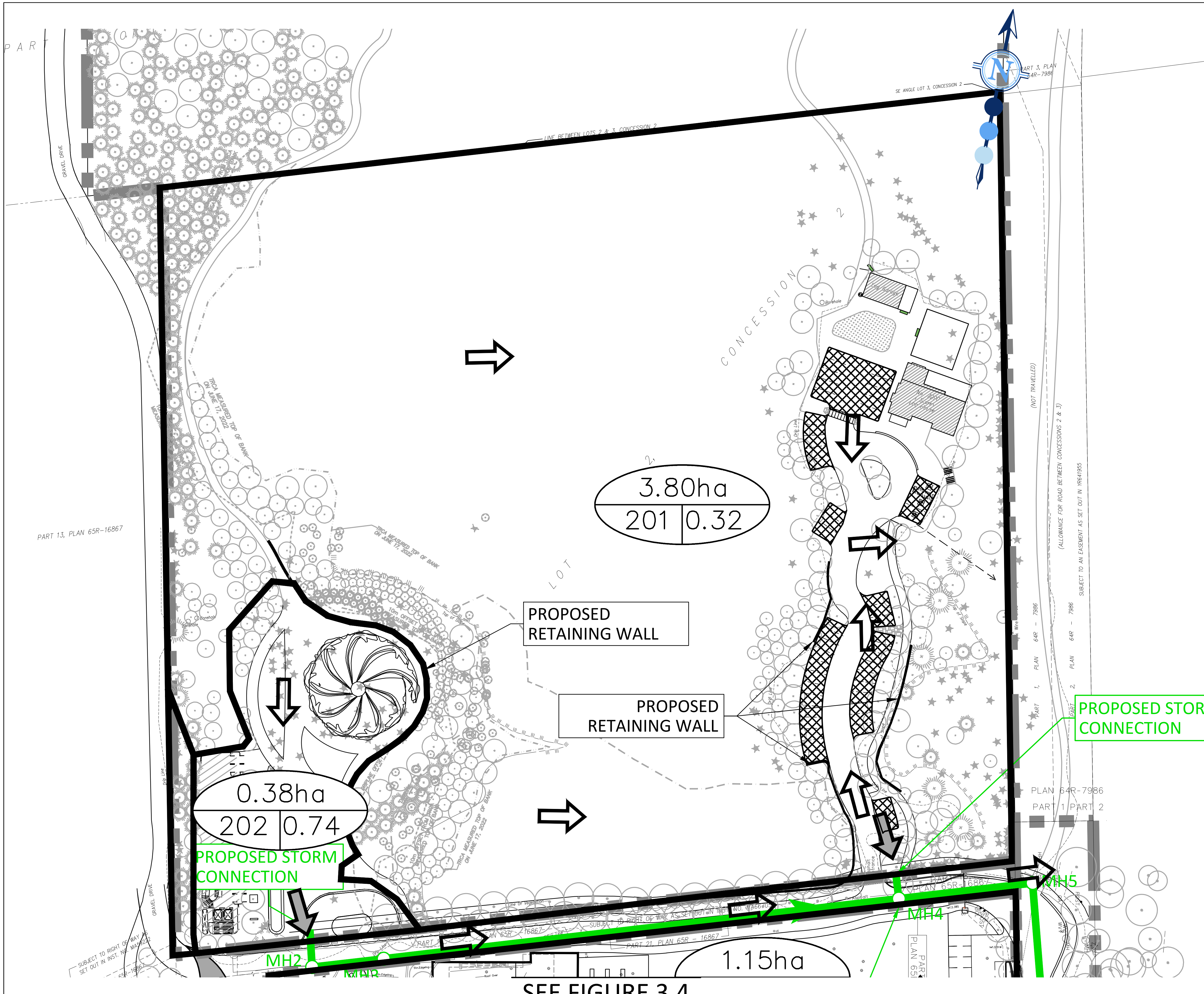
PROPOSED STORM DRAINAGE FIGURE 1

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	3.4

File: P:\2004 Bahai National Centre\Drawings\FSP\Fig\Report Figures\2004P-3.4-3.6-PROP.dwg – Revised by <JLIM> : Wed, Jan 31 2024 – 6:49pm



LEGEND:

- LIMIT OF DEVELOPMENT
- MAJOR SYSTEM - OVERLAND FLOW
- MINOR SYSTEM - STORM SEWER
- STORM DRAINAGE BOUNDARY
- EXTERNAL STORM DRAINAGE BOUNDARY
- 0.52ha / 202 / 0.74 — DRAINAGE AREA (HECTARES); PERCENT (%) IMPERVIOUS; CATCHMENT ID
- 1.08ha / 0.40 — DRAINAGE AREA (HECTARES); RUNOFF COEFFICIENT
- EXISTING STORM SEWER AND MANHOLE
- PROPOSED STORM SEWER AND MANHOLE
- PROPOSED PERMEABLE PAVEMENT
- PROPOSED ENHANCED GRASS SWALE

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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PROPOSED STORM DRAINAGE FIGURE 2

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	3.5

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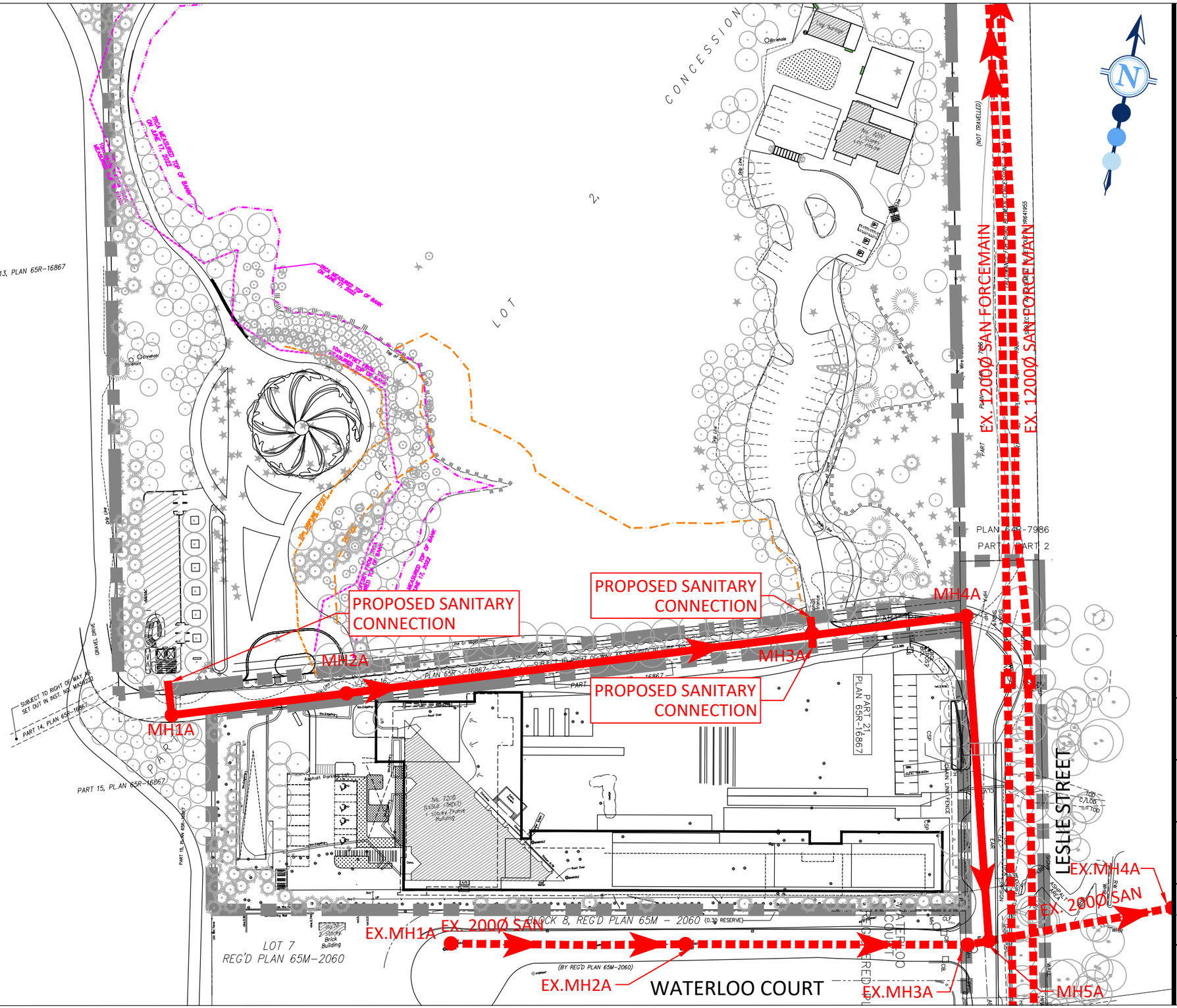

LEGEND:

- LIMIT OF PROPERTY
- DRIPLINE
- 10m DRIPLINE OFFSET
- TRCA MEASURED TOP OF BANK (JUNE 17, 2022)
- 10m TRCA MEASURED TOP OF BANK OFFSET (JUNE 17, 2022)
- PROPOSED SANITARY SEWER AND MANHOLE
- EXISTING SANITARY SEWER AND MANHOLE
- EXISTING SANITARY FORCEMAIN

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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NATIONAL BAHÁ'Í CENTRE OF CANADA

FUNCTIONAL SANITARY SERVICING PLAN

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	4.1

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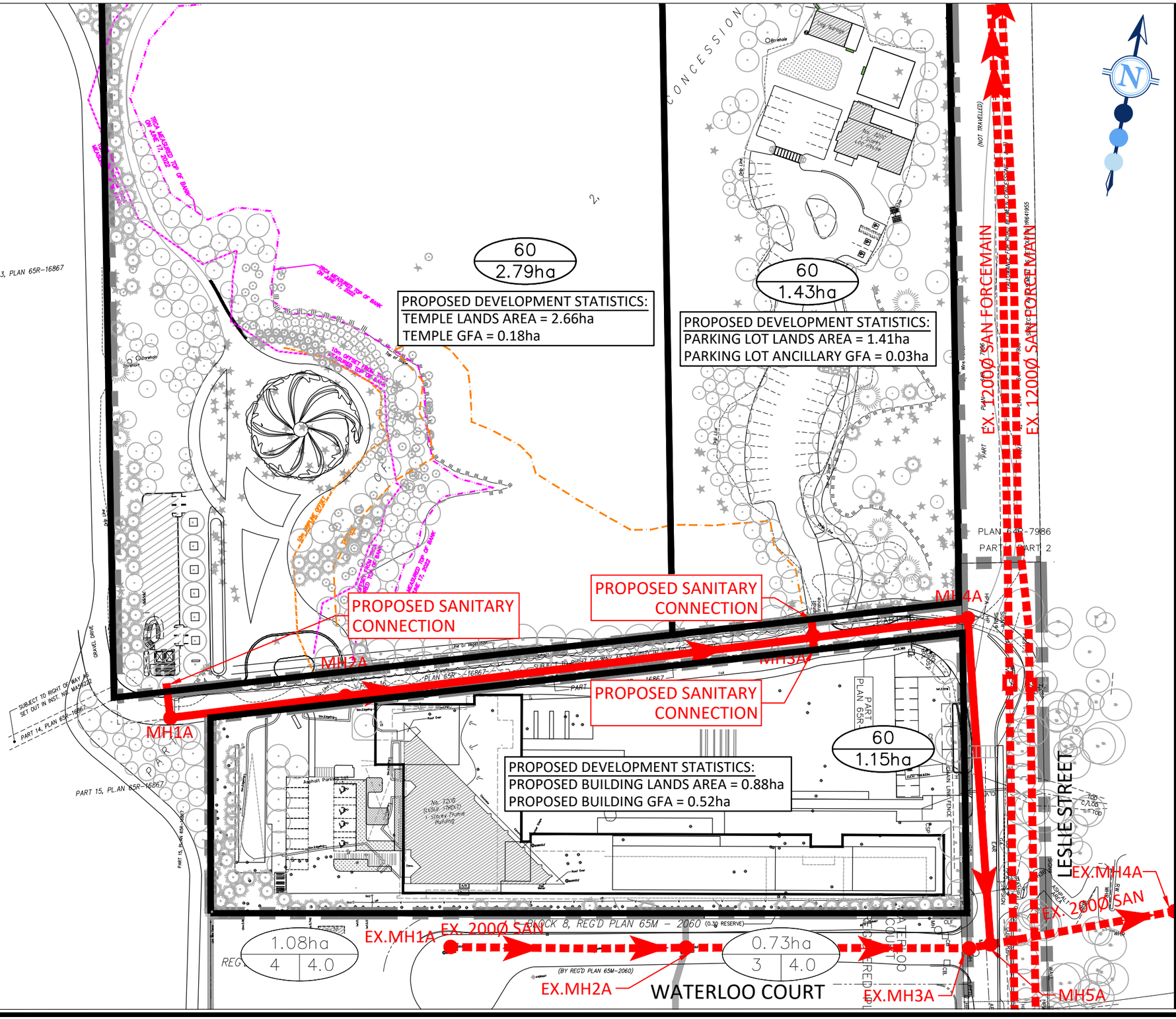

LEGEND:

- LIMIT OF PROPERTY
- DRIPLINE
- 10m DRIPLINE OFFSET
- TRCA MEASURED TOP OF BANK (JUNE 17, 2022)
- 10m TRCA MEASURED TOP OF BANK OFFSET (JUNE 17, 2022)
- PROPOSED SANITARY SEWER AND MANHOLE
- EXISTING SANITARY SEWER AND MANHOLE
- EXISTING SANITARY FORCEMAIN
- PROPOSED SANITARY DRAINAGE BOUNDARY
- EXISTING SANITARY DRAINAGE BOUNDARY

60 / 1.43ha — POPULATION PER HECTRARE; DRAINAGE AREA (HECTARES)

0.73ha / 3 | 4.0 — EXISTING DRAINAGE AREA (HECTARES); EXISTING POPULATION PER UNIT; EXISTING NUMBER OF UNITS

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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NATIONAL BAHÁ'Í CENTRE OF CANADA

PRELIMINARY SANITARY DRAINAGE PLAN

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	4.2

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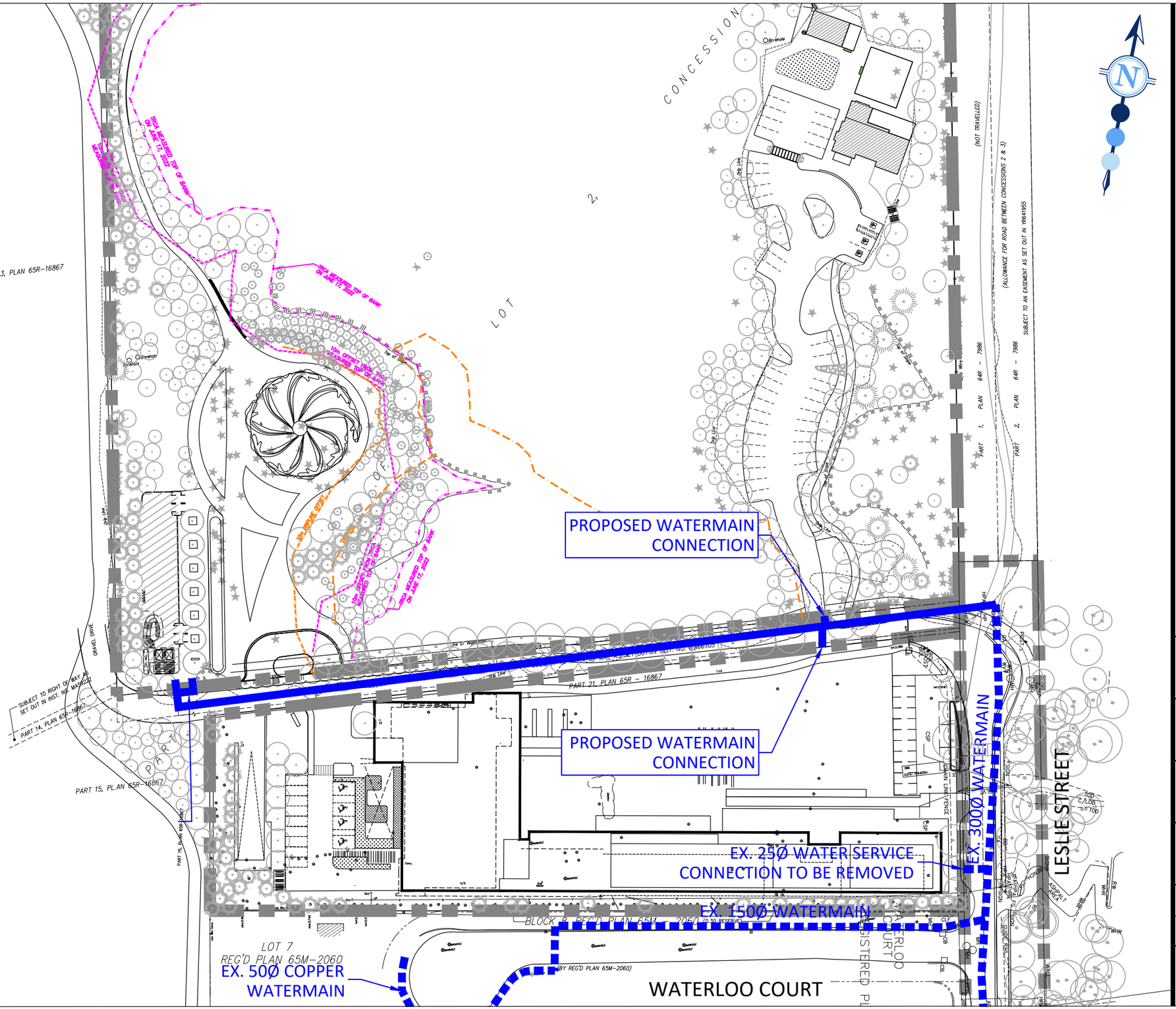

LEGEND:

- LIMIT OF PROPERTY
- DRIPLINE
- 10m DRIPLINE OFFSET
- TRCA MEASURED TOP OF BANK (JUNE 17, 2022)
- 10m TRCA MEASURED TOP OF BANK OFFSET (JUNE 17, 2022)
- PROPOSED WATERMAIN
- EXISTING WATERMAIN

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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NATIONAL BAHÁ'Í CENTRE OF CANADA

FUNCTIONAL WATERMAIN SERVICING PLAN

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	5.1

File: P:\2004 Bahai National Centre\Drawings\FSP\Fig\Report Figures\2004P-5.1-SERV-WTRM.dwg - Revised by <JLIM> : Wed, Jan 31 2024 - 6:40pm

PROPOSED SWALE

PROPOSED RETAINING WALL

PROPOSED RETAINING WALL

PROPOSED RISERS

EX. TRAIL

CONCESSION 2 S

LOT 7

PART 13, PLAN 65R-16867

PART 14, PLAN 65R-16867

PART 15, PLAN 65R-16867

PART 21, PLAN 65R-16867

PLAN 64R-7986 PART 1 PART 2

LESLIE STREET

WATERLOO COURT

LOT 7 REG'D PLAN 65M-2060

(ALLOWANCE FOR ROAD BETWEEN CONCESSIONS 2 & 3)

(NOT TRAVELLED)

SUBJECT TO RIGHT OF WAY AS SET OUT IN INST. NO. MA666705

SUBJECT TO RIGHT OF WAY AS SET OUT IN INST. NO. MA666705

TRCA MEASURED TOP OF BANK (JUNE 17, 2022)

10m OFFSET FROM TRCA MEASURED TOP OF BANK (JUNE 17, 2022)

LEGEND:

- LIMIT OF PROPERTY
- DEVELOPABLE AREA
- DRIPLINE
- 10m DRIPLINE OFFSET
- TRCA MEASURED TOP OF BANK (JUNE 17, 2022)
- 10m TRCA MEASURED TOP OF BANK OFFSET (JUNE 17, 2022)
- × 223.91 — PROPOSED ELEVATION
- × 224.35 EX — EXISTING ELEVATION
- 3.5% — PROPOSED SLOPE
- 164.98 — EXISTING CONTOUR END ELEVATION
- FLOODPLAIN LIMIT

TRCA WATER SURFACE ELEVATION (MASL) - REGIONAL STORM

152.03 814.97 153.67

- TRCA CROSS SECTION ID
- TRCA WATER SURFACE ELEVATION (MASL) - 100 YEAR STORM

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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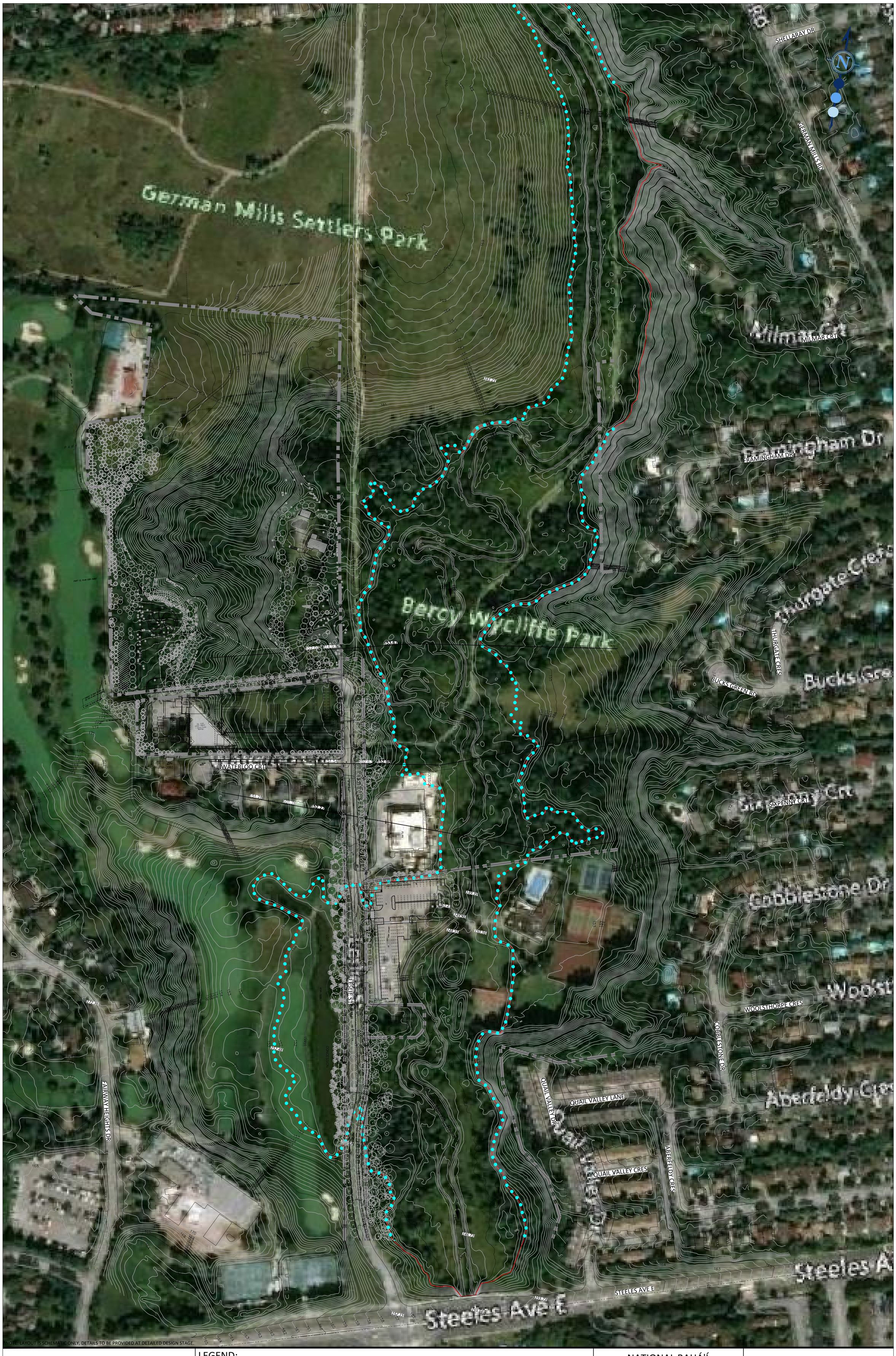
NATIONAL BAHÁ'Í CENTRE OF CANADA

PRELIMINARY GRADING PLAN

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	6.1

File: P:\2004 Bahai National Centre\Drawings\FSP\Fig\Report Figures\2004P-6.1-7.2-GRAD.dwg – Revised by <JLIM> : Wed, Jan 31 2024 – 6:37pm



LEGEND:

TRCA FLOODPLAIN

270 EXISTING CONTOUR AND ELEVATION

TRCA FLOOD PLAIN MAPPING SHEET No. 12 - JANUARY 19, 2021

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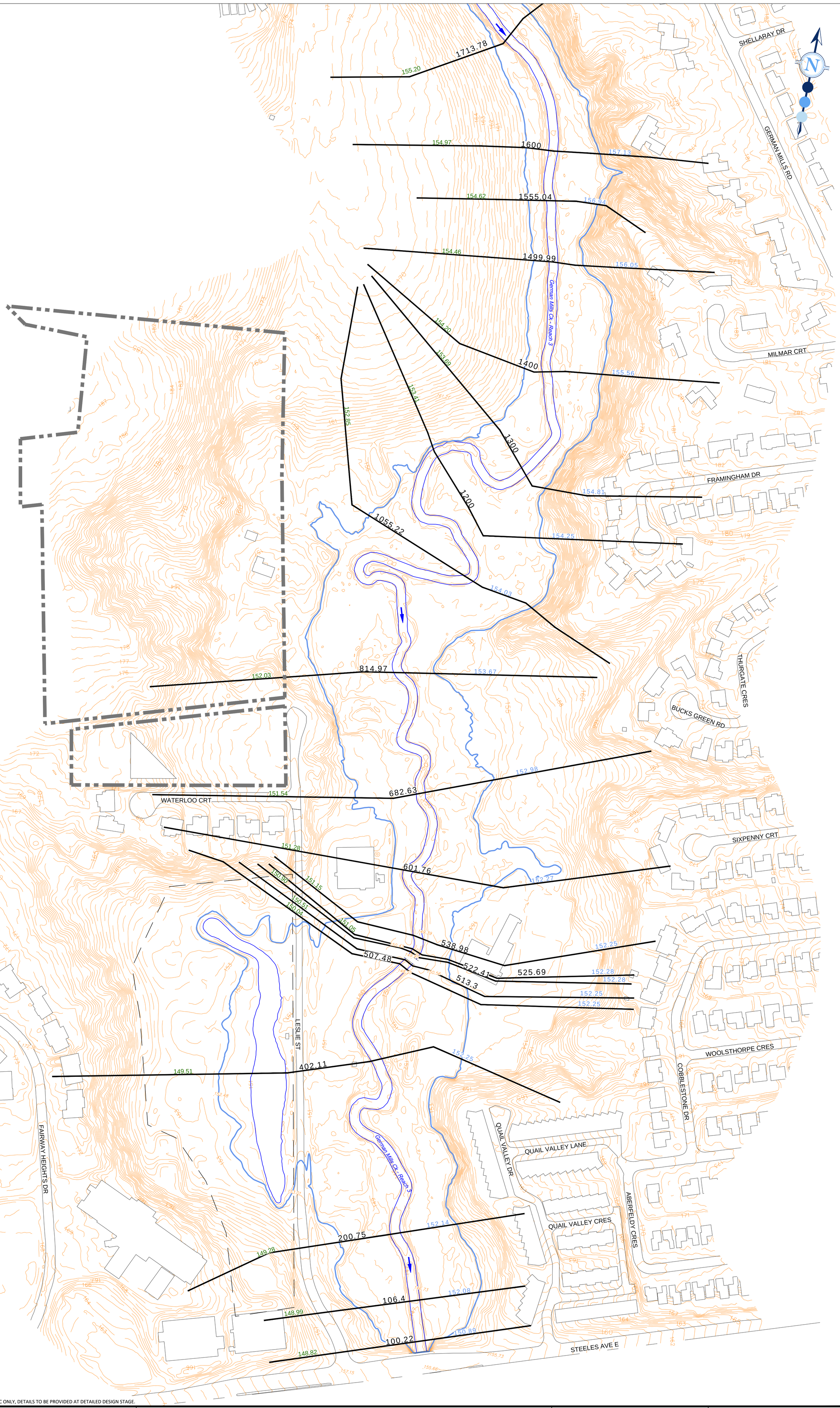
FLOODPLAIN MAPPING PLAN

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.	PROJECT No:	FIGURE No:
SCALE:	1:1500	DATE:	JANUARY 2024	2004	7.1

File: P:\2004 Bahai National Centre\Drawings\FSP\Fig\Report Figures\2004P-7.1-FLOD.dwg - Revised by <JLIM> : Wed, Jan 31 2024 - 6:44pm



*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

LEGEND:

REGIONAL FLOODLINE

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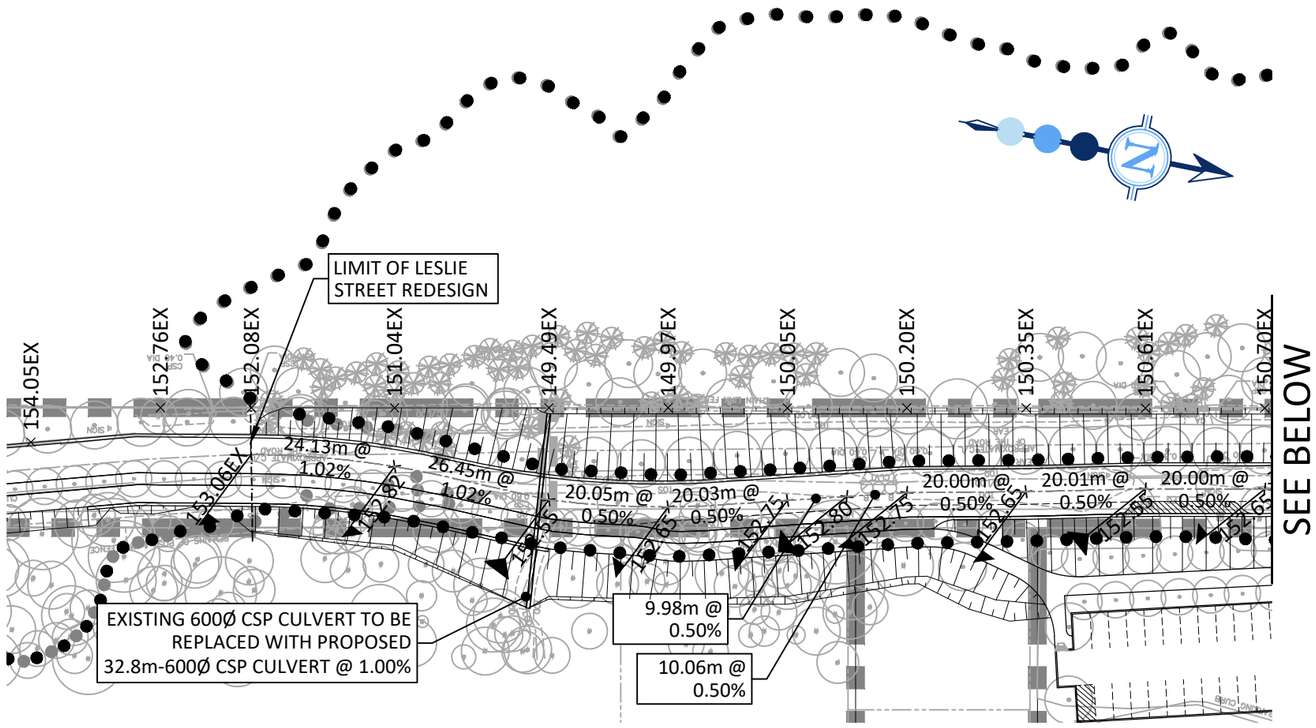
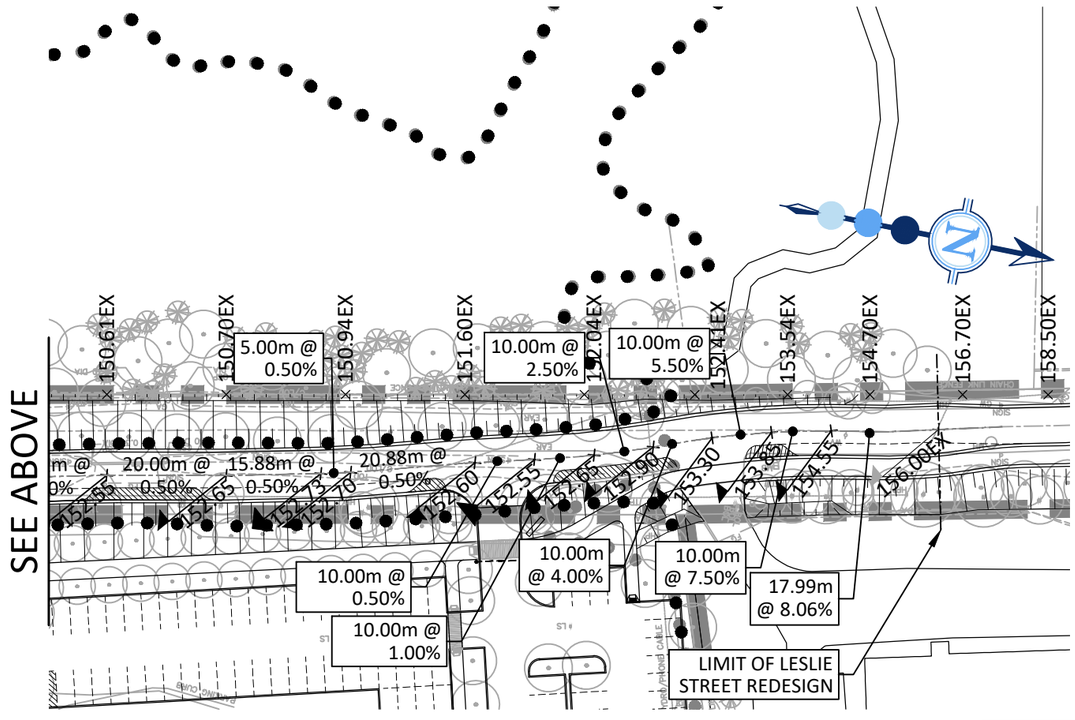
TRCA FLOODPLAIN MAPPING PLAN

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.	PROJECT No:	FIGURE No:
SCALE:	1:1500	DATE:	JANUARY 2024	2004	7.2

File: P:\2004 Bahai National Centre\Drawings\FSP\Fig\Report Figures\2004P-7.2-FLOD.dwg – Revised by <JLIM> : Wed, Jan 31 2024 – 6:34pm





LEGEND:

- LIMIT OF PROPERTY
- × 223.91 — PROPOSED ELEVATION
- × 224.35 EX — EXISTING ELEVATION
- 164.08 — EXISTING CONTOUR END ELEVATION
- EXISTING FLOODPLAIN LIMIT
- PROPOSED FLOODPLAIN LIMIT (SCHEMATIC ONLY)
- MAXIMUM 3:1 SLOPE

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

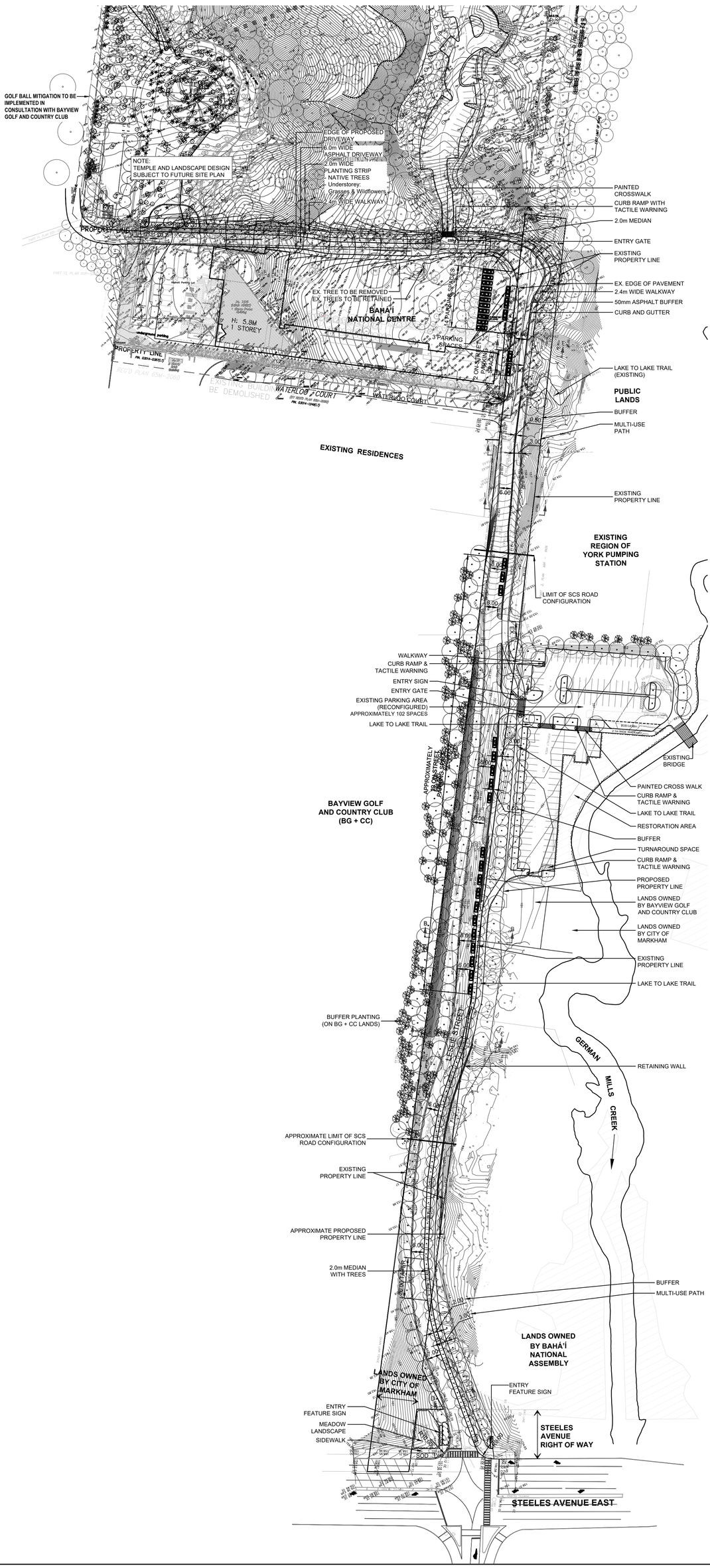
NATIONAL BAHÁ'Í CENTRE OF CANADA

LESLIE STREET REDESIGN

DESIGNED BY:	M.G.V.	CHECKED BY:	J.M.P.
SCALE:	1:1000	DATE:	JANUARY 2024
PROJECT No:	2004	FIGURE No:	7.3

File: P:\2004 Bahai National Centre\Drawings\FSP\Fig\Report Figures\2004P-6.1-7.3-GRAD.dwg – Revised by <JLIM> : Wed, Jan 31 2024 – 6:39pm

Appendix A Site Plan



Bahá'í National Assembly

Leslie Street & Driveway Improvements

Lake to Lake Trail Extension

0 10 20 50 100m

SCALE 1:1000

DATE: 2024-01-16 PROJECT NO: 17069

Appendix B Record Drawings and Background Information

NOMINAL PIPE DIAMETERS	
S.I. UNITS mm	IMPERIAL UNITS inch
25	1
100	4
150	6
250	10
300	12
400	16
450	18
600	24
660	26
750	30
1200	48
1350	54
1800	72
2100	84
3300	132
3660	144

EXISTING GROUND ELEVATION	153.400, 158.420, 157.420, 156.870, 155.670, 156.520, 160.105, 160.000, 158.000, 159.050, 159.495, 154.395, 154.465, 153.420, 154.625
INVERT ELEVATION	148.190, 148.190, 148.316, 150.276, 151.384, 152.362, 153.340, 154.318, 155.001, 155.300, 155.300, 151.560, 149.688
STATION	-0+03.5, 0+00, 0+04, 0+05, 0+11, 0+13, 0+26, 0+45, 0+50, 0+62, 0+77, 0+92, 1+00, 1+07, 1+17.475, 1+23, 1+26, 1+30.499, 1+42.252, 1+50, 1+55.042, 1+67.252, 1+97.929, 2+20

1975-Y

DATE	REVISIONS	INIT.
JAN 1981	CONSTRUCTION	WER

Topographical maps produced by KENTING EARTH SCIENCES LIMITED, OTTAWA - TORONTO, From Aerial Photographs Dated APRIL, 1974
Geodetic Datum (1927 North American)
Contour interval 2m (with 1m machine interpolations)
Transverse Mercator Projection 3° Zone
ONTARIO CO-ORDINATE SYSTEM Zone 10
Central Meridian 79°30'W | 304,800

Ontario

MINISTRY OF THE ENVIRONMENT

YORK/DURHAM SEWAGE SYSTEM CONTRACT Nº 71 PROJECT NO. 1-0106-30

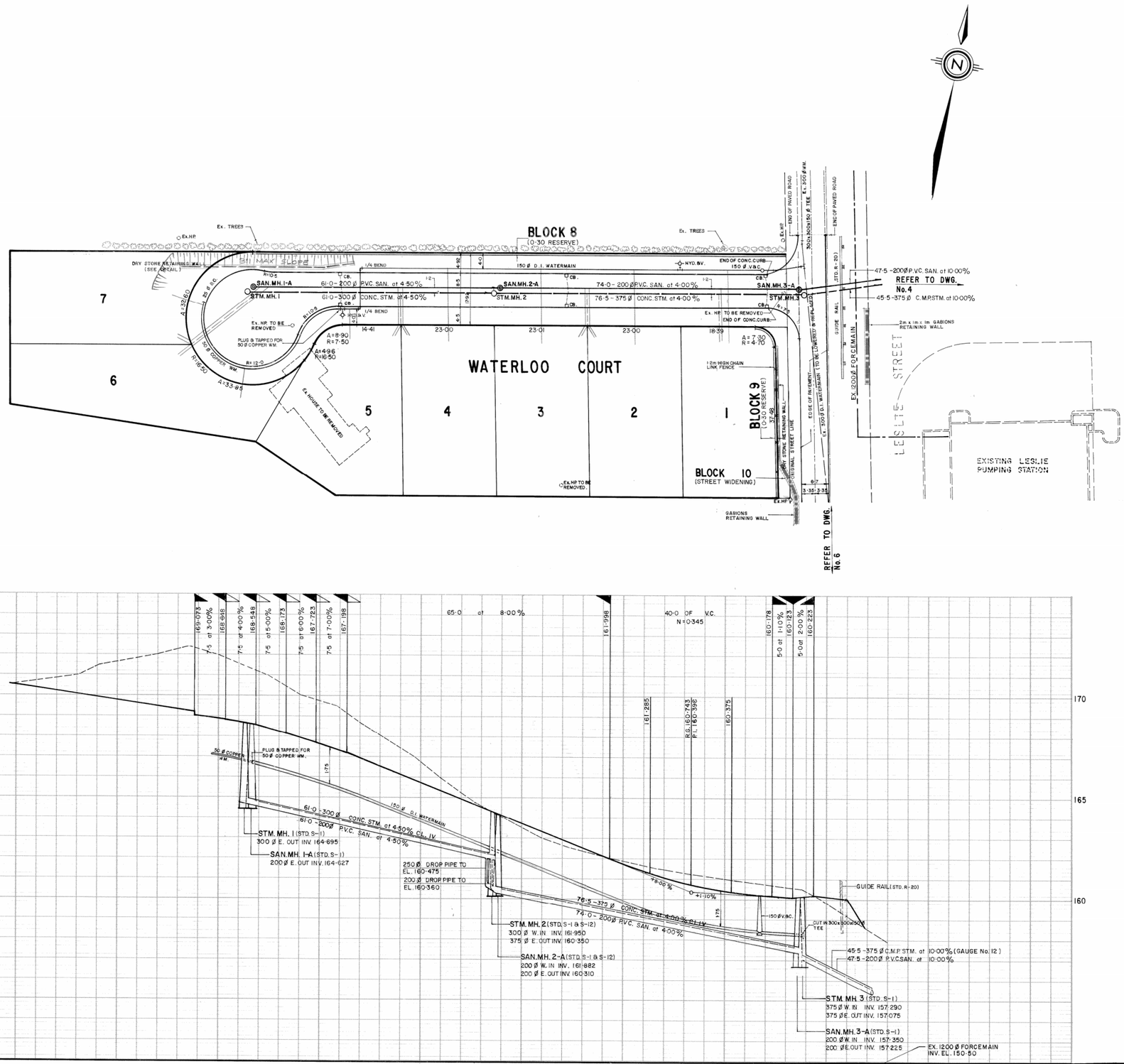
LESLIE STREET SANITARY FORCEMAIN

STATION 0+04 TO STATION 2+20

CHECKED
PROJECT MANAGER
DESIGNER

GORE & STORRIE LIMITED
CONSULTING ENGINEERS
TORONTO, ONTARIO

SCALE: HOR 1:500 VERT 1:200
FILE Nº 457-11-A1-00459
DATE: MAY, 1979
DRAWING Nº 2



REQUIRED ROAD BASE THICKNESS

INTERNAL RESIDENTIAL ROADWAYS	150 mm	COMPACTED DEPTH OF GRANULAR 'A'
	150 mm	COMPACTED DEPTH 50mm COMMERCIAL CRUSHER-RUN LIMESTONE
	75 mm	COMPACTED DEPTH 20mm COMMERCIAL CRUSHER-RUN LIMESTONE
	50 mm	COMPACTED DEPTH HL-8
	25 mm	COMPACTED DEPTH HL-3
RESIDENTIAL COLLECTORS AND INDUSTRIAL ROADWAYS	230 mm	COMPACTED DEPTH OF GRANULAR 'A'
	150 mm	COMPACTED DEPTH 50 mm COMMERCIAL CRUSHER-RUN LIMESTONE
	75 mm	COMPACTED DEPTH 20 mm COMMERCIAL CRUSHER-RUN LIMESTONE
	50 mm	COMPACTED DEPTH HL-8
	50 mm	COMPACTED DEPTH HL-3

NOTES

1. ALL CONCRETE SEWER PIPES UP TO AND INCLUDING 375 mm DIAMETER SHALL BE EQUAL TO C.S.A. SPECIFICATIONS A-257-1 E.S. OR LATEST AMENDMENT UNLESS OTHERWISE NOTED
2. ALL CONCRETE SEWER PIPES 450 mm DIAMETER AND OVER SHALL BE EQUAL TO C.S.A. SPECIFICATIONS A-257-2 CLASS III OR LATEST AMENDMENT UNLESS OTHERWISE NOTED.
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14. ALL CURBS TO BE DEPRESSED AT SIDEWALKS.
15. ALL RESTORATIONS AND RELOCATIONS TO BE COMPLETED TO THE SATISFACTION OF THE DIRECTOR OF ENGINEERING.
16. FOR ALL CONSTRUCTION DETAILS NOT SHOWN ON PLANS, REFERENCE SHALL BE MADE TO THE DESIGN STANDARDS OF THE TOWN OF MARKHAM.

AS CONSTRUCTED-AUGUST, 1981

NOTE

ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED. PIPE SIZES ARE IN MILLIMETRES.

BENCH MARK T 72

METRO PUMPING STATION ON SOUTHERLY SIDE OF STEELES AVENUE, 54.86 m NORTHERLY FROM CNR CROSSING, 643.74 m WESTERLY FROM LESLIE STREET. TABLET IN NORTHEAST END OF DOOR SILL, 0.15 m ABOVE STEP

ELEVATION: 164.784

KEY PLAN
SCALE 1:20 000

No.	DESCRIPTION	DATE	BY

REVISIONS

TOWN of MARKHAM
ENGINEERING DEPARTMENT

REGISTERED PROFESSIONAL ENGINEER — ZAVEN SARKISSIAN — PROVINCE OF ONTARIO

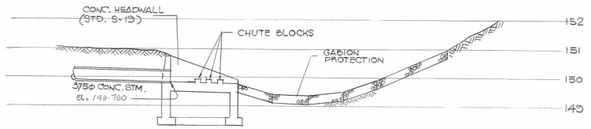
WATERLOO COURT SUBDIVISION
PLAN AND PROFILE OF
WATERLOO COURT

FRED SCHAEFFER & ASSOCIATES INC.
URBAN PLANNERS AND CONSULTING ENGINEERS
465 WILSON AVE. DOWNSVIEW, ONTARIO 635-5424

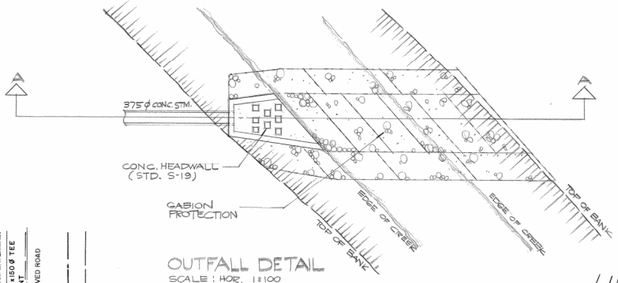
DESIGN BY: R.J.	CHECKED BY: Z.S.	PROJECT No.	
DRAWN BY: M.F.K.	CHECKED BY: M.J.	80-ES-517	
SCALES: HORIZ = 1:500 VERT = 1:100	DATE: NOVEMBER, 1980		
APPROVED ____ DIRECTOR OF ENGINEERING		DRAWING No.	
DATE		3	

WATERLOO CT
09989-W01

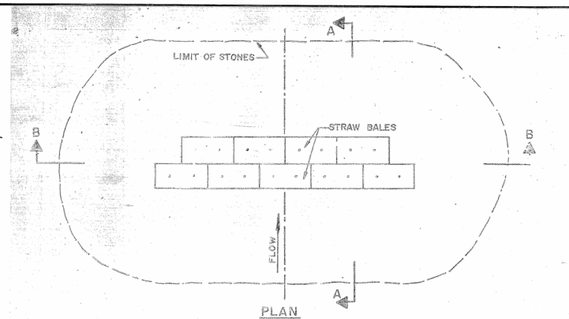
TRANSLAR 200



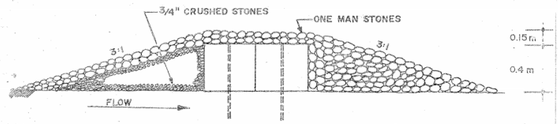
SECTION A-A



OUTFALL DETAIL
SCALE : HOR. 1:100
VER. 1:100



PLAN



SECTION A-A

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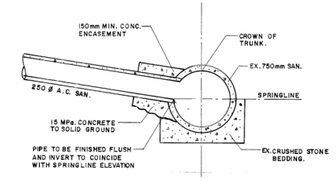
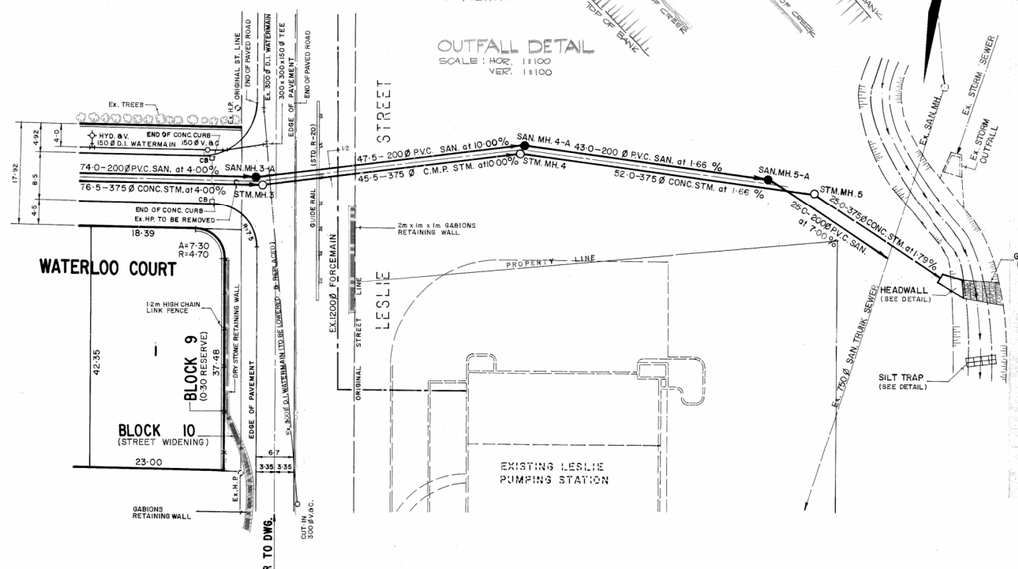
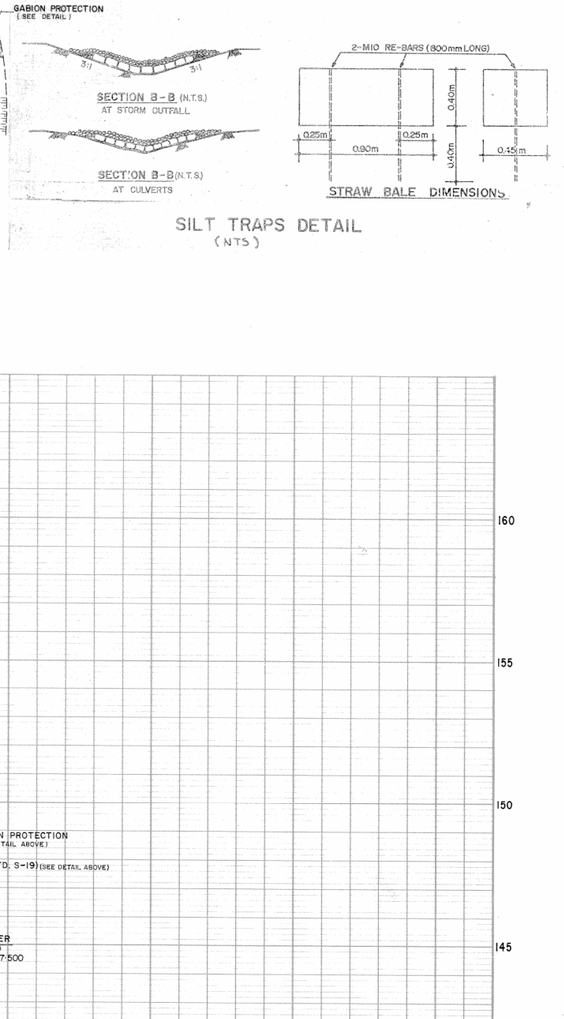


DETAIL OF 250 ø A.C. SAN. CONNECTION TO EX. 750 ø SAN. SEWER





SILT TRAPS DETAIL (NTS)

AS CONSTRUCTED - AUGUST, 1981

NOTE

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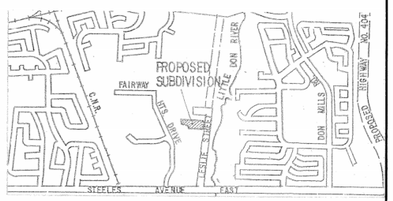
ELEVATION: 164·784m



KEY PLAN
SCALE 1:20 000

No.	DESCRIPTION	DATE	BY

REVISIONS

TOWN of MARKHAM
ENGINEERING DEPARTMENT

REGISTERED PROFESSIONAL ENGINEER ZAVEN SARKISSIAN PROVINCE OF ONTARIO

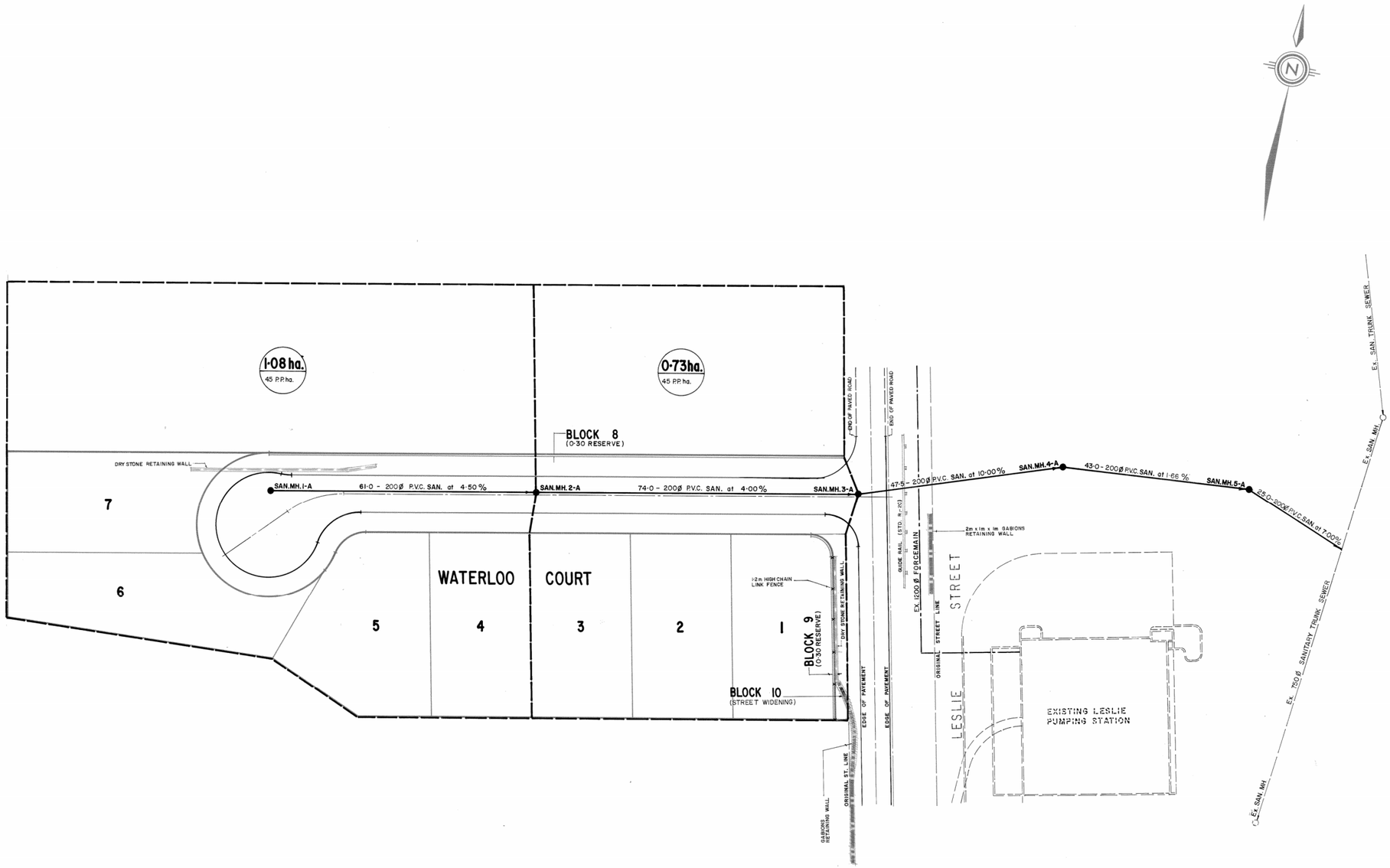
WATERLOO COURT SUBDIVISION
PLAN AND PROFILE OF
SANITARY AND STORM SEWER OUTFALL

FRED SCHAEFFER & ASSOCIATES INC.
URBAN PLANNERS AND CONSULTING ENGINEERS
465 WILSON AVE. DOWNSVIEW, ONTARIO 635-5424

EXISTING ELEVATIONS	161·0	160·5	159·0	158·0	157·0	156·0	154·0	152·0	151·5	150·94	
CHAINAGE	-025	0+000 INT.		0+025		0+050		0+075	0+100		0+125

DESIGN BY : R. JARVIS	CHECKED BY : Z. SARKISSIAN	PROJECT No.	
DRAWN BY : V. LAIFER	CHECKED BY : M. JAUKOVIC	80-ES-517	
SCALES : HORIZ = 1:500 VERT = 1:100	DATE : NOVEMBER, 1980	DRAWING No.	
APPROVED ---------- DIRECTOR OF ENGINEERING		4	
DATE			

TRANSLAR 200



AS CONSTRUCTED-AUGUST, 1981

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ELEVATION: 164·784m

KEY PLAN
SCALE 1:20 000

No.	DESCRIPTION	DATE	BY

REVISIONS

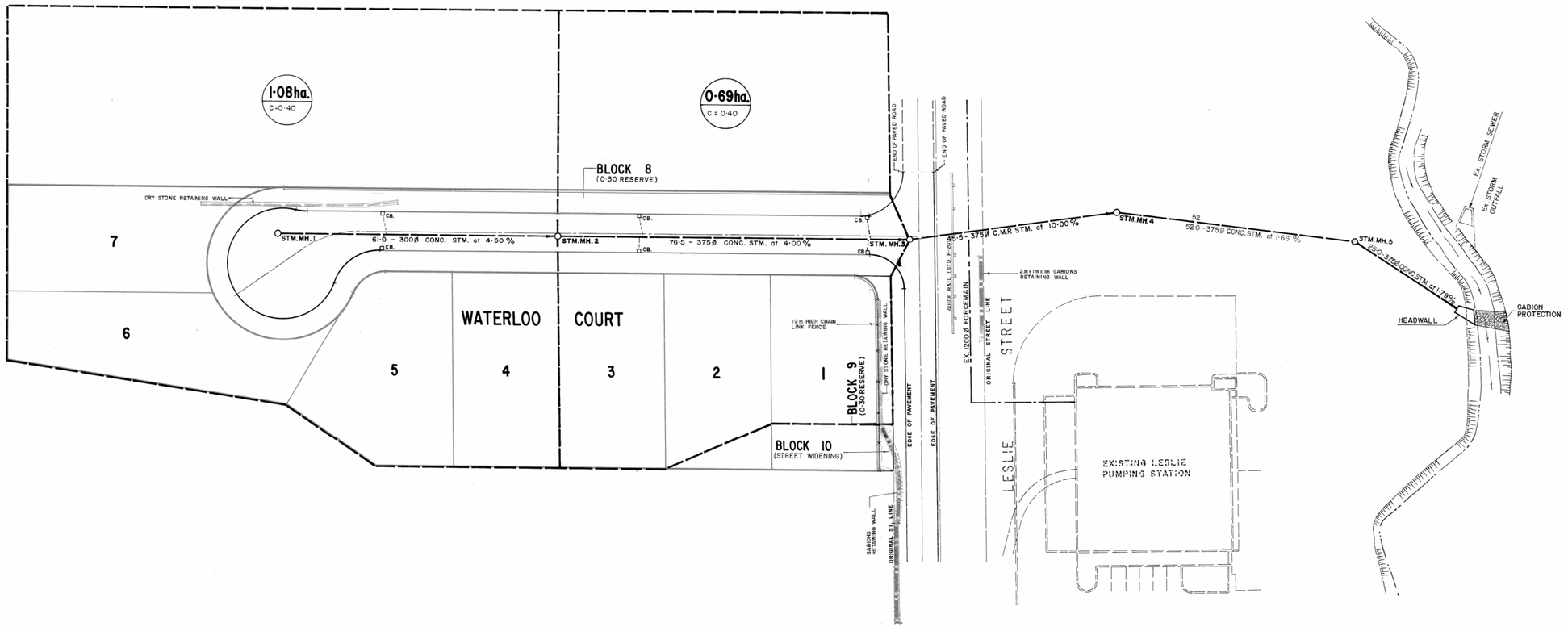
TOWN of MARKHAM
ENGINEERING DEPARTMENT

REGISTERED PROFESSIONAL ENGINEER
ZAVEN SARKISSIAN
PROVINCE OF ONTARIO

WATERLOO COURT SUBDIVISION
SANITARY TRIBUTARY AREAS

FRED SCHAEFFER & ASSOCIATES INC.
URBAN PLANNERS AND CONSULTING ENGINEERS
465 WILSON AVE. DOWNSVIEW, ONTARIO 635-5424

DESIGNED BY: R. JARVIS	CHECKED BY: Z. SARKISSIAN	PROJECT No. 80-ES-517
DRAWN BY: A.M. Roberto	CHECKED BY: M. JAUKOVIC	
SCALE: 1:500	DATE: NOVEMBER, 1980	
APPROVED _____ DIRECTOR OF ENGINEER	DATE: Dec 5/80	DRAWING No. 7



AS CONSTRUCTED - AUGUST, 1981

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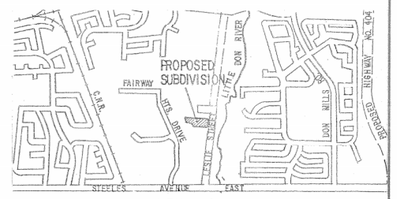
ELEVATION: 164·784m



KEY PLAN
SCALE 1:20 000

No.	DESCRIPTION	DATE	BY

REVISIONS

TOWN of MARKHAM
ENGINEERING DEPARTMENT

REGISTERED PROFESSIONAL ENGINEER Z. SARKISSIAN PROVINCE OF ONTARIO

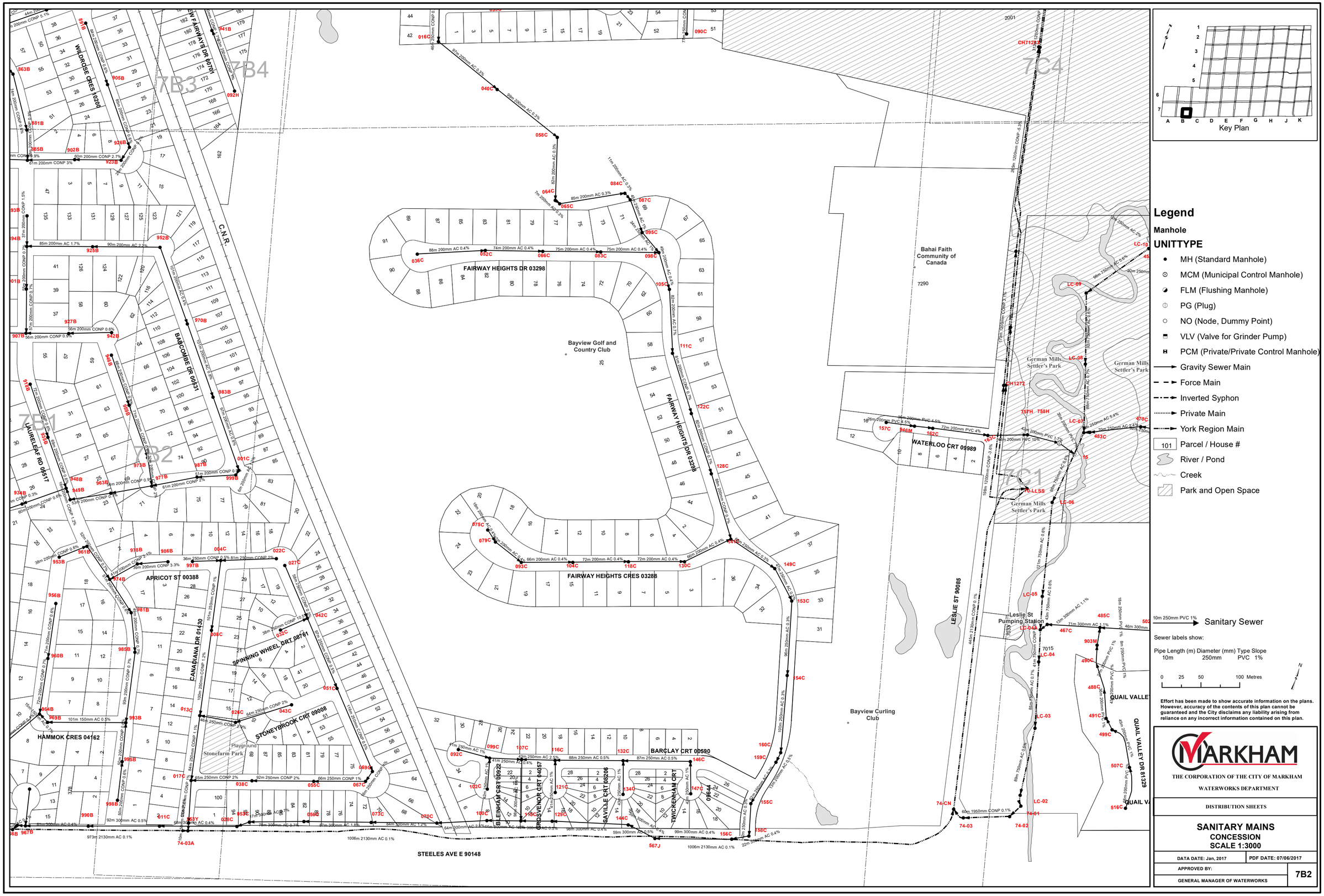
WATERLOO COURT SUBDIVISION

STORM TRIBUTARY AREAS

FRED SCHAEFFER & ASSOCIATES INC.
URBAN PLANNERS AND CONSULTING ENGINEERS
465 WILSON AVE. DOWNSVIEW, ONTARIO 635-5424

DESIGNED BY: R. JARVIS	CHECKED BY: Z. SARKISSIAN	PROJECT No. 80-ES-517
DRAWN BY: A.M. Roberto	CHECKED BY: M. JAUKOVIC	
SCALE: 1:500	DATE: NOVEMBER, 1980	DRAWING No. 8

APPROVED _____ DIRECTOR OF ENGINEERING
DATE: Aug 25, 81



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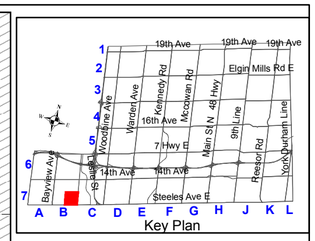


LEGEND:

HYDRANTS

- Not Isolated
- Isolated

CHAMBERS

- Maintenance Chamber
- Tapping Valve in Chamber
- Three Way Valve
- Four Way Valve
- Two Way Valve
- Air Valve
- Drain Valve
- Meter
- Pressure Reduction Valve
- Pressure Separation valve
- Valve Chamber

VALVES

- Service
- C Closed Valves
- Tapping Valve
- Valve Box

WATERMAINS

- Markham
- Private
- Region
- Toronto
- Sampling Station
- 101 Parcel / House #
- Creek
- Pressure Zone
- River / Pond
- Park and Open Space

Effort has been made to show accurate information of the plans. However, accuracy of the contents of this plan cannot be guaranteed and the City disclaims any liability arising from reliance on any incorrect information contained on this plan.

MARKHAM

THE CORPORATION OF THE CITY OF MARKHAM
WATERWORKS DEPARTMENT

DISTRIBUTION SHEETS

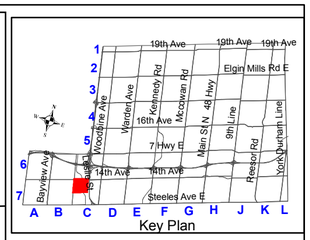
WATER MAINS
CONCESSION
SCALE 1:3000

DATA DATE: APRIL 2017 | PDF DATE: APRIL 2017

APPROVED BY:

GENERAL MANAGER OF WATERWORKS

7B2



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MARKHAM

THE CORPORATION OF THE CITY OF MARKHAM
WATERWORKS DEPARTMENT

DISTRIBUTION SHEETS

WATER MAINS
CONCESSION
SCALE 1:3000

DATA DATE: APRIL 2017 | PDF DATE: APRIL 2017

APPROVED BY:

GENERAL MANAGER OF WATERWORKS

7C4

Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

HYDROGEOLOGICAL STUDY
BAHÁ'Í NATIONAL CENTRE SITE
7200 LESLIE STREET
THORNHILL, ONTARIO

Prepared for: **National Spiritual Assembly of the Bahá'í's of Canada**

7200 Leslie Street
Thornhill, ON L3T 6L8

Attention: Mr. Mehran Anvari

File No. 1-20-0109-46
Issued: November 7, 2022
Revised : December 19, 2023

water sources may be at risk from quantity or quality threats, to assess the level of risk, and to put in place measures to eliminate or manage the threat.

Based on the review of MECP's Source Protection Information Atlas and Toronto and Region Conservation Authority (TRCA) mapping (Accessed: October 21, 2022), the following information was obtained related to the subject property:

Associated Policy Area	Applicability
Conservation Authority	Toronto and Region Conservation Authority
Source Protection Area	Toronto Source Protection Area
Watershed	Don River Watershed
Subwater Shed	German Mills Creeks – Don River Subwatershed
MECP District	City of Markham
TRCA Regulated Area	Yes
Wellhead Protection Area (WHPA)	No
Significant Groundwater Recharge Area (SGRA).	No
Highly Vulnerable Aquifer (HVA)	**Yes ; score is 6** on the western portion of the property
Wellhead Protection Areas (WHPA - Q) or Recharge Management Area	No
Intake Protection Zone (IPZ)	No
Intake Protection Zone Q (IPZ-Q)	No
Oak Ridges Moraine (ORM)	No
Niagara Escarpment Plan Area	No
Greenbelt Protection Act Area	No

Refer to **Appendix A** for associated regulatory mapping details.

3.3 Permit to Take Water (PTTW) Section 34 of the Ontario Water Resource Act

The Online MECP PTTW Database was reviewed (Accessed: October 21, 2022) for any active PTTW application records within a 1.0 km radius of the Site. The records review indicates that there is one (1) active PTTW located at a distance of 0.27 km from the Site, and is registered by Bayview Country Club Limited (Permit No.: 4288-BM6Q8S). This water taking is reportedly used for commercial purpose (Golf Course Irrigation).

5.0 RESULTS OF SUBSURFACE INVESTIGATION

The field investigation was conducted on May 24 to 27, 30 & 31, and June 1, 2, 6 and 8, 2022, and consisted of drilling and sampling a total of twenty-six (26) boreholes, extending to depths varying from 2.0 to 17.2 m below grade, as follows:

- Borehole BH1 to BH7 were advanced within a close proximity to the National Centre
- Borehole BH8 to BH10, and BH11 to BH14 were advanced in close proximity to the proposed Visitor Centre and Temple, respectively
- Borehole BH15 was not advanced due to site access limitation
- Boreholes BH16 to BH18 were advanced within close proximity to the proposed heritage building additions and new restroom buildings
- Boreholes BH19 to BH23 were advanced for the proposed parking / pavement areas
- Boreholes BH24 to BH27 were advanced as part of the environmental investigation

The borings were drilled by a specialist drilling contractor using a track/truck-mounted drill rig power auger and mud rotary drilling techniques and sampled at regular intervals with conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D 1586). The soil samples were observed and recorded by a member of our field engineering staff, who logged the borings and examined the samples as they were obtained. All samples obtained during the investigation were sealed into plastic jars and transported to our testing laboratory for detailed inspection and testing

The fieldwork (drilling, sampling, and testing) was observed full time and recorded by a Terraprobe filed staff, who logged the boring and examined the samples as they were obtained. To measure the groundwater level and investigate the quality of groundwater, ten (10) boreholes (BH3, BH4, BH8, BH11, BH14, BH18, BH24 to BH27) were instrumented with monitoring well as a part of the current investigation. The monitoring well consisted of a 50 mm diameter PVC screen with a length of PVC riser pipe, 10-ft slotted screen. Upon installation, an elevation survey of the monitoring wells relative to a local datum was completed so that relative groundwater flow direction can be assessed.

The borehole and monitoring well locations are provided on **Figure 2**.

5.1 Local Site Setting

Based on the review of the geotechnical report (**File No. 1-20-0109-01)**; the subsurface soil stratigraphy encountered during the drilling investigation is summarized in the subsections below.

The stratigraphy is based on the borehole findings, as well as the geotechnical laboratory testing conducted on selected representative soil samples. The stratigraphic boundaries indicated on the Borehole Logs are inferred from non-continuous samples and observations of drilling resistance and typically represent a transition from one soil type to another. These boundaries should not be interpreted to

represent exact planes of geological change. The subsurface conditions have been confirmed in a series of widely spaced boreholes and will vary between and beyond the borehole locations.

5.1.1 Surficial Topsoil/ Earth Fill Material

A surficial layer of asphaltic concrete about 75 mm (thick) was encountered in Boreholes 6 & 7 and was underlain by an aggregate layer of about 115 and 90 mm (thick), respectively.

Topsoil, predominantly consisted of a sandy silt/sand and gravel matrix with organics, with thickness ranging from about 25 to 320 mm was encountered in all other boreholes. Underlying the surficial topsoil, a layer of earth fill was encountered in all boreholes, and extended to a depth of about 0.8 (BH2) and 6.1 m (BH27) below grade. The earth fill material consisted of clayey silt, with some sand and trace gravel on the western portion, and sandy silt with trace to some amounts of clay and trace amounts of gravel on the eastern portion adjacent German Mills Creek floodplain.

5.1.2 Native Soils

Undisturbed native soil deposits underlie the topsoil / earth fill deposits, which extended to the full depth of investigation are as follows:

- **Clayey Silt to Silt and Clay Glacial Till**: A layer of undisturbed native clayey silt to silt and clay till deposit with variable amounts of sand (some sand to sandy) and trace amounts of gravel was encountered beneath the earth fill/surficial layers in boreholes BH3, BH6 to BH14, and BH23 to BH27 at depths varying from about 0.2 m (BH6) to 6.1 m (BH27) and extended to depths varying from about 2.3 m (BH3) to about 13.7 m (BH4). In boreholes BH4 & BH5 the clayey silt to silt and clay till was encountered underlying native sand and sandy silt to silt and sand till, respectively. Layers of sand were noted in the clayey silt to silt and clay till. The in-situ moisture contents of the clayey silt to silt and clay till samples indicated a moist condition.

- **Sandy Silt to Silt and Sand Till**: Undisturbed native sandy silt to silt and sand deposit with trace to some clay and trace amount of gravel was encountered in borehole BH5 beneath the earth fill at 1.5 m below grade. A layer of sand interrupts the till deposit from 2.3 m to 4.6 m below grade, the sandy silt to silt and sand till extends from 4.6 m to 9.1 m below grade. The in-situ moisture contents of the sandy silt to silt and sand till samples indicated a moist condition.

- **Clayey Silt to Clay and Silt**: Undisturbed native clayey silt to clay and silt deposit with trace to some sand and trace amounts of gravel was encountered beneath the clayey silt to silt and clay till layers in boreholes BH4, BH6, BH7, and BH13 at depths varying from about 4.6 m (BH6 & BH13) to 13.7 m (BH4) and extended to depths varying from about 7.6 m (BH6 & BH13) to about 17.1 m (BH4). The in-situ moisture contents of the sandy silt to sand and silt till samples indicated a moist condition.

- **Sand:** native sand deposit with trace to some silt and trace amounts of clay was encountered beneath the various layers in boreholes BH1 to BH9, BH11 to BH22, and BH27 at depths varying from about 0.8 m (BH19 to BH22) to 9.1 m (BH7) and extended to the full depth of investigation

where encountered, with the exception of boreholes BH4 & BH5 where the sand terminates at 2.3 and 4.6 m below grade, respectively. The in-situ moisture contents of the sandy silt to sand and silt till samples indicated a moist to wet condition.

The detailed stratigraphic conditions are presented on the accompanying borehole logs provided in **Appendix C**. A subsurface profile of the Site is provided in **Figure 5**. Characterization of the various soil types, including grain size analysis, was conducted and is presented in **Appendix D**. Additional information pertaining to soil stratigraphy is discussed in the geotechnical report by Terraprobe under a separate cover (**File No. 1-20-0109-01**).

5.2 Monitoring Well Installation

Monitoring wells were installed in ten (10) boreholes (BH3, BH4, BH8, BH11, BH14, BH18, BH24 to BH27) to allow for collection of the groundwater level and to investigate the groundwater quality. The monitoring wells were constructed using 50-mm diameter PVC riser pipes and screens, which were installed in each of the selected geotechnical boreholes in accordance with Ontario Regulation (O. Reg.) 903. Filter sand was placed around the well screen to approximately 0.6 m above the top of the screen. The wells were then backfilled with bentonite to approximately 0.3 m below the ground surface. All monitoring wells were surveyed using an R10 Trimble GPS relative to a geodetic datum. The details are provided below:

Well ID	Well Diameter (mm)	Ground Surface Elevation (masl)	Top of Screen		Bottom of Screen		Screened Geological Units (Native)
			Depth (mbgs)	Elev. (masl)	Depth (mbgs)	Elev. (masl)	
BH3	50	163.69	10.67	153.02	13.72	149.97	Sand
BH4	50	172.33	6.1	166.24	9.14	163.19	Clayey Silt (Till)
BH8	50	175.81	4.57	171.23	7.62	168.19	Sand
BH11	50	176.60	5.79	170.81	8.84	167.76	Sand
BH 14	50	179.10	6.1	173	9.14	169.96	Sand
BH18	50	157.11	4.57	152.54	7.62	149.49	Sand
BH24	50	177.10	3.05	174.05	6.1	171	Clayey Silt (Till)
BH25	50	186.69	6.1	180.6	9.14	177.55	Clayey Silt (Till)
BH26	50	186.74	6.1	180.64	9.14	177.6	Clayey Silt (Till)
BH27	50	185.33	6.1	179.23	9.14	176.18	Sand

Note: masl: meters above sea level, mbgs: meters below ground surface

Additional details of the monitoring well installation is presented on the enclosed borehole logs provided in **Appendix C**.

5.3 Groundwater Monitoring

The groundwater elevations were monitored in all ten (10) monitoring wells ((BH3, BH4, BH8, BH11, BH14, BH18, BH24 to BH27). A groundwater measurement was collected on June 22, 2022 (after the well development-stabilized water levels). The groundwater elevations in the monitoring wells are provided below:

Well ID	Ground Surface Elevation (masl)	June 22, 2022	
		Groundwater Depth (mbgs)	Groundwater Elevation (masl)
BH3	163.7	10.7	153.0
BH4	172.3	6.1	166.3
BH8	175.8	3.1	172.8
BH11	176.6	Dry	Dry
BH 14	179.1	Dry	Dry
BH18	157.1	4.8	152.3
BH24	177.1	Dry	Dry
BH25	186.7	7.7	179.0
BH26	186.7	7.3	179.5
BH27	185.3	Dry	Dry

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the above groundwater level recordings, it is noted that groundwater level at the site varies from 179.47 ± masl to 152.3 ± masl across the property. Yearly groundwater monitoring was initiated on site as per TRCA requirements on July 14, 2023.Groundwater levels monitored until November are attached as **Appendix I**.

The regional and local groundwater flow direction in the overburden appears to be east and southeast towards German Mills Creek tributary and corresponds to the local topography of the Site. The local groundwater flow direction may fluctuate seasonally depending on the magnitude of precipitation and surface runoff, which will affect infiltration of surface water in particular at times such as significant snowmelt and rainfall events. In order to capture the seasonal groundwater fluctuations and flow patterns at the Site, additional groundwater monitoring is required. The groundwater elevations contour and flow direction map is provided on **Figure 4**.

The monitoring wells installed at the Site need to be maintained in accordance with Ontario Water Resources Act, O. Reg. 903/90. When the wells are no longer required for monitoring or sampling, these wells will need to be appropriately decommissioned by a licensed well contractor as outlined in the Regulation.

5.4 Estimation of Hydraulic Conductivity

5.4.1 Estimation from Grain Size Distribution

In order to estimate the hydraulic conductivity (*K*) from the grain size distribution curves an excel based tool/program HydrogeoSieveXL (Devlin, J.F. 2015) is used that calculates the hydraulic conductivity from grain size distribution curves using 15 different methods. HydrogeoSieveXL was found to calculate K values essentially identical to those reported in the literature, using the published grain-size distribution curves. This program is developed by J.F Devlin, Department of Geology, University of Kansas (Developed April 29, 2014, most recent update September, 2016). HydrogeoSieveXL presents the completed data table, a grain size distribution curve, an extensive list of grain size characteristics from which effective grain diameters are calculated, a histogram of grain size distribution presented in terms of conventional grain size classes and 15 estimates of *K* calculated from the formulas. Geometric and arithmetic means of the estimated K values are also calculated. The complete report for each sample is provided in along with the grain size results in **Appendix D**. The results of the estimates are summarized below:

Borehole No./Sample ID	Sampling Depth (mbgs)	Sampling Elevation (masl)	Soil Description (Native)	Estimated Hydraulic Conductivity (m/s) (Geometric Mean)
Borehole 2, Sample 3	1.8	159	SAND, trace silt, trace clay	1.9×10^{-5}
Borehole 4, Sample 6	4.8	167.5	CLAYEY SILT TILL, sandy, trace gravel	2.2×10^{-9}
Borehole 5, Sample 8	7.7	165.2	SILT AND SAND TILL, trace to some clay, trace gravel	6.3×10^{-9}
Borehole 9, Sample 5	3.3	172.7	SILT AND CLAY TILL, some sand, trace gravel	1.4×10^{-9}
Borehole 11, Sample 11	12.3	164.3	SAND, trace to some silt, trace clay	5.4×10^{-6}
Borehole 13, Sample 6	4.8	173.3	CLAY AND SILT, trace sand	8.9×10^{-10}

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the grain size distribution analysis, the hydraulic conductivity of the cohesionless sand deposit is estimated in order of 10^{-5} to 10^{-6} m/s. Moreover, the hydraulic conductivity of the silt and clay glacial till is estimated in order ranging from 10^{-9} m/s to 10^{-10} m/s.

5.4.2 Estimation from In-*situ* Hydraulic Testing

The hydraulic conductivity was also determined based on single well response tests (Bail Tests), as per the hydrogeological investigation completed on all selected three (3) monitoring wells (BH3, BH4 and

BH8). The monitoring wells were developed in advance of the testing event, which involves the purging and removal of groundwater from the monitoring wells to remove remnants of clay, silt and other debris introduced into the monitoring well during construction and to induce the flow of formation groundwater through the well screens, thereby improving the transmissivity of the subsoil strata formation at the well screen depths. The Solinst Dataloggers (pressure transducers) were programmed to record the water levels at one (1) second of the interval throughout the tests. The data from the tests were analyzed using the Bouwer and Rice method (1976) included in the Aquifer Test v.7 software package. The results of the analysis are presented in **Appendix E**. The hydraulic properties of the strata applicable to the Site are as follows:

Monitoring Well ID	Top of Well Screen Elevation (masl)	Bottom of Well Screen Elevation (masl)	Screened Geological Units	Hydraulic Conductivity (m/s)
BH3	153.02	149.97	SAND, trace to some silt, trace clay	8.2×10^{-6}
BH4	166.24	163.19	SILT AND CLAY, sandy, trace gravel (Till)	7.0×10^{-9}
BH8	171.23	168.19	SILT AND CLAY, sandy, trace gravel (Till)	5.6×10^{-8}

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the single well response tests, the hydraulic conductivity of the native sand is estimated in order of 10^{-6} m/s and the glacial till in order ranging from 10^{-8} to 10^{-9} m/s.

5.4.3 Estimation from Literature

According to Freeze and Cherry (1979)**,** the typical hydraulic conductivity of the strata investigated at the site are:

Soil Unit	Estimated Hydraulic Conductivity Range (m/s)
Earth Fill	10^{-6}
Sand	$10^{-2} – 10^{-5}$
Silt and Clay Glacial Till (Native)	10^{-6} - 10^{-12}

Based on the analyses, the hydraulic conductivity calculated from the single well response testing and grain size analyses are consistent with the published values associated with the geological material tested.

5.5 Groundwater Quality

One (1) unfiltered groundwater sample was collected by Terraprobe and analyzed by a Canadian laboratory accredited and licensed by the Standards Council of Canada and or Canadian Association for Laboratory Accreditation. The sample was collected directly from monitoring well BH4 on February 24,

Toronto and Region Source Protection Authority (TRSPA) Water Balance Tool (Accessed: September 27, 2022), the mean annual **precipitation** is considered as 861 mm/yr. The mean annual **actual evapotranspiration** is considered as 564 mm/yr. using Thornthwaite and Matther approach.

The volume of surplus water, i.e. 861 mm/yr. - 564 mm/yr.= 297 mm/yr., that infiltrates into the soil was determined by applying an infiltration factor to the surplus volume based on topography, soil type and land cover as per Table 3.1, MOE SWMPD Manual (2003). Based on the Table 3.1 approach, the infiltration factor is estimated as 0.5, considering the topography as hilly topography (0.1), silt loam (0.2) and cover as mature forest (0.2). The infiltration factors for the post-development conditions were considered the same as the pre-development conditions.

Based on the above information, a conceptual model of groundwater flow and water balance was developed. A water balance was conducted for the post-development conditions for the entire Site, using the proposed land use statistics information and property development plan provided in the client's email dated September 19, 2022. The post-development water balance accounts for hard-surfaced areas created by buildings and pavements. The post-development conditions will result in a surplus of water available from run-off. The surplus of water available from roof runoff can be used for infiltration into the shallow groundwater system.

The following assumptions were applied for the pre-and post-development water balance:

- No infiltration will occur beneath the hard surface areas, including asphalt/concrete surfaced parking areas and walkways or driveways.
- It is assumed that there will be 10% of evaporation in hard-surface areas/impervious surfaces, and the remaining will contribute to run-off.
- Run-off from parking areas will be directed towards storm sewers and is not included in the infiltration calculations.
- Infiltration rates in open areas of the property (landscaped areas) will occur at rates similar to those for pre-development conditions.
- There will be no infiltration beneath hard-surface areas including, building, pavements, and walkways.

6.1.2 Water Balance Analysis:

Based on the Climate data, annual precipitation of 861 mm/yr., is considered and actual evapotranspiration of 564 mm/yr. There is a water surplus of 297 mm/yr., occurring at the Site that can either infiltrate into the subsurface or go as a run-off. As indicated above, the rate of infiltration was based on the Table 3.1, MOE SWMPD Manual (2003*)* and is considered as 149 mm/yr. The water balance for pre-development conditions for the entire Site is summarized in the Table below:

Summary of Site Statistics (Pre-development)

Land Use	Area (ha)	Area (m^2)

Land Use	Area (ha)	Area (m^2)
Building Footprint/Envelope	0.108	1,076.9
Hardscape/Impervious	0.243	2,427.0
Softscape/Pervious (Undeveloped Area)	8.119	81,192.9
Total	8.47	84,696.8

Pre- Development Water Balance (Entire Site)

	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Proposed Development	84,696.8	72,924	45,793	302	12,057	14,772

Development of an area affects the natural water balance of the Site. The most significant difference is the addition of impervious surfaces as a type of surface cover. Impervious surfaces prevent the infiltration of water into the soils. Net effect of the construction of impervious surfaces is that most of the precipitation that falls onto the impervious surfaces becomes surplus water and direct runoff. The natural permeability of the ground surface changes by reducing the currently undeveloped land/ open space and vegetation at the Site and replacing part of these areas with less permeable/ impervious surfaces such as building roofs, roads, and driveways. The development will result in an increased volume of runoff and a reduction in infiltration. Pre-development conditions result in approximately 12,057 m^3 of water available for infiltration to the groundwater system, as mentioned in the above table.

Based on the post-development plan, a summary of proposed land use and water balance calculations for the post-development are provided below:

Summary of Site Statistics (Post-development)

Land Use	Area (ha)	Area (m^2)
Building Footprint/Envelope	0.445	4,447
Hardscape/Impervious	0.657	6,570
Softscape/Pervious (Undeveloped Area)	7.368	73,679.8
Total	8.47	84,696.8

Post- Development Water Balance without Mitigation (Entire Site)

	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)

Proposed Development	84,696.8	72,924	41,555	949	10,941	19,479

In the post-development, the water balance calculations show that development has the potential to reduce the natural infiltration by 1,116 m^3/yr, and to increase the runoff by 4,706 m^3/yr. Conservation Ontario Guidelines (Conservation Ontario, 2013) suggest a target of 80% of the predevelopment infiltration being maintained in the post-development conditions. Calculations for the Site are indicative of the post-development infiltration being at a level of about 91 % of the pre-development infiltration. As such, post-development infiltration exceeds Conservation Ontario required target to maintain 80% of the predevelopment infiltration in the post-development conditions.

The water balance calculations are provided in **Appendix G**.

6.2 Groundwater Control and Dewatering Requirements

6.2.1 Construction Requirements and Methodology

Based on the architectural drawing set ((Master Plan, Project: Bahá'í National Centre and Temple 7200 Leslie St. Thornhill; Project No. 1709) dated September 15, 2022 prepared by Hariri Pontarini Architects, it is proposed to demolish the existing houses and construct a new one to three-storey House of Worship (Temple), a one to two-storey Visitor Centre and a one to three-storey National Centre and 3 level of underground parking structure, and relocation of Heritage Building. According to the elevation drawings number A3.00 to A3.03, it is indicated that the finished ground floor level is set at 173.5 ± m, and the finished floor levels of the underground parking garage P1, P2 and P3 are set at depths of about 4.5 mbgl (Elev. 161.5 ± m), 8.0 mbgl (Elev. 165.0 ± m) and 11.5 mbgl (Elev. 161.5 ± m) respectively. The spread footing foundations for the lowest level (P3) will likely be set at about 1.0 m below lowest FFE, i.e., Elev. 160.5 ± m and below the prevailing groundwater table.

Based on the review of the geotechnical investigation report prepared by Terraprobe **File No. 1-20-0109-01**, the conventional spread footings are made to bear on the drained dense to very dense sands or glacial till below Elev. 160.5 ± m. The foundation excavations will partially extend below the prevailing groundwater table for P3 basement levels. Foundation excavations will penetrate through upper cohesive silt and clay till and dense to very dense sand. The sand deposit will yield free-flowing water when penetrated. The groundwater table must be dewatered to a minimum of 1.2 m below the deepest excavation prior to excavation to preserve the in-situ integrity of the native soils.

Based on the above groundwater level recordings, it is noted that groundwater level varies from 179.47± masl to 152.3 ± masl in the glacial till and the sand deposit across the property. Based on the shallow groundwater flow elevations pattern across the Property, the design ground water level within the Bahá'í National Centre (BNC) building is considered at Elev. 172.76 ± m on the western boundary and 152.99 ± m on the eastern boundary.

The native wet and cohesionless sand/silt deposits must be dewatered to a minimum of 1.0 m below the lowest excavation level prior to commencing the excavation work and maintained at that level throughout

630500

630750

4852750

4852500

BH 26
BH 27
BH 25
BH 17
BH 18
BH 15
BH 16
BH 24
BH 19
BH 20
BH 21
BH 14
BH 12
BH 13
BH 22
BH 10
BH 11
BH 23
BH 9
BH 8
BH 1
BH 2
BH 6
BH 7
BH 3
BH 5
BH 4
C'
A'
A'
C'

Leslie St
Waterloo Ct
German Mills Creek
Bercy (Wycliffe Park
rway Heights Dr
rway Heights Dr

0 25 50 75 100 m

City of Toronto, ON, Maxar, Microsoft, Esri Community Maps Contributors, City of Toronto, Province of Ontario, York Region, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

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N W E S

References:

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Key Map

Notes:

Legend:

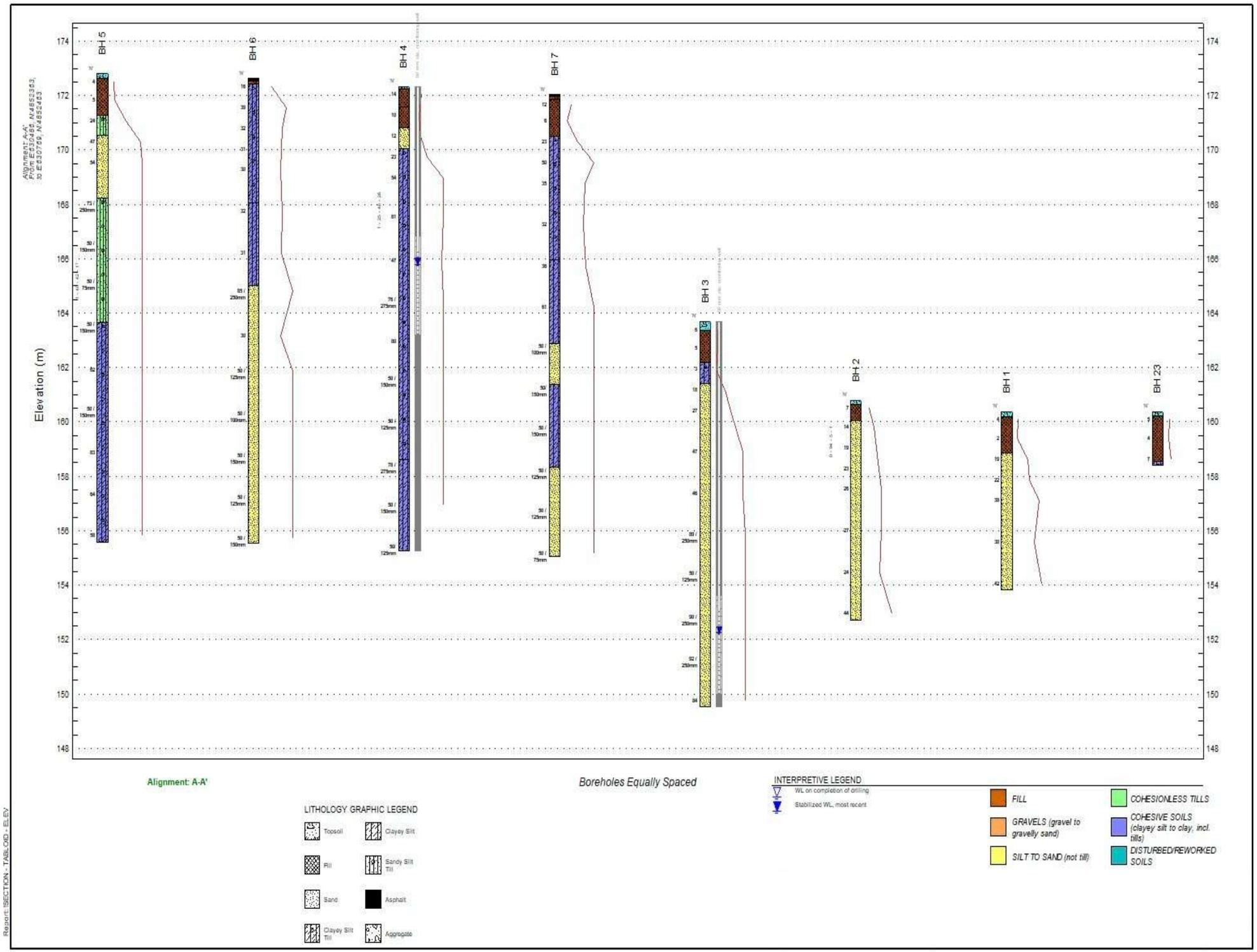
- Approximate Site Boundary
- Cross Sections
- Boreholes
- Monitoring Wells

Project Title:
Hydrogeological Investigation

Site Location:
7200 & 7290 Leslie Street, Thornhill, Ontario

Figure Title:
Borehole/Monitoring Well Location Plan and Cross-Sections

Designed By: MM	*File No.:* 1-20-0109-46
Drawn By: HK	*Scale:* As Shown
Reviewed By: SO	*Figure No.:* 2
Date: Sept 2022	



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References:

ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/ Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community.Basemaps

Key Map

Notes:

Project Title:
Hydrogeological Assessment

Site Location:
7200 and 7290 Leslie Street, Thornhill, Ontario

Figure Title:
Site Location Plan

Designed By: MM	*File No.:* 1-20-0109-46
Drawn By: HK	*Scale:* As Shown
Reviewed By: SO	*Figure No.:* 3A
Date: Sept 2022	

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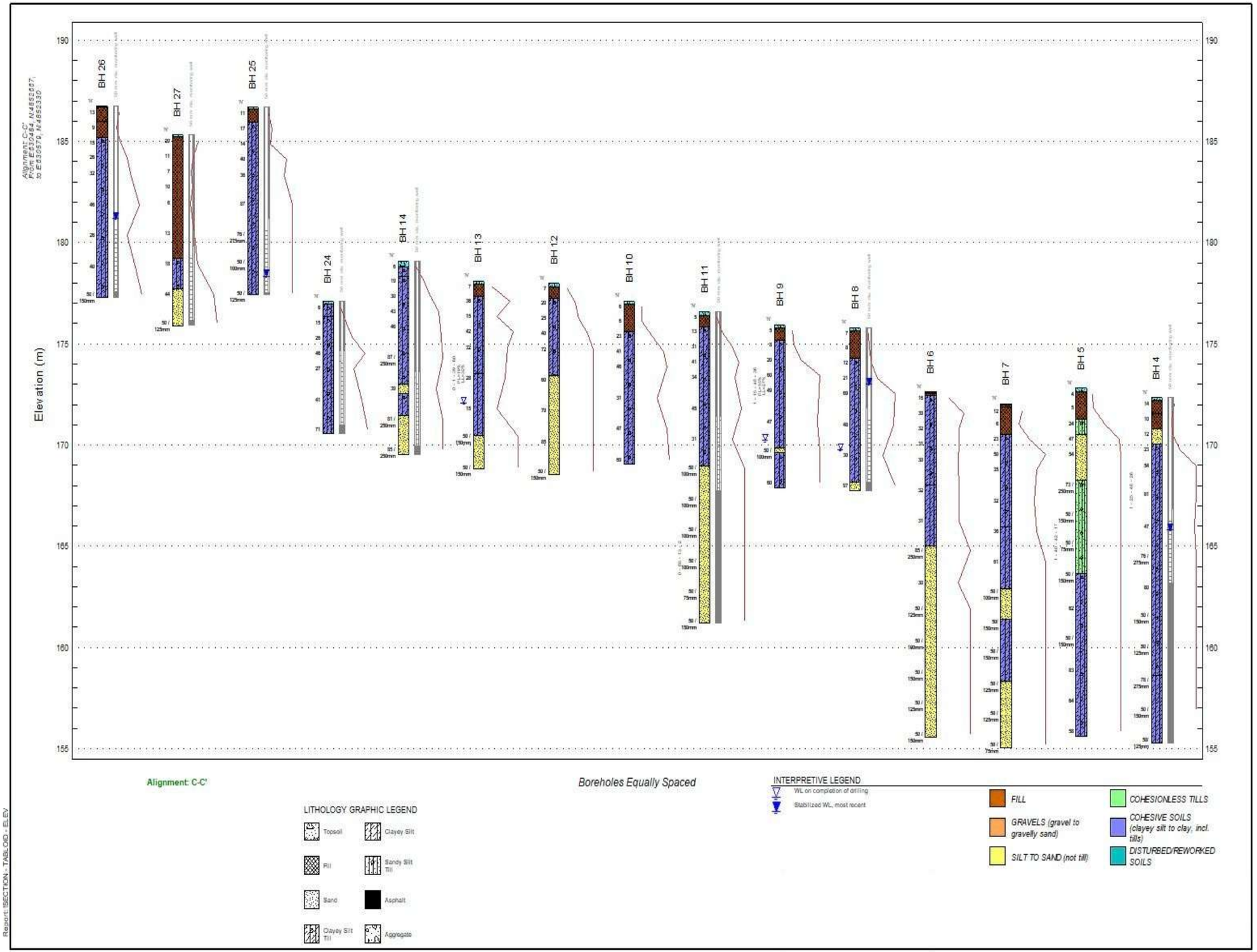

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N W E S

References:

ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/ Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community.Basemaps

Key Map

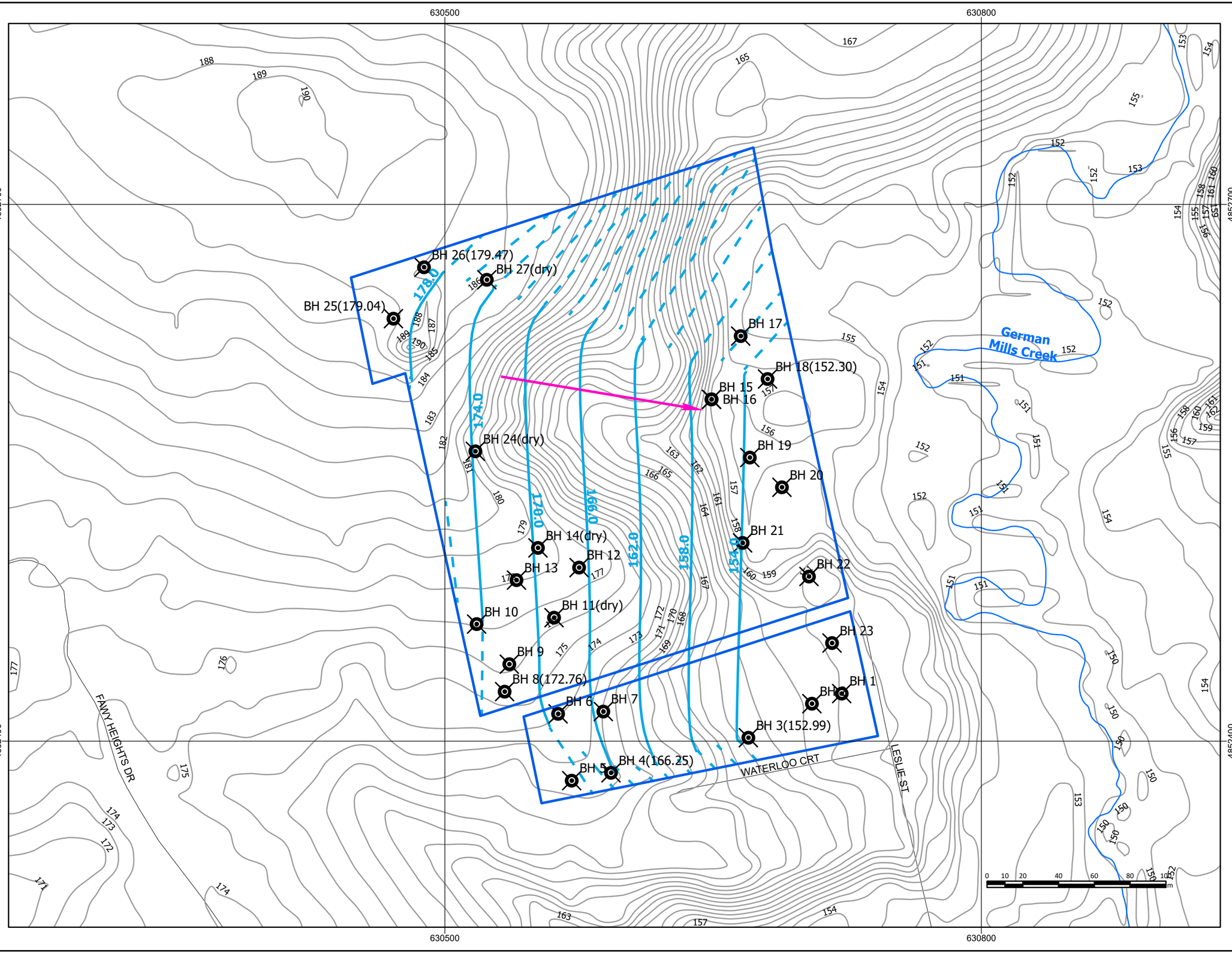
Notes:

Project Title:
Hydrogeological Assessment

Site Location:
7200 and 7290 Leslie Street, Thornhill, Ontario

Figure Title:
Site Location Plan

Designed By: MM	*File No.:* 1-20-0109-46
Drawn By: HK	*Scale:* As Shown
Reviewed By: SO	*Figure No.:* 3B
Date: Sept 2022	



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References:

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Key Map

Notes:

Legend:

- Approximate Site Location
- Interpreted Groundwater Flow Direction
- Inferred Groundwater Contours
- Interpreted Groundwater Contours

Roads Type

- Local / Street
- District of Thornhill ; Topographic Contours
- Watercourse
- Approximate BH/ Monitoring Wells Location ; Groundwater Elevations Jun 22, 2022 (masl)

Project Title: Hydrogeological Assessment	
Site Location: 7200 & 7290 Leslie Street, Thornhill, Ontario	
Figure Title: Groundwater Flow Direction	
Designed By: MM	*File No.:* 1-20-0109-46
Drawn By: HK	*Scale:* As Shown
Reviewed By: SO	*Figure No.:* 5
Date: Sept 2022	

APPENDIX C

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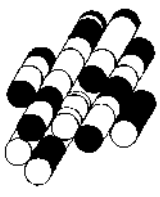

LOG OF BOREHOLE 1

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: May 24, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630722, N: 4852427 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	160.4	**GROUND SURFACE**				
0	160.2	175mm **TOPSOIL**				
	0.2	**FILL**, silty sand, trace gravel, trace clay, very loose, dark brown to brown, moist		1	SS	4
1				2	SS	2
	158.9					
	1.5	**SAND**, trace to some silt, trace clay, compact to dense, brown, moist		3	SS	19
2				4	SS	22
3				5	SS	38
4						
5				6	SS	30
6				7	SS	42
	153.8					
	6.6	**END OF BOREHOLE**				

Elevation Scale (m): 160, 159, 158, 157, 156, 155, 154

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 2

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: June 8, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630705, N: 4852421 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	**160.8**	**GROUND SURFACE**										
	160.6	165mm **TOPSOIL**										
	0.2	**FILL**, clayey silt, some sand, trace gravel, trace rootlets, trace organics, firm, dark brown, moist		1	SS	7				PID: 0 FID: 0		SS1 Analysis: M&I, PAH, PCB
	160.0											
1	0.8	**SAND**, trace to some silt, trace clay, compact to dense, brown, moist		2	SS	14	160			PID: 0 FID: 0		
				3	SS	19	159			PID: 0 FID: 0		0 94 5 1
2				4	SS	23	158			PID: 0 FID: 0		
3				5	SS	26				PID: 0 FID: 0		
4							157					
				6	SS	27	156			PID: 0 FID: 0		
5												
6				7	SS	24	155			PID: 0 FID: 0		
							154					
7												
				8	SS	44	153			PID: 0 FID: 0		
8	152.7											
	8.1	**END OF BOREHOLE**										

Penetration Test Values (Blows / 0.3m): ×Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit | Natural Water Content | Liquid Limit; PL MC LL; 10 20 30

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 3

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: IH
Date started	: June 2, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 2	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630670, N: 4852402 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers / mud rotary with casing

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
	163.7	**GROUND SURFACE**					
0	163.4	320mm **TOPSOIL**					
	0.3	**FILL**, clayey silt, some sand, trace gravel, trace rootlets, trace organics, firm, dark brown, moist		1	SS	6	
1				2	SS	5	163
	162.2						
	1.5	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, stiff, brown, moist (GLACIAL TILL)		3	SS	3	
2	161.4						162
	2.3	**SAND**, trace to some silt, trace clay, compact to very dense, brown, moist		4	SS	18	
3				5	SS	27	161
4							160
5				6	SS	47	159
6				7	SS	46	158
7							157
8				8	SS	89 / 250mm	156
9				9	SS	50 / 125mm	155
10							154
11		...wet below		10	SS	90 / 250mm	153
12				11	SS	92 / 250mm	152

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

(continued next page)

LOG OF BOREHOLE 3

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : IH
Date started : June 2, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 2 of 2	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630670, N: 4852402 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers / mud rotary with casing

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments
		(continued)											
13		**SAND**, trace to some silt, trace clay, compact to very dense, brown, moist *(continued)*					151						
14	149.5			12	SS	84	150			PID: 0 FID: 0			
	14.2												

Penetration Test Values (Blows / 0.3m): ×Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit — Natural Water Content — Liquid Limit; PL MC LL; 10 20 30

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Unstabilized water level and cave could not be measured due to the use of mud rotary drill technique.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	11.5	152.2

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 4

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started : June 2, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 1 of 2	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630593, N: 4852382 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers / mud rotary with casing

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	172.3	**GROUND SURFACE**					172					
		100mm **TOPSOIL**		1	SS	14				PID: 0 FID: 0		SS1 Analysis: M&I, PAH, PCB
	171.5	**FILL**, clayey silt, some sand, trace gravel, trace rootlets, trace organics, stiff, brown, moist										
1	0.8	**FILL**, silty sand, trace gravel, trace clay, loose, dark brown to brown, moist		2	SS	10	171			PID: 0 FID: 0		
	170.8											
2	1.5	**SAND**, trace to some silt, trace clay, compact, brown, moist		3	SS	12				PID: 0 FID: 0		
	170.0						170					
	2.3	**CLAYEY SILT**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		4	SS	23				PID: 0 FID: 0		
3				5	SS	54	169			PID: 0 FID: 0		SS5 Analysis: .pH
4							168					
5				6	SS	81				PID: 0 FID: 0		1 25 48 26
							167					
6				7	SS	47	166			PID: 0 FID: 0		
7							165					
8				8	SS	76 / 275mm				PID: 0 FID: 0		
							164					
9		...grey below		9	SS	80	163			PID: 0 FID: 0		SS9 Analysis: BTEX, VOC, PHC
10							162					
				10	SS	50 / 150mm				PID: 0 FID: 0		
11							161					
12				11	SS	50 / 125mm	160			PID: 0 FID: 0		

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

(continued next page)

LOG OF BOREHOLE 4

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started : June 2, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 2 of 2	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630593, N: 4852382 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers / mud rotary with casing

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments
		(continued)											
13		**CLAYEY SILT**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL) *(continued)*											
	158.6						159						
14	13.7	**CLAYEY SILT**, trace to some sand, trace gravel, varved, hard, grey, moist		12	SS	78 / 275mm				PID: 0 FID: 0			
							158						
15													
				13	SS	50 / 150mm	157			PID: 0 FID: 0			
16													
							156						
17	155.2			14	SS	50/ 125mm				PID: 0 FID: 0			
	17.1												

Penetration Test Values (Blows / 0.3m): Dynamic Cone — 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit — PL MC LL — 10 20 30

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

END OF BOREHOLE

Unstabilized water level and cave could not be measured due to the use of mud rotary drill technique.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	6.6	165.8

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 5

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : SM/DH
Date started : May 25, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 1 of 2	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630571, N: 4852378 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Hollow stem augers / mud rotary

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments (GR SA SI CL)
0	172.8	**GROUND SURFACE**										
	172.6	175mm **TOPSOIL**										
	0.2	**FILL**, clayey silt, some sand, trace gravel, trace rootlets, trace organics, soft to firm, dark brown to brown, moist to wet		1	SS	4				PID: 0 FID: 0		
1				2	SS	5	172			PID: 0 FID: 0		
	171.3											
	1.5	**SANDY SILT to SILT AND SAND**, trace to some clay, trace gravel, compact, brown, moist (GLACIAL TILL)		3	SS	24	171			PID: 0 FID: 0		
2	170.5											
	2.3	**SAND**, trace to some silt, trace clay, trace gravel, dense to very dense, brown, moist		4	SS	47				PID: 0 FID: 0		
3				5	SS	54	170			PID: 0 FID: 0		
	168.2											
	4.6	**SANDY SILT to SILT AND SAND**, trace to some clay, trace gravel, very dense, brown, moist (GLACIAL TILL)		6	SS	73 / 250mm	169					
4												
5							168			PID: 0 FID: 0		
6				7	SS	50 / 150mm	167			PID: 0 FID: 0		
7				8	SS	50 / 75mm	166			PID: 0 FID: 0		1 40 42 17
8							165					
	163.7											
9	9.1	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, hard, grey, wet (GLACIAL TILL)		9	SS	50 / 150mm	164			PID: 0 FID: 0		
10				10	SS	62	163			PID: 0 FID: 0		
11							162					
12				11	SS	50 / 150mm	161			PID: 0 FID: 0		

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LOG OF BOREHOLE 5

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : SM/DH
Date started : May 25, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 2 of 2	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630571, N: 4852378 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Hollow stem augers / mud rotary

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
		(continued)										
13		**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, hard, grey, wet (GLACIAL TILL) *(continued)*					160					
14				12	SS	83	159			PID: 0 FID: 0		
15							158					
				13	SS	64				PID: 0 FID: 0		
16							157					
17	155.6 17.2			14	SS	58	156			PID: 0 FID: 0		

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Unstabilized water level and cave could not be measured due to the use of mud rotary drill technique.

LOG OF BOREHOLE 6

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started : May 26, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 1 of 2	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630563, N: 4852415 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Mud rotary

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	**172.6**	**GROUND SURFACE**										
	172.4	75mm **ASPHALTIC CONCRETE**										
	0.2	115mm **AGGREGATE**		1	SS	16				PID: 0 FID: 0		SS1 Analysis: M&I, PAH, PCB
1		**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	39	172			PID: 0 FID: 0		
				3	SS	32	171			PID: 0 FID: 0		
2		...grey below		4	SS	31	170			PID: 0 FID: 0		
3				5	SS	30	169			PID: 0 FID: 0		
4	168.0											
	4.6	**CLAYEY SILT to CLAY AND SILT**, trace to some sand, varved, hard, grey, moist		6	SS	32	168			PID: 0 FID: 0		
5							167					
6				7	SS	31	166			PID: 0 FID: 0		
7	165.0											
	7.6	**SAND**, trace to some silt, trace clay, very dense, greyish brown, wet		8	SS	85 / 250mm	165			PID: 0 FID: 0		
8							164					
9				9	SS	30	163			PID: 0 FID: 0		
10												
		...trace gravel		10	SS	50 / 125mm	162			PID: 0 FID: 0		
11							161					
12				11	SS	50 / 100mm				PID: 0 FID: 0		

(continued next page)

LOG OF BOREHOLE 6

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started : May 26, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 2 of 2	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630563, N: 4852415 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Mud rotary

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments
		(continued)						Dynamic Cone 10 20 30 40; Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160	Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL 10 20 30				GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
13		**SAND**, trace to some silt, trace clay, very dense, greyish brown, wet *(continued)*					160						
14				12	SS	50 / 150mm	159			PID: 0 FID: 0			
15							158						
16				13	SS	50 / 125mm	157			PID: 0 FID: 0			
17	155.5 17.1			14	SS	50 / 150mm	156			PID: 0 FID: 0			

END OF BOREHOLE

Unstabilized water level and cave could not be measured due to the use of mud rotary drill technique.

LOG OF BOREHOLE 7

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started :	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 1 of 2	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630589, N: 4852417 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Mud rotary

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	172.0	**GROUND SURFACE**					172					
	171.8	75mm **ASPHALTIC CONCRETE**										
	0.2	90mm **AGGREGATE**		1	SS	12				PID: 0 FID: 0		
1		**FILL**, clayey silt, some sand, trace gravel, trace rootlets, trace organics, firm to stiff, brown, moist		2	SS	6	171			PID: 0 FID: 0		
	170.5											
	1.5	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, brown, moist (GLACIAL TILL)		3	SS	23				PID: 0 FID: 0		
2				4	SS	50	170			PID: 0 FID: 0		
3				5	SS	35	169			PID: 0 FID: 0		
4							168					
		...grey below		6	SS	32				PID: 0 FID: 0		
5							167					
6	165.9						166					
	6.1	**CLAYEY SILT to CLAY AND SILT**, trace to some sand, trace gravel, hard, grey, moist		7	SS	36				PID: 0 FID: 0		
7							165					
8				8	SS	61	164			PID: 0 FID: 0		
9	162.9						163					
	9.1	**SAND**, trace to some silt, trace clay, very dense, grey, moist		9	SS	50 / 100mm				PID: 0 FID: 0		
10	161.3						162					
	10.7	**CLAYEY SILT to CLAY AND SILT**, trace to some sand, trace gravel, hard, grey, moist		10	SS	50/ 150mm				PID: 0 FID: 0		
11							161					
12				11	SS	50 / 150mm	160			PID: 0 FID: 0		

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LOG OF BOREHOLE 7

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started :	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 2 of 2	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630589, N: 4852417 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Mud rotary

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
		(continued)						Dynamic Cone; Unconfined; Pocket Penetrometer; Field Vane; Lab Vane				Unstabilized Water Level; GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
13		**CLAYEY SILT to CLAY AND SILT**, trace to some sand, trace gravel, hard, grey, moist *(continued)*					159					
	158.3 13.7											
14		**SAND**, trace to some silt, trace clay, very dense, grey, wet		12	SS	50 / 125mm	158			PID: 0 FID: 0		
15				13	SS	50 / 125mm	157			PID: 0 FID: 0		
16							156					
	155.0 17.0			14	SS	50 / 75mm				PID: 0 FID: 0		

END OF BOREHOLE

Unstabilized water level and cave could not be measured due to the use of mud rotary drill technique.

LOG OF BOREHOLE 8

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: SM
Date started	: May 31, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630533, N: 4852428 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	175.8	**GROUND SURFACE**				
	175.6 / 0.2	150mm **TOPSOIL**				
		FILL, clayey silt, some sand, trace gravel, trace rootlets, trace organics, firm, dark brown to brown, moist		1	SS	7
1				2	SS	8
	174.3 / 1.5	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		3	SS	12
2				4	SS	21
3				5	SS	69
4						
5				6	SS	48
6				7	SS	30
	168.2 / 7.6	**SAND**, trace to some silt, trace clay, very dense, brown, moist		8	SS	97
8	167.7 / 8.1	**END OF BOREHOLE**				

Elevation Scale (m): 175, 174, 173, 172, 171, 170, 169, 168

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40, 80, 120, 160

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) — 10, 20, 30

Headspace Vapour (ppm): PID: 0 / FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

SS1 Analysis: Pest.

Unstabilized water level measured at 6.1 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	2.9	172.9

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 9

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: SM
Date started	: May 30, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630536, N: 4852443 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	176.0	**GROUND SURFACE**				
	175.8	150mm **TOPSOIL**				
	0.2	**FILL**, clayey silt, some sand, trace gravel, trace rootlets, trace organics, firm, dark brown, moist		1	SS	5
	175.2					
	0.8	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		2	SS	8
1						
				3	SS	20
2						
				4	SS	60
3		...grey below		5	SS	49
4						
		...sand lens, brown, wet		6	SS	47
5						
6	169.9					
	6.1					
	169.7	**SAND**, trace to some silt, trace clay, very dense, brown, moist		7	SS	50 / 100mm
	6.3	.				
7						
				8	SS	60
8	167.9					
	8.1	**END OF BOREHOLE**				

Unstabilized water level measured at 5.8 m below ground surface; borehole caved to 6.1 m below ground surface upon completion of drilling.

Elevation Scale (m): 175, 174, 173, 172, 171, 170, 169, 168

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

SS1 Analysis: Pest.

1 15 48 36

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 10

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: SM
Date started	: May 31, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630518, N: 4852465 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	177.1	**GROUND SURFACE**					177					
	176.9 / 0.2	150mm **TOPSOIL**										
		FILL, clayey silt, some sand, trace gravel, trace rootlets, trace organics, firm, brown, moist		1	SS	6				PID: 0 FID: 0		SS1 Analysis: Metals, Pest.
1				2	SS	6	176			PID: 0 FID: 0		
	175.6 / 1.5	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		3	SS	23				PID: 0 FID: 0		
2				4	SS	41	175			PID: 0 FID: 0		
3				5	SS	46	174			PID: 0 FID: 0		
4		...grey below		6	SS	31	173			PID: 0 FID: 0		
5							172					
6				7	SS	47	171			PID: 0 FID: 0		
7							170					
8	169.0 / 8.1			8	SS	69				PID: 0 FID: 0		

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Penetration Test Values (Blows / 0.3m): × Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit | Natural Water Content | Liquid Limit; PL MC LL; 10 20 30

Unstabilized Water Level

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

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LOG OF BOREHOLE 11

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: SM
Date started	: June 1, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 2	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630561, N: 4852469 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Mud rotary

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	176.6	**GROUND SURFACE**				
	176.4	200mm **TOPSOIL**				
	0.2	**FILL**, silty sand, trace gravel, trace clay, very loose, dark brown to brown, moist		1	SS	5
	175.8					
1	0.8	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		2	SS	13
2				3	SS	31
3				4	SS	41
4				5	SS	34
5				6	SS	45
6				7	SS	31
7	169.0					
	7.6	**SAND**, trace to some silt, trace clay, very dense, greyish brown, moist to wet		8	SS	50 / 100mm
8						
9				9	SS	50 / 100mm
10				10	SS	50 / 100mm
11						
12				11	SS	50 / 100mm

Elevation Scale (m): 176, 175, 174, 173, 172, 171, 170, 169, 168, 167, 166, 165

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL: 10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

SS1 Analysis: Pest.

0 85 13 2

(continued next page)

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LOG OF BOREHOLE 11

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: SM
Date started	: June 1, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 2 of 2	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630561, N: 4852469 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Mud rotary

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
		(continued)										
13		**SAND**, trace to some silt, trace clay, very dense, greyish brown, moist to wet *(continued)*					164					
14				12	SS	50 / 75mm	163			PID: 0 FID: 0		
15	161.2 15.4			13	SS	50 / 150mm	162			PID: 0 FID: 0		

END OF BOREHOLE

Unstabilized water level and cave could not be measured due to the use of mud rotary drill technique.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	dry	n/a

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 12

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: June 1, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630575, N: 4852497 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	178.0	**GROUND SURFACE**				
	177.8	200mm **TOPSOIL**				
	0.2	**FILL**, clayey silt, some sand, trace gravel, trace rootlets, trace organics, trace wood pieces, firm, dark brown, moist		1	SS	7
	177.2					
1	0.8	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	20
				3	SS	25
2				4	SS	40
3				5	SS	72
4	173.4					
	4.6	**SAND**, trace to some silt, trace clay, very dense, brown, damp to moist		6	SS	60
5						
6				7	SS	70
7						
8				8	SS	85
9						
	168.6			9	SS	50 / 150mm
	9.4	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.

Elevation Scale (m): 177, 176, 175, 174, 173, 172, 171, 170, 169

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

SS1 Analysis: Pest.

SS4 Analysis: .pH

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 13

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: SM
Date started	: May 31, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630540, N: 4852490 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	178.1	**GROUND SURFACE**				
	177.9	150mm **TOPSOIL**				
	0.2	**FILL**, clayey silt, some sand, trace gravel, trace rootlets, trace organics, firm, dark brown, moist		1	SS	7
	177.3					
1	0.8	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	36
				3	SS	15
2				4	SS	42
3				5	SS	32
4	173.5					
	4.6	**CLAYEY SILT to CLAY AND SILT**, trace to some sand, trace gravel, very stiff, grey, moist		6	SS	28
5						
6				7	SS	15
7	170.5					
	7.6	**SAND**, trace to some silt, trace clay, very dense, brown, moist		8	SS	50 / 150mm
8						
9	168.8	...damp		9	SS	50 / 150mm
	9.3					

END OF BOREHOLE

Unstabilized water level measured at 6.1 m below ground surface; borehole caved to 7.0 m below ground surface upon completion of drilling.

Elevation Scale (m): 178, 177, 176, 175, 174, 173, 172, 171, 170, 169

Penetration Test Values (Blows / 0.3m)
× Dynamic Cone
10 20 30 40
Undrained Shear Strength (kPa)
○ Unconfined + Field Vane
● Pocket Penetrometer ■ Lab Vane
40 80 120 160

Moisture / Plasticity
Plastic Limit | Natural Water Content | Liquid Limit
PL MC LL
10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

SS1 Analysis: Metals, Pest.

GRAIN SIZE DISTRIBUTION (%) (MIT)
GR SA SI CL
0 1 39 60

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 14

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: HR
Date started	: June 2, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630552, N: 4852508 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
	179.1	**GROUND SURFACE**				
0	178.8 / 0.3	280mm **TOPSOIL**		1	SS	6
	178.3 / 0.8	(WEATHERED/DISTURBED)				
1		**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	19
				3	SS	30
2				4	SS	43
3				5	SS	46
4						
5				6	SS	87 / 250mm
6	173.0 / 6.1	**SAND**, trace to some silt, trace clay, very dense, brown, moist		7	SS	39
	172.5 / 6.6	.				
7	171.5 / 7.6	**SAND**, trace to some silt, trace clay, very dense, brown, damp to moist		8	SS	81 / 250mm
8						
9				9	SS	85 / 250mm
	169.6 / 9.5					

Elevation Scale (m): 179, 178, 177, 176, 175, 174, 173, 172, 171, 170

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30

Headspace Vapour (ppm): PID: 0 / FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments: SS1 Analysis: Pest.

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	dry	n/a

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 16

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: May 25, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630649, N: 4852591 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	158.6	**GROUND SURFACE**				
		140mm **TOPSOIL**		1	SS	5
		FILL, sandy silt, trace clay, trace rootlets, trace organics, loose to compact, dark brown, moist				
	157.8 / 0.8					
1		**FILL**, silty sand, trace gravel, trace clay, compact, dark brown, moist		2	SS	11
	157.1 / 1.5					
2		**SAND**, trace to some silt, trace clay, compact to very dense, brown, wet ...loose moist		3	SS	6
				4	SS	14
3				5	SS	23
4						
5				6	SS	59
6	152.4 / 6.2			7	SS	50 / 125mm

Elevation Scale (m): 158, 157, 156, 155, 154, 153

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit; PL, MC, LL: 10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 4.6 m below ground surface; borehole caved to 5.2 m below ground surface upon completion of drilling.

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 17

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: May 25, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630665, N: 4852626 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
	155.4	**GROUND SURFACE**				
0	155.2	150mm **TOPSOIL**				
	0.2	**FILL**, silty sand, trace gravel, trace clay, loose, dark brown, moist		1	SS	5
1				2	SS	8
	153.9					
	1.5	**SAND**, trace to some silt, trace clay, compact, brown, moist		3	SS	13
2				4	SS	25
		...wet below				
3				5	SS	21
4						
				6	SS	24
5						
6				7	SS	26
	148.8					
	6.6	**END OF BOREHOLE**				

Elevation Scale (m): 155, 154, 153, 152, 151, 150, 149

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit — PL, MC, LL — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole caved to 4.9 m below ground surface upon completion of drilling.

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 18

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: May 24, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630680, N: 4852602 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	157.1	**GROUND SURFACE**				
	156.8	250mm **TOPSOIL**				
	0.3	**FILL**, silty sand, trace gravel, trace clay, very loose to loose, dark brown to brown, moist		1	SS	5
1				2	SS	4
2				3	SS	2
	154.8					
	2.3	**SAND**, trace to some silt, trace clay, compact to very dense, brown, moist		4	SS	28
3				5	SS	36
4		...wet below		6	SS	37
5						
6				7	SS	77
7						
				8	SS	50 / 125mm
8						
9	147.9			9	SS	50 / 100mm
	9.2	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

Elevation Scale (m): 157, 156, 155, 154, 153, 152, 151, 150, 149, 148

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

SS2 Analysis: M&I, PAH, PCB

SS4 Analysis: .pH

SS6 Analysis: BTEX, VOC, PHC

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	4.8	152.3

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 19

Terraprobe

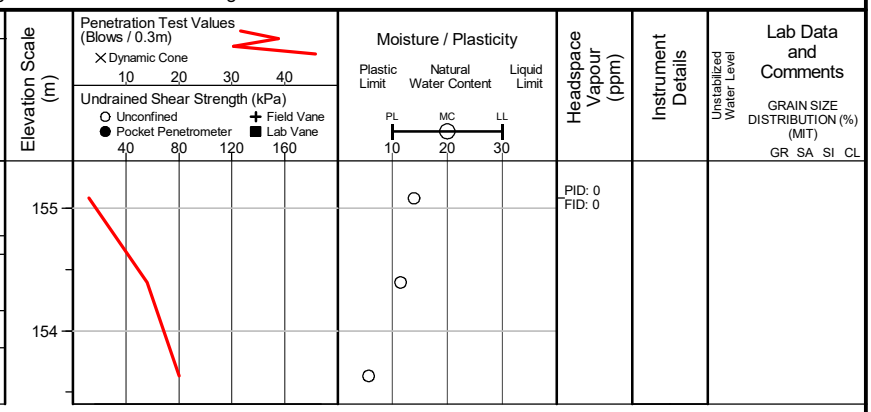
Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started : May 24, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 1 of 1	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630670, N: 4852558 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	155.4	**GROUND SURFACE**				
	155.2	150mm **TOPSOIL**				
	0.2	(WEATHERED/DISTURBED)		1	SS	3
	154.6					
1	0.8	**SAND**, trace to some silt, trace clay, compact, brown, moist		2	SS	14
				3	SS	20
	153.4					
	2.0	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.



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LOG OF BOREHOLE 20

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started : May 24, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 1 of 1	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630688, N: 4852542 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments / GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	**159.6**	**GROUND SURFACE**											
	159.4	175mm **TOPSOIL**											
	0.2	**FILL**, silty sand, some gravel to gravelly, loose, brown, moist		1	SS	4				PID: 0 FID: 0			
	158.8						159						
1	0.8	**SAND**, trace to some silt, trace clay, compact, brown, moist		2	SS	21				PID: 0 FID: 0			
				3	SS	20	158			PID: 0 FID: 0			
	157.6												
	2.0	**END OF BOREHOLE**											

Penetration Test Values (Blows / 0.3m): × Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit | Natural Water Content | Liquid Limit; PL MC LL; 10 20 30

Borehole was dry and open upon completion of drilling.

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 21

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started : May 24, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 1 of 1	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630666, N: 4852511 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments
0	**157.7**	**GROUND SURFACE**											
	157.5	165mm **TOPSOIL**											
	0.2	**FILL**, silty sand, trace gravel, trace clay, loose to compact, dark brown to brown, moist		1	SS	12				PID: 0 FID: 0			
	156.9												
1	0.8	**SAND**, trace to some silt, trace clay, trace to some gravel, loose to compact, brown, moist		2	SS	6	157			PID: 0 FID: 0			
				3	SS	28	156			PID: 0 FID: 0			
	155.7												
	2.0	**END OF BOREHOLE**											

Penetration Test Values (Blows / 0.3m): ×Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit | Natural Water Content | Liquid Limit; PL MC LL; 10 20 30

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 22

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started : May 25, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 1 of 1	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630704, N: 4852492 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	**162.1**	**GROUND SURFACE**					162	Dynamic Cone: 10 20 30 40; Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160	Plastic Limit / Natural Water Content / Liquid Limit: PL 10, MC 20, LL 30			
	161.9	175mm **TOPSOIL**										
	0.2	(WEATHERED/DISTURBED)		1	SS	5				PID: 0 FID: 0		
	161.3											
1	0.8	**SAND**, trace to some silt, trace clay, compact to dense, brown, moist		2	SS	20	161			PID: 0 FID: 0		SS2 Analysis: M&I, PAH, PCB
				3	SS	42				PID: 0 FID: 0		
	160.1											
	2.0	**END OF BOREHOLE**										

Borehole was dry and open upon completion of drilling.

Unstabilized Water Level

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

LOG OF BOREHOLE 23

Terraprobe

Project No. : 1-20-0109-01	Client : National Spiritual Assembly of the Baha'i of Canada	Originated by : DH
Date started : May 25, 2022	Project : 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by : HR
Sheet No. : 1 of 1	Location : Thornhill, Ontario	Checked by : MMT

Position : E: 630716, N: 4852455 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments
	160.4	**GROUND SURFACE**						Dynamic Cone 10 20 30 40; Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160	Plastic Limit, Natural Water Content, Liquid Limit PL MC LL 10 20 30				GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	160.2	165mm **TOPSOIL**											
	0.2	**FILL**, silty sand, trace gravel, trace to some clay, loose, brown, moist		1	SS	5	160						
1				2	SS	4							
	158.6			3	SS	7	159						
	158.4	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, firm, brown, moist (GLACIAL TILL)											
	2.0	**END OF BOREHOLE**											

Borehole was dry and open upon completion of drilling.

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 24

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: June 8, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630517, N: 4852562 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	177.1	**GROUND SURFACE**				
		140mm **TOPSOIL**		1	SS	6
		(WEATHERED/DISTURBED)				
	176.3					
	0.8	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	15
1						
				3	SS	26
2						
				4	SS	46
		...grey below				
3				5	SS	27
4						
				6	SS	41
5						
		...brown		7	SS	71
6	170.5					
	6.6	**END OF BOREHOLE**				

Elevation Scale (m): 177, 176, 175, 174, 173, 172, 171

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160

Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL, MC, LL; 10, 20, 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	dry	n/a

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 25

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: June 6, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630471, N: 4852636 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	186.7	**GROUND SURFACE**				
		90mm **TOPSOIL**		1	SS	11
		FILL, silty sand, trace gravel, trace clay, compact, dark brown, moist				
	185.9					
	0.8	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		2	SS	17
1						
				3	SS	14
2						
				4	SS	40
3						
				5	SS	36
4						
				6	SS	87
5						
		...grey below		7	SS	76 / 275mm
6						
				8	SS	50 / 100mm
7						
8						
9	177.4			9	SS	50 / 125mm
	9.3	**END OF BOREHOLE**				

Elevation Scale (m): 186, 185, 184, 183, 182, 181, 180, 179, 178

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details: Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

SS1 Analysis: M&I, PAH, PCB

SS3 Analysis: M&I, PAH, PCB

SS6 Analysis: BTEX, VOC, PHC

SS8 Analysis: BTEX, VOC, PHC, pH

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	8.4	178.3

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 26

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: June 6, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630488, N: 4852665 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	186.7	**GROUND SURFACE**				
		25mm **TOPSOIL**		1	SS	13
	185.9	**FILL**, silty sand, trace gravel, trace clay, compact, brown, moist				
	0.8	**FILL**, clayey silt, some sand, trace gravel, trace rootlets, trace organics, stiff, brown, moist		2	SS	9
	185.2					
	1.5	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		3	SS	15
				4	SS	26
				5	SS	32
				6	SS	46
		...grey below		7	SS	26
				8	SS	40
				9	SS	50 / 150mm
	177.3					
	9.4	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm): PID: 0 FID: 0

Instrument Details: Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

SS1 Analysis: M&I, PAH, PCB

SS3 Analysis: M&I, PAH, PCB

SS6 Analysis: BTEX, VOC, PHC

SS8 Analysis: BTEX, VOC, PHC

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	5.6	181.1

file: 1-20-0109-01 bh logs.gpj

LOG OF BOREHOLE 27

Terraprobe

Project No.	: 1-20-0109-01	Client	: National Spiritual Assembly of the Baha'i of Canada	Originated by	: DH
Date started	: June 6, 2022	Project	: 7200 & 7290 Leslie Street, Baha'i National Centre	Compiled by	: HR
Sheet No.	: 1 of 1	Location	: Thornhill, Ontario	Checked by	: MMT

Position : E: 630523, N: 4852658 (UTM 17T) Elevation Datum : Geodetic

Rig type : Track-mounted Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	185.3	**GROUND SURFACE**				
		75mm **TOPSOIL**		1	SS	20
		FILL, clayey silt, some sand, trace gravel, trace rootlets, trace organics, firm to very stiff, dark brown to brown, moist		2	SS	11
				3	SS	7
				4	SS	10
				5	SS	6
				6	SS	13
6	179.2					
	6.1	**CLAYEY SILT to SILT AND CLAY**, some sand to sandy, trace gravel, very stiff, brown, moist (GLACIAL TILL)		7	SS	18
	177.7					
	7.6	**SAND**, trace to some silt, trace clay, dense to very dense, brown, moist		8	SS	44
	175.9			9	SS	50 / 125mm
	9.4	**END OF BOREHOLE**				

Elevation Scale (m): 185, 184, 183, 182, 181, 180, 179, 178, 177, 176

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm):

PID: 0	FID: 0
PID: 0	FID: 0
PID: 0	FID: 0
PID: 0	FID: 0
PID: 10	FID: 0
PID: 0	FID: 0
PID: 0	FID: 0
PID: 0	FID: 0
PID: 0	FID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

SS1 Analysis: M&I, PAH, PCB

SS2 Analysis: M&I, PAH, PCB

SS5 Analysis: BTEX, VOC, PHC

SS8 Analysis: BTEX, VOC, PHC

Borehole was dry and open upon completion of drilling.

50 mm dia. monitoring well installed.

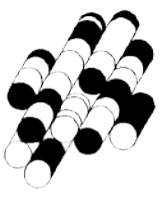
WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jun 23, 2022	dry	n/a

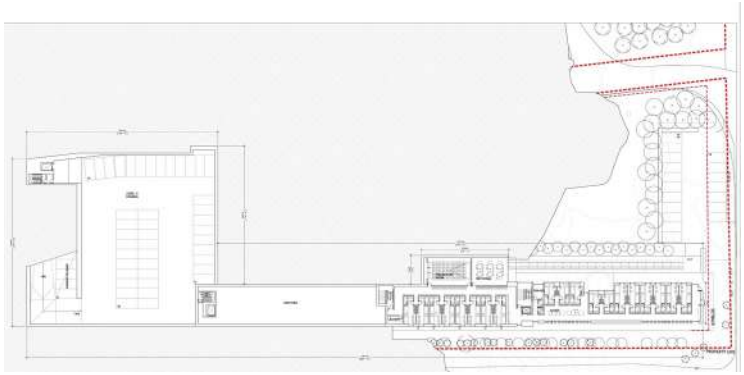
file: 1-20-0109-01 bh logs.gpj

APPENDIX H

TERRAPROBE INC.



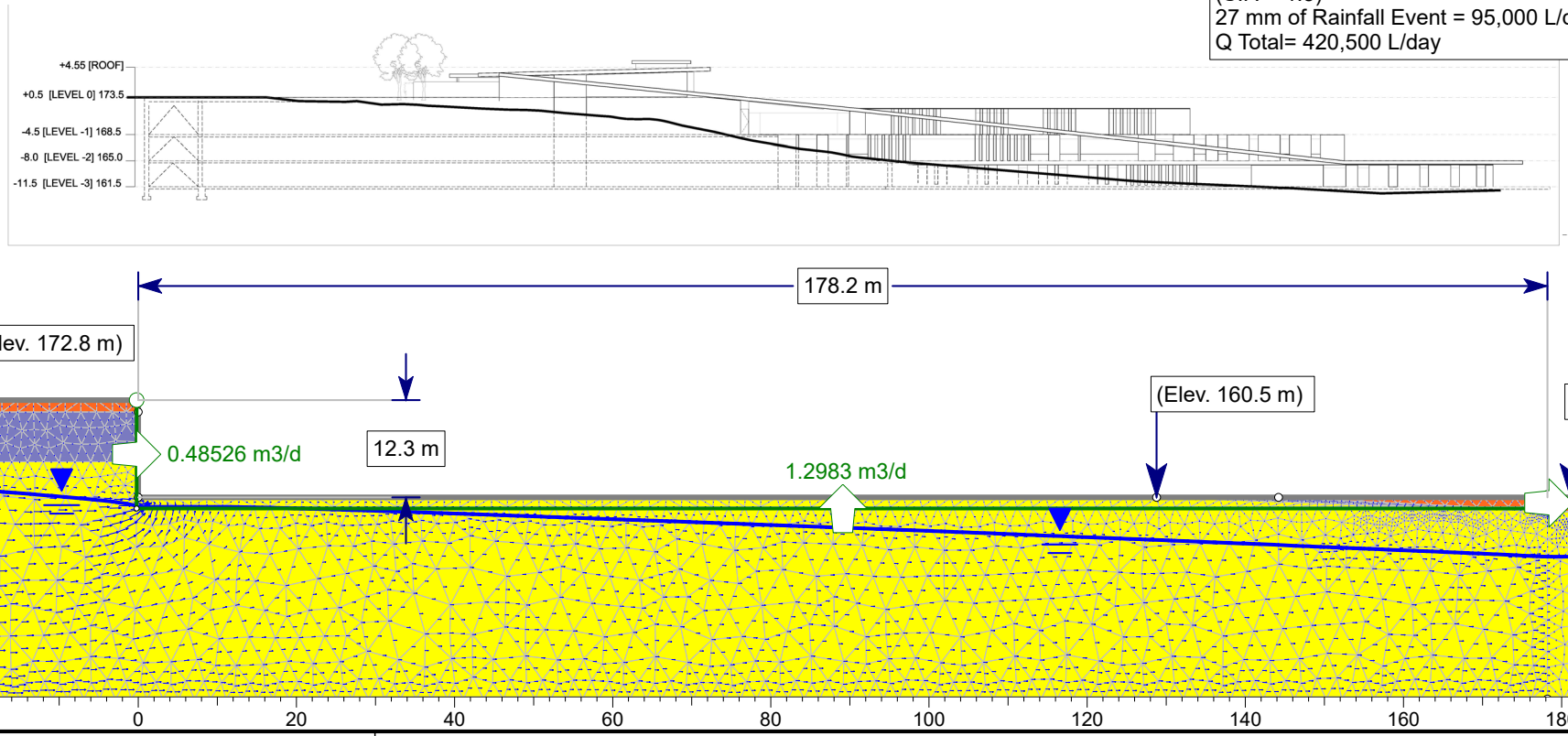
Material Name	Color	KS (m/s)
Earth Fill		1.9e-005
Clayey Silt Till		5.6e-008
Sand		1.9e-005



CONSTRUCTION DEWATERING
(PERMEABLE SHORING)
P3 Excavation Dimensions: 42.1 m x 61.9 m
Section Cut: E-W

Ground Surface: Elev. 172.8 to 160.4 masl
P3 Base of Excavation: Elev. 160.5 masl
Water Table: Elev. 166.25 to 153 masl
Dewatering Target: Elev. 159.3 masl

Q Ground Water = 325,500 L/day
(S.F. = 1.5)
27 mm of Rainfall Event = 95,000 L/day
Q Total= 420,500 L/day



Project	1-20-0109-46 Baha'i National Centre Site - 7200 Leslie Street		
Analysis Description	Constrcution Dewatering (Short Term) - Permeable Shoring		
Drawn By	MM	Scale 1:875	Company Terraprobe
Date	2022-09-27, 8:25:53 PM		File Name 1-20-0109-46_BNC.slmd

Terraprobe
an Englobe Company

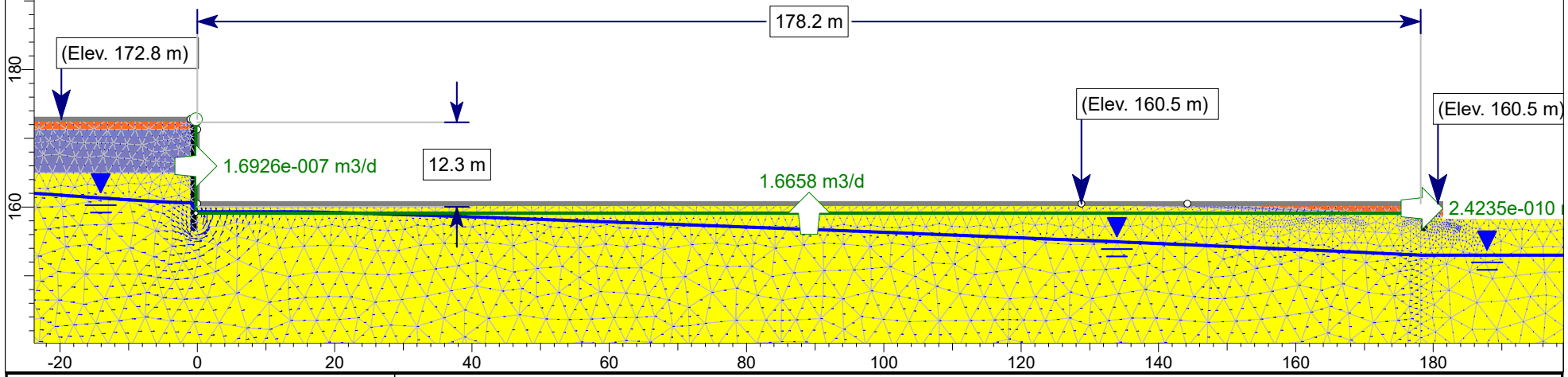
SLIDEINTERPRET 7.038

Material Name	Color	KS (m/s)
Earth Fill		1.9e-005
Clayey Silt Till		5.6e-008
Sand		1.9e-005
Caisson (ST)		1e-012

CONSTRUCTION DEWATERING - BNC
(IMPERMEABLE SHORING)
P3 Excavation Dimensions: 42.1 m x 61.9 m
Section Cut: E-W

Ground Surface: Elev. 172.8 to 160.4 masl
P3 Base of Excavation: Elev. 160.5 masl
Water Table: Elev. 166.25 to 153 masl
Dewatering Target: Elev. 159.3 masl

Q Ground Water = 68,000 L/day
(S.F. = 1.5)
27 mm of Rainfall Event = 95,000 L/day
Q Total= 163,000 L/day



Terraprobe
an Englobe Company

SLIDEINTERPRET 7.038

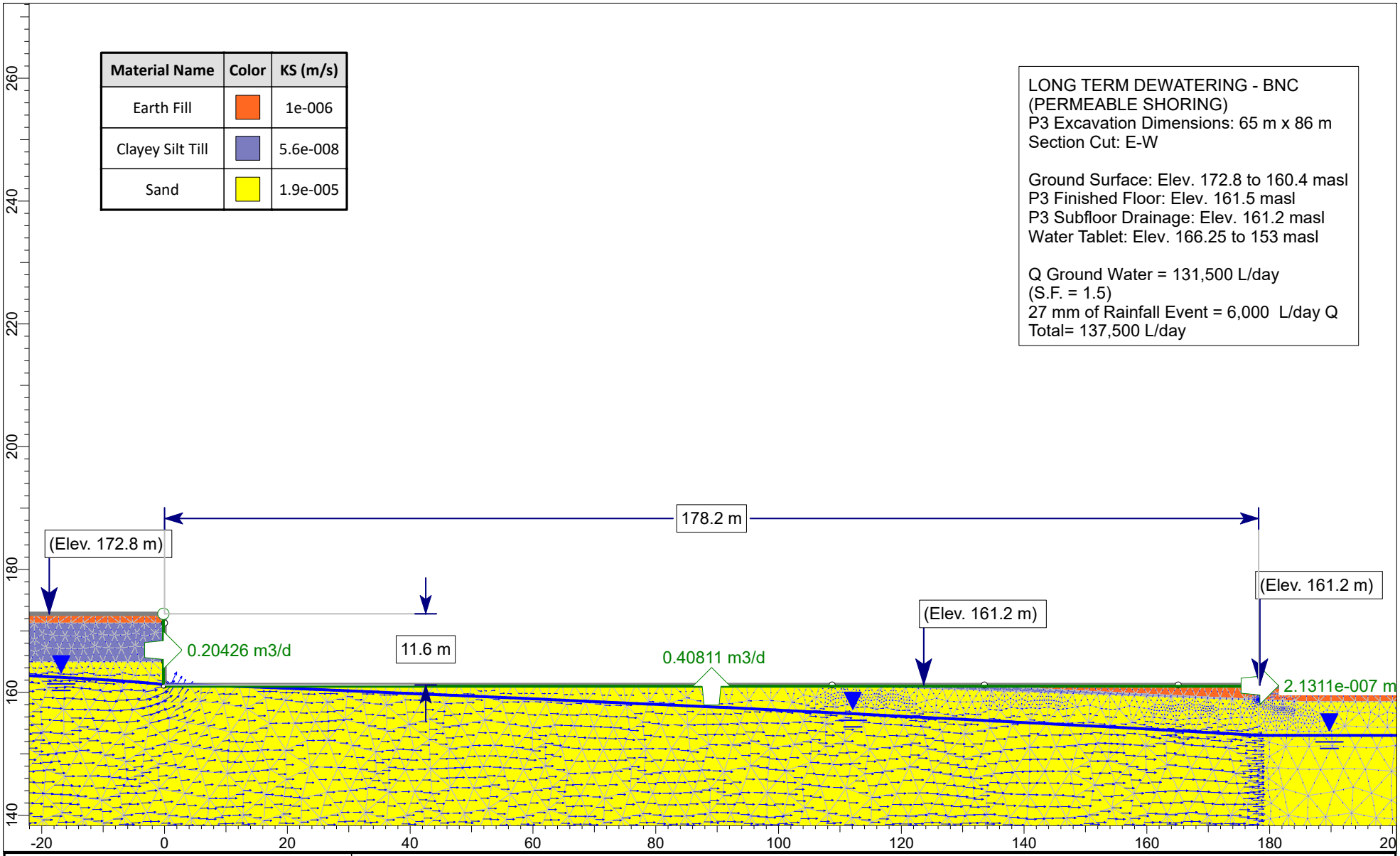
Project	1-20-0109-46 Baha'i National Centre Site - 7200 Leslie Street		
Analysis Description	Construction Dewatering (Short Term) - Impermeable Shoring		
Drawn By	MM	*Scale* 1:875	*Company* Terraprobe
Date	2022-09-27, 8:25:53 PM		*File Name* 1-20-0109-46_BNC.slmd

Material Name	Color	KS (m/s)
Earth Fill		1e-006
Clayey Silt Till		5.6e-008
Sand		1.9e-005

LONG TERM DEWATERING - BNC
(PERMEABLE SHORING)
P3 Excavation Dimensions: 65 m x 86 m
Section Cut: E-W

Ground Surface: Elev. 172.8 to 160.4 masl
P3 Finished Floor: Elev. 161.5 masl
P3 Subfloor Drainage: Elev. 161.2 masl
Water Tablet: Elev. 166.25 to 153 masl

Q Ground Water = 131,500 L/day
(S.F. = 1.5)
27 mm of Rainfall Event = 6,000 L/day Q
Total= 137,500 L/day



Terraprobe
an Englobe Company

SLIDEINTERPRET 7.038

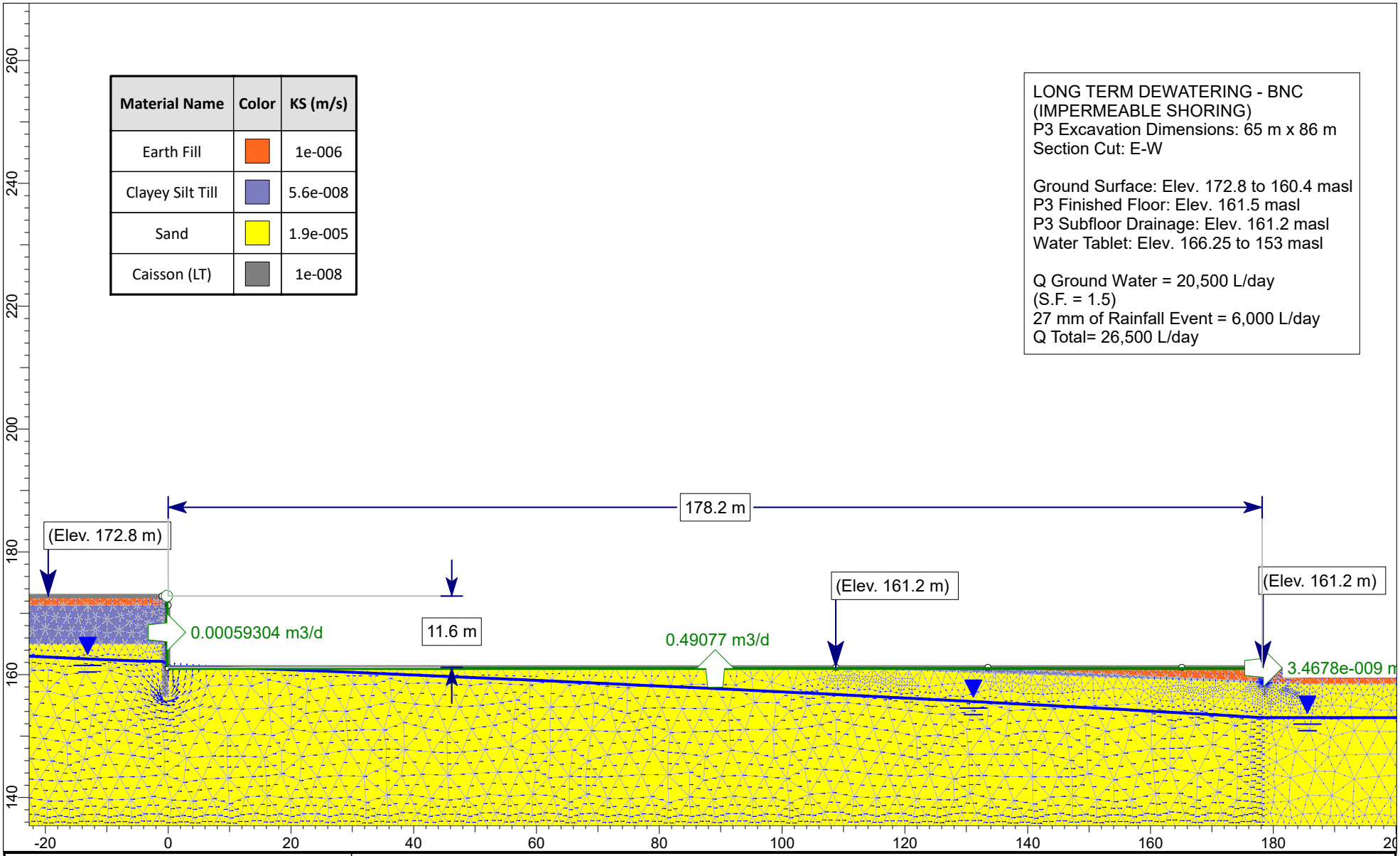
Project	1-20-0109-46 Baha'i National Centre Site - 7200 Leslie Street			
Analysis Description	Permanent Dewatering (Long Term) - Permeable Shoring			
Drawn By	MM	Scale	1:875	Company: Terraprobe
Date	2022-09-27, 8:25:53 PM			File Name: 1-20-0109-46_BNC subfloor drainage.slmd

Material Name	Color	KS (m/s)
Earth Fill		1e-006
Clayey Silt Till		5.6e-008
Sand		1.9e-005
Caisson (LT)		1e-008

LONG TERM DEWATERING - BNC (IMPERMEABLE SHORING)
P3 Excavation Dimensions: 65 m x 86 m
Section Cut: E-W

Ground Surface: Elev. 172.8 to 160.4 masl
P3 Finished Floor: Elev. 161.5 masl
P3 Subfloor Drainage: Elev. 161.2 masl
Water Tablet: Elev. 166.25 to 153 masl

Q Ground Water = 20,500 L/day
(S.F. = 1.5)
27 mm of Rainfall Event = 6,000 L/day
Q Total= 26,500 L/day



Terraprobe
an Englobe Company

SLIDEINTERPRET 7.038

Project	1-20-0109-46 Baha'i National Centre Site - 7200 Leslie Street				
Analysis Description	Permanent Dewatering (Long Term) - Impermeable Shoring				
Drawn By	MM	Scale	1:875	Company	Terraprobe
Date	2022-09-27, 8:25:53 PM			File Name	1-20-0109-46_BNC subfloor drainage.slmd

Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

HYDROGEOLOGICAL STUDY
BAHÁ'Í NATIONAL CENTRE SITE
7200 LESLIE STREET
THORNHILL, ONTARIO

Prepared for: **National Spiritual Assembly of the Bahá'í's of Canada**

7200 Leslie Street
Thornhill, ON L3T 6L8

Attention: Mr. Mehran Anvari

File No. 1-20-0109-46
Issued: November 7, 2022

Terraprobe Inc.

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www.terraprobe.ca

water sources may be at risk from quantity or quality threats, to assess the level of risk, and to put in place measures to eliminate or manage the threat.

Based on the review of MECP's Source Protection Information Atlas and Toronto and Region Conservation Authority (TRCA) mapping (Accessed: October 21, 2022), the following information was obtained related to the subject property:

Associated Policy Area	Applicability
Conservation Authority	Toronto and Region Conservation Authority
Source Protection Area	Toronto Source Protection Area
Watershed	Don River Watershed
Subwater Shed	German Mills Creeks – Don River Subwatershed
MECP District	City of Markham
TRCA Regulated Area	Yes
Wellhead Protection Area (WHPA)	No
Significant Groundwater Recharge Area (SGRA).	No
Highly Vulnerable Aquifer (HVA)	**Yes ; score is 6** on the western portion of the property
Wellhead Protection Areas (WHPA - Q) or Recharge Management Area	No
Intake Protection Zone (IPZ)	No
Intake Protection Zone Q (IPZ-Q)	No
Oak Ridges Moraine (ORM)	No
Niagara Escarpment Plan Area	No
Greenbelt Protection Act Area	No

Refer to **Appendix A** for associated regulatory mapping details.

3.3 Permit to Take Water (PTTW) Section 34 of the Ontario Water Resource Act

The Online MECP PTTW Database was reviewed (Accessed: October 21, 2022) for any active PTTW application records within a 1.0 km radius of the Site. The records review indicates that there is one (1) active PTTW located at a distance of 0.27 km from the Site, and is registered by Bayview Country Club Limited (Permit No.: 4288-BM6Q8S). This water taking is reportedly used for commercial purpose (Golf Course Irrigation).

5.0 RESULTS OF SUBSURFACE INVESTIGATION

The field investigation was conducted on May 24 to 27, 30 & 31, and June 1, 2, 6 and 8, 2022, and consisted of drilling and sampling a total of twenty-six (26) boreholes, extending to depths varying from 2.0 to 17.2 m below grade, as follows:

- Borehole BH1 to BH7 were advanced within a close proximity to the National Centre
- Borehole BH8 to BH10, and BH11 to BH14 were advanced in close proximity to the proposed Visitor Centre and Temple, respectively
- Borehole BH15 was not advanced due to site access limitation
- Boreholes BH16 to BH18 were advanced within close proximity to the proposed heritage building additions and new restroom buildings
- Boreholes BH19 to BH23 were advanced for the proposed parking / pavement areas
- Boreholes BH24 to BH27 were advanced as part of the environmental investigation

The borings were drilled by a specialist drilling contractor using a track/truck-mounted drill rig power auger and mud rotary drilling techniques and sampled at regular intervals with conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D 1586). The soil samples were observed and recorded by a member of our field engineering staff, who logged the borings and examined the samples as they were obtained. All samples obtained during the investigation were sealed into plastic jars and transported to our testing laboratory for detailed inspection and testing

The fieldwork (drilling, sampling, and testing) was observed full time and recorded by a Terraprobe filed staff, who logged the boring and examined the samples as they were obtained. To measure the groundwater level and investigate the quality of groundwater, ten (10) boreholes (BH3, BH4, BH8, BH11, BH14, BH18, BH24 to BH27) were instrumented with monitoring well as a part of the current investigation. The monitoring well consisted of a 50 mm diameter PVC screen with a length of PVC riser pipe, 10-ft slotted screen. Upon installation, an elevation survey of the monitoring wells relative to a local datum was completed so that relative groundwater flow direction can be assessed.

The borehole and monitoring well locations are provided on **Figure 2**.

5.1 Local Site Setting

Based on the review of the geotechnical report (**File No. 1-20-0109-01)**; the subsurface soil stratigraphy encountered during the drilling investigation is summarized in the subsections below.

The stratigraphy is based on the borehole findings, as well as the geotechnical laboratory testing conducted on selected representative soil samples. The stratigraphic boundaries indicated on the Borehole Logs are inferred from non-continuous samples and observations of drilling resistance and typically represent a transition from one soil type to another. These boundaries should not be interpreted to

represent exact planes of geological change. The subsurface conditions have been confirmed in a series of widely spaced boreholes and will vary between and beyond the borehole locations.

5.1.1 Surficial Topsoil/ Earth Fill Material

A surficial layer of asphaltic concrete about 75 mm (thick) was encountered in Boreholes 6 & 7 and was underlain by an aggregate layer of about 115 and 90 mm (thick), respectively.

Topsoil, predominantly consisted of a sandy silt/sand and gravel matrix with organics, with thickness ranging from about 25 to 320 mm was encountered in all other boreholes. Underlying the surficial topsoil, a layer of earth fill was encountered in all boreholes, and extended to a depth of about 0.8 (BH2) and 6.1 m (BH27) below grade. The earth fill material consisted of clayey silt, with some sand and trace gravel on the western portion, and sandy silt with trace to some amounts of clay and trace amounts of gravel on the eastern portion adjacent German Mills Creek floodplain.

5.1.2 Native Soils

Undisturbed native soil deposits underlie the topsoil / earth fill deposits, which extended to the full depth of investigation are as follows:

- **Clayey Silt to Silt and Clay Glacial Till**: A layer of undisturbed native clayey silt to silt and clay till deposit with variable amounts of sand (some sand to sandy) and trace amounts of gravel was encountered beneath the earth fill/surficial layers in boreholes BH3, BH6 to BH14, and BH23 to BH27 at depths varying from about 0.2 m (BH6) to 6.1 m (BH27) and extended to depths varying from about 2.3 m (BH3) to about 13.7 m (BH4). In boreholes BH4 & BH5 the clayey silt to silt and clay till was encountered underlying native sand and sandy silt to silt and sand till, respectively. Layers of sand were noted in the clayey silt to silt and clay till. The in-situ moisture contents of the clayey silt to silt and clay till samples indicated a moist condition.

- **Sandy Silt to Silt and Sand Till**: Undisturbed native sandy silt to silt and sand deposit with trace to some clay and trace amount of gravel was encountered in borehole BH5 beneath the earth fill at 1.5 m below grade. A layer of sand interrupts the till deposit from 2.3 m to 4.6 m below grade, the sandy silt to silt and sand till extends from 4.6 m to 9.1 m below grade. The in-situ moisture contents of the sandy silt to silt and sand till samples indicated a moist condition.

- **Clayey Silt to Clay and Silt**: Undisturbed native clayey silt to clay and silt deposit with trace to some sand and trace amounts of gravel was encountered beneath the clayey silt to silt and clay till layers in boreholes BH4, BH6, BH7, and BH13 at depths varying from about 4.6 m (BH6 & BH13) to 13.7 m (BH4) and extended to depths varying from about 7.6 m (BH6 & BH13) to about 17.1 m (BH4). The in-situ moisture contents of the sandy silt to sand and silt till samples indicated a moist condition.

- **Sand:** native sand deposit with trace to some silt and trace amounts of clay was encountered beneath the various layers in boreholes BH1 to BH9, BH11 to BH22, and BH27 at depths varying from about 0.8 m (BH19 to BH22) to 9.1 m (BH7) and extended to the full depth of investigation

where encountered, with the exception of boreholes BH4 & BH5 where the sand terminates at 2.3 and 4.6 m below grade, respectively. The in-situ moisture contents of the sandy silt to sand and silt till samples indicated a moist to wet condition.

The detailed stratigraphic conditions are presented on the accompanying borehole logs provided in **Appendix C**. A subsurface profile of the Site is provided in **Figure 5**. Characterization of the various soil types, including grain size analysis, was conducted and is presented in **Appendix D**. Additional information pertaining to soil stratigraphy is discussed in the geotechnical report by Terraprobe under a separate cover (**File No. 1-20-0109-01**).

5.2 Monitoring Well Installation

Monitoring wells were installed in ten (10) boreholes (BH3, BH4, BH8, BH11, BH14, BH18, BH24 to BH27) to allow for collection of the groundwater level and to investigate the groundwater quality. The monitoring wells were constructed using 50-mm diameter PVC riser pipes and screens, which were installed in each of the selected geotechnical boreholes in accordance with Ontario Regulation (O. Reg.) 903. Filter sand was placed around the well screen to approximately 0.6 m above the top of the screen. The wells were then backfilled with bentonite to approximately 0.3 m below the ground surface. All monitoring wells were surveyed using an R10 Trimble GPS relative to a geodetic datum. The details are provided below:

Well ID	Well Diameter (mm)	Ground Surface Elevation (masl)	Top of Screen		Bottom of Screen		Screened Geological Units (Native)
			Depth (mbgs)	Elev. (masl)	Depth (mbgs)	Elev. (masl)	
BH3	50	163.69	10.67	153.02	13.72	149.97	Sand
BH4	50	172.33	6.1	166.24	9.14	163.19	Clayey Silt (Till)
BH8	50	175.81	4.57	171.23	7.62	168.19	Sand
BH11	50	176.60	5.79	170.81	8.84	167.76	Sand
BH 14	50	179.10	6.1	173	9.14	169.96	Sand
BH18	50	157.11	4.57	152.54	7.62	149.49	Sand
BH24	50	177.10	3.05	174.05	6.1	171	Clayey Silt (Till)
BH25	50	186.69	6.1	180.6	9.14	177.55	Clayey Silt (Till)
BH26	50	186.74	6.1	180.64	9.14	177.6	Clayey Silt (Till)
BH27	50	185.33	6.1	179.23	9.14	176.18	Sand

Note: masl: meters above sea level, mbgs: meters below ground surface

Additional details of the monitoring well installation is presented on the enclosed borehole logs provided in **Appendix C**.

5.3 Groundwater Monitoring

The groundwater elevations were monitored in all ten (10) monitoring wells ((BH3, BH4, BH8, BH11, BH14, BH18, BH24 to BH27). A groundwater measurement was collected on June 22, 2022 (after the well development-stabilized water levels). The groundwater elevations in the monitoring wells are provided below:

Well ID	Ground Surface Elevation (masl)	June 22, 2022	
		Groundwater Depth (mbgs)	Groundwater Elevation (masl)
BH3	163.7	10.7	153.0
BH4	172.3	6.1	166.3
BH8	175.8	3.1	172.8
BH11	176.6	Dry	Dry
BH 14	179.1	Dry	Dry
BH18	157.1	4.8	152.3
BH24	177.1	Dry	Dry
BH25	186.7	7.7	179.0
BH26	186.7	7.3	179.5
BH27	185.3	Dry	Dry

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the above groundwater level recordings, it is noted that groundwater level at the site varies from 179.47 ± masl to 152.3 ± masl across the property.

The regional and local groundwater flow direction in the overburden appears to be east and southeast towards German Mills Creek tributary and corresponds to the local topography of the Site. The local groundwater flow direction may fluctuate seasonally depending on the magnitude of precipitation and surface runoff, which will affect infiltration of surface water in particular at times such as significant snowmelt and rainfall events. In order to capture the seasonal groundwater fluctuations and flow patterns at the Site, additional groundwater monitoring is required. The groundwater elevations contour and flow direction map is provided on **Figure 4**.

The monitoring wells installed at the Site need to be maintained in accordance with Ontario Water Resources Act, O. Reg. 903/90. When the wells are no longer required for monitoring or sampling, these wells will need to be appropriately decommissioned by a licensed well contractor as outlined in the Regulation.

5.4 Estimation of Hydraulic Conductivity

5.4.1 Estimation from Grain Size Distribution

In order to estimate the hydraulic conductivity (*K*) from the grain size distribution curves an excel based tool/program HydrogeoSieveXL (Devlin, J.F. 2015) is used that calculates the hydraulic conductivity

from grain size distribution curves using 15 different methods. HydrogeoSieveXL was found to calculate K values essentially identical to those reported in the literature, using the published grain-size distribution curves. This program is developed by J.F Devlin, Department of Geology, University of Kansas (Developed April 29, 2014, most recent update September, 2016). HydrogeoSieveXL presents the completed data table, a grain size distribution curve, an extensive list of grain size characteristics from which effective grain diameters are calculated, a histogram of grain size distribution presented in terms of conventional grain size classes and 15 estimates of *K* calculated from the formulas. Geometric and arithmetic means of the estimated K values are also calculated. The complete report for each sample is provided in along with the grain size results in **Appendix D**. The results of the estimates are summarized below:

Borehole No./Sample ID	Sampling Depth (mbgs)	Sampling Elevation (masl)	Soil Description (Native)	Estimated Hydraulic Conductivity (m/s) (Geometric Mean)
Borehole 2, Sample 3	1.8	159	SAND, trace silt, trace clay	1.9×10^{-5}
Borehole 4, Sample 6	4.8	167.5	CLAYEY SILT TILL, sandy, trace gravel	2.2×10^{-9}
Borehole 5, Sample 8	7.7	165.2	SILT AND SAND TILL, trace to some clay, trace gravel	6.3×10^{-9}
Borehole 9, Sample 5	3.3	172.7	SILT AND CLAY TILL, some sand, trace gravel	1.4×10^{-9}
Borehole 11, Sample 11	12.3	164.3	SAND, trace to some silt, trace clay	5.4×10^{-6}
Borehole 13, Sample 6	4.8	173.3	CLAY AND SILT, trace sand	8.9×10^{-10}

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the grain size distribution analysis, the hydraulic conductivity of the cohesionless sand deposit is estimated in order of 10^{-5} to 10^{-6} m/s. Moreover, the hydraulic conductivity of the silt and clay glacial till is estimated in order ranging from 10^{-9} m/s to 10^{-10} m/s.

5.4.2 Estimation from In-*situ* Hydraulic Testing

The hydraulic conductivity was also determined based on single well response tests (Bail Tests), as per the hydrogeological investigation completed on all selected three (3) monitoring wells (BH3, BH4 and BH8). The monitoring wells were developed in advance of the testing event, which involves the purging and removal of groundwater from the monitoring wells to remove remnants of clay, silt and other debris introduced into the monitoring well during construction and to induce the flow of formation groundwater through the well screens, thereby improving the transmissivity of the subsoil strata formation at the well screen depths. The Solinst Dataloggers (pressure transducers) were programmed to record the water levels at one (1) second of the interval throughout the tests. The data from the tests were analyzed using the

Bouwer and Rice method (1976) included in the Aquifer Test v.7 software package. The results of the analysis are presented in **Appendix E**. The hydraulic properties of the strata applicable to the Site are as follows:

Monitoring Well ID	Top of Well Screen Elevation (masl)	Bottom of Well Screen Elevation (masl)	Screened Geological Units	Hydraulic Conductivity (m/s)
BH3	153.02	149.97	SAND, trace to some silt, trace clay	8.2×10^{-6}
BH4	166.24	163.19	SILT AND CLAY, sandy, trace gravel (Till)	7.0×10^{-9}
BH8	171.23	168.19	SILT AND CLAY, sandy, trace gravel (Till)	5.6×10^{-8}

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the single well response tests, the hydraulic conductivity of the native sand is estimated in order of 10^{-6} m/s and the glacial till in order ranging from 10^{-8} to 10^{-9} m/s.

5.4.3 Estimation from Literature

According to Freeze and Cherry (1979), the typical hydraulic conductivity of the strata investigated at the site are:

Soil Unit	Estimated Hydraulic Conductivity Range (m/s)
Earth Fill	10^{-6}
Sand	$10^{-2} – 10^{-5}$
Silt and Clay Glacial Till (Native)	10^{-6} - 10^{-12}

Based on the analyses, the hydraulic conductivity calculated from the single well response testing and grain size analyses are consistent with the published values associated with the geological material tested.

5.5 Groundwater Quality

One (1) unfiltered groundwater sample was collected by Terraprobe and analyzed by a Canadian laboratory accredited and licensed by the Standards Council of Canada and or Canadian Association for Laboratory Accreditation. The sample was collected directly from monitoring well BH4 on February 24, 2022. The monitoring well BH4 was developed and purged prior to sample collection The sample was compared to the following:

- Regional Municipality of York Bylaw No. 2011-56 Table 1 – Limits for Sanitary Sewer Discharge
- Regional Municipality of York Bylaw No. 2011-56 Table 2 – Limits for Storm Sewer Discharge

and cover as mature forest (0.2). The infiltration factors for the post-development conditions were considered the same as the pre-development conditions.

Based on the above information, a conceptual model of groundwater flow and water balance was developed. A water balance was conducted for the post-development conditions for the entire Site, using the proposed land use statistics information and property development plan provided in the client's email dated September 19, 2022. The post-development water balance accounts for hard-surfaced areas created by buildings and pavements. The post-development conditions will result in a surplus of water available from run-off. The surplus of water available from roof runoff can be used for infiltration into the shallow groundwater system.

The following assumptions were applied for the pre-and post-development water balance:

- No infiltration will occur beneath the hard surface areas, including asphalt/concrete surfaced parking areas and walkways or driveways.
- It is assumed that there will be 10% of evaporation in hard-surface areas/impervious surfaces, and the remaining will contribute to run-off.
- Run-off from parking areas will be directed towards storm sewers and is not included in the infiltration calculations.
- Infiltration rates in open areas of the property (landscaped areas) will occur at rates similar to those for pre-development conditions.
- There will be no infiltration beneath hard-surface areas including, building, pavements, and walkways.

6.1.2 Water Balance Analysis:

Based on the Climate data, annual precipitation of 861 mm/yr., is considered and actual evapotranspiration of 564 mm/yr. There is a water surplus of 297 mm/yr., occurring at the Site that can either infiltrate into the subsurface or go as a run-off. As indicated above, the rate of infiltration was based on the Table 3.1, MOE SWMPD Manual (2003*)* and is considered as 149 mm/yr. The water balance for pre-development conditions for the entire Site is summarized in the Table below:

Summary of Site Statistics (Pre-development)

Land Use	Area (ha)	Area (m^2)
Building Footprint/Envelope	0.108	1,076.9
Hardscape/Impervious	0.243	2,427.0
Softscape/Pervious (Undeveloped Area)	8.119	81,192.9
Total	8.47	84,696.8

Pre- Development Water Balance (Entire Site)

	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Proposed Development	84,696.8	72,924	45,793	302	12,057	14,772

Development of an area affects the natural water balance of the Site. The most significant difference is the addition of impervious surfaces as a type of surface cover. Impervious surfaces prevent the infiltration of water into the soils. Net effect of the construction of impervious surfaces is that most of the precipitation that falls onto the impervious surfaces becomes surplus water and direct runoff. The natural permeability of the ground surface changes by reducing the currently undeveloped land/ open space and vegetation at the Site and replacing part of these areas with less permeable/ impervious surfaces such as building roofs, roads, and driveways. The development will result in an increased volume of runoff and a reduction in infiltration. Pre-development conditions result in approximately 12,057 m^3 of water available for infiltration to the groundwater system, as mentioned in the above table.

Based on the post-development plan, a summary of proposed land use and water balance calculations for the post-development are provided below:

Summary of Site Statistics (Post-development)

Land Use	Area (ha)	Area (m^2)
Building Footprint/Envelope	0.445	4,447
Hardscape/Impervious	0.657	6,570
Softscape/Pervious (Undeveloped Area)	7.368	73,679.8
Total	8.47	84,696.8

Post- Development Water Balance without Mitigation (Entire Site)

	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Proposed Development	84,696.8	72,924	41,555	949	10,941	19,479

In the post-development, the water balance calculations show that development has the potential to reduce the natural infiltration by 1,116 m^3/yr, and to increase the runoff by 4,706 m^3/yr. Conservation Ontario Guidelines (Conservation Ontario, 2013) suggest a target of 80% of the predevelopment infiltration being maintained in the post-development conditions. Calculations for the Site are indicative of the post-development infiltration being at a level of about 91 % of the pre-development infiltration. As such, post-development infiltration exceeds Conservation Ontario required target to maintain 80% of the predevelopment infiltration in the post-development conditions.

The water balance calculations are provided in **Appendix G**.

630500

630750

4852750

4852500

BH 26
BH 27
BH 25
BH 17
BH 18
BH 15
BH 16
BH 24
BH 19
BH 20
BH 14
BH 12
BH 13
BH 21
BH 22
BH 10
BH 11
BH 23
BH 9
BH 8
BH 1
BH 2
BH 6
BH 7
BH 3
BH 5
BH 4
C'
A'
A'
C'
Leslie St
Waterloo Ct
German Mills Creek
Bercy (Wycliffe Park
rway Heights Dr
rway Heights Dr
German Mills Creek

0 25 50 75 100 m

City of Toronto, ON, Maxar, Microsoft, Esri Community Maps Contributors, City of Toronto, Province of Ontario, York Region, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

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Construction Materials, Inspection & Testing

N W E S

References:

Map Data © Open Street Map Contributors, Microsoft, Facebook, Inc. and its affiliates, ESRI Community Maps Contributors, Map layer by ESRI.

Key Map

Notes:

Legend:

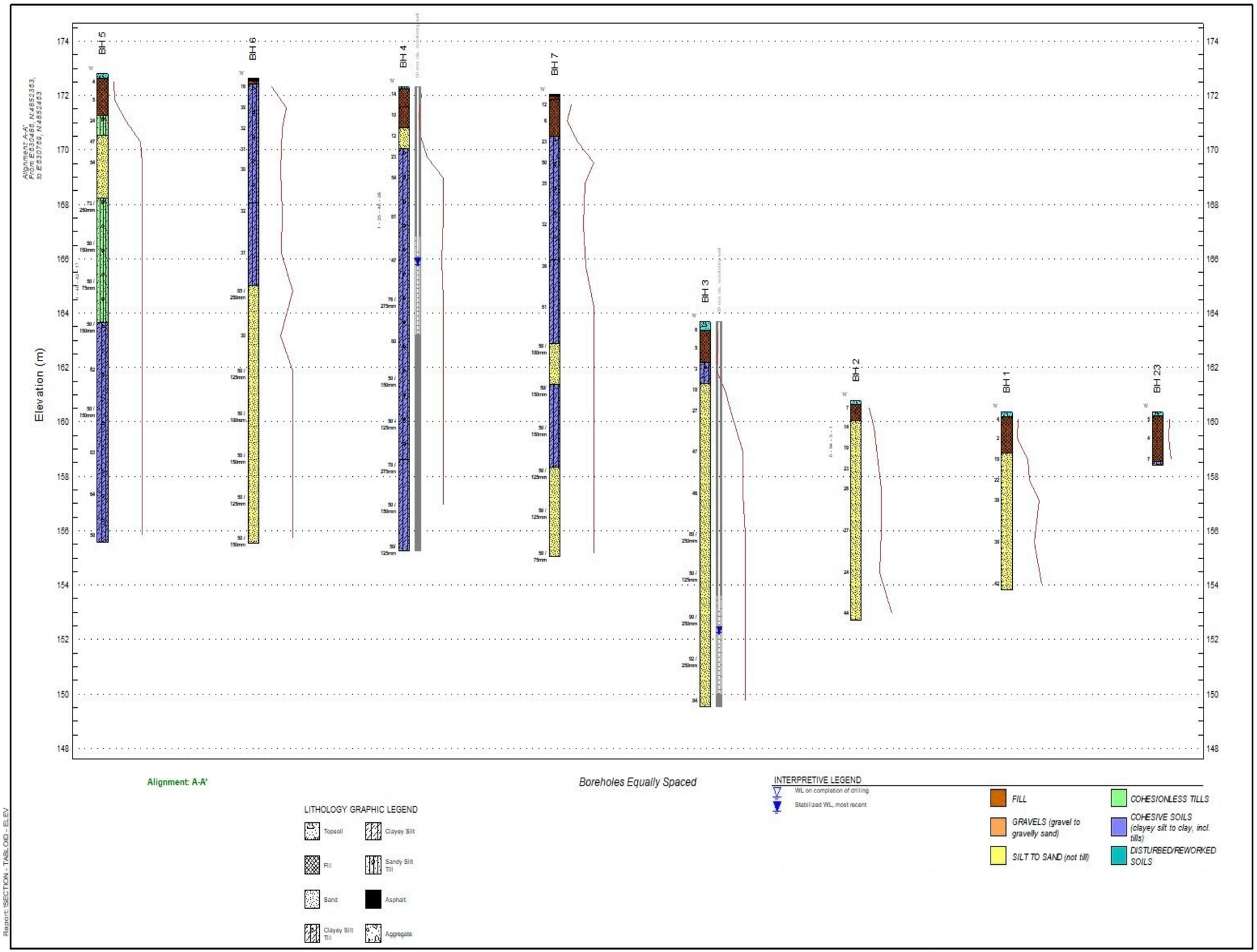
- Approximate Site Boundary
- Cross Sections
- Boreholes
- Monitoring Wells

Project Title:
Hydrogeological Investigation

Site Location:
7200 & 7290 Leslie Street, Thornhill, Ontario

Figure Title:
Borehole/Monitoring Well Location Plan and Cross-Sections

Designed By: MM	*File No.:* 1-20-0109-46
Drawn By: HK	*Scale:* As Shown
Reviewed By: SO	*Figure No.:* 2
Date: Sept 2022	



Report: SECTION - TABLOID - ELEV

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References:

ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/ Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community.Basemaps

Key Map

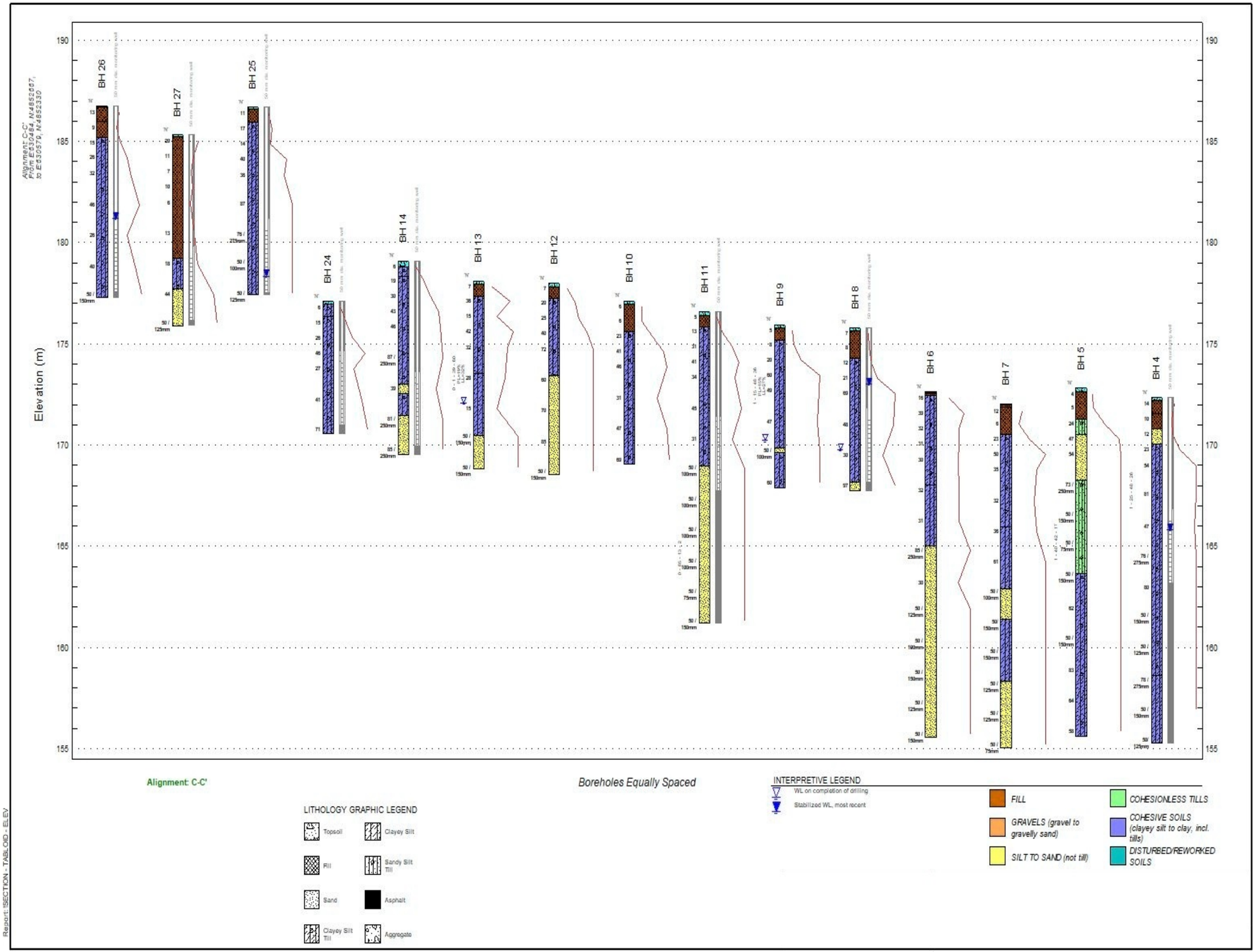
Notes:

Project Title:
Hydrogeological Assessment

Site Location:
7200 and 7290 Leslie Street, Thornhill, Ontario

Figure Title:
Site Location Plan

Designed By: MM	*File No.:* 1-20-0109-46
Drawn By: HK	*Scale:* As Shown
Reviewed By: SO	*Figure No.:* 3A
Date: Sept 2022	



Report: SECTION - TABLOID - ELEV

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References:

ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/ Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community.Basemaps

Key Map

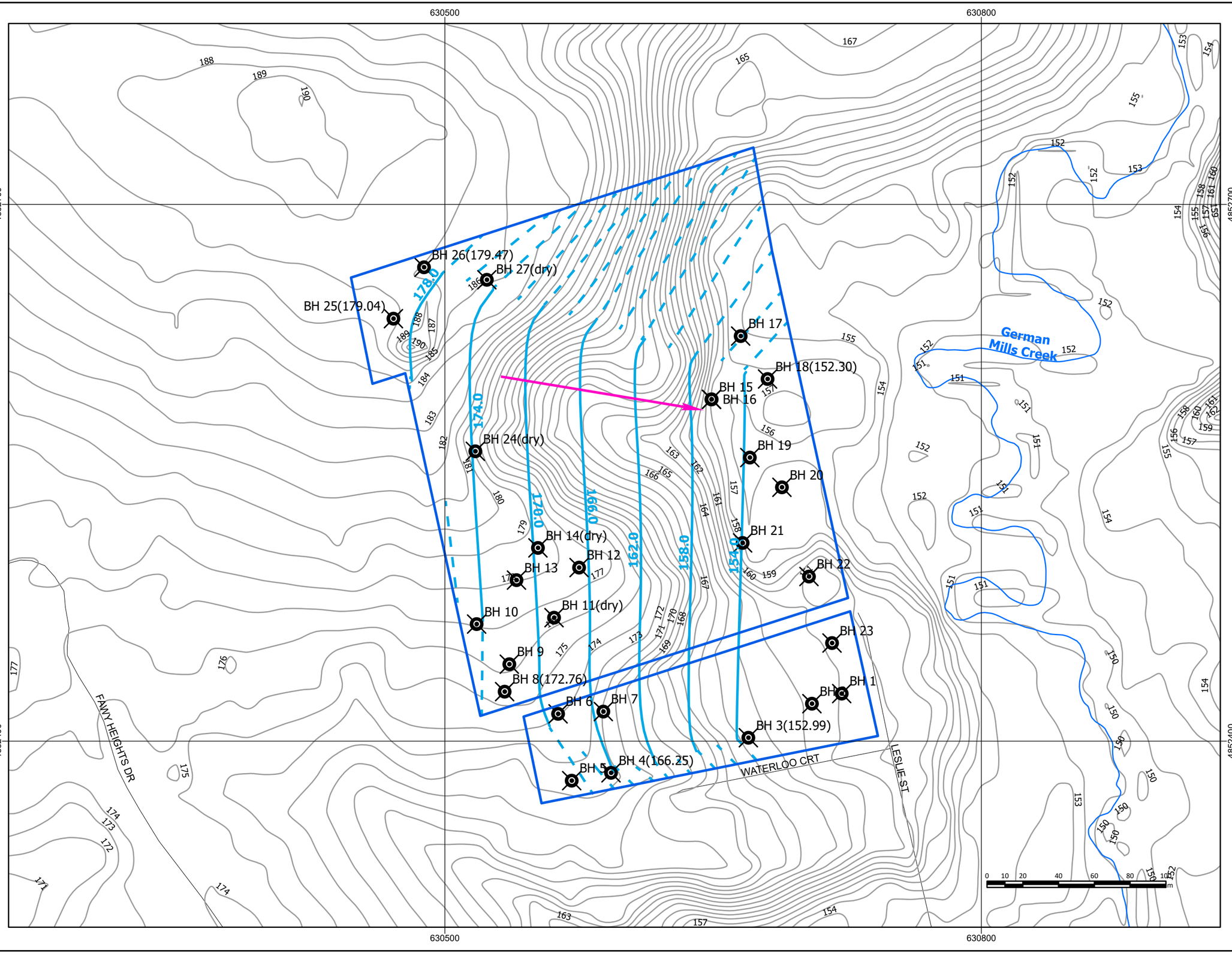
Notes:

Project Title:
Hydrogeological Assessment

Site Location:
7200 and 7290 Leslie Street, Thornhill, Ontario

Figure Title:
Site Location Plan

Designed By: MM	*File No.:* 1-20-0109-46
Drawn By: HK	*Scale:* As Shown
Reviewed By: SO	*Figure No.:* 3B
Date: Sept 2022	



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References:

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Key Map

Notes:

Legend:

- Approximate Site Location
- Interpreted Groundwater Flow Direction
- Inferred Groundwater Contours
- Interpreted Groundwater Contours

Roads Type

- Local / Street
- District of Thornhill ; Topographic Contours
- Watercourse
- Approximate BH/ Monitoring Wells Location ; Groundwater Elevations Jun 22, 2022 (masl)

Project Title:
Hydrogeological Assessment

Site Location:
7200 & 7290 Leslie Street, Thornhill, Ontario

Figure Title:
Groundwater Flow Direction

Designed By: MM	*File No.:* 1-20-0109-46
Drawn By: HK	*Scale:* As Shown
Reviewed By: SO	*Figure No.:* 5
Date: Sept 2022	

Appendix C Downstream Storm Sewer Capacity Analysis & Stormwater Management Calculations

SCS consulting group ltd

5-Year Storm Design
BAHAI NATIONAL CENTRE (7200 LESLIE STREET) EXISTING STORM DESIGN
FSP
MARKHAM, ON

Project: BAHAI NATIONAL CENTRE (7200 LESLIE STREET) EXISTING STORM DESIGN

Rainfall Intensity (i) = $\frac{A}{(T_c+B)^c}$

A= 1045.41
B= 4.9
c= 0.83

Starting T_c (min)= 10

Project No. 2004
Date: 15-Dec-23
Designed By: J.L./P.C.
Reviewed By: P.C./P.G.

P:\2004 Bahai National Centre\Design\Pipe Design\Storm\[2004P-FSP-Existing Storm Design Sheet.xlsm]Design

LOCATION			5 YEAR						EXTERNAL FLOWS				TOTAL FLOW	PIPE DATA						
STREET	MAINTENANCE HOLE		5-YEAR AREA	RUNOFF COEFF.	"AR"	ACCUM. "AR"	RAINFALL INTENSITY	ACCUM. FLOW	AREA	FLOW RATE	EXT. FLOW	ACCUM. EXT. FLOW	TOTAL (Qdes)	LENGTH	SLOPE	PIPE DIAMETER	FULL FLOW CAPACITY	FULL FLOW VELOCITY	TIME OF CONC.	ACCUM. TIME OF CONC.
	FROM	TO	(ha)	(R)			(mm/hr)	(m3/s)	(ha)	(l/s/ha)	(m3/s)	(m3/s)	(m3/s)	(m)	(%)	(mm)	(m3/s)	(m/s)	(min)	(min)
WATERLOO COURT	EX.MH1	EX.MH2	1.08	0.40	0.43	0.43	111.06	0.133	0.000	0.000	0.000	0.000	0.133	61.0	4.50	300	0.205	2.902	0.35	10.35
WATERLOO COURT	EX.MH2	EX.MH3	0.69	0.40	0.28	0.71	108.93	0.214	0.000	0.000	0.000	0.000	0.214	76.5	4.00	375	0.350	3.175	0.40	10.75
WATERLOO COURT	EX.MH3	EX.MH4	0.00	0.00	0.00	0.71	106.61	0.210	0.000	0.000	0.000	0.000	0.210	45.5	10.00	375	0.554	5.020	0.15	10.90
WATERLOO COURT	EX.MH4	EX.MH5	0.00	0.00	0.00	0.71	105.76	0.208	0.000	0.000	0.000	0.000	0.208	52.0	1.66	375	0.226	2.045	0.42	11.33
WATERLOO COURT	EX.MH5	EX.HW1	0.00	0.00	0.00	0.71	103.47	0.203	0.000	0.000	0.000	0.000	0.203	25.0	1.79	375	0.234	2.124	0.20	11.52

Hydraulic Grade Line Analysis
BAHAI NATIONAL CENTRE (7200 LESLIE STREET) EXISTING STORM DESIGN
FSP
MARKHAM, ON

EL. FROM STREETLINE TO BASEMENT (m)= 1.90
ALLOWABLE DISTANCE FROM BASEMENT TO HGL (m)= 0.50
STARTING DOWNSTREAM HGL (if above obvert) (m) = 150.14

Project: BAHAI NATIONAL CENTRE (7200 LESLIE STREET) EXISTING STORM DESIGN
Project No. 2004
Date: 15-Dec-23
Designed By: J.L./P.C.
Reviewed By: P.C./P.G.

P:\2004 Bahai National Centre\Design\Pipe Design\Storm\[2004P-FSP-Existing Storm Design Sheet.xlsm]Design

LOCATION			INVERTS		FLOW	PIPE DATA								PIPE LOSS CALCULATIONS					MH LOSS CALCULATIONS		TOTAL LOSS	HYDRAULIC GRADE LINE			HGL VS. BASEMENT SEPARATION			
STREET	FROM (U/S)	TO (D/S)	U/S (m)	D/S (m)	TOTAL PIPE FLOW (Qdes) (L/s)	PIPE DIAMETER (mm)	LENGTH (m)	MANNING's 'n'	PIPE AREA (m2)	HYD. RAD$^{2/5}$	SLOPE (%)	Qcap. (L/s)	Qdes/Qcap (%)	L/D	f	Vf	$V^2/2g$	TOTAL PIPE LOSS (m)	MH LOSS (m)	PIPE BEND LOSS (m)	TOTAL LOSS (m)	HGL (U/S) (m)	HGL SURCHARGE ABOVE U/S OBV. (m)	HGL (D/S) (m)	MH TOP (U/S) (m)	BASEMENT ELEV. (U/S) (m)	HGL TO BASEMENT (U/S) (m)	CHECK
WATERLOO COURT	EX.MH1	EX.MH2	164.695	161.950	133.3	300	61.0	0.013	0.071	0.178	4.50	205.0	0.65	203.333	0.031	1.885	0.181	1.159	0.01	0.00	1.17	164.995	0.000	162.250	168.55	166.65	1.66	OK
WATERLOO COURT	EX.MH2	EX.MH3	160.350	157.290	214.2	375	76.5	0.013	0.110	0.206	4.00	350.5	0.61	204.000	0.029	1.940	0.192	1.142	0.01	0.00	1.15	160.725	0.000	157.665	164.28	162.38	1.66	OK
WATERLOO COURT	EX.MH3	EX.MH4	157.075	152.525	209.7	375	45.5	0.013	0.110	0.206	10.00	554.2	0.38	121.333	0.029	1.898	0.184	0.651	0.01	0.00	0.66	157.450	0.000	152.900	160.18	160.18	2.73	OK
WATERLOO COURT	EX.MH4	EX.MH5	151.098	150.235	208.0	375	52.0	0.013	0.110	0.206	1.66	225.8	0.92	138.667	0.029	1.883	0.181	0.732	0.01	0.00	0.74	151.473	0.000	150.610	154.40	154.40	2.93	OK
WATERLOO COURT	EX.MH5	EX.HW1	150.208	149.760	203.5	375	25.0	0.013	0.110	0.206	1.79	234.5	0.87	66.667	0.029	1.842	0.173	0.337	0.04	0.00	0.38	150.583	0.000	150.135	152.15	152.15	1.57	OK

scs consulting group ltd

5-Year Storm Design
BAHAI NATIONAL CENTRE (7200 LESLIE STREET) PROPOSED STORM DESIGN
FSP
MARKHAM, ON

Project: BAHAI NATIONAL CENTRE (7200 LESLIE STREET) PROPOSED STORM DESIGN

Rainfall Intensity (i) = $\frac{A}{(T_c+B)^c}$

A= 1045.41
B= 4.9
c= 0.83

Starting T_c (min)= 10

Project No. 2004
Date: 26-Jan-24
Designed By: J.L./P.C.
Reviewed By: P.C./P.G.

P:\2004 Bahai National Centre\Design\Pipe Design\Storm\[2004P-FSP-Storm Design Sheet.xlsm]Design

LOCATION			5 YEAR						EXTERNAL FLOWS				TOTAL FLOW	PIPE DATA						
STREET	MAINTENANCE HOLE		5-YEAR AREA	RUNOFF COEFF.	"AR"	ACCUM. "AR"	RAINFALL INTENSITY	ACCUM. FLOW	AREA	FLOW RATE	EXT. FLOW	ACCUM. EXT. FLOW	TOTAL (Qdes)	LENGTH	SLOPE	PIPE DIAMETER	FULL FLOW CAPACITY	FULL FLOW VELOCITY	TIME OF CONC.	ACCUM. TIME OF CONC.
	FROM	TO	(ha)	(R)			(mm/hr)	(m3/s)	(ha)	(l/s/ha)	(m3/s)	(m3/s)	(m3/s)	(m)	(%)	(mm)	(m3/s)	(m/s)	(min)	(min)
WEST PARK+TEMPLE (PROPOSED)	TMPL	MH2	0.00	0.00	0.00	0.00	111.06	0.000	0.520	40.000	0.021	0.021	0.021	9.6	2.00	200	0.046	1.476	0.11	10.11
PRIVATE ROAD	MH2	MH3	0.00	0.00	0.00	0.00	110.39	0.000	0.000	0.000	0.000	0.021	0.021	18.4	0.50	250	0.042	0.857	0.36	10.47
PRIVATE ROAD	MH3	MH4	0.00	0.00	0.00	0.00	108.25	0.000	0.000	0.000	0.000	0.021	0.021	132.5	0.50	375	0.124	1.123	1.97	12.43
BNC BUILDING (PROPOSED)	BNC	MH4	0.00	0.00	0.00	0.00	111.06	0.000	1.150	40.000	0.046	0.046	0.046	1.6	2.00	250	0.084	1.713	0.02	10.02
PARKING LOT (PROPOSED)	PRKG	MH4	0.00	0.00	0.00	0.00	111.06	0.000	3.660	40.000	0.146	0.146	0.146	6.2	2.00	375	0.248	2.245	0.05	10.05
PRIVATE ROAD	MH4	MH5	0.00	0.00	0.00	0.00	97.95	0.000	0.000	0.000	0.000	0.213	0.213	34.4	1.60	375	0.222	2.008	0.29	12.72
LESLIE STREET	MH5	MH6	0.00	0.00	0.00	0.00	96.63	0.000	0.000	0.000	0.000	0.213	0.213	82.2	1.60	375	0.222	2.008	0.68	13.40
WATERLOO COURT	EX.MH1	EX.MH2	0.65	0.40	0.26	0.26	111.06	0.080	0.000	0.000	0.000	0.000	0.080	61.0	4.50	300	0.205	2.902	0.35	10.35
WATERLOO COURT	EX.MH2	EX.MH3	0.44	0.40	0.18	0.44	108.93	0.132	0.000	0.000	0.000	0.000	0.132	76.5	4.00	375	0.350	3.175	0.40	10.75
WATERLOO COURT	EX.MH3	MH6	0.00	0.00	0.00	0.44	106.61	0.129	0.000	0.000	0.000	0.000	0.129	16.6	10.00	375	0.554	5.020	0.06	10.81
WATERLOO COURT	MH6	EX.MH4	0.00	0.00	0.00	0.44	93.63	0.113	0.000	0.000	0.000	0.213	0.327	28.9	10.00	375	0.554	5.020	0.10	13.50
WATERLOO COURT	EX.MH4	EX.MH5	0.00	0.00	0.00	0.44	93.23	0.113	0.000	0.000	0.000	0.213	0.326	52.0	1.66	375	0.226	2.045	0.42	13.92
WATERLOO COURT	EX.MH5	EX.HW1	0.00	0.00	0.00	0.44	91.48	0.111	0.000	0.000	0.000	0.213	0.324	25.0	1.79	375	0.234	2.124	0.20	14.12

SCS consulting group ltd

Hydraulic Grade Line Analysis
BAHAI NATIONAL CENTRE (7200 LESLIE STREET) PROPOSED STORM DESIGN
FSP
MARKHAM, ON

Project: BAHAI NATIONAL CENTRE (7200 LESLIE STREET) PROPOSED STORM DESIGN

Project No. 2004
Date: 26-Jan-24
Designed By: J.L./P.C.
Reviewed By: P.C./P.G.

EL. FROM STREETLINE TO BASEMENT (m)= 1.90
ALLOWABLE DISTANCE FROM BASEMENT TO HGL (m)= 0.50
STARTING DOWNSTREAM HGL (if above obvert) (m) = 150.14

P:\2004 Bahai National Centre\Design\Pipe Design\Storm\[2004P-FSP-Storm Design Sheet.xlsm]Design

LOCATION			INVERTS		FLOW	PIPE DATA								PIPE LOSS CALCULATIONS					MH LOSS CALCULATIONS		TOTAL LOSS	HYDRAULIC GRADE LINE			HGL VS. BASEMENT SEPARATION			
STREET	FROM (U/S)	TO (D/S)	U/S (m)	D/S (m)	TOTAL PIPE FLOW (Qdes) (L/s)	PIPE DIAMETER (mm)	LENGTH (m)	MANNING's 'n'	PIPE AREA (m2)	HYD. RAD$^{2/3}$	SLOPE (%)	Qcap. (L/s)	Qdes/Qcap (%)	L/D	f	Vf	$V^2/2g$	TOTAL PIPE LOSS (m)	MH LOSS (m)	PIPE BEND LOSS (m)	TOTAL LOSS (m)	HGL (U/S) (m)	HGL SURCHARGE ABOVE U/S OBV. (m)	HGL (D/S) (m)	MH TOP (U/S) (m)	BASEMENT ELEV. (U/S) (m)	HGL TO BASEMENT (U/S) (m)	CHECK
WEST PARK+TEMPLE (PROPOSED)	TMPL	MH2	158.772	158.580	20.8	200	9.6	0.013	0.031	0.136	2.00	46.4	0.45	48.000	0.036	0.662	0.022	0.039	0.00	0.00	0.04	158.972	0.000	158.780	172.50	170.60	11.63	OK
PRIVATE ROAD	MH2	MH3	158.522	158.430	20.8	250	18.4	0.013	0.049	0.157	0.50	42.0	0.49	73.560	0.033	0.424	0.009	0.022	0.00	0.00	0.02	158.772	0.000	158.680	172.50	170.60	11.83	OK
PRIVATE ROAD	MH3	MH4	158.303	157.640	0.0	375	132.5	0.013	0.110	0.206	0.50	123.9	0.00	353.333	0.029	0.000	0.000	0.000	0.00	0.00	0.00	158.678	0.000	158.015	172.50	170.60	11.92	OK
BNC BUILDING (PROPOSED)	BNC	MH4	158.461	158.430	46.0	250	1.6	0.013	0.049	0.157	2.00	84.1	0.55	6.200	0.033	0.937	0.045	0.009	0.00	0.00	0.01	158.711	0.000	158.680	172.50	170.60	11.89	OK
PARKING LOT (PROPOSED)	PRKG	MH4	157.793	157.670	146.4	375	6.2	0.013	0.110	0.206	2.00	247.8	0.59	16.427	0.029	1.326	0.090	0.043	0.00	0.00	0.05	158.168	0.000	158.045	161.49	159.59	1.42	OK
PRIVATE ROAD	MH4	MH5	157.400	156.850	213.2	375	34.4	0.013	0.110	0.206	1.60	221.7	0.96	91.733	0.029	1.930	0.190	0.509	0.01	0.00	0.52	157.775	0.000	157.225	161.36	159.46	1.68	OK
LESLIE STREET	MH5	MH6	156.795	155.480	213.2	375	82.2	0.013	0.110	0.206	1.60	221.7	0.96	219.093	0.029	1.930	0.190	1.215	0.01	0.00	1.22	157.170	0.000	155.855	158.37	158.37	1.20	OK
					0.0																							
WATERLOO COURT	EX.MH1	EX.MH2	164.695	161.950	80.2	300	61.0	0.013	0.071	0.178	4.50	205.0	0.39	203.333	0.031	1.135	0.066	0.420	0.00	0.00	0.42	164.995	0.000	162.250	168.55	166.65	1.66	OK
WATERLOO COURT	EX.MH2	EX.MH3	160.350	157.290	131.9	375	76.5	0.013	0.110	0.206	4.00	350.5	0.38	204.000	0.029	1.195	0.073	0.433	0.00	0.00	0.44	160.725	0.000	157.665	164.28	162.38	1.66	OK
WATERLOO COURT	EX.MH3	MH6	157.078	155.420	129.1	375	16.6	0.013	0.110	0.206	10.00	554.2	0.23	44.213	0.029	1.169	0.070	0.090	0.00	0.00	0.09	157.453	0.000	155.795	160.18	160.18	2.73	OK
WATERLOO COURT	MH6	EX.MH4	155.415	152.525	326.6	375	28.9	0.013	0.110	0.206	10.00	554.2	0.59	77.067	0.029	2.957	0.446	1.003	0.02	0.00	1.03	155.790	0.000	152.925	158.56	158.56	2.77	OK
WATERLOO COURT	EX.MH4	EX.MH5	151.098	150.235	326.1	375	52.0	0.013	0.110	0.206	1.66	225.8	1.44	138.667	0.029	2.953	0.444	1.799	0.02	0.00	1.82	152.925	1.451	151.103	154.40	154.40	1.48	OK
WATERLOO COURT	EX.MH5	EX.HW1	150.208	149.760	324.0	375	25.0	0.013	0.110	0.206	1.79	234.5	1.38	66.667	0.029	2.934	0.439	0.854	0.11	0.00	0.96	151.103	0.521	150.140	152.15	152.15	1.05	OK

ALLOWABLE RELEASE RATE

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Catchment 101 Outlets to: German Mills Creek via Leslie

	Runoff Coefficient	Area (ha)	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
Hardscape	0.90	0.02	0.03	0.04	0.04	0.04
Rooftops	0.90	0.02	0.03	0.03	0.03	0.03
Landscape	0.25	0.60	0.23	0.26	0.28	0.29
TOTAL		0.65	0.30	0.33	0.35	0.36

Catchment 102 Outlets to: German Mills Creek via Leslie

	Runoff Coefficient	Area (ha)	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
Hardscape	0.90	0.06	0.02	0.02	0.02	0.02
Rooftops	0.90	0.03	0.01	0.01	0.01	0.01
Landscape	0.25	2.45	0.24	0.27	0.29	0.30
TOTAL		2.54	0.27	0.30	0.32	0.34

Catchment 103 Outlets to: German Mills Creek via Leslie

	Runoff Coefficient	Area (ha)	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
Landscape	0.25	1.02	0.25	0.28	0.30	0.31
TOTAL		1.02	0.25	0.28	0.30	0.31

Catchment 104 Outlets to: Waterloo Court STM

	Runoff Coefficient	Area (ha)	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
Hardscape	0.90	0.14	0.11	0.12	0.12	0.12
Rooftops	0.90	0.08	0.06	0.07	0.07	0.07
Landscape	0.25	0.93	0.20	0.22	0.24	0.25
TOTAL		1.15	0.37	0.41	0.43	0.44

ALLOWABLE RELEASE RATE

Waterloo Court STM Total

Catchment	Runoff Coefficient	Area	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
104	0.37	1.15	0.37	0.41	0.45	0.47
TOTAL		1.15	0.37	0.41	0.45	0.47

German Mills Creek via Leslie Total

Catchment	Runoff Coefficient	Area	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
101	0.30	0.65	0.05	0.05	0.05	0.06
102	0.27	2.54	0.16	0.18	0.20	0.21
103	0.25	1.02	0.06	0.07	0.07	0.08
TOTAL		4.21	0.27	0.30	0.32	0.34

Overall Total

Catchment	Runoff Coefficient	Area	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
101	0.30	0.65	0.04	0.04	0.04	0.04
102	0.27	2.54	0.13	0.14	0.16	0.16
103	0.25	1.02	0.05	0.05	0.06	0.06
104	0.37	1.15	0.08	0.09	0.10	0.10
TOTAL		5.36	0.29	0.32	0.35	0.37

ALLOWABLE RELEASE RATE

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

2 Year Storm

IDF Parameters*

a = 651.63
t = 10 min
b = 3.75
c = 0.80

Runoff Coefficient**

C1 = 0.37
C2 = 0.27
C3 = 0.00

Allowable Release Rate Calculation				
Outlet	**Area**	**time**	**Intensity**	**Flow**
ID		**t**	**i=a/(t+b)^c**	**Q=CiA/360**
	ha	***min***	***mm/hr***	***L/s***
Waterloo Court STM	1.15	10.00	80.05	95.7
German Mills Creek via Leslie	4.21	10.00	80.05	253.4

* a,b,c's per City of Markham

** Note: Per the Wet Weather Flow Management Guidelines (City of Toronto, 2006), when the percent imperviousness of a development site under pre-development condition is higher than 50%, the maximum value of C used in calculating the pre-development peak runoff rate is limited to 0.50.

5 Year storm

IDF Parameters*

a = 1045.41
t = 10 min
b = 4.9
c = 0.83

Runoff Coefficient:

C1 = 0.37
C2 = 0.27
C3 = 0.00

Allowable Release Rate Calculation				
Outlet	**Area**	**time**	**Intensity**	**Flow**
ID		**t**	**i=a/(t+b)^c**	**Q=CiA/360**
	ha	***min***	***mm/hr***	***l/s***
Waterloo Court STM	1.15	10.00	111.06	132.8
German Mills Creek via Leslie	4.21	10.00	111.06	351.6

* a,b,c's per City of Markham

ALLOWABLE RELEASE RATE

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

10 Year storm

IDF Parameters*

a = 1331.42
t = 10 min
b = 5.26
c = 0.84

Runoff Coefficient:

C1 = 0.37
C2 = 0.27
C3 = 0.00

Allowable Release Rate Calculation				
Outlet	**Area**	**time**	**Intensity**	**Flow**
ID		**t**	**i=a/(t+b)^c**	**Q=CiA/360**
	ha	***min***	***mm/hr***	***l/s***
Waterloo Court STM	1.15	10.00	134.94	161.4
German Mills Creek via Leslie	4.21	10.00	134.94	427.2

* a,b,c's per City of Markham

25 Year storm

IDF Parameters*

a = 1817.88
t = 10 min
b = 6.22
c = 0.87

Runoff Coefficient:

C1 = 0.41
C2 = 0.30

Allowable Release Rate Calculation				
Outlet	**Area**	**time**	**Intensity**	**Flow**
ID		**t**	**i=a/(t+b)^c**	**Q=CiA/360**
	ha	***min***	***mm/hr***	***l/s***
Waterloo Court STM	1.15	10.00	161.00	192.5
German Mills Creek via Leslie	4.21	10.00	161.00	560.7

* a,b,c's per City of Markham

ALLOWABLE RELEASE RATE

50 Year storm

IDF Parameters*

a = 1918.97
t = 10 min
b = 6
c = 0.86

Runoff Coefficient:

C1 = 0.45
C2 = 0.32

Allowable Release Rate Calculation				
Outlet	**Area**	**time**	**Intensity**	**Flow**
ID		**t**	**i=a/(t+b)^c**	**Q=CiA/360**
	ha	***min***	***mm/hr***	***l/s***
Waterloo Court STM	1.15	10.00	176.82	211.4
German Mills Creek via Leslie	4.21	10.00	176.82	671.8

* a,b,c's per City of Markham

100 Year storm

IDF Parameters*

a = 2167.43
t = 10 min
b = 6.03
c = 0.86

Runoff Coefficient**

C1 = 0.47
C2 = 0.34

Allowable Release Rate Calculation				
Outlet	**Area**	**time**	**Intensity**	**Flow**
ID		**t**	**i=a/(t+b)^c**	**Q=CiA/360**
	ha	***min***	***mm/hr***	***l/s***
Waterloo Court STM	1.15	10.00	199.39	298.0
German Mills Creek via Leslie	4.21	10.00	199.39	789.1

* a,b,c's per City of Markham

PROPOSED WEIGHTED RUNOFF COEFFICIENT

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Catchment 201 Outlets to: German Mills Creek via Leslie

	Runoff Coefficient	Area (ha)	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
Rooftops	0.90	0.05	0.01	0.01	0.01	0.01
Permeable Pavement	0.55	0.08	0.01	0.01	0.01	0.01
Hardscape	0.90	0.18	0.04	0.05	0.05	0.05
Landscape	0.25	3.49	0.23	0.25	0.28	0.29
TOTAL		3.80	0.30	0.33	0.35	0.36

Catchment 202 Outlets to: Waterloo Court STM

	Runoff Coefficient	Area (ha)	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
Rooftops	0.90	0.06	0.14	0.15	0.15	0.15
Hardscape	0.90	0.12	0.29	0.32	0.32	0.32
Landscape	0.25	0.20	0.13	0.14	0.16	0.16
TOTAL		0.38	0.56	0.61	0.63	0.64

Catchment 203 Outlets to: Waterloo Court STM

	Runoff Coefficient	Area (ha)	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
Rooftops	0.90	0.32	0.25	0.28	0.28	0.28
Hardscape	0.90	0.18	0.14	0.15	0.16	0.16
Landscape	0.25	0.65	0.14	0.16	0.17	0.18
TOTAL		1.15	0.53	0.59	0.60	0.61

Catchment 204 Outlets to: German Mills Creek via Leslie

	Runoff Coefficient	Area (ha)	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
Rooftops	0.90	0.00	0.00	0.00	0.00	0.00
Hardscape	0.90	0.00	0.00	0.00	0.00	0.00
Landscape	0.25	0.03	0.25	0.28	0.30	0.31
TOTAL		0.03	0.25	0.28	0.30	0.31

PROPOSED WEIGHTED RUNOFF COEFFICIENT

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Waterloo Court STM Total

Catchment	Runoff Coefficient	Area	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
202	0.56	0.38	0.14	0.15	0.17	0.17
203	0.53	1.15	0.40	0.44	0.48	0.50
TOTAL		1.53	0.54	0.59	0.65	0.67

German Mills Creek via Leslie Total

Catchment	Runoff Coefficient	Area	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
201	0.30	3.80	0.29	0.32	0.35	0.37
204	0.25	0.03	0.00	0.00	0.00	0.00
TOTAL		3.83	0.30	0.33	0.35	0.37

Overall Total

Catchment	Runoff Coefficient	Area	Weighted Runoff Coefficient	Weighted Runoff Coefficient (25 Year)	Weighted Runoff Coefficient (50 Year)	Weighted Runoff Coefficient (100 Year)
201	0.30	3.80	0.21	0.23	0.25	0.26
202	0.56	0.38	0.04	0.04	0.05	0.05
203	0.53	1.15	0.11	0.13	0.14	0.14
204	0.25	0.03	0.00	0.00	0.00	0.00
TOTAL		5.36	0.37	0.40	0.44	0.45

SUMMARY

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

				100 Year							
Catchment ID	Routing	Runoff Coef.	Area (ha)	Release Rate (L/s)	Storage Required (m^3) [1,2]	Ponding Depth (m)	Storage Available (m^3) [3]	Orifice Size (mm) [4]	Orifice Release Rate (L/s)	Uncontrolled Release Rate (L/s)	Major (Overland) Flow (L/s)
201	is routed through	0.36	3.80	763.1	0.0	0.00	0.0	uncontrolled	-	763	
202	is routed through	0.64	0.38	134.4	0.0	0.00	0.0	108	35.0		99
203	is routed through	0.61	1.15	103.3	225.7	0.00	226.0	185	103.3		
204	is routed through	0.31	0.03	5.2	0.0	0.00	0.0	uncontrolled	-	5	
Total			5.36	1006.0	225.7	-	226.0	-	-		

Waterloo Court STM Existing Release Rate	298.0	L/s
Waterloo Court STM Allowable Release Rate	213.2	L/s[3]
Waterloo Court STM Proposed Release Rate	138.3	L/s
German Mills Creek via Leslie Allowable Release Rate	789.1	L/s
German Mills Creek via Leslie Proposed Release Rate	867.7	L/s
Total Allowable Release Rate to German Mills Creek	1087.2	L/s
Total Proposed Release Rate to German Mills Creek	1006.0	L/s

Notes:
[1]Per Modified Rational Calculations (attached).
[2]Site plan storage available is provided via an underground concrete storage tank in the south-east corner of the site.
[3]The maximum allowable release rate to the Waterloo Court STM Sewer was determined via an HGL Analysis of the existing infrsastructure to identify what residual capacity is available in this existing system without impacting the upstream infrastructure (213.2 L/s).

				50 Year							
Catchment ID	Routing	Runoff Coef.	Area (ha)	Release Rate (L/s) [2]	Storage Required (m^3) [2]	Ponding Depth (m)	Storage Available (m^3) [3]	Orifice Size (mm) [4]	Orifice Release Rate (L/s)	Uncontrolled Release Rate (L/s)	Major (Overland) Flow (L/s)
201	is routed through	0.35	3.80	654.3	0.0	0.00	0.0	uncontrolled	-	654	
202	is routed through	0.63	0.38	117.9	0.0	0.00	0.0	108	35.0	0	83
203	is routed through	0.60	1.15	95.0	192.1	0.00	192.9	185	95.0		
204	is routed through	0.30	0.03	4.4	0.0	0.00	0.0	uncontrolled	-	4	
Total			5.36	871.7	192.1	-	973.6	-	-		

Waterloo Court STM Allowable Release Rate	211.4	L/s
Waterloo Court STM Proposed Release Rate	130.1	L/s
German Mills Creek via Leslie Allowable Release Rate	671.8	L/s
German Mills Creek via Leslie Proposed Release Rate	741.6	L/s
Total Allowable Release Rate to German Mills Creek	883.2	L/s
Total Proposed Release Rate to German Mills Creek	871.7	L/s

Notes:
[1]Per Modified Rational Calculations (attached).
[2]Site plan storage available is provided via an underground concrete storage tank in the south-east corner of the site.

SUMMARY

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Catchment ID	Routing		Runoff Coef.	Area (ha)	25 Year Release Rate (L/s) [2]	25 Year Storage Required (m^3) [2]	25 Year Ponding Depth (m)	25 Year Storage Available (m^3) [3]	Orifice Size (mm) [4]	Orifice Release Rate (L/s)	Uncontrolled Release Rate (L/s)	Major (Overland) Flow (L/s)
201	is routed through		0.33	3.80	553.8	0.0	0.00	0.0	uncontrolled	-	554	
202	is routed through		0.61	0.38	104.3	0.0	0.00	0.0	108	35.0	0	69
203	is routed through		0.59	1.15	87.6	164.7	0.00	165.4	185	87.6		
204	is routed through		0.28	0.03	3.7	0.0	0.00	0.0	uncontrolled	-	4	
Total				5.36	749.4	164.7	-	946.1	-	-		

Waterloo Court STM Allowable Release Rate	192.5	L/s
Waterloo Court STM Proposed Release Rate	122.6	L/s
German Mills Creek via Leslie Allowable Release Rate	560.7	L/s
German Mills Creek via Leslie Proposed Release Rate	626.8	L/s
Total Allowable Release Rate to German Mills Creek	753.2	L/s
Total Proposed Release Rate to German Mills Creek	749.4	L/s

Notes:
[1]Per Modified Rational Calculations (attached).
[2]Site plan storage available is provided via an underground concrete storage tank in the south-east corner of the site.

Catchment ID	Routing		Runoff Coef.	Area (ha)	10 Year Release Rate (L/s) [2]	10 Year Storage Required (m^3) [2]	10 Year Ponding Depth (m)	10 Year Storage Available (m^3) [3]	Orifice Size (mm) [4]	Orifice Release Rate (L/s)	Uncontrolled Release Rate (L/s)	Major (Overland) Flow (L/s)
201	is routed through		0.30	3.80	421.9	0.0	0.00	0.0	uncontrolled	-	422	
202	is routed through		0.56	0.38	79.5	0.0	0.00	0.0	108	35	0	44
203	is routed through		0.53	1.15	73.0	117.1	0.00	118.0	185	73		
204	is routed through		0.25	0.03	2.8	0.0	0.00	0.0	uncontrolled	-	3	
Total				5.36	577.2	117.1	-	898.7	-	-		

Waterloo Court STM Allowable Release Rate	161.4	L/s
Waterloo Court STM Proposed Release Rate	108.0	L/s
German Mills Creek via Leslie Allowable Release Rate	427.2	L/s
German Mills Creek via Leslie Proposed Release Rate	469.2	L/s
Total Allowable Release Rate to German Mills Creek	588.6	L/s
Total Proposed Release Rate to German Mills Creek	577.2	L/s

Notes:
[1]Per Modified Rational Calculations (attached).
[2]Site plan storage available is provided via an underground concrete storage tank in the south-east corner of the site.

SUMMARY

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

				5 Year							
Catchment ID	Routing	Runoff Coef.	Area (ha)	Release Rate (L/s) [2]	Storage Required (m^3) [2]	Ponding Depth (m)	Storage Available (m^3) [3]	Orifice Size (mm) [4]	Orifice Release Rate (L/s)	Uncontrolled Release Rate (L/s)	Major (Overland) Flow (L/s)
201	is routed through	0.30	3.80	347.3	0	0.00	0	uncontrolled	-	347	
202	is routed through	0.56	0.38	65.4	0	0.00	0	107.9	35		30
203	is routed through	0.53	1.15	63.4	92	0.00	92	185	63		
204	is routed through	0.25	0.03	2.3	0	0.00	0	uncontrolled	-	2	
Total			5.36	478.4	91.9	-	183				

Waterloo Court STM Allowable Release Rate	132.8	L/s
Waterloo Court STM Proposed Release Rate	98.4	L/s
German Mills Creek via Leslie Allowable Release Rate	351.6	L/s
German Mills Creek via Leslie Proposed Release Rate	380.0	L/s
Total Allowable Release Rate to German Mills Creek	484.4	L/s
Total Proposed Release Rate to German Mills Creek	478.4	L/s

Notes:
[1]Per Modified Rational Calculations (attached).
[2]Site plan storage available is provided via an underground concrete storage tank in the south-east corner of the site.

				2 Year							
Catchment ID	Routing	Runoff Coef.	Area (ha)	Release Rate (L/s) [2]	Storage Required (m^3) [2]	Ponding Depth (m)	Storage Available (m^3) [3]	Orifice Size (mm) [4]	Orifice Release Rate (L/s)	Uncontrolled Release Rate (L/s)	Major (Overland) Flow (L/s)
201	is routed through	0.30	3.80	250.3	0	0.00	0	uncontrolled	-	250	
202	is routed through	0.56	0.38	47.2	0	0.10	0	108	35	0	12
203	is routed through	0.53	1.15	49.9	61	0.00	61	185	50		
204	is routed through	0.25	0.03	1.7	0	0.00	0	uncontrolled	-	2	
Total			5.36	349.1	60.7	-	152				

Waterloo Court STM Allowable Release Rate	95.7	L/s
Waterloo Court STM Proposed Release Rate	85.0	L/s
German Mills Creek via Leslie Allowable Release Rate	253.4	L/s
German Mills Creek via Leslie Proposed Release Rate	264.1	L/s
Total Allowable Release Rate to German Mills Creek	349.2	L/s
Total Proposed Release Rate to German Mills Creek	349.1	L/s

Notes:
[1]Per Modified Rational Calculations (attached).
[2]Site plan storage available is provided via an underground concrete storage tank in the south-east corner of the site.

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 201

Area = **3.800** ha
"C" = **0.36**
AC= **1.3768**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **763.14** l/s
Max.Storage = **0.0** m^3

City of Markham 100 Year
a= 2167.43
b= 6.03
c= 0.86

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	199.4	763.14	457.9	457.9	0.0	<<<<
20.0	131.4	502.96	603.6	686.8	0.0	
30.0	99.4	380.29	684.5	915.8	0.0	
40.0	80.5	308.06	739.3	1144.7	0.0	
50.0	68.0	260.14	780.4	1373.6	0.0	
60.0	59.0	225.87	813.1	1602.6	0.0	
70.0	52.3	200.08	840.3	1831.5	0.0	
80.0	47.0	179.91	863.5	2060.5	0.0	
90.0	42.8	163.67	883.8	2289.4	0.0	
100.0	39.3	150.31	901.8	2518.3	0.0	
110.0	36.3	139.10	918.0	2747.3	0.0	
120.0	33.8	129.55	932.8	2976.2	0.0	
130.0	31.7	121.32	946.3	3205.2	0.0	
140.0	29.8	114.14	958.7	3434.1	0.0	
150.0	28.2	107.82	970.4	3663.1	0.0	
160.0	26.7	102.21	981.2	3892.0	0.0	
170.0	25.4	97.19	991.4	4120.9	0.0	
180.0	24.2	92.68	1001.0	4349.9	0.0	
190.0	23.1	88.60	1010.1	4578.8	0.0	
200.0	22.2	84.89	1018.7	4807.8	0.0	
210.0	21.3	81.50	1026.9	5036.7	0.0	
220.0	20.5	78.39	1034.8	5265.6	0.0	
230.0	19.7	75.53	1042.3	5494.6	0.0	
240.0	19.0	72.88	1049.4	5723.5	0.0	
250.0	18.4	70.42	1595.8	5952.5	0.0	

Area ID: 201

Area = **3.800** ha
"C" = **0.35**
AC= **1.3310**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **654.27** l/s
Max.Storage = **0.0** m^3

City of Markham 50 Year
a= 1918.97
b= 6
c= 0.86

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	176.8	654.27	392.6	392.6	0.0	<<<<
20.0	116.5	430.94	517.1	588.8	0.0	
30.0	88.0	325.75	586.3	785.1	0.0	
40.0	71.3	263.83	633.2	981.4	0.0	
50.0	60.2	222.77	668.3	1177.7	0.0	
60.0	52.3	193.42	696.3	1374.0	0.0	
70.0	46.3	171.32	719.5	1570.2	0.0	
80.0	41.6	154.04	739.4	1766.5	0.0	
90.0	37.9	140.13	756.7	1962.8	0.0	
100.0	34.8	128.69	772.1	2159.1	0.0	
110.0	32.2	119.09	786.0	2355.4	0.0	
120.0	30.0	110.91	798.6	2551.6	0.0	
130.0	28.1	103.86	810.1	2747.9	0.0	
140.0	26.4	97.71	820.8	2944.2	0.0	
150.0	24.9	92.30	830.7	3140.5	0.0	
160.0	23.6	87.50	840.0	3336.8	0.0	
170.0	22.5	83.21	848.7	3533.0	0.0	
180.0	21.4	79.34	856.9	3729.3	0.0	
190.0	20.5	75.85	864.7	3925.6	0.0	
200.0	19.6	72.67	872.1	4121.9	0.0	
210.0	18.9	69.77	879.1	4318.2	0.0	
220.0	18.1	67.11	885.8	4514.4	0.0	
230.0	17.5	64.65	892.2	4710.7	0.0	
240.0	16.9	62.39	898.4	4907.0	0.0	
250.0	16.3	60.29	904.3	5103.3	0.0	

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 201

Area = **3.800** ha
"C" = **0.33**
AC= **1.2372**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **553.76** l/s
Max.Storage = **0.0** m^3

City of Markham 25 Year
a= 1817.88
b= 6.22
c= 0.87

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
10.0	161.0	553.76	332.3	332.3	0.0
20.0	106.0	364.63	437.6	498.4	0.0
30.0	80.0	275.28	495.5	664.5	0.0
40.0	64.7	222.67	534.4	830.6	0.0
50.0	54.6	187.78	563.4	996.8	0.0
60.0	47.3	162.86	586.3	1162.9	0.0
70.0	41.9	144.10	605.2	1329.0	0.0
80.0	37.6	129.44	621.3	1495.1	0.0
90.0	34.2	117.66	635.4	1661.3	0.0
100.0	31.4	107.96	647.8	1827.4	0.0
110.0	29.0	99.83	658.9	1993.5	0.0
120.0	27.0	92.91	669.0	2159.6	0.0
130.0	25.3	86.95	678.2	2325.8	0.0
140.0	23.8	81.75	686.7	2491.9	0.0
150.0	22.4	77.18	694.6	2658.0	0.0
160.0	21.3	73.13	702.0	2824.2	0.0
170.0	20.2	69.50	708.9	2990.3	0.0
180.0	19.3	66.24	715.4	3156.4	0.0
190.0	18.4	63.30	721.6	3322.5	0.0
200.0	17.6	60.62	727.4	3488.7	0.0
210.0	16.9	58.17	732.9	3654.8	0.0
220.0	16.3	55.93	738.2	3820.9	0.0
230.0	15.7	53.86	743.3	3987.0	0.0
240.0	15.1	51.95	748.1	4153.2	0.0
250.0	14.6	50.18	752.8	4319.3	0.0

<<<<

Area ID: 201

Area = **3.800** ha
"C" = **0.30**
AC= **1.1248**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **421.92** l/s
Max.Storage = **0.0** m^3

City of Markham 10 Year
a= 1331.42
b= 5.26
c= 0.84

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
10.0	134.9	421.92	253.2	253.2	0.0
20.0	88.4	276.30	331.6	379.7	0.0
30.0	66.8	208.79	375.8	506.3	0.0
40.0	54.1	169.29	406.3	632.9	0.0
50.0	45.8	143.15	429.5	759.5	0.0
60.0	39.8	124.48	448.1	886.0	0.0
70.0	35.3	110.43	463.8	1012.6	0.0
80.0	31.8	99.45	477.3	1139.2	0.0
90.0	29.0	90.60	489.2	1265.8	0.0
100.0	26.6	83.31	499.9	1392.3	0.0
110.0	24.7	77.20	509.5	1518.9	0.0
120.0	23.0	71.99	518.3	1645.5	0.0
130.0	21.6	67.49	526.4	1772.1	0.0
140.0	20.3	63.56	533.9	1898.7	0.0
150.0	19.2	60.11	541.0	2025.2	0.0
160.0	18.2	57.04	547.6	2151.8	0.0
170.0	17.4	54.29	553.8	2278.4	0.0
180.0	16.6	51.82	559.6	2405.0	0.0
190.0	15.9	49.58	565.2	2531.5	0.0
200.0	15.2	47.54	570.5	2658.1	0.0
210.0	14.6	45.68	575.6	2784.7	0.0
220.0	14.1	43.97	580.4	2911.3	0.0
230.0	13.6	42.40	585.1	3037.9	0.0
240.0	13.1	40.94	589.5	3164.4	0.0
250.0	12.7	39.59	593.8	3291.0	0.0

<<<<

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 201

Area = **3.800** ha
"C" = **0.30**
AC= **1.1248**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **347.25** l/s
Max.Storage = **0.0** m^3

City of Markham 5 Year
a= 1045.41
b= 4.9
c= 0.83

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	111.1	347.25	208.4	208.4	0.0	<<<<
20.0	72.5	226.75	272.1	312.5	0.0	
30.0	54.8	171.34	308.4	416.7	0.0	
40.0	44.5	139.00	333.6	520.9	0.0	
50.0	37.6	117.64	352.9	625.1	0.0	
60.0	32.7	102.38	368.6	729.2	0.0	
70.0	29.1	90.90	381.8	833.4	0.0	
80.0	26.2	81.92	393.2	937.6	0.0	
90.0	23.9	74.69	403.3	1041.8	0.0	
100.0	22.0	68.73	412.4	1145.9	0.0	
110.0	20.4	63.73	420.6	1250.1	0.0	
120.0	19.0	59.46	428.1	1354.3	0.0	
130.0	17.8	55.78	435.1	1458.5	0.0	
140.0	16.8	52.57	441.6	1562.6	0.0	
150.0	15.9	49.73	447.6	1666.8	0.0	
160.0	15.1	47.22	453.3	1771.0	0.0	
170.0	14.4	44.97	458.6	1875.2	0.0	
180.0	13.7	42.94	463.7	1979.3	0.0	
190.0	13.1	41.10	468.5	2083.5	0.0	
200.0	12.6	39.43	473.1	2187.7	0.0	
210.0	12.1	37.90	477.5	2291.9	0.0	
220.0	11.7	36.50	481.7	2396.0	0.0	
230.0	11.3	35.20	485.8	2500.2	0.0	
240.0	10.9	34.00	489.7	2604.4	0.0	
250.0	10.5	32.89	493.4	2708.6	0.0	

Area ID: 201

Area = **3.800** ha
"C" = **0.30**
AC= **1.1248**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **250.30** l/s
Max.Storage = **0.0** m^3

City of Markham 2 Year
a= 651.63
b= 3.75
c= 0.8

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	80.0	250.30	150.2	150.2	0.0	<<<<
20.0	51.7	161.65	194.0	225.3	0.0	
30.0	39.0	122.04	219.7	300.4	0.0	
40.0	31.7	99.16	238.0	375.5	0.0	
50.0	26.9	84.10	252.3	450.5	0.0	
60.0	23.5	73.37	264.1	525.6	0.0	
70.0	20.9	65.30	274.2	600.7	0.0	
80.0	18.9	58.98	283.1	675.8	0.0	
90.0	17.2	53.89	291.0	750.9	0.0	
100.0	15.9	49.70	298.2	826.0	0.0	
110.0	14.8	46.17	304.7	901.1	0.0	
120.0	13.8	43.16	310.7	976.2	0.0	
130.0	13.0	40.56	316.3	1051.3	0.0	
140.0	12.2	38.28	321.6	1126.4	0.0	
150.0	11.6	36.28	326.5	1201.4	0.0	
160.0	11.0	34.50	331.2	1276.5	0.0	
170.0	10.5	32.90	335.6	1351.6	0.0	
180.0	10.1	31.46	339.7	1426.7	0.0	
190.0	9.6	30.15	343.7	1501.8	0.0	
200.0	9.3	28.96	347.5	1576.9	0.0	
210.0	8.9	27.87	351.2	1652.0	0.0	
220.0	8.6	26.87	354.7	1727.1	0.0	
230.0	8.3	25.95	358.1	1802.2	0.0	
240.0	8.0	25.09	361.3	1877.3	0.0	
250.0	7.8	24.30	364.5	1952.4	0.0	

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 202

Area = **0.380** ha
"C" = **0.64**
AC= **0.2424**
Tc = **10.0** min
Time Increment = **10.0** min
Release Rate = **134.38** l/s
Max.Storage = **0.0** m^3

City of Markham 100 Year
a= 2167.43
b= 6.03
c= 0.86

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	199.4	134.38	80.6	80.6	0.0	<<<<
20.0	131.4	88.57	106.3	120.9	0.0	
30.0	99.4	66.96	120.5	161.3	0.0	
40.0	80.5	54.25	130.2	201.6	0.0	
50.0	68.0	45.81	137.4	241.9	0.0	
60.0	59.0	39.77	143.2	282.2	0.0	
70.0	52.3	35.23	148.0	322.5	0.0	
80.0	47.0	31.68	152.1	362.8	0.0	
90.0	42.8	28.82	155.6	403.1	0.0	
100.0	39.3	26.47	158.8	443.5	0.0	
110.0	36.3	24.49	161.7	483.8	0.0	
120.0	33.8	22.81	164.2	524.1	0.0	
130.0	31.7	21.36	166.6	564.4	0.0	
140.0	29.8	20.10	168.8	604.7	0.0	
150.0	28.2	18.99	170.9	645.0	0.0	
160.0	26.7	18.00	172.8	685.3	0.0	
170.0	25.4	17.11	174.6	725.7	0.0	
180.0	24.2	16.32	176.3	766.0	0.0	
190.0	23.1	15.60	177.9	806.3	0.0	
200.0	22.2	14.95	179.4	846.6	0.0	
210.0	21.3	14.35	180.8	886.9	0.0	
220.0	20.5	13.80	182.2	927.2	0.0	
230.0	19.7	13.30	183.5	967.5	0.0	
240.0	19.0	12.83	184.8	1007.9	0.0	

Area ID: 202

Area = **0.380** ha
"C" = **0.63**
AC= **0.2399**
Tc = **10.0** min
Time Increment = **10.0** min
Release Rate = **117.94** l/s
Max.Storage = **0.0** m^3

City of Markham 50 Year
a= 1918.97
b= 6
c= 0.86

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	176.8	117.94	70.8	70.8	0.0	<<<<
20.0	116.5	77.68	93.2	106.1	-12.9	
30.0	88.0	58.72	105.7	141.5	-35.8	
40.0	71.3	47.56	114.1	176.9	-62.8	
50.0	60.2	40.16	120.5	212.3	-91.8	
60.0	52.3	34.87	125.5	247.7	-122.2	
70.0	46.3	30.88	129.7	283.1	-153.3	
80.0	41.6	27.77	133.3	318.4	-185.2	
90.0	37.9	25.26	136.4	353.8	-217.4	
100.0	34.8	23.20	139.2	389.2	-250.0	
110.0	32.2	21.47	141.7	424.6	-282.9	
120.0	30.0	19.99	143.9	460.0	-316.0	
130.0	28.1	18.72	146.0	495.3	-349.3	
140.0	26.4	17.61	148.0	530.7	-382.8	
150.0	24.9	16.64	149.7	566.1	-416.4	
160.0	23.6	15.77	151.4	601.5	-450.1	
170.0	22.5	15.00	153.0	636.9	-483.9	
180.0	21.4	14.30	154.5	672.2	-517.8	
190.0	20.5	13.67	155.9	707.6	-551.8	
200.0	19.6	13.10	157.2	743.0	-585.8	
210.0	18.9	12.58	158.5	778.4	-619.9	
220.0	18.1	12.10	159.7	813.8	-654.1	
230.0	17.5	11.65	160.8	849.2	-688.3	
240.0	16.9	11.25	161.9	884.5	-722.6	

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 202

Area = **0.380** ha
"C" = **0.61**
AC= **0.2331**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **104.34** l/s
Max.Storage = **0.0** m^3

City of Markham 25 Year
a= 1817.88
b= 6.22
c= 0.87

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	161.0	104.34	62.6	62.6	0.0	<<<<
20.0	106.0	68.71	82.4	93.9	-11.5	
30.0	80.0	51.87	93.4	125.2	-31.8	
40.0	64.7	41.96	100.7	156.5	-55.8	
50.0	54.6	35.38	106.2	187.8	-81.7	
60.0	47.3	30.69	110.5	219.1	-108.6	
70.0	41.9	27.15	114.0	250.4	-136.4	
80.0	37.6	24.39	117.1	281.7	-164.6	
90.0	34.2	22.17	119.7	313.0	-193.3	
100.0	31.4	20.34	122.1	344.3	-222.3	
110.0	29.0	18.81	124.2	375.6	-251.5	
120.0	27.0	17.51	126.1	406.9	-280.9	
130.0	25.3	16.38	127.8	438.2	-310.4	
140.0	23.8	15.40	129.4	469.5	-340.1	
150.0	22.4	14.54	130.9	500.8	-370.0	
160.0	21.3	13.78	132.3	532.1	-399.9	
170.0	20.2	13.10	133.6	563.4	-429.9	
180.0	19.3	12.48	134.8	594.8	-459.9	
190.0	18.4	11.93	136.0	626.1	-490.1	
200.0	17.6	11.42	137.1	657.4	-520.3	
210.0	16.9	10.96	138.1	688.7	-550.6	
220.0	16.3	10.54	139.1	720.0	-580.9	
230.0	15.7	10.15	140.1	751.3	-611.2	
240.0	15.1	9.79	141.0	782.6	-641.6	

Area ID: 202

Area = **0.380** ha
"C" = **0.56**
AC= **0.2119**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **79.50** l/s
Max.Storage = **0.0** m^3

City of Markham 10 Year
a= 1331.42
b= 5.26
c= 0.84

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	134.9	79.50	47.7	47.7	0.0	<<<<
20.0	88.4	52.06	62.5	71.6	-9.1	
30.0	66.8	39.34	70.8	95.4	-24.6	
40.0	54.1	31.90	76.6	119.3	-42.7	
50.0	45.8	26.97	80.9	143.1	-62.2	
60.0	39.8	23.46	84.4	167.0	-82.5	
70.0	35.3	20.81	87.4	190.8	-103.4	
80.0	31.8	18.74	89.9	214.7	-124.7	
90.0	29.0	17.07	92.2	238.5	-146.3	
100.0	26.6	15.70	94.2	262.4	-168.2	
110.0	24.7	14.55	96.0	286.2	-190.2	
120.0	23.0	13.56	97.7	310.1	-212.4	
130.0	21.6	12.72	99.2	333.9	-234.7	
140.0	20.3	11.98	100.6	357.8	-257.1	
150.0	19.2	11.33	101.9	381.6	-279.7	
160.0	18.2	10.75	103.2	405.5	-302.3	
170.0	17.4	10.23	104.3	429.3	-325.0	
180.0	16.6	9.76	105.5	453.2	-347.7	
190.0	15.9	9.34	106.5	477.0	-370.5	
200.0	15.2	8.96	107.5	500.9	-393.4	
210.0	14.6	8.61	108.5	524.7	-416.3	
220.0	14.1	8.29	109.4	548.6	-439.2	
230.0	13.6	7.99	110.2	572.4	-462.2	
240.0	13.1	7.71	111.1	596.3	-485.2	

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 202

Area = **0.380** ha
"C" = **0.56**
AC= **0.2119**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **65.43** l/s
Max.Storage = **0.0** m^3

City of Markham 5 Year
a= 1045.41
b= 4.9
c= 0.83

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
10.0	111.1	65.43	39.3	39.3	0.0
20.0	72.5	42.73	51.3	58.9	0.0
30.0	54.8	32.28	58.1	78.5	0.0
40.0	44.5	26.19	62.9	98.1	0.0
50.0	37.6	22.17	66.5	117.8	0.0
60.0	32.7	19.29	69.5	137.4	0.0
70.0	29.1	17.13	71.9	157.0	0.0
80.0	26.2	15.44	74.1	176.7	0.0
90.0	23.9	14.07	76.0	196.3	0.0
100.0	22.0	12.95	77.7	215.9	0.0
110.0	20.4	12.01	79.3	235.6	0.0
120.0	19.0	11.20	80.7	255.2	0.0
130.0	17.8	10.51	82.0	274.8	0.0
140.0	16.8	9.90	83.2	294.4	0.0
150.0	15.9	9.37	84.3	314.1	0.0
160.0	15.1	8.90	85.4	333.7	0.0
170.0	14.4	8.47	86.4	353.3	0.0
180.0	13.7	8.09	87.4	373.0	0.0
190.0	13.1	7.74	88.3	392.6	0.0
200.0	12.6	7.43	89.2	412.2	0.0
210.0	12.1	7.14	90.0	431.9	0.0
220.0	11.7	6.88	90.8	451.5	0.0
230.0	11.3	6.63	91.5	471.1	0.0
240.0	10.9	6.41	92.3	490.7	0.0

<<<<

Area ID: 202

Area = **0.380** ha
"C" = **0.56**
AC= **0.2119**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **47.16** l/s
Max.Storage = **0.0** m^3

City of Markham 2 Year
a= 651.63
b= 3.75
c= 0.8

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
10.0	80.0	47.16	28.3	28.3	0.0
20.0	51.7	30.46	36.6	42.4	0.0
30.0	39.0	22.99	41.4	56.6	0.0
40.0	31.7	18.68	44.8	70.7	0.0
50.0	26.9	15.85	47.5	84.9	0.0
60.0	23.5	13.82	49.8	99.0	0.0
70.0	20.9	12.30	51.7	113.2	0.0
80.0	18.9	11.11	53.3	127.3	0.0
90.0	17.2	10.15	54.8	141.5	0.0
100.0	15.9	9.36	56.2	155.6	0.0
110.0	14.8	8.70	57.4	169.8	0.0
120.0	13.8	8.13	58.6	183.9	0.0
130.0	13.0	7.64	59.6	198.1	0.0
140.0	12.2	7.21	60.6	212.2	0.0
150.0	11.6	6.84	61.5	226.4	0.0
160.0	11.0	6.50	62.4	240.5	0.0
170.0	10.5	6.20	63.2	254.7	0.0
180.0	10.1	5.93	64.0	268.8	0.0
190.0	9.6	5.68	64.8	283.0	0.0
200.0	9.3	5.46	65.5	297.1	0.0
210.0	8.9	5.25	66.2	311.3	0.0
220.0	8.6	5.06	66.8	325.4	0.0
230.0	8.3	4.89	67.5	339.6	0.0
240.0	8.0	4.73	68.1	353.7	0.0

<<<<

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 203

Area = **1.150** ha
"C" = **0.61**
AC= **0.7031**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **103.28** l/s
Max.Storage = **225.7** m^3

City of Markham 100 Year
a= 2167.43
b= 6.03
c= 0.86

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
10.0	199.4	389.74	233.8	62.0	171.9
20.0	131.4	256.87	308.2	93.0	215.3
30.0	99.4	194.22	349.6	123.9	225.7
40.0	80.5	157.33	377.6	154.9	222.7
50.0	68.0	132.86	398.6	185.9	212.7
60.0	59.0	115.36	415.3	216.9	198.4
70.0	52.3	102.18	429.2	247.9	181.3
80.0	47.0	91.88	441.0	278.9	162.2
90.0	42.8	83.59	451.4	309.8	141.5
100.0	39.3	76.76	460.6	340.8	119.7
110.0	36.3	71.04	468.9	371.8	97.0
120.0	33.8	66.16	476.4	402.8	73.6
130.0	31.7	61.96	483.3	433.8	49.5
140.0	29.8	58.29	489.6	464.8	24.9
150.0	28.2	55.06	495.6	495.8	0.0
160.0	26.7	52.20	501.1	526.7	0.0
170.0	25.4	49.64	506.3	557.7	0.0
180.0	24.2	47.33	511.2	588.7	0.0
190.0	23.1	45.25	515.9	619.7	0.0
200.0	22.2	43.36	520.3	650.7	0.0
210.0	21.3	41.62	524.5	681.7	0.0
220.0	20.5	40.03	528.5	712.6	0.0
230.0	19.7	38.57	532.3	743.6	0.0
240.0	19.0	37.22	536.0	774.6	0.0
250.0	18.4	35.97	539.5	805.6	0.0

<<<<

Area ID: 203

Area = **1.150** ha
"C" = **0.60**
AC= **0.6950**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **95.04** l/s
Max.Storage = **192.1** m^3

City of Markham 50 Year
a= 1918.97
b= 6
c= 0.86

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
10.0	176.8	341.63	205.0	57.0	148.0
20.0	116.5	225.02	270.0	85.5	184.5
30.0	88.0	170.09	306.2	114.0	192.1
40.0	71.3	137.76	330.6	142.6	188.1
50.0	60.2	116.32	349.0	171.1	177.9
60.0	52.3	100.99	363.6	199.6	164.0
70.0	46.3	89.45	375.7	228.1	147.6
80.0	41.6	80.43	386.1	256.6	129.5
90.0	37.9	73.17	395.1	285.1	110.0
100.0	34.8	67.19	403.2	313.6	89.5
110.0	32.2	62.18	410.4	342.1	68.3
120.0	30.0	57.91	417.0	370.7	46.3
130.0	28.1	54.23	423.0	399.2	23.8
140.0	26.4	51.02	428.6	427.7	0.9
150.0	24.9	48.20	433.8	456.2	0.0
160.0	23.6	45.69	438.6	484.7	0.0
170.0	22.5	43.45	443.2	513.2	0.0
180.0	21.4	41.43	447.4	541.7	0.0
190.0	20.5	39.61	451.5	570.2	0.0
200.0	19.6	37.95	455.4	598.7	0.0
210.0	18.9	36.43	459.0	627.3	0.0
220.0	18.1	35.04	462.5	655.8	0.0
230.0	17.5	33.76	465.9	684.3	0.0
240.0	16.9	32.58	469.1	712.8	0.0
250.0	16.3	31.48	472.2	741.3	0.0

<<<<

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 203

Area = **1.150** ha
"C" = **0.59**
AC= **0.6738**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **87.58** l/s
Max.Storage = **164.7** m^3

City of Markham 25 Year
a= 1817.88
b= 6.22
c= 0.87

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
10.0	161.0	301.55	180.9	52.5	128.4
20.0	106.0	198.56	238.3	78.8	159.5
30.0	80.0	149.91	269.8	105.1	164.7
40.0	64.7	121.26	291.0	131.4	159.6
50.0	54.6	102.26	306.8	157.6	149.1
60.0	47.3	88.68	319.3	183.9	135.3
70.0	41.9	78.47	329.6	210.2	119.4
80.0	37.6	70.49	338.4	236.5	101.9
90.0	34.2	64.07	346.0	262.7	83.3
100.0	31.4	58.79	352.7	289.0	63.7
110.0	29.0	54.36	358.8	315.3	43.5
120.0	27.0	50.60	364.3	341.6	22.7
130.0	25.3	47.35	369.3	367.8	1.5
140.0	23.8	44.52	374.0	394.1	0.0
150.0	22.4	42.03	378.3	420.4	0.0
160.0	21.3	39.82	382.3	446.7	0.0
170.0	20.2	37.85	386.0	472.9	0.0
180.0	19.3	36.07	389.6	499.2	0.0
190.0	18.4	34.47	392.9	525.5	0.0
200.0	17.6	33.01	396.1	551.7	0.0
210.0	16.9	31.68	399.1	578.0	0.0
220.0	16.3	30.46	402.0	604.3	0.0
230.0	15.7	29.33	404.8	630.6	0.0
240.0	15.1	28.29	407.4	656.8	0.0
250.0	14.6	27.33	409.9	683.1	0.0

<<<<

Area ID: 203

Area = **1.150** ha
"C" = **0.53**
AC= **0.6125**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **72.98** l/s
Max.Storage = **117.1** m^3

City of Markham 10 Year
a= 1331.42
b= 5.26
c= 0.84

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)
10.0	134.9	229.76	137.9	43.8	94.1
20.0	88.4	150.46	180.6	65.7	114.9
30.0	66.8	113.70	204.7	87.6	117.1
40.0	54.1	92.19	221.2	109.5	111.8
50.0	45.8	77.95	233.9	131.4	102.5
60.0	39.8	67.79	244.0	153.3	90.8
70.0	35.3	60.14	252.6	175.2	77.4
80.0	31.8	54.16	259.9	197.1	62.9
90.0	29.0	49.34	266.4	219.0	47.5
100.0	26.6	45.37	272.2	240.9	31.4
110.0	24.7	42.04	277.5	262.7	14.7
120.0	23.0	39.20	282.3	284.6	0.0
130.0	21.6	36.75	286.7	306.5	0.0
140.0	20.3	34.61	290.8	328.4	0.0
150.0	19.2	32.73	294.6	350.3	0.0
160.0	18.2	31.06	298.2	372.2	0.0
170.0	17.4	29.56	301.6	394.1	0.0
180.0	16.6	28.22	304.8	416.0	0.0
190.0	15.9	27.00	307.8	437.9	0.0
200.0	15.2	25.89	310.7	459.8	0.0
210.0	14.6	24.88	313.4	481.7	0.0
220.0	14.1	23.94	316.1	503.6	0.0
230.0	13.6	23.09	318.6	525.5	0.0
240.0	13.1	22.29	321.0	547.4	0.0
250.0	12.7	21.56	323.4	569.3	0.0

<<<<

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 203

Area = **1.150** ha
"C" = **0.53**
AC= **0.6125**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **63.40** l/s
Max.Storage = **91.9** m^3

City of Markham 5 Year
a= 1045.41
b= 4.9
c= 0.83

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	111.1	189.10	113.5	38.0	75.4	
20.0	72.5	123.48	148.2	57.1	91.1	
30.0	54.8	93.30	167.9	76.1	91.9	<<<<
40.0	44.5	75.70	181.7	95.1	86.6	
50.0	37.6	64.06	192.2	114.1	78.1	
60.0	32.7	55.75	200.7	133.1	67.6	
70.0	29.1	49.50	207.9	152.1	55.8	
80.0	26.2	44.61	214.1	171.2	43.0	
90.0	23.9	40.67	219.6	190.2	29.4	
100.0	22.0	37.43	224.6	209.2	15.4	
110.0	20.4	34.70	229.0	228.2	0.8	
120.0	19.0	32.38	233.1	247.2	0.0	
130.0	17.8	30.38	236.9	266.3	0.0	
140.0	16.8	28.63	240.5	285.3	0.0	
150.0	15.9	27.08	243.7	304.3	0.0	
160.0	15.1	25.71	246.8	323.3	0.0	
170.0	14.4	24.49	249.8	342.3	0.0	
180.0	13.7	23.38	252.5	361.4	0.0	
190.0	13.1	22.38	255.2	380.4	0.0	
200.0	12.6	21.47	257.7	399.4	0.0	
210.0	12.1	20.64	260.0	418.4	0.0	
220.0	11.7	19.87	262.3	437.4	0.0	
230.0	11.3	19.17	264.5	456.4	0.0	
240.0	10.9	18.52	266.6	475.5	0.0	
250.0	10.5	17.91	268.7	494.5	0.0	

Area ID: 203

Area = **1.150** ha
"C" = **0.53**
AC= **0.6125**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **49.93** l/s
Max.Storage = **60.7** m^3

City of Markham 2 Year
a= 651.63
b= 3.75
c= 0.8

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	80.0	136.30	81.8	30.0	51.8	
20.0	51.7	88.03	105.6	44.9	60.7	<<<<
30.0	39.0	66.46	119.6	59.9	59.7	
40.0	31.7	54.00	129.6	74.9	54.7	
50.0	26.9	45.80	137.4	89.9	47.5	
60.0	23.5	39.95	143.8	104.9	39.0	
70.0	20.9	35.56	149.3	119.8	29.5	
80.0	18.9	32.12	154.2	134.8	19.4	
90.0	17.2	29.35	158.5	149.8	8.7	
100.0	15.9	27.06	162.4	164.8	0.0	
110.0	14.8	25.14	165.9	179.8	0.0	
120.0	13.8	23.50	169.2	194.7	0.0	
130.0	13.0	22.09	172.3	209.7	0.0	
140.0	12.2	20.85	175.1	224.7	0.0	
150.0	11.6	19.76	177.8	239.7	0.0	
160.0	11.0	18.78	180.3	254.6	0.0	
170.0	10.5	17.91	182.7	269.6	0.0	
180.0	10.1	17.13	185.0	284.6	0.0	
190.0	9.6	16.42	187.2	299.6	0.0	
200.0	9.3	15.77	189.3	314.6	0.0	
210.0	8.9	15.18	191.2	329.5	0.0	
220.0	8.6	14.63	193.2	344.5	0.0	
230.0	8.3	14.13	195.0	359.5	0.0	
240.0	8.0	13.66	196.8	374.5	0.0	
250.0	7.8	13.23	198.5	389.5	0.0	

ON-SITE DETENTION AND ORIFICE DETAILS

Area ID

Orifice Equation: $Q = C_d A(2gh)^{1/2}$

Orifice Diameter:	185	mm
Area:	0.027	m^2
g =	9.81	m/sec^2
C_d =	0.62	

Type of Control:	VERTICAL
Location:	0

Underground Storage

Volume = 275.6 m^3

	Stage (m)	Head (m)	Storage (m^3)	Discharge (m^3/s)
Invert E.L.	157.00	0.00	0.0	0.00
2 Year WL	157.55	0.46	60.6	0.050
5 Year WL	157.83	0.74	91.5	0.063
10 Year WL	158.07	0.98	118.0	0.073
25 Year WL	158.50	1.41	165.4	0.088
50 Year WL	158.75	1.66	192.9	0.095
100 Year WL	159.05	1.96	226.0	0.103

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 204

Area = **0.030** ha
"C" = **0.31**
AC= **0.0094**
Tc = **10.0** min
Time Increment = **10.0** min
Release Rate = **5.20** l/s
Max.Storage = **0.0** m^3

City of Markham 100 Year
a= 2167.43
b= 6.03
c= 0.86

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	199.4	5.20	3.1	3.1	0.0	<<<<
20.0	131.4	3.42	4.1	4.7	0.0	
30.0	99.4	2.59	4.7	6.2	0.0	
40.0	80.5	2.10	5.0	7.8	0.0	
50.0	68.0	1.77	5.3	9.4	0.0	
60.0	59.0	1.54	5.5	10.9	0.0	
70.0	52.3	1.36	5.7	12.5	0.0	
80.0	47.0	1.23	5.9	14.0	0.0	
90.0	42.8	1.11	6.0	15.6	0.0	
100.0	39.3	1.02	6.1	17.1	0.0	
110.0	36.3	0.95	6.3	18.7	0.0	
120.0	33.8	0.88	6.4	20.3	0.0	
130.0	31.7	0.83	6.4	21.8	0.0	
140.0	29.8	0.78	6.5	23.4	0.0	
150.0	28.2	0.73	6.6	24.9	0.0	
160.0	26.7	0.70	6.7	26.5	0.0	
170.0	25.4	0.66	6.8	28.1	0.0	
180.0	24.2	0.63	6.8	29.6	0.0	
190.0	23.1	0.60	6.9	31.2	0.0	
200.0	22.2	0.58	6.9	32.7	0.0	
210.0	21.3	0.55	7.0	34.3	0.0	
220.0	20.5	0.53	7.0	35.9	0.0	
230.0	19.7	0.51	7.1	37.4	0.0	
240.0	19.0	0.50	7.1	39.0	0.0	

Area ID: 204

Area = **0.030** ha
"C" = **0.30**
AC= **0.0090**
Tc = **10.0** min
Time Increment = **10.0** min
Release Rate = **4.42** l/s
Max.Storage = **0.0** m^3

City of Markham 50 Year
a= 1918.97
b= 6
c= 0.86

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	176.8	4.42	2.7	2.7	0.0	<<<<
20.0	116.5	2.91	3.5	4.0	0.0	
30.0	88.0	2.20	4.0	5.3	0.0	
40.0	71.3	1.78	4.3	6.6	0.0	
50.0	60.2	1.51	4.5	8.0	0.0	
60.0	52.3	1.31	4.7	9.3	0.0	
70.0	46.3	1.16	4.9	10.6	0.0	
80.0	41.6	1.04	5.0	11.9	0.0	
90.0	37.9	0.95	5.1	13.3	0.0	
100.0	34.8	0.87	5.2	14.6	0.0	
110.0	32.2	0.81	5.3	15.9	0.0	
120.0	30.0	0.75	5.4	17.3	0.0	
130.0	28.1	0.70	5.5	18.6	0.0	
140.0	26.4	0.66	5.5	19.9	0.0	
150.0	24.9	0.62	5.6	21.2	0.0	
160.0	23.6	0.59	5.7	22.6	0.0	
170.0	22.5	0.56	5.7	23.9	0.0	
180.0	21.4	0.54	5.8	25.2	0.0	
190.0	20.5	0.51	5.8	26.5	0.0	
200.0	19.6	0.49	5.9	27.9	0.0	
210.0	18.9	0.47	5.9	29.2	0.0	
220.0	18.1	0.45	6.0	30.5	0.0	
230.0	17.5	0.44	6.0	31.9	0.0	
240.0	16.9	0.42	6.1	33.2	0.0	

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 204

Area = **0.030** ha
"C" = **0.28**
AC= **0.0083**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **3.69** l/s
Max.Storage = **0.0** m^3

City of Markham 25 Year
a= 1817.88
b= 6.22
c= 0.87

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	161.0	3.69	2.2	2.2	0.0	<<<<
20.0	106.0	2.43	2.9	3.3	0.0	
30.0	80.0	1.84	3.3	4.4	0.0	
40.0	64.7	1.48	3.6	5.5	0.0	
50.0	54.6	1.25	3.8	6.6	0.0	
60.0	47.3	1.09	3.9	7.8	0.0	
70.0	41.9	0.96	4.0	8.9	0.0	
80.0	37.6	0.86	4.1	10.0	0.0	
90.0	34.2	0.78	4.2	11.1	0.0	
100.0	31.4	0.72	4.3	12.2	0.0	
110.0	29.0	0.67	4.4	13.3	0.0	
120.0	27.0	0.62	4.5	14.4	0.0	
130.0	25.3	0.58	4.5	15.5	0.0	
140.0	23.8	0.55	4.6	16.6	0.0	
150.0	22.4	0.51	4.6	17.7	0.0	
160.0	21.3	0.49	4.7	18.8	0.0	
170.0	20.2	0.46	4.7	19.9	0.0	
180.0	19.3	0.44	4.8	21.0	0.0	
190.0	18.4	0.42	4.8	22.2	0.0	
200.0	17.6	0.40	4.9	23.3	0.0	
210.0	16.9	0.39	4.9	24.4	0.0	
220.0	16.3	0.37	4.9	25.5	0.0	
230.0	15.7	0.36	5.0	26.6	0.0	
240.0	15.1	0.35	5.0	27.7	0.0	

Area ID: 204

Area = **0.030** ha
"C" = **0.25**
AC= **0.0075**
Tc = **10.0** min
Time Increment = **10.0** min

Release Rate = **2.81** l/s
Max.Storage = **0.0** m^3

City of Markham 10 Year
a= 1331.42
b= 5.26
c= 0.84

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	134.9	2.81	1.7	1.7	0.0	<<<<
20.0	88.4	1.84	2.2	2.5	0.0	
30.0	66.8	1.39	2.5	3.4	0.0	
40.0	54.1	1.13	2.7	4.2	0.0	
50.0	45.8	0.95	2.9	5.1	0.0	
60.0	39.8	0.83	3.0	5.9	0.0	
70.0	35.3	0.74	3.1	6.8	0.0	
80.0	31.8	0.66	3.2	7.6	0.0	
90.0	29.0	0.60	3.3	8.4	0.0	
100.0	26.6	0.56	3.3	9.3	0.0	
110.0	24.7	0.51	3.4	10.1	0.0	
120.0	23.0	0.48	3.5	11.0	0.0	
130.0	21.6	0.45	3.5	11.8	0.0	
140.0	20.3	0.42	3.6	12.7	0.0	
150.0	19.2	0.40	3.6	13.5	0.0	
160.0	18.2	0.38	3.7	14.3	0.0	
170.0	17.4	0.36	3.7	15.2	0.0	
180.0	16.6	0.35	3.7	16.0	0.0	
190.0	15.9	0.33	3.8	16.9	0.0	
200.0	15.2	0.32	3.8	17.7	0.0	
210.0	14.6	0.30	3.8	18.6	0.0	
220.0	14.1	0.29	3.9	19.4	0.0	
230.0	13.6	0.28	3.9	20.3	0.0	
240.0	13.1	0.27	3.9	21.1	0.0	

MODIFIED RATIONAL METHOD

Baha'i National Centre
Project Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Area ID: 204

Area = **0.030** ha
"C" = **0.25**
AC= **0.0075**
Tc = **10.0** min
Time Increment = **10.0** min
Release Rate = **2.32** l/s
Max.Storage = **0.0** m^3

City of Markham 5 Year
a= 1045.41
b= 4.9
c= 0.83

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	111.1	2.32	1.4	1.4	0.0	<<<<
20.0	72.5	1.51	1.8	2.1	0.0	
30.0	54.8	1.14	2.1	2.8	0.0	
40.0	44.5	0.93	2.2	3.5	0.0	
50.0	37.6	0.78	2.4	4.2	0.0	
60.0	32.7	0.68	2.5	4.9	0.0	
70.0	29.1	0.61	2.5	5.6	0.0	
80.0	26.2	0.55	2.6	6.3	0.0	
90.0	23.9	0.50	2.7	6.9	0.0	
100.0	22.0	0.46	2.7	7.6	0.0	
110.0	20.4	0.42	2.8	8.3	0.0	
120.0	19.0	0.40	2.9	9.0	0.0	
130.0	17.8	0.37	2.9	9.7	0.0	
140.0	16.8	0.35	2.9	10.4	0.0	
150.0	15.9	0.33	3.0	11.1	0.0	
160.0	15.1	0.31	3.0	11.8	0.0	
170.0	14.4	0.30	3.1	12.5	0.0	
180.0	13.7	0.29	3.1	13.2	0.0	
190.0	13.1	0.27	3.1	13.9	0.0	
200.0	12.6	0.26	3.2	14.6	0.0	
210.0	12.1	0.25	3.2	15.3	0.0	
220.0	11.7	0.24	3.2	16.0	0.0	
230.0	11.3	0.23	3.2	16.7	0.0	
240.0	10.9	0.23	3.3	17.4	0.0	

Area ID: 204

Area = **0.030** ha
"C" = **0.25**
AC= **0.0075**
Tc = **10.0** min
Time Increment = **10.0** min
Release Rate = **1.67** l/s
Max.Storage = **0.0** m^3

City of Markham 2 Year
a= 651.63
b= 3.75
c= 0.8

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	80.0	1.67	1.0	1.0	0.0	<<<<
20.0	51.7	1.08	1.3	1.5	0.0	
30.0	39.0	0.81	1.5	2.0	0.0	
40.0	31.7	0.66	1.6	2.5	0.0	
50.0	26.9	0.56	1.7	3.0	0.0	
60.0	23.5	0.49	1.8	3.5	0.0	
70.0	20.9	0.44	1.8	4.0	0.0	
80.0	18.9	0.39	1.9	4.5	0.0	
90.0	17.2	0.36	1.9	5.0	0.0	
100.0	15.9	0.33	2.0	5.5	0.0	
110.0	14.8	0.31	2.0	6.0	0.0	
120.0	13.8	0.29	2.1	6.5	0.0	
130.0	13.0	0.27	2.1	7.0	0.0	
140.0	12.2	0.26	2.1	7.5	0.0	
150.0	11.6	0.24	2.2	8.0	0.0	
160.0	11.0	0.23	2.2	8.5	0.0	
170.0	10.5	0.22	2.2	9.0	0.0	
180.0	10.1	0.21	2.3	9.5	0.0	
190.0	9.6	0.20	2.3	10.0	0.0	
200.0	9.3	0.19	2.3	10.5	0.0	
210.0	8.9	0.19	2.3	11.0	0.0	
220.0	8.6	0.18	2.4	11.5	0.0	
230.0	8.3	0.17	2.4	12.0	0.0	
240.0	8.0	0.17	2.4	12.5	0.0	

Post-Development Conditions

Land Use	Area (ha)	Rainfall Depth (mm)	Rainfall Volume (m^3)
	(1)	(2)	(3) = (2)x(1)x10 m3/ha-mm
Hardscaping	0.49	5	24.3
Rooftops	0.43	5	21.4
Total	**0.91**		**45.7**

Water balance treatment of the 45.7 cu.m is required.
The permeable pavers in the vistor parking area are designed to satisfy this required retention volume, however a water re-use component is proposed in the underground storage tank infrastructure under the outlet invert and the active storage component, and an enhanced grassed swale with an infiltration component is proposed at the eastern parking lot outlet.

Permeable Pavement Sizing
Catchment A

Baha'i National Centre
Job Number: 2004
Date: January 2024
Designer Initials: M.G.V.

Water Quality Storage Requirements per MECP Criteria (Refer to Table 3.2 from MECP Design Manual (2003)):

This Permeable Pavement is designed to provide Enhanced Level Protection:

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MECP SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Lev			
		35	55	70	85
Enhanced (Level 1)	1. Infiltration	25	30	35	40
	2. Wetlands	80	105	120	140
	3. Hybrid Wet Pond/Wetland	110	150	175	195
	4. Wet Pond	140	190	225	250
Normal (Level 2)	1. Infiltration	20	20	25	30
	2. Wetlands	60	70	80	90
	3. Hybrid Wet Pond/Wetland	75	90	105	120
	4. Wet Pond	90	110	130	150
Basic (Level 3)	1. Infiltration	20	20	20	20
	2. Wetlands	60	60	60	60
	3. Hybrid Wet Pond/Wetland	60	70	75	80
	4. Wet Pond	60	75	85	95
	5. Dry Pond (ContinuousFlow)	90	150	200	240

Eastern Parking Lot Impervious Level =	16.53	%	
Storage Volume for Impervious Level =	20.0	m^3/ha	*Per Table 3.2 from MECP Design Manual (200
Required Storage Volume (V) =	73.2	m^3	
Provided Storage Volume =	73.3	m^3	

Therefore, the provided storage volume exceeds the storage volume required to provide Enhanced (Level 1) Protection.

Permeable Pavement Drawdown Time:

Permeable Pavement Area (A) =	764.0	m^2	
Percolation Rate =	22.8	mm/hr	*Per the HydrogeoSieveXL Program discussed (Section 5.4.1), and the In-situ Single Well Response Tests (Section 5.4.2) in the Terraprobe Hydrogeological Report (dated December 2023)
Safety Factor =	4.5		*Per TRCA SWM Criteria 2012
Design Percolation Rate (P) =	5.08	mm/hr	
Depth of Filter (d) =	0.24	m	

*Equation 4.2 Surface Area of Soakaway Pit MECP Stormwater Management Planning and Design Manual

$$d = \frac{PT}{1000}$$

Arranged to solved for drawdown time:

$$T = \frac{1000d}{P}$$

Drawdown Time (t) =	47.3	hr

Permeable Pavement Sizing
Catchment A

Baha'i National Centre
Job Number: 2004
Date: January 2024
Designer Initials: M.G.V.

TRCA LID Sizing Criteria:

Void Space Ratio (V_r) = 0.4

$$A_f = \frac{WQV}{dV_r}$$ Equation (2)

Minimum footprint area (A_f) = 762.5 m^2

Proposed Permeable Pavement footprint area = 764.0 m^2

Since the proposed Permeable Pavement footprint is greater than the minimum, the proposed Permeable Pavement is in accordance with the TRCA LID criteria.

Proposed Permeable Pavement footprint area = 764 m^2
Proposed impervious drainage area = 3700 m^2

Ratio of impervious drainage area to footprint surface area = 0.21 = 5 :1

As calculated, the ratio of impervious drainage area to proposed Permeable Pavement surface area falls within the 5:1 to 20:1 TRCA LID criteria.

Water Balance Calculations:

Overall Water Balance Volume Required = 45.7 m^3
Proposed Permeable Pavement Area = 764.0 m^2
Proposed Permeable Pavement Depth = 0.2 m

Water Balance Volume Provided = 73.3 m^3

Therefore, the proposed permeable pavement for the eastern parking area provides 73.35 m3 of water balance.

Appendix D Sanitary Flow Calculations

SCS consulting group ltd

SCS consulting group ltd

SANITARY SEWER FLOW CALCULATIONS

Job Number: 2004
Date: January 2024
Designer Initials: J.Y.L.

Bahai National Centre

Proposed Sanitary Flow Calculations - 7200 Leslie Street (Bahai National Centre)		
Average Domestic Flow Rate (Per City of Markham Sanitary Design Critera)	365	L/cap/day
Peaking Factor (Harmon) (Per City of Markham Sanitary Design Critera)	4.00	
Infiltration Rate (Per City of Markham Sanitary Design Critera)	0.26	L/s/ha
Temple (Institutional)		
Gross Ground Floor Area for Temple	0.18	ha
Area for Temple Lands	2.66	ha
Pop. per Hectare of Gross Floor Area (Per City of Markham Sani. Design Critera)	60.0	people / ha
Population for Temple	10.8	persons
Domestic Flow for Temple	0.05	L/s
Peaked Domestic Flow for Temple	0.18	L/s
Infiltration for Temple	0.05	L/s
Infiltration for Temple Lands	0.69	L/s
Total Flow for Temple	0.9	L/s
Proposed Building (Institutional)		
Gross Ground Floor Area for Proposed Building	0.52	ha
Area for Proposed Building Lands	0.88	ha
Pop. per Hectare of Gross Floor Area (Per City of Markham Sani. Design Critera)	60.0	people / ha
Population of Proposed Building	31.2	persons
Domestic Flow for Proposed Building	0.13	L/s
Peaked Domestic Flow for Proposed Building	0.53	L/s
Infiltration for Proposed Building	0.14	L/s
Infiltration for Proposed Building Lands	0.23	L/s
Total Flow for Proposed Building	0.9	L/s
Parking Lot (Institutional)		
Gross Floor Area for Parking Lot Ancillary Buildings	0.03	ha
Area for Parking Lot Lands	1.41	ha
Pop per Hectare of Gross Floor Area (Per City of Markham Sani. Design Critera)	60.0	people / ha
Population for Parking Lot	1.5	persons

Bahai National Centre

Domestic Flow for Parking Lot	0.01	L/s
Peaked Domestic Flow for Parking Lot	0.03	L/s
Infiltration for Parking Lot Ancillary Buildings	0.01	L/s
Infiltration for Parking Lot Lands	0.37	L/s
Total Flow for Parking Lot	0.4	L/s
Total Proposed Sanitary Flow	***2.2***	***L/s***
Existing Waterloo Court (Residential)		
Area for Existing Waterloo Court	1.81	ha
Existing Units	7	units
Existing Population per Unit (Per City of Markham Sanitary Design Critera)	4.0	person / unit
Existing Population	28.0	persons
Existing Residential Flow	0.12	L/s
Existing Peaked Residential Flow	0.47	L/s
Existing Infiltration	0.5	L/s
Total Existing Sanitary Flow	***0.9***	***L/s***

SCS consulting group ltd

Sanitary Design Sheet
BAHAI NATIONAL CENTRE (7200 LESLIE STREET) FSP SANITARY DSGN
FSP
Markham, ON

Minimum Sewer Diameter (mm) =	**200**	**Avg. Domestic Flow (l/cap/day) =**	**365**
Mannings n =	**0.013**	**Infiltration Rate (l/s/ha) =**	**0.26**
Minimum Velocity (m/s) =	**0.60**	**Max. Harmon Peaking Factor =**	**4.0**
Maximum Velocity (m/s) =	**3.65**	**Min. Harmon Peaking Factor =**	**1.5**
Minimum Pipe Slope (%) =	**0.50**	**NOMINAL PIPE SIZE USED**	

Project: BAHAI NATIONAL CENTRE (7200 LESLIE STREET) FSP SANITARY
Project No. 2004
Date: 26-Jan-24
Designed By: J.L./P.C.
Reviewed By: P.C./P.G.

P:\2004 Bahai National Centre\Design\Pipe Design\Sanitary\[2004P-FSP-Sanitary Sheet Design.xlsm]Design

LOCATION			RESIDENTIAL							INDUSTRIAL/COMMERCIAL/INSTITUTIONAL					FLOW CALCULATIONS								PIPE DATA				
STREET	MANHOLE		AREA	ACCUM. AREA	UNITS	DENSITY		RESIDENTIAL POPULATION	ACCUM. RESIDENTIAL POPULATION	AREA	ACCUM. AREA	POPULATION DENSITY	FLOW RATE	ACCUM. EQUIV. POPULATION	INFILTRATION	TOTAL ACCUM. POPULATION	AVG. DOMESTIC FLOW	ACCUM. AVG. DOMESTIC FLOW	PEAKING FACTOR	PEAKED RESIDENTIAL FLOW	ICI FLOW	TOTAL FLOW	LENGTH	PIPE DIAMETER	SLOPE	FULL FLOW CAPACITY	FULL FLOW VELOCITY
	FROM	TO				PER UNIT	PER HA																				
			(ha)	(ha)	(#)	(p/unit)	(p/ha)			(ha)	(ha)	(p/ha)	(l/s/ha)		(L/s)		(L/s)	(L/s)		(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(L/s)	(m/s)
LESLIE STREET	TEMPLE	MH1A	0	0	0			0	0	2.66	2.66	0	0	0	0.69	0	0.0	0.0	4.00	0.0	0.0	0.7	8.8	200	0.50	23.2	0.74
LESLIE STREET	TEMPLE	MH1A	0	0	0			0	0	0.18	0.18	60	0	10.8	0.05	10.8	0.0	0.0	4.00	0.2	0.0	0.2	8.8	200	0.50	23.2	0.74
LESLIE STREET	MH1A	MH2A	0	0	0			0	0	0	2.84	0	0	10.8	0.74	10.8	0.0	0.0	4.00	0.2	0.0	0.9	44.8	200	0.50	23.2	0.74
LESLIE STREET	MH2A	MH3A	0	0	0			0	0	0	2.84	0	0	10.8	0.7	10.8	0.0	0.0	4.00	0.2	0.0	0.9	119.6	200	0.50	23.2	0.74
LESLIE STREET	BLDG	MH3A	0	0	0			0	0	0.88	0.88	0	0	0	0.23	0	0.0	0.0	4.00	0.0	0.0	0.2	3.5	200	0.50	23.2	0.74
LESLIE STREET	BLDG	MH3A	0	0	0			0	0	0.52	0.52	60	0	31.2	0.14	31.2	0.1	0.1	4.00	0.5	0.0	0.7	3.5	200	0.50	23.2	0.74
LESLIE STREET	PRKG LOT	MH3A	0	0	0			0	0	1.405	1.405	0	0	0	0.37	0	0.0	0.0	4.00	0.0	0.0	0.4	4.2	200	0.50	23.2	0.74
LESLIE STREET	PRKG LOT	MH3A	0	0	0			0	0	0.025	0.025	60	0	1.5	0.01	1.5	0.0	0.0	4.00	0.0	0.0	0.0	4.2	200	0.50	23.2	0.74
LESLIE STREET	MH3A	MH4A	0	0	0			0	0	0	5.67	0	0	43.5	1.47	43.5	0.0	0.2	4.00	0.7	0.0	2.2	39.5	200	0.50	23.2	0.74
LESLIE STREET	MH4A	MH5A	0	0	0			0	0	0	5.67	0	0	43.5	1.47	43.5	0.0	0.2	4.00	0.7	0.0	2.2	83.0	200	0.50	23.2	0.74
WATERLOO COURT	EXMH1A	EXMH2A	1.08	1.08	4	4		16	16	0	0	0	0	0	0.28	16	0.1	0.1	4.00	0.3	0.0	0.6	61.0	200	4.50	69.5	2.21
WATERLOO COURT	EXMH2A	EXMH3A	0.73	1.81	3	4		12	28	0	0	0	0	0	0.47	28	0.1	0.1	4.00	0.5	0.0	0.9	74.0	200	4.00	65.6	2.09
EASEMENT	MH5A	EXMH3A	0	0	0			0	0	0	5.67	0	0	43.5	1.47	43.5	0.0	0.2	4.00	0.7	0.0	2.2	1.0	200	0.50	23.2	0.74
EASEMENT	EXMH3A	EXMH4A	0.05	1.86	0			0	28	0	5.67	0	0	43.5	1.96	71.5	0.0	0.3	4.00	1.2	0.0	3.2	47.5	200	10.00	103.7	3.30
EASEMENT	EXMH4A	EXMH5A	0.04	1.9	0			0	28	0	5.67	0	0	43.5	1.97	71.5	0.0	0.3	4.00	1.2	0.0	3.2	52.0	200	1.66	42.2	1.34
EASEMENT	EXMH5A	EXMH6A	0.02	1.92	0			0	28	0	5.67	0	0	43.5	1.97	71.5	0.0	0.3	4.00	1.2	0.0	3.2	25.0	200	7.00	86.7	2.76

Appendix E Water Distribution Analysis

YorkMaps

1: 9,028
July 28, 2022

Notes

This map was printed from a YorkMaps application.

HYDRANT INSPECTION & FLOW REPORT

SUGGESTED NFPA RATING	
BLUE	CLASS AA
4460 gpm @ 20 psi (138 kPa)	

ONTARIO CLEAN WATER AGENCY
AGENCE ONTARIENNE DES EAUX

Prepared By: The Ontario Clean Water Agency
Prepared For: SCS Consulting
Residual Hyd Andrew Cruickshank
Flow Hyd(s) Kelly Smith, Kurt Kahler

Date: 3-Aug-22 Time: 8:33 AM

HYDRANT DESCRIPTION

Hydrant ID:	457A	Side of Street:	N/W	Make:	Canada Valve	Open Dir:	Left
Address:	2 Waterloo Court			Model:	Century	Latitude:	
Location:	Markham ON			Year:	NA	Longitude:	

GENERAL INSPECTION

OK - Good Condition *FR - Future Repair Required* *N/A - Not Applicable* *CF - Component Failure*

Upper Section	OK	FR	N/A	CF
Bonnet	☐	☐	☑	☐
Operating Nut	☐	☐	☑	☐
Gaskets / Bolts	☐	☐	☑	☐
O-Ring(s)	☐	☐	☑	☐

Mid Section	OK	FR	N/A	CF
Port Height	☐	☐	☑	☐
Caps / Nozzles	☐	☐	☑	☐
Chains	☐	☐	☑	☐
Traffic Flange	☐	☐	☑	☐

General	OK	FR	N/A	CF
Accessibility	☐	☐	☑	☐
Position / Height	☐	☐	☑	☐
Paint Cond	☐	☐	☑	☐
Drain Ports	☐	☐	☑	☐

Hydrostatic Leak Testing		
Hydrant Closed	Above Grade Leak	N/A
	Subsurface Leak	N/A
Hydrant Open	Above Grade Leak	N/A
	Subsurface Leak	N/A

Maintenance	
Lubricate Operating Nut	N/A
Lubricate & Clean Nozzle Threads	N/A
Lubricate & Clean Cap Threads	N/A
Water Removed (if non-draining)	N/A

Auxiliary / Secondary Valve	
Located / Accessible	N/A
Operated/Exercised	N/A
Number of Turns	N/A
Open Direction	

Comments:

Auxiliary Valve Location:

FLUSHING

*If hydrants are being flow tested, inspections and flushing are completed prior to testing

Hydrant Operated	Clear Flow Obtained	Cl2 Residual	Time Flushed	Flow	Total Flow	Dechlorinated
Yes - Easily Operated	Yes	N/A	5 minutes	2389 gal	11943 gal	Yes

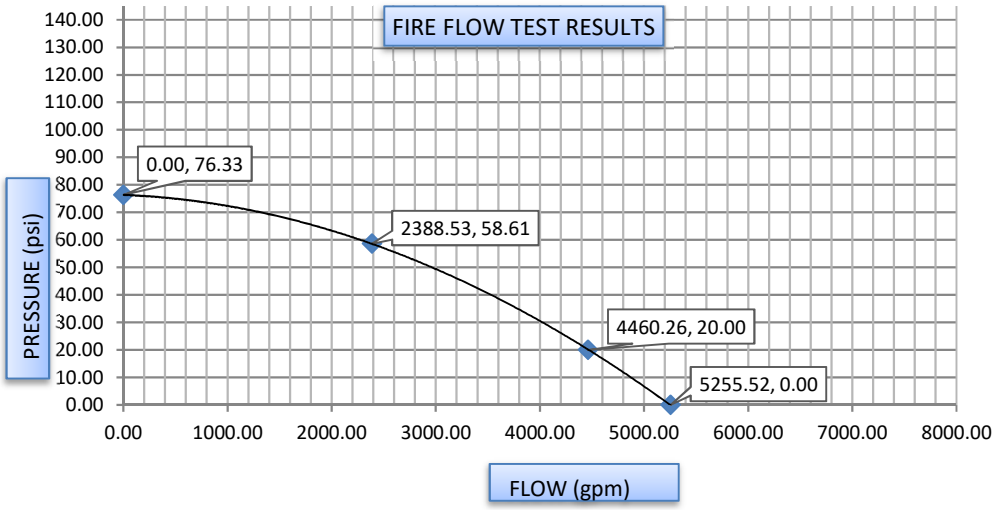
Comments: **STATIC AFTER FLOW TEST WAS PERFORMED 74.56 PSI**

FLOW TESTING

*Flow testing results may be from previous year(s). Note date & time

Date: 3-Aug-22 Time: 8:33 AM

Flow Hydrant								Test Hydrant		
ID	Flow Device Used	Size	Coefficient	Time Flushed	Flow	Total Flow	Pitot	ID	Static	Residual
379A	Pollard Diffuser	2.5"	0.832	5.0 minutes	776 gal	3878 gal	25 psi	457A	76.33	58.61
379A	Pollard Diffuser	2.5"	0.832	5.0 minutes	776 gal	3878 gal	25 psi			
455A	Pollard Diffuser	2.5"	0.832	5.0 minutes	491 gal	2453 gal	10 psi			
455A	Pollard Diffuser	2.5"	0.832	5.0 minutes	347 gal	1734 gal	5 psi			



Calculated Results	
Calculated Flow @ 20 psi	4460 gpm
Calculated Flow @ 0 psi	5256 gpm
Pressure Drop	23.21%

Comments:

Municipal Engineering Solutions

August 29, 2022 Project No. 17002-148

Sent via email
Miren Etxezarreta-Aranburu
Hariri Pontarini Architects
235 Carlaw Avenue, Suite 301
Toronto, ON M4M 2S1
c/o SCS Consulting Group Ltd.

Subject: 7015-7200 Leslie Street Development
Water Distribution Modeling
City of Markham, Region of York

Dear Ms. Etxezarreta-Aranburu,

We are pleased to submit our report entitled "7015-7200 Leslie Street Development Watermain Analysis" outlining the results of our water distribution analysis for the proposed residential development in the City of Markham, Region of York.

A WaterCAD model of the immediate area was developed utilizing the design information provided to Municipal Engineering Solutions and a hydrant test performed by the Ontario Clean Water Agency in August 2022. The findings of our analysis are summarized in the following report.

We trust you find this report satisfactory. Should you have any questions or require further clarification, please call.

Yours truly,

Municipal Engineering Solutions

Kristin St-Jean, P.Eng.

/KS

File Location: C:\Users\krist\Documents\Projects\17002-148 7015-7200 Leslie Street, Markham\5.0 Report\17002-148 7015-7200 Leslie Street Watermain Analysis_20220829.docx

55 Gilbank Drive, Aurora, Ontario L4G 6H9
Tel: 905.726.1016 Cell: 416.434.0186 Fax: 905.726.1225

7015-7200 LESLIE STREET DEVELOPMENT

WATERMAIN ANALYSIS

PREPARED BY:

MUNICIPAL ENGINEERING SOLUTIONS

FOR:

HARIRI PONTARINI ARCHITECTS
August 2022

Project Number: 17002-148

TABLE OF CONTENTS

APPENDICES

Section 1 – INTRODUCTION

Municipal Engineering Solutions ("MES") was retained by Hariri Pontarini Architects to conduct a hydraulic water analysis for the proposed development located at 7015-7200 Leslie Street in the City of Markham (Region of York). As part of this hydraulic assessment MES was requested to undertake the following:

1. Calculate/verify water demands for the proposed development using City of Markham, provincial and industry design standards;
2. Create a water model of the immediate area using boundary conditions from a hydrant test;
3. Run the model to size the subject mains to achieve service criteria during Minimum Hour, Peak Hour and fire flow during Maximum Day demand; and
4. Prepare a Report summarizing the modeling results for agency review and design purposes.

1.1 Development Background

The development site is located on the west side of Leslie Street, north of Waterloo Court in the City of Markham. The development consists of a National Building (mixed use - institutional/residential), a Place of Worship, a Welcome Center outside the Place of Worship and a Visitor Center. The Visitor Center is an existing one-storey log cabin that will be modified to include an addition and servicing. The breakdown of the buildings is shown in **Appendix A**. The proposed development is shown below on **Figure 1**.

Figure 1 - Proposed 7015-7200 Leslie Street Development

Section 2 – WATERMAIN DESIGN CRITERIA

The design criteria utilized to estimate the water demands for the hydraulic water model follows general industry standards and is calculated using the design criteria and guidelines outlined in the City of Markham Design Criteria, the Ministry of the Environment, Conservation and Parks (MECP) Watermain Design Criteria and the Fire Underwriters Survey.

The following sections summarize the specific design criteria used to carry out the hydraulic watermain assessment for this development.

2.1 Equivalent Population Densities & Water Design Factors

To calculate the equivalent population and water design factors for this development MES used City of Markham standard residential population densities as noted in the City of Markham Engineering Design Criteria (June 2013, Rev 2). **Table 1** summarizes the residential population densities and **Table 2** summarizes the average daily demand and peaking factors used for this analysis.

Table 1 – Equivalent Population Density

Type of Development	Equivalent Population
Mixed Use	330 Persons/m^2 floor area
Institutional	60 Persons/Ha of site area

Source: City of Markham Design Criteria, June 2013

Table 2 - Water Design Factors

Type of Development	Average Daily Demand	Minimum Hourly Demand Peaking Factor	Maximum Daily Demand Peaking Factor	Peak Hourly Demand Peaking Factor
Mixed Use (Residential)	365 L/capita/day	0.7	2.0	4.5
Mixed Use (Non-Residential)	365 L/capita/day	0.7	1.4	2.5

Source: City of Markham Design Criteria, June 2013

Section 3 –FLOW DEMANDS

Utilizing the equivalent population data from Table 1 and the corresponding Minimum Hour, Maximum Day and Peak Hour data from Table 2 the water demands for this development were calculated.

3.1 Equivalent Population Flow Demands

The calculated demands for the development are summarized in **Table 3**. For additional details on the development water demands and assigned demand nodes used in the water model see **Appendix A**.

Table 3 – Water Demand for the 7015-7200 Leslie Street Development

	Average Day Demand (L/s)	Minimum Hour Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)
Demands	1.79	1.24	2.94	5.90

3.2 Fire Flow Demands

The fire demands for this development were calculated using the Fire Underwriters Survey ("FUS") formula outlined in the *'Water Supply For Public Fire Protection Guideline',* dated 2020. The minimum required fire flows assumed for this development are summarized in **Table 4**. Details on the calculations are included in **Appendix A**.

Table 4 – Minimum Fire Flow Requirements

Type of Development	Fire Flow (L/S)
National Center	117
Place of Worship	117
Welcome Center	133
Log Cabin/Visitor Center	117

Source: Fire Underwriters Survey, 2020

As noted, the fire flows in Table 4 above are calculated using the FUS formula. Table 5 below summarizes the criteria utilized to develop the fire flow requirements as well as the assumptions made. The National Center will be of concrete construction and fully sprinklered. The Place of Worship will be fully sprinklered and the construction type is not yet known, therefore it was assumed to be wood-frame construction. The existing log cabin and additions were assumed to be one fire area for the purposes of the FUS calculation, all wood-frame construction.

Once the detailed design data (specifics) for these building(s) are known the assumptions noted in Table 5 must be reviewed and confirmed by the appropriate designer (architect or sprinkler system designer) and any design/criteria changes required are to be reported to MES. Regardless, the building construction, internal piping and sprinkler systems will all need to be designed to suit the available flow and pressure.

Table 5 – FUS Criteria/Assumptions

	Type of Development			
	National Center	Place of Worship	Welcome Center	Log Cabin/Visitor
Type of Construction	Noncombustible Construction	Unknown (Assumed to be Wood Frame Construction)	Unknown (Assumed to be Wood Frame Construction)	Wood Frame Construction
Occupancy Type	Limited Combustible	Combustible	Combustible	Combustible
Fire Protection (Sprinkler/Firewalls)	Sprinklered	Sprinklered	None	None
Area Considered	Total Building Area 5,163 m^2	Total Building Area 971 m^2	Total Building Area 446 m^2	Total Building Area (existing and proposed) 485 m^2

Note: For Additional Information on FUS Criteria Refer to Water Supply for Public Protection Guide, Fire Underwriters Survey, 2020

3.3 External Demands

The hydrant test results would have considered the demands external to the development.

Section 4 – OTHER SYSTEM REQUIREMENTS

4.1 System Pressure Requirements

In addition to meeting the various flow requirements, the system must also satisfy minimum and maximum pressure requirements as outlined by the City. The City's pressure requirements are outlined in the Standard Guidelines and stipulate the following:

1. The maximum system pressure under static load or during minimum hourly demand shall be 650 kPa (95 psi).
2. The minimum system pressure when the system is tested for fire flow during peak daily flow shall be 140 kPa (20 psi).
3. The minimum pressure during peak hourly demand shall be 300 kPa (44 psi).
4. The normal method of reduction of pressures to comply with the Ontario Building Code (reduction of pressures to 550 kPa, 80 psi) is by pressure reducing valves to be installed on individual services.
5. The maximum recommended static pressure shall be 650 kPa (95 psi). In no case can the pressure on the system exceed 700 kPa (100 psi).

4.2 Watermain Sizing

The City of Markham stipulates a minimum pipe size of 150 mm diameter for residential developments and requires that all watermains are adequately sized to maintain demand flows at the required pressures without causing excessive energy loss or result in water quality decay. The watermain system must therefore be designed to accommodate the greater of the following:

- Maximum day plus fire demand
- Peak hour demand

The minimum pipe size for commercial and industrial areas shall be 300 mm diameter and for residential areas the minimum pipe size shall be 150 mm diameter. For distribution systems providing fire protection the minimum pipe size shall be 150 mm diameter in accordance with Ministry of the Environment, Conservation and Parks (MECP) and NFPA requirements.

To provide appropriate fire protection, reliable supply and pressures the water distribution system should be looped wherever possible to improve supply security and water quality.

4.3 Watermain C-Factor

In designing and modeling of the pipes the Coefficient of Roughness (C-Factor) factors from the City's design criteria and as suggested by the MECP were utilized. The Coefficient of Roughness assigned to each pipe size is summarized in **Table 6** below.

Table 6 - Hazen-Williams Coefficient of Roughness (C-Factors)

Size of Pipe (Diameter in mm)	Coefficient of Roughness (C)
150 mm	100
200 mm to 250 mm	110
300 mm to 600 mm	120
Greater Than 600 mm	130

Source: City of Markham Engineering Design Criteria June 2013

Section 5 – ANALYSIS & MODELING RESULTS

In order to conduct the hydraulic water analysis for the proposed development the water demands were estimated by MES using the design criteria previously discussed and a WaterCAD model of the immediate area was developed using boundary conditions from a hydrant test. The following sections discuss the model setup and results.

5.1 Model Setup

A hydrant test was performed on Leslie Street/Waterloo Court by the Ontario Clean Water Agency on August 3rd, 2022. The hydrant test results are included in **Appendix B.**

The buildings will be serviced from an extension of the existing 300mm watermain on Leslie Street.

The development was modeled under the existing planning scenario only. The finished floor elevations of the buildings range from approximately 156.5 to 178.0 m. Friction factor for all new pipes added to the model were assigned according to Table 6. Fire flows were based on the FUS formula.

5.2 Hydraulic Grade Line

The model was setup with a dummy pump and reservoir, set at ground elevation, and a hydrant curve was added to the pump to match the results of the hydrant tests. To check the adequacy of the pump curve entered in to the model, a simulated hydrant curve (modeled flow) at the location of the hydrant test (Node J-4) was graphed against the data points of the actual hydrant test. The comparison graph is included in **Appendix B**.

The Hydraulic Grade Line (HGL) generated for each of the various demand scenarios is summarized in **Table 7**. The HGL listed is the HGL of the "pump" discharge (Pump P-1).

Table 7 – Hydraulic Grade Line (HGL) at Pump Discharge

Scenario	HGL at Pump Discharge
Average Day	213.83
Minimum Hour	213.83
Maximum Day	213.82
Peak Hour	213.80
Maximum Day + Fire	204.30

The pump tables and the pump curve for Pump P-1 are attached to this report in **Appendix C**.

5.3 Watermain Sizing and System Pressures

The analysis was conducted under existing servicing conditions for Minimum Hour, Maximum Day, Peak Hour and Maximum day plus Fire demands to size the watermains and meet the pressure requirements. The proposed watermain layout is shown in **Appendix A**.

Modeled service pressures for the development are summarized in **Table 8**. All pressures lie within the required operating range under minimum hour, maximum day, maximum day plus fire flow and peak hour. Since modeling was done using a single demand scenario for boundary conditions (hydrant test), it is anticipated that pressures will be lower during peak hour and higher during minimum hour than indicated in the modeling.

Detailed pipe and node tables are attached to this report in **Appendix C**.

Table 8 - Modeled Service Pressures

Scenario	Average Day	Minimum Hour	Maximum Day	Peak Hour	Max. Day + Fire
Results	351 – 561 kPa (50.9 to 81.3 psi)	351 – 561 kPa (50.9 to 81.4 psi)	351 – 560 kPa (50.8 to 81.3 psi)	350 – 558 kPa (50.8 to 80.9 psi)	163 to 199 L/s @ 140 kPa

There is an existing hydrant at the end of the cul-de-sac on Waterloo Court where the modelling indicates that the City's minimum fire flow requirement of 117 L/s (7,000 L/min) will not be met. This is an existing condition and the addition of the proposed watermain does not have any significant impact on the available fire flow at this location.

The modelling indicates that pressures are expected to exceed 550 kPa at the log cabin building. A pressure reducing valve may be required on the domestic service to this building to comply with the Ontario Building Code.

Section 6 – CONCLUSIONS/RECOMMENDATIONS

The proposed watermain layout for the 7015-7200 Leslie Street Development can achieve hydraulic requirements as prescribed by the City of Markham watermain design criteria as summarized below.

- The service pressures from the proposed watermain layout are expected to range between 350 kPa to 561 kPa (50.8 psi to 81.4 psi). Pressures are expected to be lower during peak hour and higher during minimum hour than indicated in the modeling.
- The available fire flow meets or exceeds the minimum fire flow demands utilized for this assessment at the minimum pressure of 140 kPa based on the proposed watermain configuration and assumptions made within this report but must be confirmed when additional building information becomes available.
- The modelling indicates that the City's minimum fire flow requirement of 117 L/s (7,000 L/min) will not be met at the west end of Waterloo Court cul-de-sac. This is an existing condition and the addition of the proposed development does not have any significant impact on the available fire flow at this location (i.e. 86 L/s existing vs 85 L/s post development).
- The modeling indicates that pressures are expected to exceed 550 kPa (80 psi) at the log cabin building. A pressure reducing valve may be required on the domestic service to this building to comply with the Ontario Building Code.
- The FUS criteria summarized in Table 5 and Appendix A, including all assumptions and building configurations, must be reviewed and confirmed by the designer(s), architect and mechanical consultant when additional information becomes available to ensure the criteria used to calculate the fire flows within this report are still valid prior to implementation and construction.
- Confirmation and/or changes to the criteria should also be provided to and reviewed with MES prior to the finalization of the detailed design drawings and construction of the watermain system. Final design parameters are to be provided to MES prior to construction for further review to confirm that the actual (final) site conditions and building design(s) reflect those modeled by MES within this report.
- The hydrant tests used for the boundary conditions provides a snapshot of the system performance and does not capture the system variation as accurately as boundary information from a calibrated model or system monitoring. The City of Markham must confirm that the results presented in this report are in keeping with the pressures currently measured in the area.
- This report, including all modeling assumptions used, is to be submitted to and reviewed by the water operating authority (municipality) to confirm that the modeling parameters used are acceptable to the operating authority and/or confirm if modified domestic or fire flow requirements are required or should be implemented for this particular development.

Appendix A

Demands

Markham Design Criteria

Engineering Design Criteria, June 2013 Revision 2 (unless otherwise stated)

Equivalent Population by Area

Type of Development	Equivalent Population Density *(Person/Hectare)*
Schools/Instututional	60
Light Industrial Areas	70
Offices	150
Commercial Retail	100
Heavy Industrial Areas	First Principles
Mixed Uses	330

Water Design Factors

Average Daily Demand (m^3/capita/day)	0.365
Minimum Hour Demand P.F.	0.7
Maximum Daily Demand P.F.	
Residential	2
Non-Residential	1.4
Maximum Hourly Demand P.F.	
Residential (p.m.)	*4.5*
Non-Residential (a.m.)	*2.5*

Coefficient of Roughness

Size of Pipe (mm Dia.)	Coefficient of Roughness (C)
150	100
200-250	110
300-600	120
Over 600	130

Minimum Pipe Size

Type of Development	Size of Pipe (mm Dia.)
Residential	150
Commercial/Industrial/Community	300

Working Pressures

Parameter	Pressure
Normal Condition	
Minimum Max Hour Pressure	300 kPa (44 psi)
Maximum (Building Code)	550 kPa (80 psi)
Maximum recommended	650 kPa (95 psi)
Fire Flow Conditions	
Minimum Pressure	140 kPa (20 psi)

Water Demands
7015-1720 Leslie Street Development
August 2022

Municipal Engineering Solutions

Proposed Development

Node	Description	Elevation			Equivalent Population		Demands			
			Mixed Use	Mixed Use	Total Population	Total Population	Avg Day	Min Hour	Max Day	Peak Hour
		(m)	*(sq.m)*	*(site Ha)*	*(Residential)*	*(Non-Residential)*	*(L/s)*	*(L/s)*	*(L/s)*	*(L/s)*
J-13	National Center	170.00	*5163.0*	-	170	0	0.72	0.50	1.44	3.23
J-17	Place of Worship + Welcome Center	178.00	-	2.790	0	167	0.71	0.49	0.99	1.76
J-8	Log Cabin + Visitor Center	156.46	-	1.430	0	86	0.36	0.25	0.51	0.91
		TOTAL	**5163**	**4.220**	**170**	**253**	**1.79**	**1.24**	**2.94**	**5.90**

National Center - 330 persons/sq.m floor area
Place of Worship and Log Cabin - 60 persons/Ha

Calculations are based on "Water Supply for Public Fire Protection Guide" by Fire Underwriters Survey Dated 2020

Municipal Engineering Solutions

FUS CALCULATION

Project:	7015-7200 Leslie Street Development	**Building Type/Block #**	National Center (Institutional/Residential)
Project Number:	17002-148	**Firewalls/Sprinkler:**	Sprinklered
Project Location:	City of Markham	**Number of Units/Unit #'s**	
Date:	August 2022		

1.0 FUS Formula

$$RFF = 220C\sqrt{A}$$

where: RFF = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the Total Effective Floor Area in square metres (excluding basements at least 50% below grade) [a]

NBC Occupancy	Group C	
Type of Construction [b]	Noncombustible Construction (Type II)	
Footprint area	2775.0	sq. metres
C =	0.8	
A =	5163.0	Total Effective Area [a]
F =	**13000**	**L/min** (rounded)

2.0 Occupancy Adjustment

Type of Occupancy [c]	Limited Combustible	
Hazard Allowance	-0.15	
	-1950	L/min
Adjusted Fire Flow	**11050**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	YES	30%	40%
Standard Water Supply	YES	10%	
Fully Supervised system	NO	0%	

Sprinkler Credit **4420 L/min**

4.0 Exposure Adjustment

Construction Type of the Exposed Building Face: Type II (unprotected openings)

North Side		Percent	Total*
Distance to Building (m)	over 30	0%	4%
Length (ft) by height in storeys	na		
South Side			
Distance to Building (m)	20.1 to 30	4%	
Length (ft) by height in storeys	over 100		
East Side			
Distance to Building (m)	over 30	0%	
Length (ft) by height in storeys	na		
West Side			
Distance to Building (m)	over 30	0%	
Length (ft) by height in storeys	na		

*max 75%

Exposures Surcharge **440 L/min**

Total Required Fire Flow (rounded)	**7000**	**L/min**
	117	**L/sec**

a) For buildings with a construction coefficient from 1.0 to 1.5, consider 100% of all floor areas. For buildings with a construction coefficient below 1.0 (vertical openings are inadequately protected), consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to a maximum of eight. If the vertical openings and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors.

b) Wood Frame=1.5, Mass Timber= 0.8 to 1.5, Ordinary=1.0, Noncombustible=0.8, Fire-Resistive=0.6

c) Noncombustible=-25%, Limited Combustible=-15%, Combustible=0%, Free Burning=+15%, Rapid Burning=+25%

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Calculations are based on "Water Supply for Public Fire Protection Guide" by Fire Underwriters Survey Dated 2020

Municipal Engineering Solutions

FUS CALCULATION

Project:	7015-7200 Leslie Street Development	**Building Type/Block #**	Place of Worship
Project Number:	17002-148	**Firewalls/Sprinkler:**	Sprinklered
Project Location:	City of Markham	**Number of Units/Unit #'s**	
Date:	August 2022		

1.0 FUS Formula

$$RFF = 220C\sqrt{A}$$

where: RFF = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the Total Effective Floor Area in square metres (excluding basements at least 50% below grade) [a]

NBC Occupancy	Group A	
Type of Construction [b]	Wood Frame Construction	(Type V)
Footprint area	971.0	sq. metres
Storeys	1	
C =	1.5	
A =	971.0	Total Effective Area [a]
F =	**10000**	**L/min** (rounded)

2.0 Occupancy Adjustment

Type of Occupancy [c]	Combustible	
Hazard Allowance	0	
	0	L/min
Adjusted Fire Flow	**10000**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	YES	30%	40%
Standard Water Supply	YES	10%	
Fully Supervised system	NO	0%	

Sprinkler Credit **4000 L/min**

4.0 Exposure Adjustment

Construction Type of the Exposed Building Face: Type V (unprotected openings)

		Percent	Total*
North Side			
Distance to Building (m)	over 30	0%	10%
Length (ft) by height in storeys	na		
South Side			
Distance to Building (m)	over 30	0%	
Length (ft) by height in storeys	na		
East Side			
Distance to Building (m)	over 30	0%	
Length (ft) by height in storeys	na		
West Side			
Distance to Building (m)	20.1 to 30	10%	
Length (ft) by height in storeys	na		

*max 75%

Exposures Surcharge **1000 L/min**

Total Required Fire Flow	**7000**	**L/min**
(rounded)	**117**	**L/sec**

a) For buildings with a construction coefficient from 1.0 to 1.5, consider 100% of all floor areas. For buildings with a construction coefficient below 1.0 (vertical openings are inadequately protected), consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to a maximum of eight. If the vertical openings and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors.

b) Wood Frame=1.5, Mass Timber= 0.8 to 1.5, Ordinary=1.0, Noncombustible=0.8, Fire-Resistive=0.6

c) Noncombustible=-25%, Limited Combustible=-15%, Combustible=0%, Free Burning=+15%, Rapid Burning=+25%

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Calculations are based on "Water Supply for Public Fire Protection Guide" by Fire Underwriters Survey Dated 2020

Municipal Engineering Solutions

FUS CALCULATION

Project:	7015-7200 Leslie Street Development	**Building Type/Block #**	Welcome Center/Washrooms
Project Number:	17002-148	**Firewalls/Sprinkler:**	None
Project Location:	City of Markham	**Number of Units/Unit #'s**	
Date:	August 2022		

1.0 FUS Formula

$$RFF = 220C\sqrt{A}$$

where: RFF = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the Total Effective Floor Area in square metres (excluding basements at least 50% below grade) [a]

NBC Occupancy	Group A	
Type of Construction [b]	Wood Frame Construction	(Type V)
Footprint area	446.0	sq. metres
Storeys	1	
C =	1.5	
A =	446.0	Total Effective Area [a]
F =	**7000**	**L/min** (rounded)

2.0 Occupancy Adjustment

Type of Occupancy [c]	Combustible	
Hazard Allowance	0	
	0	L/min
Adjusted Fire Flow	**7000**	**L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	0%	0%
Standard Water Supply	NO	0%	
Fully Supervised system	NO	0%	

Sprinkler Credit **0 L/min**

4.0 Exposure Adjustment

Construction Type of the Exposed Building Face: Type V (unprotected openings)

		Percent	Total*
North Side			
Distance to Building (m)	over 30	0%	10%
Length (ft) by height in storeys	na		
South Side			
Distance to Building (m)	over 30	0%	
Length (ft) by height in storeys	na		
East Side			
Distance to Building (m)	20.1 to 30	10%	
Length (ft) by height in storeys	na		
West Side			
Distance to Building (m)	over 30	0%	
Length (ft) by height in storeys	na		

*max 75%

Exposures Surcharge **700 L/min**

Total Required Fire Flow (rounded)	**8000 L/min**
	133 L/sec

a) For buildings with a construction coefficient from 1.0 to 1.5, consider 100% of all floor areas. For buildings with a construction coefficient below 1.0 (vertical openings are inadequately protected), consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to a maximum of eight. If the vertical openings and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors.

b) Wood Frame=1.5, Mass Timber= 0.8 to 1.5, Ordinary=1.0, Noncombustible=0.8, Fire-Resistive=0.6

c) Noncombustible=-25%, Limited Combustible=-15%, Combustible=0%, Free Burning=+15%, Rapid Burning=+25%

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Calculations are based on "Water Supply for Public Fire Protection Guide" by Fire Underwriters Survey Dated 2020

Municipal Engineering Solutions

FUS CALCULATION

Project:	7015-7200 Leslie Street Development	**Building Type/Block #**	Existing Log Cabin with Addition
Project Number:	17002-148	**Firewalls/Sprinkler:**	None
Project Location:	City of Markham	**Number of Units/Unit #'s**	
Date:	August 2022		

1.0 FUS Formula

$$RFF = 220C\sqrt{A}$$

where: RFF = required fire flow in litres per minute;
C = the Coefficient related to the type of construction; and
A = the Total Effective Floor Area in square metres (excluding basements at least 50% below grade) [a]

NBC Occupancy	Group A	
Type of Construction [b]	Wood Frame Construction	(Type V)
Footprint area	485.0	sq. metres
Storeys	1	
C =	1.5	
A =	485.0	Total Effective Area [a]
F =	**7000**	**L/min** (rounded)

2.0 Occupancy Adjustment

Type of Occupancy [c]	Combustible
Hazard Allowance	0
	0 L/min
Adjusted Fire Flow	**7000 L/min**

3.0 Sprinkler Adjustment

		Credit	Total
NFPA 13 sprinkler standard	NO	0%	0%
Standard Water Supply	NO	0%	
Fully Supervised system	NO	0%	

Sprinkler Credit **0 L/min**

4.0 Exposure Adjustment

Construction Type of the Exposed Building Face: Type V (unprotected openings)

		Percent	Total*
North Side			
Distance to Building (m)	over 30	0%	0%
Length (ft) by height in storeys	na		
South Side			
Distance to Building (m)	over 30	0%	
Length (ft) by height in storeys	na		
East Side			
Distance to Building (m)	over 30	0%	
Length (ft) by height in storeys	na		
West Side			
Distance to Building (m)	over 30	0%	
Length (ft) by height in storeys	na		

*max 75%

Exposures Surcharge **0 L/min**

Total Required Fire Flow (rounded)	**7000 L/min**
	117 L/sec

a) For buildings with a construction coefficient from 1.0 to 1.5, consider 100% of all floor areas. For buildings with a construction coefficient below 1.0 (vertical openings are inadequately protected), consider the two largest adjoining floors plus 50% of each of any floors immediately above them up to a maximum of eight. If the vertical openings and exterior vertical communications are properly protected, consider only the area of the largest floor plus 25% of each of the two immediately adjoining floors.

b) Wood Frame=1.5, Mass Timber= 0.8 to 1.5, Ordinary=1.0, Noncombustible=0.8, Fire-Resistive=0.6

c) Noncombustible=-25%, Limited Combustible=-15%, Combustible=0%, Free Burning=+15%, Rapid Burning=+25%

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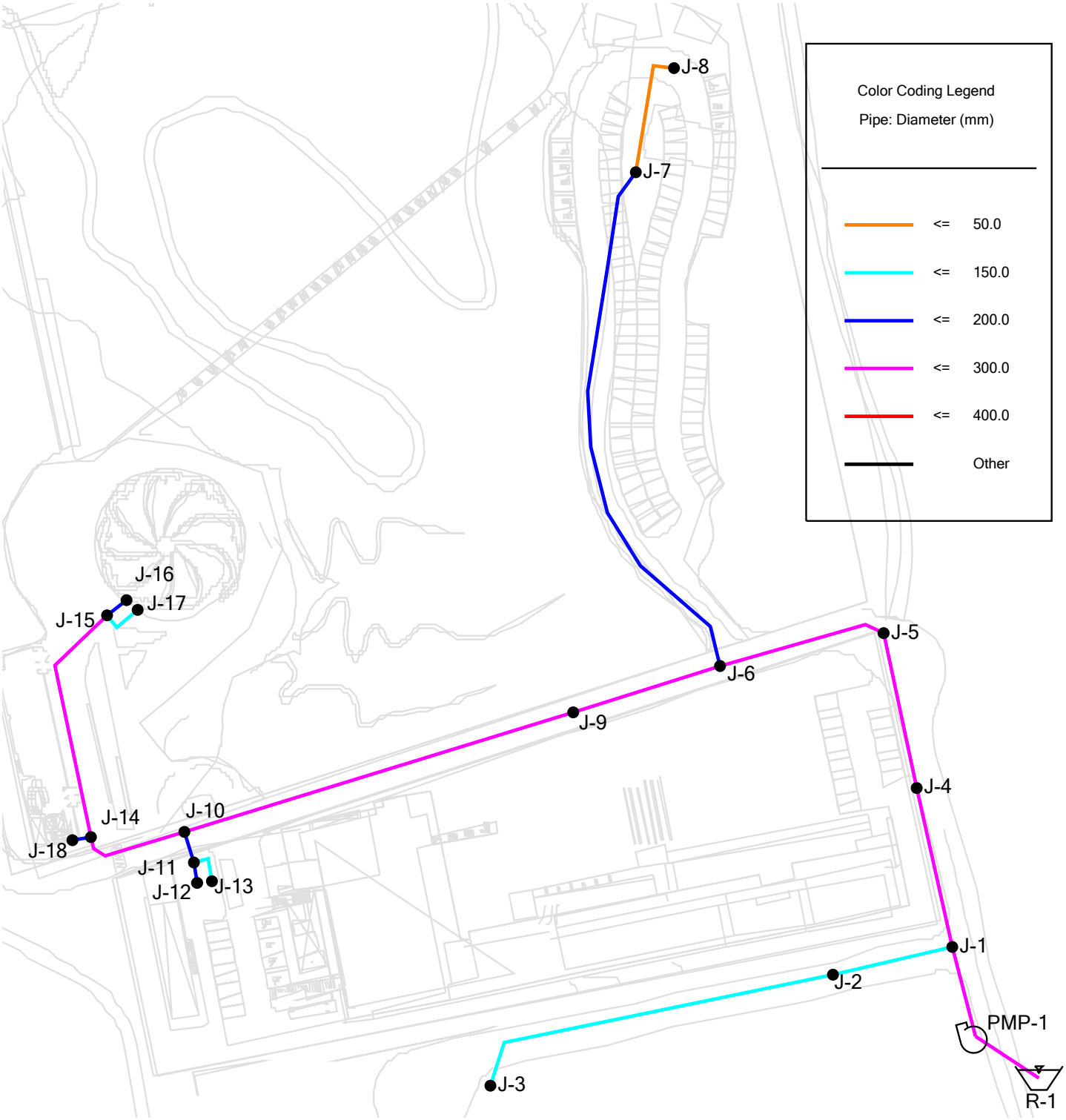
Pipe and Node IDs



Appendix B

Boundary Information

HYDRANT INSPECTION & FLOW REPORT

SUGGESTED NFPA RATING	
BLUE	CLASS AA
4460 gpm @ 20 psi (138 kPa)	

ONTARIO CLEAN WATER AGENCY
AGENCE ONTARIENNE DES EAUX

Prepared By: The Ontario Clean Water Agency
Prepared For: SCS Consulting
Residual Hyd Andrew Cruickshank
Flow Hyd(s) Kelly Smith, Kurt Kahler

Date: 3-Aug-22 Time: 8:33 AM

HYDRANT DESCRIPTION

Hydrant ID:	457A	Side of Street:	N/W	Make:	Canada Valve	Open Dir:	Left
Address:	2 Waterloo Court			Model:	Century	Latitude:	
Location:	Markham ON			Year:	NA	Longitude:	

GENERAL INSPECTION

OK - Good Condition *FR - Future Repair Required* *N/A - Not Applicable* *CF - Component Failure*

Upper Section	OK	FR	N/A	CF
Bonnet	☐	☐	☑	☐
Operating Nut	☐	☐	☑	☐
Gaskets / Bolts	☐	☐	☑	☐
O-Ring(s)	☐	☐	☑	☐

Mid Section	OK	FR	N/A	CF
Port Height	☐	☐	☑	☐
Caps / Nozzles	☐	☐	☑	☐
Chains	☐	☐	☑	☐
Traffic Flange	☐	☐	☑	☐

General	OK	FR	N/A	CF
Accessibility	☐	☐	☑	☐
Position / Height	☐	☐	☑	☐
Paint Cond	☐	☐	☑	☐
Drain Ports	☐	☐	☑	☐

Hydrostatic Leak Testing		
Hydrant Closed	Above Grade Leak	N/A
	Subsurface Leak	N/A
Hydrant Open	Above Grade Leak	N/A
	Subsurface Leak	N/A

Maintenance	
Lubricate Operating Nut	N/A
Lubricate & Clean Nozzle Threads	N/A
Lubricate & Clean Cap Threads	N/A
Water Removed (if non-draining)	N/A

Auxiliary / Secondary Valve	
Located / Accessible	N/A
Operated/Exercised	N/A
Number of Turns	N/A
Open Direction	

Comments:

Auxiliary Valve Location:

FLUSHING

*If hydrants are being flow tested, inspections and flushing are completed prior to testing

Hydrant Operated	Clear Flow Obtained	Cl2 Residual	Time Flushed	Flow	Total Flow	Dechlorinated
Yes - Easily Operated	Yes	N/A	5 minutes	2389 gal	11943 gal	Yes

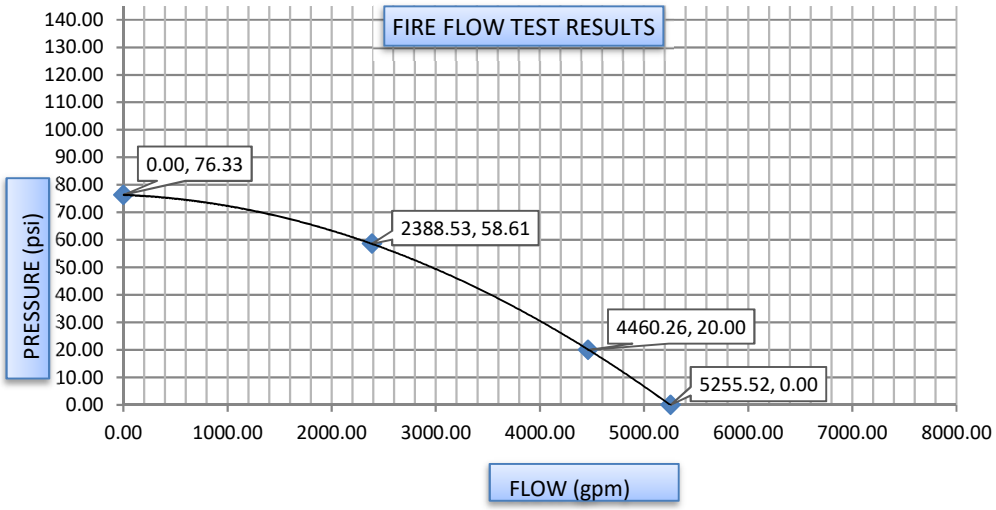
Comments: **STATIC AFTER FLOW TEST WAS PERFORMED 74.56 PSI**

FLOW TESTING

*Flow testing results may be from previous year(s). Note date & time

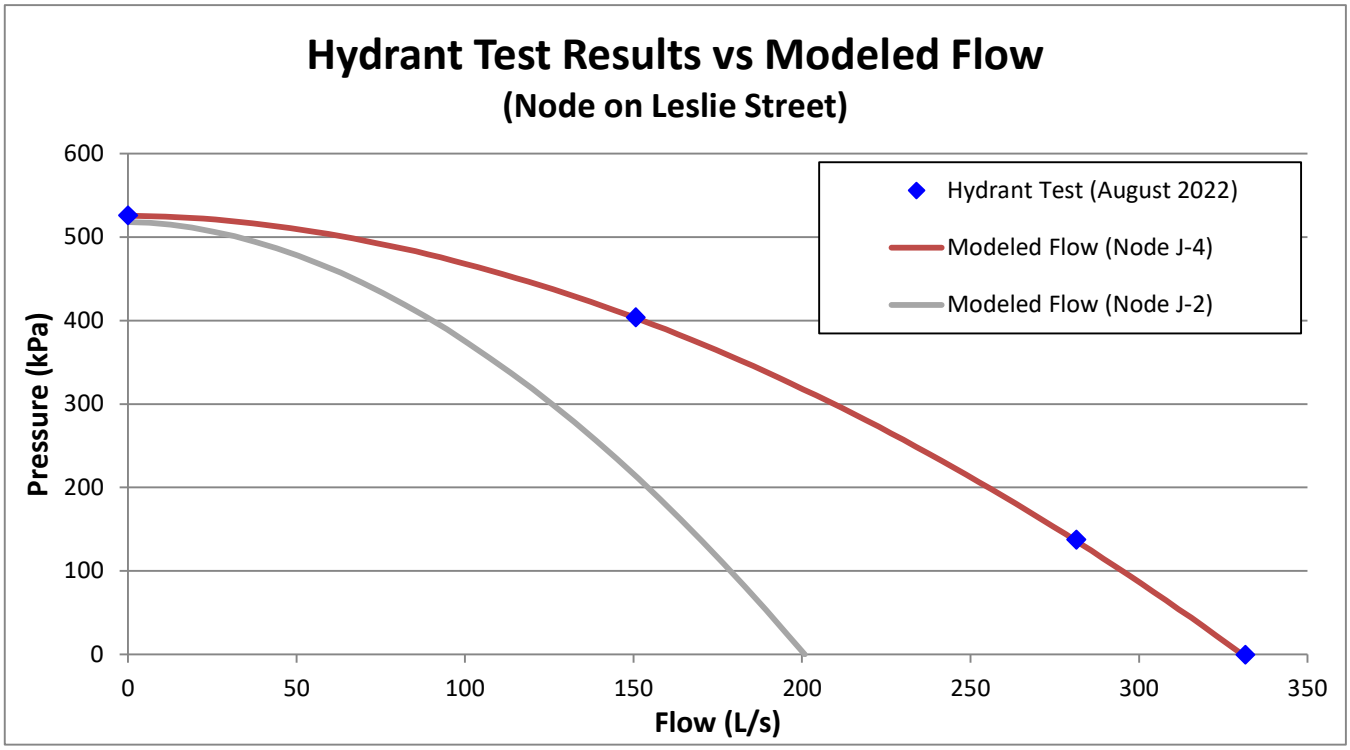
Date: 3-Aug-22 Time: 8:33 AM

Flow Hydrant								Test Hydrant		
ID	Flow Device Used	Size	Coefficient	Time Flushed	Flow	Total Flow	Pitot	ID	Static	Residual
379A	Pollard Diffuser	2.5"	0.832	5.0 minutes	776 gal	3878 gal	25 psi	457A	76.33	58.61
379A	Pollard Diffuser	2.5"	0.832	5.0 minutes	776 gal	3878 gal	25 psi			
455A	Pollard Diffuser	2.5"	0.832	5.0 minutes	491 gal	2453 gal	10 psi			
455A	Pollard Diffuser	2.5"	0.832	5.0 minutes	347 gal	1734 gal	5 psi			



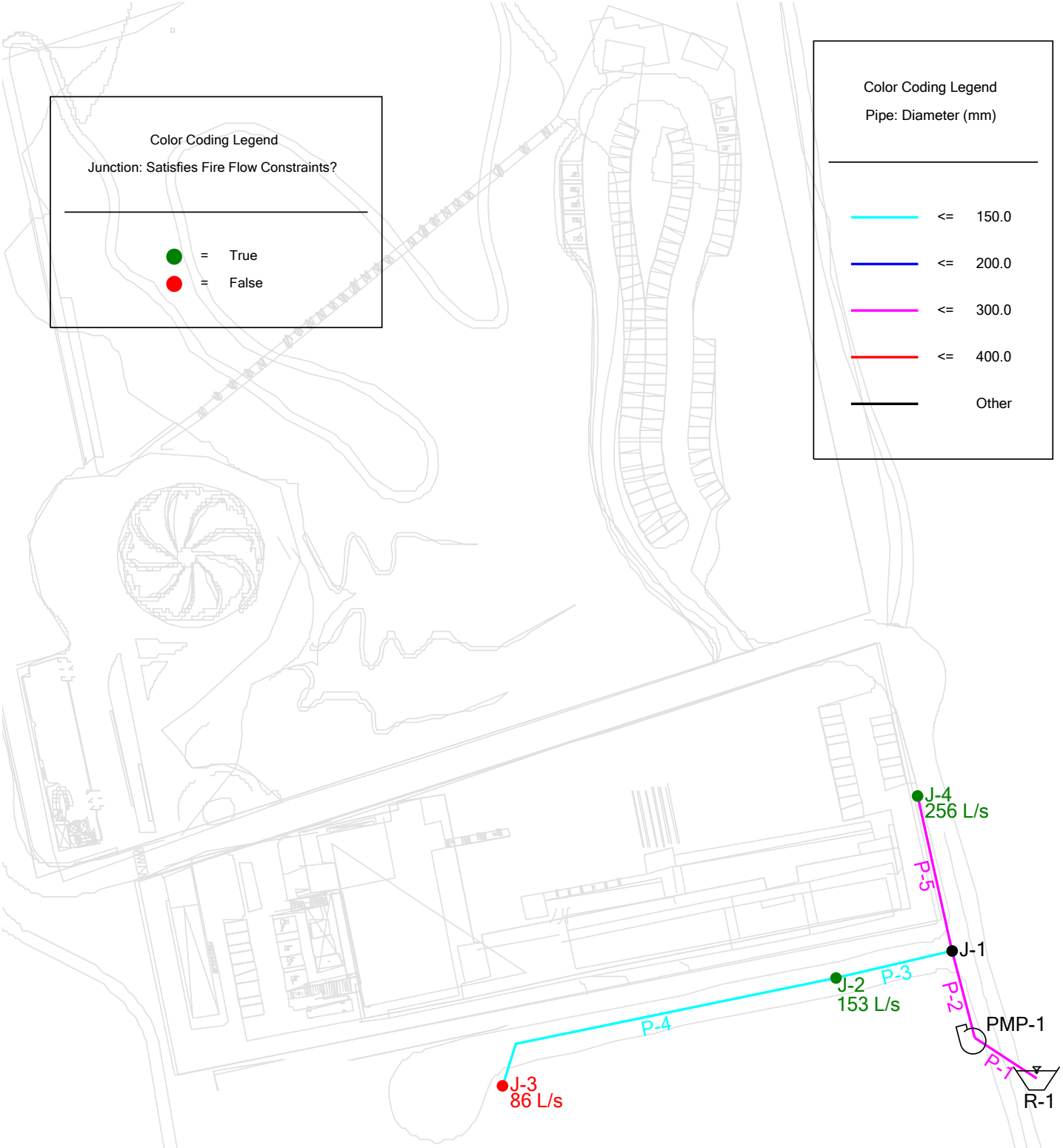
Calculated Results	
Calculated Flow @ 20 psi	4460 gpm
Calculated Flow @ 0 psi	5256 gpm
Pressure Drop	23.21%

Comments:



	Static Pressure	Residual Pressure	Test Flow	Theoretical Flow at 140 kPa
	(kPa)	(kPa)	(L/s)	(L/s)
Hydrant Test	526.3	404.1	150.7	281.4
Model	525.6	406.4	148.5	278.3

Existing System
Available Fire Flow



Existing Conditions (Available Fire Flow)
7015-1720 Leslie Street Development
August 2022

Municipal Engineering Solutions

Fire Flow Table						
ID	Fire Flow Demand (L/s)	Total Demand (L/s)	Total Available Flow (L/s)	Available Fire Flow (L/s)	Fire Flow Met?	Notes
J-2	117.00	117.00	152.58	152.58	TRUE	Existing Hydrant
J-3	117.00	117.00	85.53	85.53	FALSE	Existing Hydrant
J-4	117.00	117.00	256.29	256.29	TRUE	Existing Hydrant

MIN	**85.53**
MAX	**256.29**

Appendix C

Model Results

Results
7015-1720 Leslie Street Development
August 2022

Municipal Engineering Solutions

Average Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(kPa)*
J-1	0.00	160.20	213.83	524.84
J-2	0.00	160.91	213.83	517.89
J-3	0.00	167.70	213.83	451.44
J-4	0.00	160.13	213.83	525.52
J-5	0.00	159.83	213.83	528.46
J-6	0.00	161.47	213.83	512.40
J-7	0.00	156.97	213.83	556.44
J-8	0.36	156.46	213.77	560.85
J-9	0.00	163.80	213.83	489.60
J-10	0.00	170.54	213.83	423.63
J-11	0.00	170.00	213.83	428.92
J-12	0.00	170.00	213.83	428.92
J-13	0.72	170.00	213.83	428.91
J-14	0.00	174.33	213.83	386.54
J-15	0.00	178.00	213.83	350.62
J-16	0.00	178.00	213.83	350.62
J-17	0.71	178.00	213.83	350.62
J-18	0.00	176.00	213.83	370.20

MIN		**156.46**		**350.62**
MAX		**178.00**		**560.85**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(L/s)*	*(m/s)*
P-1	R-1	PMP-1	18.21	300.0	120.0	1.79	0.03
P-2	PMP-1	J-1	22.18	300.0	120.0	1.79	0.03
P-3	J-1	J-2	29.39	150.0	100.0	0.00	0.00
P-4	J-2	J-3	91.46	150.0	100.0	0.00	0.00
P-5	J-1	J-4	39.13	300.0	120.0	1.79	0.03
P-6	J-4	J-5	38.02	300.0	120.0	1.79	0.03
P-7	J-5	J-6	41.08	300.0	120.0	1.79	0.03
P-8	J-6	J-7	131.21	200.0	110.0	0.36	0.01
P-9	J-7	J-8	30.84	50.0	100.0	0.36	0.18
P-10	J-6	J-9	36.98	300.0	120.0	1.43	0.02
P-11	J-9	J-10	97.67	300.0	120.0	1.43	0.02
P-12	J-10	J-11	7.72	200.0	110.0	0.72	0.02
P-13	J-11	J-12	4.93	200.0	110.0	0.00	0.00
P-14	J-11	J-13	8.97	150.0	100.0	0.72	0.04
P-15	J-10	J-14	25.95	300.0	120.0	0.71	0.01
P-16	J-14	J-15	59.46	300.0	120.0	0.71	0.01
P-17	J-15	J-16	5.91	200.0	110.0	0.00	0.00
P-18	J-15	J-17	10.28	150.0	100.0	0.71	0.04
P-19	J-14	J-18	4.48	200.0	110.0	0.00	0.00

Minimum Hour

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(kPa)*
J-1	0.00	160.20	213.83	524.85
J-2	0.00	160.91	213.83	517.90
J-3	0.00	167.70	213.83	451.45
J-4	0.00	160.13	213.83	525.54
J-5	0.00	159.83	213.83	528.47
J-6	0.00	161.47	213.83	512.42
J-7	0.00	156.97	213.83	556.46
J-8	0.25	156.46	213.80	561.16
J-9	0.00	163.80	213.83	489.62
J-10	0.00	170.54	213.83	423.65
J-11	0.00	170.00	213.83	428.94
J-12	0.00	170.00	213.83	428.94
J-13	0.50	170.00	213.83	428.94
J-14	0.00	174.33	213.83	386.56
J-15	0.00	178.00	213.83	350.64
J-16	0.00	178.00	213.83	350.64
J-17	0.49	178.00	213.83	350.64
J-18	0.00	176.00	213.83	370.22

MIN		**156.46**		**350.64**
MAX		**178.00**		**561.16**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(L/s)*	*(m/s)*
P-1	R-1	PMP-1	18.21	300.0	120.0	1.24	0.02
P-2	PMP-1	J-1	22.18	300.0	120.0	1.24	0.02
P-3	J-1	J-2	29.39	150.0	100.0	0.00	0.00
P-4	J-2	J-3	91.46	150.0	100.0	0.00	0.00
P-5	J-1	J-4	39.13	300.0	120.0	1.24	0.02
P-6	J-4	J-5	38.02	300.0	120.0	1.24	0.02
P-7	J-5	J-6	41.08	300.0	120.0	1.24	0.02
P-8	J-6	J-7	131.21	200.0	110.0	0.25	0.01
P-9	J-7	J-8	30.84	50.0	100.0	0.25	0.13
P-10	J-6	J-9	36.98	300.0	120.0	0.99	0.01
P-11	J-9	J-10	97.67	300.0	120.0	0.99	0.01
P-12	J-10	J-11	7.72	200.0	110.0	0.50	0.02
P-13	J-11	J-12	4.93	200.0	110.0	0.00	0.00
P-14	J-11	J-13	8.97	150.0	100.0	0.50	0.03
P-15	J-10	J-14	25.95	300.0	120.0	0.49	0.01
P-16	J-14	J-15	59.46	300.0	120.0	0.49	0.01
P-17	J-15	J-16	5.91	200.0	110.0	0.00	0.00
P-18	J-15	J-17	10.28	150.0	100.0	0.49	0.03
P-19	J-14	J-18	4.48	200.0	110.0	0.00	0.00

Municipal Engineering Solutions

Maximum Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(kPa)*
J-1	0.00	160.20	213.82	524.79
J-2	0.00	160.91	213.82	517.84
J-3	0.00	167.70	213.82	451.39
J-4	0.00	160.13	213.82	525.47
J-5	0.00	159.83	213.82	528.40
J-6	0.00	161.47	213.82	512.35
J-7	0.00	156.97	213.82	556.38
J-8	0.51	156.46	213.71	560.27
J-9	0.00	163.80	213.82	489.54
J-10	0.00	170.54	213.82	423.57
J-11	0.00	170.00	213.82	428.85
J-12	0.00	170.00	213.82	428.85
J-13	1.44	170.00	213.82	428.84
J-14	0.00	174.33	213.82	386.48
J-15	0.00	178.00	213.82	350.56
J-16	0.00	178.00	213.82	350.56
J-17	0.99	178.00	213.82	350.55
J-18	0.00	176.00	213.82	370.13

MIN		**156.46**		**350.55**
MAX		**178.00**		**560.27**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(L/s)*	*(m/s)*
P-1	R-1	PMP-1	18.21	300.0	120.0	2.94	0.04
P-2	PMP-1	J-1	22.18	300.0	120.0	2.94	0.04
P-3	J-1	J-2	29.39	150.0	100.0	0.00	0.00
P-4	J-2	J-3	91.46	150.0	100.0	0.00	0.00
P-5	J-1	J-4	39.13	300.0	120.0	2.94	0.04
P-6	J-4	J-5	38.02	300.0	120.0	2.94	0.04
P-7	J-5	J-6	41.08	300.0	120.0	2.94	0.04
P-8	J-6	J-7	131.21	200.0	110.0	0.51	0.02
P-9	J-7	J-8	30.84	50.0	100.0	0.51	0.26
P-10	J-6	J-9	36.98	300.0	120.0	2.43	0.03
P-11	J-9	J-10	97.67	300.0	120.0	2.43	0.03
P-12	J-10	J-11	7.72	200.0	110.0	1.44	0.05
P-13	J-11	J-12	4.93	200.0	110.0	0.00	0.00
P-14	J-11	J-13	8.97	150.0	100.0	1.44	0.08
P-15	J-10	J-14	25.95	300.0	120.0	0.99	0.01
P-16	J-14	J-15	59.46	300.0	120.0	0.99	0.01
P-17	J-15	J-16	5.91	200.0	110.0	0.00	0.00
P-18	J-15	J-17	10.28	150.0	100.0	0.99	0.06
P-19	J-14	J-18	4.48	200.0	110.0	0.00	0.00

Peak Hour

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(kPa)*
J-1	0.00	160.20	213.80	524.58
J-2	0.00	160.91	213.80	517.63
J-3	0.00	167.70	213.80	451.18
J-4	0.00	160.13	213.80	525.25
J-5	0.00	159.83	213.80	528.17
J-6	0.00	161.47	213.80	512.11
J-7	0.00	156.97	213.79	556.13
J-8	0.91	156.46	213.46	557.89
J-9	0.00	163.80	213.79	489.29
J-10	0.00	170.54	213.79	423.30
J-11	0.00	170.00	213.79	428.58
J-12	0.00	170.00	213.79	428.58
J-13	3.23	170.00	213.79	428.53
J-14	0.00	174.33	213.79	386.21
J-15	0.00	178.00	213.79	350.29
J-16	0.00	178.00	213.79	350.29
J-17	1.76	178.00	213.79	350.27
J-18	0.00	176.00	213.79	369.86

MIN		**156.46**		**350.27**
MAX		**178.00**		**557.89**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(L/s)*	*(m/s)*
P-1	R-1	PMP-1	18.21	300.0	120.0	5.90	0.08
P-2	PMP-1	J-1	22.18	300.0	120.0	5.90	0.08
P-3	J-1	J-2	29.39	150.0	100.0	0.00	0.00
P-4	J-2	J-3	91.46	150.0	100.0	0.00	0.00
P-5	J-1	J-4	39.13	300.0	120.0	5.90	0.08
P-6	J-4	J-5	38.02	300.0	120.0	5.90	0.08
P-7	J-5	J-6	41.08	300.0	120.0	5.90	0.08
P-8	J-6	J-7	131.21	200.0	110.0	0.91	0.03
P-9	J-7	J-8	30.84	50.0	100.0	0.91	0.46
P-10	J-6	J-9	36.98	300.0	120.0	4.99	0.07
P-11	J-9	J-10	97.67	300.0	120.0	4.99	0.07
P-12	J-10	J-11	7.72	200.0	110.0	3.23	0.10
P-13	J-11	J-12	4.93	200.0	110.0	0.00	0.00
P-14	J-11	J-13	8.97	150.0	100.0	3.23	0.18
P-15	J-10	J-14	25.95	300.0	120.0	1.76	0.02
P-16	J-14	J-15	59.46	300.0	120.0	1.76	0.02
P-17	J-15	J-16	5.91	200.0	110.0	0.00	0.00
P-18	J-15	J-17	10.28	150.0	100.0	1.76	0.10
P-19	J-14	J-18	4.48	200.0	110.0	0.00	0.00

Maximum Day Plus Fire Flow

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(kPa)*
J-1	0.00	160.20	206.03	448.55
J-2	0.00	160.91	206.03	441.60
J-3	0.00	167.70	206.03	375.15
J-4	0.00	160.13	205.62	445.24
J-5	0.00	159.83	205.23	444.29
J-6	0.00	161.47	204.80	424.05
J-7	117.00	156.97	193.63	358.83
J-8	0.51	156.46	193.52	362.72
J-9	0.00	163.80	204.80	401.24
J-10	0.00	170.54	204.80	335.27
J-11	0.00	170.00	204.80	340.55
J-12	0.00	170.00	204.80	340.55
J-13	1.44	170.00	204.80	340.54
J-14	0.00	174.33	204.80	298.18
J-15	0.00	178.00	204.80	262.26
J-16	0.00	178.00	204.80	262.26
J-17	0.99	178.00	204.80	262.25
J-18	0.00	176.00	204.80	281.83

MIN		**156.46**		**262.25**
MAX		**178.00**		**448.55**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(L/s)*	*(m/s)*
P-1	R-1	PMP-1	18.21	300.0	120.0	119.94	1.70
P-2	PMP-1	J-1	22.18	300.0	120.0	119.94	1.70
P-3	J-1	J-2	29.39	150.0	100.0	0.00	0.00
P-4	J-2	J-3	91.46	150.0	100.0	0.00	0.00
P-5	J-1	J-4	39.13	300.0	120.0	119.94	1.70
P-6	J-4	J-5	38.02	300.0	120.0	119.94	1.70
P-7	J-5	J-6	41.08	300.0	120.0	119.94	1.70
P-8	J-6	J-7	131.21	200.0	110.0	117.51	3.74
P-9	J-7	J-8	30.84	50.0	100.0	0.51	0.26
P-10	J-6	J-9	36.98	300.0	120.0	2.43	0.03
P-11	J-9	J-10	97.67	300.0	120.0	2.43	0.03
P-12	J-10	J-11	7.72	200.0	110.0	1.44	0.05
P-13	J-11	J-12	4.93	200.0	110.0	0.00	0.00
P-14	J-11	J-13	8.97	150.0	100.0	1.44	0.08
P-15	J-10	J-14	25.95	300.0	120.0	0.99	0.01
P-16	J-14	J-15	59.46	300.0	120.0	0.99	0.01
P-17	J-15	J-16	5.91	200.0	110.0	0.00	0.00
P-18	J-15	J-17	10.28	150.0	100.0	0.99	0.06
P-19	J-14	J-18	4.48	200.0	110.0	0.00	0.00

Fire Flow Requirement of 117 L/s placed at Node J-7

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Maximum Day Plus Fire Flow

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(kPa)*
J-1	0.00	160.20	204.00	428.63
J-2	0.00	160.91	204.00	421.68
J-3	0.00	167.70	204.00	355.23
J-4	0.00	160.13	203.48	424.28
J-5	0.00	159.83	202.98	422.32
J-6	0.00	161.47	202.44	400.97
J-7	0.00	156.97	202.44	445.01
J-8	0.51	156.46	202.33	448.90
J-9	0.00	163.80	201.96	373.44
J-10	0.00	170.54	200.68	294.98
J-11	0.00	170.00	200.68	300.27
J-12	0.00	170.00	200.68	300.27
J-13	1.44	170.00	200.68	300.26
J-14	0.00	174.33	200.35	254.64
J-15	0.00	178.00	200.35	218.72
J-16	0.00	178.00	200.35	218.72
J-17	0.99	178.00	200.35	218.71
J-18	133.00	176.00	199.87	233.60

MIN		**156.46**		**218.71**
MAX		**178.00**		**448.90**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(L/s)*	*(m/s)*
P-1	R-1	PMP-1	18.21	300.0	120.0	135.94	1.92
P-2	PMP-1	J-1	22.18	300.0	120.0	135.94	1.92
P-3	J-1	J-2	29.39	150.0	100.0	0.00	0.00
P-4	J-2	J-3	91.46	150.0	100.0	0.00	0.00
P-5	J-1	J-4	39.13	300.0	120.0	135.94	1.92
P-6	J-4	J-5	38.02	300.0	120.0	135.94	1.92
P-7	J-5	J-6	41.08	300.0	120.0	135.94	1.92
P-8	J-6	J-7	131.21	200.0	110.0	0.51	0.02
P-9	J-7	J-8	30.84	50.0	100.0	0.51	0.26
P-10	J-6	J-9	36.98	300.0	120.0	135.43	1.92
P-11	J-9	J-10	97.67	300.0	120.0	135.43	1.92
P-12	J-10	J-11	7.72	200.0	110.0	1.44	0.05
P-13	J-11	J-12	4.93	200.0	110.0	0.00	0.00
P-14	J-11	J-13	8.97	150.0	100.0	1.44	0.08
P-15	J-10	J-14	25.95	300.0	120.0	133.99	1.90
P-16	J-14	J-15	59.46	300.0	120.0	0.99	0.01
P-17	J-15	J-16	5.91	200.0	110.0	0.00	0.00
P-18	J-15	J-17	10.28	150.0	100.0	0.99	0.06
P-19	J-14	J-18	4.48	200.0	110.0	133.00	4.23

Fire Flow Requirement of 133 L/s placed at Node J-18

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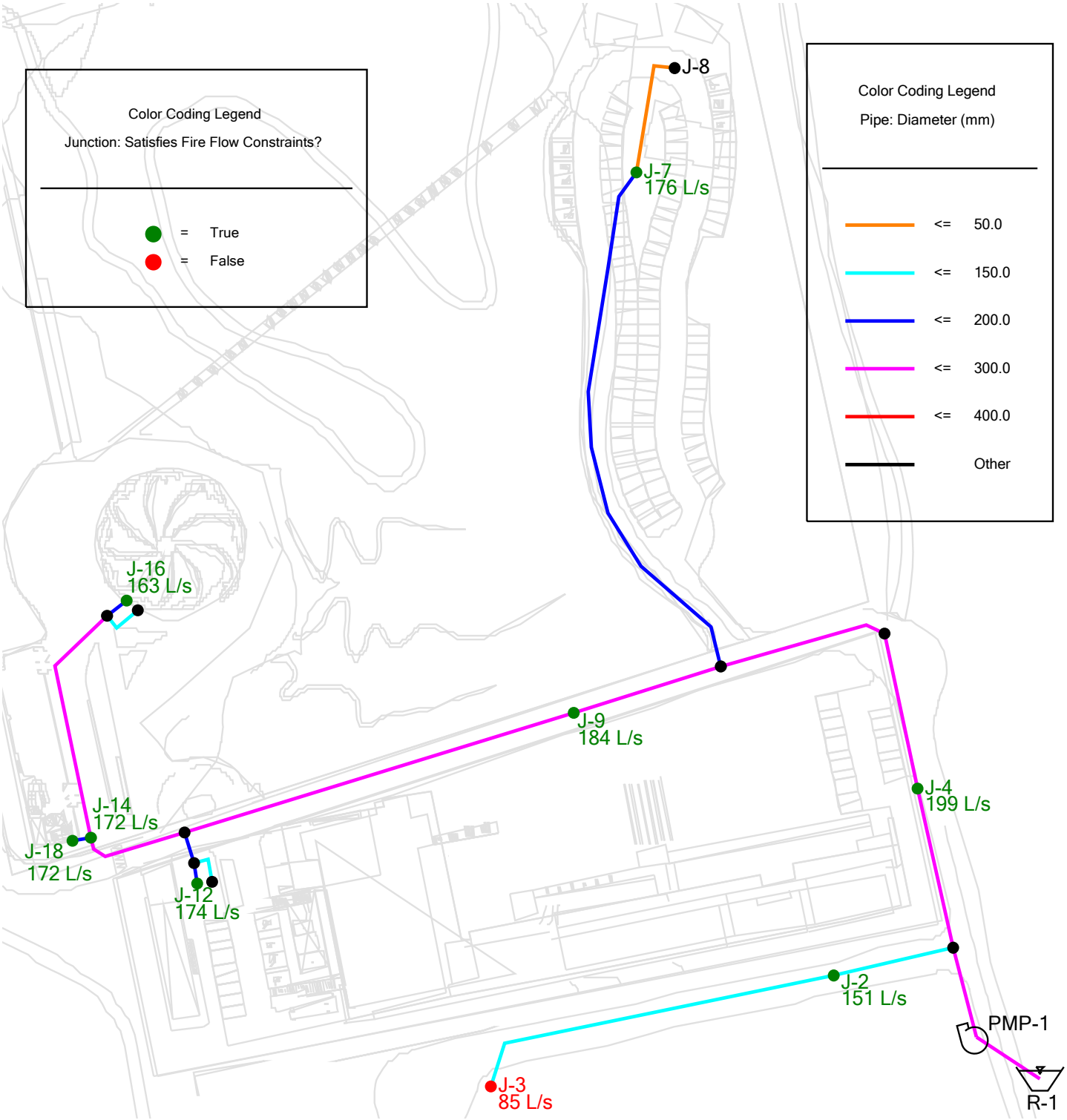
Fire Flow Table						
ID	Fire Flow Demand (L/s)	Total Demand (L/s)	Total Available Flow (L/s)	Available Fire Flow (L/s)	Fire Flow Met?	Notes
J-2	117.00	117.00	151.45	151.45	TRUE	
J-3	117.00	117.00	85.14	85.14	FALSE	Existing Condition
J-4	117.00	117.00	198.92	198.92	TRUE	
J-7	117.00	117.00	175.75	175.75	TRUE	
J-9	117.00	117.00	184.48	184.48	TRUE	
J-12	117.00	117.00	174.42	174.42	TRUE	
J-14	133.00	133.00	172.03	172.03	TRUE	
J-16	117.00	117.00	162.93	162.93	TRUE	
J-18	133.00	133.00	172.03	172.03	TRUE	

MIN	**162.93**
MAX	**198.92**

(Min/max excludes nodes J-2 and J-3 on Waterloo Court)

Scenario: Maximum Day
Available Fire Flow



Average Day							
Pump Table							
ID	Elevation *(m)*	Pump Definition	Pump Status	Hydraulic Grade (Suction) *(m)*	Hydraulic Grade (Discharge) *(m)*	Flow (Total) *(L/s)*	Pump Head *(m)*
PMP-1	160.13	Hydrant Test (Waterloo Ct)	On	160.13	213.83	1.79	53.70

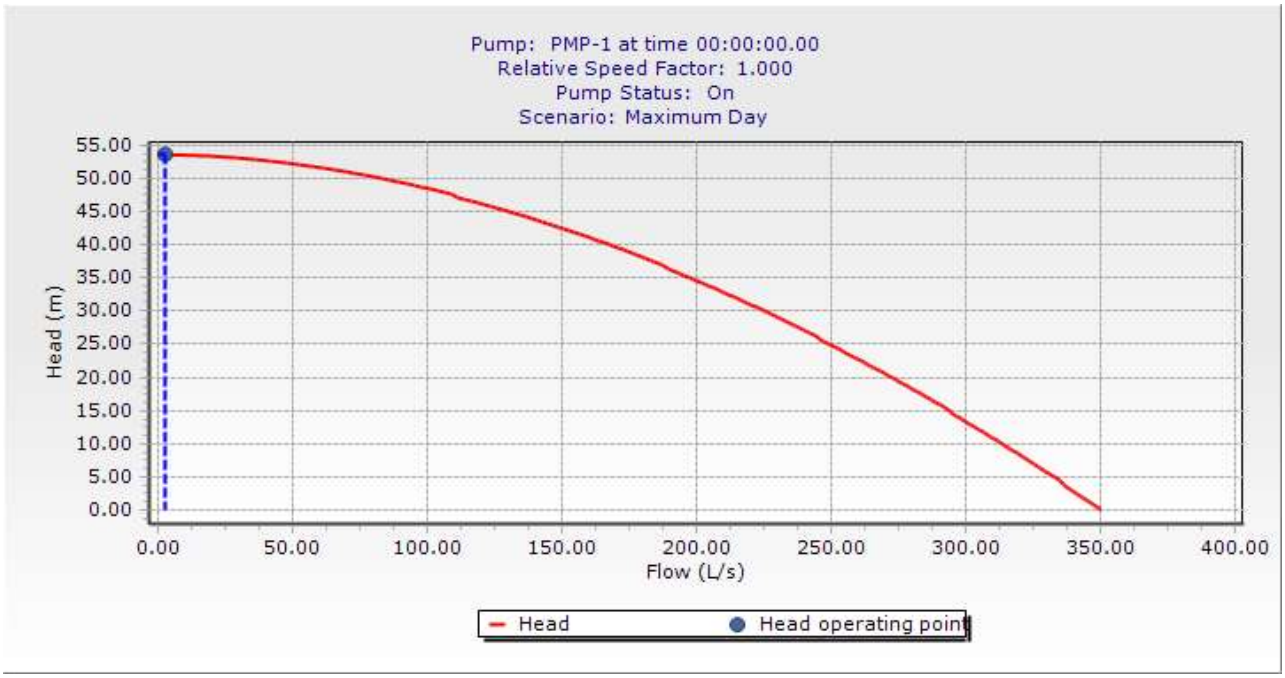
Minimum Hour							
Pump Table							
ID	Elevation *(m)*	Pump Definition	Pump Status	Hydraulic Grade (Suction) *(m)*	Hydraulic Grade (Discharge) *(m)*	Flow (Total) *(L/s)*	Pump Head *(m)*
PMP-1	160.13	Hydrant Test (Waterloo Ct)	On	160.13	213.83	1.24	53.70

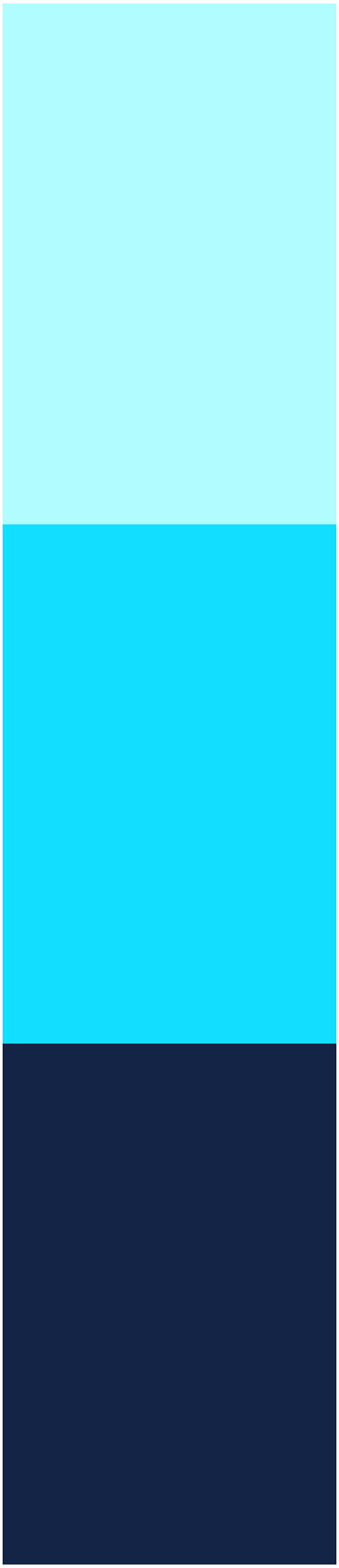
Maximum Day							
Pump Table							
ID	Elevation *(m)*	Pump Definition	Pump Status	Hydraulic Grade (Suction) *(m)*	Hydraulic Grade (Discharge) *(m)*	Flow (Total) *(L/s)*	Pump Head *(m)*
PMP-1	160.13	Hydrant Test (Waterloo Ct)	On	160.13	213.82	2.94	53.69

Peak Hour							
Pump Table							
ID	Elevation *(m)*	Pump Definition	Pump Status	Hydraulic Grade (Suction) *(m)*	Hydraulic Grade (Discharge) *(m)*	Flow (Total) *(L/s)*	Pump Head *(m)*
PMP-1	160.13	Hydrant Test (Waterloo Ct)	On	160.13	213.80	5.90	53.67

Maximum Day + Fire							
Pump Table							
ID	Elevation *(m)*	Pump Definition	Pump Status	Hydraulic Grade (Suction) *(m)*	Hydraulic Grade (Discharge) *(m)*	Flow (Total) *(L/s)*	Pump Head *(m)*
PMP-1	160.13	Hydrant Test (Waterloo Ct)	On	159.89	204.30	135.84	44.41

Fire Flow Requirement of 133 L/s placed at Node J-18





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