Bradford Highlands

Functional Servicing and Stormwater Management Report

November 2024

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Submission History

Submission	Date	In Support Of	Distributed To
1st (completed by another consultant)	October 2023	Draft Plan Approval	(unknown)
2nd	November 2024	Draft Plan Approval	Bradford West Gwillimbury, Lake Simcoe Region Conservation Authority, Bradford Highlands Joint Venture

1.0 Introduction

SCS Consulting Group Ltd. has been retained by Bradford Capital Joint Venture to prepare a Functional Servicing and Stormwater Management Report (FSSR) for a proposed development located at 23 Brownlee Drive in the Town of Bradford West Gwillimbury.

1.1 Purpose of the Functional Servicing and Stormwater Management Report

This FSSR has been prepared in support of a Plan of Subdivision for the proposed development. The Draft Plan of Subdivision is provided in **Appendix A**. The proposed development consists of the following land uses:

- low density residential;
- medium density residential;
- parks and walkways;
- school;
- SWM pond blocks; and,
- proposed roads.

The purpose of this report is to demonstrate that the development can be graded and serviced in accordance with the Town of Bradford West Gwillimbury, Lake Simcoe Region Conservation Authority (LSRCA), and the Ministry of Environment, Conservation and Parks (MECP) design criteria.

1.2 Study Area

The Draft Plan of Subdivision area is approximately 60 ha in size and is bound by the following as shown on **Figure 1.1**:

- Line 6 and existing residential development to the north;
- existing residential development (Bradford Capital Holdings Inc. Subdivision) to the east;
- Line 5, existing residential development and the Holland River North Canal to the south; and
- existing agricultural land to the west.

The study area extends on either side of Brownlee Drive and surrounds the existing residential properties on Brownlee Drive.

The existing subject land is currently comprised of the Bradford Highlands Golf Course and a rural residential property, accessible by Brownlee Drive, Line 5 to the South, and Line 6 to the North. The proposed development is located within the West Holland

Watershed in the Town of Bradford West Gwillimbury. The southern portion of the site exists within the Greenbelt area.

1.3 Background Information

In preparation of the servicing and stormwater management (SWM) strategies, the following design guidelines and standards were used:

- Ministry of Environment, Conservation and Parks (MECP) Municipal Stormwater Consolidated Linear Infrastructure Environmental Compliance Approval 116-S701 (July 27, 2022).
- Lake Simcoe Conservation Authority (LSRCA) Technical Guidelines for Stormwater Management Submissions (April 2022);
- Engineering Design Criteria Manual for the Town of Bradford West Gwillimbury (September 2015);
- Lake Simcoe Protection Plan (July 2009);
- Ministry of Environment (MOE) Stormwater Management Planning and Design Manual (March 2003); and,
- Ministry of Transportation (MTO) Drainage Management Manual (1997).

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

- Town of Bradford West Gwillimbury, Master Environmental Servicing Plan, Green Valley Community Plan, prepared by RJ Burnside, dated June 2009; and
- Stormwater Management Report, Bradford Capital Residential Subdivision, prepared by Sernas Associates, dated October 2014.

The servicing and SWM strategies are also based on the following approved Engineering Drawings obtained from the Town of Bradford West Gwillimbury, included in **Appendix B-1**.

- Bradford Capital Holdings Inc., Record drawings and design sheets, prepared by Urban Ecosystems Limited dated April 2014;
- Bradford East Developments Inc., Record drawings, prepared by Urban Ecosystems Limited dated January 2015;
- Islington Investments Limited, Record drawings of Brownlee Drive, prepared by Andrew Brodie Associates Inc. dated September 1984;6th Line Reconstruction, Record drawings prepared by RJ Burnside & Associates Limited dated April 2008;
- Bradford Capital Holdings Inc. External Sanitary Easement, Record drawings prepared by Urban Ecosystems Limited dated April 2014;

- Simcoe Road Urbanization and Forcemains, Record easement drawings prepared by Accardi Schaeffers Consulting dated May 2014;
- 6th Line Plan and Profile, Record drawings prepared by RJ Burnside dated April 25, 2008.

The servicing and SWM strategies are also based on the following supplemental reports:

- Preliminary Geotechnical Investigation, Bradford Highlands Golf Course Redevelopment, Bradford, Ontario, prepared by WSP, dated August 2023;
- Preliminary Hydrogeological Assessment, Proposed Residential Subdivision, Bradford Highlands Golf Course, prepared by WSP, dated October 2024;
- Bradford Highlands Golf Club, Environmental Impact Study, prepared by Beacon Environmental, dated November 2024.
- Water Balance Report, Bradford Highlands Golf Course Redevelopment, prepared by WSP, dated November 2024.

2.0 Geotechnical and Hydrogeological Conditions

2.1 Soils

The soil classifications for the site were identified using the Ontario Soil Survey Complex from OMAFRA and land uses visible in recent aerial photography and site reconnaissance. The mapping identifies that the soils within the northern portion of the site were identified to be Schomberg Silty Clay Loam, the soils within the southern portion of the site were identified to be Bondhead Loam, and the soils along the Holland River North Canal were identified to be Muck. According to the Design Flood Estimation Design Chart H2-6A, Schomberg Silty Clay Loam is considered to be of hydrologic soil Group C, Bondhead Loam is considered to be of Group B, and Muck to be of Group B. The Preliminary Geotechnical Investigation (WSP, August 2023), identifies Sandy Clay Silt at boreholes within the northern portion of the site, and Sandy Silt Clay, Clay silt and silty clay at boreholes within the southern portion of the site. These soil types appear consistent with the OMAFRA soils mapping. The Soil Conservation Service Curve Numbers (CN) have been determined for the subject site based on this information. Refer to **Appendix B-2** for the soils mapping, excerpts from the Preliminary Geotechnical Investigation (WSP, 2023).

WSP have also completed hydraulic conductivity testing using single-well response testing at wells throughout the site. The hydraulic conductivity was measured to be $2x10^{-6}$ m/s and $3x10^{-8}$ m/s within the silty clay, $9x10^{-8}$ m/s within the sandy clay till, and $2x10^{-7}$ m/s and $4x10^{-8}$ m/s within the clayey silt till. The geometric mean hydraulic conductivity value based on all the testing results was found to be $1x10^{-7}$ m/s. Refer to **Appendix B-3** for results of the hydraulic conductivity testing. Additional in-situ percolation rate testing is being completed at the locations of proposed infiltration facilities, the results of which were not available at the time of preparation of this report.

2.2 Groundwater

WSP monitored groundwater levels across the site with readings from March 2016 to August 2023 via ten (10) groundwater monitoring wells installed across the site. Based on the groundwater levels collected to date, the seasonally high groundwater elevations had been found to range from above grade (artesian groundwater conditions) to approximately 0.6 m below ground surface. Refer to **Appendix B-3** for excerpts from the Preliminary Hydrogeological Assessment (WSP, 2024) including the groundwater monitoring results.

3.0 Topography and Grading

3.1 Existing Conditions

3.1.1 Topography

Under existing conditions, the northern portion of the site slopes southeast towards the neighbouring Bradford Capital Subdivision to the east, while the southern portion of the site slopes southeast to the Holland River North Canal.

The existing topography has a wide range of slopes ranging from 0% to 32%. The ground surface elevations through the study area range from approximately 251.66 m in the north near Line 6, to approximately 218.72 m in the southeast at the Holland River North Canal. Refer to **Figures 3.1** and **3.2** for an illustration of the existing topography for the site.

Several drainage features have been identified within the site through the Environmental Impact Study (EIS), prepared by Beacon Environmental Ltd. (2024), including:

- Two Headwater drainage features (Drainage Feature A and B) originating at approximately the northeast corner of the site, flowing eastward towards the neighbouring Bradford Capital Holdings Inc. Subdivision to the east;
- A headwater drainage feature (Drainage Feature C) originating at the neighboring agricultural lands to the west, flowing eastward across the site and towards the neighbouring Bradford Capital Holdings Inc. Subdivision to the east;
- A headwater drainage feature (Drainage Feature D) originating at the neighboring agricultural lands to the west, flowing southeastward across the proposed site and into an existing golf course pond at the southeast corner of the site; and,
- A headwater drainage feature (Drainage Feature E) flowing southeastward across the southwest corner of the site, and its associated wetlands.

The EIS also identifies wetland communities along the Drainage Feature D, E, and at the southern portion of the site straddling the Greenbelt Boundary.

3.1.2 Floodplain

The floodplain of the Holland River North Canal extends into the subject site as illustrated on **Figures 3.1** and **3.2**. The regulatory flood elevationis presented in **Appendix B-4,** which shows the Regional (Hurricane Hazel) flood elevation is 220.88 m within the subject site. The 100 year and Regional floodlines have been delineated using the detailed topographic survey information, as shown on **Figures 3.1** and **3.2**. The site is regulated by LSRCA under Ontario Regulation (O.Reg.) 41/24 and as such a permit will be required for site development.

The headwater drainage features through the site do not have regulated floodplains associated with them due to the drainage area being less than 125 ha.

3.2 Proposed Conditions

3.2.1 Site Grading

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

- Satisfy the Town of Bradford West Gwillimbury lot and road grading criteria including:
  - Minimum Road Grade: 0.5%
  - Maximum Road Grade (Local & Collector): 6.0%
  - Maximum Road Grade (Arterial): 5.0%
  - Minimum Lot Grade: 2%
  - Maximum Lot Grade: 5%
- Provide continuous road grades for overland flow conveyance;
- Minimize the need for retaining walls;
- Minimize the volume of earth to be moved and minimize cut/fill differential;
- Minimize the need for rear lot catchbasins; and,
- Achieve the stormwater management objectives required for the proposed development.

A preliminary grading plan for the subject site is provided on **Figures 3.4** and **3.5.**

Due to the existing site topography, a large grading differential exists across the site and resulted in steep road gradients on Street B that do not to meet the Town design criteria of maintaining a maximum gradient of 3.5% through intersections. Additionally, there are grading constraints along Street A, at the connection to Line 5 due to the steep topography of the existing lots, that will require retaining walls as shown on **Figure 3.5**.

HDF A, B and C will be removed, as supported by the EIS (Beacon, 2024). HDF-D will be realigned into a drainage corridor through the site, which will tie back into the existing roadside channel along Brownlee Drive prior to continuing southeast within a Walkway/Drainage corridor identified as Block 465 on the Draft Plan of Subdivision (**Appendix A**). HDF-E will be realigned into a drainage corridor for the reaches that transect through the site and will tie back into its existing channel at the site boundary.

Grading details of the proposed open channels and associated culverts for features HDF-D and HDF-E are shown on **Figures 3.6** to **3.8**.

At the detailed design stage, the preliminary grading shown on **Figures 3.4** and **3.5** will be subject to a more in-depth analysis in an attempt to balance the cut and fill volumes and minimize slopes and walls.

4.0 Rights-of-way and Sidewalks

The proposed right-of-way cross-sections specified will be in accordance with Town standard drawing B102, B1103 and B106. Copies of the cross-sections are provided in **Appendix C**.

The proposed sidewalk location plan is provided on **Figures 4.1** and **4.2**. For the areas where sidewalk will be provided along one side of the street, sidewalks will typically be located on the north or west side of the boulevard or the boulevard side where the larger number of frontages can be serviced. For local roads sidewalks will be installed on one side, while with collector roads the sidewalk will be installed on both sides.

5.0 Storm Drainage and Servicing

5.1 Existing Conditions

5.1.1 Storm Drainage

Under existing conditions, the site has two outlets. Refer to **Figures 3.1**, **3.2**, and **3.3** for the existing storm drainage catchment boundaries, outlets, and impervious values. The existing impervious coverage has been estimated based on the topographic survey and aerial photography. Refer to **Appendix D-1** for the calculations.

Outlet 1:
The existing West Holland North Canal receives drainage from the southern portion of the site at the southeastern property line. Refer to Catchments 1101 through 1111 on **Figures 3.2** and **3.3**.

Outlet 2:
The neighbouring Bradford Capital Subdivision receives runoff from the northern portion of the site at several locations along the shared property line. Refer to Catchments 1201 through 1204 on **Figures 3.1** and **3.3**. Runoff enters the storm sewers within the existing subdivision and drains into the existing SWM Pond 700-2 (refer to **Figure 3.3**).

SWM Pond 700-2 drains to a tributary of the North Canal on the east side of Simcoe Road. This tributary drains northeast towards the main channel of the North Canal. The existing SWM Pond 700-2 is identified in the Town's SWM CLI-ECA as *SWMF-0017 – SWM Wet Pond (Gibson Circle Pond)*. The Bradford Capital SWM Report (Sernas Associates, revised October 2014) identifies that runoff from Bradford Capital Subdivision discharges to the tributary at Point P, located at Simcoe Road (refer to **Figure 3.3**). Point P was used as a flow node to demonstrate compliance with the quantity control criteria. Excerpts from the Bradford Capital SWM Report and the Town's SWM CLI-ECA are included in **Appendix B-5**.

5.1.2 Storm Servicing

The existing storm servicing surrounding the site is located within the Bradford Capital Development to the east. The existing storm sewer system currently captures and conveys drainage from a portion of the existing golf course lands through a series of rear yard catchbasins and a 1200 mm diameter storm sewer inlet at the south end of Inverness Way. Storm runoff captured by the existing storm sewer system is conveyed to the existing SWM Pond 700-2 to the east, identified as Outlet 2 on **Figure 3.3**. All existing lots serviced by the storm sewer system, from the headwall to the pond inlet, are on sump pumps and protected from any storm sewer surcharging. The existing services can be seen on **Figures 5.3** and **5.4**.

5.2 Proposed Conditions

5.2.1 Storm Drainage

The proposed drainage areas and catchment imperviousness are shown on **Figures 5.1** and **5.2**. External drainage areas and catchment imperviousness are shown on **Figure 3.3**. The impervious coverage has been estimated based on anticipated zoning. Refer to **Appendix D-2** for the calculations.

Minor system runoff from the northern part of site (Catchment 2201) and external catchments (Catchments 1202 and 1203) will be collected by the proposed storm sewer system and directed to a flow splitter located at the intersection of Street C and Street H. Low flows will be directed to the existing Bradford Capital storm sewer system up to the allowable release. This runoff will be treated in the existing SWM Pond 700-2. Runoff in excess of that rate will be directed south via the storm sewer system, discharging to a proposed SWM pond, and ultimately discharging to the North Canal at Outlet 1. Major system runoff from these catchments will drain via overland flow within the road right-of-way and ultimately to the SWM pond.

A small portion of Street A near the intersection with Line 5 (Catchment 2103 and external Catchment 1106) will drain uncontrolled to Line 5. A small portion of Street A near the intersection with Line 6 (Catchment 2301) will drain uncontrolled to Line 6 to avoid overland flow from Line 6 coming into the site.

Runoff from Street C east of Street H (Catchment 2202) will drain directly to the existing Bradford Capital storm sewer system. This runoff will be treated in the existing SWM Pond 700-2.

Runoff from the southern part of the site (Catchment 2101) and external catchments (Catchments 1104, 1105, 1106, 1108, 1109, 1111, and 1204) will be collected and conveyed by the storm sewer system and major system overland flow and directed to the SWM pond.

Runoff from the external Catchments 1102, 1107, 1108 and runoff from the site Catchments 2106 and 2107 will be conveyed to the realigned HDF-D. The realigned HDF-D drainage corridor, will tie back into the existing roadside channel along Brownlee Drive prior to continuing southeast within a Walkway/Drainage corridor identified as Block 465 on the Draft Plan of Subdivision (**Appendix A**). Runoff from HDF-D will then be captured via a catchbasin located within the Walkway/Drainage Block 465 near the rear of proposed Block 292 and conveyed via a culvert under Street A. The culvert will discharge to the HDF-D downstream of Street A which will be maintained as existing conditions and discharge to the Environmental Protection area (Catchment 2102), ultimately draining into the North Canal at Outlet 1.

Runoff from the external Catchment 1103 and runoff from the site Catchment 2105 will be conveyed to the realigned HDF-E.

5.2.2 Headwater Drainage Feature Conveyance

Hydrologic modelling utilizing the Visual Otthymo Version 6.2 software (VO6) was completed to determine the proposed flow rates to the two HDFs based on the 4-hour and 24-hour Chicago and the 12 hr and 24-hour SCS Type II Distribution methods. A separate VO6 scenario was created to isolate the drainage to the HDF's, while supporting model parameters are consistent with the existing and proposed hydrology modelling parameters. The VO6 model schematic is shown in **Appendix D-3**. The greater of the 100 year and Regional flows were used to confirm conveyance capacity. **Table 5.1** summarizes the 100 year and Regional flow rates for HDF-D and HDF-E.

Table 5.1: Summary of Peak Flows for HDF

HDF	100 year 4 hour Chicago (m3/s)	100 year 12 hour SCS Type II (m3/s)	100 year 24 hour SCS Type II (m3/s)	100 year 24 hour Chicago (m3/s)	Regional Storm (m3/s)
HDF-D	2.59	3.78	4.21	3.48	3.36
HDF-E	2.82	4.00	4.37	3.78	5.08

HDF-D will be conveyed in a realigned open channel with a minimum top width of 3.8 m, a 750 mm diameter culvert crossing Street P, where it then outlets to the existing open channel/ditch through the existing Brownlee Drive. The existing ditch on Brownlee Drive then discharges to a proposed channel with a minimum top width of 5.4 m within Block 465, is further captured by a 3.0 m x 2.4 m super catchbasin sized for the required inlet capacity assuming 50% blockage, and conveyed by a 1200 mm diameter culvert under Street A, ultimately discharging to the existing HDF-E south of Street A that will be maintained in it's existing condition. Supporting channel conveyance and super catchbasin capture calculations for HDF-D are provided in **Appendix E-1**.

HDF-E will be conveyed in a realigned open channel corridor with a variable slope and flow depth. The corridor width for HDF-E was determined based on a 14 m meander belt width as recommended through the EIS (Beacon, 2024), plus the required sloping to match to proposed elevations. The corridor will be subject to a natural channel design by a fluvial geomorphologist at detailed design stage to confirm the low flow channel planform and restoration requirements. HDF-E will be conveyed under Street A by a minimum 9.1 m wide by 1.2 m high culvert for hydraulic conveyance. The culvert size is subject to fluvial geomorphologist recommendations. Supporting channel conveyance and culvert sizing calculations for HDF-E are provided in **Appendix E-2**.

5.2.3 Storm Servicing

5.2.3.1 Minor System

The preliminary layout for the proposed storm sewer within the subject lands is provided on the Preliminary Servicing Plan, **Figures 5.3** and **5.4**.

The storm sewer system (minor system) will be designed for the 10-year return storm as per the Bradford West Gwillimbury standards (2015). The storm sewers are proposed to drain towards the proposed Stormwater Management (SWM) facility (Outlet 1 on **Figure 5.1**), with a portion of flows being directed to the existing stub located on Inverness Way, discharging ultimately to the West Holland Canal (refer to Outlet 2 on **Figure 5.2**). The flows being directed to the existing storm sewer system on Inverness Way will be 2.525 m^3/s. The pre-development flow allowance from the subject lands was 2.41 m^3/s. To accommodate a slightly higher flow through the existing storm sewer system, a Hydraulic Grade Line analysis has been prepared confirming that there are no impacts to the downstream sewer system. All existing lots serviced by the downstream storm sewer system, from the headwall to the pond inlet, are on sump pumps and protected from any storm sewer surcharging. The downstream storm sewer analysis is located in **Appendix E**.

The storm sewer system will typically be designed with grades between 0.5% and 4.5%. Throughout the proposed development, the storm sewer will be constructed at a minimum depth of 1.2 m to provide frost protection and 3.3 m to service foundation drains by gravity. It is anticipated that all storm sewers will be able to be provided deep enough to service foundation drains by gravity.

The storm drainage system will be designed in accordance with the Bradford West Gwillimbury (2015) and MECP guidelines, including the following:

- Pipes to be sized to accommodate runoff from a 10-year storm event;
- Minimum Pipe Size: 300 mm diameter;
- Maximum Flow Velocity: 6.0 m/s;
- Minimum Flow Velocity: 0.8 m/s;
- Minimum Pipe Depth: 2.7 m to obvert for gravity service connections; and,
- Minimum Pipe Depth: 1.2 m to obvert.

5.2.3.2 Major System

Major system flows (greater than the 10 year up to the 100 year storm event) will be conveyed within the road rights-of-way to the SWM pond. The right-of-way conveyance capacity calculations are provided in **Appendix F** which show that the major system flows can be safely conveyed within the proposed road rights-of-way.

6.0 Stormwater Management

6.1 Stormwater Management Criteria

The following stormwater management criteria have been established based on the greatest requirements of each of the design guidelines and standards listed in **Section 1.3**. The stormwater management criteria are summarized below in **Table 6.1**:

Table 6.1: Stormwater Management Criteria

Criteria	Control Measure
Quality Control	Total Suspended Solids (TSS): Control* 90th percentile storm event and if conventional methods are necessary, then MECP Enhanced Level Protection (80% TSS Removal). (CLI ECA 116-S701, LSRCA, Town)
Phosphorus	Per Lake Simcoe Protection Plan, a Phosphorus Loading Study is to be done to determine the existing and proposed phosphorus loading rates. Minimize phosphorus loadings to Lake Simcoe and its tributaries. Evaluate anticipated changes in phosphorus loadings between existing and proposed. If it is demonstrated that the site's post to existing phosphorus budget cannot be met, and Maximum Extent Possible* has been attained, the proponent may use LSRCA's Phosphorus Offsetting Policy. (CLI ECA 116-S701, LSRCA)
Erosion Control	A minimum 24-hour extended detention of runoff from a 25mm-4 hour Chicago storm event shall be provided for erosion protection. (LSRCA, MECP)
Runoff Volume Control	Proposed runoff volume from a 25 mm rainfall event over the total impervious area shall be captured and retained/treated on-site or in accordance with LSRCA's Flexible Treatment guidelines if full compliance with the 25 mm guideline is not possible. (LSRCA)

Criteria	Control Measure
Water Budget	The site is located within a Wellhead Protection Area (WHPA) Q1/Q2 and is a Significant Groundwater Recharge Area and Ecologically Significant Groundwater Recharge Area. Therefore, an evaluation of anticipated water balance changes between existing and proposed condition must be conducted, and a plan detailing how changes will be minimized must be provided. (SGBLS SPP & LSPP) Catchment-based water budget to be completed for Key Natural Heritage Features. (LSRCA) Control* as per the evaluation of anticipated changes in water balance between existing and proposed assessed through a stormwater management plan. The assessment should include sufficient detail to be used at a local site level. If it is demonstrated, using the approved water balance estimation methods that the site's proposed to existing water balance cannot be met, and Maximum Extent Possible has been attained, the proponent may use Lake Simcoe and Region Conservation Authority's Recharge Compensation Program. (CLI ECA 116-S701)
Quantity Control	Peak Flow: Control proposed peak flows to existing peak flows for the 2 through 100 year storm events. (Town, LSRCA)

*Refer to Town of Bradford West Gwillimbury Consolidated Linear Infrastructure Environmental Compliance Approval 116-S701, Appendix A (included in **Appendix B-7**) for further explanation on design criteria.

Based on the Sustainable Technology Evaluation Program (STEP) LID wiki, the 90th Percentile Volume Target for the site is approximately the 27.5 mm rainfall event (refer to Figure 3.67 in **Appendix B-7**).

6.2 Proposed Stormwater Management Plan

In accordance with the Ministry of the Environment Stormwater Management Planning and Design Manual (MOE, 2003), a review of stormwater management best practices was completed using a treatment train approach, which evaluated lot-level, conveyance system and end-of-pipe alternatives.

The following study area characteristics and constraints were taken into consideration:

- The topography is rolling;
- Based on the Geotechnical Investigation (WSP, August 2023) , study area soils consisted of sandy clay silt, sandy silt clay, clay silt and silty clay soils;

- Based on the Hydrogeological Investigation by WSP (2024), single well response tests were completed and indicate that the native soils have a geometric mean hydraulic conductivity of $1x10^{-7}$ m/s which is approximately 15 mm/hr;
- Within the installed site wells, seasonally high groundwater was observed at depths above surface to less than 0.6 m below surface (WSP, August 2024);
- The proposed subdivision development consists primarily of a low and medium density residential; and,
- The study area drains to existing storm sewers within the adjacent residential subdivision development and to the Holland River North Canal.

The feasibility of at-source, conveyance and end-of-pipe SWM controls were evaluated for use in the proposed development to achieve the design criteria provided in **Section 6.1**. A groundwater depth map was prepared to determine the depth of the seasonally high groundwater level to the proposed finished ground to determine opportunities for infiltration measures (see **Figure 6.1**). Refer to **Appendix G** for a summary of the feasibility evaluation.

Based on the feasibility evaluation, the proposed SWM Plan will include a treatment train of the following LID measures and end-of-pipe SWM controls:

- Rear yard infiltration trenches;
- Bioretention in wetland compensation areas;
- End-of-Pipe SWM Facility; and
- Manufactured Treatment Device - Filtration Type.

The following sections provide additional information on the proposed LID measures and end-of-pipe SWM facilities, respectively.

6.2.1 Low Impact Development Measures

Low Impact Development (LID) measures provide reduction of runoff and promote infiltration at the source. Each type of LID measure has the potential to provide water quality control including both TSS and phosphorus removal, erosion control, and/or water budget benefits. These LID measures, combined in a treatment train with end-of pipe SWM measures, will work towards achieving the SWM criteria listed in **Section 6.1,** as further described in the following sections.

6.2.1.1 Rear Yard Infiltration Trenches

Rear yard infiltration trenches are proposed for all split draining lots which can provide 1.0 m separation between the infiltration trench and the seasonally high groundwater level to receive runoff from the back half of the roofs. The trenches will be located beneath the rear yard swales and will receive runoff from the back half of the roofs by overland runoff from roof leaders directed to the rear yard swales. Infiltration measures are required by the Ontario Building Code to be a minimum of 5 m from a foundation.

Each infiltration trench will be composed of washed clear stone and a sand filter with approximate dimensions of 0.2 m deep and 2.0 m wide, which will capture approximately 14 mm of runoff from the back half of the roofs. The length of the trench will vary depending on the size of the lots.

Based on the design infiltration rate of 15 mm/hr, the runoff storage volume in the trench can be infiltrated within 48 hours. Refer to **Figures 6.2** and **6.3** for locations and to **Figure 6.4** for details. Calculations are provided in **Appendix G**. As shown the provided LID volume is 0.04 mm based on the site constraints, which does not achieve the 90th percentile control target, therefore, conventional methods for quality control are required to achieve an Enhanced Level of Protection (80% TSS Removal).

6.2.2 End-of-Pipe Stormwater Management Facility

A wet SWM pond is proposed to provide quality, erosion and quantity control. The SWM pond will be located at the southeast corner of the development lands, as shown on **Figure 5.2**, and will outlet to a proposed outfall channel that discharges to Outlet 1, the North Canal. The SWM pond will be sized for a total minor system drainage area of 31.94 ha assuming an imperviousness of 44% and a major system drainage area of 73.95 ha assuming an imperviousness of 42%. Refer to **Figure 6.5** for the SWM Pond details.

6.2.2.1 Quality Control

An "Enhanced" level of quality control is required for the proposed development. The quality control parameters as presented in Table 3.2 of the MOE Stormwater Management Planning and Design Manual, March 2003 were used in the design of the facility. The facility will be sized to service a minor system drainage area of 31.94 ha. Based on Table 3.2 and an imperviousness of 44%, a total permanent pool storage of 3,928 m^3 is required to obtain an "Enhanced" level of protection. The available permanent pool storage is 16,521 m^3. Refer to **Appendix G** for required and provided permanent pool volume calculations and **Figure 6.5** for the SWM facility plan showing the limit of the permanent pool.

6.2.2.2 Erosion Control

The extended detention volume for the proposed stormwater management facilities will be sized based on the detention of the 25 mm - 4 hour Chicago rainfall event. The volume calculated for the extended detention will be attenuated for a minimum of 24 hours. The required extended detention storage volume based on the runoff volume detained for 24 hours was determined to be approximately 2,794 m^3. This volume is larger than the extended detention volume based on 40 m^3/ha or 1,278 m^3 based on the 31.94 ha drainage area.

Refer to **Appendix G** for extended detention required volume calculations and **Appendix D-2** for the VO6 model schematic. The hydrologic model is also available in digital format on filesharing link included on the **Appendix D** cover page.

6.2.2.3 Quantity Control

As outlined in **Section 6.1**, control of proposed flows to existing levels is required for the 2 through 100-year storm events. The existing flow rates for the 2 through 100-year storm events have been established utilizing the Visual Otthymo Version 6.2 software (VO6) based on the 4-hour and 24-hour Chicago and the 12 hr and 24-hour SCS Type II Distribution methods. The study area is located within the Town of Bradford West Gwillimbury, therefore, the IDF rainfall information was obtained from the Town's design guidelines to determine the existing peak flows to outlet locations. The existing flows from the study area to Outlet 1 are summarized in **Table 6.2**.

Table 6.2: Summary of Existing Peak Flows – Outlet 1 – North Canal

Return Period	4hr Chicago	12hr SCS Type II	24hr SCS Type II	24hr Chicago
2 Year	1.042	1.527	1.717	1.501
5 Year	2.070	3.093	3.460	2.930
10 Year	2.894	4.311	4.796	4.034
25 Year	4.058	6.038	6.689	5.569
50 Year	5.013	7.479	8.254	6.814
100 Year	5.892	8.940	9.938	8.049

A summary of modelling parameters and an existing VO6 schematic are provided in **Appendix D-1** with digital modelling files included via a file sharing link on the **Appendix D** header page.

Proposed hydrologic modelling was completed using the VO6 model to determine the required SWM pond volume in order to meet the existing peak flow rates. A summary of the resulting storage requirements for the SWM pond are provided in **Tables 6.3** to **6.6**.

Table 6.3: Proposed SWM Pond Storage Requirements – 4-hour Chicago

Return Period Storm	Discharge (m^3/s)	Storage (m^3)
2 Year	0.111	4,080
5 Year	0.243	6,640

Return Period Storm	Discharge (m^3/s)	Storage (m^3)
10 Year	0.317	8,780
25 Year	0.401	12,050
50 Year	0.459	14,910
100 Year	0.508	17,660

Table 6.4: Proposed SWM Pond Storage Requirements – 12-hour SCS Type II

Return Period Storm	Discharge (m^3/s)	Storage (m^3)
2 Year	0.140	4,620
5 Year	0.295	8,070
10 Year	0.374	10,940
25 Year	0.466	15,280
50 Year	0.530	18,970
100 Year	0.587	22,850

Table 6.5: Proposed SWM Pond Storage Requirements – 24-hour SCS Type II

Return Period Storm	Discharge (m^3/s)	Storage (m^3)
2 Year	0.157	4,910
5 Year	0.315	8,720
10 Year	0.396	11,860
25 Year	0.489	16,560
50 Year	0.554	20,580
100 Year	0.615	24,980

Table 6.6: Proposed SWM Pond Storage Requirements – 24-hour Chicago

Return Period Storm	Discharge (m^3/s)	Storage (m^3)
2 Year	0.157	4,910
5 Year	0.302	8,320
10 Year	0.379	11,130
25 Year	0.469	15,390
50 Year	0.531	19,040
100 Year	0.584	22,650

6.2.2.4 General SWM Facility Design Criteria

Preliminary SWM facility grading is provided on **Figure 6.5**. The SWM block size was established based on the following general criteria:

- A 4 m wide maintenance access road will be provided from a proposed municipal road with a maximum longitudinal slope of 10% and a crossfall of 2% (max). It will be used to facilitate machinery to access the forebay during scheduled maintenance as well as to access the outlet structure for maintenance purposes;
- A minimum 3.0 m wide platform at a maximum cross-slope of 4% provided around the property boundary of the SWM block for the purposes of grass cutting;
- A horizontal terrace of 3.0 m required for continuous slope changes in elevation greater than 3.0 m;
- A maximum slope of 3:1 from the pond bottom to 0.5 m below the normal water level will be provided (or as recommended by the geotechnical engineer);
- A maximum slope of 6:1 from 0.5 m below and above the normal water level will be provided;
- A maximum slope of 4:1 above the maximum extended detention level up to 2 m beyond the high water level;
- A maximum slope of 3:1 from 2.0 m beyond high water level; and,
- In order to facilitate sediment removal operations, either of the following may be proposed and are subject to review and approval of the overall approach to sediment management and removal during detailed design:
  - provision of a sediment drying space for each forebay, suitable to contain the volume of sediment and water remaining in the forebay (after completing pond drain-down procedures) located adjacent to each sediment forebay and higher than the maximum extended detention water level, OR
  - provision of a pond by-pass sewer (sized based on the minor system design criteria) between the inlet and the outlet in order to divert incoming flows around the pond for the duration of clean out operations (allows for sediment drying in-situ).

6.2.3 Assessment of Existing SWM Pond 700-2

The existing SWM pond (SWM Pond 700-2) located within the Bradford Capital subdivision to the east of the proposed development accepts flows from the subject site in the existing condition, and provides quality, erosion and quantity control. The location of SWM Pond 700-2 is shown on **Figure 3.3**. SWM Pond 700-2 outlets to a tributary of the North Canal west of Simcoe Street, north of Jonkman Boulevard. Excerpts of the Bradford Capital SWM report can be found in **Appendix B-5**. A stage-storage-discharge rating table for SWM Pond 700-2 was prepared using the information available in the SWM Report and is included in **Appendix G**.

The existing site drainage areas that were accommodated in SWM pond 700-2 were based on the existing conditions. An assessment was completed to demonstrate that the proposed drainage can be accommodated in SWM Pond 700-2 and that the original design criteria will still be achieved, including the target peak flows at Point P, shown on **Figure 3.3**.

As discussed in **Section 5.2.3**, a downstream HGL analysis was completed for the Bradford Capital storm sewer system from the existing upstream end to the SWM pond 700-2 inlet headwall, included in **Appendix E**. The capacity available for flows from the Bradford Highlands lands was determined to be 2.550 m^3/s.

A flow splitter has been incorporated into the design to limit the amount of flow to the capacity of the existing Bradford Capital downstream storm sewer system and SWM Pond 700-2. Minor system drainage from 41.01 ha and both the major and minor system from 1.44 ha of proposed development lands will drain to SWM Pond 700-2. The total proposed drainage area and imperviousness to SWM Pond 700-2 will be 81.45 ha at 43% imperviousness. The combination of flows form the flow splitter and Catchment 2202 will not exceed the capacity available in the downstream storm sewer system of 2.550 m^3/s.

6.2.3.1 Quality Control

Based on the CLI-ECA and original ECA (**Appendix B-5**) for SWM Pond 700-2, (also referred to as *SWMF-0017 – SWM Wet Pond (Gibson Circle Pond))*, an “Enhanced” level of quality control is required. The quality control parameters as presented in Table 3.2 of the Stormwater Management Planning and Design Manual, (MOE, March 2003) were used in the assessment of the facility. Based on Table 3.2 and an imperviousness of 43%, a total permanent pool storage of 9,842 m^3 is required to obtain an “Enhanced” level of protection. Based on the CLI-ECA and original ECA , the available permanent pool storage is 12,890 m^3. Refer to **Appendix G** for required and provided permanent pool volume calculations.

6.2.3.2 Erosion Control

Based on the CLI-ECA (**Appendix B-5**), the extended detention volume for the proposed stormwater management facility was based on the detention of the 25 mm - 4 hour Chicago rainfall event. The volume calculated for the extended detention must be attenuated for a minimum of 24 hours. The required extended detention storage volume based on the runoff volume detained for 24 hours was determined to be approximately 6,748 m^3. Based on the Outflow Summary table in **Appendix G**, the extended detention volume will be detained over approximately 108 hours. Refer to **Appendix G** for extended detention required volume calculations and **Appendix D-2** for the VO6 model schematic. The hydrologic model is also available in digital format on filesharing link included on the **Appendix D** cover page.

6.2.3.3 Quantity Control

Per the Bradford Capital SWM Report, control of proposed flows to existing levels at Point P was provided for the 2 through 100-year storm events. The existing flow rates used as allowable rates were primarily obtained from the Bradford Capital SWM Report Table 2.6.4 (included here as **Appendix B-5**). For the 24-hour SCS Type II storm, the Bradford Capital SWM Report Table 2.6.4 appears to have erroneously reported the 24-Hour Chicago peak flows. In the absence of access to the hydrologic modelling files for Bradford Capital to correct this reporting, the Green Valley Community Plan MESP values were used for this storm distribution.

Refer to excerpts from the Bradford Capital SWM Report in **Appendix B-5** and the Green Valley Community Plan MESP in **Appendix B-6**. The existing flow rates at Point P as reported in the Bradford Capital SWM Report and the Green Valley Community Plan MESP are summarized in **Table 6.7**.

Table 6.7: Summary of Existing Peak Flows – Outlet 2 – Point P

Return Period	4hr Chicago*	12hr SCS Type II*	24hr SCS Type II**	24hr Chicago*
2 Year	1.03	1.39	0.98	1.43
5 Year	1.95	2.68	1.88	2.75
10 Year	2.68	3.67	2.56	3.76
25 Year	3.71	5.07	3.48	5.17
50 Year	4.56	6.23	4.20	6.34
100 Year	5.34	7.41	4.94	7.59

*Refer to **Appendix B-5** for Table 2.6.4 of the Bradford Capital SWM Report.
Refer to **Appendix B-6 for Table 6.4 of the Green Valley Community Plan MESP.

The SWM Pond 700-2 will control proposed flows at Point P to existing rates for the 2 to 100 year storm events. Proposed hydrologic modelling was completed using the VO6 model to determine the required SWM Pond 700-2 volume in order to meet the existing peak flow rates based on the proposed development contributing proposed flows to the pond. A summary of the resulting storage requirements for the SWM pond are provided in **Tables 6.8** to **6.11**.

Table 6.8: SWM Pond 700-2 Storage Requirements – 4-hour Chicago

Return Period Storm	Discharge (m^3/s)	Storage (m^3)
2 Year	0.187	8,960
5 Year	0.540	11,740
10 Year	0.881	13,340
25 Year	1.364	15,200
50 Year	1.743	16,520
100 Year	2.068	17,570

Table 6.9: SWM Pond 700-2 Storage Requirements – 12-hour SCS Type II

Return Period Storm	Discharge (m^3/s)	Storage (m^3)
2 Year	0.290	10,050
5 Year	0.870	13,290
10 Year	1.400	15,340
25 Year	2.127	17,750
50 Year	2.736	19,560
100 Year	3.355	21,290

Table 6.10: SWM Pond 700-2 Storage Requirements – 24-hour SCS Type II

Return Period Storm	Discharge (m^3/s)	Storage (m^3)
2 Year	0.333	10,430
5 Year	1.049	14,050
10 Year	1.667	16,260
25 Year	2.516	18,920
50 Year	3.226	20,950
100 Year	4.018	22,900

Table 6.11: SWM Pond 700-2 Storage Requirements – 24-hour Chicago

Return Period Storm	Discharge (m^3/s)	Storage (m^3)
2 Year	0.294	10,080
5 Year	0.860	13,250
10 Year	1.351	15,160
25 Year	1.996	17,360
50 Year	2.531	18,960
100 Year	3.060	20,500

6.2.4 Manufactured Treatment Device (MTD)

The MTD, specifically a stormwater filter, has been sized for polishing stormwater effluent from the SWM pond to provide phosphorus removal. Refer to **Appendix G** for sizing calculations which provides a treatment flow rate of 66.3 L/s. To achieve the phosphorus removal credit, the stormwater filter will need to be ETV or TAPE certified. The sizing of the unit will be confirmed at detailed design.

6.3 Stormwater Management Plan Performance

6.3.1 Water Quality

An “Enhanced” protection level for quality control will be achieved through the implementation of the proposed and existing end-of-pipe SWM facilities, as outlined in **Section 6.2.2.1** and **Section 6.2.3.1**, respectively. Refer to **Appendix G** for provided permanent pool volume calculations.

6.3.2 Phosphorus Budget

Under the Lake Simcoe Protection Plan, a stormwater management plan must demonstrate how loadings are minimized between existing and proposed conditions. Furthermore, the Lake Simcoe Offsetting Policy (May 2023) states that:

> “The load from the development on the property will not exceed pre-development loadings. In situations where the phosphorus load cannot be met or demonstrated in a post-development scenario to achieve the pre-development loadings, the developer or proponent shall be required to provide offsetting to the LSRCA.”

A spreadsheet based on the MECP database application Lake Simcoe Phosphorus Loading Development Tool (v2, 01-April-2012 update) was used to complete the phosphorus budget for the proposed development. Based on the Loading Development

Tool, the existing annual loadings were calculated to be 13.49 kg/year. The existing land uses are identified on **Figures 6.6** and **6.7**.

The residential lots are considered high intensity development according to the MECP Phosphorus Tool. The proposed phosphorus loading with no best management practices (BMPs) was calculated to be 92.73 kg/yr. The proposed phosphorus loading with BMPs was calculated to be 27.37 kg/yr. The proposed land uses and delineation of areas to the treatment facilities for the proposed development are shown on **Figures 6.8** and **6.9**.

Table 6.12 provides a summary of the existing, unmitigated proposed, and mitigated proposed condition phosphorus loading rates. Refer to **Appendix H** for proposed phosphorus loading calculations.

Table 6.12: Phosphorus Budget Summary

Existing Phosphorus Loading (kg/yr)	Proposed Phosphorus Loading without BMPs (kg/yr)	Proposed Phosphorus Loading with BMPs (kg/yr)
13.49	92.73	27.37

As per LSRCA's Phosphorus Offsetting Policy, the increase in phosphorus loading will be offset at a rate of $35,770/kg/year, at a 2.5:1 ratio. The cost of the phosphorus offsetting will total $1,426,929, which includes a 15% administration cost. Refer to **Appendix H** for phosphorus offsetting calculations.

6.3.3 Erosion Control

The erosion control criterion is to provide a minimum of 24 hour extended detention of the runoff from a 25 mm rainfall event which will be achieved in both the proposed and existing end-of-pipe wet pond storage. The preliminary design requirements of the proposed end-of-pipe SWM facility are discussed above in a **Section 6.2.2**. Refer to **Appendix G** for the stage-storage-discharge table calculations including detention time. The assessment of the existing end of pipe SWM facility is discussed in **Section 6.2.3**.

6.3.4 Volume Control

The volume control criterion stipulates that proposed runoff volume from a 25 mm rainfall event over the total impervious area shall be captured and retained/treated on-site or in accordance with LSRCA's Flexible Treatment Guidelines if full compliance with the 25 mm guideline is not possible. (LSRCA). In accordance with the LSRCA's Flexible Treatment Guidelines, the volumes associated with the 5 mm, 12.5 mm and 25 mm rainfall amounts are summarized in **Table 6.13**.

Table 6.13: Volume Control Summary - Target

Rainfall Depth	Volume (m^3)
5 mm (minimum)	1,560.4
12.5 mm	3,901.1
25 mm (Target)	7,801.9

Proposed LIDs and BMPs have been sized to provide this storage volume where feasible as outlined in **Section 6.2.1**.

The treatment train of the SWM pond and MTD at the SWM pond outlet will capture and filter the SWM pond effluent through the MTD, providing on-site capture and filtration. The MTD is sized to treat 66.3 L/s, which provides a capture and treatment volume of approximately 3121 m^3 of runoff that is stored in the SWM pond. Note that this is the total provided volume corresponding to the outflow rate and does not consider the total outflow volume from the reservoir routing routine, therefore, this is a conservative estimate of the treatment volume.

As shown through the LID sizing and volume control calculations in **Appendix G**, a total treatment volume of 3133.0 m^3 is provided through the proposed rear yard infiltration trenches and MTD filtration, equivalent to 10.0 mm.

Due to site constraints, specifically high groundwater (refer to **Figure 6.1**), the target infiltration/retention volume associated with 25 mm rainfall depth was infeasible. The proposed BMPs were exhausted in all feasible locations in an attempt to meet the 12.5 mm infiltration depth, however, this was not achievable. The minimum volume control depth of 5.0 mm is achieved with the proposed infiltration trenches and MTD filtration.

6.3.5 Water Budget

The assessment and quantification of infiltration across the study site is discussed in Water Balance Report (WSP, 2024) included in **Appendix I**. The report also provides preliminary water budget calculations for the subject site. It provides an assessment of existing and proposed conditions and establishes a proposed target for infiltration for the development site.

Based on the Water Balance Report, the total existing annual infiltration rate is 59,000 m^3/year. Due to the introduction of impervious surfaces, there will be an overall reduction of approximately 32,000 m^3/year. This serves as the target infiltration rate for the development in order to mitigate the loss of infiltration associated with development.

As outlined in **Section 6.2.1**, LID measures, will be implemented, where feasible, to mitigate changes to the infiltration rates. It is anticipated that a proposed infiltration volume of approximately 45,000 m^3 can be achieved through the proposed mitigation measures.

The water balance offsetting fee was determined based on $100/$m^3$ of infiltration deficit in addition to 15% attributed to administrative fees. Using the proposed infiltration with mitigations, the infiltration deficit is 14,000 m^3/year. The water balance offsetting fee is $1,610,000.

As seen in **Section 6.3.2**, the water balance offsetting fee is higher than the phosphorus offsetting fee. Therefore, the water balance offsetting fee will be paid as compensation.

A catchment-based water balance was completed for HDF-D, HDF-E, and the wetland at the south end of the site. Refer to the Water Balance Report (WSP 2024), included in **Appendix I**.

6.3.6 Quantity Control

The proposed SWM pond and the existing SWM Pond 700-2 will control proposed flows to existing levels for the 2 through 100-year storm events. **Table 6.14** and **Table 6.15** provide a comparison of existing and proposed flows at the outlets/flow nodes downstream of the subject site.

Table 6.14: Comparison of Existing and Proposed Peak Flows – Outlet 1 (North Canal)

Storm Distribution	4-hour Chicago		12-Hour SCS Type II		24-Hour SCS Type II		24-Hour Chicago	
Return Period	**Ex.**	**Prop.**	**Ex.**	**Prop.**	**Ex.**	**Prop.**	**Ex.**	**Prop.**
2 Year	1.042	0.922	1.527	1.362	1.717	1.538	1.501	1.338
5 Year	2.070	1.880	3.093	2.829	3.460	3.170	2.93	2.665
10 Year	2.894	2.639	4.311	3.939	4.796	4.388	4.034	3.663
25 Year	4.058	3.689	6.038	5.493	6.689	6.090	5.569	5.041
50 Year	5.013	4.545	7.479	6.780	8.254	7.490	6.814	6.137
100 Year	5.892	5.328	8.94	8.079	9.938	8.997	8.049	7.240

Table 6.15: Comparison of Existing and Proposed Peak Flows – Outlet 2 (Point P)

Storm Distribution	4-hour Chicago		12-Hour SCS Type II		24-Hour SCS Type II		24-Hour Chicago	
Return Period	**Ex. ***	**Prop.**	**Ex. ***	**Prop.**	**Ex. ***	**Prop.**	**Ex. ***	**Prop.**
2 Year	1.03	0.206	1.39	0.316	0.98	0.363	1.43	0.32
5 Year	1.95	0.588	2.68	0.958	1.88	1.163	2.75	0.942
10 Year	2.68	0.964	3.67	1.562	2.56	1.849	3.76	1.487
25 Year	3.71	1.498	5.07	2.383	3.48	2.846	5.17	2.213
50 Year	4.56	1.919	6.23	3.105	4.20	3.700	6.34	2.858
100 Year	5.34	2.285	7.41	3.838	4.94	4.669	7.59	3.501

*Refer to **Appendix B-5** for Table 2.6.4 of the Bradford Capital SWM Report.
Refer to **Appendix B-6 for Table 6.4 of the Green Valley Community Plan MESP.

As shown in **Table 6.14** and **Table 6.15**, the proposed flows are less than or equal to the existing flows for the 2 through 100-year storm events at all target locations and thus the quantity control criterion is achieved.

7.0 Sanitary Servicing

7.1 Existing Sanitary Sewer System

The existing sanitary sewer system is located within the Bradford Capital Holdings Inc. development and extends east to Simcoe Road, conveying flows north and east to the Green Valley Sanitary Pump Station (SPS) located on Line 6. Refer to **Figures 5.3** and **5.4**.

An existing 300 mm sanitary stub is located on Inverness Way extending from the existing maintenance hole for the future extension of Street C.

The existing sanitary sewer system was sized for drainage from the development lands. A detailed downstream sanitary sewer capacity assessment has been prepared for each sewer run from the existing 300 mm diameter sewer stub on Inverness Way to the Green Valley SPS. The drainage plan and design sheets for the existing and proposed sanitary flows can be seen in **Appendix J**.

The Green Valley SPS was designed to accommodate a flow rate of 93.0 L/s and has a firm capacity of 102 L/s. Excerpts from the Green Valley SPS Design Brief are in **Appendix B-8.**

Sanitary sewage downstream of the Green Valley SPS discharges to the Bradford Water Pollution Control Plant (WPCP). The wastewater generated from Bradford and Bond Head settlement areas is treated at the WPCP prior to discharge into the West Holland River, located within the Lake Simcoe watershed. The WPCP was originally constructed in 1962 and has undergone numerous enhancements, most recently in 2009. The WPCP has a rated capacity of 19.4 million litres per day (MLD). It is classified as a Class 4 Treatment Facility and a Class 3 Collection System.

The Town published a WPCP Summary Report (February 2024) outlining the average daily flow to the plant in 2023 as part of their annual reporting requirements. The average daily influent flow to the plant was 12.662 MLD. As a result, the plant appears to have a current surplus capacity of approximately 6.738 MLD. Excerpts from this report are in **Appendix B-8**.

In 2012, the Town completed a Municipal Class Environmental Assessment to support the expansion of the plant. The final Environmental Study Report (ESR) Report identified infrastructure improvements that would increase the rated capacity of the plant to 23.3 MLD to accommodate future growth and reduce the total phosphorus in the effluent. These upgrades were not implemented upon completion of the EA.

In 2022, the Town retained Hatch Limited to complete an addendum to the 2012 ESR to provide updated recommendations supporting the latest technology used for tertiary filtration systems. The ESR Addendum does not propose any revisions to the increase in rated capacity (to 23.3 MLD). The Final ESR Addendum was filed for public and agency review on October 1, 2024. See **Appendix B-8** for excerpts of the report. The Town intends to proceed with construction of the WPCP upgrades in the summer of 2025.

7.2 Proposed Sanitary Sewer System

The proposed development will connect to the existing sanitary sewer at Inverness Way. The preliminary layout for the proposed sanitary sewer within the subject lands is provided on **Figures 7.1** and **7.2**.

The proposed development will have a total area of 45.23 ha with a population of 2981 that will generate a total flow of 39.2 L/s as shown on **Figures 7.1** and **7.2**. With the introduction of these flows, the total flow at the Green Valley SPS will now equal 97.1 L/s, which will remain below the firm capacity of 102 L/s as shown on the design sheet provided in **Appendix J**.

The sanitary sewers within the proposed development will have slopes ranging between 0.5% and 4.5% (typically) and will be provided at 2.7 m to 7.7 m deep. The critical sanitary sewer run is located on Street C and south on Street L towards the low point of the site located at the proposed SWM pond, where minimum cover is achieved.

The sanitary sewer system will be designed in accordance with the Bradford West Gwillimbury and MECP criteria, including but not limited to:

- Residential Sanitary Generation Rate: 250 L/c/d;
- Institutional Sanitary Generation Rate: 19.8 m^3/ha/day (0.23 L/s/ha);
- Population Density:
  - Single/ Semi-Detached: 3.36 people/unit;
  - Townhouses: 2.83 people/unit;
- Peaking Factor: Harmon (Max. 5.0);
- Infiltration Rate: 0.20 L/s/ha;
- Minimum Pipe Size: 250 mm diameter;
- Minimum Pipe Cover: 2.7 m;
- Minimum Actual Velocity: 0.60 m/s; and,
- Maximum Velocity: 3.0 m/s.

8.0 Water Supply and Distribution

8.1 Existing Water Distribution

The Town of Bradford West Gwillimbury drinking water system is categorized as a large municipal residential system. The Town's drinking water supply is provided by two (2) municipal wells, Church Well No.1 and Church Well No.2, and treated surface water provided by the Innisfil Lake Simcoe Water Filtration Plant (WFP) located in the Town of Innisfil.

The Town is split up into four (4) different pressure zones which are supplied by either well water or surface water. Pressure zones 1A and 1B are primarily supplied with groundwater and Zones 2A and 2B are supplied with surface water via the Innisfil WFP. A series of Pressure Reducing Valves (PRV) exist along the boundaries of zones 1 and 2. The valves operate in a manner that control pressures along the zone boundary and provide back-up water supply from zone 2 to zone 1.

Increase in water supply to support growth in the Town is anticipated to be sourced from the Innisfil WFP. InnServices, the Town of Innisfil's private utility supplier, is currently undertaking a Master Servicing Plan Update that will identify sustainable water servicing solutions to accommodate growth up to 2051. The Town of Bradford West Gwillimbury and Innisfil have entered into an Inter-Municipal Water Supply Agreement, which allows for 19 MLD of water supply to the Town of Bradford West Gwillimbury, to meet the growth demands in Bradford West Gwillimbury (supporting 2051 maximum day demands).

The existing water distribution system consists of a 300 mm diameter watermain on Line 6 and a 250 mm diameter watermain on Inverness Way. There are four (4) existing pressure reducing valves along the pressure district boundary south of Line 6 at Inverness Way, Barrow Avenue, Simcoe Road and Zina Parkway. The PRV located at Inverness Way is the primary valve (i.e. active and flowing) and the other three valves are secondary.

The existing watermain system is illustrated on **Figure 5.3** and **5.4**.

8.2 Proposed Water System

The proposed development will be serviced by an extension of the municipal water distribution system primarily supplied by municipal wells and is located on the south side of pressure zone 1.

The proposed water distribution system will connect to the existing 300 mm diameter watermain on Line 6 and a 250 mm diameter watermain on Inverness Way. A PRV is required on Street A, south of Line 6. The final location and setting of the PRV will be confirmed at detailed design in consultation with the Town to ensure that existing areas are not adversely affected. There is a possibility that units at lower elevations in the development may need individual pressure reducing valves on the water services. The units requiring individual pressure reduction will be reviewed at the detailed design stage.

The hydraulic analysis of the proposed watermain system is shown in **Appendix K**. The preliminary layout for the proposed watermain system is provided on **Figure 5.3** and **5.4.**

The watermain system will be designed in accordance with the Bradford West Gwillimbury and MECP criteria including:

- Residential water usage rate: 300 L/cap/d;
- Population Density: 3.36 people/unit;
- Institutional: 5.0 m^3/ha/d;
- Minimum Pipe Size: 150 mm diameter;
- Minimum Pipe Depth: 1.8 m; and,
- Maximum Hydrant Spacing: 120 m.

9.0 Servicing Allocation

As part of the Draft Plan of Subdivision approval, servicing capacity allocation is provided by the Town of Bradford West Gwillimbury Council.

10.0 Cost Sharing

The cost of infrastructure which benefits multiple properties, such as trunk storm sewers, trunk sanitary sewers, sanitary pumping stations, watermains, collector roads, and stormwater management facilities, should be shared by the benefiting landowners.

11.0 Utility Considerations

The utility companies (hydro, natural gas, and telecommunications) were circulated the first submission of the proposed draft plan of subdivision. The following responses were received.

11.1 Hydro

Hydro One Networks Inc. responded on March 21, 2024 and noted that they did not have any comments or concerns at the time. Their preliminary review considered issues affecting their 'High Voltage Facilities and Corridor Lands' only. Hydro One Networks Inc. is also the local area distribution supplier and will be contacted to confirm the low voltage distribution facility capacity.

11.2 Gas

Enbridge Gas responded on December 28, 2023 and noted no objection to the proposed application. Further coordination with Enbridge Gas will be completed at the detailed design stage.

11.3 Telecommunications

Bell Canada responded on January 2, 2024 provided draft plan conditions. Further coordination with Bell Canada will be completed at the detailed design stage.

Availability of cable and fibre optic telecommunications has not yet been confirmed.

12.0 Erosion and Sediment Control During Construction

During the detailed design stage, 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 fencing, mud mats, catchbasin sediment control devices, rock check dams and temporary sediment control ponds). These measures will be designed and constructed as per the Technical Guidelines for Stormwater Management Submissions (LSRCA, 2022). A detailed erosion and sediment control plan will be prepared for review and approval by the Town of Bradford West Gwillimbury and the LSRCA 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 watercourses and properties are minimized both during and following construction.

13.0 Summary

This Functional Servicing and Stormwater Management Report has been prepared in support of the Draft Plan of Subdivision and Zoning By-law Amendment applications for the proposed Bradford Highlands development in the Town of Bradford West Gwillimbury. This report outlines the means by which the proposed development can be graded and serviced in accordance with the Town of Bradford West Gwillimbury, Lake Simcoe Region Conservation Authority, Lake Simcoe Protection Plan, and the Ministry of Environment, Conservation and Parks design criteria and policies.

General Information

- The existing land use is golf course and a rural residential property;
- The proposed development is located in the West Holland River watershed; and,
- The proposed development consists of low rise residential, park, school, environmental protection, and a stormwater management block.

Grading

- The proposed development grading has been developed to match to the existing surrounding grades, and provide conveyance of stormwater runoff, including external drainage; and
- The site grading will be subject to further grading design at the detailed design stage.

Rights-of-Way and Sidewalks

- The proposed development will follow Bradford West Gwillimbury standards B102, B103 and B106 for the design of right-of-ways and sidewalks.

Storm Servicing and Stormwater Management

- Storm Servicing:
  - Storm runoff will be conveyed by storm sewers designed in accordance with Municipality and MECP criteria;
  - Storm sewers will generally be designed for the 10 year storm event; and
  - Adequate 100 year overland flow routes will be provided.
- Existing external drainage will be accommodated through the proposed development via a municipal storm sewer.
- Due to site constraints, 90th percentile runoff volume control cannot be achieved. Therefore, conventional methods are required to meet water quality and water balance criteria;
- Quality Control: Enhanced water quality protection can be provided through the use of a proposed and existing wet SWM pond;

- Phosphorus Budget: A phosphorus budget analysis was completed, which shows that the proposed phosphorus export will exceed the existing conditions. The phosphorus export is being mitigated through the use of rear yard infiltration trenches, wet SWM ponds, and a stormwater filter to the maximum extent possible. The phosphorus export exceeding existing conditions will be subject to LSRCA's Phosphorus Offsetting Policy;
- Erosion Control: The runoff volume from a 25 mm rainfall event will be detained over a minimum of 24 hours by a proposed and existing wet SWM pond;
- Volume Control: The on-site retention/filtration of runoff will be provided to the extent feasible by a treatment train of LIDs and BMPs through the use of rear yard infiltration trenches, wet SWM pond and MTD filtration to achieve the minimum LSRCA Volume Control objective;
- Water Budget: WSP has completed a water budget analysis. Due to site constraints, a recharge deficit is anticipated and will be subject to LSRCA's Recharge Compensation Program;
- Quantity Control: Quantity control will be provided via a wet SWM pond and an existing downstream SWM pond (SWM Pond 700-2) to control proposed runoff rates in the 2 through 100 year storm events;

Sanitary Servicing

- The proposed development will connect to the existing sanitary stub on Inverness Way and the Green Valley SPS;
- The proposed development will generate a flow of 39.1 L/s; and
- The proposed total flow at the Green Valley SPS will be 97.1 L/s, which is below the firm capacity of 102 L/s.

Water Supply and Distribution

- There are existing municipal watermains on Line 6 and Inverness Way;
- The development is proposed to be serviced with three connections to the existing watermain network;
- Municipal Engineering Solutions has completed a watermain hydraulic analysis to show that there is sufficient domestic and fire flows to service the development;
- A PRV is required on Street A, south of Line 6; and
- Water supply allocation is required from the Town.

Erosion and Sediment Control during Construction

- An erosion and sediment control plan will be prepared at the detailed engineering stage, in accordance with the LSRCA Technical Guidelines for Stormwater Management Submissions.

Utility Considerations

- Utility companies have been contacted and no concerns have been noted.

Respectfully Submitted:

SCS Consulting Group Ltd.

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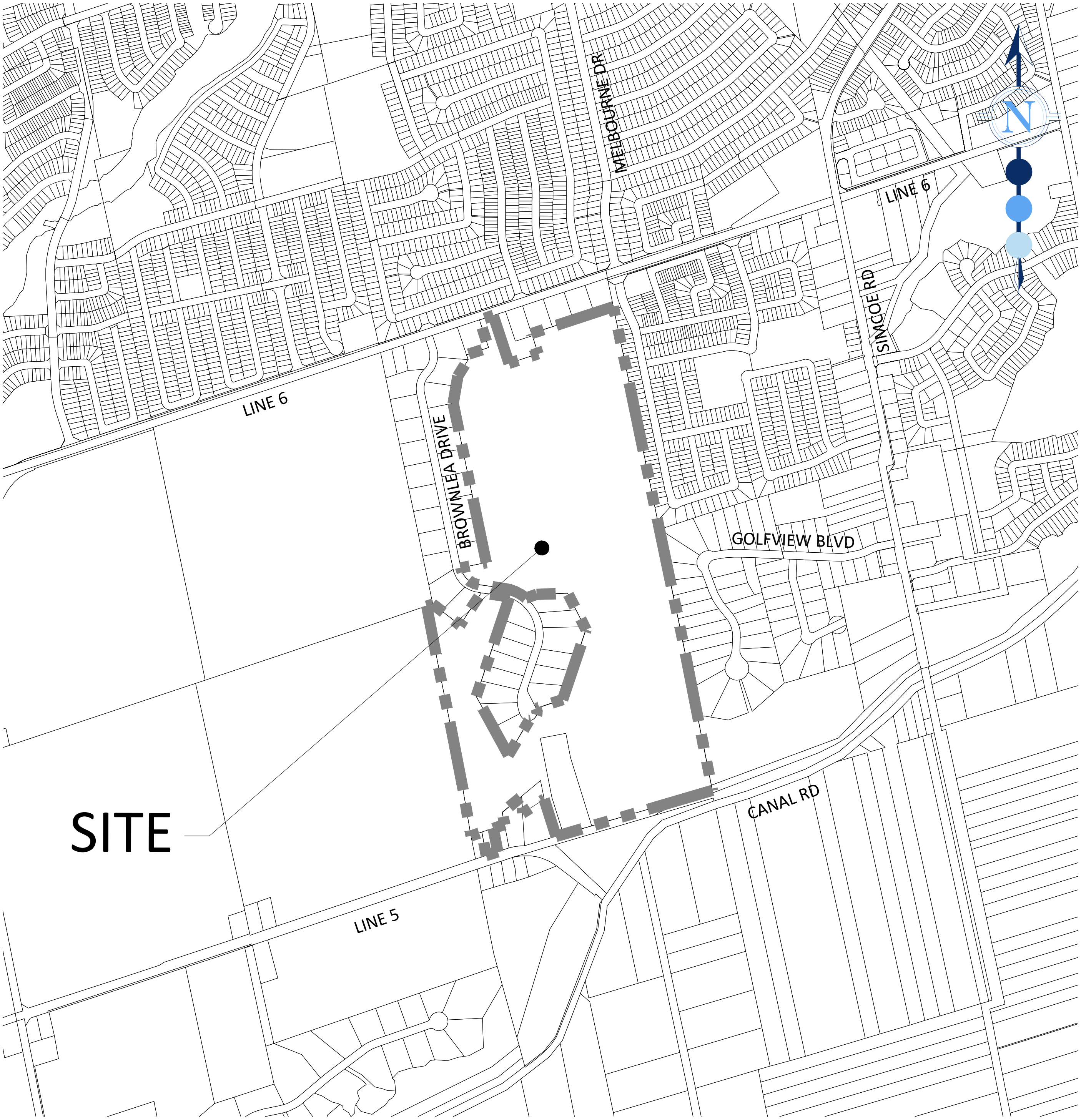
Figures

SCS consulting group ltd



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

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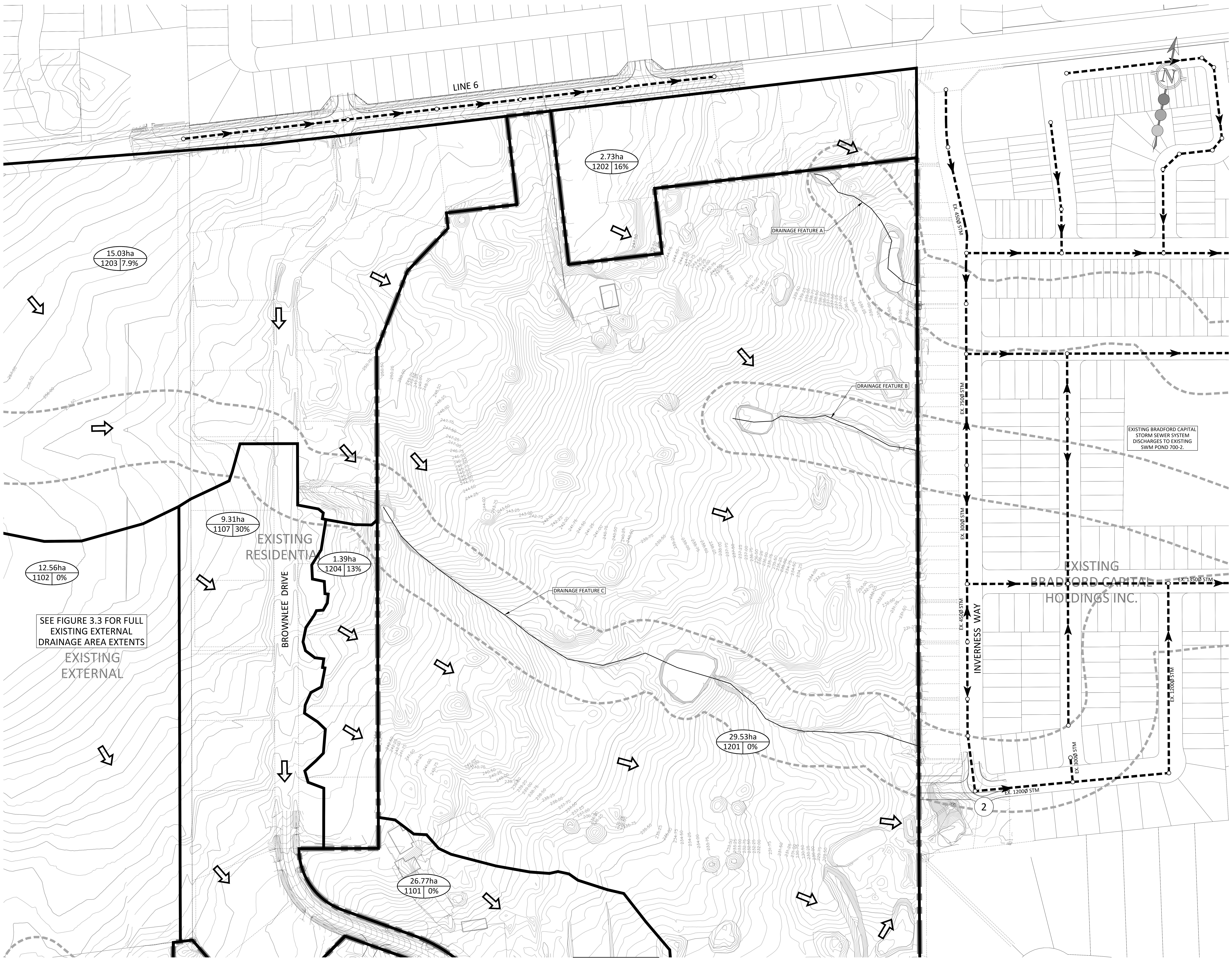
BRADFORD HIGHLANDS

SITE LOCATION PLAN

DESIGNED BY: R.J.S.	CHECKED BY: P.S.	PROJECT No: 1791	FIGURE No: 1.1
SCALE: 1:15000	DATE: NOVEMBER 2024		



SEE FIG. 3.2

LEGEND:

- LIMIT OF DEVELOPMENT
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- EXISTING STORM SEWER AND MAINTENANCE HOLE
- MAX 3:1 SLOPE
- 236.25 EXISTING ELEVATION AND CONTOUR
- STORM DRAINAGE FLOW DIRECTION
- STORM DRAINAGE BOUNDARY
- 0.35ha DRAINAGE AREA (HECTARES)
- 20% IMPERVIOUSNESS
- 99 CATCHMENT ID
- 100 YEAR FLOODLINE
- REGIONAL FLOODLINE
- WATERCOURSE BANKS AND FLOW DIRECTION
- 1 OUTLET ID

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BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

EXISTING STORM DRAINAGE PLAN 1

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	3.1

SEE FIG. 3.1

LEGEND:

- LIMIT OF DEVELOPMENT
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- EXISTING STORM SEWER AND MAINTENANCE HOLE
- MAX 3:1 SLOPE
- 236.25 EXISTING ELEVATION AND CONTOUR
- STORM DRAINAGE FLOW DIRECTION
- STORM DRAINAGE BOUNDARY
- 0.35ha / 99 | 20%: DRAINAGE AREA (HECTARES), IMPERVIOUSNESS, CATCHMENT ID
- 100 YEAR FLOODLINE
- REGIONAL FLOODLINE
- WATERCOURSE BANKS AND FLOW DIRECTION
- 1 OUTLET ID

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BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

EXISTING STORM DRAINAGE PLAN 2

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	3.2

BRADFORD HIGHLANDS JOINT VENTURE

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LEGEND:

- LIMIT OF DEVELOPMENT
- STORM DRAINAGE BOUNDARY
- OVERLAND FLOW DIRECTION
- 0.35ha — DRAINAGE AREA (HECTARES); 20% — IMPERVIOUSNESS; 99 — CATCHMENT ID
- WATERCOURSE BANKS AND FLOW DIRECTION
- (1) OUTLET ID

BRADFORD HIGHLANDS

OVERALL STORM DRAINAGE PLAN

DESIGNED BY:	E.A.S./H.Y.	CHECKED BY:	E.T.C.K.	PROJECT No:	FIGURE No:
SCALE:	1:3000	DATE:	NOVEMBER 2024	1791	3.3

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-3.3-STRM-OVRL.dwg – Revised by <SOZDEMIR> : Fri, Nov 01 2024 – 1:23pm

LEGEND:

	LIMIT OF DEVELOPMENT
× 223.91	PROPOSED ELEVATION
× 224.35EX	EXISTING ELEVATION
0.5%	ROAD SLOPE
	MAX 3:1 SLOPE
236.25	EXISTING ELEVATION AND CONTOUR
	LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
	100 YEAR FLOODLINE (LSRCA, 2024)
	REGIONAL FLOODLINE (LSRCA, 2024)
	WATERCOURSE BANKS AND FLOW DIRECTION

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

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BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PRELIMINARY GRADING PLAN 1

DESIGNED BY:	M.P./K.S.	CHECKED BY:	P.S.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	3.4

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-3.4-3.5-GRAD.dwg — Revised by <SOZDEMIR> : Fri, Nov 01 2024 — 1:26pm

LEGEND:

	LIMIT OF DEVELOPMENT
× 223.91	PROPOSED ELEVATION
× 224.35EX	EXISTING ELEVATION
0.5%	ROAD SLOPE
	MAX 3:1 SLOPE
	EXISTING ELEVATION AND CONTOUR
	LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
	100 YEAR FLOODLINE (LSRCA, 2024)
	REGIONAL FLOODLINE (LSRCA, 2024)
	WATERCOURSE BANKS AND FLOW DIRECTION

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

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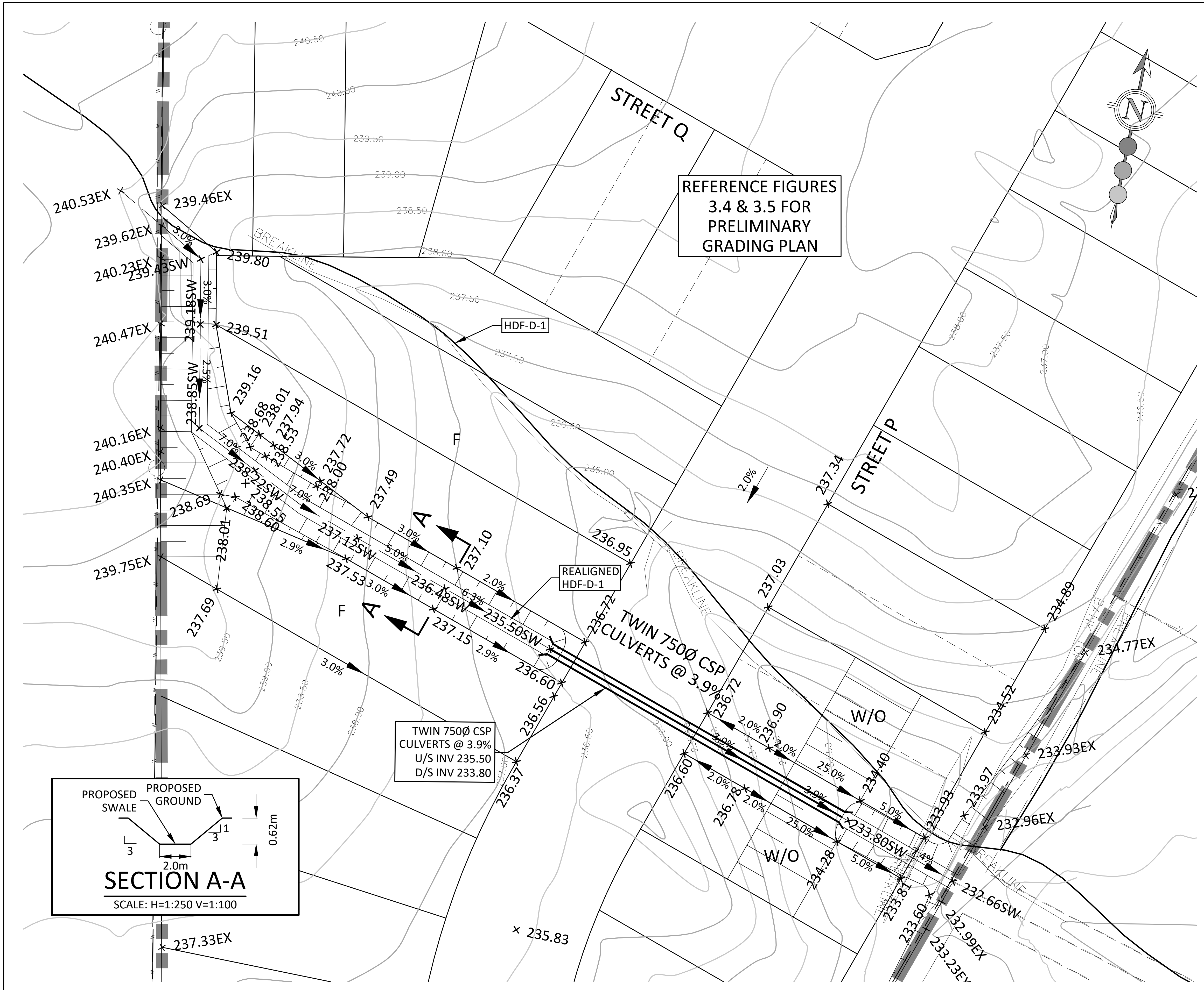
BRADFORD HIGHLANDS

PRELIMINARY GRADING PLAN 2

DESIGNED BY:	M.P./K.S.	CHECKED BY:	P.S.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	3.5



LEGEND:

LIMIT OF DEVELOPMENT

× 223.91 PROPOSED ELEVATION

× 224.35EX EXISTING ELEVATION

0.5% ROAD SLOPE

MAX 3:1 SLOPE

236.25 EXISTING ELEVATION AND CONTOUR

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

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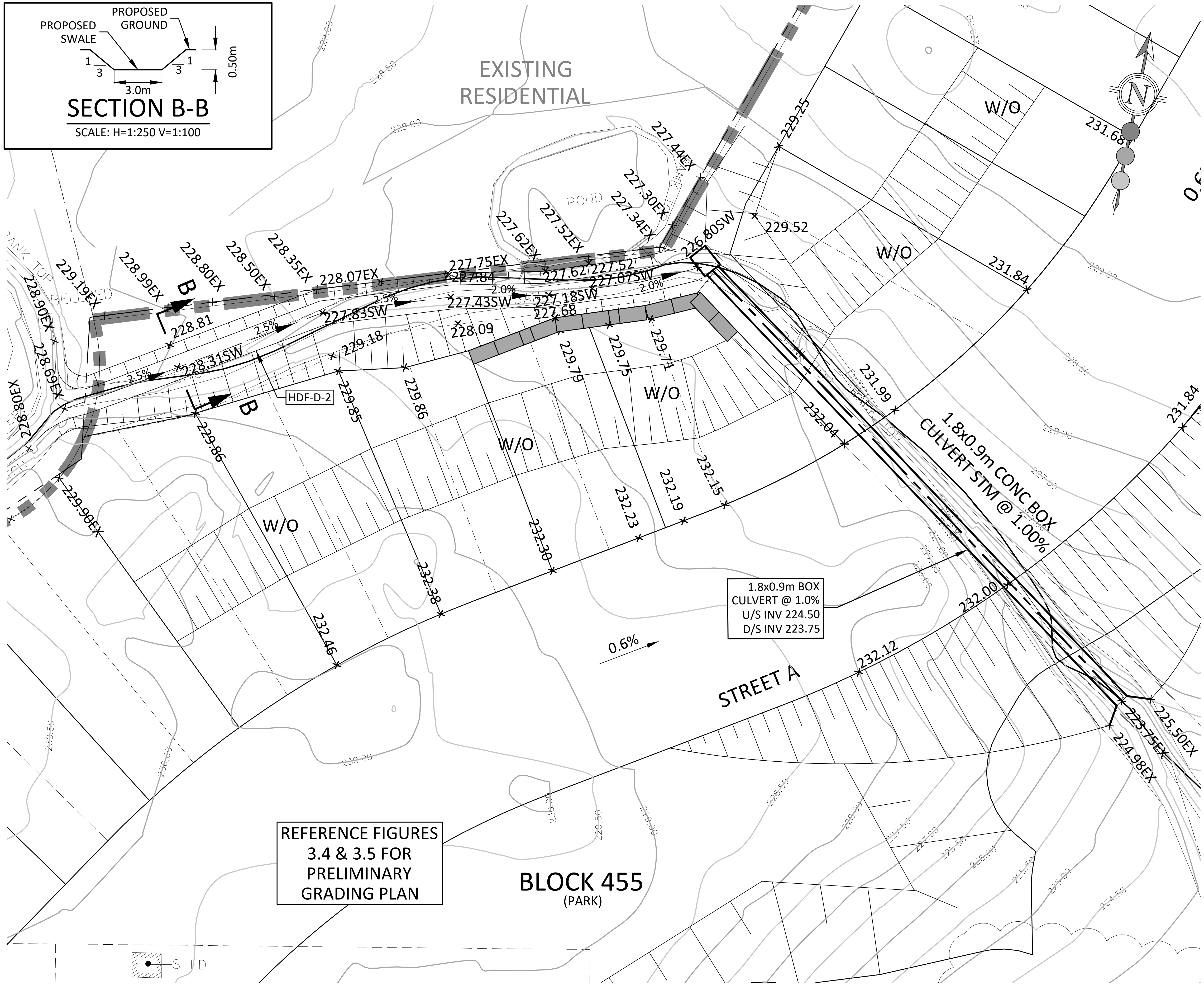
BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PRELIMINARY HDF-D-1 GRADING PLAN

DESIGNED BY:	K.A.S.	CHECKED BY:	P.S.
SCALE:	1:500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	3.6

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-3.6-3.7-GRAD.dwg - Revised by <SOZDEMIR> : Fri, Nov 01 2024 - 3:27pm



LEGEND:

LIMIT OF DEVELOPMENT

× 223.91 PROPOSED ELEVATION

× 224.35EX EXISTING ELEVATION

0.5% ROAD SLOPE

MAX 3:1 SLOPE

236.25 EXISTING ELEVATION AND CONTOUR

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

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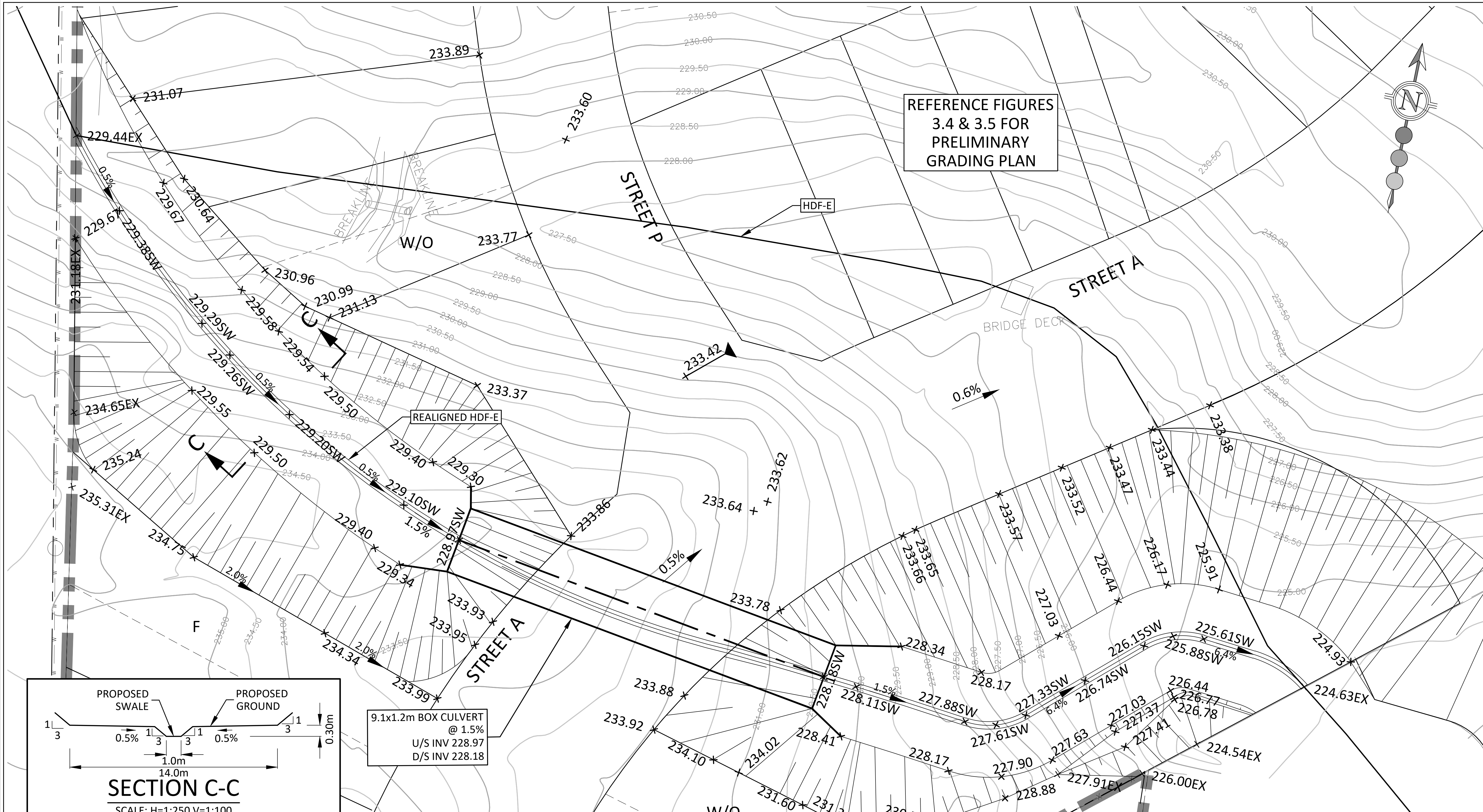
BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PRELIMINARY HDF-D-2 GRADING PLAN

DESIGNED BY:	K.A.S.	CHECKED BY:	P.S.
SCALE:	1:500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	3.7



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

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LEGEND:

(dashed bar)	LIMIT OF DEVELOPMENT
× 223.91	PROPOSED ELEVATION
(hatched line)	MAX 3:1 SLOPE
× 224.35EX	EXISTING ELEVATION
0.5%	ROAD SLOPE
236.25	EXISTING ELEVATION AND CONTOUR

BRADFORD HIGHLANDS

PRELIMINARY HDF-E GRADING PLAN

DESIGNED BY:	K.A.S.	CHECKED BY:	P.S.
SCALE:	1:500	DATE:	NOVEMBER 2024

PROJECT No: 1791

FIGURE No: 3.8

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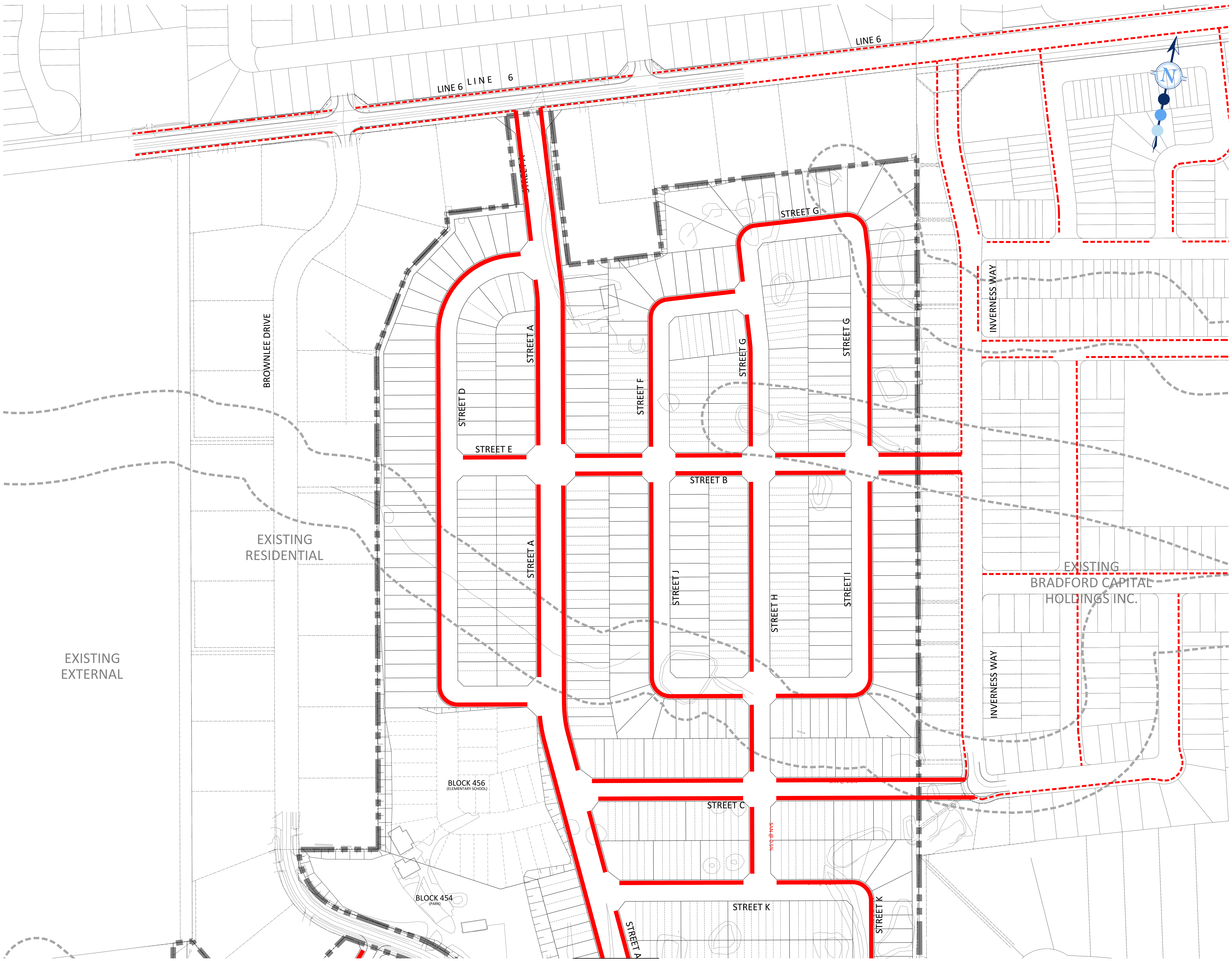

SEE FIG. 4.2

LEGEND:

LIMIT OF DEVELOPMENT

LSCRA REGULATION LIMIT
(SOURCE: LSRCA OPEN DATA OCT 2024)

PROPOSED 1.5m WIDE SIDEWALK

EXISTING 1.5m WIDE SIDEWALK

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

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BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

SIDEWALK LOCATION PLAN

DESIGNED BY:	M.P./K.S.	CHECKED BY:	P.S.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	4.1

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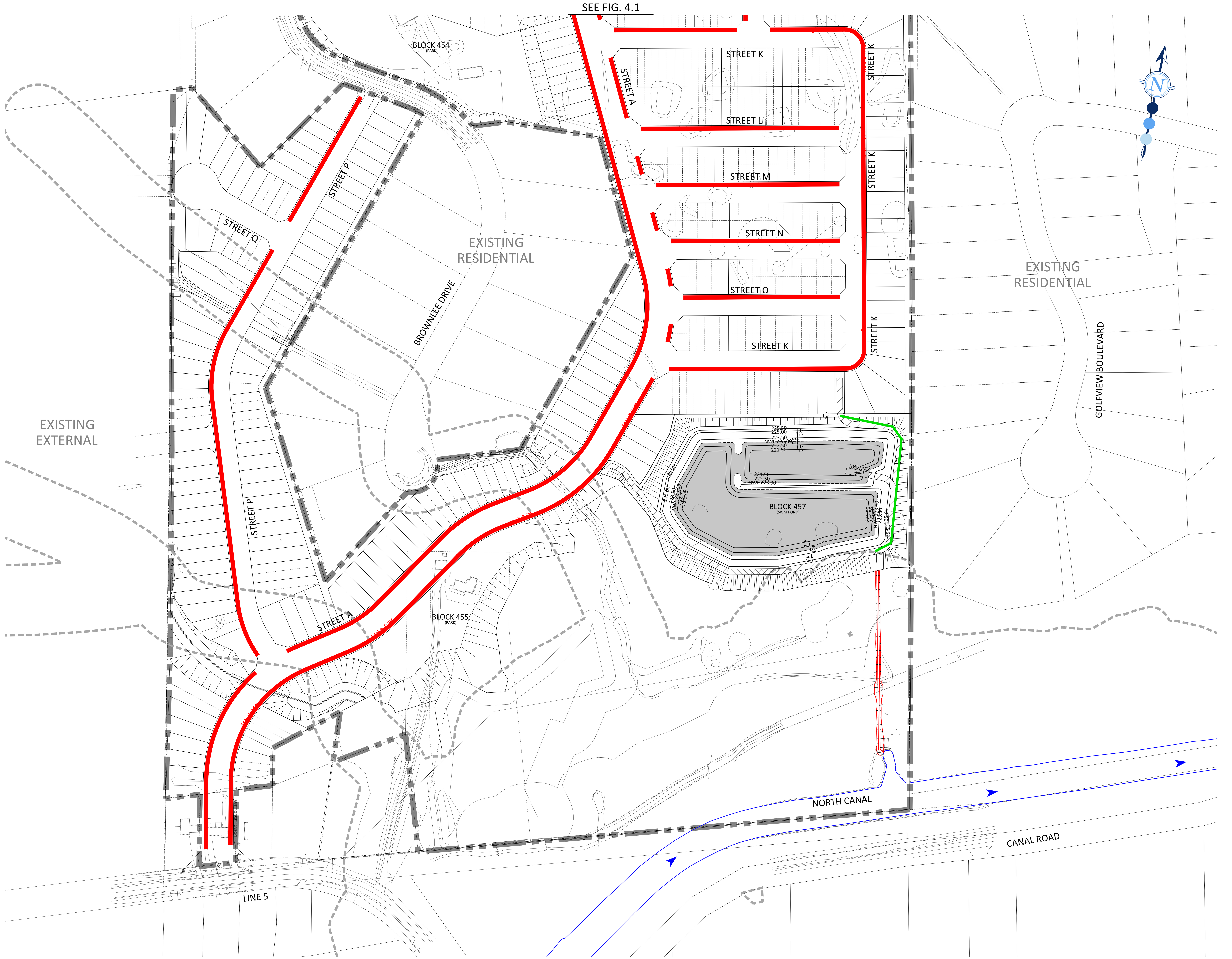

LEGEND:

LIMIT OF DEVELOPMENT

LSCRA REGULATION LIMIT
(SOURCE: LSRCA OPEN DATA OCT 2024)

PROPOSED 1.5m WIDE SIDEWALK

EXISTING 1.5m WIDE SIDEWALK

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

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BRADFORD HIGHLANDS JOINT VENTURE

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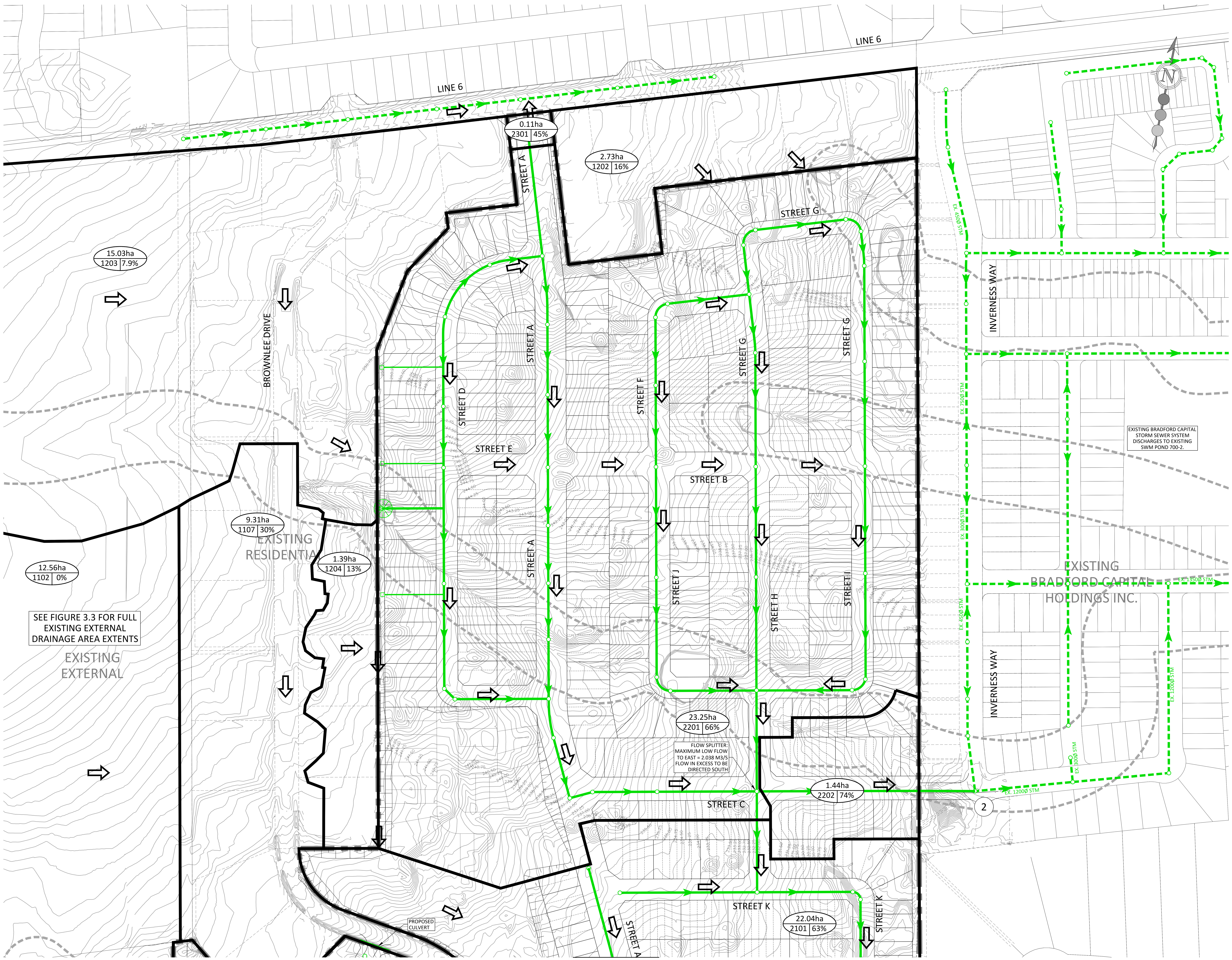
SIDEWALK LOCATION PLAN

DESIGNED BY:	M.P./K.S.	CHECKED BY:	P.S.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	4.2



SEE FIG. 5.2

LEGEND:

- LIMIT OF DEVELOPMENT
- LSRCA REGULATION LIMIT
- MAX 3:1 SLOPE
- 236.25 EXISTING ELEVATION AND CONTOUR
- MAJOR STORM DRAINAGE FLOW DIRECTION
- STORM DRAINAGE BOUNDARY
- 0.35ha / 99 / 20%: DRAINAGE AREA (HECTARES); IMPERVIOUSNESS; CATCHMENT ID
- 100 YEAR FLOODLINE
- REGIONAL FLOODLINE
- 100 YEAR STORM CAPTURE
- PROPOSED STORM SEWER AND MAINTENANCE HOLE
- EXISTING STORM SEWER AND MAINTENANCE HOLE
- WATERCOURSE BANKS AND FLOW DIRECTION
- 1 OUTLET ID

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

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BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED STORM DRAINAGE PLAN 1

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	5.1

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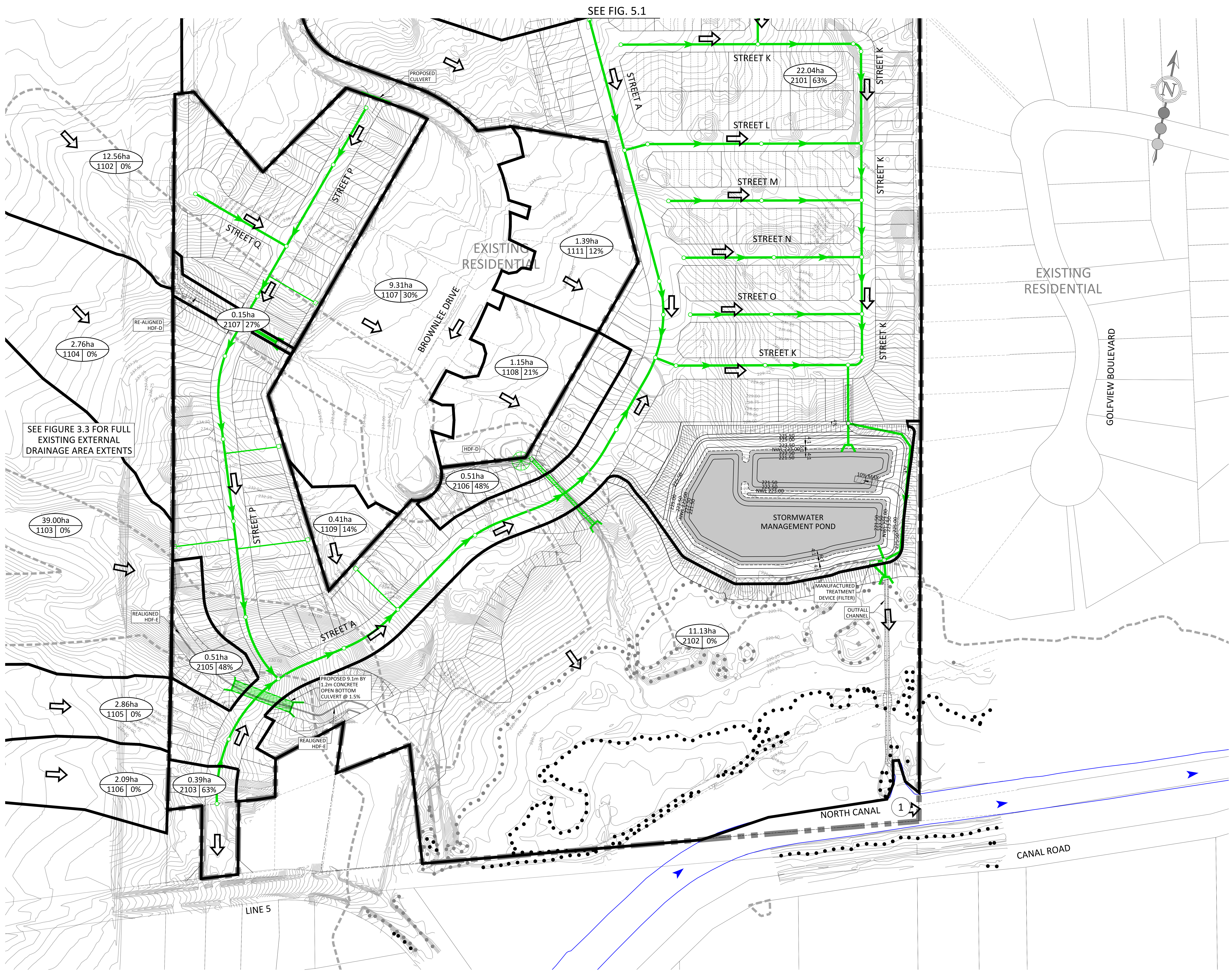

LEGEND:

- LIMIT OF DEVELOPMENT
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- MAX 3:1 SLOPE
- 236.25 — EXISTING ELEVATION AND CONTOUR
- MAJOR STORM DRAINAGE FLOW DIRECTION
- STORM DRAINAGE BOUNDARY
- 0.35ha / 99 | 20% — DRAINAGE AREA (HECTARES), RUNOFF IMPERVIOUSNESS, CATCHMENT ID
- 100 YEAR FLOODLINE
- REGIONAL FLOODLINE
- 100 YEAR STORM CAPTURE
- PROPOSED STORM SEWER AND MAINTENANCE HOLE
- EXISTING STORM SEWER AND MAINTENANCE HOLE
- WATERCOURSE BANKS AND FLOW DIRECTION
- 1 — OUTLET ID

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

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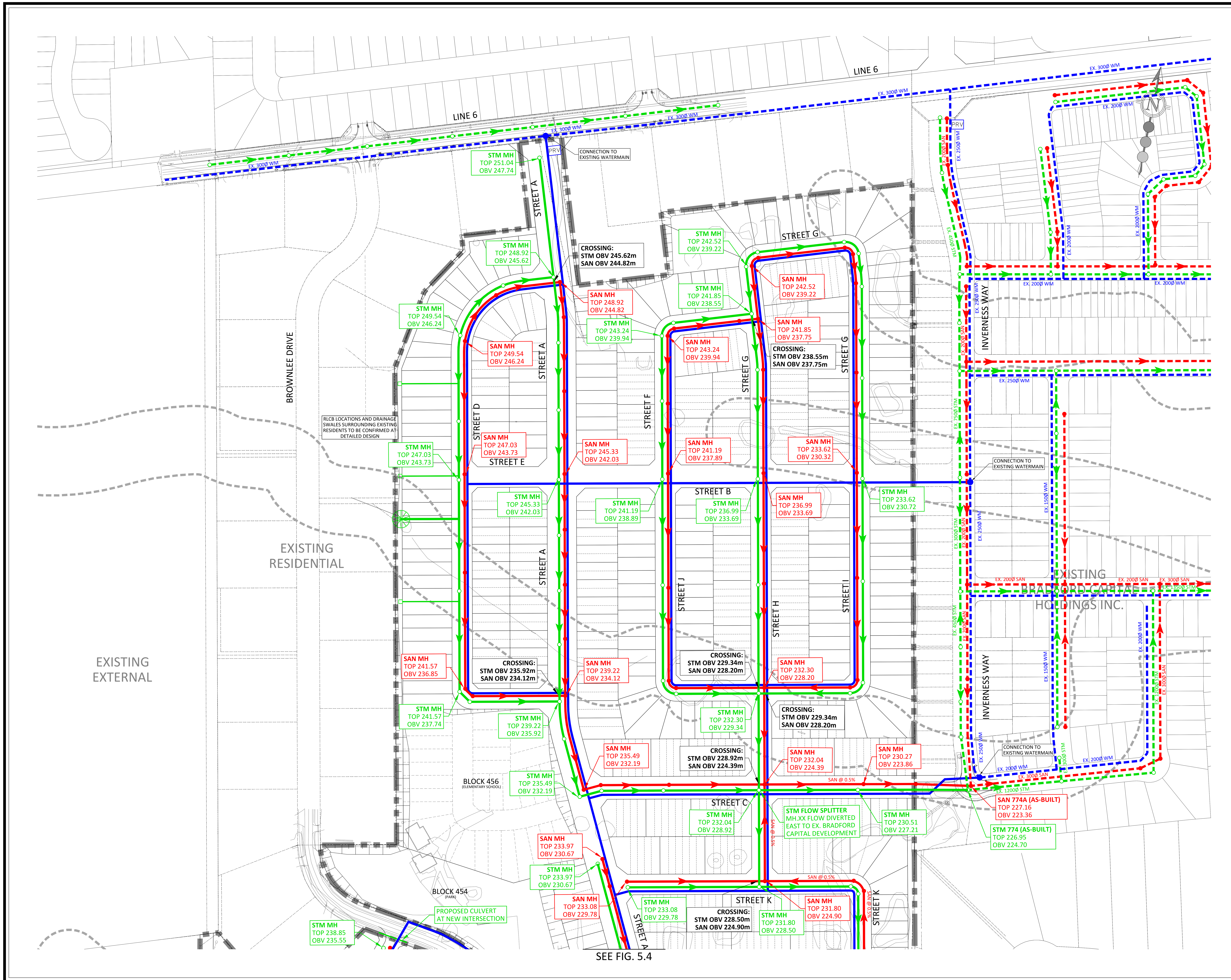
BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED STORM DRAINAGE PLAN 2

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No: 1791		FIGURE No: 5.2	

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-5.1-5.2-STRM-PROP.dwg – Revised by <SOZDEMIR> : Fri, Nov 01 2024 – 1:32pm



SEE FIG. 5.4

LEGEND:

- LIMIT OF DEVELOPMENT
- PROPOSED STORM SEWER AND MAINTENANCE HOLE
- PROPOSED SANITARY SEWER AND MAINTENANCE HOLE
- EXISTING STORM SEWER AND MAINTENANCE HOLE
- EXISTING SANITARY SEWER AND MAINTENANCE HOLE
- PROPOSED WATERMAIN
- EXISTING WATERMAIN
- 100 YEAR CAPTURE POINT
- PRV PROPOSED PRV

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

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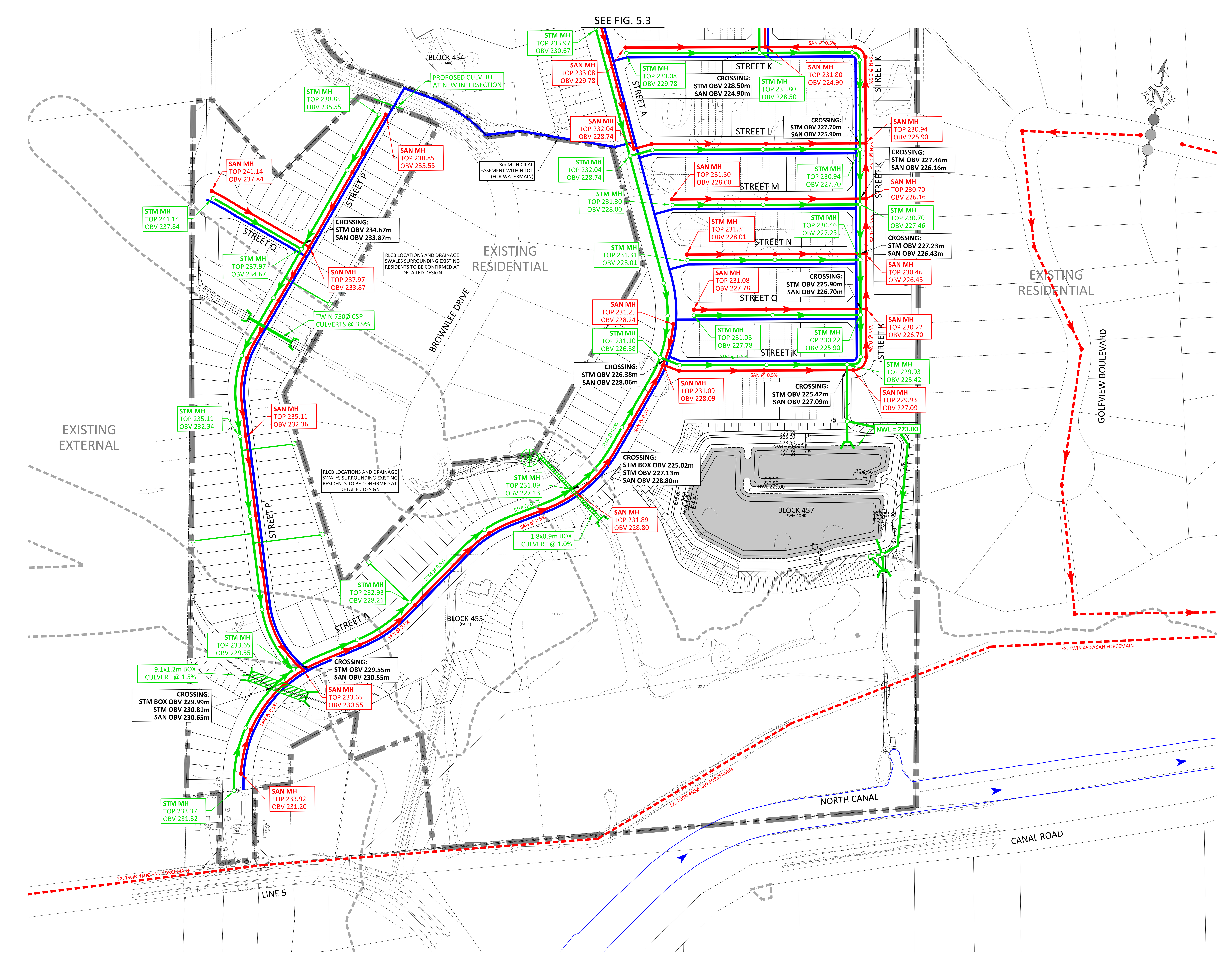
BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED SERVICING PLAN 2

DESIGNED BY:	M.P./K.S.	CHECKED BY:	P.S.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	5.3

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-5.3-5.4-SERV.dwg – Revised by <KSCHAEFER> : Fri, Nov 01 2024 – 10:10am



LEGEND:

	LIMIT OF DEVELOPMENT
	PROPOSED STORM SEWER AND MAINTENANCE HOLE
	PROPOSED SANITARY SEWER AND MAINTENANCE HOLE
	EXISTING STORM SEWER AND MAINTENANCE HOLE
	EXISTING SANITARY SEWER AND MAINTENANCE HOLE
	PROPOSED WATERMAIN
	EXISTING WATERMAIN
	100 YEAR CAPTURE POINT
PRV	PROPOSED PRV

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

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BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED SERVICING PLAN 1

DESIGNED BY:	M.P./K.S.	CHECKED BY:	P.S.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	5.4

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-5.3-5.4-SERV.dwg – Revised by <KSHAEFER> : Fri, Nov 01 2024 – 10:12am

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

BRADFORD HIGHLANDS
JOINT VENTURE

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LEGEND:

LIMIT OF PROPERTY

LSRCA REGULATION LIMIT
(SOURCE: LSRCA OPEN DATA OCT 2024)

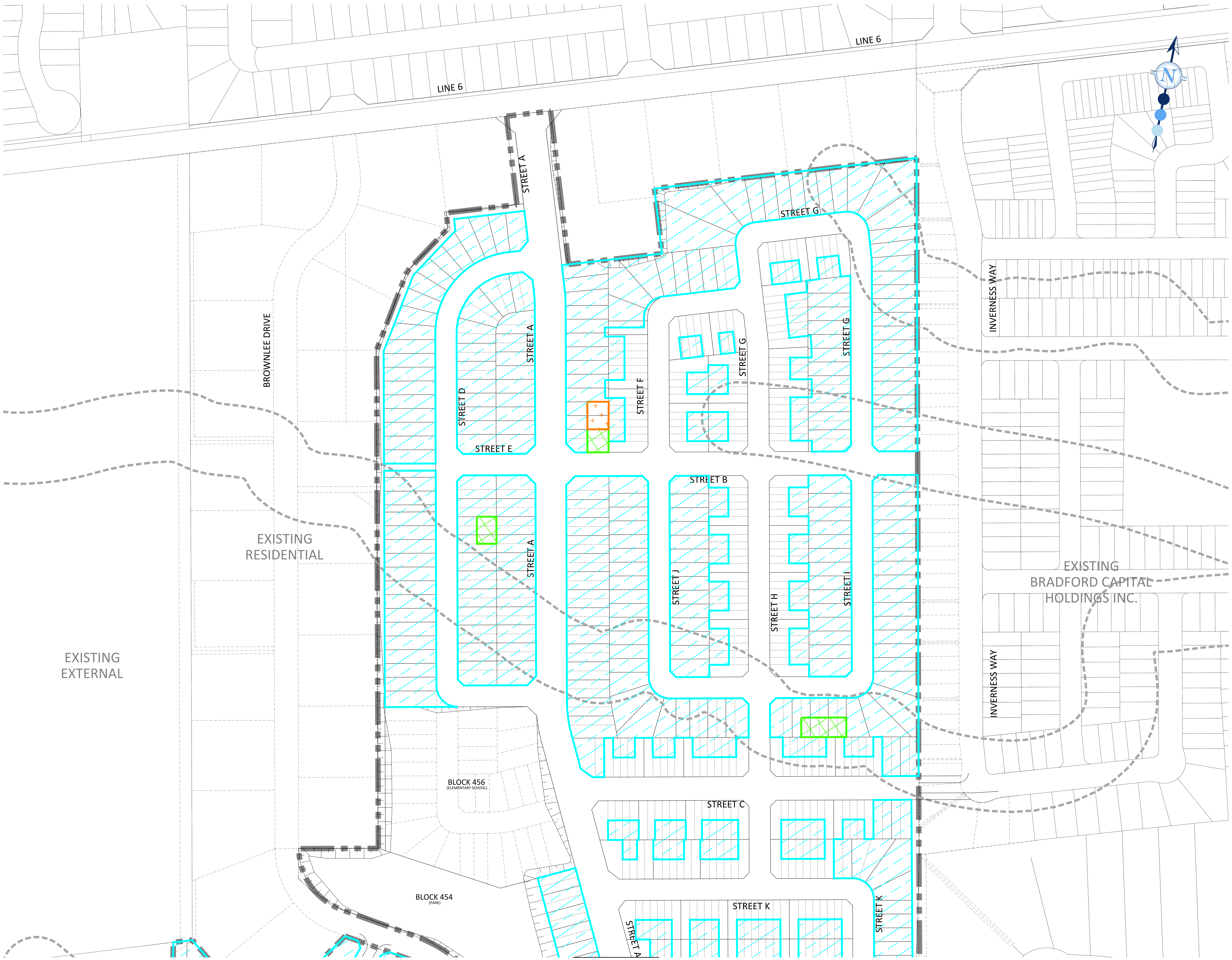
WATERCOURSE BANKS AND FLOW DIRECTION

BRADFORD HIGHLANDS

GROUNDWATER DEPTH MAP

DESIGNED BY: E.A.S./H.Y.	CHECKED BY: E.T.C.K.	PROJECT No: 1791	FIGURE No: 6.1
SCALE: 1:2000	DATE: NOVEMBER 2024		

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-6.1-GRND-WATR.dwg - Revised by <SOZDEMIR> : Fri, Nov 01 2024 - 1:36pm



SEE FIG. 6.3

LEGEND:

- LIMIT OF DEVELOPMENT
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- ROOF TO GRASS DRAINAGE AREA
- REAR YARD SHALLOW INFILTRATION TRENCH DRAINAGE AREA - SEMI-DETACHED LOTS
- REAR YARD SHALLOW INFILTRATION TRENCH DRAINAGE AREA - SINGLE LOTS
- WATERCOURSE BANKS AND FLOW DIRECTION

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

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BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED LID PLAN 1

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	6.2

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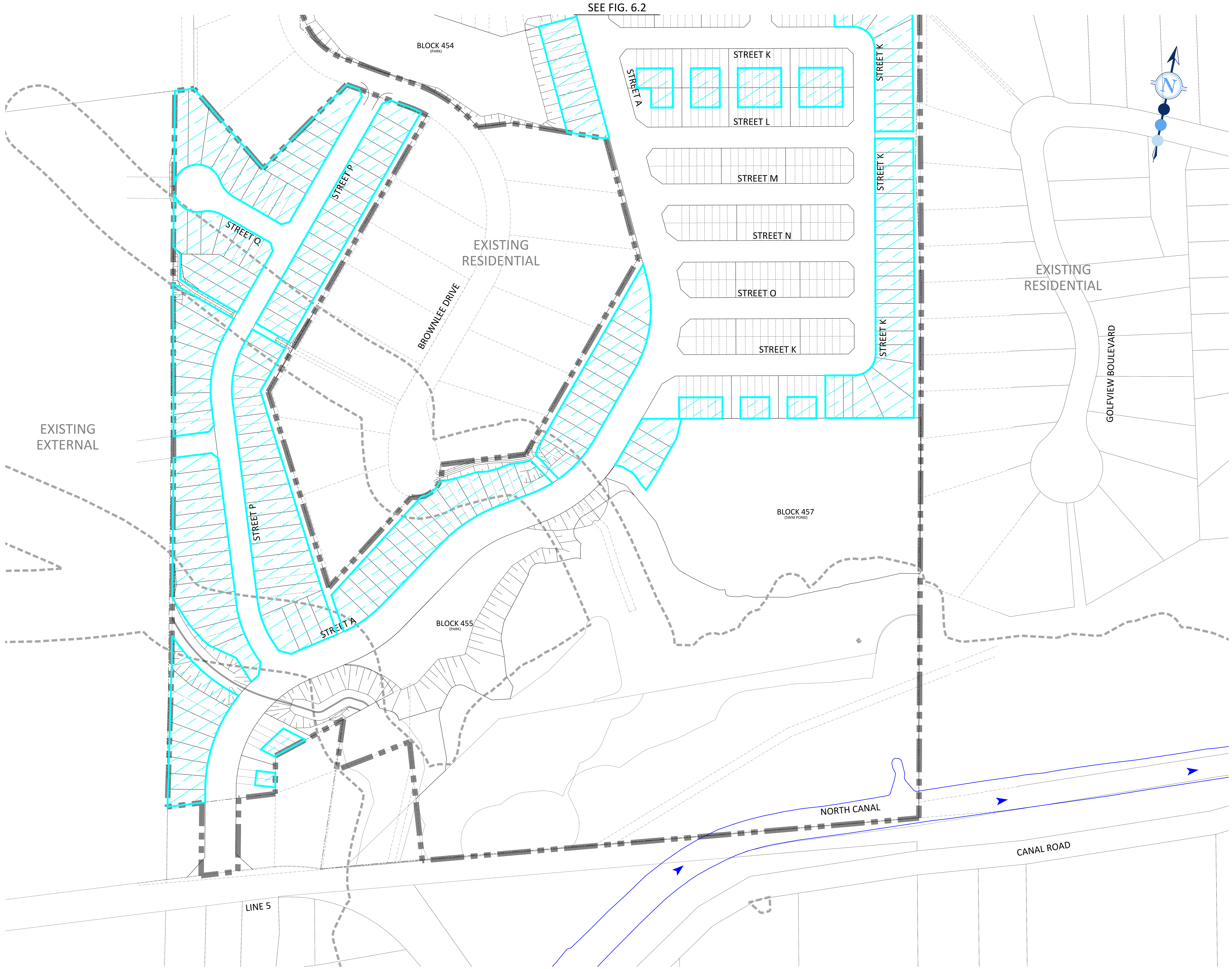

LEGEND:

- LIMIT OF DEVELOPMENT
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- ROOF TO GRASS DRAINAGE AREA
- REAR YARD SHALLOW INFILTRATION TRENCH DRAINAGE AREA - SEMI-DETACHED LOTS
- REAR YARD SHALLOW INFILTRATION TRENCH DRAINAGE AREA - SINGLE LOTS
- WATERCOURSE BANKS AND FLOW DIRECTION

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

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BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED LID PLAN 2

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	6.3

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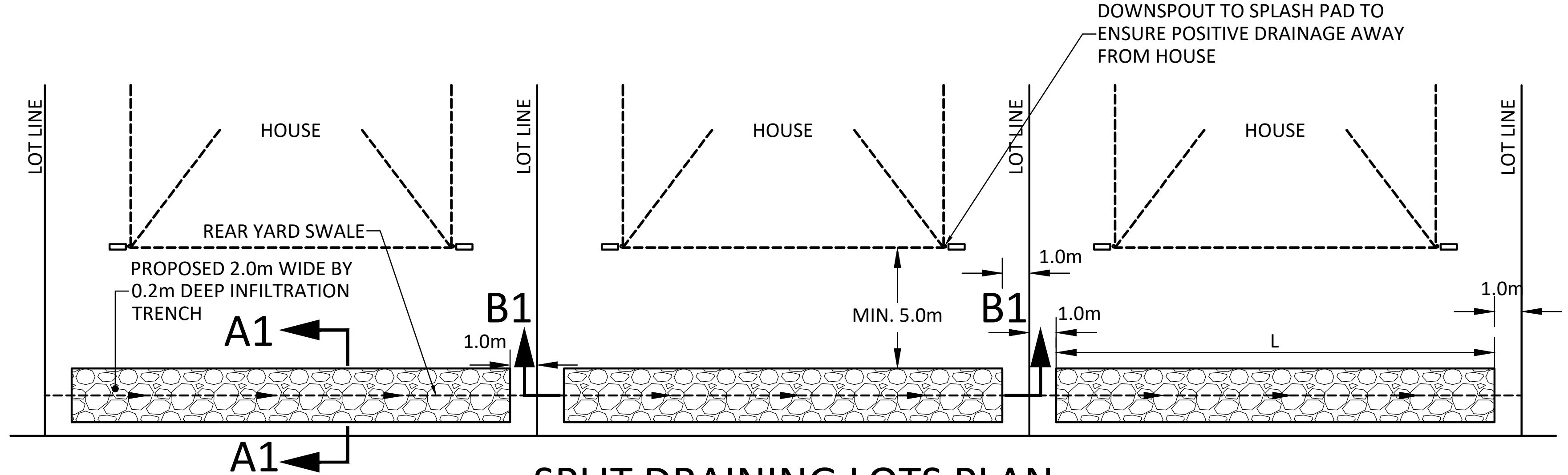
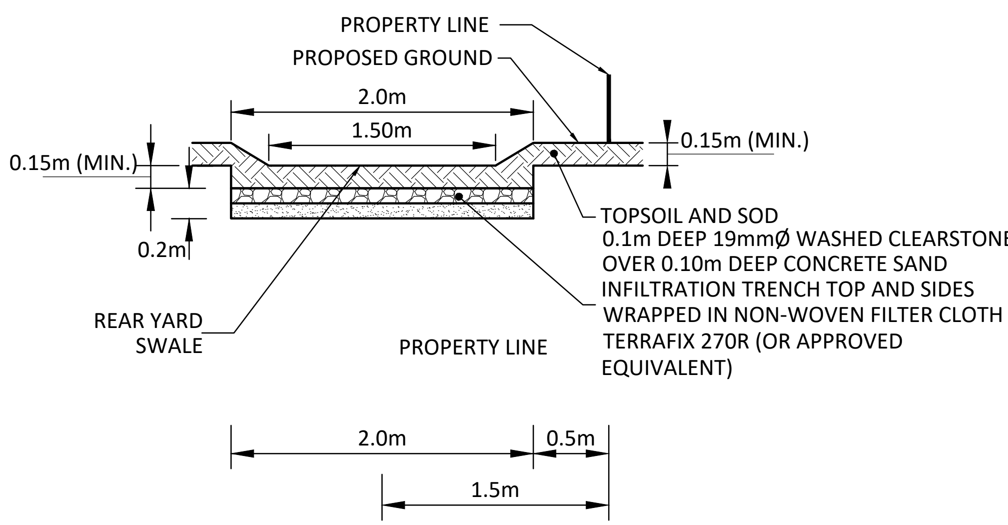


SPLIT DRAINING LOTS PLAN

SCALE 1:250

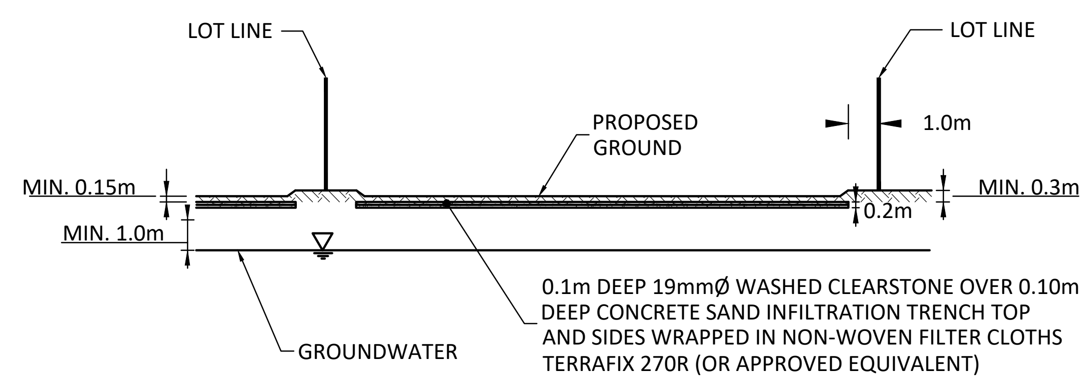
LOT FRONTAGE (m)	L LENGTH (m)	D DEPTH (m)	W WIDTH (m)
11.6 (SINGLES)	9.6	0.2	2.0
7.6 (SEMI-DETACHED)	5.6	0.2	2.0

INFILTRATION TRENCH DIMENSION SUMMARY



SECTION A1-A1 INFILTRATION TRENCH ASSEMBLY

SCALE 1:50



SECTION B1-B1

SCALE 1:250

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

BRADFORD HIGHLANDS JOINT VENTURE

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

LEGEND:

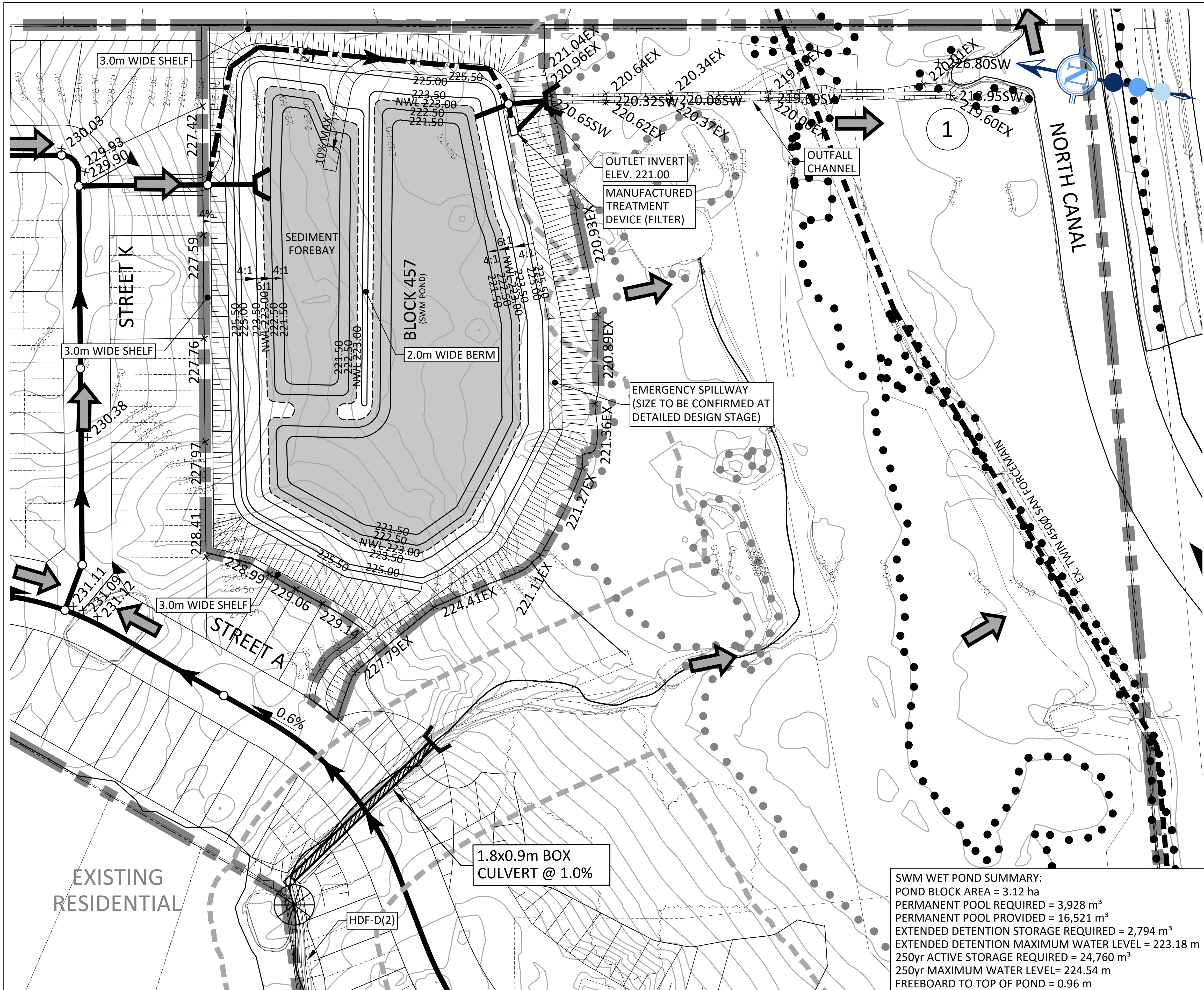
BRADFORD HIGHLANDS

REAR YARD INFILTRATION TRENCH DETAIL

DESIGNED BY:	E.A.S./H.Y.	CHECKED BY:	E.T.C.K.
SCALE:	1:1000	DATE:	NOVEMBER 2024

PROJECT No: 1791

FIGURE No: 6.4



SWM WET POND SUMMARY:
POND BLOCK AREA = 3.12 ha
PERMANENT POOL REQUIRED = 3,928 m³
PERMANENT POOL PROVIDED = 16,521 m³
EXTENDED DETENTION STORAGE REQUIRED = 2,794 m³
EXTENDED DETENTION MAXIMUM WATER LEVEL = 223.18 m
250yr ACTIVE STORAGE REQUIRED = 24,760 m³
250yr MAXIMUM WATER LEVEL= 224.54 m
FREEBOARD TO TOP OF POND = 0.96 m

LEGEND:

- LIMIT OF SWM POND BLOCK
- LIMIT OF DEVELOPMENT
- 221.00 EXISTING CONTOUR AND ELEVATION
- PROPOSED STORM SEWER AND MAINTENANCE HOLE
- MAINTENANCE BYPASS PIPE
- 155.00 PROPOSED CONTOUR ELEVATION
- NWL 153.00 PROPOSED NORMAL WATER LEVEL ELEVATION
- 100 YEAR CAPTURE LOCATION
- OVERLAND FLOW ROUTE
- MAX 3:1 SLOPING
- PERMANENT POOL
- MAINTENANCE ACCESS ROAD
- OVERLAND FLOW ROUTE/SPILLWAY
- 100 YEAR FLOODLINE (LSRCA, 2024)
- REGIONAL FLOODLINE (LSRCA, 2024)
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- 1 OUTLET ID

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

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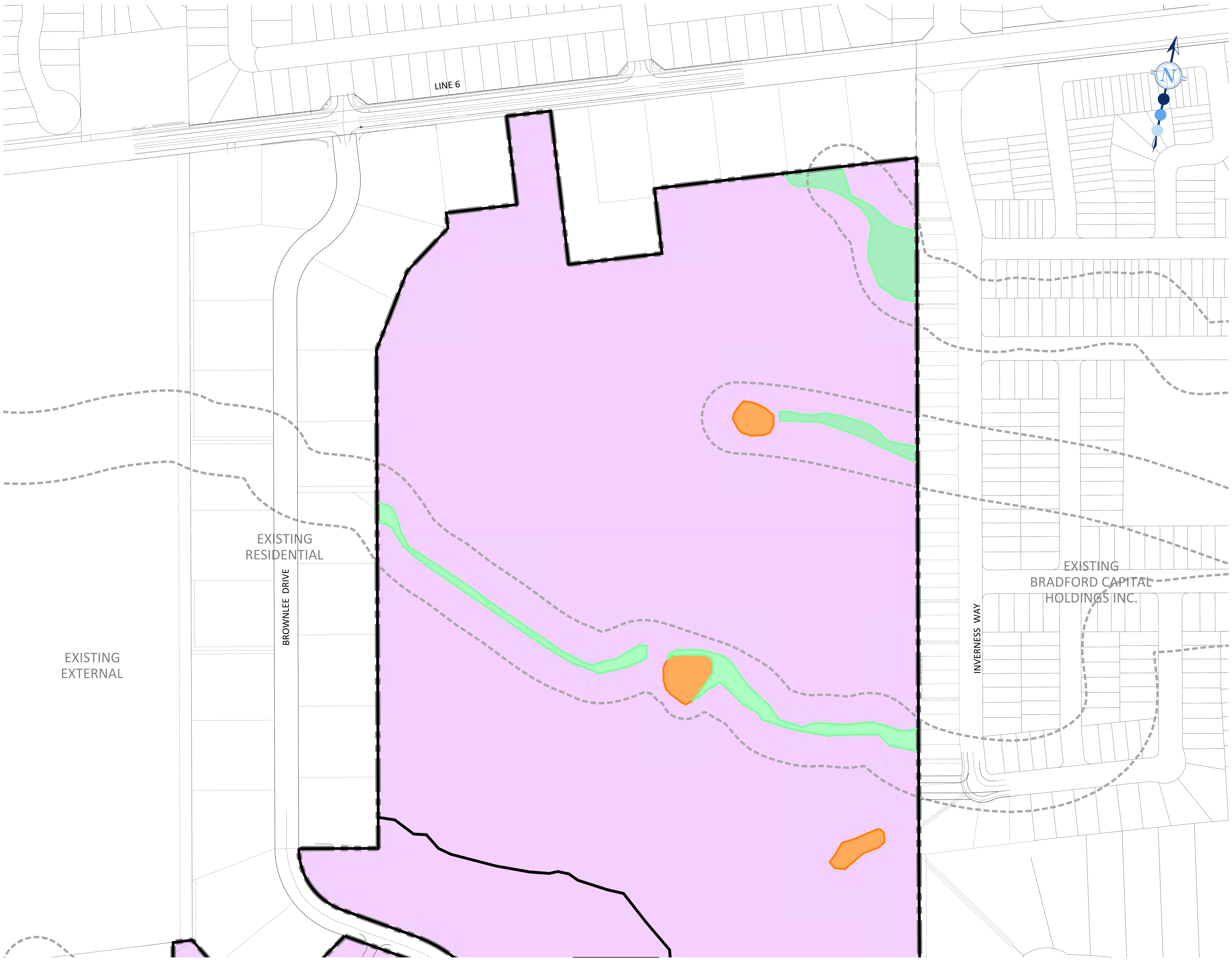
BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED STORMWATER MANANGEMENT FACILITY

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	6.5



SEE FIG. 6.7

LEGEND:

LIMIT OF DEVELOPMENT
STORM DRAINAGE BOUNDARY
LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)

EXISTING LAND USE	TOTAL AREA (ha)
GOLF COURSE	52.21
LOW INTENSITY RESIDENTIAL	1.65
WETLAND	4.53
OPEN WATER	0.85
FOREST	0.76

WATERCOURSE BANKS AND FLOW DIRECTION

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

BRADFORD HIGHLANDS JOINT VENTURE

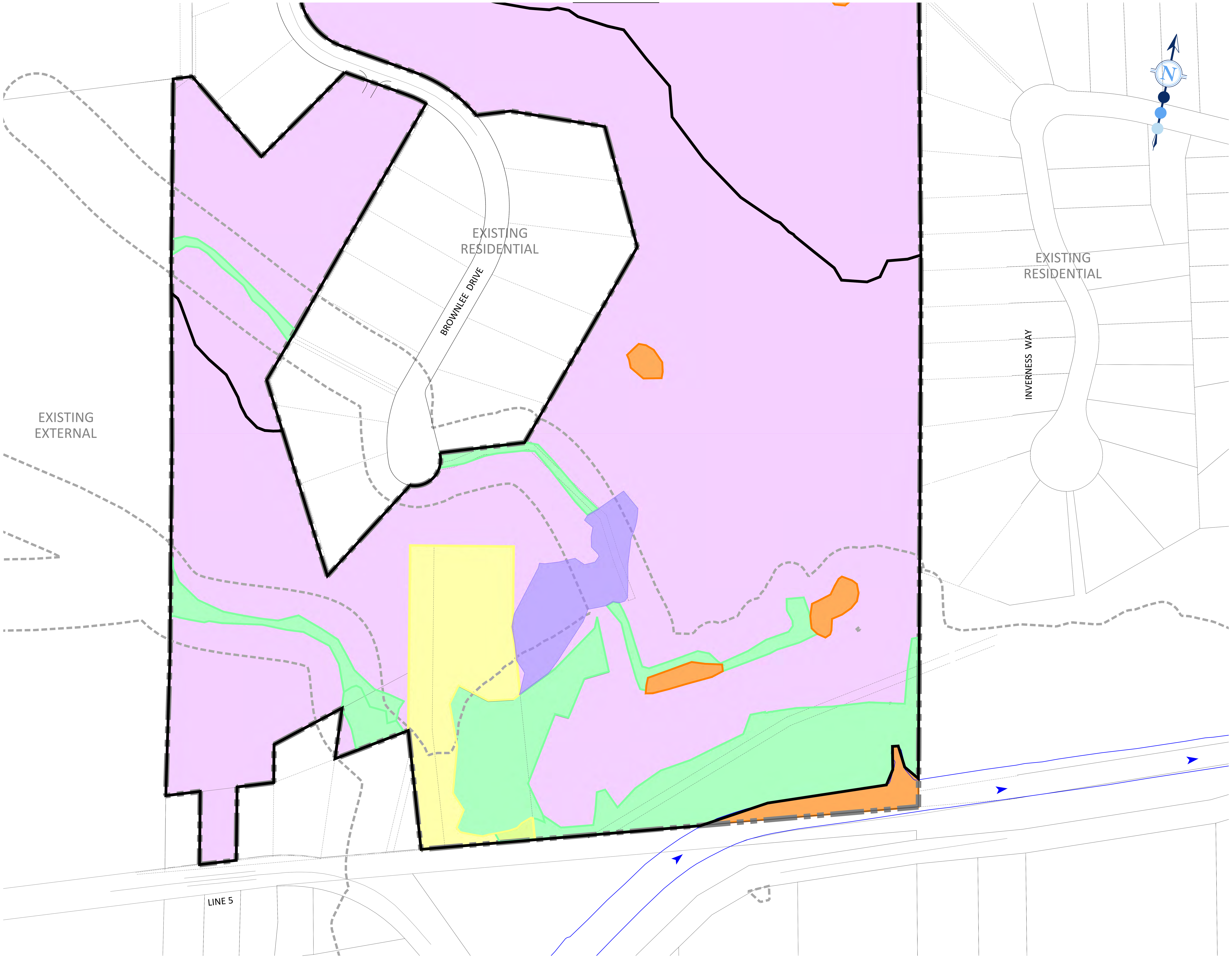
BRADFORD HIGHLANDS

EXISTING
PHOSPHORUS BUDGET PLAN 1

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	6.6

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-6.6-6.7-PHSB-EXST.dwg - Revised by <SOZDEMIR> : Fri, Nov 01 2024 - 1:59pm

SEE FIG. 6.6



LEGEND:

LIMIT OF DEVELOPMENT

STORM DRAINAGE BOUNDARY

LSRCA REGULATION LIMIT
(SOURCE: LSRCA OPEN DATA OCT 2024)

EXISTING LAND USE	TOTAL AREA (ha)
GOLF COURSE	52.21
LOW INTENSITY RESIDENTIAL	1.65
WETLAND	4.53
OPEN WATER	0.85
FOREST	0.76

WATERCOURSE BANKS AND FLOW DIRECTION

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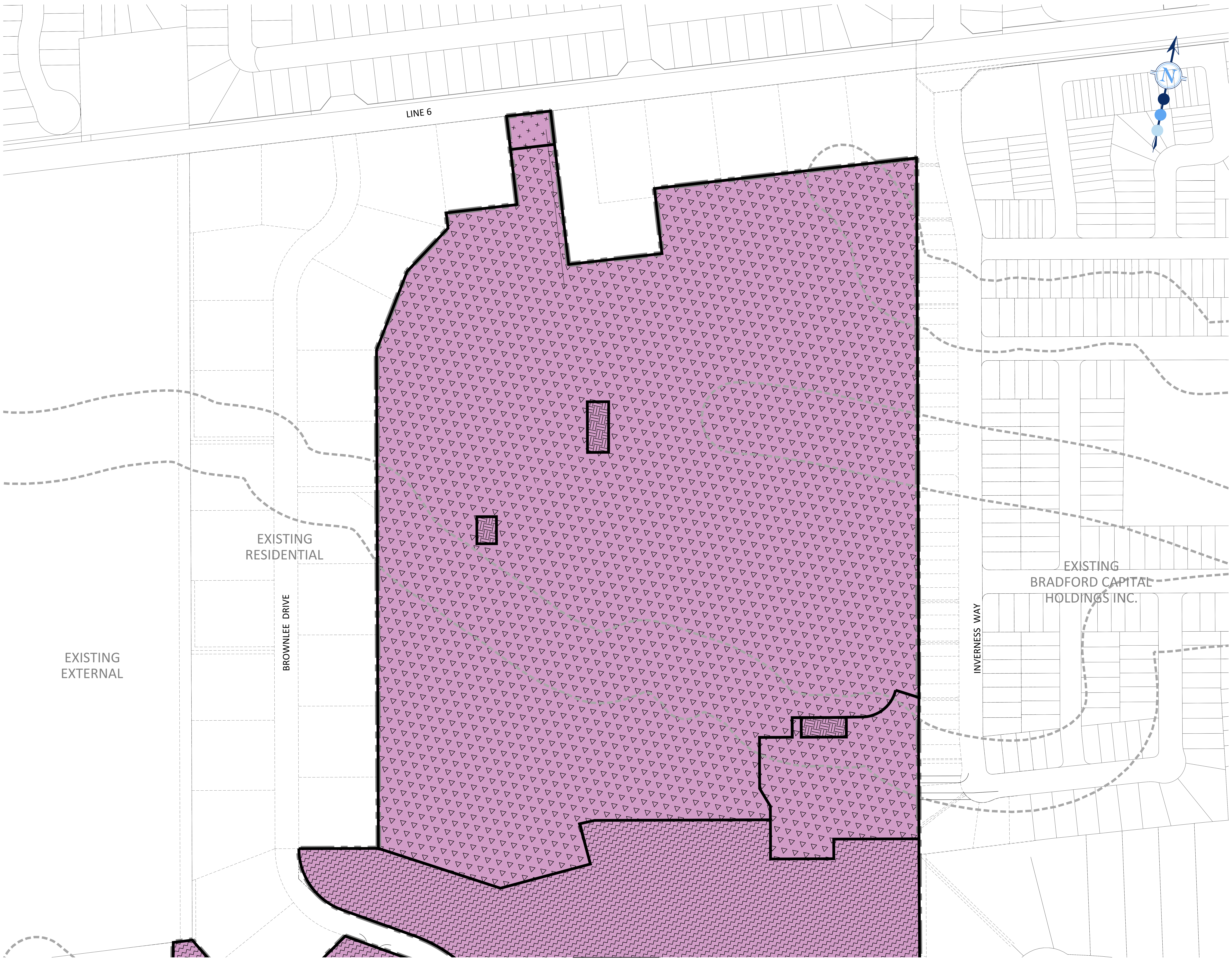
BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

EXISTING
PHOSPHORUS BUDGET PLAN 2

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	6.7

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-6.6-6.7-PHSB-EXST.dwg – Revised by <SOZDEMIR> : Fri, Nov 01 2024 – 1:59pm



SEE FIG. 6.9

LEGEND:

LIMIT OF DEVELOPMENT

STORM DRAINAGE BOUNDARY

LSRCA REGULATION LIMIT
(SOURCE: LSRCA OPEN DATA OCT 2024)

PROPOSED LAND USE	TOTAL AREA TO BEST MANAGEMENT PRACTICE (ha)			
	REAR YARD INFILTRATION & WET DETENTION POND	WET DETENTION POND	WET LAND DETENTION POND AND STORMWATER FILTER	NO TREATMENT
HIGH INTENSITY DEVELOPMENT (RESIDENTIAL)	0.18	24.50	22.04	3.48
TRANSITIONAL	0.00	0.00	0.00	5.27
WETLAND	0.00	0.00	0.00	3.27
WOODLOT	0.00	0.00	0.00	0.76
OPEN WATER	0.00	0.00	0.00	0.50

WATERCOURSE BANKS AND FLOW DIRECTION

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

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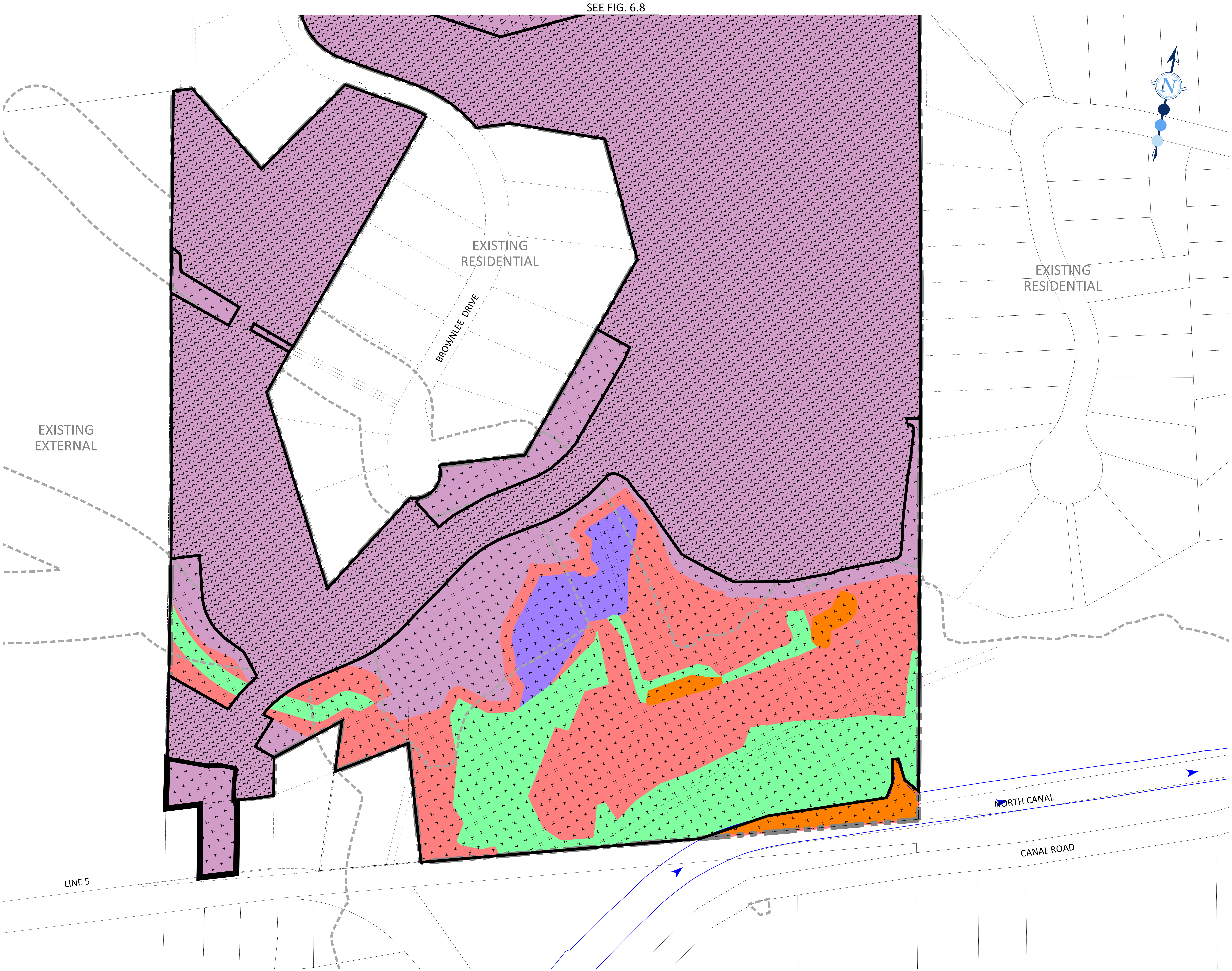
BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED
PHOSPHORUS BUDGET PLAN 1

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	6.8

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-6.8-6.9-PHSB-PROP.dwg - Revised by <SOZDEMIR> : Fri, Nov 01 2024 - 2:02pm



LEGND:

LIMIT OF DEVELOPMENT

STORM DRAINAGE BOUNDARY

LSRCA REGULATION LIMIT
(SOURCE: LSRCA OPEN DATA OCT 2024)

PROPOSED LAND USE	TOTAL AREA TO BEST MANAGEMENT PRACTICE (ha)			
	REAR YARD INFILTRATION & WET DETENTION POND	WET DETENTION POND	WET LAND DETENTION POND AND STORMWATER FILTER	NO TREATMENT
HIGH INTENSITY DEVELOPMENT (RESIDENTIAL)	0.18	24.50	22.04	3.48
TRANSITIONAL	0.00	0.00	0.00	5.27
WETLAND	0.00	0.00	0.00	3.27
WOODLOT	0.00	0.00	0.00	0.76
OPEN WATER	0.00	0.00	0.00	0.50

WATERCOURSE BANKS AND FLOW DIRECTION

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

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FAX: (905) 475-8335

BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED
PHORUS BUDGET PLAN 2

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	6.9

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-6.8-6.9-PHSB-PROP.dwg - Revised by <SOZDEMIR> : Fri, Nov 01 2024 - 2:02pm

SEE FIG. 7.2

LEGEND:

LIMIT OF DEVELOPMENT

LSRCA REGULATION LIMIT
(SOURCE: LSRCA OPEN DATA OCT 2024)

PROPOSED SANITARY SEWER AND MAINTENANCE HOLE

EXISTING SANITARY SEWER AND MAINTENANCE HOLE

SANITARY DRAINAGE BOUNDARY

EXTERNAL SANITARY DRAINAGE BOUNDARY

0.35ha — DRAINAGE AREA (HECTARES)
307 — NUMBER OF PERSONS
99 — NUMBER OF UNITS

AREA — EXTERNAL SANITARY DRAINAGE AREA (ha)
1.30L/s/ha — PROPOSED FLOW RATE OR POPULATION DENSITY (PERSONS PER HECTARE)

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

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MARKHAM, ONTARIO L3R 8B8
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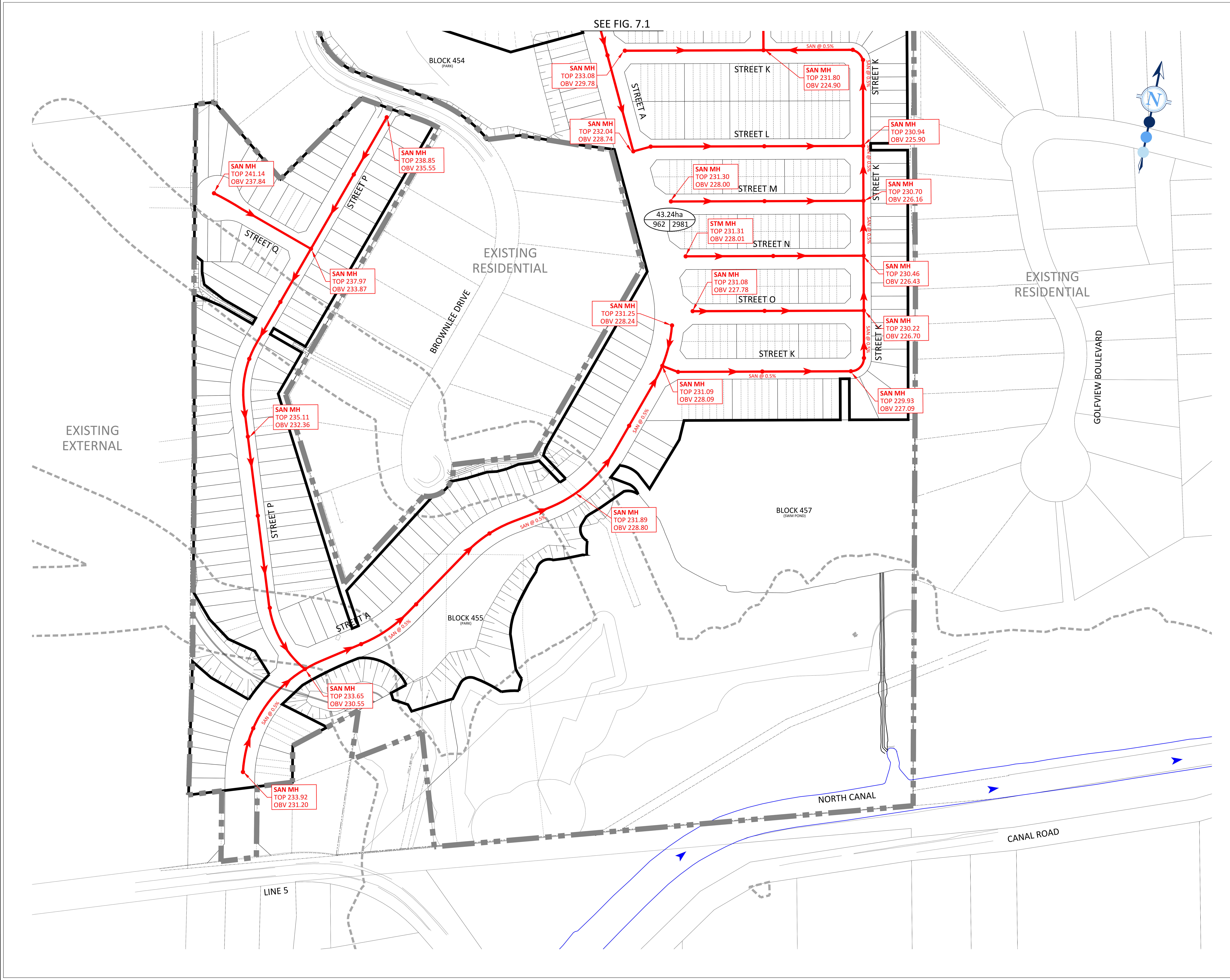
FAX: (905) 475-8335

BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED SANITARY SERVICING PLAN

DESIGNED BY:	M.P./K.S.	CHECKED BY:	P.S.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	7.1



LEGEND:

- LIMIT OF DEVELOPMENT
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- PROPOSED SANITARY SEWER AND MAINTENANCE HOLE
- EXISTING SANITARY SEWER AND MAINTENANCE HOLE
- SANITARY DRAINAGE BOUNDARY
- EXTERNAL SANITARY DRAINAGE BOUNDARY
- 0.35ha — DRAINAGE AREA (HECTARES)
- 307 — NUMBER OF PERSONS
- 99 — NUMBER OF UNITS
- AREA — EXTERNAL SANITARY DRAINAGE AREA (ha)
- 1.30L/s/ha — PROPOSED FLOW RATE OR POPULATION DENSITY (PERSONS PER HECTARE)

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

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BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED SANITARY SERVICING PLAN

DESIGNED BY:	M.P./K.S.	CHECKED BY:	P.S.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	7.2

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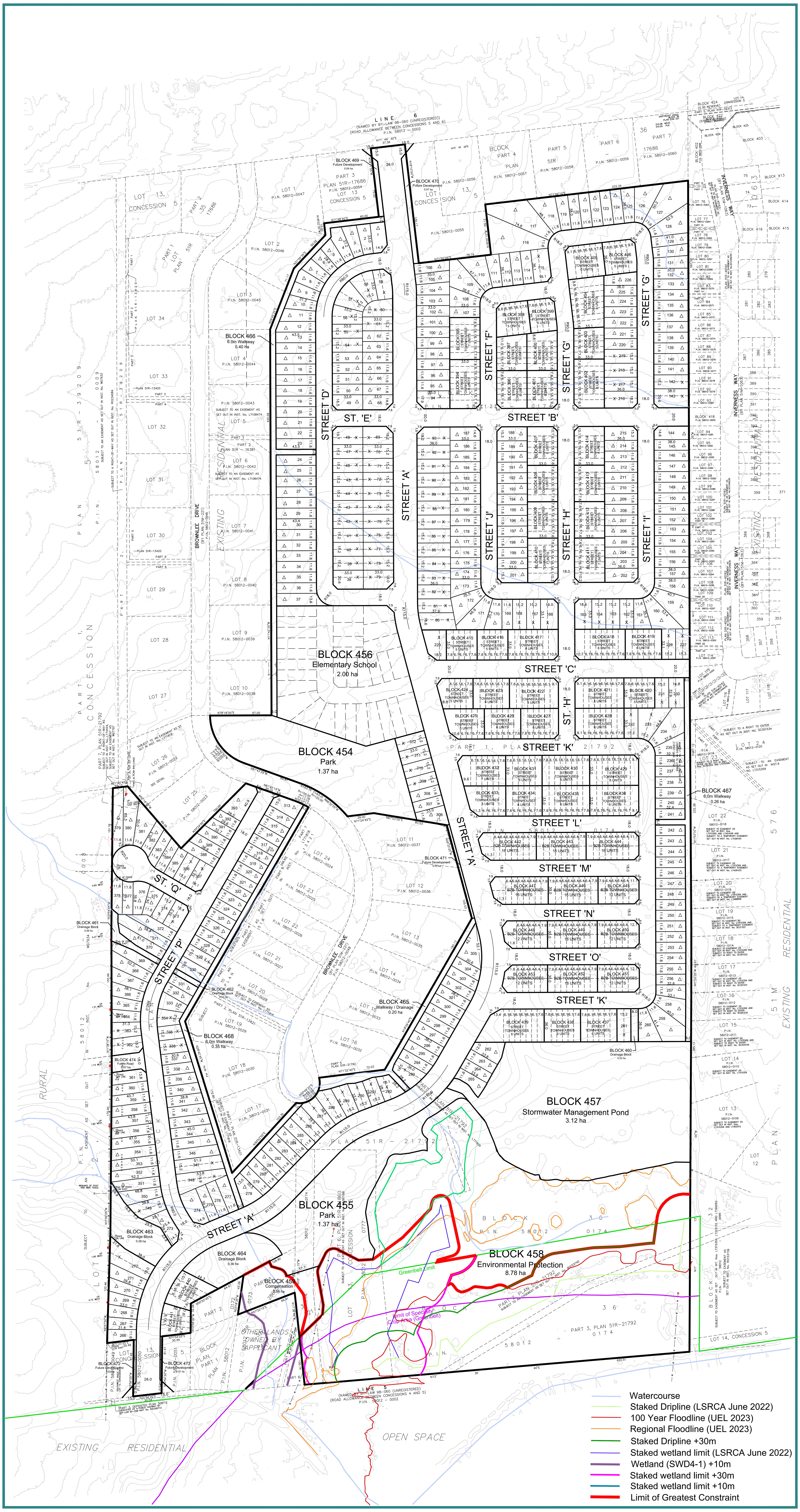
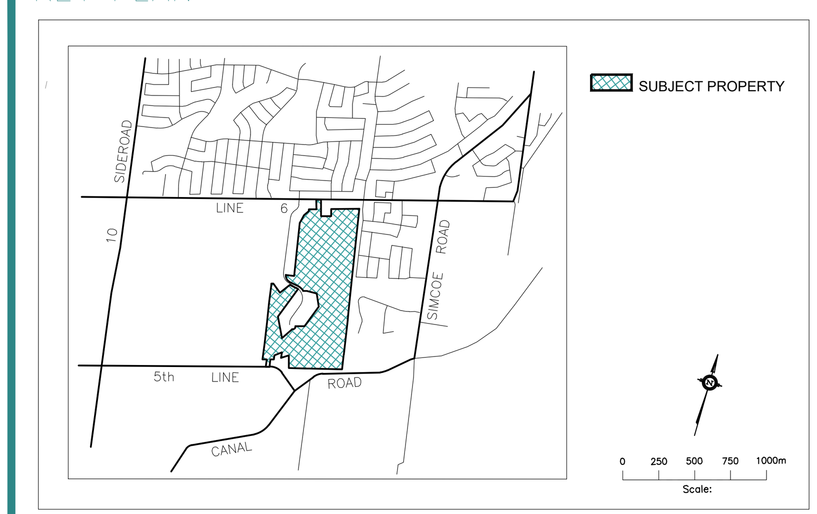
Appendix A Draft Plan of Subdivision

DRAFT PLAN OF SUBDIVISION
OPTION 1

Part of Block 36, Plan 51M-221 and Part of Lot 13, Concession 5
(Geographic Township of West Gwillimbury)
Town of Bradford-West Gwillimbury
County of Simcoe



KEY PLAN



SCHEDULE OF LAND USE

Lot/Block	Land Use	Units	Area(ha)
1-393	Single Detached min. 11.6m (38ft)	299	19.54
	Semi Detached min. 7.6m (25ft)	188	
394-441	Street Townhouses min. 6.1m (20ft)	303	6.95
442-453	B2B Townhouses min. 6.4m (21ft)	172	1.85
454-455	Parks		2.74
456	Elementary School		2.00
457	Stormwater Management Ponds		3.12
458	Environmental Protection		8.78
459	Compensation		0.38
460-464	Drainage Blocks		0.75
465	Walkway / Drainage Block		0.20
466-468	6m Walkways		1.01
469-473	Future Development		0.17
474	Future Road		0.07
Public Roads	Street 'A' 26.0m ROW 1,550m Streets 'B'-'C' 20.0m ROW 575m Streets 'D'-'Q' 18.0m ROW 3,930m		12.44
Total	6,055m	962	60.00

Approved subject to conditions in accordance with section 51(31) of the Planning Act, RSO, Chap. P. 13, as amended

This___day of__________, 20__

Director of Planning, Development and Tourism, County of Simcoe

OWNER'S AUTHORIZATION

We, ICG Golf Inc., Bayview-Wellington (Highlands) Inc. and 2523951 Ontario Inc. hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the County of Simcoe.

ICG Golf Inc. — Date

Bayview-Wellington (Highlands) Inc. — Date

2523951 Ontario Inc. — Date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided as shown on this Plan and their relationship to the adjacent lands are accurately and correctly shown.

ALOKA KUMARANAYAKE — October 2, 2023

R-PE Surveying Ltd.
Ontario Land Surveyors — Date

ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT, CHAPTER P.13 (R.S.O. 1990).

(a),(e),(f),(g),(j),(l) - As shown of the Draft Plan.
(b),(c) - As shown on the Draft and Key Plan.
(d) - Land to be used in accordance with the Schedule of Land Use.
(i) - Soil is sands, silts, clay and tills.
(h),(k) - Full municipal services to be provided.

NOTE: Contours relate to Canadian Geodetic Datum.
Contour interval is 1m with .25m interpolated.

Scale: 1:2000

0 25 50 100 150 200m

Date	Revision	By

Prepared For:
ICG Golf Inc.
Bayview-Wellington (Highlands) Inc.
2523951 Ontario Inc.
October 7, 2024
MGP File: 15-2422

Malone Given Parsons.
140 Renfrew Drive, Suite 201 | Markham, ON L3R 6B3 | 905 513 0170 | mgp.ca

Appendix B Background Information

Appendix B-1 Record Drawings

SCS consulting group ltd

TOWN OF BRADFORD WEST GWILLIMBURY
STORM SEWER DESIGN SHEET
AS BUILT AUGUST 20, 2021

Project / Subdivision: ARG - BRADFORD CAPITAL
Consulting Engineer: Urban Ecosystems Limited
Project No.: 08017

Design Parameters (5 Year Storm)
A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 990.848
T_c = time of concentration — B= 6.013
C= 0.806

Design Parameters (100 Year Storm)
A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 1443.95
T_c = time of concentration — B= 5.273
C= 0.776

Design Equations
$$I= \frac{A}{(t + B)^C}$$
$$Q= 2.78 \times A \times C \times I$$

Prepared by: ____
Checked by: ____
Last Revised: ____

NOTE: The pipe capacity is limited to maximum values according to Table 9 of the Design Manual.

DESIGN DATE: 10-04-12 — System to be Designed for: 5 Year Storm

Location					Drainage Area Characteristics						Rainfall / Runoff							Sewer Data									
STREET NAME	FROM M.H.	INVERT m	TO M.H.	INVERT m	AREA ha	CUM. AREA	C 5 yr.	C 100 yr.	C*A	CUM. C*A	accum. time	Int(5yr) mm/hr	Int(25yr) mm/hr	Int.(100yr) mm/hr	5yr. Flow cms	25yr. Flow cms	100yr. Flow cms	PIPE mm	LGTH. m	GRD. %	% Full	CAP. cms	V - full m/sec	V-actual	section time	accum. time	MANN. "n"
EXT. WEST BLK. 417 100 year intensity-coeff. 5 year equivalent coeff.	DICB 686 DICB 686	100.000 100.000	860 860		7.88 7.88	7.88 7.88	0.30 0.30		2.364 2.364	2.364 2.364	18.00 18.00	75.677		125.967	0.497		0.824	600	38.0	3.00	74	1.11	3.801	3.849	0.17		0.013
INVERNESS - control pipe	860	100.000	684		0.00	7.88	0.60		0.000	2.364	18.17	75.256	102.769	124.873	0.494			600	2.5	1.21	70	0.705	2.414	2.619	0.02		0.013
INVERNESS WAY	684	100.000	679		0.54	8.42	0.60		0.324	2.688	18.18	75.213	102.711	124.802	0.561	0.767		750	65.9	0.32	85	0.66	1.441	1.635	0.76		0.013
INVERNESS WAY	679	100.000	678		0.19	8.61	0.60		0.114	2.802	18.95	73.356	100.215	121.743	0.571	0.780		750	35.5	0.30	90	0.64	1.395	1.590	0.42		0.013
INVERNESS WAY	620	100.000	680		0.26	0.26	0.60		0.156	0.156	10.00	104.905	142.504	174.111	0.045	0.062		300	46.3	1.53	36	0.12	1.710	1.560	0.45		0.013
EXT. WEST - Lots 83 / 84 100 year intensity-coeff. 5 year equivalent coeff.	DICB 694 DICB 694	100.000 100.000	864 864		6.01 6.01	6.01 6.01	0.30 0.30		1.803 1.803	1.803 1.803	18.00 18.00	75.677		125.967	0.379		0.629	525	38.0	4.00	70	0.90	4.016	3.775	0.16		0.013
INVERNESS - control pipe	864	100.000	680		0.00	6.01	0.60		0.000	1.803	18.16	75.278	102.789	124.910	0.377			525	2.5	1.61	66	0.569	2.548	2.739	0.02		0.013
INVERNESS WAY	680	100.000	678		0.20	6.47	0.60		0.120	2.079	18.17	75.237	102.733	124.842	0.434	0.593		600	38.0	1.30	59	0.73	2.502	2.590	0.25		0.013
BARROW AVE.	678	100.000	676		0.52	15.60	0.60		0.312	5.193	19.37	72.366	98.884	120.113	1.044	1.426		825	83.0	1.22	63	1.65	2.998	3.182	0.46		0.013
TAY BLVD.	690	100.000	676		0.32	0.32	0.60		0.192	0.192	10.00	104.905	142.504	174.111	0.056	0.076		300	56.8	1.57	44	0.13	1.732	1.683	0.55		0.013
BARROW AVE.	676	100.000	674		0.58	16.50	0.60		0.348	5.733	19.83	71.323	97.481	118.396	1.135	1.552		900	71.8	1.53	49	2.34	3.557	3.504	0.34		0.013
BARROW AVE.	674	100.000	672		0.48	16.98	0.60		0.288	6.021	20.17	70.583	96.486	117.180	1.180	1.613		900	74.0	1.50	51	2.31	3.522	3.540	0.35		0.013
POND - BARROW AVE.	672	100.000	602		0.27	17.25	0.60		0.162	6.183	20.52	69.831	95.475	115.943	1.199	1.639		1050	75.0	0.69	51	2.37	2.647	2.634	0.47		0.013
St. 1 at 6th Line 100 year intensity-coeff. 5 year equivalent coeff.	- 626	100.000 100.000	- 624		0.25 0.25	0.25 0.25	0.60 1.00		0.150 0.250	0.150 0.250	10.00 10.00	104.905		174.111	0.073		0.073	300	48.1	1.37	62	0.12	1.618	1.707	0.50		0.013
INVERNESS WAY	624	100.000	623		0.12	0.37	0.65		0.078	0.328	10.50	102.360	139.101	169.851	0.093	0.127		300	19.5	2.82	55	0.17	2.322	2.366	0.14		0.013
EXT. WEST BLK. 402 100 year intensity-coeff. 5 year equivalent coeff.	RYCB76/402	100.000	- 623		1.06 1.06	1.06 1.06	0.30 0.30		0.318 0.318	0.318 0.318	10.00 10.00	104.905		174.111	0.093		0.154	375	27.0	1.00	51	0.18	1.604	1.596	0.28		0.013

TOWN OF BRADFORD WEST GWILLIMBURY
STORM SEWER DESIGN SHEET
AS BUILT AUGUST 20, 2021

Project / Subdivision: ARG - BRADFORD CAPITAL
Consulting Engineer: Urban Ecosystems Limited
Project No.: 08017

Design Parameters (5 Year Storm)
A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 990.848
T_c = time of concentration — B= 6.013
C= 0.806

Design Parameters (100 Year Storm)
A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 1443.95
T_c = time of concentration — B= 5.273
C= 0.776

Design Equations
$$I= \frac{A}{(t + B)^C}$$
$$Q= 2.78 \times A \times C \times I$$

Prepared by: ____
Checked by: ____
Last Revised: ____

NOTE: The pipe capacity is limited to maximum values according to Table 9 of the Design Manual.

DESIGN DATE: 10-04-12 — System to be Designed for: 5 Year Storm

Location					Drainage Area Characteristics						Rainfall / Runoff							Sewer Data									
STREET NAME	FROM M.H.	INVERT m	TO M.H.	INVERT m	AREA ha	CUM. AREA	C 5 yr.	C 100 yr.	C*A	CUM. C*A	accum. time	Int(5yr) mm/hr	Int(25yr) mm/hr	Int.(100yr) mm/hr	5yr. Flow cms	25yr. Flow cms	100yr. Flow cms	PIPE mm	LGTH. m	GRD. %	% Full	CAP. cms	V - full m/sec	V-actual	section time	accum. time	MANN. "n"
INVERNESS WAY	623	100.000	622		0.30	1.73	0.60		0.180	0.824	10.64	101.666	138.173	168.690	0.233	0.317		450	46.4	2.82	47	0.50	3.042	2.982	0.25		0.013
EXT. WEST - Lots 77 / 78 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB77/78	100.000 100.000	- 622		0.35 0.35	0.35 0.35	0.30 0.30		0.105 0.105	0.105 0.105	10.00 10.00	104.905		174.111	0.031		0.051	250	37.0	2.50	31	0.10	1.936	1.704	0.32		0.013
INVERNESS WAY	622	100.000	620		0.14	2.22	0.60		0.084	1.015	10.89	100.432	136.522	166.628	0.283	0.385		450	26.7	2.96	55	0.51	3.117	3.179	0.14		0.013
ALGEO WAY	620	100.000	618		0.38	2.60	0.65		0.247	1.262	11.03	99.753	135.614	165.495	0.350	0.475		525	80.6	3.35	43	0.82	3.675	3.454	0.37		0.013
RYCB - Blk 414 / 415 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB414/415	100.000 100.000	- pipe		0.08 0.08	0.08 0.08	0.65 1.07		0.052 0.086	0.052 0.086	10.00 10.00	104.905		174.111	0.025		0.025	250	39.5	5.00	18	0.14	2.738	2.062	0.24		0.013
RYCB - Blk 411 / 412 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB411/412	100.000 100.000	- pipe		0.06 0.06	0.06 0.06	0.65 1.07		0.039 0.064	0.039 0.064	10.00 10.00	104.905		174.111	0.019		0.019	250	42.0	0.50	43	0.04	0.866	0.814	0.81		0.013
RYCB - Blk 412 / 72 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB412/72	100.000 100.000	- pipe		0.05 0.05	0.05 0.05	0.65 1.07		0.033 0.054	0.033 0.054	10.00 10.00	104.905		174.111	0.016		0.016	250	42.0	0.50	36	0.04	0.866	0.784	0.81		0.013
COMMERCIAL - FORTIS CR. FORTIS CR.	649 648	100.000 100.000	648 646		0.40 0.59	0.40 1.15	0.80 0.65		0.320 0.384	0.320 0.907	10.00 10.09	104.905 104.441	142.504 141.884	174.111 173.334	0.093 0.263	0.127 0.357		375 450	8.5 72.0	1.00 2.47	51 56	0.18 0.47	1.604 2.847	1.596 2.919	0.09 0.42		0.013 0.013
FORTIS CR.	646	100.000	618		0.13	1.31	0.65		0.085	0.991	10.51	102.289	139.005	169.731	0.282	0.383		525	34.9	1.63	49	0.57	2.563	2.538	0.23		0.013
ALGEO WAY	618	100.000	616		0.36	4.27	0.65		0.234	2.487	11.40	98.062	133.351	162.672	0.677	0.921		675	84.2	3.00	45	1.52	4.112	3.947	0.34		0.013
RYCB - Blk 409 / 410 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB409/410	100.000 100.000	- pipe		0.06 0.06	0.06 0.06	0.65 1.07		0.039 0.064	0.039 0.064	10.00 10.00	104.905		174.111	0.019		0.019	250	38.5	0.50	43	0.04	0.866	0.814	0.74		0.013
FORTIS CR.	642	100.000	640		0.24	0.30	0.65		0.156	0.220	10.74	101.148	137.480	167.825	0.062	0.084		300	59.6	2.80	37	0.17	2.314	2.110	0.43		0.013
FORTIS CR.	640	100.000	638		0.17	0.47	0.65		0.111	0.331	11.17	99.106	134.748	164.414	0.091	0.124		375	56.9	2.02	35	0.26	2.280	2.064	0.42		0.013
FORTIS CR.	638	100.000	636		0.07	0.54	0.65		0.046	0.376	11.59	97.214	132.216	161.258	0.102	0.138		375	13.0	1.54	45	0.23	1.991	1.911	0.11		0.013
RYCB - Blk 405 / 406 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB405/406	100.000 100.000	- pipe		0.05 0.05	0.05 0.05	0.65 1.07		0.033 0.054	0.033 0.054	10.00 10.00	104.905		174.111	0.016		0.016	250	43.0	0.50	36	0.04	0.866	0.784	0.83		0.013
RYCB - Blk 405 / 63 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB405/63	100.000 100.000	- pipe		0.06 0.06	0.06 0.06	0.65 1.07		0.039 0.064	0.039 0.064	10.00 10.00	104.905		174.111	0.019		0.019	250	43.5	0.50	43	0.04	0.866	0.814	0.84		0.013
FORTIS CR.	636	100.000	634		0.29	0.94	0.65		0.189	0.682	11.70	96.732	131.571	160.455	0.183	0.249		450	59.7	1.66	48	0.38	2.334	2.288	0.43		0.013

TOWN OF BRADFORD WEST GWILLIMBURY
STORM SEWER DESIGN SHEET
AS BUILT AUGUST 20, 2021

Project / Subdivision: ARG - BRADFORD CAPITAL
Consulting Engineer: Urban Ecosystems Limited
Project No.: 08017

Design Parameters (5 Year Storm)
A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 990.848
T_c = time of concentration — B= 6.013
C= 0.806

Design Parameters (100 Year Storm)
A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 1443.95
T_c = time of concentration — B= 5.273
C= 0.776

Design Equations
$$I= \frac{A}{(t + B)^C}$$
$$Q= 2.78 \times A \times C \times I$$

Prepared by: ____
Checked by: ____
Last Revised: ____

NOTE: The pipe capacity is limited to maximum values according to Table 9 of the Design Manual.

DESIGN DATE: 10-04-12 — System to be Designed for: 5 Year Storm

Location					Drainage Area Characteristics						Rainfall / Runoff							Sewer Data									
STREET NAME	FROM M.H.	INVERT m	TO M.H.	INVERT m	AREA ha	CUM. AREA	C 5 yr.	C 100 yr.	C*A	CUM. C*A	accum. time	Int(5yr) mm/hr	Int(25yr) mm/hr	Int.(100yr) mm/hr	5yr. Flow cms	25yr. Flow cms	100yr. Flow cms	PIPE mm	LGTH. m	GRD. %	% Full	CAP. cms	V - full m/sec	V-actual	section time	accum. time	MANN. "n"
FORTIS CR.	634	100.000	632		0.07	1.01	0.65		0.046	0.728	12.12	94.896	129.112	157.395	0.192	0.261		450	13.1	1.68	50	0.39	2.348	2.325	0.09		0.013
RYCB - Blk 407 / 66 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB407/66	100.000 100.000	- pipe		0.11 0.11	0.11 0.11	0.65 1.07		0.072 0.118	0.072 0.118	10.00 10.00	104.905		174.111	0.034		0.035	250	38.0	3.50	30	0.12	2.291	1.979	0.28		0.013
FORTIS CR.	632	100.000	630		0.15	1.27	0.65		0.098	0.943	12.21	94.505	128.589	156.745	0.248	0.337		525	34.0	1.47	46	0.54	2.434	2.361	0.23		0.013
FORTIS CR.	630	100.000	628		0.17	1.44	0.65		0.111	1.054	12.45	93.544	127.301	155.145	0.274	0.372		525	10.9	1.56	49	0.56	2.508	2.470	0.07		0.013
FORTIS CR.	628	100.000	616		0.48	1.92	0.65		0.312	1.366	12.52	93.249	126.906	154.655	0.354	0.481		525	72.1	1.51	64	0.55	2.467	2.640	0.49		0.013
ALGEO WAY	616	100.000	614		0.47	6.66	0.65		0.306	4.158	13.01	91.319	124.322	151.447	1.055	1.436		750	72.3	1.56	73	1.45	3.181	3.499	0.38		0.013
RYCB - Lot 58 / 59 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB58/59	100.000 100.000	- pipe		0.12 0.12	0.12 0.12	0.60 1.00		0.072 0.120	0.072 0.120	10.00 10.00	104.905		174.111	0.035		0.035	250	46.5	2.00	40	0.09	1.731	1.610	0.45		0.013
ALGEO WAY	614	100.000	606		0.33	7.11	0.65		0.215	4.493	13.39	89.879	122.392	149.056	1.121	1.527		975	65.4	0.46	71	1.59	2.057	2.232	0.53		0.013
St. 3 at 6th Line 100 year intensity-coeff. 5 year equivalent coeff. RYCB - Lot 4 / 5 100 year intensity-coeff. 5 year equivalent coeff.	- 612 - RYCB4/5	100.000 100.000 100.000 100.000	- 610 - pipe		0.18 0.18 0.09 0.09	0.18 0.18 0.09 0.09	0.60 1.00 0.60 1.00		0.108 0.180 0.054 0.090	0.108 0.180 0.054 0.090	10.00 10.00 10.00 10.00	104.905 104.905		174.111 174.111	0.052 0.026		0.052 0.026	300	40.0	0.50	37	0.07	0.978	0.892	0.68		0.013
BARROW AVE.	612	100.000	610		0.62	0.89	0.65		0.403	0.673	10.68	101.438	137.867	168.308	0.190	0.258		375	105.4	2.00	73	0.26	2.269	2.507	0.77		0.013
CAYTON CR.	665	100.000	610		0.27	0.27	0.60		0.162	0.162	10.00	104.905	142.504	174.111	0.047	0.064		375	61.5	0.47	38	0.13	1.100	1.010	0.93		0.013
BARROW AVE.	610	100.000	608		0.26	1.42	0.65		0.169	1.004	11.46	97.798	132.998	162.232	0.273	0.371		525	28.2	1.45	50	0.54	2.418	2.406	0.19		0.013
BARROW AVE.	608	100.000	606		0.24	1.66	0.65		0.156	1.160	11.65	96.930	131.835	160.784	0.312	0.425		675	49.9	0.32	63	0.50	1.343	1.424	0.62		0.013
RYCB - Lot 11 / 12 100 year intensity-coeff. 5 year equivalent coeff.	- RYCB11/12	100.000 100.000	- pipe		0.10 0.10	0.10 0.10	0.60 1.00		0.060 0.100	0.060 0.100	10.00 10.00	104.905		174.111	0.029		0.029	250	44.0	0.50	66	0.04	0.866	0.931	0.85		0.013
CAYTON CR.	665	100.000	660		0.35	0.45	0.60		0.210	0.310	10.85	100.636	136.795	166.969	0.087	0.118		450	58.2	0.36	48	0.18	1.087	1.071	0.89		0.013
CAYTON CR.	660	100.000	659		0.14	0.59	0.60		0.084	0.394	11.74	96.538	131.312	160.132	0.106	0.144		525	5.8	0.34	40	0.26	1.171	1.100	0.08		0.013
Area Fronting 6th Line	PLUG	100.000	874		0.92	0.92	0.65		0.598	0.598	10.00	104.905	142.504	174.111	0.174	0.237		450	3.0	0.65	73	0.24	1.461	1.607	0.03		0.013

TOWN OF BRADFORD WEST GWILLIMBURY
STORM SEWER DESIGN SHEET
AS BUILT AUGUST 20, 2021

Project / Subdivision: ARG - BRADFORD CAPITAL
Consulting Engineer: Urban Ecosystems Limited
Project No.: 08017

Design Parameters (5 Year Storm)
A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 990.848
T_c = time of concentration — B= 6.013
C= 0.806

Design Parameters (100 Year Storm)
A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 1443.95
T_c = time of concentration — B= 5.273
C= 0.776

Design Equations
$$I= \frac{A}{(t + B)^C}$$
$$Q= 2.78 \times A \times C \times I$$

Prepared by: ____
Checked by: ____
Last Revised: ____

NOTE: The pipe capacity is limited to maximum values according to Table 9 of the Design Manual.

DESIGN DATE: 10-04-12 — System to be Designed for: 5 Year Storm

Location					Drainage Area Characteristics						Rainfall / Runoff							Sewer Data									
STREET NAME	FROM M.H.	INVERT m	TO M.H.	INVERT m	AREA ha	CUM. AREA	C 5 yr.	C 100 yr.	C*A	CUM. C*A	accum. time	Int(5yr) mm/hr	Int(25yr) mm/hr	Int.(100yr) mm/hr	5yr. Flow cms	25yr. Flow cms	100yr. Flow cms	PIPE mm	LGTH. m	GRD. %	% Full	CAP. cms	V - full m/sec	V-actual	section time	accum. time	MANN. "n"
RYCB - Lot 14 / 15 100 year intensity-coeff. 5 year equivalent coeff. -	- 874 RYCB -	100.000 100.000	- 659 -		0.06 0.06	0.06 0.06 0.98	0.60 1.00		0.036 0.060	0.036 0.060 0.658	10.03 10.03 10.03	104.725 104.725		173.809	0.017 0.191		0.017	600	63.0	0.30	5	0.35	1.202	0.565	0.87		0.013
CAYTON CR.	659	100.000	658		0.00	1.57	0.60		0.000	1.052	11.82	96.178	130.829	159.531	0.281	0.382		675	6.8	0.44	48	0.58	1.575	1.551	0.07		0.013
CAYTON CR.	658	100.000	656		0.49	2.06	0.60		0.294	1.346	11.89	95.866	130.412	159.012	0.358	0.487		675	73.3	0.29	76	0.47	1.278	1.425	0.96		0.013
CAYTON CR.	656	100.000	654		0.14	2.20	0.60		0.084	1.430	12.85	91.932	125.143	152.466	0.365	0.497		675	16.5	0.30	76	0.48	1.300	1.450	0.21		0.013
CAYTON CR.	654	100.000	652		0.46	2.66	0.60		0.276	1.706	13.06	91.110	124.041	151.100	0.432	0.587		750	59.0	0.29	69	0.63	1.371	1.481	0.72		0.013
CAYTON CR.	652	100.000	606		0.26	2.92	0.60		0.156	1.862	13.78	88.440	120.463	146.668	0.457	0.623		750	55.1	0.42	61	0.75	1.650	1.717	0.56		0.013
BARROW AVE.	606	100.000	602		0.41	12.10	0.60		0.246	7.760	14.33	86.485	117.843	143.428	1.864	2.540		1200	105.6	0.30	84	2.23	1.908	2.156	0.92		0.013
HEADWALL	602	100.000	HW600		0.00	29.35	0.60		0.000	13.943	20.99	68.846	94.148	114.323	2.666	3.645		1500	25.3	0.40	57	4.66	2.557	2.634	0.16		0.013
INVERNESS WAY	684	100.000	792		0.60	0.60	0.60		0.360	0.360	10.00	104.905	142.504	174.111	0.105	0.142		300	93.9	1.93	75	0.14	1.921	2.132	0.81		0.013
EXT. WEST - Lots 105 / 106 100 year intensity-coeff. 5 year equivalent coeff.	DICB 816 DICB 816	100.000 100.000	858 858		1.35 1.35	1.35 1.35	0.30 0.30		0.405 0.405	0.405 0.405	12.00 12.00	95.411		158.254	0.107		0.178	450	38.0	0.50	85	0.21	1.281	1.287	0.49		0.013
INVERNESS - control pipe	858	100.000	778		0.00	1.35	0.60		0.000	0.405	12.49	93.352	127.044	154.826	0.105			375	2.5	1.09	55	0.191	1.675	1.700	0.02		0.013
INVERNESS WAY	778	100.000	780		0.22	1.57	0.60		0.132	0.537	12.52	93.251	126.909	154.658	0.139	0.189		450	34.7	0.72	55	0.25	1.537	1.568	0.38		0.013
EXT. WEST - Lots 102 / 103 100 year intensity-coeff. 5 year equivalent coeff.	DICB 815 DICB 815	100.000 100.000	859 859		1.32 1.32	1.32 1.32	0.30 0.30		0.396 0.396	0.396 0.396	12.00 12.00	95.411		158.254	0.105		0.174	375	38.0	1.50	78	0.22	1.965	1.926	0.32		0.013
INVERNESS - control pipe	859	100.000	780		0.00	1.32	0.60		0.000	0.396	12.32	94.057	127.989	155.999	0.103			375	2.5	1.03	56	0.186	1.628	1.661	0.03		0.013
INVERNESS WAY	780	100.000	792		0.07	2.96	0.60		0.042	0.975	12.90	91.752	124.902	152.167	0.248	0.338		525	14.6	0.76	64	0.39	1.750	1.864	0.14		0.013
TUPLING STREET	792	100.000	786		0.33	3.89	0.60		0.198	1.533	13.03	91.212	124.178	151.270	0.388	0.529		525	84.0	3.00	50	0.78	3.478	3.443	0.40		0.013
TAY CR.	690	100.000	796		0.50	0.50	0.60		0.300	0.300	10.00	104.905	142.504	174.111	0.087	0.119		300	60.5	1.90	63	0.14	1.906	2.020	0.53		0.013
TAY CR.	796	100.000	786		0.50	1.00	0.60		0.300	0.600	10.53	102.192	138.876	169.570	0.170	0.231		375	77.6	2.13	64	0.27	2.341	2.494	0.55		0.013

No.	Revision	Date	By	Appr'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20,21
PROVINCE OF ONTARIO

Bradford West Gwillimbury

URBAN ECOSYSTEMS LIMITED
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UEL

BRADFORD CAPITAL HOLDINGS INC.
DESIGN SHEETS - STORM SEWERS

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. DES-2
Scale Horz. 1:500 (0m, 10m, 20m)		Sheet No. — OF —

ID - P:\2008\08017-BRADFORD-WEST\PRINTING\08017-PRINTING-DES-2-3-STORM Design Sheets.dwg - Thu, 9 Jul 2015 - 1404

TOWN OF BRADFORD WEST GWILLIMBURY
STORM SEWER DESIGN SHEET
AS BUILT AUGUST 20, 2021
Project / Subdivision **ARG - BRADFORD CAPITAL**
Consulting Engineer **Urban Ecosystems Limited**
Project No.: **08017**

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A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 980.848
T_c = time of concentration — B= 6.013
C= 0.806

Design Parameters (100 Year Storm)
A = drainage area (ha) — T_{init}= 10 min
C = runoff coefficient — A= 1443.95
T_c = time of concentration — B= 5.273
C= 0.776

Design Equations
$$I = \frac{A}{(t+B)^C}$$
Q= 2.78 x A x C x I

Prepared by:
Checked by:
Last Revised:

NOTE: The pipe capacity is limited to maximum values according to Table 9 of the Design Manual.

DESIGN DATE: 10-04-12 System to be Designed for: 5 Year Storm

STREET NAME	FROM M.H.	INVERT m	TO M.H.	INVERT m	AREA ha	CUM. AREA	C 5 yr.	C 100 yr.	C*A	CUM. C*A	accum. time	Int(5yr) mm/hr	Int(25yr) mm/hr	Int.(100yr) mm/hr	5yr. Flow cms	25yr. Flow cms	100yr. Flow cms	PIPE mm	LGTH. m	GRD. %	% Full	CAP. cms	V - full m/sec	V-actual	section time	accum. time	MANN. "n"
LANARK ST.	790	100.000	788		0.33	0.33	0.60		0.198	0.198	10.00	104.905	142.504	174.111	0.058	0.078		375	40.9	0.29	59	0.10	0.864	0.890	0.79		0.013
LANARK ST.	788	100.000	786		0.48	0.81	0.60		0.288	0.486	10.79	100.916	137.170	167.437	0.136	0.185		525	80.6	0.30	55	0.25	1.100	1.122	1.22		0.013
TUPLING ST.	786	100.000	760		0.54	6.24	0.60		0.324	2.943	13.44	89.687	122.135	148.738	0.733	0.998		900	84.0	0.30	71	1.03	1.575	1.709	0.89		0.013
INVERNESS WAY	778	100.000	777		0.36	0.36	0.60		0.216	0.216	10.00	104.905	142.504	174.111	0.063	0.085		300	46.4	3.15	35	0.18	2.454	2.221	0.32		0.013
EXT. WEST - Lots 109 / 110																											
100 year intensity-coeff.	DICB 818	100.000	856		3.34	3.34	0.30		1.002	1.002	18.00			125.567			0.349										
5 year equivalent coeff.	DICB 818	100.000	856		3.34	3.34	0.30		1.002	1.002	18.00	75.677			0.211			450	38.0	2.50	74	0.47	2.865	2.750	0.22		0.013
INVERNESS - control pipe	856	100.000	777		0.00	3.34	0.60		0.000	1.002	18.22	75.120	102.586	124.649	0.209			450	2.5	1.30	62	0.339	2.066	2.179	0.02		0.013
INVERNESS WAY	777	100.000	776		0.25	3.95	0.60		0.150	1.368	18.24	75.069	102.518	124.566	0.285	0.389		600	33.9	0.53	61	0.47	1.598	1.686	0.35		0.013
INVERNESS WAY	776	100.000	---		0.11	4.06	0.60		0.066	1.434	18.59	74.199	101.348	123.131	0.295	0.404		600	18.5	0.70	55	0.54	1.836	1.873	0.17		0.013
EXT. WEST - Lots 113 / 114																											
100 year intensity-coeff.	DICB 781	100.000	854		1.00	1.00	0.30		0.300	0.300	10.00			174.111			0.145										
5 year equivalent coeff.	DICB 781	100.000	854		1.00	1.00	0.30		0.300	0.300	10.00	104.905			0.087			450	39.0	1.00	49	0.30	1.812	1.565	0.36		0.013
INVERNESS - control pipe	-	100.000	774		0.00	1.00	0.60		0.000	0.300	10.36	103.048	140.021	171.002	0.086			450	3.5	0.53	40	0.217	1.319	1.227	0.04		0.013
INVERNESS WAY	---	100.000	774		0.20	5.26	0.60		0.120	1.854	10.40	102.824	139.722	170.627	0.529	0.719		600	24.5	0.70	99	0.54	1.836	2.112	0.22		0.013
EXT. WEST - Lots 115 / 116					17.71																						
100 year intensity-coeff.	---	100.000	---		19.98	19.98	0.30		5.994	5.994	30.00			90.936			1.514										
5 year equivalent coeff.	---	100.000	---		19.98	19.98	0.30		5.994	5.994	30.00	54.588			0.909												
	---		---																								
INVERNESS - control pipe	---	100.000	---		0.00	19.98	0.60		0.000	5.994	30.00	54.588	74.928	90.936	0.909												
INVERNESS WAY	---	100.000	---		0.13	25.37	0.60		0.078	7.926	30.00	54.588	74.928	90.936	1.202	1.649											
EXT. WEST - Lots 116 / 117																											
	---	100.000	---		0.08	0.08	0.60		0.048	0.048	10.00			174.111			0.023										
	---	100.000	---		0.08	0.08	1.00		0.080	0.080	10.00	104.905			0.023												
	---	100.000	---																								
100 year intensity-coeff.	---	100.000	---		8.44	8.52	0.30		2.532	2.612	24.00			105.093			0.762										
5 year equivalent coeff.	---	100.000	---		8.44	8.52	0.30		2.532	2.612	24.00	63.225			0.459												
INVERNESS - control pipe	PLUG	100.000	774		0.00	33.89	0.60		0.000	10.538	30.00	54.588	74.928	90.936	1.597			1200	21.0	0.50	56	2.876	2.463	2.513	0.14		0.013

No.	Revision	Date	By	Appr'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT
ROSARIO.SACCO
AUGUST 20,21

Bradford West Gwillimbury

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BRADFORD CAPITAL HOLDINGS INC.
DESIGN SHEETS - STORM SEWER

Surveyed by: P.E. Checked by: R.S. Project No. 08017
Drawn by: V.T. Approved by: R.S.
Designed by: D.J.S. Date: APRIL 4, 2014 Drawing No. DES-3
Scale Horz. 1:500 0m 10m 20m
Sheet No. - OF -

TOWN OF BRADFORD WEST GWILLIMBURY
SANITARY SEWER DESIGN SHEET
AS BUILT - AUGUST 20, 2021

Project / Subdivision BRADFORD CAPITAL RESIDENTIAL SUBDIVISION

Consulting Engineer: ______ Prepared by: ______
Project No.: ______ Checked by: ______
Last Revised: ______

Design Parameters

Residential Density = 3.14 cap/unit; Manning 'n' = 0.013; Extran. Flow (pre 2000) = 0.5 L/s/ha; Extran. Flow (post 2000) = 0.2 L/s/ha
Residential = 250 L/cap/day; Industrial = 35 m^3/ha*day; Institutional = 19.8 m^3/ha*day; Commercial = 28 m^3/ha*day

Design Equations

$M(r) = 1 + \frac{14}{4 + \sqrt{P}}$ $Q(i) = i \times A$ $Q(d) = \Sigma(Q(x))$

$M(ind) = 6.6604 \cdot A^{-0.1992}$ $Q(r) = \frac{P \cdot q(r) \cdot M}{86400}$

NOTE: Table 14 of the Engineering Standards is to be referenced for Maximum Capacity

Notes/Comments:

Street	From MH #	From Inv	To MH #	To Inv	Ind. Area (ha)	Comm. Area (ha)	Inst. Area (ha)	Pre 2000 Res. Area (ha)	Post 2000 Res. Area (ha)	Res. Units #	Res. Population cap.	Cum. Industrial P.F. M(ind)	Cum. Industrial Area A(ind)	Cum. Commercial Area A(c)	Cum. Institutional Area A(ins)	Residential P.F. M(r)	Cum. Pre 2000 Res. Area A(r)	Cum. Post 2000 Res. Area A(r)	Cum. Res. Population P	Industrial Peak Flow (L/s) Q(ind)	Commercial Peak Flow (L/s) Q(c)	Institutional Peak Flow (L/s) Q(ins)	Population Peak Flow (L/s) Q(r)	Peak Extraneous Flow (L/s) Q(i)	Total Design Flow (L/s) Q(d)	Length (m)	Pipe Size (mm)	Type of Pipe	Grade (%)	Full Flow Capacity (L/s)	Full Flow Velocity (m/s)	Actual velocity at design flow (m/s)
Inverness - West	626		624						0.17	2	6.3					4.43		0.17	6.3				0.08	0.03	0.11	39.6	200	PVC	1.51%	40.3	1.28	0.295
Inverness - West	624		622						0.41	7	22.0					4.36		0.58	28.3				0.36	0.12	0.47	59.0	200	PVC	3.02%	57.0	1.81	0.417
Inverness - West	622		620						0.25	4	12.6					4.33		0.83	40.8				0.51	0.17	0.68	30.9	200	PVC	3.56%	61.9	1.97	0.611
Algeo - West	620		618						0.59	16	50.2					4.25		1.42	91.1				1.12	0.28	1.40	82.2	200	PVC	3.03%	57.1	1.82	0.672
Fortis - Comm West	649		648			0.39								0.39							0.13			0.08	0.20	11.5	200	PVC	1.50%	40.2	1.28	0.294
Fortis - West	648		646						0.43	19	59.7			0.39		4.30		0.43	59.7		0.13		0.74	0.16	1.03	73.5	200	PVC	2.54%	52.3	1.66	0.516
Fortis - West	646		618						0.12	2	6.3			0.39		4.29		0.55	65.9		0.13		0.82	0.19	1.13	34.5	200	PVC	1.07%	33.9	1.08	0.454
Algeo - West	618		616						0.41	11	34.5			0.39		4.15		2.38	191.5		0.13		2.30	0.55	2.98	83.2	200	PVC	3.45%	60.9	1.94	0.911
Fortis - West	642		640						0.19	6	18.8					4.38		0.19	18.8				0.24	0.04	0.28	29.5	200	PVC	2.95%	56.3	1.79	0.412
Fortis - West	640		638						0.42	12	37.7					4.30		0.61	56.5				0.70	0.12	0.83	89.5	200	PVC	2.38%	50.6	1.61	0.499
Fortis - West	638		636						0.10	2	6.3					4.29		0.71	62.8				0.78	0.14	0.92	15.7	200	PVC	1.97%	46.0	1.47	0.542
Fortis - West	636		634						0.44	14	44.0					4.24		1.15	106.8				1.31	0.23	1.54	61.4	200	PVC	1.71%	42.9	1.37	0.573
Fortis - West	634		632						0.26	4	12.6					4.22		1.41	119.3				1.46	0.28	1.74	16.6	200	PVC	1.45%	39.5	1.26	0.591
Fortis - West	632		630						0.06							4.22		1.47	119.3				1.46	0.29	1.75	34.5	200	PVC	1.74%	43.3	1.38	0.647
Fortis - West	630		628						0.26	4	12.6					4.21		1.73	131.9				1.61	0.35	1.95	9.6	200	PVC	1.35%	38.1	1.21	0.619
Fortis - West	628		616						0.50	12	37.7					4.17		2.23	169.6				2.05	0.45	2.49	67.0	200	PVC	1.21%	36.1	1.15	0.635
Algeo - West	616		614						0.49	12	37.7			0.39		4.02		5.10	398.8		0.13		4.64	1.10	5.87	71.3	200	PVC	1.50%	40.2	1.28	0.921
Algeo - West	614		606						0.26	4	12.6			0.39		4.02		5.36	411.3		0.13		4.78	1.15	6.06	70.7	200	PVC	0.50%	23.2	0.74	0.619
Barrow - West	612		610						0.66	12	37.7					4.34		0.66	37.7				0.47	0.13	0.60	80.6	200	PVC	3.04%	57.2	1.82	0.564
Cayton - West	666		665						0.28	5	15.7					4.39		0.28	15.7				0.20	0.06	0.26	39.0	200	PVC	1.54%	40.7	1.30	0.298
Cayton - West	665		610						0.34	6	18.8					4.34		0.62	34.5				0.43	0.12	0.56	55.5	200	PVC	0.56%	24.5	0.78	0.289
Barrow - West	610		608						0.26	6	18.8					4.25		1.54	91.1				1.12	0.31	1.43	31.3	200	PVC	1.50%	40.2	1.28	0.537
Barrow - West	608		606						0.36	8	25.1					4.23		1.90	116.2				1.42	0.38	1.80	48.9	200	PVC	0.51%	23.4	0.75	0.434
Cayton - West	666		659						0.23	3	9.4					4.42		0.23	9.4				0.12	0.05	0.17	23.1	200	PVC	1.65%	42.1	1.34	0.308
Cayton - West	659		658						0.23	2	6.3					4.39		0.46	15.7				0.20	0.09	0.29	16.2	200	PVC	0.62%	25.8	0.82	0.255
Cayton - West	658		656						0.66	12	37.7					4.31		1.12	53.4				0.67	0.22	0.89	76.1	200	PVC	0.46%	22.2	0.71	0.297
Cayton - West	656		654						0.18	2	6.3					4.30		1.30	59.7				0.74	0.26	1.00	9.8	200	PVC	0.61%	25.6	0.82	0.342
Cayton - West	654		652						0.36	6	18.8					4.27		1.66	78.5				0.97	0.33	1.30	59.5	200	PVC	0.44%	21.8	0.69	0.353
Cayton - West	652		606						0.57	7	22.0					4.24		2.23	100.5				1.23	0.41	1.64	61.9	200	PVC	0.53%	23.9	0.76	0.420

TOWN OF BRADFORD WEST GWILLIMBURY
SANITARY SEWER DESIGN SHEET
AS BUILT - AUGUST 20, 2021
Project / Subdivision BRADFORD CAPITAL RESIDENTIAL SUBDIVISION
Consulting Engineer / Project No. / Prepared by / Checked by / Last Revised
Design Parameters: Residential Density = 3.14 cap/unit; Manning 'n' = 0.013; Extran. Flow (pre 2000) = 0.5 L/s/ha; Extran. Flow (post 2000) = 0.2 L/s/ha; Residential = 250 L/cap/day; Industrial = 35 m3/ha*day; Institutional = 19.8 m3/ha*day; Commercial = 28 m3/ha*day
Design Equations
NOTE: Table 14 of the Engineering Standards is to be referenced for Maximum Capacity

Notes/Comments:

Street	From MH #	From Inv	To MH #	To Inv	Ind. Area (ha)	Comm. Area (ha)	Inst. Area (ha)	Pre 2000 Res. Area (ha)	Post 2000 Res. Area (ha)	Res. Units #	Res. Population cap.	Cum. Industrial P.F. M(ind)	Cum. Industrial Area A(ind)	Cum. Commercial Area A(c)	Cum. Institutional Area A(ins)	Residential P.F. M(r)	Cum. Pre 2000 Res. Area A(r)	Cum. Post 2000 Res. Area A(r)	Cum. Res. Population P	Q(ind)	Q(c)	Q(ins)	Q(r)	Q(i)	Q(d)	Length (m)	Pipe Size (mm)	Type of Pipe	Grade (%)	Full Flow Capacity (L/s)	Full Flow Velocity (m/s)	Actual velocity at design flow (m/s)
Barrow - West	606		605						0.16	2	6.3			0.39		3.92		9.65	634.3		0.13		7.19	1.97	9.29	38.9	200	PVC	0.50%	23.2	0.74	0.694
Barrow - West	605		604						0.01					0.39		3.92		9.66	634.3		0.13		7.19	1.97	9.29	7.2	200	PVC	0.55%	24.3	0.77	0.716
Barrow - West	604		600						0.31	4	12.6			0.39		3.91		9.97	646.8		0.13		7.33	2.03	9.48	75.7	200	PVC	0.50%	23.2	0.74	0.694
Inverness - West	682		678						0.41	6	18.8					4.38		0.41	18.8				0.24	0.08	0.32	63.4	200	PVC	1.53%	40.6	1.29	0.297
Inverness - West	679		678						0.51	5	15.7					4.39		0.51	15.7				0.20	0.10	0.30	49.7	200	PVC	1.53%	40.6	1.29	0.297
Barrow - West	678		676						0.55	10	31.4					4.33		1.47	65.9				0.82	0.29	1.11	77.5	200	PVC	1.91%	45.3	1.44	0.534
Barrow - West	676		674						0.51	10	31.4					4.25		1.98	97.3				1.20	0.40	1.59	67.6	200	PVC	3.65%	62.7	1.99	0.738
Barrow - West	674		672						0.39	6	18.8					4.23		2.37	116.2				1.42	0.47	1.89	79.8	200	PVC	3.95%	65.2	2.07	0.768
Barrow - West	672		670						0.17	2	6.3					4.22		2.54	122.5				1.49	0.51	2.00	36.5	200	PVC	1.20%	35.9	1.14	0.583
Barrow - West	670		600						0.04							4.22		2.58	122.5				1.49	0.52	2.01	27.7	200	PVC	0.61%	25.6	0.82	0.475
BarrGib SWM - West	600		749						0.04					0.39		3.87		12.59	769.3		0.13		8.62	2.56	11.30	49.0	250	PVC	0.50%	42.0	0.86	0.718
Inverness - West	679		794						0.40	6	18.8					4.38		0.40	18.8				0.24	0.08	0.32	43.9	200	PVC	2.00%	46.4	1.48	0.340
Inverness - West	794		792						0.83	16	50.2					4.28		1.23	69.1				0.86	0.25	1.10	102.1	200	PVC	1.70%	42.8	1.36	0.504
Inverness - West	778		792						0.15	2	6.3					4.43		0.15	6.3				0.08	0.03	0.11	37.8	200	PVC	1.58%	41.0	1.30	0.300
Tupling - West	792		786						0.36	5	15.7					4.25		1.74	91.1				1.12	0.35	1.47	83.7	200	PVC	3.58%	61.9	1.97	0.729
Tay - West	691		690						0.45	9	28.3					4.36		0.45	28.3				0.36	0.09	0.45	55.5	200	PVC	2.43%	51.1	1.63	0.374
Tay - West	690		786						0.66	12	37.7					4.29		1.11	65.9				0.82	0.22	1.04	97.0	200	PVC	2.52%	52.1	1.66	0.514
Gibson - West	790		788						0.40	8	25.1					4.37		0.40	25.1				0.32	0.08	0.40	32.5	200	PVC	1.50%	40.2	1.28	0.294
Gibson - West	788		786						0.33	5	15.7					4.33		0.73	40.8				0.51	0.15	0.66	81.0	200	PVC	0.50%	23.2	0.74	0.273
Tupling - West	786		760						0.65	11	34.5					4.12		4.23	232.4				2.77	0.85	3.62	85.0	200	PVC	0.52%	23.7	0.75	0.550
Inverness - West	778		776						0.80	15	47.1					4.32		0.80	47.1				0.59	0.16	0.75	93.7	200	PVC	3.03%	57.1	1.82	0.563
Inverness - West	776		774						0.53	5	15.7					4.29		1.33	62.8				0.78	0.27	1.05	39.2	200	PVC	0.48%	22.7	0.72	0.340
Inverness - West	PLUG		774																							24.0	300	PVC	0.50%	68.4	0.97	0.222
Inverness - West	774		770						0.69	10	31.4					4.25		2.02	94.2				1.16	0.40	1.56	84.2	300	PVC	0.51%	69.1	0.98	0.361
Inverness - West	770		768						0.75	9	28.3					4.22		2.77	122.5				1.49	0.55	2.05	70.4	300	PVC	0.50%	68.4	0.97	0.358
Inverness - West	768		766						0.22	2	6.3					4.21		2.99	128.7				1.57	0.60	2.17	10.9	300	PVC	0.55%	71.7	1.01	0.426
Inverness - West	766		764						0.39	6	18.8					4.19		3.38	147.6				1.79	0.68	2.47	70.3	300	PVC	0.51%	69.1	0.98	0.410
Inverness - West	764		760						0.47	8	25.1					4.17		3.85	172.7				2.08	0.77	2.85	82.8	300	PVC	0.51%	69.1	0.98	0.459
Tupling - West	760		754						0.63	11	34.5					4.00		8.71	439.6				5.09	1.74	6.83	87.0	300	PVC	0.53%	70.4	1.00	0.632

TOWN OF BRADFORD WEST GWILLIMBURY
SANITARY SEWER DESIGN SHEET
AS BUILT - AUGUST 20, 2021
Project / Subdivision BRADFORD CAPITAL RESIDENTIAL SUBDIVISION
Consulting Engineer / Project No. / Prepared by / Checked by / Last Revised
Design Parameters: Residential Density = 3.14 cap/unit; Manning 'n' = 0.013; Extran. Flow (pre 2000) = 0.5 L/s/ha; Extran. Flow (post 2000) = 0.2 L/s/ha; Residential = 250 L/cap/day; Industrial = 35 m3/ha*day; Institutional = 19.8 m3/ha*day; Commercial = 28 m3/ha*day
Design Equations
NOTE: Table 14 of the Engineering Standards is to be referenced for Maximum Capacity

Notes/Comments:

Street	From MH #	From Inv	To MH #	To Inv	Ind. Area (ha)	Comm. Area (ha)	Inst. Area (ha)	Pre 2000 Res. Area (ha)	Post 2000 Res. Area (ha)	Res. Units #	Res. Population cap.	Cum. Industrial P.F. M(ind)	Cum. Industrial Area A(ind)	Cum. Commercial Area A(c)	Cum. Institutional Area A(ins)	Residential P.F. M(r)	Cum. Pre 2000 Res. Area A(r)	Cum. Post 2000 Res. Area A(r)	Cum. Res. Population P	Q(ind)	Q(c)	Q(ins)	Q(r)	Q(i)	Q(d)	Length (m)	Pipe Size (mm)	Type of Pipe	Grade (%)	Full Flow Capacity (L/s)	Full Flow Velocity (m/s)	Actual velocity at design flow (m/s)
Gibson - West	738		756						0.26	5	15.7					4.39		0.26	15.7				0.20	0.05	0.25	41.0	200	PVC	1.39%	38.7	1.23	0.283
Gibson - West	756		754						0.54	10	31.4					4.32		0.80	47.1				0.59	0.16	0.75	76.5	200	PVC	0.58%	24.3	0.77	0.325
Gibson - West	754		753						0.25	4	12.6					3.97		9.76	499.3				5.74	1.95	7.69	52.5	300	PVC	0.53%	70.4	1.00	0.654
Gibson - West	753		752						0.22	2	6.3					3.97		9.98	505.5				5.81	2.00	7.81	63.5	300	PVC	0.52%	69.7	0.99	0.664
Gibson - West	752		749						0.15	2	6.3					3.97		10.13	511.8				5.88	2.03	7.90	23.5	300	PVC	0.59%	74.3	1.05	0.690
Gibson - West	749		704						0.04	3	9.4			0.39		3.73		22.76	1290.5		0.13		13.91	4.63	18.67	59.5	300	PVC	0.55%	71.7	1.01	0.850
Lewis - West	722		721						0.40	8	25.1					4.37		0.40	25.1				0.32	0.08	0.40	41.3	200	PVC	1.50%	40.2	1.28	0.294
Lewis - West	721		720						0.63	12	37.7					4.29		1.03	62.8				0.78	0.21	0.99	76.4	200	PVC	0.53%	23.9	0.76	0.357
Lewis - West	720		704						0.50	8	25.1					4.26		1.53	87.9				1.08	0.31	1.39	91.0	200	PVC	0.53%	23.9	0.76	0.388
Gibson - West	704		598						0.37	5	15.7			0.39		3.70		24.66	1394.2		0.13		14.94	5.01	20.07	69.4	300	PVC	0.60%	74.9	1.06	0.888
Gibson - West	738		736						0.24	4	12.6					4.39		0.24	12.6				0.16	0.05	0.21	36.5	200	PVC	1.45%	39.5	1.26	0.289
Gibson - West	736		724						0.72	11	34.5					4.32		0.96	47.1				0.59	0.21	0.80	83.8	200	PVC	0.51%	23.4	0.75	0.313
Gibson - West	plug		724						1.20	13	40.8					4.33		1.20	40.8				0.51	0.24	0.75	11.5	200	PVC	0.51%	23.4	0.75	0.313
Gibson - West	724		726						0.21	3	9.4					4.25		2.47	97.3				1.20	0.49	1.69	33.8	200	PVC	0.52%	23.7	0.75	0.389
Gibson - West	726		728						0.50	8	25.1					4.22		2.97	122.5				1.49	0.59	2.09	57.1	200	PVC	0.51%	23.4	0.75	0.451
Gibson - West	730		728						0.28	3	9.4					4.42		0.28	9.4				0.12	0.06	0.18	18.7	200	PVC	1.66%	42.3	1.35	0.309
Gibson - West	728		712						0.11	1	3.1					4.21		3.36	135.0				1.64	0.67	2.32	37.3	200	PVC	0.51%	23.4	0.75	0.473
Gibson - West	712		710						0.83	14	44.0					4.17		4.19	179.0				2.16	0.84	3.00	76.0	200	PVC	0.51%	23.4	0.75	0.513
Gibson - West	710		709						0.55	9	28.3					4.14		4.74	207.2				2.48	0.95	3.43	66.7	200	PVC	0.49%	23.0	0.73	0.529
Gibson - West	709		708						0.41	6	18.8					4.13		5.15	226.1				2.70	1.03	3.73	53.6	200	PVC	0.41%	21.0	0.67	0.503
Gibson - West	708		598													4.13		5.15	226.1				2.70	1.03	3.73	10.9	200	PVC	0.55%	24.3	0.77	0.565
Internal Easement	598		596						0.04					0.39		3.66		29.85	1620.2		0.13		17.14	6.05	23.31	45.2	300	PVC	0.80%	86.5	1.22	1.025
Internal Easement	596		594						0.03					0.39		3.66		29.88	1620.2		0.13		17.14	6.05	23.32	23.4	300	PVC	0.73%	82.6	1.17	0.999
Internal Easement	594		591						0.08					0.39		3.66		29.96	1620.2		0.13		17.14	6.07	23.33	86.1	375	PVC	0.26%	105.2	0.95	0.762
Simcoe - West	FUT		593						5.69	27	84.8					4.26		5.69	84.8				1.05	1.14	2.18	10.0	200	PVC	0.50%	23.2	0.74	0.469
Simcoe - West	593		591						0.46	5	15.7					4.24		6.15	100.5				1.23	1.23	2.46	92.0	250	PVC	0.35%	35.2	0.72	0.417
Simcoe - West	591		590						0.27	1	3.1			0.39		3.64		36.38	1723.8		0.13		18.13	7.35	25.61	19.6	375	PVC	0.40%	118.9	1.08	0.853
Simcoe - West	FUT		590				2.12		23.18	90	282.6				2.12	4.09		23.18	282.6			0.49	3.34	5.06	8.89	6.0	250	PVC	0.50%	42.0	0.86	0.678
Street 1 - East	590		589						0.04					0.39	2.12	3.58		59.60	2006.5		0.13	0.49	20.81	12.00	33.42	51.5	375	PVC	0.35%	103.7	0.94	0.834
Street 1 - East	589		588						0.25	2	6.3			0.39	2.12	3.58		59.85	2012.7		0.13	0.49	20.87	12.05	33.53	51.5	375	PVC	0.35%	103.7	0.94	0.834
Street 1 - East	588		586						0.19	3	9.4			0.39	2.12	3.58		60.04	2022.2		0.13	0.49	20.96	12.09	33.66	46.0	375	PVC	0.35%	103.7	0.94	0.834

TOWN OF BRADFORD WEST GWILLIMBURY
SANITARY SEWER DESIGN SHEET
AS BUILT - AUGUST 20, 2021
Project / Subdivision BRADFORD CAPITAL RESIDENTIAL SUBDIVISION
Consulting Engineer / Project No. / Prepared by / Checked by / Last Revised
Design Parameters: Residential Density = 3.14 cap/unit; Manning 'n' = 0.013; Extran. Flow (pre 2000) = 0.5 L/s/ha; Extran. Flow (post 2000) = 0.2 L/s/ha; Residential = 250 L/cap/day; Industrial = 35 m3/ha*day; Institutional = 19.8 m3/ha*day; Commercial = 28 m3/ha*day
Design Equations
NOTE: Table 14 of the Engineering Standards is to be referenced for Maximum Capacity

Notes/Comments:

Street	From MH #	From Inv	To MH #	To Inv	Ind. Area (ha)	Comm. Area (ha)	Inst. Area (ha)	Pre 2000 Res. Area (ha)	Post 2000 Res. Area (ha)	Res. Units #	Res. Population cap.	Cum. Industrial P.F. M(ind)	Cum. Industrial Area A(ind)	Cum. Commercial Area A(c)	Cum. Institutional Area A(ins)	Residential P.F. M(r)	Cum. Pre 2000 Res. Area A(r)	Cum. Post 2000 Res. Area A(r)	Cum. Res. Population P	Q(ind)	Q(c)	Q(ins)	Q(r)	Q(i)	Q(d)	Length (m)	Pipe Size (mm)	Type of Pipe	Grade (%)	Full Flow Capacity (L/s)	Full Flow Velocity (m/s)	Actual velocity at design flow (m/s)
Med Dens. - East	plug		586						0.94	60	188.4					4.16		0.94	188.4				2.27	0.19	2.45	9.5	200	PVC	2.00%	46.4	1.48	0.753
South Fut. St 2 - East	plug		586				0.66		12.20	239	750.5				2.78	3.88		12.20	750.5			0.64	8.42	3.00	12.05	10.5	250	PVC	0.40%	37.6	0.77	0.680
Street 1 - East	586		584						0.07					0.39	2.78	3.45		73.25	2961.0		0.13	0.64	29.54	15.28	45.58	41.0	375	PVC	0.35%	103.7	0.94	0.892
Street 1 - East	584		582						0.42	12	37.7			0.39	2.78	3.44		73.67	2998.7		0.13	0.64	29.87	15.37	46.00	74.5	375	PVC	0.35%	103.7	0.94	0.902
Street 1 - East	582		578						0.30	6	18.8			0.39	2.78	3.44		73.97	3017.5		0.13	0.64	30.04	15.43	46.23	90.5	375	PVC	0.35%	103.7	0.94	0.902
North Fut. St. 7 - East	plug		578						1.11	14	44.0					4.33		1.11	44.0				0.55	0.22	0.77	7.0	200	PVC	1.50%	40.2	1.28	0.396
South Fut. St. 6 - East	plug		578						2.36	55	172.7					4.17		2.36	172.7				2.08	0.47	2.56	13.5	200	PVC	0.50%	23.2	0.74	0.497
Street 1 - East	578		576						0.12	2	6.3			0.39	2.78	3.41		77.56	3240.5		0.13	0.64	32.01	16.15	48.92	33.0	375	PVC	0.35%	103.7	0.94	0.920
Street 1 - East	576		574						0.27	5	15.7			0.39	2.78	3.41		77.83	3256.2		0.13	0.64	32.15	16.20	49.11	37.0	375	PVC	0.35%	103.7	0.94	0.920
Street 1 - East	574		572						0.42	6	18.8			0.39	2.78	3.41		78.25	3275.0		0.13	0.64	32.31	16.28	49.36	36.0	375	PVC	0.35%	103.7	0.94	0.920
South Fut. St. 6 - East	plug		572						2.89	45	141.3					4.20		2.89	141.3				1.72	0.58	2.29	11.5	200	PVC	0.50%	23.2	0.74	0.469
Street 1 - East	572		571						0.12	1	3.1			0.39	2.78	3.39		81.26	3419.5		0.13	0.64	33.58	16.89	51.23	24.0	375	PVC	0.35%	103.7	0.94	0.930
Street 1 - East	571		570						0.01					0.39	2.78	3.39		81.27	3419.5		0.13	0.64	33.58	16.89	51.23	13.0	375	PVC	0.35%	103.7	0.94	0.930
Zima -Street 1 - East	plug		568						3.14	30	94.2					4.25		3.14	94.2				1.16	0.63	1.79	35.0	200	PVC	0.50%	23.2	0.74	0.430
Street 1 - East	568		570						0.01							4.25		3.15	94.2				1.16	0.63	1.79	13.0	375	PVC	0.50%	124.0	1.12	0.348
External Easement	570		566						0.04					0.39	2.78	3.38		84.46	3513.7		0.13	0.64	34.40	17.53	52.69	48.5	375	PVC	0.35%	103.7	0.94	0.934
External Easement	566		564						0.08					0.39	2.78	3.38		84.54	3513.7		0.13	0.64	34.40	17.54	52.70	100.0	375	PVC	0.35%	103.7	0.94	0.934
External Easement	564		561						0.08					0.39	2.78	3.38		84.62	3513.7		0.13	0.64	34.40	17.56	52.72	100.0	375	PVC	0.35%	103.7	0.94	0.934
External Easement	561		560						0.04					0.39	2.78	3.38		84.66	3513.7		0.13	0.64	34.40	17.57	52.73	49.5	375	PVC	0.35%	103.7	0.94	0.934
External Easement	560		Ex 16						0.01					0.39	2.78	3.38		84.67	3513.7		0.13	0.64	34.40	17.57	52.73	10.5	450	PVC	0.50%	201.6	1.27	1.062

No.	Revision	Date	By	Appr'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20/21
PROVINCE OF ONTARIO

Bradford West Gwillimbury

URBAN ECOSYSTEMS LIMITED
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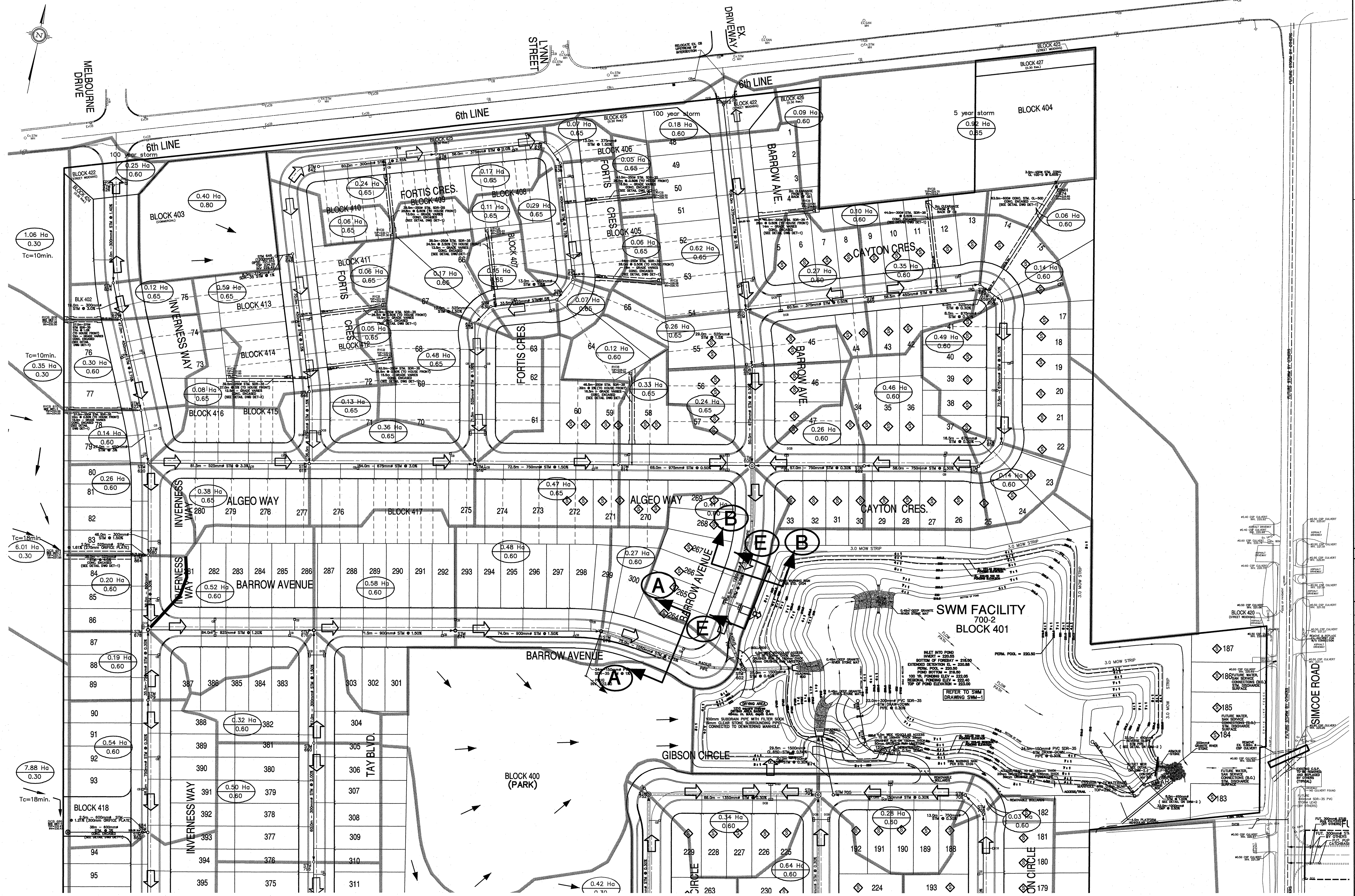
UEL

BRADFORD CAPITAL HOLDINGS INC.
DESIGN SHEETS - SANITARY SEWER

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017	
Drawn by: V.T.	Approved by: R.S.		
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. DES-1	
Scale Horz. 1:500 (0m 10m 20m)		Sheet No. – OF –	



SEE DWG. STM-2

LEGEND

WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
0.14Ha	DRAINAGE AREA
0.60	RUNOFF COEFFICIENT

NOTES :

(S) SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST–ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256–JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
Aug 19/15
DATE

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
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BRADFORD CAPITAL HOLDINGS INC.
STORM DRAINAGE PLAN

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. STM–1
Scale Horz. 1:1000 (0m 20m 40m)		Sheet No. – OF –

RIGHT OF WAY CAPACITY TO CONVEY 100 YEAR OVERLAND FLOW
SUMMARY

(A) 5.45m 4.55m 4.55m 5.45m; @ 2.0% @ 2.0% @ 2.0% @ 2.0%; 20.0m RIGHT OF WAY

R.O.W. FLOW CAPACITY @ 0.50% ROAD SLOPE	Q ROW CAPACITY = 2.5 cms. PER TOWN MANUAL FIGURE 2 ROAD CAPACITY
OVERLAND FLOW OTTSWM MAJOR OVERLAND FLOW CALCULATION AT SECTION A–A BARROW AVENUE	Q OVERLAND FLOW = 0.80 cms.

(B) 5.45m 4.55m 4.55m 5.45m; @ 2.0% @ 2.0% @ 2.0% @ 2.0%; 20.0m RIGHT OF WAY

R.O.W. FLOW CAPACITY @ 0.50% ROAD SLOPE	Q ROW CAPACITY = 2.5 cms. PER TOWN MANUAL FIGURE 2 ROAD CAPACITY
OVERLAND FLOW OTTSWM MAJOR OVERLAND FLOW CALCULATION AT SECTION B–B BARROW AVENUE	Q OVERLAND FLOW = 0.60 cms.

OVERLAND FLOW INLET SECTION
SECTION E - E

(E) 20m; 224.20 0.30m 224.20; 223.90

SPILLWAY CAPACITY = 2.1 c.m.s.
TOTAL EXPECTED FLOW = 1.40 c.m.s. – V = 0.70m/s

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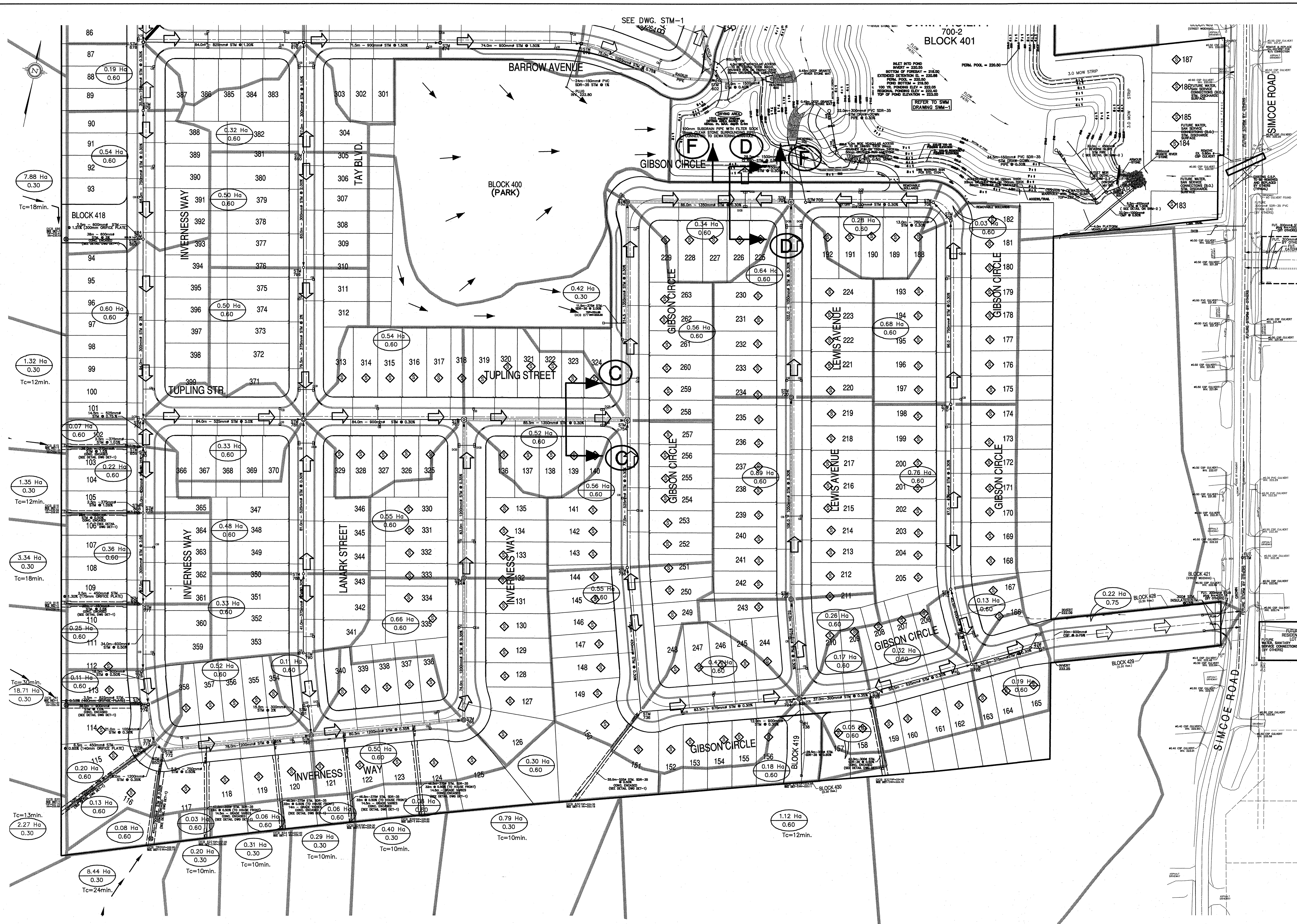

LEGEND

Symbol	Description
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
0.14Ha	DRAINAGE AREA
0.60	RUNOFF COEFFICIENT

NOTES :

(S) SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST–ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256–JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
aug 19/15
DATE

Bradford west Gwillimbury

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BRADFORD CAPITAL HOLDINGS INC.
STORM DRAINAGE PLAN

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	Drawing No. STM–2
Designed by: D.J.S.	Date: APRIL 4, 2014	Sheet No. – OF –

Scale
Horz. 1:1000 — 0m 20m 40m

RIGHT OF WAY CAPACITY TO CONVEY 100 YEAR OVERLAND FLOW
SUMMARY

(C)

PL — 5.45m @ 3.0% — 4.55m @ 2.0% — CL — 4.55m @ 2.0% — 5.45m @ 3.0% — PL

20.0m RIGHT OF WAY

R.O.W. FLOW CAPACITY @ 0.50% ROAD SLOPE	$Q_{ROW\ CAPACITY}$ = 3.9 cms. PER TOWN MANUAL FIGURE 2 ROAD CAPACITY
OVERLAND FLOW OTTSWM MAJOR OVERLAND FLOW CALCULATION AT SECTION C–C TUPLING STREET	$Q_{OVERLAND\ FLOW}$ = 1.18 cms.

(D)

PL — 5.45m @ 3.0% — 4.55m @ 2.0% — CL — 4.55m @ 2.0% — 5.45m @ 3.0% — PL

20.0m RIGHT OF WAY

R.O.W. FLOW CAPACITY @ 0.50% ROAD SLOPE	$Q_{ROW\ CAPACITY}$ = 3.9 cms. PER TOWN MANUAL FIGURE 2 ROAD CAPACITY
OVERLAND FLOW OTTSWM MAJOR OVERLAND FLOW CALCULATION AT SECTION D–D GIBSON CIRCLE	$Q_{OVERLAND\ FLOW}$ = 1.39 cms.

OVERLAND FLOW INLET SECTION
SECTION F - F

(F)

30m
224.24 — 0.30m — 223.95 — 224.24

SPILLWAY CAPACITY = 3.2 c.m.s.
TOTAL EXPECTED FLOW = 2.17 c.m.s. – V = 0.65m/s

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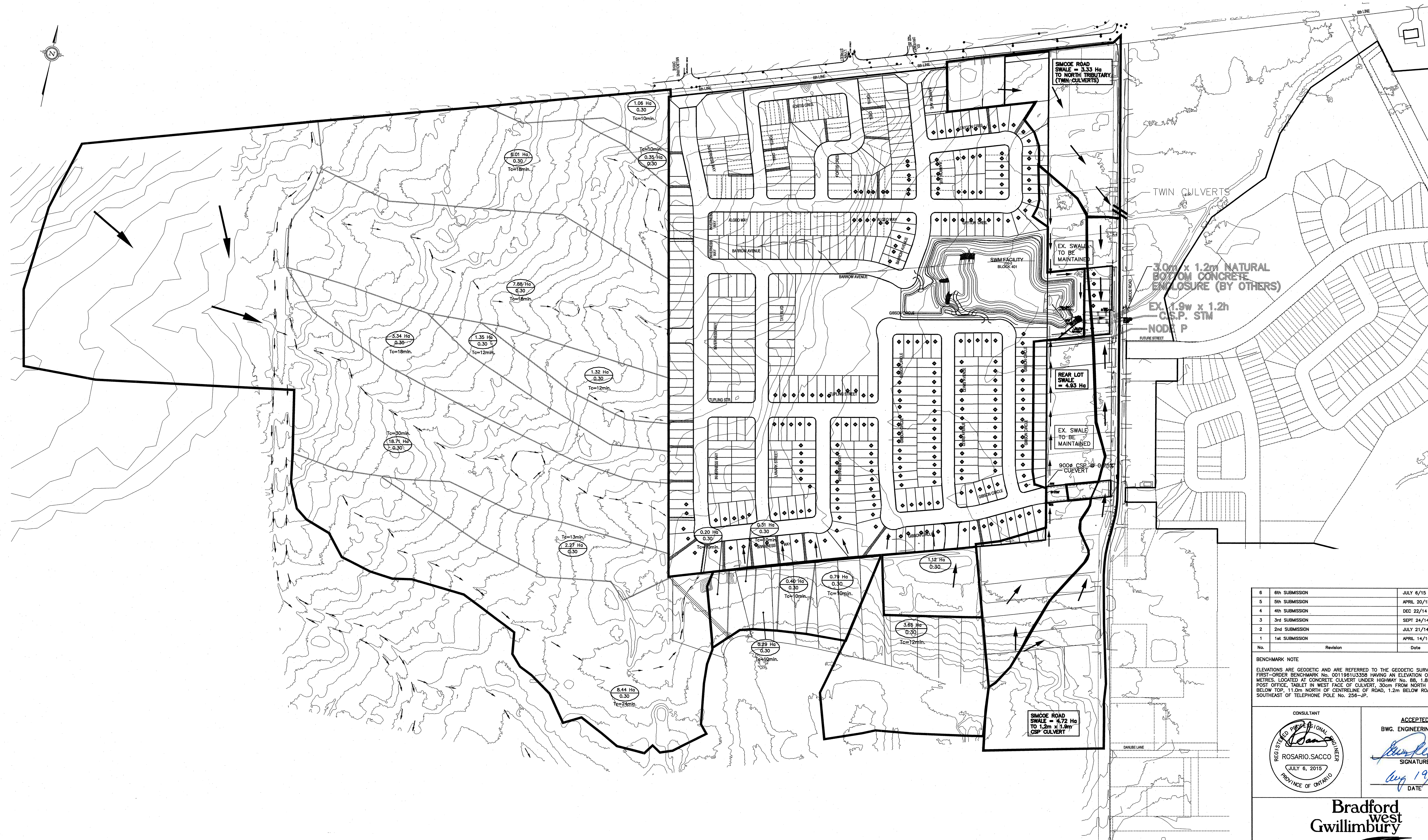

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
Aug 19/15
DATE

Bradford west Gwillimbury

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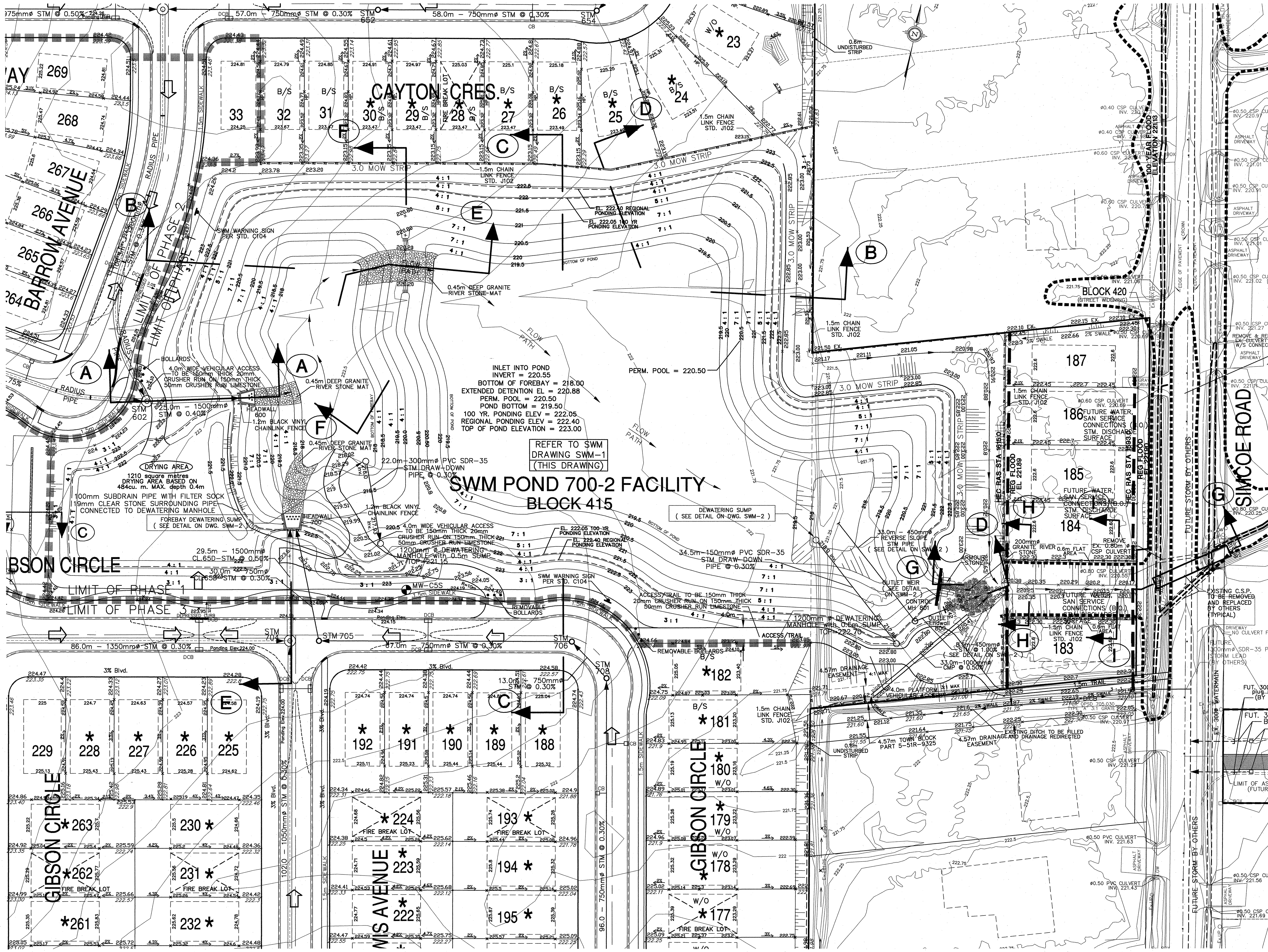
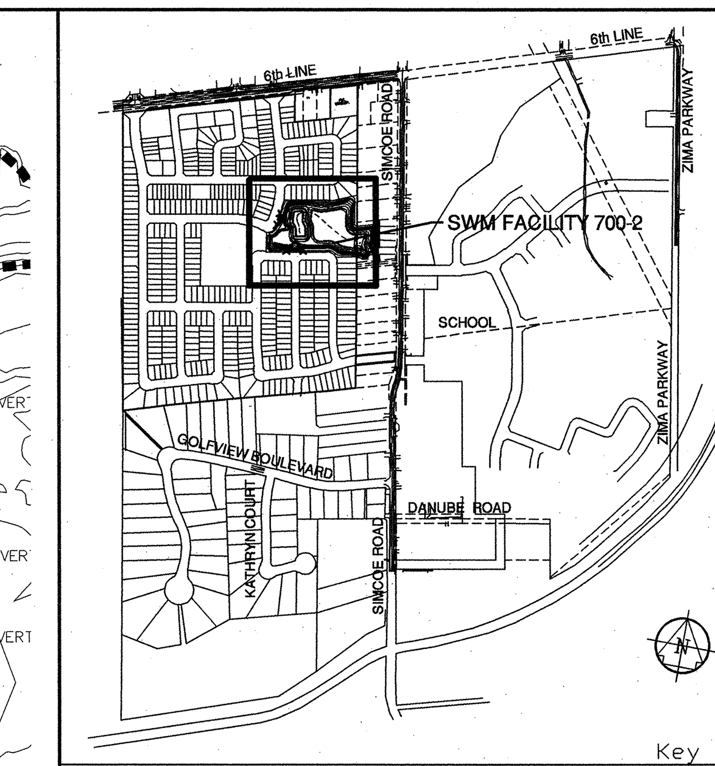
UEL

BRADFORD CAPITAL HOLDINGS INC.
EXTERNAL STORM DRAINAGE PLAN

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. STM-3
Scale 0m 20m 40m Horz. 1:2500		Sheet No. – OF –

ID - P:\2008\08017-BRADFORD-WEST\PRINTING\08017-PRINTING-EXTERNAL STORM-STM3.dwg - Thu, 9 Jul 2015 - 13:38





SWM POND 700-2 FACILITY OPERATING CHARACTERISTICS					
	DISCHARGE (m^3/s)	REQUIRED STORAGE (m^3)	STORM DISTRIBUTION	PROVIDED STORAGE (m^3)	WSEL (m)
PERMANENT POOL	–	9,411		12,889	220.50
EXTENDED DETENTION	0.04	4,808	4 hr Chicago	4,888	220.88
2 YEAR	0.21	9,000	24 hr SCS	9,453	221.20
5 YEAR	0.98	13,000	24 hr SCS	13,324	221.45
10 YEAR	1.88	15,200	24 hr SCS	15,763	221.60
25 YEAR	3.12	18,400	24 hr SCS	19,151	221.80
50 YEAR	4.12	20,900	24 hr SCS	20,903	221.90
100 YEAR	5.32	23,500	24 hr SCS	23,604	222.05

NOTE:

SHOP DRAWINGS AND STRUCTURAL DESIGN INFORMATION FOR WEIR WALL AND ARMOUR STONE WING WALLS ARE TO BE SUBMITTED TO LSRCA PRIOR TO CONSTRUCTION

NOTE :

SWM FACILITY IS TO BE CONSTRUCTED IN ACCORDANCE WITH THE GEOTECHNICAL REPORT AND CONSTRUCTION IS TO BE OVERSEEN BY THE GEOTECHNICAL CONSULTANT

No.	Revision	Date	By	Appr'd
8.	6th SUBMISSION	JULY 6/15	R.S.	
7.	5th SUBMISSION	APRIL 20/15	R.S.	
6.	4th SUBMISSION	DEC 22/14	R.S.	
5.	REVISED PER LSRCA COMMENTS.	SEPT 25/14	R.S.	
4	TOWN 3rd SUBMISSION	SEPT 24/14	R.S.	
3	TOWN 2nd SUBMISSION	JULY 21/14	R.S.	
2	REVISED PER TOWN/LSRCA COMMENTS.	MAR 13/14	D.J.S.	
1	REVISED PER TOWN/LSRCA COMMENTS.	FEB 07/12	D.J.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
Aug 19/15
DATE

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BRADFORD CAPITAL HOLDINGS INC.

STORM WATER MANAGEMENT POND 700-2

Surveyed by:	P.E.	Checked by:	R.S.	Project No. 08017
Drawn by:	V.T.	Approved by:	R.S.	
Designed by:	D.J.S.	Date:	APRIL 4, 2014	Drawing No. SWM-1
Scale Horz. 1:500 (0m 10m 20m)				Sheet No. - OF -

ID - P:\2008\08017-BRADFORD-WEST\PRINTING\08017-SWM-1-WEST.dwg - Fri, 10 Jul 2015 - 13:31

NOTES :

- FOR STRUCTURE AND PIPING DETAILS SEE DRAWINGS SWM-2 and 3
- FOR CROSS SECTIONS A-A TO F-F SEE DRAWINGS SWM-4,5 and 6
- FOR CROSS SECTIONS G-G TO I-I AND SUMMARY POND CROSS SECTION SEE DRAWING SWM-3

SEE DWG. SAN-2

LEGEND

WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK

0.18Ha
6 | 2

AREA
RESIDENTIAL UNITS
POPULATION

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.

SIGNATURE

Aug 19/15

DATE

Bradford West Gwillimbury

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f. (905)856-0698

BRADFORD CAPITAL HOLDINGS INC.
SANITARY DRAINAGE PLAN

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017	
Drawn by: V.T.	Approved by: R.S.		
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. SAN-1	
Scale Horz. 1:1000 (0m 20m 40m)		Sheet No. – OF –	

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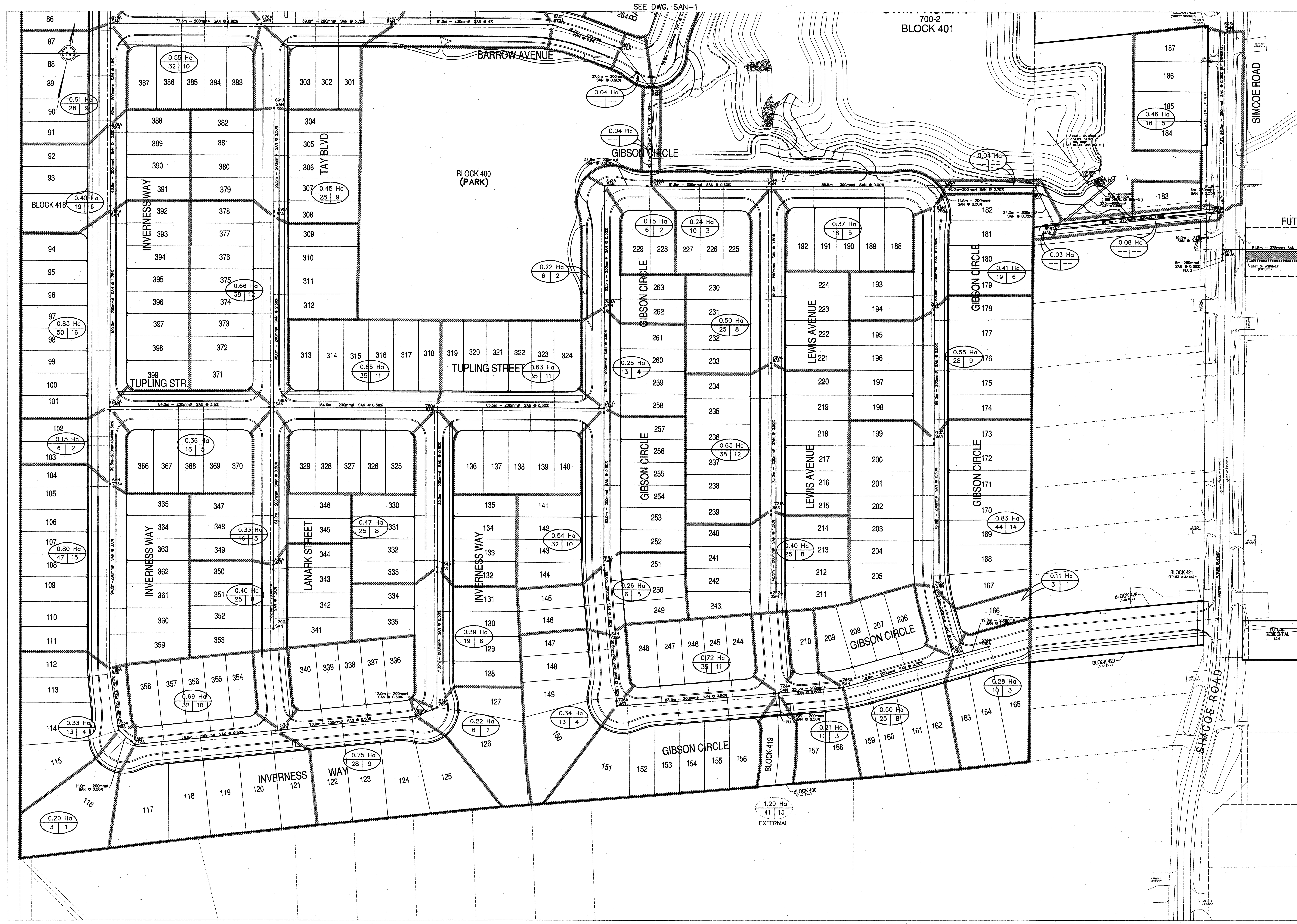

LEGEND

WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
0.18Ha	AREA
2	RESIDENTIAL UNITS
6	POPULATION

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
Aug 19/15
DATE

Bradford west Gwillimbury

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UEL

BRADFORD CAPITAL HOLDINGS INC.
SANITARY DRAINAGE PLAN

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. SAN-2
Scale Horz. 1:1000 (0m 20m 40m)		Sheet No. – OF –

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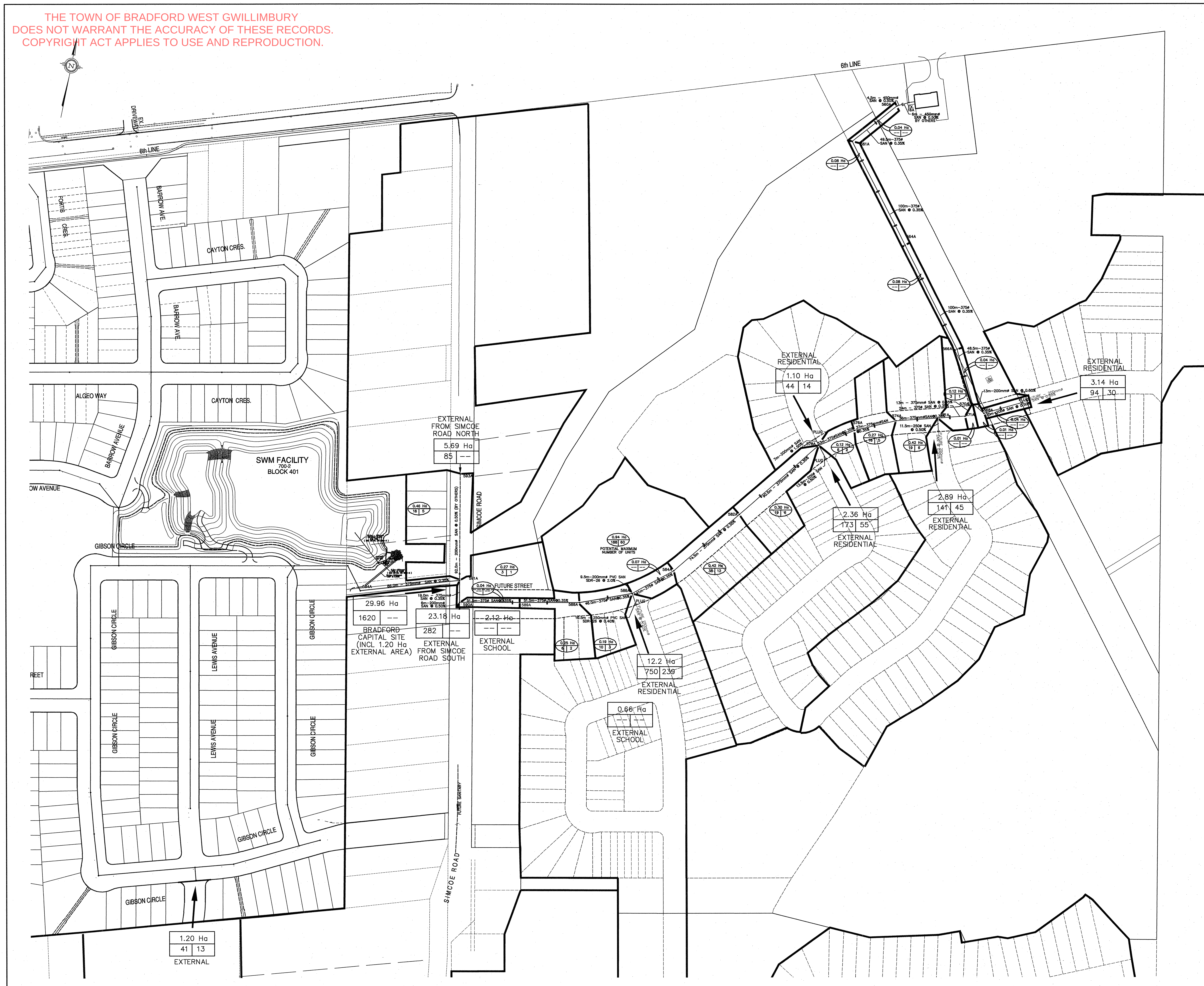

LEGEND

AREA	
TOTAL POP.	# UNITS /BASIN

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

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CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
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BRADFORD CAPITAL HOLDINGS INC.
EXTERNAL SANITARY DRAINAGE PLAN

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. SAN-3
Scale Horz. 1:1500 (0m 20m 40m)		Sheet No. – OF –

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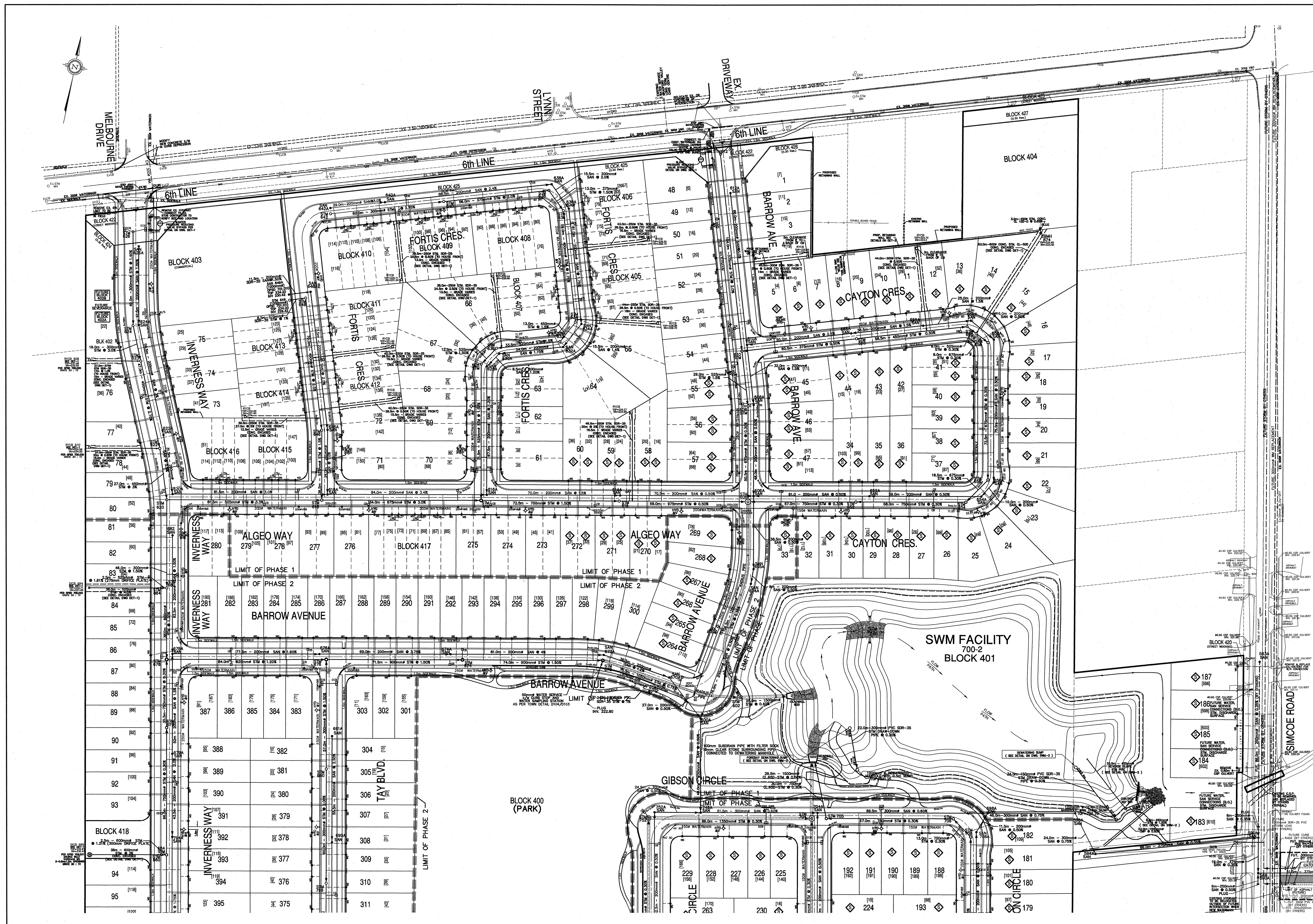

Key Plan

LEGEND

WB	WATER BOX / SERVICE
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XO—XO—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—Z—	1.8m PRIVACY FENCE
—XOX—XOX—	ACOUSTIC FENCE
	DOUBLE STORM & SANITARY SERVICE
	SINGLE SANITARY SERVICE
	SINGLE STORM SERVICE

NOTES :

(S) SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
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3	3rd SUBMISSION	SEPT 24/14	RS	
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BENCHMARK NOTE

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CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
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Bradford West Gwillimbury

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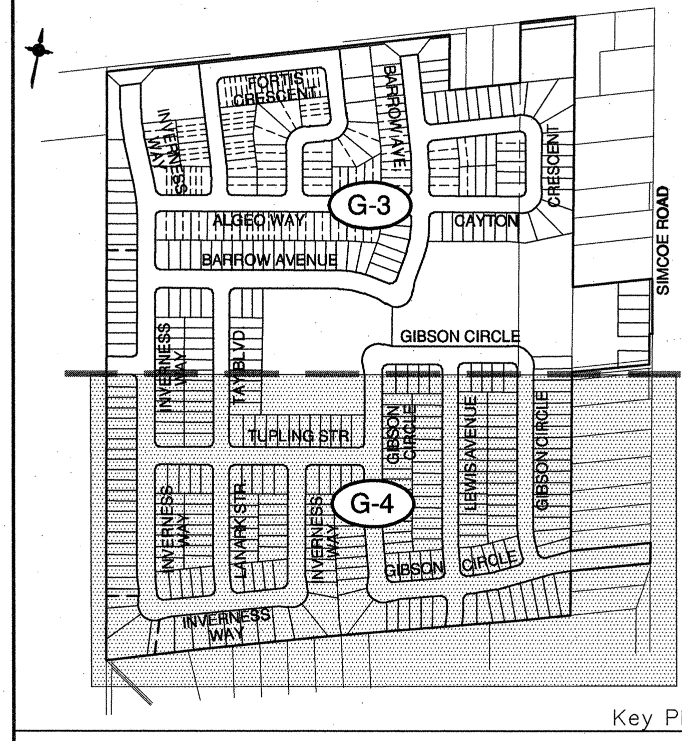
BRADFORD CAPITAL HOLDINGS INC.
GENERAL UNDERGROUND SERVICES PLAN

Surveyed by: P.E.		Checked by: R.S.		Project No. 08017
Drawn by: V.T.		Approved by: R.S.		
Designed by: D.J.S.		Date: APRIL 4, 2014		Drawing No. G–3
Scale Horz. 1:1000 (0m, 20m, 40m)				Sheet No. – OF –

ID – P:\2008\08017–BRADFORD–WEST\PRINTING\08017–PRINTING–UNDERGROUND –G–3–4.dwg – Thu, 9 Jul 2015 – 11:38



LEGEND

WB	WATER BOX / SERVICE
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
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620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
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DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—X□—X□—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—Z—	1.8m PRIVACY FENCE
—XOX—XOX—	ACOUSTIC FENCE
	DOUBLE STORM & SANITARY SERVICE
	SINGLE SANITARY SERVICE
	SINGLE STORM SERVICE

NOTES :

S SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
Aug 19/15
DATE

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
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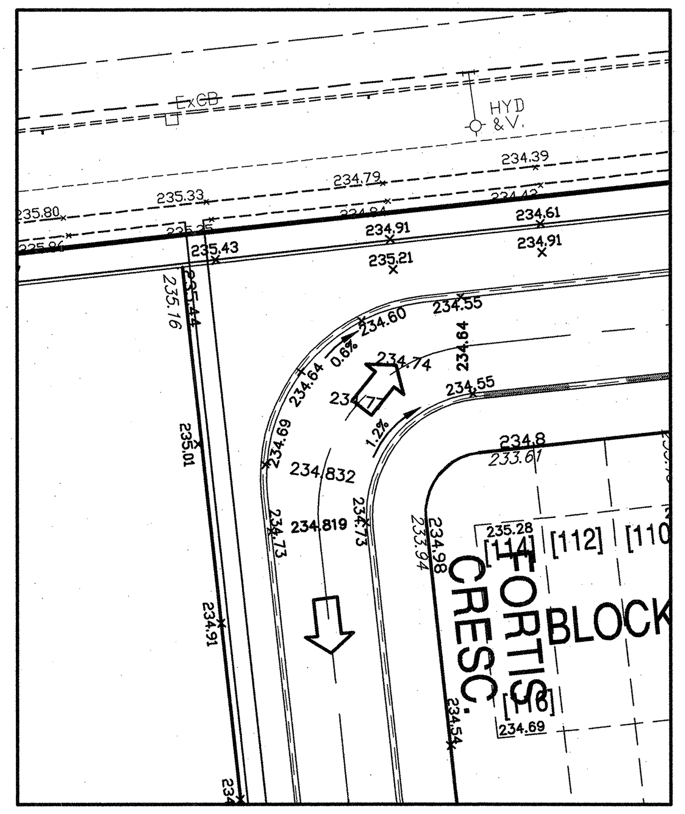
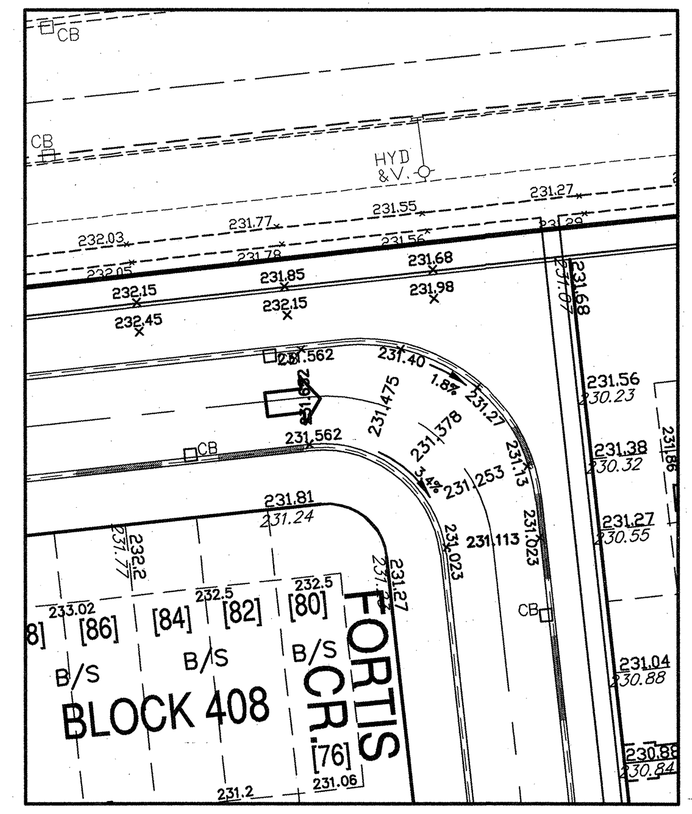
BRADFORD CAPITAL HOLDINGS INC.
GENERAL UNDERGROUND SERVICES PLAN

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. G-4
Scale Horz. 1:1000 (0m 20m 40m)		Sheet No. – OF –

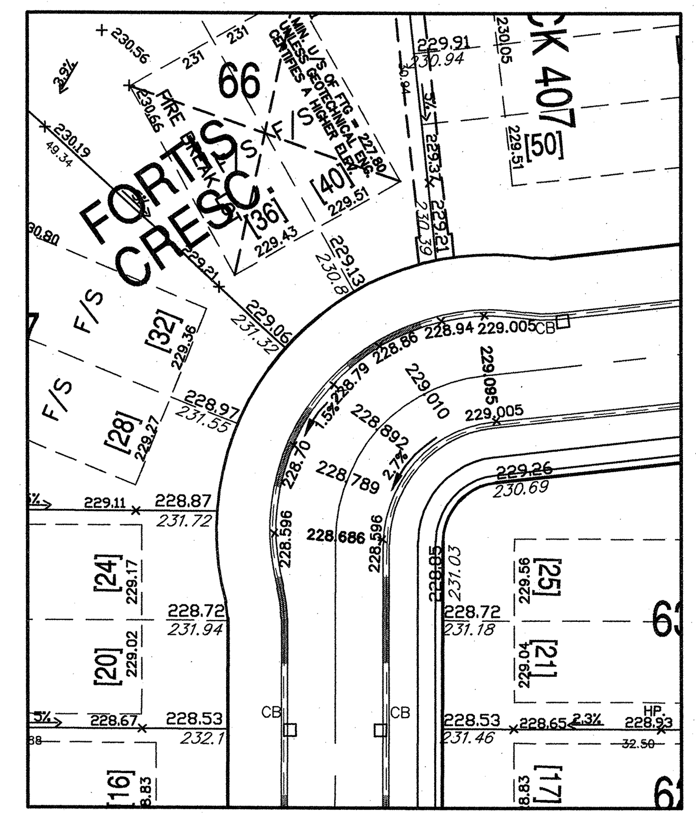
ID - P:\2008\08017-BRADFORD-WEST\PRINTING\08017-PRINTING-UNDERGROUND -G-3-4.dwg - Thu, 9 Jul 2015 - 11:39



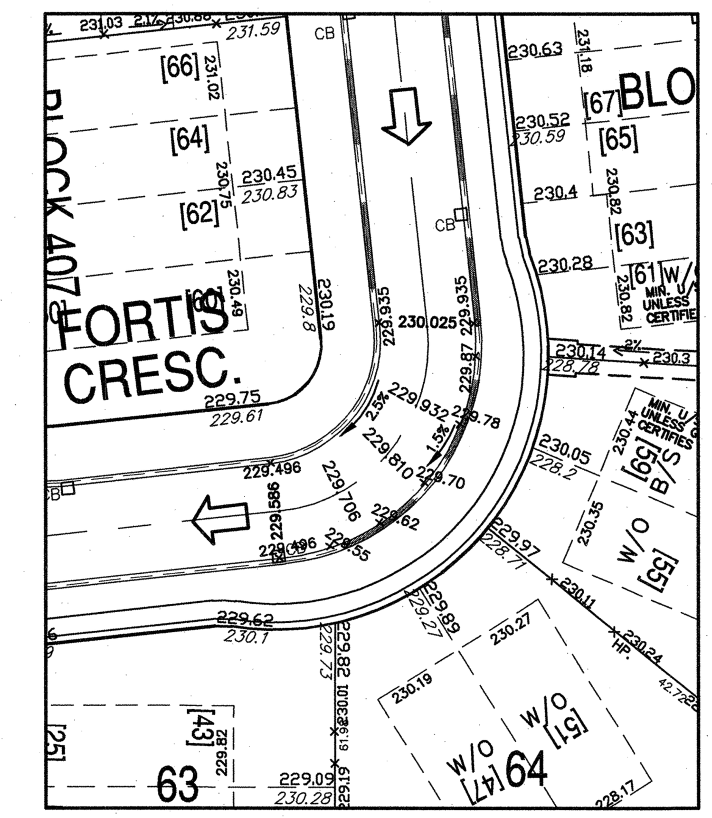
CURB GUTTER DETAIL 1



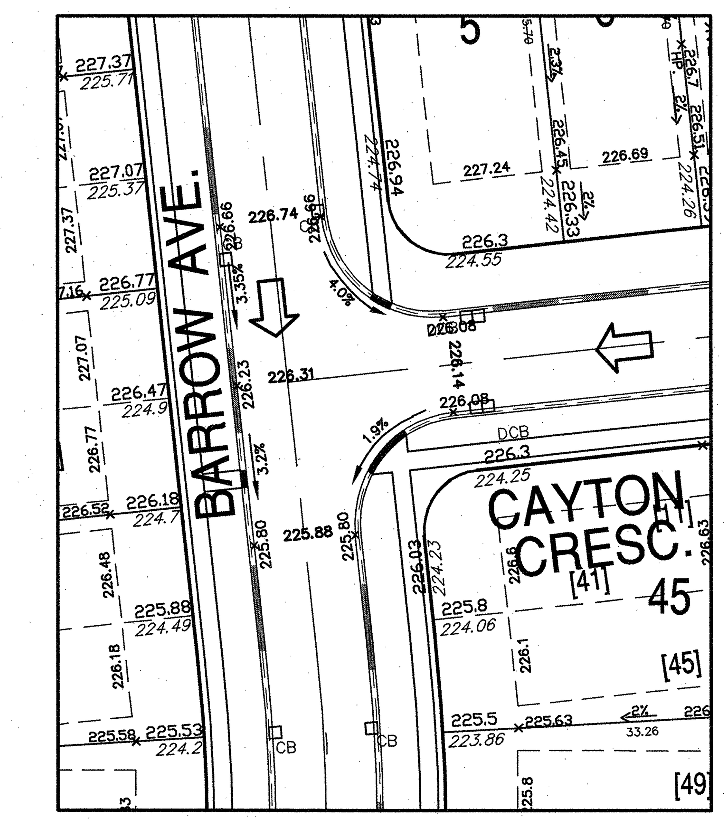
CURB GUTTER DETAIL 2



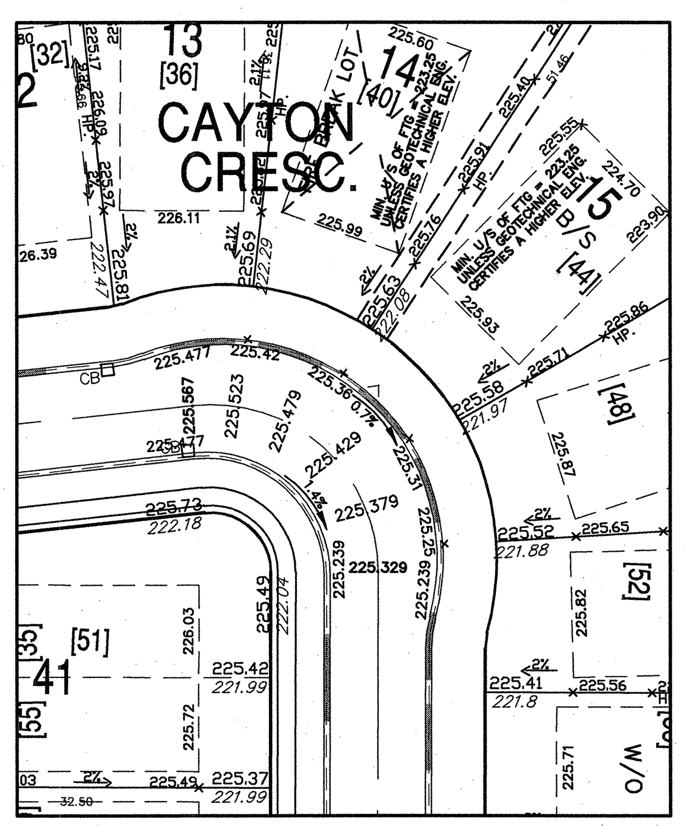
CURB GUTTER DETAIL 3



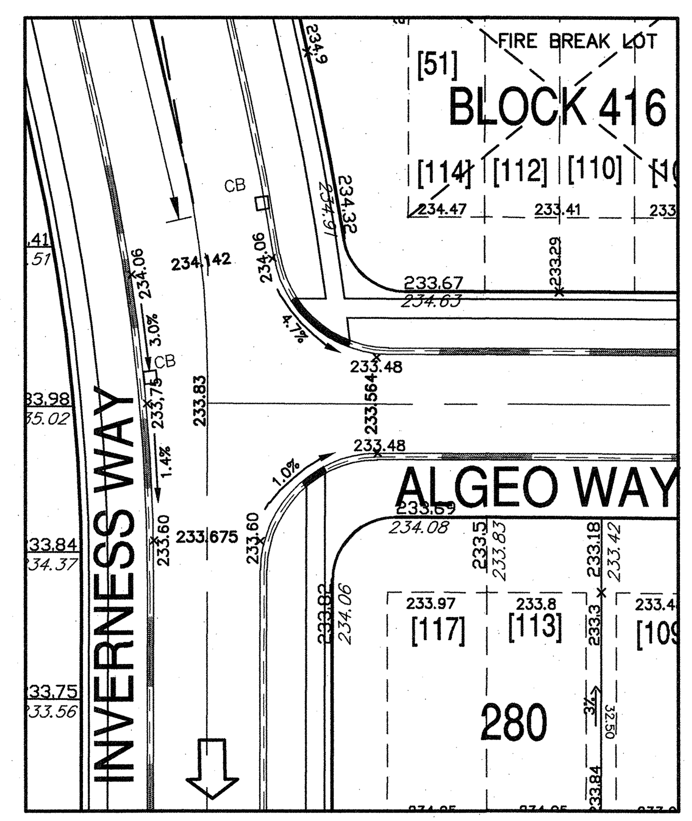
CURB GUTTER DETAIL 4



CURB GUTTER DETAIL 5



CURB GUTTER DETAIL 6



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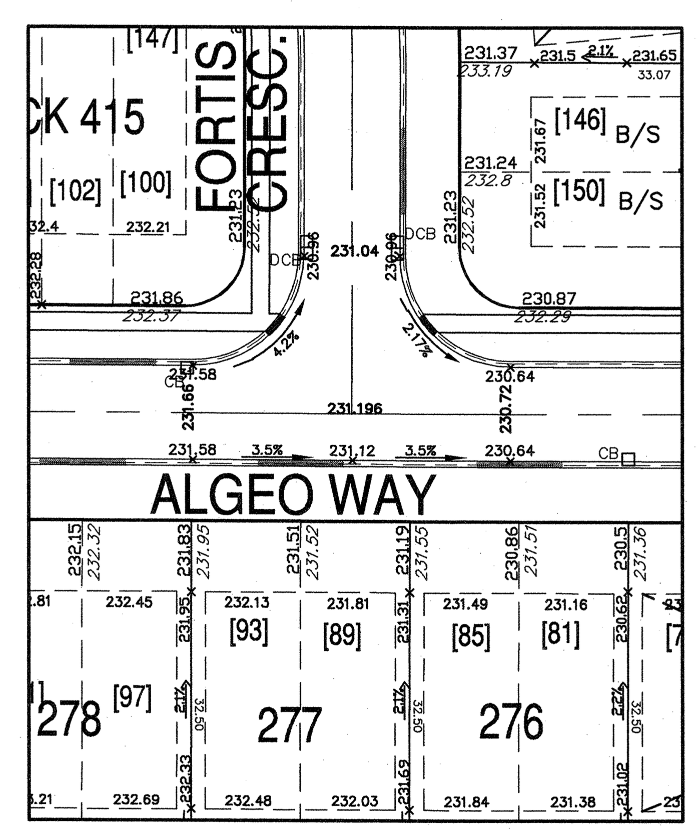

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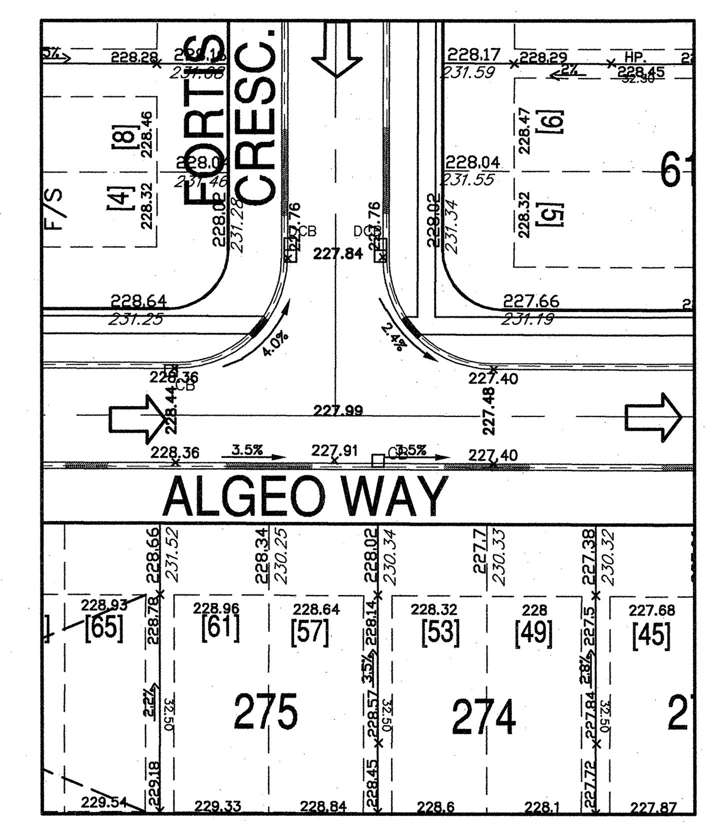

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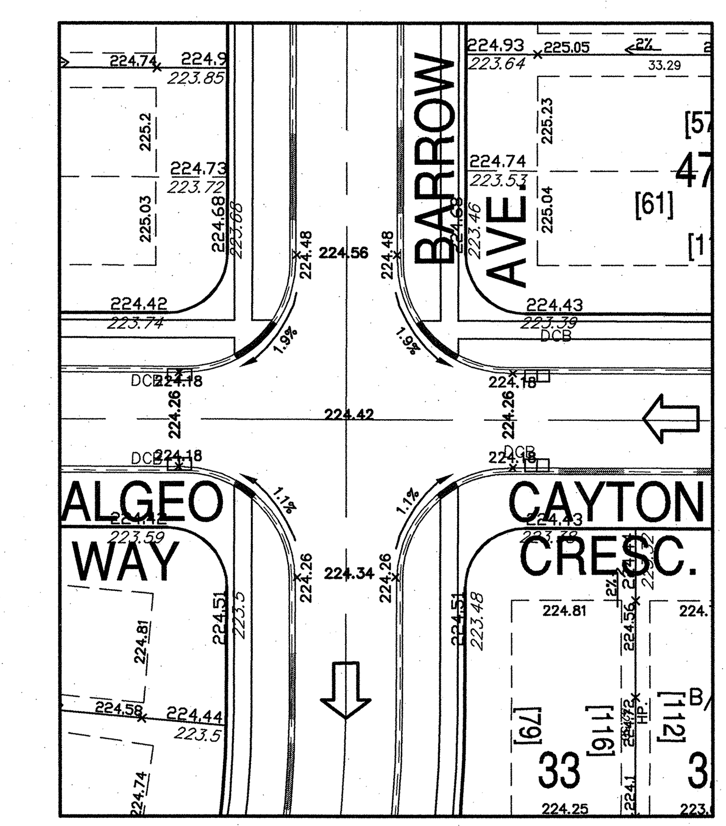

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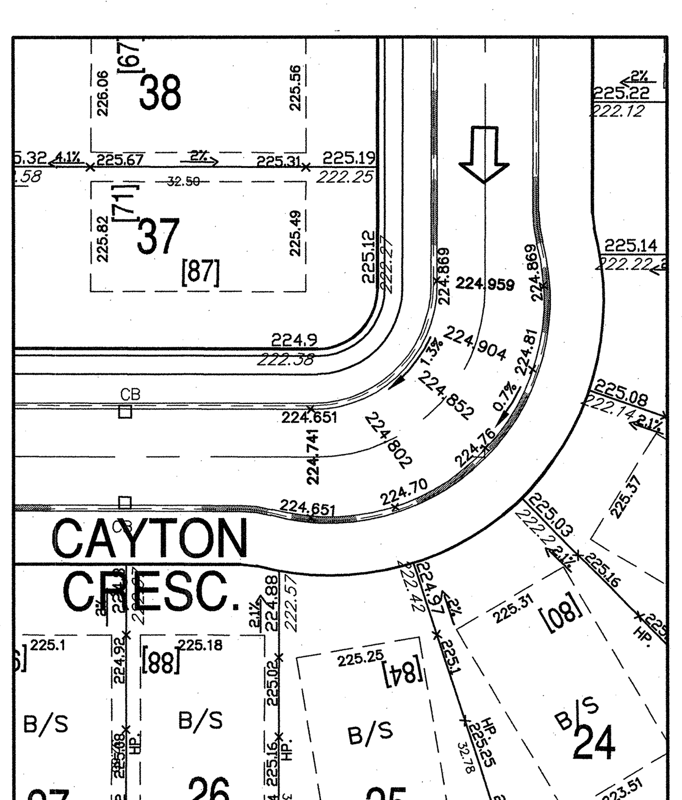

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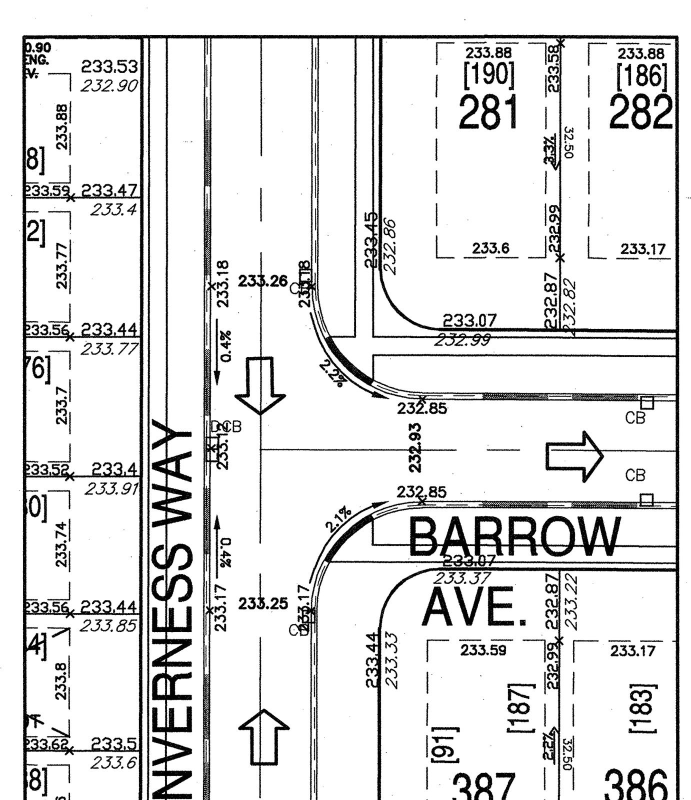

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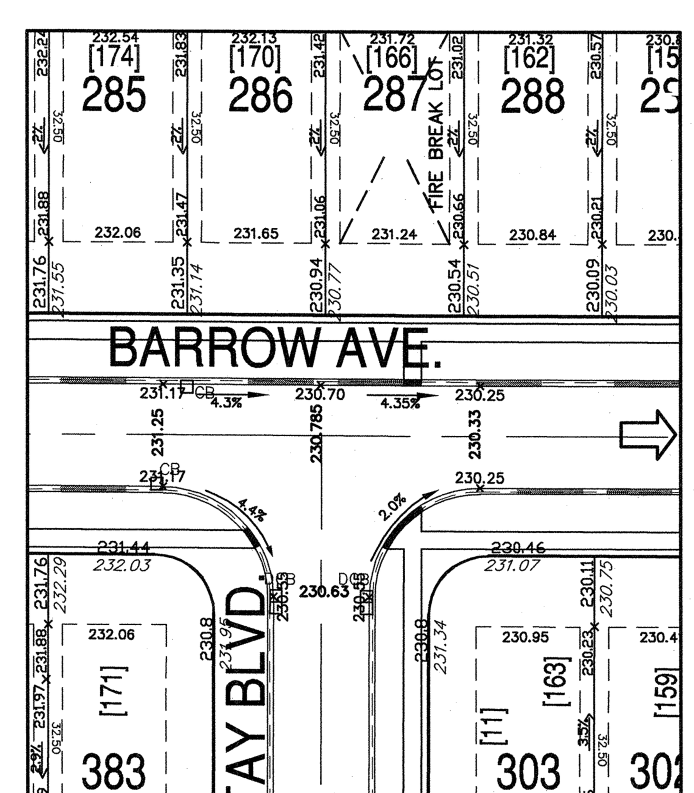

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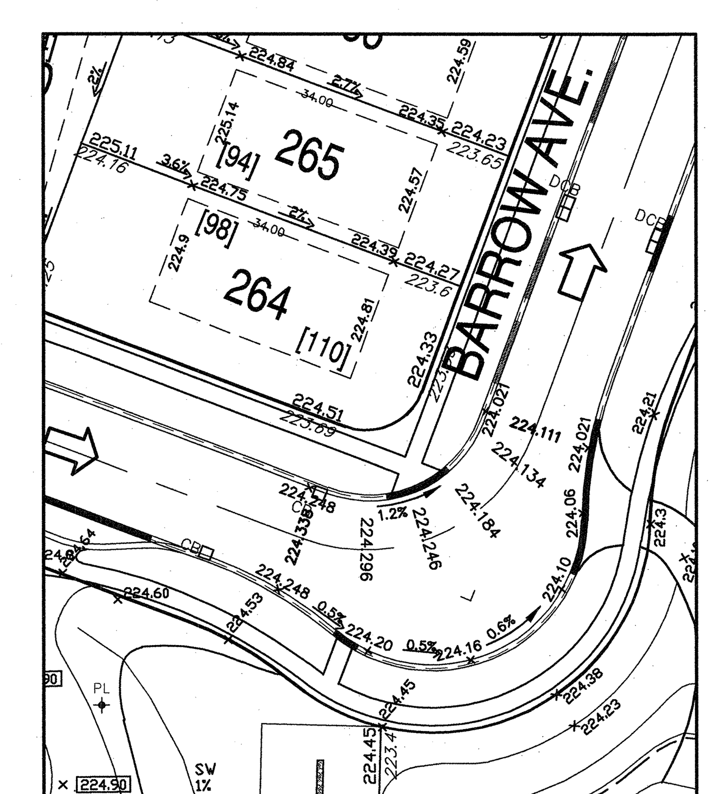

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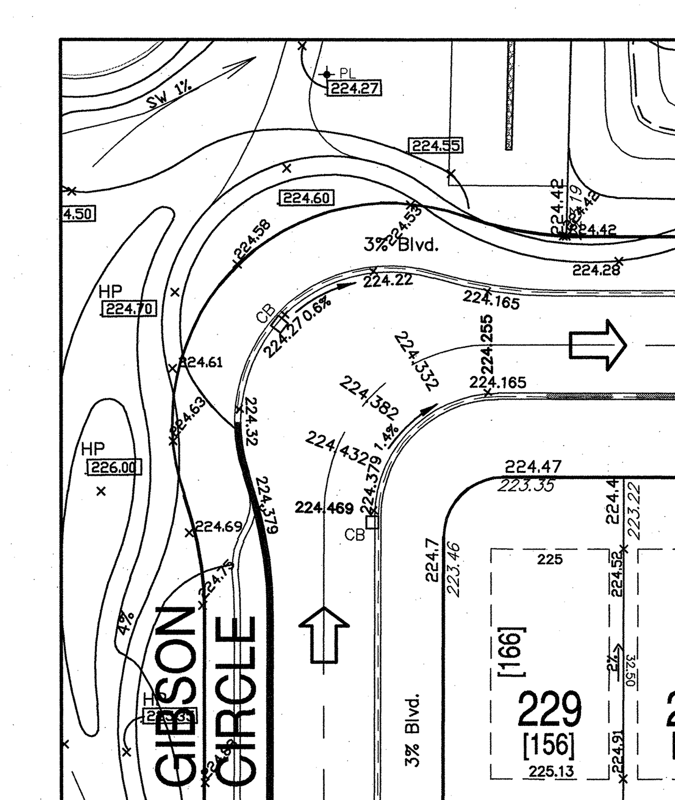
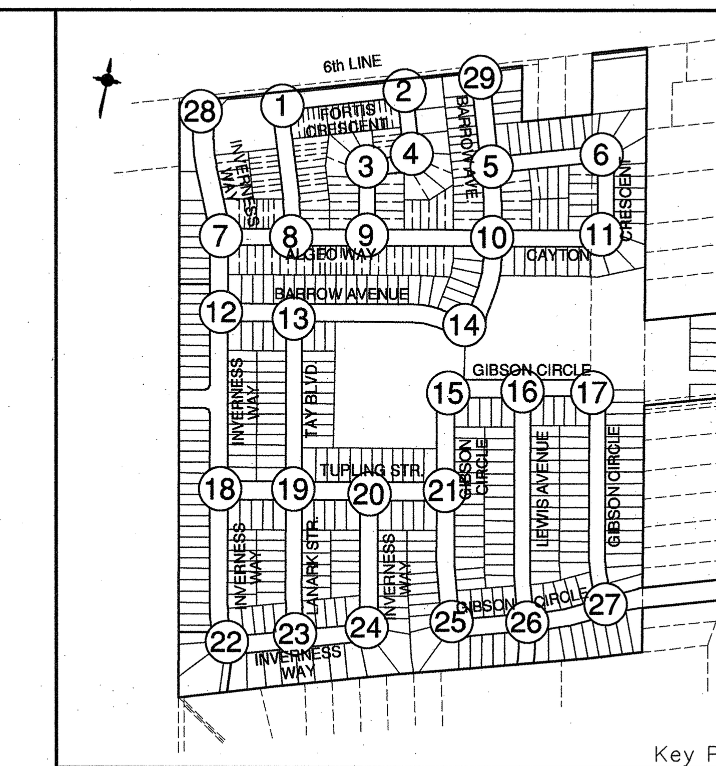


CURB GUTTER DETAIL 15



LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVATION

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.

SIGNATURE

Aug 19/15
DATE

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
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BRADFORD CAPITAL HOLDINGS INC.
CURB AND GUTTER DETAILS

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. GD-1
Scale Horz. 1:500 (0m 10m 20m)		Sheet No. – OF –

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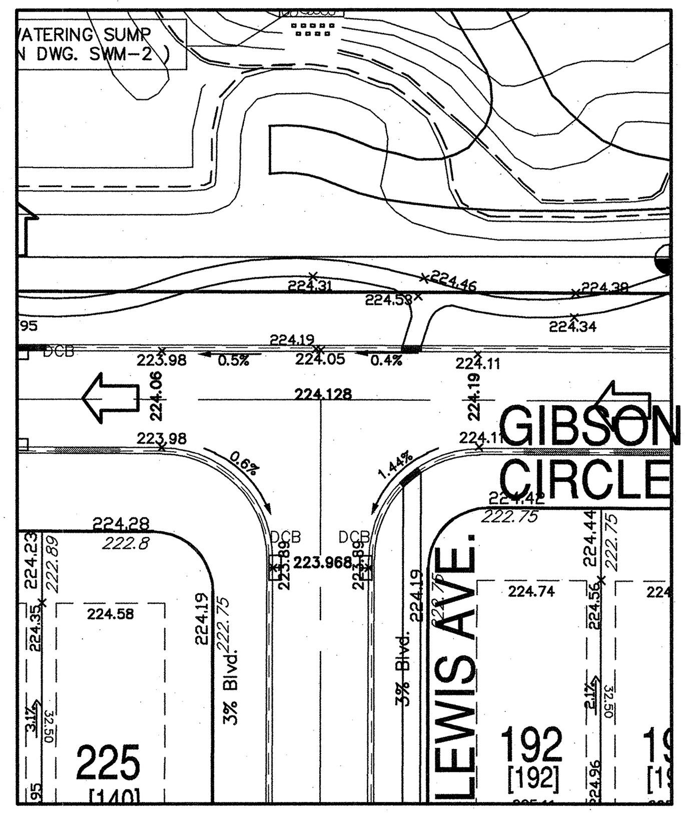

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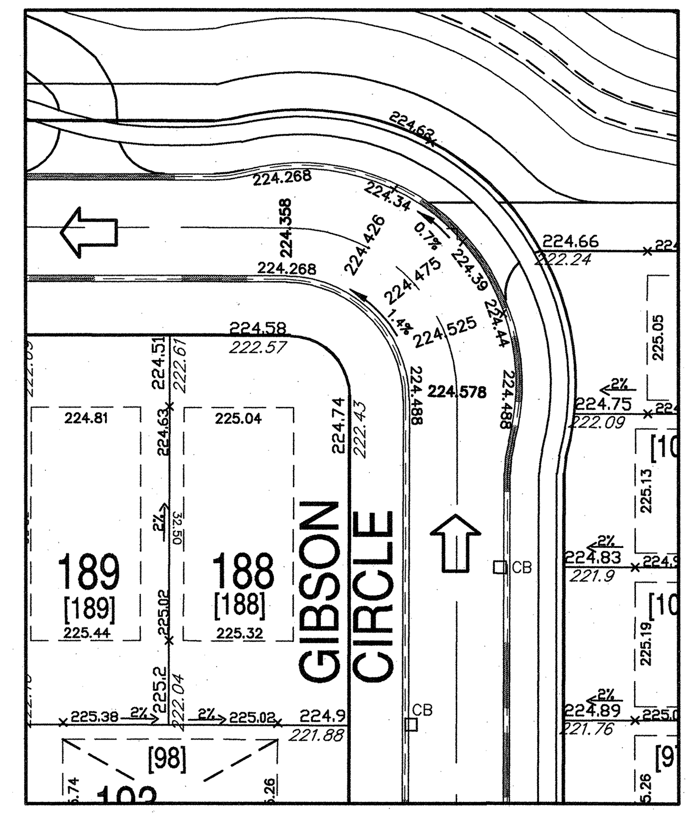

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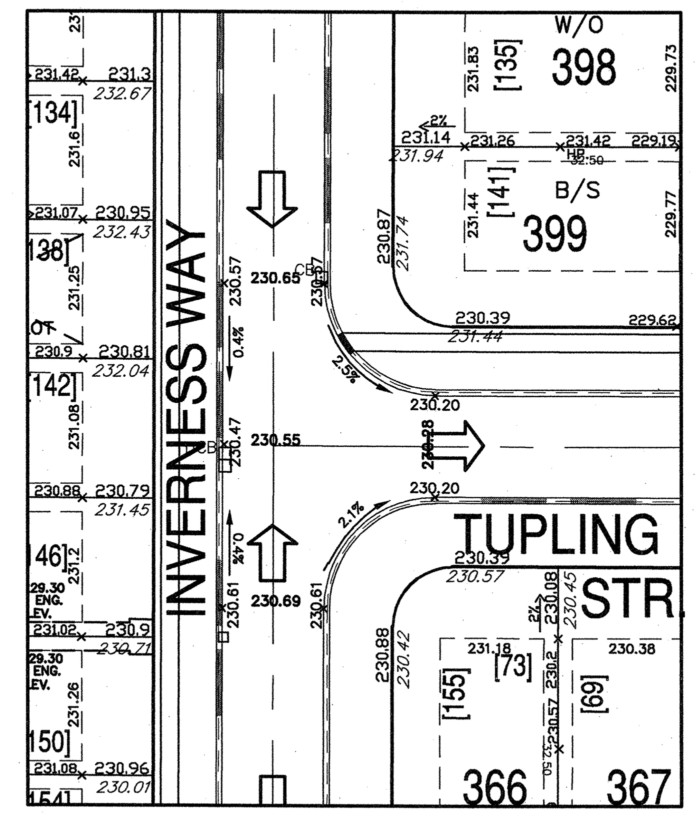

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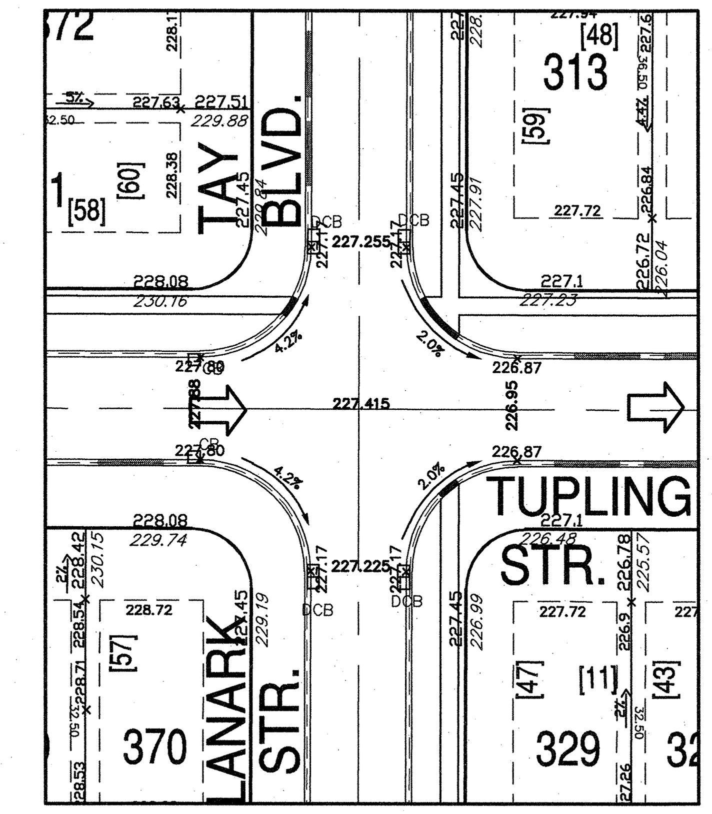

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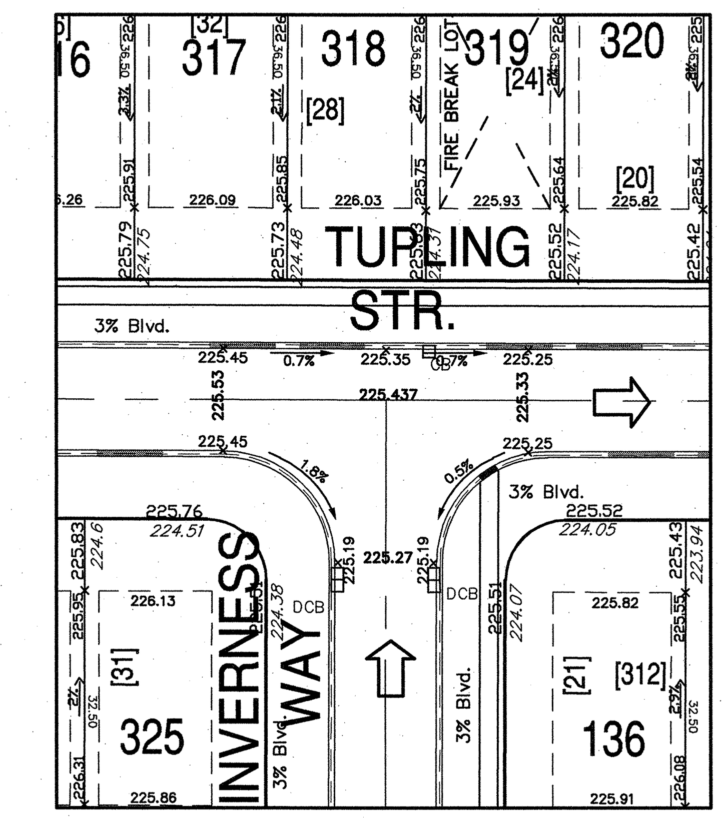

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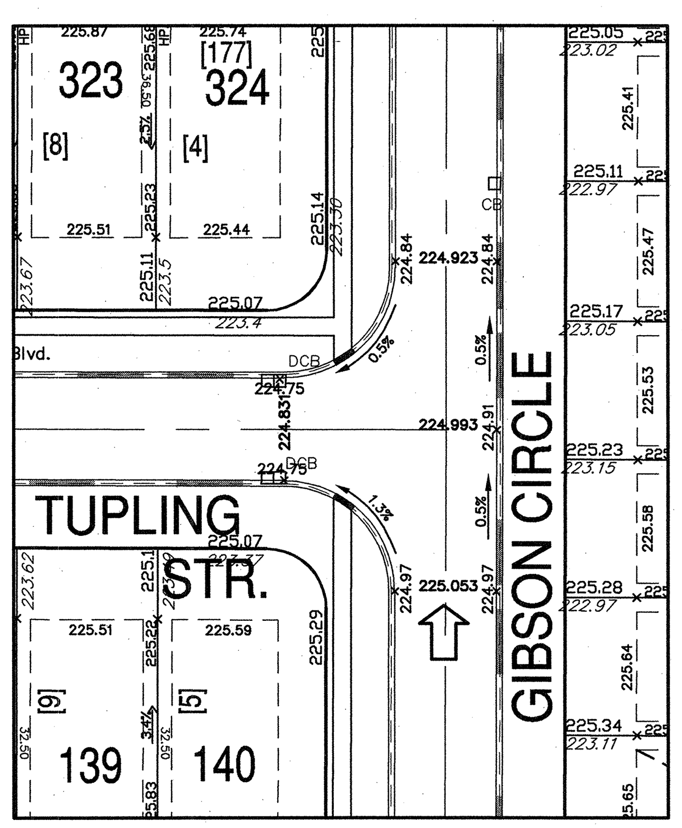

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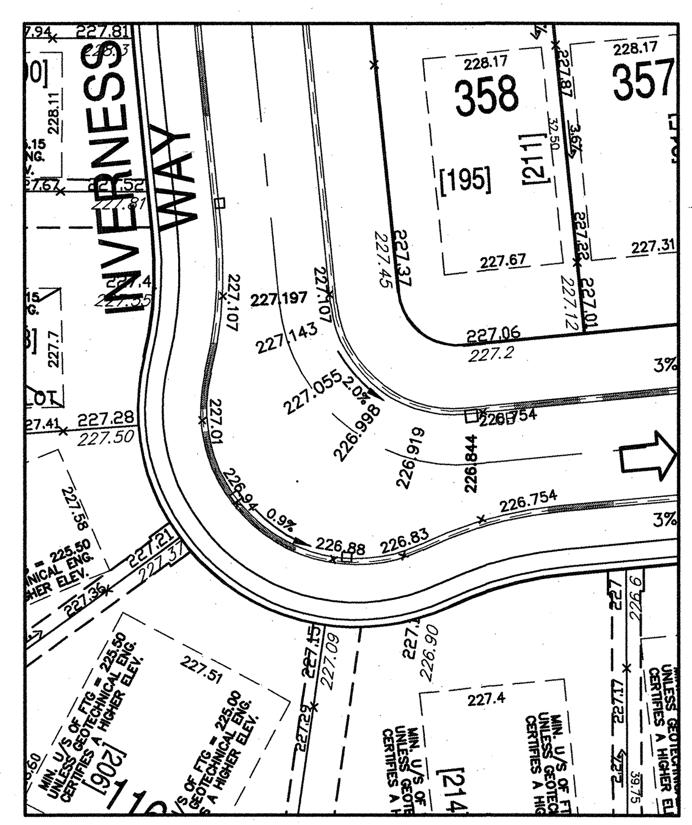

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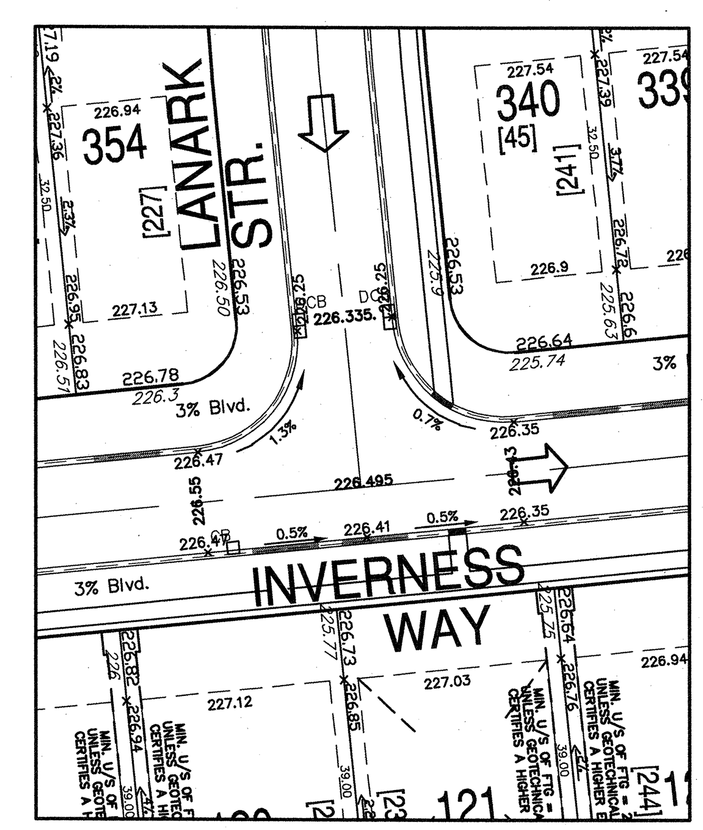

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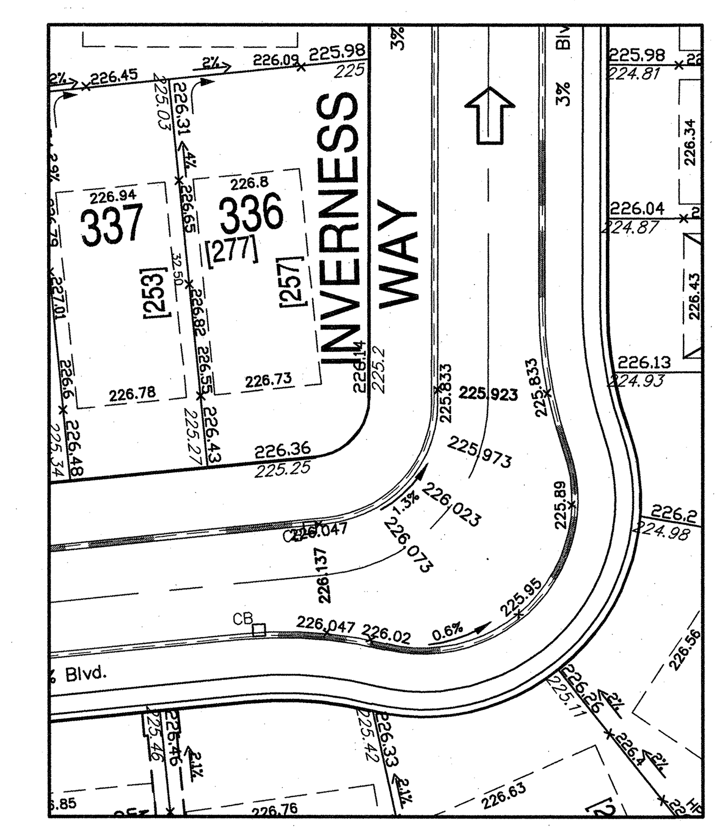

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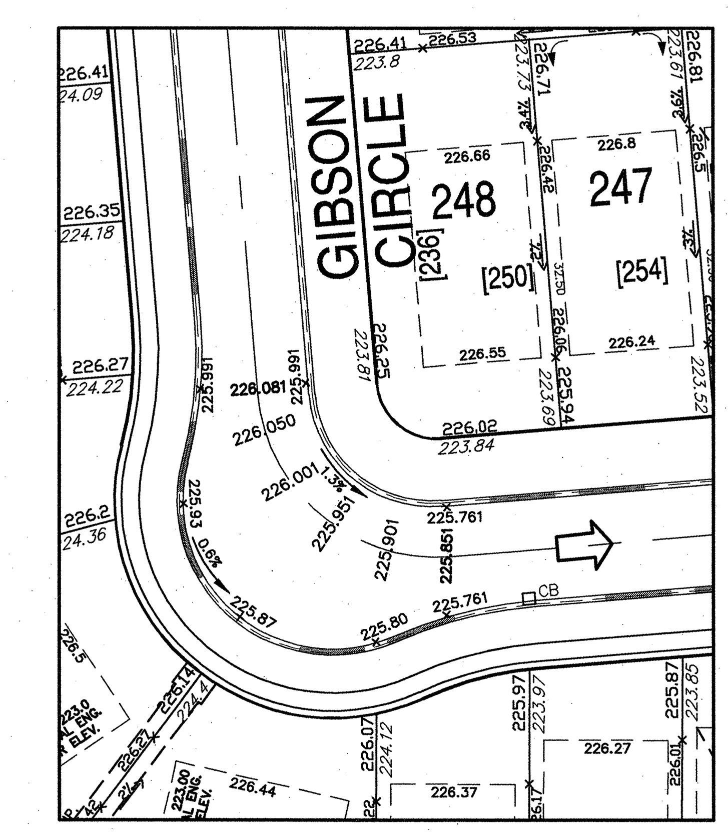

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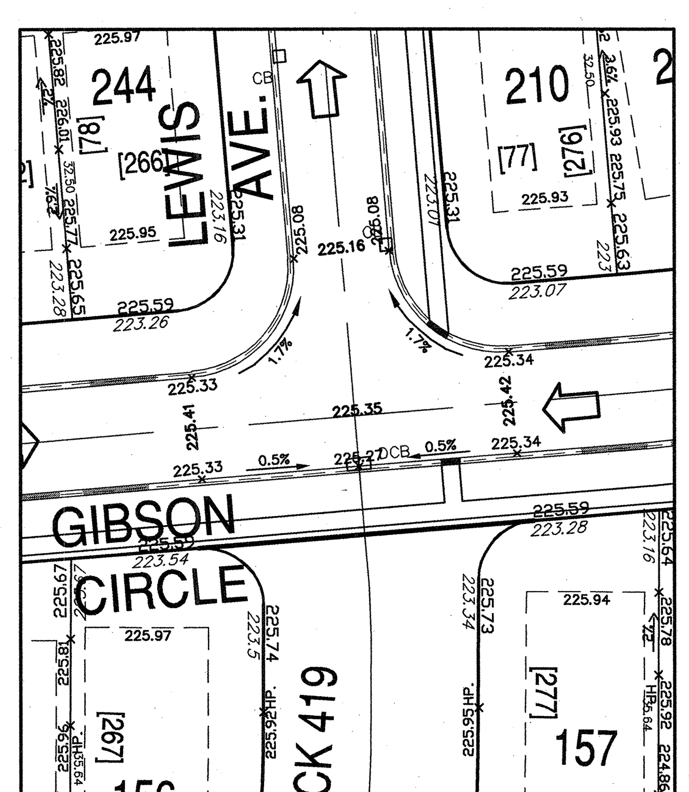

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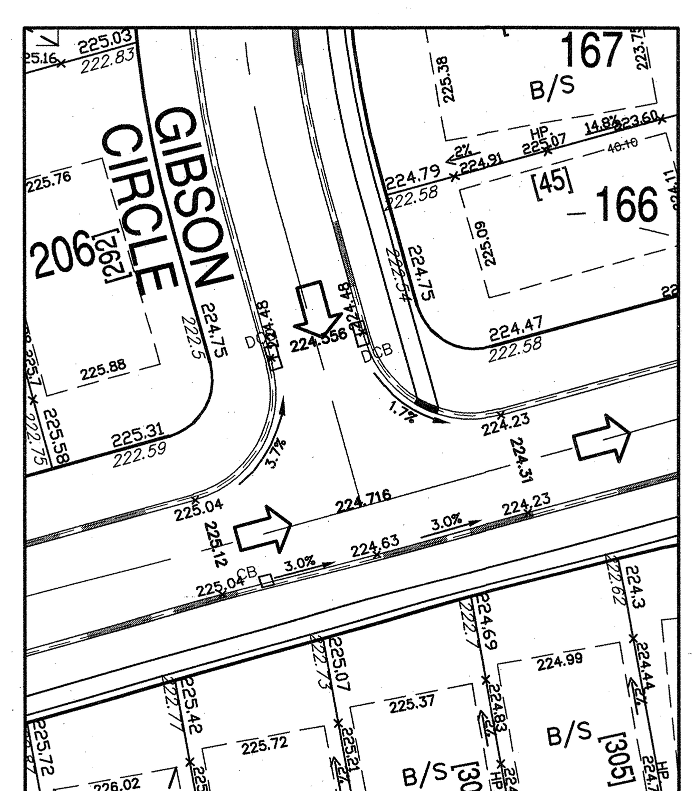

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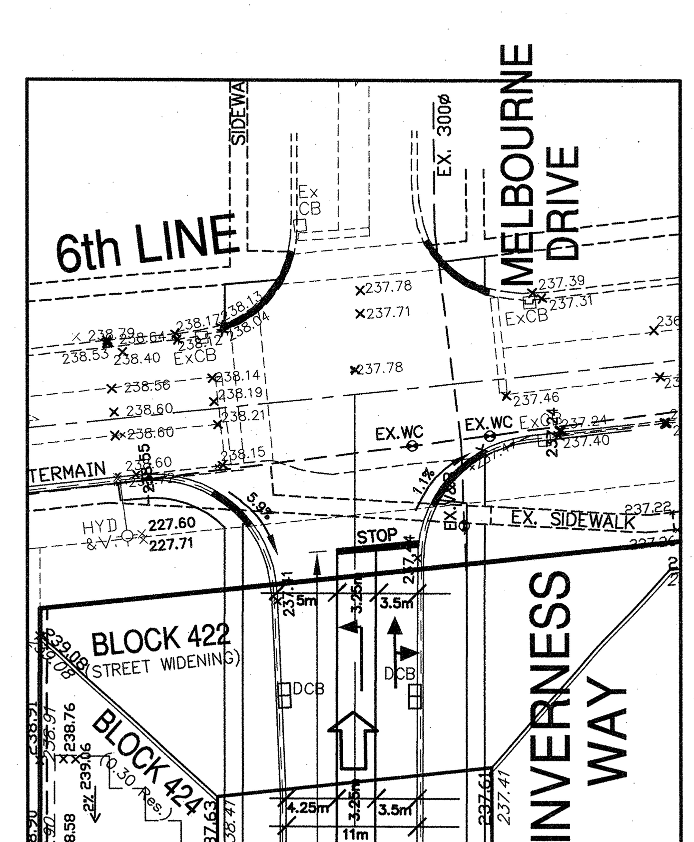

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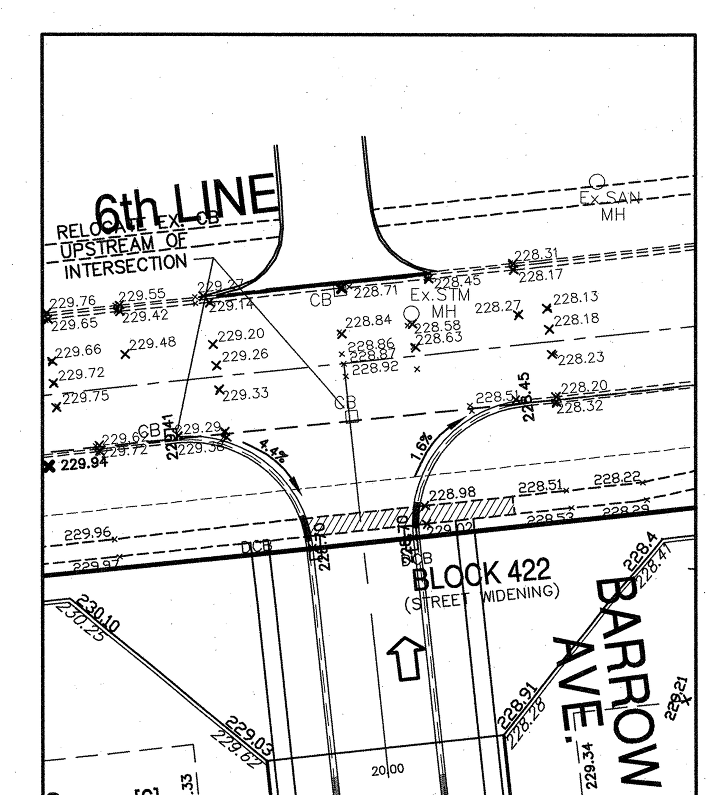

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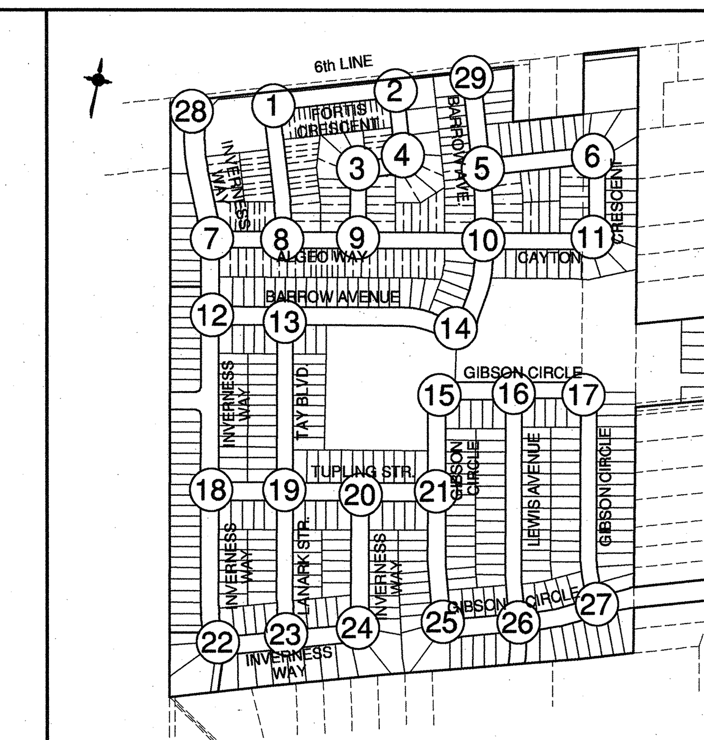

Key Plan

LEGEND

232.55	PROPOSED ELEVATION
232.43 ×	EXISTING ELEVAITON

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.

SIGNATURE

Aug 19/15
DATE

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
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UEL

BRADFORD CAPITAL HOLDINGS INC.
CURB AND GUTTER DETAILS

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. GD-2
Scale: Horz. 1:500 (0m 10m 20m)		Sheet No. – OF –

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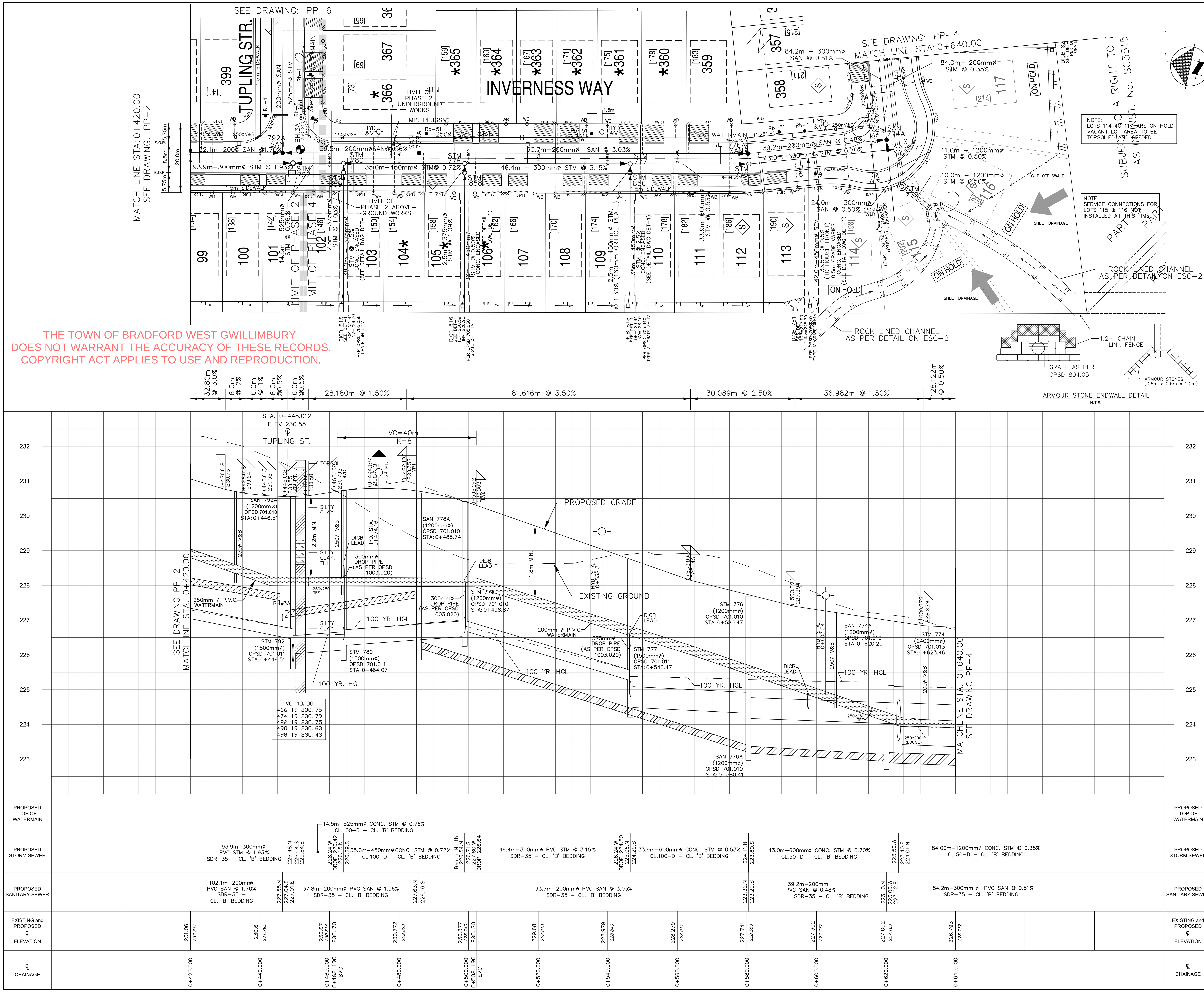

Key Plan

LEGEND

232.55	PROPOSED ELEVATION
232.43 •	EXISTING ELEVATION
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XO—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—	1.8m PRIVACY FENCE
—XOX—	ACOUSTIC FENCE

S SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
8	AS–CONSTRUCTED	AUGUST 20/21	M.L.	
7	REVISED SOUTH WEST QUADRANT OF SUBDIVISION	APRIL 11/16	R.S.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST–ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256–JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20/21
PROVINCE OF ONTARIO

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856-0629
f. (905)856-0698

BRADFORD CAPITAL HOLDINGS INC.
INVERNESS WAY
FROM STA. 0+420 TO STA. 0+640.00

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. PP-3 REV
Scale Horz. 1:500 Vert. 1:50	0m 10m 20m / 0m 1m 2m	Sheet No. - OF -

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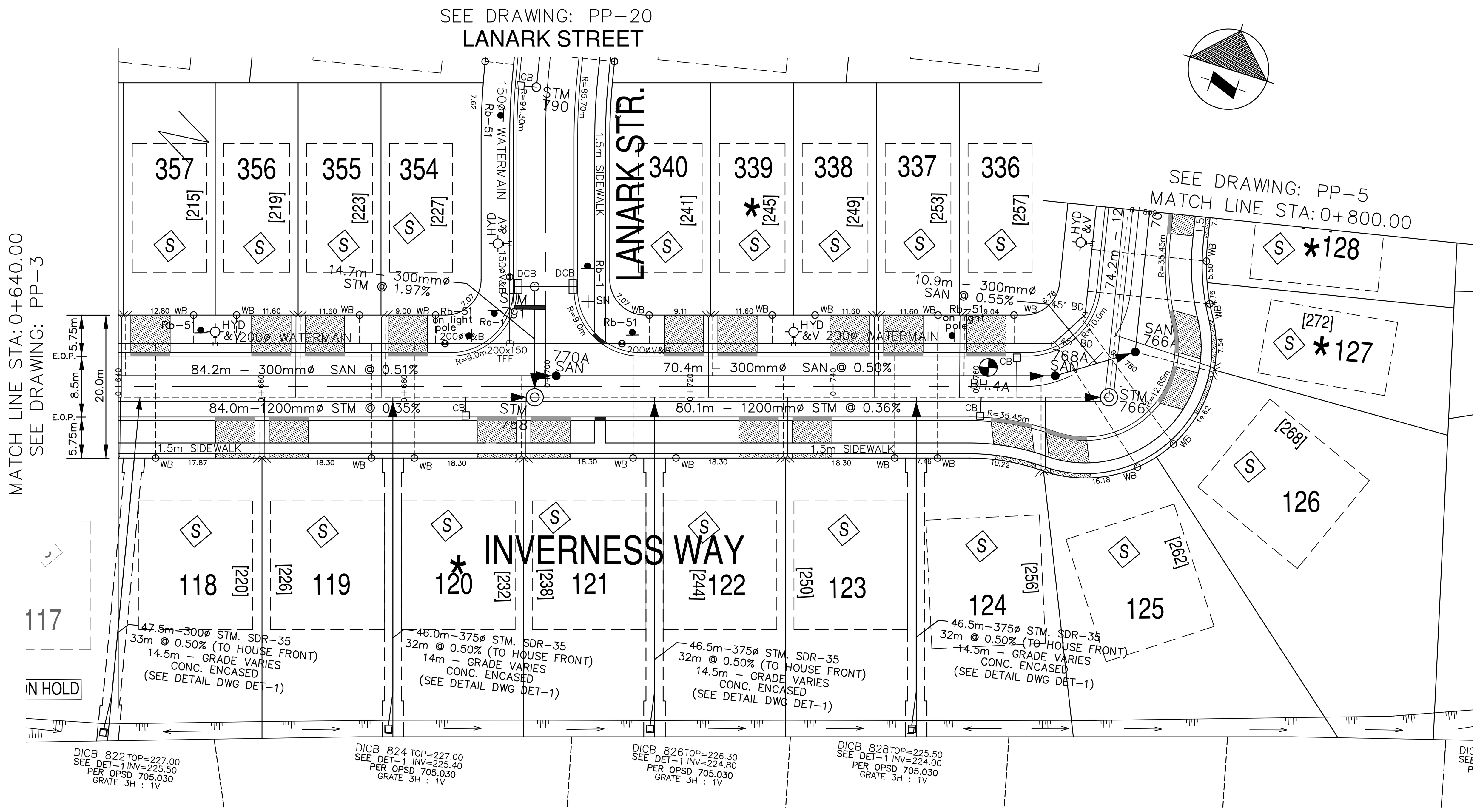

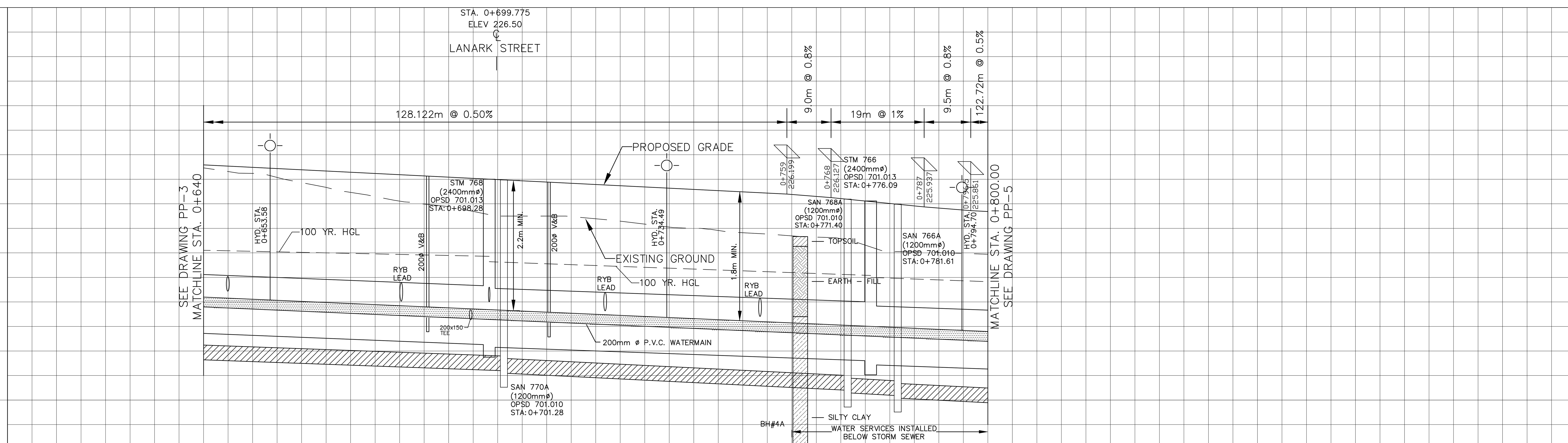

PROPOSED TOP OF WATERMAIN	
PROPOSED STORM SEWER	84.00m–1200mmø CONC. STM @ 0.35% CL.50–D – CL. 'B' BEDDING; 223.11 W, 223.07 E, 223.97 N; 80.1m–1200mmø CONC. STM @ 0.36% CL.50–D – CL. 'B' BEDDING; 222.78 W, 222.74 N; 74.2m–1200mmø CONC. STM @ 0.40% CL.50–D – CL. 'B' BEDDING
PROPOSED SANITARY SEWER	84.2m–300mm ø PVC SAN @ 0.51% SDR–35 – CL. 'B' BEDDING; 222.59 W, 222.54 E; 70.4m–200mmø PVC SAN @ 0.50% SDR–35 – CL. 'B' BEDDING; 10.9m–300mmø PVC SAN @ 0.55% SDR–35 – CL. 'B' BEDDING; 222.19 W, 222.14 E; 222.08 W, 222.03 N; 70.3m–300mmø PVC SAN @ 0.51% SDR–35 – CL. 'B' BEDDING
EXISTING and PROPOSED ℄ ELEVATION	226.793 / 226.732; 226.694 / 226.437; 226.594 / 226.055; 226.494 / 225.750; 226.394 / 225.695; 226.294 / 225.500; 226.191 / 225.346; 226.007 / 225.019; 225.843 / 224.972
℄ CHAINAGE	0+640.000; 0+660.000; 0+680.000; 0+700.000; 0+720.000; 0+740.000; 0+760.000; 0+780.000; 0+800.000

Key Plan

LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVAITON
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W ℄ P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XO—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—	1.8m PRIVACY FENCE
—XOX—	ACOUSTIC FENCE

S SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	App'd
8	AS–CONSTRUCTED	AUGUST 20/21	M.L.	
7	REVISED SOUTH WEST QUADRANT OF SUBDIVISION	APRIL 7/16	R.S.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST–ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256–JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER ROSARIO.SACCO AUGUST 20/21 PROVINCE OF ONTARIO

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856-0629
f. (905)856-0698

UEL

BRADFORD CAPITAL HOLDINGS INC.
INVERNESS WAY
FROM STA. 0+640.OO TO STA. 0+800.00

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. PP-4 REV
Scale Horz. 1:500 Vert. 1:50		Sheet No. - OF -

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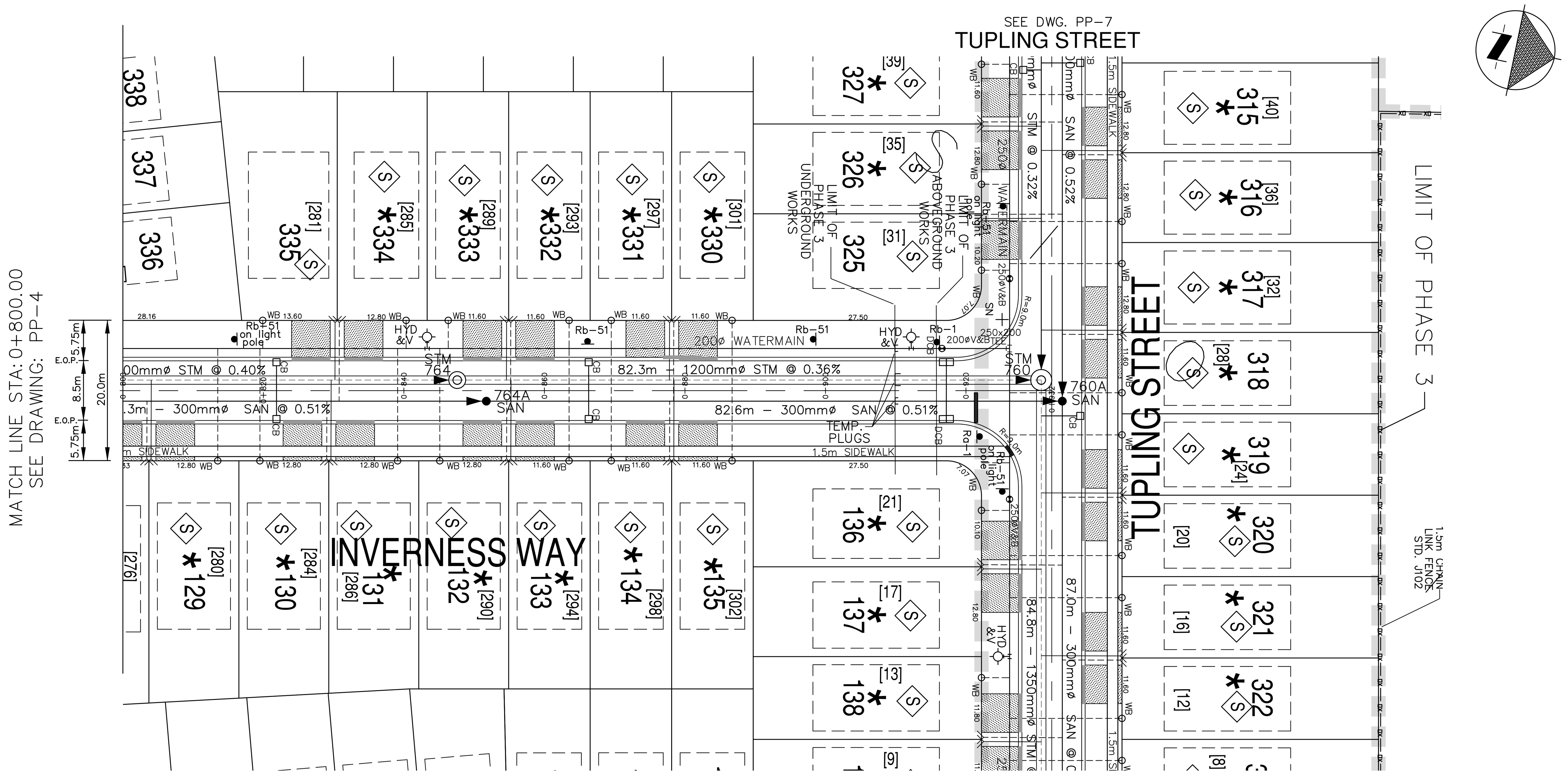

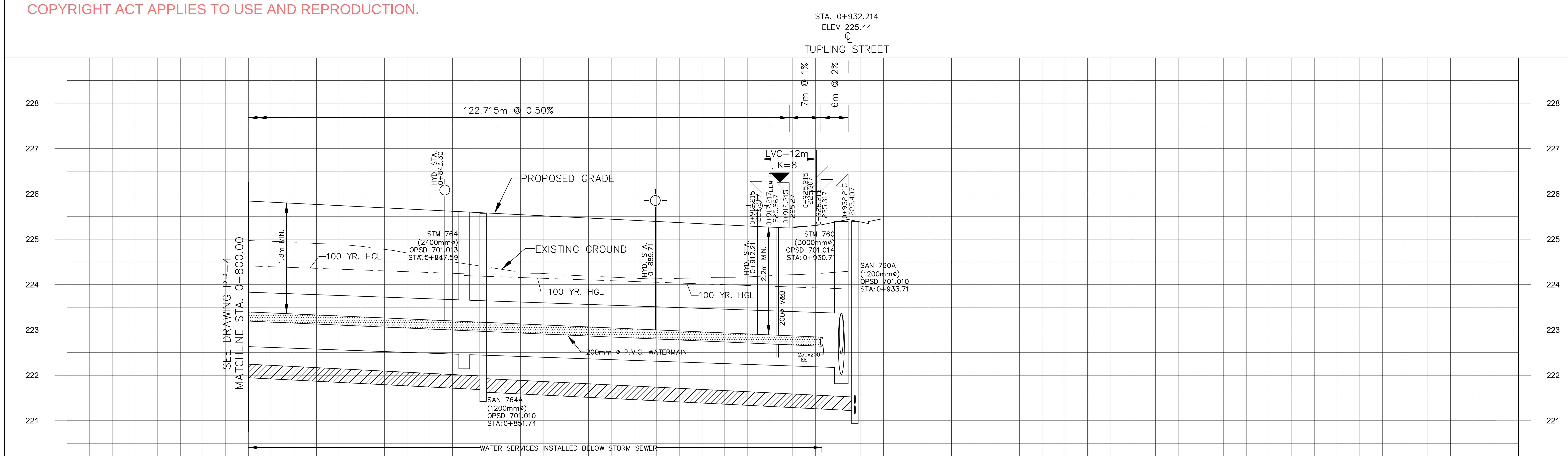

PROPOSED TOP OF WATERMAIN: VC 12.00 — 914.41 225.27; 916.81 225.27; 919.21 225.27; 921.61 225.28; 924.01 225.30

PROPOSED STORM SEWER: 74.2m–1200mmø CONC. STM @ 0.40% CL.50-D – CL. 'B' BEDDING | 222.44.S 222.42.N | 82.3m–1200mmø CONC. STM @ 0.36% CL.50-D – CL. 'B' BEDDING | 222.12.S 222.49.W 222.00.E

PROPOSED SANITARY SEWER: 70.3m–300mmø PVC SAN @ 0.51% SDR-35 – CL. 'B' BEDDING | 221.67.S 221.62.N | 82.6m–300mmø PVC SAN @ 0.51% SDR-35 – CL. 'B' BEDDING | 221.20.S 221.41.W 221.18.E

℄ CHAINAGE	0+800.000	0+820.000	0+840.000	0+860.000	0+880.000	0+900.000	0+913.210 BVC	0+920.000	0+925.210 EVC
EXISTING and PROPOSED ℄ ELEVATION	225.843 / 224.972	225.743 / 224.891	225.643 / 224.603	225.543 / 224.279	225.443 / 224.166	225.343 / 224.150	225.28	225.272 / 224.219	225.310

LEGEND

- 232.55 — PROPOSED ELEVATION
- 232.43 — EXISTING ELEVAITON
- WB — WATER BOX
- VC — VALVE CHAMBER
- V&B — VALVE & BOX
- EXISTING CULVERT
- P&W CL P&B — EXISTING FENCE
- STM 640 — STORM MAINTENANCE HOLES
- CBMH 874 — CATCHBASIN MAINTENANCE HOLES
- 620A SAN — SANITARY MAINTENANCE HOLES
- 25m – 250mm ø — SEWER
- 200 DIA. PVC W/M — PROPOSED WATERMAIN
- RLCB — REAR LOT CATCHBASIN
- CB — CATCHBASIN
- DCB — DOUBLE CATCHBASIN
- DICB — DITCH INLET CATCHBASIN
- HYD &V — HYDRANT & VALVE
- CURB & GUTTER & DEPRESSION
- 1.5m CONC. S/W — SIDEWALK
- —X—X— 1.2m BLACK VINYL CHAINLINK FENCE
- —XO— 1.5m BLACK VINYL CHAINLINK FENCE
- —Z—Z— 1.8m PRIVACY FENCE
- —XOX— ACOUSTIC FENCE

(S) SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20/21
PROVINCE OF ONTARIO

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
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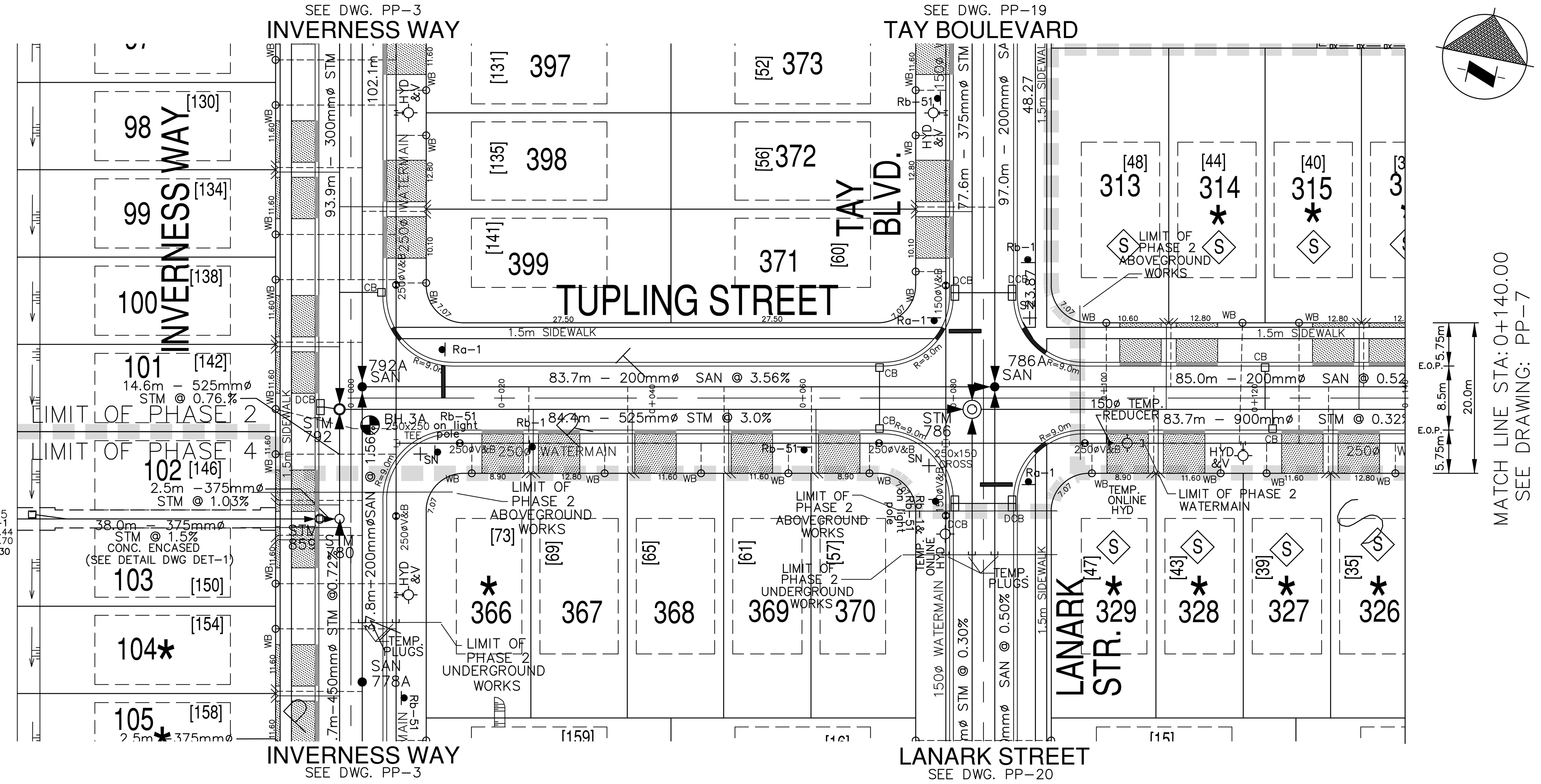
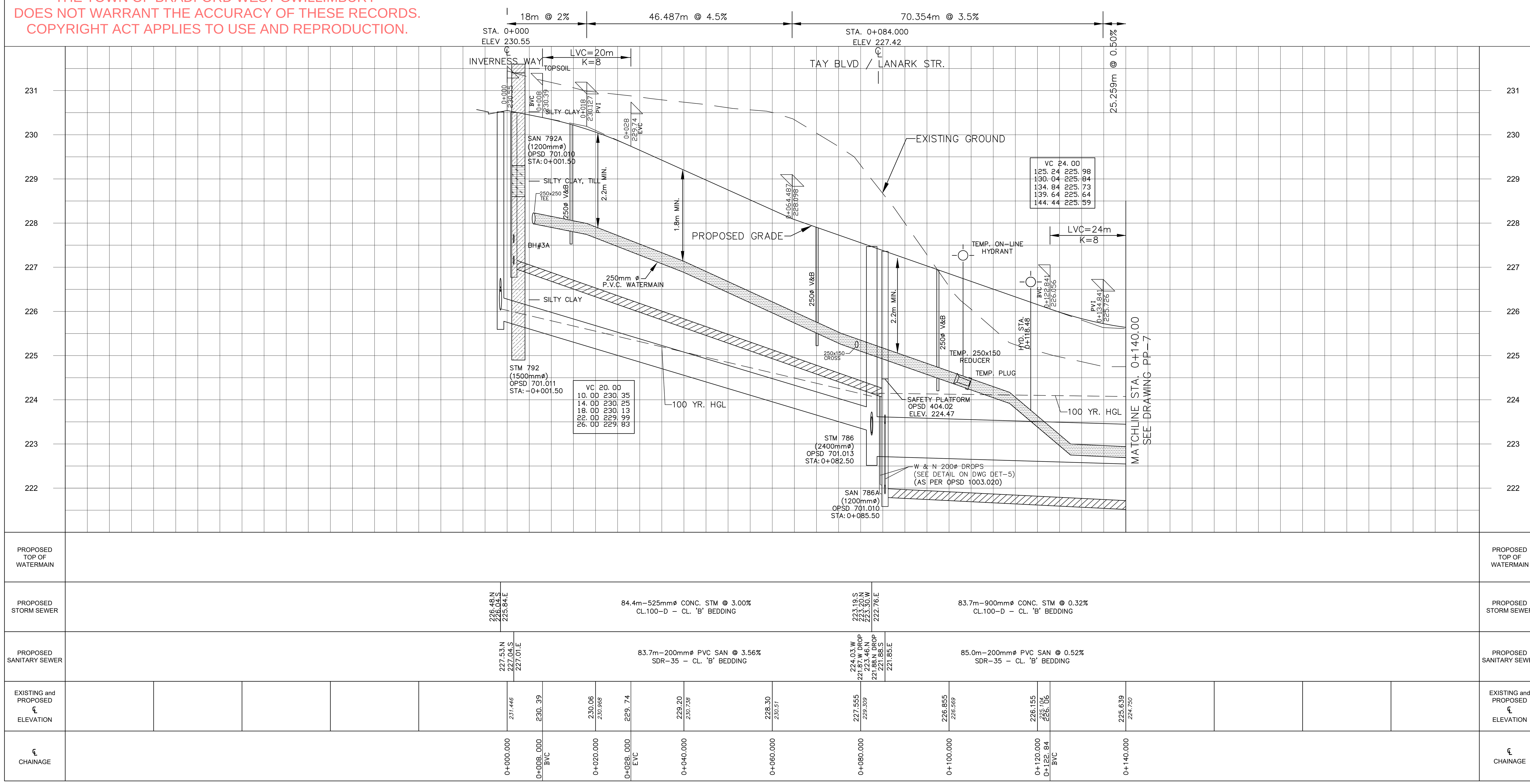
f. (905)856-0698

BRADFORD CAPITAL HOLDINGS INC.
INVERNESS WAY
FROM STA. 0+800.OO TO STA. 0+932.214

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. PP-5
Scale Horz. 1:500 Vert. 1:50		Sheet No. - OF -

ID - \\tsclient\P\2008\08017-BRADFORD-WEST\PLAN PROFILES\08017 - P1 to P10.dwg - Thu, 7 Apr 2016 - 18:31





LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVATION
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XD—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—	1.8m PRIVACY FENCE
—XDX—	ACOUSTIC FENCE

(S) SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	App'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20/21
PROVINCE OF ONTARIO

Bradford West Gwillimbury

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UEL

BRADFORD CAPITAL HOLDINGS INC.
TUPLING STREET
FROM STA. 0+000.OO TO STA. 0+140.00

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. PP-6
Scale Horz. 1:500 Vert. 1:50		Sheet No. - OF -

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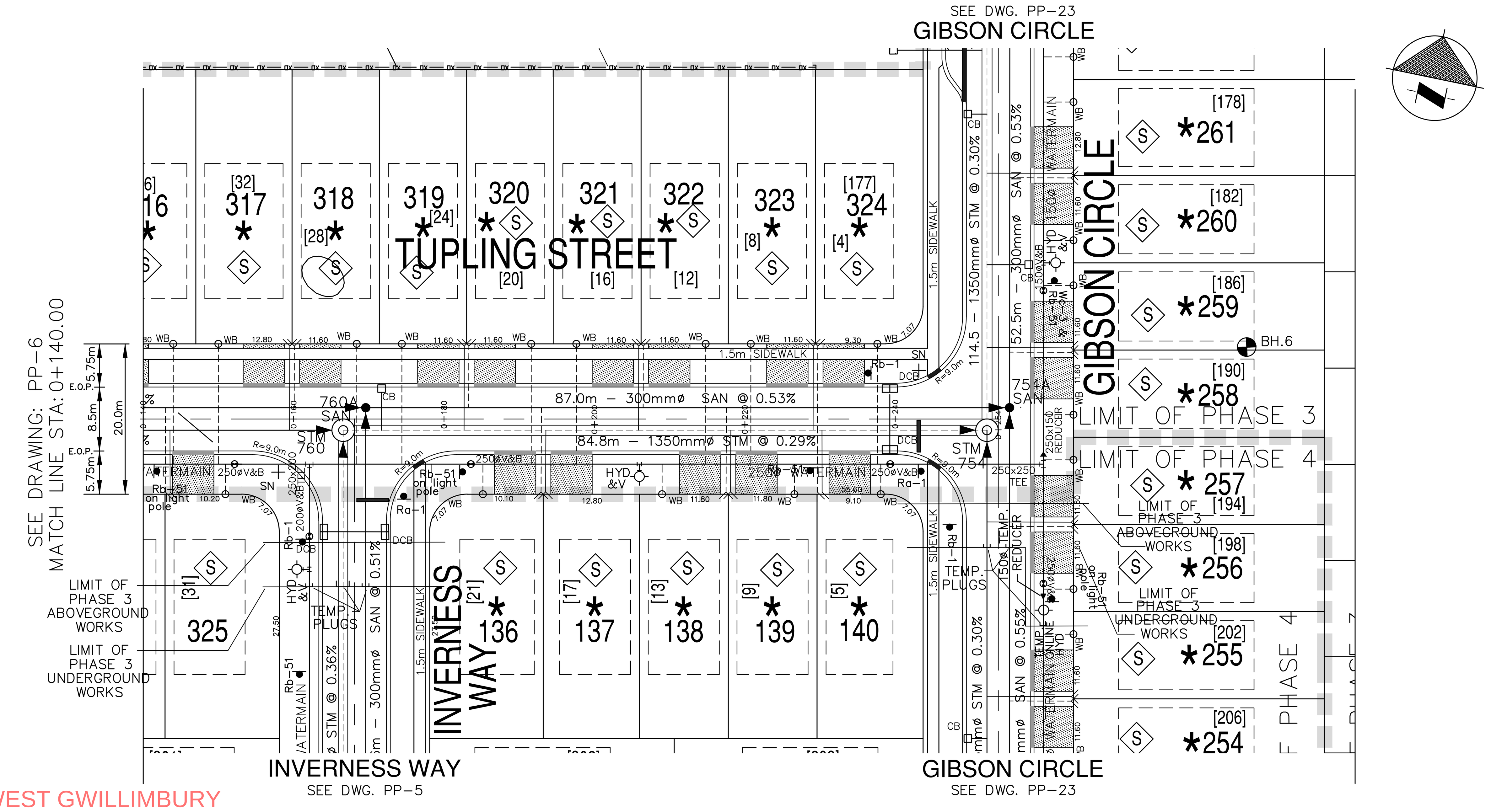

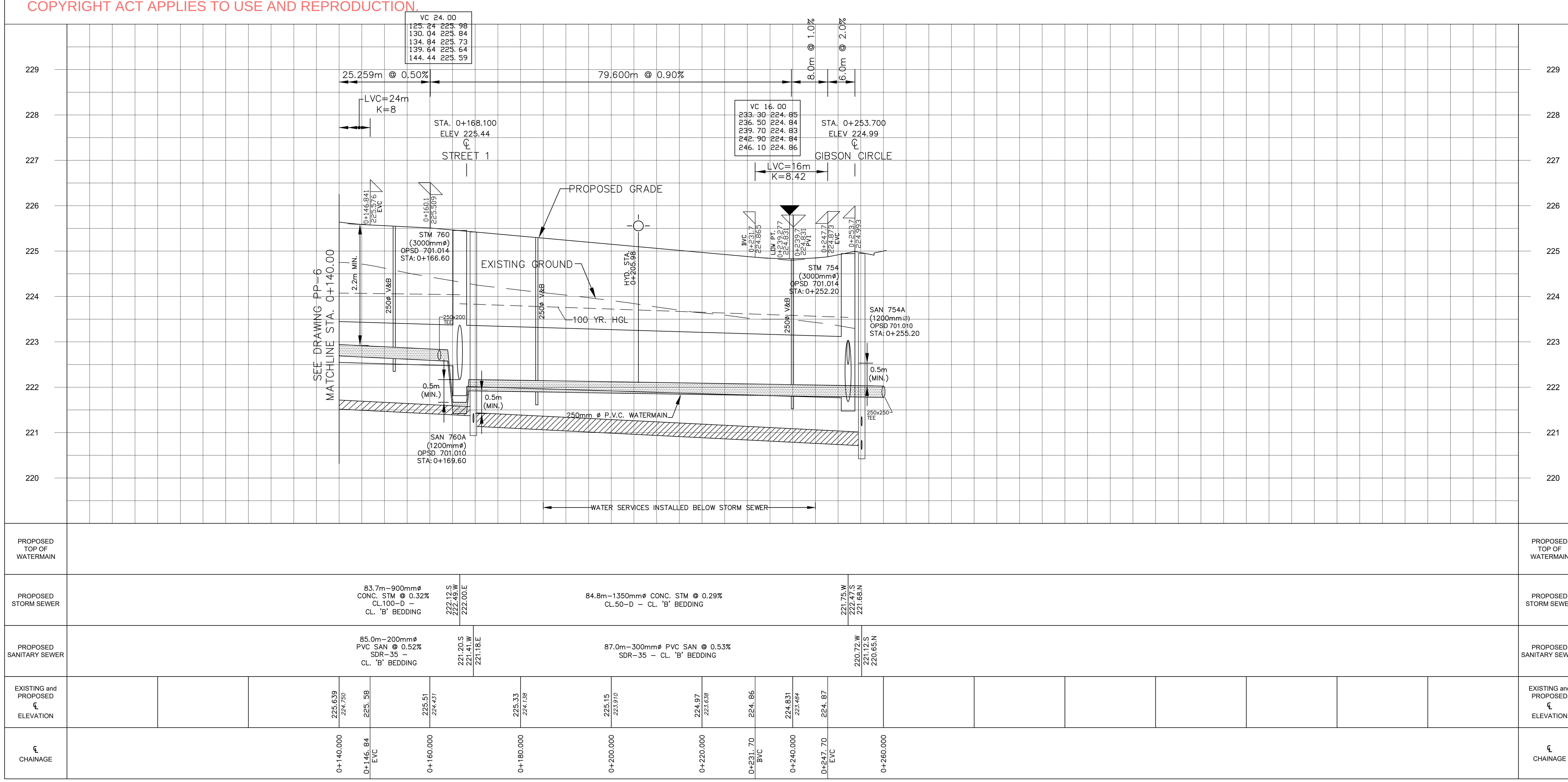

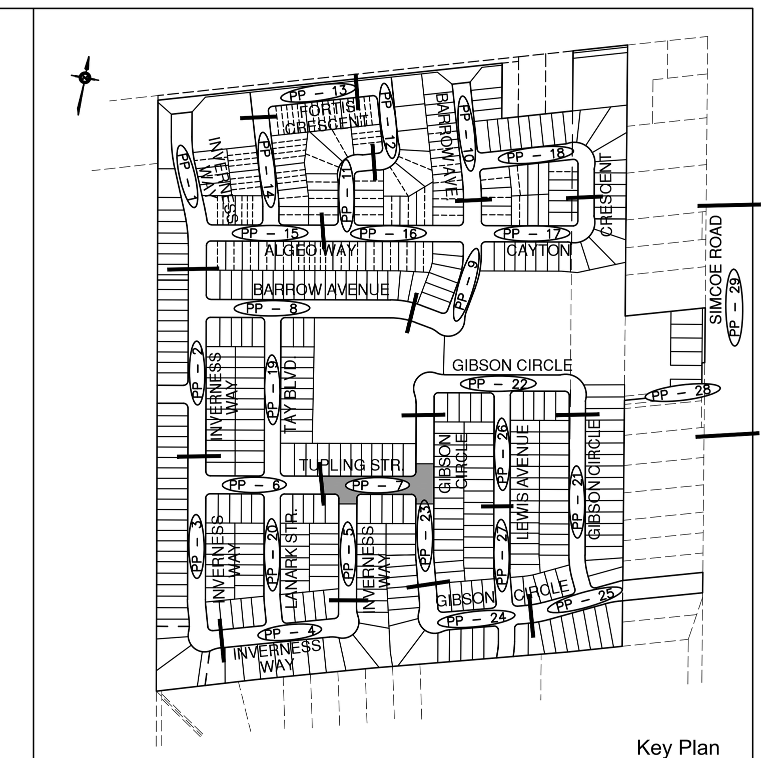

LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVAITON
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XO—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—	1.8m PRIVACY FENCE
—XOX—	ACOUSTIC FENCE

(S) SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20,21
PROVINCE OF ONTARIO

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
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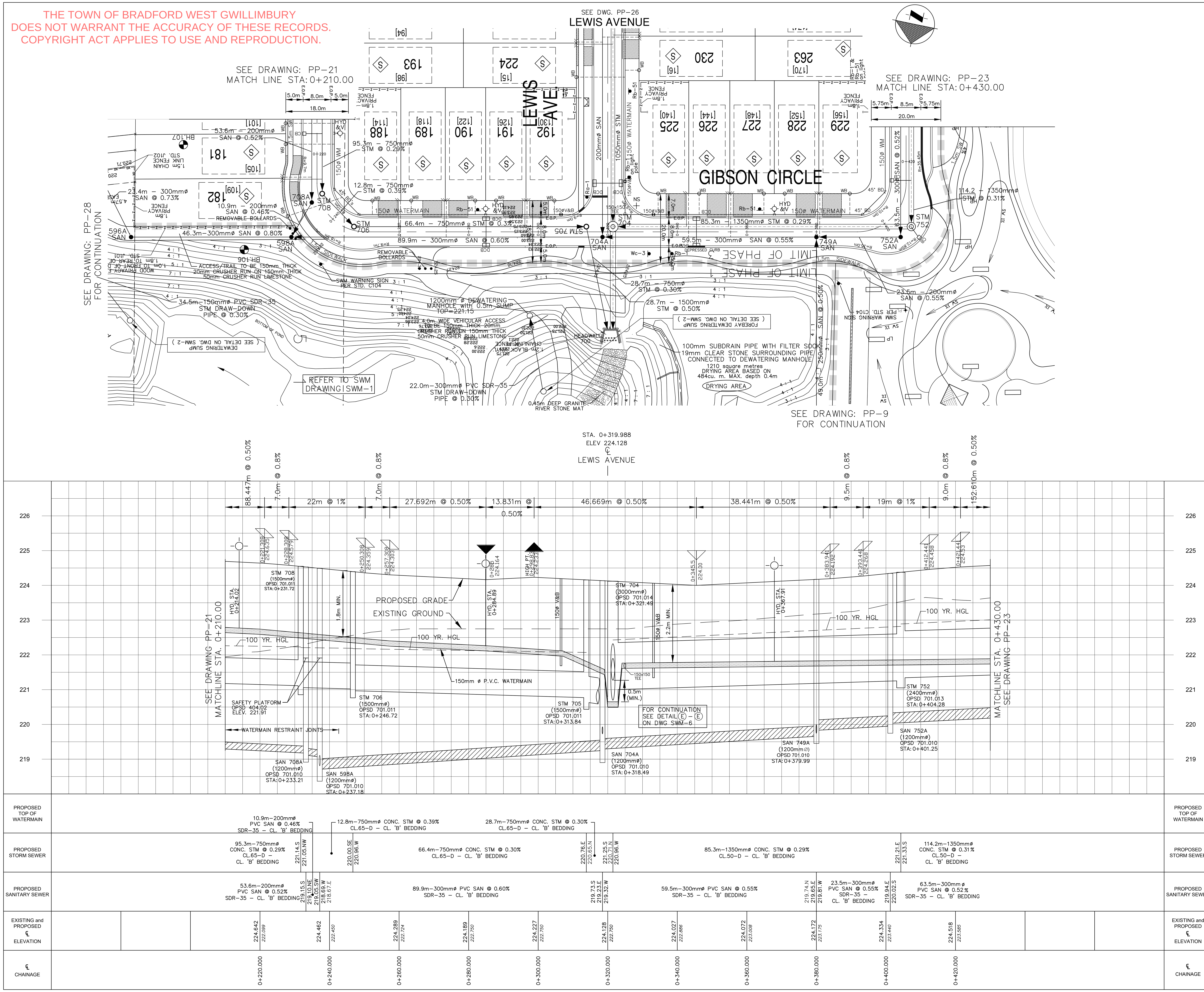
BRADFORD CAPITAL HOLDINGS INC.
TUPLING STREET
FROM STA. 0+140.00 TO STA. 0+253.70

Surveyed by:	P.E.	Checked by:	R.S.	Project No. 08017
Drawn by:	V.T.	Approved by:	R.S.	
Designed by:	D.J.S.	Date:	APRIL 4, 2014	Drawing No. PP-7
Scale Horz. 1:500 Vert. 1:50				Sheet No. - OF -

ID – \\tsclient\P\2008\08017–BRADFORD–WEST\PLAN PROFILES\08017 – P1 to P10.dwg – Thu, 7 Apr 2016 – 18:31



Key Plan

LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVATION
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XO—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—	1.8m PRIVACY FENCE
—XOX—	ACOUSTIC FENCE

SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	App'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20, 21
PROVINCE OF ONTARIO

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
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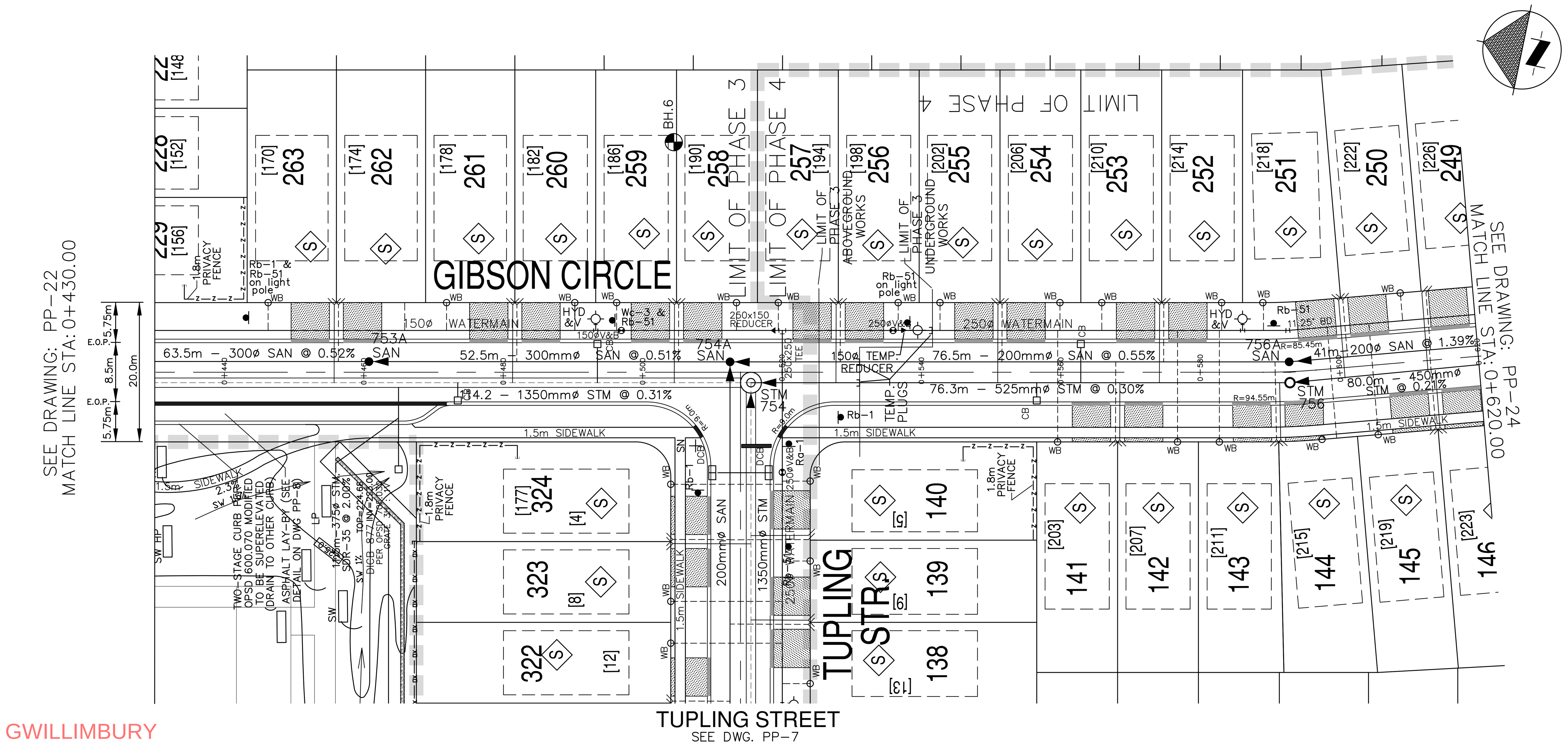
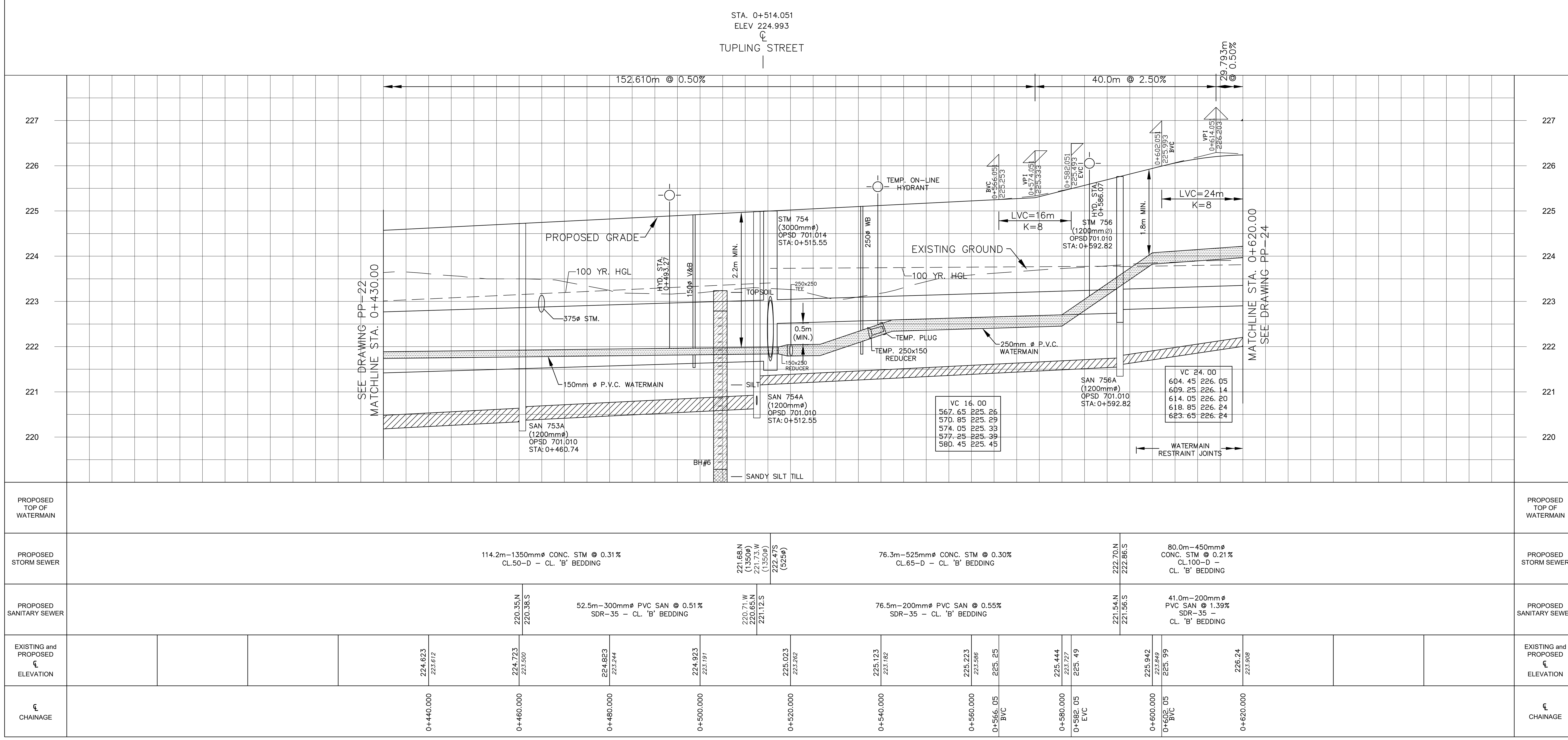
f. (905)856-0698
UEL

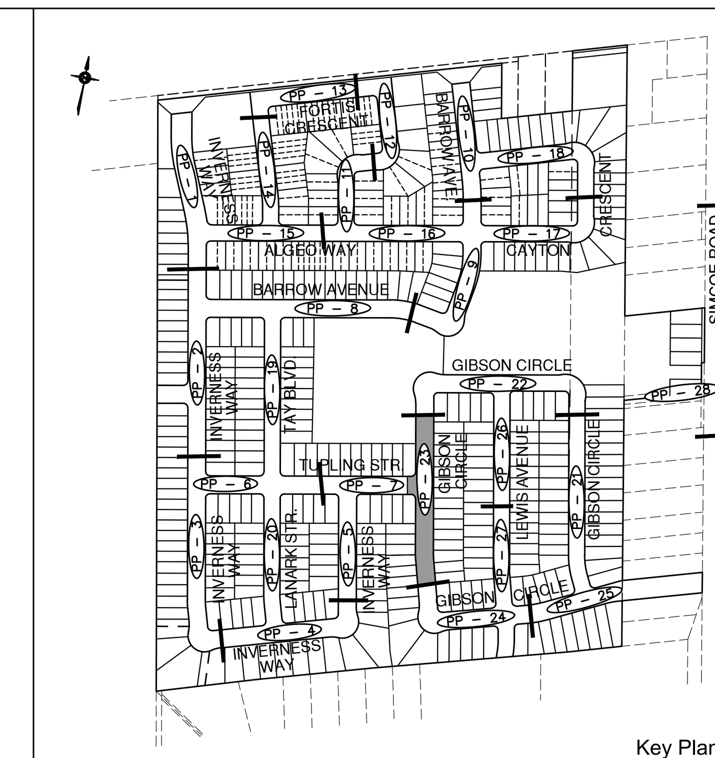
BRADFORD CAPITAL HOLDINGS INC.
GIBSON CIRCLE
FROM STA. 0+210.00 TO STA. 0+430.00

Surveyed by:	P.E.	Checked by:	R.S.	Project No.	08017
Drawn by:	V.T.	Approved by:	R.S.		
Designed by:	D.J.S.	Date:	APRIL 4, 2014	Drawing No.	PP-22
Scale Horz. 1:500 Vert. 1:50				Sheet No.	- OF -

ID – P:\2008\08017-BRADFORD-WEST\PLAN PROFILES\08017 – P19 to P27.dwg – Tue, 1 Sep 2015 – 1015







LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVATION
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—X□—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—	1.8m PRIVACY FENCE
—X□X—	ACOUSTIC FENCE

S SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20,21
PROVINCE OF ONTARIO

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
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f. (905)856-0698

BRADFORD CAPITAL HOLDINGS INC.
GIBSON CIRCLE
FROM STA. 0+430.00 TO STA. 0+620.00

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. PP-23
Scale Horz. 1:500 Vert. 1:50	0m 10m 20m / 0m 1m 2m	Sheet No. - OF -

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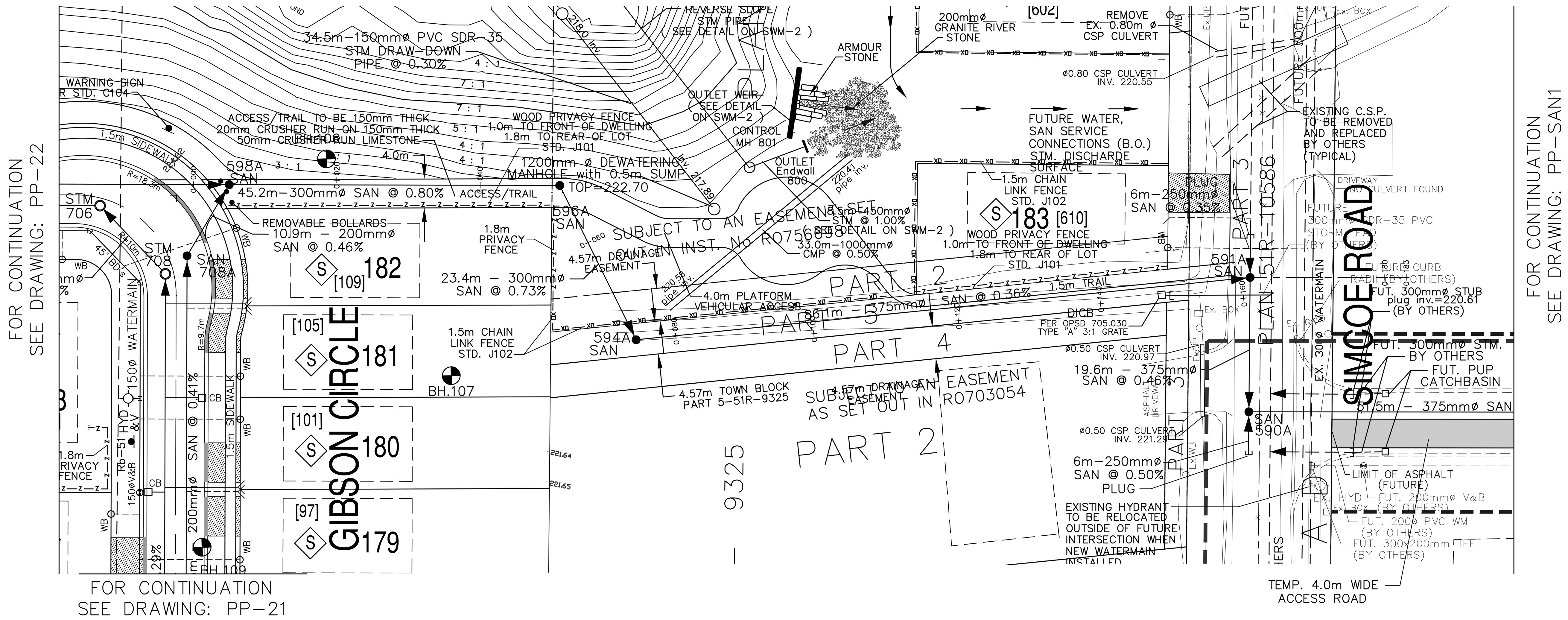
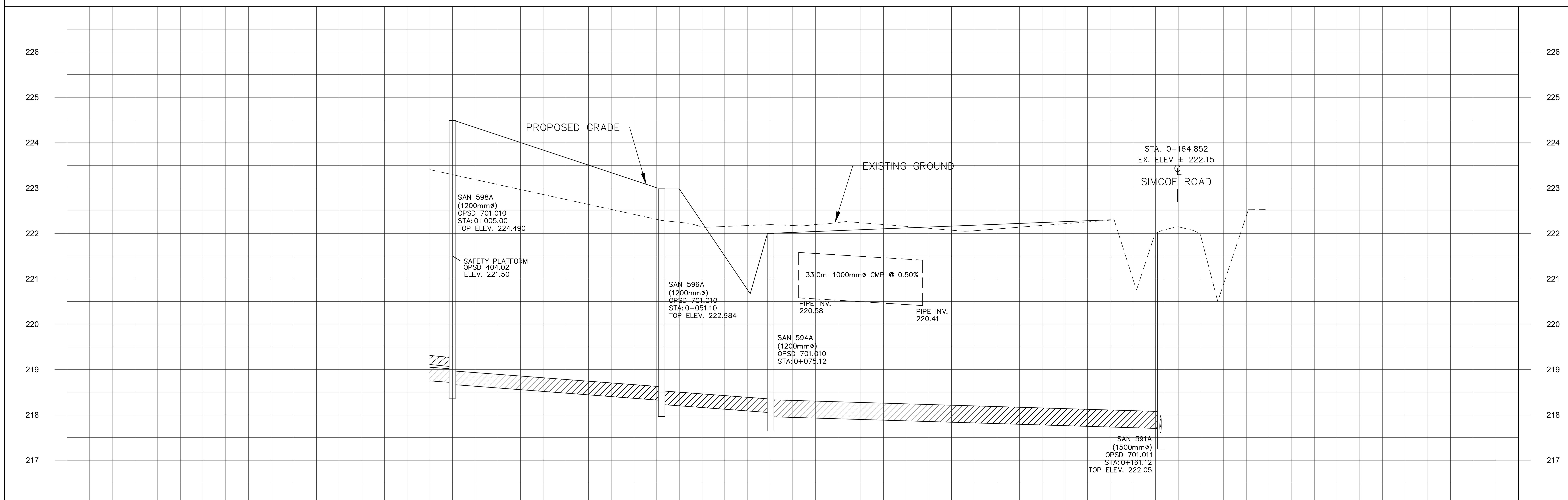


NOTE:
SIMCOE ROAD RECONSTRUCTION INCLUDING BALANCE OF U/G SERVICING BY OTHERS



PROPOSED TOP OF WATERMAIN	
PROPOSED STORM SEWER	
PROPOSED SANITARY SEWER	218.69 W, 219.05 SW, 218.67 E; 45.2m–300mmø PVC SAN @ 0.80% SDR–35 – CL. 'B' BEDDING; 218.31 W, 218.24 SE; 23.4m–300mmø PVC SAN @ 0.73% SDR–35 – CL. 'B' BEDDING; 218.07 NW, 217.96 E; 86.1m–375mmø PVC SAN @ 0.36% SDR–35 – CL. 'B' BEDDING; 217.65 W, 217.75 N (250ø), 217.65 S (375ø)
EXISTING and PROPOSED ℄ ELEVATION	
℄ CHAINAGE	0+000, 0+020, 0+040, 0+060, 0+080, 0+100, 0+120, 0+140, 0+160, 0+180, 0+183

LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVAITON
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XO—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—	1.8m PRIVACY FENCE
—XOX—	ACOUSTIC FENCE

(S) SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	App'd
7	AS–CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST–ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256–JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20, 21
PROVINCE OF ONTARIO

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
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uel@urbanecosystems.com
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UEL

BRADFORD CAPITAL HOLDINGS INC.
SANITARY EASEMENT
FROM STA. 0+000.OO TO STA. 0+183.00

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. PP-28
Scale Horz. 1:500 Vert. 1:50	0m 10m 20m / 0m 1m 2m	Sheet No. - OF -

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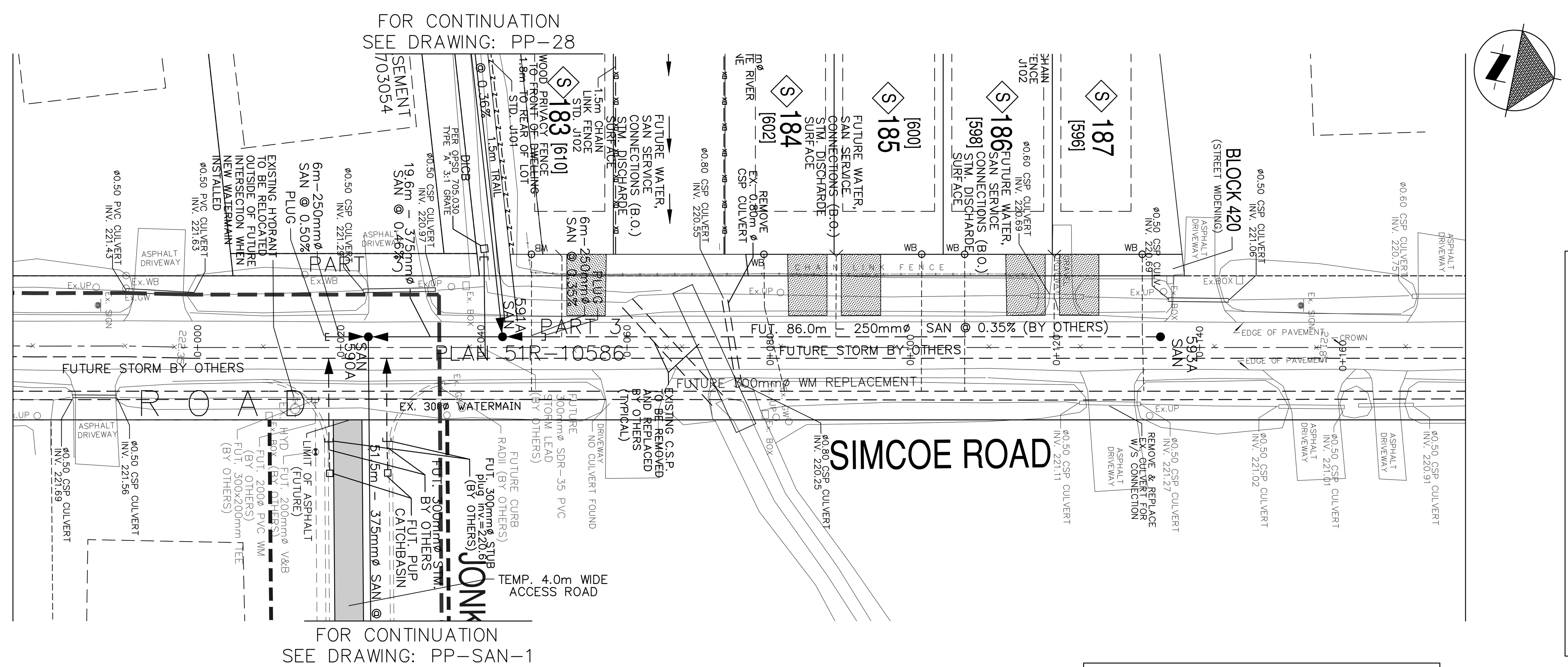
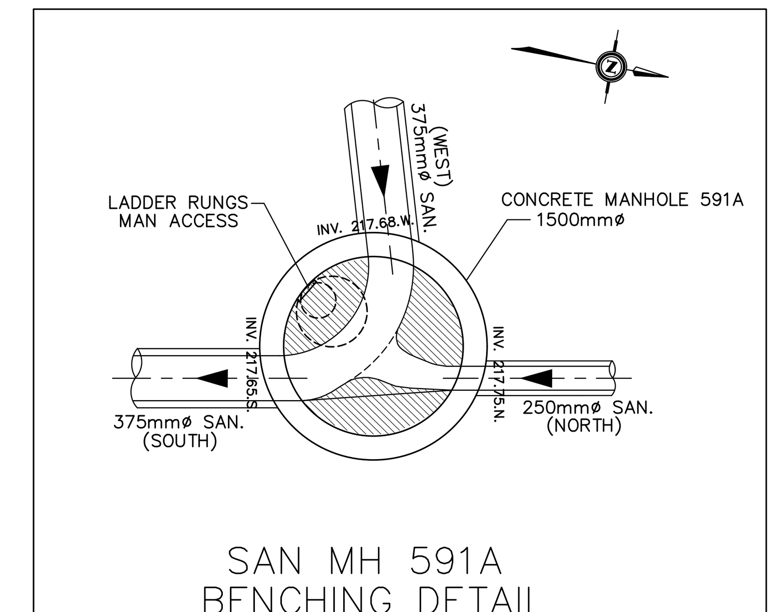


NOTE:
SIMCOE ROAD RECONSTRUCTION INCLUDING BALANCE OF U/G SERVICING BY OTHERS



SAN MH 591A
BENCHING DETAIL
1:50 SCALE

LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVAITON
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X —X—	1.2m BLACK VINYL CHAINLINK FENCE
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—Z —Z—	1.8m PRIVACY FENCE
—XOX—	ACOUSTIC FENCE

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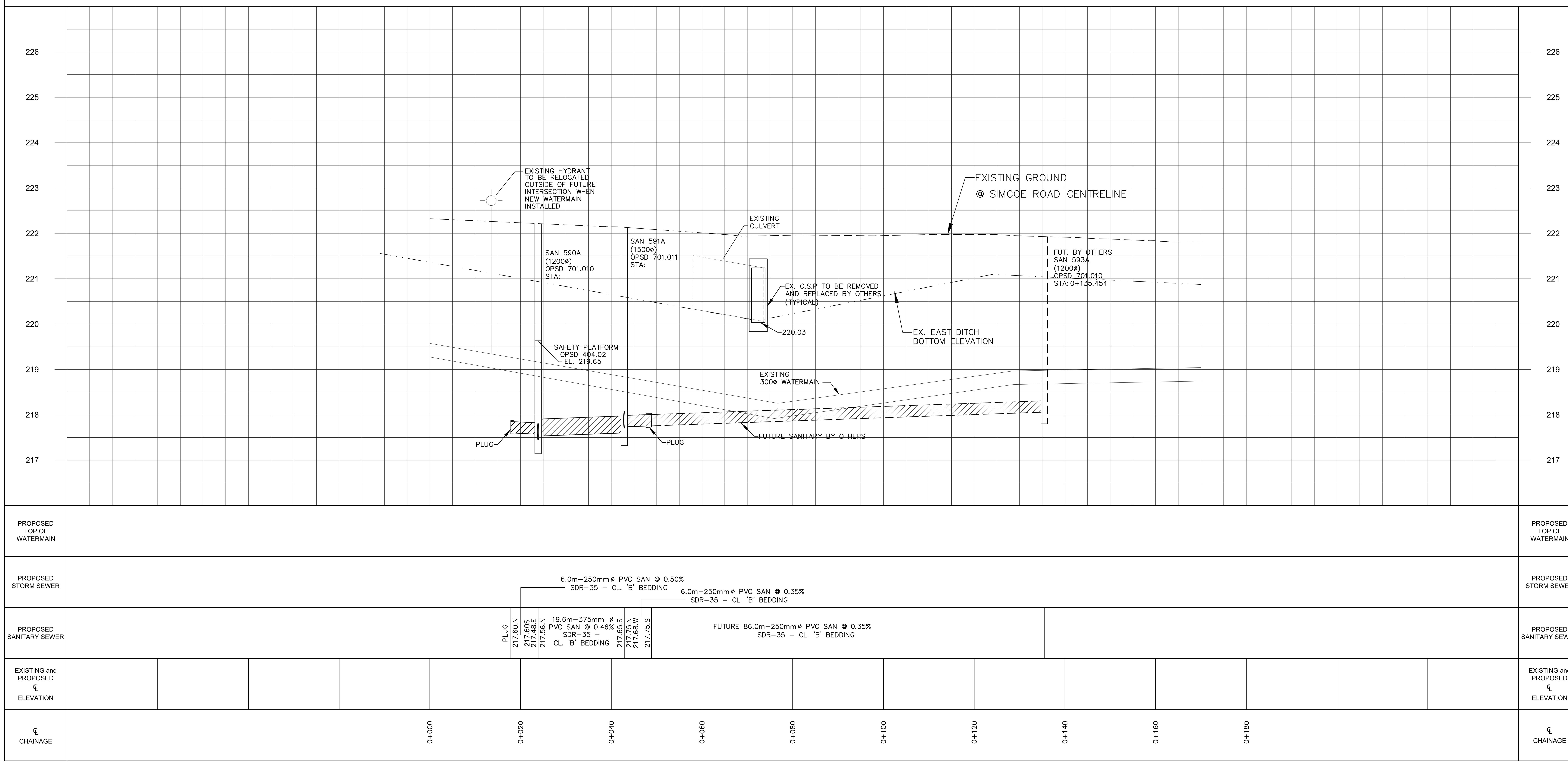

No.	Revision	Date	By	Appr'd
7	AS–CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST–ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256–JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
AUGUST 20,21
PROVINCE OF ONTARIO

Bradford West Gwillimbury

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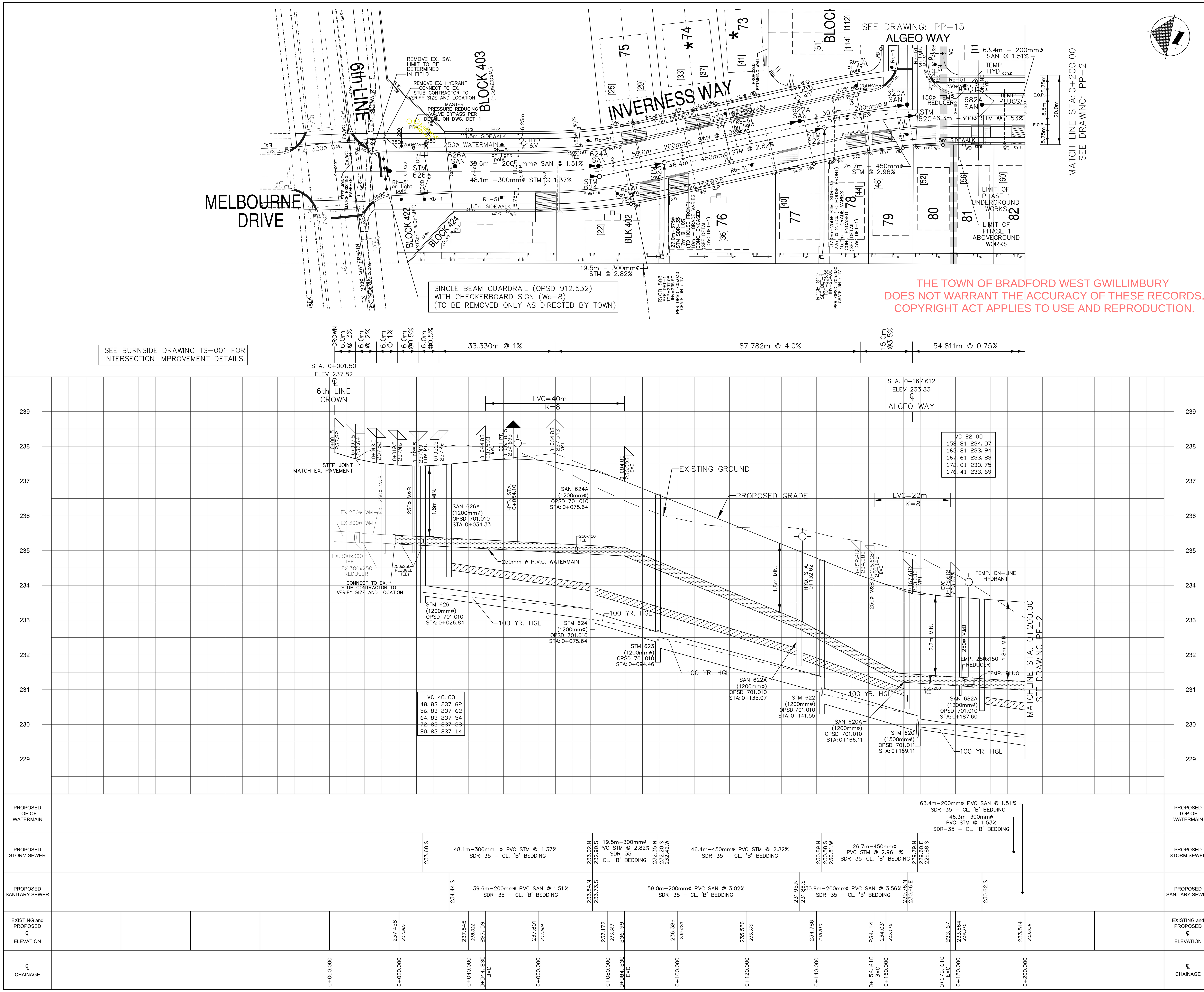
f. (905)856-0698

BRADFORD CAPITAL HOLDINGS INC.
SIMCOE ROAD
FROM STA. 0+000.OO TO STA. 0+120.00

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	Drawing No. PP-29
Designed by: D.J.S.	Date: APRIL 4, 2014	Sheet No. - OF -
Scale Horz. 1:500 Vert. 1:50	0m 10m 20m / 0m 1m 2m	

ID – P:\2008\08017–BRADFORD–WEST\PLAN PROFILES\08017 – P28 to P30.dwg – Fri, 10 Jul 2015 – 11:25



VC	22.00
158.81	234.07
163.21	233.94
167.61	233.83
172.01	233.75
176.41	233.69

VC	40.00
48.83	237.62
56.83	237.62
64.83	237.54
72.83	237.38
80.83	237.14

PROPOSED TOP OF WATERMAIN: 63.4m–200mmø PVC SAN @ 1.51% SDR–35 – CL. 'B' BEDDING; 46.3m–300mmø PVC STM @ 1.53% SDR–35 – CL. 'B' BEDDING

PROPOSED STORM SEWER: 48.1m–300mm ø PVC STM @ 1.37% SDR–35 – CL. 'B' BEDDING; 19.5m–300mmø PVC STM @ 2.82% SDR–35 – CL. 'B' BEDDING; 46.4m–450mmø PVC STM @ 2.82% SDR–35 – CL. 'B' BEDDING; 26.7m–450mmø PVC STM @ 2.96 % SDR–35–CL. 'B' BEDDING

PROPOSED SANITARY SEWER: 39.6m–200mmø PVC SAN @ 1.51% SDR–35 – CL. 'B' BEDDING; 59.0m–200mmø PVC SAN @ 3.02% SDR–35 – CL. 'B' BEDDING; 30.9m–200mmø PVC SAN @ 3.56% SDR–35 – CL. 'B' BEDDING

THE TOWN OF BRADFORD WEST GWILLIMBURY DOES NOT WARRANT THE ACCURACY OF THESE RECORDS. COPYRIGHT ACT APPLIES TO USE AND REPRODUCTION.

Key Plan

LEGEND

- 232.55 — PROPOSED ELEVATION
- 232.43 — EXISTING ELEVAITON
- WB — WATER BOX
- VC — VALVE CHAMBER
- V&B — VALVE & BOX
- EXISTING CULVERT
- P&W CL P&W — EXISTING FENCE
- STM 640 — STORM MAINTENANCE HOLES
- CBMH 874 — CATCHBASIN MAINTENANCE HOLES
- 620A SAN — SANITARY MAINTENANCE HOLES
- 25m – 250mm ø — SEWER
- 200 DIA. PVC W/M — PROPOSED WATERMAIN
- RLCB — REAR LOT CATCHBASIN
- CB — CATCHBASIN
- DCB — DOUBLE CATCHBASIN
- DICB — DITCH INLET CATCHBASIN
- HYD &V — HYDRANT & VALVE
- CURB & GUTTER & DEPRESSION
- 1.5m CONC. S/W — SIDEWALK
- —X—X— — 1.2m BLACK VINYL CHAINLINK FENCE
- —XO— — 1.5m BLACK VINYL CHAINLINK FENCE
- —Z—Z— — 1.8m PRIVACY FENCE
- —XOX— — ACOUSTIC FENCE

SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER ROSARIO.SACCO AUGUST 20,21 PROVINCE OF ONTARIO

Bradford west Gwillimbury

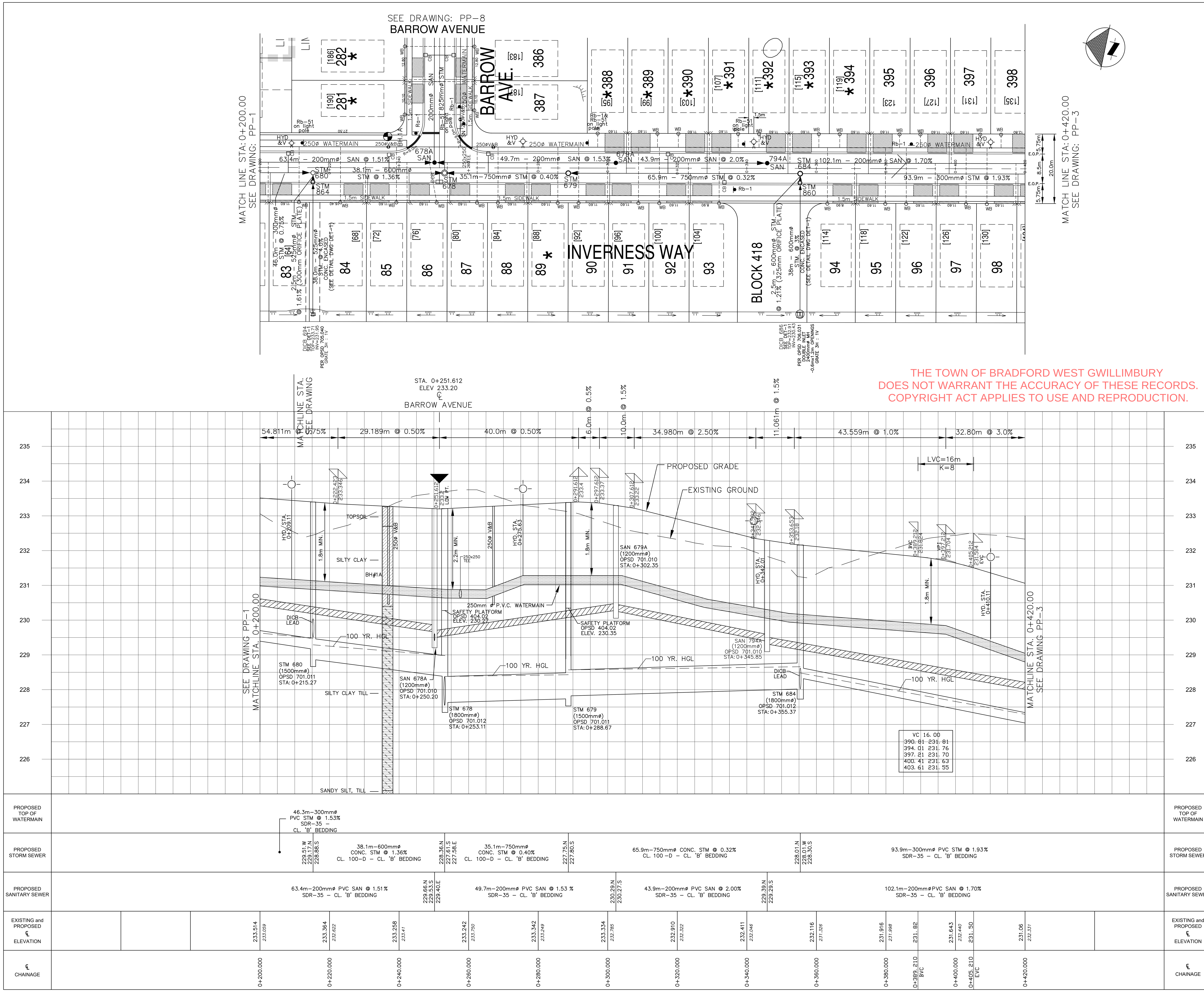
URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856-0629
f. (905)856-0698

UEL

BRADFORD CAPITAL HOLDINGS INC.
INVERNESS WAY
FROM STA. 0+000.OO TO STA. 0+200.00

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. PP-1
Scale Horz. 1:500 Vert. 1:50		Sheet No. - OF -

ID - \\tsclient\P\2008\08017-BRADFORD-WEST\PLAN PROFILES\08017 - P1 to P10.dwg - Thu, 7 Apr 2016 - 18:30



LEGEND

232.55	PROPOSED ELEVATION
232.43 ×	EXISTING ELEVATION
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XO—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—	1.8m PRIVACY FENCE
—XOX—	ACOUSTIC FENCE

SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	App'd
7	AS-CONSTRUCTED	AUGUST 20/21	M.L.	
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256–JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER ROSARIO.SACCO AUGUST 20/21 PROVINCE OF ONTARIO

Bradford west Gwillimbury

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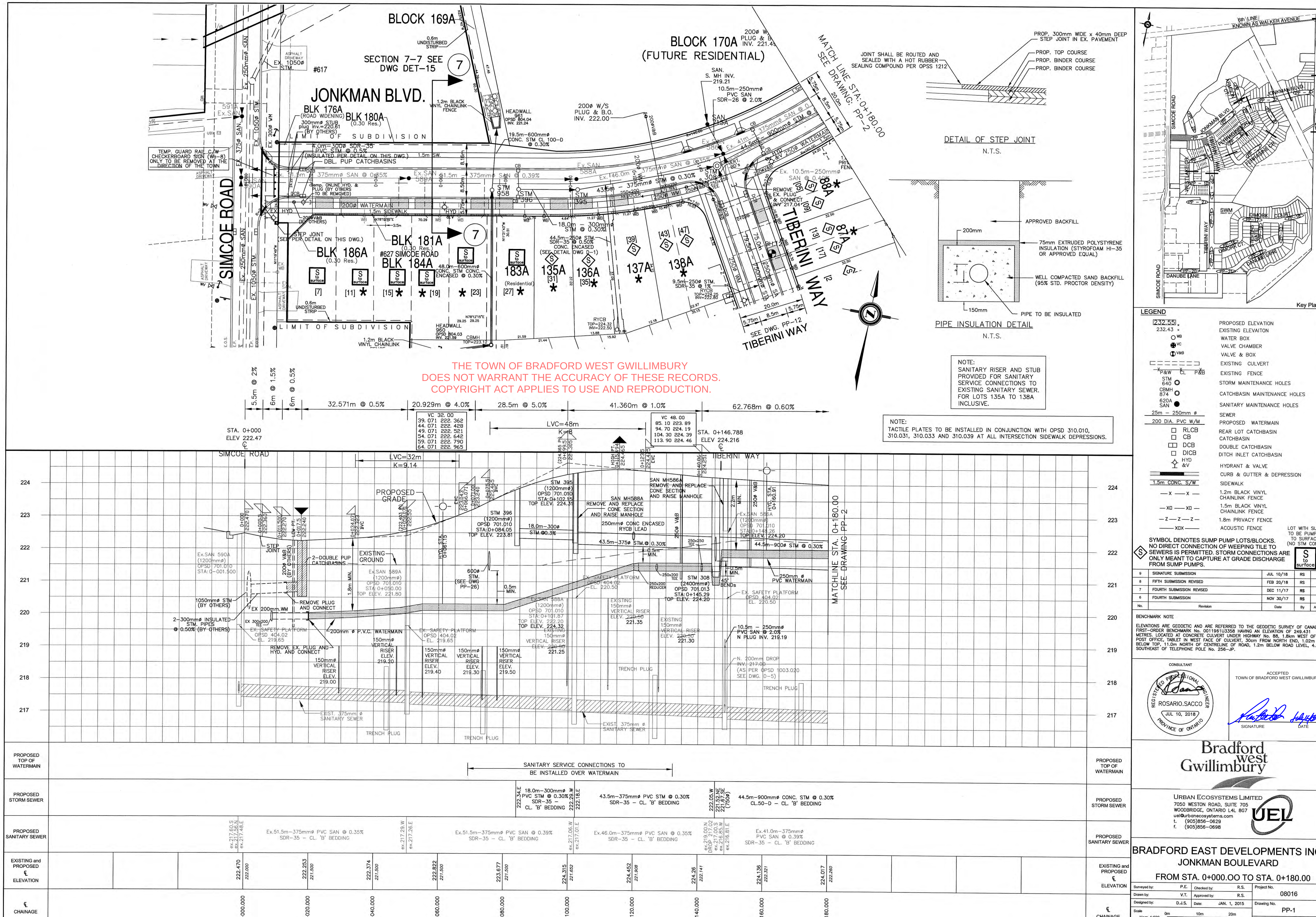
UEL

BRADFORD CAPITAL HOLDINGS INC.
INVERNESS WAY
FROM STA. 0+200.00 TO STA. 0+420.00

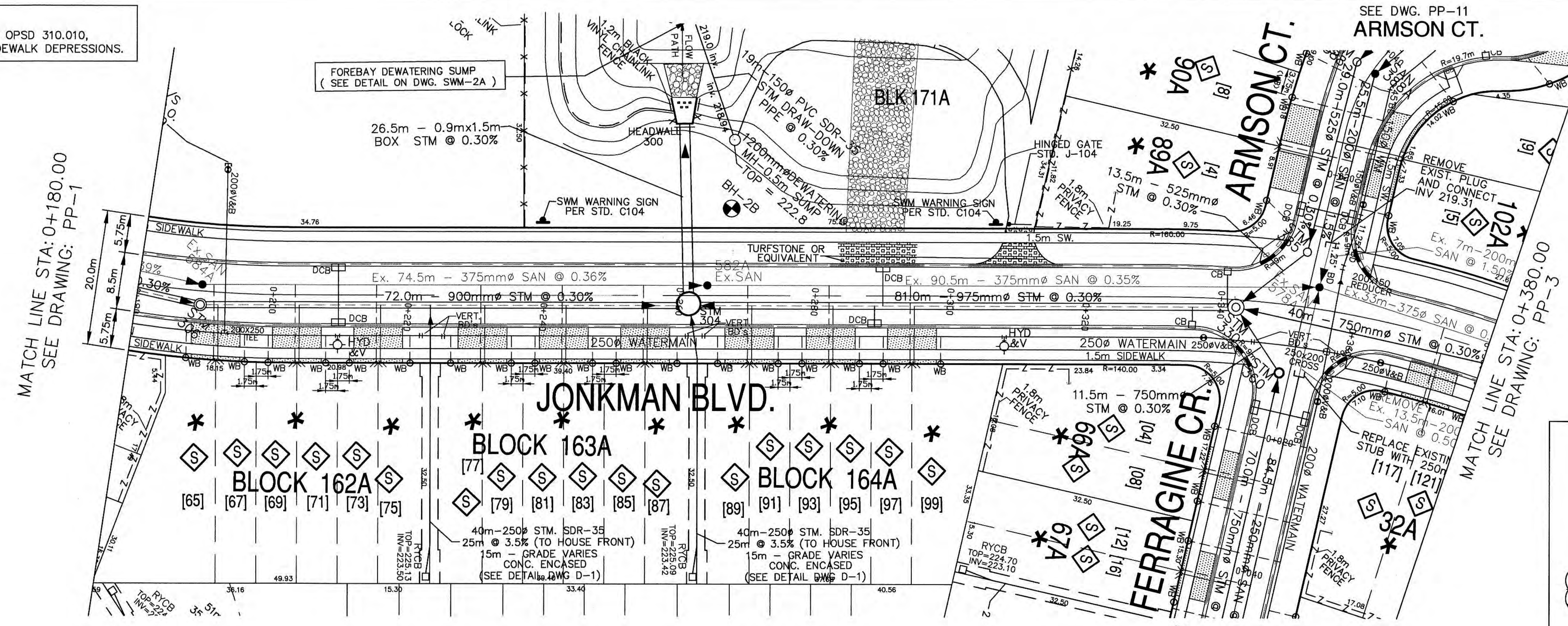
Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. PP-2
Scale Horz. 1:500 Vert. 1:50		Sheet No. - OF -

ID - \\tsclient\P\2008\08017-BRADFORD-WEST\PLAN PROFILES\08017 - P1 to P10.dwg - Thu, 7 Apr 2016 - 18:30

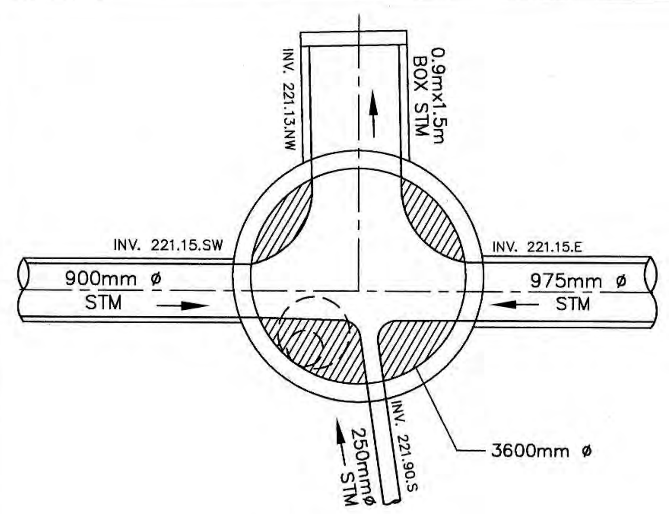


BLOCK 169A
BLOCK 170A
(FUTURE RESIDENTIAL)
SECTION 7-7 SEE DWG DET-15
JONKMAN BLVD.
SIMCOE ROAD
TIBERINI WAY
MATCH LINE STA. 0+180.00 SEE DRAWING PP-2
BLK 176A
BLK 180A
BLK 181A
BLK 184A
BLK 186A
183A
135A
136A
137A
138A
L I M I T O F S U B D I V I S I O N
THE TOWN OF BRADFORD WEST GWILLIMBURY
DOES NOT WARRANT THE ACCURACY OF THESE RECORDS.
COPYRIGHT ACT APPLIES TO USE AND REPRODUCTION.
DETAIL OF STEP JOINT
N.T.S.
JOINT SHALL BE ROUTED AND SEALED WITH A HOT RUBBER SEALING COMPOUND PER OPSS 1212
PROP. 300mm WIDE x 40mm DEEP STEP JOINT IN EX. PAVEMENT
PROP. TOP COURSE
PROP. BINDER COURSE
PROP. BINDER COURSE
APPROVED BACKFILL
75mm EXTRUDED POLYSTYRENE INSULATION (STYROFOAM HI-35 OR APPROVED EQUAL)
WELL COMPACTED SAND BACKFILL (95% STD. PROCTOR DENSITY)
PIPE TO BE INSULATED
PIPE INSULATION DETAIL
N.T.S.
NOTE:
SANITARY RISER AND STUB PROVIDED FOR SANITARY SERVICE CONNECTIONS TO EXISTING SANITARY SEWER. FOR LOTS 135A TO 138A INCLUSIVE.
NOTE:
TACTILE PLATES TO BE INSTALLED IN ACCORDANCE WITH OPSD 310.010, 310.031, 310.033 AND 310.039 AT ALL INTERSECTION SIDEWALK DEPRESSIONS.
STA. 0+000
ELEV 222.47
STA. 0+146.788
ELEV 224.216
32.571m @ 0.5%
20.929m @ 4.0%
28.5m @ 5.0%
41.360m @ 1.0%
62.768m @ 0.60%
LVC=32m
K=9.14
LVC=48m
SANITARY SERVICE CONNECTIONS TO BE INSTALLED OVER WATERMAIN
PROPOSED TOP OF WATERMAIN
PROPOSED STORM SEWER
PROPOSED SANITARY SEWER
EXISTING and PROPOSED ℄ ELEVATION
℄ CHAINAGE
18.0m–300mmø PVC STM @ 0.30% SDR–35 – CL. 'B' BEDDING
43.5m–375mmø PVC STM @ 0.30% SDR–35 – CL. 'B' BEDDING
44.5m–900mmø CONC. STM @ 0.30% CL.50–D – CL. 'B' BEDDING
Ex.51.5m–375mmø PVC SAN @ 0.35% SDR–35 – CL. 'B' BEDDING
Ex.51.5m–375mmø PVC SAN @ 0.39% SDR–35 – CL. 'B' BEDDING
Ex.46.0m–375mmø PVC SAN @ 0.35% SDR–35 – CL. 'B' BEDDING
Ex.41.0m–375mmø PVC SAN @ 0.39% SDR–35 – CL. 'B' BEDDING
0+000.000
0+020.000
0+040.000
0+060.000
0+080.000
0+100.000
0+120.000
0+140.000
0+160.000
0+180.000
Key Plan
LEGEND
PROPOSED ELEVATION
EXISTING ELEVAITON
WATER BOX
VALVE CHAMBER
VALVE & BOX
EXISTING CULVERT
EXISTING FENCE
STORM MAINTENANCE HOLES
CATCHBASIN MAINTENANCE HOLES
SANITARY MAINTENANCE HOLES
SEWER
PROPOSED WATERMAIN
REAR LOT CATCHBASIN
CATCHBASIN
DOUBLE CATCHBASIN
DITCH INLET CATCHBASIN
HYDRANT & VALVE
CURB & GUTTER & DEPRESSION
SIDEWALK
1.2m BLACK VINYL CHAINLINK FENCE
1.5m BLACK VINYL CHAINLINK FENCE
1.8m PRIVACY FENCE
ACOUSTIC FENCE
SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.
LOT WITH SUMP TO BE PUMPED TO SURFACE (NO STM CONN.)
9 SIGNATURE SUBMISSION JUL 10/18 RS
8 FIFTH SUBMISSION REVISED FEB 20/18 RS
7 FOURTH SUBMISSION REVISED DEC 11/17 RS
6 FOURTH SUBMISSION NOV 30/17 RS
No. Revision Date By Appr'd
BENCHMARK NOTE
ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST–ORDER BENCHMARK No. 0011981U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE. TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256–JP.
CONSULTANT
ROSARIO.SACCO
JUL 10, 2018
PROVINCE OF ONTARIO
ACCEPTED
TOWN OF BRADFORD WEST GWILLIMBURY
SIGNATURE DATE
Bradford West Gwillimbury
URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856–0629
f. (905)856–0698
UEL
BRADFORD EAST DEVELOPMENTS INC.
JONKMAN BOULEVARD
FROM STA. 0+000.00 TO STA. 0+180.00
Surveyed by: P.E. Checked by: R.S. Project No. 08016
Drawn by: V.T. Approved by: R.S.
Designed by: D.J.S. Date: JAN. 1, 2015 Drawing No. PP-1
Scale Horz. 1:500 Vert. 1:50
Sheet No. - OF -

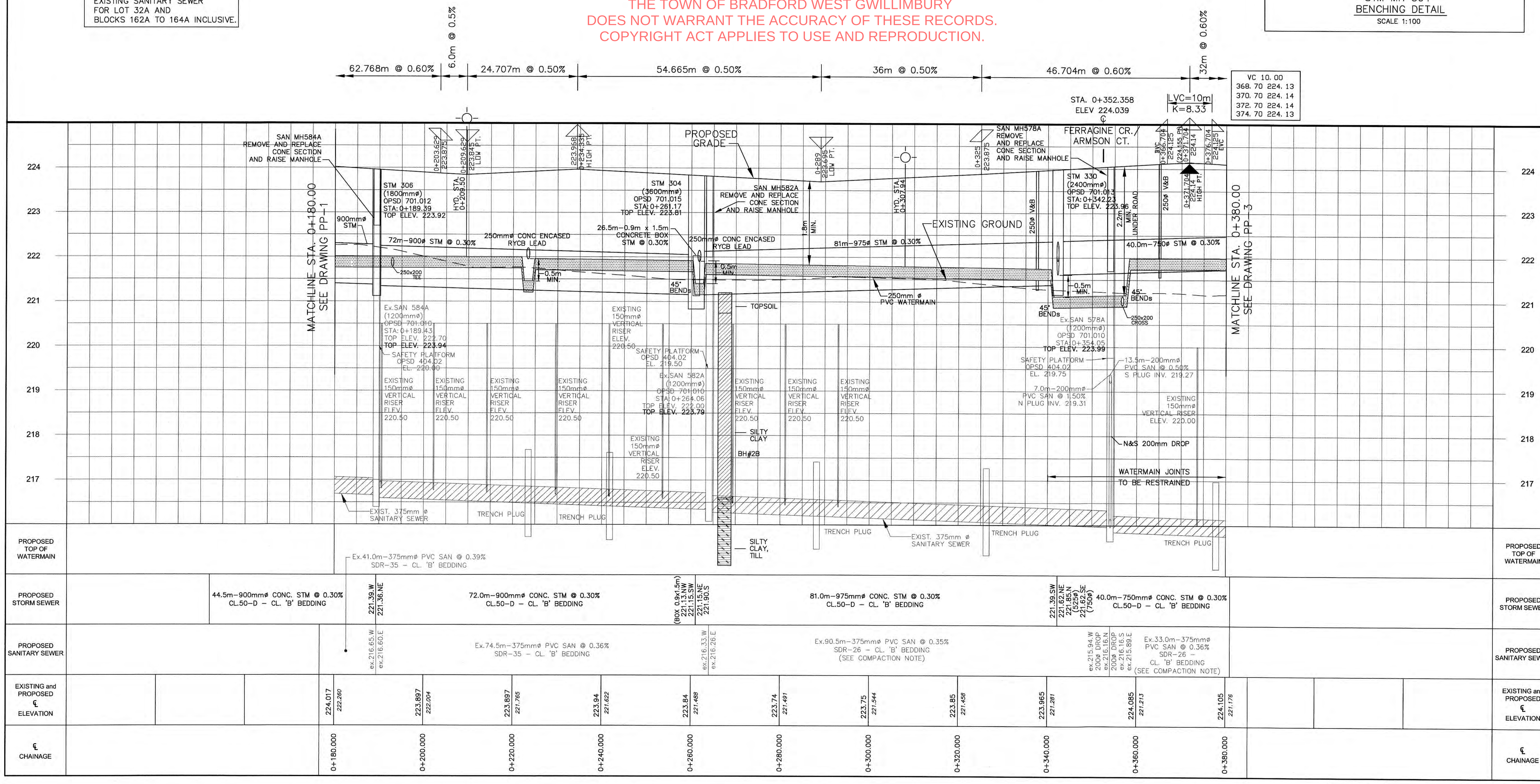
NOTE:
TACTILE PLATES TO BE INSTALLED IN CONJUNCTION WITH OPSD 310.010, 310.031, 310.033 AND 310.039 AT ALL INTERSECTION SIDEWALK DEPRESSIONS.

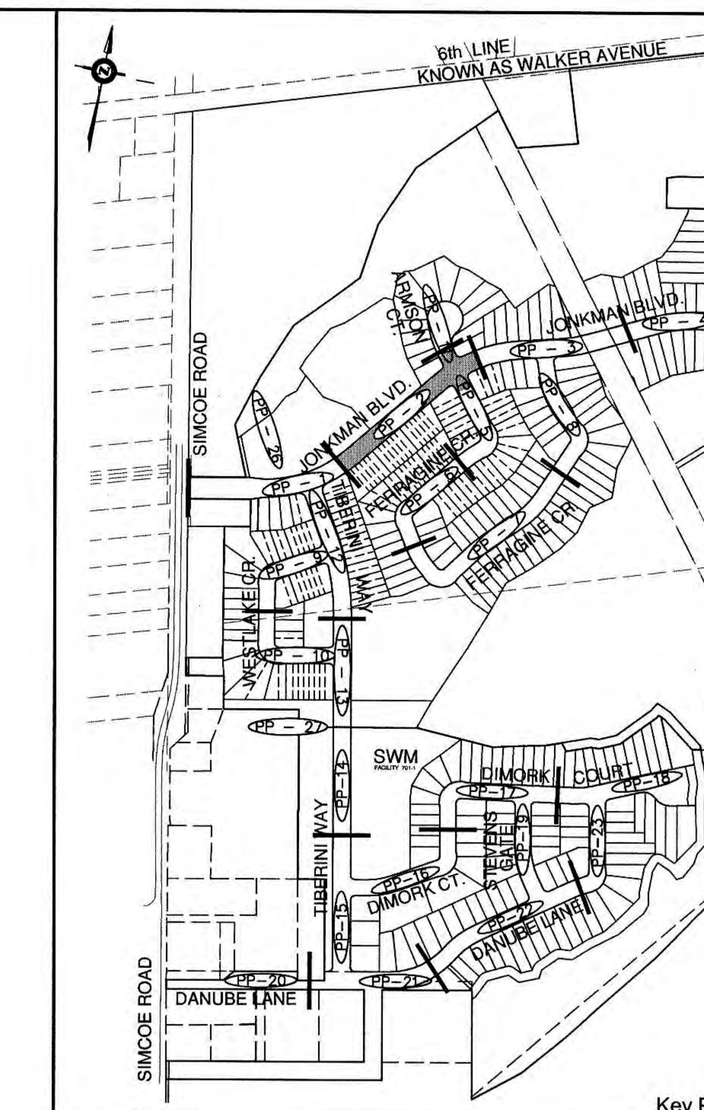


NOTE:
SANITARY RISER AND STUB PROVIDED FOR SANITARY SERVICE CONNECTIONS TO EXISTING SANITARY SEWER FOR LOT 32A AND BLOCKS 162A TO 164A INCLUSIVE.



STM MH 304
BENCHING DETAIL
SCALE 1:100





LEGEND

232.55	PROPOSED ELEVATION
232.43 ×	EXISTING ELEVATION
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W — ℄ — P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XO—XO—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—Z—	1.8m PRIVACY FENCE
—XOX—	ACOUSTIC FENCE

SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
7	SIGNATURE SUBMISSION	JUL 10/18	RS	
6	FIFTH SUBMISSION	FEB 20/18	RS	
5	FOURTH SUBMISSION	NOV 30/17	RS	
4	THIRD SUBMISSION	AUG 24/17	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES, LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30m FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256–JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JUL 10, 2018
PROVINCE OF ONTARIO

ACCEPTED
TOWN OF BRADFORD WEST GWILLIMBURY

SIGNATURE DATE

Bradford West Gwillimbury

URBAN ECOSYSTEMS LIMITED
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WOODBRIDGE, ONTARIO L4L 8G7
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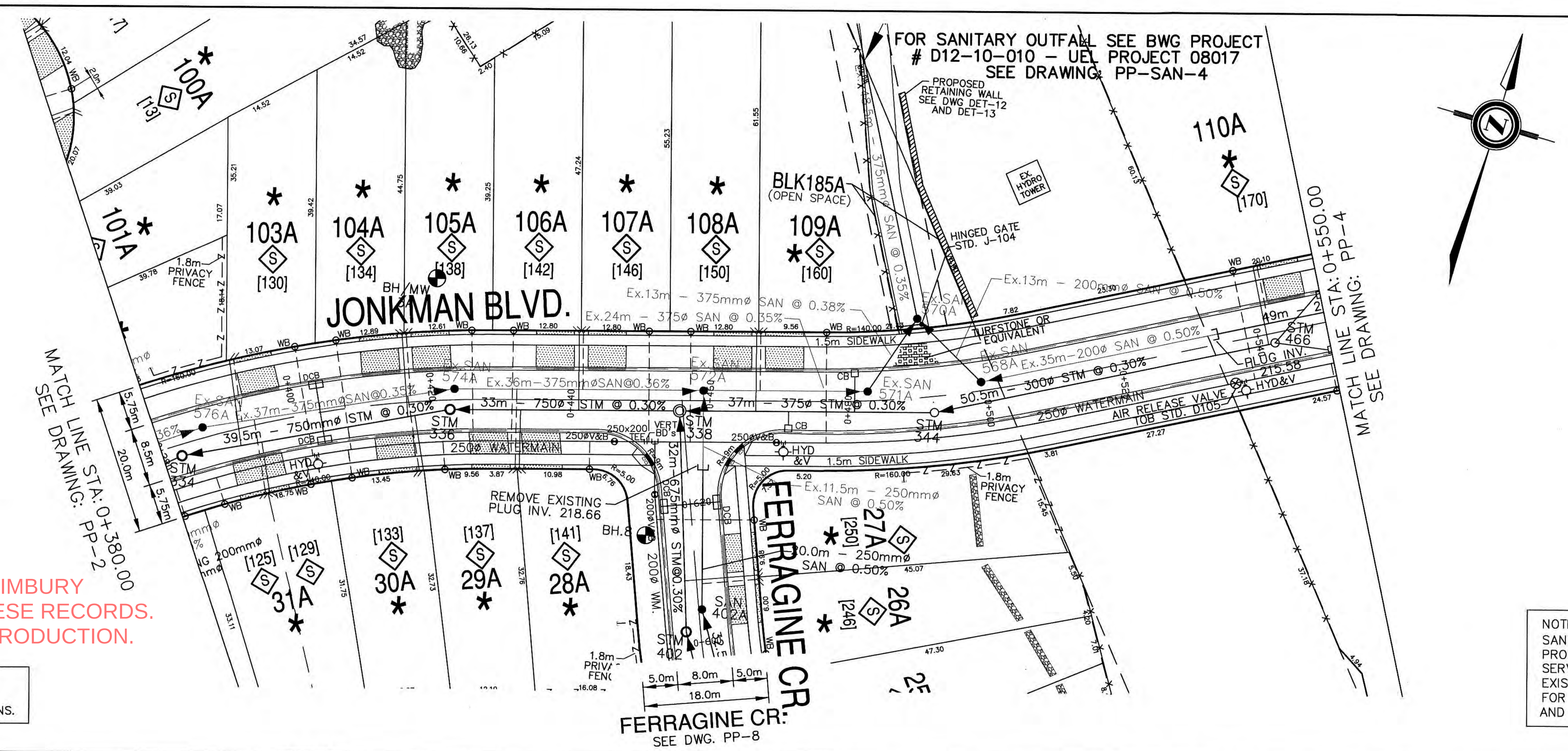
t. (905)856–0629
f. (905)856–0698

UEL

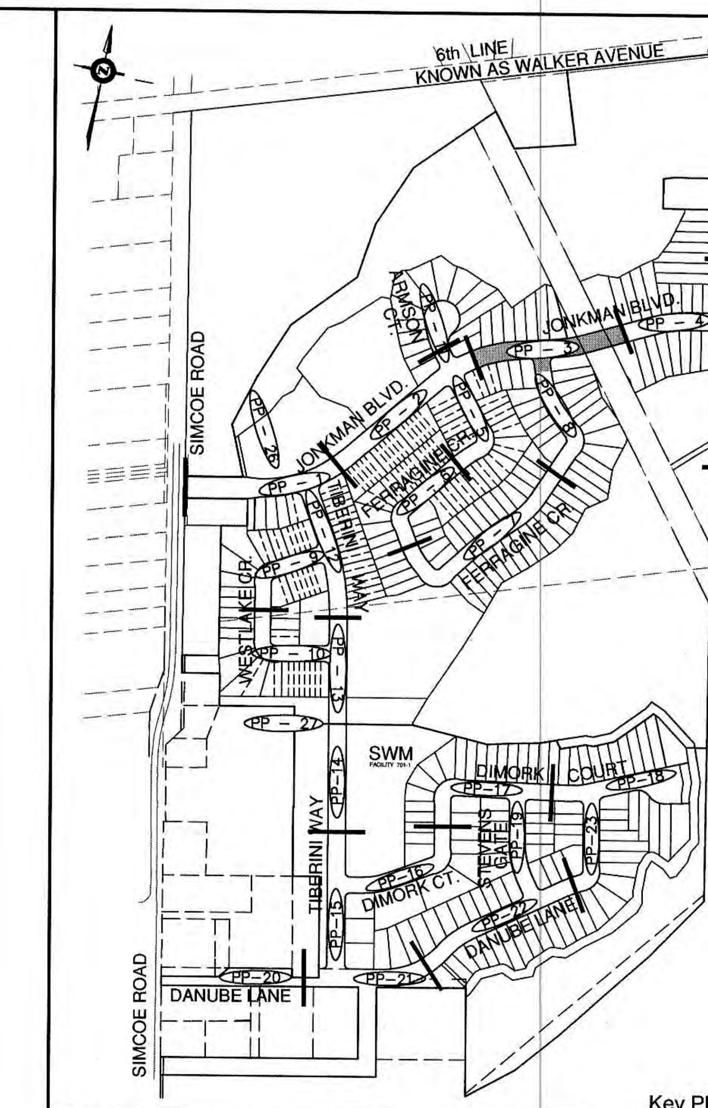
BRADFORD EAST DEVELOPMENTS INC.
JONKMAN BOULEVARD
FROM STA. 0+180.00 TO STA. 0+380.00

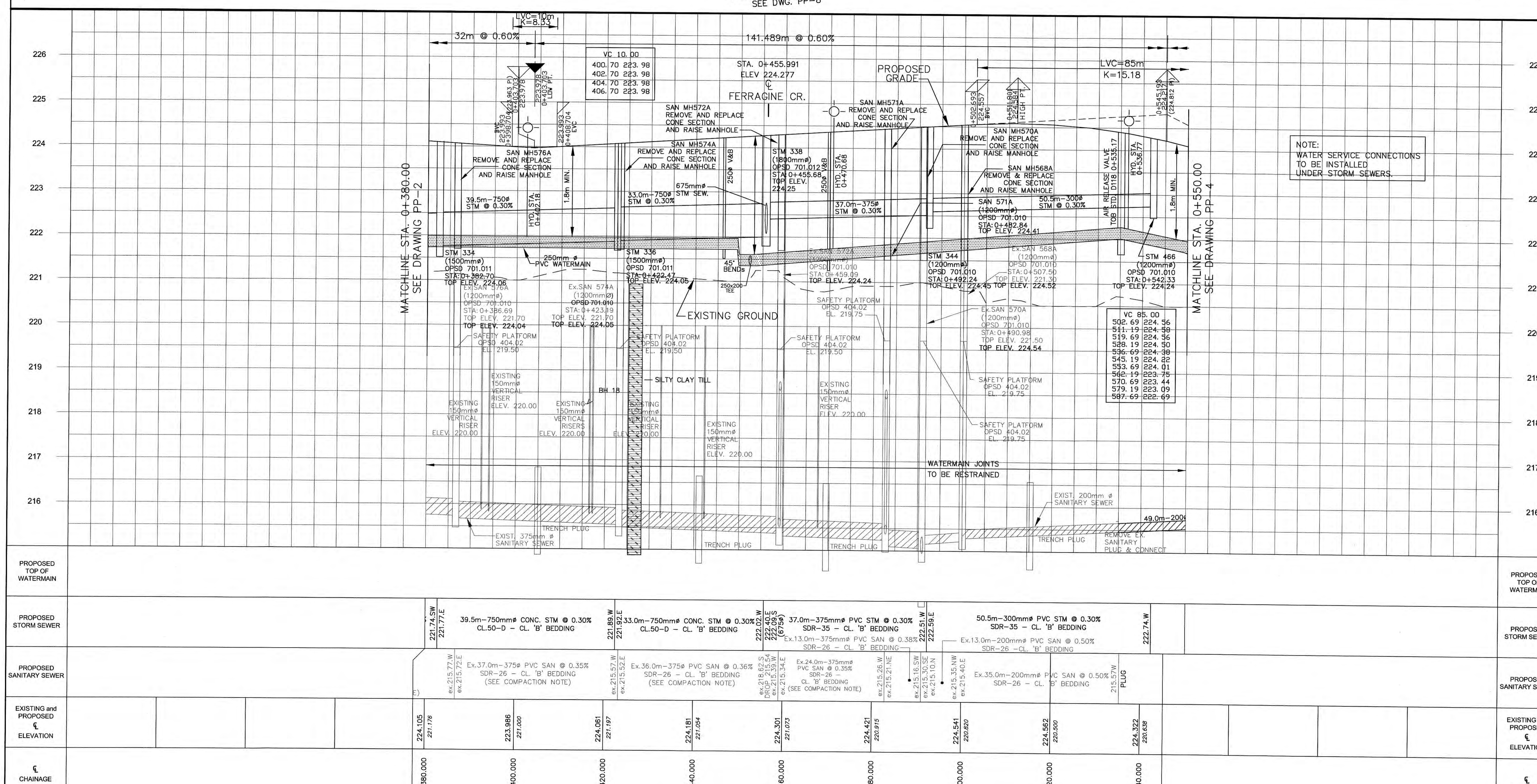
Surveyed by: P.E.	Checked by: R.S.	Project No. 08016
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: JAN. 1, 2015	Drawing No. PP-2
Scale Horz. 1:500 Vert. 1:50	0m 10m 20m / 0m 1m 2m	Sheet No. - OF -



NOTE:
TACTILE PLATES TO BE INSTALLED IN CONJUNCTION WITH OPSD 310.010, 310.031, 310.033 AND 310.039 AT ALL INTERSECTION SIDEWALK DEPRESSIONS.

NOTE:
SANITARY RISER AND STUB PROVIDED FOR SANITARY SERVICE CONNECTIONS TO EXISTING SANITARY SEWER FOR LOTS 28A TO 38A INCLUSIVE AND LOTS 103A TO 109A INCLUSIVE





LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVAITON
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X—X—	1.2m BLACK VINYL CHAINLINK FENCE
—XD—XD—	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—Z—	1.8m PRIVACY FENCE
—XDX—	ACOUSTIC FENCE

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4	THIRD SUBMISSION	AUG 24/17	RS	

BENCHMARK NOTE

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CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JUL 10, 2018
PROVINCE OF ONTARIO

ACCEPTED
TOWN OF BRADFORD WEST GWILLIMBURY

SIGNATURE DATE

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
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WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856–0629
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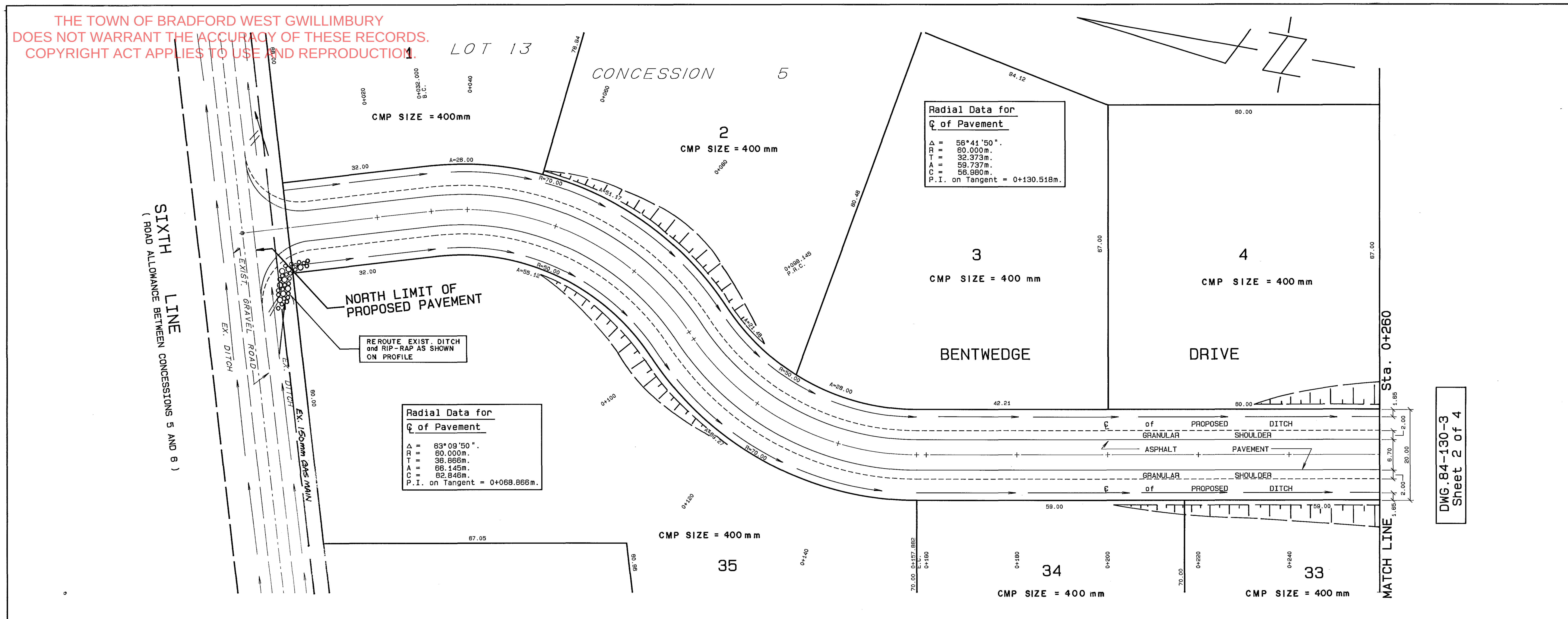
BRADFORD EAST DEVELOPMENTS INC.
JONKMAN BOULEVARD
FROM STA. 0+380.00 TO STA. 0+550.00

Surveyed by: P.E.	Checked by: R.S.	Project No. 08016
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: JAN. 1, 2015	Drawing No. PP-3
Scale Horz. 1:500 Vert. 1:50		Sheet No. - OF -



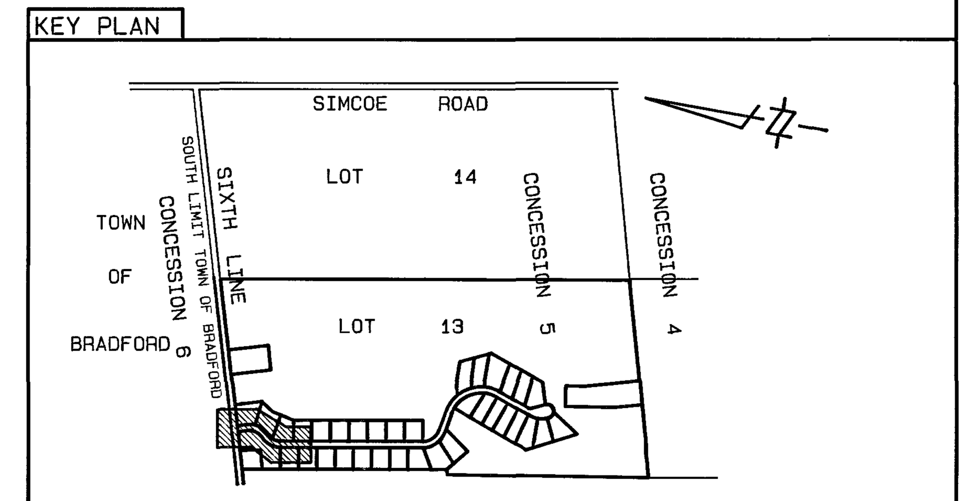
REVISIONS

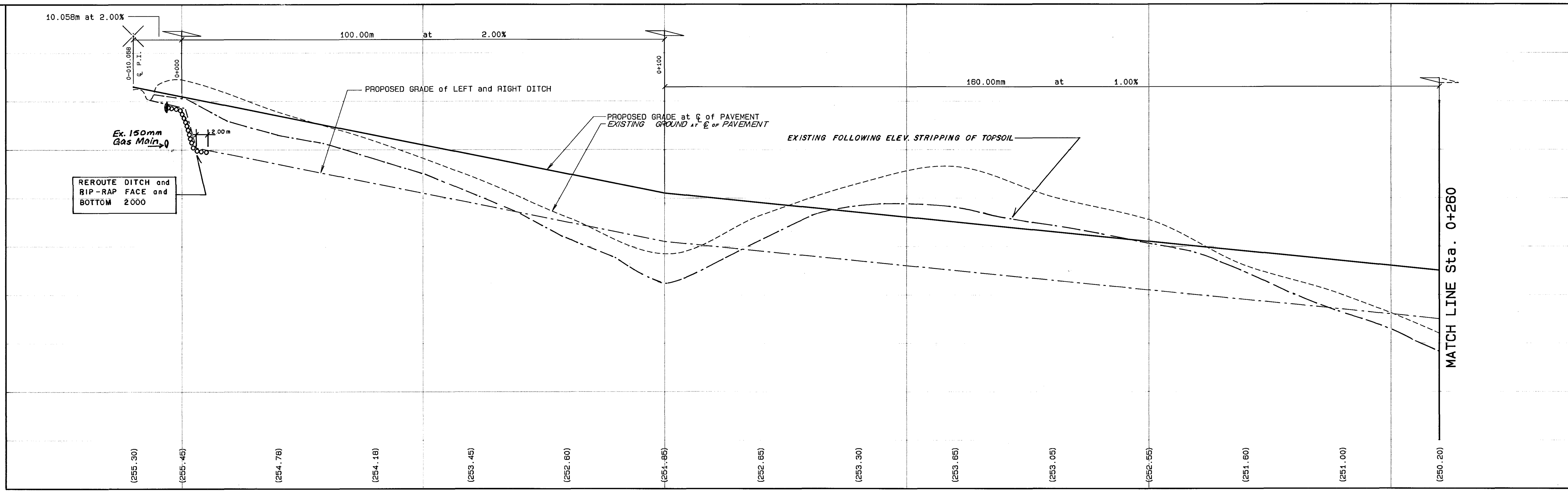
NO.	DESCRIPTION	BY	DATE

NOTES:

1. STANDARD DRAWINGS OF THE MINISTRY OF TRANSPORTATION AND COMMUNICATIONS CONSTITUTE PART OF THE PLANS OF THE CONTRACT.
2. INFORMATION REGARDING ANY EXISTING SERVICES AND/OR UTILITIES SHOWN HEREON IS FURNISHED AS THE BEST AVAILABLE INFORMATION. THE CONTRACTOR SHALL INTERPRET THIS INFORMATION AS HE SEES FIT WITH THE UNDERSTANDING THAT THE OWNER DISCLAIMS ALL RESPONSIBILITY FOR ITS ACCURACY AND/OR SUFFICIENCY.
3. ALL DIMENSIONS SHALL BE CHECKED AND VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO ANY CONSTRUCTION AND HE SHALL REPORT ANY DISCREPANCIES IMMEDIATELY TO THE ENGINEER.
4. APPROVED FILL MATERIAL TO BE COMPACTED TO A DRY DENSITY NOT LESS THAN 95% OF THE STANDARD PROCTOR DENSITY. AFTER COMPACTION SOIL DENSITY TESTS SHALL BE CONDUCTED TO ENSURE ADEQUATE COMPACTION AND STABILITY OF THE FILL AND TEST RESULTS SHALL BE SUBMITTED TO THE ENGINEER.
5. ROADWAY CROSS SECTION AND LAYOUT SHALL CONFORM TO DETAILS SHOWN ON DRAWING 84-130-4.
6. ALL TOPSOIL AND ORGANIC MATERIAL WITHIN ROAD ALLOWANCE HAS BEEN STRIPPED PRIOR TO THE START OF CONSTRUCTION.
7. PAVEMENT DESIGN:
   25mm COMPACTED DEPTH HL-3 ASPHALT TOP COURSE
   50mm COMPACTED DEPTH HL-8 ASPHALT BINDER COURSE
   150mm COMPACTED DEPTH M.T.C. GRANULAR "A" BASE
   300mm COMPACTED DEPTH M.T.C. GRANULAR "B" SUB-BASE

KEY PLAN





℄ Chainage	0-010.058 P.I.	0+000 S/L	0+020	0+032.000 B.C.	0+040	0+060	0+080	0+098.145 P.R.C.	0+100	0+120	0+140	0+157.882 E.C.	0+160	0+180	0+200	0+220	0+240	0+260
Exist. Ground	(255.30)	(255.45)	(254.78)		(254.18)	(253.45)	(252.60)		(251.85)	(252.65)	(253.30)		(253.65)	(253.05)	(252.55)	(251.60)	(251.00)	(250.20)
Elevation of Left Ditch		254.040	253.700	253.460	253.300	252.900	252.500	252.137	252.100	251.900	251.700	251.521	251.500	251.300	251.100	250.900	250.700	250.500
Elevation of Right Ditch		254.040	253.700	253.460	253.300	252.900	252.500	252.137	252.100	251.900	251.700	251.521	251.500	251.300	251.100	250.900	250.700	250.500
Elevation at ℄ of Pavement	255.301	255.100	254.700	254.460	254.300	253.900	253.500	253.137	253.100	252.900	252.700	252.521	252.500	252.300	252.100	251.900	251.700	251.500

REFERENCE DRAWINGS

DWG.NO.	DESCRIPTION

CLIENT

ISLINGTON INVESTMENTS LIMITED

APPROVED BY TOWNSHIP OF WEST GWILLIMBURY ENGINEER

W. J. BURNS P. ENG.

DATE: DECEMBER 11 1984

DESIGNED BY

DATE: Oct 1984

FILE 84-130

PLAN 51 M 221

TOWNSHIP OF WEST GWILLIMBURY

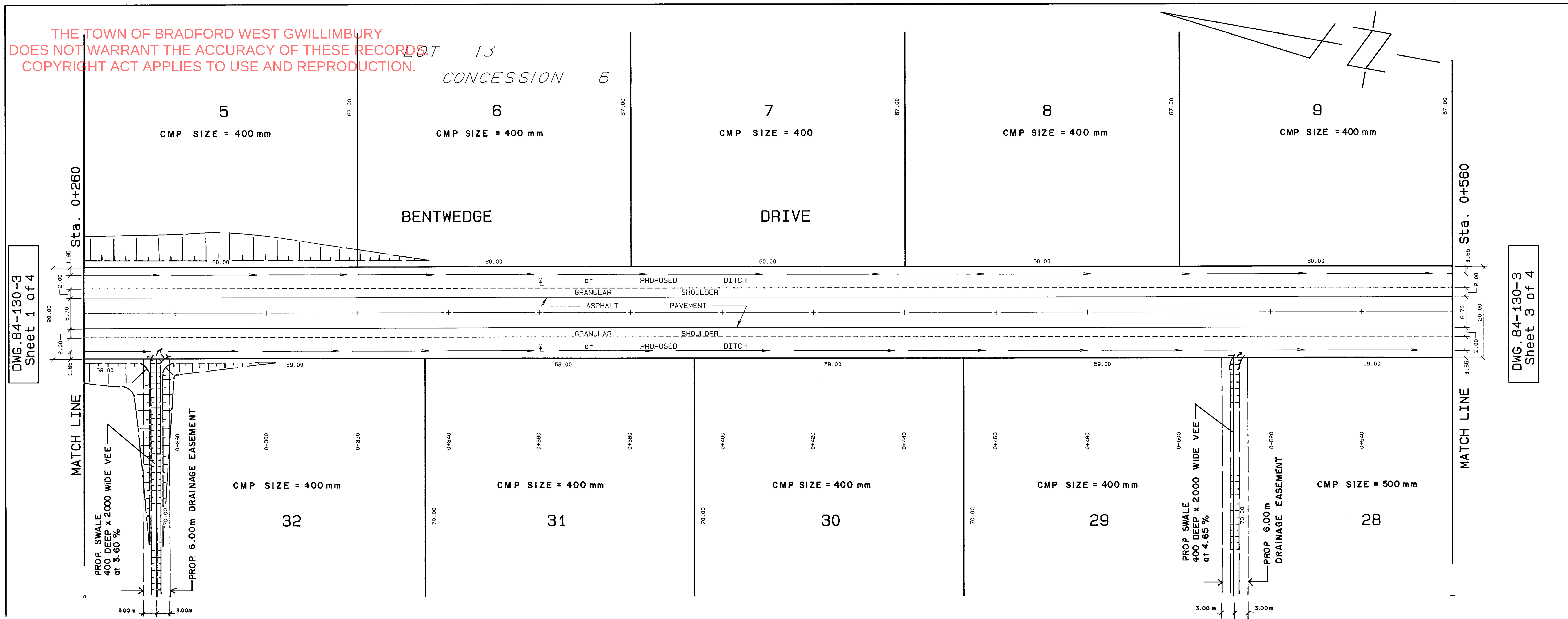
SCALES: HORIZONTAL 0 5 10 20 40 metres; VERTICAL 0 0.5 1 2 4 metres

Plan and Profile of BROWNLEE ~~BENTWEDGE~~ DRIVE
FROM SIXTH LINE TO 0+260

Andrew Brodie Associates Inc.
Consulting Engineers Thornhill , Ontario

A. F. BRODIE

DESIGNED BY: AFB	DATE: SEPT. 1984	DRAWN BY: K.K.C.
CHECKED BY: K.D.M.		
SCALES HORIZONTAL: 1: 500 VERTICAL: 1: 50		DRAWING NO. 84-130-3 Sheet 1 of 4



REVISIONS

NO.	DESCRIPTION	BY	DATE

NOTES:

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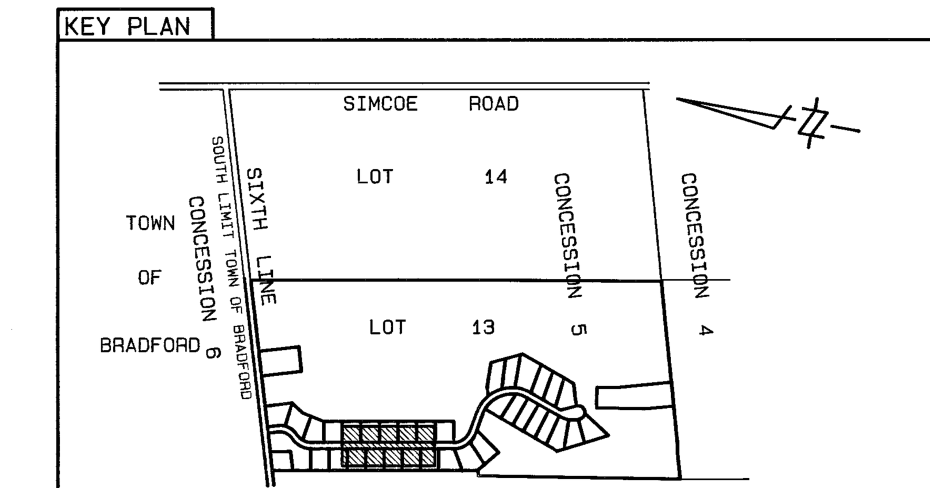
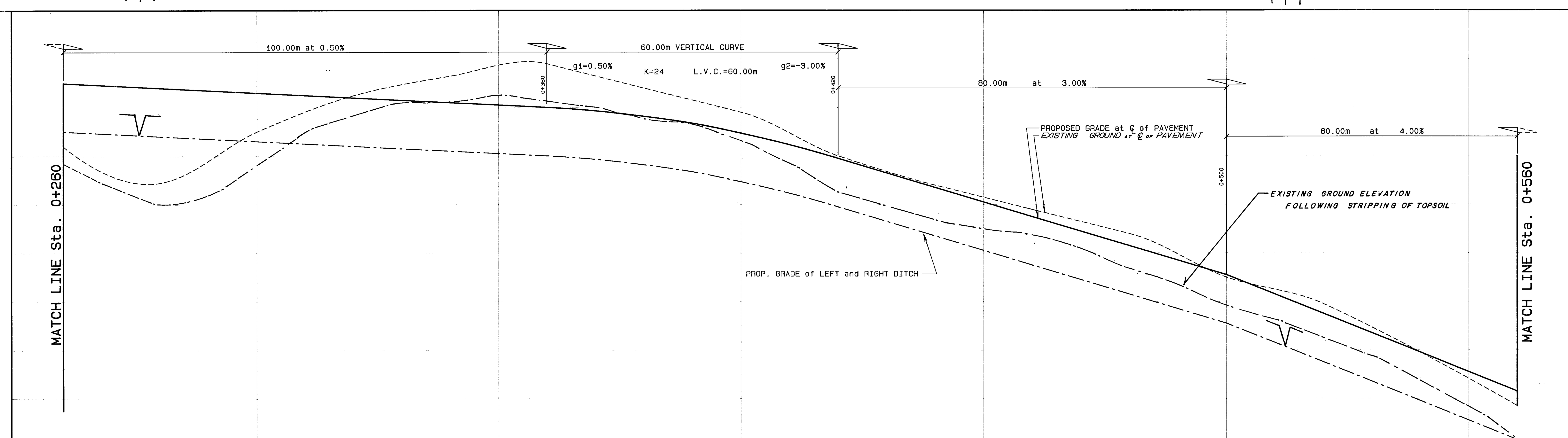
5. ROADWAY CROSS SECTION AND LAYOUT SHALL CONFORM TO DETAILS SHOWN ON DRAWING 84-130-4.
6. ALL TOPSOIL AND ORGANIC MATERIAL WITHIN ROAD ALLOWANCE HAS BEEN STRIPPED PRIOR TO THE START OF CONSTRUCTION.
7. PAVEMENT DESIGN:
   25mm COMPACTED DEPTH HL-3 ASPHALT TOP COURSE
   50mm COMPACTED DEPTH HL-8 ASPHALT BINDER COURSE
   150mm COMPACTED DEPTH M.T.C. GRANULAR "A" BASE
   300mm COMPACTED DEPTH M.T.C. GRANULAR "B" SUB-BASE

KEY PLAN





Exist. Ground	(250.20)	(249.45)	(250.50)	(251.25)	(251.65)	(251.90)		(251.40)		(250.90)		(250.00)	(249.40)	(248.90)	(248.30)	(247.50)	(246.95)	(245.95)	(244.85)
Elevation of Left Ditch	250.500	250.400	250.300	250.200	250.100	250.000	249.929	249.817	249.683	249.487	249.230	248.950	248.350	247.750	247.150	246.550	245.750	244.950	244.150
Elevation of Right Ditch	250.500	250.400	250.300	250.200	250.100	250.000	249.929	249.817	249.683	249.487	249.230	248.950	248.350	247.750	247.150	246.550	245.750	244.950	244.150
Elevation at ℄ of Pavement	251.500	251.400	251.300	251.200	251.100	251.000	250.929	250.817	250.683	250.487	250.230	249.950	249.350	248.750	248.150	247.550	246.750	245.950	245.150
℄ Chainage	0+260	0+280	0+300	0+320	0+340	0+360		0+380		0+400		0+420	0+440	0+460	0+480	0+500	0+520	0+540	0+560

REFERENCE DRAWINGS

DWG.NO.	DESCRIPTION

CLIENT

ISLINGTON INVESTMENTS LIMITED

DESIGNED BY
DATE: Oct 84

APPROVED BY TOWNSHIP OF WEST GWILLIMBURY ENGINEER
W. J. BURNS P. ENG.
DATE: DECEMBER 11 1984

FILE 84-130 | PLAN 51 M 221

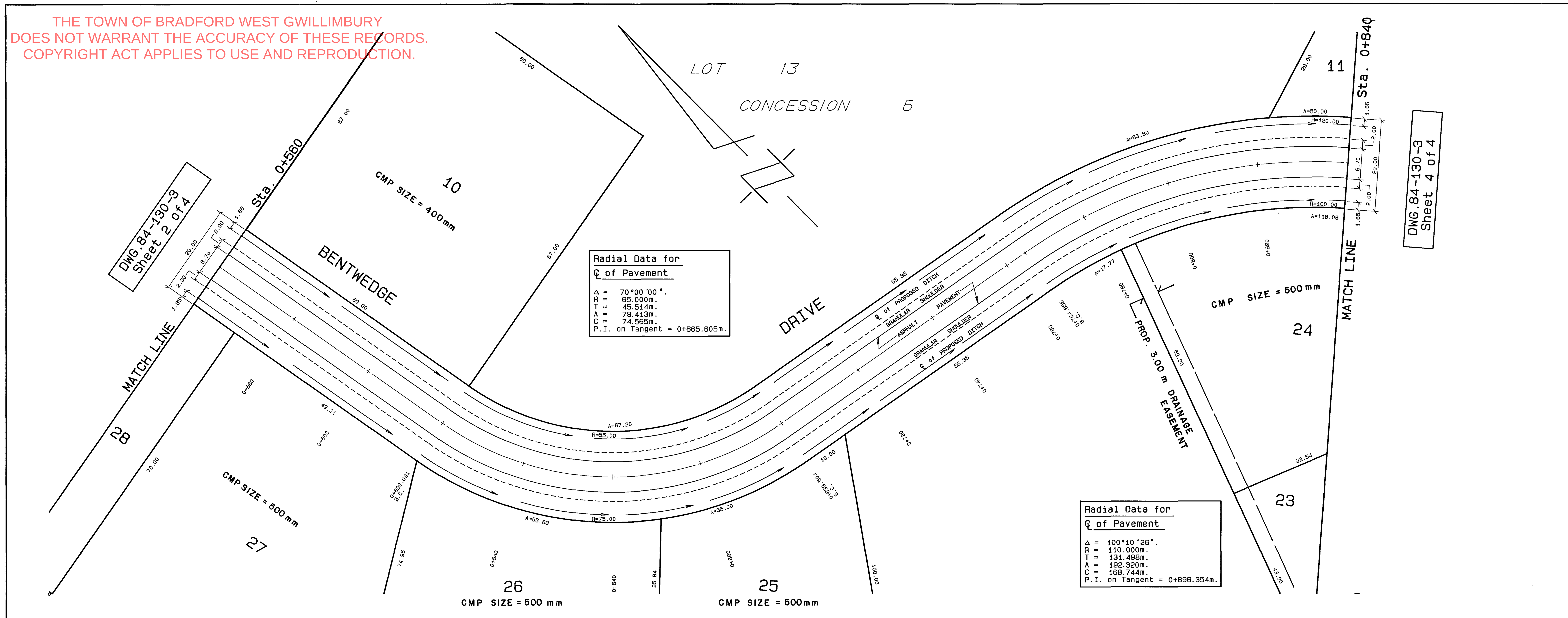
TOWNSHIP OF WEST GWILLIMBURY

SCALES
HORIZONTAL 0 5 10 20 40 metres
VERTICAL 0 0.5 1 2 4 metres

Plan and Profile of ~~BENTWEDGE~~ BROWNLEE DRIVE
FROM Sta 0+260 TO Sta 0+560

Andrew Brodie Associates Inc.
Consulting Engineers Thornhill, Ontario

DESIGNED BY: AFB | DATE: SEPT. 1984 | DRAWN BY: P.B.S.
CHECKED BY: K.D.M.
SCALES HORIZONTAL: 1: 500 VERTICAL: 1: 50
DRAWING NO. 84-130-3 Sheet 2 of 4



REVISIONS

NO.	DESCRIPTION	BY	DATE

NOTES:

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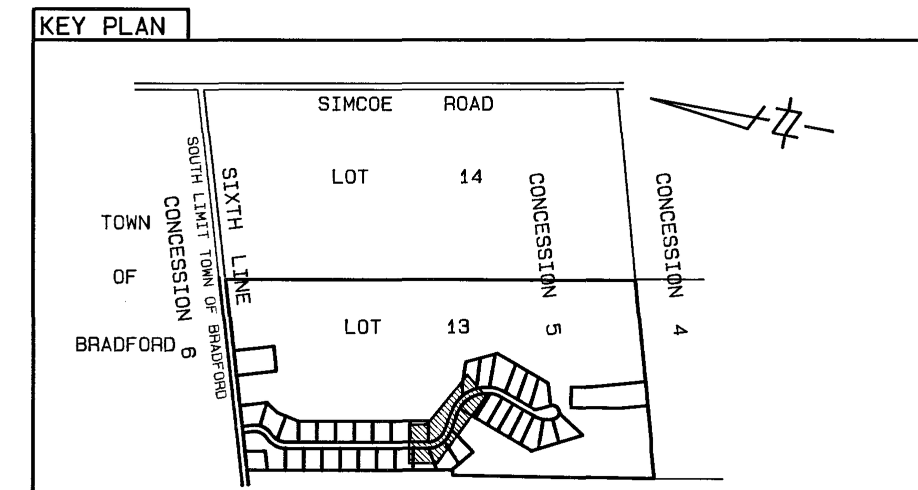
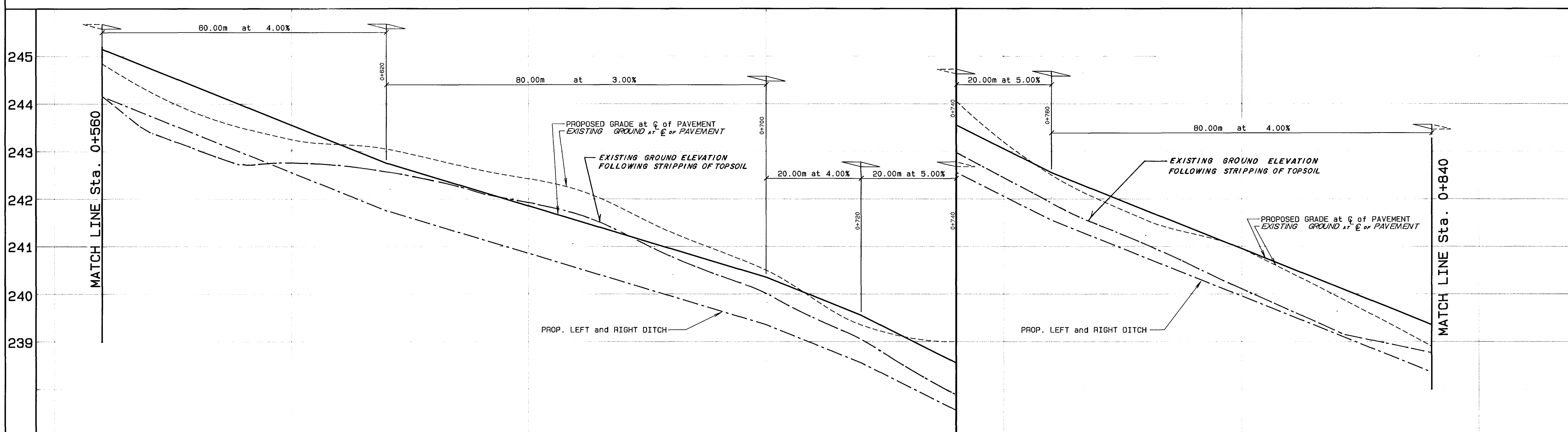
5. ROADWAY CROSS SECTION AND LAYOUT SHALL CONFORM TO DETAILS SHOWN ON DRAWING 84-130-4.
6. ALL TOPSOIL AND ORGANIC MATERIAL WITHIN ROAD ALLOWANCE **HAS BEEN** STRIPPED PRIOR TO THE START OF CONSTRUCTION.
7. PAVEMENT DESIGN:
   25mm COMPACTED DEPTH HL-3 ASPHALT TOP COURSE
   50mm COMPACTED DEPTH HL-6 ASPHALT BINDER COURSE
   150mm COMPACTED DEPTH M.T.C. GRANULAR "A" BASE
   300mm COMPACTED DEPTH M.T.C. GRANULAR "B" SUB-BASE

KEY PLAN





℄ Chainage	Exist. Ground	Elevation of Left Ditch	Elevation of Right Ditch	Elevation at ℄ of Pavement
0+560	(244.85)	244.150	244.150	245.150
0+580	(243.80)	243.350	243.350	244.350
0+600	(243.25)	242.550	242.550	243.550
0+620 / 0+620.091 B.C.	(243.05)	241.750 / 241.747	241.750 / 241.747	242.750 / 242.747
0+640	(242.60)	241.150	241.150	242.150
0+660	(242.20)	240.550	240.550	241.550
0+680	(241.30)	239.950	239.950	240.950
0+699.504 E.C. / 0+700	(240.50)	239.365 / 239.350	239.365 / 239.350	240.365 / 240.350
0+720	(239.35)	238.550	238.550	239.550
0+740	(238.00)	237.550	237.550	238.550
0+760 / 0+764.856 B.C.	(237.50)	236.550 / 236.356	236.550 / 236.356	237.550 / 237.356
0+780	(236.55)	235.750	235.750	236.750
0+800	(235.95)	234.950	234.950	235.950
0+820	(234.95)	234.150	234.150	235.150
0+840	(233.90)	233.350	233.350	234.350

REFERENCE DRAWINGS

DWG.NO.	DESCRIPTION

CLIENT

ISLINGTON INVESTMENTS LIMITED

A.Brodie
DESIGNED BY
DATE: Oct 1984

APPROVED BY
TOWNSHIP OF WEST GWILLIMBURY ENGINEER

W.J. Burns P. ENG.
DATE: DECEMBER 11 1984

FILE 84-130

PLAN 51 M 221

TOWNSHIP OF WEST GWILLIMBURY

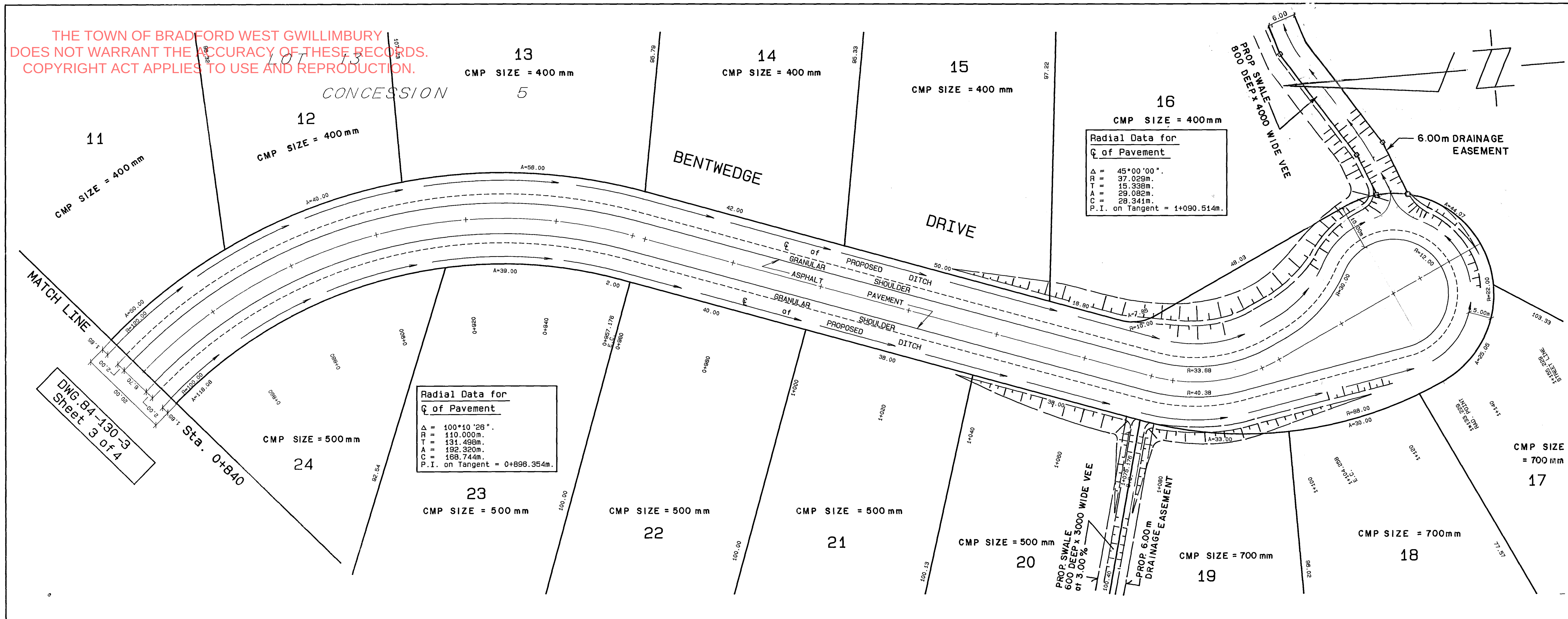
SCALES
HORIZONTAL 0 5 10 20 40 metres
VERTICAL 0 0.5 1 2 4 metres

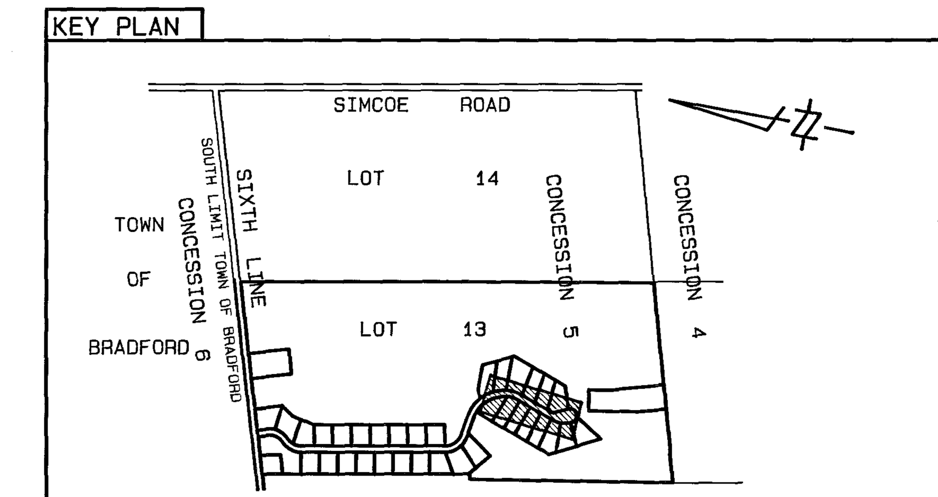
Plan and Profile of BROWNLEE ~~BENTWEDGE~~ DRIVE
FROM Sta 0+560 TO Sta 0+840

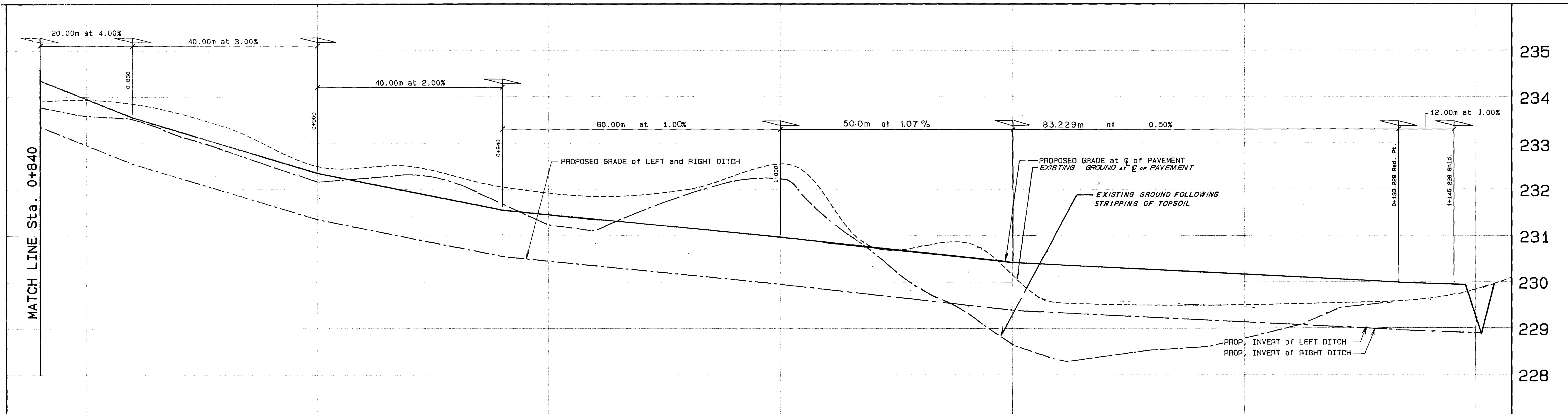
Andrew Brodie Associates Inc.
Consulting Engineers Thornhill, Ontario

A. F. BRODIE

DESIGNED BY: AFB	DATE: SEPT. 1984	DRAWN BY: P.B.S.
CHECKED BY: K.D.M.		
SCALES HORIZONTAL: 1:500 VERTICAL: 1:50		DRAWING NO. 84-130-3 Sheet 3 of 4







℄ Chainage	Exist. Ground	Elevation of Left Ditch	Elevation of Right Ditch	Elevation at ℄ of Pavement
0+840	(233.90)	233.350	233.350	234.350
0+860	(233.85)	232.550	232.550	233.550
0+880	(233.35)	231.950	231.950	232.950
0+900	(232.50)	231.350	231.350	232.350
0+920	(232.50)	230.950	230.950	231.950
0+940	(232.05)	230.550	230.550	231.550
0+957.176 E.C.		230.378	230.378	231.378
0+960	(231.85)	230.350	230.350	231.350
0+980	(232.00)	230.150	230.150	231.150
1+000	(232.55)	229.950	229.950	230.950
1+020	(230.75)	229.730	229.730	230.737
1+040	(230.85)	229.510	229.510	230.523
1+050	(230.15)	229.400	229.400	230.416
1+060	(229.55)	229.360	229.360	230.366
1+075.176 B.C.		229.299	229.299	230.290
1+080	(229.55)	229.280	229.280	230.266
1+100	(229.55)	229.200	229.200	230.166
1+104.258 E.C.		229.183	229.183	230.145
1+120	(229.55)			230.066
1+133.229 RAD.PT.	(229.65)			230.000
1+145.229 EDGE of SHOULDER		OUTLET 228.760	DITCH 228.760	
1+155.229 S/L	(230.10)			

REVISIONS

NO.	DESCRIPTION	BY	DATE
1	Revision to Profile Grade.	M.G.	Feb. '85

NOTES:

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   150mm COMPACTED DEPTH M.T.C. GRANULAR "A" BASE
   300mm COMPACTED DEPTH M.T.C. GRANULAR "B" SUB-BASE

REFERENCE DRAWINGS

DWG.NO.	DESCRIPTION

CLIENT

ISLINGTON INVESTMENTS LIMITED

APPROVED BY TOWNSHIP OF WEST GWILLIMBURY ENGINEER

AnBrodie
DESIGNED BY
DATE: Oct 84

W. J. BURNS P. ENG.
DATE: DECEMBER 11 1984

FILE 84-130

PLAN 51 M 221

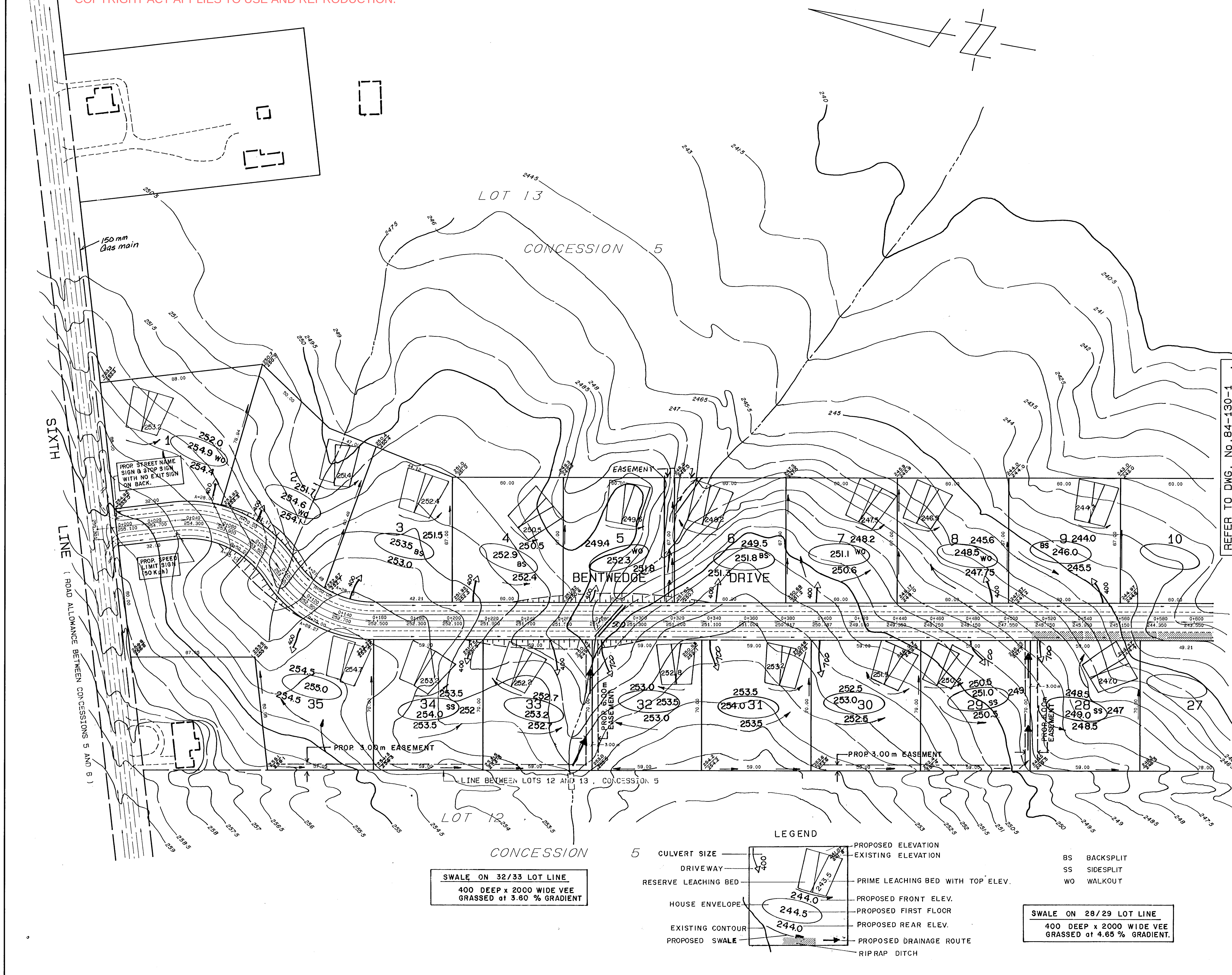
TOWNSHIP OF WEST GWILLIMBURY

SCALES
HORIZONTAL 0 5 10 20 40 metres
VERTICAL 0 0.5 1 2 4 metres

Plan and Profile of BROWNLEE ~~BENTWEDGE~~ DRIVE
FROM Sta 0+840 TO CUL-DE-SAC

Andrew Brodie Associates Inc.
Consulting Engineers Thornhill, Ontario

DESIGNED BY: AFB	DATE: SEPT. 1984	DRAWN BY: K.K.C.
CHECKED BY: K.D.M.	Rev. Mar. 1985 Golf course swale and road grades	
SCALES HORIZONTAL: 1: 500 VERTICAL: 1: 50		DRAWING NO. 84-130-3 Sheet 4 of 4



REVISIONS

NO.	DESCRIPTION	BY	DATE
1.	As built culvert sizes, easement added	AB	17/12/90

NOTES:

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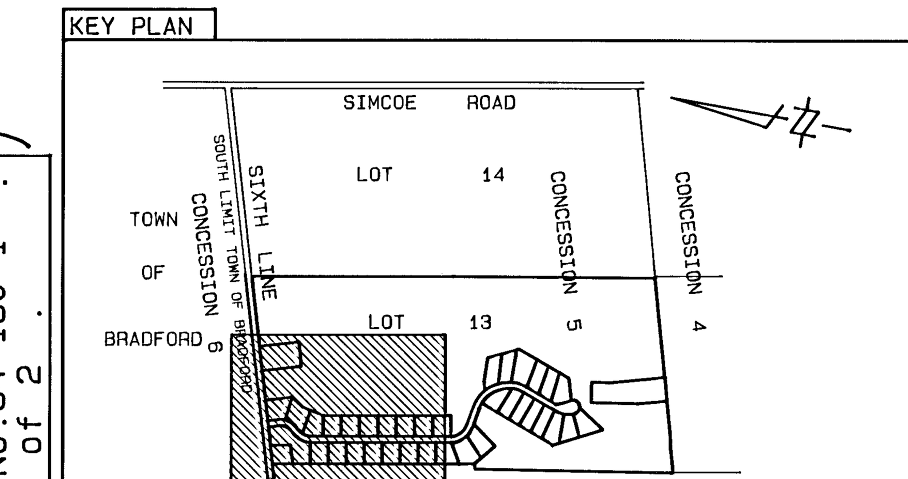
   150mm COMPACTED DEPTH M.T.C. GRANULAR "A" BASE
   300mm COMPACTED DEPTH M.T.C. GRANULAR "B" SUB-BASE
8. ALL DRIVEWAY CULVERTS SHALL BE CORRUGATED STEEL PIPE, METAL THICKNESS = 1.3mm UP TO 600mm Dia. and 1.6mm 700mm Dia and GREATER IN ACCORDANCE WITH M.T.C. STD DD·812·A.

KEY PLAN



REFERENCE DRAWING

DWG NO.	DESCRIPTION

CLIENT

ISLINGTON INVESTMENTS LIMITED

B. R. WHITEHEAD — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

DESIGNED BY

DATE OCTOBER 11 1984

APPROVED BY TOWNSHIP OF WEST GWILLIMBURY ENGINEER

Wm John Burns
W. J. BURNS P. ENG.

DATE DECEMBER 11 1984

FILE 84-130

PLAN 51M 221

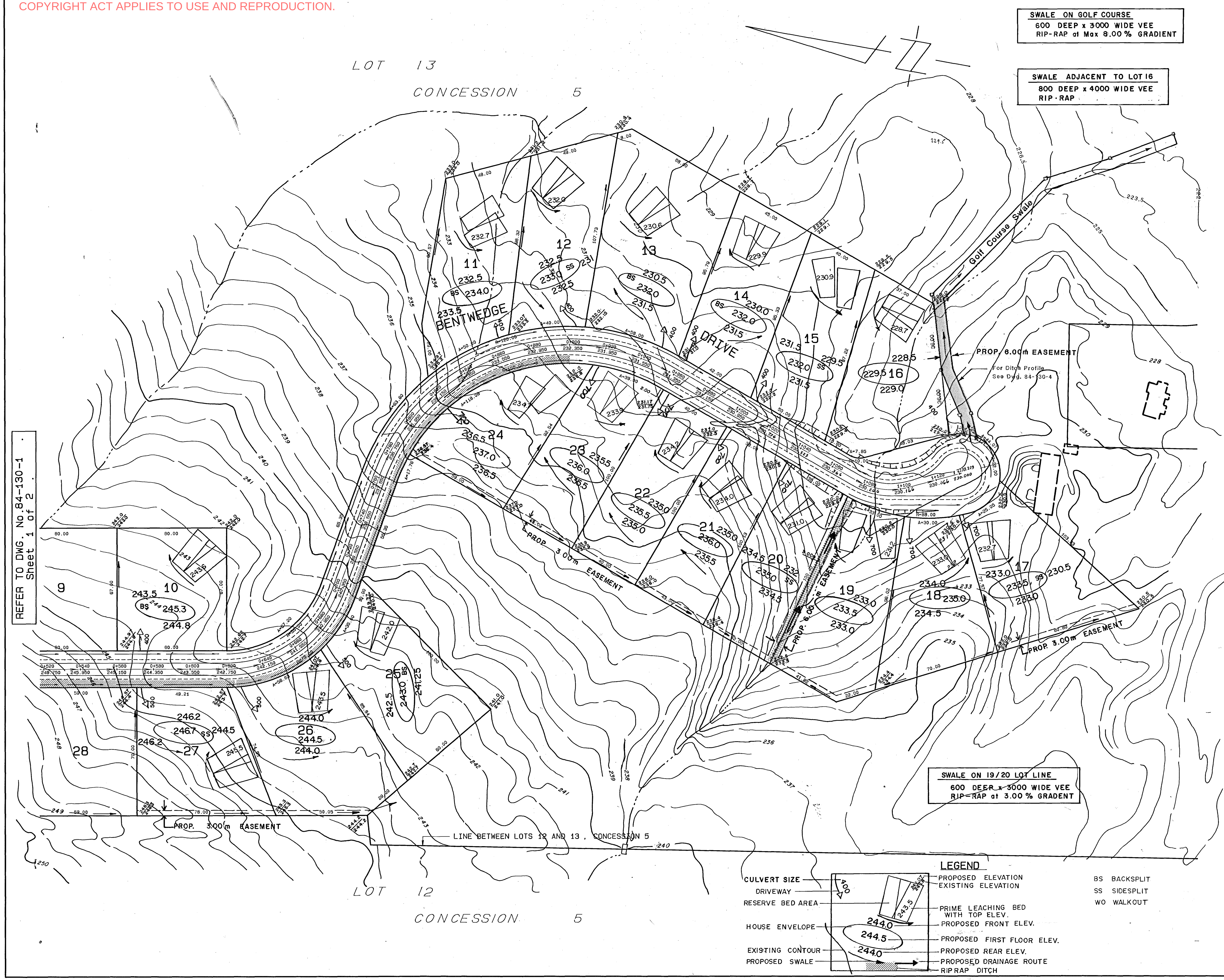
TOWNSHIP OF WEST GWILLIMBURY

SCALE 0 10 20 40 80 metres

GENERAL PLAN OF ROAD AND LOT GRADING

Andrew Brodie Associates Inc.
Consulting Engineers Thornhill, Ontario

DESIGNED BY: AFB & BRW	DATE: SEPT, 1984	DRAWN BY: K.K.C.
CHECKED BY: K.D.M.		
SCALES HORIZONTAL: 1: 1000		DWG.NO. 84-130-1 Sheet 1 of 2



REVISIONS

NO.	DESCRIPTION	BY	DATE
1	Revision to Road & Lot Grades and Outlet Ditch Alignment.	M.G.	Feb. '85
2.	as built culvert sizes	AB	17/12/90

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   300mm COMPACTED DEPTH M.T.C. GRANULAR "B" SUB-BASE
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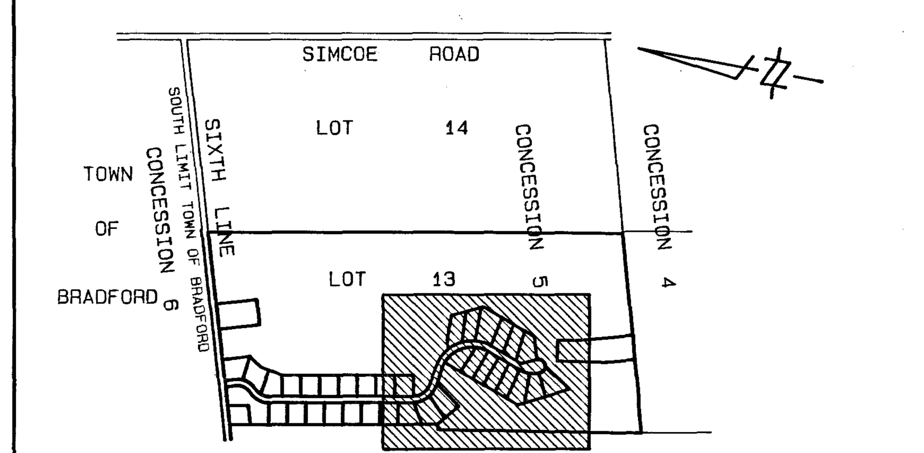
KEY PLAN



REFERENCE DRAWING

DWG NO.	DESCRIPTION

CLIENT

ISLINGTON INVESTMENTS LIMITED

B. R. WHITEHEAD
DESIGNED BY
DATE OCTOBER 11 1984

APPROVED BY TOWNSHIP OF WEST GWILLIMBURY ENGINEER
W. J. BURNS P. ENG.
DATE DECEMBER 11 1984

FILE 84-130 | PLAN 51 M 221

TOWNSHIP OF WEST GWILLIMBURY

SCALE 0 10 20 40 80 metres

GENERAL PLAN
OF ROAD AND LOT GRADING

Andrew Brodie Associates Inc.
Consulting Engineers Thornhill, Ontario

DESIGNED BY: AFB & BRW	DATE: SEPT, 1984	DRAWN BY: P.B.S.
CHECKED BY: K.D.M.	Rev. Mar. 1985 Golfcourse swale and road grades	
SCALES HORIZONTAL: 1: 1000		DWG.NO. 84-130-1 Sheet 2 of 2

1. This drawing is the exclusive property of R J Burnside & Associates Limited and the reproduction of any part without prior written consent of this office is strictly prohibited
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project

No.	Issue / Revision	Date
0	ISSUED FOR TENDER	APRIL 25, 2008

6th LINE RECONSTRUCTION

BURNSIDE
R.J. Burnside & Associates Limited
15 Townline, Orangeville, Ontario L9W 3R4
telephone (519) 941-5331 fax (519) 941-8120
web www.rjburnside.com

Client
TOWN OF BRADFORD WEST GWILLIMBURY
P.O. BOX 160
BRADFORD, ONTARIO
L3Z 2A8

Drawing Title
PLAN AND PROFILE
6th LINE
0+375 to 0+700

Drawn By	Checked	Designed By	Checked	Drawing No
D.C.M. / B.J.	G.E.C.	B.J.	G.E.C.	P6
Scale 1:500 H 1:50 V		Project No M1292.1		Rev 0

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3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

No.	Issue / Revision	Date
0	ISSUED FOR TENDER	APRIL 25, 2008

6th LINE RECONSTRUCTION

BURNSIDE
R. J. Burnside & Associates Limited
15 Townline, Orangeville, Ontario L9W 3R4
telephone (519) 941-5331 fax (519) 941-8120
web www.rjburnside.com

Client
TOWN OF BRADFORD WEST GWILLIMBURY
P.O. BOX 160
BRADFORD, ONTARIO
L3Z 2A8

Drawing Title
PLAN AND PROFILE
6th LINE
0+700 to 1+025

Drawn By	Checked	Designed By	Checked	Drawing No
D.C.M. / B.J.	G.E.C.	B.J.	G.E.C.	P7

Scale 1:500 H 1:50 V
Project No M1292.1
Rev 0

No.	Issue / Revision	Date
0	ISSUED FOR TENDER	APRIL 25, 2008

6th LINE RECONSTRUCTION

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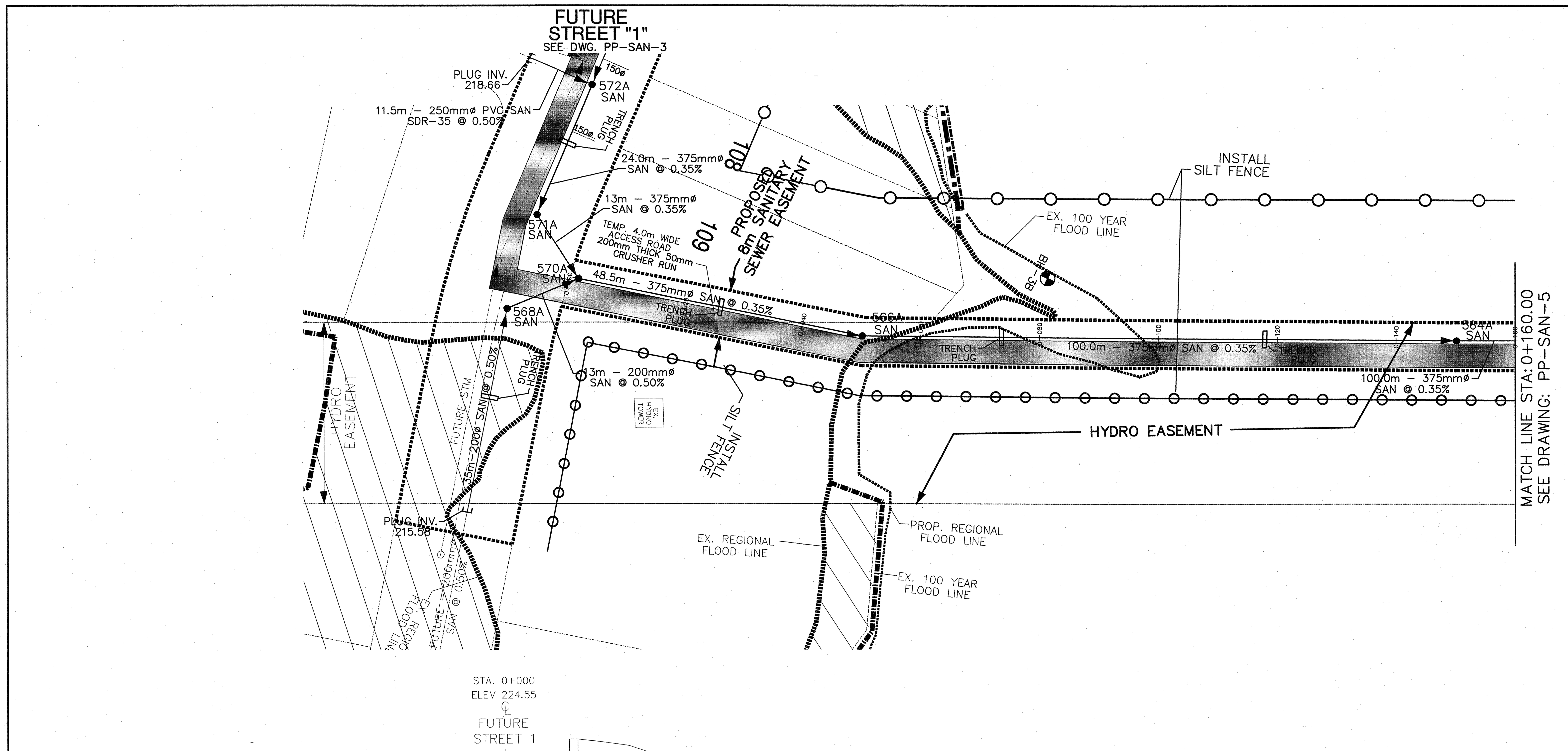
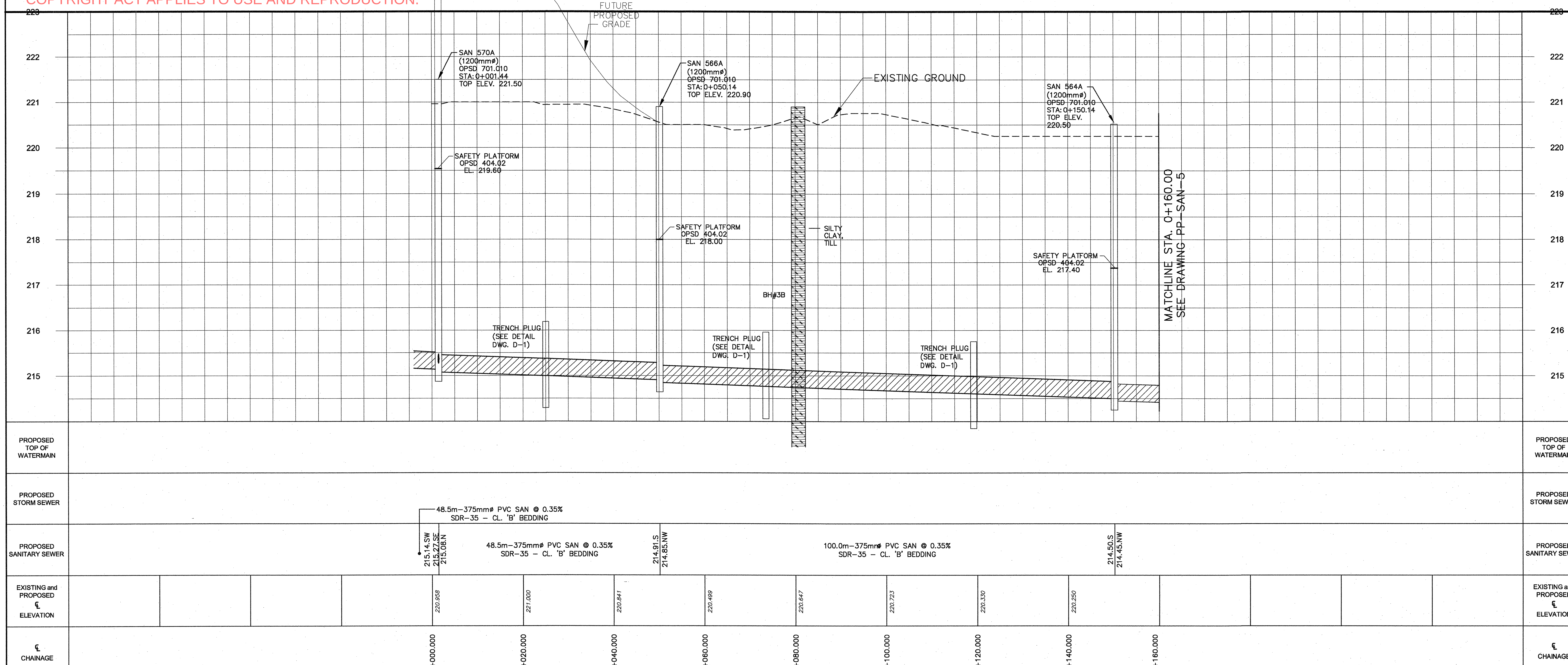
Client
TOWN OF BRADFORD WEST GWILLIMBURY
P.O. BOX 160
BRADFORD, ONTARIO
L3Z 2A8

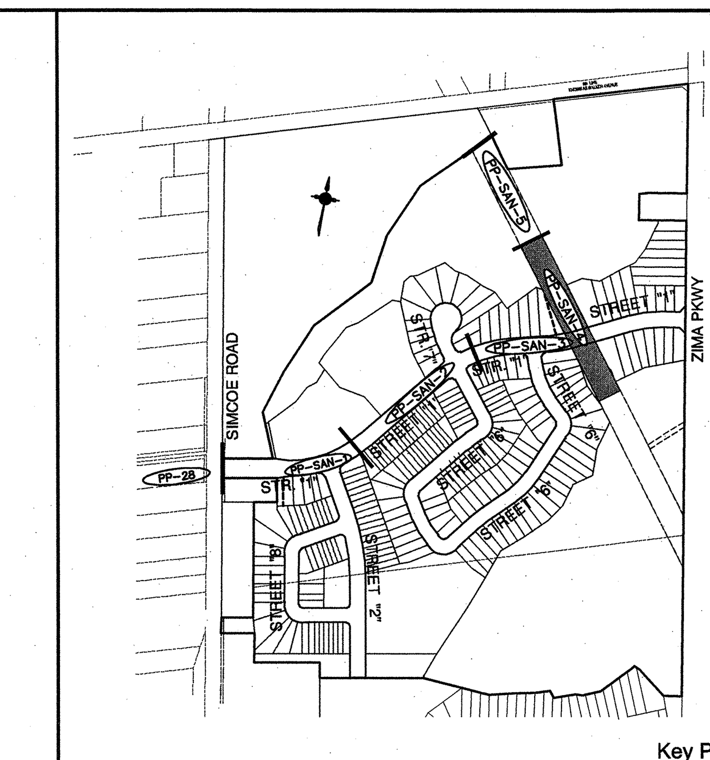
Drawing Title
PLAN AND PROFILE
6th LINE
0+050 to 0+375

Drawn By	Checked	Designed By	Checked	Drawing No
D.C.M. / B.J.	G.E.C.	B.J.	G.E.C.	P5
Scale 1:500 H 1:50 V		Project No M1292.1		Rev 0



NOTE:
- SILT FENCE TO BE INSTALLED 20m NORTH AND WEST OF SANITARY SEWER EASEMENT PRIOR TO ANY WORKS COMMENCING
- ADDITIONAL SILT FENCE TO BE INSTALLED 5m NORTH AND EAST OF THE SANITARY SEWER EASEMENT THROUGH THE HYDRO CORRIDOR
- TOPSOIL WITHIN EASEMENT AREA PLUS ADDITIONAL 10m AREA TO BE WINDROWED ALONG THE NORTH AND WEST SIDES OF THE SEWER TRENCH FOR THE DURATION OF THE WORKS
- UPON COMPLETION OF THE WORKS, TOPSOIL IS TO BE REINSTATED ON TO ALL DISTURBED AREAS
- SILT FENCE TO REMAIN IN PLACE UNTIL DISTURBED AREA HAS RE-VEGETATED





LEGEND

232.55 ×	PROPOSED ELEVATION
232.43 ×	EXISTING ELEVAITON
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m - 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
—X —X —	1.2m BLACK VINYL CHAINLINK FENCE
—X□ —X□ —	1.5m BLACK VINYL CHAINLINK FENCE
—Z—Z—Z—	1.8m PRIVACY FENCE
—X□X—	ACOUSTIC FENCE
	SILT FENCE

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
Aug 19/15
DATE

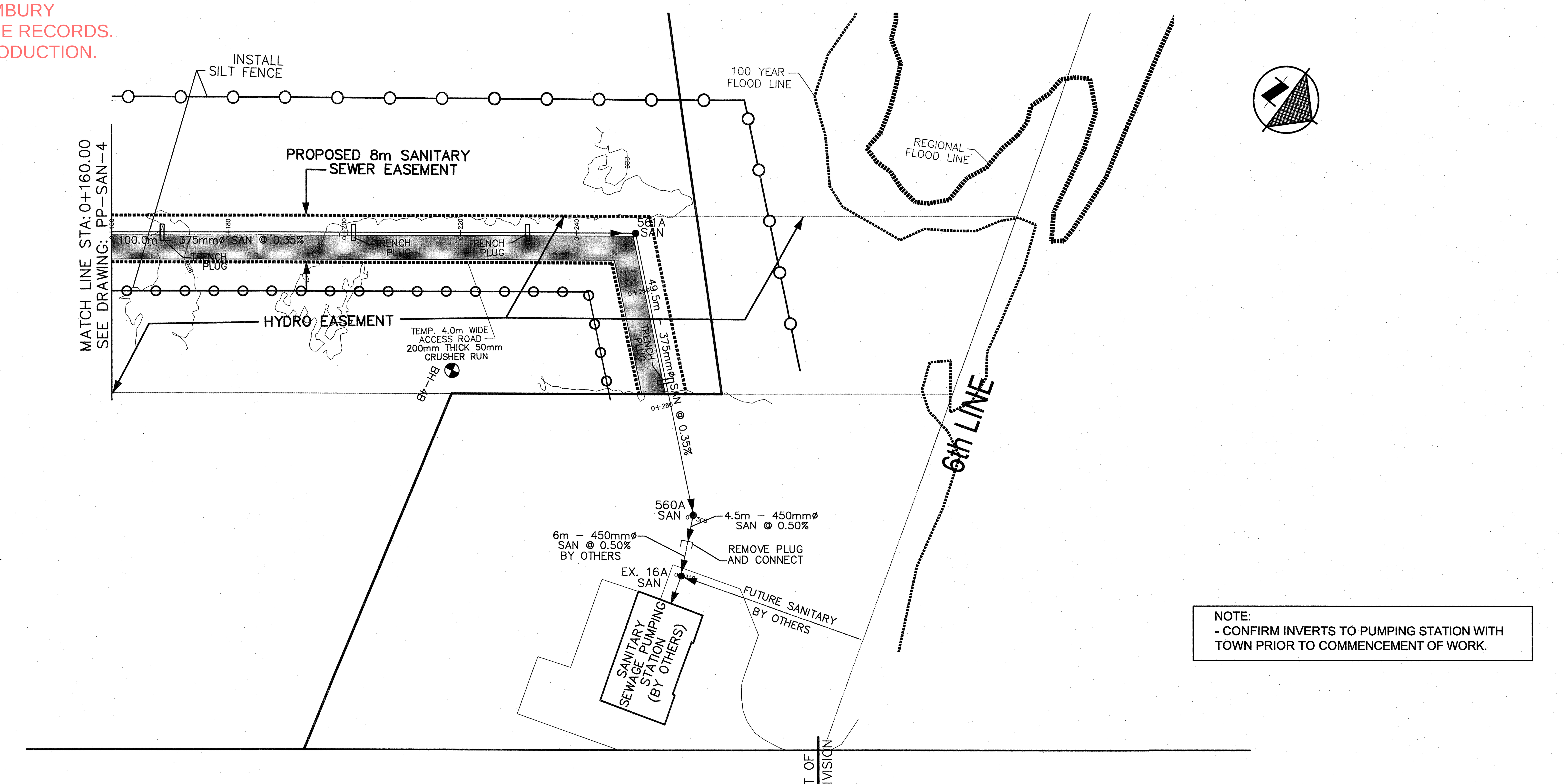
Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856-0629
f. (905)856-0698

BRADFORD CAPITAL HOLDINGS INC.
EXTERNAL SANITARY EASEMENT
FROM STA. 0+000.00 TO STA. 0+160.00

Surveyed by: P.E.		Checked by: R.S.		Project No. 08017
Drawn by: V.T.		Approved by: R.S.		
Designed by: D.J.S.		Date: APRIL 4, 2014		Drawing No. PP-SAN-4
Scale Horz. 1:500 Vert. 1:50	0m 10m 20m / 0m 1m 2m			Sheet No. - OF -

ID - P:\2008\08017-BRADFORD-WEST\PLAN PROFILES\08017 - PPSAN1 TO PPSAN5.dwg - Fri, 10 Jul 2015 - 11:53



NOTE:
- SILT FENCE TO BE INSTALLED 20m NORTH AND WEST OF SANITARY SEWER EASEMENT PRIOR TO ANY WORKS COMMENCING
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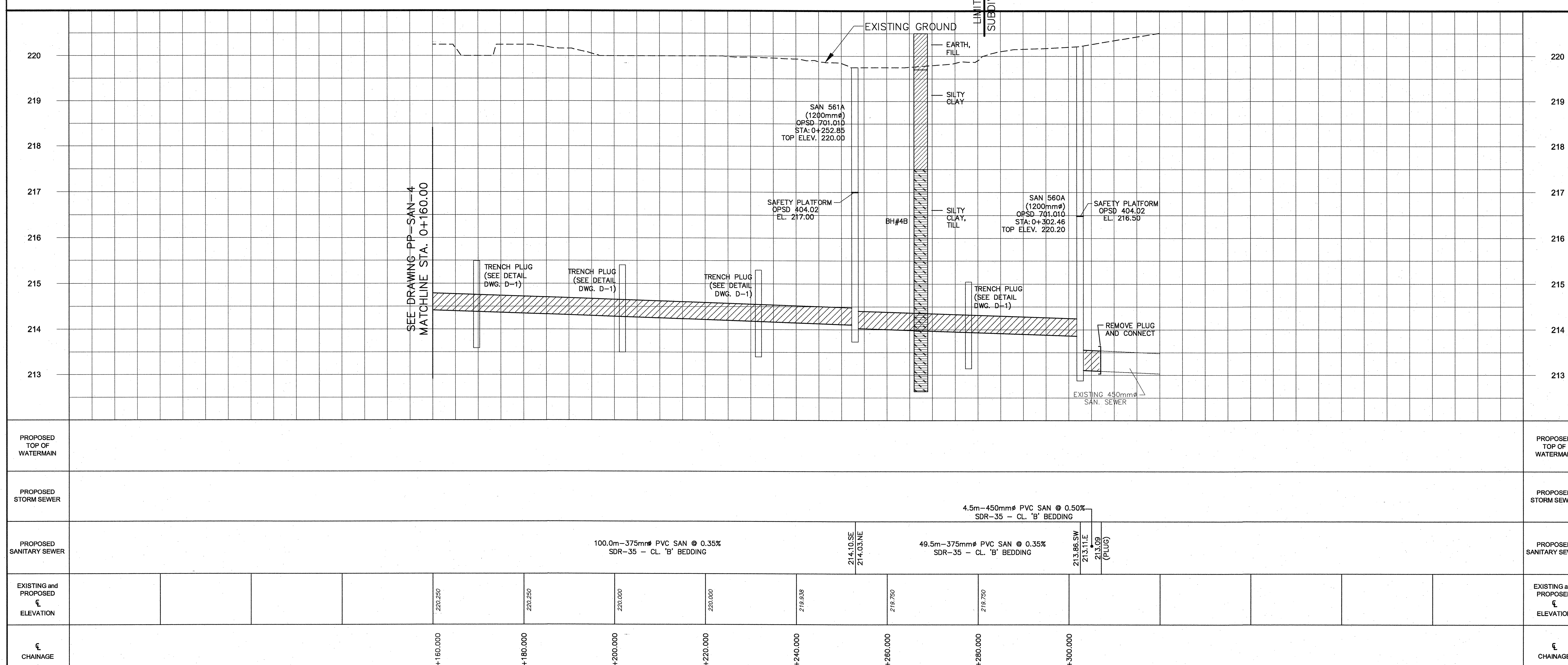
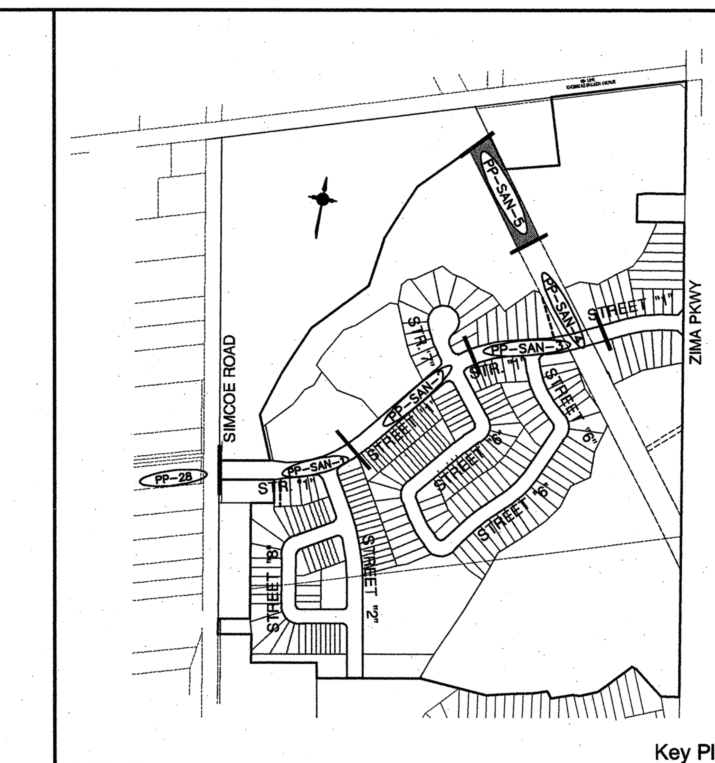
- SILT FENCE TO REMAIN IN PLACE UNTIL DISTURBED AREA HAS RE-VEGETATED

NOTE:
- CONFIRM INVERTS TO PUMPING STATION WITH TOWN PRIOR TO COMMENCEMENT OF WORK.





LEGEND

232.55	PROPOSED ELEVATION
232.43	EXISTING ELEVAITON
WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W ℄ P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m - 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
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XO	1.5m BLACK VINYL CHAINLINK FENCE
Z	1.8m PRIVACY FENCE
XOX	ACOUSTIC FENCE
	SILT FENCE

No.	Revision	Date	By	App'd
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1	1st SUBMISSION	APRIL 14/14	RS	

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CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
Aug 19/15
DATE

Bradford west Gwillimbury

URBAN ECOSYSTEMS LIMITED
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WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856-0629
f. (905)856-0698
UEL

BRADFORD CAPITAL HOLDINGS INC.
EXTERNAL SANITARY EASEMENT
FROM STA. 0+160.00 TO STA. 0+306.50

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. PP-SAN-5
Scale Horz. 1:500 Vert. 1:50	0m 10m 20m / 0m 1m 2m	Sheet No. - OF -

ID - P:\A2008\08017-BRADFORD-WEST\PLAN PROFILES\08017 - PPSAN1 TO PPSAN5.dwg - Fri, 10 Jul 2015 - 11:05

ROAD BASE THICKNESS

2.50m GRAVEL MAINTENANCE ACCESS
– TOWN STD. B111 (MODIFIED)

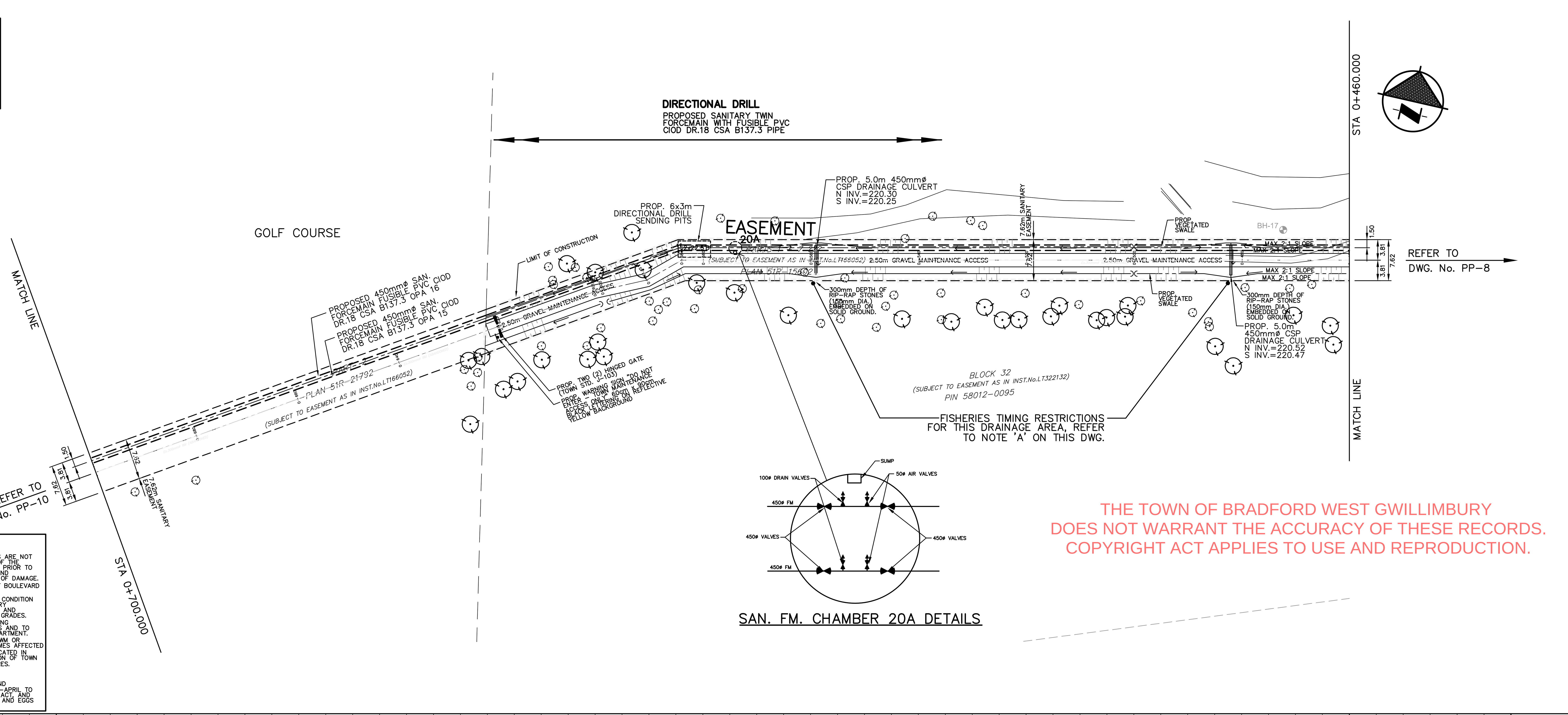
350mm OF 19mmø CRUSHER–RUN LIMESTONE
(REFER TO TYPICAL SECTION ON DWG. SEC–8)

NOTES:

A. ALL CONSTRUCTION ACTIVITIES OCCURRING ON DRAINAGE AREAS NOTED ON THIS DWG. SHOULD BE COMPLETED IN ACCORDANCE WITH WARM WATER FISHERIES TIMING RESTRICTIONS AS FOLLOWS: NO IN WATER WORK BETWEEN APRIL 1ST AND JUNE 30TH IN ANY GIVEN YEAR.

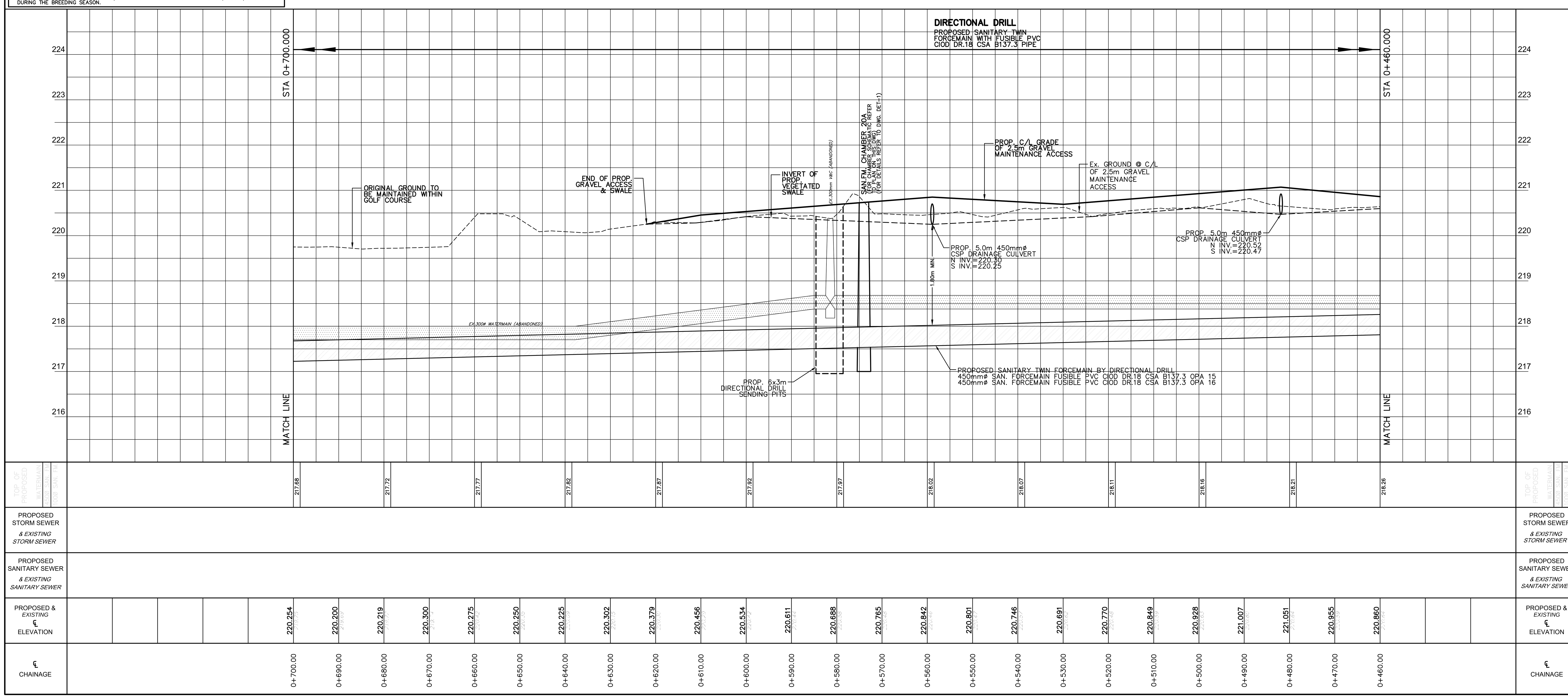
NOTES:

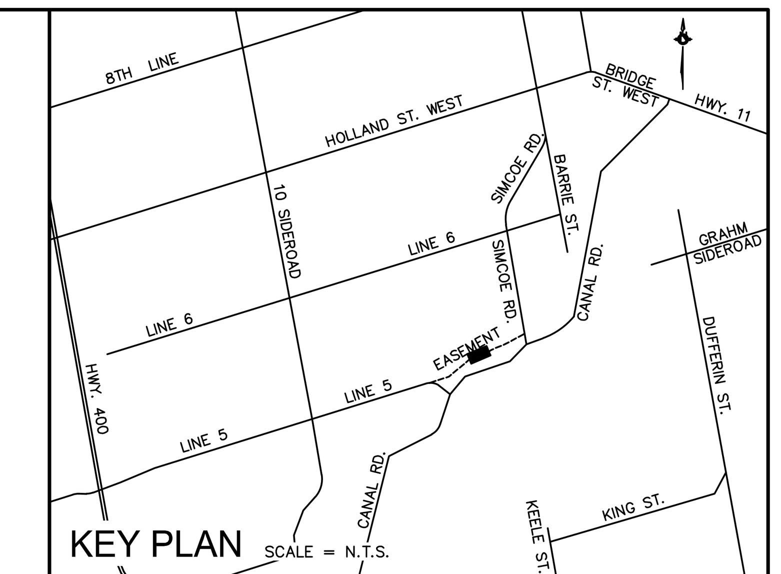
1, MINIMIZE ANY DISTURBANCE IN GOLF COURSE, ANY DAMAGE SHALL BE REPLACED AT CONTRACTOR'S OWN COSTS
2, ALL WORKS WITHIN GOLF COURSE MUST BE COMPLETED BEFORE SPRING 2016



NOTES:

1. THE LOCATION OF ALL UNDERGROUND AND ABOVEGROUND UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON CONTRACT DRAWINGS, AND WHERE SHOWN THE ACCURACY OF THE LOCATION AND ELEVATION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. PRIOR TO COMMENCING CONSTRUCTION THE CONTRACTOR SHALL VERIFY THE EXACT LOCATION AND ELEVATION OF SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITIES OF DAMAGE.
2. REFER TO LANDSCAPE DWGs. L–101 TO L–104 FOR SIMCOE RD., LINE 5 & EASEMENT BOULEVARD RESTORATION DETAIL (100mm TOPSOIL & SEEDING MIX),
3. ALL OTHER AREAS DISTURBED DURING CONSTRUCTION TO BE RESTORED TO ORIGINAL CONDITION OR BETTER AND TO THE SATISFACTION OF THE TOWN OF BRADFORD WEST GWILLIMBURY ENGINEERING DEPARTMENT. GRASSED AREAS SHALL BE TOPPED WITH 100mm TOPSOIL AND SODDED AS PER OPSD–218.01. ALL EX. SERVICES SHALL BE ADJUSTED TO SUIT NEW GRADES.
4. THE LOCATION OF PROPOSED SANITARY AND WATER SERVICE CONNECTIONS TO EXISTING PROPERTIES SHALL BE DETERMINED IN THE FIELD IN CONSULTATION WITH THE OWNERS AND TO THE SATISFACTION OF THE TOWN OF BRADFORD WEST GWILLIMBURY ENGINEERING DEPARTMENT.
5. Ex. 300mmø WM TO REMAIN IN SERVICE DURING CONSTRUCTION OF PROP. 300mmø WM OR TEMPORARY WATER SERVICE TO BE INSTALLED TO MAINTAIN WATER FLOW TO ALL HOMES AFFECTED
6. LOCATION OF ALL SUMP PUMP OUTLETS INTO EXISTING DRAINAGE DITCHES TO BE LOCATED IN THE FIELD IN CONSULTATION WITH THE OWNERS AND REINSTATED TO THE SATISFACTION OF TOWN OF BRADFORD WEST GWILLIMBURY WITH PROPER SEDIMENT/EROSION CONTROL MEASURES. (IE. RIP–RAP OR SPLASH PAD).
7. FOR GENERAL NOTES REFER TO DWG. No. GN–1.
8. CONSTRUCTION ACTIVITIES INVOLVING THE REMOVAL OF VEGETATION (i.e. CLEARING AND GRUBBING) SHOULD BE RESTRICTED FROM OCCURRING BEGINNING APPROXIMATELY MID–APRIL TO APPROXIMATELY MID–JULY IN ACCORDANCE WITH THE MIGRATORY BIRDS CONVENTION ACT, AND THE MIGRATORY BIRDS REGULATIONS, TO AVOID IMPACTING MIGRATORY BIRDS, NESTS, AND EGGS DURING THE BREEDING SEASON.





LEGEND:

- EXISTING BELL / ROGERS PEDESTAL
- EXISTING HYDRO TRANSFORMER & PAD
- EXISTING UTILITY POLE WITH GUY WIRE
- EXISTING TRAFFIC POLE
- DENOTES EX. UTL. TO BE RELOCATED BY OTHERS
- EXISTING HYDRANT AND VALVE
- EXISTING VALVE CHAMBER
- EXISTING WATER BOX
- EXISTING GAS VALVE
- EXISTING CATCHBASIN
- EXISTING CATCHBASIN WITH ICD
- EXISTING DOUBLE CATCHBASIN
- IRON BAR
- STANDARD IRON BAR
- EXISTING SANITARY SEWER & MH
- EXISTING STORM SEWER & MH
- EXISTING WATERMAIN
- EXISTING CULVERT
- EXISTING FENCE
- EXISTING CURB
- EXISTING STREET SIGNS
- PROPOSED STORM SEWER & MANHOLE
- PROPOSED SANITARY SEWER & MANHOLE
- PROPOSED WATERMAIN
- PROPOSED CATCHBASIN
- PROPOSED DOUBLE CATCHBASIN
- DENOTES DITCH INLET CATCHBASIN WITH OPSD 403.010 HONEYCOMB GRATING
- DENOTES DOUBLE DITCH INLET CATCHBASIN WITH OPSD 403.010 HONEYCOMB GRATING
- DENOTES TWO DITCH INLET CATCHBASIN WITH 375ø PVC INTERCONNECTION PIPE
- PROPOSED 1.8x0.9m INLET STRUCTURE WITH HEAVY HONEYCOMB GRATING
- PROPOSED VALVE & CHAMBER
- PROPOSED VALVE & BOX
- PROPOSED HYDRANT AND VALVE
- PROPOSED CURB DEPRESSION
- PROPOSED LIGHT STANDARD
- PROPOSED SINGLE SANITARY SERVICE
- PROPOSED WATER SERVICE & VB
- PROPOSED SIDEWALK
- PROPOSED ASPHALT DRIVEWAY
- PROPOSED DRAINAGE CULVERT UNDER DRIVEWAY (TYP.)
- DENOTES LIMIT OF CONSTRUCTION
- DENOTES EXISTING TREE
- DENOTES EXISTING TREE (TO BE PROTECTED)
- DENOTES EXISTING TREE (TO BE REMOVED)
- DENOTES PROPOSED TREE
- DENOTES PROPOSED SHRUBS
- PROPOSED RETAINING WALL
- PROPOSED DITCH WITH SUBDRAIN AT BOTTOM
- DENOTES TEST HOLE
- DENOTES STREET SIGN

No.	Revision	Date	By	Appr'd
6	–ISSUED FOR CONSTRUCTION	JAN. 2016	C.Z.	
5	–ISSUED FOR TENDER	OCT. 2015	C.Z.	
4	–ISSUED FOR MOE SUBMISSION	AUG. 2015	C.Z.	
3	–ISSUED FOR LSRCA SUBMISSION	JUL. 2015	C.Z.	

Benchmarks

No.	Elevation	Description
00819848153	221.345	ELEVATIONS ARE GEODETIC AND ARE REFERRED TO MINISTRY TRANSPORTATION OF ONTARIO FIRST ORDER BENCHMARK 00819848153 HAVING AN ORTHOMETRIC ELEVATION OF 221.345 METRES. ELEVATIONS ARE REFERENCED TO THE CANADIAN GEODETIC VERTICAL DATUM OF 1928, 1978 ADJUSTMENT (CGVD–1928:1978). LOCATED AT CONCRETE AND STEEL BRIDGE CARRYING HWY 11 OVER HOLLAND RIVER, 1.6m SOUTH OF JUNCTION OF HWY 11 AND HWY 88 AND 58m NORTH OF ENTRANCE TO PAGE–ARNORD MARINA. TABLET IS SET HORIZONTALLY IN EAST FACE OF COPING, 10.7m EAST OF CENTRELINE OF HWY 11, 39cm NORTH OF SOUTHEAST CORNER OF BRIDGE AND 12cm BELOW TOP OF COPING.

CONSULTANT

LICENSED PROFESSIONAL ENGINEER
G.E. ACCARDI
2016.01.27
PROVINCE OF ONTARIO

ACCEPTED
TOWN OF BRADFORD
WEST GWILLIMBURY

SIGNATURE DATE

Bradford west Gwillimbury

ACCARDI SCHAEFFERS CONSULTING
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-5591 Fax: (905) 738-6875

SIMCOE ROAD
URBANIZATION AND FORCEMAINS
PLAN & PROFILE
EASEMENT
FROM STA. 0+460.00 TO 1+700.00

Surveyed by:	Checked by: G.E.A.	Project No. 2014 - 4060
Drawn by: C.Z.	Approved by: P.S.	
Designed by: M.N.	Date: MAY 2014	Drawing No. PP - 9
Scale Horz. 1:500 Vert. 1:50	0m 10m 20m / 0m 1m 2m	Sheet No. 38 - OF - 114

ROAD BASE THICKNESS

2.50m GRAVEL MAINTENANCE ACCESS – TOWN STD. B111 (MODIFIED)

350mm OF 19mmø CRUSHER–RUN LIMESTONE (REFER TO TYPICAL SECTION ON DWG. SEC–8)

NOTES:

A. ALL CONSTRUCTION ACTIVITIES OCCURRING ON DRAINAGE AREAS NOTED ON THIS DWG. SHOULD BE COMPLETED IN ACCORDANCE WITH WARM WATER FISHERIES TIMING RESTRICTIONS AS FOLLOWS: NO IN WATER WORK BETWEEN APRIL 1ST AND JUNE 30TH IN ANY GIVEN YEAR.

NOTES:

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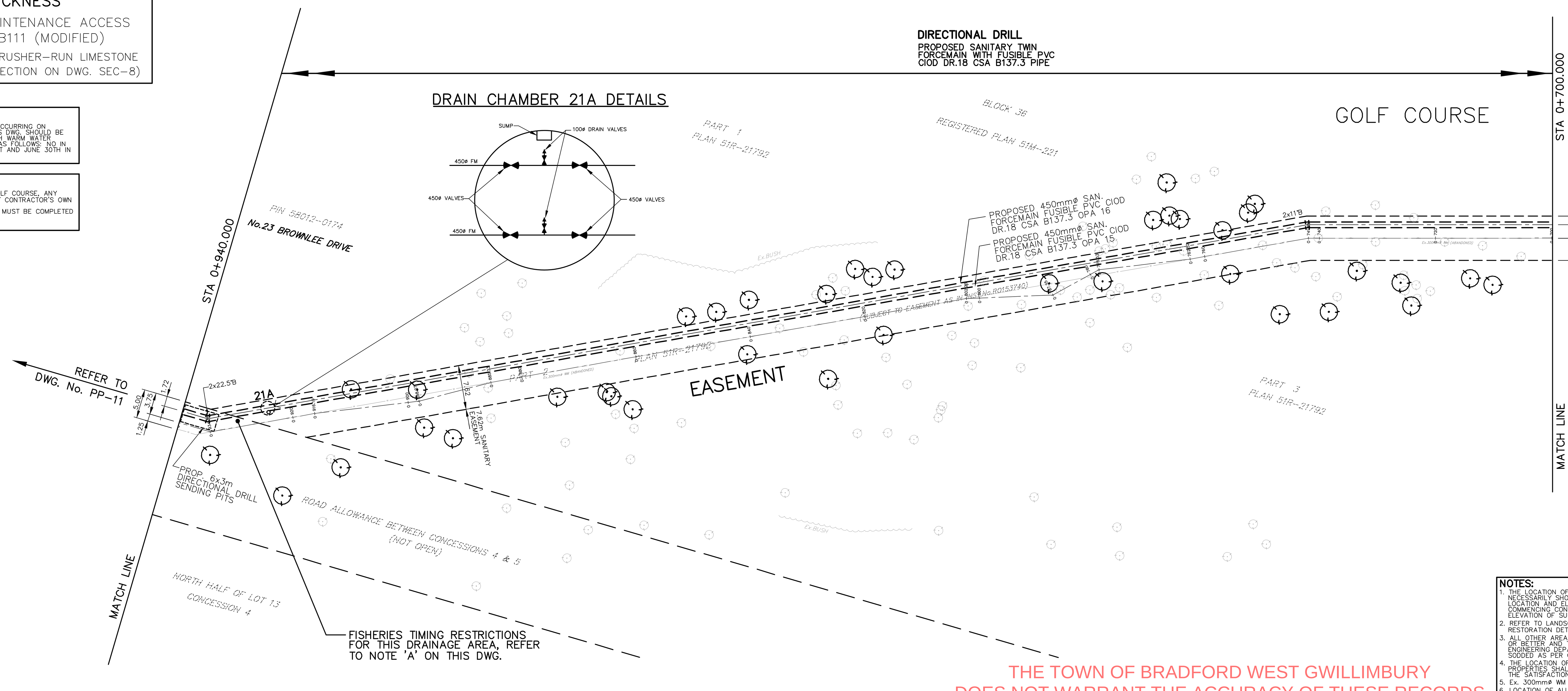

NOTES:

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3. ALL OTHER AREAS DISTURBED DURING CONSTRUCTION TO BE RESTORED TO ORIGINAL CONDITION OR BETTER AND TO THE SATISFACTION OF THE TOWN OF BRADFORD WEST GWILLIMBURY ENGINEERING DEPARTMENT. GRASSED AREAS SHALL BE TOPPED WITH 100mm TOPSOIL AND SODDED AS PER OPSD–218.01. ALL EX. SERVICES SHALL BE ADJUSTED TO SUIT NEW GRADES.
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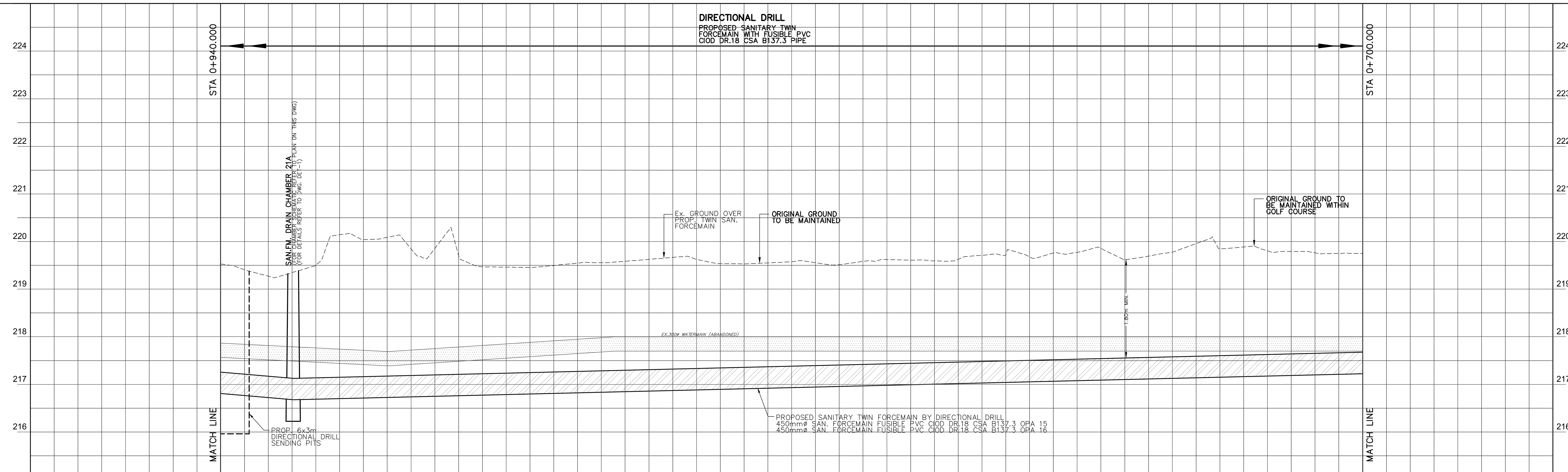
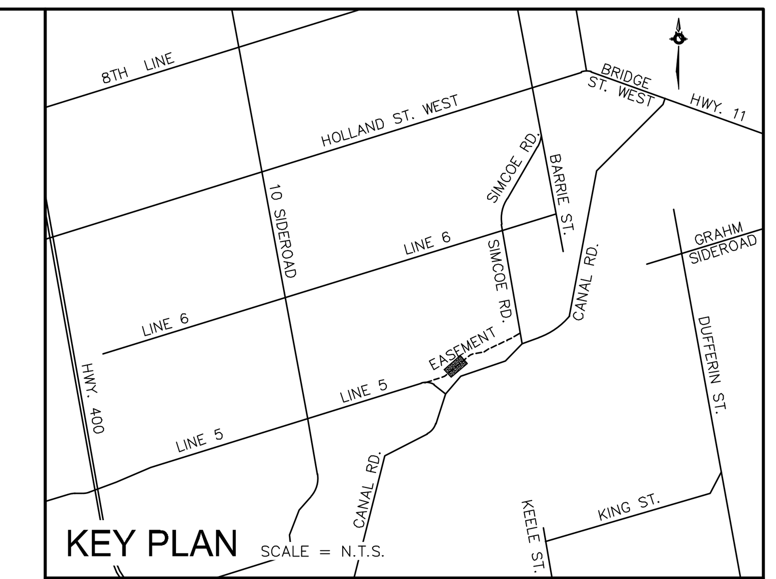
5. Ex. 300mmø WM TO BE REMAIN IN SERVICE DURING CONSTRUCTION OF PROP. 300mmø WM.
6. LOCATION OF ALL SUMP PUMP OUTLETS INTO EXISTING DRAINAGE DITCHES TO BE LOCATED IN THE FIELD IN CONSULTATION WITH THE OWNERS AND REINSTATED TO THE SATISFACTION OF TOWN OF BRADFORD WEST GWILLIMBURY WITH PROPER SEDIMENT/EROSION CONTROL MEASURES. (IE. RIP–RAP OR SPLASH PAD).
7. FOR GENERAL NOTES REFER TO DWG. No. GN–1.



CHAINAGE	TOP OF PROPOSED WATERMAIN / 450ø SAN. FM / 100ø SAN. FM	PROPOSED STORM SEWER & EXISTING STORM SEWER	PROPOSED SANITARY SEWER & EXISTING SANITARY SEWER	PROPOSED & EXISTING ℄ ELEVATION
0+940.00	217.26			219.693
0+930.00				219.800
0+920.00	217.14			219.720
0+910.00				219.691
0+900.00	217.19			219.661
0+890.00				219.632
0+880.00	217.24			219.668
0+870.00				219.704
0+860.00	217.29			219.739
0+850.00				219.775
0+840.00	217.33			219.811
0+830.00				219.891
0+820.00	217.38			219.971
0+810.00				220.091
0+800.00	217.43			219.970
0+790.00				219.897
0+780.00	217.48			219.823
0+770.00				219.750
0+760.00	217.53			219.759
0+750.00				219.768
0+740.00	217.58			219.884
0+730.00				220.000
0+720.00	217.63			220.100
0+710.00				220.200
0+700.00	217.68			220.254



LEGEND:

- EXISTING BELL / ROGERS PEDESTAL
- EXISTING HYDRO TRANSFORMER & PAD
- EXISTING UTILITY POLE WITH GUY WIRE
- EXISTING TRAFFIC POLE
- DENOTES EX. UTL. TO BE RELOCATED BY OTHERS
- EXISTING HYDRANT AND VALVE
- EXISTING VALVE CHAMBER
- EXISTING WATER BOX
- EXISTING GAS VALVE
- EXISTING CATCHBASIN
- EXISTING CATCHBASIN WITH ICD
- EXISTING DOUBLE CATCHBASIN
- IRON BAR
- STANDARD IRON BAR
- EXISTING SANITARY SEWER & MH
- EXISTING STORM SEWER & MH
- EXISTING WATERMAIN
- EXISTING CULVERT
- EXISTING FENCE
- EXISTING CURB
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- PROPOSED VALVE & BOX
- PROPOSED HYDRANT AND VALVE
- PROPOSED CURB DEPRESSION
- PROPOSED LIGHT STANDARD
- PROPOSED SINGLE SANITARY SERVICE
- PROPOSED WATER SERVICE & VB
- PROPOSED SIDEWALK
- PROPOSED ASPHALT DRIVEWAY
- PROPOSED DRAINAGE CULVERT UNDER DRIVEWAY (TYP.)
- DENOTES LIMIT OF CONSTRUCTION
- DENOTES EXISTING TREE
- DENOTES EXISTING TREE (TO BE PROTECTED)
- DENOTES EXISTING TREE (TO BE REMOVED)
- DENOTES PROPOSED TREE
- DENOTES PROPOSED SHRUBS
- PROPOSED RETAINING WALL
- PROPOSED DITCH WITH SUBDRAIN AT BOTTOM
- DENOTES TEST HOLE
- DENOTES STREET SIGN

No.	Revision	Date	By	Appr'd
7	–ISSUED FOR CONSTRUCTION	JAN. 2016	C.Z.	
6	–REVISED PER LSRCA COMMENTS	NOV. 2015	C.Z.	
5	–ISSUED FOR TENDER	OCT. 2015	C.Z.	
4	–ISSUED FOR MOE SUBMISSION	AUG. 2015	C.Z.	

Benchmarks

No.	Elevation	Description
00819848153	221.345	ELEVATIONS ARE GEODETIC AND ARE REFERRED TO MINISTRY TRANSPORTATION OF ONTARIO FIRST ORDER BENCHMARK 00819848153 HAVING AN ORTHOMETRIC ELEVATION OF 221.345 METRES. ELEVATIONS ARE REFERENCED TO THE CANADIAN GEODETIC VERTICAL DATUM OF 1928, 1978 ADJUSTMENT (CGVD–1928:1978). LOCATED AT CONCRETE AND STEEL BRIDGE CARRYING HWY 11 OVER HOLLAND RIVER, 1.6m SOUTH OF JUNCTION OF HWY 11 AND HWY 88 AND 58m NORTH OF ENTRANCE TO PAGE–ARNORD MARINA. TABLET IS SET HORIZONTALLY IN EAST FACE OF COPING, 10.7m EAST OF CENTRELINE OF HWY 11, 39cm NORTH OF SOUTHEAST CORNER OF BRIDGE AND 12cm BELOW TOP OF COPING.

CONSULTANT

LICENSED PROFESSIONAL ENGINEER
G.E. ACCARDI
2016.01.27
PROVINCE OF ONTARIO

ACCEPTED
TOWN OF BRADFORD WEST GWILLIMBURY

SIGNATURE DATE

Bradford west Gwillimbury

ACCARDI SCHAEFFERS CONSULTING
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-5591 Fax: (905) 738-6875

SIMCOE ROAD URBANIZATION AND FORCEMAINS
PLAN & PROFILE
EASEMENT
FROM STA. 0+700.00 TO 1+940.00

Surveyed by:		Checked by:	G.E.A.
Drawn by:	C.Z.	Approved by:	P.S.
Designed by:	M.N.	Date:	MAY 2014

Scale: Horz. 1:500, Vert. 1:50

Project No. 2014 - 4060

Drawing No. PP - 10

Sheet No. 39 - OF - 114

Appendix B-2 Geotechnical Report Excerpts

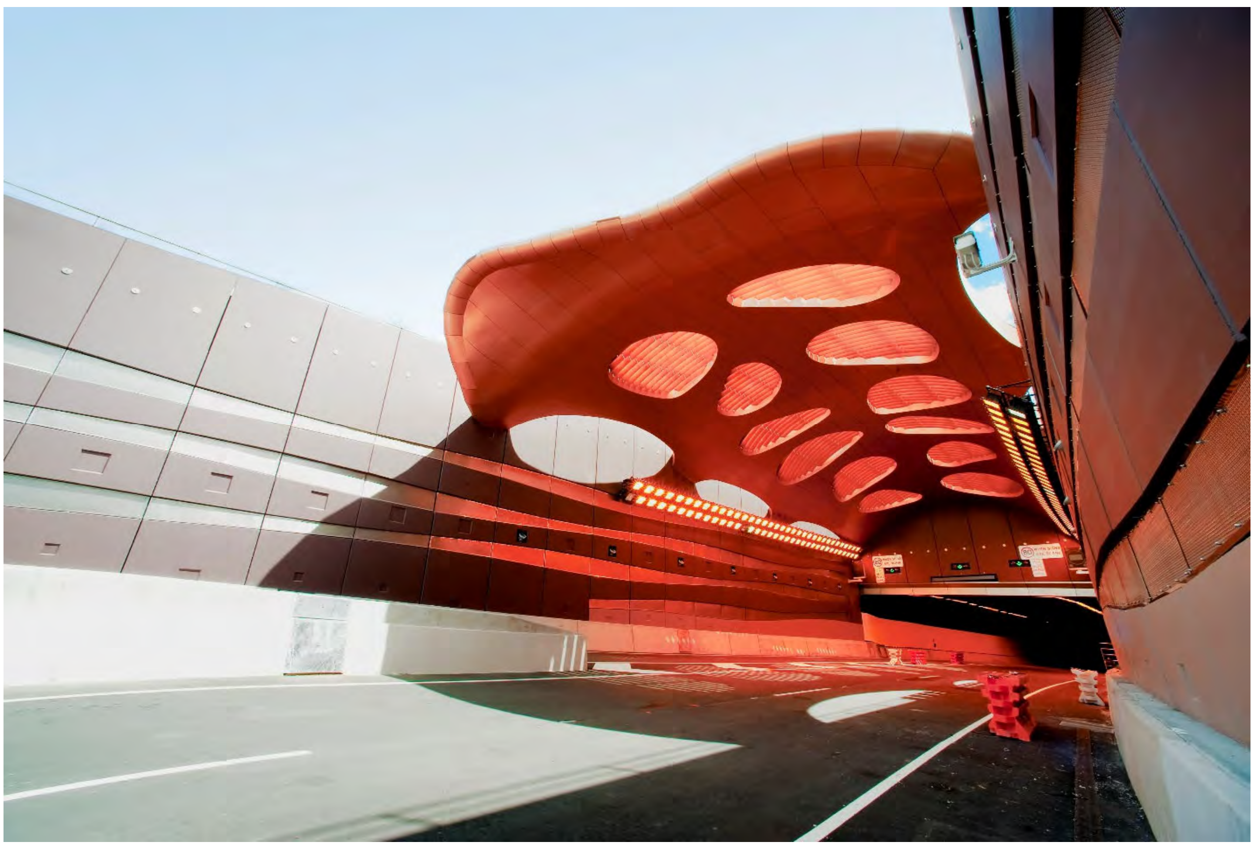
SCS consulting group ltd

BRADFORD HIGHLANDS JOINT VENTURE

PRELIMINARY GEOTECHNICAL INVESTIGATION- BRADFORD HIGHLANDS GOLF COURSE REDEVELOPMENT, BRADFORD, ONTARIO

AUGUST 02, 2023

FINAL



4 SUBSURFACE CONDITIONS

Based on the OGS Earth Quaternary Geology GIS map of Ontario issued by Ministry of Northern Development and Mines, the Site is situated within coarse-textured glaciolacustrine deposits consisting of sand, gravel including minor silt and clay, foreshore and basinal deposits; and till consisting of sandy silt to silty sand textured till on paleozoic terrain.

Based on the results of the field investigation, the subsurface conditions at the borehole locations generally comprised a topsoil overlying cohesive deposit (silty clay to clay and silt) and the cohesive deposit is underlain by a glacial till (clayey sandy silt to clayey silty sand and sand and silt) and non-cohesive deposit (silty sand to sand).

For details of the subsurface conditions encountered at the borehole locations, reference should be made to the individual borehole log sheets presented in **Borehole Log - *Appendix A*** and the associated laboratory test results in ***Appendix B***. The properties of the soil types encountered at the boreholes are described briefly in the following sections.

4.1 TOPSOIL

Topsoil was encountered in each of the boreholes advanced within the property boundary. The recorded approximate topsoil thicknesses at the borehole locations are summarized in **Table 4.1** below.

Table 4.1 Topsoil Thickness

BOREHOLE NO	APPROX. TOPSOIL THICKNESS (mm)	BOREHOLE NO	APPROX. TOPSOIL THICKNESS (mm)
BH22-01	500	BH22-10	400
BH22-02	400	BH22-11	450
BH22-03	500	BH22-12	600
BH22-04	300	BH22-13	510
BH22-05	450	BH22-14	510
BH22-06	450	BH22-15	410
BH22-07	250	BH22-16	200
BH22-08	300	BH22-17	300
BH22-09	450	BH22-18	610

It should be noted that topsoil quantities should not be calculated from the borehole information, as large variations in depth may exist between boreholes. A detailed topsoil layer thickness survey is required to determine an accurate evaluation of quantity.

4.2 COHESIVE DEPOSITS - SILTY CLAY TO CLAY AND SILT

Native cohesive deposits were encountered in all of the boreholes beneath the topsoil except boreholes BH22-05 and BH22-16. These cohesive deposits ranged between brown to grey silty clay to clay and silt with trace to some sand and trace gravel. The in-situ water contents of this deposit were variable and ranged between drier than the plastic limit to wetter than the plastic limit. The cohesive deposit extended to depths ranging between 2.1 mbgs and 5.5 mbgs. The native cohesive deposits were generally interlayered with the glacial till encountered at the site.

The measured SPT 'N' values in the cohesive deposits ranged between 4 blows to greater than 50 blows per 0.3 m of penetration, suggestive of a soft to hard consistency. The natural moisture contents, as determined by laboratory tests, ranged approximately from 10% to 13%.

Three (3) laboratory particle size distribution analyses were conducted on selected samples obtained from the cohesive deposits. Test results are provided in **Table 4.2**, according to the Unified Soil Classification System (USCS), and are shown on the borehole logs in ***Appendix A***. The particle size distribution curves are provided in ***Appendix B***.

Table 4.2 Grain Size Distribution for cohesive deposits

BOREHOLE NO.	SAMPLE NO.	DEPTH (mbgs)	SOIL DESCRIPTION	GRAIN SIZE DISTRIBUTION			
				% GRAVEL	% SAND	% SILT	% CLAY
BH22-4	SS6	4.6-5.1	Sandy silt and clay, trace gravel	7.9	25.9	66.2	
BH22-08	SS4	2.3-2.8	Clay and silt, some sand, trace gravel	1.6	11	37.9	49.5
BH22-13	SS3	1.5-1.9	Sandy clayey Silt, trace gravel	3.5	27.5	38.1	30.9
BH22-17	SS3	1.5-1.9	Silty clay, trace sand	0.0	0.8	32.5	66.7

Three Atterberg Limit tests were carried out on the above-noted samples from borehole BH22-08, BH22-13, and BH22-17. The results are summarized in **Table 4.3** and are shown on the borehole logs in ***Appendix A***. A plasticity chart with the test results is provided in ***Appendix B***.

Table 4.3 Atterberg Limits for cohesive deposits

BOREHOLE NO.	SAMPLE NO	DEPTH (mbgs)	SOIL DESCRIPTION	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)
BH22-08	SS4	2.3-2.8	Clay and silt, some sand, trace gravel	26	16	10
BH22-13	SS3	1.5-1.9	Sandy clayey Silt, trace gravel	20	13	7
BH22-17	SS3	1.5-1.9	Silty clay, trace sand	30	18	12

4.3 GLACIAL TILL

A variable glacial till was encountered in all boreholes except BH22-07 and BH22-08. The till was generally interlayered with the non-cohesive and cohesive deposits. The till ranged between brown to grey non-cohesive till (sand and silt to sandy silt with some clay and trace gravel) to cohesive till (clayey sandy silt to clayey silty sand with some sand and trace gravel). The water contents of this layer were variable from drier than the plastic limit to wetter than plastic limits. This deposit was encountered at a depth ranging between 2.8 mbgs and 5.5 mbgs and extended to depths ranging between 5.5 mbgs to 11.1 mbgs (termination depth in boreholes BH22-02, BH22-04, BH22-05, BH22-06, BH22-09, BH22-12, BH22-13, BH22-14, BH22-16, and BH22-17).

The measured SPT ‘N’ values in the non-cohesive till deposits ranged between 23 blows to greater than 50 blows per 0.3 m of penetration, indicating that the non-cohesive till deposits were generally compact to very dense.

The measured SPT ‘N’ values in the cohesive till deposits ranged between 15 blows to greater than 50 blows per 0.3 m of penetration, indicating of a very stiff to hard consistency.

The natural moisture contents, as determined by laboratory tests, ranged approximately from 7% to 22%.

Laboratory particle size distribution analyses were conducted on six selected samples obtained from the glacial till. Test results are provided in **Table 4.4**, according to the Unified Soil Classification System (USCS), and are shown on the borehole logs in ***Appendix A***. The particle size distribution curves are provided in ***Appendix B***.

Table 4.4 Grain Size Distribution for Glacial Till

BOREHOLE NO.	SAMPLE NO.	DEPTH (mbgs)	SOIL DESCRIPTION	GRAIN SIZE DISTRIBUTION			
				% GRAVEL	% SAND	% SILT	% CLAY
BH22-2	SS4	2.3-2.8	Clayey sandy silt, trace gravel	1.6	25.9	38.3	34.2
BH22-3	SS8	7.6-8.0	Sandy silt and clay till, trace gravel	3.8	27	34.5	34.7
BH22-5	SS5	3.1-3.4	Silty clay, trace sand, trace gravel	2.4	5	34.6	58
BH22-6	SS8	7.6-8.0	Clayey silt, some sand, trace gravel	1.8	17.2	48.1	32.9
BH22-12	SS4	2.9-2.8	Sand and silt, some clay, trace gravel	1.8	48.1	35.6	14.5
BH22-18	SS5	3.1-3.5	Clayey silty sand, trace gravel	2.9	42.1	34.9	20.1

Atterberg Limit testing was carried out on the above-noted samples from boreholes BH22-2, BH22-3, BH22-5, BH22-6, BH22-12 and BH22-18. The results are summarized in **Table 4.5** and are shown on the borehole logs in ***Appendix A.*** The results indicated that the sand and silt from BH22-12 was non-plastic, in accordance with the Canadian Foundation Engineering Manual (2006). A plasticity chart with the test results is provided in ***Appendix B***.

Table 4.5 Atterberg Limits for Glacial Till

BOREHOLE NO.	SAMPLE NO.	DEPTH (mbgs)	SOIL DESCRIPTION	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)
BH22-2	SS4	2.3-2.8	Clayey sandy silt, trace gravel	20	12	8
BH22-3	SS8	7.6-8.0	Sandy Silt and Clay till, , trace gravel	18	11	7
BH22-5	SS5	3.1-3.4	Silty clay, trace sand, trace gravel	26	16	10
BH22-6	SS8	7.6-8.0	Clayey silt, some sand, trace gravel	19	12	7
BH22-12	SS4	2.9-2.8	Sand and silt, some clay, trace gravel	NP	NP	NP
BH22-18	SS5	3.1-3.5	Clayey silty sand, trace gravel	16	12	4

4.4 NON-COHESIVE DEPOSITS – SILTY SAND TO SAND

A brown to grey native non-cohesive deposits were encountered below the topsoil, glacial till and silty clay in boreholes BH22-01, BH22-03, BH22-05, BH22-07, BH22-08, BH22-10, BH22-11, BH22-15, BH22-16 and BH22-18 respectively. This soil layer ranged between sandy silt and clay to sand material and generally moist to wet at the time of investigation. This soil layer was encountered at a depth ranging between 0.2 mbgs and 10.7 mbgs and extended to the depth ranging between 0.6 mbgs and termination depth in boreholes BH22-01, BH22-03, BH22-07, BH22-08, BH22-10, BH22-15, and BH22-18 respectively.

The measured SPT 'N' values in the non-cohesive deposits ranged from 8 blows to greater than 50 blows per 0.3 m of penetration, indicating that the non-cohesive deposits were generally loose to very dense. Based on the laboratory test, the natural moisture content of this non-cohesive deposits ranged between 7.0% and 24%.

Two (2) laboratory particle size distribution analyses were conducted on selected sample obtained from non-cohesive deposits. Test results are provided in **Table 4.6**, according to the Unified Soil Classification System (USCS), and are shown on the borehole logs in ***Appendix A***. The particle size distribution curves are provided in ***Appendix B***.

Table 4.6 Grain Size Distribution for non-cohesive deposits

BOREHOLE NO.	SAMPLE NO.	DEPTH (mbgs)	SOIL DESCRIPTION	GRAIN SIZE DISTRIBUTION			
				% GRAVEL	% SAND	% SILT	% CLAY
BH22-5	SS3	1.5-1.9	Sand, some silt and clay, trace gravel	6.3	73.9	19.8	

4.5 GROUNDWATER

Groundwater (free water) and caving were noted in some boreholes advanced at the site during the investigation immediately upon completion of drilling. Monitoring wells were installed in four boreholes. The groundwater levels in monitoring wells were recorded on April 26, 2022.

A summary of the groundwater levels measured in the monitoring wells installed at the site is provided below in **Table 4.7**; Minimum and maximum groundwater levels recorded in the monitoring wells, are indicated in **red** in the table below.

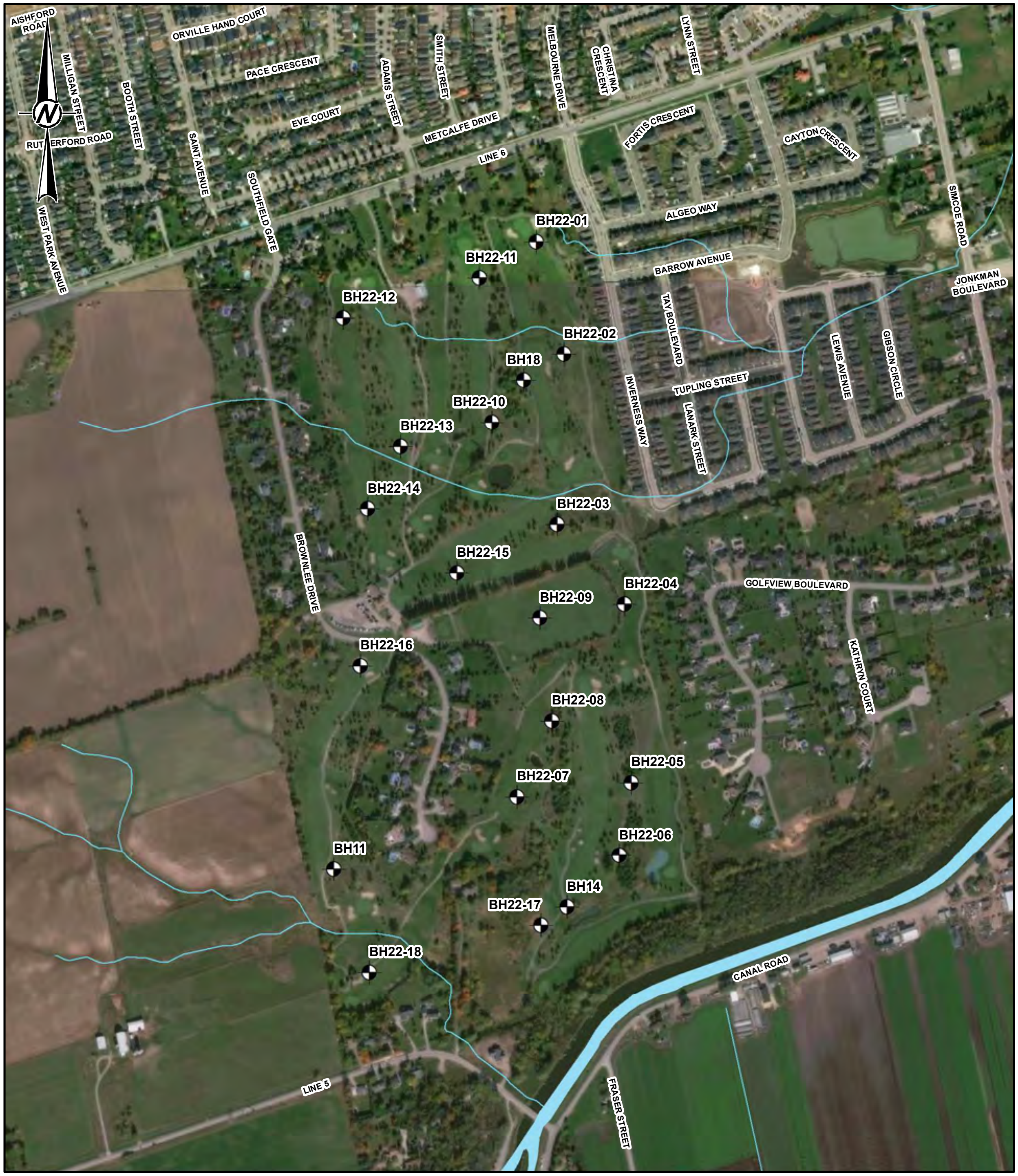
Table 4.7 Groundwater and Caving Observation

BOREHOLE	DATE	BH ELEVATION (masl)	GROUNDWATER DEPTH (mbgs)	GROUNDWATER ELEVATION (masl)	MEASUREMENT SOURCE
BH22-03	April 26, 2022	231.5	-	-	**Monitoring Well
BH22-05	April 26, 2022	224.0	**0.2**	223.8	Monitoring Well
BH22-06	April 26, 2022	220.7	0.3	220.4	Monitoring Well
BH22-09	April 26, 2022	231.6	0.9	230.7	Monitoring Well
*BH2	Dec 8, 2016	242.46	3.4	242.3	Monitoring Well
*BH3	Dec 8, 2016	242.56	3.4	241.9	Monitoring Well
*BH5	Dec 8, 2016	244.76	3.2	244.9	Monitoring Well
*BH8	Sep 23, 2016	234.42	1.5	235.1	Monitoring Well
*BH11	Dec 8, 2016	226.23	**4.4**	229.2	Monitoring Well
*BH14	Dec 8, 2016	218.88	0.2	220.2	Monitoring Well
*BH16	Dec 8, 2016	230.16	4.0	227.6	Monitoring Well
*BH18	Dec 8, 2016	236.05	1.3	235.7	Monitoring Well

** Groundwater level data from previous field investigation conducted in 2016.*
*** Water was at the top of casing and unable to read water level from monitoring well on April 26, 2022.*

It should be noted that the groundwater levels can vary between borehole locations and are subject to seasonal fluctuations in response to major weather events.

PATH: S:\Clients\Bradford_Highlands\Bradford_Highlands_Golfcourse\99_PROJ\22517668\40_PROD\0001_BoreholePlan\22517668-0001-HS-0001.mxd PRINTED ON: 2022-05-02 AT: 1:57:32 PM



LEGEND

- BOREHOLE
- WATERCOURSE
- WATERBODY

FINAL

0 250 500

1:10,000 METRES

REFERENCE(S)

1. BASEDATA OBTAINED FROM MRNF LIO 2020
2. BASE IMAGERY: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. PRO JECTION: TRANSVERSE MERCATOR DATUM : NAD 83 COORDINATE SYSTEM : UTM ZONE 17N

CLIENT
BRADFORD HIGHLANDS

PROJECT
BRADFORD HIGHLANDS GOLF COURSE
23 BROWNLEE DRIVE, BRADFORD, ONTARIO

TITLE
BOREHOLE LOCATION PLAN

CONSULTANT

WSP GOLDER

YYYY-MM-DD	2022-03-08
DESIGNED	SO
PREPARED	SO/DB
REVIEWED	FJ
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
22517668	0001	0.0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

25mm

0

LEGEND

- BOREHOLE LOCATION
- APPROXIMATE PHASE TWO BOUNDARY
- APPROXIMATE MNR NATURAL HERITAGE BOUNDARY

0 100 200

1:6,000 METRES

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015

PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2017

BOREHOLE LOCATION SURVEY: RADY-PENTEK & EDWARD SURVEYING LTD., JULY 28, 2016

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

BASE IMAGERY SOURCE: GOOGLE EARTH, 2015

CLIENT

BRADFORD HIGHLANDS JOINT VENTURE

PROJECT

PRELIMINARY GEOTECHNICAL INVESTIGATION
BRADFORD HIGHLANDS GOLF COURSE

TITLE

BOREHOLE LOCATION PLAN

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-02-13
PREPARED	SB
DESIGN	
REVIEW	NL
APPROVED	

PROJECT No.	Phase	Rev.	Figure
1543120	2000	AA	2

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm

wsp

LOG OF BOREHOLE BH22-01

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668

CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:

PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM

DATUM: UTM NAD , ZONE
Date: Mar-29-2022 to Mar-29-2022
COMPILED BY FJ

BH LOCATION: N 4883640 E 613921
Eqipment: Drill Tech Geoprobe 420M

SOIL PROFILE: (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.10	Ground Surface											
0.00	**TOPSOIL:** (500 mm)		1	SS	18		237					
236.60 / 0.50	**SILTY CLAY:** Brown to grey, trace gravel, cobble fragment, cohesive w<PL, stiff to hard. ---------------------- wet spon		2	SS	11		236					
			3	SS	10		235					
			4	SS	18		234					
			5	SS	34							
233.10 / 4.00	**SANDY CLAYEY SILT TILL:** Grey, trace gravel, cohesive w>PL, very stiff to hard.		6	SS	27		233, 232					
			7	SS	50/127mm		231					
230.10 / 7.00	**SILTY SAND:** Grey, some plastic fines, wet, very dense.		8	SS	61		230					

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity. ○ $^{\varepsilon}$=3% Strain at Failure

LOG OF BOREHOLE BH22-01

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-29-2022 to Mar-29-2022
COMPILED BY FJ
BH LOCATION: N 4883640 E 613921
Eqipment: Drill Tech Geoprobe 420M

(m) ELEV DEPTH	SOIL PROFILE – DESCRIPTION (Continued)	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P – NATURAL MOISTURE CONTENT W – LIQUID LIMIT W_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
229.00 / 8.10	**END OF BOREHOLE** Notes: 1). Upon completion of drilling, borehole had caved at 6.1 meter below ground surface (mbgs).						229					

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES +3, ×3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-02

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-29-2022 to Mar-29-2022
COMPILED BY FJ
BH LOCATION: N 4883457 E 613966
Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION	Sample NUMBER	TYPE	"N" BLOWS/0.3 m	Water Content (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
234.50	Ground Surface					
0.00	**TOPSOIL:** (400 mm)	1	SS	7		
234.10 / 0.40	**SILTY CLAY:** Brown, trace gravel, cohesive w<PL, soft to very stiff.	2	SS	3		
		3	SS	17		
		4	SS	31		2 26 38 34
231.60 / 2.90	**CLAYEY SANDY SILT TILL:** Brown to grey, trace sand, trace gravel, cohesive w<PL, hard. ---------------------- grey	5	SS	46		
		6	SS	46		
	---------------------- auger grinding noted at 6.1 m.	7	SS	50/100mm		
228.30 / 6.20	**END OF BOREHOLE**					

Notes:
1). Borehole was terminated due to auger refusal.
2). Upon completion of drilling, borehole had caved at 5.5 meters below ground surface (mbgs) and groundwater level was at approximately at 0.7 meters below ground surface (mbgs).

Chart headings: SOIL PROFILE; SAMPLES; STRATA PLOT; GROUND WATER CONDITIONS; ELEVATION (234, 233, 232, 231, 230, 229); DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3)

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

wsp

LOG OF BOREHOLE BH22-03

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision		REF. NO.: 22517668	
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger	ENCL NO.:	
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm	ORIGINATED BY	PM
DATUM: UTM NAD , ZONE	Date: Mar-24-2022 to Mar-24-2022	COMPILED BY	FJ
BH LOCATION: N 4883181 E 613955	Eqipment: Drill Tech Geoprobe 420M		

SOIL PROFILE

(m) ELEV DEPTH	DESCRIPTION
231.50	Ground Surface
0.00	**TOPSOIL:** (500 mm)
231.00 0.50	**SILTY CLAY:** Brown, cohesive w~PL, firm to very stiff. --------------------- wet spon --------------------- oxidizing staining
226.00 5.50	**SANDY SILT AND CLAY TILL:** Grey, trace gravel, cohesive w~PL, very stiff to hard.

SAMPLES

NUMBER	TYPE	"N" BLOWS/0.3 m	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	4	
2	SS	15	
3	SS	13	
4	SS	17	
5	SS	30	
6	SS	20	
7	SS	23	
8	SS	41	4 27 35 35

Column headings: STRATA PLOT; GROUND WATER CONDITIONS; ELEVATION (231, 230, 229, 228, 227, 226, 225, 224); DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20, 40, 60, 80, 100); PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) (10, 20, 30); POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3); REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL.

Depth scale (m): 1, 2, 3, 4, 5, 6, 7, 8

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-03

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-24-2022 to Mar-24-2022
COMPILED BY FJ
BH LOCATION: N 4883181 E 613955
Eqipment: Drill Tech Geoprobe 420M

(m) ELEV / DEPTH	SOIL PROFILE – DESCRIPTION (Continued)	SAMPLES NUMBER	TYPE	"N" BLOWS / 0.3 m	ELEVATION	WATER CONTENT (%)
	SANDY SILT AND CLAY TILL: Grey, trace gravel, cohesive w~PL, very stiff to hard.(Continued)				223	
9		9	SS	76	222	o
221.50 / 10.00	**SILTY SAND:** Grey, wet, very dense.				221	
220.63 / 10.87		10	SS	50/127mm		o
	END OF BOREHOLE					

Column headings: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L, WATER CONTENT (%) 10 20 30; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3); REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL; STRATA PLOT; GROUND WATER CONDITIONS.

Notes:
1). Upon completion of drilling, groundwater level was at approximately 0.30 meter below ground surface (mbgs).
2). A 50mm diameter monitoring well was installed with screens from 7.6 mbgs to 10.6 mbgs.

Water Level Reading:

Date	Depth (m bgs.)
April 26, 2022	Water was at the top of casing and unable to read water level from monitoring well

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-04

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-23-2022 to Mar-23-2022
COMPILED BY FJ
BH LOCATION: N 4883052 E 614065
Eqipment: Drill Tech Geoprobe 420M

SOIL PROFILE | SAMPLES | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) | SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30) | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m^3) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GR	SA	SI	CL
229.90	Ground Surface								
0.00	**TOPSOIL:** (300 mm)								
229.60 / 0.30	**SILTY CLAY:** Brown, cohesive w<PL, soft to very stiff.		1	SS	4				
			2	SS	9				
			3	SS	17				
227.77 / 2.13	**SANDY SILT AND CLAY :** Brown, trace gravel, cohesive w<PL, very stiff.		4	SS	19				
			5	SS	26				
			6	SS	26	8	26	(66)	
224.45 / 5.45	**CLAYEY SILT TILL:** Grey, trace sand, trace gravel, cohesive w<PL, very stiff to hard.		7	SS	40				
			8	SS	41				

Elevation scale: 229, 228, 227, 226, 225, 224, 223, 222
Depth scale: 1, 2, 3, 4, 5, 6, 7, 8

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-04

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-23-2022 to Mar-23-2022
COMPILED BY FJ
BH LOCATION: N 4883052 E 614065
Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION (Continued)	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT TILL: Grey, trace sand, trace gravel, cohesive w<PL, very stiff to hard.(Continued)							
9						221		
		9	SS	39				
10						220		
11		10	SS	28		219		
218.77 / 11.13	**END OF BOREHOLE**							

Notes:
1). Upon completion of drilling, groundwater level was at approximately 0.91 meter below ground surface (mbgs).

Column headings: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3); STRATA PLOT

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-05

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision | REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture | Method: Solid Stem Auger | ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario | Diameter: 152 mm | ORIGINATED BY PM
DATUM: UTM NAD , ZONE | Date: Mar-25-2022 to Mar-25-2022 | COMPILED BY FJ
BH LOCATION: N 4882763 E 614075 | Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
224.00	Ground Surface					
0.00	**TOPSOIL:** (450 mm)	1	SS	16	○	
223.55 / 0.45	**SAND:** Brown, some silt, trace to some gravel, cobble fragment, moist to wet, compact to dense.	2	SS	19	○	
		3	SS	21	○	6 74 (20)
		4	SS	39	○	
		5	SS	28	├○──┤	2 5 35 58
		6	SS	64	○	
218.50 / 5.50	**SILTY CLAY TILL:** Grey, trace gravel, trace sand, cohesive w<PL, very stiff to hard.	7	SS	30	○	
		8	SS	50/270mm	○	

Column headings: SOIL PROFILE; SAMPLES; GROUND WATER CONDITIONS; ELEVATION; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT W_L; WATER CONTENT (%) (10 20 30); POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3); STRATA PLOT.

Elevation: 223, 222, 221, 220, 219, 218, 217. Depth: 1, 2, 3, 4, 5, 6, 7, 8.

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-05

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-25-2022 to Mar-25-2022
COMPILED BY FJ
BH LOCATION: N 4882763 E 614075
Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION (Continued)	SAMPLE NUMBER	TYPE	"N" BLOWS / 0.3 m	ELEVATION	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY CLAY TILL: Grey, trace gravel, trace sand, cohesive w<PL, very stiff to hard.(Continued)						
9					215		
		9	SS	35		o (≈20)	
10					214		
213.13 / 10.87		10	SS	40		o (≈21)	
	END OF BOREHOLE						

Notes:
1). Upon completion of drilling, groundwater level was at approximately 0.30 meter below ground surface (mbgs).
2). A 50mm diameter monitoring well was installed with screens from 6.10mbgs to 9.14 mbgs.

Water Level Reading:

Date	Depth (m bgs.)
April 26, 2021	0.2

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100
PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L
WATER CONTENT (%) 10 20 30
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m^3)
STRATA PLOT
GROUND WATER CONDITIONS

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-06

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-29-2022 to Mar-29-2022
COMPILED BY FJ
BH LOCATION: N 4882644 E 614056
Eqipment: Drill Tech Geoprobe 420M

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.70	Ground Surface				
0.00	**TOPSOIL:** (450 mm)	1	SS	10	
220.25 0.45	**SILTY CLAY:** Brown to grey, cohesive w<PL to w>PL, soft to very stiff.	2	SS	7	
	---------------------- w>PL	3	SS	3	
	---------------------- no soil sample recovery	4	SS	15	
	---------------------- grey	5	SS	16	
		6	SS	7	
215.20 5.50	**CLAYEY SILT TILL:** Grey, some sand, trace gravel, cobbles fragment, cohesive w<PL, hard.	7	SS	56	
		8	SS	89	2 17 48 33

Column headings: STRATA PLOT; GROUND WATER CONDITIONS; ELEVATION (220, 219, 218, 217, 216, 215, 214, 213); DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT W_L, WATER CONTENT (%) (10 20 30); POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3)

Depth scale (m): 1, 2, 3, 4, 5, 6, 7, 8

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
$+^3, \times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision	REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture / Method: Solid Stem Auger	ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario / Diameter: 152 mm	ORIGINATED BY PM
DATUM: UTM NAD , ZONE / Date: Mar-29-2022 to Mar-29-2022	COMPILED BY FJ
BH LOCATION: N 4882644 E 614056 / Eqipment: Drill Tech Geoprobe 420M	

ELEV (m) / DEPTH	DESCRIPTION (Continued)	NUMBER	TYPE	"N" BLOWS/0.3 m	ELEVATION	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT TILL: Grey, some sand, trace gravel, cobbles fragment, cohesive w<PL, hard.(Continued)				212		
9		9	SS	50/127mm		○	
10					211		
209.78		10	SS	50/152mm	210	○	
10.92	**END OF BOREHOLE**						

Notes:
1). Upon completion of drilling, groundwater level was at approximately 1.5 meter below ground surface (mbgs).
2). A 50mm diameter monitoring well was installed with screens from 7.62 mbgs to 10.67 mbgs.

Water Level Reading:

Date	Depth (m bgs.)
April 26, 2021	0.3

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-07

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-23-2022 to Mar-23-2022
COMPILED BY FJ
BH LOCATION: N 4882740 E 613889
Eqipment: Drill Tech Geoprobe 420M

(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m	Natural moisture content (%) (approx.)
229.10	Ground Surface				
228.85 / 0.00	**TOPSOIL:** (250 mm)				
0.25	**SILTY CLAY:** Brown, trace sand, trace gravel, cobble fragment, cohesive w~PL, firm to hard.	1	SS	6	~21
	--------------------- wet spon	2	SS	7	~21
		3	SS	17	~17
		4	SS	20	~14
		5	SS	38	~15
225.10 / 4.00	**SILTY SAND:** Brown, trace gravel, rock fragments, moist, very dense.	6	SS	50/152mm	~10
	--------------------- no soil sample recovery	7	SS	50/25mm	
221.41 / 7.69	**END OF BOREHOLE**	8	SS	50/25mm	

Notes:

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

Column headings: STRATA PLOT; GROUND WATER CONDITIONS; ELEVATION (229–222); DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3); REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

LOG OF BOREHOLE BH22-07

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision		REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger	ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm	ORIGINATED BY PM
DATUM: UTM NAD , ZONE	Date: Mar-23-2022 to Mar-23-2022	COMPILED BY FJ
BH LOCATION: N 4882740 E 613889	Eqipment: Drill Tech Geoprobe 420M	

SOIL PROFILE: (m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	1). Upon completion of drilling, borehole had caved at 5.4 meter below ground surface (mbgs).											

WSP-SOIL-ROCK-MAY-29-2017_FROM STCATHERINES.GLB
WSP SOIL LOG 2DIG 13.05.2022-FJ-BH LOGS-221-02423-00 -BRADFORD HOLLAND.GPJ 5-16-22

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-08

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668

CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:

PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM

DATUM: UTM NAD , ZONE
Date: Mar-24-2022 to Mar-24-2022
COMPILED BY FJ

BH LOCATION: N 4882862 E 613947
Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
228.10	Ground Surface					
0.00	**TOPSOIL:** (300 mm)					
227.80 / 0.30	**CLAY AND SILT:** Brown to grey, some sand, trace gravel, cohesive w<PL, firm to hard.	1	SS	6		
		2	SS	7		
		3	SS	15		
		4	SS	29		2 11 38 50
		5	SS	34		
224.10 / 4.00	**SILTY SAND:** Grey, trace gravel, moist to wet, very dense.					
		6	SS	97		
		7	SS	50/101mm		
220.35		8	SS	50		
7.75	**END OF BOREHOLE**					

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH (kPa): ○ UNCONFINED; + FIELD VANE & Sensitivity; ● QUICK TRIAXIAL; × LAB VANE — 20 40 60 80 100
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30
POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3)
ELEVATION: 228, 227, 226, 225, 224, 223, 222, 221

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GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-08

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision | REF. NO.: 22517668

CLIENT: Bradford Highlands Joint Venture | Method: Solid Stem Auger | ENCL NO.:

PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario | Diameter: 152 mm | ORIGINATED BY PM

DATUM: UTM NAD , ZONE | Date: Mar-24-2022 to Mar-24-2022 | COMPILED BY FJ

BH LOCATION: N 4882862 E 613947 | Eqipment: Drill Tech Geoprobe 420M

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION Continued	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION					
	Notes: 1). Upon completion of drilling, borehole had caved at 4.2 meter below ground surface (mbgs) and groundwater was at approximate depth of 1.8 mbgs.											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision | REF. NO.: 22517668

CLIENT: Bradford Highlands Joint Venture | Method: Solid Stem Auger | ENCL NO.:

PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario | Diameter: 152 mm | ORIGINATED BY PM

DATUM: UTM NAD , ZONE | Date: Mar-23-2022 to Mar-23-2022 | COMPILED BY FJ

BH LOCATION: N 4883030 E 613927 | Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	ELEVATION	WATER CONTENT (%)
231.60	Ground Surface					
0.00	**TOPSOIL:** (450 mm)	1	SS	4		~24
231.15 / 0.45	**SILTY CLAY:** Brown, trace sand, trace organics, cohesive w<PL, firm.				231	
		2	SS	4		~23
					230	
		3	SS	6		~28
		4	SS	8		~19
					229	
		5	SS	17		~10
					228	
227.60 / 4.00	**CLAYEY SILT TILL:** Brown to grey, trace sand, trace gravel, cohesive w<PL to w~PL, very stiff to hard.					
		6	SS	34	227	
					226	
		7	SS	24		~12
					225	
					224	
		8	SS	28		~13

Column headings: SOIL PROFILE; SAMPLES; GROUND WATER CONDITIONS; ELEVATION; DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m³); REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3 , × 3 : Numbers refer to Sensitivity ○ ε=3% Strain at Failure

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision — REF. NO.: 22517668

CLIENT: Bradford Highlands Joint Venture — Method: Solid Stem Auger — ENCL NO.:

PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario — Diameter: 152 mm — ORIGINATED BY PM

DATUM: UTM NAD , ZONE — Date: Mar-23-2022 to Mar-23-2022 — COMPILED BY FJ

BH LOCATION: N 4883030 E 613927 — Eqipment: Drill Tech Geoprobe 420M

(m) ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m	ELEVATION	WATER CONTENT (%)	REMARKS
	Continued **CLAYEY SILT TILL:** Brown to grey, trace sand, trace gravel, cohesive w<PL to w~PL, very stiff to hard.(Continued)				223		
9		9	SS	50/101mm	222	~10	
10					221		
220.80 / 10.80	**END OF BOREHOLE**	10	SS	50/127mm		~13	

Chart headings: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH (kPa): O UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20, 40, 60, 80, 100); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10, 20, 30; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3); REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL; STRATA PLOT; GROUND WATER CONDITIONS.

Notes:
1). A 50mm diameter monitoring well was installed with screens from 7.62 mbgs to 10.67 mbgs.

Water Level Reading:

Date	Depth (m bgs.)
April 26, 2021	0.9

LOG OF BOREHOLE BH22-10

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-26-2022 to Mar-26-2022
COMPILED BY FJ
BH LOCATION: N 4883347 E 613849
Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	ELEVATION
238.30	Ground Surface				
0.00	**TOPSOIL:** (400 mm)	1	SS	10	238
237.90 / 0.40	**SILTY CLAY:** Brown to grey, trace gravel, cohesive w~PL, stiff to hard.	2	SS	19	237
	---------------------- wet	3	SS	26	
		4	SS	24	236
235.46 / 2.84	**SANDY CLAYEY SILT TILL:** Grey, trace gravel, cobbles fragment, cohesive w<PL, hard.	5	SS	15	235
	---------------------- grey	6	SS	50/127mm	234
232.80 / 5.50	**SAND:** Grey, trace silt, cobbles fragment, wet, dense to very dense.	7	SS	60	233, 232
230.32		8	SS	35	231

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED; + FIELD VANE & Sensitivity; ● QUICK TRIAXIAL; × LAB VANE — 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-10

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-26-2022 to Mar-26-2022
COMPILED BY FJ
BH LOCATION: N 4883347 E 613849
Eqipment: Drill Tech Geoprobe 420M

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
7.98	**END OF BOREHOLE** Notes: 1). Upon completion of drilling, borehole had caved at 7.01 meter below ground surface (mbgs) and groundwater level was at approximately 4.8 meter below ground surface (mbgs).											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

WSP-SOIL-ROCK-MAY-29-2017 FROM STCATHERINES.GLB WSP SOIL LOG 2022 13-05-2022 F-BH LOGS-221-05425-00 -BRADFORD HOLLAND.GPJ 5-16-22

LOG OF BOREHOLE BH22-11

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision | REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture | Method: Solid Stem Auger | ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario | Diameter: 152 mm | ORIGINATED BY PM
DATUM: UTM NAD , ZONE | Date: Mar-29-2022 to Mar-29-2022 | COMPILED BY FJ
BH LOCATION: N 4883581 E 613829 | Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	NATURAL MOISTURE CONTENT (approx. %)
241.90	Ground Surface				
241.90 / 0.00	**TOPSOIL:** (450 mm)	1	SS	6	
241.45 / 0.45	**SILTY CLAY:** Brown, trace gravel, cohesive w<PL, firm to very stiff.	2	SS	11	
		3	SS	14	
	------------------ w<PL	4	SS	26	
239.08 / 2.82	**SAND:** Brown, some silt, wet, dense to very dense.	5	SS	38	
		6	SS	50/127mm	
236.40 / 5.50	**SANDY CLAYEY SILT TILL:** Grey, cohesive w<PL, hard.	7	SS	50/101mm	
235.05 / 6.85	**SILTY SAND:** Brown, wet, very dense.	8	SS	50/152mm	
234.03 / 7.87	**END OF BOREHOLE**				

Other column headings: STRATA PLOT; GROUND WATER CONDITIONS; ELEVATION (241, 240, 239, 238, 237, 236, 235); DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20, 40, 60, 80, 100); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (10, 20, 30); POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3); REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision		REF. NO.: 22517668	
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger	ENCL NO.:	
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm	ORIGINATED BY	PM
DATUM: UTM NAD , ZONE	Date: Mar-29-2022 to Mar-29-2022	COMPILED BY	FJ
BH LOCATION: N 4883581 E 613829	Eqipment: Drill Tech Geoprobe 420M		

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	Notes: 1). Upon completion of drilling, borehole had caved at 6.1 meter below ground surface (mbgs) and groundwater level was at approximately 1.5 meter below ground surface (mbgs).											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-12

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision | REF. NO.: 22517668

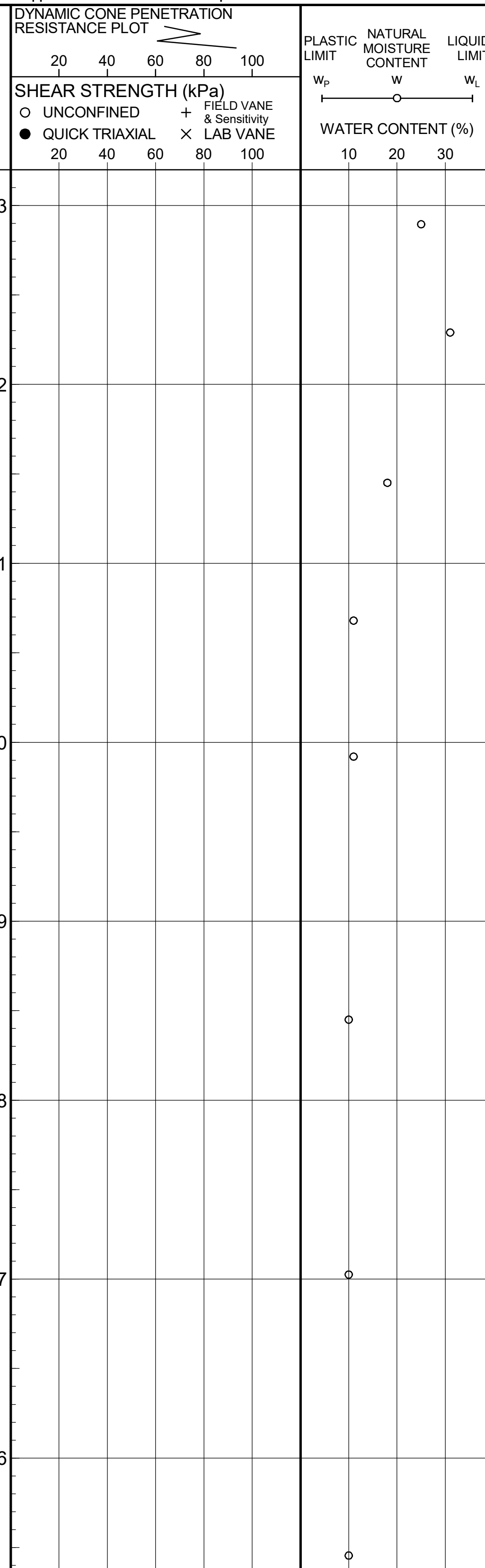
CLIENT: Bradford Highlands Joint Venture | Method: Solid Stem Auger | ENCL NO.:

PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario | Diameter: 152 mm | ORIGINATED BY PM

DATUM: UTM NAD , ZONE | Date: Mar-28-2022 to Mar-28-2022 | COMPILED BY FJ

BH LOCATION: N 4883516 E 613608 | Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS / 0.3 m	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
213.20	Ground Surface				
0.00	**TOPSOIL:** (600 mm)	1	SS	5	
212.59 / 0.61	**SILTY CLAY:** Brown, cohesive w~PL, firm to stiff.	2	SS	7	
	wet spon	3	SS	11	
		4	SS	17	2 48 36 15
		5	SS	25	
209.20 / 4.00	**SAND AND SILT TILL:** Brown, some clay, trace gravel, moist, compact to very dense.	6	SS	36	
		7	SS	50/152mm	
		8	SS	50/101mm	
205.33 / 7.87	**END OF BOREHOLE**				



Column headings: GROUND WATER CONDITIONS; ELEVATION; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m³)

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision		REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger	ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm	ORIGINATED BY PM
DATUM: UTM NAD , ZONE	Date: Mar-28-2022 to Mar-28-2022	COMPILED BY FJ
BH LOCATION: N 4883516 E 613608	Eqipment: Drill Tech Geoprobe 420M	

SOIL PROFILE: (m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH (kPa): O UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	Notes: 1). Upon completion of drilling, groundwater level was at approximately 1.5 meter below ground surface (mbgs).											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity

O ε=3% Strain at Failure

LOG OF BOREHOLE BH22-13

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-28-2022 to Mar-28-2022
COMPILED BY FJ
BH LOCATION: N 4883307 E 613701
Eqipment: Drill Tech Geoprobe 420M

(m) ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	WATER CONTENT (%) (natural moisture content w)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
241.60	Ground Surface					
0.00	**TOPSOIL:** (510 mm)	1	SS	5		
241.09 / 0.51	**SANDY CLAYEY SILT:** Brown, trace gravel, cohesive w~PL, firm to very stiff.	2	SS	23		
		3	SS	19		4 28 38 31
		4	SS	27		
		5	SS	37		
237.60 / 4.00	**CLAYEY SILT TILL:** Brown, trace sand, trace gravel, cohesive w<PL, very stiff to hard.	6	SS	32		
		7	SS	31		
233.90 / 7.70	no soil sample recovery	8	SS	50/139mm		
	END OF BOREHOLE					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-13

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-28-2022 to Mar-28-2022
COMPILED BY FJ
BH LOCATION: N 4883307 E 613701
Eqipment: Drill Tech Geoprobe 420M

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION					
	Continued											
	Notes: 1). Upon completion of drilling, borehole had caved at approximately 7.3 meter below ground surface (mbgs).											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-14

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision		REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture	Method: Solid Stem Auger	ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario	Diameter: 152 mm	ORIGINATED BY PM
DATUM: UTM NAD , ZONE	Date: Mar-25-2022 to Mar-25-2022	COMPILED BY FJ
BH LOCATION: N 4883207 E 613647	Eqipment: Drill Tech Geoprobe 420M	

SOIL PROFILE: (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION
242.80	Ground Surface						
0.00	**TOPSOIL:** (510 mm)		1	SS	5		
242.29 / 0.51	**SILTY CLAY:** Brown, trace rootlets, trace sand, cohesive w~PL, firm to stiff.		2	SS	4		242
			3	SS	13		241
			4	SS	24		240
			5	SS	80		239
238.80 / 4.00	**CLAYEY SILT TILL:** Brown to grey, trace sand, trace gravel, cohesive w<PL, very stiff to hard.		6	SS	50/152mm		238
			7	SS	46		237 / 236
234.82			8	SS	52		235

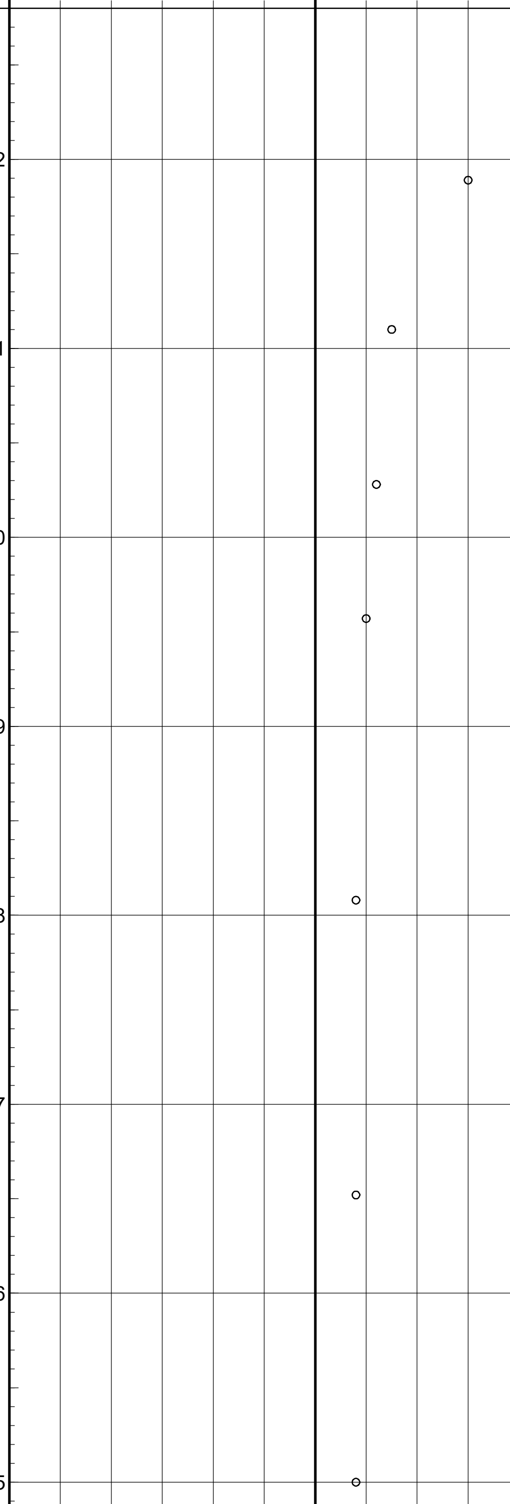
DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE & Sensitivity, × LAB VANE: 20 40 60 80 100

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m^3) | REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL



Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-14

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision — REF. NO.: 22517668

CLIENT: Bradford Highlands Joint Venture — Method: Solid Stem Auger — ENCL NO.:

PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario — Diameter: 152 mm — ORIGINATED BY PM

DATUM: UTM NAD , ZONE — Date: Mar-25-2022 to Mar-25-2022 — COMPILED BY FJ

BH LOCATION: N 4883207 E 613647 — Eqipment: Drill Tech Geoprobe 420M

(m) ELEV / DEPTH	SOIL PROFILE: DESCRIPTION (Continued)	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
7.98	**END OF BOREHOLE** Notes: 1). Upon completion of drilling, groundwater was at approximately 0.9 meter below ground surface (mbgs).											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-15

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-23-2022 to Mar-23-2022
COMPILED BY FJ
BH LOCATION: N 4883102 E 613793
Eqipment: Drill Tech Geoprobe 420M

SOIL PROFILE

(m) ELEV DEPTH	DESCRIPTION
235.60	Ground Surface
0.00	**TOPSOIL:** (410 mm)
235.19 / 0.41	**SILTY CLAY:** Brown, cohesive w<PL, soft to very stiff. --------------------- grey, w~PL
231.60 / 4.00	**CLAYEY SILT TILL:** Grey, trace gravel, trace sand, cobble fragments, cohesive w<PL, very stiff to hard.
228.60 / 7.00	**SILTY SAND:** Grey, moist to wet, very dense.

SAMPLES

NUMBER	TYPE	"N" BLOWS / 0.3 m
1	SS	4
2	SS	10
3	SS	16
4	SS	50
5	SS	51
6	SS	24
7	SS	83
8	SS	78

GROUND WATER CONDITIONS

ELEVATION: 235, 234, 233, 232, 231, 230, 229, 228

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3 : Numbers refer to Sensitivity
○ ε=3% Strain at Failure

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision | REF. NO.: 22517668

CLIENT: Bradford Highlands Joint Venture | Method: Solid Stem Auger | ENCL NO.:

PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario | Diameter: 152 mm | ORIGINATED BY PM

DATUM: UTM NAD , ZONE | Date: Mar-23-2022 to Mar-23-2022 | COMPILED BY FJ

BH LOCATION: N 4883102 E 613793 | Eqipment: Drill Tech Geoprobe 420M

(m) ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
227.50												
8.10	**END OF BOREHOLE** Notes: 1). Upon completion of drilling, borehole had caved at 5.2 meters below ground surface (mbgs).											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-16

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision — REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture — Method: Solid Stem Auger — ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario — Diameter: 152 mm — ORIGINATED BY PM
DATUM: UTM NAD , ZONE — Date: Mar-23-2022 to Mar-23-2022 — COMPILED BY FJ
BH LOCATION: N 4882952 E 613636 — Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	NATURAL MOISTURE CONTENT W (%) (approx.)
238.90	Ground Surface				
0.00	**TOPSOIL:** (200 mm)				
238.70 / 0.20	**SAND:** Brown, trace gravel, moist, loose.	1	SS	8	~7
238.29 / 0.61	**SILTY CLAY:** Brown, trace gravel, cohesive w<PL, very stiff to hard.	2	SS	15	~22
	wet spon	3	SS	32	~15
		4	SS	50/127mm	~6
		5	SS	50/152mm	~7
234.90 / 4.00	**SANDY CLAYEY SILT TILL:** Brown to grey, trace gravel, cobble fragment, cohesive w<PL, hard.	6	SS	50/127mm	~6
		7	SS	50/152mm	~6
		8	SS	50/139mm	~10
231.18 / 7.72	**END OF BOREHOLE**				

Column headings: SOIL PROFILE; SAMPLES; GROUND WATER CONDITIONS; ELEVATION (238, 237, 236, 235, 234, 233, 232); DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m³); REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668

CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:

PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM

DATUM: UTM NAD , ZONE
Date: Mar-23-2022 to Mar-23-2022
COMPILED BY FJ

BH LOCATION: N 4882952 E 613636
Eqipment: Drill Tech Geoprobe 420M

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION Continued	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m							
	Notes: 1). Upon completion of drilling, groundwater level was at approximately 1.5 meters below ground surface (mbgs).											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-17

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-25-2022 to Mar-25-2022
COMPILED BY FJ
BH LOCATION: N 4882531 E 613929
Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION (SOIL PROFILE)	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	ELEVATION	WATER CONTENT (%) (approx.)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
219.90	Ground Surface						
0.00	**TOPSOIL:** (300 mm)						
219.60 / 0.30	**SILTY CLAY:** Brown to grey, trace sand, trace rootlets, cohesive w<PL, soft to very stiff.	1	SS	3		~24	
	---------------------- wet	2	SS	6	219	~21	
		3	SS	16	218	~24 (PL–LL range ~17–30)	0 1 33 67
		4	SS	17	217	~21	
	---------------------- grey	5	SS	11	216	~20	
215.90 / 4.00	**SANDY CLAYEY SILT TILL:** Grey, trace gravel, cohesive w<PL, hard.	6	SS	16	215	~13	
		7	SS	55	214 / 213	~9	
211.88		8	SS	60	212	~10	

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity   ○ ε=3% Strain at Failure

Graph axes: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m³)

LOG OF BOREHOLE BH22-17

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision | REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture | Method: Solid Stem Auger | ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario | Diameter: 152 mm | ORIGINATED BY PM
DATUM: UTM NAD , ZONE | Date: Mar-25-2022 to Mar-25-2022 | COMPILED BY FJ
BH LOCATION: N 4882531 E 613929 | Eqipment: Drill Tech Geoprobe 420M

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
8.02	**END OF BOREHOLE** Notes: 1). Upon completion of drilling, borehole had caved at 7.3 meter below ground surface (mbgs) and borehole was dry.											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH22-18

PROJECT: GEOTECHNICAL INVESTIGATION For Proposed Residential Subdivision
REF. NO.: 22517668
CLIENT: Bradford Highlands Joint Venture
Method: Solid Stem Auger
ENCL NO.:
PROJECT LOCATION: 23 Brownlee Drive, Bradford, Ontario
Diameter: 152 mm
ORIGINATED BY PM
DATUM: UTM NAD , ZONE
Date: Mar-24-2022 to Mar-24-2022
COMPILED BY FJ
BH LOCATION: N 4882455 E 613650
Eqipment: Drill Tech Geoprobe 420M

ELEV (m) / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
232.40	Ground Surface					
0.00	**TOPSOIL:** (610 mm)	1	SS	4	232	
231.79 / 0.61	**SILTY CLAY:** Brown cohesive w<PL, stiff.	2	SS	12	231	
		3	SS	22		
		4	SS	22	230	
229.60 / 2.80	**CLAYEY SILTY SAND TILL:** Brown, trace sand, trace gravel, cohesive w<PL, very stiff to hard.	5	SS	30	229	3 42 35 21
		6	SS	50/127mm	228	
226.90 / 5.50	**SILTY SAND:** Brown, trace gravel, moist, very dense.	7	SS	50/101mm	227, 226	
		8	SS	50/101mm	225	

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE — 20 40 60 80 100

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

POCKET PEN. (Cu) (kPa) — NATURAL UNIT WT (kN/m^3)

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

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SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION Continued	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m							
224.30 8.10	**END OF BOREHOLE** Notes: 1). Upon completion of drilling, groundwater level was at approximately 0.7 meter below ground surface (mbgs).											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3 , × 3 : Numbers refer to Sensitivity ○ ε=3% Strain at Failure

Enclosure 1-B: Explanation of Terms Used in the Record of Borehole

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
NR	No recovery
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

WH – Samples sinks under "weight of hammer"

Dynamic Cone Penetration Resistance, N_d:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in).

Textural Classification of Soils (ASTM D2487-10)

Classification	Particle Size
Boulders	> 300 mm
Cobbles	75 mm - 300 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm - 4.75 mm
Silt	0.002 mm - 0.075 mm
Clay	<0.002 mm(*)

(*) Canadian Foundation Engineering Manual (4th Edition)

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

Soil Description

a) Cohesive Soils(*)

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

(*) Hierarchy of Shear Strength prediction
1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT "N" value
5. Pocket penetrometer

b) Cohesionless Soils

Density Index (Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
Γ	Unit weight

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH1

BORING DATE: March 11, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		249.32							
0	Buggy Mount D-90; 4" O/D Solid Stem Auger	TOPSOIL		0.00	1A						
		(ML) CLAYEY SILT, trace gravel, trace to some sand; mottled brown; cohesive, w>PL to w~PL, stiff to very stiff		0.13	1B	DO	8				
1					2	DO	15				
		(CL) SILTY CLAY and SAND, trace to some gravel; brown to greyish-brown, (TILL); cohesive, w<PL to w~PL, stiff to hard		247.95 / 1.37	3	DO	11			MH	
2		Sand seam in sample 4			4	DO	45				
3		Sand and gravel seam at 3.3 mbgs			5	DO	50/ 152 mm				
4		Coarse sand seam at 4.2 mbgs			6	DO	91				
					7	DO	89				
5		End of Borehole		244.32 / 5.00							

NOTE:

1. Groundwater measured at a depth of 4.3 m below existing grade in open borehole upon completion of drilling March 11, 2016.

6

7

8

9

10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

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PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH10

BORING DATE: March 15, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT (w, approx.)	ADDITIONAL LAB. TESTING
		GROUND SURFACE	237.49					
0	Buggy Mount D-90, 4" O/D Solid Stem Auger	TOPSOIL	0.00					
		(CL/ML) SILTY CLAY to CLAYEY SILT, trace sand; light brown; cohesive, w>PL to w~PL, stiff	237.29 / 0.20	1	DO	8	○	
1				2	DO	15	○	
				3	DO	11	○	
2				4	DO	11	○	
3		(CL) SILTY CLAY and SAND to sandy CLAY, trace to some gravel; greyish-brown, (TILL); cohesive, w~PL, very stiff to hard	234.39 / 3.10	5	DO	16	Wp–W–Wl	MH
4			232.77	6	DO	50/ 152 mm	○	MH
		End of Borehole	4.72					

Column headings also printed: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10, 20, 30, 40); STRATA PLOT; PIEZOMETER OR STANDPIPE INSTALLATION

NOTE:

1. Groundwater measured at a depth of 4.5 m below existing grade in open borehole upon completion of drilling March 15, 2016.

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH11

BORING DATE: March 16, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT / Wp–W–Wl	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	233.55						
0	Buggy Mount D-90; 8" O/D Hollow Stem Auger	TOPSOIL	0.00	1	DO	12			Casing; Silica Sand
		(ML/CL) CLAYEY SILT to SILTY CLAY, trace gravel, trace to some sand; brown to mottled brown to brownish-grey to grey; cohesive, w>PL to w~PL, stiff to very stiff	233.14 / 0.41	2	DO	13			
2				3	DO	24			Hole Plug
				4	DO	17			
3				5	DO	19			Silica Sand
4				6	DO	23	Wp–W–Wl	MH	8-Dec-2016
5				7	DO	26			10 Slot PVC Screen
		(CL) SILTY CLAY and SAND, trace gravel; grey, (TILL); cohesive, w~PL, hard	227.99 / 5.56	8	DO	50/ 152 mm			
7				9	DO	68			
		End of Borehole	226.23 / 7.32						

NOTE:

1. Borehole dry upon completion of drilling March 16, 2016.
2. Groundwater measured at a depth of 3.3 m below existing grade on September 23, 2016.
3. Groundwater measured at a depth od 4.4 m below existing grade on December 8, 2016.

Chart axes: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT (10, 20, 30, 40)

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

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PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH12

SHEET 1 OF 1

DATUM: Geodetic

BORING DATE: March 15, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT / HYDRAULIC CONDUCTIVITY	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	228.74						
0	Buggy Mount D-90, 8" O/D Solid Stem Auger	TOPSOIL	0.00	1	DO	6			
		(CL) SILTY CLAY, trace to some sand, trace to some gravel, cobble fragments; greyish-brown, oxidation staining, (TILL); cohesive, w~PL to w>PL, very stiff to hard	228.23 0.51	2	DO	16			
		(CL) SILTY CLAY and SAND, trace to some gravel; greyish-brown, (TILL); cohesive, w~PL, hard	227.04 1.70	3A 3B	DO	46		MH	
				4	DO	50/ 127 mm			
				5	DO	50/ 127 mm			
				6	DO	50/ 76 mm			
		End of Borehole	223.94 4.80						

NOTE:

1. Groundwater measured at a depth of 2.8 m below existing grade in open borehole upon completion of drilling March 15, 2016.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl: 10 20 30 40

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH13

BORING DATE: March 21, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: D-25 RT, 4 1/4" O/D Hollow Stem Auger

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING
GROUND SURFACE	228.16					
TOPSOIL	0.00	1	DO	8		
(CL) sandy CLAY, trace gravel, trace to some sand; brown to greyish-brown, (TILL); cohesive, w~PL to w<PL, stiff to very stiff	227.47 / 0.69	2	DO	8	Wp–W–Wl	MH
		3	DO	23		
(SM/SP-GW) SILTY SAND to SAND and GRAVEL; greyish-brown, (TILL); non-cohesive, moist to wet, dense	226.03 / 2.13	4	DO	48		
(CL) SILTY CLAY and SAND, some gravel; greyish-brown, (TILL); cohesive, w~PL, hard	225.26 / 2.90	5	DO	50/127 mm		
End of Borehole Refusal on Boulder	224.83 / 3.33					

NOTE:

1. Groundwater measured at a depth of 2.1 m below existing grade in open borehole upon completion of drilling March 21, 2016.

Chart headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢ W ⊣ Wl (10, 20, 30, 40); PIEZOMETER OR STANDPIPE INSTALLATION

Depth scale (metres): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

RECORD OF BOREHOLE: BH14

PROJECT: 1543120
LOCATION: See Figure 2
BORING DATE: March 21, 2016
SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: D-25 RT, 4 1/4" O/D Hollow Stem Auger

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	220.48					
Mixed SILTY CLAY and TOPSOIL	0.00	1	DO	7		Casing; Silica Sand; 8-Dec-2016
(CL) SILTY CLAY, trace sand; mottled brown to greyish-brown to brown, oxidation; cohesive, w>PL to w<PL, stiff to hard	219.79 / 0.69	2	DO	14		
		3	DO	21		Hole Plug
		4	DO	37		
		5	DO	33		Silica Sand
		6	DO	17	MH	10 Slot PVC Screen
		7	DO	22		
End of Borehole	213.93 / 6.55					

Chart headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. +, Q - ●, rem V. ⊕, U - ○) (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT, Wp —○W— Wl (10, 20, 30, 40)

NOTES:

1. Groundwater measured at a depth of 1.6 m below existing grade in open borehole upon completion of drilling March 21, 2016.
2. Groundwater measured at a depth of 0.7 m below existing grade September 12, 2016.
3. Grounwater measuted at a depth of 0.2 m below existing grade on December 8, 2016.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: CL
CHECKED: NL

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PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH15

BORING DATE: March 22, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		224.54							
0	D-25 RT; 4 1/4" O/D Hollow Stem Auger	TOPSOIL		0.00	1A	DO	4				
		(CL) SILTY CLAY and SAND, some gravel; brown to mottled brown-grey, (TILL); cohesive, w~PL, very stiff to hard		224.06 / 0.48	1B						
1					2	DO	25		○		
					3	DO	50		○		
2					4	DO	50/ 127 mm		○		
3					5	DO	65		○⊢⊣	MH	
4											
					6	DO	82		○		
5		End of Borehole		219.51 / 5.03							

NOTE:

1. Groundwater measured at a depth of 1.5 m below existing grade in open borehole upon completion of drilling March 22, 2016.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH16

BORING DATE: March 21, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT (%)	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		231.66					
0	D-25 RT, 4 1/4" O/D Hollow Stem Auger	TOPSOIL		0.00	1	DO	10		Casing; Silica Sand
		(ML/CL) CLAYEY SILT to SILTY CLAY, trace sand; mottled greyish-brown to grey; cohesive, w>PL to w<PL, stiff to very stiff		230.97 / 0.69					
1					2	DO	11		
					3	DO	21		Hole Plug
2					4	DO	27		
3					5	DO	21		Silica Sand
4									8-Dec-2016; 10 SLot PVC Screen
5					6	DO	20		
6					7	DO	21		
		End of Borehole		225.11 / 6.55					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp W Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

NOTES:

1. Groundwater measured at a depth of 1.5 m below existing grade in open borehole upon completion of drilling March 21, 2016.
2. Groundwater measured at a depth of 2.8 m below existing grade September 12, 2016.
3. Grounwater measured at a depth of 4.0 m below existing grade December 8, 2016.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

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RECORD OF BOREHOLE: BH17

PROJECT: 1543120
LOCATION: See Figure 2
BORING DATE: March 23, 2016
SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING
		GROUND SURFACE	235.02					
0	D-25 RT; 4 1/4" O/D Hollow Stem Auger	TOPSOIL	0.00	1A	DO	7		
		(CL/ML) SILTY CLAY to CLAYEY SILT, trace sand, trace gravel; mottled brown to grey, oxidation; cohesive, w~PL to w>PL, firm to very stiff	234.51 / 0.51	1B				
1				2	DO	18	O	
				3	DO	22	O	
2		Coarse sand seams at 1.8 and 1.9 mbgs						
				4	DO	27	O	
3				5	DO	20	O	
4		(ML) sandy SILT, trace gravel; grey; non-cohesive, wet, very dense	230.98 / 4.04					
				6	DO	50/ 102 mm	O	MH
5		End of Borehole	230.19 / 4.83					

NOTE:

1. Groundwater measured at a depth of 1.1 m below existing grade in open borehole upon completion of drilling March 23, 2016.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - O; 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp —O W— Wl; 10 20 30 40
PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: CL
CHECKED: NL

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH18

SHEET 1 OF 1

BORING DATE: March 23, 2016

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT (%)	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	236.95					
0	D-25 RT; 4 1/4" O/D Hollow Stem Auger	TOPSOIL	0.00	1A	DO	11		Casing; Silica Sand
		(ML) CLAYEY SILT, trace sand, trace gravel; brownish-grey; cohesive, w~PL to w>PL, very stiff	236.52 / 0.43	1B				
1				2	DO	23	~18	Hole Plug; ▽ 8-Dec-2016
				3	DO	29	~20	
2		Coarse sand seam at 1.9 mbgs						Silica Sand
		(CL) sandy CLAY, trace to some gravel; mottled brown to grey, (TILL); cohesive, w~PL, hard	234.75 / 2.20	4	DO	80	~11	
3				5	DO	80	~15	10 Slot PVC Screen
4				6	DO	54	~10	
		End of Borehole on Refusal	232.68 / 4.27					

NOTES:

1. Groundwater measured at a depth of 0.9 m below existing grade in open borehole upon completion of drilling March 23, 2016.
2. Groundwater measured at a depth of 1.7 m below existing grade September 12, 2016.
3. Groundwater measured at a depth of 1.3 m below existing grade on December 8, 2016.

Column headings also printed: SOIL PROFILE; STRATA PLOT; SAMPLES; DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40); ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH19

BORING DATE: March 23, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		241.21							
0	D-25 RT; 4" O/D Solid Stem Auger	TOPSOIL		0.00	1A						
		(CL) sandy SILTY CLAY, trace to some gravel; mottled brown grey to greyish brown, (TILL); cohesive, w<PL to w>PL, firm to very stiff		240.93 0.28	1B	DO	6				
1					2	DO	22				
					3	DO	21			MH	
2		(SM) SILTY SAND, trace to some gravel; greyish brown, (TILL); non-cohesive, moist, very dense		239.08 2.13							
					4	DO	72				
3					5	DO	93/ 279 mm				
4					6	DO	50/ 127 mm				
		End of Borehole		236.51 4.70							
5		NOTE: 1. Groundwater measured at a depth of 1.6 m below existing grade in open borehole upon completion of drilling March 23, 2016.									
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH2

BORING DATE: March 14, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		245.66					
0	Truck Mount CME 55; 8" O/D Hollow Stem Auger	TOPSOIL		0.00					Casing
		FILL-(CL) SILTY CLAY, trace sand, trace to some gravel; brown; cohesive, w~PL, firm		0.15	1	DO	5	Metals, inorganics	Silica Sand
		(CL) SILTY CLAY and SAND, trace to some gravel, cobble fragments; greyish-brown, (TILL); cohesive, w~PL, very stiff to hard		245.15 / 0.51					
1					2	DO	28		Hole Plug
2					3	DO	35		Silica Sand
					4	DO	75	MH, VOC, PHC, pH	
3					5	DO	90		8-Dec-2016
									10 Slot PVC Screen
4					6	DO	95/ 279 mm		
					7	DO	50/ 51 mm		
5				240.22	8	DO	50/ 102 mm	VOC, PHC	
		End of Borehole		5.44					

NOTE:

1. Groundwater measured at a depth of 3.2 m below existing grade in open borehole upon completion of drilling March 14, 2016.
2. Groundwater measured at a depth of 3.4 m below existing grade in monitoring well on December 8, 2016.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ●; rem V. ⊕ U - ○; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp W Wl; 10 20 30 40

Depth scale: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH3

BORING DATE: March 11, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: Buggy Mount D-90, 8" O/D Hollow Stem Auger

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80)
SHEAR STRENGTH Cu, kPa (20, 40, 60, 80) — nat V. + Q - ● ; rem V. ⊕ U - ○
HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3})
WATER CONTENT PERCENT — Wp ⊢ ○W ⊣ Wl (10, 20, 30, 40)

SOIL PROFILE — DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	245.36					
FILL-(SW/GP) SAND and GRAVEL, some silt, asphalt fragments; brown; non-cohesive, moist, compact	0.00	1A				Casing
	0.08	1B	DO	14	Metals, inorganics	Silica Sand
FILL-(CL) SILTY CLAY, some sand, some gravel; brown; cohesive, w>PL, stiff	244.95 / 0.41					
(CL) SILTY CLAY and SAND, some gravel; brown to greyish-brown, (TILL); cohesive, w~PL, very stiff to hard		2	DO	49	VOC, PHC	Hole Plug
		3	DO	67		Silica Sand
		4	DO	81	VOC, PHC	
		5	DO	67		8-Dec-2016; 10 Slot PVC Screen
		6	DO	80/ 229 mm		
		7	DO	95/ 279 mm		
		8	DO	75		
End of Borehole	239.44 / 5.92					

NOTES:

1. Groundwater measured at a depth of 2.8 m below existing grade in open borehole upon completion of drilling March 14, 2016.
2. Groundwater measured at a depth of 3.3 m below existing grade September 12, 2016.
3. Groundwater measured at a depth of 3.4 m below existing grade December 8, 2016.

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH4

BORING DATE: March 14, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT (%)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		245.21						
0	Truck Mount CME 55; 8" O/D Hollow Stem Auger	FILL-(ML) CLAYEY SILT, some sand, some gravel; brown; cohesive, w>PL, stiff		0.00	1	DO	10	~14	Metals, inorganics	Casing; Silica Sand
		(CL) SILTY CLAY and SAND, trace to some gravel, cobble fragments; greyish-brown, (TILL); cohesive, w~PL, hard		244.52 / 0.69	2	DO	30	~8		Hole Plug
					3	DO	34	~7		Silica Sand
					4	DO	47	~8	VOC, PHC	
					5	DO	49	~10		10 Slot PVC Screen
					6	DO	50/ 25 mm			
					7	DO	91	~12	VOC, PHC	
				239.57 / 5.64	8	DO	50/ 152 mm	~21		
		End of Borehole								

NOTE:

1. Groundwater measured at a depth of 4.4 m below existing grade in open borehole upon completion of drilling March 14, 2016.
2. Monitoring well unable to be located due to golf course landscaping.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl: 10 20 30 40

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

RECORD OF BOREHOLE: BH5

PROJECT: 1543120
LOCATION: See Figure 2

SHEET 1 OF 1
DATUM: Geodetic

BORING DATE: March 15, 2016

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: Truck Mount CME 55, 8" O/D Hollow Stem Auger

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	248.16					
TOPSOIL	0.00	1	DO	3		Casing; Silica Sand
	247.65					
FILL-(ML) CLAYEY SILT and SAND; light brown; cohesive, w<PL to w>PL, firm	0.51	2	DO	6		Hole Plug
		3	DO	6	MH	
	246.03					
(CL) SILTY CLAY and SAND, some gravel; greyish-brown, (TILL); cohesive, w~PL to w>PL, hard	2.13	4	DO	46		
Coarse sand seam at 2.6 mbgs						Silica Sand
		5	DO	56	MH	8-Dec-2016
						10 Slot PVC Screen
		6	DO	53		
	241.84	7	DO	50/ 76 mm		
End of Borehole	6.32					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 10 20 30 40

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

NOTES:

1. Groundwater measured at a depth of 3.4 m below existing grade in open borehole upon completion of drilling March 15, 2016.
2. Groundwater measured at a depth of 2.9 m below existing grade September 12, 2016.
3. Groundwater measured at a depth of 3.2 m below existing grade December 8, 2016.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CL
CHECKED: NL

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH6

BORING DATE: March 15, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: Buggy Mount D-90, 4" O/D Solid Stem Auger

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	GROUND SURFACE	242.51				
0	TOPSOIL	0.00	1	DO	4	
	(CL) SILTY CLAY, trace sand; brown to mottled light brown; cohesive, w<PL to w~PL, stiff to very stiff	242.00 / 0.51	2	DO	12	MH
			3	DO	21	
2	(CL) SILTY CLAY and SAND, trace to some gravel, cobble fragments; greyish-brown to grey, (TILL); cohesive, w~PL, hard	240.38 / 2.13	4	DO	49	
			5	DO	75/ 279 mm	
			6	DO	42	
			7	DO	36	
5	End of Borehole	237.48 / 5.03				

NOTE:

1. Groundwater measured at a depth of 4.7 m below existing grade in open borehole upon completion of drilling March 15, 2016.

Column headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10, 20, 30, 40); PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

RECORD OF BOREHOLE: BH7

PROJECT: 1543120
LOCATION: See Figure 2
BORING DATE: March 15, 2016
SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT (approx.)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	241.08						
0	Buggy Mount D-90; 4" O/D Solid Stem Auger	TOPSOIL	0.00						
				1	DO	8	~20		
		FILL-(ML) CLAYEY SILT, trace sand; light brown; cohesive, w>PL, stiff	240.62 / 0.46						
1				2	DO	11	~19		
				3	DO	11	~19		
2		(CL) SILTY CLAY and SAND, trace to some gravel, cobble fragments; greyish-brown, (TILL); cohesive, w~PL, hard	238.95 / 2.13						
				4	DO	40	~10	MH, NP	
3				5	DO	50/127 mm	~10		
4									
				6	DO	32	~10		
5		End of Borehole	236.05 / 5.03						

End of Borehole

NOTE:

1. Groundwater measured at a depth of 4.2 m below existing grade in open borehole upon completion of drilling March 15, 2016.

Chart headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —W— Wl (10, 20, 30, 40)

DEPTH SCALE 1 : 50

LOGGED: CL
CHECKED: NL

Golder Associates

PROJECT: 1543120

LOCATION: See Figure 2

RECORD OF BOREHOLE: BH8

BORING DATE: March 10, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	236.62					
0	Buggy Mount D-90; 8" O/D Hollow Stem Auger	FILL-(CL) SILTY CLAY, trace sand, mixed organics; brown to light brown; cohesive, w<PL, firm to stiff	0.00	1	DO	7		Casing; Hole Plug
		(CL) sandy CLAY, trace to some gravel; mottled brown to brown to brownish-grey to grey, (TILL); cohesive, w>PL to w~PL, stiff to hard	235.93 / 0.69	2	DO	10		Silica Sand
2				3	DO	20		
				4	DO	64/254 mm	MH, BTEX, PHC	10 Slot PVC Screen
3				5	DO	88		
4				6	DO	50/152 mm	BTEX, PHC	
		End of Borehole	232.51 / 4.11					

End of Borehole

NOTES:

1. Groundwater measured at a depth of 2.2 m below existing grade in open borehole upon completion of drilling March 10, 2016.
2. Groundwater measured at a depth of 1.5 m below existing grade September 12, 2016.
3. Monitoring well unable to be accessed due to damaged well cover.

Chart headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa, nat V. + Q - ●, rem V. ⊕ U - ○ (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT, Wp —○W— Wl (10, 20, 30, 40)

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: CL

CHECKED: NL

RECORD OF BOREHOLE: BH9

PROJECT: 1543120
LOCATION: See Figure 2
BORING DATE: March 11, 2016
SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	236.24					
0	Buggy Mount D-90; 8" O/D Hollow Stem Auger	FILL-(SP/GP) SAND and GRAVEL, some silt; grey; non-cohesive, moist, compact	0.00	1A	DO	12		Casing
		(CL) SILTY CLAY, trace sand; brown; cohesive, w>PL, stiff to very stiff to hard	235.73 / 0.51	1B			BTEX, PHC, pH	
1				2	DO	14		Hole Plug
2				3	DO	21	MH	
				4	DO	37	BTEX, PHC, pH	Silica Sand
3		(CL) SILTY CLAY and SAND, trace to some gravel; greyish-brown to grey, (TILL); cohesive, w>PL, very stiff to hard	233.26 / 2.98	5	DO	35		
4				6	DO	60		10 Slot PVC Screen
5				7	DO	28	MH	
				8	DO	46		
6				9	DO	29		
		End of Borehole	229.69 / 6.55					

NOTE:

1. Groundwater measured at a depth of 4.9 m below existing grade in open borehole upon completion of drilling March 11, 2016.
2. Monitoring well unable to be located due to golf course landscaping.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl — 10 20 30 40

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: CL
CHECKED: NL

GTA-BHS 001 S:\CLIENTS\GERANIUM\HIGHLAND_GOLFCOURSE_BRADFORD\02_DATA\GINT\1543120-BG-0002.GPJ GAL-MIS.GDT 2-15-17 STB

Appendix B-3 Hydrogeological Assessment Excerpts

SCS consulting group ltd

REPORT

Preliminary Hydrogeological Assessment

Proposed Residential Subdivision, Bradford Highlands Golf Course, 23 Brownlee Drive, Bradford, Ontario L3Z 2A4

Submitted to:

Bradford Highlands Joint Venture

111 Creditstone Road,
Concord, Ontario
L4K 1N3

Attention: Neil Palmer

Submitted by:

WSP Canda Inc.

121 Commerce Park Drive, Unit L, Barrie, Ontario, L4N 8X1, Canada

+1 705 722 4492

22517668 Rev 1

October 31, 2024

3.0 2022 FIELD INVESTIGATION

3.1 Drilling and Well Installations

The current combined geotechnical and hydrogeological drilling program was carried out from March 14 to 16, 2022, during which time 18 boreholes (designated as BH22-1 to BH22-18) were advanced across the Site. The boreholes were advanced to depths ranging from 6.2 to 11.1 mbgs. The boreholes were advanced using a Geoprobe track mounted rig supplied and operated by Drill Tech Drilling & Shoring Inc. of Newmarket, Ontario, subcontracted to WSP. The approximate borehole locations are shown on Figure 2 (Borehole Location Plan; Appendix B). The results of the drilling program are presented on the Record of Borehole sheets in Appendix D. Grain size sampling results from the drilling program are provided in Appendix D.

Four boreholes were completed as 50-millimetre (mm) diameter monitoring wells, consisting of a PVC riser pipe, with a slotted screen sealed at a selected depth within the borehole. The annular borehole space around each screened interval was backfilled with silica sand, to a height of approximately 0.3 m above the top of the screen. The remaining annular space was backfilled to ground surface with bentonite chips. The well installation details are presented on the Record of Borehole sheets (Appendix D). The depths of the wells ranged from about 9.2 to 10.7 mbgs.

The results of the drilling program indicated that overburden deposits at the Site generally consisted of topsoil overlying native deposits of silty clay and silty clay to clayey silt till. A unit of sand and silty sand was identified at various boreholes across the Site, generally underlying the silty clay and silty clay till. Figure 4A and Figure 4B (Appendix B) provide geological cross-sections across the Site. Bedrock was not encountered at any of the borehole locations.

3.2 Groundwater Level Measurements

A groundwater level monitoring program was implemented as part of the current investigation, starting in April 2022. The program consisted of collecting quarterly manual groundwater level readings at each of the monitoring wells at the Site, and installation of pressure transducers at four of the monitoring wells (BH2, BH11, BH22-3, and BH22-09) to collect continuous water level readings. Manual water levels were measured at each location with an electric water level tape, which was cleaned between well locations. Table A attached, provides all available manual water level measurements collected to date at the Site. The groundwater hydrographs from the data logger measurements to date are presented in Appendix F.

The depth to groundwater at the Site was found to range from above grade (i.e., artesian) to approximately 4.51 mbgs, where the ground surface is defined as the existing grade. The water table across the Site was found to be situated within the silty clay unit, at elevations ranging from about 219.4 to 247.5 masl. Groundwater level monitoring over 2022 / 2023 (Appendix F) indicates that the groundwater level at the Site was highest during the spring (i.e., March, April, May) with water levels then declining over the summer months. At monitoring wells BH2, BH11 and BH22-3 the groundwater level was within about 0.2 m of ground surface during the spring period. The pattern of groundwater level fluctuations at well BH22-03 differed somewhat from the other wells. It is surmised that the water level readings before August 2022 are anomalously low due to an incomplete hydrostatic seal at the wellhead. Readings after August 2022 show a pattern of fluctuation consistent with the other wells, with the highest water levels noted during the spring months, and levels then declining in the summer of 2023. The range of fluctuations in the groundwater table over the year was 2.5 to 3 m. For well BH22-09, which is under confined conditions, water levels fluctuated by about 1 m.

Figure 5 (Appendix B) shows the inferred groundwater flow direction at the Site, which essentially mimics the topographic slope. Artesian conditions were noted at monitoring well BH16 in 2018, and at monitoring well BH22-03 during the current investigation. Well BH16 was screened within the silty clay and well BH22-03, although screened in the silty clay, contacted the underlying sand at the bottom of the screen. It is expected that the artesian conditions are associated with confined (i.e., pressurized) conditions in the deeper sand / silty sand unit.

3.3 Hydraulic Conductivity

Single-well response testing was carried in April 2022 as part of the current investigation. The testing was carried out by rapidly purging a known volume of water from each well with a dedicated inertial (i.e., Waterra) pump and monitoring the subsequent water level recovery with manual electric water level tape.

The data was analyzed using the AQTESOLV for Windows version 4.50 Professional software. The Bouwer-Rice (1976) method for unconfined conditions was used to analyse the single well response testing data. Testing was also completed as part of the 2018 investigation. The single-well response testing results from both investigations are provided in Appendix E.

The tested wells were screened within the silty clay (BH5, BH14 and BH16), sandy clay till (BH8 and BH18), and clayey silt till (BH22-05 and BH22-09). The hydraulic conductivity was measured to be between 2×10^{-6} m/s and 3×10^{-8} m/s in the silty clay, 9×10^{-8} m/s in the sandy clay till, and 2×10^{-7} m/s and 4×10^{-8} m/s in the clayey silt till. Geometric mean hydraulic conductivity value based on all the testing results was found to be 1×10^{-7} m/s.

3.4 Groundwater Quality

Groundwater quality samples were collected at monitoring well BH22-3 using low-flow sampling techniques, according to standard environmental practices. The samples were stored on ice following collection, and were delivered to Caduceon Laboratories of Barrie, Ontario for analysis of a subset of the Provincial Water Quality Objectives (PWQO). The laboratory analytical data sheets are provided in Appendix G.

The analytical results indicate that the concentrations of the analyzed parameters were below their respective PWQO values, with the exception of total phosphorous [130 ug/L], total cobalt [1 ug/L], total iron [2310 ug/L], and total aluminium [1620 ug/L], each of which were reported at concentrations in excess of the PWQO in the unfiltered sample. The concentration of total suspended solids (TSS) was 206 mg/L. Elevated TSS concentrations are common for groundwater samples collected from relatively new monitoring wells completed in fine grained material, and the presence of elevated phosphorous, iron, cobalt, and aluminium concentrations is assumed to be a consequence of the relatively high TSS concentration.

In order to assess the impact of TSS on the sample, and to provide an indication of water quality following TSS removal (i.e., as part of a construction dewatering setup), an additional filtered sample was collected and submitted for the analysis of metals and total phosphorus. The analytical results from the filtered sample showed that the metals exceedances noted in the filtered sample were no longer present. The phosphorous concentration in the filtered sample was 20 ug/L, which is significantly lower than was noted in the unfiltered sample.

Prior to commencing any temporary construction dewatering activities, the suitability of the water for discharge will need to be confirmed by the contractor. It is recommended that samples be collected from the treatment system and submitted for laboratory analysis prior to commencing the full construction activities. The laboratory results should be provided to a Qualified Professional in order to confirm the discharge water is suitable for release under the applicable guidelines.

4.0 DEWATERING EVALUATION

At the time of reporting, no information was available regarding planned excavation depths required for construction. As such, WSP was unable to provide detailed comment on the water taking requirements, or potential concerns related to dewatering, at the Site. Based on the single well response testing results, it is expected the groundwater yield from the various clay-rich units (i.e., silty clay, clayey silt till, sandy clay) will be relatively limited. The occurrence of artesian conditions in the central portion of the Site indicates that the

Tables

Table A
Groundwater Level Measurements

Well ID	Borehole Depth (mbgs)	Ground Surface (masl)	Measuring Point (masl)	Stick up (m)	Measurement Date	Water Level (mbtoc)	Water Level (mbgs)	Water Level (masl)	Hydraulic Conductivity (m/s)	Primary Unit
BH22-03	10.67	231.5	231.46	-0.04	26-Apr-22	Artesian	-	-	-	CLAYEY SILT TILL
					31-May-22	Artesian	-	-		
					18-Aug-22	Artesian	-	-		
					18-Nov'22	Artesian	-	-		
					14-Aug-23	Artesian	-	-		
					14-May-24	Artesian	- 4.32	235.78		
BH22-05	9.10	224.0	223.91	-0.06	26-Apr-22	0.17	0.23	223.74	4E-08	CLAYEY SILT TILL
					31-May-22	0.29	0.35	223.62		
					18-Aug-22	0.91	0.97	223.00		
					18-Nov-22	0.76	0.82	223.16		
					14-Aug-23	0.43	0.49	223.48		
					14-May-24	0.41	0.47	223.50		
BH22-06	10.70	220.7	220.64	-0.04	26-Apr-22	0.33	0.37	220.31	-	SANDY CLAYEY SILT TILL
					31-May-22	0.49	0.53	220.15		
					18-Aug-22	1.24	1.28	219.41		
					18-Nov-22	0.79	0.83	219.85		
					14-Aug-23	0.26	0.30	220.39		
					14-May-24	-	-	-		
BH22-09	10.70	231.6	231.52	-0.07	26-Apr-22	0.84	0.91	230.68	2E-07	CLAYEY SILT TILL
					31-May-22	1.28	1.35	230.24		
					18-Aug-22	1.99	2.05	229.54		
					18-Nov-22	2.47	2.54	229.05		
					14-Aug-23	1.16	1.52	230.37		
					14-May-24	0.66	1.52	230.86		
BH2	5.20	245.7	245.5	-0.16	23-Mar-16	0.75	0.91	244.75	-	SILTY CLAY
					28-Mar-16	0.01	0.17	245.49		
					21-Oct-16	3.60	3.76	241.90		
					8-Dec-16	3.40	3.56	242.10		
					5-Apr-17	0.58	0.74	244.92		
					26-Apr-22	1.45	1.61	244.05		

Table A
Groundwater Level Measurements

Well ID	Borehole Depth (mbgs)	Ground Surface (masl)	Measuring Point (masl)	Stick up (m)	Measurement Date	Water Level (mbtoc)	Water Level (mbgs)	Water Level (masl)	Hydraulic Conductivity (m/s)	Primary Unit
					31-May-22	2.05	2.21	243.45		
					18-Aug-22	3.31	3.47	242.19		
					18-Nov-22	3.32	3.48	242.18		
					14-Aug-23	2.16	2.32	243.34		
					14-May-24	0.79	0.95	244.71		
BH3	5.20	245.4	245.3	-0.09	22-Mar-16	0.77	0.86	244.50	-	SILTY CLAY
					28-Mar-16	0.13	0.22	245.14		
					12-Sep-16	3.31	3.40	241.96		
					21-Oct-16	3.62	3.71	241.65		
					8-Dec-16	3.43	3.52	241.84		
					24-Feb-17	1.55	1.64	243.72		
					26-Apr-22	Buried	-	-		
					31-May-22	Buried	-	-		
					18-Aug-22	3.23	3.32	242.05		
					18-Nov-22	3.36	3.45	241.92		
					14-Aug-23	2.17	2.26	243.11		
					14-May-24	0.85	0.94	244.43		
BH4	5.20	245.2	245.1	-0.15	22-Mar-16	1.05	1.20	244.01		SILTY CLAY
					28-Mar-16	0.26	0.41	244.80		
					21-Oct-16	3.84	3.99	241.22		
					24-Feb-17	1.88	2.03	243.18		
					18-Apr-17	0.59	0.74	244.47		
					26-Apr-22	Buried	-	-		
					31-May-22	Buried	-	-		
					18-Aug-22	Buried	-	-		
					18-Nov-22	Buried	-	-		
					14-Aug-23	Buried	-	-		
					14-May-24	Buried	-	-		

Table A
Groundwater Level Measurements

Well ID	Borehole Depth (mbgs)	Ground Surface (masl)	Measuring Point (masl)	Stick up (m)	Measurement Date	Water Level (mbtoc)	Water Level (mbgs)	Water Level (masl)	Hydraulic Conductivity (m/s)	Primary Unit
BH5	6.10	248.2	248.1	-0.09	12-Sep-16	2.99	3.08	245.08	2E-06	SILTY CLAY
					8-Dec-16	3.22	3.31	244.85		
					5-Apr-17	0.59	0.68	247.48		
					26-Apr-22	Buried	-	-		
					31-May-22	Buried	-	-		
					18-Aug-22	Buried	-	-		
					18-Nov-22	3.36	3.45	244.72		
					14-Aug-23	1.16	1.25	246.91		
					14-May-24	0.61	0.70	247.46		
BH8	4.30	236.9	236.9	-0.05	23-Mar-16	0.69	0.74	236.19	9E-08	sandy CLAY
					28-Mar-16	0.34	0.39	236.54		
					21-Oct-16	1.51	1.56	235.37		
					8-Dec-16	1.67	1.72	235.21		
					5-Apr-17	0.45	0.50	236.43		
					26-Apr-22	Buried	-	-		
					31-May-22	Buried	-	-		
					18-Aug-22	1.60	1.65	235.29		
					18-Nov-22	1.43	1.48	235.45		
					14-Aug-23	-	-	-		
					14-May-24	0.59	0.64	236.29		
BH9	5.8	236.2	236.20	-0.04	23-Mar-16	0.70	0.74	235.50	-	SILTY CLAY
					28-Mar-16	0.30	0.34	235.90		
					12-Sep-16	1.54	1.58	234.66		
					5-Apr-17	0.72	0.76	235.48		
					26-Apr-22	Buried	-	-		
					31-May-22	Buried	-	-		
					18-Aug-22	Buried	-	-		
					18-Nov-22	Buried	-	-		
					14-Aug-23	Buried	-	-		
					14-May-24	Buried	-	-		

Table A
Groundwater Level Measurements

Well ID	Borehole Depth (mbgs)	Ground Surface (masl)	Measuring Point (masl)	Stick up (m)	Measurement Date	Water Level (mbtoc)	Water Level (mbgs)	Water Level (masl)	Hydraulic Conductivity (m/s)	Primary Unit
BH11	6.9	233.2	233.05	-0.13	23-Sep-16	3.25	3.38	229.80	-	SILTY CLAY
					8-Dec-16	4.38	4.51	228.67		
					5-Apr-17	0.11	0.24	232.94		
					26-Apr-22	0.70	0.83	232.35		
					31-May-22	1.59	1.72	231.46		
					18-Aug-22	2.84	2.97	230.21		
					18-Nov-22	2.89	3.02	230.16		
					14-Aug-23	1.68	1.81	231.38		
					14-May-24	0.79	0.92	232.26		
BH14	6.1	220.3	220.48	-0.16	12-Sep-16	0.67	0.83	219.81	3E-08	SILTY CLAY
					8-Dec-16	0.24	0.40	220.24		
					5-Apr-17	0.05	0.21	220.43		
					26-Apr-22	0.12	0.28	220.36		
					31-May-22	0.25	0.41	220.23		
					18-Aug-22	0.29	0.45	220.19		
					18-Nov-22	0.28	0.44	220.20		
					14-Aug-23	0.28	0.44	220.20		
					14-May-24	0.25	0.41	220.23		
BH16	6.10	231.7	231.5	-0.12	12-Sep-16	2.82	2.94	228.72	1E-07	CLAYEY SILT to SILTY CLAY
					8-Dec-16	4.02	4.14	227.52		
					5-Apr-17	Artesian	-	-		
					26-Apr-22	Buried	-	-		
					31-May-22	Buried	-	-		
					18-Aug-22	Buried	-	-		
					18-Nov-22	4.41	4.53	227.13		
					14-Aug-23	0.89	1.01	230.65		
					14-May-24	0.10	0.22	231.44		

Table A
Groundwater Level Measurements

Well ID	Borehole Depth (mbgs)	Ground Surface (masl)	Measuring Point (masl)	Stick up (m)	Measurement Date	Water Level (mbtoc)	Water Level (mbgs)	Water Level (masl)	Hydraulic Conductivity (m/s)	Primary Unit
BH18	3.80	237.0	236.9	-0.1	12-Sep-16	1.73	1.83	235.12	9E-08	sandy CLAY
					8-Dec-16	1.26	1.36	235.59		
					5-Apr-17	0.04	0.14	236.81		
					26-Apr-22	0.37	0.47	236.49		
					31-May-22	0.87	0.97	235.98		
					18-Aug-22	1.44	1.54	235.41		
					18-Nov-22	1.09	1.19	235.77		
					14-Aug-23	0.44	0.54	236.42		
					14-May-24	0.505	0.605	236.345		

Notes:

1. m toc meters below top of casing
2. masl meters above sea level
3. m bgs meters below ground surface
4. Table to be read in conjunction with accompanying report
5. Superscript [1] denotes approximate stickups

Table B
Piezometer Water Level Measurements

Well ID	Stick-Up (m)	Measurement Date	Water Level (mbtoc)	Water Level (mbgs)	Surface Water Depth (mbtoc)	Comments
MP-01	0.41	12-Apr-17	0.848	0.44	---	
		12-Apr-17	0.824	0.41	---	
		12-May-17	0.539	0.13	0.31	recharging
MP-02	0.36	12-Apr-17	0.624	0.26	---	
		12-Apr-17	0.068	-0.29	---	
		12-May-17	0.178	-0.18	0.33	discharging
MP-03	0.35	12-Apr-17	0.768	0.42	---	
		12-Apr-17	0.768	0.42	---	
		12-May-17	0.344	-0.01	0.36	discharging
MP-04	0.52	12-Apr-17	1.138	0.62	---	
		12-Apr-17	1.105	0.59	---	
		12-May-17	0.388	-0.13	0.43	discharging
MP-05	0.64	12-Apr-17	0.633	-0.01	---	
		12-Apr-17	0.631	-0.01	---	
		12-May-17	0.753	0.11	dry	recharging
		2-Oct-17	1.055	0.42	dry	recharging
MP-06	0.54	12-Apr-17	0.921	0.38	---	
		12-Apr-17	0.734	0.19	---	
		12-May-17	0.521	-0.02	0.53	discharging
		2-Oct-17	1.14	0.60	dry	recharging
MP-07	0.41	12-Apr-17	0.935	0.53	---	
		12-Apr-17	0.92	0.51	---	
		12-May-17	0.565	0.16	0.41	recharging
		2-Oct-17	1.085	0.68	dry	recharging
MP-08	0.57	12-Apr-17	1.045	0.48	---	
		12-Apr-17	1.035	0.47	---	
		12-May-17	0.571	0.00	0.57	
		2-Oct-17	0.59	0.02	dry	recharging

Table B
Piezometer Water Level Measurements

Well ID	Stick-Up (m)	Measurement Date	Water Level (mbtoc)	Water Level (mbgs)	Surface Water Depth (mbtoc)	Comments
MP-09	0.51	12-Apr-17	0.618	0.11	---	
		12-Apr-17	0.779	0.27	---	
		12-May-17	0.509	0.00	0.59	
		2-Oct-17	0.53	0.02	dry	recharging

Notes:

1. m toc meters below top of casing
2. mbgs meters below ground surface
3. negative values denote water levels above ground surface
4. Initial April 12 reading immediately post installation. Second reading approximately 1 hour post installation.
5. Table to be read in conjunction with accompanying report

LEGEND

APPROXIMATE PHASE TWO BOUNDARY

APPROXIMATE MNR NATURAL HERITAGE BOUNDARY

CROSS SECTION

PREVIOUS INVESTIGATIONS

BOREHOLE LOCATION

MONITORING WELL LOCATION

APPROXIMATE MINI-PIEZOMETER LOCATION

2022 INVESTIGATIONS

BOREHOLE LOCATION 2022

MONITORING LOCATION 2022

0 100 200

1:6,000 METRES

REFERENCE(S)

BASE DATA - MNR, LIO, OPEN SOURCE ESRI

DRAFT PLAN: MGP OCTOBER, 2024

BOREHOLE LOCATION SURVEY: RADY-PENTEK & EDWARD SURVEYING LTD., JULY 28, 2016

PROJECTION: UTM NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

BASE IMAGERY - BING, SEPTEMBER 2022

CLIENT

BRADFORD HIGHLANDS

PROJECT

BRADFORD HIGHLANDS GOLF COURSE REDEVELOPMENT

2789 LINE 6 AND 23 BROWNLEE DRIVE

TOWN OF BRADFORD WEST GWILLIMBURY, ONTARIO

TITLE

SITE BOREHOLE PLAN

CONSULTANT

YYYY-MM-DD	2024-10-30
PREPARED	JPR
DESIGN	
REVIEW	
APPROVED	DPD

PROJECT No.	CONTROL	Rev.	FIGURE
22517668	0004	----	2

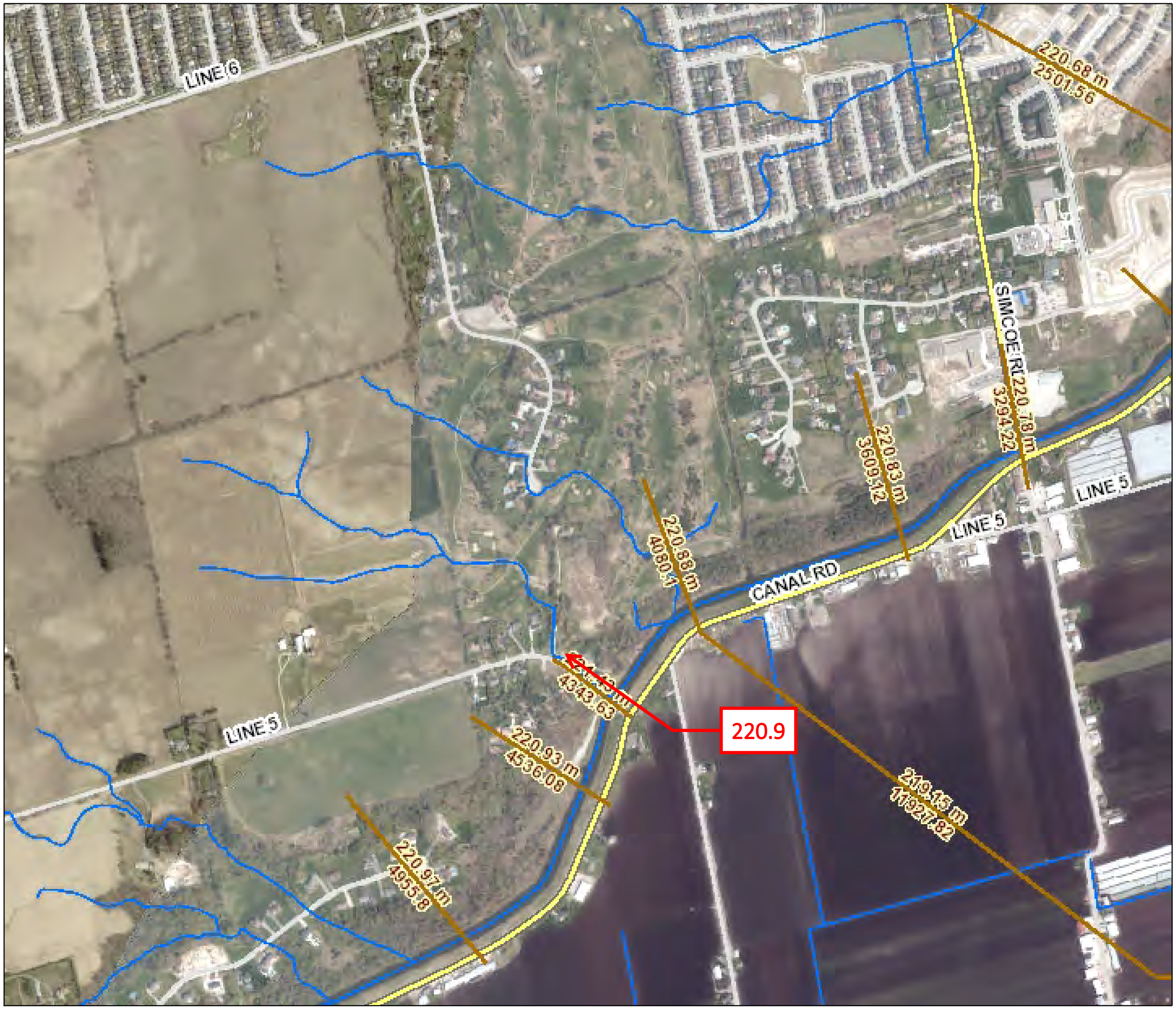
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm

Appendix B-4 Floodplain Elevations

23 Brownlee - Hydraulic Cross Sections with Regulatory Flood Elevations

Lake Simcoe Region conservation authority



Features

- Cross Sections - Engineering
- Watercourse
- Lake Simcoe
- Roads
  - Hwy 400 Series
  - Highway, Arterials
  - Local Road
- Railway
- Lower Tier Municipality

Printed On:
9/10/2024

WGS_1984_Web_Mercator_Auxiliary_Sphere

Mapped By:

Scale 1: 12,982

Meters

659 0 330 659

Appendix B-5 Bradford Capital SWM Report Excerpts

	box culvert to a 25.2m long riverstone lined downstream channel. 10m wide emergency spillway at a separate located from the outlet structure with its elevation at 1.36m above permanent pool.
Receive Emergency Sanitary Overflows	No.
Notes / Additional Information	Assumed.

SWMF-0017 - SWM Wet Pond (Gibson Circle Pond)

Location	117 Gibson Circle
Watershed/Subwatershed	Primary Watershed Name: Great Lakes - St. Lawrence River Secondary Watershed Name: Eastern Georgian Bay Tertiary Watershed Name: Severn River - Lake Simcoe Quaternary Watershed Name: Holland River
Receiver of discharge	Morris Road Municipal Drain
Outlet location	Lat: 44.0968 Long: -79.5683
Catchment Area	89ha
Level of Treatment for suspended solids	Enhanced
Treatment for other contaminants, as required	N/A
Level of Volume control	12890 m^3
Design Storm	100 Year
Reference ECA(s)	7461-9UQFUB
Reference Works as part of treatment train	N/A
Brief Description	Extended detention pond with a sediment forebay and a main wetland type detention cell. Having a total permanent pool volume of approximately 12890m^3, an extended detention storage volume of approx. 4890m^3 for quality and erosion control for the runoff from the initial 25mm precipitation of rainfall event
Receive Emergency Sanitary Overflows	No.
Notes / Additional Information	Assumed.

SWMF-0019 - SWM Dry Pond (Arthur Evans Pond)

Location	6 Arthur Evans Crescent
Watershed/Subwatershed	Primary Watershed Name: Great Lakes - St. Lawrence River Secondary Watershed Name: Eastern Georgian Bay Tertiary Watershed Name: Severn River - Lake Simcoe Quaternary Watershed Name: Holland River
Receiver of discharge	Unnamed watercourse

Content Copy Of Original

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

ENVIRONMENTAL COMPLIANCE APPROVAL
NUMBER 7461-9UQFUB
Issue Date: March 18, 2015

Bradford Capital Holdings Inc.
111 Creditstone Rd
Vaughan, Ontario
L4K 1N3

Site Location: Bradford Capital Residential Subdivision
2627 Line 6 / 658 Simcoe Road / 2695 Line 6 / 604 Simcoe Road / 612 Simcoe Road / 2531 Line 6
Lot 14 and 15, Concession 5
Bradford West Gwillimbury Town, County of Simcoe

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act , R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

stormwater management facility servicing the Bradford Capital Residential Subdivision's drainage area of approximately 33 hectares (ha), plus servicing external areas of approximately 50 ha, and approximately 6.3 of existing developed area, for a total of approximately 89 ha, consisting of:

an extended detention pond (SWM Pond 700-2) with a sediment forebay and a main wetland type detention cell, having a total permanent pool volume of approximately 12,890 m^3, an extended detention storage volume of approximately 4,890 m^3 for quality and erosion control for the runoff from the initial 25mm precipitation of a rainfall event to be released over a minimum 24-hour period, and an additional attenuation storage volume of approximately 23,600 m^3 for peak flow control up to the 100 year storm event to pre-development levels, complete with inlet pipe and headwall, reverse sloped outlet pipe and outflow control manhole with major storm outfall pipe with orifice discharging to the pond outfall swale, Simcoe Road crossing and ultimately to the Holland River North Canal.

For the purpose of this environmental compliance approval, the following definitions apply:

"Approval" means this entire document and any schedules attached to it, and the application;

"Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;

"District Manager" means the District Manager of the Toronto, York-Durham, and Halton-Peel offices of the Ministry;

"EPA" means the *Environmental Protection Act* , R.S.O. 1990, c.E.19, as amended;

"Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;

"Owner" means Bradford Capital Holdings Inc. and its successors and assignees;

"OWRA" means the *Ontario Water Resources Act* , R.S.O. 1990, c. O.40, as amended;

"Regional Water Compliance Manager" means the Regional Water Compliance Manager of the _____ Region of the Ministry;

"Source Protection Plan" means a drinking water source protection plan prepared under the *Clean Water Act, 2006 ;* and

"Water Supervisor" means the Water Supervisor for the Toronto, York-Durham, and Halton-Peel offices of the Ministry; and

"Works" means the sewage works described in the Owner's application, and this Approval.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

(1) The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

(2) Except as otherwise provided by these conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval, and the application for approval of the Works.

(3) Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the Conditions in this Approval shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

(4) Where there is a conflict between the documents listed in the Schedule submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

(5) The Conditions of this Approval are severable. If any Condition of this Approval,or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

(6) This Approval is for the treatment and disposal of stormwater run-off from the proposed development of approximately 39 hectares. This Approval is also for the treatment and disposal of stormwater run-off from an external area of approximately 50 hectares draining to the site. The Approval is based on an average imperviousness of approximately 35%. Any future development changes within the total drainage area that might increase the required storage volumes or increase the flows to or from the wet pond or any structural/physical changes to the stormwater management facility including inlets or outlets will require an amendment to this Approval.

(7) The issuance of, and compliance with the Conditions of this Approval does not:

(a) relieve any person of any obligation to comply with any provision of any applicable statute, regulation or other legal requirement, including, but not limited to, the obligation to obtain approval from the local conservation authority necessary to construct or operate the sewage Works; or

(b) limit in any way the authority of the Ministry to require certain steps be taken to require the Owner to furnish any further information related to compliance with this Approval.

2. EXPIRY OF APPROVAL

This Approval will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Approval.

3. CHANGE OF OWNER

1. The Owner shall notify the District Manager and the Director,in writing, of any of the following changes within thirty (30) days of the change occurring:

(a) change of Owner;

(b) change of address of the Owner;

(c) change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the *Business Names Act* , R.S.O. 1990, c.B17 shall be included in the notification to the District Manager; and

(d) change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the *Corporations Information Act* , R.S.O. 1990, c. C39 shall be included in the notification to the District Manager.

(2) In the event of any change in ownership of the Works,other than a change to a successor municipality, the Owner shall notify in writing the succeeding owner of the existence of this Approval,and a copy of such notice shall be forwarded to the District Manager and the Director.

(3) Notwithstanding any other requirements in this Approval, upon transfer of the ownership or assumption of the Works to a municipality if applicable, any reference to the District Manager shall be replaced with the Water Supervisor.

4. OPERATION, MAINTENANCE AND MONITORING

(1) The Owner shall ensure that the design minimum liquid retention volume(s) is maintained at all times and ensure that the Sediment Removal Efficiency and cleanout of the SWM pond is undertaken based on a 10-year maintenance period commencing from time of ownership

assumption of the Works to the municipality. Also, the Owner shall perform a sediment accumulation analysis every five (5) years to confirm the actual loading and accumulated volume, as per specifications of section 4.4 of the SWM Report, Sernas Associates, dated April 2012, Revised October 2014.

(2) The Owner shall inspect the Works at least once a year and, if necessary, clean and maintain the Works to prevent the excessive buildup of sediments and/or vegetation.

(3) The Owner shall maintain a logbook to record the results of these inspections and any cleaning, maintenance operations and monitoring reports undertaken, and shall keep the logbook at the offices of the Owner for inspection by the Ministry. The logbook shall include the following:

(a) the name of the Works;

(b) the date and results of each inspection, maintenance and cleaning, including an estimate of the quantity of any materials removed; and

(c) Sediment accumulation analysis and sediment removal efficiency and cleanout records.

5. TEMPORARY EROSION AND SEDIMENT CONTROL

(1) The Owner shall install and maintain temporary sediment and erosion control measures during construction and conduct inspections once every **two (2) weeks** and after each significant storm event (a significant storm event is defined as a minimum of 25 mm of rain in any 24 hours period). The inspections and maintenance of the temporary sediment and erosion control measures shall continue until they are no longer required and at which time they shall be removed and all disturbed areas reinstated properly.

(2) The Owner shall maintain records of inspections and maintenance which shall be made available for inspection by the Ministry, upon request. The record shall include the name of the inspector, date of inspection, and the remedial measures. if any, undertaken to maintain the temporary sediment and erosion control measures.

6. RECORD KEEPING

The Owner shall retain for a minimum of ten (10) years from the date of their creation, all records and information related to or resulting from the operation and maintenance activities required by this Approval.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the

standards that apply at the time of construction to ensure the ongoing protection of the environment..

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to approved Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included to require that the Works be properly operated and maintained such that the environment is protected .

5. Condition 5 is included as installation, regular inspection and maintenance of the temporary sediment and erosion control measures is required to mitigate the impact on the downstream receiving watercourse during construction until they are no longer required.

6. Condition 6 is included to require that all records are retained for a sufficient time period to adequately evaluate the long-term operation and maintenance of the Works.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

1. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The environmental compliance approval number;
6. The date of the environmental compliance approval;
7. The name of the Director, and;
8. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary* Environmental Review Tribunal 655 Bay Street, Suite 1500 Toronto, Ontario M5G 1E5	AND	The Director appointed for the purposes of Part II.1 of the Environmental Protection Act Ministry of the Environment and Climate Change 2 St. Clair Avenue West, Floor 12A Toronto, Ontario M4V 1L5

*** Further information on the Environmental Review Tribunal 's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 314-3717 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 18th day of March, 2015

Edgardo Tovilla, P.Eng.
Director
appointed for the purposes of Part II.1 of the *Environmental Protection Act*

ET/
c: District Manager, MOECC Barrie
Rosario Sacco, P. Eng., Urban Ecosystems Limited, Bradford Capital Holdings Inc.

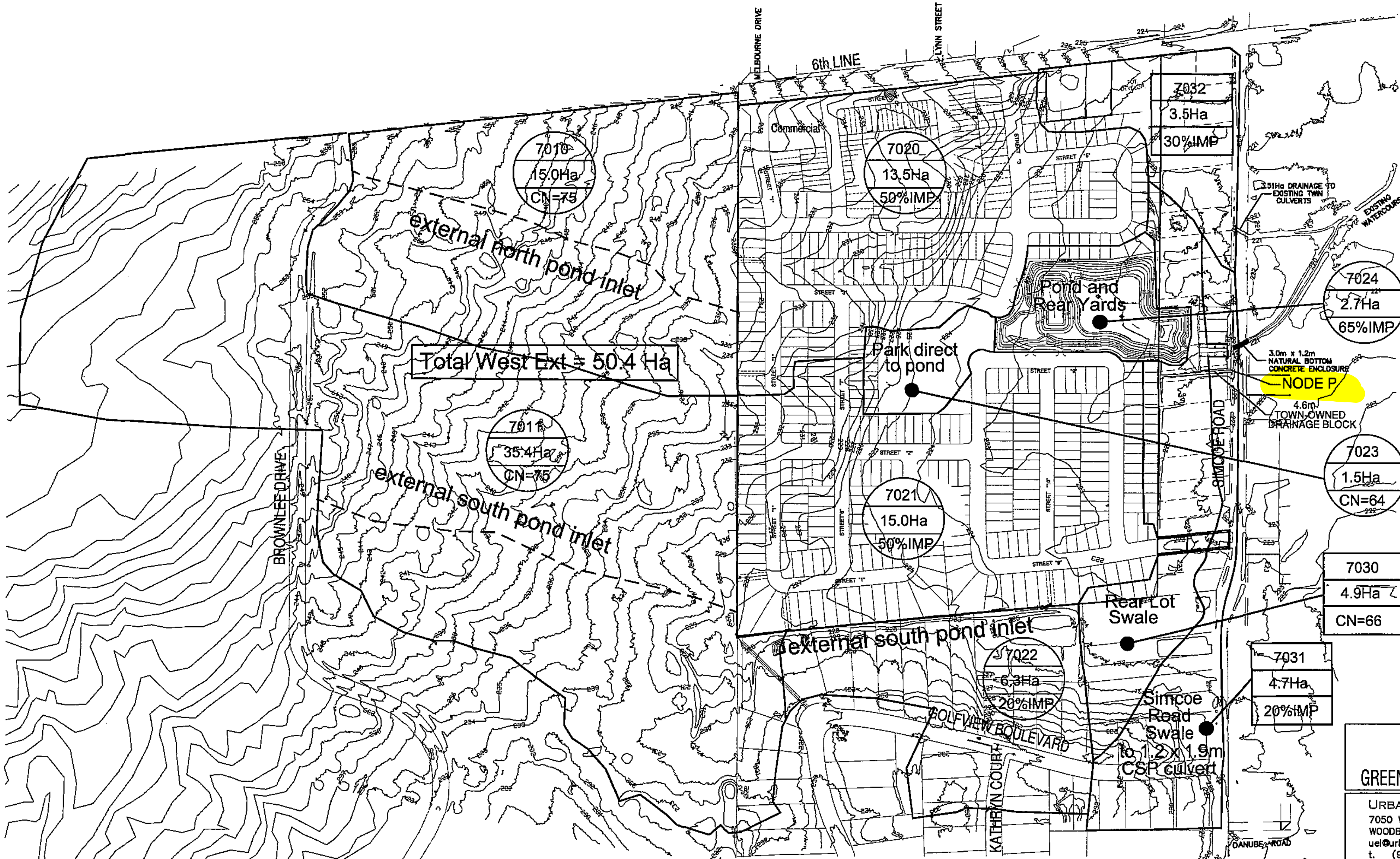
STORMWATER MANAGEMENT REPORT

BRADFORD CAPITAL
RESIDENTIAL SUBDIVISION
PART OF LOT 14, CONCESSION 5
TOWN OF BRADFORD WEST GWILLIMBURY

PREPARED FOR:

BRADFORD CAPITAL HOLDINGS INC.

April 2012
Revised October 2014
09204



CONTROLLED AREAS

UN CONTROLLED AREAS

Controlled		Uncontrolled
7020	- SUB-CATCHMENT ID -	7030
13.5Ha	- SUB-CATCHMENT AREA -	4.9Ha
50%IMP	- CURVE NUMBER OR - %IMPERVIOUS	CN=66

BRADFORD CAPITAL
RESIDENTIAL SUBDIVISION
GREEN VALLEY COMMUNITY PLAN AREA

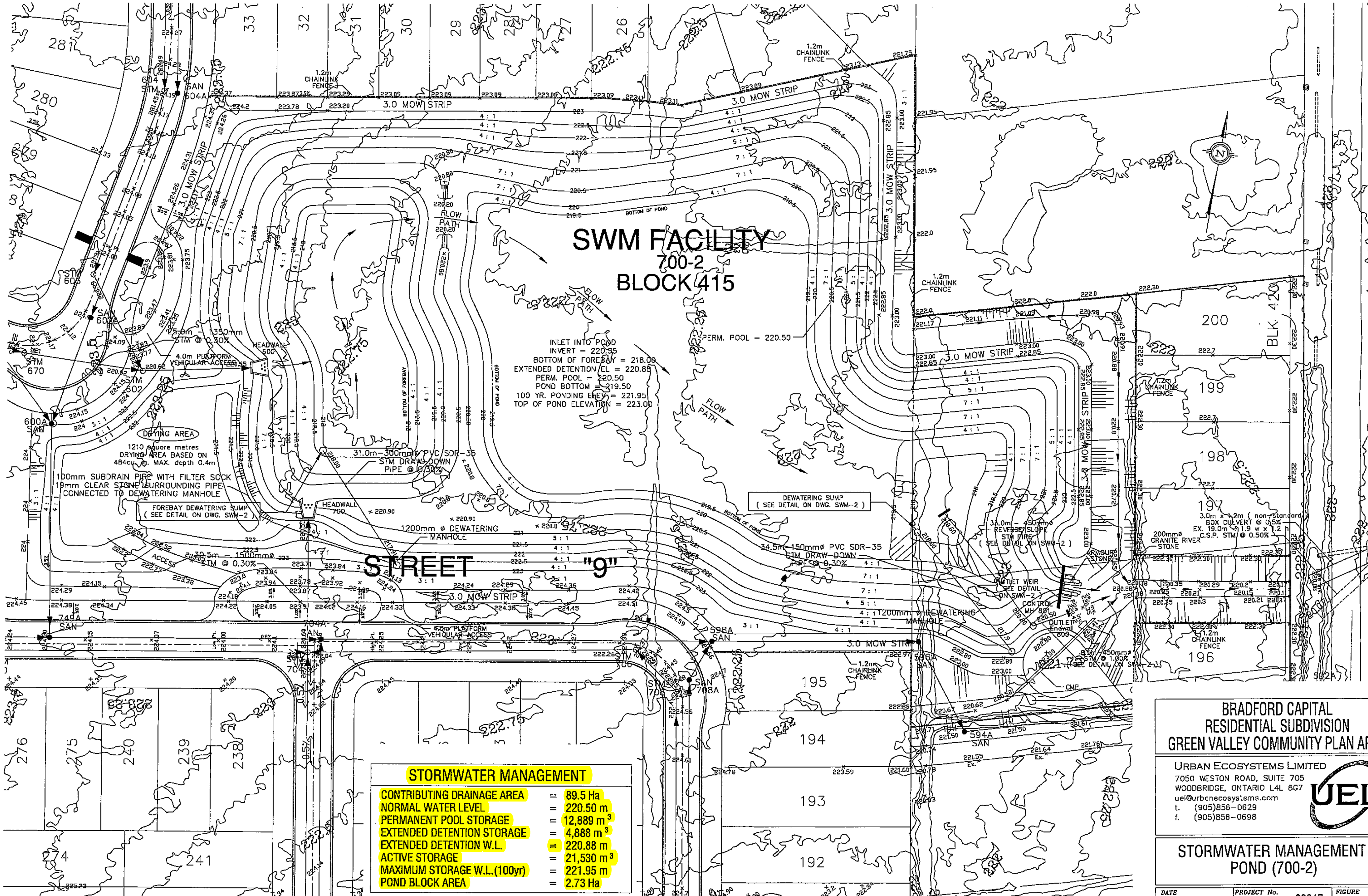
URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856-0629
f. (905)856-0698

UEL

POST-DEVELOPMENT DRAINAGE
AREA PLAN

DATE	PROJECT No.	FIGURE
OCTOBER 2014	08017	FIGURE 3

P:\2008\08017-BRADFORD-WEST\PRINTING\08017-SWM-REPORT-PRE-POST-DEVELOPMENT-DRAINAGE-FIGURES-2 and 3.dwg - Thu, 9 Oct 2014 - 11:13



STORMWATER MANAGEMENT

CONTRIBUTING DRAINAGE AREA	=	89.5 Ha
NORMAL WATER LEVEL	=	220.50 m
PERMANENT POOL STORAGE	=	12,889 m^3
EXTENDED DETENTION STORAGE	=	4,888 m^3
EXTENDED DETENTION W.L.	=	220.88 m
ACTIVE STORAGE	=	21,530 m^3
MAXIMUM STORAGE W.L.(100yr)	=	221.95 m
POND BLOCK AREA	=	2.73 Ha

BRADFORD CAPITAL
RESIDENTIAL SUBDIVISION
GREEN VALLEY COMMUNITY PLAN AREA

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856-0629
f. (905)856-0698
UEL

STORMWATER MANAGEMENT
POND (700-2)

DATE	PROJECT No.	FIGURE
JANUARY 2013	08017	FIGURE 4

ID - P:\2008\08017-BRADFORD-WEST\PRINTING\08017-SWM-REPORT-STMWATER-MANAGEMENT-POND-FIGURE-4.dwg - Thu, 9 Oct 2014 - 11:21

2.6.2 STORMWATER QUANTITY CONTROL

The flow in excess of the low flow orifice will be discharged through an adjacent weir located immediately north of the outlet control maintenance hole. This orifice/weir combination will discharge to the outlet swale through the drainage block, which directs flows to the proposed concrete box culvert under Simcoe Road.

The outlet weir consists of a stepped concrete weir with the following configuration (see Drawing SWM-2):

- an initial 1.2 m rectangular weir with crest elevation of 221.0 m up to an elevation of 221.3 m (Weir 1);
- an additional 2.8 m rectangular weir (0.8 m either side of Weir 1) with a crest elevation of 221.3 m extending up to a maximum elevation of 222.0 m (Weir 2); and
- an additional 6.0 m rectangular weir (1.6 m either side of Weir 2) with a crest elevation of 222.0 m extending up to a maximum elevation of 223.00 m. Weir 3 will act as the emergency spillway.

This stepped weir (Weirs 1 and 2), along with the 200 mm orifice will provide the control for the pond outflow. It would provide a maximum peak discharge of 4.40 m^3/s with available storage of 22,600 m^3 (EL. 222.0 m) exceeding the storage requirement of 22,200 m^3 for the 12 hour SCS 100 year design storm event. Table 2.6.3 (on the following page) provides the pond release rates and storage requirements for all the design storm events.

A VO2 model was used to establish the post development runoff from the proposed development to determine the maximum water levels of the pond and the peak discharges for the various storm events. Overland flow from the park block and rear lots adjacent to the pond, plus inflow from external areas are accounted for in the model. The discharge-storage relationship for the SWM Pond 700-2 is included in Appendix C. A copy of the VO2 model input, output and storm files are included in Appendix B and an electronic copy of the model is provided on a CD.

Table 2.6.3: Pond 700-2 Release Rates and Storage Requirements

Design Storm (year)	Design Storm Rainfall Distributions							
	4 hr Chicago		24hr Chicago		12hr SCS		24hr SCS	
	Discharge (m^3/s)	Storage (m^3)	Discharge (m^3/s)	Storage (m^3)	Discharge (m^3/s)	Storage (m^3)	Discharge (m^3/s)	Storage (m^3)
25mm	0.04	4,400						
2yr	0.10	7,500	0.20	8,800	0.18	8,600	0.21	9,000
5yr	0.39	11,100	0.81	12,500	0.75	12,400	0.98	13,000
10yr	0.89	12,700	1.57	14,500	1.58	14,500	1.88	15,200
25yr	1.68	14,700	2.64	17,200	2.74	17,400	3.12	18,400
50yr	2.33	16,400	3.50	19,300	3.68	19,800	4.12	20,900
100yr	2.92	17,900	4.34	21,500	4.64	22,200	5.32	23,500

Peak flows at Simcoe Road and at Point P, for the proposed and existing conditions are tabulated below in the Table 2.6.4, for all design storms.

Table 2.6.4 : Pre & Post development Flow Rates – Simcoe Road and Point P

Design Storm (year)	Post Development Flow Rates (m^3/s)							
	4 hr Chicago		24hr Chicago		12hr SCS		24hr SCS	
	Existing	Post-Development[1]	Existing	Post-Development[1]	Existing	Post-Development[1]	Existing	Post-Development[1]
2yr	1.03	0.19(0.15)	1.43	0.27(0.21)	1.39	0.28(0.20)	1.43	0.25(0.23)
5yr	1.95	0.43(0.42)	2.75	0.90(0.88)	2.68	0.83(0.82)	2.75	1.09(1.07)
10yr	2.68	0.99(0.97)	3.76	1.74(1.71)	3.67	1.74(1.71)	3.76	2.09(2.05)
25yr	3.71	1.86(1.82)	5.17	2.92(2.86)	5.07	3.03(2.97)	5.17	3.48(3.40)
50yr	4.56	2.59(2.53)	6.34	3.89(3.80)	6.23	4.09(3.99)	6.34	4.60(4.49)
100yr	5.34	3.24(3.16)	7.59	4.83(4.71)	7.41	5.16(5.03)	7.59	5.93(5.79)
Regional (Hazel)	-	-	-	-	-	-	*12.18*	11.76(11.47)

Notes:- 1. Peak flow values at Simcoe Road are based on the total contributing area west of Simcoe Road (102.8ha) and include the values in brackets, which are flows at Point P only. The flows at Point P drain through the proposed Simcoe Road culvert (from 99.0ha).

Outfall Channel and Proposed Simcoe Road Culvert

SCS, 2024:
The flows in this column appear to be incorrectly reported. For the 24-Hour SCS Storm distribution, Refer to Table 6.4 from the Green Valley Community Plan MESP (RJ Burnside, 2008), included in Appendix B-6.

As previously mentioned, flows from the pond outlet discharge through being conveyed by an outfall channel under Simcoe Road by the propo outfall channel has a roughly trapezoidal cross-section and approximate a bottom width of 5 m, a top width of 18 m, a height of 1.5 m, a length of 35

A review of the hydraulics of existing Simcoe Road culverts identifie capacity to convey the major storm post-development flows without sur Road (low elevation 221.70 m). It should be noted that twin 0.9 m diam approximately 140 m north were not considered in the hydraulic analysis. However, as part of municipal works proposed for Simcoe Road, the existing culverts will be replaced at that time with a 3.0 m x 1.2 m concrete box culvert.

The HEC-RAS hydraulic model was used to determine the size of the proposed culvert and analyse its ability to convey storm flows. The analysis also yielded water surface elevations upstream and downstream of the proposed culvert which helped in understanding the extent of flooding under larger storm events. The scope of the model encompassed the length of Tributary 1, starting from the outfall channel downstream of the pond and concluding downstream of 6th Line, including the oval CSP culvert on 6th Line. The model was also used to guide and verify the design of the residential development on the east side of Simcoe Road. As such, results within the model relating to the eastern development are discussed in a separate report (Bradford East Residential Developments SWM Report, Sernas 2014). A summary of the results of the hydraulic analysis are included in Appendix D and an electronic copy of the model is provided on a CD.

Flows resulting from the 100 year and Regional storm events were obtained from the VO2 hydrology model discussed in the preceding sections.

Appendix B-6 Green Valley Community Plan MESP Excerpts

SCS consulting group ltd

Town of Bradford West Gwillimbury
Master Environmental Servicing Plan
Green Valley Community Plan

Prepared by

R.J. Burnside & Associates Limited
16775 Yonge Street Suite 200 Newmarket ON L3Y 8J4 Canada

June 2008

File No: MSO 09139

Table 6.4 Pre- and Post-Development Controlled Flow Rates (m^3/s)

Green Valley Subwatersheds	25 mm 4 hr. Chicago	4 hr. Chicago						24 hr. Chicago						24 hr. SCS					
		2 yr.	5 yr.	10 yr.	25 yr.	50 yr.	100 yr.	2 yr.	5 yr.	10 yr.	25 yr.	50 yr.	100 yr.	2 yr.	5 yr.	10 yr.	25 yr.	50 yr.	100 yr.
Green Valley catchments (Point P – at Simcoe Road)	0.45 (0.29)	0.96 (0.71)	1.83 (1.42)	2.51 (1.94)	3.47 (2.88)	4.26 (3.66)	5.00 (4.36)	1.32 (0.93)	2.50 (1.86)	3.39 (2.74)	4.63 (3.95)	5.65 (4.92)	6.62 (5.91)	0.98 (0.73)	1.88 (1.58)	2.56 (2.34)	3.48 (3.26)	4.20 (3.95)	4.94 (4.64)
Green Valley catchments (Point Q – at Morris Rd. canal)	0.67 (0.62)	1.51 (1.35)	3.20 (2.85)	4.54 (4.08)	6.53 (5.99)	8.19 (7.59)	9.70 (9.06)	2.07 (1.77)	4.41 (3.87)	6.27 (5.65)	8.89 (8.25)	10.90 (10.19)	14.79 (14.53)	1.68 (1.44)	3.80 (3.43)	5.42 (5.06)	7.75 (7.38)	9.49 (9.09)	12.52 (12.07)
Green Valley catchments (Point R – at property boundary)	0.08 (0.06)	0.21 (0.13)	0.46 (0.29)	0.67 (0.42)	0.98 (0.61)	1.24 (0.77)	1.48 (0.98)	0.32 (0.20)	0.68 (0.43)	0.98 (0.62)	1.40 (0.89)	1.76 (1.28)	2.11 (1.69)	0.22 (0.15)	0.45 (0.28)	0.63 (0.40)	0.88 (0.76)	1.09 (1.03)	1.30 (1.29)

Legend: 0.45 = pre-development flow
(0.20) = post-development controlled flow

Appendix B-7 CLI-ECA Criteria – 90th Percentile Retention

SCS consulting group ltd

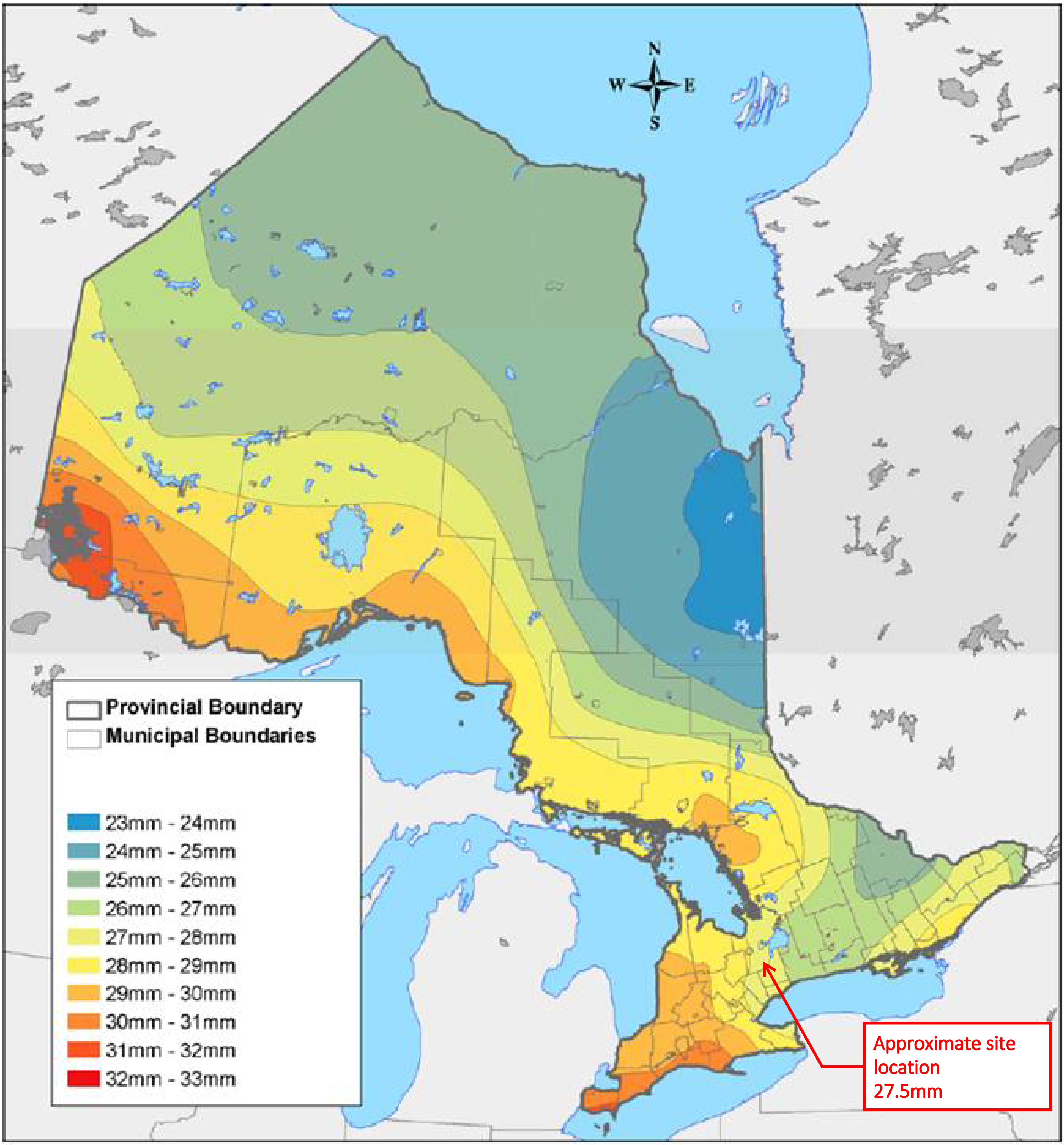


Figure 3.67 – Recommended Regional 90% Percentile Volume Targets for Ontario
(represented by the 95th percentile daily rainfall contours April - October, where daily volume exceeds 2mm).

Source: STEP LID Wiki (retrieved October 2024)

Appendix A – Stormwater Management Criteria

1.0 Applicability of Criteria

1.1 The criteria listed under Table A1 of this Appendix applies to all drainage areas greater than 0.1 ha, with the construction erosion and sediment control criteria applying also to sites <0.1 ha;

1.2 Despite condition 1.1 of Appendix A, if some or all of the criteria listed under Table A1 of this Appendix have been assessed for and addressed in other adjacent developed lands to the project site through a subwatershed plan or equivalent study, then those criteria may not be applicable to the project site.

Table A1. Performance Criteria

Water Balance [1]	**FOR DEVELOPMENT SCENARIOS** [2] **Assessment Studies:** i) Control [3] as per the criteria identified in the water balance assessment completed in one or more of the following studies [15], if undertaken: a watershed/subwatershed plan; Source Protection Plan (Assessment Report component); Master Stormwater Management Plan, Master Environmental Servicing Plan; Class EA, or similar approach that transparently considers social, environmental and financial impacts; or local site study including natural heritage, Ecologically significant Groundwater Recharge Areas (EGRA), inflow and infiltration strategies. The assessment should include sufficient detail to be used at a local site level and consistent with the various level of studies; OR **IF Assessment Studies in i) NOT completed:** ii) Control [3] the recharge [4] to meet Pre-development [5] conditions on property; **OR** iii) Control [3] the runoff from the 90th percentile storm event. **Lake Simcoe Watershed Municipalities:** iv) Control [3] as per the evaluation of anticipated changes in water balance between Pre-development and post-development assessed through a Stormwater management plan in support of an application for Major Development [6]. The assessment should include sufficient detail to be used at a local site level. If it is demonstrated, using the approved water balance estimation methods [7], that the site's post to Pre-development water balance cannot be met, and Maximum Extent Possible [8] has been attained, the proponent may use Lake Simcoe and Region Conservation Authority's (LSRCA) Recharge Compensation Program [9]. **FOR RETROFIT SCENARIOS** [10] **Assessment Studies:** i) Control as per criteria identified in the water balance assessment completed in one or more of the following studies: a watershed/subwatershed plan, Source Protection Plan (Assessment Report component), Master Stormwater Management Plan, Master Environmental Servicing Plan,

	Class EA, or local site study including natural heritage, EGRA, inflow and infiltration strategies, if undertaken. The assessment should include sufficient detail to be used at a local site level and consistent with the various level of studies; **OR** ii) If constraints [11] identified in i), then control [3] as per Maximum Extent Possible [8] based on environmental site feasibility studies or address local needs[14]. **IF Assessment Studies in i) NOT completed:** iii) Control [3] the recharge [4] to meet Pre-development [5] conditions on property; **OR** iv) Control [3] the runoff from the 90th percentile storm event.
Water Quality [1]	**FOR DEVELOPMENT SCENARIOS** [2] All of the following criteria must be met for development scenarios: **General:** i) Characterize the water quality to be protected and Stormwater Contaminants (e.g., suspended solids, nutrients, bacteria, water temperature) for potential impact on the Natural Environment, and control as necessary, **OR** ii) As per the watershed/subwatershed plan, similar area-wide Stormwater study, or Stormwater management plan to minimize, or where possible, prevent increases in Contaminant loads and impacts to receiving waters. **Suspended Solids:** i) Control [3] 90th percentile storm event and if conventional methods are necessary, then enhanced, normal, or basic levels of protection (80%, 70%, or 60% respectively) for suspended solids removal (based on the receiver). **Phosphorus:** i) Minimize existing phosphorus loadings to Lake Erie and its tributaries, as compared to 2018 or conditions prior to the proposed development, **OR** ii) Minimize phosphorus loadings to Lake Simcoe and its tributaries. Proponents with development sites located in the Lake Simcoe watershed shall evaluate anticipated changes in phosphorus loadings between Pre-development and post-development through a Stormwater management plan in support of an application for Major Development [6]. The assessment should include sufficient detail to be used at a local site level. If, using the approved phosphorus budget tool [12], it is demonstrated that the site's post to Pre-development phosphorus budget cannot be met, and Maximum Extent Possible [8] has been attained, the proponent may use LSRCA's Phosphorus Offsetting Policy [9]. **FOR RETROFIT SCENARIOS** [10] i) Improve the level of water quality control currently provided on site; **AND** ii) As per the 'Development' criteria for Suspended Solids, **OR** iii) **If 'Development' criteria for Suspended Solids cannot be met**, Works are designed as a multi-year retrofit project, in accordance with a rehabilitation study or similar area-wide Stormwater study, such that the completed treatment train will achieve the 'Development' criteria for Suspended Solids or local needs[14], within ten (10) years; **OR**

	iv) If constraints [11] identified in ii) and iii), then control [3] as per Maximum Extent Possible [8] based on environmental site feasibility studies.
Erosion Control (Watershed) [1]	**FOR DEVELOPMENT SCENARIOS** [8] i) As per erosion assessment completed in watershed/subwatershed plan, Master Stormwater Management Plan, Master Environmental Servicing Plan, Drainage Plan, Class EA, local site study, geomorphologic study, or erosion analysis; **OR** ii) As per the Detailed Design Approach or Simplified Design Approach methods described in the Stormwater Management Planning and Design Manual: a. The Detailed Design Approach may be selected by the proponent for any development regardless of size and location within the watershed provided technical specialists are available for the completion of the technical assessments; or considered more appropriate than the simplified approach given the size and location of the development within the watershed and the sensitivity of the receiving waters in terms of morphology and habitat function. b. The Simplified Design Approach may be adopted for watersheds whose development area is generally less than twenty hectares AND either one of the following two conditions apply: 1) The catchment area of the receiving channel at the point-of-entry of Stormwater drainage from the development is equal to or greater than twenty-five square kilometres; or 2) Meets the following conditions: • The channel bankfull depth is less than three quarters of a metre; • The channel is a headwater stream; • The receiving channel is not designated as an Environmentally Sensitive Area (ESA) or Area of Natural or Scientific Interest (ANSI) and does not provide habitat for a sensitive aquatic species; • The channel is stable to transitional; and • The channel is slightly entrenched; **OR** iii) In the absence of a guiding study, detain at minimum, the runoff volume generated from a 25 mm storm event over 24 to 48 hours. **FOR RETROFIT SCENARIOS** [10] i) If approaches i-iii) under 'Development Scenarios' are not feasible as per identified constraints [11], then improve the level of erosion control [3] currently provided on site to Maximum Extent Possible [8] based on environmental site feasibility studies or address local needs[14].
Water Quantity (Minor and Major System) [1]	**i)** As per municipal standards, Master Stormwater Management Plan, Class EA, Individual EA and/or ECA, as appropriate for the type of project [13]
Flood Control (Watershed Hydrology) [1]	**FOR DEVELOPMENT SCENARIOS** [2] i) Manage peak flow control as per watershed/subwatershed plans, municipal criteria being a minimum 100 year return storm (except for site-specific considerations and proximity to receiving water bodies), municipal guidelines and standards, Individual/Class EA, ECA, Master Plan, as appropriate for the type of project [13].

	FOR RETROFIT SCENARIOS [10] i) If approaches i) under 'Development Scenarios' are not feasible as per identified constraints [11], then improve the level of flood control [3] currently provided on site to Maximum Extent Possible [8] based on environmental site feasibility studies.
Construction Erosion and Sediment Control	i) Manage construction erosion and sediment control through development and implementation of an erosion and sediment control (ESC) plan. The ESC plan shall: a. Have regard to Canadian Standards Association (CSA) W202 Erosion and Sediment Control Inspection and Monitoring Standard (as amended); OR b. Have regard to Erosion and Sediment Control Guideline for Urban Construction 2019 by TRCA (as amended). ii) Be prepared by a QP for sites with drainage areas greater than 5 ha or if specified by the Owner for a drainage lower than 5 ha. iii) Installation and maintenance of the ESC measures specified in the ESC plan shall have regard to CSA W208:20 Erosion and Sediment Control Installation and Maintenance (as amended). iv) For sites with drainage areas greater than 5 ha, a QP shall inspect the construction ESC measures, as specified in the ESC plan.
Footnote	1. Where the opportunity exists on your project site or the same subwatershed, reallocation of development elements may be optimal for management as described in footnote [3]. 2. Development includes new development, redevelopment, infill development, or conversion of a rural cross-section into an urban cross-section. 3. Stormwater volumes generated from the geographically specific 90th percentile rainfall event on an annual average basis from all surfaces on the entire site are targeted for control. Control is in the following hierarchical order, with each step exhausted before proceeding to the next: 1) retention (infiltration, reuse, or evapotranspiration), 2) LID filtration, and 3) conventional Stormwater management. Step 3, conventional Stormwater management, should proceed only once Maximum Extent Possible [8] has been attained for Steps 1 and 2 for retention and filtration. 4. Recharge is the infiltration and movement of surface water into the soil, past the vegetation root zone, to the zone of saturation, or water table. 5. Pre-development is defined as the more stringent of the two following scenarios: 1) a site's existing condition, or 2) as defined by the local municipality. 6. Major Development has the same meaning as in the Lake Simcoe Protection Plan, 2009. 7. Currently, the approved tool by LSRCA for calculating the water balance is the Thornthwaite-Mather Method. Other tools agreed upon by relevant approval agencies (e.g., LSRCA, municipality, or Ministry) may also be acceptable, subject to written acceptance by the Director. 8. Maximum Extent Possible means maximum achievable Stormwater volume control through retention and LID filtration engineered/landscaped/technical Stormwater practices, given the site constraints [11]. 9. Information pertaining to LSRCA's Recharge Compensation Program and Phosphorus Offsetting Policy is available on LSRCA's website (lsrca.on.ca), or in "Water Balance Recharge Policy for the Lake Simcoe Protection Plan", dated July 2021, and prepared by Lake Simcoe Region Conservation Authority and "Phosphorus Offsetting Policy", dated July 2021, and prepared by Lake Simcoe Region Conservation Authority.

	10. Retrofit means: 1) a modification to the management of the existing infrastructure, 2) changes to major and minor systems, or 3) adding Stormwater infrastructure, in an existing area on municipal right-of-way, municipal block, or easement. It does not include conversion of a rural cross-section into an urban cross-section. 11. Site constraints must be documented. A list of site constraints can be found in Table A2. 12. Tools for calculating phosphorus budgets may include the Ministry's Phosphorus Tool, the Low Impact Development Treatment Train Tool developed in partnership by TRCA, LSRCA, and Credit Valley Conservation (CVC), or other tools agreed upon by the LSRCA and other relevant approval agencies including the municipality. 13. Possible to look at combined grey infrastructure and LID system capacity jointly. 14. Local needs include requirements for water quality, erosion, and/or water balance retrofits identified by the owner through ongoing operation and maintenance of the stormwater system, including inspection of local receiving systems and the characterization of issues requiring remediation through retrofit controls. 15. All studies shall conform with Ministry policies. If any conclusions in the studies negate policy, then the project will require a direct submission to the Ministry for review through an application pertaining to a Schedule C Notice.

Table A2. Stormwater Management Practices Site Constraints

	Site Constraints
a)	Shallow bedrock [1], areas of blasted bedrock [2], and Karst;
b)	High groundwater [1] or areas where increased infiltration will result in elevated groundwater levels which can be shown through an appropriate area specific study to impact critical utilities or property (e.g., susceptible to flooding);
c)	Swelling clays [3] or unstable sub-soils;
d)	Contaminated soils (e.g., brownfields);
e)	High Risk Site Activities including spill prone areas;
f)	Prohibitions and or restrictions per the approved Source Protection Plans and where impacts to private drinking water wells and /or Vulnerable Domestic Well Supply Areas cannot be appropriately mitigated;
g)	Flood risk prone areas or structures and/ or areas of high inflow and infiltration (I/I) where wastewater systems (storm and sanitary) have been shown through technical studies to be sensitive to groundwater conditions that contribute to extraneous flow rates that cause property flooding / Sewer back-ups;
h)	For existing municipal rights-of-way infrastructure (e.g., roads, sidewalks, utility corridor, Sewers, LID, and trails) where reconstruction is proposed and where surface and subsurface areas are not available based on a site-specific assessment completed by a QP;
i)	For developments within partially separated wastewater systems where reconstruction is proposed and where, based on a site-specific assessment completed by a QP, can be shown to: i Increase private property flood risk liabilities that cannot be mitigated through design; ii Impact pumping and treatment cost that cannot be mitigated through design; or

iii	Increase risks of structural collapse of Sewer and ground systems due to infiltration and the loss of pipe and/or pavement support that cannot be mitigated through design.
j)	Surface water dominated or dependent features including but not limited to marshes and/or riparian forest wetlands which derive all or a majority of their water from surface water, including streams, runoff, and overbank flooding. Surface water dominated or dependent features which are identified through approved site specific hydrologic or hydrogeologic studies, and/or Environmental Impact Statements (EIS) may be considered for a reduced volume control target. Pre-consultation with the MECP and local agencies is encouraged;
k)	Existing urban areas where risk to water distribution systems has been identified through assessments to meet applicable drinking water requirements, including Procedures F-6 and F-6-1, and substantiated by a QP through an appropriate area specific study and where the risk cannot be reasonably mitigated per the relevant design guidelines;
l)	Existing urban areas where risk to life, human health, property, or infrastructure has been is identified and substantiated by a QP through an appropriate area specific study and where the risk cannot be reasonably mitigated per the relevant design guidelines;
m)	Water reuse feasibility study has been completed to determine non-potable reuse of Stormwater for onsite or shared use;
n)	Economic considerations set by infrastructure feasibility and prioritization studies undertaken at either the local/site or municipal/system level [4].

Footnote:

1. May limit infiltration capabilities if bedrock and groundwater is within 1m of the proposed Facility invert per Table 3.4.1 of the LID Stormwater Planning and Design Guide (2010, V1.0 or most recent by TRCA/CVC). Detailed assessment or studies are required to demonstrate infiltration effects and results may permit relaxation of the minimum 1m offset.
2. Where blasting is more localized, this constraint may not be an issue elsewhere on the property. While infiltration-based practices may be limited in blasted rock areas, other forms of LID, such as filtration, evapotranspiration, etc., are still viable options that should be pursued.
3. Swelling clays are clay soils that is prone to large volume changes (swelling and shrinking) that are directly related to changes in water content.
4. Infrastructure feasibility and prioritization studies should comprehensively assess Stormwater site opportunities and constraints to improve cost effectiveness, environmental performance, and overall benefit to the receivers and the community. The studies include assessing and prioritizing municipal infrastructure for upgrades in a prudent and economically feasible manner.

Appendix B-8 Wastewater Background Excerpts

SCS consulting group ltd

Town of Bradford West Gwillimbury
2023 WPCP/WWC Summary Report

Environmental Compliance Approval
No. 3705-BGRP97

Air Certificate of Approval
No. 9408-7SFP7B

Consolidated Linear Infrastructure Environmental Compliance Approval
No. 116-W601

Wastewater Treatment Facility Class IV
Certification No. 297

Wastewater Collection Facility Class III
Certification No. 3060

February 2024

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C. TSS Influent Historical Trend
D. Total Phosphorus Influent Historical Trend
E. TKN Influent Historical Trend
F. pH Effluent Historical Trend
G. TSS Effluent Historical Trend
H. E.Coli Effluent Historical Trend
I. CBOD5 Effluent Historical Trend
J. TAN Effluent Historical Trend
K. Total Phosphorus Effluent Historical Trend
L. Wellhead Protection Area Map

1. Introduction

This report contains the relevant information required to meet the annual reporting requirements outlined within the Town of Bradford West Gwillimbury's (Town) Water Pollution Control Plant (WPCP) Environmental Compliance Approval (ECA) No.3705-BGRP97 and the Wastewater Collection System Consolidated Linear Infrastructure (CLI) ECA No. 116-W601. This report provides a performance summary for the time period of January 1st to December 31st 2023.

Compliance with regulatory requirements, policies, and the ECA's continue to be monitored through the Supervisory Control and Data Acquisition (SCADA) system, overseen by certified operations staff, compliance staff, accredited laboratory and other regular reporting mechanisms.

1.1 Service Information

The Town's Wastewater Collection System (WWC) and WPCP collectively services a population of approximately 35,430. This includes 11,495 residential connections and 315 general connections (industrial, commercial and institutional).

The WPCP has a rated capacity of 19,400 cubic meters per day (m^3/day).

1.2 Regulatory Requirements

In Ontario, municipal wastewater treatment/collection and discharge is governed by a number of regulatory acts, regulations and instruments. This includes but is not limited to the following:

- Ontario Environmental Protection Act (EPA)
- Ontario Water Resources Act (OWRA)
- Environmental Compliance Approval(s) (ECA)
- Canadian Environmental Protection Act (CEPA)
- Wastewater System Effluent Regulation (WSER)

More specifically, this report fulfills the requirements set out within the Town of BWG's ECA No. 3705-BGRP97 and CLI ECA 116-W601. The associated stipulations are outlined in Table 1 and 2 on the following pages.

Table 1. ECA Reporting Requirements

ECA Reporting Requirement	Report Section
A. A summary and interpretation of all influent monitoring data, and a review of the historical tend of the sewage characteristics and flow rates.	**2.4.1**
B. A summary and interpretation of all Final Effluent monitoring data, including concentration, flow rates, loading and a comparison to the design objectives and compliance limits in this Approval, including an overview of the success and adequacy of the Works.	**2.3, 2.4.2, 2.4.3**
C. A summary of any deviation from the monitoring schedule and reasons for the current reporting year and a schedule for the next reporting year.	**2.4**
D. A summary of all operating issues encountered and corrective actions taken.	**7**
E. A summary of all normal and emergency repairs and maintenance activities carried out on any major structure, equipment, apparatus or mechanism forming part of the Works.	**2.5**
F. A summary of any effluent assurance or control measures undertaken.	**2, 7.4**
G. A summary of the calibration and maintenance carried out on all Influent and Final Effluent monitoring equipment to ensure that the accuracy is within the tolerance of that equipment as required in this approval or recommended by the manufacturer.	**2.5**
H. A summary of efforts made to achieve the design objectives in this Approval, including an assessment of the issues and recommendations for pro-active actions if any are required under the following situations: I. When any of the design objectives is not archived more than 50% of the time in a year, or there is an increasing trend in deterioration of Final Effluent quality. II. When the Annual Average Daily Influent Flow reaches 80% of the Rated Capacity.	**2**
I. A tabulation of the volume of sludge generated, an outline of anticipated volumes to be generated in the next reporting period and a summary of the locations to where the sludge was disposed.	**5**
J. A summary of any complaints received and any steps taken to address the complaints.	**4**
K. A summary of all Bypasses, Overflows, other situations outside of Normal Operating Conditions and spills within the meaning of Part X of EPA and abnormal discharge events.	**7**
L. A summary of all Notice of Modification to Sewage Works completed under Paragraph I. d. of Condition 10, including a report on status of implementation of all modification.	**2.2**
M. A summary of efforts made to achieve conformance with Procedure F-5-1 including but not limited to projects undertaken and competed in the sanitary sewer system that result in overall Bypass/ Overflow elimination including expenditures and proposed projects to eliminate Bypass/ Overflows with estimated budget forecast for the year following that for which the report is submitted.	**2, 3.3, 7**

Table 2. CLI ECA Reporting Requirement

CLI ECA Reporting Requirement	Report Section

A. If applicable, includes a summary of all required monitoring data along with an interpretation of the data and any conclusion drawn from the data evaluation about the need for future modifications to the Authorized System or system operations.	**3.4**
B. Includes a summary of any operating problems encountered and corrective actions taken.	**3, 7**
C. Includes a summary of all calibration, maintenance, and repairs carried out on any major structure, equipment, apparatus, mechanism, or thing forming part of the Municipal Sewage Collection System.	**3.4**
D. Includes a summary of any complaints related to the Sewage Works received during the reporting period and any steps taken to address the complaints.	**4**
E. Includes a summary of all Alterations to the Authorized System within the reporting period that are authorized by this Approval including a list of Alterations that pose a Significant Drinking Water Threat.	**3.3**
F. Includes a summary of all Collection System Overflow(s) and Spill(s) of Sewage, including: I. Dates; II. Volumes and durations; III. If applicable, loadings for total suspended solids, BOD, Total Phosphorus, and total Kjeldahl nitrogen, and sampling results for E.coli; IV. Disinfection, if any; and V. Any adverse impact(s) and any corrective actions, if applicable.	**7**
G. Includes a summary of efforts made to reduce Collection System Overflows, Spills, STP Overflows, and/or STP Bypasses, including the following items, as applicable I. A description of projects undertaken and completed in the Authorized System that result in overall overflow reduction or elimination including expenditures and proposed projects to eliminate overflows with estimated budget forecast for the year following that for which the report is submitted. II. Details of the establishment and maintenance of a PPCP including a summary of project progresses compared to the PPCP's timelines. III. An assessment of the effectiveness of each action taken. IV. An assessment of the ability to meet Procedure F-5-1 or Procedure F-5-5 objectives (as applicable) and if able to meet the objectives, an overview of next steps and estimated timelines to meet the objectives. V. Public reporting approach including proactive efforts.	**2, 3, 7**

1.3 Laboratory and Analysis

1.3.1 External Analysis

In 2023 the WPCP utilized SGS Canada Inc., a facility which holds accreditation through the Canadian Association of Laboratory Accreditation (CALA). Their Accreditation No. is 1001225. SGS Canada Inc. performed all of the required analysis on the WPCP influent and effluent samples in accordance with the prescribed frequency of the WPCP ECA. Below is a list of the parameters analyzed:

- Biochemical Oxygen Demand (BOD5)[1]
- Unionized Ammonia[2]
- Carbonaceous Biochemical Oxygen Demand (CBOD5)
- E.coli[2]
- Total Suspended Solids (TSS)
- Total Ammonia Nitrogen (TAN)
- Total Phosphorus
- Total Kjeldahl Nitrogen (TKN)
- Nitrite as Nitrogen[2]
- Nitrate as Nitrogen[2]

1.3.2 In-House Analysis

In addition to the sample analysis conducted by the aforementioned accredited laboratory, the WPCP has its own laboratory on-site. The on-site laboratory allows operational analysis to be conducted to inform process adjustments and improvements to enhance effluent quality. The parameters analyzed in the internal laboratory are as follows:

- pH
- Temperature
- Total Phosphorus
- TAN
- Alkalinity

1.4 Maintenance

1.4.1 General Description

In order to ensure that all WPCP and Collection System equipment is reliable and in good working order, the Town has a Preventative Maintenance (PM) program in place for all wastewater plant and collection equipment and associated facilities. The PM program is performed as recommended by the original equipment manufacturer as per the WPCP ECA section (8) Operation and Maintenance and WWC System Schedule E Section (3) Operations and Maintenance. Inspection, testing and calibration of electrical, mechanical, instrumentation and SCADA equipment is performed and documented by fully trained and qualified technicians. The equipment includes process equipment, heating, ventilation and air conditioning (HVAC) systems, standby power and high voltage switchgear. Identified PM deficiencies are flagged and scheduled for repair in a

[1] Influent analysis only.

[2] Effluent analysis only.

priority manner. Critical process equipment that is not performing to specification is repaired or replaced immediately.

In order to conduct efficient and effective maintenance at each facility, plant maintenance activities are tracked on a computerized maintenance management system (CMMS). The CMMS monitors and schedules all of the WPCP and associated facilities maintenance plans, issues work orders for these plans and any other scheduled and unscheduled work that may be required.

The Wastewater Division manages approximately 3,300 PM work orders that are automatically generated by the current PM program, WorkTech. The work orders are generated as specified by the equipment's operations & maintenance manual.

2. WPCP

2.1 Facility Description

The WPCP is located at 225 Dissette Street, Bradford West Gwillimbury.

The first treatment system was constructed in 1962 and consisted of a pumping station and a waste stabilization pond. The facility has undergone various upgrades since the initial plant was constructed.

In 2012 the Town's WPCP and Collection System were re-rated to its current classification. The WPCP is rated as a Class four (4) and Collection System as a Class three (3).

Currently the facility is comprised of Plant B, C and D.

Plant B has a design average daily flow of 3,075m^3/day. The treatment process consists of biological treatment through aeration tanks and two (2) clarifiers.

Plant C has a design average daily flow of 4,325m^3/day, consisting of two (2) sequencing batch reactors (SBR's).

Plant D has a design average daily flow of 12,000m^3/day. There are four (4) aeration tanks with a combined volume of 10,560m^3, as well as four (4) clarifiers.

Following primary and secondary treatment wastewater is directed to tertiary treatment. In tertiary treatment wastewater flows through sand filters and undergoes ultra-violet (UV) disinfection. Alum Sulfate coagulant is added to wastewater at several places in the treatment train for phosphorus removal. Finally, upon reaching rigorous standards, treated effluent is discharged into the West Holland River through the final effluent channel.

In 2019 the WPCP was issued the current ECA 3705-BGRP97, revoking ECA No. 9725-8W4QSG. The amended ECA was a result of a regulatory update to have Limited Operational Flexibility (LOF) added to the ECA. The amended ECA was completed to assist in optimization efforts of the WPCP. The amendment was administrative and did not require technical review. Although the effluent TAN objective and the limit timeframe was adjusted to align with seasonal changes.

In 2022, the Town's Wastewater Collection System was issued its first CLI ECA 116-W601, the issuance of this approval revoked all other Town owned ECA's within the collection system.

Table 3 below identifies the current WPCP rated capacity, 2023 service area, and other applicable information regarding the operation of the WPCP.

Table 3. Water Pollution Control Plant Details

Water Pollution Control Plant	
Rated Capacity	19,400m^3/day
Service Area	Bradford West Gwillimbury
2023 Service Population	35,430
In-service Date	Plant B 1982 Plant C 1997 Plant D 2009
Effluent Receiver	West Holland River
Major Processes	
Plant B	Extended Aeration
Plant C	Sequencing Batch Reactors (SBR)
Plant D	Extended Aeration
	Tertiary treatment
	U.V Disinfection Continuous Discharge
	Biosolids Storage Lagoons 20,000m^3 (only 10,000m^3 aerated)
	Digester Sludge Stabilization
	Biosolids Storage Tanks 25,000m^3
	Emergency Sewage Overflow Pond 44,000m^3

2.2 Notice of Modification to Sewage Works

There were three (3) Notice of Modification to Sewage Works prepared in 2023. The notices outlined the replacement of a bar screen, a fitting installation on the septage receiving hatch, and the replacement of a fine bubble aeration system.

The first Notice of Modification to Sewage Works of 2023 was related to the bar screen. The existing standby manual bar screen in the Headworks was replaced with a new mechanical bar screen. This project has been completed.

The installation of a cam-lock fitting to the septage receiving hatch was the second Notice of Modification of Sewage Works. This project has been completed.

The third Notice was for the replacement of an aging fine bubble aeration system with a new fine bubble aeration system in the Sequencing Batch Reactors of Plant C. The existing system was replaced due to the aging of the existing system. This project was completed.

2.3 Flow Monitoring Data

Influent and effluent flows are monitored and recorded at the BWG WPCP, the following subsection explores the data collected in 2023. Table 4 and 5 outline the total flows both received from the BWG collection system and discharged into the West Holland River.

Plant B was brought back online from September 21, 2023 to November 16, 2023 as shown in Figure 2. Only influent flow is measured for Plant B individually. The effluent flows for Plant B are captured within Plant C's effluent flows as Plant B flows into Plant C Filter building. Influent flows for Plant B are estimates because of suspected errors in the flow meters readings. The Plant B influent readings are adjusted based on the ratio of effluent to influent. Plant B was brought online to provide treatment capacity during the upgrade of diffusers in the SBR's of Plant C.

In 2023 there were four (4) events, described in further detail below, where flow monitoring recording was interrupted, all events were reported to the MECP Barrie District Office. The Town's WPCP maintained continuous monitoring and recording of influent and effluent flow as required in Condition 9 of the ECA.

On March 14th and 15th maintenance was completed on the WPCP Headworks Building PLC. The Headworks Building is where influent data is collected from the flow meter for SCADA. On March 15th a SCADA review revealed that the recorded influent flow was not accurate, an error in the transfer of data recorded lower flows than expected. The Town's SCADA provider corrected the issue. There were no gaps within the flow trending, flow monitoring was maintained at all times by the influent flow meters. The Town maintained continuous monitoring and recording of influent and effluent flow as required in Condition 9 of the ECA. No further action was requested by the MECP Barrie District Office.

On April 13th at 22:48 HR a PLC fault occurred that caused an issue with the trending of Plant D effluent flow. The issue was resolved on April 14th at 8:30 HR. Only the Plant D effluent flow trending was impacted by the fault. All other operations at the WPCP were normal. Flow monitoring was continuously maintained at all times at the WPCP by the effluent and influent flow meters. Plant D effluent flow for April 13th and 14th were estimates based on available influent and effluent flow data. No further action was requested by the MECP Barrie District Office.

After Plant B was brought back online on September 21st a suspected error with the influent flow meter was noted by operations staff. Flow monitoring was continuously maintained, however, the readings were found to be inaccurate and lower than the volume of influent entering the system. A calculation based on the proportion of influent to effluent flow was used to correct for the error. A third party contractor completed an inspection and calibration of the flow meter. No further action was requested by the MECP Barrie District Office.

The final occurrence was during a site-wide PLC upgrade project at the WPCP. The Plant C effluent flow meter encountered corrupt data faults between December 6th and 16th. Following correction of the fault, the Plant C effluent meter was not reading accurately from December 16th to January 4th. Flows were reported as lower than anticipated. A third party flow technician made minor setting adjustments to the flow meter and the issue was corrected. For both periods flows were estimated based on influent and effluent flow data available from local/manual readings. The WPCP maintained continuous monitoring and recording of influent and final effluent discharged as the meters themselves were not affected and the manual readings on the flow devices were continuously recorded daily despite the loss of SCADA capability. No further action was requested by the MECP Barrie District Office.

Table 4. WPCP Influent Flows in 2023

Influent Flows 2023						
Month	**Maximum Daily Flow (m^3)**	**Average Daily Influent (m^3)**	**Total Flow (m^3)**	**Maximum Flow Plant B (m^3) ***	**Maximum Flow Plant C (m^3)**	**Maximum Flow Plant D (m^3)**
Jan	16,984	12,715	394,154	0	4,870	12,114
Feb	18,653	13,749	384,985	0	5,084	13,741
Mar	17,283	14,190	439,890	0	4,737	12,559
Apr	17,706	14,230	426,901	0	4,752	12,954
May	14,755	12,774	395,996	0	4,361	10,563
Jun	16,665	12,348	370,443	0	4,510	12,318
Jul	14,959	12,548	388,998	0	4,421	10,752
Aug	13,963	11,854	367,459	0	4,316	9,647
Sep	12,614	11,619	348,570	2,398	4,142	8,788
Oct	11,845	11,153	345,748	2,452	1,784	8,228
Nov	13,902	11,765	352,956	2,383	4,450	9,314
Dec	14,193	13,078	405,420	0	4,992	9,383
		Annual Total (m^3)	**4,621,521**			

* Plant B was only online from Sept 21 to Nov 16 during Plant C SBRs aerator replacement

Table 5. WPCP Effluent Flows in 2023

Effluent Flows 2023					
Month	Maximum Daily Flow (m^3)	Average Daily Effluent (m^3)	Total Flow (m^3)	Maximum Flow Plant C (m^3)	Maximum Flow Plant D (m^3)
Jan	17,272	12,078	374,405	3,502	13,770
Feb	18,025	13,035	364,989	3,625	14,400
Mar	16,572	13,216	409,708	3,222	13,350
Apr	16,340	12,877	386,306	3,280	13,060
May	13,447	11,370	352,458	4,825	10,260
Jun	15,049	10,393	311,801	3,309	11,740
Jul	13,167	10,450	323,964	3,327	9,840
Aug	12,092	10,026	310,802	3,242	8,890
Sep	11,300	10,208	306,237	3,610	8,280
Oct	10,390	9,783	303,288	3,231	7,260
Nov	12,195	10,075	302,248	3,425	8,770
Dec	12,264	10,911	338,240	3,455	8,810
Annual Total (m^3)			**4,084,447**		

The total monthly flows for influent and effluent are graphed below in Figure 1. Influent flow is higher than effluent flow for all months of the year. March had the highest monthly total flow at 439,890m^3, in contrast to the lowest monthly total of 302,248m^3 in November.

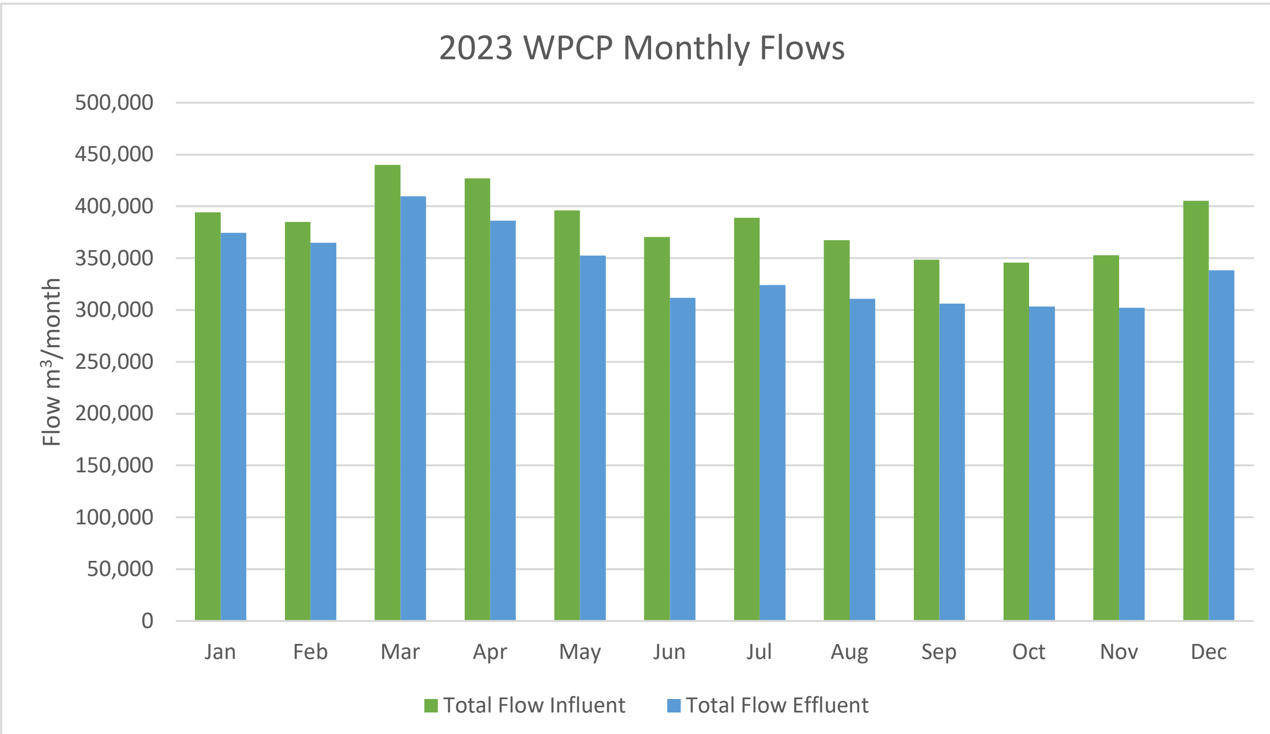

Figure 1. WPCP Total Monthly Flows.

It can be seen that Plant D processes more influent and discharges more effluent than Plant C in all months of the year. The total monthly flows have been broken into influent, effluent and treatment trains below in Figure 2.

As mentioned previously, Plant B was brought back online from September 21, 2023 to November 16, 2023. This was done during an upgrade to the Plant C diffusers which can be seen reflected in the lower Plant C influent numbers during the three months. Plant B does not have separately recorded effluent because it flows into Plant C filter building, hence why there is no significant change seen in Plant C Effluent during the diffuser upgrade.

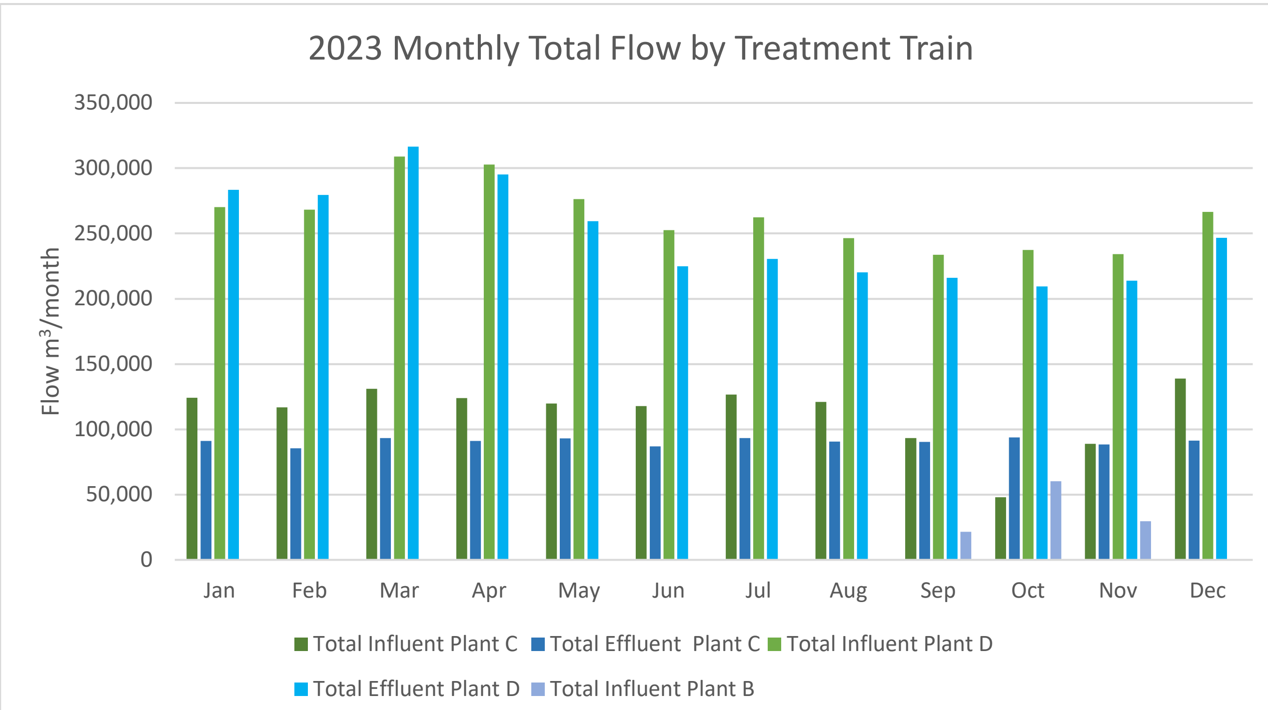

Figure 2. Monthly Total Flows by Treatment Train.

Figure 3 identifies the average monthly influent and effluent flows for the WPCP. The rated capacity refers to the average daily flow for which the works is approved to handle, specifically influent. Both influent and effluent flow remain well below the rated capacity. The average daily influent flow for the works in 2023 was 12,662m^3/day and the effluent flow was 11,190m^3/day.

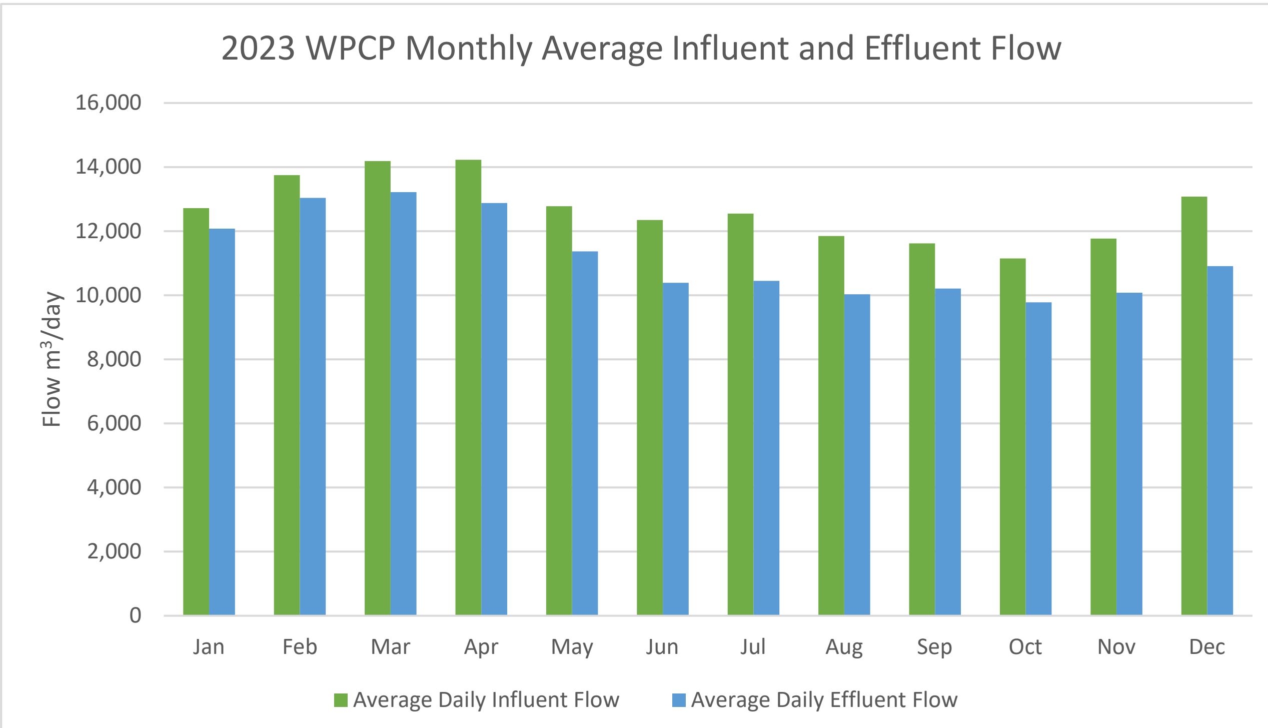

Figure 3. Average Daily Influent and Effluent Flow.

In 2023, the total volume of effluent discharged to the West Holland River increased by three and a half percent (3.5%) from 2022. More specifically the WPCP discharged 138,701m^3 more effluent in 2023. Figure 4 visually identifies the year over year trend from 2015 to 2023 in monthly total effluent discharged at the WPCP.

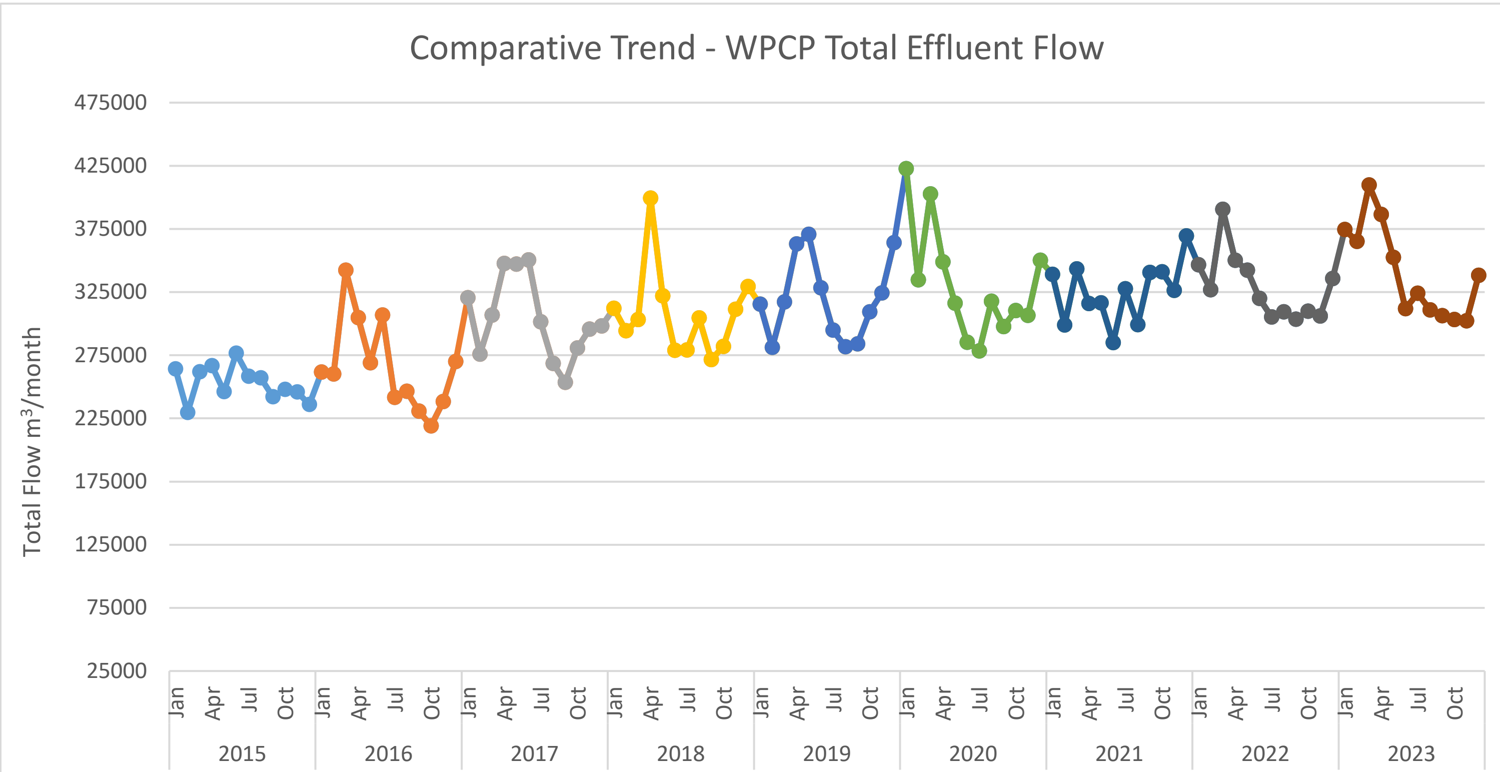

Figure 4. Historical Trend Total Effluent Flow.

2.4 Analytical Data

Condition 9 Monitoring and Recording of the ECA requires a scheduled monitoring program, meeting the requirements of Schedule E of the ECA. This includes sample type, location, and frequency of analysis.

The Town maintains a sampling schedule in order to meet the requirements of the ECA, the 2024 schedule can be found in Appendix A.

There were zero deviations from the sampling schedule in 2023 and all required sampling was completed.

The following subsections provide an overview of influent and effluent concentration data analysis.

Additionally, the Town completed a benthic survey in West Holland River as due diligence near the end of 2022, the results are included in this report in section 2.5.

2.4.1 Influent

2.4.1.1 BOD5

The monthly average influent concentrations for BOD5 are graphed in Figure 5. May experienced the highest BOD5 monthly average concentration of 284mg/L, and October had the lowest concentration of 158mg/L. The annual average concentration and the monthly annual concentration was 249mg/L.

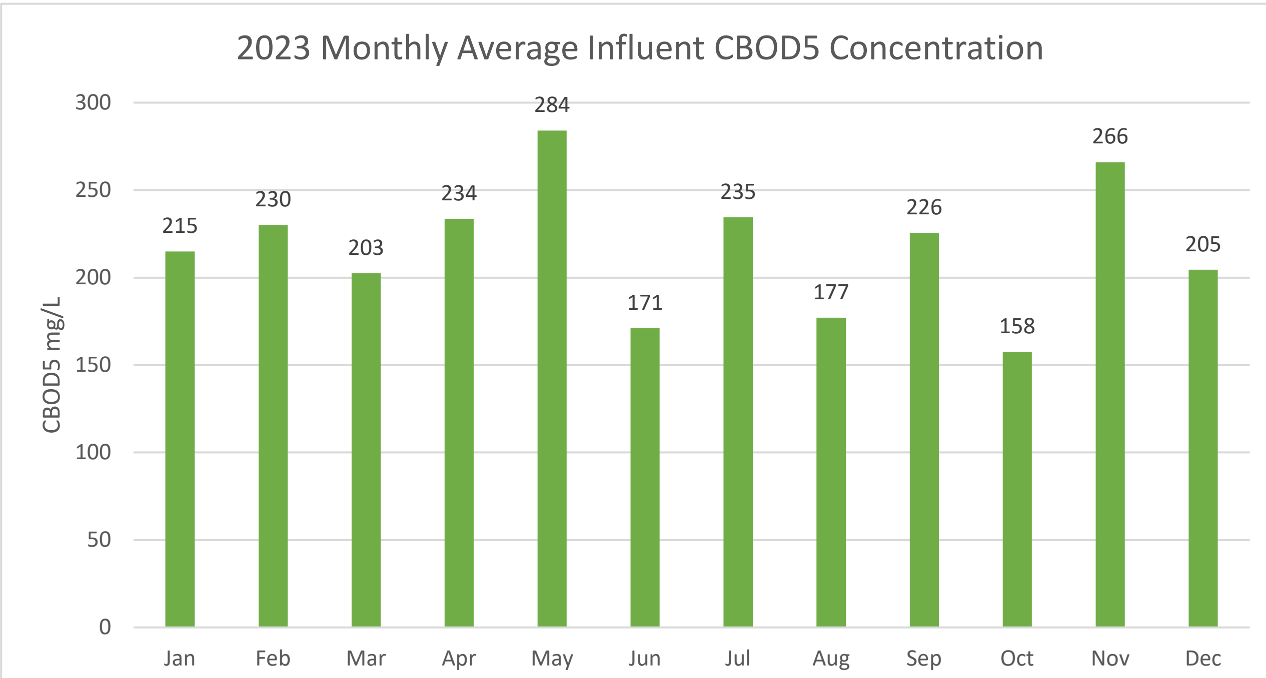

Figure 5. Monthly Average Influent BOD5 Concentration.

A historical trend of influent BOD5 concentrations can be found in Appendix B. The historical trend captures monthly data from 2017 to 2023. There have been no significant changes to the influent BOD5 concentrations. There was a slight increase in BOD5 concentrations compared to 2022. The largest outlier is the monthly average concentration in March 2019 of 560mg/L, an erroneous single sample result of 897mg/L on March 20th 2019 is attributed to the increased concentration.

2.4.1.2 TSS

The monthly average influent TSS concentration has been graphed in Figure 6. December had the highest TSS concentration at 641mg/L, while August had the lowest at 207mg/L. The annual average concentration for TSS was 352mg/L.

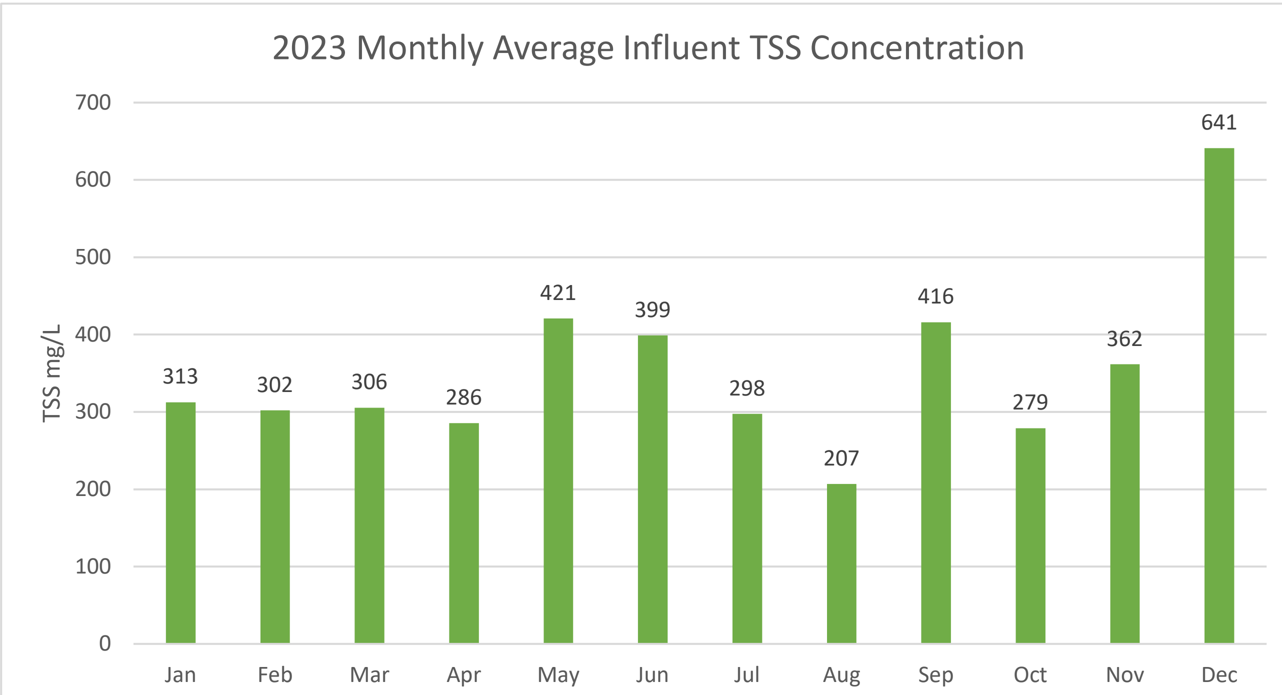

Figure 6. Monthly Average Influent TSS Concentration.

A historical trend of influent TSS concentrations can be found in Appendix C. The historical trend captures monthly data from 2017 to 2023. The trend shows that there has been an increase in the monthly concentrations of TSS starting in 2019 and continuing into 2023. An erroneous single sample of 815mg/L on December 20th 2023 is responsible for the large spike in TSS concentrations seen in December of 2023.

2.4.1.3 Total Phosphorus

The monthly average influent Total Phosphorus concentration is graphed below in Figure 7. The annual average concentration for Total Phosphorus is 4.32mg/L. The average monthly concentration did not fluctuate significantly month to month, the highest being 5.44mg/L (December) and lowest 3.25mg/L (February).

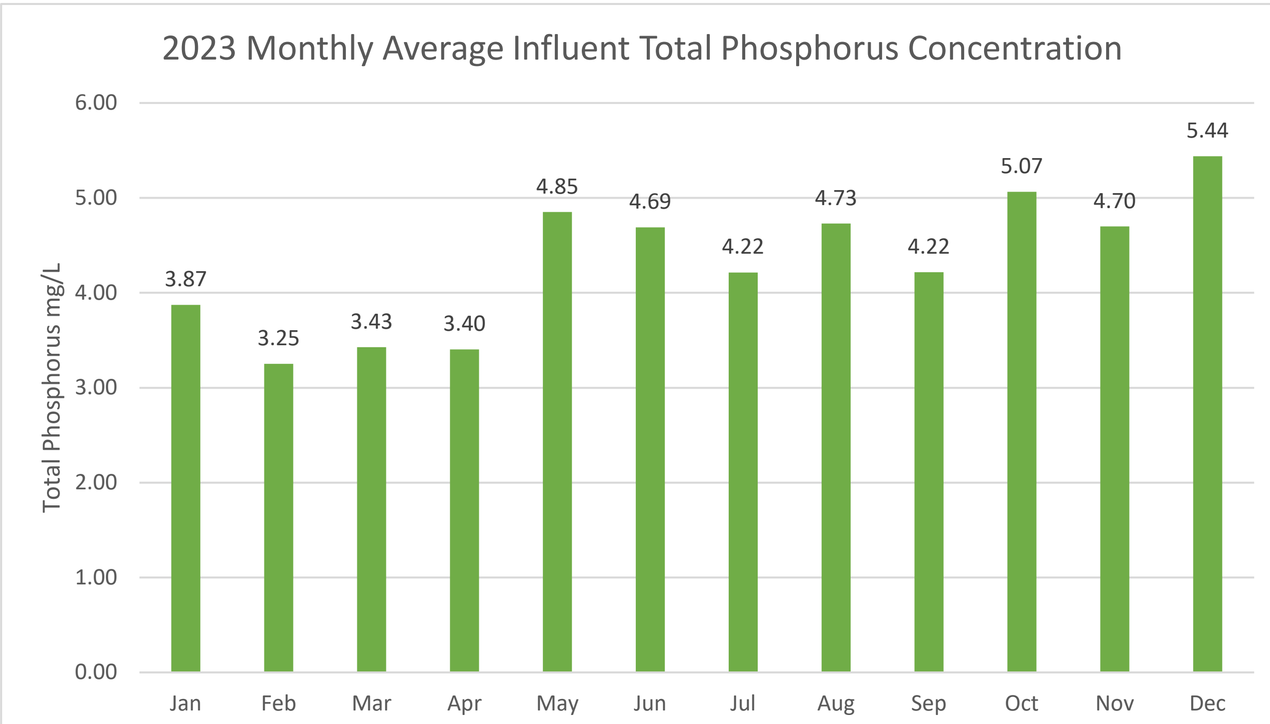

Figure 7. Monthly Average Influent Total Phosphorus Concentration.

A historical trend of influent Total Phosphorus concentrations can be found in Appendix D. The historical trend captures monthly data from 2017 to 2023. The trend shows a decreasing concentration of the monthly averages from 2019 and 2020, with a trend of slightly increasing concentrations in 2021 and 2022, followed by a slight decrease in 2023.

2.4.1.4 TKN

The monthly average influent concentrations for TKN are graphed in Figure 8. December experienced the highest monthly average concentration at 54.00mg/L. While April had the lowest monthly average concentration of 31.8mg/L. The annual average concentration and monthly annual average concentration were 40.35mg/L.

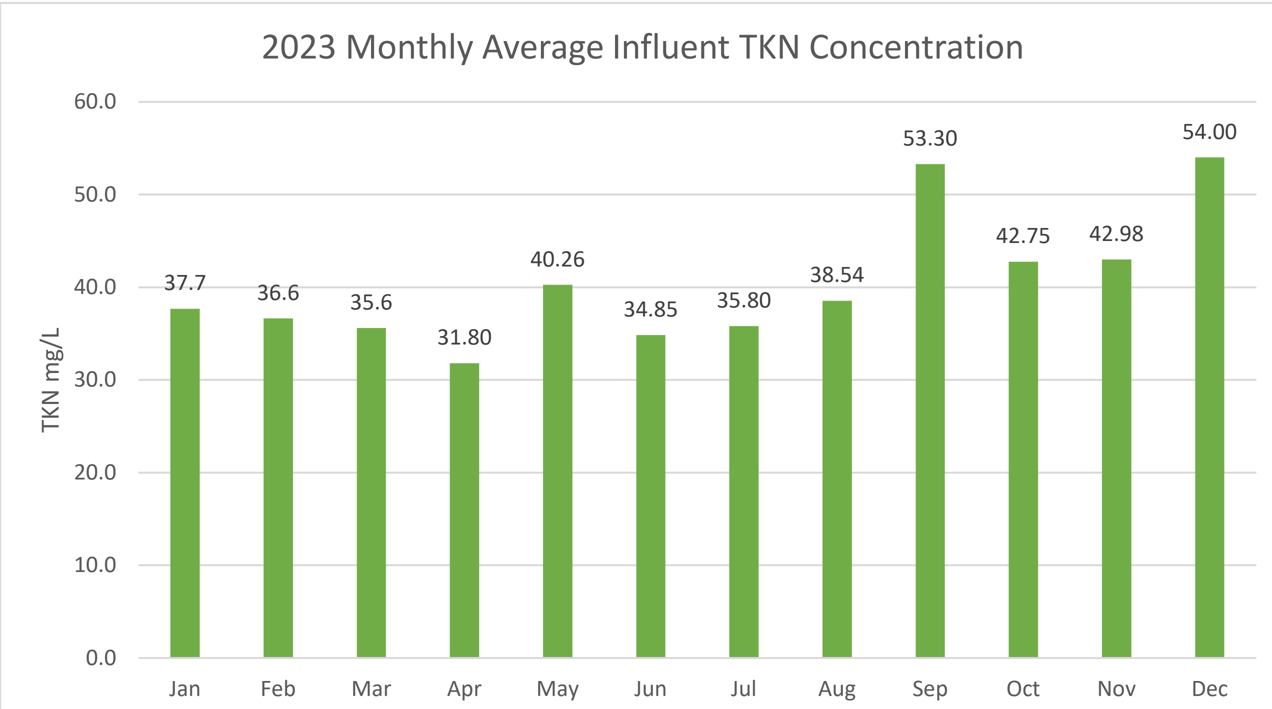

Figure 8. Monthly Average Influent TKN Concentration.

A historical trend of influent TKN concentrations can be found in Appendix E. The historical trend captures monthly data from 2017 to 2023. In 2023 there was an overall decrease to the TKN concentrations compared to 2022. All months excluding September (53.3mg/L) had a lower average TKN concentrations year-over-year. However, September (53.3mg/L) and December (54.0mg/L) were two of the highest averages since 2017.

2.4.2 Effluent

2.4.2.1 Monitoring Data

The parameters discussed within this section do not have compliance objectives and limits stipulated within the ECA but are part of the required monitoring program.

Nitrite and Nitrate

The below Figures 9 and 10 graph the month's average effluent concentrations. Even though the ECA does not prescribe objectives and limits for the parameters the Canadian Council of Ministers of the Environment (CCME) has recommended guidelines for aquatic life long term exposure for the parameters. Nitrite has a guideline of 0.197mg/L and Nitrate has a guideline of 13mg/L. Although if the guidelines are exceeded it does not necessarily imply that aquatic life will be adversely affected (Canadian Council of Ministers of the Environment, 2012) (Canadian Council of Ministers of the Environment, 2020).

A single erroneous sample result of 1.14mg/L on June 7th, 2023 is attributed to the spike seen in June outside of the normal average of 0.03mg/L.

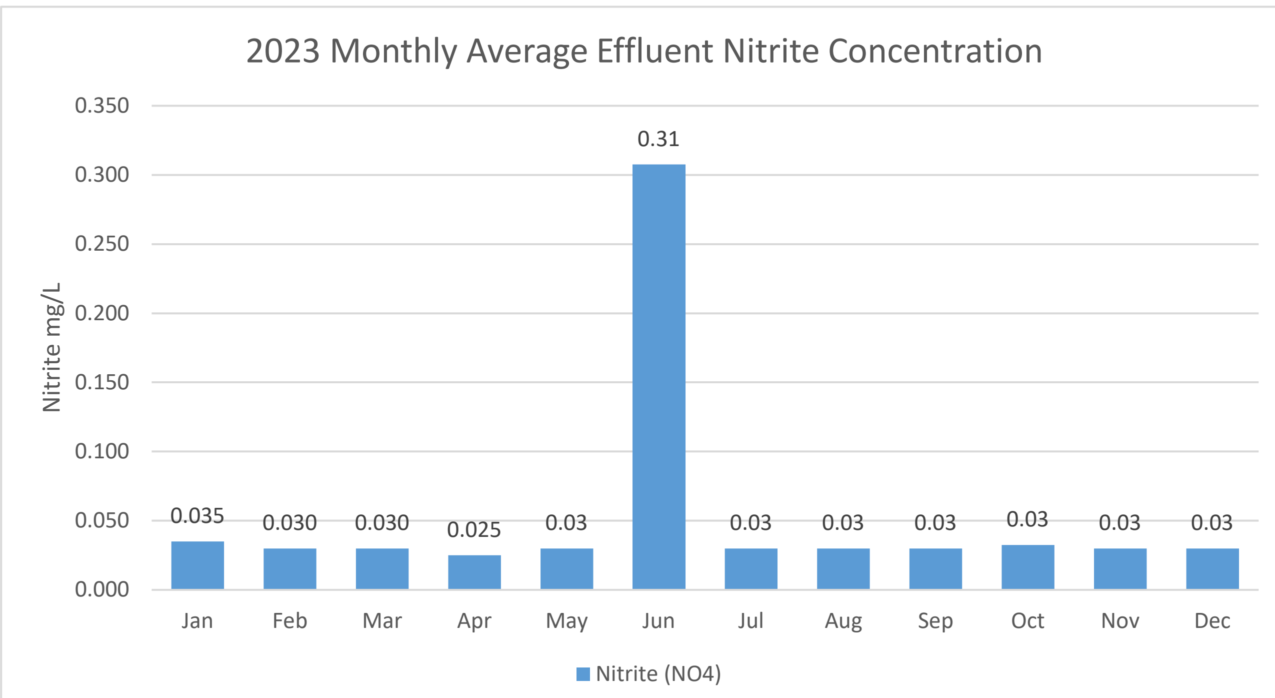

Figure 9. Monthly Average Effluent Nitrite Concentration.

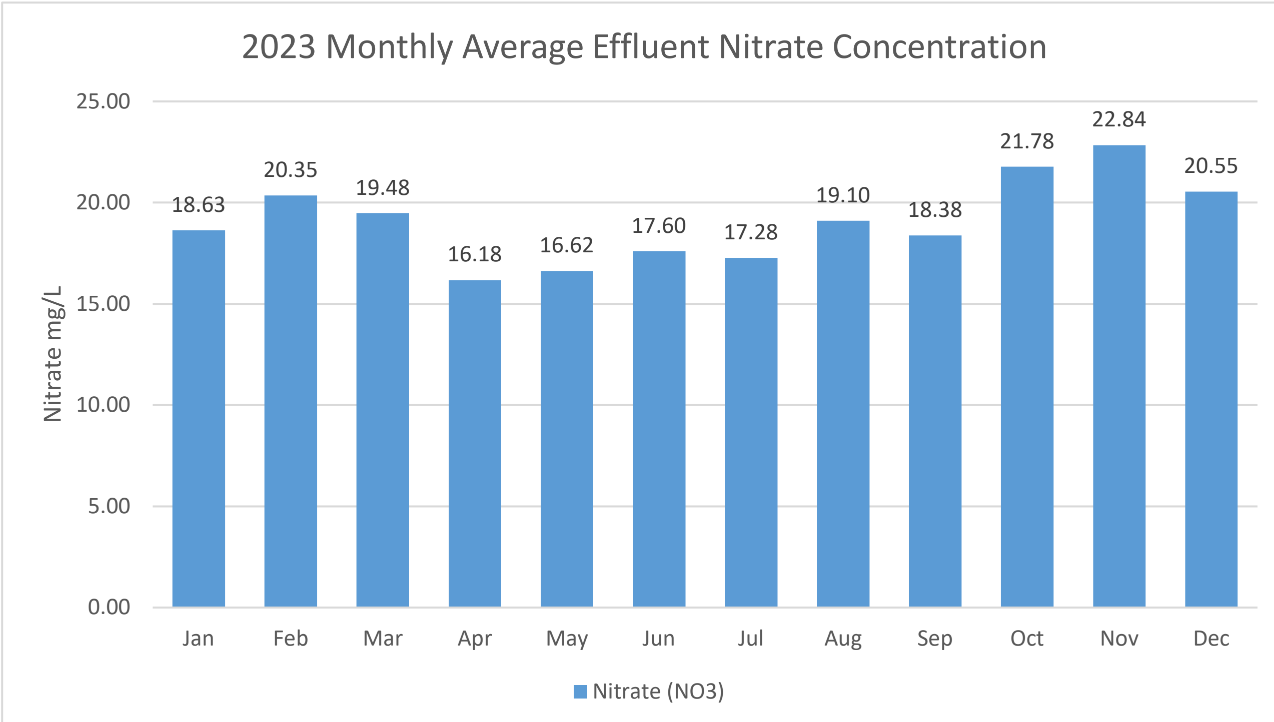

Figure 10. Monthly Average Effluent Nitrate Concentration.

Unionized Ammonia

Unionized Ammonia is a calculated parameter using the effluent TAN concentration, pH and temperature. The pH and temperature are determined in the field at the time of sampling for TAN. As depicted below the unionized ammonia concentration does not fluctuate significantly throughout 2023. The monthly average for all months is at or below 0.0010mg/L except October (0.0013mg/L) as seen graphed in Figure 11. Similar to Nitrate and Nitrite the CCME has a recommended guideline for aquatic life for Unionized Ammonia of 0.019mg/L (Canadian Council of Ministers of the Environment, 2010).

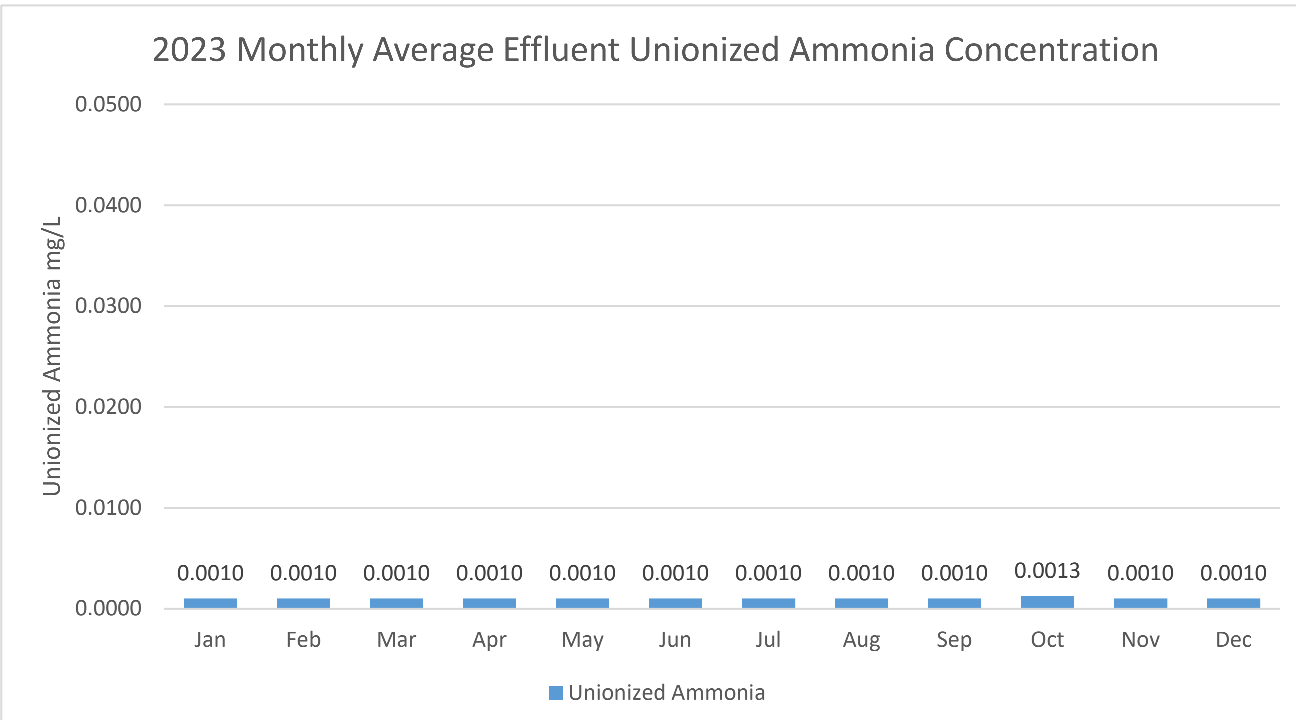

Figure 11. Monthly Average Effluent Unionized Ammonia Concentration.

TKN

The monthly average effluent TKN concentrations see slight fluctuations throughout the year, ranging from 0.5mg/L to 1.43mg/L. The monthly average concentrations are graphed below in Figure 12.

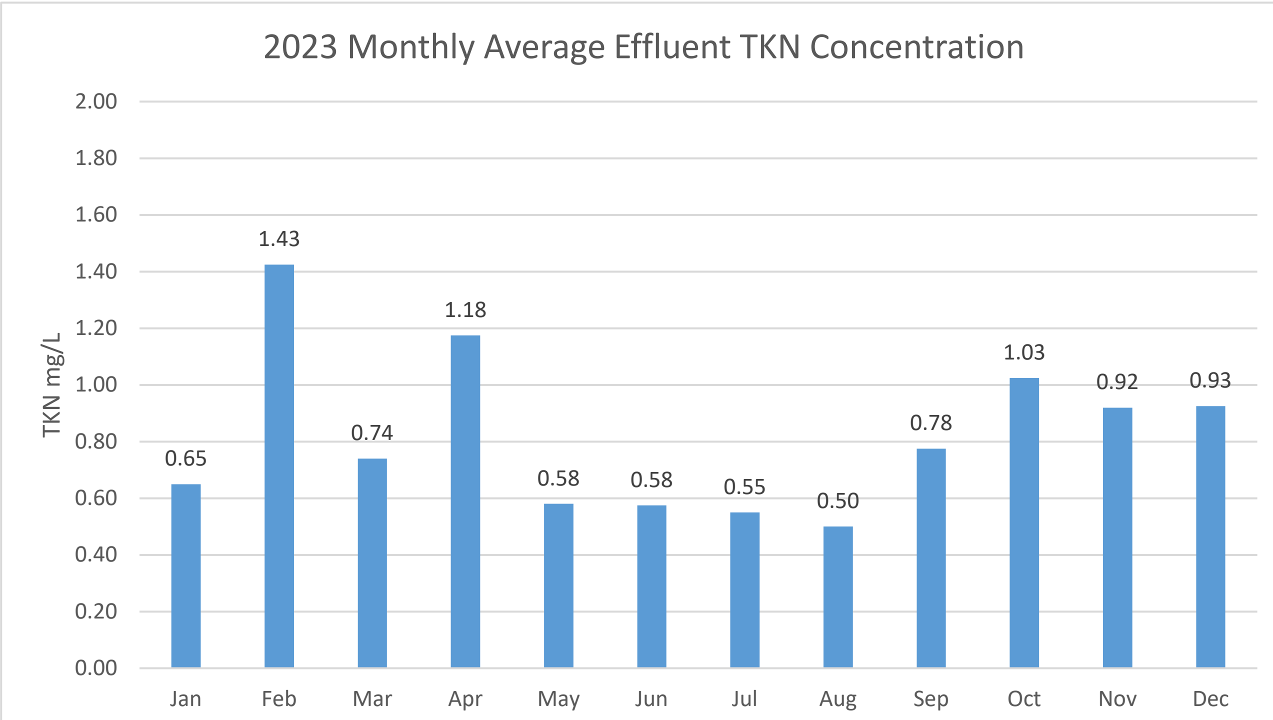

Figure 12. Monthly Average TKN Concentration.

2.4.3 Effluent Objectives and Limits

The WPCP ECA outlines effluent objectives to establish non-enforceable effluent quality concentrations as a trigger to best maintain the operational effluent quality. The WPCP has used best efforts to maintain operational effluent objectives outlined below in Table 6. The Effluent Objectives Table from ECA No. 3705-BGRP97 has been displayed to identify the requirements.

Table 6. ECA Effluent Objectives.

Effluent Objectives		
Effluent Parameter	Averaging Calculator	Objective (mg/L unless otherwise indicated)
CBOD5	Monthly Average Effluent Concentration	5
Total Suspended Solids	Monthly Average Effluent Concentration	5
Total Phosphorus	Monthly Average Effluent Concentration	0.096
Total Ammonia Nitrogen	Monthly Average Effluent Concentration	0.6 (May 1 to October 31)
		2.0 (November 1 to April 30)
E.Coli	Monthly Geometric Mean Density	50 CFU/100mL
pH	Single Sample Result	6.5-8.5 inclusive

The WPCP ECA outlines effluent limits to maintain the health of the West Holland River and to meet the Ministry's effluent quality requirements. The effluent limits are outlined below in Table 7. In Figures 13-22 effluent samples analyzed by SGS Canada Inc. are utilized to compare analytical results to the effluent limits and objectives.

All sampling is completed within the guidelines of the ECA and are carried out in compliance with the sampling methods and procedures set out by the MECP. The sample frequency and analysis meets and surpasses the minimum requirements.

The WPCP operated within the requirements for all parameters outlined within the current WPCP ECA.

Table 7. Final Effluent Compliance Limits.

Final Effluent Compliance Limits		
Effluent Concentration Limits		
Final Effluent Parameter	Averaging Calculator	Limit (maximum unless otherwise indicated)
CBOD5	Monthly Average Effluent Concentration	10 mg/L
Total Suspended Solids	Monthly Average Effluent Concentration	10 mg/L
Total Phosphorus	Annual Average Effluent Concentration	0.098 mg/L
Total Ammonia Nitrogen	Monthly Average Effluent Concentration	0.8 (May 1 to October 31) 2.5 (November 1 to April 30)
E.Coli	Monthly Geometric Mean Density	100 CFU/100mL
pH	Single Sample Result	6.0-9.5 inclusive
Effluent Loading Limits		
Final Effluent Parameter	Averaging Calculator	Limit (maximum unless otherwise indicated)
CBOD5	Monthly Average Daily Effluent Loading	194 kg/d
Total Suspended Solids	Monthly Average Daily Effluent Loading	194 kg/d
Total Phosphorus	Annual Average Daily Effluent Loading	1.912 kg/d

2.4.3.1 pH

pH was consistently maintained between the ECA limits of 6.0 to 9.5 within the reporting year as seen in Figure 13. The monthly averages ranged between 6.94 and 7.12. The single sample results ranged within 6.5-7.8, as mentioned pH was maintained within both the ECA high and low limits and objectives.

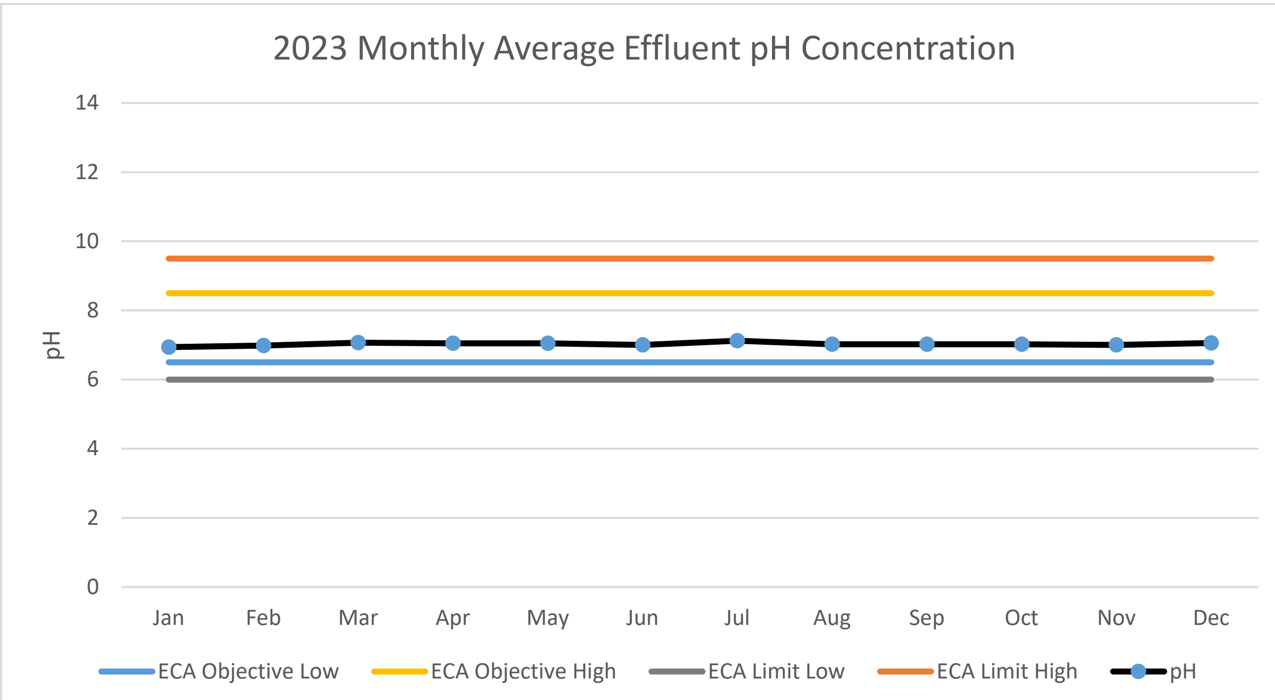

Figure 13. Monthly Average pH Compared to the ECA.

A Historical Trend of monthly pH recordings from 2015 to 2023 can be found in Appendix F. The historical trend visualizes the monthly average trends for pH. It can be seen that in 2017, 2019 and 2021 there was more variation. In 2015, 2016, 2018, 2020, 2022, and 2023 minimal variation was seen.

2.4.3.2 Total Suspended Solids

Figure 14 below graphs the 2023 TSS data and is compared to the limit and objective set by the WPCP ECA. The monthly average concentration for TSS fluctuated slightly throughout the year, January had the highest average at 5mg/L and July with the lowest of 2.25mg/L. The monthly average TSS remained below both the objective and limit in all months except January. The monthly average TSS for January was at the objective limit of 5 mg/L.

The annual average concentration for TSS was 3.46mg/L and the annual monthly average concentration was 3.45mg/L, both below the ECA objective.

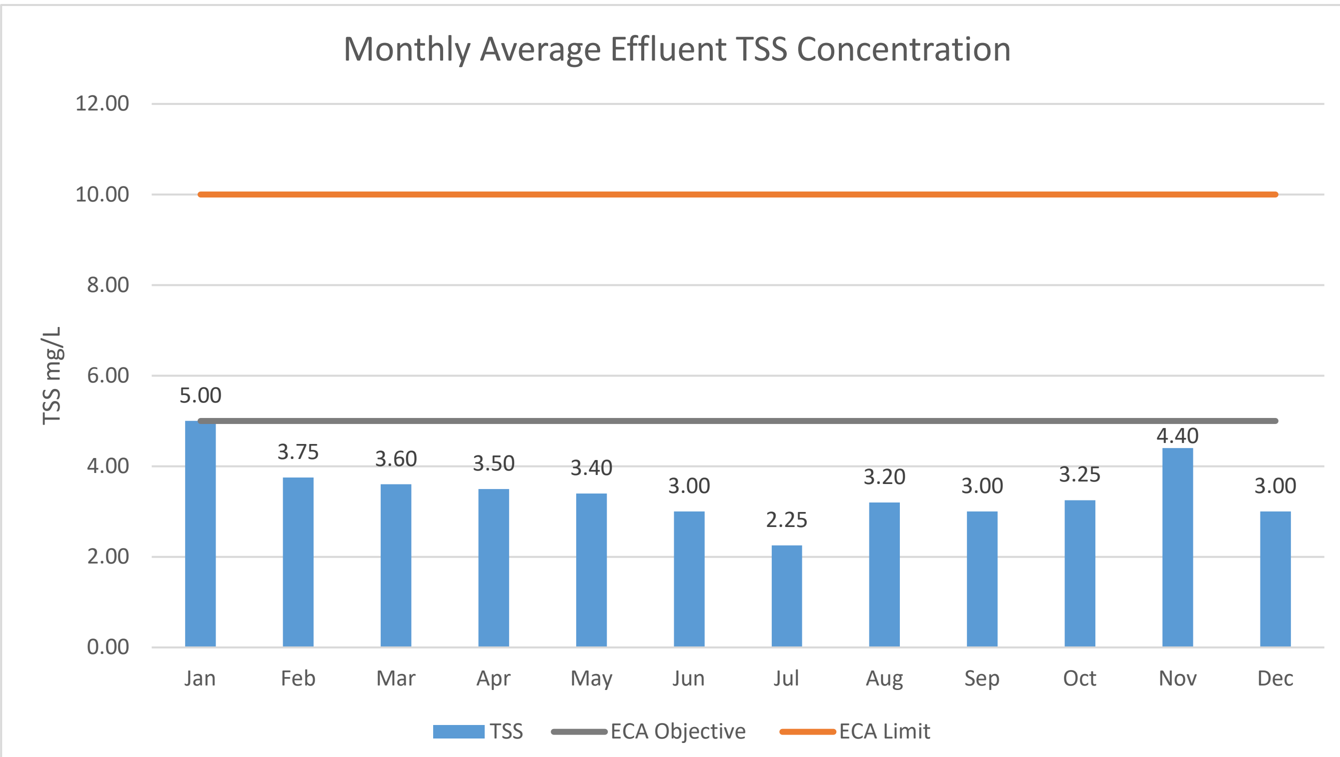

Figure 14. Monthly Average Total Suspended Solids Concentration Compared to the ECA.

In APPENDIX G, TSS is graphed as a Historical Trend from 2015 to 2023. There is variation in the monthly concentration which starts to increase in 2017. 2022 is a decrease from the highest levels of 2021, 2023 is an increase from 2022 though still below the 2021 average. Monthly average concentrations remain below the ECA objective and limit, except for results in December 2017, January to March of 2021, and January 2023 which exceeded the objective.

Throughout 2023 the monthly loading remains well below the ECA limit of 194kg/day, as shown in Figure 15 below.

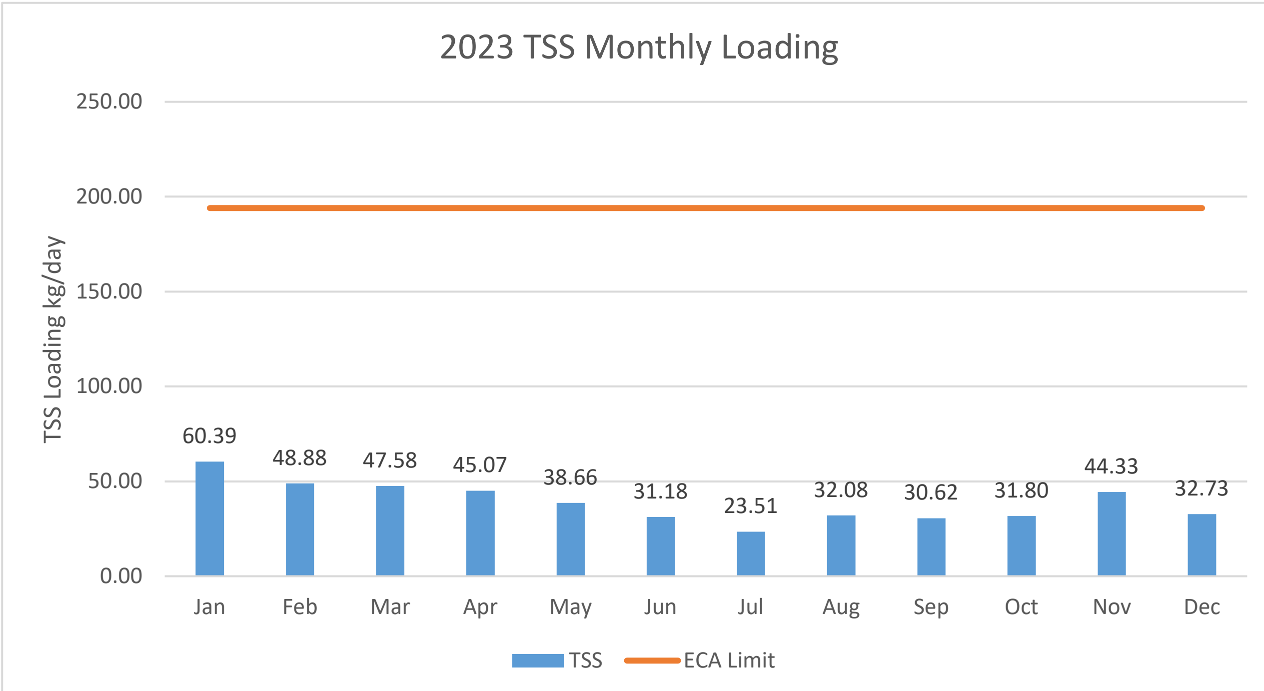

Figure 15. Monthly Average TSS Waste Loading Concentration Compared to the ECA.

2.4.3.3 E.coli

Figure 16 below identifies the E.coli effluent data throughout 2023 compared to the ECA limit and objective. E.coli did not exceed the ECA limit or surpass the objective. The E.coli monthly geometric mean ranged from 2.00 to 6.79cfu/100mL, and the single sample results ranged 0 to 30cfu/100mL. There were two (2) occurrences where the E.coli result was zero (0) (April 5 and Dec 13) to calculate the geometric mean the value one (1) was used.

There were no occurrences when the single sample results or monthly average concentration exceeded the ECA objective or limit.

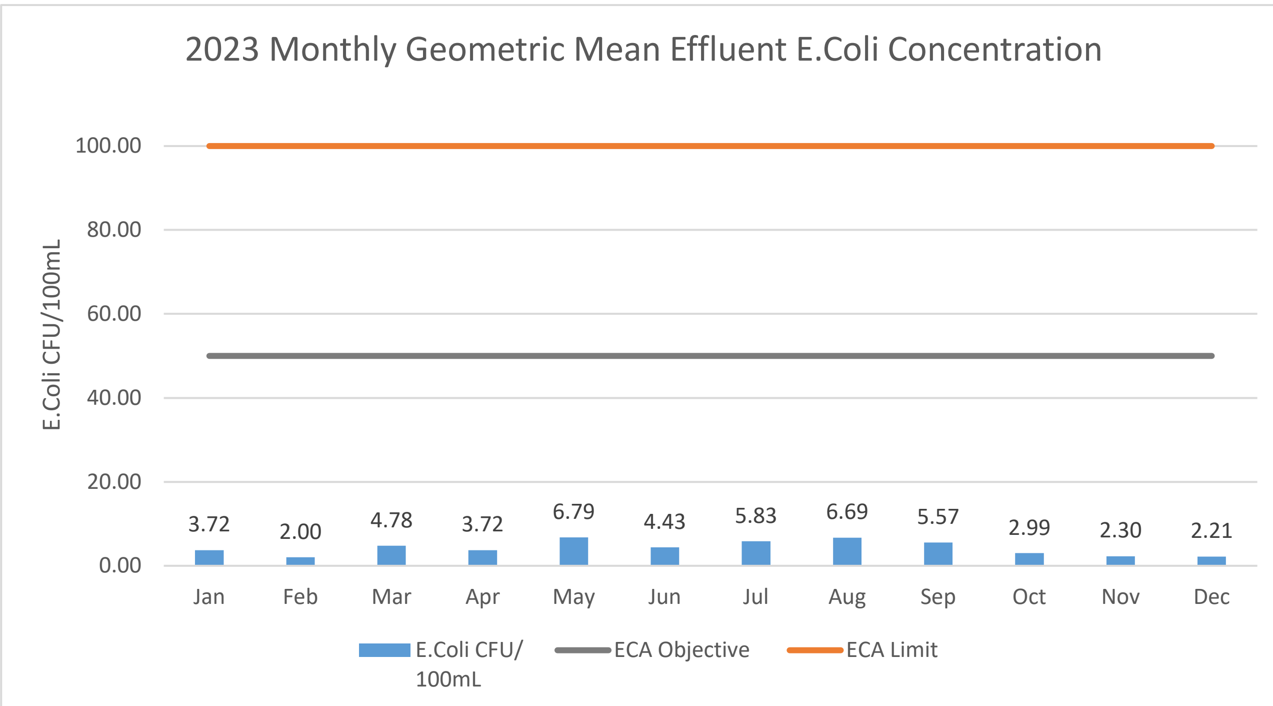

Figure 16. Monthly Geometric Mean E.coli Concentration Compared to the ECA.

In APPENDIX H, E.coli concentrations are graphed as a Historical Trend for 2015 to 2023. Overall, the effluent characteristics for E.coli remain well below the objective and limit of the ECA. An upward trend in E.coli concentrations was seen at the end of 2021 into 2022. 2023 saw a decrease from 2021 and 2022 levels, though still above the monthly averages from 2015 to 2020. Additionally, slight monthly variation started to increase in 2018.

2.4.3.4 Carbonaceous Biochemical Oxygen Demand

In 2023 the CBOD5 concentration did not exceed either the ECA objective or limit. Figure 17 below displays the CBOD5 concentrations compared to the ECA objective and limit. The highest monthly average concentration was 3.00mg/L in January. The lowest monthly average concentration of 2mg/L occurs in March, April, May, June, September, October and November.

The monthly annual average concentration was 2.20mg/L and the annual average concentration was 2.19mg/L.

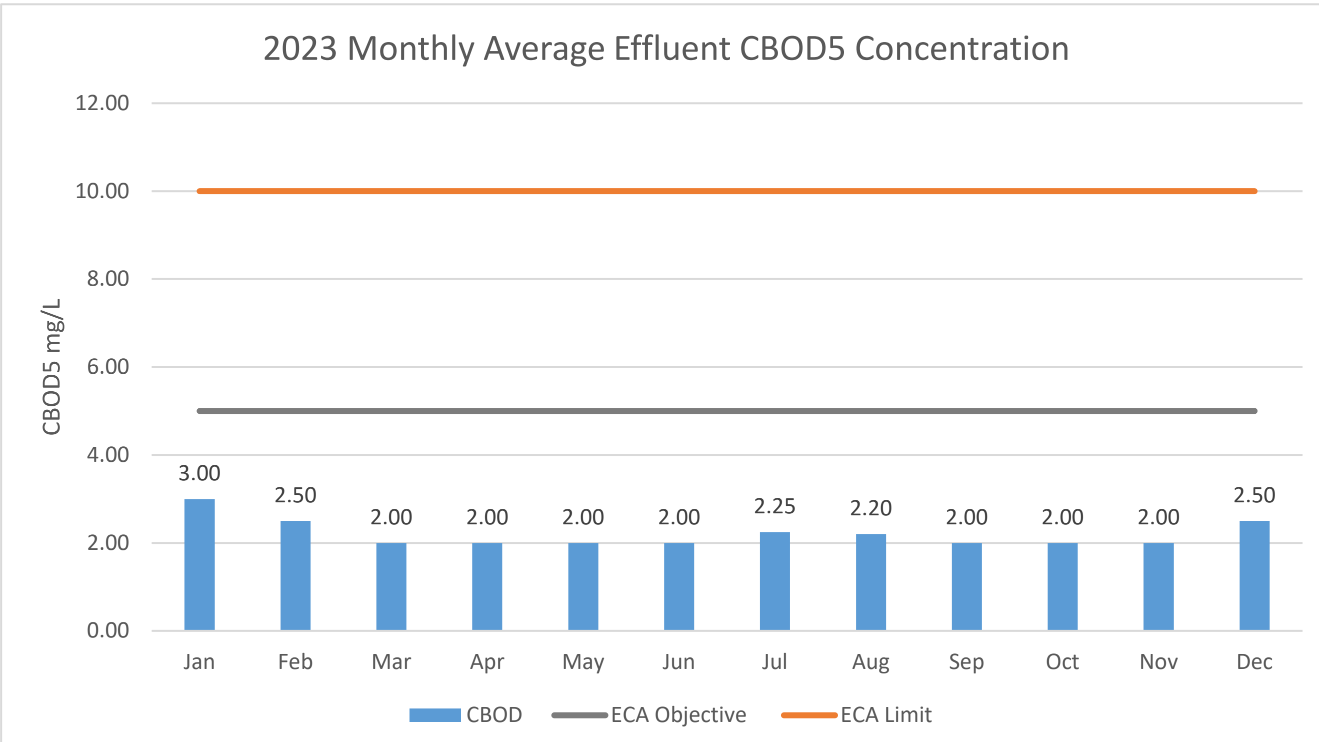

Figure 17. Monthly Average CBOD5 Concentration Compared to the ECA.

In APPENDIX I, a Historical Trend of the monthly averages for CBOD5 is graphed. The monthly average concentration is consistently similar varying marginally month to month from 2015 to 2023, there is no trend currently indicating a change in the effluent characteristics of CBOD5. There was one (1) significantly high monthly average concentration in June of 2016, although a similar monthly average concentration has not been recorded since and the result did not exceed the ECA limit.

CBOD5 monthly waste loading stayed below the ECA limit, as shown in Figure 18. The average loading does not fluctuate considerably throughout the year (range from 20.42 to 36.23 kg/day) and stays well below the limit of 194 kg/day.

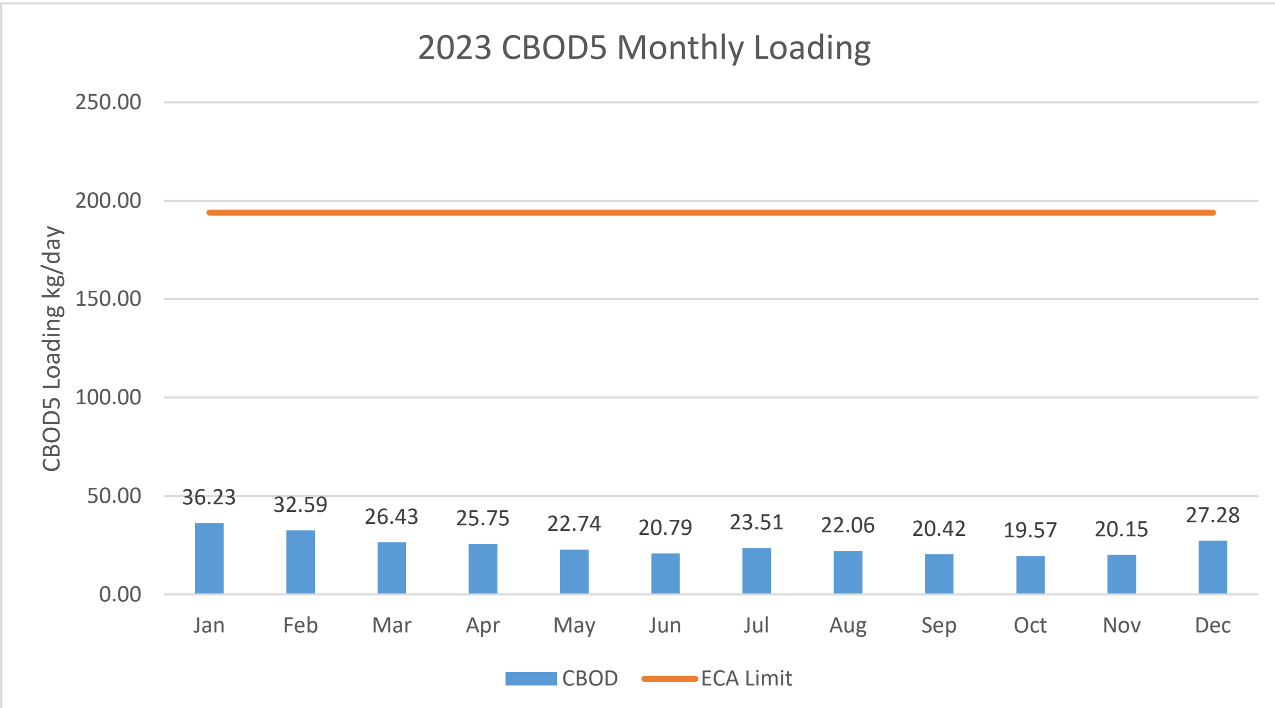

Figure 18. Monthly Effluent Average CBOD5 Waste Loading Compared to the ECA.

2.4.3.5 Total Ammonia Nitrogen

TAN monthly average concentrations stayed below the objective and limit of the ECA for all months. Figure 19 identifies the monthly average concentration of TAN throughout 2023. As identified in the ECA the limit and objective for TAN increases to 2.5mg/L and 2.0 mg/L in November to April of each calendar year and decreases to 0.8mg/L and 0.6mg/L in May to October. The monthly average concentrations range between 0.20 (October) and 0.04 (April and July). Overall there is minimal variability throughout the year.

No single sample result exceeded the ECA limit within the reporting year.

The monthly annual average concentration and the annual average concentration were 0.07mg/L.

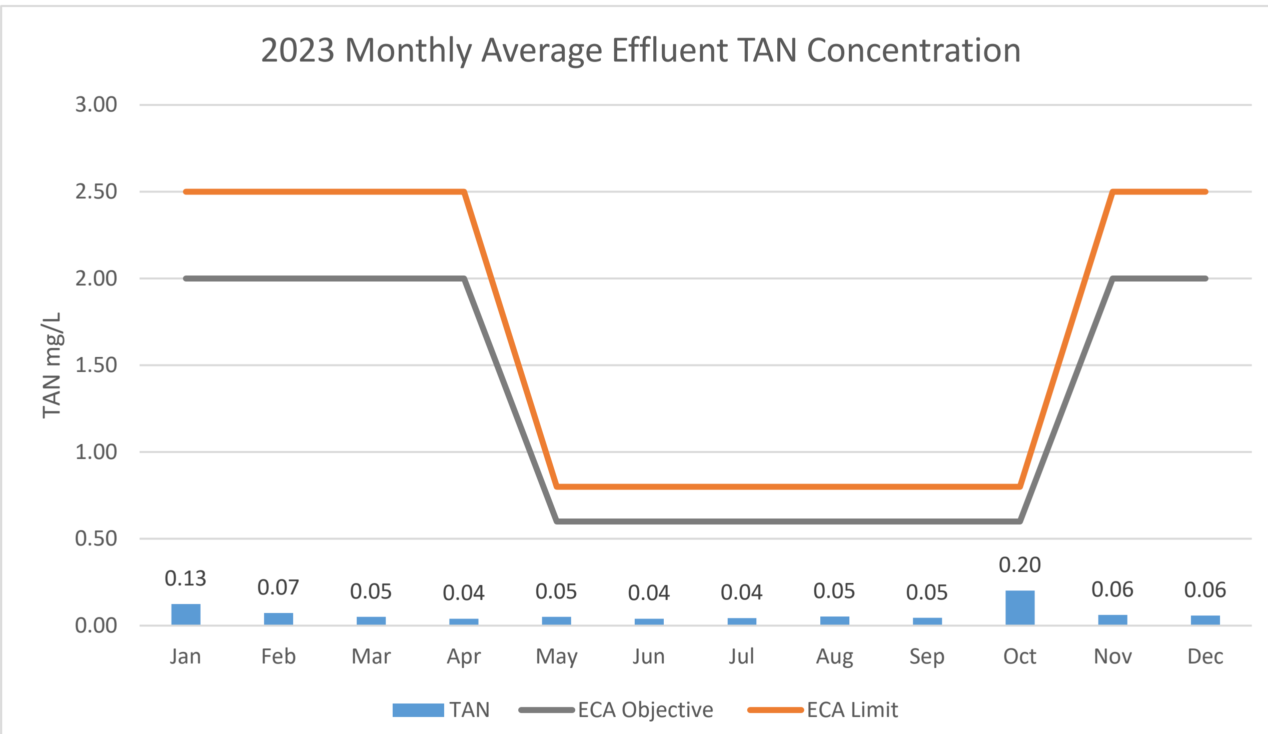

Figure 19. Monthly Average TAN Concentration Compared to the ECA.

In APPENDIX J, the monthly average TAN concentrations are graphed as a Historical Trend for 2015 to 2023. TAN monthly average concentrations trended down in 2017 and 2018 from a previous upward trend at the end of 2016. 2019 and 2020 saw a slight increase though results remained stable between the years, followed by an increase in 2022. 2023 saw a decrease back to near 2016 levels.

2.4.3.6 Total Phosphorus

The monthly average Total Phosphorus concentrations fluctuated between 0.045mg/L and 0.114mg/L. ECA compliance is determined based on the annual average effluent concentration which is discussed further in this subsection. Only the ECA objective for Total Phosphorus is subject to a monthly average concentration. In January the monthly average effluent objective was exceeded for Total Phosphorus. While the concentration may have exceeded the ECA objective, this does not indicate non-compliance with the approval as compliance is determined by the annual average effluent concentration limit.

Figure 20 below depicts the average monthly effluent concentrations for Total Phosphorus.

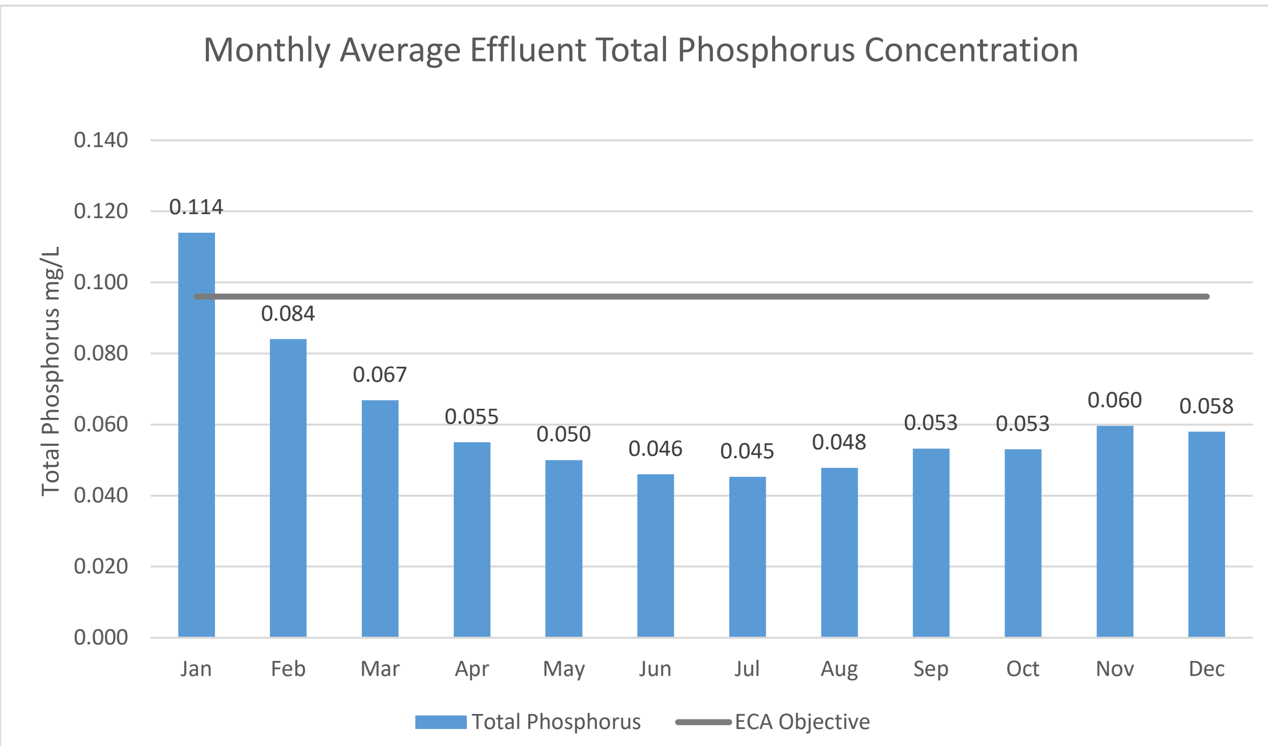

Figure 20. Monthly Average Total Phosphorus Concentration Compared to the ECA.

In APPENDIX K, Total Phosphorus monthly concentrations has been graphed in a Historical Trend for 2015 to 2023. It can be seen that January of 2021 has the highest monthly average concentration within the trend. A spike in January of 2023 is higher than any previous results in 2022 though the average for 2023 is lower than 2022. There is variance month to month within the entire trend. The highest monthly average concentration was January 2021 at 0.139mg/L and the lowest was May 2018 and July 2019 at 0.041mg/L.

The Annual Average Daily Effluent Loading of Total Phosphorus for the WPCP was 0.679kg/day which is well below the compliance limit of 1.912kg/day. The Annual Average Daily Effluent loading is depicted in Figure 21.

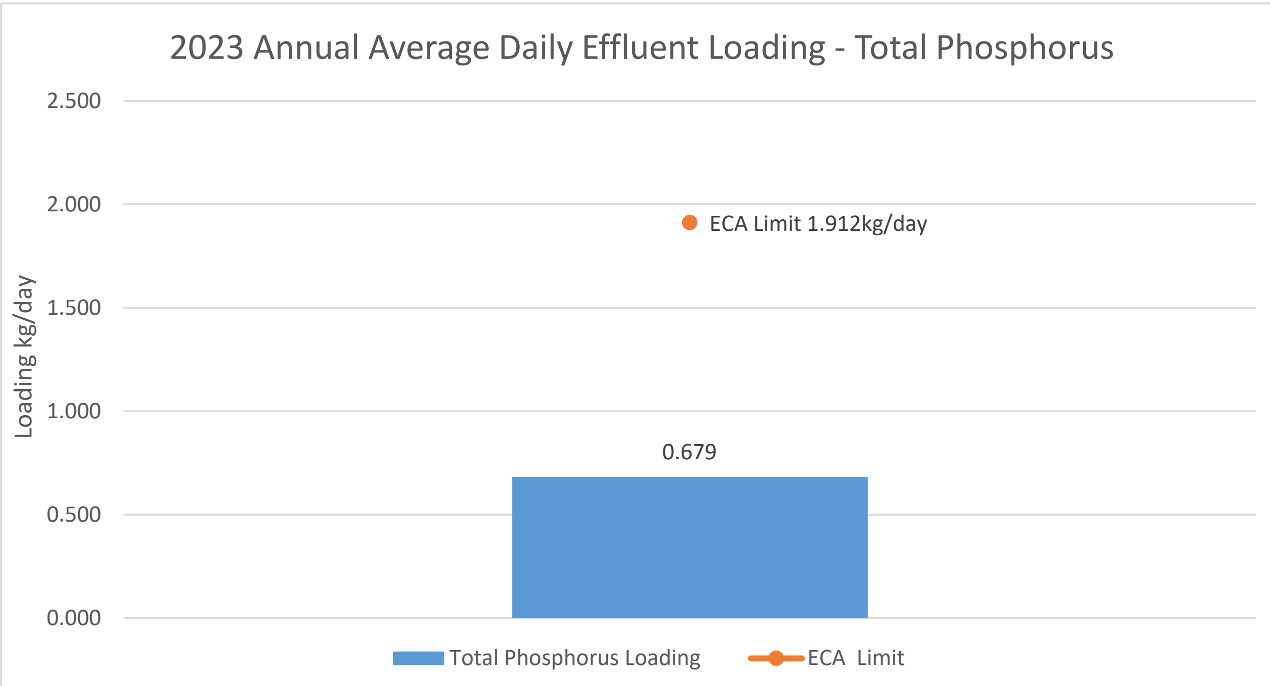

Figure 21. Annual Average Daily Effluent Loading Total Phosphorus

The Total Phosphorus annual average effluent concentration does not surpass the objective and limit of 0.096mg/L and 0.098mg/L. The annual average effluent concentration is 0.061mg/L.

The annual average Total Phosphorus concentrations have been compared below in Figure 22. The highest annual average concentration occurred in 2016 and lowest in 2018. 2023 saw a decrease from 2021 and with concentrations going from 0.074mg/L to 0.061mg/L. All annual average concentrations remain below the annual average concentration limit.

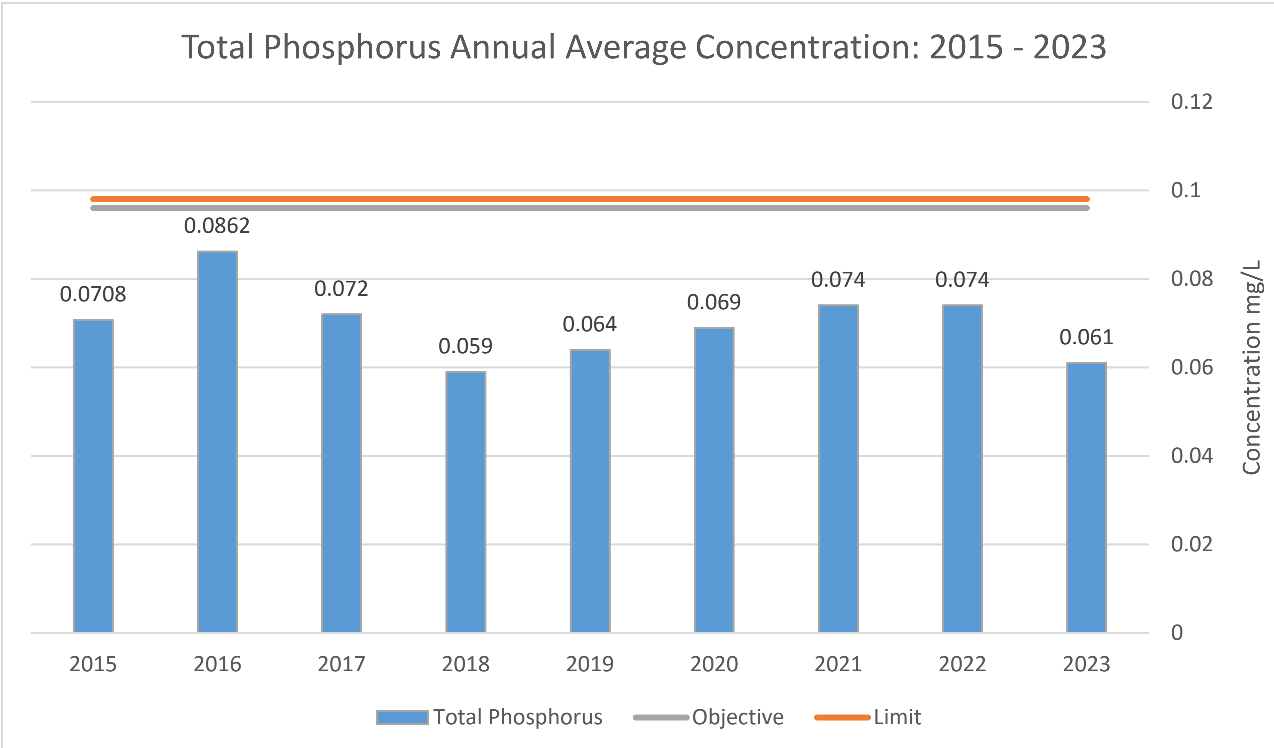

Figure 22. Total Phosphorus Annual Average Concentration Trend 2015-2023.

2.4.4 Operational Exceedance

The BWG WPCP did not experience any operational exceedances in 2023.

2.5 Operations and Maintenance

The WPCP met the operational and maintenance requirements stipulated within the ECA, there were no changes to daily operations in 2023. All annual calibrations of major equipment of the works have been completed which includes but is not limited to laboratory equipment and flow meters.

The WPCP has continued to implement and update a Quality Management System, Standard Operating Procedures (SOP's) and Policies. Additionally, the Septage Hauling Program under the Sewer Use By-law 2013-68 (By-law) remains enforced. The Town has continued to monitor new Industrial, Commercial and Institutional (ICI's) facilities connected to Town infrastructure through the By-law. For additional information on the Septage Hauling Program and imported sewage monitoring refer to Section 6 Septage Receiving.

In addition to the routine maintenance previously discussed in section 1.4, the following list provides a highlight to maintenance completed within the reporting year:

- Replaced the fine bubble aeration system in Plant C SBRs.
- The standby manual bar screen in the Headworks was replaced with a mechanical bar screen
- WPCP System Wide PLC Upgrade and alarm reconfiguration.
- Plant B brought back online from September to November.
- Completed 3,291 PM work orders, up from 2,978 PMs in 2022.

The 2022 Benthic Invertebrate Study is included in this annual report as the results did not arrive in time to be included in the 2022 Annual Report. It was the eight (8th) invertebrate study for the WPCP receiving stream. The study was completed by Hutchinson Environmental Services Ltd. The study is completed every other year with the next to be conducted in 2024. Biological metrics were compared upstream and downstream of the of the WPCP outfall, the differences between the sampling locations was not statistically significant. Based on the results, it was concluded that treated effluent from the WPCP is not clearly impacting benthic invertebrate populations (Hutchinson Environmental Sciences Ltd., 2023).

The WPCP has met strict regulatory requirements for effluent disposal into the receiving stream as previously discussed, to protect water quality, fish and other aquatic life, as identified within the current ECA.

2.5.1 Chemical Usage

In 2023 a total of approximately 780,300 litres (L) of Aluminum Sulphate (alum) was used in the wastewater treatment process. The monthly alum usage is displayed in Table 8 below. Alum is injected at the filter inlet, Plant D clarifier inlet, and the head works flow splitting chamber where the de-gritted water can be sent to Plant B, C, or D aeration tanks. Alum is injected into the system for phosphorous removal by chemical precipitation.

Table 8. Chemical Usage – Alum 2023

Chemical Usage – Alum 2023		
Month	Storage Tanks Total (L)	Polishing Tank (L)
January	62,849	1,971
February	56,783	1,971
March	64,159	2,424
April	61,990	2,552
May	63,470	2,755
June	60,578	2,252
July	63,495	2,454
August	63,428	2,378
September	64,853	2,234
October	65,526	1,877
November	64,238	1,566
December	62,912	1,593
Total (L):	754,280	26,027
Annual Total (L):	**780,307**	

3. Collection System

3.1 Facility Description

The Town's Collection System is certified as a Class three (3) system. The BWG collection system consists of approximately 2,050 maintenance holes, 36.93km of forcemain, 128.64km of gravity sewers, and nine (9) Pumping Stations.

The function of the pumping stations within the BWG collection system is to collect and transport sewage to the WPCP for treatment.

3.2 General Overview

3.2.1 Artesian Pumping Station

Artesian Pumping Station is located at 135 Artesian Industrial Parkway, approximately 800m north of Dissette Street. The station was constructed in 1996. Sanitary sewage flows by gravity from both directions in 300mm and 350mm PVC sewer mains to Manhole 1613 directly opposite the station on Artesian Industrial Parkway. The Pumping Station consists of three (3) pumps with a flow capacity of 2,419m^3/day. This

Pumping Station is monitored via SCADA and is equipped with a portable generator for back-up power.

3.2.2 Dissette Pumping Station

The Dissette Pumping Station is located at 21 Dissette Street with a rated capacity of 27,268m^3/day. The station was originally constructed in 1970 and an expansion was built in 1982. The station has two (2) separate buildings housing four (4) pumps and two (2) separate wet wells, which can be operated together and separately. This station is monitored via SCADA and is also equipped with a back-up generator.

3.2.3 Green Valley Pumping Station

Green Valley Pumping Station is located at 2541 Line 6 and was constructed in 2014. The rated flow capacity for this station is 201L/s. The Pumping Station consists of three (3) pumps and two (2) side by side wet wells that can be operated separately or as one (1). This station is also equipped with an odor control system, bar screen conveyer and back-up generator. The station is monitored via SCADA.

3.2.4 Industrial Pumping Station

The Industrial Pumping Station is located at 30 Industrial Road on the north side of Industrial Road, east of Dissette Street. This Pumping Station has a rated capacity of 18.8L/s and is equipped with two (2) pumps, a back-up generator and is monitored via SCADA.

3.2.5 Middletown Pumping Station

The Middletown Pumping Station was commissioned in May of 2016 and is located at 212 Rutherford Road. The Pumping Station was constructed to serve 18.13 hectares of residential lands designed with a peak flow of 24.5L/s. The station consists of a pre-cast wet well housing two (2) pumps, back-up diesel generator and is monitored via SCADA.

3.2.6 Ritchie Stong Pumping Station

Ritchie Stong Pumping Station is located at 458 Holland Street West and is the largest capacity Pumping Station within the Town’s WWC system. The Pumping Station has a capacity of 420L/s. This station is equipped with four (4) pumps, an odor control system, bar screen conveyer, back-up generator and is monitored via SCADA.

3.2.7 Simcoe Road Pumping Station

Simcoe Road Pumping Station is located at 772 Simcoe Road and was commissioned in February of 2017. The Pumping Station was constructed to service 4.64 hectares and designed for a peak flow of 3.6 L/s. This station consists of a wet well with two (2) pumps, and has the ability to connect to a portable generator. The station is monitored via SCADA.

3.2.8 400 Lands Pumping Station

The 400 Lands Pumping Station is located at 3580 line 5 in the Town of Bradford West Gwillimbury. The station was commissioned in January of 2020 and started receiving flow in April, 2021. The facility has a total station capacity of 347L/s. The station houses a dry pit and two (2) wet wells, as well as four (4) dry pit submersible pumps each with a rated capacity of 115.8L/s. The station is equipped with a back-up generator and odour control unit and is monitored via SCADA.

3.2.9 Bond Head Pumping Station

The Bond Head Pumping Station is located at Part of Lot 24, Concession 7 in the Town of Bradford West Gwillimbury. The station was commissioned in 2021. The gates were opened for the station to receive flow on July 26, 2023. The station houses a dry pit and two (2) wet wells, as well as three (3) submersible pumps. The station is equipped with a back-up generator, an odour control unit and is monitored via SCADA.

3.3 Alterations to the Authorized System

Within the reporting period there were three (3) SS1 forms submitted to the Town and one (1) form that was previously submitted in 2022 not previously reported on.

The Alteration previously submitted in 2022 is for a new development to construct and connect a future sewer for the 400 Employment Lands. It will connect to an existing sanitary sewer going to the existing 400 Lands Pumping Station. The underground construction work is complete. The area is not assumed.

An Alteration form submitted February 2023 is for the installation of a Sanitary Sewer for the Centreville Townhouse Block. It is a residential development area. The underground construction for the work has been completed.

A third Alteration was submitted to the Town in March 2023 is under an Intersection and Signalization project. The installation of a new sanitary sewer on County Road 88 near the intersection of Sideroad 5. As part of the Alteration, a sanitary service will be installed for Sir William Osler Public School to permit future additional student capacity at the school. The underground construction for the work has been completed.

The fourth Alteration submitted to the Town in June 2023 is a revision to a previously approved design. It is for the installation of a new sanitary sewer on Danube Lane with revised pipe sizes form the original submission. The underground construction for the work has been completed.

None of the Alterations were determined to pose a Significant Drinking Water Threat. All of the proposed works are wholly located within the municipal boundaries of the Town of BWG.

3.4 Operations and Maintenance

All required maintenance has been carried out to ensure the WWC System is in compliance with all regulatory requirements. There is a PM program in effect to help maintain the integrity of all infrastructure, equipment and associated facilities to ultimately avoid any overflow or bypasses to the environment. The PM program is carried out as per the manufacturer recommendations. Over and above the routine maintenance previously discussed in section 1.4 the following provides additional maintenance and an overview of the operational highlights that took place within the collection system.

- 3,303 meters of sanitary main line inspected.
- 341 property lines were located and added to GIS mapping.
- 763 lines flushed in the south section of Town. The Town is separated into north and south sections with Holland Street being the dividing line. The north and south sections are flushed on a yearly rotating schedule.
- Bond Head Pumping Station began receiving flow in July.
- New carbon media was installed in the Green Valley Pumping Station odor control system.

In addition to the maintenance activities listed above, two reports were completed for WWC system in 2023. The reports were both requirements of the CLI ECA.

The Significant Drinking Water Threat Assessment Report for Proposed Alterations was completed in May 2023. It was completed as per Schedule E Condition 7.2 of the WWC CLI ECA. Its purpose was to identify significant drinking water threats caused by alterations to the WWC system, outline how to assess future proposed alterations, and summarize design considerations to mitigate future drinking water threat risks. No significant drinking water threats were found.

The Assessment of Wet Weather Flows Compared to Dry Weather Flows Report was completed in November 2023. It was completed as per Schedule E Condition 8.1.1. Ten years of data was analyzed to quantify the impact of wet weather (inflow and infiltration) on the WWC and WPCP. The report concluded infiltration and inflow from wet weather events were not significant sources of increased flow to wastewater system.

All annual calibrations of major equipment of the works were completed. All required calibrations have been completed by qualified professionals to ensure the WWC system operates in compliance with CLI ECA and other regulatory requirements.

The Wastewater Division has shifted to complete the majority of maintenance in-house. The flushing program, pump inspections, infrared inspections, and all CCTV inspections continue to be completed by internal staff.

4. Summary of Complaints

The Town maintains a record of all wastewater-related complaints and the remedial actions taken to resolve each situation as required by the WPCP ECA, WWC CLI ECA and Air CofA. For more information regarding the WPCP Air CofA refer to APPENDIX P.

In 2023 there was zero (0) odour complaints as a result of wastewater operations. Figure 23 shows a historic trend for odour complaints received and reported in accordance with the CofA. There was a drop in complaints between 2015 and 2018, and a slight increase in 2019. Overall the amount of odour complaints has decreased each year since 2019, receiving two (2) in 2020, one (1) in 2021, zero (0) in 2022, and zero (0) in 2023.

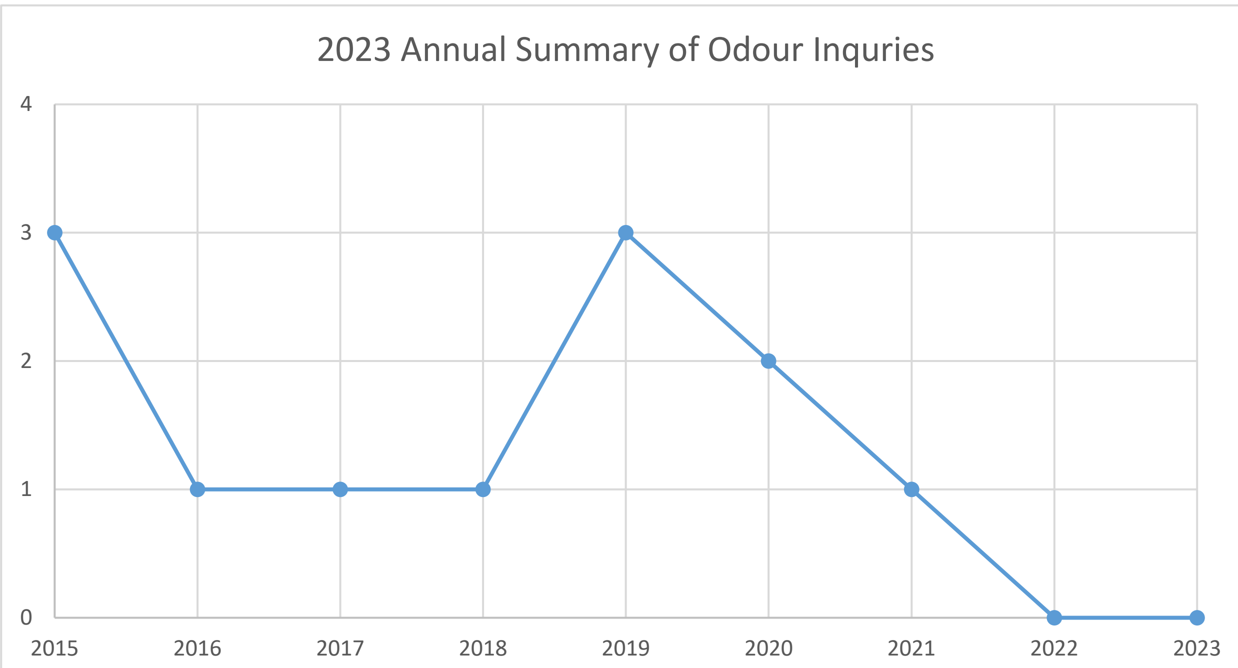

Figure 23. Odour Inquiry Reporting Trend 2015-2023

5. Biosolid Management

The WPCP produced 27,164m^3 of sludge in the reporting year. The biosolids that were produced met the MECP Ontario Guidelines for Sewage Sludge Utilization on Agricultural Lands and conditions specified under the Nutrient Management Act.

The biosolids produced by the WPCP were land applied to agricultural fields starting in April to November in accordance with the Nutrient Management Act. A summary of NASM land application is provided below (Table 9). The total amount of Non-agricultural Source Material (NASM) applied to agricultural land is an approximate total of 27,164m^3.

The volume of sludge expected to be produced within 2024 is 32,000m^3.

Table 9. NASM Land Application Totals 2023

NASM Land Application Total 2023	
NSAM Plan	**Total Land Applied (m^3)**
25122	540
25020	1,474
60332	738
24757	3,049
60501	1,303
24086	501
24534	908
24084	849
24021	3,189
24612	2,405
60555	4,423
25148	4,056
60608	1,669
24132	1,295
24520	554
24478	221
Total Sum	**27,164**

6. Septage Receiving

Imported Septage is the waste removed from a residential sewage system within the Town which was contained within a septic tank or sewage holding tank.

In 2023, septage was received in all months. The total septage received in 2023 at the BWG WPCP was 845.25m^3. The Septage Hauling Program in conjunction with the Sewer Use By-law 2013-68, was implemented January 1st, 2017. The program has given the Town the increased ability to ensure the source of septage received at the WPCP is only from within the geographical boundaries of the Town. The program will continue in 2024 with no changes.

The monitoring parameters for imported sewage sampling as required in Schedule D of the ECA are listed in Table 10.

Table 10. Imported Sewage monitoring requirements.

Imported Sewage – Imported Sewage Receiving Station		
Parameter	**Sample Type**	**Minimum Frequency**
BOD5	Grab	Monthly
Total Suspended Solids	Grab	Monthly
Total Phosphorus	Grab	Monthly
Total Kjeldahl Nitrogen	Grab	Monthly

Figures 24-27 depict the monitoring analysis of the required parameters outlined in the Table above. There is a high variety within the concentrations for all parameters analyzed for imported sewage, due to the volatility of the type of material. As mentioned imported sewage was received in all months of 2023.

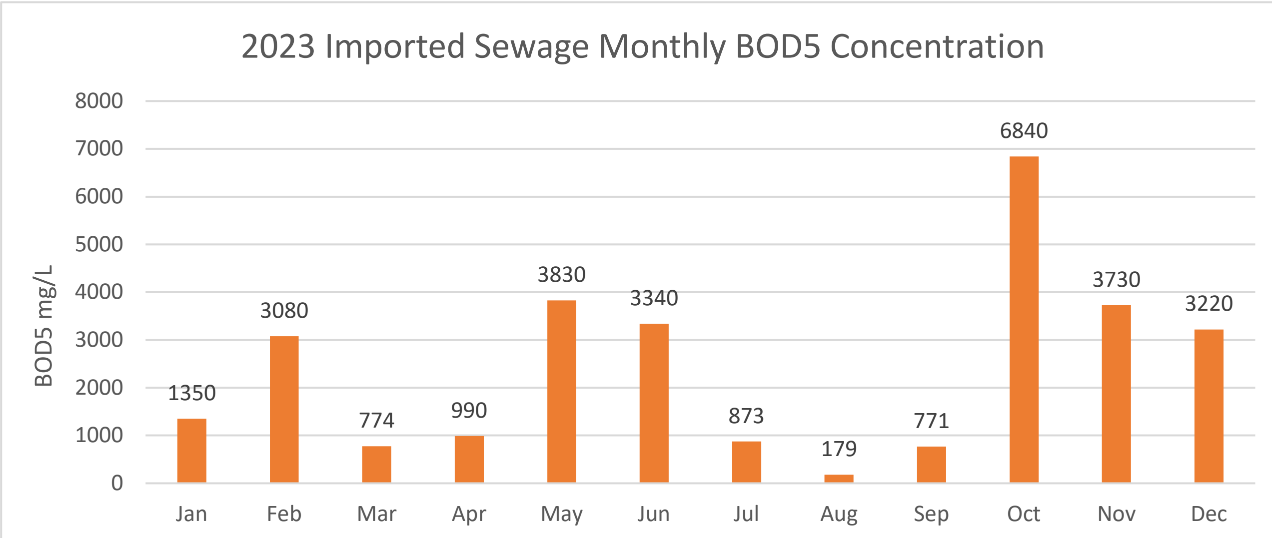

Figure 24. Imported Sewage Monthly BOD5 Concentration.

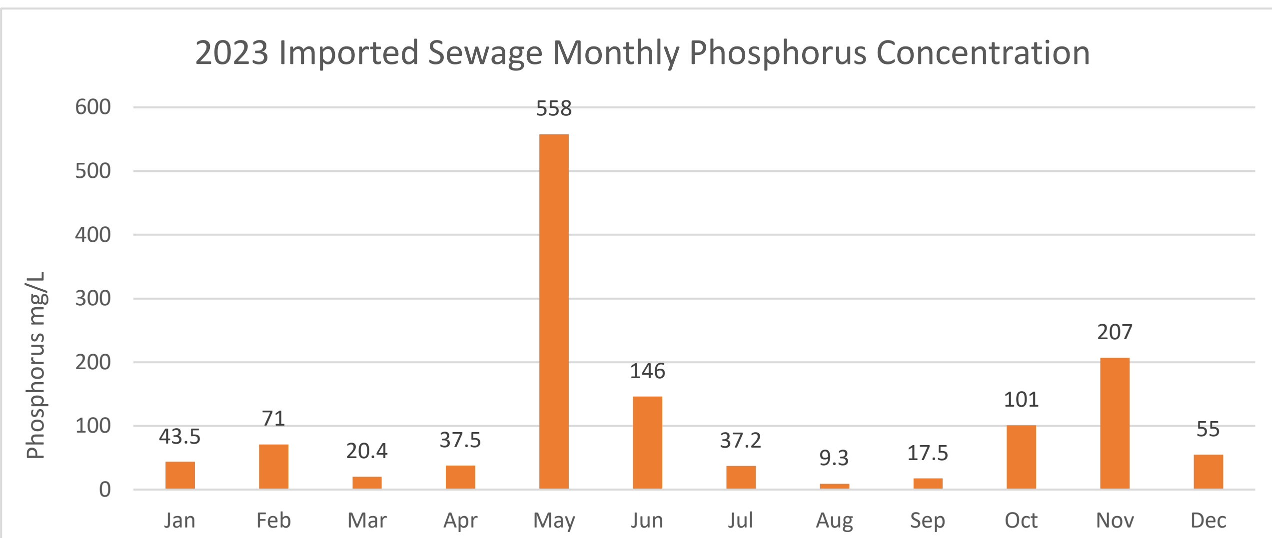

Figure 25. Imported Sewage Monthly Total Phosphorus Concentration.

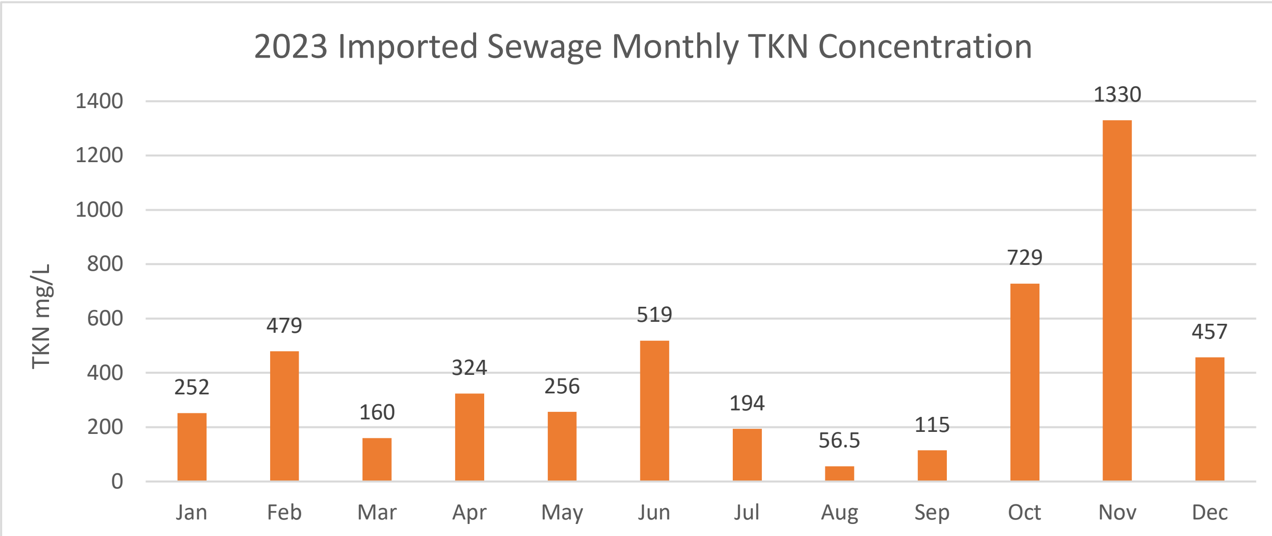

Figure 26. Imported Sewage Monthly TKN Concentration.

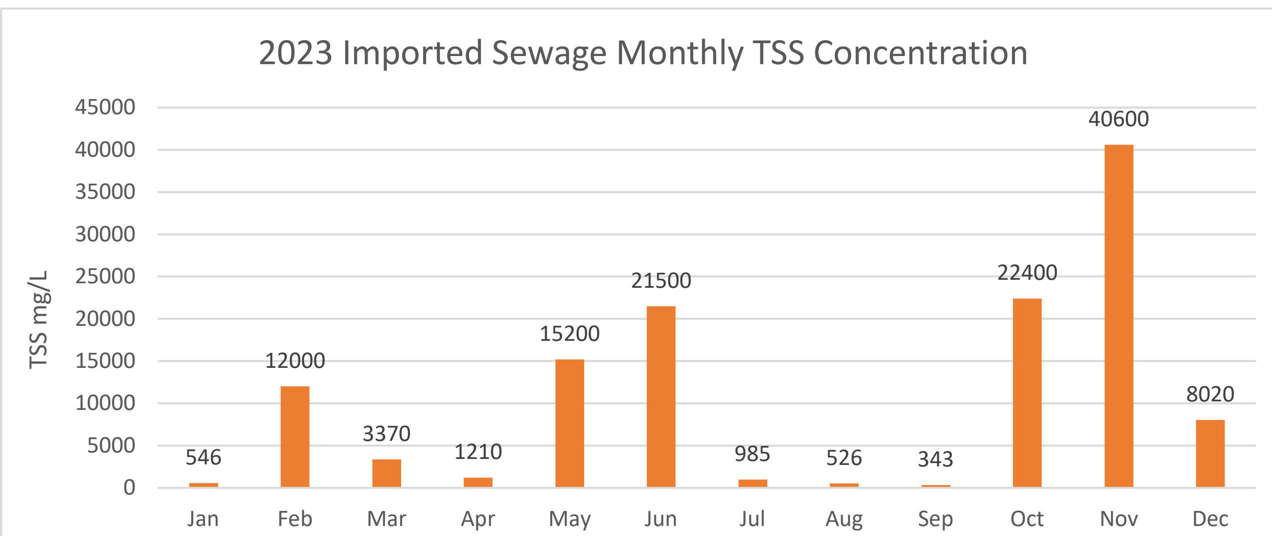

Figure 27. Imported Sewage Monthly TSS Concentration.

7. Emergency Occurrences

7.1 Abnormal Discharges, Spills and Bypass Events

The WPCP had one (1) spill event and WWC system had one (1) spill event in 2023. There were no bypass, overflow, or other abnormal discharge events in 2023.

The spill in the WWC system occurred on January 30th. The Town was notified at 11:05HR of a sanitary sewage spill. The spill was caused by a blocked service lateral. Approximately 2 m^3 of sewage was spilled during the event. Wastewater Staff attended the site and collected a grab sample of the sewage, as required by the CLI ECA Schedule E subsection 3.4.2. The sample was submitted to SGS Lakefield for analysis, the analytical results can be found in Table 11. The spilled material was contained to the driveway and roadway. Staff removed the blockage and remediated the site using a hose and a vacuum truck. Remediation was completed at 13:20HR.

The Spills Action Centre (SAC) was contacted at 11:58HR. The SAC reference number 1-2H4BYJ was assigned. No further direction or information was requested. The Ministry of Health (MOH) was contacted at 13:41HR, no further direction or information was requested.

Table 11. Summary of Analytical Results for WWC Spill

Analytic Results for WWC Spill	
Parameter	**Concentration**
BOD5	332 mg/L
Total Suspended Solids	159 mg/L
Total Phosphorus	2.91 mg/L
Total Kjeldahl Nitrogen	28.9 mg/L
Total Ammonia Nitrogen	3.8 mg/L
E.coli	123000 cfu/100mL

The spill at the WPCP occurred on On August 15th at 17:07HR. It was caused by a ruptured hose which lead to 13.3m^3 of biosolids to spilling on site at the WPCP. The incident was contained to the loading area at the WPCP. Staff collected a grab sample, the sample was submitted to SGS Lakefield for analysis. Remediation of the site was completed by staff using a hose and vacuum truck, the material was disposed on site at the plant. SAC was contacted at 18:11HR. The SAC reference number 1-3QLBFU was assigned. No further direction or information was requested.

Baseline grab samples were taken in 2023 at applicable wastewater pumping stations as required by Schedule E Condition 3.4.1 of the CLI ECA. Standard Operating Procedures are in place for any overflow/spill event that occurs at the WPCP or in the WWC system.

7.2 Flow Diversion at WPCP

In 2023 there were two (2) flow diversions conducted. In this context a flow diversion is conducted as sludge dewatering and supernating. The diverted supernatant is sent to the lagoons and will be fed back to the head of the plant for treatment when appropriate. Flow diversions were conducted on March 28-30 and Oct 17-20.

7.3 Control Measures

The WPCP has quality assurance and quality control measures in place to ensure that the effluent requirements have been met. The control measures include a PM program, SCADA, back-up generator(s), a sampling program, and storage lagoons.

In 2019, the Compliance and Wastewater Divisions rolled-out a Quality Management System (QMS), which has been an ongoing initiative for the Division. The WW QMS was modeled after the DWQMS framework. The WW QMS was developed and implement to formalize a system for documentation, processes and responsibilities for the Wastewater System.

In the event that the plant is unable to handle the flow, there is a provision at the WPCP to allow the excess flow to be diverted to one (1) of the on-site storage lagoons. If this happens, the sewage is held in this lagoon until such a time that it is feasible to return the sewage back to the head of the plant. The WPCP is equipped with a 1,000 kilowatt (kW) diesel generator which provides one hundred percent (100%) back-up power to the WPCP in case of a power outage. This eliminates any sewage diversion to the holding lagoon due to a power failure. Diverting sewage to a temporary location and then pumping it back to the head of the plant is not considered a by-pass event.

On March 16th, the Wastewater Division conducted a mock emergency focusing on a sanitary forcemain break and spill in the WWC system. The exercise was conducted in-person with both a field component and a table-top discussion. Additionally, staff reviewed past emergencies since the last exercise and changes to the Emergency and Contingency Plan for wastewater operations.

7.4 Call-outs

The WPCP and WWC system received 108 (one hundred and eight) call-outs in 2023. Figure 28 visually identifies the frequency of call-outs the wastewater division has received from 2013 to 2023. 2023 saw a sharp increase with fifty-three (53) more call-outs than 2022.

In 2017 a number of the call-outs were related to communication problems between the Pumping Stations and the WPCP. The communication issues were rectified in 2018 and the improvement can be seen within the decrease of call-outs in the following years. The recent increase can be attributed to communication issues and PLC alarms from ongoing projects at the WPCP including a Plant-wide PLC upgrade and alarm reconfiguration.

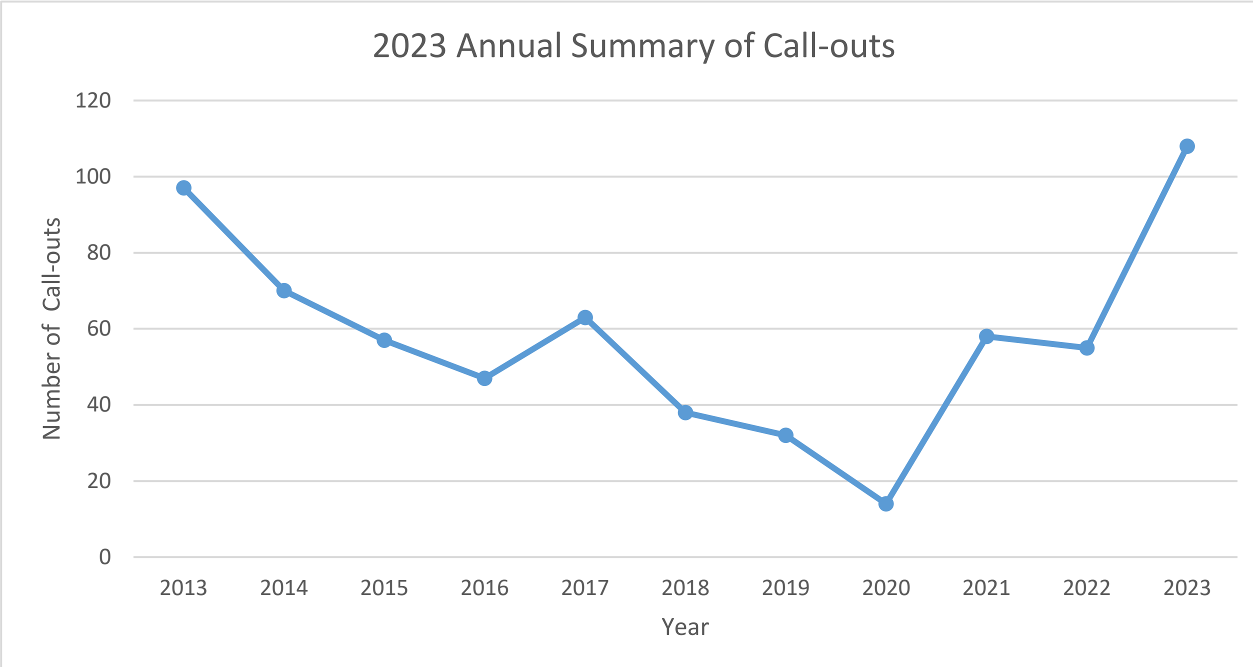

Figure 28. Wastewater call-outs from 2013-2023.

Documentation is completed for both call-outs during work hours and after hours of operation. All call-outs received in 2023 are categorized by type of call in Figure 29. This includes the location of the call-out and if the call-out required on-site action or was completed remotely. Call-outs were received for the WPCP and Collection System. An ‘other’ category which includes responding to sewer blockages and non-site specific call-outs exists, but no Call-outs were received in the category for 2023.

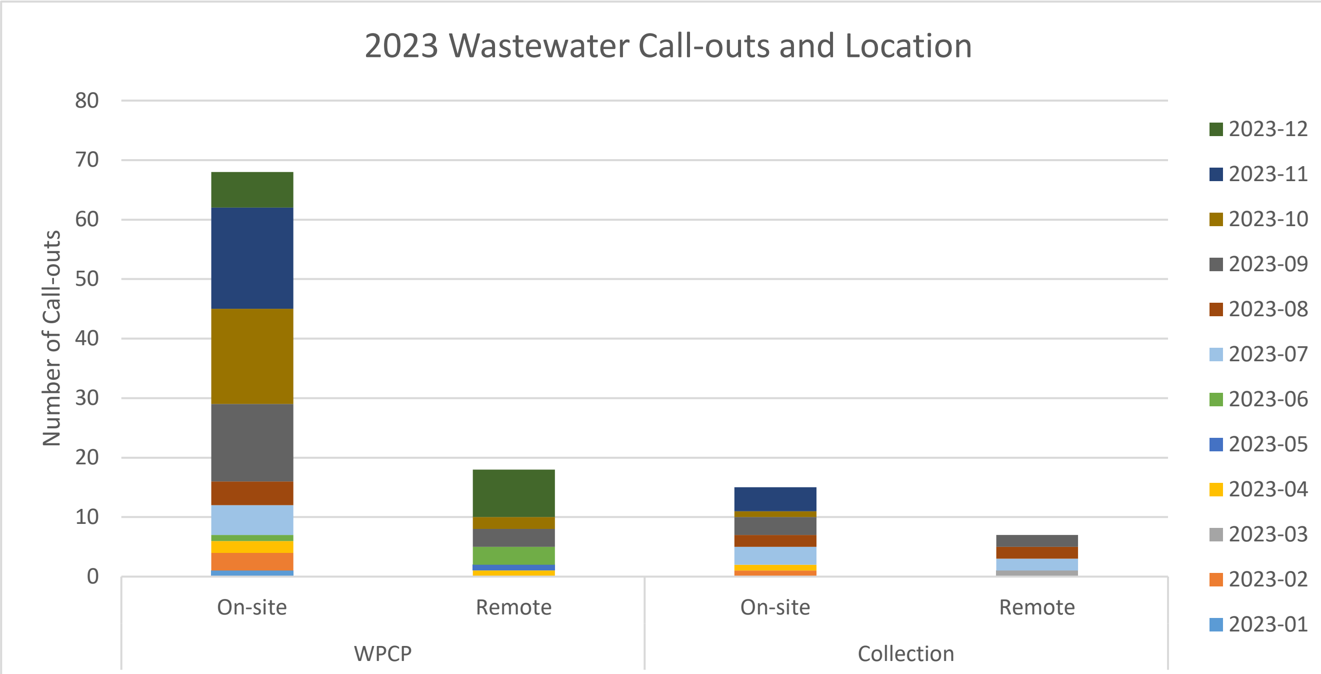

Figure 29. Wastewater Call-outs for 2023 by location.

November and September had the highest number of call-outs totaling 21 (twenty-one) in both months. On average, the wastewater division acknowledged approximately nine (9) call-outs per month. The 2023 call-outs per month are outlined in Figure 30, there were call-outs in all months.

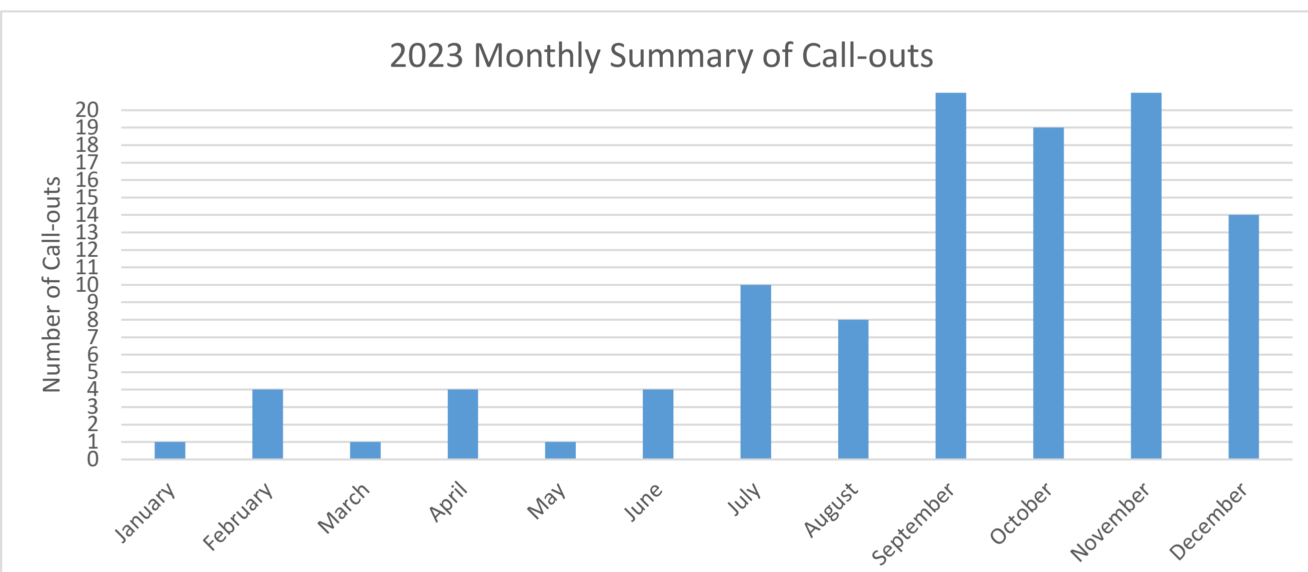

Figure 30. 2023 Call-outs by month.

8. Source Water Protection

The Source Water Protection Plan for the South Georgian Bay Lake Simcoe Source Protection Region contains policies designed to prevent contaminates from getting into municipal wells and water supplies, refer to APPENDIX L for wellhead protection area map. The BWG WPCP is outside of the wellhead protection area and does not have any applicable Source Water Protection policies to adhere to.

9. Wastewater System Effluent Regulation (WSER)

WSER is a Federal Regulation in place to protect the environment and human health. The regulation applies to facilities that deposit deleterious substances into areas frequented by fish and areas referred to in the Fisheries Act subsection 36(3). The regulation also applies to facilities that have an influent of at least $100m^3$ per day or year. The BWG WPCP is required to follow the aforementioned regulation.

The Town of BWG submitted all required quarterly reports for 2023. The reports state the total effluent deposited (m^3), the number of day's effluent was deposited, average CBOD5 and average TSS concentrations. One (1) report in each year must include the determination if the effluent was acutely lethal. The acute lethality sampling was conducted in the second quarter on June 6th, 2023 and the results determined that the effluent was not acutely lethal. Nautilus Environmental conducted the acute lethality testing for the WPCP. Figure 31 and 32 graph the quarterly average for TSS and CBOD5 WSER reporting.

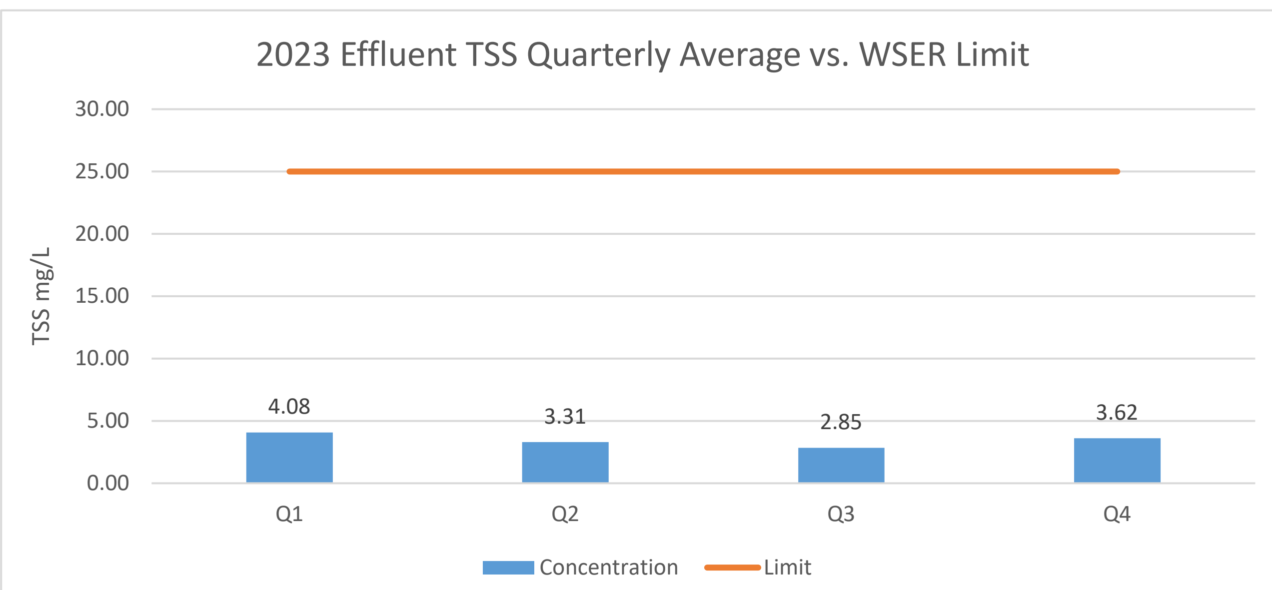

Figure 31. Effluent TSS Quarterly Average vs. WSER Limit.

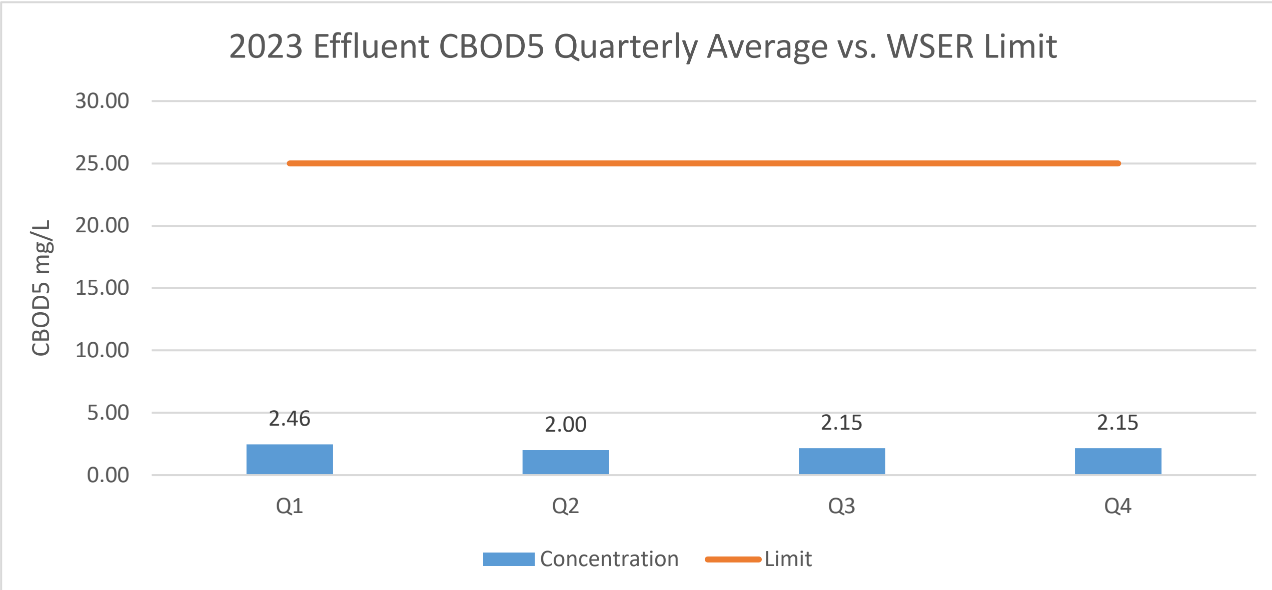

Figure 32. Effluent CBOD5 Quarterly Average vs. WSER Limit.

10. Education and Outreach

The Town's website (www.townofbwg.com) contains educational information regarding the wastewater system, the WPCP, and current outreach initiatives including the I Don't Flush Campaign.

In addition to electronic information, Town staff attended a public event to educate the public on how they can help protect the Town's infrastructure and the environment, though informative pamphlets and games.

Education and outreach initiatives empower the local community to do their part in protecting the environment.

10.1 I Don't Flush

With the growing problem of unacceptable household waste being flushed down toilets, the Town worked in partnership with the "I Don't Flush" awareness campaign.

The campaign focuses on pharmaceutical, Fats, oils and greases (FOG), and what not to flush awareness. The Town continues to promote the "I Don't Flush" campaigns, through the Town's website and events.

11. Conclusions

The Town managed and operated the WPCP and Collection System in accordance with the current ECA's and legislation including the EPA and OWRA.

The following conclusions are provided on the basis of the information reviewed in this report, in addition, a technical summary can be found in Table 12.

- The WPCP and WWC system continue to operate in compliance with applicable legislation and regulatory requirements.
- The WPCP and WWC system did not experience any operational exceedances.
- All required sampling was conducted and met or surpassed legislative requirements.
- No bypass or overflows events occurred at the WPCP or in the Collection System.
- Two (2) spills occurred in 2023, one at the WPCP and one in the Collection System as discussed in Section 7.1.
- Zero odour complaints reported related to wastewater operations.
- The Assessment of Wet Weather Flows Compared to Dry Weather Flows and Significant Drinking Water Threat Assessment Report for Proposed Alterations were completed as required by the CLI ECA for the WWC system.
- Baseline grab samples were taken at applicable wastewater pumping stations as required by the CLI ECA
- The Town is working on the continual improvement of the works through a Quality Management System as well as accommodating new infrastructure needs.
- The Town is helping to educate the public to protect the wastewater system and the natural environment through the "I Don't Flush" campaign and other educational initiatives.

Table 12. WPCP Annual Summary Information Table

2023 WPCP Annual Summary Table		
Service Population	35,430	
Flow		
Item	**Influent**	**Effluent**
Average Daily Flow (m^3)	12,662	11,190
Average Daily Flow Plant D (m^3)	8,657	8,207
Average Daily Flow Plant C (m^3)	3,700	2,983
Average Daily Flow Plant B (m^3)	1,954	N/A*
Rated Capacity (**19,400m^3/day**) Used	65%	58%
Total Flow (m^3)	4,621,521	4,084,447
Max Day Flow Plant D (m^3)	13,741	14,400
Max Day Flow Plant C(m^3)	5,084	4,825
Total Phosphorus Concentrations and Loadings		
Parameter	**Concentration/ Loading**	**ECA Limit**
Annual Average Daily Effluent Loading (kg/day)	0.679	1.912
Annual Average Effluent Concentration (mg/L)	0.061	0.098
Chemical Usage		
Total Alum (L)	780,307	
Odour Inquires		
Number of odour Inquiries attributed to the Wastewater System	0	
Biosolids		
Approximate volume of biosolids produced (m^3)	27,164m^3	
Volume of biosolids land applied (m^3)	27,164m^3	

Septage Hauling Program			
Number Haulers Enrolled:	3	Amount of Septage Received (m^3):	845.25

*Plant B Effluent is captured in the Plant C Effluent total as Plant B flows into Plant C Filter Building

12. References

Canadian Council of Ministers of the Environment. (2010). *Canadian water quality guidelines for the protection of aquatic life: Ammonia.* Winnipeg: Canadian Council of Ministers of the Environment.

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Hutchinson Environmental Sciences Ltd. . (2021). *Bradford West Gwillimbury WPCP 2020 Benthic Invertebrate Study.* Bracebridge: Hutchinson environmental Sciences Ltd. .

Appendix A

Bradford West Gwillimbury — A Growing Tradition	**WPCP Sampling Schedule - 2024** **WWD-031**	**Wastewater Department** **Resources**
Revised: December 5, 2023	**Revision: 10**	**Page 1 of 1**

Parameter	pH (Field Analysis)	Temperature (Field Analysis°C)	Total Phosphorus	Total Ammonia Nitrogen (TAN)	Total Kjeldahl Nitrogen (TKN)	Total Suspended Solids (TSS)	Carbonaceous Biological Oxygen Demand (CBOD5)	Biological Oxygen Demand (BOD5)	E.Coli	Total Solids	Nitrate as Nitrogen	Nitrite as Nitrogen	Metals (Al, As, Cd, Co, Cr, Cu, Fe, Hg, K, Mn, Mo, Ni, Pb, Se, Na, Zn)	Un-ionized Ammonia	Benthic Monitoring (NOTE 7)	Acute Lethality (NOTE 6)
Internal Laboratory Analysis																
Raw Influent	Grab															
Frequency	W															
Requirement	Due Diligence															
Final Effluent	Grab/ Probe/ Analyzer	Grab/ Probe/ Analyzer	24Hr Comp	24Hr Comp												
Frequency	W	W	W	W												
Requirement	ECA/ MUMP	ECA	Due Diligence	Due Diligence												
External Laboratory Analysis																
Raw Influent			24Hr Comp	24Hr Comp	24Hr Comp	24Hr Comp	24Hr Comp	24Hr Comp					Grab			
Frequency			W	W	W	BM	BM	BM					Q			
Requirement			ECA/ MUMP	Due Diligence	ECA/ MUMP	ECA/ MUMP	Due Diligence	ECA/ MUMP					NPRI			
Final Effluent			24Hr Comp	24Hr Comp	24Hr Comp	24Hr Comp	24Hr Comp		Grab		24Hr Comp	24Hr Comp	Grab	Calculated	Grab	Grab
Frequency			W	W	W	W	W		W		W	W	Q	W	2 Year	Y
Requirement			ECA/ MUMP	ECA/ MUMP	ECA/ MUMP	ECA/ MUMP/ WSER	ECA/ MUMP/ WSER		ECA/ MUMP		ECA	ECA	NPRI	ECA	Due Diligence	WSER
Sludge/ Biosolids			8Hr Comp	8Hr Comp	8Hr Comp				8Hr Comp	8Hr Comp	8Hr Comp	8Hr Comp	8Hr Comp			
Frequency			M (Feb-Nov)	M (Feb-Nov)	M (Feb-Nov)				M (Feb-Nov)	M (Feb-Nov)	M (Feb-Nov)	M (Feb-Nov)	M (Feb-Nov)			
Requirement			ECA	ECA	Due Diligence				O.Reg 267/03 General	O.Reg 267/03 General/ ECA	O.Reg 267/03 General/ ECA	O.Reg 267/03 General	O.Reg 267/03 General/ ECA			
Imported Sewage			Grab		Grab	Grab		Grab								
Frequency			M		M	M		M								
Requirement			ECA		ECA	ECA		ECA								

ECA 3705-BGRP97 Condition 9.b. **Sampling Rotation Schedule 2024:**	Influent/ Effluent:	Tuesday	Imported Sewage	First load of the month received	Biosolids:	Tuesday (Feb-Nov) Monthly

Legend	
W	Weekly
D	Daily
Q	Quarterly
BM	Bi-monthly, twice per month
M	Monthly
Y	Yearly
2 Year	Every two (2) years
RED	Scheduled Analysis

Note 1: This schedule is to be used as a reference only and may be altered by the ORO conforming with all applicable legislation.

Note 2: The ECA requirement is in reference to the current Environmental Compliance Approval No. 3705-BGRP97 issued to the Water Pollution Control Plant on November 12, 2019.

Note 3: MUMP requirement is in reference to the Municipal Utility Monitoring Program (MUMP) parameters that are reported to the MECP and the current Water Inspector quarterly.

Note 4: O.Reg 267/03 is the General regulation issued under the Nutrient Management Act, this governs the sampling requirements for non-agricultural source material.

Note 5: WSER requirement is in reference to the Federal Wastewater System Effluent Regulation.

Note 6: Acute Lethality sampling is conducted the second week of June annually.

Note 7: Benthic Monitoring last completed 2022, next sampling 2024. Sampling is conducted in the effluent receiving stream (West Holland River).

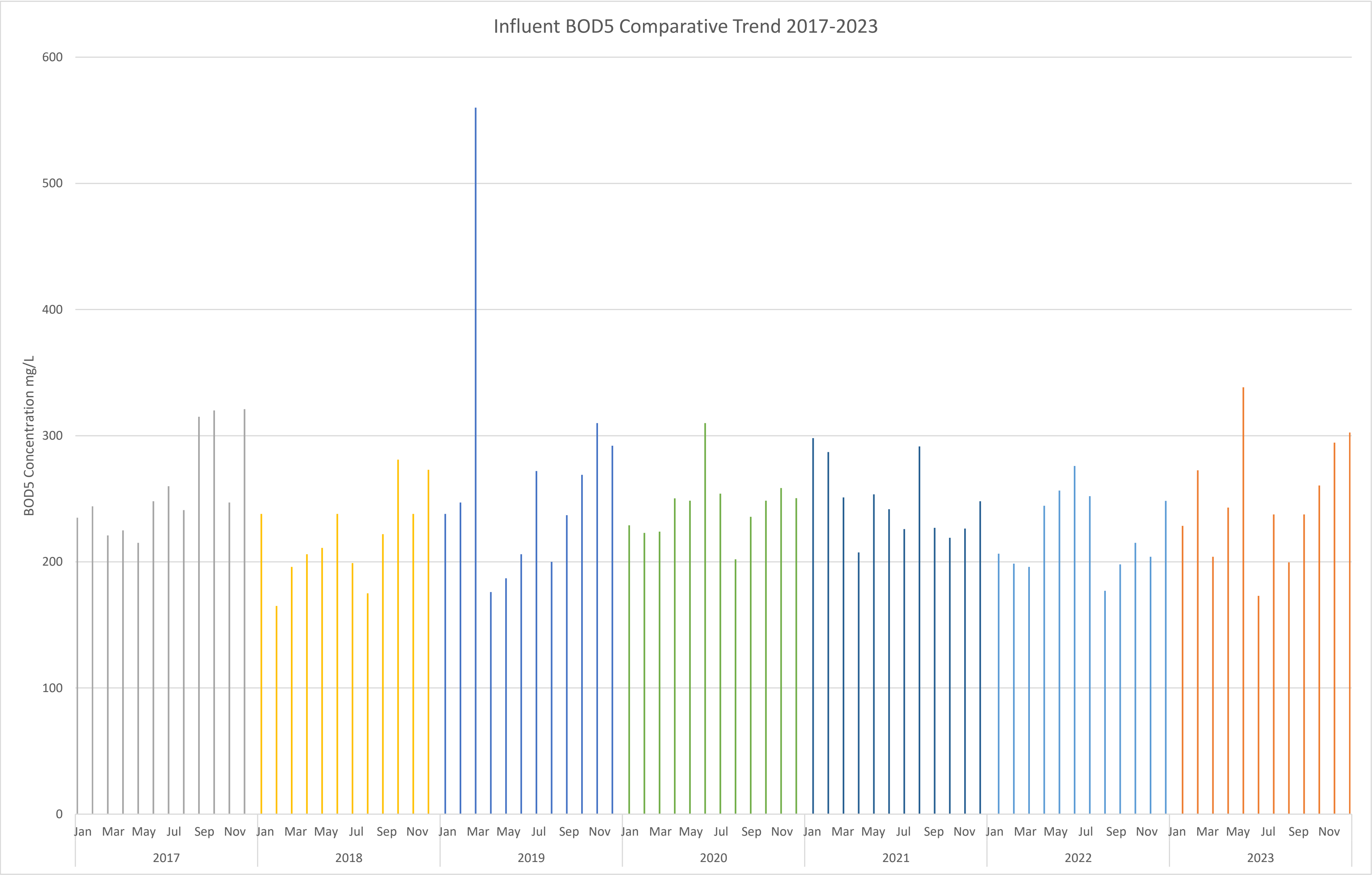
Note 8: Imported Sewage, sampling is only required when septage has been received within the month.

Note 9: The sampling schedule has been developed to conform with the requirements of applicable legislation. In some cases exceeds the frequency required in the legislative tool.

Note 10: NPRI is in reference to the National Pollutant Release Inventory.

Appendix B

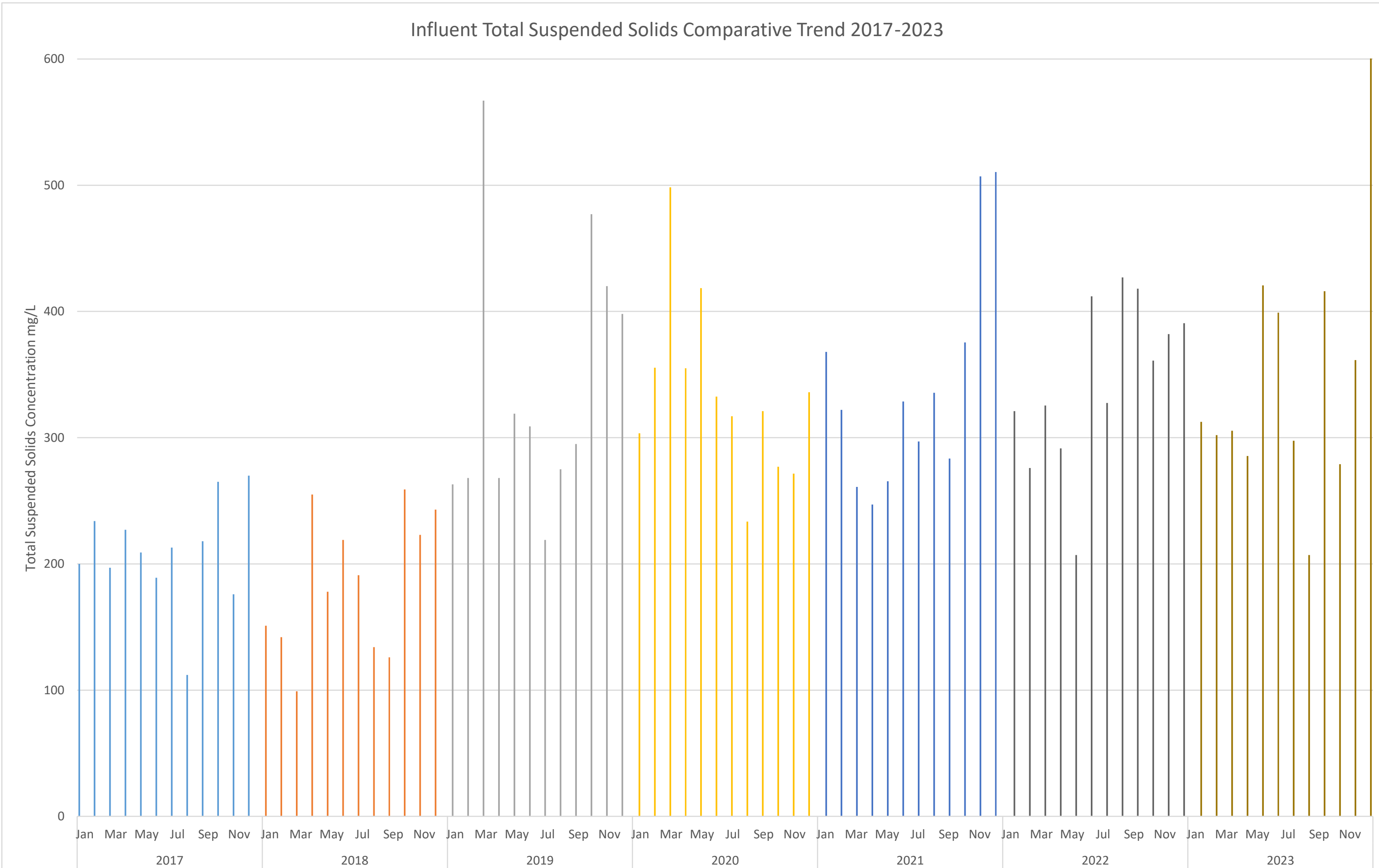
Appendix B



Influent BOD5 Comparative Trend 2017-2023
BOD5 Concentration mg/L
600
500
400
300
200
100
0
Jan Mar May Jul Sep Nov
2017
2018
2019
2020
2021
2022
2023

Appendix C

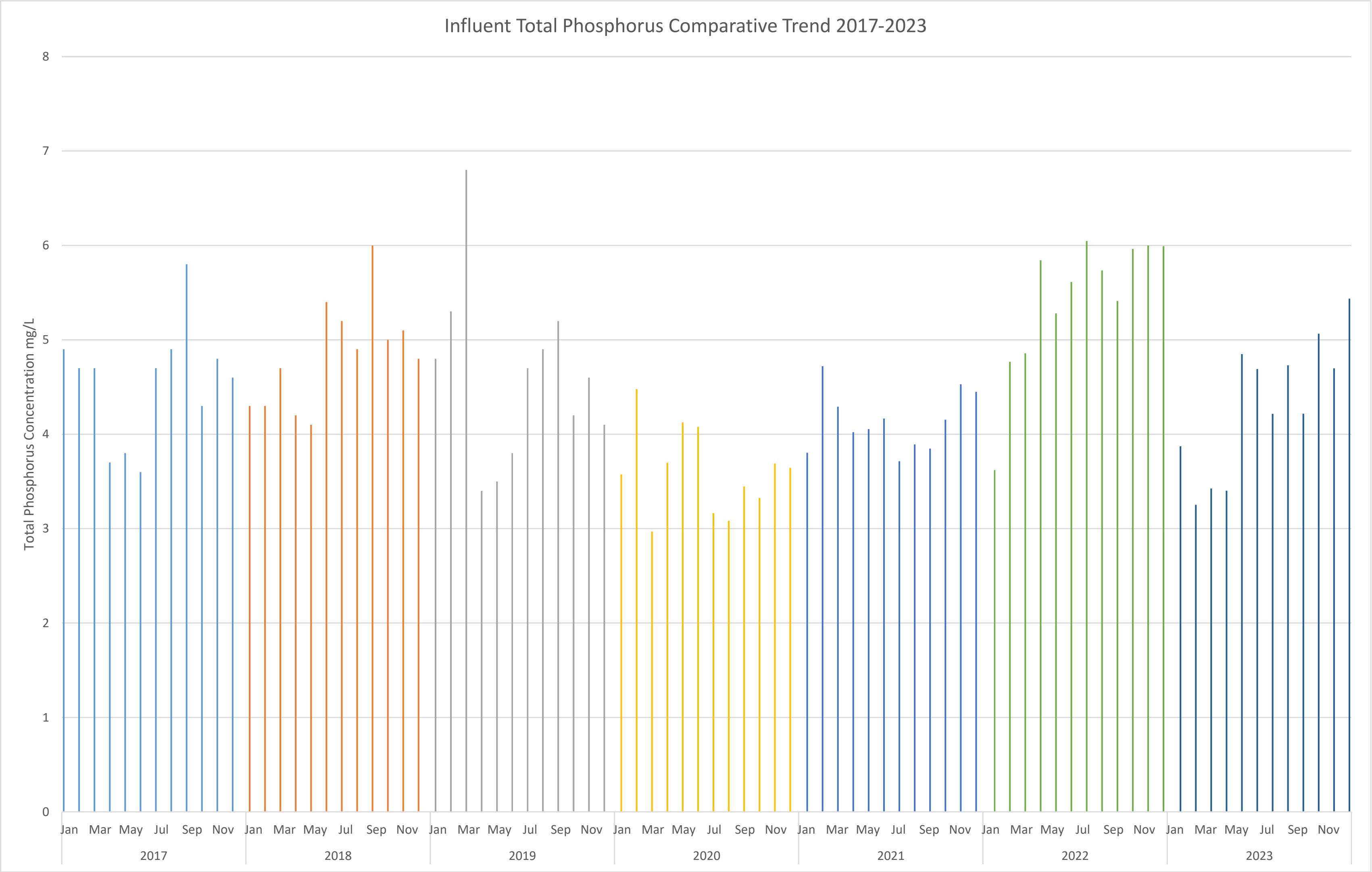
Appendix C



Influent Total Suspended Solids Comparative Trend 2017-2023
Total Suspended Solids Concentration mg/L
600
500
400
300
200
100
0
Jan Mar May Jul Sep Nov
2017
2018
2019
2020
2021
2022
2023

Appendix D

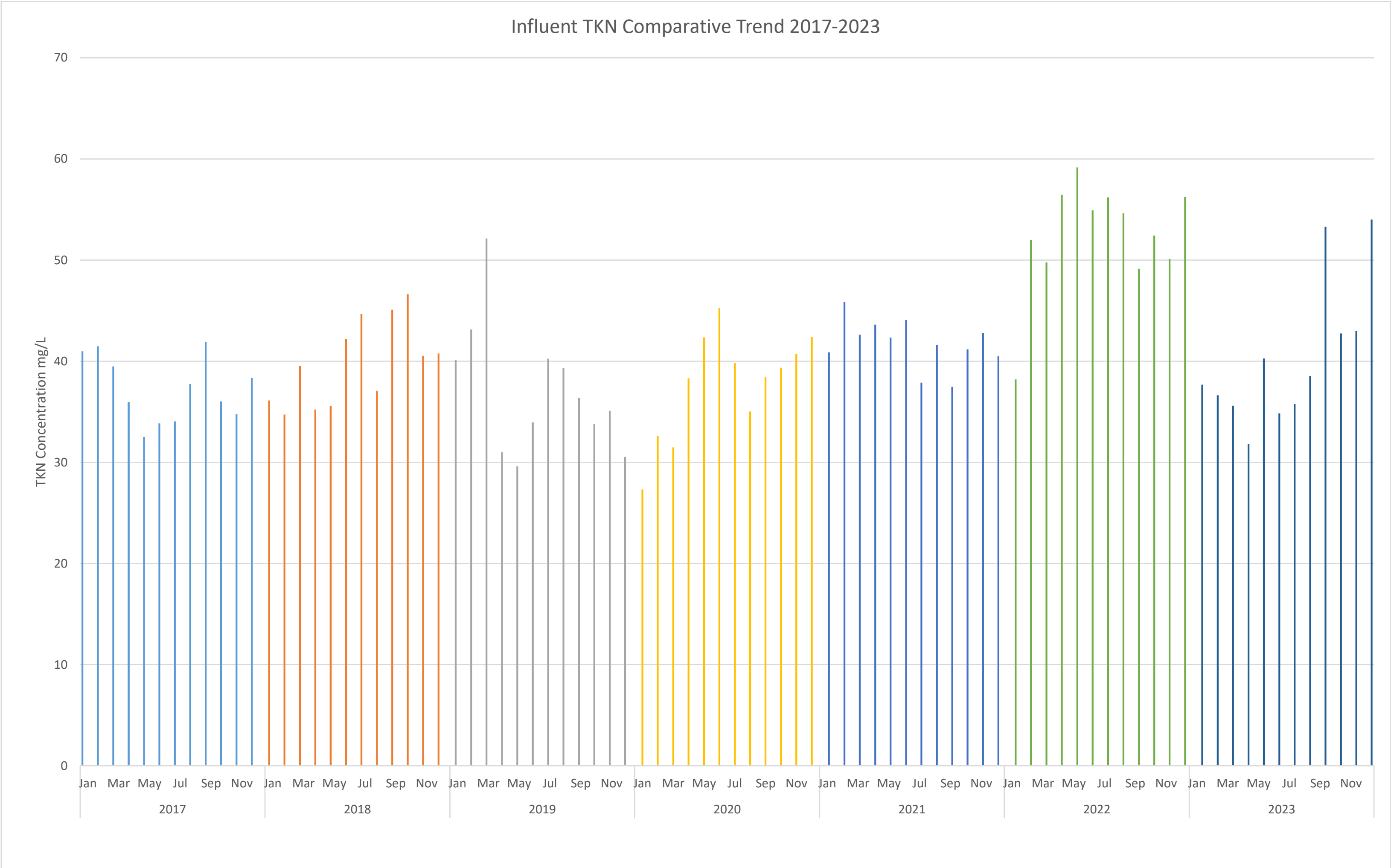
Appendix D



Influent Total Phosphorus Comparative Trend 2017-2023
Total Phosphorus Concentration mg/L
0
1
2
3
4
5
6
7
8
Jan
Mar
May
Jul
Sep
Nov
2017
2018
2019
2020
2021
2022
2023

Appendix E

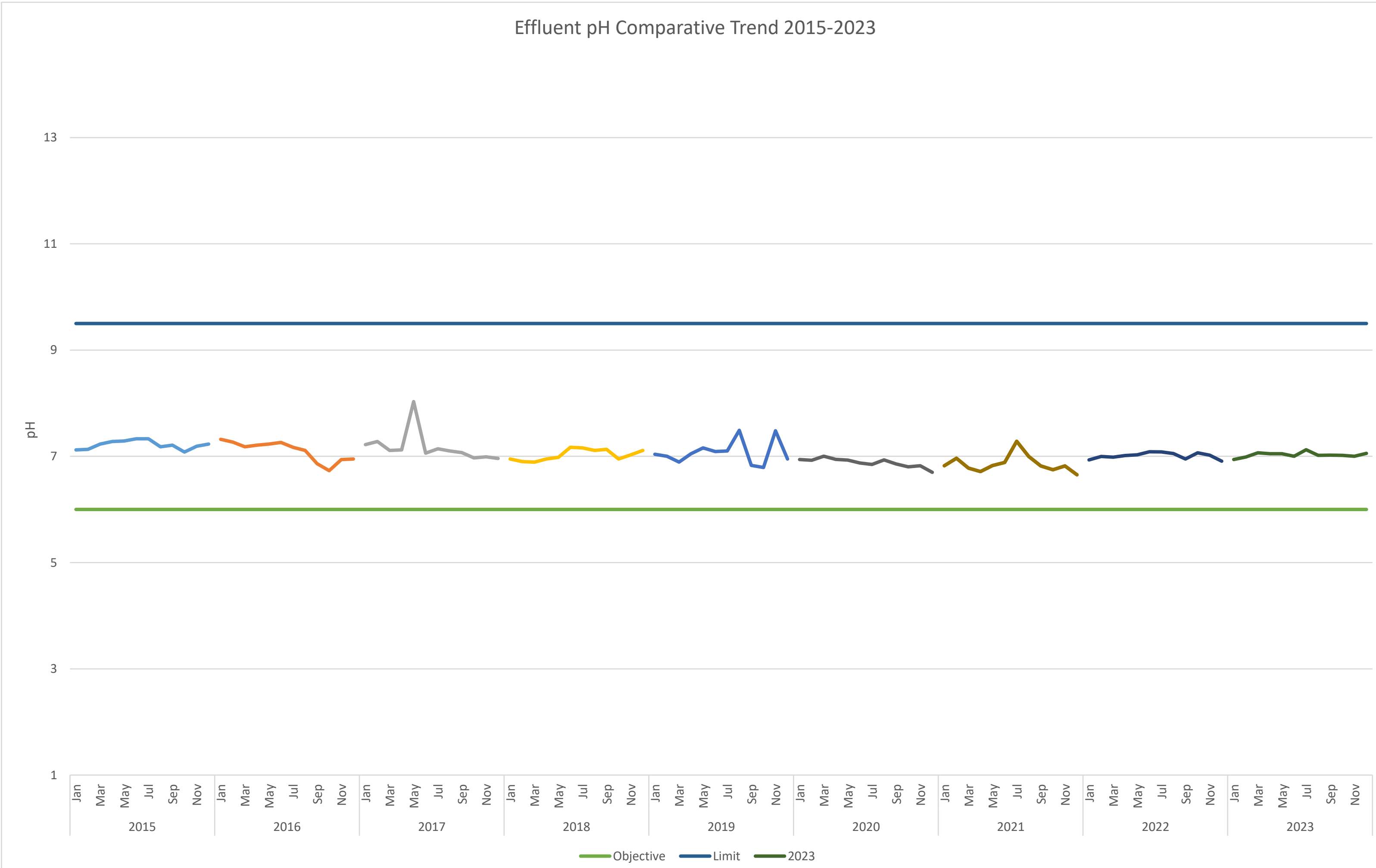
Appendix E



Influent TKN Comparative Trend 2017-2023
TKN Concentration mg/L
0
10
20
30
40
50
60
70
Jan
Mar
May
Jul
Sep
Nov
2017
2018
2019
2020
2021
2022
2023

Appendix F

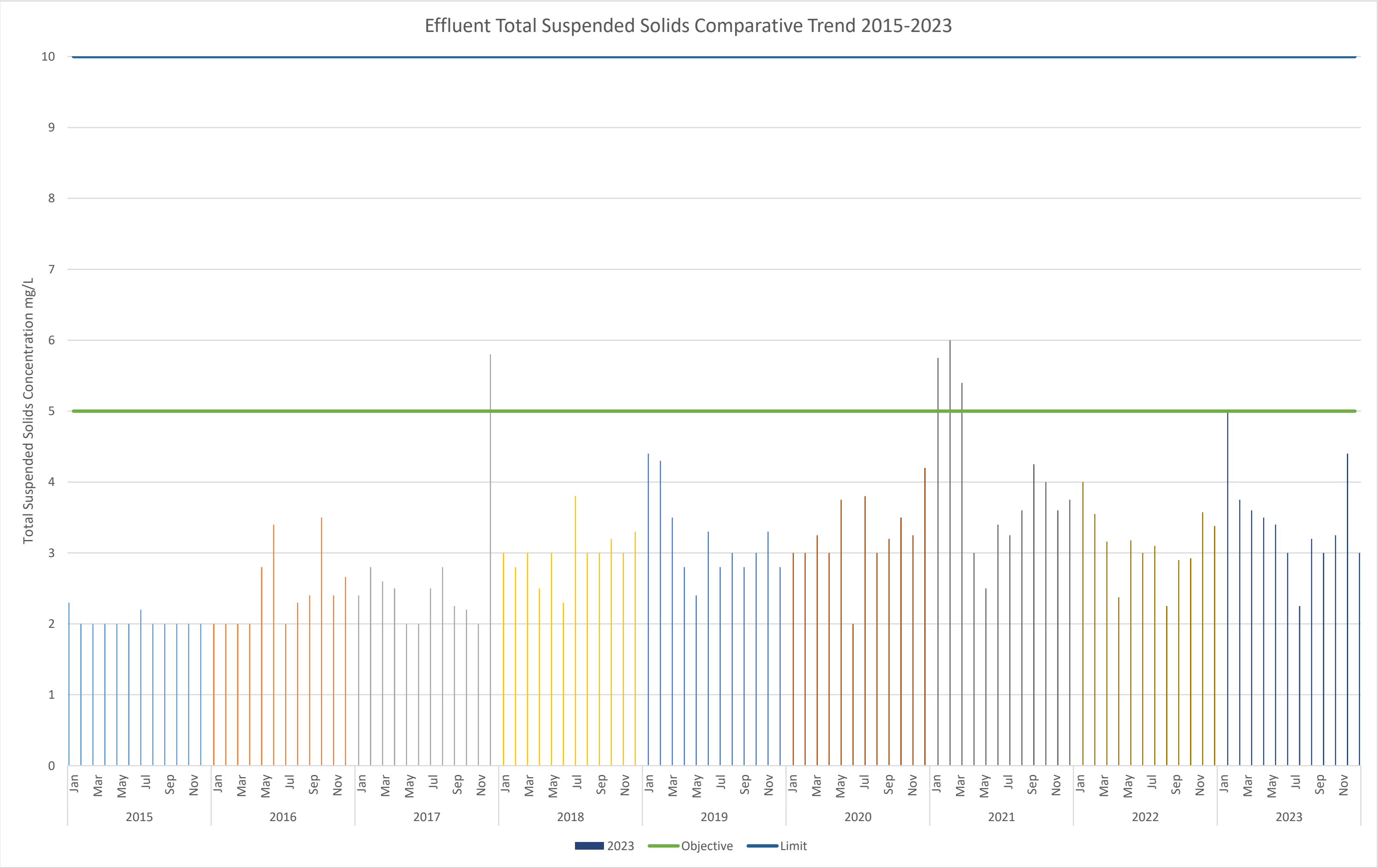
Appendix F



Effluent pH Comparative Trend 2015-2023
pH
13
11
9
7
5
3
1
Jan Mar May Jul Sep Nov
2015 2016 2017 2018 2019 2020 2021 2022 2023
Objective
Limit
2023

Appendix G

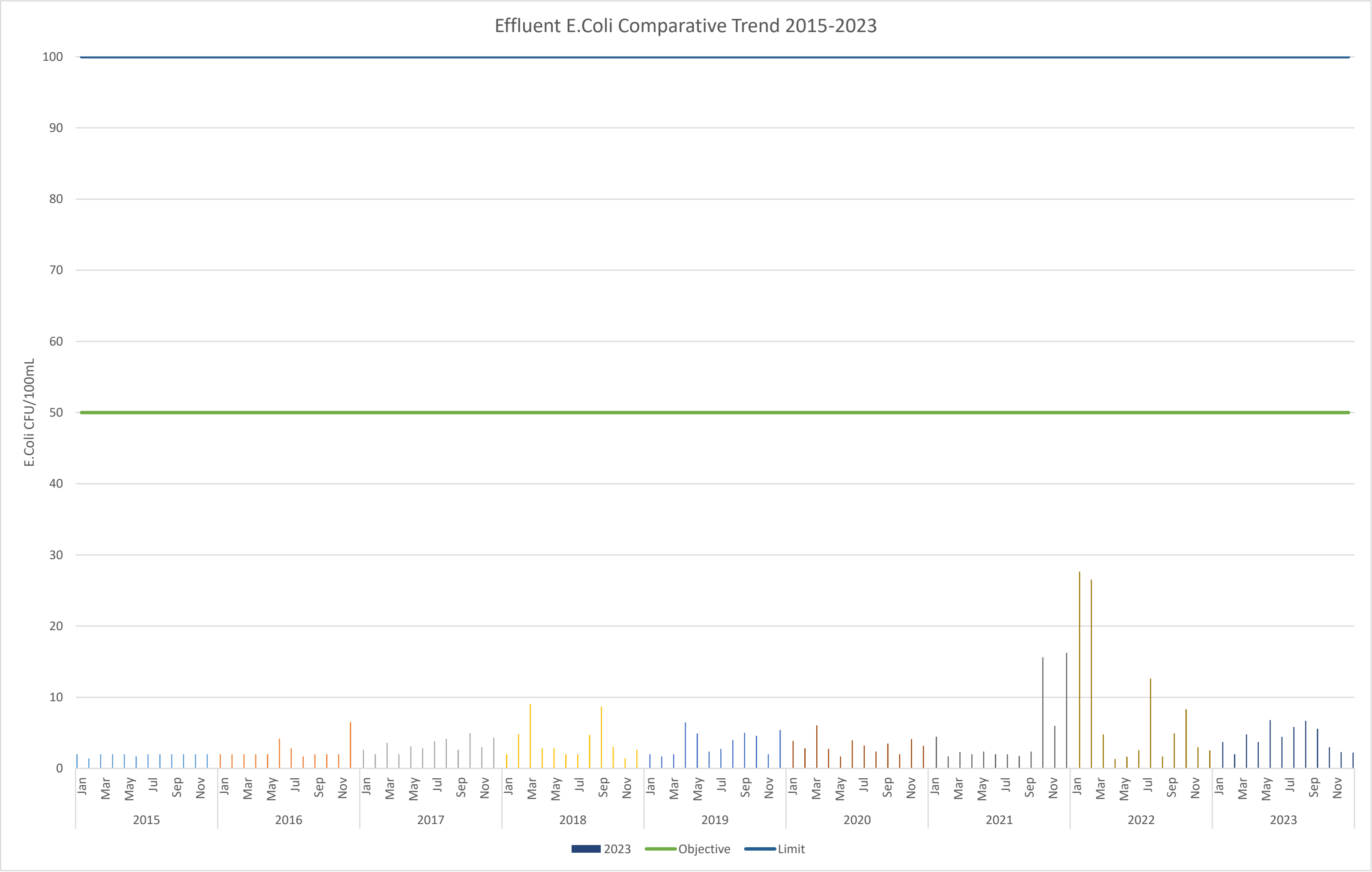
Appendix G



Effluent Total Suspended Solids Comparative Trend 2015-2023
Total Suspended Solids Concentration mg/L
0
1
2
3
4
5
6
7
8
9
10
Jan Mar May Jul Sep Nov
2015
2016
2017
2018
2019
2020
2021
2022
2023
2023
Objective
Limit

Appendix H

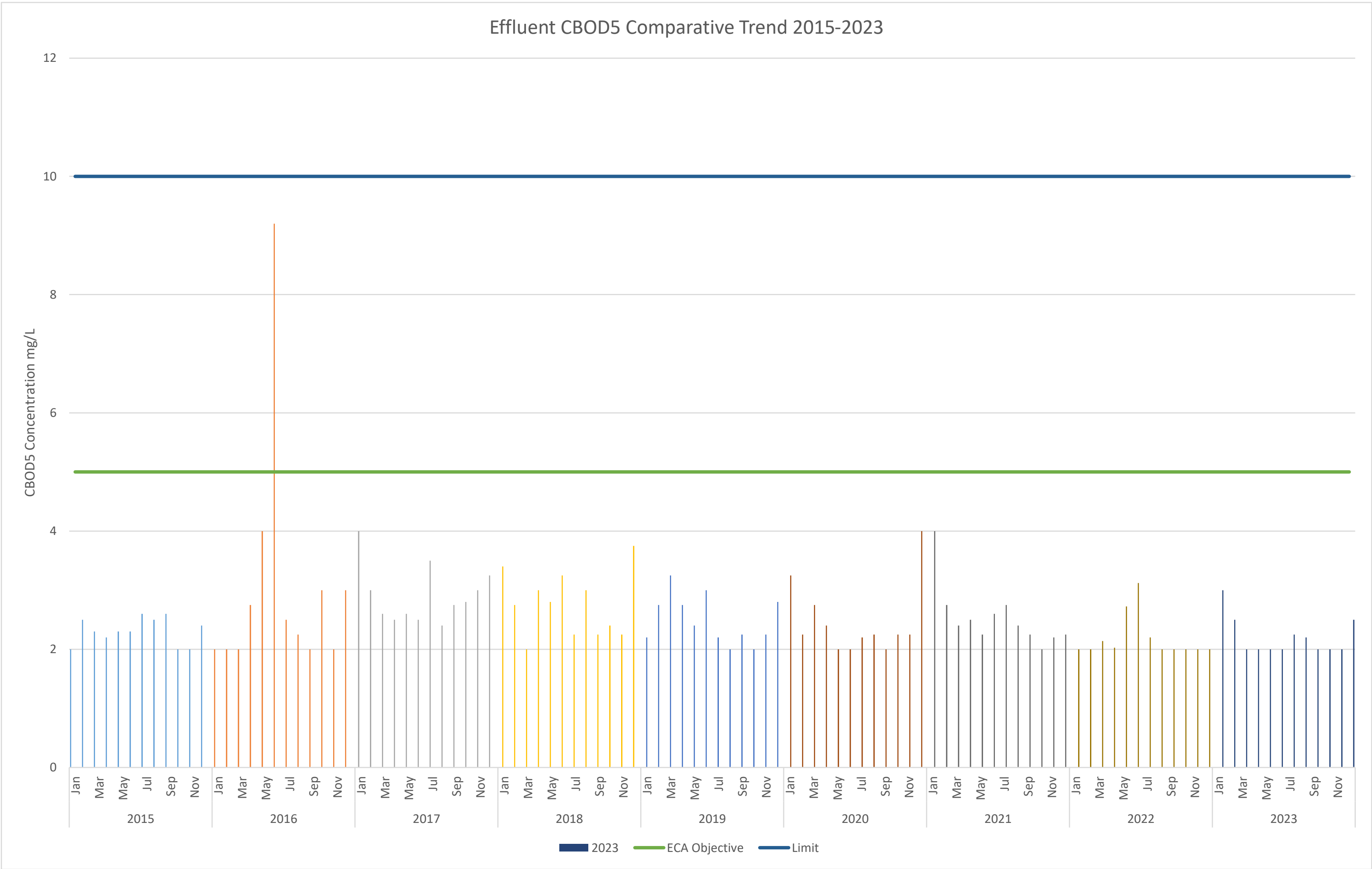
Appendix H



Effluent E.Coli Comparative Trend 2015-2023
E.Coli CFU/100mL
0
10
20
30
40
50
60
70
80
90
100
Jan Mar May Jul Sep Nov
2015
2016
2017
2018
2019
2020
2021
2022
2023
2023
Objective
Limit

Appendix I

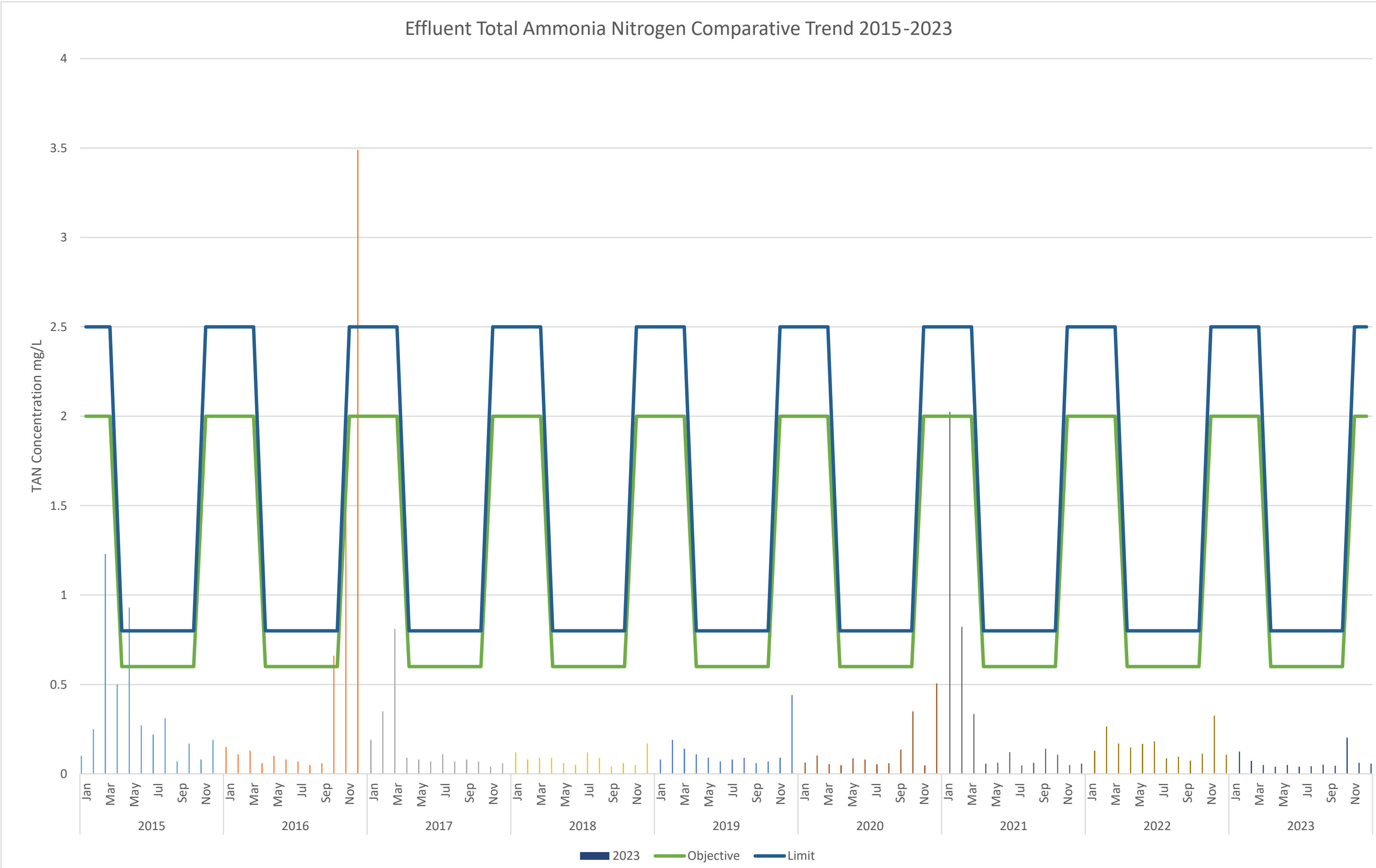
Appendix I



Effluent CBOD5 Comparative Trend 2015-2023
CBOD5 Concentration mg/L
12
10
8
6
4
2
0
Jan
Mar
May
Jul
Sep
Nov
2015
2016
2017
2018
2019
2020
2021
2022
2023
2023
ECA Objective
Limit

Appendix J

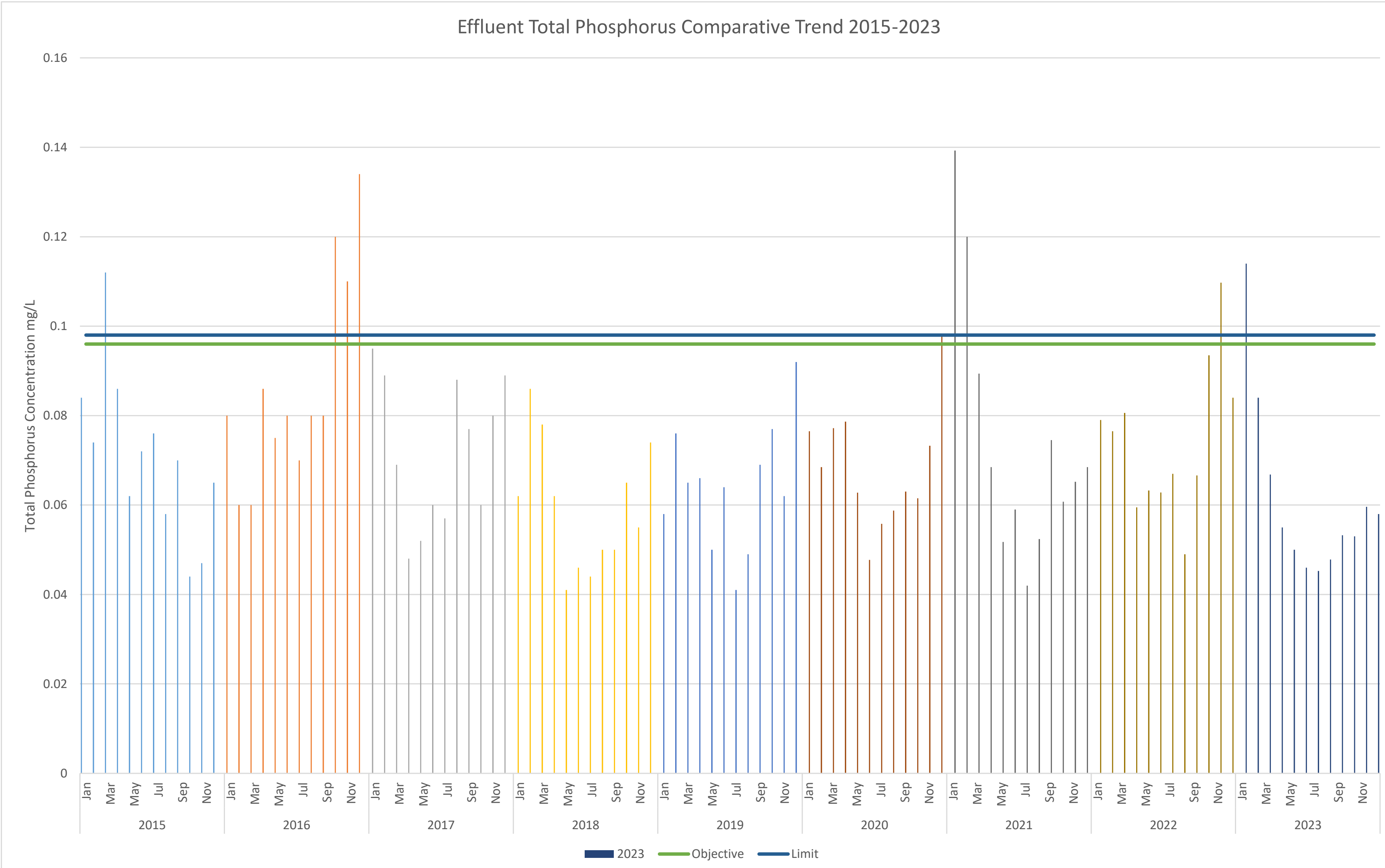
Appendix J



Effluent Total Ammonia Nitrogen Comparative Trend 2015-2023
TAN Concentration mg/L
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan Mar May Jul Sep Nov
2015
2016
2017
2018
2019
2020
2021
2022
2023
2023
Objective
Limit

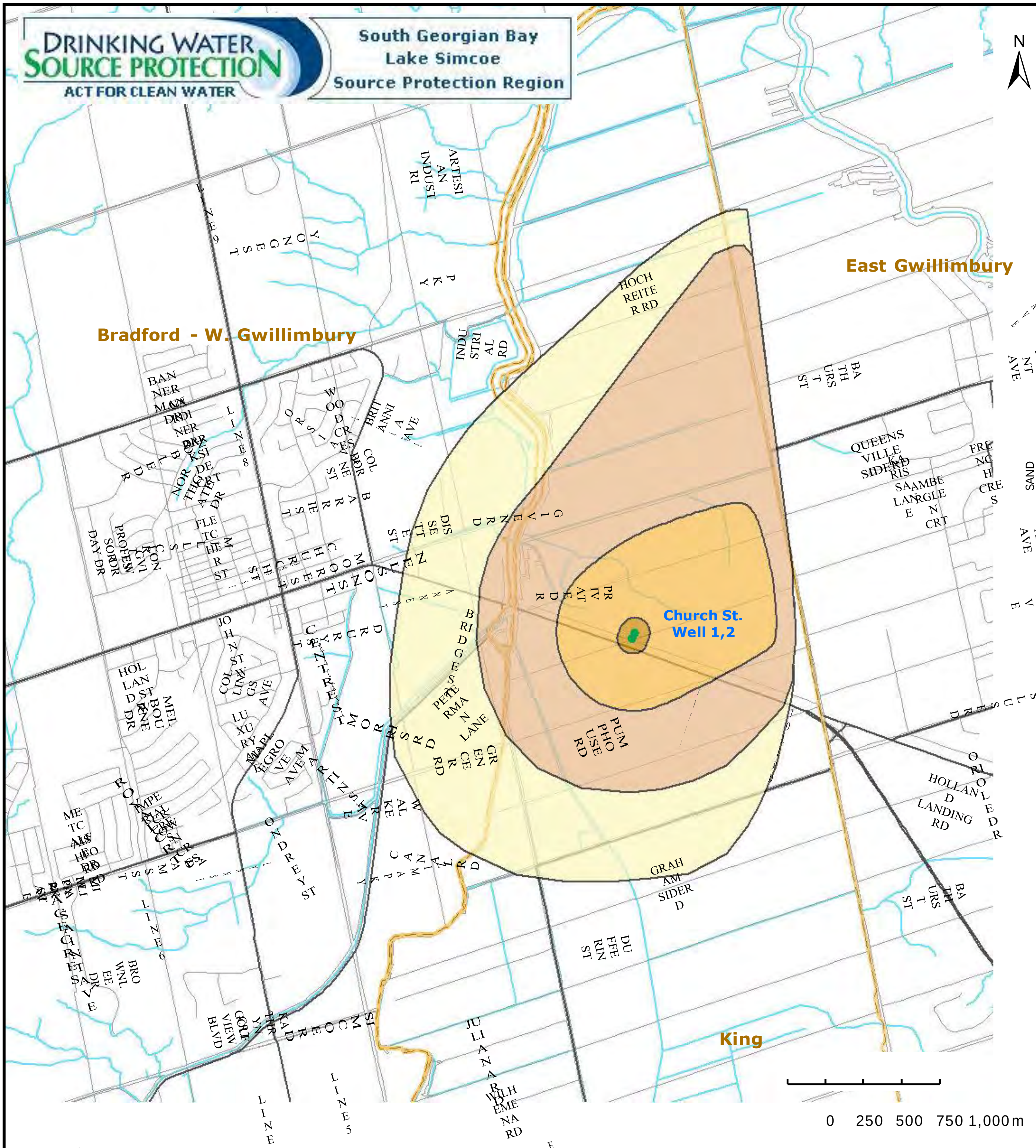
Appendix K

Appendix K



Effluent Total Phosphorus Comparative Trend 2015-2023
Total Phosphorus Concentration mg/L
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Jan Mar May Jul Sep Nov
2015
2016
2017
2018
2019
2020
2021
2022
2023
2023
Objective
Limit

Appendix L



- Municipal Supply Well in Bradford-West Gwillimbury
- WHPA-A (100m)
- WHPA-B (2-years time of travel)
- WHPA-C1 (10-years time of travel)
- WHPA-D (25-years time of travel)
- Municipality Boundary
- Water Course

Wellhead Protection Areas
Bradford-West Gwillimbury

Created by: LSRCA
Date: 2014-04-08
Scale: 1:35,000
UTM Zone 17N, NAD83

GENIVAR

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 9a-1

Project Report

October 1, 2024

THE CORPORATION OF THE TOWN OF BRADFORD WEST GWILLIMBURY ENVIRONMENTAL STUDY REPORT ADDENDUM

WATER POLLUTION CONTROL PLANT (WPCP) TERTIARY UPGRADE

2024/10/01	0	Final - For Public and Agency Review	C. Brennen	M. Armstrong	M. Walters	
Date	**Rev.**	**Status**	**Prepared By**	**Checked By**	**Approved By**	**Approved By**
HATCH						**Client**

Executive Summary

Hatch was retained by the Town of Bradford West Gwillimbury (the Town) to undertake an Amendment to the previously completed Schedule ‘C’ Municipal Class Environmental Assessment (Class EA) completed in 2012 for the expansion of the Bradford Water Pollution Control Plant (WPCP) (the Project). The Class EA process was documented in an Environmental Study Report (the ESR).

This ESR Addendum is being undertaken in accordance with the planning and decision-making process for a Schedule ‘C’ Class Environmental Assessment (EA). Due to the time lapsed since the completion of the ESR, and the new technological upgrades, an Addendum is required to document the changes prior to the Project implementation.

The ESR included upgrading the plants’ capacity to 23.3 MLD in order to accommodate an increase in the Towns’ population. The scope of work in the ESR included the construction of a tertiary ballasted flocculation system and completing a Water Conservation and Efficiency Strategy for the water and wastewater flows. The focus of the ESR was on optimizing the existing facilities and complement the optimized facility with additional treatment to achieve the 23.3 MLD goal, rather than constructing new facilities.

This ESR Addendum outlines the proposed changes which include the construction of a new 1,150 m^2 tertiary treatment facility with a submerged-type membrane system, instead of the ballasted flocculation system assessed in the ESR, in order to meet the more stringent phosphorus loading requirements. In addition, the scope includes:

- Relocation of existing UV treatment systems to the new facility;
- Connection of the tertiary effluent to the existing outfall pipe;
- Construction of new roads to access the building;
- Design and construction of a stormwater drainage system;
- Construction of a new outdoor diesel generator and switch gear; and
- General repairs and rehabilitation including the replacement of the outfall pipe without increasing the WPCP capacity.

As part of this Addendum Report, archaeological, hydrological, geotechnical, and ecological studies were undertaken. Mitigation measures have been updated based on the findings of these studies to meet the standards of the current planning context. It is expected that the construction of upgrades subject to this Addendum will be commenced in 2025.

Table of Contents

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List of Figures

Appendices

Glossary of Terms and Acronyms

ANSI:	Area of Natural and Scientific Interest
BMP:	Best Management Practice
BOD:	Biochemical Oxygen Demand
COSEWIC:	Committee on the Status of Endangered Wildlife in Canada
EA:	Environmental Assessment
EAA:	*Environmental Assessment Act*
ECA:	Environmental Compliance Approval
ESA:	*Endangered Species Act, 2007*
ESC:	Erosion and Sediment Control
ESR:	Environmental Study Report
FWCA:	*Fish and Wildlife Conservation Act, 1996*
OBBA:	Ontario Breeding Bird Atlas
LSRCA:	Lake Simcoe Region Conservation Authority
MBCA:	*Migratory Birds Convention Act, 1994*
MOE/MOEE/MOECC/ MECP:	Ministry of the Environment/Ministry of the Environment and Energy/Ministry of the Environment and Climate Change/ Ministry of the Environment, Conservation and Parks. The Ministry of the Environment was created in 1972 and merged with the Ministry of Energy to form the Ministry of Environment and Energy (MOEE) from 1993 to 1997 and again in 2002. The Ministry of the Environment changed its name to the Ministry of the Environment and Climate Change (MOECC) on June 24, 2014. The Ministry changed its name to Ministry of the Environment, Conservation and Parks (MECP) on June 29, 2018. Thus, the MOE/MOEE/MOECC and MECP are considered to be synonymous for the purposes of this Report.
MLD:	Million Litres per Day
MCM:	Ministry of Citizenship and Multiculturalism
PDR:	Preliminary Design Report

Glossary of Terms and Acronyms

PSW:	Provincially Significant Wetland
SAR:	Species at Risk
SARA:	*Species at Risk Act*
SUE:	Subsurface Utility Engineering
SWH:	Significant Wildlife Habitat
TKN:	Total Kjeldahl Nitrogen
TP:	Total Phosphorus
TSS:	Total Suspended Solids
WPCP:	Water Pollution Control Plant

1. Introduction

In 2022 Hatch Limited (Hatch) was retained by the Corporation of the Town of Bradford West Gwillimbury (the Town) to undertake an Addendum to the previously completed Class Environmental Assessment (Class EA) for the expansion of the Bradford Water Pollution Control Plant (WPCP). The previous EA was completed in 2012.

Due to the time lapsed since the completion of the EA and the changes to the tertiary filtration technology (i.e., from a ballasted flocculation system to a submerged-type membrane system), an Addendum to the 2012 Class EA is required. Enhanced engagement with Indigenous communities will be undertaken to better align with the requirements under the Class EA process.

1.1 Background

The WPCP is located at 225 Dissette Street in Bradford, Ontario (see Figure 1-1). The wastewater generated from Bradford and Bond Head area is treated at the WPCP prior to discharge into the West Holland River, located within the Lake Simcoe watershed.

The WPCP was constructed in 1962 and consisted of a pumping station and a waste stabilization pond. The WPCP has undergone modifications in 1970, 1982, 1997, 1999, 2001 and most recently 2009. The WPCP has a current capacity of 19.4 million litres per day (MLD). It is classified as a Class 4 Treatment Facility and a Class 3 Collection System.

Figure 1-1: Aerial Photo of the Bradford WPCP (Google Earth, 2022)

1.2 Class EA and the Selection of the Preferred Design

The 2011 Town of Bradford West Gwillimbury's Master Servicing Plan Update (C.C. Tantham & Associates Ltd, 2011) identified the need for additional wastewater treatment capacity to meet the servicing requirement to accommodate future growth.

The Town completed the Environmental Assessment process for the expansion in 2012, as documented in a report entitled the Bradford West Gwillimbury Water Pollution Control Plant Environmental Study Report Phases 3 and 4 Final (The ESR) in March 2012 (Ainley & Associates Ltd. and Black & Veatch Canada, 2012).The preferred design identified through the Class EA (2012) outlined the need for several upgrades including upgrades to the tertiary system to reduce the total phosphorus in the effluent. The design included the following:

- Optimize Plants C and D and modify Plant B to obtain a total rated capacity of 23.3 MLD;
- Construct ballasted flocculation process upstream of the existing sand filters;
- Complete a Water Conservation and Efficiency Strategy for the water and wastewater flows within the respective Service Areas; and
- Evaluate and implement changes to improve the management of biosolids that reflect current and future regulatory requirements.

The ESR identified potential impacts to the environment that could result from the expansions' design and identified proposed mitigation measures. The preferred design was presented to the public and Indigenous communities, and the Town had planned to move forward with Project implementation.

1.3 Rationale for Project Change

Considering the lapse in time from the completion of the ESR to the start of construction of the WPCP Tertiary Upgrade project (i.e., implementation), and the proposed changes to the treatment technology, the Project is required to undergo an Addendum to the original ESR from 2012. As part of the Addendum, the planning and decision-making process was reviewed, as well as the current environmental setting to ensure project and mitigation measures still meet the current planning context. The process followed is documented in this ESR Addendum.

While the proposed capacity expansion did not change from 23.3 MLD, the proposed tertiary treatment technology was changed from ballasted flocculation to membrane technology and related piping and building. The proposed changes are summarized in Table 1-1.

The rationale behind the change in technology lies with the current requirements for the Environmental Compliance Approval (ECA) Total Phosphorus (TP) in effluent to be limited to a maximum total of 0.096 mg/L, for a total annual loading of 697.88 kg/year, based on an Annual Average Daily Effluent Loading of 1.912 kg/d. This indicates to the Town that the effluent TP must be limited to 0.08 mg/L to allow for potential future capacity expansions. As a result of this stringent TP limit, it has become necessary for the Town to implement tertiary filtration technology to be consistent with the requirements for an ECA.

The new tertiary filtration will require the construction of a new building, which will extend further into the Lake Simcoe Region Conservation Authority (LSRCA) regulated boundary. The LSRCA advised that the construction of the new building is identified as a major development according to their policies, as it will be greater than 500 m^2. It should be noted that a portion of the existing WPCP is already located within the LRSCA regulated boundary.

Table 1-1: Changes from the Original 2012 Design

Component of Original Design	2012 Design	Proposed Changes
Tertiary Treatment	Monthly average Total Phosphorus (TP) level of 0.08 mg/L or below.	Monthly average TP level of 0.08 mg/L or below
	Ballasted flocculation system.	Submerged-type membrane system.
	Ballasted flocculation building to replace the sand filter buildings.	Construction of a new tertiary membrane building including an area for centralized UV disinfection.
Building	No changes to the outfall.	Connection of tertiary effluent to existing outfall pipe.
	No additional road construction.	Paved access to new building.
	Maintain the same diesel generator and switchgear.	New diesel generator outside the building and switchgear inside the existing switchgear building.

1.4 The Purpose of the Addendum

The ESR identified that all the proposed works would be completed within the existing site. Given the change in the technology and changes to environmental legislation prior to project implementation, there is a need to summarize these changes and share them with review agencies, the public and Indigenous communities prior to project implementation.

As part of the Addendum, previously completed work is summarized, the proposed change to the WPCP described and the impacts and mitigation will be confirmed. Then the Addendum will be shared with Indigenous communities for a 60-day review period, and to Ministry of the Environment, Conservation and Parks (MECP) and the Lake Simcoe Region Conservation Authority (LRSCA) for a 60-day review period. Finally, the Addendum will be distributed to the public and stakeholders for a 30-day review period.

It should be noted that only the items included in this Addendum are available for comment as part of the review. All comments related to the previously completed ESR are outside the scope of this Addendum.

2. Project Description

The proposed changes since the ESR includes the implementation of a new tertiary treatment process to meet future TP discharge limits, which include:

- The construction of a new 1,150 m² tertiary treatment facility including an area for central UV disinfection;
- Connection of the tertiary effluent to the existing outfall pipe;
- The addition of paved access to the new building;
- Decommissioning of the existing tertiary filtration system;
- Relocation of the existing UV systems in Existing Filter Buildings C and D to centralize it in the new membrane building;
- Construction of a new diesel generator outside the building and switchgear inside the existing switchgear building; and
- General repairs and rehabilitation including the replacement of the outfall pipe without increasing the WPCP capacity.

A few alternatives are being considered with regards to drainage to address water quality and water quantity control for the new construction. These are described in further detail in Section 2.2.

2.1 Tertiary Treatment Options

The following tertiary treatment methods were considered for the upgrade:

- Ballasted flocculation, where coagulants for soluble phosphorus, microsand and polymers are used to create weighted flocs that remove phosphorus through a hydrocyclone separator;
- Reactive filtration, where phosphorus and suspended solids are removed by adsorption, rather than coagulation, and filtered out by passing the effluent through a bed of sand;
- Pressurized membrane filtration system, where effluent is passed through a synthetic semi-permeable membrane with pores sized to reject the target particles using pressure; and
- Submerged membrane filtration system, where effluent is passed through a synthetic semi-permeable membrane with pores sized to reject the target particles using a vacuum.

A more detailed summary of these technologies is available in the Preliminary Design Report (Hatch Ltd., 2022).

A weighted evaluation matrix was prepared to assess the tertiary treatment methods. After weighing all the information available from the analysis, the preferred option was identified to be the submerged-type membrane system.

A six-month pilot study was undertaken to confirm the feasibility and performance of tertiary membrane filtration as part of this plant expansion. The pilot study was carried out from November 2021 to July 2022, through different seasons and temperature conditions. It also involved different flow rates and solids inputs and tested the use of alum for phosphorus removal. The study consisted of six phases, with each phase involving four weeks of testing and a period of high flow conditions.

An additional month of pilot study has been completed to test the existing dynasand system as a pre-treatment to the tertiary membrane filtration. A full report of the pilot studies was submitted to the Town for review (under separate cover).

Additionally, the members of the Town's Plant Operations staff are already familiar with the submerged-type membrane system and understand its capabilities. There are many of submerged-type membrane systems in operation, so there are resources available for advice or maintenance as needed. All of these factors contributed to the submerged-type membrane system being selected as the preferred solution.

The position of the new tertiary building is preferred to be located close to the existing outfall, however there is limited footprint available for the new building.

2.2 Drainage

The proposed design to address drainage on-site involves directing runoff from the proposed process building into the existing pond with a sediment forebay and an ultimate outlet to Holland Canal/River system.

The building is designed in accordance with recommendations of LSRCA, during development of the Preliminary Design Report (PDR) (Hatch Ltd., 2022), to ensure all building openings of the Tertiary building are 300 mm above the Regional Flood Line.

3. Description of the Environment

The existing environmental conditions are summarized in the following section.

3.1 Planning Objectives

The following Acts, regulations, guidance documents and plans are applicable to the proposed work.

3.1.1 Federal

3.1.1.1 Migratory Birds Convention Act (1994)

The *Migratory Birds Convention Act* (1994) (MBCA) prohibits the killing, capturing, injuring, taking, or disturbing of migratory birds (including eggs) and the damaging, destroying, removing, or disturbing of nests.

3.1.1.2 Species at Risk Act (2002)

The Species at Risk Act (2002) (SARA) prohibits the killing, harming, harassing, capturing, buying, selling, trading, taking, collecting, or possession of an individual, a part, or a derivative of any wildlife species that is listed as extirpated, endangered or threatened under the Act and damage or destruction of the species' residence.

The *Fish and Wildlife Conservation Act* (1997) (FWCA) prohibits the hunting or trapping of specially protected wildlife as defined by the Act and non-game birds, and limits the hunting and trapping of big game, game mammals, game birds, furbearing mammals, game reptiles, game amphibians, and other wildlife described by the Act to those with a license to do so under the regulations of the Act.

3.1.2 Provincial

3.1.2.1 Endangered Species Act (2007)

The *Endangered Species Act*, (2007) (ESA) prohibits the killing, harming, harassment, capture, taking, possessing, collecting, buying, leasing, or trading of any species that are listed as 'Threatened', 'Endangered' or 'Extirpated'.

3.1.2.2 Greenbelt Plan

The study area has been identified as Protected Countryside under the Greenbelt Plan (2017) during the desktop review.

3.1.2.3 Lake Simcoe Region Conservation Authority - Ontario Regulation 179/06

Ontario Regulation 179/06 regulates work taking place within valley and stream corridors, wetlands and associated areas of interference. Any works undertaken within the regulation limit will require a permit from the LSRCA.

The study area overlaps land regulated by the LSRCA. Ground disturbance and construction of buildings within the regulated area requires a permit before seeking a building permit from the Town. As a result, the project requires approval under O. Reg. 179/06 of the *Conservation Authorities Act* (1990).

Permanent facilities are planned to be constructed within the regulated boundary.

Figure 3-1: A Map of the LSRCA Boundaries on the WPCP Property (LSRCA GIS Services, 2023)

Through discussions with the LSRCA during the development of the Preliminary Design Report (Hatch Ltd., 2022), it was recommended that a Natural Heritage Evaluation Study (NHES) be completed and include the following:

- Tree Inventory/Arborist Report;
- Bat snag survey (only if trees are being removed);
- Vascular plant inventory;
- Compensation plan for tree/vegetation removals;
- Wetland evaluation with updated mapping (including potential impacts to adjacent Cedar Creek Provincially Significant Wetland, as required based on MECP consultation);
- Wetland boundary staking;
- Ecological Land Classification (ELC) survey;
- Species at Risk (SAR) screening based on habitat present within project site;
- Bird screening;

- Design drawings with tree/vegetation removals and tree protection measures, construction staging and erosion and sediment control (ESC) measures;
- Work to be completed and submitted to LSRCA under Ontario Regulation 179/06; and
- Floodplain impact assessment.

The NHES was used to summarize the existing conditions and proposed impacts.

3.1.2.4 *Lake Simcoe Protection Plan*

The study area is within the *Lake Simcoe Protection Act* (2008) Watershed Boundary and subject to the Lake Simcoe Protection Plan, which was created under the *Lake Simcoe Protection Act* (2008) in 2008. This Plan establishes a “Minimum Vegetation Protection Zone” around key natural heritage features within which development or site alternation is not permitted. As required by LSRCA, an Ecological Offsetting Strategy will be prepared for the disturbance to the wetland and minimum vegetation protection zone (MVPZ) within the study area. Once the final site plan has prepared the offsetting strategy will be prepared based on LSRCA requirements and submitted for review.

3.2 Natural Environment

The following section summarizes the natural environment information from the geotechnical investigation completed by Orbit Engineering Limited, in 2021, and from the NHES completed by LGL Limited (LGL) in 2023 (Appendix A).

3.2.1 Soil and Terrain

Geotechnical investigation was performed by Orbit Engineering Limited to evaluate the subsurface conditions for the WPCP upgrades. The results of this investigation were presented in a report entitled *Hydrogeological Investigation – Bradford WPCP Tertiary Upgrade 225 Dissette Street, Bradford West Gwillimbury, ON* (Orbit Engineering Ltd., 2021) (under separate cover). Through a combination of field studies and desktop review, Orbit determined the following information. The study area is located within the Simcoe Lowland physiographic region. The physiographic landform in which the site is located on is called the Clay Plains, Peat and Muck. The terrain is generally a low relief plateau with an approximate elevation of 220 m.

Eurofins Laboratories (CALA Member) tested the quality of the soil collected by Orbit in accordance with MECP sampling protocols. All soils on the property meet MECP Table 3 Industrial Commercial Community Use (ICC) Standards for coarse texture soils and the Synthetic Precipitation Leaching Procedure (SPLP) samples also meet O. Reg. 406/19 Table 3.1 ICC Soil Reuse Standards for Table 3 ICC sites. Based on laboratory test results, the excavated soil may be re-used at the same site for grading purposes.

3.2.2 Aquatic Habitat

The Holland Canal/River system flows adjacent to the WPCP (See Figure 3-2). It has been identified as a permanently flowing warmwater fish habitat as per the West Holland River Subwatershed Management Plan. A desktop review included data from a fish sampling station near the study area where a warmwater fish community was sampled. This returned 18 warmwater fish species in proximity to the site (Ministry of Natural Resources and Forestry and ArcGIS Hub, 2023).

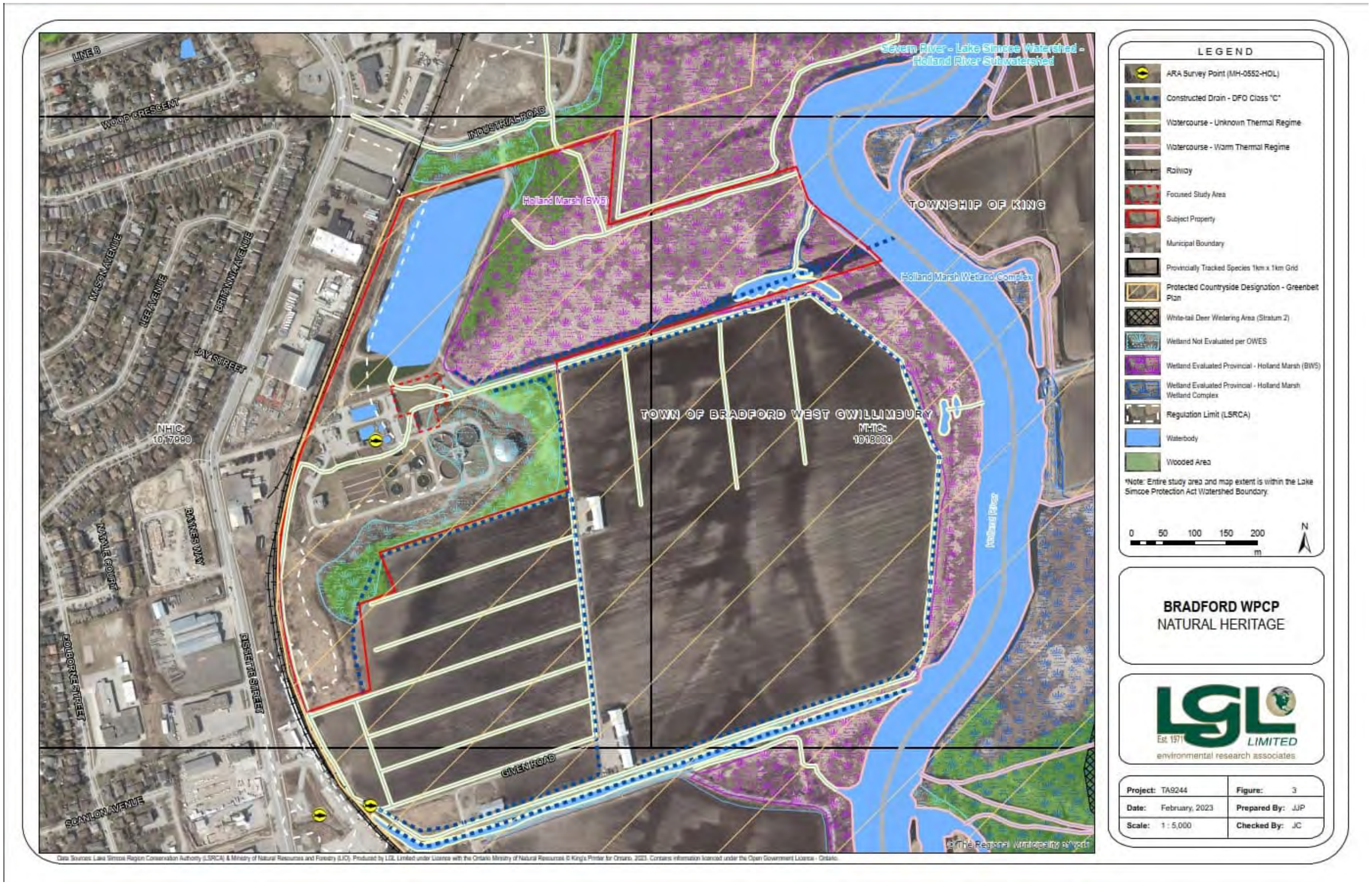

Figure 3-2: A Map of the Site and Surrounding Natural Areas (LGL, 2022)

A full list of species is included in Appendix A. The flows in the channel consist of runoff from upstream drainage areas, including a confluence with the WPCP outfall. The flows of the outfall are significantly greater in volume than the flows of the tributary.

The West Holland River Subwatershed management plan identified a timing work window of April 1 to June 30 where no in-water work is permitted is required. Additionally, a minimum setback of 15 m from the West Holland River is required.

Based on a review of secondary source information from the MNRF and Fisheries and Oceans Canada (DFO), there are no aquatic species at risk in the study area.

3.2.3 Vegetation

Vegetation communities were delineated by LGL according to Ecological Land Classification for Southern Ontario: First Approximation and its Application (Lee, 1998) using aerial photo interpretation and field surveys on July 12 and September 9, 2022. Vegetation communities within the study area consist of a mixture of wetland and cultural communities. As detailed in Appendix A, a total of five vegetation community types were identified within the study area including:

MAS2-1 Cattail Mineral Shallow Marsh. Tree and shrub cover less than 25 percent, with standing or flowing water up to two meters deep for most of the growing season. Mineral soil, with cattails being the dominant species of vegetation;

OAO Open Aquatic. Open water;

SWT2 Mineral Thicket Swamp. Tree or shrub cover over 25 percent and dominated by hydrophytic shrub and tree species;

CUM1-1 Dry-Moist Old Field Meadow. Tree and shrub cover less than 25 percent. Disturbed community type comprised primarily of non-native and invasive species; and

CUT1 Mineral Cultural Thicket. Tree cover less than 25 percent, shrub cover over 25 percent with mineral soil.

In addition, Manicured Landscapes (M) were identified in the study area. All vegetation communities identified within the study area are considered widespread and common in Ontario.

Several small wetland communities were identified within the study area. The limits of the wetland communities were staked in the field with LSRCA ecology staff on September 9, 2022. The communities were largely dominated by cattail species (*Typha spp.*). It is likely these communities are remnant portions of wetlands that were once connected to the PSW to the east, before being bisected by Given Road.

Culvert vegetation communities within the study area consist of mineral cultural meadow and mineral cultural meadow and mineral cultural thicket. Cultural communities were generally observed along the edge of the watercourse and pond within the study area. These communities contain a large proportion of non-native plant species that are well adapted to persist in areas that are regularly disturbed including species that are adapted to high light conditions and limited soil moisture.

A total of 50 plant species were identified in the study area during the botanical investigation. A list of vascular plants is presented in Appendix A. Of the plants identified, no nationally or provincially tracked species were identified, and no plant species that are considered locally or regionally rare were identified. Additionally, no plant SAR were identified during site visits or the desktop review.

3.2.4 Wildlife

The study area provides modest quality wildlife habitat. Much of the areas has been disturbed by the existing and surrounding land uses, including the existing WPCP. A modest diversity of species is supported by the range of habitats in the study area, including thicket, meadow, aquatic, and anthropogenic habitats. Generally, these habitats are tolerant to human disturbance.

3.2.4.1 Breeding Birds

Breeding Bird Surveys were conducted on the mornings of June 10 and July 8, 2022 in accordance with the Ontario Breeding Bird Atlas (OBBA) Protocol (Cadman M. D., 2007). Twenty-two bird species were documented during targeted breeding bird surveys conducted within the study area. An additional six bird species were documented within the study area as incidental species.

Breeding was confirmed for three species [Canada Geese (*Branta canadensis*), Mallard (*Anas platyrhynchos*) and Wood Duck (*Aix sponsa*)] and breeding was suspected for two species [Common Grackle (*Quiscalus quiscula*) and Red-winged Blackbird (*Agelaius phoeniceus*)]. Further, other migratory bird species are expected to be nesting across the naturalized area. A full list of species encountered during the Breeding Bird surveys can be found in Appendix A.

3.2.4.2 Reptiles and Amphibians

Anuran surveys were performed on May 31 and June 21, 2022, in accordance with the Marsh Monitoring Program (2000). Three amphibian species, the Green Frog (*Rana clamitans*), Northern Leopard Frog (*Lithobates pipiens*) and American Toad (*Anaxyrus americanus*) were confirmed in the study area.

One turtle species, the Painted Turtle (*Chrysemys picta*), was identified in the study area. Additionally, the study area was identified as historic Snapping Turtle (*Chelydra serpentina*) habitat during the desktop review.

3.2.4.3 Mammals

The LGL report recorded incidental observations of Eastern Cottontail (*Sylvilagus floridanus*), and Muskrat (*Ondatra zibethicus*).

3.2.4.4 Species At Risk

Species at Risk (SAR) in the study area were assessed using a combination of a desktop review of wildlife atlases and species occurrence databases, consultation with the Ministry of Environment, Conservation and Parks (MECP), and targeted field surveys.

No plant SAR were encountered during the vegetation and tree inventories.

Two bird SAR were confirmed in incidental observations during the breeding bird surveys including the threatened Barn Swallow (*Hirundo rustica*), and threatened Bank Swallow (*Riparia riparia*). Of the bird species identified, 22 have protection under the *Migratory Bird Convention Act* (MBCA) (1994). A full list of the bird species identified is available in Appendix A.

The study area was identified to have historic Snapping Turtle (*Chelydra serpentina*) habitat during the desktop review. As Snapping Turtles are listed as ‘special concern’ under the Ontario ESA, federal SARA, and Committee on the Status of Endangered Wildlife in Canada (COSEWIC), however they are not afforded habitat protection under either legislation. However, they are protected under the *Fish and Wildlife Conservation Act* (FWCA) as ‘Schedule 4 – Game Reptiles’. The study area is considered to have suitable habitat, though no Snapping Turtles were identified in the study area during the 2022 site investigations.

3.2.5 Designated Natural Areas

3.2.5.1 Areas of Natural and Scientific Interest (ANSIs)

There are no Areas of Natural and Scientific Interest (ANSIs) within the study area.

3.2.5.2 Provincially Significant Wetlands (PSWs)

The Holland Marsh Wetland Complex (BW5) Provincially Significant Wetland (PSW) is located within a portion of the WPCP property and the PSW’s western limit is located immediately north of the study area where the building upgrades are proposed. The PSW is located on the eastern side of the West Holland River within the Township of King, and ranges from approximately 400 m to 805 m from the eastern limits of the WPCP property.

3.2.5.3 Environmentally Sensitive Areas

There are no Environmentally Sensitive Areas within the study area.

3.2.5.4 Significant Valleylands

There are no Significant Valleylands within the study area.

3.2.5.5 Significant Woodlands

There are no Significant Woodlands within the study area.

3.2.5.6 *Significant Wildlife Habitat (SWH)*

A review of each Significant Wildlife Habitat (SWH) category, as defined in the Significant Wildlife Habitat Criteria Schedule (for Ecoregion 6E) was completed for the study area. The following categories of SWH have the potential to occur within the study area:

- Seasonal Concentration Areas of Reptile Hibernaculum - Not confirmed within the study area, but potential exists;
- Turtle Nesting Areas - Not confirmed within the study area, however potential exists;
- Terrestrial Grayfish – Not confirmed within the study area, however suitable habitat exists;
- Waterfowl Nesting Area – Not confirmed within the study area, however potential suitable habitat exists; and
- Amphibian Movement Corridors – Not confirmed within the study area, however potential exists.

3.3 Cultural Environment Heritage

3.3.1 *Archaeological resources*

The proposed expansion to the WPCP includes a small segment outside of the existing fence line, however it is still within the WPCP's property. This area has previously been disturbed as part of the lagoon.

During a meeting between the Town and Alderville First Nation on December 8th, 2023, the First Nation requested the archaeological assessment reports from the previous EAs. It was found that a Stage 1 Archaeological Assessment was not completed during the previous EAs. As such, a Stage 1 Archaeological Assessment was conducted by Archaeological Research Associates Ltd. (ARA) in April 2024 as part of this ESR Addendum. The Stage 1 Archaeological Assessment is included in Appendix B.

Results of the Stage 1 Archaeological Assessment determined that the study area lacked any significant archaeological potential. The Assessment confirmed that these lands had been significantly disturbed by historical land modifications. ARA recommended that no further archaeological assessment be required within the study area.

As part of the archaeological assessment, ARA contacted the following Indigenous Communities:

- Alderville First Nation.
- Beausoleil First Nation.
- Chippewas of Georgina Island First Nation.
- Chippewas of Rama First Nation.
- Curve Lake First Nation.

- Hiawatha First Nation.
- Mississauga's of Scugog Island First Nation.
- Huron-Wendat Nation; and
- Métis Nation of Ontario.

Each was offered the opportunity to participate in the field work and were provided the draft Stage 1 Archaeological Assessment report for their review and comments prior to its submittal to the Ministry of Citizenship and Multiculturalism (MCM).

No communities participated in the Stage 1 Archaeological Assessment site review. Two communities (Rama and the Huron-Wendat) provided their histories for inclusion in the report after completing their reviews of the draft report,

3.4 Technical

3.4.1 Utilities

A Subsurface Utility Engineering (SUE) report was prepared as part of the PDR by Multiview. Multiview completed a Quality Level A (QL-A) investigation through a combination of record data analysis, field verification and professional judgement. The SUE Report identified the buried utilities including the effluent wastewater, stormwater, electrical, water and effluent water utilities in the vicinity of the proposed tertiary treatment plant.

3.4.2 Geotechnical

A geotechnical investigation was completed as part of the PDR by Orbit Engineering (under separate cover). Five boreholes were advanced on the site and were completed as monitoring wells. The investigation found that the soil conditions consisted of the following stratigraphy:

- 100 to 300 mm of topsoil in four of the five BH.
- 75 mm pavement, in one of the five boreholes.
- Fill materials in all five boreholes ranging from 0.9 to 2.3 m thick. The fill generally was composed of sandy silt with a trace to some topsoil, rootlets, gravel and clay.
- Clayey silt in two of the boreholes ranging from 2.1 to 4.6 m thick; and
- Sandy silt to Silty Sand Till in all five boreholes at depths ranging from 0.9 to 3.1 m below ground level and extending to the maximum explored depth of 10.3 m.

3.4.3 Hydrogeological

A hydrogeological investigation was completed as part of the PDR by Orbit Engineering (under separate cover). Water levels were measured in the five monitoring wells were measured on September 1 and November 3, 2021. Groundwater elevations ranged from 219.1 to 220.2 m Above Sea Level (mASL) in September, and 219.3 and 220.7 mASL in November. Inferred groundwater flow direction is generally inferred to be north-east towards Lake Simcoe.

4. Consultation Process

As part of the pre-design process, Hatch contacted the LSRCA to discuss the project with them. A proposed preliminary site plan was submitted to LSRCA so they would have an accurate understanding of what is being proposed to be constructed at the site. Representatives from Hatch and Town met with the LSRCA on multiple meetings, January 21, and August 9, 2022, to discuss options and associated requirements. The site plans (existing and proposed) were used as the basis for discussion.

The Addendum was shared with Indigenous Communities for a 60-day review period and will be shared with the MECP and the LSRCA for a 60-day review period. Comments will be discussed with the Town prior to finalization.

The study must follow the requirements of the *Environmental Assessment Act* for consultation pursuant to the Municipal Class EA. Revisions to Schedule C projects, which requires the issuance of a Revised Notice of Filling of Addendum to start the 30-day calendar review period of the ESR Addendum for the public and stakeholders. The Notice of Filing of ESR Addendum will be issued to those on the Project contact list; placed on the Town’s website, in the local newspaper and distributed to those within a 500 m buffer of the study area. The notice will outline how to submit comments and request a Section 16(6) Order within the 30-day review period. In the event that no comments are received, the proponent can then proceed to implementation and construction.

It should be noted that only the items included in the Addendum are subject to review. All other items covered under the original EA but excluded from the Addendum will be not subject to a Section 16(6) Order.

5. Indigenous Community Engagement

It is important for the success of the Project to perform meaningful engagement with the appropriate Indigenous communities as part of the ESR Addendum process. Although the previous ESR concluded that Indigenous communities had “no issues or concerns”, the Town reached out to the Indigenous communities to offer to meet and provide access to studies that may be of interest. Indigenous communities as rights holders should have an opportunity to comment on the ESR Addendum and Appendices prior to finalization.

The Town requested the following Indigenous communities for their comments on the ESR Addendum and supporting Appendices on August 31, 2023:

- Williams Treaty First Nation.
  - Hiawatha First Nation.
  - Alderville First Nation.
  - Mississauga’s of Scugog Island.
  - Chippewas of Beausoleil First Nation.
  - Chippewas of Georgina Island First Nation.
  - Chippewas of Rama First Nation; and
  - Curve Lake First Nation.
- Huron-Wendat Nation; and
- Metis Nation of Ontario.

On November 11, 2023, the Town followed up with the identified Indigenous communities indicating that the 60-day review period was had reached its end. The Town provided an invitation to the Indigenous communities for an opportunity to discuss the ESR addendum, either virtually or in-person.

Alderville First Nation expressed an interest in participating in a virtual meeting. The meeting between the Town and Alderville First Nation was held virtually on December 8, 2023. Outcomes of this meeting found that records of the 2008 Stage 1 Archaeological Assessment for the study area were not available. To address the missing Assessment, as noted in Section 3.3.1, a Stage 1 Archaeological Assessment was conducted by ARA in April 2024. ARA notified the identified Indigenous communities of the planned Stage 1 property inspection in early April 2024 and provided them with the draft report of the Stage 1 Archaeological Assessment for their comment. Details of the Indigenous Engagement related to the Stage 1 Archaeological Assessment can be found in Section 3.3.1.

Supplementary meeting invitations were sent to the identified Indigenous communities on February 8, 2024. No further meetings were requested by Indigenous Communities.

Details of the Indigenous consultation record and documentation of email correspondence can be found in the Appendix C. Additional outreach was provided to the identified Indigenous communities with final offers to meet and review the draft reports on March 19, 2024, and April 3, 2024. Only the Chippewas of Georgina Island First Nation responded to this outreach, who requested additional copies of the draft Environmental Study Report Addendum and draft Natural Heritage Evaluation Study. These reports were provided to the Chippewas of Georgina Island First Nation on April 3, 2024.

A summary of the consultation activities is provided in Appendix C.

6. Potential Environmental Impacts

6.1 Fisheries and Aquatic Habitats

The construction of the expansion and connection to the outfall pipe has the potential to effect water quality through on-site erosion, which may impact the West Holland River's water quality downstream. To mitigate this, standard ESC (i.e., silt fencing, flow checks, filter socks, etc.) will be implemented and regularly maintained. Additionally, any exposed areas will be re-vegetated immediately once the construction work is completed, preventing sediment from entering the river.

Water temperature may also be affected due to the expansion, however the impacts to the river are negligible due to the warmwater stream community's tolerance to disturbance, and the shade the riparian vegetation provides. It is not anticipated that riparian vegetation adjacent to the river will be impacted by the WPCP expansion or associated water temperature increases. Additionally, no new barriers to fish passage will result from this project.

6.2 Vegetation and Vegetation Communities

Effects to vegetation and vegetation communities may include:

- Displacement of/disturbance to vegetation and vegetation communities; and
- Displacement of/disturbance to rare, threatened or endangered vegetation and vegetation communities.

The proposed expansion to the WPCP will almost entirely be restricted to manicured lands. The overall significance of the removal is considered low. Connection of the tertiary effluent to the existing outfall pipe will result in the removal of a portion of the cultural meadow community. It is anticipated that plant species displaced and/or disturbed within the cultural communities due to the disturbance will re-colonize available lands post-construction. Minor encroachment into the Minimum Vegetation Protection Zone (MVPZ) of the staked wetland boundary will occur. To offset the impacts, an Ecological Offsetting Strategy in accordance with the LSRCA guidelines will be prepared.

No displacement or disturbance to rare plant species or vegetation communities will occur as a result of the proposed WPCP expansion.

6.3 Wildlife and Wildlife Communities

Impacts as a result of the proposed expansion will occur entirely within areas that have been previously disturbed by human activity which consists of low-quality habitat; therefore, it is not anticipated to disturb wildlife or wildlife habitat. Only minor infringement to cultural meadow communities will occur as a result of the expansion of the headwall, and result in very minor disturbance to wildlife and wildlife habitat.

6.4 Species at Risk

Three species at risk have been identified in the study area, however the likelihood of the proposed works having a negative effect on SAR is low as encroachment into suitable habitats will be minimal with potential impacts only associated with the edges of the open aquatic community. There are no negative impacts associated with the proposed tertiary building footprint and only minimal temporary impacts to the open aquatic community anticipated as a result of the connection of the tertiary effluent to the existing outfall pipe.

No impacts to the two avian SAR (Barn Swallow or Bank Swallow) are anticipated as a result of the proposed works. Minor habitat impacts to turtle SAR would include encroachment on possible nesting habitat along riparian cultural meadow and aquatic communities. Vegetation removals in these communities as a result of the headwall replacement and outfall pipe installation may result in impacts to potential nesting habitat.

6.5 Ground Water and Dewatering Rates

Orbit completed a subsurface investigation, hydrogeological assessment, and an analysis of hydraulic conductivity testing and groundwater monitoring data as part of the PDR.

Based on their findings, it is recommended that no long-term dewatering system be implemented, rather a short-term dewatering system should be designed and evaluated by a qualified Engineer and performed by a licenced dewatering contractor. The maximum total dewatering rate is to be approximately 11.4 m^3/day. Fine soil particles must be removed before the water is discharged into the Town sewer system. The highest zone of influence was estimated to be approximately 11.6 m. Orbit recommends an Engineer be retained to assess the impacts of potential land subsidence for the zone of influence during the dewatering process. The estimated rate in the case of the construction of only one pile cap is below the MECP threshold of 50 m^3/day for the Environmental Activity and Sector Registry (EASR) registration.

6.6 Soil Quality

Orbit completed a geotechnical investigation in 2021. This included desktop reviews, site visits, sampling, and laboratory works to determine the soil quality and predict and mitigate potential impacts. The soil generally consisted of surficial topsoil (100 mm-300 mm thick), fill (0.9 m to 2.3 m below the surface at varying thickness), and native soil layers. Laboratory testing determined that the soils may be re-used, with further information regarding the re-use of soils presented in Section 7.6 of this report.

6.7 Surface Water Quality

To minimize potential adverse impacts on water quality during construction, material stockpiles, excavated soils and demolition debris will be not permitted near the outfall channel.

6.8 Air Quality

Material handling issues such as excavation, demolition, loading and hauling, comprise most significant source of dust during construction activities. The required construction activities are not expected to create large quantities of dust. Dust control during these activities can be easily achieved through proper planning and implementation of best construction practices and mitigation measures in keeping with the MECP guidelines.

6.9 Noise

There will be a short-term increase in on-site noise during construction activities. Sound levels at the nearest property are expected to be within the MECP sound level limits.

6.10 Construction Traffic

Traffic will increase during construction from the hours of 7 am to 7 pm weekdays and some weekends. The impact of traffic on the Bradford West Gwillimbury community is expected to be minimal due to the surrounding industrial land use and the proximity to Highway 400, areas which are already prone to traffic from industrial vehicles.

7. Mitigation Measures

The potential environmental impacts associated with implementation of a new tertiary treatment process are anticipated to be negligible. Many of the potential impacts can be mitigated through proper construction practices, good housekeeping practices for storage/stockpiling and equipment fueling/maintenance on site, and the use of ESC measures. Additional mitigation measures for specific valued components are outlined in the following sections.

7.1 Fisheries and Aquatic Habitats

Due to the nature of the project, construction is required near the West Holland River. As a result, the following mitigation measures will be put in place to prevent negative impacts to the aquatic habitat:

- No in-water work between April 1 and June 30 to protect the warmwater fish community, consistent with LSRCA guidelines;
- Utilizing construction fencing to minimize the area of disturbance;
- Installing ESC prior to development, and regularly inspecting and maintaining them;
- Containing all debris/materials associated with the project to prevent them from entering watercourses;
- Re-vegetating riparian areas and/or covering riparian areas with an erosion control blanket as quickly as possible to stabilize the banks and minimize the potential for erosion and sedimentation; and
- Have a third-party fisheries biologist/inspector of ESC be present for the duration of in-water works. When direct work within the watercourse is not being undertaken, inspection of erosion control features should be undertaken weekly by site crew, and more frequently associated with rain events and/or spring snow melt.

7.2 Vegetation and Vegetation Communities

Plantings of trees, shrubs and appropriate seed mixes in areas of disturbed soil due to the proposed works, will provide increased shade and cover to the respective channels.

As many of the plants identified in the site visits were invasive species, special care must be taken to prevent the spread of invasive plant species, both on and off site. Mitigation measures include:

- Sanitizing and inspecting construction vehicles and equipment in accordance with the *Clean Equipment Protocol for Industry* (Halloran, 2013) prior to leaving and moving to the next site.
- Restoring disturbed areas using native seed mix and woody species similar to the those in the surrounding area; and
- Hiring professionals to perform enhancement planting to provide additional buffering and mitigate impacts related to vegetation removals.

Ecological offsetting for the disturbance to the wetland and minimum vegetation protection zone is required by the LSRCA. To comply with the regulations, an Ecological Offsetting Strategy will be prepared and submitted for review once the site plan is finalized.

7.3 Wildlife and Wildlife Habitat

7.3.1 Migratory Birds

To comply with these requirements, the removal, disturbance, or disruption of vegetation should be completed outside of the window of April 1 to August 31, as per the Environment Canada guidelines. If these activities must take place during the timing window, a nest screening survey will be performed by a qualified avian biologist.

7.3.2 Species at Risk

The contractor will be informed of this legislation, and provisions will be included to ensure that the wildlife is not harmed, harassed, or killed. The contractor will have to remain vigilant, move equipment at a slow pace to prevent trampling, and will be instructed not to handle or harass any wildlife species encountered during construction. Erosion control fencing will be simultaneously used to prevent erosion and to section off any wetlands, ditches, and watercourse/pond margins to prohibit entry into the sensitive areas by the contractor.

Should any SAR be encountered during construction, they will be allowed to naturally disperse from the site. In the event that the SAR in question does not disperse from the site, a qualified biologist will be contacted to discuss options for resuming construction.

7.4 Waste Management

All waste materials from construction will be contained and disposed of in accordance with applicable laws, regulations and guidelines.

7.5 Soil Quality

The applicable site condition standard for the property is determined to be Table 3 ICC standards. All soils on the property meet MECP Table 3 ICC Standards for coarse texture soils and the SPLP samples also meet O. Reg. 406/19 Table 3.1 ICC Soil Reuse Standards for Table 3 ICC sites. Based on laboratory test results, the excavated soil may be re-used at the same site for grading purposes. The reuse is still subject to geotechnical considerations. Alternatively, excess soil may be reused at redevelopment sites accepting soil meeting the MECP Table 3 Standards for ICC property uses. Acceptance of this material is at the discretion of the receiving site(s).

During excavations, if any soil is encountered that has unusual stains or odors (e.g., hydrocarbon or solvent odors), or contains rubble, debris, cinders or other visual evidence of impact, this soil should be segregated, and a Qualified Person should be contacted immediately. Such soil should not be removed from the subject site until the results of an assessment are available.

Additionally, all soil management and disposal activities must comply with requirements associated with site alteration agreements, noise and traffic bylaws, and permitting regimes established by the Town and the LSRCA.

7.6 Surface Water Quality

Installation and maintenance of ESC measures as noted in Section 7.1, including controls for materials and soil stockpiles.

7.7 Air Quality

The main impact on air quality that is anticipated for the WPCP is dust. Mitigation measures include:

- Following MECP best practises for construction;
- Spraying down the site and roadways;
- Limiting excavation on windy days;
- Properly washing trucks; and
- Using dust covers on haulage trucks.

The other air quality impact anticipated is vehicle exhaust fumes. Mitigation measures for exhaust include maintaining equipment and emission control devices, as well as limiting idling.

While the appropriate mitigation measures will be implemented during construction, there may be localized residual dust emission around the site.

To prevent air quality impacts associated with construction, vehicle exhaust fumes, emission control devices and equipment must be functional and effective. New or well-maintained heavy equipment and machinery, preferably fitted with muffler/exhaust system baffles and engine covers will be used.

7.8 Noise

Construction activities will be restricted to the hours as prescribed in the Town of Bradford West Gwillimbury noise by-law.

The contractor will be responsible for ensuring that equipment is in sound working order and using noise attenuation devices to be in compliance with MECP requirements both on and off site.

7.9 Construction Traffic

Measures will be put into place during construction to minimize impact from mud and dust on roadways. Construction sequencing will be developed such that operation and maintenance trucks will continue to have access to the site as needed during construction.

7.10 Aesthetic Impacts

The new building will be designed to match the architectural aesthetic of the existing buildings on site.

8. Permits and Approvals

During design, there are several permits and approvals that will be required as outlined below.

Table 8-1: Summary of Permits and Approvals

Permit or Approval Level	Permit or Approval
Provincial	Environmental Compliance Authorization – Sewage
	Electrical Safety Authority review
	LSRCA O.Reg 179/06
Municipal	Town of Bradford West Gwillimbury Building Permit

9. Implementation Schedule

The proposed implementation schedule for the implementation of the new tertiary treatment process is as follows:

- Detailed Design: Q1 2023 to Q4 2024
- Complete Applications for Permits and Approvals: Q4 2024
- Tender: Q4 2024/Q1 2025
- Construction award: Q2 2025
- Substantial Completion: Q4 2027

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Carson Brennan
MA:cb

Appendix E

Environmental Study Report (2012)

  

Bradford West Gwillimbury Water Pollution Control Plant
Environmental Study Report Phases 3 and 4

Final - March 2012

Submitted by

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F Lake Simcoe Phosphorus Reduction Strategy
G Bradford WPCP Class EA Receiving Water Assimilation Study – June 2011
H Air Quality Impacts Assessment Report
I Public Information Centre
J Rerating Study
K Notice of Completion and Related Correspondence

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Abbreviations and Acronyms

°C	degrees Celsius
ADF	Average Day Flow
B&V	Black & Veatch Canada
BAF	Biologically Aerated Filter
bioP	biological phosphorus removal
BNR	Biological Nutrient Removal

BOD5	Biological Oxygen Demand (in five days)
CAS	Conventional Activated Sludge
CBOD5	Carbonaceous Biological Oxygen Demand (in five days)
Class EA	Municipal Class Environmental Assessment
cm	centimetre
cm/s	centimetre per second
CofA	Certificate of Approval
DAF	Dissolved Air Flotation
dB	decibel
DO	Dissolved Oxygen
Dwg.	Drawing
EA	Municipal Class Environmental Assessment
EBR	Ontario Environmental Bill of Rights Registry
E. coli	Escherichia coli
EPA	United States Environmental Protection Agency
ESR	Environmental Study Report
F/M ratio	food to microorganism ratio
GE	General Electric
HESL	Hutchinson Environmental Sciences Ltd.
HRT	Hydraulic Retention Time
Hwy	Highway
I/I	Inflow and Infiltration
ICI	Industrial, Commercial and Institutional
IFAS	Integrated fixed-film activated sludge
kg	kilogram
kg/day	kilogram per day
kg/year	kilogram per year
L	litre
L x W x H	Length times width times height
L/c/d	Litres per capita per day
lmh	Litres per square metre per hour
LOT	Limit of Technology
LSEMS	Lake Simcoe Environmental Management Strategy
LSPP	Lake Simcoe Protection Plan
m	metre
m/s	metres per second
m2	square metre
m3	cubic metre
m3/day	cubic metre per day
Max.	Maximum
MEA	Municipal Engineer's Association
mg/L	milligram per litre
mL	millilitre
ML/d	Megalitres per day
MLD	Megalitres per day / Million litres per day
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed liquor volatile suspended solids
MOE	Ontario Ministry of the Environment

n/a	not applicable
NH3	un-ionized Ammonia
NH3 + NH4	Ammonia
NHIC	Natural Heritage Information Centre
NMS	Nutrient Management Strategy
No.	Number
NPV	Net Present Value
O&M	Operations and Maintenance
OMB	Ontario Municipal Board
OP	Official Plan
OPA#1	Official Plan Amendment Number 1
O.Reg.	Ontario Regulation
o/s	out of service
P	phosphorus
PAO	Phosphorus Accumulating Organisms
PF	Peak Flow
PIC	Public Information Centre
ppu	persons per unit
PRS	Phosphorus Reduction Strategy
PWQO	Ontario Provincial Water Quality Objectives
Q	Flow
RAS	Return Activated Sludge
SBR	Sequencing Batch Reactor
SLR	Solids Loading Rate
SOR	Surface Overflow Rate
SPR	Shoreline Protection Regulation
SRT	Solids Retention Time
TAL	Technology Achievable Limit
TKN	Total Kjeldahl Nitrogen
Town	Town of Bradford West Gwillimbury
TP	Total Phosphorus
TSS	Total Suspended Solids
UV	Ultraviolet
VFA	Volatile fatty acid
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WCES	Water Conservation and Efficiency Strategy
WEFTEC	Water Environment Federation Technical Exhibition and Conference
WERF	Water Environment Research Foundation
WPCP	Water Pollution Control Plant
WQT	Water Quality Trading feasibility study

EXECUTIVE SUMMARY

Background

To accommodate planned growth, the Town of Bradford West Gwillimbury completed a Master Servicing Plan Update to satisfy the requirements of Phases 1 and 2 of the Class Environmental Assessment planning process. The Master Plan Update was documented in a Report entitled "Water Supply and Wastewater Servicing Master Plan Update, Town of Bradford West Gwillimbury, Class Environmental Assessment, Final Study Report" (C. C. Tatham & Associates Ltd, March 31, 2011). The Study identified the need for additional wastewater treatment capacity and recommended that the existing WPCP be expanded. The Town retained the team of Ainley & Associates Limited and Black & Veatch Canada (Ainley/B&V) in January 2011, to undertake Phases 3 and 4 of the Class EA planning process and to document the planning in an Environmental Study Report.

Class EA - Phase 1

The Town issued a Notice of Study Commencement on May 21, 2008, which advised the public that the Town was investigating "...alternative solutions for water supply and wastewater treatment to accommodate the short-term and 25-year projected population growth....".

Phase 1 included determination of the socio-economic and natural environments of the Study Area. The Town's existing sewage collection system and water pollution control plant were described in general detail. The servicing requirements were outlined and were presented in Table 5 of the Servicing Master Plan Update. The future average day and peak flows were determined to be 23,300 m3/d and 53,400 m3/d respectively (Table 12 of the Servicing Master Plan Update).

The Problem Statement was defined as part of the Phase 1 Class EA as follows:

"A Master Servicing Study for water supply and wastewater treatment capacity was completed in January 2003, and an Addendum to the Water Servicing Study was completed in September 2003. The resulting master servicing plans need to be updated to accommodate the planned growth as set out in the Town's Official Plan and amendments. The preferred water supply and wastewater treatment solutions will need to comply with all regulations, meet environmental protection and sustainability objectives, and be cost-effective."

Class EA – Phase 2

Phase 2 consisted of identifying possible alternatives to address the problem statement and the selection of the Preferred Alternative. The evaluation determined an expansion of the Bradford WPCP with effluent discharge to the Holland River to be the best alternative.

Class EA - Phase 3

At the commencement of Phase 3, the Town published a Notice to advise the public and the review agencies of its intent to complete the Class EA planning process (continuing on from the Servicing Master Plan Update). The Notice was published on March 31, 2011 and again on April 7, 2011 in the Bradford Times.

The MOE's Phosphorus Reduction Strategy (PRS), June 2010, identified a new baseline phosphorus compliance load of 698 kg/year for the Bradford WPCP to be achieved by 2015 or by the next plant expansion. The requirement for further incremental reductions will be re-evaluated by the Province in 2015 during the first review of the PRS.

It should be noted that the June 2010 PRS (discussed in Section 6.0) qualified the requirement for future incremental TP loading reductions by stating that a re-evaluation will be completed in 2015. As such, the requirement for staged decreases in TP loading from the Bradford WPCP has not been addressed in this ESR. In addition, the need to include and assess the option of water quality trading was considered to be unnecessary at this time and therefore, the option of water quality trading has not been considered in this ESR.
Hutchinson Environmental Sciences Ltd. Completed an Assimilation Study of the West Holland River and determined that the aquatic habitat and surface water quality of the River at Bradford are degraded. Total phosphorus concentrations in the river exceed the PWQO most of the time and ammonia concentrations are elevated though do meet the PWQO for unionized ammonia. Some metal concentrations consistently exceed PWQOs and turbidity (suspended solids) in the river is high, indicating large algal productivity, and benthic invertebrate communities upstream and downstream of the outfall are indicative of degraded water quality. During low flow, the current (17 MLD) and proposed (23.3 MLD) effluent flow is higher than the river discharge. Therefore, the West Holland River generally does not have a large assimilative capacity. It is proposed to treat the effluent to stringent water quality levels in order to reduce the impact on the River.

The major conclusions of the Assimilation Study are as follows:

1. For all scenarios, the extent of the mixing zone that exceeds the PWQO of unionized ammonia is limited to one side of the river and does not exceed a length of 110 m. Therefore the effluent plume does not represent a barrier to movement of aquatic life.

2. The effluent is diluting total phosphorus concentrations in the river.

3. The effluent meets the requirement of non-lethal toxicity.

These results demonstrate that the proposed effluent from an expanded Bradford West Gwillimbury WPCP will meet the requirements for a mixing zone and for non-lethality and that the effluent can be discharged to the River.

Black & Veatch completed an assessment of the potential to optimize the existing plant. In summary, the existing WPCP can be expanded to a meet the proposed future flow rate of 23.3 MLD through optimization of specific existing treatment processes coupled with the addition of a tertiary phosphorus removal facility. In general the summarized recommendations are as follows:

- Replace or upgrade influent pumps for peak flows
- Re-rate existing screens and install an additional screen and new by-pass channel
- Re-rate activated sludge systems in plants B, C and D and provide required blower capacity
- Provide ballasted flocculation tertiary treatment facility including larger equalization basin
- Install a thickened waste activated sludge facility

A Phase 3 Public Information Centre was held on June 22, 2011 for the purpose of identifying Alternatives to increase the WPCP capacity and to present the Town's Recommended Alternative. Only one major comment was received as a result of the PIC. A letter dated July 8, 2011 was received from Cassels Brock (Lawyer) on behalf of their client, Tsam lands. A concern was expressed that the Tsam lands may not be included in the capacity increase. The Town responded, stating that the Tsam lands were indeed included in the population projection outlined in the Servicing Master Plan Update.

The Steering Committee determined that the following recommendations regarding the proposed capacity increase for the Bradford WPCP would be proposed for public and review agency comment:

1. The Town intends to optimize the existing plant performance, with no additional capital works as an interim phase in order to obtain an immediate capacity increase.
2. Identified upgrades will be undertaken by the Town to increase the capacity of the secondary treatment process to handle a flow rate of 23.3 MLD.
3. The Town will install a facility to thicken waste activated sludge to 4%.
4. The Town will install a larger equalization basin and a ballasted flocculation system to improve phosphorus removal.
5. The budget capital cost estimate for the proposed works is $20 million, which is to be funded through Development Charges. In addition to the above-mentioned recommendations, the Town will undertake to improve its existing water conservation and reuse program.

The Town further requested that the Consulting Team determine the current optimized capacity of the WPCP assuming no capital works were undertaken. A Re-rating Study was completed which concluded that the overall plant capacity could be increased from the currently approved rating of 17.4 MLD to 19.4 MLD by simply upgrading the alum pumping capacity. It is the Town's intention to apply for a re-rated Certificate of Approval prior to proceeding with any major capital works.

Principal Environmental Impacts of the Project and Proposed Mitigating Measures

Due to the fact that the proposed capital works are not major and will not require any land acquisition (all works can be completed within the confines of the existing site), the environmental impacts are related to construction and can be mitigated as outlined in Section 13.

Public's Principal Concerns

Based on comments received as a result of the initial Notice and the PIC, the public does not have any concerns with the proposed works. A summary of all comments received during the Class EA planning process was prepared and is included in Section 16.0.

The Public was given the opportunity to provide comment throughout the Class EA planning process.

As a result of the publication of the initial Notice and the PIC, the Town received some responses from review agencies, mainly asking to be kept informed. The Lake Simcoe Conservation Authority requested pre-consultation and the Ministry of the Environment outlined its "general comments" on the Class EA process.

Project Implementation

It is the Town's intention to apply to the MOE for a re-rating of the plant capacity from the current 17.4 MLD to 19.4 MLD as outlined in this ESR. Assuming the re-rating is approved by the MOE, the Town will, in the future, expand the plant capacity from 19.4 MLD to 23.3 MLD as one stage. The decision to undertake the expansion in one stage (one construction contract) was based on the following considerations:

- If sub-components of the expansion were to be completed on their own (such as the upgrade to the tertiary treatment facility), no additional capacity above 19.4 MLD would be gained; and
- If the Project is broken into three or four sub-components and completed over a number of years the combined total cost of these smaller contracts would most likely be greater than if the works were completed as one contract.

Phase 4

The Notice of Completion, initiating the 30-day public review of the Draft ESR, was published in the January 19 and 26, 2012 issues of the Bradford West Gwillimbury Times.

A copy of the Draft ESR was sent to the Ministry of the Environment, Central Region, Technical Support Section on January 18, 2012 under cover of letter which responded to previous MOE comments.

As a result of the publication of the Notice of completion, the Town received comments from Chippewas of Rama First Nation, (letter dated January 20, 2012), Don Boswell, Senior Claims Analyst, Ontario Research Team, Specific Claims Branch (email dated January 26, 2012) and the MOE (letter dated February 23, 2012).

The Chippewas of Rama First Nation wanted to make sure that Ms. Karry Sandy-McKenzie was included in the Contact list. It is noted that Ms. Sandy-McKenzie was included in the Contact List throughout the Class EA planning process.

Mr. Boswell suggested that additional web sites might need to be researched in order to advise First Nations groups of the Town's intention. The following First Nations groups were identified as a result of the additional research:

- Saugeen First Nation (located west of Owen Sound)
- Chippewas of Nawash First Nation (located on the Bruce Peninsula)
- Wasauksing First Nation (located near Parry Sound)

These three first Nation groups were deemed to be remote from Bradford West Gwillimbury and therefore, they were not added to the Contact List.

The MOE expressed addition comment on the proposed effluent concentration for CBOD as it relates to the DO level in the receiving West Holland River. The MOE also provided additional comment on the Air Quality Impacts Assessment Report. A response letter was provided to the MOE (dated March 23, 2012). In summary, the Town committed to:

- Prepare a work plan (for MOE review and comment) to assess current DO levels in the West Holland River and to model the proposed increase in effluent flow (23.3 MLD) as part of the final design for the future plant expansion,
- Revise the effluent CBOD limit depending on the results of the DO assessment,
- Undertake additional dispersion modeling and an assessment of compliance with O. Reg. 419/05 as part of the final design of the proposed expansion to 23.3 MLD, and
- Identify specific air quality mitigation measures as part of the additional dispersion modeling.

The ESR was finalized on March 23, 2012.

1.0 Introduction

The Town of Bradford West Gwillimbury (BWG) completed Phases 1 and 2 of a Class Environmental Assessment planning process culminating in the documentation of a Servicing Master Plan Update (Final Study Report) dated March 31, 2011 (C. C. Tatham & Associates Ltd.). That "Study Report" identified water and wastewater servicing requirements to address future growth associated with three Official Plan Amendments (OPA 9, 15 and 16). With respect to wastewater treatment, the Servicing Master Plan Update recommended an expansion of the Bradford WPCP to a capacity of 23,300 m3/d taking into account the maximum phosphorus load of 698 kg/year. A copy of the Servicing Master Plan Update is included in Appendix A.

In order to complete the Class EA planning process for the expansion/upgrade of the Town's wastewater treatment capacity, the Town undertook an Expression of Interest/Request for Proposal process to retain a Consulting Engineering Team. The Team of Ainley Group (Ainley) and Black & Veatch Canada (B & V) was awarded the assignment in January 2011.

2.0 Steering Committee

A Steering Committee was formed from members of Town staff and the Consulting Engineering Team (see list below) for the purpose of directing the progress of the Phase 3 and 4 Class EA planning process and to facilitate the decision making process. Steering Committee meetings were held on a regular basis and copies of all meeting minutes are included in Appendix B. In addition, a Workshop meeting was held with Town Operating Staff and a copy of the minutes is also included in Appendix B. A copy of notes prepared from an April 26, 2011 meeting with the MOE is also included in Appendix B.

On June 7, 2011, a presentation was made to Town Council by members of the Steering Committee. A copy of the presentation is included in Appendix B.

The list of Steering Committee Members is as follows:

Debbie Korolnek	- Director of Engineering, Bradford West Gwillimbury
Jon Morton	- Project Manager, Bradford West Gwillimbury
Brad Sullivan	- Chief Plant Operator, Bradford West Gwillimbury
Rick Way	- Senior Plant Operator, Bradford West Gwillimbury
David Latarius	- Engineering Assistant, Bradford West Gwillimbury
Richard Waite	- Project Director, Black& Veatch Canada
Joe Mullan	- Project Manager, Ainley Group
Brian Edwards	- Assistant Project Manager, Black & Veatch Canada
Reid Mitchell	- Ainley Group

3.0 Initial Notification

An initial Notice was prepared and published in the local newspaper on March 31, 2011 and April 7, 2011. The purpose of the Notice was to advise the public and the Review Agencies of the Town's intent to continue with the Class EA planning process and to provide notification of an upcoming Public Information Centre. A copy of the Notice, the Communication List and all related correspondence is included in Appendix C. A summary of the correspondence received as a result of the Initial Notice is as follows:

- Alderville Fist Nation letter dated April 1, 2011 – minimal potential impact, wants to be kept informed
- MOE letter dated April 4, 2011 – General Comments
- Chippewas of RAMA First Nation letter dated April 4, 2011 – direct all future correspondence to Karry Sandy-McKenzie
- Email dated April 4, 2011 from Rob Baldwin of the Lake Simcoe Conservation Authority – requesting information and wanting to attend working group sessions
- Email dated April 20, 2011 from Enbridge – wants to be advised when design is underway in order to protect buried plant
- Email dated April 28, 2011 from R. Baldwin of LSRCA – wants pre-consultation
- Ministry of Aboriginal Affairs letter dated May 20, 2011 – provides suggested First Nations contacts.

4.0 Class Environmental Assessment Planning Process

Ontario Municipalities are subject to the requirements of the Environmental Assessment Act (EAA) for public works projects. The Municipal Engineer's Association's (MEA) "Municipal Class Environmental Assessment" document (October 2000, as amended in 2007) provides municipalities with a phased procedure, approved under the EAA, to plan most municipal works projects. These are usually limited in scale with a predictable set of environmental impacts and mitigation measures. As noted in the MEA Document, the "Key Principles of successful environmental assessment planning" are:

- Consultation
- Reasonable range of alternatives
- Consideration of effects on all aspects of environment
- Systematic evaluation
- Clear documentation
- Traceable decision-making.

The MEA procedure for the BWG WPCP Class EA is a Schedule C planning process, involving five Phases.

- Phase 1 – Problem or Opportunity
- Phase 2 – Alternative Solutions
- Phase 3 – Alternative Design Concepts for Preferred Solution
- Phase 4 – Environmental Study Report
- Phase 5 – Implementation

The Town completed phases 1 and 2 and the planning was documented in the Town's "Water Supply and Wastewater Servicing Master Plan Update (Final Study Report) dated March 31, 2011.

The team of Ainley/Black & Veatch was retained to complete and document Phases 3 and 4 of the Class EA planning process and this ESR provides that documentation. The implementation Phase will be undertaken as necessary by the Town.

5.0 Background Information and Reports

5.1 Water Supply and Wastewater Servicing Master Plan Update, Final Study Report, March 31, 2011

The Water Supply and Wastewater Servicing Master Plan Update (Master Plan Update), provides documentation of the Problem Statement, the Study Area and the identification, assessment and selection of the Preferred Phase 2 Solution regarding wastewater treatment.

The Problem Statement is outlined in Clause 2.1 of the Master Plan Update and is reprinted as follows:

"A Master Servicing Study for water supply and wastewater treatment capacity was completed in January 2003, and an Addendum to the Water Servicing Study was completed in September 2003. The resulting master servicing plans need to be updated to accommodate the planned growth as set out in the Town's Official Plan and amendments. The preferred water supply and wastewater treatment solutions will need to comply with all regulations, meet environmental protection and sustainability objectives, and be cost-effective."

The "Study Area" is defined in Clause 2.2 and on Figure 1 of the Master Plan Update. In general, there are three designated areas within the Town that require municipal wastewater servicing. They are: the Bradford Urban Area, the Highway 400/County Road 88 Area and the Bond Head Settlement Area.

Following publication of a Notice dated October 20, 2008, a Public Information Centre (PIC) was held on November 5, 2008 to present the Recommended Alternatives for water supply and storage and for wastewater treatment. Public comments were summarized in Table 20 of the Servicing Master Plan Update. With respect to wastewater treatment, the following comments are noted:

- WPCP should provide anaerobic treatment to denitrify to reduce nitrate loadings to the Holland River and the Lake
- Include expansion of water conservation programs and encourage incentives for water reduction etc.
- Concerned about internal phosphorus loadings from the West and East Holland Rivers from late fall to early spring, and the impact of the WPCP effluent.
- Interested in effluent dilution and assimilative capacity in the West Holland River when water is pumped out for irrigation in the Holland Marsh.
- Early consultation with MOE.

A Notice of Study Completion was issued on July 15, 2010.

The Preferred Wastewater Solution (related to the existing WPCP) is summarized in the Executive Summary of the Master Plan Update as follows:

"Expansion of the Bradford WPCP to a capacity of 23,300 m3/day.

The required capacity of the expansion assumes that BWG continues to inspect, maintain and upgrade its sanitary sewage collection system such that the current low inflow and infiltration rates are maintained or improved.

The design of the WPCP expansion will consider:

- ***The actual capacity of the WPCP's secondary treatment units, established from stress test results.***
- ***Modifications to the secondary biological treatment process and the sludge treatment and management approach to minimize space utilization, energy usage and costs, and to optimize overall process performance.***
- ***Significant improvements to the tertiary treatment process to comply with an effluent phosphorus concentration of 0.08 mg/L, which would result in a maximum phosphorus load of 698 kg/year at design flows. The design effluent criterion for phosphorus will be confirmed during Phase 3 of the Class EA.***

If required, BWG will consider achieving further reductions in phosphorus loadings by offsetting with other sources of phosphorus and by participating in a water quality trading program, if available."

5.2 Assimilative Capacity Study and Benthic Invertebrate Studies

5.2.1 Desktop Assimilative Capacity Study – 2005

A desktop study was conducted by R.J. Burnside & Associates Limited in February 2005 to assess the capacity of the Holland River at Bradford to assimilate the discharge from the proposed expanded Bradford WPCP and establish effluent discharge criteria.

The study reviewed historical flow and water quality data to determine background concentrations for the parameters of interest and established the maximum acceptable WPCP discharge concentrations for key wastewater contaminants on a monthly basis.

The desktop study concluded the following:

- The West Holland River is MOE Policy 2 with respect to Total Phosphorus and therefore has no remaining assimilative capacity for this parameter all year round. Regardless of the concentration of phosphorus in the WPCP effluent, the PWQO criterion cannot be met downstream. A monthly average TP concentration of 0.11 mg/L or less would be required in the WPCP effluent to meet these MOE requirements. Relative to the C of A compliance limit of 0.14 mg/l, this represents a small but significant reduction.
- The West Holland River is usually MOE Policy 1 with respect to un-ionized ammonia for the whole year except for July. The downstream average in-stream un-ionized ammonia must be maintained at or below 0.02 mg/l for every month except for July where it should be below the historical 75th percentile concentration of 0.045 mg/l. The total ammonia limit of 0.3 mg/l is therefore suggested to meet the PWQO in the summer. A limit of 2.1 mg/l is suggested in the winter.
- The West Holland River is usually MOE Policy 1 with respect to E. coli except for the months of July and November. A year round compliance limit of 123 organisms/100ml (or less) is recommended to ensure consistent compliance with the PWQOs and MOE policies.
- A monthly maximum average TP concentration of 0.11 mg/l would result in a maximum daily loading to Lake Simcoe of 1.914 kg/day (based on a design flow of 17,400 m3/day) which is higher than the current loading allotment specified by the Certificate of Approval but lower than the total daily allotment (cap) of 2.046 kg/day currently allocated to Bradford WPCP.
- For the purposes of phosphorus impact on surface water and compliance with the MOE policies, there is no limitation on phosphorus flow rate as long as the concentration limit of

0.11 mg/l is met. However, the loading limit to Lake Simcoe effectively places a flow rate limit on the WPCP discharge and at higher flow rates than currently proposed, other water quality parameters become limiting to flow.

- A low flow analysis of the West Holland River shows that flows are lowest in June, July and September, with 7Q20 flows ranging from 0.15 m3/s in September to 1.02 m3/s in April.
- From an assimilative capacity perspective, the critical water quality parameters are TP and un-ionized ammonia. Significant reductions in the effluent limits would be required to comply with MOE Policies and Objectives (0.11 mg/l for TP and 0.3 mg/l for total ammonia)
- Basic pH sensitivity analysis shows that the maximum allowable total ammonia in the effluent can be increased substantially if the after-mixing pH in the River is lowered relative to historical levels. For example, if the after-mixing pH were reduced consistently below 7.5, the WPCP ammonia limit for compliance with the MOE policies increases from 0.3 mg/l to 1.4 mg/l. It is recommended that a more detailed assessment of expected after-mixing river pH be performed to confirm appropriate ammonia criteria prior to detailed design. This would need to consider the future pH of the effluent, which may be impacted by future changes in the supply of potable water. Currently all potable water distributed within the Town is derived from groundwater. A new water transmission main from the Town of Innisfil will be constructed to provide the Town with potable (lake-based) water, which will be "softer" and less alkaline than the groundwater currently used in the Town.
- The resulting effluent criteria, as proposed by R. J. Burnside & Associates Limited in 2005, is summarized in the Table below.

Table 5-1 Effluent Criteria as prescribed by the 2005 Desktop Assimilative Capacity Study

Parameter	Existing Non-Compliance Criteria on C of A (ADF = 8,870 m3/day)	Effluent Criteria to meet MOE Policies (ADF = 8,870 m3/day)	Effluent Criteria to meet MOE Policies (ADF = 17,400 m3/day)
Total Phosphorus	0.14 mg/L (1.24 kg/d)	0.11 mg/L (0.96 kg/d)	0.11 mg/L (1.94 kg/d)
Total (Ammonia + Ammonium) Nitrogen	2.0 mg/L (April – Oct) 4.5 mg/L (Nov – March)	0.3 mg/L (April – Oct) 3.4 mg/L (Nov – March)	0.3 mg/L (April – Oct) 2.1 mg/L (Nov – March)
E.coli.	200 organisms/100ml	145 organisms/100ml	123 organisms/100ml
In addition, un-ionized ammonia levels shall not exceed 0.1 mg/L in the effluent			

5.2.2 Benthic-invertebrate Study – 2004

In 2004, a benthic-invertebrate study, to monitor potential environmental impacts of the WPCP outfall on the receiving West Holland River, was initiated by Tarandus Associates Limited. A total of six sites were sampled and studied (three upstream and three downstream of the WPCP). The BioMAP WQI for the data suggests that the water quality is impaired at all six sampling locations including the "control" station located 1.75 km upstream of the WPCP discharge. The results of the other benthic metrics including richness, EPT index (total number of mayflies, stoneflies and caddisflies found at a given location), taxon dominance and Hilsenhoff Biotic Index also indicate degraded water quality throughout the study area. These do not, however, show any spatial trends in water quality and therefore show no correlation between the water quality and the operation of the WPCP. It is suggested that the main sources of water quality impairment is organic in nature, not surprisingly since the river flows through one of Ontario's largest intensive agricultural operations.

5.2.3 Benthic-invertebrate Study - 2010

A benthic invertebrate study was conducted by Azimuth Environmental Consulting Inc. on the West Holland River wastewater effluent discharge area at the WPCP in 2010. The same six sites as in the 2004 report were sampled and studied. The study concluded that the results indicated no apparent trend between the benthic invertebrate communities upstream and downstream of the River WPCP outfall, which would indicate that in general the treated effluent discharge does not appear to be adversely impacting on the water quality. However, the results also indicate that the River contains generally poor water quality and substantial organic pollution within the study area as well as a low range of biodiversity and community complexity. These conditions are likely to be attributed to a combination of the surrounding urban and agricultural land-use practices as well as the natural characteristics of the River.

5.3 Outfall Studies

With respect to the hydraulic capacity of the existing outfall pipe and channel, no background information was available. The outfall is considered to be comprised of a 600 mm dia. High Density Polyethylene pipe (about 54 m long) from the plant's final effluent channel followed by an existing channel that drains to the West Holland River. Based on a review of various internal diameters for a 600 mm pipe, the maximum water level in the final plant channel will vary from 220.68 m up to 221.127 m. This is based on the design peak flow rate of 53.4 MLD and a maximum flood elevation in the channel of 219.91 m. The existing top wall of the plant's final effluent channel is approximately 221.5 m. Therefore, the existing outfall pipe appears to be suitably sized to handle the design peak flow rate.

It is noted that Certificate of Approval # 6664-7ZGKXG describes the "Final Effluent Chamber and Outfall" as "a final effluent chamber to combine disinfected effluent from the existing and proposed UV channels, with pipe and outfall for discharge to West Holland River". This indicates that the mixing zone, for assimilation assessment, is the point where the outfall meets the river.

5.4 Geotechnical Report, October 1995

A geotechnical investigation was undertaken, by Terraprobe Limited in October 1995 at the site of the proposed Plant C expansion. A total of six boreholes were drilled to determine the soil and groundwater conditions in the area. The soil conditions at the boreholes were found to be SANDY SILT to SILTY SAND FILL over NATIVE SILT followed by SANDY SILT TILL. Groundwater was found at depths ranging from 1.8 to 4.5 m. This soil was considered suitable for the support of various structures on conventional spread footings and/or concrete tank pads. However, it was recommended that all deleterious material be removed from the footings area prior to pouring concrete. Also, the native silt soils at the site were deemed to be suitable for support of sewers and other related piping but it was recommended that the thrust blocks be cast against undisturbed native ground. It was recommended that the building foundations and tanks be extended to a depth of 1.5 to 6 m below existing grade and therefore, the recommended safe side slope configuration for temporary unbraced excavations was 1 ½ to 1 (horizontal to vertical). Additional consideration was given to deep excavations in close proximity to existing foundations and structures so that there was minimal loss of ground support. Excavated soils at the site were deemed to be difficult to place and recompact as backfill and therefore it was recommended to import OPSS Granular 'B' type material for backfilling structures. It was recommended that any soft, loose or disturbed soils encountered as a result of groundwater seepage or construction traffic be excavated and replaced with suitably compacted sand fill.

A further geotechnical investigation was undertaken, by Terraprobe in December 2003, in support of the February 2005 ESR (Burnside). A total of six boreholes were drilled to determine the soil and groundwater conditions in the area. The investigation found varying depths of fill throughout the site ranging from 1.8 to 4.7 m below the existing grade. Buildings constructed as slab on grade would require greater than the conventional 1.2 m depth for footings and the removal of all fill material below the slab. At the location of the aerobic digesters and biosolids storage tanks, the depth of fill was approximately 4m below grade. This condition required relatively deep foundations and/or the use of engineered fill as the full depth of the fill had to be excavated and filled below the tank slabs. The bearing capacities ranged from 100 to 250 kPa with the lower value located in the northern edge of the site. However, it was recommended that most of the tanks be founded at an elevation with a minimum bearing capacity of 150 kPa. Therefore the existing capacities were deemed to be suitable. The water table was measured at 2 to 3 m below grade but varied seasonally. The structures were therefore designed for hydrostatic pressure and uplift assuming the water table was at grade. For deeper/larger span structures, this may have resulted in heavier (thicker) bases/walls or alternatively, pressure relief valves may have been installed where appropriate.

Based on previous geotechnical assessments, the soil conditions at the plant site are considered to be acceptable for either a plant expansion or optimization of the existing facilities.

5.5 Stormwater Management Assessment, Feb 2005

As part of the February 2005 ESR (Environmental Study Report, Bradford Water Pollution Control Plant WPCP Expansion), impacts on the Regional Floodplain and Provincially Significant Wetlands were identified (Clause 10.2 of the 2005 ESR). In summary, the following points were noted:

- The WPCP, including the suggested 2005 expansion, is located just within the limit of the Regional storm floodplain.
- Given the large expanse of the Holland River floodplain at the location of the WPCP, it is not expected that the minimal loss of floodplain storage would have a noticeable effect on the Regional Flood levels.

In addition, storm drainage was assessed as part of the 2005 ESR (Clause 10.7 of the 2005 ESR). A summary of the points made is as follows:

- Erosion and sediment control measures, meeting Town and LSRCA standards are to be installed, inspected and maintained during construction.
- De-watering operations are to include sediment traps or filter bags as required to reduce sediment load to the surrounding areas.
- Stabilization of exposed soils is to take place as soon as possible following completion of the construction.
- Any disturbance of the existing ditch outfall area is to be stabilized with suitable native shrub species, as outlined in the LSRCA requirements.

- Existing storm drainage characteristics of the adjacent properties (upstream and downstream) are to be maintained.
- Final design details are to address measures to control possible oil, gas or fuel spills during construction.

All of these observations and recommendations are applicable to either an expansion of the existing plant or to optimization of the existing treatment facilities.

5.6 Stress Testing Report for Plants B and C, Jan 2008

TSH (now AECOM) was retained by the Town in 2006 to complete stress testing of Plants B and C for the purpose of re-rating the capacities of those two facilities. The Report titled "Stress Testing of Plants B and C" was provided to the Town under cover of a letter dated January 10, 2008. The Report notes that during the preparation of the February 2005 Environmental Study Report for Plant D, the capacity of Plant B was reduced by the MOE from 4544 m3/d to 3075 m3/d to account for future nitrification requirements and clarifier capacity. The Report also notes the rated capacity of Plant C as 4325 m3/d.

The Report assumed that the effluent loading requirements, as outlined in the Certificate of Approval, would be retained in the future.

TSH developed an industry standard BioWin process computer model for both Plants B and C. Higher than normal flows were directed to each of the two plants during various periods between July 2006 and June 2007. According to the Report, the model "correlated very well with the actual plant operation and therefore is a useful tool in predicting future plant performance."

The stress testing indicated that, with various modifications, Plant B could be re-rated to 4544 m3/d and Plant C could be re-rated to 6015 m3/d. Coupled with the rated capacity of Plant D, the overall plant capacity would be 20559 m3/d. Allowing for the robustness of future Plant D (under construction in 2008), the TSH Report concluded that the entire facility could be re-rated to 22560 m3/d or higher.

The Report also concluded the following:

- Plant B experienced issues with respect to establishing nitrification during certain periods of stress testing as a result of blower breakdown
- Removal of sludge from the secondary clarifier in Plant B resulted in denitrification occurring within the clarifier during the summer period, resulting in impairment of effluent quality
- With mechanical improvements, the proposed effluent limits can be met by not relying on blending for either Plant B or C.

A summary of the facility modifications as recommended by TSH is as follows:

- Upgrade the influent flow measuring and monitoring for both Plants B and C
- Install an automatic flow splitting device for Plants B and C influent
- Provide new blowers for Plant B
- Upgrade the return sludge pumps for Plant B
- Expand the equalization tank in Plant C
- Upgrade the equalization tank pumps for Plant C.

The conclusions and recommendations of the Report were considered during the 2011 Optimization Assessment, which was undertaken as part of this Class EA planning process. The results of the most recent assessment are identified in Clause 5.14 of this ESR.

5.7 Record Drawings

Record Drawings were available for Plant C (Ainley Group File 197022 dated June 1998) and for Plant B (Proctor & Redfern File 77119 dated October 1983). In addition, Record Drawings related to the Main Sewage Pump Station Extension (Proctor & Redfern File 77119 dated March 1984) were also reviewed. These Record Drawings were used to confirm facility sizes for optimization assessment.

The Town provided "As Tendered" Drawings for Plant D, printed July 2006 for Class EA purposes.

5.8 Historical Flow Data

The Town provided the historical flow and population data for the years 2007 to 2010. It is assumed that wastewater flow rates for future growth of industrial, commercial, institutional and residential will remain proportionate to current flow levels. It is noted that although the historical flow data provides both influent and effluent flow information, the Town advised that the influent flow data is not accurate. Therefore, for the purposes of this Class EA, all historical flows are effluent flows.

The Town provided the serviced populations.

Table 5-2 below lists estimated annual historical average daily effluent flows per capita.

Table 5-2 Annual Average Daily Flows per Capita

Year	Serviced Population	Average Daily Flow (ADF) m3/d	Peak Day Flow (PDF) m3/d	Peak Factor	Actual per Capita flows (L/c/d)
2007	19,060	5827	9646	1.66	306
2008	21,218	6768	16014	2.37	319
2009	22,000	7227	17185	2.38	329
2010	23,293	7107	12384	1.74	305

5.9 Proposed Design Flows

The design criterion for the capacity increase was determined by the Town as part of the Master Servicing Study. The design criteria are summarized in Table 5.3 (overleaf).

Based on the design criteria, average day flows and peak flows were determined for the proposed growth. Tables 5.4 and 5.5 (overleaf) outline the design flows.

In summary, the design flow rates to service a residential population of 47,400 persons and an employment equivalent population of 30,000 are as follows:

- Average Day Flow = 23,250 m^3/d
- Peak Flow = 53,400 m^3/d

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Bradford WPCP EA

Table 5.3 - Design Criteria

Water Consumption	Average Day		Peaking Factor
Residential	250	L/c/day	Harmon
Extraneous	90	L/c/day	2.5
Existing Industrial, Com and Inst in Bradford Urban Area	5	m^3/net ha/day	2
Future Industrial and Com in Hwy 400 Area	8	m^3/net ha/day	2

Table 5.4 - Average Day Flows

	Residential		Employment			Extraneous	Total
	Population	Avg Day Flows (m^3/d)	Population	Area (ha)	Avg Day Flows (m^3/d)	m^3/d	m^3/d
Bradford Urban Area	38,800	9,700	15,000	378	1,890	4,227	15,817
Interphase Industrial				21	168	55	223
Bond Head Area	4,400	1,100				396	1,496
Highway 400 Employment			15,000	405	3,240	1,041	4,281
Total	**43,200**	**10,800**	**30,000**	**804**	**5,298**	**5,719**	**21,817**
Allowance for Intensification and Infilling	4,200	1,050				378	1,428
Total	**47,400**	**11,850**	**30,000**	**804**	**5,298**	**6,097**	**23,245**
						SAY	**23,250**

Table 5.5 - Peak Flows (m^3/d)

	Harmon	Residential	Employment	Extraneous	Total
Bradford Urban Area	2.37	22,976	3,780	10,568	37,324
Interphase Industrial			336	138	474
Bond Head Area	3.30	3,626		990	4,616
Highway 400 Employment			6,480	2,603	9,083
Total	2.32	**25,101**	**10,596**	**14,298**	**49,995**
Allowance for Intensification and Infilling		2,436		945	3,381
Total		**27,537**	**10,596**	**15,243**	**53,376**
				SAY	**53,400**

Note: The total peak flow from all areas is not the sum of the individual peak flows. It was recalculated with a residential peaking factor of 2.32 to account for the total population. S:\110060\Working File\Bradford WPCP Data\Tables 5.3, 5.4 and 5.5.xls

5.10 Historical Raw Wastewater Concentrations

The historical raw wastewater concentrations, shown in Table 5-6 below, for 5-day Carbonaceous Biochemical Oxygen Demand (CBOD5), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Kjeldahl Nitrogen (TKN) are based on the Town's SCADA Reports.

Table 5-6 Historical Raw Wastewater Data

Year/Parameter	CBOD5 mg/L	TSS mg/L	TP mg/L	TKN mg/L
2007	171	181	4.2	32
2008	173	171	3.6	29
2009	155	179	4.2	30
2010	183	135	4.2	34

Historical influent data from January 2007 through December 2010 was evaluated to develop the raw influent wastewater characteristics. An influent composite sample is taken once per week and does not include any side-streams (except return from the grit classifier). The influent flow meter readings are inaccurate at current flows, therefore the effluent flow is used for Ministry of Environment reporting purposes.

The annual average flows, concentrations, loads and peaking factors for 2007 through 2010 are presented in Table 5-7. Outlier sample values were eliminated from the data set. Furthermore, the raw influent Total Suspended Solids (TSS) data in 2010 shows periods of very low TSS, which are inconsistent with the influent carbonaceous biochemical oxygen demand (CBOD5), total Kjeldahl nitrogen (TKN) and total phosphorus (TP). Therefore, 2010 data are presented but have not been considered in developing the influent wastewater characteristics.

Table 5-7 Historical Average Flows, Loads and Peaking Factors (2007 through 2010)

	2007	2008	2009	2010
Effluent Flow				
Average (AA)	5827	6772	7227	7107
Max Month (MM)	6491	8807	8778	7832
Peak Day (PD)	9646	16014	17185	12384
PD/AA	1.7	2.4	2.4	1.7
MM/AA	1.11	1.30	1.21	1.10
$CBOD_5$				
Average concentration	171	173	155	183
Average Load	994	1174	1118	1303
Max Month Load	1198	1587	1536	1794
Peak Day Load	1340	1833	1914	2411
MM/AA	1.20	1.35	1.37	1.38
PD/MM	1.12	1.16	1.25	1.34
TSS				
Average concentration	181	171	179	135
Average Load	1056	1159	1293	959
Max Month Load	1444	1586	1681	2090
Peak Day Load	1840	1955	1917	2879
MM/AA	1.37	1.37	1.30	2.18
PD/MM	1.27	1.23	1.14	1.38
TKN				
Average concentration	32	29	30	34
Average Load	186	195	214	244
Max Month Load	208	247	280	300
Peak Day Load	251	318	365	348
MM/AA	1.11	1.27	1.31	1.23
PD/MM	1.21	1.29	1.30	1.16
TP				
Average concentration	4.2	3.6	4.2	4.2
Average Load	24	24	31	30
Max Month Load	29	30	43	35
Peak Day Load	37	42	60	44
MM/AA	1.17	1.22	1.39	1.16
PD/MM	1.31	1.42	1.41	1.25

Design raw influent wastewater characteristics were then developed based on the historical plant data from 2007 through 2009.

Table 5-7 presents the design annual average (AA), maximum month (MM), and peak day (PD) flows and loads for the raw influent wastewater. Based on the historical trend of the influent wastewater, it appears that the maximum month flow and the maximum month load could occur simultaneously (see Figure 5-1). Therefore, the maximum month concentrations are calculated based on the maximum month flow and the capacity of the plant has been evaluated based on the maximum month flow and loads.

The plant measures influent CBOD5, however the MOE recommends that BOD5 is used "for the assessment of raw sewage and primary effluents in estimating design parameters such as organic loadings and process air requirements of the secondary treatment process[1]". Therefore influent BOD was estimated based on a typical CBOD/BOD ratio of 0.92. A VSS/TSS ratio of 0.85 was assumed for the raw influent solids.

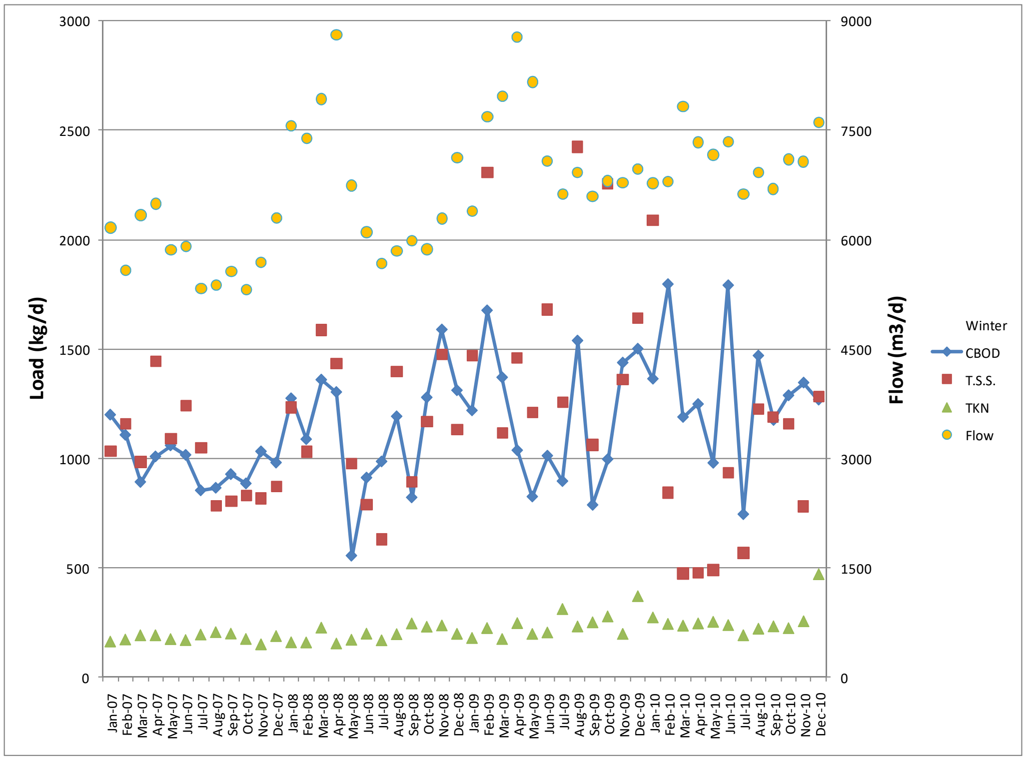


Figure 5-1 Historical Flows and Influent Loads illustrating coincident load and flow peaks during freezing period

The addition of alum for phosphorous removal generates a significant amount of chemical sludge that has to be accounted for in the design. The chemical sludge generated was estimated on a stoichiometric basis. The influent TSS in the table that follows was adjusted to account for the chemical sludge from alum addition.

[1] MOE Design Guidelines for Sewage Works, 2008, Page 8-10

Table 5-8 Design Raw Influent Characteristics

Parameter	Peaking Factor	MLD	mg/L	kg/day
Annual Average				
Flow	----	23.3	----	----
BOD_5 (1)	----	----	200	4,660
TSS – raw (2)	----	----	180	4,194
TSS – (chemical sludge)			218	5,079
TKN (3)	----	----	32.0	746
TP	----	----	4.2	98
Maximum Month (4)				
Flow	1.20	28.0	----	----
BOD_5 (1)	1.33	----	212	5,928
TSS – raw (2)	1.38	----	207	5,788
TSS – (chemical sludge)			250	6,990
TKN (3)	1.23	----	34.7	970
TP	1.23	----	4.9	137
Peak Day (5)				
Flow	2.29	53.4	----	----
Peak Hourly (6)				
Flow	2.78	64.77	----	----

Note:
(1) CBOD/BOD ratio of 0.92.
(2) TSS data from 2010 was ignored.
(3) Total Kjeldahl Nitrogen (TKN)
(4) Maximum month peaking factors represent MM/AA.
(5) Peak day flow factor represents PD/AA.
(6) Peak hourly flow factor represent the PH/AA. Peak hour is based on all 4 influent operating simultaneously at maximum capacity)

5.11 Historical Effluent Quality Data

Historically, the existing Bradford WPCP has performed well with respect to meeting effluent concentration criteria. A tabulation of effluent parameters for CBOD5, TSS, TP, TKN, Total Ammonia Nitrogen and E. coli is shown below.

Table 5-9 Historical Effluent Data

	CBOD5 (mg/L)	TSS (mg/L)	TP (mg/L)	TKN (mg/L)	NH3 + NH4 (mg/L)	E. coli
Effluent Objective	5	5	0.08		0.6 (apr–oct) 2.0 (nov-mar)	< 50
Effluent Limit	10	10	0.082		0.8 (apr–oct) 2.5 (nov-mar)	<100
2007 – Annual Average	3	3	0.09	2.72	1.44	4
2008 – Annual Average	3	2	0.08	1.75	0.64	36
2009 – Annual Average	2	3	0.08	0.97	0.34	7
2010 – Annual Average	2	2	0.06	1.29	0.39	8

The pH is consistently between 6.0 and 9.5.

With respect to actual loadings, Table 5-10 shows a comparison of effluent criteria against recorded loadings.

Table 5-10 Historical Effluent Loadings

Parameter – Limit	2007 Average	2008 Average	2009 Average	2010 Average
ADF m^3/d – 17,400	5,827	6,768	7,227	7,107
TP – 0.11 mg/L, 2.046 kg/d	0.53 kg/d	0.49kg/d	0.47 kg/d	0.33 kg/d
Total Ammonia Nitrogen – 0.8 or 2.5 mg/L	1.44 mg/l	0.64 mg/l	0.34 mg/l	0.39 mg/l
CBOD – 10 mg/L, 174 kg/d	18.38 kg/d	17.26 kg/d	14.12 kg/d	14.45 kg/d
TSS – 10 mg/L, 174 kg/d	19.38 kg/d	12.55 kg/d	14.57 kg/d	14.15 kg/d

Based on average daily flows and TP loadings, the historical annual total phosphorus loadings for 2007 to 2010 are as follows:

2007 = 0.53 x 365 = 193 kg

2008 = 0.49 x 366 = 179 kg

2009 = 0.47 x 365 = 172 kg

2010 = 0.33 x 365 = 120 kg

5.12 Current Certificate of Approval

The current Certificate of Approval was also referenced with respect to existing effluent requirements. A copy of Amended Certificate of Approval No. 6664-7ZGKXG is included in Appendix D. In addition, Certificate of Approval No. 9408-7SFP7B was issued for Air. A copy is also included in Appendix D.

5.13 Recently Completed Studies

In order to evaluate all of the options to increase the capacity of the BWG WPCP, it was necessary to complete two additional studies. An Optimization Study was completed in order to determine if optimization is a feasible solution. The findings are summarized in Section 5.14.

In addition, an Assimilation Study was undertaken to assess the impact of the proposed effluent loadings on the West Holland River. The findings are summarized in Section 8

5.14 Optimization of Existing Plant Processes

5.14.1 Report Summary

As part of the Class EA Assignment, an assessment of the feasibility of optimizing operation of the existing plant was undertaken. An Optimization Report was prepared and copy is included in Appendix E. In summary, it has been concluded that through the completion of relatively minor modifications, the capacity of the Bradford WPCP can be re-rated from 17.4 MLD to 23.3 MLD. This option will be evaluated with other options described hereinafter. The recommendations for plant optimization are outlined in the Report and are reiterated as follows:

Table 5-11 Recommendations for Plant Optimization

Unit Process	Existing Capacity	Upgrades
Influent Pumps	4 x 181 L/s, each pump rated for 16.2 MLD for an installed capacity of 64.8 MLD and a firm capacity of 48.6 MLD	• Replace two influent pumps to 23,000 m^3/d units to provide firm capacity of 55,000 m^3/d • Bypass residual peak instantaneous flows to equalization lagoon
Headworks Screening	2 x 24,400 m^3/d mechanically cleaned screens	• Rerate existing screens to 34,000 m^3/d. • Install 46,000 m^3/d screen in bypass channel • Construct new external bypass pipe or channel • Install standby grit classifer
Grit Removal	2 x 24,400 m^3/d vortex units	• No improvement – bypass at higher flows
Activated Sludge Systems	Plants B, C & D = 17,400 m^3/d	• Rerate existing tankage at 23,300 m^3/d • Install additional blowers as needed

Unit Process	Existing Capacity	Upgrades
		• Chlorine dosing system for filamentous control
Digester Supernatant	Filter reject pump capacity is insufficient to handle digester supernatant	• Redirect (pump) digester supernatant to the headworks instead of to the filter reject system
Tertiary Phosphorus Removal	None	• Install larger equalization basin upstream of existing sand filter • Install ballasted flocculation system
Filtration and UV Disinfection	Existing Capacity = 63,600 m^3/d	• No improvements – sufficient capacity
Sludge Stabilization		• Install thickening technology to thicken WAS to 4% by adding new TWAS facility building with duty and standby RDT and polymer system

5.14.2 Recommendations for Reliability

In order to ensure that Optimization is viable, the Optimization Report identifies recommendations for reliability:

Plant B

The recommendations for Plant B reliability are:

- Base Load Plant B to prevent peak day flow event overloading clarifiers. This will require operation of the automatic gate and flow meter at the existing influent flow splitter
- Divert more flow to Plant D at peak flow when all Plant D clarifiers are in operation
- If Plant D is operating reliably for nitrification then consider sending Plant D WAS to Plant B as a nitrifying seed to ensure nitrification year-round
- Convert Plant B digester capacity to aeration capacity for additional treatment at lower MLSS in Plant B
- Install additional blower for Plant B, replace coarse bubble diffusers with fine bubble diffusers in converted aerobic digester
- Modify influent and effluent channels to suit.

Plant C

The recommendations for Plant C reliability are:

- Upgrade or expand aeration blower capacity for Plant C
- Supply provision for chlorination Plant C recycle (control Sludge Volume Index)
- Increase SBR decant equalization working volume from existing capacity (597 m^3) to approximately 1,890 m^3.

Plant D

The recommendations for Plant D reliability are:

- Install motorized valves on some aeration diffuser drop legs to provide DO control of aeration
- Install aeration in the combined mixed liquor channel at the end of the aeration basins to ensure MLSS stays in suspension
- Fix the octagon MLSS Flow splitter to clarifiers
- Supply provision for chlorinating Plant D RAS recycle (control Sludge Volume Index)

On Site Pump Station and Headworks

The recommendations for pump station and headworks reliability are:

- Replace two existing influent pumps with larger units, each capable of pumping 23,000 m^3/d to ensure adequate firm capacity for the peak day flow
- Headworks screen equipment is undersized for the peak day flow of 53.4 MLD and undersized for the instantaneous nameplate peak capacity of the influent pumps
- Install additional screen in the bypass channel and rerate the existing two screens and/or install a replacement bypass channel
- Grit classifier wash water and decant drains to a single influent wet well limiting plant redundancy – flow must be diverted to both raw influent wet wells
- Provide additional standby grit classifier for flexibility and security.

Other Recommendations

The following additional recommendations were noted during the assessment of the existing plant:

- Demolish Plant A to free up space for the new equalization tank and the new prefiltration facility
- Repair leaks in the existing air supply piping
- Repair the existing biofilter in the headworks (currently susceptible to freezing)

5.14.3 Recommendations for Biosolids Processing

The Optimization Study provides the following recommendations with respect to treatment of biosolids:

- Convert Plant B aerobic digester to aeration basin
- Provide capability to transfer sludge from Plant B to other locations for treatment or storage
- Reuse the existing SBR equalization tank for dilute WAS storage prior to thickening
- Install a biosolids thickening centrifuge or gravity belt thickener or rotating drum thickener
- Construct a new TWAS facility near the existing aerobic digesters and biosolids storage tanks.

5.14.4 Recommendations for Tertiary Treatment Upgrade

The Optimization Study considered several options to improve tertiary treatment and short-listed two alternatives – Ballasted Flocculation and Tertiary Clarifiers. Ballasted Flocculation is the recommended solution.

6.0 Provincial Requirements

6.1 General

The Lake Simcoe Protection Act became law in December 2008. The act required the Province to establish a protection plan for Lake Simcoe and surrounding area. The Lake Simcoe Protection Plan (LSPP) took effect on June 2, 2009. The purpose of the plan is to provide direction that will help protect and restore the ecological health of the Lake Simcoe watershed as important decisions are made, including decisions about new development. The LSPP also outlines a number of proposed actions to be undertaken by both the public and private sectors. In the near-term, the plan focuses on the issues most critical to the health of the lake, including improving water quality through reducing the amount of nutrients, primarily phosphorus, entering the lake. Recommendations included in the LSPP were to develop a phosphorus reduction strategy, study the feasibility of water quality trading to help reduce phosphorus loading to the Lake, and to develop a regulation to protect the shorelines of Lake Simcoe.

In 2009 the Province filed interim Regulation 60/08 (amended to O. Reg. 130/09), titled, "Lake Simcoe Protection" under the Ontario Water Resources Act. The Regulation contained measures to protect Lake Simcoe and to reduce phosphorus loadings to the lake in the short term until the Province could implement long term measures under the Lake Simcoe Protection Act and the associated Lake Simcoe Protection Plan. As a result of the legislation, the BWG WPCP will have to meet more stringent permit limits, in particular for total phosphorus (TP).

Section 2(1) of Regulation 60/08 assigned individual limits to the total amount of phosphorus that can be discharged from each of 15 wastewater treatment plants located in the Lake Simcoe Basin. With respect to the BWG WPCP, the interim annual TP loading for the period from April 1, 2008 to March 31, 2010 was 361 kg/year.

6.2 Phosphorus Reduction Strategy

As a result of the issuance of the Phosphorus Reduction Strategy, the annual TP loading limit was revised. The "Lake Simcoe Protection Plan" (LSPP) contains measures to protect Lake Simcoe and to reduce phosphorus loadings to the lake, including the Phosphorus Reduction Strategy (PRS), Water Quality Trading Feasibility Study (WQT) and the Shoreline Protection Regulation.

Basically, the PRS has decreased the annual loading of TP from the BWG WPCP from the 747kg/year (Current Certificate of Approval) to 698 kg/year. The Province's intent is to reduce loadings of phosphorus to Lake Simcoe. Lake Simcoe is a sensitive water body that is currently suffering from nutrient enrichment. It was the subject of an intensive remedial program (the Lake Simcoe Environmental Management Strategy, "LSEMS"), which has now been superseded by the Lake Simcoe Protection Plan. A copy of the June 2010 Phosphorus Reduction Strategy is included in Appendix F.

6.3 Water Quality Trading Feasibility Study

The WQT feasibility study looked at different means to implement a WQT program to determine if it is feasible for the Lake Simcoe Watershed. Water Quality Trading is a market based way to control pollutants by trading them as commodities, with a net overall reduction as the goal. In the Lake Simcoe Watershed, the main pollutant that was investigated for trading is phosphorus. As part of the feasibility study, a number of items were considered including; if a there is a market for trading (demand is greater than supply); other successful programs and past studies of the watershed to determine if the phosphorus could be quantified.

The WQT feasibility study concludes that WQT is feasible for the Lake Simcoe Watershed. However, based on the comments received during the February 17, 2010 to April 3, 2010 public review period, the MOE will determine whether to proceed with implementing a WQT Program. If they decide to implement a program, the specifics of how it will operate will be determined at that time. The feasibility study did make recommendations for the MOE to consider. One of these recommendations includes establishing a central "clearinghouse" where all credits are sold and all credits are purchased. This would make the process more transparent and accountable and would prevent private deals between two parties. However, the specifics as to how the clearinghouse would be created and managed as well as any specifics on how credits will be sold and subsequently purchased will be determined as part of the program implementation. The MOE has indicated that, if water quality trading is a future option, the details of such a program will be provided prior to 2015.

The ESR is based on the assumption that water quality trading will not be in place for the next plant expansion.

6.4 Shoreline Protection Regulation

The Shoreline Protection Regulation (SPR) generally prohibits the removal of natural vegetation in existing naturally vegetated areas within shoreline buffer areas and shoreline natural areas, which may be areas within 15m of the lake or 30m of a stream. The intent is to leave these areas undisturbed, i.e. no removal, pruning, cutting or grubbing. Some exceptions are proposed but, in these cases, compensation will be required elsewhere to achieve "no net loss" of natural vegetation.

The regulation requires establishment of a vegetated riparian area at the time other works or activities are undertaken along the shore of a lake or a stream and applies within 15m to works such as erosion control, boathouse or dock construction or new landscaping. It would require that works within 15m revegetate to a distance of 5m from shoreline (15m is the "trigger", 5m is the "requirement") to mitigate past activities, and it would appear to be triggered by a building permit application.

The regulation prohibits significant shoreline alteration such new or expanded dredging into shoreline, new or expanded lagoons, and new or expanded channels between pond/lagoon and lake (i.e. this would prevent future Big Bay Point developments). The regulation says that developments transitioned by O. Reg. 219/09 "may be exempt"; however, we believe the proper wording should be "are exempt".

The regulation prohibits fertilizer use but appears to focus on "residential/aesthetic" uses as it exempts agriculture and allows municipal sports applications if need is demonstrated via soil testing. There is a total prohibition of fertilizer use within 5m of shoreline, and fertilizer must be phosphorus free within 30m. The prohibition could include compost, manure etc.

The regulation would prohibit new septic system or subsurface sewage works within 100m of shoreline or any permanent stream. Some exemptions would apply (agriculture, replacement of old system) but there does not appear to be an exemption for new cases even where advanced sewage treatment precedes disposal to a tile field that is used for disposal only, not treatment. This part of the regulation would be regulated under the Ontario Building Code.

The regulation would prohibit wetland interference, including:

- Activities that would change wetland boundary or wetland hydrology
- Removal of vegetation from wetland, or natural vegetation within 30m of wetland (vegetation removal would not change wetland classification)

There are some exceptions and exemptions; however the regulation even defines wetland drainage as a form of site alteration.

Implementation by and large would be through adding regulations to existing permits (Building Permits, Dock Permits) or the Public Lands Act. Voluntary compliance is encouraged; alternatively municipalities may be required to put in place bylaws consistent with regulation.

It was concluded that the Shoreline Protection Regulation does not have any significance with respect to the capacity increase of the Bradford West Gwillimbury WPCP.

6.5 Water Conservation and Efficiency Strategy

Prior to June 2014, the Town is required to address the requirements of the Province's Water Conservation and Efficiency Strategy. This includes commitment to the completion of a Water Conservation and Efficiency Strategy (WCES), to assess historical water/wastewater conditions and implement a strategy for water efficiency. The Water Conservation and Efficiency Strategy should be completed in conjunction with detailed design, prior to the proposed plant expansion. It is noted that the Lake Simcoe Protection Plan (LSPP) requires that a WCES be completed with implementation beginning by June 2, 2014. The WCES should span the full planning horizon. The WCES should :

- Provide targets for conservation, efficiency, inflow and infiltration reduction to the WPCP
- Provide timelines for achieving the targets, as well as strategies, tactics, programs and initiatives to be used, including the cost to implement these
- Assess methods of achieving conservation measures such as improved management practices, the use of flow restricting devices and other hardware
- Encourage water conservation incentives, education and demand monitoring in an attempt to reduce water consumption
- Aggressively reduce wet weather peak inflow and infiltration rates into the collection system through enhanced system monitoring (flow measurement), system inspections and regular maintenance
- Develop a strict Sewer Use Bylaw along with regular monitoring program
- Assess the feasibility of non-potable effluent reuse/recycling complete with practices and technologies associated with water reuse/recycling
- Consider the potential impacts of climate change.

In addition, the WCES is to include a program for the reduction of inflow and infiltration from the WPCP collection system. This program shall include reduction priorities, targets, timelines, tactics and initiatives, and the associated costs to implement these.

The WCES is also to include an implementation plan for the proposed initiatives. It shall also include a monitoring and reporting plan to assess the effectiveness of the initiatives as well as the achievement of water conservation and/or efficiency targets.

The Town must commit to consult with the public, relevant government agencies and the Ministry of the Environment's Central Regional Office on its proposed WCES.

The WCES shall include a review of best in class water conservation and efficiency programs, initiatives, strategies and tactics adopted by other jurisdictions. The review shall include an analysis of best in class tactics/strategies used by other jurisdictions throughout the world. This review shall be made public and shall form part of the consultation process for the WCES, as required above.

In conclusion, the Town of Bradford West Gwillimbury is required to address the requirements of the Water Conservation and Efficiency Strategy prior to June 2, 2014.

PHASE 3 REPORT

7.0 Existing Wastewater Treatment Plant

The Bradford WPCP is located east of Dissette Street (# 225 Dissette), south of Jay Street. Based on a review of the Master Plan Update - Final Study Report, the WPCP is comprised of four plant "trains" which are described as follows:

- Plant A – no longer in use (abandoned)
- Plant B - extended aeration activated sludge facility - rated capacity of 3,075 m^3/d.
- Plant C - added in 1998 - sequencing batch reactor activated sludge facility - rated capacity of 4,325 m^3/d
- Plant D - added in the fall of 2009 - comprised of Plants D1 and D2, each rated at 5,000 m^3/d.
- Total Rated Capacity = 17,400 m^3/d.
- Peak Flow Capacity = 40,800 m^3/d.

It is noted that Plant D was designed for an ADF of 12,000 m^3/d and a peak flow rate of 30,840 m3/d to ensure process robustness.

A complete description of the existing WPCP is included in Clause 6.2.2 of the Master Plan Update (Appendix A).

8.0 Effluent Discharge Criteria to West Holland River

8.1 West Holland River Aquatic Baseline Review

8.1.1 General

In order to determine the impact of an increase in treated effluent flow being added to the West Holland River, Hutchinson Environmental Sciences Limited (HESL) was retained to undertake an assimilation assessment. A copy of the HESL Report "Receiving Water Assimilation Study, June 2011" is included in Appendix G. In order to complete the assimilation assessment, HESL determined that an aquatic baseline review was needed.

The objectives of the West Holland River Aquatic Baseline Review were to:

- Summarize the existing aquatic conditions in the West Holland River to provide baseline conditions that future water quality in the river – potentially affected by the Bradford WPCP - will be compared to; and,
- Discuss the current water quality in the West Holland River as it relates to aquatic habitat, water quality standards and the Lake Simcoe Phosphorus Reduction Strategy.

In addition to the studies summarized in Section 5.2 the following sources were consulted: West Holland River Subwatershed Plan (Lake Simcoe Region Conservation Authority 2010), Estimate of Phosphorus Loadings to Lake Simcoe (The Louis Berger Group 2010) and Environmental Study Report, Bradford WPCP Expansion (Burnside & Associates 2005) as well as data recently collected by the Provincial Water Quality Monitoring Network. This section presents a summary of the detailed baseline review, which is included in the HESL Assimilation Study as Appendix C "Site Visit Technical Memorandum".

8.1.2 Physical Setting

The West Holland River flows northerly and joins with the East Holland River north of Bradford, before discharging into Lake Simcoe at Cooks Bay, further to the north. The West Holland River subwatershed is approximately 350 km^2 in area. Topography in the West Holland River subwatershed is relatively flat, with the West Holland River flowing through low lying and flat polders for approximately 15 km. The BWG-WPCP, discharges through a 650 m long channel into the lower portion of the West Holland River.

The West Holland River subwatershed is largely a low-lying, agricultural watershed, including intensive agriculture conducted in polders (wetlands that were drained and converted to agricultural use). The West Holland River subwatershed also includes appreciable urbanized land areas. Run-off from agricultural land and urban areas, as well as storm sewer discharge from urban areas, carries sediment, nutrients and contaminants into the West Holland River.

Tributaries in the southern and central portions of the subwatershed (i.e., at and downstream of the Bradford WPCP) run through silt and clay glacial till. When eroded during spring runoff or rainfall events, silt and clay easily stay suspended in moving surface water and can travel long distances in the West Holland River. Tributaries, canals and overland flow contribute appreciable eroded agricultural soils to the West Holland River. Most eroded soils have nutrients adsorbed to them (e.g., phosphorus and nitrogen) that contribute to nutrient loading in the West Holland River; agricultural soil is especially nutrient rich due to its organic nature and fertilizer input.

The combination of natural physical settings and land use in the West Holland River watershed has led to degraded water quality and aquatic habitat of the West Holland River, as described in the sections below.

8.1.3 Hydrology

While there is currently no ongoing flow monitoring on the West Holland River, data are available from the Lake Simcoe Region Conservation Authority station at Highway 11 until 1991, as summarized in Burnside and Associates (2005). West Holland River Flow follows patterns typical for south Ontario streams, with maximum flows during spring freshet, minimum flows during summer and low flow during winter. Due to irrigation and drainage requirements of the upstream agricultural operations in the Holland Marsh, however, the flows are heavily modified. Burnside (2005) provided a 7Q20 estimate of 0.15 m^3/s.

8.1.4 Water Quality

Data collected at the Provincial Water Quality Monitoring Network Station ca. 1.3 km upstream of the BWG-WPCP indicate that the West Holland River water quality is degraded. Forty-seven of 49 water samples contained phosphorus concentrations greater than the PWQO of 0.03 mg/L and several metals concentrations (aluminum, cadmium, zinc, iron, cobalt, lead) exceeded PWQOs frequently. Concentrations of nitrogen species were elevated but the samples did not exceed the PWQO of 0.02 mg/L for un-ionized ammonia. Dissolved oxygen concentrations were below the PWQO for cold water biota during the summer months. High turbidity values suggest that many of the metals, as well as phosphorus, are present in particulate form on soil particles from urban and agricultural runoff in the watershed. High turbidity in the river also indicates that there may be appreciable algal productivity in the river in the later summer and early fall.

8.1.5 Aquatic Habitat

Vegetation in some riparian areas of the subwatershed's watercourses has been removed to accommodate development, agricultural and other activities, leaving the watercourse banks vulnerable to erosion once the stabilizing influence of the roots of vegetation is removed. Other habitat stressors identified in the West Holland River watershed are barriers to fish movement, such as dams, culverts and stormwater retention structures, bank hardening and stabilization and invasive species.

Slow flow and enriched nutrient status of the West Holland River produces thick riverbed sediments and a robust community of emergent aquatic plants. On the other hand, turbidity and algal growth in the water column tend to limit light penetration into the water column and the growth of submerged aquatic plants.

Monitoring of fish communities by the LSRCA from 2005 to 2007 showed that warm water species are present in the West Holland River at and downstream of Bradford. Cold water fish species are present in some of the tributaries feeding into the West Holland River at and downstream of Bradford.

Benthic invertebrate communities have been assessed on several occasions in the areas up and downstream of the Bradford WPCP. The results of the studies consistently indicated that there is degraded water quality and habitat in the West Holland River near Bradford, and that there is no significant difference above and below the point of discharge of the effluent.

8.1.6 Summary

Overall, the aquatic habitat and surface water quality of the West Holland River at Bradford and downstream are degraded. The water is nutrient rich, turbid, oxygen poor in summer and regularly exceeds PWQOs for several metals. This is the result of naturally nutrient-rich soils in the area and highly modified watershed, river channel and hydrology from urban development and agricultural operations. There are emergent aquatic vegetation communities as well as warm- and coldwater fish communities, but the benthic invertebrate communities consistently indicate degraded habitat quality up- and downstream of the WPCP. Therefore, the West Holland River generally does not have a large assimilative capacity.

8.2 Proposed Effluent Criteria

Proposed effluent criteria have been determined based on the current C. of A. and on the TP limits established by the PRS. Furthermore, the effect of plant effluent on the West Holland River receiving waters after expansion was investigated by conservative mixing modelling and using the proposed effluent compliance criteria. The results of the modelling showed that the Bradford WPCP discharge after expansion to 23.3 ML/d would meet all MOE requirements for a mixing zone in the West Holland River. The WPCP effluent is non-lethal but will continue to produce a small volume mixing zone in the West Holland River in which un-ionized ammonia concentrations exceed the PWQO. In terms of Total Phosphorus concentrations, it will have a diluting effect on the nutrient-rich West Holland River. The details of the assimilation assessment are outlined in the HESL Report (Appendix G).

The proposed effluent criteria for a plant expansion to 23.3 MLD are shown in Table 8-1 below.

Table 8-1 Effluent Criteria for 23.3 MLD Plant Expansion

Parameter	Objective Limit	Compliance Limit
Total Phosphorus (TP) mass loading	680kg/year	698kg/year
Total Phosphorus (TP)	0.08mg/L	0.082mg/L
CBOD5	5mg/L	10mg/L
Total Suspended Solids (TSS)	5mg/L	10mg/L
Total Ammonia Nitrogen	0.6 (April 1 to Oct 31) 2.0 (Nov 1 to Mar 31)	0.8 mg/L (Apr 1 to Oct 31) 2.5 mg/L (Nov 1 to Mar 31)
E. coli	50 organisms per 100 millilitres	100 organisms per 100 millilitres
PH	Maintain between 6.0 and 9.5 inclusive at all times	Maintain between 6.0 and 9.5 inclusive at all times

8.3 Regulatory Context: Effluent Toxicity and Mixing Zones

A common concern for WWTP discharges to surface water is potential for effluent toxicity from the un-ionized fraction of ammonia (NH_3). This un-ionized fraction of ammonia increases with temperature and pH of the water and can have negative effects on aquatic life, such as fish and invertebrates. For the purpose of regulating surface water quality, chronic (long-term) effects and acute (immediate) effects are distinguished.

The Ontario Ministry of the Environment (MOE) requires that all effluent discharging to surface waters be non-acutely lethal at the end of the pipe. This generally requires an effluent concentration of 0.2 mg/L or less of un-ionized ammonia (NH_3), as a conservative estimate of the lethal threshold[2]. The proposed total ammonia compliance limits for the BWG WPCP effluent in summer (0.8 mg/L) and winter (2.5 mg/L) meet the requirement of non-lethality (Table 8.1, and Table 8.2)) at the "end-of-pipe". This is true if pH and temperature of the effluent or the river itself are used for calculating the proportion of un-ionized ammonia. In reality, the pH and temperature will lie in between effluent and river levels at the point of initial mixing; and accordingly, the un-ionized ammonia values will lie in between the river and effluent values as indicated in Table 8.2.

Table 8.2. Un-ionized Ammonia Concentrations in BWG WPCP Effluent Compared to Provincial Requirements. .

Season	Total Ammonia Compliance Limit	Effluent/ River pH (75th percentile)	Effluent/River Temperature (75th percentile)	Un-ionized Ammonia in Effluent/River	Meets lethal threshold (0.2 mg/L)?	Meets PWQO (0.02 mg/L)?
Summer (Apr-Oct)	0.8 mg/L	7.6 / 8	21.4°C / 21.2°C	0.014 mg/L / 0.03 mg/L	Yes / Yes	Yes / No
Winter (Nov-Mar)	2.5 mg/L	7.6 / 7.9	16.2°C / 6.4°C	0.03 mg/L / 0.03 mg/L	Yes / Yes	No / No

Beyond the requirement for non-lethal effluent, the MOE manages surface water quality through the Ontario Provincial Water Quality Objectives (PWQO, MOE 1994). These are a set of narrative and numeric criteria which the MOE use to ensure that surface waters are of a quality suitable for aquatic life and recreation. Waters which are below the PWQO are considered safe for the long-term survival of the most sensitive life stage of the most sensitive aquatic species expected in Ontario waters. The PWQO for un-ionized ammonia is 0.02 mg/L. In winter, the PWQO is exceeded at the end of pipe under both effluent and river conditions (Table 8.2). Under the high-pH and high temperature conditions often encountered in summer in West Holland River, the PWQO of 0.02 mg/L will be exceeded where the Bradford WPCP effluent meets the river. High river temperatures and higher river pH will drive the un-ionized proportion of ammonia over the PWQO despite the dilution effect at the point of initial mixing.

[2] *The MOE does not provide formal documented guidance on what levels of un-ionized ammonia are considered acutely toxic. We therefore consulted EPA (2009) which recommends 5 mg/L ammonia nitrogen as a criterion for acute toxicity at pH 8 and 25°C or, that the average not exceed 4.5 mg/L over any 4 day period. Total ammonia concentrations of 5 and 4.5 mg/L correspond to un-ionized concentrations of 0.27 and 0.24 mg/L respectively at pH 8 and 25°C. USEPA. 2009. DRAFT 2009 UPDATE AQUATIC LIFE AMBIENT WATER QUALITY CRITERIA FOR AMMONIA – FRESHWATER EPA 822-D-09-001. December 2009.*
Environment Canada (2009) provide a median LC50 of 0.481 mg/L unionized ammonia (NH_3) for rainbow trout and 1.16 mg/L for the most sensitive daphnid species tested. An effluent concentration of 0.2 mg/L or less would therefore assure no acute toxicity to test organisms. Environment Canada/Health Canada (2001) Canadian Environmental Protection Act. Ammonia in the Aquatic Environment – Priority Substances List Assessment Report. February 2001. TD195.A44P74 2000

Although the PWQO represents a desirable water quality standard, the MOE also recognize the concept of mixing zones for assimilation of waste water discharges. A mixing zone is "an area of water contiguous to a point source … where the water quality does not comply with one or more of the Provincial Water Quality Objectives" (MOE 1994).The mixing zone recognizes that the cost of treating all effluent streams to PWQO level may not be feasible and that residual waste may be diluted and assimilated in the aquatic environment with no adverse effect. Mixing zones are allowed, however, subject to several conditions:

- Mixing zones are not an allowable substitute for reasonable or practical effluent treatment. For the BWG WPCP this requirement will be met through the use of technology that permits treatment to high quality effluent.
- Water quality must not be acutely lethal at any point in a mixing zone. This is assured by the proposed effluent that meets the lethal threshold of 0.2 mg/L for un-ionized ammonia prior to discharge.
- Mixing zones should be as small as possible. This condition is met at the BWG WPCP through a highly treated effluent and relatively quick dilution at the outlet as shown by the modeling exercise below.
- The mixing zone must not form a barrier to the passage of aquatic life. In practice, this means that it should not permanently occupy the entire width or depth of the receiving water. This condition is met for the BWG WPCP, as shown by the modeling below.
- The mixing zone should not prevent any beneficial uses of the water. In practice this is generally interpreted as a requirement that the mixing zone not interact with a swimming area. There is no swimming area close to the outfall.

8.4 Dispersion Analysis

Existing information on the West Holland River near Bradford was summarized and the dispersion of effluent from the upgraded plant in the West Holland River was modeled. In this section, the approach and results of the hydrodynamic modelling of the effluent plume behaviour are summarized and implications for West Holland River water quality within the current regulatory context are discussed. A thorough background review on the West Holland River including flow characteristics, water and habitat quality and aquatic biota as well as the detailed methodology and results of effluent mixing modeling are provided in the HESL Report (Appendix G).

The main objective of the modelling exercise was to estimate the size and location of the effluent plume where the PWQO for un-ionized ammonia (NH3) will be exceeded and thus assess if the above listed requirements for mixing zones will be met by the effluent of the proposed expanded WPCP. Total phosphorus (TP) was also modelled in order to display by how much West Holland River will be diluted for this parameter. The modelled effluent quality corresponds to the proposed compliance limits, e.g., 0.8 mg/L total ammonia for summer, 2.5 mg/L total ammonia for winter and 0.082 mg/L total phosphorus.

Three scenarios were developed that represent a range of seasonal conditions. The worst-case scenario for an ammonia-enriched effluent is represented by warm summer conditions (75th percentile temperature) and low flow (September 7Q20; 0.15 m^3/s) in the West Holland River. High temperatures promote a high ratio of un-ionized ammonia and low flow limits the amount of water available for effluent dilution. Winter low flow conditions (January 7Q20; 0.52 m^3/s) were modeled because during winter, biological assimilation of ammonia is inhibited by low temperature and low flow limits mixing. An average summer scenario was constructed in order to describe the mixing zone under average summer flows (summer average flow; 0.91 m^3/s).

Dispersion modeling was based on available water quality and quantity information as summarized in the baseline review and channel morphometry data collected during a field visit. A conservative approach was taken to modeling, e.g., input parameters for the model were chosen to represent conditions favouring the occurrence of un-ionized ammonia. Modeling was carried out using a standard professional near-field mixing modeling tool (CORMIX(R)).

For both summer flow scenarios, the discharge is described as a shoreline-attached jet and plume that are strongly deflected by the river flow and attached to the bottom due to shallow discharge depth. The plume remains attached to the shore and flows parallel to the main flow, while spreading laterally. The PWQO for unionized ammonia is met at ca. 110 m downstream from the outlet for the summer average flow and at ca 80 m distance from the outlet for the summer low flow scenario. These points are shown as dotted yellow lines on the figures. The plume exceeding PWQO is larger for the average scenario, because higher river velocities carry the plume faster downstream than under the low flow scenario.

The winter scenario resulted in the same flow classification as the summer scenarios: a shoreline-attached deflected plume. The winter plume, however, spreads laterally much more quickly and reaches the right bank ca. 20 m downstream of the outlet (Figure 7.2). This is caused by a much larger temperature difference between effluent and river water in winter as opposed to similar temperatures in summer. In winter, the warm effluent floats on top of the cold river water and spreads laterally until it reaches the other bank. Ammonia PWQO is met ca. 8 m downstream of the discharge location under the winter low flow scenario.

Total phosphorus concentrations in the effluent after the expansion will be lower than the West Holland River most of the time. The effluent will therefore have a diluting effect on West Holland River. The total phosphorus concentrations will be diluted by ca. 30 % under the summer low flow scenario, by ca. 20 % under the summer average flow scenario (Figure 7.1) and by ca. 25% under the winter scenario.

The major conclusions of the dispersion analysis are as follows:

1. For all scenarios, the extent of the mixing zone that exceeds the PWQO of un-ionized ammonia is limited to one side of the river and does not exceed a length of 110 m. Therefore the effluent plume does not represent a barrier to movement of aquatic life. In the winter scenario, although the plume extends across the width of the river, it only occupies the upper 0.5 m of the water column and so does not represent a barrier to the movement of aquatic life.
2. Total phosphorus concentrations in the river are being diluted by the effluent.

These results demonstrate that the effluent of the expanded Bradford West Gwillimbury WPCP will meet the requirements for a mixing zone. The assimilative capacity of the West Holland River, however, is limited due to impaired water quality, low flow velocities and relatively small flow compared to effluent flow. This means that the West Holland River may not have the capacity to assimilate increased effluent volumes of the same quality from any future expansions beyond the currently proposed one, in particular in terms of ammonia. Any future expansion would require explicit modelling of the proposed flows and effluent qualities.

9.0 Summary of Design Basis for Capacity Increase

9.1 General

The influent wastewater characteristics were reviewed in detail and, in combination with the flow projections developed in Section 5.9, this information was used to develop loading projections. These influent characteristics, flow and loading projections were used to assess the feasibility and extent of optimization of the existing plant and to consider other methods of providing additional treatment capacity.

9.2 Wastewater Treatment Plant Loading Rates

The primary constituents of concern for the BWPCP are: BOD5, TSS, TP and total Kjeldahl nitrogen (TKN). Table 9-1 lists the influent concentrations and loadings of these parameters at the BWPCP, averaged over the years 2007-2010.

Table 9-1 Influent Characteristics (2007-2010 Average)

Constituent	Concentration (mg/L)	Flow (m^3/d)		Average Loading (kg/d)
		Average	Peak Daily	
CBOD5	170.5	6,733*	17,185 (recorded in 2009)	1148
TSS	166.5			1121
TP	4.0			26.9
TKN	31.3			210

* Average effluent flow rate.

Projected loading rates were developed for the proposed expansion to 23.3 MLD average daily flow. The influent criteria for this future expansion are summarized in Table 9-2. It is noted that the plant designs for secondary treatment are based on maximum month loading conditions. Other processes in the plant are generally sized based on peak hydraulic conditions.

It is recognized that at the present time, the serviced area of the Town is mixed residential with some light commercial and industry. Depending on future industrial growth, the historical raw wastewater concentrations for both TKN and TP may change. It is proposed, therefore, to increase the concentrations slightly for preliminary design purposes to allow for some future flexibility with respect to industrial and commercial wastewater servicing. It is proposed to use slightly higher concentrations for design purposes as follows:

Table 9-2 Influent Flow and Loading Criteria for Expansion to 23.3 MLD

Parameter	Peaking Factor	MLD	mg/L	Kg/day
Annual Average				
Flow	----	23.3	----	----
BOD_5	----	----	200	4,660
TSS (raw)	----	----	180	4,194
TSS with Chem. Sludge	----	----	218	5,079
TKN	----	----	32.0	746
TP	----	----	4.2	98
Maximum Month(1)				
Flow	1.2	28.0	----	----
BOD_5	1.33	----	212	5,928
TSS (raw)	1.38	----	207	5,788
TSS with Chem. Sludge			250	6,990
TKN	1.23	----	34.7	970
TP	1.23	----	4.9	137

Notes:

1. Evaluation of historical data shows that the maximum month load and flow could occur simultaneously.
2. Peak day flow factor represents PD/AA. Peak day load factor represents PD/MM and applies to the full max month load used under winter design conditions.

10.0 Wastewater Secondary Treatment Alternatives

10.1 General

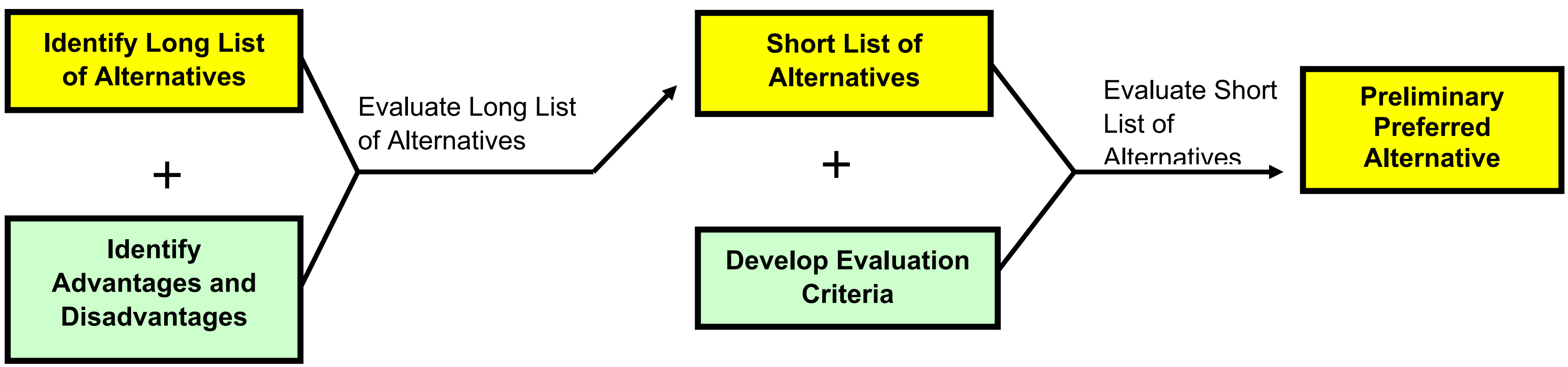
This section includes a description and evaluation of the wastewater secondary treatment alternatives.

10.2 Evaluation Approach for Wastewater Treatment Processes

A wide range of wastewater treatment processes was considered for expanding the BWG WPCP. These alternatives are differentiated in terms of the predominant treatment characteristics. The process undertaken to select the preferred wastewater treatment alternatives was based on the following approach as outlined in Figure 10-1:

- Identify feasible treatment alternatives (long list) that could possibly be constructed at the existing site
- Summarize the advantages and disadvantages of each alternative
- Develop a short list of alternatives based on analysis of the long list
- Develop evaluation criteria to evaluate the short list of alternatives
- Apply the evaluation criteria to each short-listed alternative
- Select the preferred alternative.

Figure 10-1 Planning Process to Select Preferred Biological Treatment Alternative



10.3 Long List Evaluation

10.3.1 General

The current BWG WPCP capacity includes three treatment trains (Plants B, C, and D) with different capacities and capabilities. Some possible alternatives for the incremental expansion and upgrade of the treatment facilities include:

1. Re-rating of the Existing Extended Aeration Process with upgrades to plant B
2. Expand Plant D and retain Plants B and C to provide additional volume and capacity;
3. Expand the Existing Extended Aeration Process (Plant D)
4. Enhance the existing capacity by converting Plant D to Integrated Fixed-film Activated Sludge (IFAS) Process
5. Enhance the existing capacity by converting either Plant D or C to Membrane Bioreactor
6. Improve water conservation, reuse in accordance with the MOE's Water Conservation and Efficiency Strategy.

10.3.2 Alternative 1 - Re-rating of the Existing Extended Aeration Process

The capacities listed in the Certificate of Approval for Plants B, C and D are 3,075 m^3/d, 4,325 m3/d and 10,000 m^3/d, respectively. Several studies have been conducted to assess optimization of the WPCP. As discussed in Section 5.14, it was found that by base loading Plant B to 3,075 m3/day, a re-rated capacity for Plant C and D of 6,333 and 14,437 m^3/d, respectively can be achieved. This results in a total optimized plant capacity of 23,845 m^3/d.

This alternative would allow for the best use of infrastructure and is the most cost effective alternative having a minimal capital cost. It is consistent with current operating practices and would have the least environmental impact and the shortest schedule due to the minimal construction required. In addition, this alternative will allow for immediate additional capacity for allocation.

10.3.3 Alternative 2 - Add Primary Clarifiers to Plant D

It would be possible to significantly increase the capacity of the existing treatment trains by adding primary clarifiers upstream of the aeration basins. The primary clarifiers would remove approximately 60% of the influent total suspended solids and about 30% of the BOD, which would reduce the load to the aeration basins and allow more flow to be treated in the existing volume. If primary clarifiers are added, the 23,300 m^3/d capacity could easily be met, although it will be necessary to assess the capability of the existing aeration blowers for meeting the overall oxygen demand for the additional flow. Future expansions beyond 23,300 m^3/d may require additional secondary clarifiers to be constructed.

In addition to lower aeration basin loadings and a corresponding reduction in aeration energy requirements, incorporating primary clarifiers also provides an opportunity for significant reduction in total chemical usage for phosphorus removal through two mechanisms. First, adding chemicals to multiple locations through the process has been shown to result in significant reductions in overall chemical consumption. Second, a portion of the spent chemicals from a new tertiary chemical phosphorus removal process can be returned to the primary clarifiers via the backwash water, and has been shown at some facilities to improve solids removal and phosphorus removal in the primary clarifiers, even without direct addition of chemicals at the clarifiers themselves.

A disadvantage of adding primary clarifiers at this time is that some changes to the solids handling system may be needed to accommodate primary sludge. It also would be necessary to cover and provide odour control for the primary clarifiers.

The existing aerobic digesters were designed to facilitate future conversion to anaerobic digestion. Although it is possible to operate aerobic digesters with a combination of primary sludge and waste activated sludge, the plant would be expending considerable aeration energy to stabilize the raw primary sludge. Conversion to anaerobic digestion would eliminate the need for this air and would allow the plant to generate biogas, which could be used as fuel for heating and other uses around the plant. This, however, would result in a significant change to the existing operation, and the 23,300 m^3/d capacity is not out of range for cost-effective operation of an extended aeration process with aerobic digestion. Therefore, maintaining the existing extended aeration system and aerobic digestion process until the next expansion beyond 23,300 m^3/d may be more attractive to the Town.

10.3.4 Alternative 3 - Expansion of Existing Extended Aeration Process (Plant D)

A further alternative is to provide additional aeration basin volume to achieve the proposed 23,300 m^3/d capacity. This could add an additional treatment train to Plant D, similar in size to the existing Plant D basins. Considering the relatively small overall increase in total capacity, adding some additional volume is likely the simplest approach if the full 23,300 m^3/d capacity is not able to be achieved through re-rating alone because it would be consistent with the current operation. This alternative would have a significant capital cost and would have more environmental impact due to the additional construction required.

10.3.5 Alternative 4 - Enhancement of Existing Capacity by Converting to an IFAS Process

An additional alternative for achieving the capacity increase without adding more basin volume would be to convert the existing activated sludge process to operation as an integrated fixed-film activated sludge process (IFAS). Free-floating plastic media would be added to the aeration basins to provide area for bacteria to grow, thus increasing the effective solids inventory in the basins but without increasing the overall mixed liquor suspending solids (MLSS) concentrations. The media are retained in the aeration basins by media retention sieves. By avoiding an increase in MLSS, the capacity of the secondary clarifiers is enhanced. By converting Plant D for operation as an IFAS process, it was determined that there should provide enough capacity should be provided to meet the total requirement without modifying Plants B and C.

This alternative would be the best use of existing infrastructure and would save space by not requiring additional construction. This is also a resilient and reliable process. The disadvantages include the use of smaller screens and a significant change in process, which would require significant operator training.

10.3.6 Alternative 5 - Enhancement of Existing Capacity by Converting to a Membrane Bioreactor (MBR) Process

An MBR process could be implemented with or without primary clarifiers. Instead of using secondary clarifiers and filters, the membranes would provide solids separation. Fine screens would be incorporated downstream from the existing headworks to keep debris from accumulating in the MBR process. MBRs are commonly designed at an MLSS concentration of 8,000 to 10,000 mg/L, which allows for smaller aeration basins or re-rating of existing basins. Apart from the use of membranes for solids separation, the MBR would function the same way as an activated sludge system. Very good phosphorus removal to very low concentrations is possible by simply adding chemicals to the MLSS just before the membranes, and experience thus far shows that effluent TP concentrations of less than 0.05 mg/L can be achieved. If the Town were to pursue an MBR method of treatment, the most cost-effective option is likely to upgrade either Plant B or C to an MBR, thus effectively doubling its capacity. The MBR effluent flow could bypass the filters and go straight to disinfection, eliminating the potential need to expand the filters at this time. By operating the remaining treatment trains as extended aeration activated sludge basins with secondary clarifiers, the total cost of membranes and total energy costs for the plant operation would be minimized.

Although MBRs produce a high quality effluent in a reduced aeration basin volume, one disadvantage is that they consume more energy than traditional activated sludge processes because of the need for scour air to keep the membranes clean. The MBR manufacturers have been working to optimize air scour requirements and methodologies, and the energy requirement is being improved. Another disadvantage would be the use of a completely new process which would require significant operator training.

In addition to increasing the capacity rating of the activated sludge process, some improvements are needed to the headworks and disinfection facilities as well as tertiary phosphorus removal.

10.3.7 Alternative 6 – Improve Water Conservation and Reuse

The requirements of the Provincial Water Conservation and Efficiency Strategy (WCES) are described in Section 6.0. The Town is required to meet the Province's requirements by June 2014. On its own, this Alternative will not provide the capacity increase that the Town is looking for. However, it must be considered as a complimentary solution to the selected treatment process Alternative.

10.4 Screening of Alternatives

Table 10-1 provides a summary of the advantages and disadvantages of the secondary wastewater treatment alternatives.

Table 10-1: Advantages and Disadvantages of Wastewater Treatment Processes

Alternatives	Advantages	Disadvantage
Alternative 1 - Rerate Plants B, C and D with modification to B.	• Best use of the existing infrastructure • Consistence with current operation • The most cost effective alternative • Minimum environmental impact due to minimized construction • Minimal capital cost • Reduced schedule	• Need additional basin volume for next expansion
Alternative 2 - New Primaries to D	• Increase the capacity of the existing basins • Reduction in aeration energy requirements significant reduction in total chemical usage for phosphorous removal • Conversion of aerobic digestion to anaerobic digestion which would save energy and produce biogas	• Significant change to solids handling system • Require covers for primary clarifiers for odor control
Alternative 3 - New Aeration to D	• Simple approach, constant with current operation • Ease of next plat's expansion	• Significant capital cost • More environmental impact
Alternative 4 - Convert Plant D to IFAS	• Saves space • Best use of existing infrastructure • Resilient process	• Requires smaller screens • New process • Requires operator training
Alternative 5 - Convert either Plant B or C to MBR	• Best use of existing infrastructure • Similar to activated sludge process except for the solids separation • No need for tertiary filter with membranes	• High energy consumption • Requires installation of fine screens • New process • Requires operator training
Alternative 6 – Improve Water Conservation and Reuse	• Meets Provincial requirements of WCES • May reduce water demand and raw wastewater flow	• Not a complete solution to provide required capacity increase

10.5 Short List Evaluation

10.5.1 Description

Based on an evaluation of the advantages and disadvantages of each secondary treatment alternative the following alternatives were short-listed for more in depth evaluation:

- **Alternative 1** – Optimize Plants C and D and upgrade Plant B to obtain a total rated capacity of 23,300 m^3/d
- **Alternative 2** – Expand Plant D and retain Plants B and C to obtain a total capacity of 23,300 m^3/d
- **Alternative 6** – Improve water conservation, reuse in accordance with the MOE's "Water Conservation and Efficiency Strategy"

10.5.2 Evaluation Criteria

The evaluation used is not based on a numerical ranking system. To ensure statistical validity, such an approach would have to strictly adhere to statistical methods that are often difficult to apply in a multi-faceted issue such as a Municipal Class EA. Instead, a descriptive or qualitative evaluation is used to consider the suitability of alternative solutions and design concepts. In this respect, the trade-offs that have been made between alternatives are described in the text of the report and these trade-offs form the rationale for:

1. the identification of the preferred alternative,
2. an advantage or
3. accepting a disadvantage to address a higher priority consideration.

Evaluation criteria were developed to evaluate the short listed alternatives. The purpose of the evaluation was to select the alternative that offers the greatest potential to solve the identified wastewater servicing problem.

The evaluation criteria address a wide range of technical, environmental, social, and financial concerns. An increasing level of detail was used to evaluate the short listed alternatives, and a qualitative rating scale was established for each criterion (i.e., high, medium and low). A "High" rating is most preferred and a "Low" rating is the least preferred as shown in Table 10-2. Table 10-3 lists the evaluation criteria used in the Short List Evaluation and the descriptions along with the definition for each rating.

Table 10-2 Criterion Table

○	Minimal impact
◉	Moderate impact
●	High impact

Table 10-3 Evaluation Criteria for Short List of Alternatives

Criterion	Criterion Description	Criterion Measure Guidelines	
Natural Environment			
Water Quality	Potential to impact the receiving water quality	○	Minimal impact
		○	Moderate impact
		●	High impact
Aquatic Systems	Potential to impact aquatic systems	○	Minimal impact
		○	Moderate impact
		●	High impact
Land Requirement	Land area requirement for biological process	○	Minimal land required
		○	Moderate land required
		●	Large land required
Groundwater Resources	Potential to impact groundwater resources	○	Minimal or no impact
		○	Moderate impact
		●	High impact
Floodplain	Potential to impact floodplains	○	Minimal or no impact
		○	High impact
		●	Minimal or no impact
Technical			
Reliability	Reliable operation with minimal maintenance requirements and ability to meet effluent quality objectives	○	Very reliable
		○	Moderately reliable
		●	Not reliable
Ease of Implementation/Integration	Can be easily implemented on a technical, regulatory and practical basis	○	Very easy
		○	Moderately easy
		●	Not easy
Ease of Operation	Process is easily operated	○	Very easy
		○	Moderately easy

Criterion	Criterion Description	Criterion Measure Guidelines	
		●	Not easy
Ease of Expansion	Process is easily expanded	○ ◉ ●	Very easy Moderately easy Not easy
Future TP Limit	Ability to meet current and future MOE requirements	○ ◉ ●	High Moderate Low
Social Environment			
Noise	Potential to produce noise during construction and/or operation	○ ◉ ●	Minimal potential Moderate potential High potential
Air Quality	Potential to produce air quality impacts during construction and/or operation	○ ◉ ●	Minimal potential Moderate potential High potential
Immediate Benefit	Potential for increasing allocated capacity	○ ◉ ●	Minimal or no impact Moderate impact High impact
Visual/Aesthetic	Potential for visual impact to the area	○ ◉ ●	Minimal or no impact Moderate impact High impact
Community Health and Safety	Potential impacts to community health and safety	○ ◉ ●	Little or no risk Moderate risk High risk
Economic			
Capital Cost	Opinion of probable capital cost	○ ◉	Low cost Moderate cost

Criterion	Criterion Description	Criterion Measure Guidelines	
		●	High cost
Operating/ Maintenance Cost	Opinion of probable operating and maintenance cost	○ ◉ ●	Low cost Moderate cost High cost

10.5.3 Short List Evaluation

The short-listed secondary treatment Alternatives 1 and 2 were evaluated based on the criteria in Table 10-3. Summaries of the evaluations are provided in Table 10-4. Alternative 6 was not evaluated as a stand alone solution. Alternative 6 will be complimentary to the selected solution.

Table 10-4 Evaluation of Short List of Biological Process Alternatives

Criterion	Optimization	Expand Plant D
Natural Environment		
Water Quality	○	○
Aquatic Systems	○	○
Land Requirement	○	◉
Groundwater Resources	○	○
Floodplain	○	◉
Technical		
Reliability	○	○
Ease of Implementation	○	◉
Ease of Expansion	○	◉
Ease of operation	○	○
Future TP Limit	○	○
Social and Environmental Impacts		
Noise	○	○
Air Quality	○	○
Visual/Aesthetic	○	◉
Community Health and Safety	○	○
Immediate Benefit	○	●
Economic		
Capital Cost	○	●
Operating/Maintenance Cost	○	○

10.6 Selection of the Recommended Alternative

Based on the evaluation, Alternative 1 was selected as the Recommended Alternative for expansion of the secondary treatment process. Alternative 6 will also be included in the overall solution. The primary factors for the selection of Alternative 1 are:

- Less land required
- Provides immediate benefit
- Less capital cost.

10.7 Selection of the Preferred Alternative

Based on the fact that no major public or review agency comments were received as a result of the June 22, 2011 PIC, the Steering Committee selected the Preferred Alternative (Combination of Alternative 1 and 6) in accordance with the Recommended Solution as outlined in Section 10.6.

11.0 Biosolids Treatment Alternatives

11.1 General

Currently biosolids treatment process for all three plants is provided by aerobic digestion for stabilization and destruction of VSS. Plants B, C and D stabilize WAS in new aerobic digester tanks that were constructed with the recent expansion. Pre-thickening of WAS is not performed, WAS is fed to the digesters at relatively dilute concentration (less than 1% total solids). During digestion, biosolids are thickened decanting a supernatant or clarified liquor to the head of the plant and the digested sludge is then stored during the winter months in new biosolids storage tanks that were also constructed with the last plant expansion. Final disposal of stabilized biosolids is through agricultural land application.

MOE guidelines recommend 45 days of sludge retention time (SRT) including both the digester process and the SRT of the activated sludge process. Plant B digester tankage is presently not used. However if re-instated the total digester volume for Plant B is 1,549 m^3, which, on an annual average basis would provide 31 days of sludge retention time for WAS produced at 3,075 m^3/d based loaded capacity. The available 6,500 m^3 total digester volume for plant C and D will only provide 23-24 days retention time for WAS produced. Therefore, digester capacity is limited at 23,300 m^3/d future design flow.

This section includes a description and evaluation of the treatment alternatives of WAS to produce biosolids.

11.2 Identification and Evaluation of Alternatives

11.2.1 Identification of Alternatives

Two possible alternatives for the treatment of WAS for the expansion of the biosolids treatment processes are available to produce biosolids for land application. They are:

1. Construct a new Thicken Waste Activated Sludge (TWAS) Facility and thicken WAS to approximately 3% thus increasing existing aerobic digester capacity and biosolids storage
2. Convert to anaerobic digestion process

11.2.2 Alternative 1 – Thicken Waste Activated Sludge

This alternative will see the decommissioning of Plant B’s aerobic digester and with the demolishing of Plant A, will eliminate biosolids storage for Plant B. Construction of a new TWAS facility near the existing aerobic digester for Plant C and D will increase the WAS concentration to 3% providing the minimum number of days of SRT and adequate biosolids storage capacity to achieve a minimum 240 days of winter storage. This facility will include two rotating drum filters (duty and standby), utilization of an obsolete EQ tank for pre-thickening storage, polymer dosing system, and new building. All WAS from plant B, C, and D will be diverted to this new unit process.

Advantages:

- Consistent with the current biosolids treatment process of aerobic digestion
- Utilizes existing infrastructure minimize capital cost thus the most economical process from a capital investment perspective given the size of the wastewater treatment plant
- Least amount of constructability issues or complexity as the facility can be constructed while minimizing the impact to existing operations
- Lowest operating and maintenance cost compared to anaerobic digestion at this size of a wastewater treatment plant.

Disadvantages:

- Does not provide for future sustainable energy recovery of biogases
- Does not provide for the recovery of TP

11.2.3 Alternative 2 – Convert to Anaerobic Digestion

Anaerobic mesophilic (35ºC temperature) digestion is a very common process for digesting primary sludge and a mixture of primary and secondary sludge, but is not as common for digestion of waste activated sludge only. Anaerobic digestion is more common in larger wastewater treatment plants and active digestion results in volatile solids reduction and gas production. Conversion of the existing aerobic digestion process would require decommissioning of Plant B's aerobic digester and with the demolishing of Plant A, will eliminate biosolids storage for Plant B. Major retrofits to the primary and secondary digesters are required and major supporting infrastructure would also need to be constructed for gas collection/storage, energy recovery, etc. In addition, a WAS thickening facility is also required in order to ensure that the MOE guidelines of 15 days of nominal hydraulic retention time (HRT) is achieved in the primary digesters.

Advantages:

- Eliminates the need for aeration blowers compared with aerobic digestion.
- Provides for a sustainable energy resource while saving money by allowing gas generated to be an energy source (e.g. heating, power production, supplemental gas for dryer systems)
- Substantial savings on energy costs and lower costs for large wastewater treatment plants
- Greater VSS destruction (although not substantially greater for WAS digestion)
- Potential for phosphorus recovery from centrate (as an add-on technology)

Disadvantages:

- Initial capital cost are very high in comparison
- Sensitive to adverse effects from lower temperatures in winter (heating is required)
- Increased potential for odours and corrosive gases
- New process that will require additional training for operations and maintenance staff
- Higher potential for foaming issues
- Potential for struvite formation
- Still requires prethickening of sludge.

11.3 Recommendation of Alternative

Based on a comparative evaluation of the advantages and disadvantages of the two alternatives the recommended alternative is to thicken the waste activated sludge in order to make use of the existing digester capacity and biosolids storage volume. This selection was made for following reasons:

- Lowest capital cost
- Best use of existing infrastructure
- Least impact to existing plant operation
- Least complexity of operation
- Lowest construction complexity and installation.

11.4 Selection of Recommended Alternative

Based on the evaluation of the advantages and disadvantages of the two alternatives the Recommended Alternative is to thicken the waste activated sludge in order to make use of the existing digester capacity. This selection was made for the following reasons:

- Lowest capital cost
- Least impact to existing plant operation
- Least complexity of operation.

11.5 Selection of the Preferred Alternative

Based on the fact that no major public or review agency comments were received as a result if the June 22, 2011 PIC, the Steering Committee selected Alternative 1 as the Preferred Solution in accordance with the Recommended Solution as outlined in Section 11.4.

12.0 Wastewater Tertiary Treatment Alternatives

12.1 General

This section includes a description and evaluation of the tertiary treatment alternatives.

12.2 Long List Evaluation

12.2.1 General

Possible alternatives for the tertiary treatment options include:

1. Ballasted Flocculation using Actiflo or Densadeg ahead of existing sand filters
2. Adsorption using CoMag or BluePRO in series with ferric chloride
3. Enhanced Filtration using membranes
4. Enhanced Pre-filtration using Flocculation and DAF or Flocculation and Lamella Clarifiers

12.2.2 Ballasted Flocculation using Actiflo or Densadeg Ahead of Existing Sand Filters

Chemical Flocculation and clarification, such as Actiflo® or DensaDeg® followed by sand filtration has been used to meet low phosphorus limits and has been successfully implemented at a number of plants across the US and Canada. Polishing with filters would be needed to ensure that low phosphorus limits are met.

The Actiflo® process is comprised of coagulation, sand and polymer injection, floc maturation, lamella clarification and sand recovery. The microsand acts as a seed for floc formation. The microsand ballasted flocs display unique settling characteristics, which allow clarifier designs with very high overflow rates and short retention times.

The DensaDeg® Process is similar to Actiflo in many ways but relies on the use of recycled, previously settled sludge to assist with floc formation and to increase the mass of the settling flocs.

Both processes were successfully pilot tested in 2000 at the Regional plant in New Tecumseth with the goal of achieving a total phosphorus limit (design objective) of 0.07 mg/L.

Both these technologies have small footprints, are reliable options and are easy to operate. They also both allow for rapid response to chemical changes. The disadvantages of this option include the clogging of the effluent filters due to the binding of the sand from polymer overuse, the additional preventative maintenance required to the pumps and the need to monitor sand levels closely. This option will also produce dilute sludge and will require screening of secondary effluent.

12.2.3 Adsoption using CoMag or BluePRO in series with ferric chloride

The Blue Water TechnologiesBluePro® process consists of treating secondary effluent in a reactor where FeCl3 is added before the liquid is passed to a continuously backwashing filter similar. The FeCl3 coats the media granules and a precipitation/adsorption process removes the phosphorus from the liquid to very low levels. During on-going filter backwash the iron phosphate coating is partially removed and recycled back to the activated sludge plant where a considerable reduction in phosphorus takes place.

The CoMagTM process is a "magneto-chemical" process that incorporates the use of finely divided magnetic ballast to bind the precipitated phosphorus and other fine particles. Magnetite provided a magnetic ballast seed that when mixed with alum and polymer increases both flocculation and settling rates which reduce the tanks sizes significantly. The floc particles are attracted to a magnet and magnetic separation is used for polishing the effluent rather than sand filtration or membrane systems. The magnetite is separated and recycled. The footprint is smaller than that of filters and phosphorus removal to 0.05 mg/L has been achieved.

12.2.4 Enhanced Filtration using membranes

Tertiary Membranes – Several municipal WWTPs in North America (e.g., Ashland WWTP) have had successful experience using tertiary membranes to achieve very low effluent TP concentrations. The membrane system consists of hollow strands of porous plastic fibres. Clean water is collected inside the hollow fiber. Chemical addition facilities would be provided upstream from the membranes.

Membrane Bioreactors (MBR) – The MBR process uses membranes to provide solids separation. MBRs are commonly designed at an MLSS concentration of 8,000 to 10,000 mg/L, which allows for smaller aeration basins. Apart from the use of membranes for solids separation, the MBR would function the same way as an activated sludge system. Experience this far shows that effluent TP concentrations of less than 0.05 mg/L is possible by simply adding chemicals to the MLSS just before the membranes. It is also possible to operate for biological phosphorus removal with chemical trim.

12.2.5 Enhanced Pre-filtration using Flocculation and DAF or Flocculation and Lamella Clarifiers

The Parkson DynaSand D2 process consists of chemical addition and two continuously backwashing filters in series, similar to the BluePro process. With D2 alternative coagulants can be used and there may or may not be adsorption (in addition to precipitation), depending on the coagulant used. A lamella settler is provided for solids separation from the backwash water.

12.3 Screening of Alternatives

Table 12-1 provides a summary of the advantages and disadvantages of the tertiary treatment alternatives.

Table 12-1 Advantages and Disadvantages of the Tertiary Treatment Alternatives.

Process	Advantages	Disadvantages
Alternative # 1 **Ballasted Flocculation** • Actiflo + Dynasand • Densadeg + Dynasand	• Small foot print • Reliable option • Ease of operation • Rapid response to chemical changes • Proprietary technology • Actiflo was piloted at Innisfil	• Overuse of polymer may bind the sand and clog the effluent filters • Dilute sludge • Sand pumps require preventative maintenance • Sand levels most be monitored • Require screening of secondary effluent
Alternative # 2 **Adsorption** • CoMag + Dynasand • Add coagulant + BluePro	• Blue Pro is a proven technology and was piloted at Innisfil • Relatively smaller footprint than other Alternatives	• Require ferric chloride as coagulant • Comag is a new technology with little experience
Alternative # 3 **Enhanced Filtration** • Double Dynasand • Membrane filtration • Tube settlers + Upflow adsorption clarifier + Downflow dual media filtration	• Proven technologies • Membranes are flexible to flow and loads • Membranes and Dynasand were piloted at Innisfil • Membranes are recognized by MOE as the limit of technology for 0.05 mg/L TP on Lake Simcoe	• Require ferric chloride as coagulant • Expensive option
Alternative # 4 **Enhanced Pre-Filtration** • Flocculation + Dissolved Air Floatation • Flocculation + Tertiary Clarifiers or Lamella Clarifiers	• Popular technology • Flexible to flow and load fluctuation	• Expensive option

12.4 Short List Evaluation

12.4.1 Description

Based on an evaluation of the advantages and disadvantages of each tertiary treatment alternative the following alternative treatment processes were short-listed for more in depth evaluation:

- **Alternative # 1** – Ballasted flocculation using Actiflo ahead of existing sand filters
- **Alternative # 4** – Enhanced filtration using Lamella Clarifiers

12.4.2 Short List Evaluation

The short-listed tertiary treatment alternatives were evaluated based on the criteria in Table 10-3. Summaries of the evaluations are provided in Table 12-2.

Table 12-2 Evaluation of Tertiary Wastewater Treatment Processes Shortlist

Criterion	Ballasted Flocculation	Lamella Clarifiers
Natural Environment		
Water Quality	○	○
Aquatic Systems	○	○
Land Requirement	○	○
Groundwater Resources	○	○
Floodplain	○	○
Technical		
Reliability	○	○
Ease of Implementation	○	**○**
Ease of Expansion	○	**○**
Ease of Operation	**○**	○
Social and Environmental Impacts		
Noise	○	○
Air Quality	○	○
Visual/Aesthetic	○	○
Community Health and Safety	○	○
Economic		
Capital Cost	**○**	**○**
Operating/Maintenance Cost	○	○

12.5 Selection of the Recommended Alternative

Based on the evaluation of the two alternatives, Ballasted Flocculation was selected as the Recommended Alternative. Although it may be slightly more difficult to operate than Enhanced Pre-Filtration, it is easier to integrate into the existing plant and is easier to expand. Ballasted Flocculation is also considered a better choice to meet future, reduced TP limits.

12.6 Selection of the Preferred Alternative

Based on the fact that no major public or review agency comments were received as a result of the June 22, 2011 PIC, the Steering Committee selected the Preferred Alternative in accordance with the Recommended Alternative as outlined in Section 12.5.

13.0 Impact of Recommended Alternative on the Environment and Mitigating Measures

The preferred solution does not significantly impact environmental features within and surrounding the study area. Any potential impact will be identified, addressed, monitored, and mitigated as required.

13.1 Truck Traffic

During construction, vehicular traffic to and from the project area will increase as construction equipment is delivered and removed, and construction materials are delivered. To mitigate these impacts, construction times will be limited in accordance with local by-laws. The need for a traffic impact study will be assessed during final design but it is considered that the long-term impacts will be minimal.

In order to mitigate the impacts to the local community, an established truck route should be selected by the Town.

13.2 Noise, Dust and Mud

Potential sources of noise, dust, and vibration include truck traffic and regular construction activities. These impacts can be mitigated as follows:

- Ensuring all vehicles and construction equipment are equipped with effective muffling devices and are operated in a fashion so as to minimize noise in the project area
- Enforcing the local noise by-law for all construction activities
- Restricting all truck traffic, excavation equipment, and other activity that potentially generates significant noise levels to normal working hours
- Excavated soil and rock material should be used on-site as much as possible in order to minimize truck haulage to off-site disposal areas
- Dust control agent can be applied as necessary.

13.3 Fuel Spills

During the refuelling of construction equipment, spills could occur with the potential of contaminating surface water and groundwater. Mitigation measures include:

- Preparing a contingency plan for cleaning up fuel spills
- Only allowing designated areas that are no closer than 15 m to any watercourse for refuelling construction equipment
- Providing spill containment for on-site storage tanks

13.4 Continuity of Operation

As the continuing operation of the BWPCP is of utmost importance, careful consideration will be given during the design and construction scheduling to avoid impacts on the plant operation. Since there are three separate "trains" it may be possible to work on one plant (B, C or D) while the other two are in operation. The construction of the equalization tank will not be an operational issue but the addition of the ballasted flocculation tertiary treatment units may require some flow diversion.

13.5 Vegetation and Loss of Tree Cover

The construction will encounter some shrubbery, bushes, and trees, which will need to be removed. Protective fencing will be placed around all trees that are designated to remain, in order to clearly define the construction work area.

Vegetated lands disturbed during construction will either be replanted with natural wild grasses and saplings of trees indigenous to the area (save for areas that require clearing for the BWPCP expansion) or trees will be planted in other areas of the site such as along the property boundaries.

13.6 Noise Assessment

It is considered that the proposed new equipment (pumps, blowers, tertiary treatment and sludge thickening) will not add any appreciable noise to the existing environment. However, it is recognized that in order to determine the need for and extent of any mitigation measures, a noise assessment may be required as part of final design. At that time, a more detailed knowledge of equipment requirements will be available, which will result in a more reliable and useful noise assessment. At this time (Class EA stage), the impact of additional noise is considered to be minimal and easily mitigated.

13.7 Odour Assessment

A preliminary odour screening assessment was recently completed and the results are provided in Appendix H. In summary, there are no odour impacts that cannot be mitigated, as a result of the proposed capital works to expand the plant to a capacity of 23.3 MLD.

At the present time and based on the preliminary proposed works, the only suggested mitigation measure is the addition of a carbon filter unit at the future thickened waste activated sludge (TWAS) facility. Additional mitigation measures may be identified as part of the future additional dispersion modeling that will be required as part of the final design of the plant expansion to 23.3 MLD.

14.0 Stormwater Management Assessment

The proposed upgrades will not impact the existing site drainage in any way. There is sufficient grade around the site to accommodate the new building/tanks. The previously completed stormwater assessment is considered to be adequate for the proposed works.

15.0 Opinion of Cost

A budget cost estimate was prepared as part of the Class EA planning process for the recommended works. The estimate is in $2011 and includes an allowance for engineering & contingencies.

The capital cost is to be funded 100% by Development Charges. The capital cost estimate is a planning level estimate, based on conceptual design prepared for Class EA planning purposes. The estimate is accurate to within +50% and –30%.

Table 15-1 – Estimated Capital Cost

Description	Estimated Capital Cost
General site works	$600,000
Upgrades to onsite pump station	$300,000
Upgrades to headworks	$900,000
Demolition of Plant A	$300,000
Upgrades to Plant B	$1,000,000
Upgrades to Plant C	$700,000
Upgrades to Plant D Aeration	$200,00
New equalization tank and ballasted flocculation facility	$13,000,000
New water activated sludge thickening facility	$3,000,000
Total Estimated Capital Cost	**$20,000,000**

16.0 Phase 3 Public Information Centre – Public's Principal Concerns

A Phase 3 Public Information Centre was held on June 22, 2011 to present the overall Recommended Solution and to obtain public and Review Agency input. A copy of the PIC Material and related correspondence is included in Appendix I. A summary of the verbal and written comments received is as follows:

- Letter dated July 8, 2011 from Cassels Brock Lawyers representing the Tsam Lands and requesting clarification of the service area. A response letter was provided by the Town dated July 12, 2011.
- Verbal inquiry regarding nitrification

Copies of the PIC Notice, Communication Plan, PIC Displays, sign-in sheet, letters and a memo outlining the comments received are included in Appendix I.

A summary of all comments received as a result of the Class EA is provided in Table 16-1.

TABLE 16-1 Summary of Comments

FROM/DATE	NATURE OF COMMENT	ADDRESSED THROUGH CLASS EA
Alderville First Nation April 1, 2011	- Minimal impact to First Nations rights - Keep us informed	- Notices were sent
MOE – April 4, 2010	- Address noted issues	- See Section 18.0
Chippewas of Rama First Nation – April 4, 2010	- Direct all future correspondence to Karry Sandy-McKenzie	- Future Notices were sent to Ms. Sandy-McKenzie
Enbridge Gas – April 20, 2010	- Send copies of plans during final design to determine conflict with gas plant	- No action required at this time
LSRCA – April 4, 2010	- Wants representation on "Working Group"	- Invited to PIC and was offered opportunity to meet to discuss the Project
LSRCA – April 28, 2010	- Suggests some pre-consultation	- Was invited to June 13, 2011 Steering Committee meeting

FROM/DATE	NATURE OF COMMENT	ADDRESSED THROUGH CLASS EA
		(did not attend) - Was invited to June 22, 2011 PIC (did not attend) - Was informed that PIC Information is on the Town's Web Site
Ministry of Aboriginal Affairs – May 20, 2011	- Suggests appropriate First Nations Contacts	- Contacts were added to Communication Plan
Unidentified PIC attendee – June 22, 2011	- Does nitrification occur? - What is retention time in the Plant?	- Plant is design for nitrification to meet ammonia limit - Retention time is not relevant to Class EA
Cassels Brock – July 8, 2011	- Do the "Tsam Lands" have capacity in the current plant?	- Town letter dated July 12, 2011 responded that wastewater treatment capacity is currently available for the Tsam Lands.
Hiawatha First Nation – June 7, 2011	- Minimal impact to First Nations rights - Keep us informed	- Notices were sent
Cassles Brock – July 18, 2011	- Wanted clarification on Tsam Lands	- Town email dated July 18, 2011 confirms that there is sufficient capacity in the existing plant to accommodate the Tsam Lands
Curve Lake First Nation – July 6, 2011	- Not currently aware of any issues - Contact Karry Sandy-McKenzie	- Ms. Sandy-McKenzie was added to Contact List - Town letter dated July 27, 2011 to Karry Sandy-McKenzie noted Web Site location for PIC information

17.0 First Nations Consultation

Based on a review of the responses received, no issues or concerns were raised by the Aboriginal Communities. The list of First Nation Groups that were consulted is included in the Communication Plan in Appendix I.

18.0 Design Considerations Resulting from Public and Agency Consultation

There are no design issues that need to be considered as a result of public consultation.

With respect to the MOE letter dated April 4, 2011, the following points are noted in response to the Ministry's concerns.

18.1 Ecosystem Protection and Restoration

All of the proposed works will be constructed within the limits of the developed area of the WPCP property. The existing wet land within and adjacent to the WPCP property will not be developed in any way. As such, the form and function of the wet land ecosystem will be maintained with no impact. Mitigation measures have been identified and described in Section 13 of this ESR.

No natural heritage features have been identified since all proposed works are within the currently developed area of the WPCP property. The effluent outfall will not be changed in any way and it has been proven that the additional effluent flow will meet Provincial requirements for discharge to the West Holland River. The MNR and the DFO were contacted as part of the Class EA process and neither of those agencies had any comment on the proposed undertaking.

The level of growth is consistent with the Town's OP and all policies related to ecosystem protection are considered to have been addressed due to the fact that the proposed works are within a currently developed area of the existing WPCP property.

18.2 Surface Water and Groundwater

It is recognized that approval under Section 53 of the OWRA will be required. An assimilative capacity assessment of the West Holland River was completed as part of the Class EA planning process, based on assumed effluent criteria. That Report will be used when the Town applies for a Certificate of Approval. The proposed effluent criteria was presented to the MOE Central Region during the Class EA process. The Town recognizes the TP loading requirement of 698 kg/year and the selection of the proposed works was based on that requirement. Biosolids ("residue") treatment needs were assessed and addressed as part of the Class EA process.

There are no water supply wells in the immediate area of the WPCP. The locations of the municipal wells are far removed from the WPCP site. There will not be any water takings required for the construction and operation of the expanded plant. No existing wells will be impacted or abandoned. The groundwater conditions are described in the Geotechnical Reports that have been reviewed as part of the Class EA process.

A Contingency Plan for dealing with potential adverse effects on surface water (e.g. fuel spills) will be prepared prior to construction.

The impacts to groundwater-dependant natural features will be minimal considering the fact that the groundwater table is 2 m below grade. Water taking for construction purposes will be minimal (excavation dewatering) and the discharge impact can be mitigated. There will be no significant impacts to the groundwater. The need for a Permit to Take Water will be assessed during final design but at this time, the need for such a Permit is considered to be low.

18.3 Air Quality, Dust and Noise

A screening of potential sources of air pollution from the proposed works has been completed and the results are provided in Appendix H of this ESR. In summary, there are no odour impacts that cannot be mitigated, as a result of the proposed capital works to expand the plant to a capacity of 23.3 MLD.

The effects of dust, generated as a result of construction, will be mitigated as outlined in Section 13 of this ESR.

As noted in Section 13.6, the proposed works include pump and blower replacements, to be installed in existing buildings. As such, the effect on the noise level in the area of the WPCP will be minimal. The Town acknowledges that a noise assessment will be required as part of the final design process.

18.4 Servicing and Facilities

The need for a revised Certificate of Approval for both wastewater and air is recognized.

The Ministry's references are noted.

18.5 Waste Materials and Spills

The requirement for disposal of waste that is generated during construction is noted.

The requirements for removal of soil from the site will be reviewed during final design but at this time, it is suggested that all excavated material will be reused within the WPCP site.

All underground pipes within the WPCP are owned by the Town. There are no underground storage tanks proposed.

18.6 Mitigation and Monitoring

The requirements mitigation and monitoring are noted.

18.7 Planning and Policy

The requirements of Planning and Policy are noted.

18.8 Class EA Process

The ESR provides:

- Clear and complete documentation of the planning process
- Documentation of the consultation process including public consultation efforts
- Identification of concerns and how they were addressed
- Copies of comments submitted and responses
- Identification of potential environmental impacts and proposed mitigation measures
- A list of permits/approvals that will be needed prior to construction.

18.9 Aboriginal Peoples Consultation

The Ministry of Aboriginal Affairs and the Department of Indian and Northern Affairs were contacted throughout the Class EA planning process in addition to numerous other First Nations contacts. All comments received as a result of the consultation process have been identified in this ESR.

19.0 Summary of Preferred Alternative

A summary of the Preferred Alternative is as follows:

- Apply to the to the Ministry of the Environment for a revised Certificate of Approval with a total WPCP capacity of 19.4 MLD in conjunction with increasing the capacity of the alum pumps;
- Optimize Plants C and D and modify Plant B to obtain a total rated capacity of 23.3 MLD;
- Increase existing aerobic digester capacity by adding thickening of Waste Activated Sludge (WAS);
- Construct ballasted flocculation process upstream of the existing sand filters;
- Complete a Water Conservation and Efficiency Strategy (WCES) for the water and waste water flows within the respective Service Areas. The WCES is also to be completed in accordance with the requirements of the Lake Simcoe Protection Plan (LSPP).

20.0 Re-rating Study

An assessment of the plant's interim capacity was recently completed to determine what level of capacity increase would be reasonable, assuming no major capital works were undertaken at the WPCP. A copy of the Re-rating Study is included in Appendix J. The Study concludes that the overall capacity of the WPCP can be increased from the currently approved rating of 17.4 MLD to 19.4 MLD by simply upgrading the capacity of the alum pumps. This 2 MLD capacity increase is currently available in the Plant D train.

It is the Town's intent to apply to the Ministry of the Environment for a revised Certificate of Approval based on the Re-rating Study. This will allow the Town to allocate additional wastewater treatment capacity to new development within future growth areas, prior to undertaking any major capital works.

21.0 Monitoring Requirements

After expansion of the BWG WPCP and following acceptance testing, the Town will assume full-time operation of the system. The Town intends to continue monitoring users discharging into the sewer system to ensure that they do not impact plant operation. The Town will also ensure that it complies with applicable environmental regulations. For compliance with the MOE CofAs, the Town will put in place a monitoring program that satisfies both the provincial requirements and the plant's operational needs. The BWG WPCP has a wastewater laboratory that will continue to provide the necessary information to plant operations for process control, plant effluent quality, and solids quality monitoring to ensure that the plant complies with provincial and municipal requirements. Samplers will be provided to monitor raw and treated wastewater. An annual report will be prepared to document the plant's performance. The Town will monitor effluent quality, as required by the MOE's CofA.

The Town will continue to monitor flows in the collection system in an attempt to locate areas of excessively high inflow/infiltration (high wet weather flows). The Town will continue to rehabilitate the collection system as necessary.

In addition, the Town should review and upgrade its Sewer Use By-Law to limit wastewater flows and parameters from commercial and industrial sources. Such sources should be monitored.

22.0 Permits and Approvals

The following submissions are to be made during detailed design once sufficient information has been prepared for agency review purposes.

The MOE Certificates of Approval that will be required include:

- C of A (wastewater) – required for all works, to be submitted near completion of design.
- C of A (air) – required for emergency power system and for various parts of the Bradford WPCP expansion and requires an air assessment/noise attenuation study in support of the C of A, to be submitted near completion of design.

Other approvals and permits include:

- Site Plan Approval – required for all works, to be submitted to the Town and County near completion of design.
- Building Permit – to be submitted to the Town (by Contractor) during start of construction.

23.0 Implementation Schedule

Key milestones of the preliminary schedule are as follows:

- Posting of ESR for 30-day review – January 19 to February 17, 2012
- Apply to the MOE for a rerating of the WPCP to 19.4 MLD
- Completion and implementation of Water Conservation and Efficiency Strategy
- Completion of preliminary design to expand the WPCP rating from 19.4 MLD to 23.3 MLD
- Apply to the MOE for a rerating of the WPCP to 23.3 MLD
- Completion of detailed design and approvals for 23.3 MLD Plant
- Award of contract for construction
- Completion of Construction

Based on the finding of the Re-rating Study, it is the Town's intention to apply to the MOE for a re-rating of the plant capacity from the current 17.4 MLD to 19.4 MLD. Assuming the re-rating is approved by the MOE, the Town will, in the future, expand the plant capacity from 19.4 MLD to 23.3 MLD as one stage. The decision to undertake the expansion in one stage (one construction contract) was based on the following considerations:

- If sub-components of the expansion were to be completed on their own (such as the upgrade to the tertiary treatment facility), no additional capacity above 19.4 MLD would be gained; and
- If the Project is broken into three or four sub-components and completed over a number of years the combined total cost of these smaller contracts would most likely be greater than if the works were completed as one contract.

PHASE 4 REPORT

24.0 Notice of Completion

The Notice of Completion was published in the local newspapers on Thursday January 19 and Thursday January 26, 2012. The Notice was sent to residents within a 1km radius of the BWG WPCP. A copy of the Notice and mailing lists are included in Appendix K. The Notice was added to the Town's web site.

Prior to the publication of the Notice of Completion, a Draft version of the ESR was reviewed by the MOE. The Draft ESR was sent to the Ministry on October 25, 2011. The Ministry's comments on the Draft ESR were provided in a letter dated November 29, 2011. A copy of the MOE's letter is included in Appendix K. All applicable Ministry comments have been addressed in the ESR.

In addition, the proposed effluent criteria for a re-rating of the plant to a capacity of 19.4 MLD, was provided to the MOE Environmental Approvals and Assessment Branch for comment. A copy of the email is provided in Appendix K.

As a result of the publication of the Notice of completion, the Town received comments from Chippewas of Rama First Nation, (letter dated January 20, 2012), Don Boswell, Senior Claims Analyst, Ontario Research Team, Specific Claims Branch (email dated January 26, 2012) and the MOE (letter dated February 23, 2012). Copies of these three items of correspondence are included in Appendix K.

The Chippewas of Rama First Nation wanted to make sure that Ms. Karry Sandy-McKenzie was included in the Contact list. It is noted that Ms. Sandy-McKenzie was included in the Contact List.

Mr. Boswell suggested that additional web sites might need to be researched in order to advise First Nations groups of the Town's intention. The following First Nations groups were identified as a result of the additional research:

- Saugeen First Nation (located west of Owen Sound)
- Chippewas of Nawash First Nation (located on the Bruce Peninsula)
- Wasauksing First Nation (located near Parry Sound)

These three first Nation groups were deemed to be remote from Bradford West Gwillimbury and therefore, they were not added to the Contact List.

The MOE expressed addition comment on the proposed effluent concentration for CBOD as it relates to the DO level in the receiving West Holland River. The MOE also provided additional comment on the Air Quality Impacts Assessment Report. A response letter was provided to the MOE (dated March 23, 2012) and a copy is included in Appendix K. In summary, the Town committed to:

- Prepare a work plan (for MOE review and comment) to assess current DO levels in the West Holland River and to model the proposed increase in effluent flow (23.3 MLD) as part of the final design for the future plant expansion,
- Revise the effluent CBOD limit depending on the results of the DO assessment,
- Undertake additional dispersion modeling and an assessment of compliance with O. Reg. 419/05 as part of the final design of the proposed expansion to 23.3 MLD, and
- Identify specific air quality mitigation measures as part of the additional dispersion modeling.

25.0 Recommendations and Conclusions

Considering all of the information provided in this ESR, it is recommended that the Town:

- Proceed with the planning and implementation of a Water Conservation and Efficiency Strategy in conformance with the Lake Simcoe Protection Plan;
- Consider continuing with its existing program of investigating the sanitary sewer system in order to monitor and possibly reduce wet weather flows to the plant;
- Make application to the MOE for an Environmental Compliance Approval (ECA) to allow an interim capacity increase (re-rating to 19.4 MLD) based on optimization of the existing WPCP facilities with no additional capital works;
- Consider the timing for the design of the necessary works as outlined in this ESR, to increase the capacity of the WPCP to 23,300 m^3/d including obtaining all applicable approvals;
- Prepare a work plan to assess current DO levels in the West Holland River and discuss the work plan with the MOE prior to initiation of the Assessment;
- Undertake the work plan to assess the impact on DO levels in the West Holland River based on the proposed flow increase to 23.3 MLD including computer modelling and reassess effluent CBOD limits based on the results of the DO modelling;
- Undertake additional air quality impact assessment dispersion modelling based on the proposed plant expansion to 23.3 MLD complete with an assessment of compliance with O. Reg. 419/05;
- Make application to the MOE for an ECA to increase the capacity of the WPCP to 23.3 MLD based on the final design;
- Complete the construction of the works that are identified in this ESR when deemed necessary for future growth; and
- Implement any mitigation measures associated with both the construction and the operation of the expanded plant.

In conclusion, this ESR provides sufficient documentation of the Class EA planning process that was followed by the Town of the Bradford West Gwillimbury to support an interim capacity increase from 17.4 MLD to 19.4 MLD without any capital works. The ESR also provides documentation of the planning process to support a future capacity increase from 19.4 MLD to 23.3 MLD based on future assessments (DO in the West Holland River and additional Air Quality) and on the completion of a future final design of the proposed expansion facilities.

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DESIGN BRIEF

Final

Green Valley Sanitary Pumping Station

Project Location:
Bradford West Gwillimbury, Ontario

Prepared for:
Mr. David Latarius, C.Tech., rcsi – Project Manager
Town of Bradford West Gwillimbury
100 Holland Court
Bradford, ON L3Z 1R8

December 18, 2013

MTE File: 37153-100

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APPENDICES

1.0 INTRODUCTION

MTE Consultants Inc. has been retained by the Town of Bradford West Gwillimbury to develop the detailed design and construction documents for the Green Valley Sanitary Pumping Station (SPS) in the vicinity of Line 6 and Parkwood Avenue, in the Town of Bradford West Gwillimbury. This design brief identifies the components of the SPS and includes the design criteria and approach taken to complete the detailed design.

The proposed pumping station site is to be severed off a larger existing property with the address 2531 Line 6 which is bounded by Line 6 to the north, Zima Parkway to the east, and future development and environmental protection areas to the south and west.

The Green Valley SPS is designed to service a combination of new development and existing residential, commercial and institutional / long term care facility lands in the Town of Bradford West Gwillimbury. These lands are located on both the north and south sides of Line 6 in the vicinity of Simcoe Road and Walker Avenue / Zima Parkway and cover a total area of 149 ha.

A single forcemain will extend from the pumping station in the north-east direction to an outlet manhole located in the vicinity of the intersection of Barrie Street and John Street. From there wastewater will enter a gravity sewer system which ultimately outlets to the existing Bradford Wastewater Treatment Plant located southeast of the intersection of Dissette Street and Jay Street.

The Town of Bradford West Gwillimbury has reviewed and approved both the pumping station design and the forcemain design. This report has been prepared in support of the Environmental Compliance Approval (ECA) application for the Green Valley Sewage Pumping Station. Environmental Compliance Approval application for the forcemain will be submitted along with an application for gravity sewer works along Line 6 and Walker Ave (separate from pumping station ECA application).

This report is to be read in conjunction with the pumping station design drawings listed in Appendix A.

2.0 DESIGN PARAMETERS

2.1 Design Guidelines

The following is a summary of the design parameters for the Green Valley SPS:

- **Design Flow Rates** as per The Engineering Design Criteria Manual for the Town of Bradford West Gwillimbury and the *MOE Design Guidelines for Sewage Works (2008)* an average daily per capita flow of 250 L/cap/day with an infiltration allowance of 0.5L L/s/ha in areas where sewers were constructed prior to the year 2000 and 0.2 L/s/ha for areas serviced later than 2000 were used.

The design populations of 3.14 ppl/unit (single/semi density - residential), 60 ppl/ha (institutional) and 94 ppl/ha (long term care facility) were used. The Harmon Peaking Factor was applied to residential flows to calculate the peak design flow rate for the entire catchment area;

- **Pumping Station and Forcemain Design Standards** as per the *MOE Design Guidelines for Sewage Works (2008),* and;

- **Standby Generator Set** as per the Ministry of Environment Standard Specification for Diesel Engine Generator Sets (MOE Spec No. 2, June 1981). The standby generator specified for the Green Valley SPS will be registered through the Environmental Activity and Sector Registry (EASR).

2.2 Design Flow Rate

The design flow rates for the Green Valley SPS were finalized through the "Revised Notice of Completion Master Study for Planned Service Area Revision Schedule "B" Class Environmental Assessment Green Valley Sanitary Pumping Station", (MTE Consultants Inc., April 9, 2013) and are based on the development area in accordance with the Town of Bradford West Gwillimbury Engineering Design Criteria Manual.

The Green Valley SPS is designed for a total catchment area of approximately 149 ha. The majority of these lands are bound by Line 6 to the north, Zima Parkway to the east, Canal Road to the south and the Bradford Highlands Golf Club to the west. There are three small catchment areas to the north of Line 6 that that account for the future decommissioning of three small sanitary pumping stations; Townsend SPS, Walker SPS & the Simcoe Rd / Line 6 SPS.

The service area will consist of a combination of residential (primarily single family units) and institutional lands which includes a long term care facility with 150 beds.

In accounting for extraneous flows, institutional flows and peaked residential flows (Harmon Peaking Factor applied), the design flow rates for the Green Valley SPS are summarized as follows:

Peak Flow	***93.0 L/s***
Average Flow	***58.6 L/s***

For further details outlining design flow calculations and service area refer to Appendix B which includes the "Revised Notice of Completion Master Study for Planned Service Area Revision Schedule "B" Class Environmental Assessment Green Valley Sanitary Pumping Station", dated April 9, 2013 and the "Design Flow, Green Valley Sewage Pumping Station" technical memorandum, dated November 15, 2012.

2.3 Wet Well Sizing

In accordance with the *MOE Design Guidelines for Sewage Works (2008)*, the wet well has been sized based on a minimum 10 minute cycle time. The required wet well volume was determined based on a two pump system plus one redundant pump of equal size. Wet well sizing is discussed further in Section 3.3.

2.4 Firm Capacity and Forcemain Velocities

In accordance with the *MOE Design Guidelines for Sewage Works (2008)*, the firm pumping capacity has been established based on the largest pump being out of operation. A total of three pumps, two duty and one standby, will be provided in the Green Valley SPS. The station's design flow is 93.0 L/s. The proposed 300 mm diameter forcemain will maintain velocities within the MOE recommended range of 0.6 m/s to 3.0 m/s. It should be noted that a minimum velocity of 1.1 m/s is generally preferred to ensure solids remain in suspension, and once the velocity exceeds 2.6 m/s, measures should be taken to provide additional forcemain capacity within the system. Pump and forcemain sizing is discussed further in Section 3.2.

3.0 PUMPING STATION DESIGN SUMMARY

3.1 Description

The Green Valley SPS is to be located on a future severed site off 2531 Line 6, in Bradford, ON. The Site is approximately 220 m west of the intersection of Sixth Line and Zima Parkway. The Town of Bradford's Zoning By-law currently identifies the Site as a combination of Future Development (FD) and Environmental Protection (EP). The Site will be serviced with water and three phase electrical power.

The pumping station will be a wet well/dry well type with all major components located in one building footprint. The basement of the SPS building will consist of a two chamber cast-in-place concrete wet well which abuts up to the drywell containing three pumps, process piping, valves and metering equipment. At grade, the station will consist of a screenings room to house a vertical mechanical bar screen which extends down to the gravity inlet in the wet well. Adjacent to the screenings rooms, the station will have an office, washroom, storage room and control room directly above the dry well. The control room will also house pump lifting hatches and electric hoist. A separate standby generator room will be located adjacent to the control room.

The vertical, permanent dry well style pumps will be complete with variable frequency drives (vfds). The SPS will consist of an outdoor deep bed scrubber style odor control unit, a station by-pass / swab launch line, and a PLC based control system connected to the Town-wide SCADA system.

A full description of the ultimate station is contained in Appendix C, and equipment details are included in Section 3.9.

3.2 Pumps and Forcemain Capacity

Xylem vertical permanent dry well style pumps have been sized for the ultimate design flow rate of 93.0 L/s. Three (3) identical pumps will be used (two duty and one standby).

With the proposed process piping and forcemain configuration, one (1) pump running will provide 80.0 L/s. **Two (2) pumps running will provide the pumping station's firm capacity of 102 L/s,** slightly exceeding the required design flowrate of 93.0 L/s. During normal operation, the sewage level will oscillate between level set points described in more detail in Section 3.4. Each pump will be installed with variable frequency drives (VFDs). The pumps will have rotational duty such that there is equal use of each pump.

The three (3) pumps are arranged to discharge into a common 300 mm diameter header which passes through a magnetic flow meter located in the dry well. The common header decreases in size to 200 mm diameter to maintain the required minimum velocity through the magnetic flow meter.

A single 300 mm diameter discharge forcemain will be installed from the pumping station to the gravity discharge outlet manhole located in the vicinity of the intersection of Barrie Street and John Street. The forcemain will run within the Line 6, Walker Avenue, Simcoe Road, and Barrie Street right-of-ways having a total length of approximately 1773 m. Refer to the forcemain drawings in **Appendix D**.

The theoretical operational point of one pump ON, based on the proposed outlet forcemain is a flowrate of 80 L/s at a Total Dynamic Head (TDH) of 38.9 m of H_20. This yields a velocity of 1.1 m/s in the 300 mm diameter forcemain. The theoretical operational point of two pumps ON (station's firm capacity), is a flowrate of 102.2 L/s at a TDH of 47.5m, yielding a velocity of 1.5 m/s in the forcemain. Both pumping scenarios result in forcemain velocities within the MOE recommended range of 0.6 m/s to 3.0 m/s.

Appendix E contains the head loss calculations for the pump selection.

3.3 Wet Well Sizing

The proposed wet well will consist of twin 5.25m x 4.0m chambers. *MOE Design Guidelines for Sewage Works (2008)* recommend that the sewage wet wells be sized to allow a minimum 10 minute cycle times, which is equivalent to six pump starts per hour. It is also recommended that the time required to fill the wet well volume not exceed 30 minutes based on the average design flow rate of 58.6 L/s.

In order to accommodate a pumping station operating flow rate of 102 L/s, the required working wet well volume was calculated using the following equation:

$$\boldsymbol{Wet\ well\ volume\ (m^3) =\ Q_{pumping\ capacity\ \left(\frac{m3}{min}\right)} \times \frac{T_{cycle\ time\ (min)}}{4}}$$

A cycle time of 10 minutes was utilized, with two duty pumps running able to accommodate a capacity of 6.13 m^3/min (102.2 L/s). This corresponds to a minimum required wet well volume of 15.3 m^3.

To further determine the critical pump operating depth, a polynomial was derived based on the geometry of the entire wet well (both chambers) to account for the change in wet well area with increasing depth due to benching. The solved polynomial yielded a critical pump operating depth of 0.5m, i.e. when two (2) pumps are running (Q=102 L/s) the float separation between pumps ON and pumps OFF must be at least *0.5m* to avoid excessive wear on pump motors. Refer to **Appendix F** for detailed wet well sizing calculations.

To provide a small factor of safety (ensuring pumps operate with a minimum cycle time of greater than 10 minutes) and to allow for additional storage volume within the wet well, the Green Valley SPS design allows for an operating depth of *0.7m* between two (2) pumps ON and pumps OFF controls.

This pumping station will have the ability to operate with only one pump running during periods of low incoming flows; i.e. a single pump ON control will be set at a lower elevation than the two pumps ON control elevation. As described previously, the theoretical operational point of one pump ON is at flowrate of 80 L/s. Using the calculations described previously (using a cycle time of 10 minutes), this corresponds to a volume of 12 m^3, and a critical operating depth of 0.4m for one pump ON. The design for the Green Valley SPS allows for an operating depth of exactly 0.4m for one pump ON. The working wet well volume of 12.0 m^3 corresponds to a fill time of approximately 3.4 minutes based on an average design flow rate of 58.6 L/s.

The cast-in-place wet well structure is to be approximately 12.3 m deep from finished grade to underside of structure.

3.4 Wet Well Operating Levels

The invert elevation of the 450 mm diameter inlet sewer on the west side of the wet well will be approximately 213.00 m. The proposed wet well operating levels for the Green Valley SPS are shown below:

Wet well base (Interior)	209.40 m
Minimum sewage depth (Pumps Off)	211.00 m
Sewage Accumulation Allowance	0.40 m
Duty Pump ON	211.40 m
Sewage Accumulation Allowance	0.30 m
Standby Pump ON	211.70 m
Sewage Accumulation Allowance	0.30 m

High Level Alarm (HLA) 212.00 m

The full list of alarms will be available for viewing on the local panel in the control building and on the Town of Bradford West Gwillimbury's wastewater treatment plant SCADA system. The SCADA system will be equipped with a communication link to allow for remote operation and facilitate the downloading of operational data. In the event that the ultrasonic level transducer fails, the pump control will be transferred to the backup float system.

3.5 Emergency Storage Capacity

There is no overflow built into this sanitary collection system. The lowest basement in the subdivision is located south of the Green Valley SPS and slightly east of the proposed Green Valley subdivision's SWM facility. The lowest basement finished floor elevation is conservatively estimated at 218.0 mAMSL. The emergency storage volume is calculated as the volume in the wet well and gravity sewer system below elevation 218.0 mAMSL. The total emergency storage capacity within the wet well and gravity sewer system combined was calculated to be 435.4 m^3, which is equivalent to 78 minutes of storage at a peak flow rate of 93.0 L/s and 124 minutes of storage at an average flow rate of 58.6 L/s. Descriptions of the calculated storage volumes are described below.

3.5.1 Wet Well Storage Volume

The proposed wet well will provide an emergency sewage storage volume of 201.6 m^3. This volume was calculated based on an elevation difference within the wet well of 218.0 m AMSL (lowest basement finished floor elevation) down to 212.0 m AMSL (high level alarm). A factor of 0.8 was applied to the total open space volume to account for the volume reduction due to the safety grating and mechanical bar screen.

3.5.2 Gravity Sewer System Storage Volume

The proposed upstream gravity sewers that will discharge to the Green Valley SPS will provide sewage storage capacity in the event of an emergency. The wet well will accommodate one inlet sewer: a 450 mm diameter sewer from the west side of the wet well that services the Green Valley SPS catchment area.

This 450 mm diameter inlet sewer will discharge into the wet well at an invert elevation of 213.0 m. The proposed gravity sewer system will be made up of a series of 200mm and 450 mm diameter sewers all with 1,200 mm diameter manholes. The total emergency sewage storage volume available within the collection system is equal to 233.79 m^3, which is the total volume of sewers and manholes up to an elevation of 218.0 m AMSL.

The wet well and upstream sewer system storage calculations are provided in **Appendix F.**

3.6 Ventilation

A natural gas fired make-up air unit will be installed at grade, exterior to the west side of the screenings room. This make-up air unit will be complete with duct work supplying continuous heated fresh air into the wet well and screenings room at all times. The heated air will prolong the service life of the wet well by reducing corrosion of metals and concrete. The heat is necessary to prevent freezing during the winter while still allowing pressurized ventilation.

A deep bed scrubber type odour control unit will be installed at grade, exterior to the south side of the screenings room. This unit will be complete with a continuous running fan to help pull air through the screenings room and wet well into the media within the odour control unit. The odour control unit will discharge air to the atmosphere and minimize the accumulation of odour causing gases both inside (wet well and screenings room) and outside of the pumping station building.

Note: *Natural gas-fired heating equipment was used where feasible to reduce heating costs during winter months.*

3.7 Emergency Generator

A diesel 200 kW standby generator will provide power in the event of an electricity outage at the site. The generator is sized to have two pumps (duty 1 and duty 2) running as well as power to station auxiliary equipment (lights, receptacles, ventilation and controls). The generator will automatically start upon a sustained outage in the permanent power supply. The automatic transfer switch will operate to connect the generator to the station equipment while disconnecting the permanent power supply. Two 935 L (each) double-walled diesel storage tanks complete with low fuel sensor have sufficient capacity to allow the station to operate for 24 hours on standby power.

3.8 Pump Design Summary

Based on the requirements identified in the *MOE Design Guidelines for Sewage Works (2008),* the design of a SPS must consider the following three conditions:

1. C = 120 at the lowest observed level in the wet well
2. C = 130 at median level observed in the wet well
3. C = 140 at the highest level observed in the wet well

A system head curve was developed for the above three conditions by calculating the theoretical operating TDH for the entire system with the selected pumps (To achieve a design flow rate of at least 93 L/s).

The approach used to calculate TDH is outlined below:

TDH (m) = Suction Head Lift (m) + Static Head (m) + Dynamic Head (m)

Suction Head Lift (m)	=	Height the water will rise before arriving at the pump volute. For the Green Valley SPS, (this is equal to 0 since the pumps will have a submerged volute at all times) plus dynamic loss through the pump suction piping.
Static Head (m)	=	Maximum height of water column observed in the system
Dynamic Head (m)	=	Dynamic friction losses through pipes (m) + Minor Losses through valves and fittings (m)

The following is a summary of the pumping station design based on the three conditions:

Table 1 – Design Calculation Summary

Parameter	C=120	C=130	C=140
Pumping Station Operating Flowrate – 2 Pumps ON (L/s)	97.5	102.2	106.5
Forcemain Diameter (mm)	300	300	300
Forcemain Lengths (m)	1755	1755	1755
300 mm Forcemain Velocity (2 Pumps ON)	1.55	1.62	1.69
300 mm Forcemain Velocity (1 Pump ON)	1.22	1.27	1.32
Low Wet Well Water Level (m)	211.00	-	-
Median Wet Well Water Level (m)	-	211.50	-
High Wet Well Water Level (m)	-	-	212.00
High Point Elevation (m)	235.5	235.5	235.5
Forcemain End Point Elevation (m)	235.5	235.5	235.5
Maximum Static Head (m)	24.5	-	-
Minimum Static Head (m)	-	-	24.1
Maximum Total Dynamic Head (m)	48.2	-	-
Minimum Total Dynamic Head (m)	-	-	47.0

The Green Valley SPS required design flow rate of 93 L/s can be accommodated (and slightly exceeded) with the selected pumps. In the two pumping scenarios (1 pump ON & 2 pumps ON) forcemain velocities are maintained within the MOE recommended range of 0.6 m/s to 3.0 m/s. Refer to Appendix E for headloss calculations in the SPS and 300 mm diameter forcemain.

3.9 Wet Well Recirculation Line

A recirculation line with outlets in both chambers of the wet well has been provided to agitate the wet well during the pump cycle. The agitation will serve to reduce sludge buildup on the bottom of the surface of the wet well. At the start of each pump RUN cycle, an actuated valve will open and to allow some of the pump discharge to recirculate back to the wet well. The flow rate through the 75 mm diameter recirculation line can be adjusted if necessary by throttling the shutoff valves prior to the wet well. The duration of the recirculation can be adjusted by an operator input into the PLC such that the actuated valve will close prior to the pump shutting OFF.

3.10 Green Valley SPS Equipment

The Green Valley SPS is equipped with the following equipment:

Pumps	Three x ITT XYLEM model NT 3301 HT 3~ 466 vertical permanent dry well pumps, 85 H.P., 600 V / 3 phase / 60 Hz, 1775 RPM - Two pump system complete with redundant standby pump (see Appendix F);
Shutoff Valves	Valmatic Cam-centric 100% port plug valves. Four x 250 mm diameter, three x 150 mm diameter, three x 300 mm diameter and three x 75 mm diameter valves throughout process piping as indicated on drawings. Valves will have a variety of operators (hand wheel, chain wheel, 50 mm diameter operating nut and valve box, electric valve actuator) dependent on its purpose;
Check Valves	Three x 150 diameter Valmatic swing flex check valves in dry well;
Suction Piping	250 mm diameter Schedule 10 304L SS piping with welded, flanged, or Victaulic (grooved) joints within the wet well;
Discharge Piping	150 mm, 200 mm & 300 mm diameter Schedule 10 304L SS piping with welded, flanged, or Victaulic (grooved) joints within the wet well;
Wet Well	Twin 5.25m x 4.0m cast-in place reinforced concrete chambers to provide 32.7 m^3 of active capacity;
By-pass connection	Allows for maintenance and solids flushing through the discharge forcemain as well as a connection for discharge from a temporary pump;
Level Detection	Ultrasonic level transmitter (Milltronics 100) in each wet well chamber with complete set of redundant float switches (Pumps OFF, duty pump ON, standby pump ON, and high level alarm float switches);
Flow Measurement	200 mm diameter Krohne electromagnetic flow meter in dry well chamber;

Wet Well Access	Manufactured hatches cast into screening room floor c/w aluminum ladders and intermediate platform landings;
Water Services	50 mm diameter water service to into the pumping station building with reduced pressure zone backflow preventer to service site. Fixtures will include hot water heater, boot wash, hand sink, shower and water closet within building interior with multiple hose bibs throughout building interior and exterior;
Forcemain	1773 m of 300 mm diameter HDPE DR17 IPS Driscoplex Series 4100;
Bar Screen	Intermittently operating vertical mechanical bar screen with a receiving trough and auger to dry and transfer the screenings to a storage bin for off-site disposal at the Municipal landfill. Bar screen operates on a timer with a level switch override to ensure free-flowing conditions are maintained.
Wet Well and Screen Room Venting	Continuous operating natural gas-fired make-up air to heat incoming air and provide continuous air exchanges throughout wet well and screening room;
Standby Generator	200 kW diesel set with automatic transfer switch, block heater, two - 935 L (247 USgal) double wall fuel tanks, wall-exit exhaust and hospital grade silencer, motorized air intake louvre;
Pumping Station Building	Masonry block and clay brick construction with wood truss, shingled roof and board gypsum for interior ceiling finish. Building will consist of screening room, mechanical room, washroom, office, electrical room and generator room at grade with a reinforced concrete wet well and dry well as a basement. There will be three double doors and one single door access to building at grade;
HVAC	Four electric unit heaters, three baseboard heaters, an exterior odour control unit, three gas-fired unit heaters, a gas fired make-up air unit and furnace, motorized ventilation louvres, an inline duct fan and three exhaust fans on a temperature/adjustable timer control system;
Electrical	Three phase power to pumps, mechanical bar screen, HVAC equipment, welding receptacle and valve actuator, 120V light and receptacles, five exterior lights on building;

Control System	Programmable logic controller, alarm reporting, flow trending, pump run time recording, uninterruptable power supply and connection to Town of Bradford West Gwillimbury SCADA system;
Alarms	Audible and visual alarm indication, alarm on high wet well level, low wet well level, standby generator set fail, low gen set fuel level and pump fail;
Recirculation System	75mm diameter piping with shut-off valves and an actuated valve automatically operates to recycle a portion of the pump discharge back to agitate the wet well for an operator adjustable length of time;
Sump Pump	1.0HP, solids handling sump pump is provided in dry well with discharge piping into the wet well along with grated floor trench and sump.

4.0 SUMMARY

The Green Valley SPS has been designed to service a combination of new development and existing, residential, commercial and institutional / long term care facility lands in the Town of Bradford West Gwillimbury. These lands are located on both the north and south sides of Line 6 in the vicinity of Simcoe Road and Walker Avenue / Zima Parkway and cover a total area of 149 ha for a peak design flow rate of 93.0 L/s. The system has been designed in accordance with the Town of Bradford West Gwillimbury Engineering Design Criteria Manual and the *MOE Design Guidelines for Sewage Works (2008).* The Green Valley SPS had a firm capacity of 102 L/s. This report has been prepared in support of an ECA Application for the Green Valley SPS.

All of which is respectfully submitted,

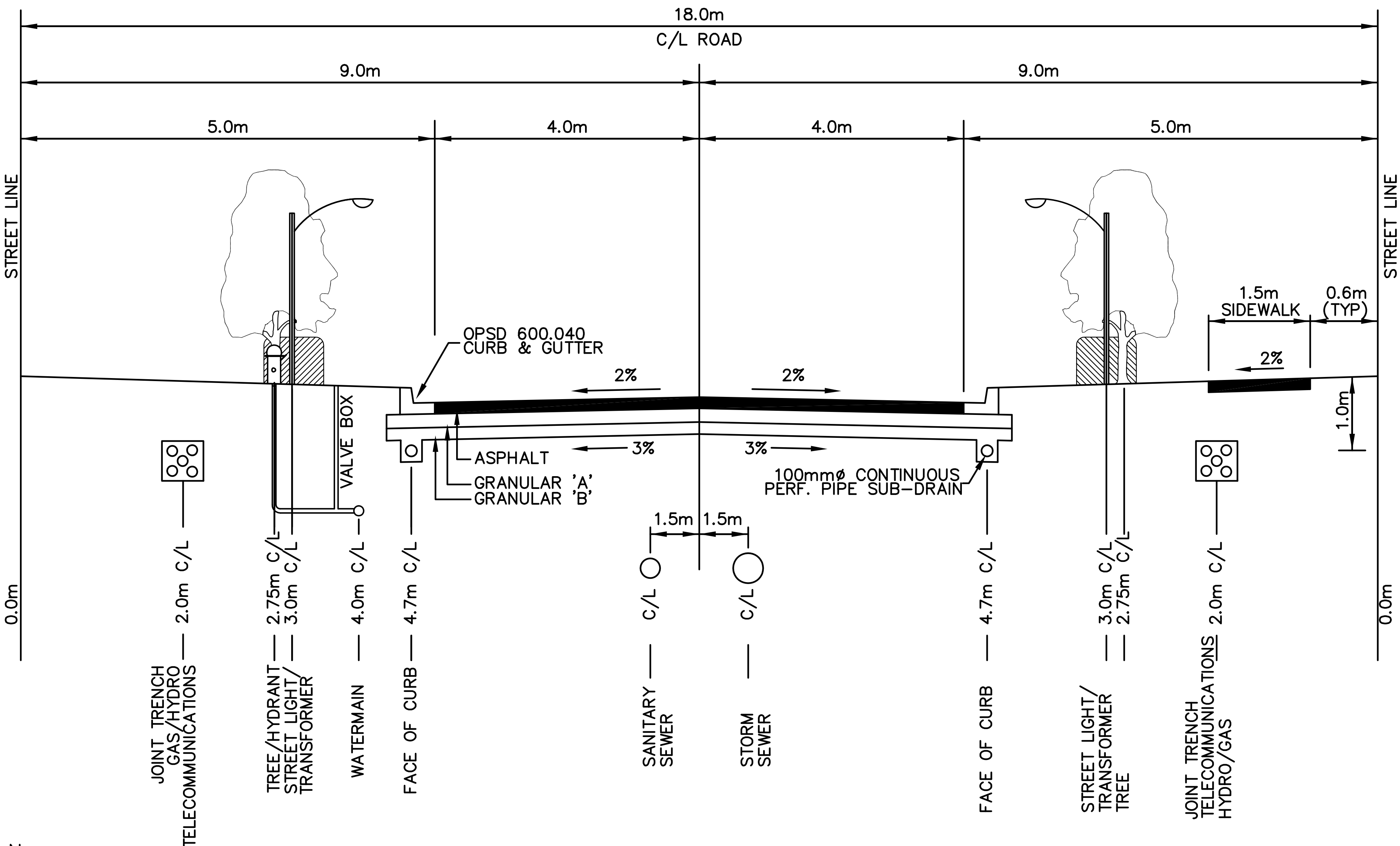
MTE CONSULTANTS INC.

LICENSED PROFESSIONAL ENGINEER
Dec 20/13
D. J. WILHELM
PROVINCE OF ONTARIO

Nolan Danard, EIT.
Designer

Dave Wilhelm, P.Eng.
Design Engineer

Appendix C Right-of-Way Cross Sections



NOTES:

1. PAVEMENT DESIGN SHALL CONFORM TO BWG DESIGN STANDARDS AND/OR APPROVED GEOTECHNICAL REPORT.
2. ACTIVELY GROWING No.1 NURSERY SOD TO BE LAID ON 100mm OF TOPSOIL PROPERLY GRADED AND ROLLED.
3. TREES TO BE HAND DUG.
4. DEPTH OF COVER ON ALL MUNICIPAL INFRASTRUCTURE SHALL CONFORM TO MINIMUM BWG DESIGN STANDARDS.
5. BOULEVARDS SHALL SLOPE AT 2% MINIMUM TO 5% MAXIMUM.

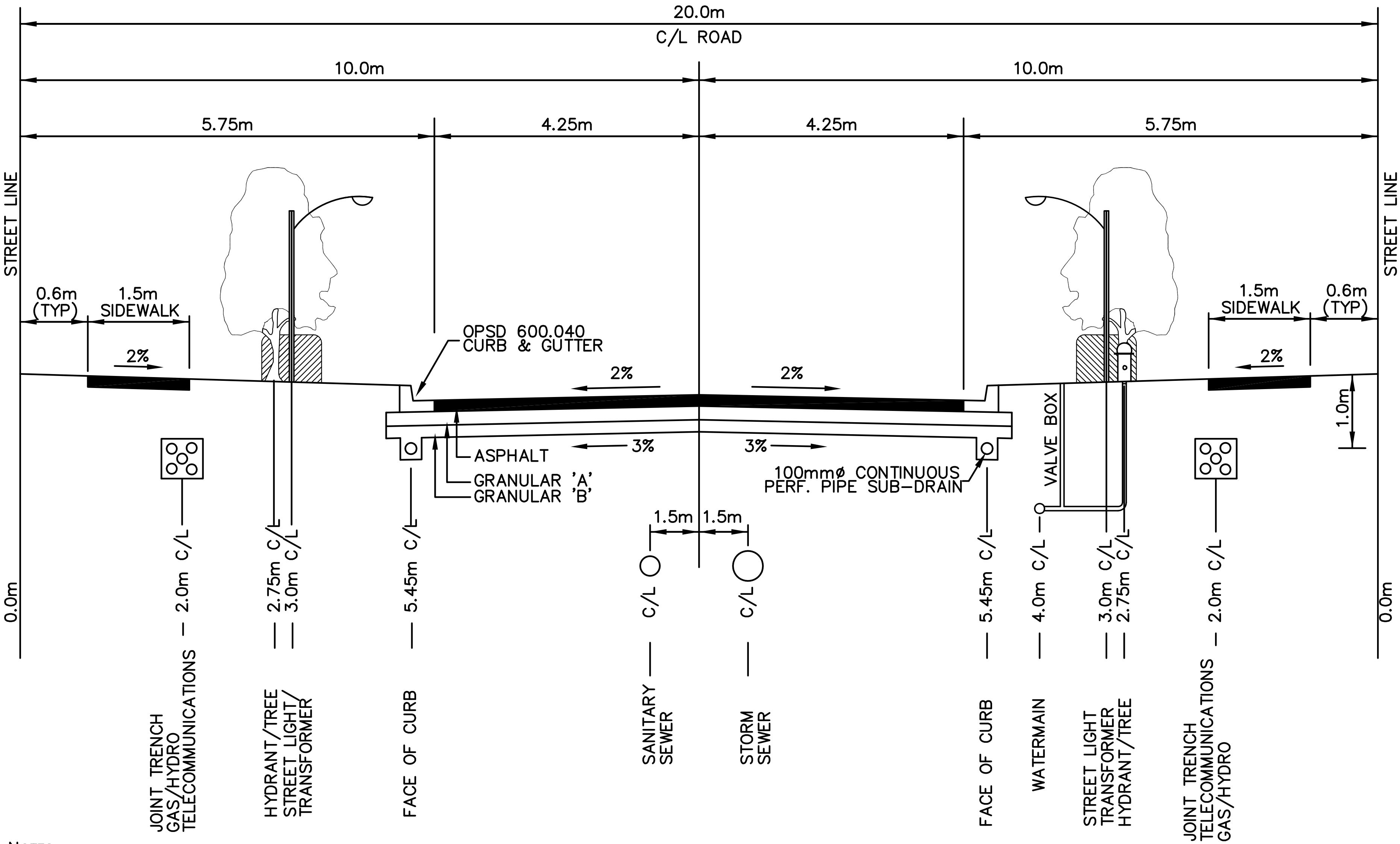
TOWN OF BRADFORD WEST GWILLIMBURY

18m URBAN ROAD ALLOWANCE

SCALE: N.T.S.

LAST REVISED: NOV 2014

STD.DWG. B102



NOTES:

1. PAVEMENT DESIGN SHALL CONFORM TO BWG DESIGN STANDARDS AND/OR APPROVED GEOTECHNICAL REPORT.
2. ACTIVELY GROWING No.1 NURSERY SOD TO BE LAID ON 100mm OF TOPSOIL PROPERLY GRADED AND ROLLED.
3. TREES TO BE HAND DUG.
4. DEPTH OF COVER ON ALL MUNICIPAL INFRASTRUCTURE SHALL CONFORM TO MINIMUM BWG DESIGN STANDARDS.
5. BOULEVARDS SHALL SLOPE AT 2% MINIMUM TO 5% MAXIMUM.

ALL DIMENSIONS IN mm UNLESS OTHERWISE SPECIFIED.

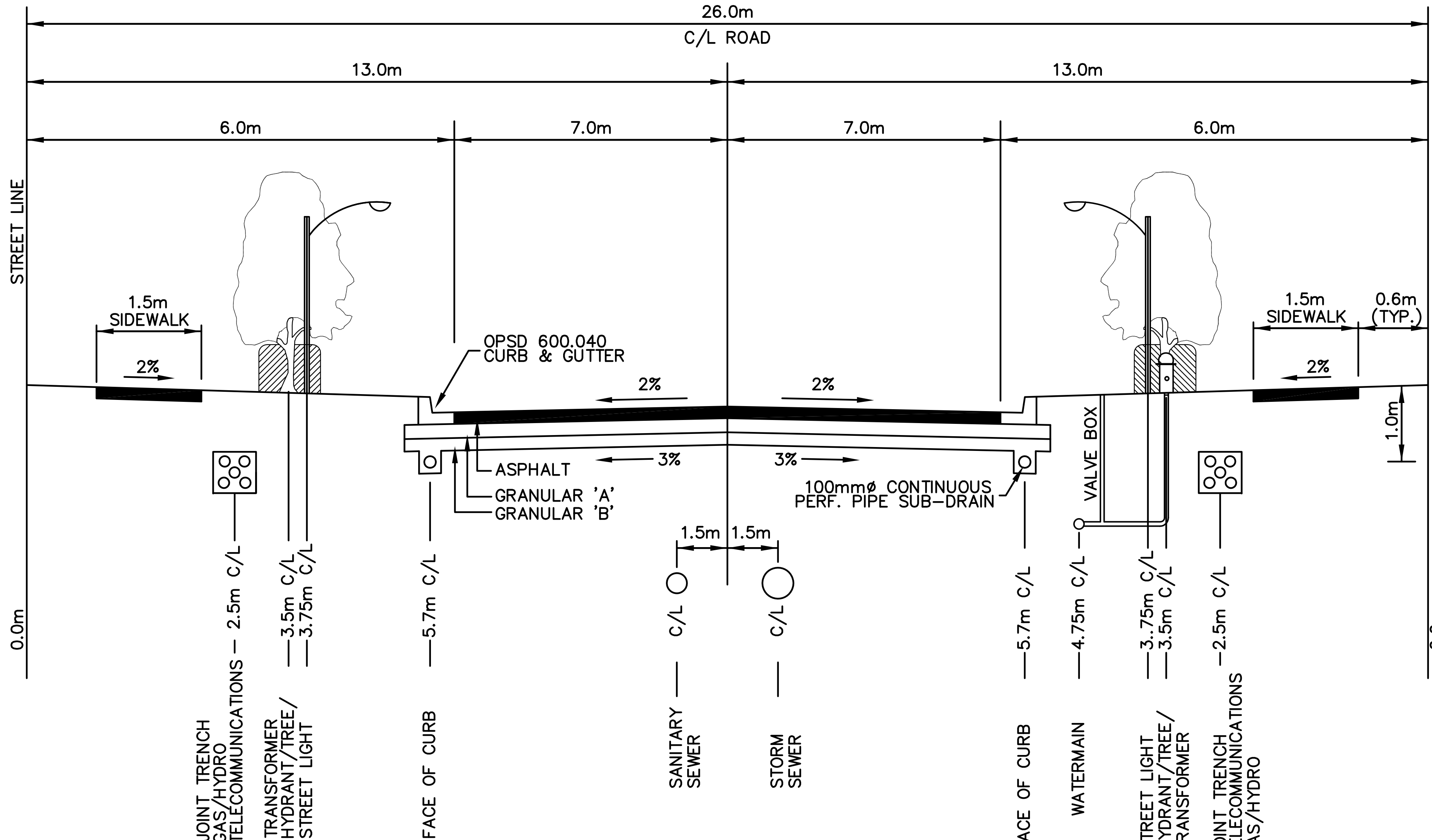
TOWN OF BRADFORD WEST GWILLIMBURY

20m URBAN ROAD ALLOWANCE

SCALE: N.T.S.

LAST REVISED: NOV 2014

STD.DWG. B103



NOTES:

1. PAVEMENT DESIGN SHALL CONFORM TO BWG DESIGN STANDARDS AND/OR APPROVED GEOTECHNICAL REPORT.
2. ACTIVELY GROWING No.1 NURSERY SOD TO BE LAID ON 100mm OF TOPSOIL PROPERLY GRADED AND ROLLED.
3. TREES TO BE HAND DUG.
4. DEPTH OF COVER ON ALL MUNICIPAL INFRASTRUCTURE SHALL CONFORM TO BWG DESIGN STANDARDS.
5. BOULEVARDS SHALL SLOPE AT 2% MINIMUM TO 5% MAXIMUM.

TOWN OF BRADFORD WEST GWILLIMBURY	
26m MAJOR ROAD ALLOWANCE	SCALE: N.T.S.
	LAST REVISED: NOV 2014
	STD.DWG. B106

Appendix D Hydrologic Modelling

The following secure link is being provided by **SCS Consulting Group Ltd.** to share Bradford Highlands hydrologic modelling files:

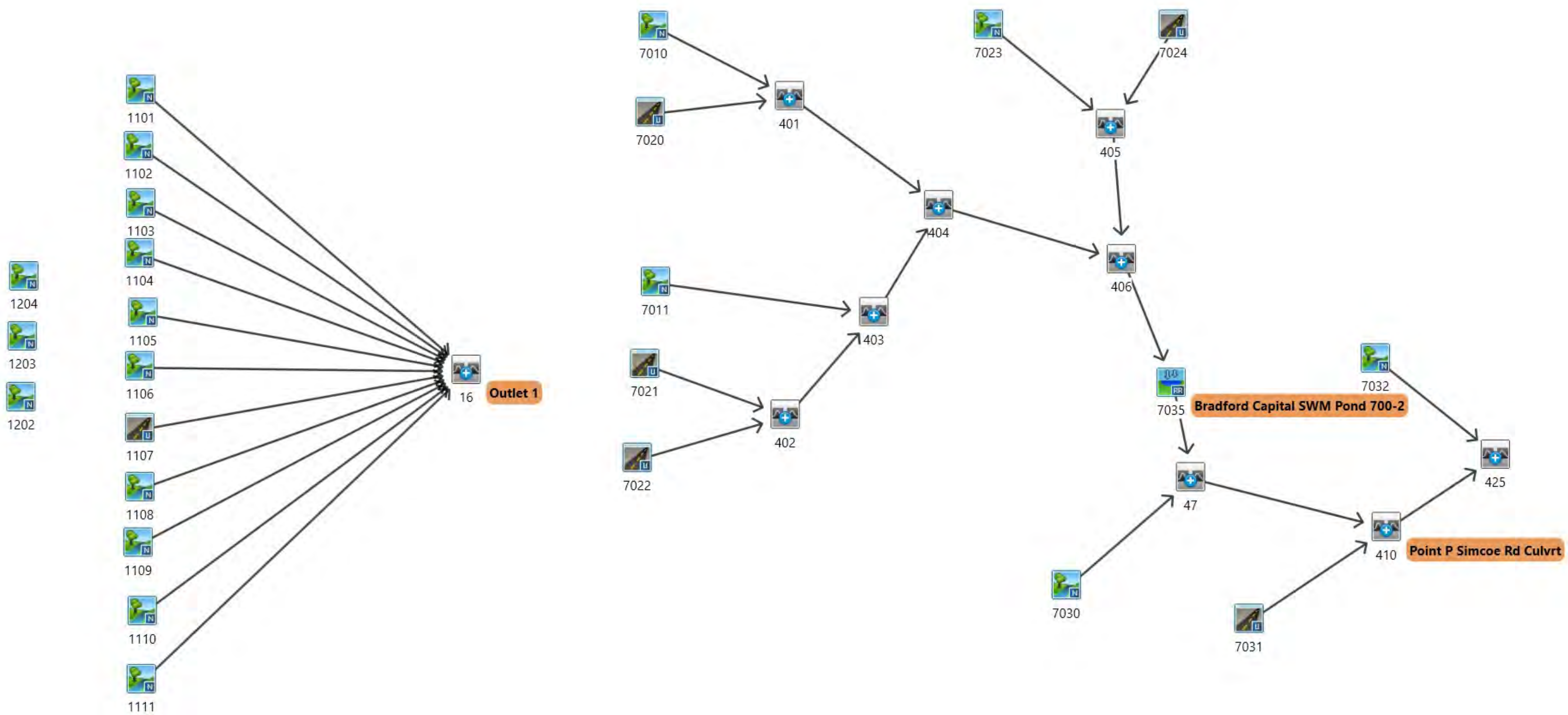
https://filesafecloud.scsconsultinggroup.com/url/ehummzfu5irxtsdw

Appendix D-1 Existing Hydrologic Modelling

SCS consulting group ltd

Existing Condition VO6 Schematic

Bradford Highlands
Project Number: 1791
Date: November 2024



Existing Conditions
VO2 Parameter Summary

NASHYD

Number	1101	1102	1103	1104	1105	1106	1108	1109	1110	1111	1202	1203	1204
Description	Site	To HDF-D	To HDF-E	To Site	To Site	To Site	To Site (South Portion After Split)	To site	To HDF- D	To Site (North Portion After Split)	North East	To HDF-C	To Site
DT(min)	1	1	1	1	1	1	1	1	1	1	1	1	1
Area (ha)	26.77	12.56	39.00	2.76	2.86	2.09	1.15	0.41	3.39	1.39	2.73	15.03	1.39
CN*	57.0	78.0	72.0	77.0	77.0	77.0	67.0	62.0	69.0	75.0	77.0	72.0	75.0
IA(mm)	6.0	8.1	8.3	8.0	8.0	8.0	4.8	4.6	5.0	4.6	4.5	6.3	4.6
TP Method	Uplands	Uplands	Uplands	Uplands	Uplands	Uplands	Uplands	Uplands	Uplands	Uplands	Uplands	Uplands	Uplands
TP (hr)	0.49	0.23	0.41	0.13	0.27	0.24	0.06	0.06	0.07	0.09	0.05	0.30	0.03

STANDHYD

Number	1107
Description	To HDF-D
DT(min)	1
Area (ha)	9.31
TIMP[1,1]	0.30
XIMP[1,2]	0.01
CN*	69.0
IA(mm)	5.0
SLPP(%)	2
LGP(m)	40
MNP	0.25
DPSI (mm)	2.0
SLPI(%)	2
LGI(m)	249.13
MNI	0.013

[1]Note that where there is NO directly connected area (ie: roof runoff to grassed areas), the hydrology program does not accept XIMP=0%, therefore, XIMP = 1% has been used

[2]Note that where there is NO pervious area, the hydrology program does not accept TIMP and XIMP=100%, therefore, TIMP and XIMP = 99% has been used

Total Area = 120.8 ha

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

Existing Conditions
CN Calculations

Site Soils: (per Bradford West Gwillimbury County Soils Mapping)

Soil Type	**Hydrologic Soil Group**
Bondhead Loam	B
Schomberg Silty Clay Loam	C

TABLE OF CURVE NUMBERS (CN's)**

Land Use		Hydrologic Soil Type							Manning's	Source
		A	AB	B	BC	C	CD	D	'n'	
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40	MTO
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40	MTO
Gravel		76	80.5	85	87	89	90	91	0.30	USDA
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25	USDA
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17	MTO
Crop		66	70	74	78	82	84	86	0.13	MTO
Fallow (Bare)		77	82	86	89	91	93	94	0.05	MTO
Low Density Residences		57	64.5	72	76.5	81	83.5	86	0.25	USDA
Streets, paved		98	98	98	98	98	98	98	0.01	USDA

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. USDA (1986), Urban Hydrology for Small Watersheds, Table 2.2-Runoff Curve Numbers for Urban Areas

HYDROLOGIC SOIL TYPE (%) - Existing Conditions

	Hydrologic Soil Type							
Catchment	**A**	**AB**	**B**	**BC**	**C**	**CD**	**D**	**TOTAL**
1101	0.0	0.0	87.5	0.0	12.5	0.0	0.0	100
1102	0.0	0.0	62.0	0.0	38.0	0.0	0.0	100
1103	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100
1104	0.0	0.0	98.5	0.0	1.5	0.0	0.0	100
1105	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100
1106	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100
1108	0.0	0.0	85.7	0.0	14.3	0.0	0.0	100
1109	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100
1110	0.0	0.0	13.9	0.0	86.1	0.0	0.0	100
1111	0.0	0.0	2.6	0.0	97.4	0.0	0.0	100
1202	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100
1203	0.0	0.0	76.6	0.0	23.4	0.0	0.0	100
1204	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100
1107	0.0	0.0	19.0	0.0	81.0	0.0	0.0	100

HYDROLOGIC SOIL TYPE (%) - Existing Conditions

	Hydrologic Soil Type							
Catchment	**A**	**AB**	**B**	**BC**	**C**	**CD**	**D**	**TOTAL**
1101			87.5		12.5			100
1102			62.0		38.0			100
1103			100.0					100
1104			98.5		1.5			100
1105			100.0					100
1106			100.0					100
1108			85.7		14.3			100
1109			100.0					100
1110			13.9		86.1			100
1111			2.6		97.4			100
1202					100.0			100
1203			76.6		23.4			100
1204					100.0			100
1107			19.0		81.0			100

SCS consulting group ltd

Existing Conditions
CN Calculations

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

LAND USE (%) - Existing Conditions										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
1101	0.0	20.8	0.0	79.2	0.0	0.0	0.0	0.0	0.0	100.0
1102	0.0	3.6	0.0	0.0	0.0	96.4	0.0	0.0	0.0	100.0
1103	0.0	14.5	0.0	0.0	0.0	85.5	0.0	0.0	0.0	100.0
1104	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
1105	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
1106	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
1108	0.0	0.0	0.0	79.5	0.0	0.0	0.0	0.0	20.5	100.0
1109	0.0	0.0	0.0	85.6	0.0	0.0	0.0	0.0	14.4	100.0
1110	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
1111	0.0	0.0	0.0	87.8	0.0	0.0	0.0	0.0	12.2	100.0
1202	0.0	0.0	0.0	84.1	0.0	0.0	0.0	0.0	15.9	100.0
1203	0.0	0.0	0.0	41.3	0.0	50.8	0.0	0.0	7.9	100.0
1204	0.0	0.0	0.0	86.8	0.0	0.0	0.0	0.0	13.2	100.0
1107	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0

Note: Where STANDHYD command used (shaded), impervious fraction is not considered in CN determination, since %Imp directly input in STANDHYD command

LAND USE (%) - Existing Conditions										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow	Low Density Residences	Impervious	Total
1101		20.8		79.2						100.0
1102		3.6				96.4				100.0
1103		14.5				85.5				100.0
1104						100.0				100.0
1105						100.0				100.0
1106						100.0				100.0
1108				79.5				20.5	20.5	120.5
1109				85.6					14.4	100.0
1110				100.0						100.0
1111				87.8					12.2	100.0
1202				84.1					15.9	100.0
1203				41.3		50.8			7.9	100.0
1204				86.8					13.2	100.0
1107				100.0						100.0

Note: Where STANDHYD command used (shaded), impervious fraction is not considered in CN determination, since %Imp directly input in STANDHYD command

CURVE NUMBER (CN) - Existing Conditions										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow	Low Density Residences	Impervious	Total
1101	0.0	12.8	0.0	49.6	0.0	0.0	0.0	0.0	0.0	62
1102	0.0	2.3	0.0	0.0	0.0	74.3	0.0	0.0	0.0	77
1103	0.0	8.7	0.0	0.0	0.0	63.3	0.0	0.0	0.0	72
1104	0.0	0.0	0.0	0.0	0.0	74.1	0.0	0.0	0.0	74
1105	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
1106	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
1108	0.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	20.1	70
1109	0.0	0.0	0.0	52.2	0.0	0.0	0.0	0.0	14.1	66
1110	0.0	0.0	0.0	72.2	0.0	0.0	0.0	0.0	0.0	72
1111	0.0	0.0	0.0	64.7	0.0	0.0	0.0	0.0	11.9	77
1202	0.0	0.0	0.0	62.2	0.0	0.0	0.0	0.0	15.6	78
1203	0.0	0.0	0.0	26.4	0.0	38.6	0.0	0.0	7.7	73
1204	0.0	0.0	0.0	64.2	0.0	0.0	0.0	0.0	13.0	77
1107	0.0	0.0	0.0	71.5	0.0	0.0	0.0	0.0	0.0	72

** AMC II assumed

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

Existing Conditions
CN Calculations

Step	Input Values															
	Subcatchment:	1101		1102	1103	1104	1105	1106	1108	1109	1110	1111	1202	1203	1204	1107
1	**CN (AMC II):**	**62**		**77**	**72**	**74**	**74**	**74**	**70**	**66**	**72**	**77**	**78**	**73**	**77**	**72**
2	CN (AMC III) =	79		89	86	88	88	88	85	82	86	89	90	87	89	86
3	100 Year Precipitation, P =	122.36	mm	122.36	122.36	122.36	122.36	122.36	122.36	122.36	122.36	122.36	122.36	122.36	122.36	122.36

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S} \qquad S = \frac{(P - Ia)^2}{Q} - (P - Ia)$$

Q = rainfall excess or runoff, mm
S = potential maximum retention or available storage, mm

$$CN = \frac{25400}{S + 254} \qquad S = \frac{25400}{CN} - 254$$

CN* = modified SCS curve # that better reflects Ia conditions in Ontario

Step	Output Values															
	Subcatchment:	1101		1102	1103	1104	1105	1106	1108	1109	1110	1111	1202	1203	1204	1107
	S_{III} =	67.52	mm	31.39	41.35	34.64	34.64	34.64	44.82	55.76	41.35	31.39	28.22	37.95	31.39	41.35
	SCS Assumption of 0.2 S = Ia =	13.50	mm	6.28	8.27	6.93	6.93	6.93	8.96	11.15	8.27	6.28	5.64	7.59	6.28	8.27
4	Q_{III} =	67.18	mm	91.37	83.74	88.79	88.79	88.79	81.27	74.07	83.74	91.37	93.99	86.25	91.37	83.74
	Preferred Initial Abstraction, Ia =	6.0	mm	8.1	8.3	8.0	8.0	8.0	4.8	4.6	5.0	4.6	4.5	6.3	4.6	5.0
5	S^*_{III} =	85.07	mm	28.67	41.31	32.93	32.93	32.93	52.50	69.52	47.12	33.96	29.90	40.14	34.01	47.12
6	CN^*_{III} =	74.91	mm	89.86	86.01	88.52	88.52	88.52	82.87	78.51	84.35	88.21	89.47	86.35	88.19	84.35
	CN^*_{III}=	**75**	Rounded	**90**	**86**	**89**	**89**	**89**	**83**	**79**	**84**	**88**	**89**	**86**	**88**	**84**
7	**CN^*_{II}=**	**57**	convert	**78**	**72**	**77**	**77**	**77**	**67**	**62**	**69**	**75**	**77**	**72**	**75**	**69**

Explanation of Procedure

1 Determine CN based on typical AMC II conditions (attached)
2 Convert CN from AMC II to AMC III conditions (standard SCS tables)
3 Get precipitation depth P for 100 year storm
4 Using CN_{III} with Ia = 0.2S, compute Q_{III} for 100 year precipitation
5 For the same Q_{III}, compute S^*_{III} using Ia=1.5mm (or otherwise determined)
6 Compute CN^*_{III} using S^*_{III}
7 Calculate CN^*_{II} using SCS conversion table

Existing Conditions
IA Calculations

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

LAND USE (%) - Existing Conditions										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
1101		20.8		79.2						100.0
1102		3.6				96.4				100.0
1103		14.5				85.5				100.0
1104						100.0				100.0
1105						100.0				100.0
1106						100.0				100.0
1108				79.5				20.5	20.5	120.5
1109				85.6					14.4	100.0
1110				100.0						100.0
1111				87.8					12.2	100.0
1202				84.1					15.9	100.0
1203				41.3		50.8			7.9	100.0
1204				86.8					13.2	100.0
1107				100.0						100.0

IA VALUES (mm) - Existing Conditions										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
IA (mm)	8	10	2	5	8	8	3	2	2	
1101		2.1		4.0						6.0
1102		0.4				7.7				8.1
1103		1.5				6.8				8.3
1104						8.0				8.0
1105						8.0				8.0
1106						8.0				8.0
1108				4.0				0.4	0.4	4.8
1109				4.3					0.3	4.6
1110				5.0						5.0
1111				4.4					0.2	4.6
1202				4.2					0.3	4.5
1203				2.1		4.1			0.2	6.3
1204				4.3					0.3	4.6
1107				5.0						5.0

* IA values based on LSRCA guidelines

Existing Conditions
Time to Peak Calculations

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

Uplands Method:

Catchment ID	High Elevation	Low Elevation	Length (m)	Slope (%)	Land Cover Type	Velocity (m/s)	Time of Concentration (s)	Time of Concentration (hr)	Time to Peak (hr)
1101a	242.00	219.90	771.0	2.87	Pasture	0.37	2084.0	0.58	0.39
1101b	219.90	219.15	82.0	0.91	Woodland	0.14	567.0	0.16	0.11
1101									**0.49**
1102a	258.00	245.75	412	2.97	Cultivated Straight Row	0.48	857.2	0.24	0.16
1102b	245.75	245.10	15	4.35	Woodland	0.31	47.7	0.01	0.01
1102c	245.10	239.45	168	3.36	Cultivated Straight Row	0.51	329.3	0.09	0.06
1102									**0.23**
1103a	255.02	251.87	205	1.54	Cultivated Straight Row	0.35	590.6	0.16	0.11
1103b	251.87	250.00	117	1.59	Woodland	0.19	615.4	0.17	0.11
1103c	250.00	240.00	335	2.98	Cultivated Straight Row	0.48	695.7	0.19	0.13
1103d	240.00	229.40	289	3.67	Waterway	0.88	327.3	0.09	0.06
1103									**0.41**
1104a	246.37	235.15	300	3.74	Pasture	0.42	709.1	0.20	0.13
1104									**0.13**
1105a	252.00	248.91	179	1.73	Cultivated Straight Row	0.37	488.3	0.14	0.09
1105b	248.91	235.00	395	3.53	Pasture	0.41	960.6	0.27	0.18
1105									**0.27**
1106a	251.00	235.40	500	3.12	Pasture	0.39	1295.5	0.36	0.24
1106									**0.24**
1108a	231.00	226.92	126	3.23	Pasture	0.39	321.8	0.09	0.06
1108									**0.06**
1109a	234.00	230.74	114	2.86	Pasture	0.37	308.5	0.09	0.06
1109									**0.06**
1110a	244.82	235.24	193	4.96	Pasture	0.49	395.4	0.11	0.07
1110									**0.07**
1111a	233.38	229.00	164	2.67	Pasture	0.36	459.4	0.13	0.09
1111									**0.09**
1202a	250.62	247.64	87	3.43	Pasture	0.41	214.4	0.06	0.04
1202b	247.64	245.79	26	7.10	Pasture	0.58	44.5	0.01	0.01
1202									**0.05**
1203a	261.03	258.92	54	3.88	Pasture	0.43	125.7	0.03	0.02
1203b	258.92	253.41	315	1.75	Cultivated Straight Row	0.37	852.9	0.24	0.16
1203c	253.41	247.84	217	2.57	Pasture	0.35	620.3	0.17	0.12
1203									**0.30**
1204a	248.07	245.41	67	3.97	Pasture	0.44	153.7	0.04	0.03
1204									**0.03**

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Existing Conditions
Percent Impervious Calculations

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

			1107	
Catchment Area (ha)			9.31	
Land Use Areas	Timp	Ximp	Land Use	Total
Parks/Open Space	0%	0%		0
Impervious	100%	0%	2.83	2.83
Gravel	90%	90%		0
Rooftop	90%	90%		0
Employment		0%		0
Mixed Use				0
Single Houses		35%		
25m ROW		69%		0
Back to back		33%		0
Townhouses		35%		0
Open Space		0%	6.48	6.48
		Total Land Use =	9.31	9.31
		Timp =	30%	30%
		Ximp =	0%	0%

CHART H2-6A - HYDROLOGIC SOIL GROUPS FOR PRINCIPAL SOIL TEXTURES IDENTIFIED ON AGRICULTURAL SOILS MAPS (6)

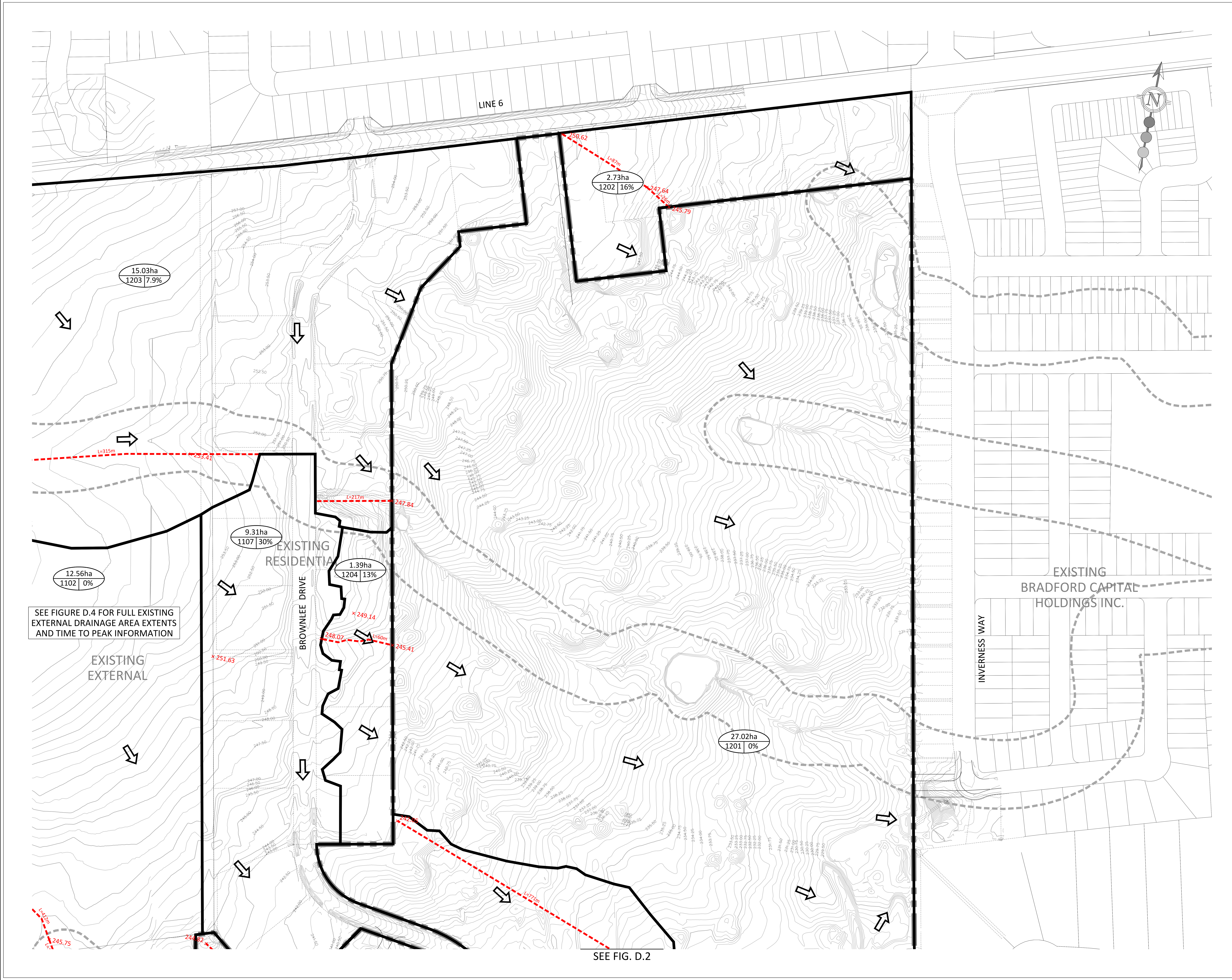
Soils Series	Soil Texture	Hyd. Soil Grp.	Soils Series	Soil Texture	Hyd. Soil Grp.	Soils Series	Soil Texture	Hyd. Soil Grp.
Alberton	si l	BC	Bolingbr.	s	A	"	c	C
Allendale	s l	B	Bondhead	s l	AB	"	l	BC
Alliston	s l	AB	"	l	B	Camilla	s l	AB
Almonte	si c l	C	Bookton	s l	AB	"	si l	BC
Ameliasbg	c l	C	Boomer	l	B	Campbell	si c	C
"	l	B	Brady	s l	AB	Cane	si l	BC
Ancaster	si l &s	B	"	s	A	"	si c l	C
"	si l	BC	Brant	s &si l	B	Carp	c &c l	C
Anstruther	s	A	Brantford	si l	BC	Casey	si l	BC
Appleton	si l & s	B	"	si c l	C	Cashel	c	D
Atherley	c	C	"	l	BC	Castor	s l	AB
"	si c l	C	"	c l	D	"	si l	BC
Athol	s l	A	Brentha	s l	A	"	c	C
Atwood	c	C	"	l	B	Chesley	si l	BC
Ayr	s l	B	Brethour	si l	BC	"	si c l	C
Bainsville	s	B	Breypen	limest.	B	"	c l	C
"	si l	B	Bridgman	s	A	Chinguac'y	l	BC
Balderson	s l	B	Brighton	s	A	"	si l	BC
Bamford	s	AB	"	s l	AB	"	c l	C
Bancroft	s	A	Brisbane	s g	AB	"	c	D
"	s l	B		l	B	Christy	s l	B
Bass	c	D	Brockport	c	D	Clyde	l	BC
Bastard	s	A	Brooke	l	B	"	si l	BC
Battersea	si l	BC	Brookston	s l	B	"	c l	C
"	s l	AB	"	l	C	"	c	C
Bearbrook	s l	B	"	si l	C	Colborne	s	A
"	si c l	C	"	si c l	C	Colwood	s l	B
"	c	C	"	c l	C	"	si l	B
Belmeade	m & c	B	"	c	C	"	l	BC
Bennington	s l	B	Bucke	s	AB	Codrington	si l	BC
"	s	A	"	s l	AB	Conestogo	l	BC
"	si l	A	Burford	s l	A	Conover	c l	C
Berrien	s	AB	"	l	AB	"	l	BC
"	s l	AB	Burnbrae	l	B	Cooksville	c	D
Berriedale	s & si	AB	Burnstown	l	B	Coutts	s l	AB
Beverly	l	BC	Burpee	s	A	"	l	BC
"	si l	C	Burris	c l	C	Craigleith	c	C
"	si c l	C	Buzwah	si c l	C	Cramahe	s g	A
Binbrook	si l	C	Buzwah	c l	D	Crombie	s l	B
Blackwell	c	C	Caledon	s l	A	"	si l	BC
Blanche	si l	BC	"	l	B	Dack	c	D
Blue	c l	C	Caistor	c l	C	Dalton	s	AB

Notes: 1. See footnotes to Chart H2-2.

2. Key to abbreviations: c - clay; f - fine; g - gravel; l - loam; ma - marl; m - muck; p - peat; r - rock; s - sand; si - silt.

CHART H2-6A - continued

Soils Series	Soil Texture	Hyd. Soil Grp.	Soils Series	Soil Texture	Hyd. Soil Grp.	Soils Series	Soil Texture	Hyd. Soil Grp.
Lockport	c	D	Mountain	s l	AB	"	l	C
London	l	BC	Muck	m	B	"	si l	C
"	si l	BC	Murray	si l /f		"	si c l	CD
Lovering	si c l	C		s	B	"	c l	CD
"	c	D	Napanee	c /si l	C	"	c	CD
"	c l	CD	Neebing	s /si	B	Petherwick	si l	BC
Lyons	l	B	Nepean	s	AB	Phipps	si c l	C
Macton	l	B	Newburgh	s l	A	"	c l	C
Magnetawan	si l	BC	"	si l	BC	Piccadilly	s l	B
Mallard	s	AB	Newcastle	l	BC	"	l	BC
"	s l	AB	"	c l	C	"	si l	BC
Malton	c	C	"	si l	BC	Pike	c	D
Mannheim	l	B	Newton	s l	B	Pike Lake	l	B
Manotick	s	AB	Nelson	c	D	Plainfield	s	A
Maplewood	si l	BC	New lisk.	si c	C	Pontypool	s	A
Marionville	s	B	"	c	C	"	s l	AB
"	s l	B	Niagara	c	D	Powassan	si l	BC
Martin	s /g	AB	Nipissing	s /si	B	Preston	s l	B
Maryhill	l	BC	Norham	si l	BC	Raglan	s /g	A
Matilda	l	BC	North Gow.	c l	C	Rainy Riv.	p	B
Matson	si l	BC	"	c	C	Renfrew	c l	C
Medonte	si l	BC	O'Connor	c	D	"	l	BC
"	si c l	C	Oliver	l /si l	B-BC	Rideau	c l	D
McCool	c	C	Oneida	l	BC	"	c	D
McInnis Cr	c l/l		"	si l	BC	Rosslyn	s /g	A
	&P	BC	"	si c l	C	Rubicon	s	AB
McIntyre	s	AB	"	c l	D	"	s l	AB
Miami	l	BC	Ontario	l	BC	Sandford	c	D
"	si l	BC	Osgoode	l	BC	Sargent	s /g	A
"	c l	D	"	si l	BC	"	s l	AB
"	g l	AB	"	si c l	C	Saugeen	si l	BC
Milberta	c /si		Oshtemo	s	A	"	si c l	C
	c l	C	Osnabruck	c l	C	"	c l	D
Mill	s	B	Osprey	s l	A	Schomberg	si l	BC
	s l	B	"	l	B	"	si c l	C
Milliken	s l	AB	Otonabee	s l	A	"	c l	C
"	l	BC	"	l	B	Scoble	si c	C
Minesing	ma si		Otterskin	s l	B	Seely's Bay	si c l	C
	c l	BC	Oxdrift	c	D	Shashawan	l	B
"	ma c	C	Paipoonge	c	C	Shenston	c l &p	BC
Mississauga	c	C	Parkhill	l	BC	Sidney	c	C
Monaghan	l	BC	"	si l	BC	Sifton	si c /c	
"	si l	BC	Peat	p	B		l	C
"	c l	C	Peel	c	D	Simcoe	si l	BC
Monteagle	s l	A	Pelham	s l	A	"	si c l	C
"	sl + r	B	Pense	si l	BC	"	c l	C
Moose	s l	B	Pense	si c l	C	Slate River	s /l	B
"	l	BC	Perch	c	C	Smithfield	si l	C
Morley	c si		Percy	s	A	"	si l	C
	c l	C	"	f s l	B	"	c l	CD
Morrisburg	c	C	"	s l	B	Smithville	l	BC
Moscow	si c	C	Perth	s l	AB	"	si c l	C



LEGEND:

- LIMIT OF DEVELOPMENT
- LSRCA REGULATION LIMIT
- MAX 3:1 SLOPE
- 236.25 EXISTING ELEVATION AND CONTOUR
- STORM DRAINAGE FLOW DIRECTION
- STORM DRAINAGE BOUNDARY
- 0.35ha — DRAINAGE AREA (HECTARES)
- 20% — IMPERVIOUSNESS
- 99 — CATCHMENT ID
- × 235.40 TIME TO PEAK ELEVATION
- L=249m TIME TO PEAK FLOW PATH
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- WATERCOURSE BANKS AND FLOW DIRECTION

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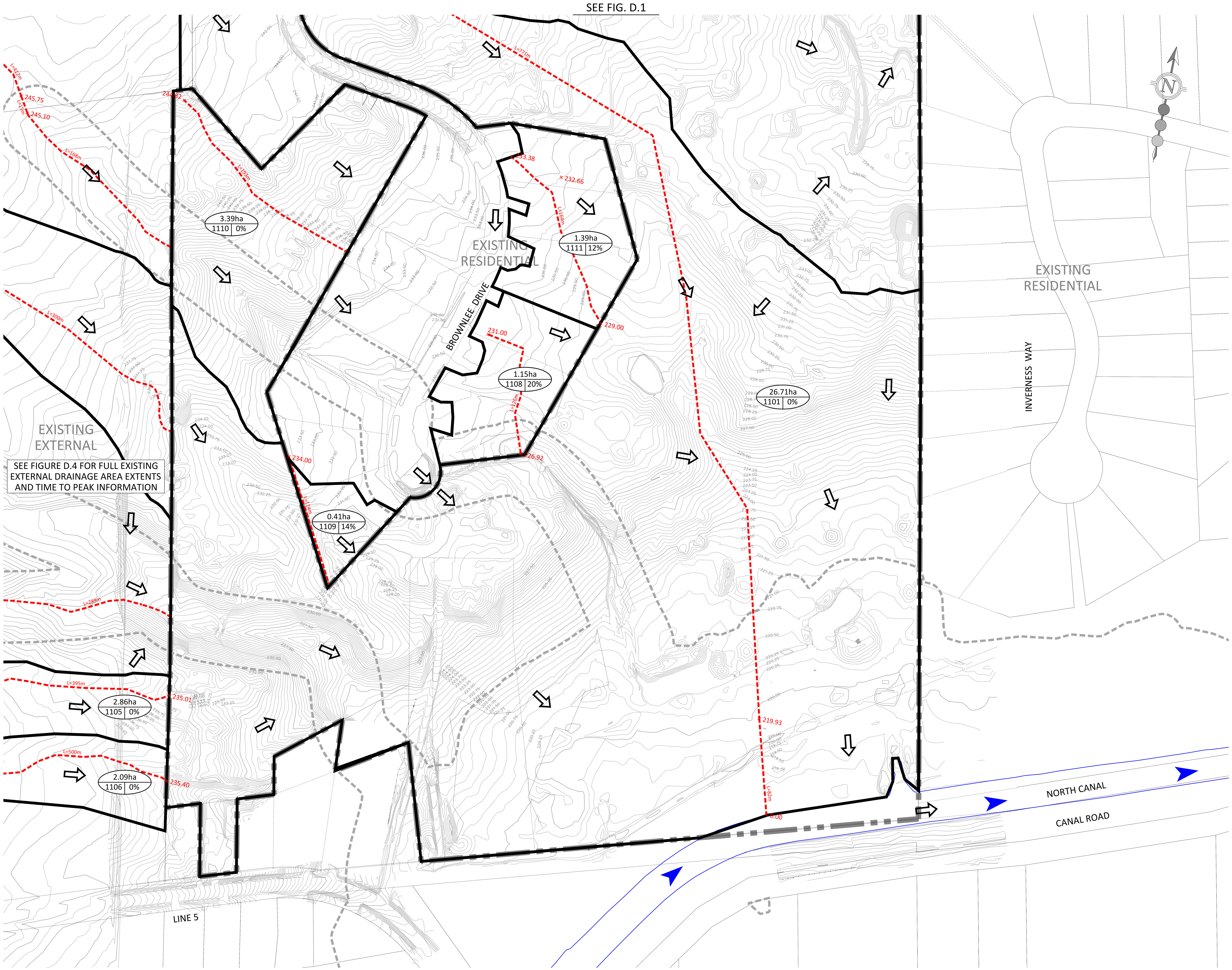
TEL: (905) 475-1900
FAX: (905) 475-8335

BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

EXISTING TIME TO PEAK PLAN 1

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	D.1



LEGEND:

- LIMIT OF DEVELOPMENT
- LSRCA REGULATION LIMIT
- MAX 3:1 SLOPE
- EXISTING ELEVATION AND CONTOUR
- STORM DRAINAGE FLOW DIRECTION
- STORM DRAINAGE BOUNDARY
- 0.35ha / 99 | 20%: DRAINAGE AREA (HECTARES), IMPERVIOUSNESS, CATCHMENT ID
- × 235.40 TIME TO PEAK ELEVATION
- L=249m TIME TO PEAK FLOW PATH
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- WATERCOURSE BANKS AND FLOW DIRECTION

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BRADFORD HIGHLANDS JOINT VENTURE

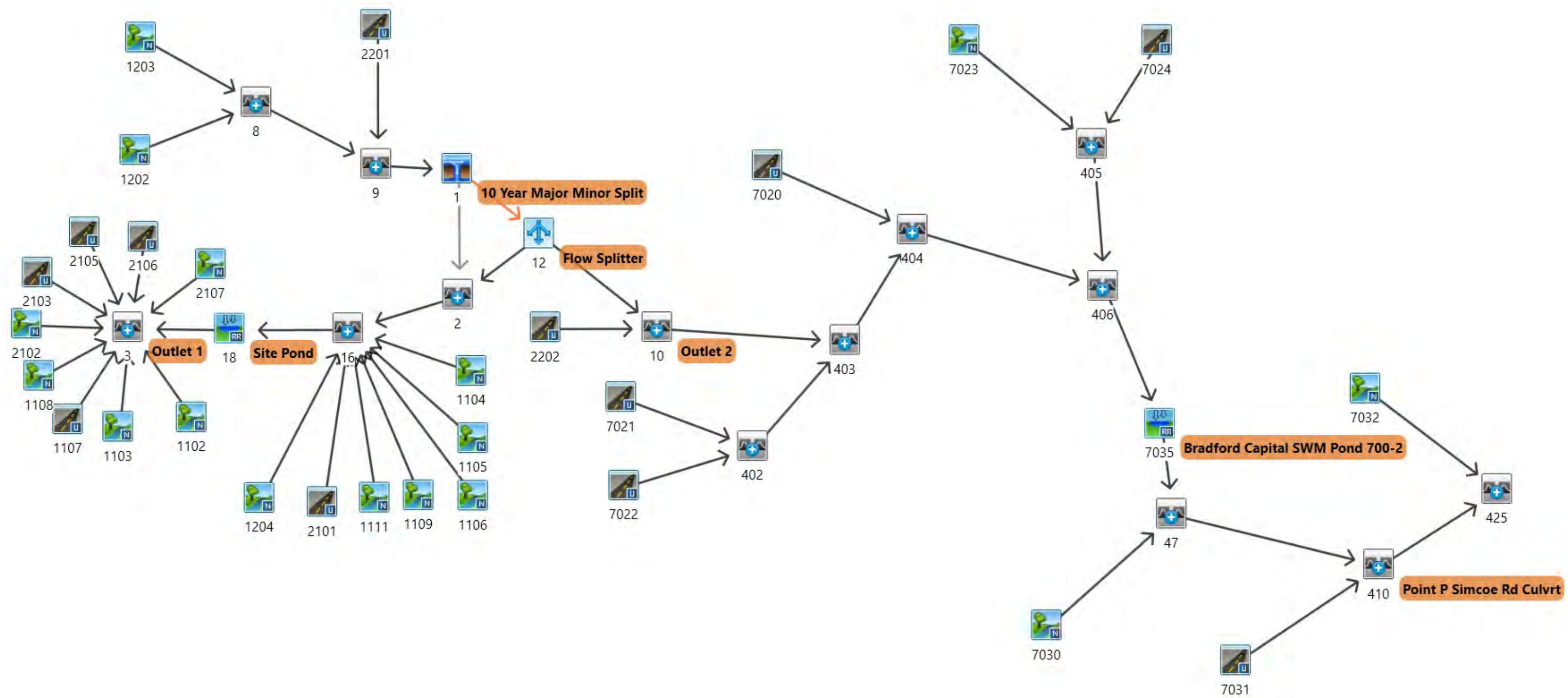
BRADFORD HIGHLANDS

EXISTING TIME TO PEAK PLAN 2

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	D.2

Appendix D-2 Proposed Hydrologic Modelling

SCS consulting group ltd	**Proposed Condition VO6 Schematic**	Bradford Highlands Project Number: 1791 Date: November 2024



P:\1791 Bradford Highlands\Design\SWM\FSP\Hydrology\Schematics\1791-Proposed Condition Schematic.doc

Proposed Conditions
VO Parameter Summary

NASHYD

Number	2102	2107
Description		
DT(min)	1	1
Area (ha)	11.13	0.15
CN*	57.0	75.0
IA(mm)	6.4	6.3
TP Method	Uplands	Uplands
TP (hr)	0.14	0.15

STANDHYD

Number	2101	2201	2202	2103	2301	2105	2106
Description							
DT(min)	1	1	1	1	1	1	1
Area (ha)	22.04	23.25	1.44	0.39	0.11	0.51	0.69
TIMP[2]	0.63	0.66	0.74	0.63	0.45	0.48	0.51
XIMP[1,2]	0.38	0.41	0.39	0.38	0.28	0.29	0.31
CN*	63.0	73.0	73.0	54.0	73.0	54.0	54.0
IA(mm)	5.0	5.0	5.0	5.0	5.0	5.0	5.0
SLPP(%)	2	2	2	2	2	2	2
LGP(m)	40	40	40	40	40	40	40
MNP	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DPSI (mm)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
SLPI(%)	1	1	1	1	1	1	1
LGI(m)	383.32	393.71	98.01	51.07	26.53	58.02	67.95
MNI	0.013	0.013	0.013	0.013	0.013	0.013	0.013

[1] Note that where there is NO directly connected area (ie: roof runoff to grassed areas), the hydrology program do

[2] Note that where there is NO pervious area, the hydrology program does not accept TIMP and XIMP=100%, there

Total Area = 59.7 ha

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: HY

Proposed Conditions
CN Calculations

Site Soils: (per OMAFRA Soils Mapping)

Soil Type	Hydrologic Soil Group
BONDHEAD LOAM	B
SCHOMBERG SILTY CLAY LOAM	C

TABLE OF CURVE NUMBERS (CN's)**

Land Use	Hydrologic Soil Type							Manning's 'n'	Source
	A	AB	B	BC	C	CD	D		
Meadow "Good"	30	44	58	64.5	71	74.5	78	0.40	MTO
Woodlot "Fair"	36	48	60	66.5	73	76	79	0.40	MTO
Gravel	76	80.5	85	87	89	90	91	0.30	USDA
Lawns "Good"	39	50	61	67.5	74	77	80	0.25	USDA
Pasture/Range	58	61.5	65	70.5	76	78.5	81	0.17	MTO
Crop	66	70	74	78	82	84	86	0.13	MTO
Fallow (Bare)	77	82	86	89	91	93	94	0.05	MTO
Low Density Residences	57	64.5	72	76.5	81	83.5	86	0.25	USDA
Streets, paved	98	98	98	98	98	98	98	0.01	USDA

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. USDA (1986), Urban Hydrology for Small Watersheds, Table 2.2-Runoff Curve Numbers for Urban Areas

HYDROLOGIC SOIL TYPE (%) - Proposed Conditions

Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
2102	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100
2107	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100
2101	0.0	0.0	55.3	0.0	44.7	0.0	0.0	100
2201	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100
2202	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100
2103	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100
2301	0.0	0.0	0.0	0.0	100.0	0.0	0.0	100
2105	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100
2106	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100

HYDROLOGIC SOIL TYPE (%) - Proposed Conditions

Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
2102			100					100
2107			100					100
2101			55.3		44.7			100
2201					100			100
2202					100			100
2103			100					100
2301					100			100
2105			100					100
2106			100					100

LAND USE (%) - Proposed Conditions

Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
2102	0.0	30.0	0.0	67.8	0.0	0.0	0.0	0.0	2.2	100.0
2107	0.0	0.0	0.0	0.0	72.3	0.0	0.0	0.0	27.7	100.0
2101	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
2201	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
2202	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
2103	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
2301	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
2105	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
2106	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0

Note: Where STANDHYD command used (shaded), impervious fraction is not considered in CN determination, since %Imp directly input in STANDHYD command

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: HY

Proposed Conditions
CN Calculations

LAND USE (%) - Proposed Conditions										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
2102		30.0		67.8					2.2	100.0
2107					72.3				27.7	100.0
2101				100.0						100.0
2201				100.0						100.0
2202				100.0						100.0
2103				100.0						100.0
2301				100.0						100.0
2105				100.0						100.0
2106				100.0						100.0

Note: Where STANDHYD command used (shaded), impervious fraction is not considered in CN determination, since %Imp directly input in STANDHYD command

CURVE NUMBER (CN) - Proposed Conditions										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
2102	0.0	18.0	0.0	41.4	0.0	0.0	0.0	0.0	2.2	62
2107	0.0	0.0	0.0	0.0	47.0	0.0	0.0	0.0	27.2	74
2101	0.0	0.0	0.0	66.8	0.0	0.0	0.0	0.0	0.0	67
2201	0.0	0.0	0.0	74.0	0.0	0.0	0.0	0.0	0.0	74
2202	0.0	0.0	0.0	74.0	0.0	0.0	0.0	0.0	0.0	74
2103	0.0	0.0	0.0	61.0	0.0	0.0	0.0	0.0	0.0	61
2301	0.0	0.0	0.0	74.0	0.0	0.0	0.0	0.0	0.0	74
2105	0.0	0.0	0.0	61.0	0.0	0.0	0.0	0.0	0.0	61
2106	0.0	0.0	0.0	61.0	0.0	0.0	0.0	0.0	0.0	61

** AMC II assumed

SCS consulting group ltd

Proposed Conditions
CN Calculations

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: HY

Step	**Input Values**										
Step	Subcatchment:	2102		2107	2101	2201	2202	2103	2301	2105	2106
1	**CN (AMC II):**	**62**		**74**	**67**	**74**	**74**	**61**	**74**	**61**	**61**
2	CN (AMC III) =	79		88	83	88	88	78	88	78	78
3	100 Year Precipitation, P =	122.36	mm	122.36	122.36	122.36	122.36	122.36	122.36	122.36	122.36

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S} \qquad S = \frac{(P - Ia)^2}{Q} - (P - Ia)$$

Q = rainfall excess or runoff, mm
S = potential maximum retention or available storage, mm

$$CN = \frac{25400}{S + 254} \qquad S = \frac{25400}{CN} - 254$$

CN* = modified SCS curve # that better reflects Ia conditions in Ontario

Step	**Output Values**										
	Subcatchment:	2102		2107	2101	2201	2202	2103	2301	2105	2106
	S_{III} =	67.52	mm	34.64	52.02	34.64	34.64	71.64	34.64	71.64	71.64
	SCS Assumption of 0.2 S = Ia =	13.50	mm	6.93	10.40	6.93	6.93	14.33	6.93	14.33	14.33
4	Q_{III} =	67.18	mm	88.79	76.44	88.79	88.79	64.96	88.79	64.96	64.96
	Preferred Initial Abstraction, Ia =	6.4	mm	6.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0
5	S^*_{III} =	84.11	mm	35.59	62.83	37.76	37.76	94.68	37.76	94.68	94.68
6	CN^*_{III} =	75.12	mm	87.71	80.17	87.06	87.06	72.85	87.06	72.85	72.85
	CN^*_{III}=	**75**	Rounded	**88**	**80**	**87**	**87**	**73**	**87**	**73**	**73**
7	**CN^*_{II}=**	**57**	convert	**75**	**63**	**73**	**73**	**54**	**73**	**54**	**54**

Proposed Conditions
IA Calculations

LAND USE (%) - Proposed Conditions										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
2102		30.0		67.8					2.2	100.0
2107					72.3				27.7	100.0
2101				100.0						100.0
2201				100.0						100.0
2202				100.0						100.0
2103				100.0						100.0
2301				100.0						100.0
2105				100.0						100.0
2106				100.0						100.0

IA VALUES (mm) - Proposed Conditions										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
IA (mm)	8	10	2	5	8	8	3	2	2	
2102		3.0		3.4					0.0	6.4
2107					5.8				0.6	6.3
2101				5.0						5.0
2201				5.0						5.0
2202				5.0						5.0
2103				5.0						5.0
2301				5.0						5.0
2105				5.0						5.0
2106				5.0						5.0

* IA values based on LSRCA guidelines

Proposed Conditions
Time to Peak Calculations

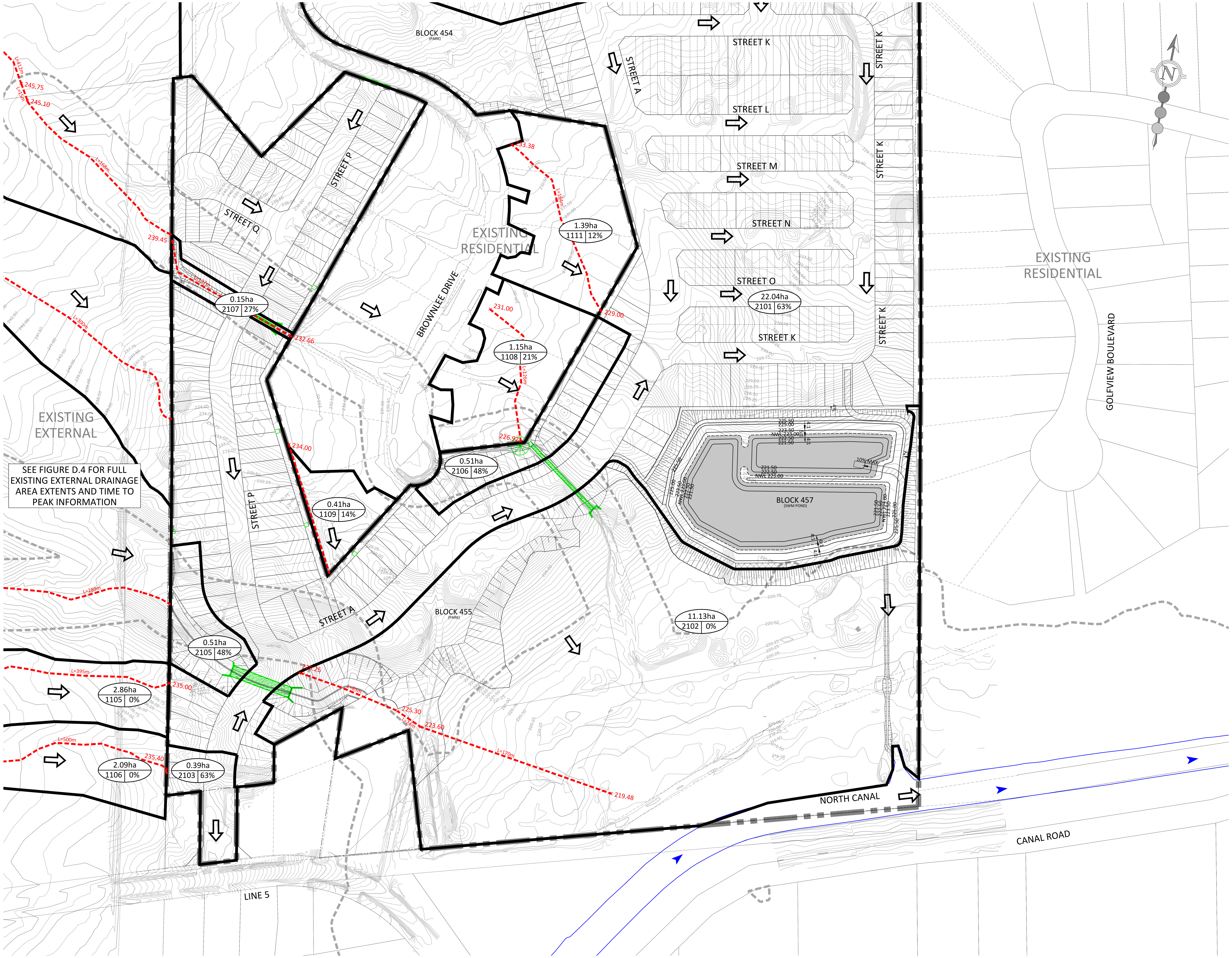
Uplands Method:

Catchment ID	High Elevation	Low Elevation	Length (m)	Slope (%)	Land Cover Type	Velocity (m/s)	Time of Concentration (s)	Time of Concentration (hr)	Time to Peak (hr)
2102a	229.25	224.00	85	6.18	Pasture	0.55	155.9	0.04	0.03
2102b	224.00	223.60	24	1.69	Woodland	0.20	120.0	0.03	0.02
2102c	223.60	219.48	170	2.42	Pasture	0.34	500.6	0.14	0.09
2102									**0.14**
2107a	239.62	232.66	137	5.07	Forest (Heavy Litter)	0.17	804.6	0.22	0.15
2107									**0.15**

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: HY

Proposed Conditions
Percent Impervious Calculations

			2101	2201	2202	2103	2301	2105	2106
Catchment Area (ha)			22.04	23.25	1.44	0.39	0.11	0.51	0.69
Land Use Areas	Timp	Ximp							
Parks	0%	0%							
School Block	55%	55%		1.99					
Single Houses/ Duplexes	65%	40%	9.73	15.48	0.51	0.33	0.07	0.37	0.54
Townhouses	80%	40%	3.85	5.33	0.91	0.04			
B2B Townhouses	85%	45%	3.56						
Open Space/ OLFR	0%	0%	2.08	0.45	0.02	0.02	0.03	0.13	0.15
SWM Pond	50%	50%	2.82						
		43%							
		0%							
		Total Land Use =	22.04	23.25	1.44	0.39	0.10559	0.51	0.69
		Timp =	63%	66%	74%	63%	45%	48%	51%
		Ximp =	38%	41%	39%	38%	28%	29%	31%



LEGEND:

- LIMIT OF DEVELOPMENT
- MAX 3:1 SLOPE
- EXISTING ELEVATION AND CONTOUR
- STORM DRAINAGE FLOW DIRECTION
- STORM DRAINAGE BOUNDARY
- DRAINAGE AREA (HECTARES) (0.35ha)
- IMPERVIOUSNESS (21%)
- CATCHMENT ID (99)
- TIME TO PEAK ELEVATION (× 235.40)
- TIME TO PEAK FLOW PATH (L=249m)
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- WATERCOURSE BANKS AND FLOW DIRECTION

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

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

BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

PROPOSED TIME TO PEAK PLAN

DESIGNED BY:	H.Y./E.A.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	D.3

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-D.3-PEAK-PROP.dwg — Revised by <SOZDEMIR> : Fri, Nov 01 2024 – 9:56am

LEGEND:

- LIMIT OF DEVELOPMENT
- STORM DRAINAGE BOUNDARY
- LSRCA REGULATION LIMIT (SOURCE: LSRCA OPEN DATA OCT 2024)
- L=XXXm — TIME OF PEAK FLOW PATH AND LENGTH
- 0.35ha / 99 | 20% — DRAINAGE AREA (HECTARES); IMPERVIOUSNESS; CATCHMENT ID
- WATERCOURSE BANKS AND FLOW DIRECTION

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

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
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FAX: (905) 475-8335

BRADFORD HIGHLANDS JOINT VENTURE

BRADFORD HIGHLANDS

EXTERNAL TIME TO PEAK PLAN

DESIGNED BY:	E.A.S./H.Y.	CHECKED BY:	E.T.C.K.
SCALE:	1:3000	DATE:	NOVEMBER 2024
PROJECT No:	1791	FIGURE No:	D.4

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-D.4-PEAK-EXTN.dwg - Revised by <SOZDEMIR> : Tue, Oct 29 2024 - 7:51pm

Flow Splitter – Rating Table Summary

Storm Event	Flow to Outlet 1 (Site Pond) (m^3/s)	Flow to Outlet 2 (Bradford Capital Pond 700-2) (m^3/s)	Total Flows (m^3/s)
No Flow	0	0	0
25mm 4-hour Chicago Storm[1]	0.0001	1.078	1.0781
10-year 4-hour Chicago Storm[2]	1.8331	2.0379	3.871
Events Exceeding 10 Year Chicago Storm[3]	10	2.038	12.038

[1] Entire runoff from 25mm 4-hour Chicago Storm is to be conveyed to the Bradford Capital Pond for Quality Treatment

[2] Runoff generated by the 10-year 4-hour Chicago storm split to each outlet

[3] A maximum of 2.038 of runoff to be conveyed from the flow splitter to the Downstream node, such that the total flow to the downstream sewer does not cause surcharging.

Flow Splitter – Downstream Node Summary

Node	Flow (m^3/s)
Node 1: 10 Year Minor Flow to Flow Splitter	3.871
Node 12: Flow Splitter to Catchment 2	2.038
Node 10: Combined with Major Flow event from Catchment 2202	2.505
Downstream Sewer Capacity Before Surcharging	2.550

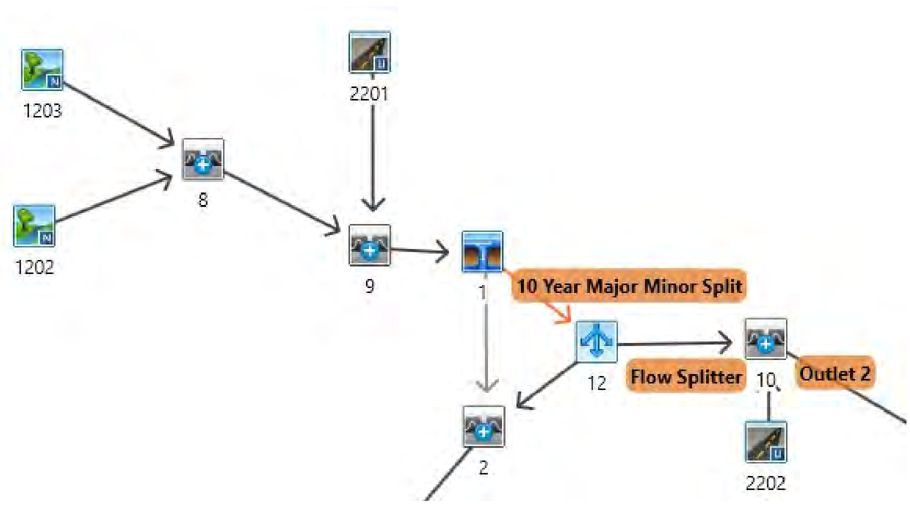
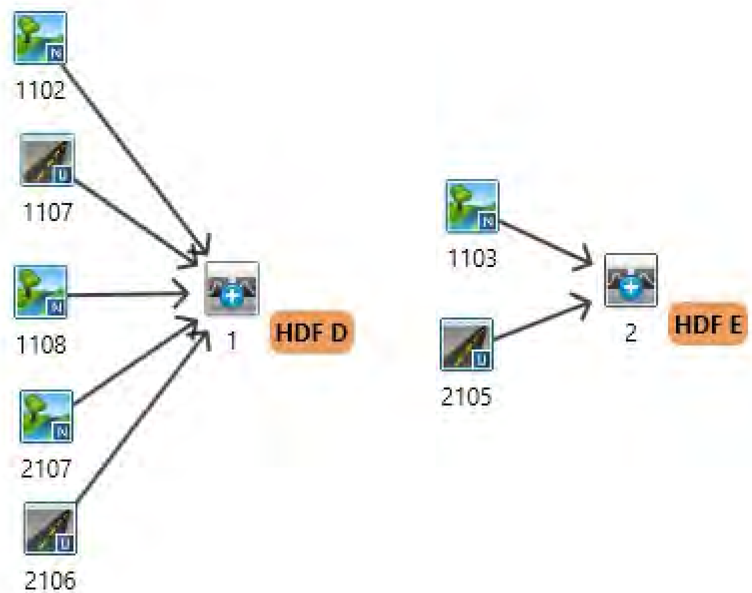


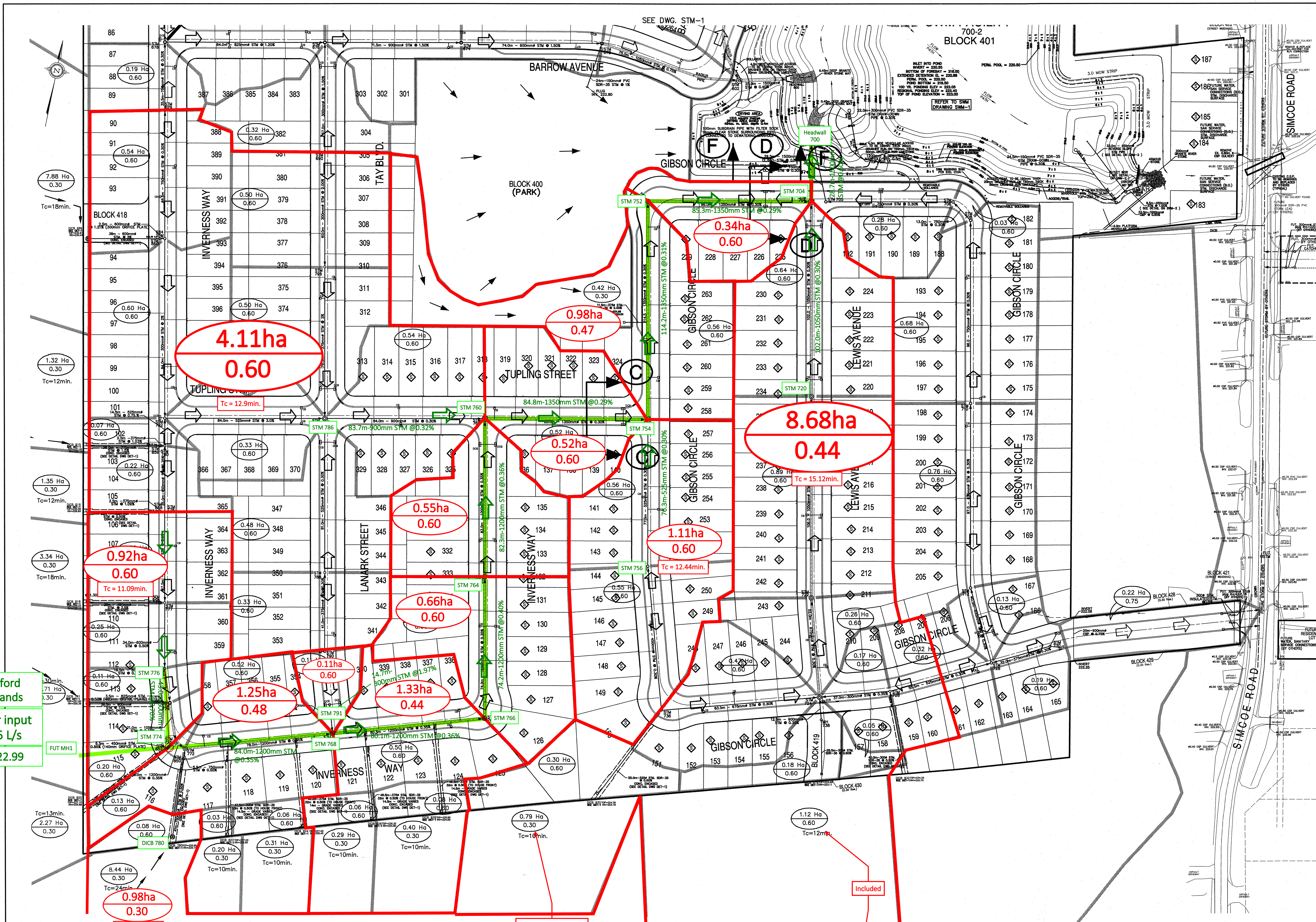
Figure: Node Schematic at the Flow Splitter

Appendix D-3 Headwater Drainage Feature Hydrologic Modelling Schematic

SCS consulting group ltd


1102
1107
1108
2107
2106
1
HDF D
1103
2105
2
HDF E

Appendix E Downstream Storm Sewer Analysis



LEGEND

WB	WATER BOX
VC	VALVE CHAMBER
V&B	VALVE & BOX
	EXISTING CULVERT
P&W CL P&B	EXISTING FENCE
STM 640	STORM MAINTENANCE HOLES
CBMH 874	CATCHBASIN MAINTENANCE HOLES
620A SAN	SANITARY MAINTENANCE HOLES
25m – 250mm ø	SEWER
200 DIA. PVC W/M	PROPOSED WATERMAIN
RLCB	REAR LOT CATCHBASIN
CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
DICB	DITCH INLET CATCHBASIN
HYD &V	HYDRANT & VALVE
	CURB & GUTTER & DEPRESSION
1.5m CONC. S/W	SIDEWALK
0.14Ha	DRAINAGE AREA
0.60	RUNOFF COEFFICIENT

NOTES :

(S) SYMBOL DENOTES SUMP PUMP LOTS/BLOCKS. NO DIRECT CONNECTION OF WEEPING TILE TO SEWERS IS PERMITTED. STORM CONNECTIONS ARE ONLY MEANT TO CAPTURE AT GRADE DISCHARGE FROM SUMP PUMPS.

No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT 24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
Aug 19/15
DATE

Bradford West Gwillimbury

URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856-0629
f. (905)856-0698

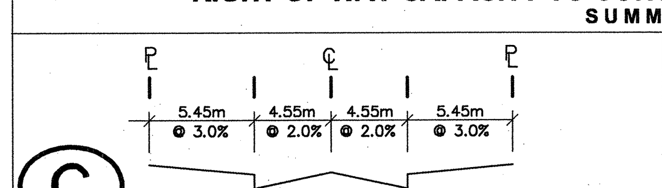
UEL

BRADFORD CAPITAL HOLDINGS INC.
STORM DRAINAGE PLAN

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. STM-2
Scale Horz. 1:1000 (0m 20m 40m)		Sheet No. – OF –

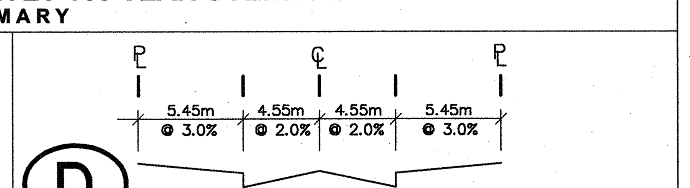
ID - P:\2008\08017-BRADFORD-WEST\PRINTING\08017-PRINTING-STORM-DRAINAGE-STM-1.2.dwg - Thu, 9 Jul 2015 - 13:30

RIGHT OF WAY CAPACITY TO CONVEY 100 YEAR OVERLAND FLOW
SUMMARY



R.O.W. FLOW CAPACITY @ 0.50% ROAD SLOPE — $Q_{ROW\ CAPACITY}$ = 3.9 cms. PER TOWN MANUAL FIGURE 2 ROAD CAPACITY

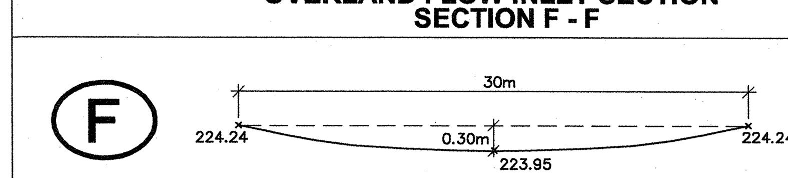
OVERLAND FLOW OTTSWM MAJOR OVERLAND FLOW CALCULATION AT SECTION C-C TUPLING STREET — $Q_{OVERLAND\ FLOW}$ = 1.18 cms.



R.O.W. FLOW CAPACITY @ 0.50% ROAD SLOPE — $Q_{ROW\ CAPACITY}$ = 3.9 cms. PER TOWN MANUAL FIGURE 2 ROAD CAPACITY

OVERLAND FLOW OTTSWM MAJOR OVERLAND FLOW CALCULATION AT SECTION D-D GIBSON CIRCLE — $Q_{OVERLAND\ FLOW}$ = 1.39 cms.

OVERLAND FLOW INLET SECTION
SECTION F - F



SPILLWAY CAPACITY = 3.2 c.m.s.

TOTAL EXPECTED FLOW = 2.17 c.m.s. – V = 0.65m/s

100-Year Storm Design
Bradford Highlands
External Sewer
Bradford West Gwillimbury, Simcoe County

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

A= 1443.947
B= 5.273
c= 0.776

Starting T_c (min)= 10

Project: Bradford Highlands
Project No. 1791
Date: 30-Oct-24
Designed By: M.P./K.A.S.
Reviewed By: P.S.

P:\1791 Bradford Highlands\Design\Pipe Design\Storm\[1791-Storm Design Sheet - 100 YR EXTERNAL.xlsm]Design

LOCATION			100 YEAR						CB FLOW			EXTERNAL FLOWS				TOTAL FLOW	PIPE DATA						
STREET	MANHOLE FROM	MANHOLE TO	100-YEAR AREA (ha)	RUNOFF COEFF. "R"	"AR"	ACCUM. "AR"	RAINFALL INTENSITY (mm/hr)	ACCUM. FLOW (m3/s)	CB's (#)	FLOW (m3/s)	ACCUM. CB FLOW (m3/s)	AREA (ha)	FLOW RATE (l/s/ha)	EXT. FLOW (m3/s)	ACCUM. EXT. FLOW (m3/s)	TOTAL (Qdes) (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	TIME OF CONC. (min)	ACCUM. TIME OF CONC. (min)
BRADFORD HIGHLANDS	FUT MH1	MH774	0.000	0.000	0.000	0.000	109.01	0.000	0	0.000	0.000	1.000	2525.000	2.525	2.525	2.525	50.0	0.50	1200	2.755	2.438	0.34	22.99
INVERNESS WAY	MH776	MH774	0.920	0.750	0.690	0.690	168.20	0.322	0	0.000	0.000	0.000	0.000	0.000	0.000	0.322	43.0	0.70	600	0.513	1.817	0.39	11.09
INVERNESS WAY	DICB 780	MH774	0.000	0.000	0.000	0.000	174.11	0.000	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	41.0	0.50	750	0.787	1.782	0.38	10.38
INVERNESS WAY	MH774	MH768	1.250	0.597	0.746	1.436	107.99	0.431	0	0.000	0.000	0.810	0.000	0.000	2.525	2.956	84.0	0.35	1200	2.305	2.039	0.69	23.68
LANARK STREET	MH791	MH768	0.110	0.750	0.083	0.083	174.11	0.040	0	0.000	0.000	0.000	0.000	0.000	0.000	0.040	14.7	1.97	300	0.136	1.920	0.13	10.13
INVERNESS WAY	MH768	MH766	1.330	0.555	0.739	2.258	106.00	0.665	0	0.000	0.000	0.000	0.000	0.000	2.525	3.190	80.1	0.36	1200	2.338	2.068	0.65	24.32
INVERNESS WAY	MH766	MH764	0.660	0.750	0.495	2.753	104.20	0.797	0	0.000	0.000	0.000	0.000	0.000	2.525	3.322	74.2	0.40	1200	2.465	2.180	0.57	24.89
INVERNESS WAY	MH764	MH760	0.550	0.750	0.413	3.165	102.68	0.903	0	0.000	0.000	0.000	0.000	0.000	2.525	3.428	82.3	0.36	1200	2.338	2.068	0.66	25.55
TUPLING STREET	MH786	MH760	3.570	0.750	2.678	2.678	158.02	1.175	0	0.000	0.000	0.000	0.000	0.000	0.000	1.175	83.7	0.32	900	1.024	1.610	0.87	12.90
TUPLING STREET	MH760	MH754	0.520	0.750	0.390	6.233	100.96	1.748	0	0.000	0.000	0.000	0.000	0.000	2.525	4.273	84.8	0.29	1350	2.873	2.008	0.70	26.26
GIBSON CIRCLE	MH756	MH754	1.110	0.750	0.833	0.833	163.64	0.378	0	0.000	0.000	0.000	0.000	0.000	0.000	0.378	76.3	0.30	525	0.235	1.088	1.17	12.44
GIBSON CIRCLE	MH754	MH752	0.980	0.588	0.576	7.641	99.20	2.106	0	0.000	0.000	0.000	0.000	0.000	2.525	4.631	114.2	0.31	1350	2.970	2.076	0.92	27.17
GIBSON CIRCLE	MH752	MH704	0.340	0.750	0.255	7.896	97.02	2.128	0	0.000	0.000	0.000	0.000	0.000	2.525	4.653	85.3	0.29	1350	2.873	2.008	0.71	27.88
LEWIS AVENUE	MH720	MH704	8.520	0.541	4.613	4.613	144.57	1.852	0	0.000	0.000	0.000	0.000	0.000	0.000	1.852	102.0	0.30	1050	1.495	1.727	0.98	15.12
LEWIS AVENUE	MH704	HW 700	0.000	0.000	0.000	12.508	95.41	3.315	0	0.000	0.000	0.000	0.000	0.000	2.525	5.840	28.7	0.50	1500	4.996	2.829	0.17	28.05

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100-Year Hydraulic Grade Line Analysis
Bradford Highlands
External Sewer
Bradford West Gwillimbury, Simcoe County

Project: Bradford Highlands
Project No. 1791
Date: 30-Oct-24
Designed By: M.P./K.A.S.
Reviewed By: P.S.

EL. FROM STREETLINE TO BASEMENT (m)= 1.90
ALLOWABLE DISTANCE FROM BASEMENT TO HGL (m)= 0.50
STARTING DOWNSTREAM HGL (if above obvert) (m) = 222.05

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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
BRADFORD HIGHLANDS	FUT MH1	MH774	223.750	223.500	2525.0	1200	50.0	0.013	1.131	0.448	0.50	2755.4	0.92	41.667	0.020	2.233	0.254	0.210	0.01	0.00	0.22	228.617	3.667	228.394	228.32	226.42	-2.20	N/A
INVERNESS WAY	MH776	MH774	224.311	224.010	322.4	600	43.0	0.013	0.283	0.282	0.70	513.5	0.63	71.667	0.025	1.140	0.066	0.119	0.05	0.00	0.17	228.562	3.651	228.394	227.74	225.84	-2.72	SUMP
INVERNESS WAY	DICB 780	MH774	224.215	224.010	0.0	750	41.0	0.013	0.442	0.328	0.50	786.8	0.00	54.667	0.023	0.000	0.000	0.000	0.00	0.00	0.00	228.394	3.429	228.394	226.95	225.05	-3.34	SUMP
INVERNESS WAY	MH774	MH768	223.404	223.110	2955.8	1200	84.0	0.013	1.131	0.448	0.35	2305.4	1.28	70.000	0.020	2.614	0.348	0.483	0.02	0.00	0.50	228.394	3.790	227.894	227.00	225.10	-3.29	SUMP
LANARK STREET	MH791	MH768	224.260	223.970	39.9	300	14.7	0.013	0.071	0.178	1.97	135.7	0.29	49.000	0.031	0.564	0.016	0.025	0.01	0.00	0.04	227.931	3.372	227.894	226.60	224.70	-3.23	SUMP
INVERNESS WAY	MH768	MH766	223.068	222.780	3189.7	1200	80.1	0.013	1.131	0.448	0.36	2338.1	1.36	66.750	0.020	2.820	0.405	0.536	0.30	0.00	0.84	227.894	3.626	227.054	226.49	224.59	-3.30	SUMP
INVERNESS WAY	MH766	MH764	222.737	222.440	3321.7	1200	74.2	0.013	1.131	0.448	0.40	2464.5	1.35	61.833	0.020	2.937	0.440	0.539	0.02	0.00	0.56	227.054	3.117	226.493	226.01	224.11	-2.95	SUMP
INVERNESS WAY	MH764	MH760	222.416	222.120	3427.7	1200	82.3	0.013	1.131	0.448	0.36	2338.1	1.47	68.583	0.020	3.031	0.468	0.636	0.35	0.00	0.99	226.493	2.877	225.506	225.60	223.70	-2.79	SUMP
TUPLING STREET	MH786	MH760	222.758	222.490	1175.2	900	83.7	0.013	0.636	0.370	0.32	1023.5	1.15	93.000	0.022	1.847	0.174	0.353	0.01	0.00	0.36	225.867	2.209	225.506	227.56	225.66	-0.21	SUMP
TUPLING STREET	MH760	MH754	221.996	221.750	4272.8	1350	84.8	0.013	1.431	0.485	0.29	2872.8	1.49	62.815	0.019	2.985	0.454	0.543	0.34	0.00	0.88	225.506	2.160	224.622	225.51	223.61	-1.90	SUMP
GIBSON CIRCLE	MH756	MH754	222.929	222.700	378.4	525	76.3	0.013	0.216	0.258	0.30	235.4	1.61	145.333	0.026	1.748	0.156	0.591	0.01	0.00	0.60	225.220	1.766	224.622	225.02	223.12	-2.10	SUMP
GIBSON CIRCLE	MH754	MH752	221.684	221.330	4630.5	1350	114.2	0.013	1.431	0.485	0.31	2970.2	1.56	84.593	0.019	3.235	0.533	0.860	0.40	0.00	1.26	224.622	1.588	223.362	224.33	222.43	-2.19	SUMP
GIBSON CIRCLE	MH752	MH704	221.207	220.960	4653.0	1350	85.3	0.013	1.431	0.485	0.29	2872.8	1.62	63.185	0.019	3.251	0.539	0.648	0.40	0.00	1.05	223.362	0.805	222.310	224.13	222.23	-1.13	SUMP
LEWIS AVENUE	MH720	MH704	221.556	221.250	1852.2	1050	102.0	0.013	0.866	0.410	0.30	1494.9	1.24	97.143	0.021	2.139	0.233	0.469	0.01	0.00	0.48	222.781	0.175	222.300	224.63	222.73	-0.05	SUMP
LEWIS AVENUE	MH704	HW 700	220.694	220.550	5840.1	1500	28.7	0.013	1.767	0.520	0.50	4995.9	1.17	19.133	0.018	3.305	0.557	0.196	0.03	0.00	0.22	222.274	0.080	222.050	224.12	222.22	-0.05	SUMP

Appendix F Major System Conveyance Calculations

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Appendix F-1 HDF-D Conveyance Calculations

100 Year - Flow Channel

Mannings' Equation for Trapezoidal Channel				
Required Flow Depth (m) =	0.30			
Side Slope Ratio (H:V) =	3.0	:1	Top width (m) =	3.8
Bed Width (m)=	2.00			
Area (m^2)=	0.870		Hyd. Rad, 'R' (m) =	0.223228
Wetted Perimeter (m)=	3.897			
Slope (%) =	3.50		Friction Slope Sf (m/m) =	0.0350
Manning 'n' =	0.025			
Channel Capacity, Q =	2.396	m3/sec	Velocity (m/s) =	2.754
100 year flow (VO 24 hr) =	2.075	m3/sec		

Culvert Calculator Report
Culvert - 2.075m3/s

Solve For: Section Size

Culvert Summary

Allowable HW Elevation	236.60	m	Headwater Depth/Height	1.36	
Computed Headwater Eleva	236.32	m	Discharge	2.0750	m^3/s
Inlet Control HW Elev.	236.32	m	Tailwater Elevation	0.30	m
Outlet Control HW Elev.	236.32	m	Control Type	Inlet Control	

Grades

Upstream Invert	235.28	m	Downstream Invert	234.92	m
Length	18.00	m	Constructed Slope	0.020000	m/m

Hydraulic Profile

Profile	S2		Depth, Downstream	0.47	m
Slope Type	Steep		Normal Depth	0.44	m
Flow Regime	Supercritical		Critical Depth	0.63	m
Velocity Downstream	3.48	m/s	Critical Slope	0.007965	m/m

Section

Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	0.76	m
Section Size	750 mm		Rise	0.76	m
Number Sections	2				

Outlet Control Properties

Outlet Control HW Elev.	236.32	m	Upstream Velocity Head	0.34	m
Ke	0.20		Entrance Loss	0.07	m

Inlet Control Properties

Inlet Control HW Elev.	236.32	m	Flow Control	Submerged	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	0.9	m^2
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

100 Year - Flow Channel

Mannings' Equation for Trapezoidal Channel				
Required Flow Depth (m) =	0.40			
Side Slope Ratio (H:V) =	3.0	:1	Top width (m) =	5.4
Bed Width (m)=	3.00			
Area (m^2)=	1.680		Hyd. Rad, 'R' (m) =	0.303807
Wetted Perimeter (m)=	5.530			
Slope (%) =	2.00		Friction Slope Sf (m/m) =	0.0200
Manning 'n' =	0.025			
Channel Capacity, Q =	4.295	m3/sec	Velocity (m/s) =	2.556
100 year flow (VO 24 hr) =	4.213	m3/sec		

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

BORDEN GRATE
SUPER CATCHBASIN SIZING
HDF-D2

Super Catchbasin Capacity		
Depth above grate =	0.30	m
Area of Orifice =	0.0041	m^2
Orifice Coefficient =	0.6	
Total Discharge, Q=	0.006	m^3/sec
Discharge Vel., V=	1.456	m/sec

Honeycomb Grating

Grating Length =	3.0	m
Grating Width =	2.4	m

Super Catchbasin Opening

Length =	3.000	m
Width =	2.400	m
Area =	7.200	m^2
Lost Area to Structural Support =	0.000	m^2
Area Lost to Grating/Opening =	0.00091	m^2
Orifice Opening Area =	0.0041	m^2
Effective number of Openings =	1429	
Grating Open Area =	5.898	m^2
Assumed Blockage =	**50.0**	**%**
Effective Grating Open Area =	2.949	m^2
Effective flow Capacity =	4.2929	m^3/sec
Super CB Lead Capacity =	0.00	m^3/sec
Number of Super Catchbasins =	1	
Super Catchbasin Capacity =	4.293	m^3/sec
Number of Std. Double CB's =	0	
Double Catchbasin Capacity =		m^3/sec (sag capacity)
Total Inlet Capacity =	**4.293**	m^3/sec

Appendix F-2 HDF-E Conveyance Calculations

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Existing Natural Channel (HDF - E) Regional

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	4.000 %
Discharge	5.077 m³/s

Section Definitions

Station (m)	Elevation (m)
0+00.000	233.292
0+00.100	233.277
0+04.010	233.100
0+12.770	232.826
0+14.240	232.812
0+15.940	232.686
0+16.110	232.673
0+17.110	232.500
0+20.000	231.842
0+25.820	230.516
0+28.950	230.392
0+30.990	230.301
0+38.000	229.574
0+40.000	229.478
0+40.150	229.471
0+45.880	229.411
0+47.840	229.365
0+53.120	229.537
0+55.780	230.133
0+57.530	230.504
0+60.000	230.819
0+60.010	230.821
0+69.090	232.402
0+73.890	233.159
0+77.350	233.828
0+79.480	234.279
0+80.000	234.351
0+80.990	234.489
0+88.020	235.375
0+96.050	235.963
0+97.510	236.071

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.000, 233.292)	(0+97.510, 236.071)	0.035

Existing Natural Channel (HDF - E) Regional

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	269.1 mm
Roughness Coefficient	0.035
Elevation	229.634 m
Elevation Range	229.365 to 236.071 m
Flow Area	2.8 m²
Wetted Perimeter	16.153 m
Hydraulic Radius	175.4 mm
Top Width	16.13 m
Normal Depth	269.1 mm
Critical Depth	311.4 mm
Critical Slope	2.022 %
Velocity	1.79 m/s
Velocity Head	0.164 m
Specific Energy	0.43 m
Froude Number	1.365
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 mm
Length	0.000 m
Number Of Steps	0

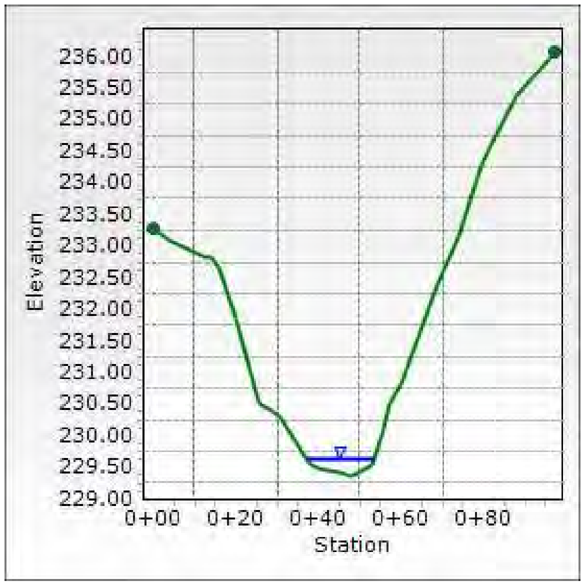
GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	269.1 mm
Critical Depth	311.4 mm
Channel Slope	4.000 %
Critical Slope	2.022 %

Cross Section for Existing Natural Channel (HDF - E) Regional

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	4.000 %
Normal Depth	269.1 mm
Discharge	5.077 m³/s



Low Flow Channel (HDF - E)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	1.500 %
Discharge	0.500 m^3/s

Section Definitions

Station (m)	Elevation (m)
0+07.041	0.300
0+07.941	0.000
0+08.941	0.000
0+09.841	0.300

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+07.041, 0.300)	(0+09.841, 0.300)	0.035

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	258.3 mm
Roughness Coefficient	0.035
Elevation	0.258 m
Elevation Range	0.000 to 0.300 m
Flow Area	0.5 m^2
Wetted Perimeter	2.633 m
Hydraulic Radius	174.1 mm
Top Width	2.55 m
Normal Depth	258.3 mm
Critical Depth	232.0 mm
Critical Slope	2.285 %
Velocity	1.09 m/s
Velocity Head	0.061 m
Specific Energy	0.32 m
Froude Number	0.822
Flow Type	Subcritical

Low Flow Channel (HDF - E)

GVF Input Data

Downstream Depth	0.0 mm
Length	0.000 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	258.3 mm
Critical Depth	232.0 mm
Channel Slope	1.500 %
Critical Slope	2.285 %

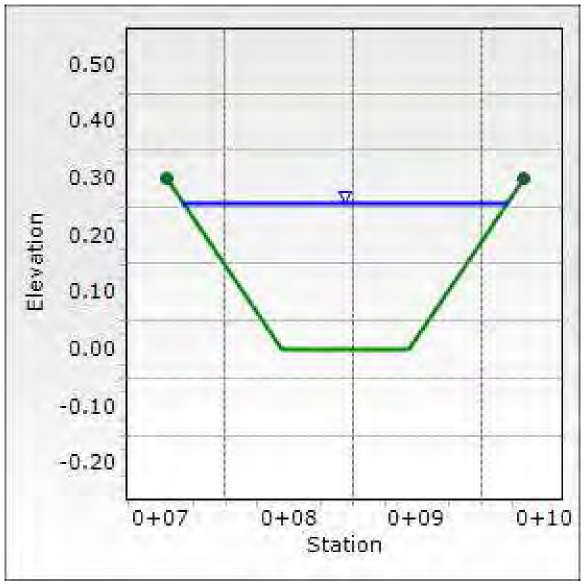
Cross Section for Low Flow Channel (HDF - E)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.500 %
Normal Depth	258.3 mm
Discharge	0.500 m³/s



Main Channel (HDF - E) at Property Line

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.500 %
Discharge	5.077 m³/s

Section Definitions

Station (m)	Elevation (m)
0+00.000	0.808
0+01.441	0.328
0+07.041	0.300
0+07.941	0.000
0+08.941	0.000
0+09.841	0.300
0+15.441	0.328
0+16.882	0.808

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.000, 0.808)	(0+01.441, 0.328)	0.080
(0+01.441, 0.328)	(0+15.441, 0.328)	0.035
(0+15.441, 0.328)	(0+16.882, 0.808)	0.080

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	678.8 mm
Roughness Coefficient	0.044
Elevation	0.679 m
Elevation Range	0.000 to 0.808 m
Flow Area	6.1 m²
Wetted Perimeter	16.318 m
Hydraulic Radius	373.0 mm
Top Width	16.11 m
Normal Depth	678.8 mm
Critical Depth	507.1 mm
Critical Slope	3.148 %

Main Channel (HDF - E) at Property Line

Results	
Velocity	0.83 m/s
Velocity Head	0.035 m
Specific Energy	0.71 m
Froude Number	0.433
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 mm
Length	0.000 m
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	678.8 mm
Critical Depth	507.1 mm
Channel Slope	0.500 %
Critical Slope	3.148 %

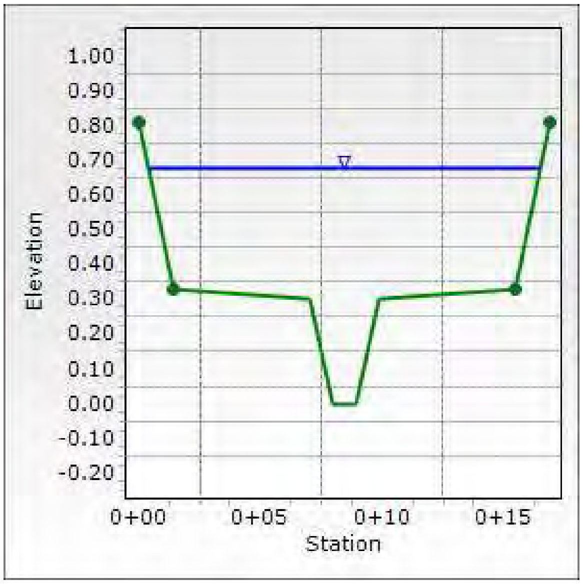
Cross Section for Main Channel (HDF - E) at Property Line

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.500 %
Normal Depth	678.8 mm
Discharge	5.077 m³/s



Main Channel (HDF - E)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.500 %
Discharge	5.077 m³/s

Section Definitions

Station (m)	Elevation (m)
0+00.000	0.808
0+01.441	0.328
0+07.041	0.300
0+07.941	0.000
0+08.941	0.000
0+09.841	0.300
0+15.441	0.328
0+16.882	0.808

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.000, 0.808)	(0+01.441, 0.328)	0.080
(0+01.441, 0.328)	(0+15.441, 0.328)	0.035
(0+15.441, 0.328)	(0+16.882, 0.808)	0.080

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	554.8 mm
Roughness Coefficient	0.041
Elevation	0.555 m
Elevation Range	0.000 to 0.808 m
Flow Area	4.1 m²
Wetted Perimeter	15.533 m
Hydraulic Radius	266.2 mm
Top Width	15.36 m
Normal Depth	554.8 mm
Critical Depth	507.2 mm
Critical Slope	2.779 %

Main Channel (HDF - E)

Results	
Velocity	1.23 m/s
Velocity Head	0.077 m
Specific Energy	0.63 m
Froude Number	0.756
Flow Type	Subcritical

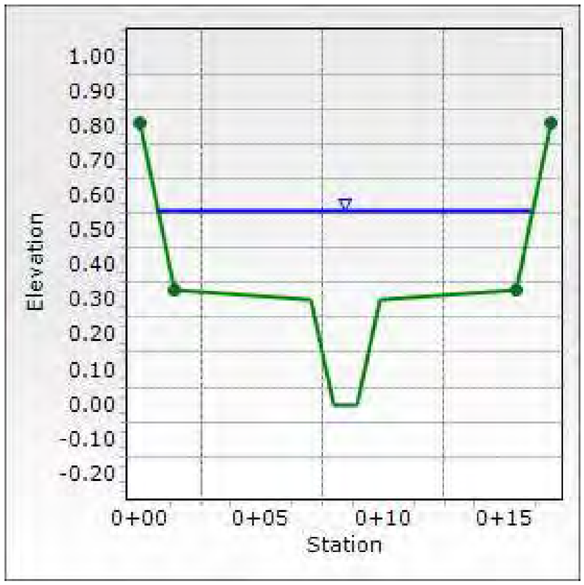
GVF Input Data	
Downstream Depth	0.0 mm
Length	0.000 m
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	Infinity m/s
Upstream Velocity	Infinity m/s
Normal Depth	554.8 mm
Critical Depth	507.2 mm
Channel Slope	1.500 %
Critical Slope	2.779 %

Cross Section for Main Channel (HDF - E)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	1.500 %
Normal Depth	554.8 mm
Discharge	5.077 m³/s



Culvert Analysis Report
Culvert-1

Culvert Summary					
Computed Headwater Eleva	229.61	m	Discharge	5.0770	m³/s
Inlet Control HW Elev.	229.57	m	Tailwater Elevation	228.92	m
Outlet Control HW Elev.	229.61	m	Control Type	Outlet Control	
Headwater Depth/Height	0.45				

Grades					
Upstream Invert	229.07	m	Downstream Invert	228.55	m
Length	35.00	m	Constructed Slope	0.015000	m/m

Hydraulic Profile					
Profile	M1		Depth, Downstream	0.37	m
Slope Type	Mild		Normal Depth	0.34	m
Flow Regime	Subcritical		Critical Depth	0.32	m
Velocity Downstream	1.48	m/s	Critical Slope	0.019287	m/m

Section					
Section Shape	Box		Mannings Coefficient	0.035	
Section Material	Concrete		Span	9.14	m
Section Size	DESPAN - 9144X1220		Rise	1.22	m
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	229.61	m	Upstream Velocity Head	0.14	m
Ke	0.50		Entrance Loss	0.07	m

Inlet Control Properties					
Inlet Control HW Elev.	229.57	m	Flow Control	Unsubmerged	
Inlet Type	45° bevels; 10 - 45° skewed headwall		Area Full	11.2	m²
K	0.49800		HDS 5 Chart	11	
M	0.66700		HDS 5 Scale	4	
C	0.03270		Equation Form	2	
Y	0.75000				

Appendix F-3 Right-of-Way Conveyance Capacity Calculations

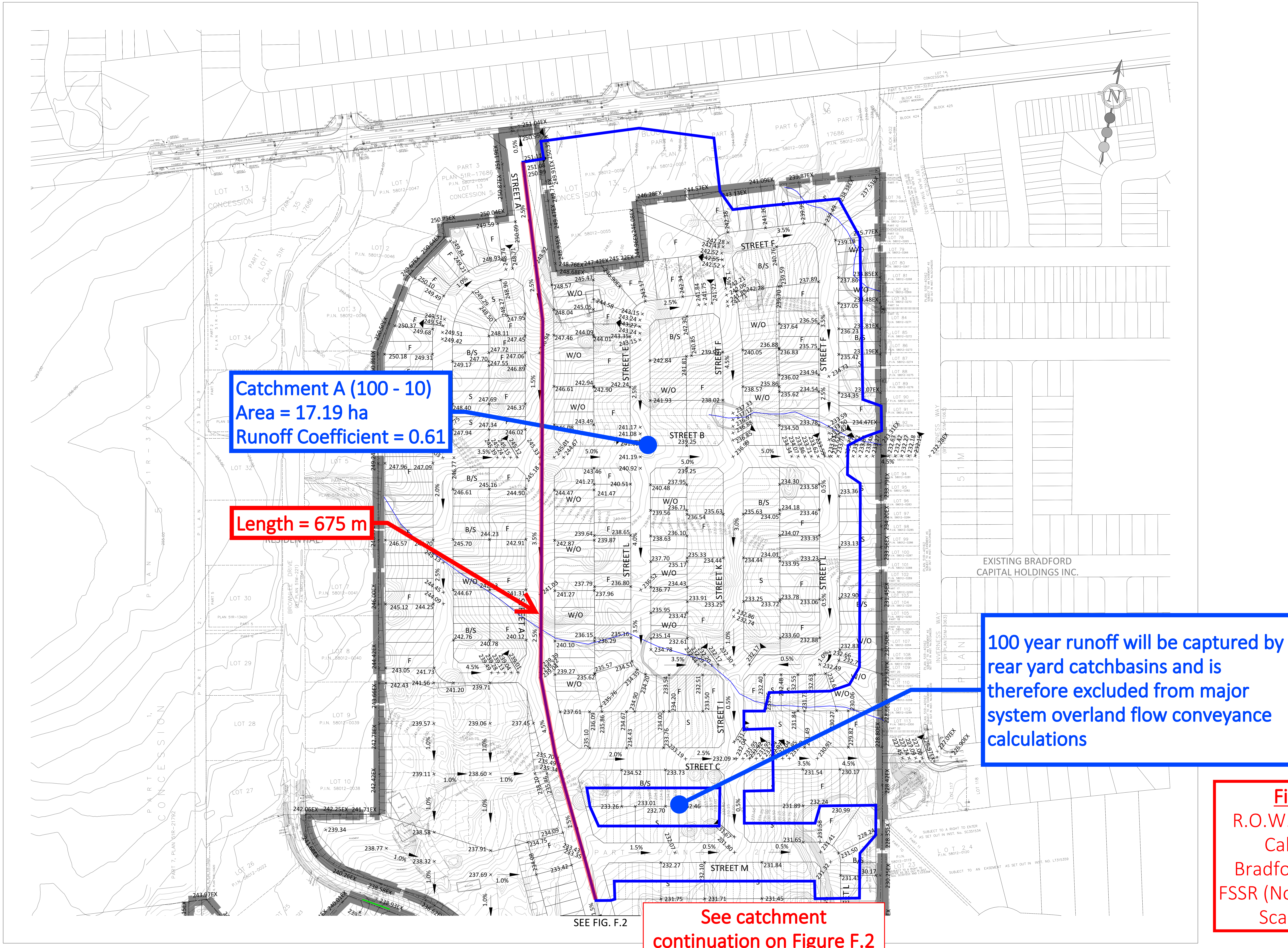


Figure F.1
R.O.W. Conveyance Calculations
Bradford Highlands
FSSR (November 2024)
Scale: 1:1500

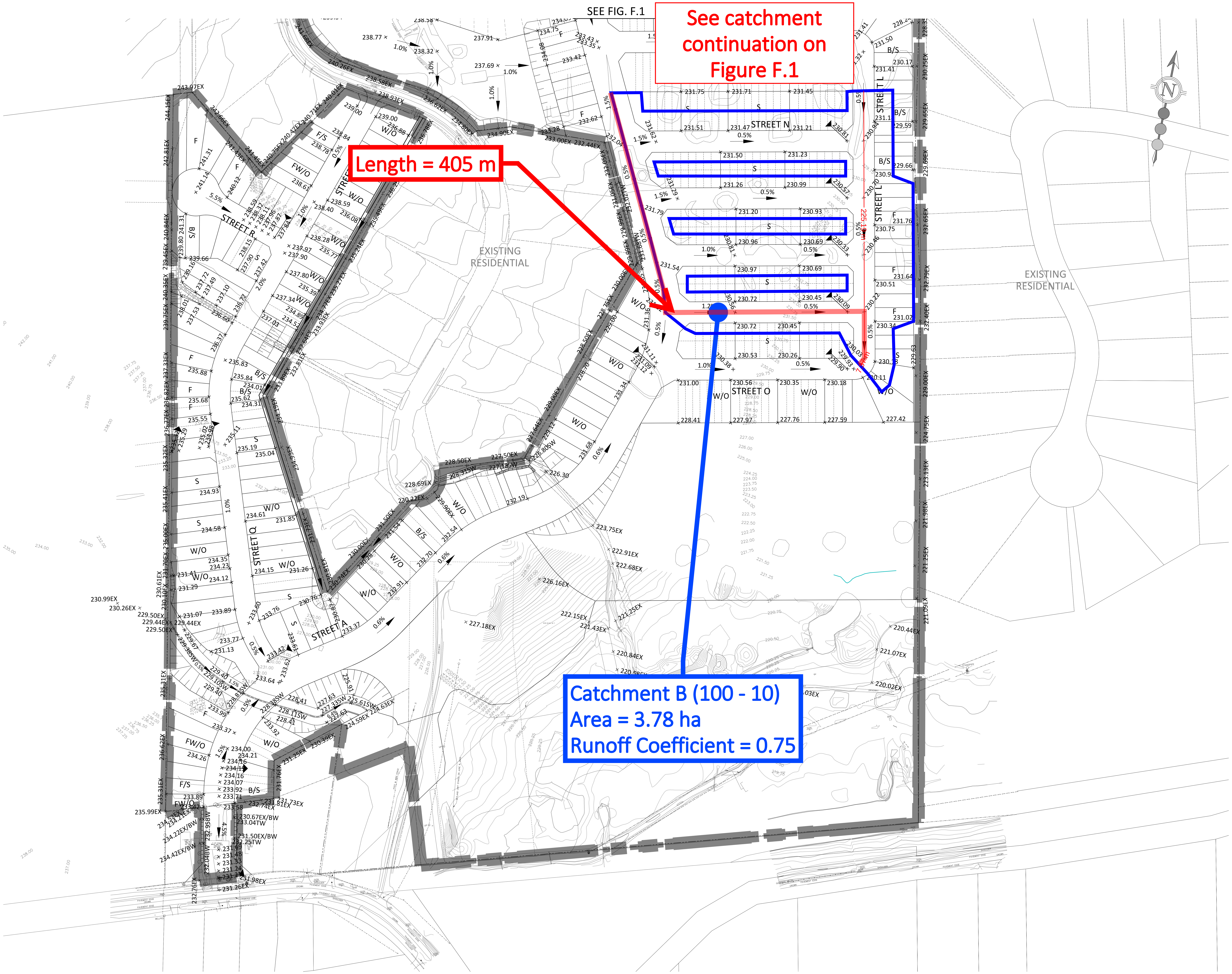


Figure F.2
R.O.W. Conveyance Calculations
Bradford Highlands
FSSR (November 2024)
Scale: 1:1500

OVERLAND FLOW CALCULATIONS

Catchment A — **100 Year Return Period Factor =** 1.25

	Runoff Coefficient	Area (ha)*	Weighted Runoff Coefficient (10 Year)	Weighted Runoff Coefficient (100 Year)
Townhouse	0.76	5.85	0.26	0.32
External Rural Residential	0.40	1.39	0.03	0.04
Singles	0.66	8.38	0.32	0.40
Road	0.70	1.56	0.06	0.08
TOTAL		**17.19**	**0.61**	**0.76**

Catchment B

	Runoff Coefficient	Area (ha)	Weighted Runoff Coefficient (10 Year)	Weighted Runoff Coefficient (100 Year)
Townhouse	0.76	0.50	0.10	0.13
Singles	0.66	0.84	0.15	0.18
Back-to-Backs	0.80	1.97	0.42	0.52
Road	0.70	0.46	0.09	0.11
TOTAL		3.78	0.75	**0.94**

Catchment A & B	**Return Period** 10 Year	
Area (ha)=	20.97	
Runoff Coeff. =	0.64	
T_c (min)=	19.00	(10 min. plus (675 + 405) m @ 2 m/s)
a =	**1118.79**	
b =	**6.018**	
c =	**0.800**	
Intensity (mm/hr) =	85.14	
Runoff (m^3/s) =	**3.150**	

Catchment A & B	**Return Period** 100 Year
Area (ha)=	20.97
Runoff Coeff. =	0.64
T_c (min)=	19.00
a =	**1443.947**
b =	**5.273**
c =	**0.776**
Intensity (mm/hr) =	121.53
Runoff (m^3/s) =	**4.496**

*Area per Figures F.1 and F.2
*IDF parameters per Bradford West Gwillimbury

10 Year Flow (Catchment A)

Q_{5yr} (m^3/s) = **3.150**

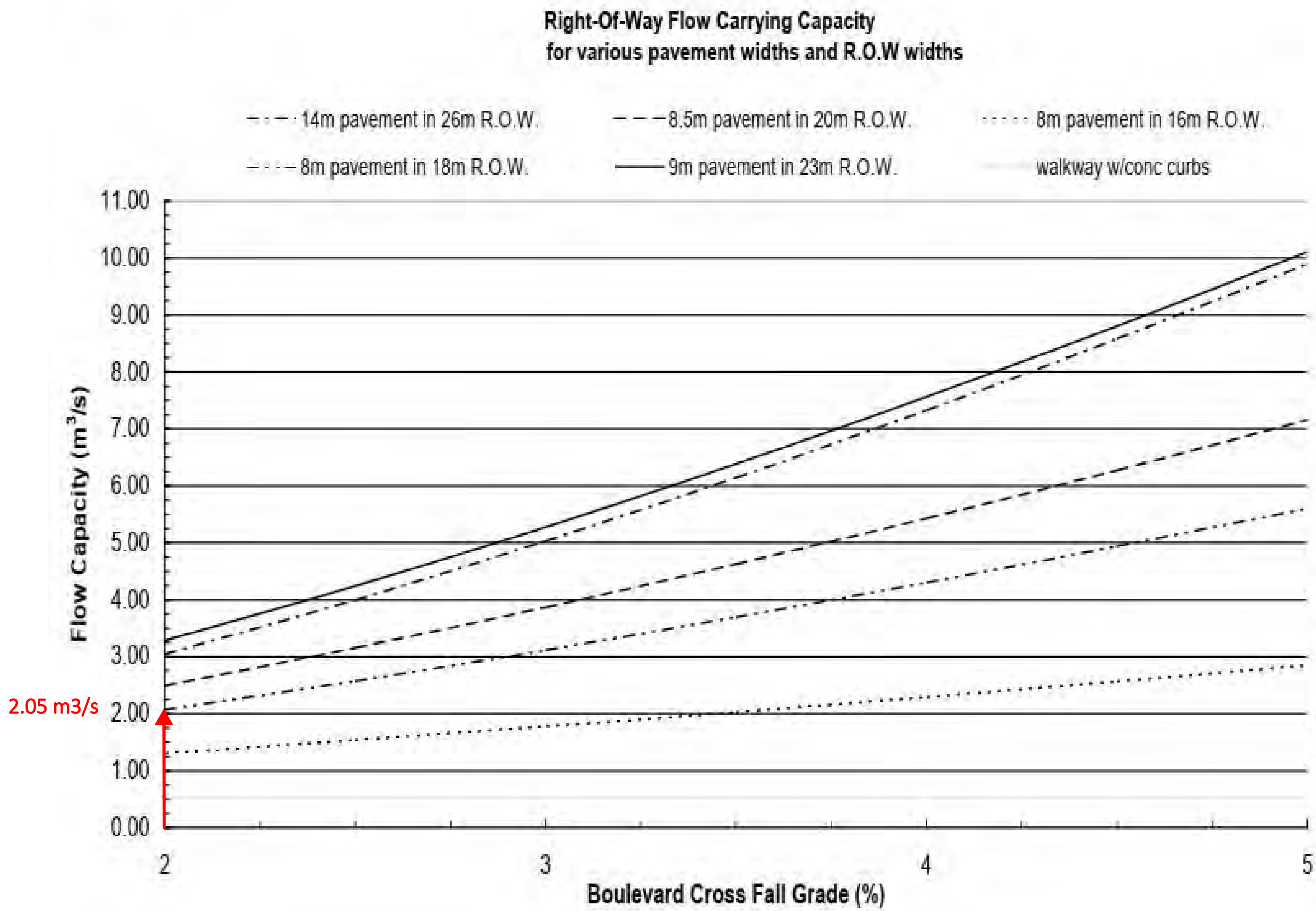
100 Year Flow(Catchment A)

Q_{100yr} (m^3/s) = **4.496**

Required 100 Year Conveyance Capacity

$Q_{100\text{-}5yr}$ (m^3/s) = **1.346**

Figure 2



A 8.5 m pavement in 18m ROW with 2% boulevard cross fall has sufficient overland flow capacity for +/-2.05 m3/s, which is greater than the calculated major system overland flow rate of 1.35 m3/s. Therefore, there is sufficient major system overland flow capacity.

Appendix F-4 SWM Pond Outfall Channel Conveyance Calculations

100 Year - Flow Channel

Mannings' Equation for Trapezoidal Channel				
Required Flow Depth (m) =	0.30			
Side Slope Ratio (H:V) =	3.0	:1	Top width (m) =	3.3
Bed Width (m)=	1.50			
Area (m^2)=	0.720		Hyd. Rad, 'R' (m) =	0.211929
Wetted Perimeter (m)=	3.397			
Slope (%) =	0.90		Friction Slope Sf (m/m) =	0.0090
Manning 'n' =	0.025			
Channel Capacity, Q =	0.971	m3/sec	Velocity (m/s) =	1.349
100 year flow (VO 24 hr) =	0.615	m3/sec		

Appendix G Stormwater Management

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Drainage Area Characteristics
Site Pond

Weighted Impervious Calculation

Catchment ID	Total Area	Imperviousness	Impervious Area
	(ha)	(%)	(ha)
1104	2.76	0	0.00
1105	2.86	0	0.00
1106	2.09	0	0.00
1111	1.39	12.2	0.17
1109	0.41	14.4	0.06
2101	22.04	63	13.89
2103	0.39	0.63	0.00
Total	**31.94**	**44**	**14.12**

Drainage Area Characteristics

Site Pond

PERMANENT POOL

Level of Protection = Enhanced (Level 1)

Weighted Impervious = 44 %

Drainage Area = 31.94 ha

SWMP Type = 4. Wet Pond

Required Water Quality Control (including 40m^3/ha for extended detention)= 163.0 m^3/ha
Required Permanent Pool (minus 40m^3/ha for extended detention)= 123 m^3/ha

Required Permanent Pool = 3928 m^3

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		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 (Continuous Flow)	90	150	200	240

EXTENDED DETENTION

Using the 25mm - 4 hour Chicago Storm

Erosion Control Volume (V) = Runoff Depth (mm) x Drainage Area (ha) x 10 (m^3) / (mm)(ha)

Erosion Control Volume (V) = 8.749 mm x 31.94 ha x 10 m^3 / mm·ha

Erosion Control Volume (V) = 2794 m^3

Using 40m^3/ha

Extended Detention Volume (V) = 40m^3/ha x Drainage Area (ha)

Extended Detention Volume (V) = 40 m^3/ha 31.94 ha

Extended Detention Volume (V) = 1277.60 m^3

Governing Volume (V) = 2794 m^3

Drainage Area Characteristics
Site Pond

Elevation (m)	Area (m^2)	Area (m^2)	H (m)	Vol (m^3)	Volume (m^3)	Storage (m^3)	Depth (m)	
221.5	8749.715				0		0	
		10161	1	10160.54				
222.5	11571.36				10161		1	
		12721	0.5	6360.578				
223	**13870.95**				16521	**0**	**1.5**	**N.W.L.**
		14984	0.5	7492.083				
223.5	16097.38				24013	7492.083	2	
		17850	1.5	26775				
225	19602.64				50788	34267	3.5	

Permanent Pool Volume Required = 3928 m^3
Permanent Pool Volume Provided = 16521 m^3

Extended Detention volume required = 2794 m^3
Extended Detention waterlevel = 223.22 m

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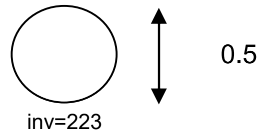
CONTROL STRUCTURE SUMMARY
SITE POND

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

Orifice 1

Invert =	223.00	m
Size =	0.500	m
Orifice Coefficient, C =	0.62	
Obvert =	223.5	m



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OUTFLOW SUMMARY
SITE POND

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

Starting Water Level (m) = 223.00
Elevation Increment (m) = 0.02

Shading represents Storage-Discharge pairings used in VO modelling

Upstream Elevation (m)	Low Flow Constriction (m^3/s)	Orifice 1 Outflow (cms)	Orifice 2 Outflow (cms)	Orifice 3 Outflow (cms)	Weir 1 Outflow (cms)	Weir 2 Outflow (cms)	Weir 3 Outflow (cms)	Ditch Inlet Outflow (cms)	Super CB Capacity (m^3/s)	Capture Grate Outflow (cms)	Backwater Elevation (m)	Stage (m)	Total Flow (cms)	Storage (m^3)	Detention Time (hrs)
223.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.00	0.000	0	0.0
223.02	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.02	0.001	278	0.0
223.04	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.04	0.002	557	0.0
223.06	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.06	0.005	837	19.9
223.08	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.08	0.009	1119	30.4
223.10	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.10	0.015	1401	37.0
223.12	0.000	0.021	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.12	0.021	1685	41.4
223.14	0.000	0.028	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.14	0.028	1970	44.7
223.16	0.000	0.036	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.16	0.036	2256	47.2
223.18	0.000	0.045	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.18	0.045	2543	49.2
223.20	0.000	0.054	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.20	0.054	2832	50.8
223.22	0.000	0.064	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.22	0.064	3121	52.2
223.24	0.000	0.075	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.24	0.075	3412	53.3
223.26	0.000	0.075	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.26	0.075	3703	54.4
223.28	0.000	0.093	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.28	0.093	3996	55.3
223.30	0.000	0.121	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.30	0.121	4290	56.1
223.32	0.000	0.143	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.32	0.143	4585	56.7
223.34	0.000	0.162	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.34	0.162	4882	57.3
223.36	0.000	0.179	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.36	0.179	5179	57.8
223.38	0.000	0.194	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.38	0.194	5478	58.2
223.40	0.000	0.209	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.40	0.209	5778	58.6
223.42	0.000	0.222	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.42	0.222	6079	59.0
223.44	0.000	0.235	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.44	0.235	6381	59.4
223.46	0.000	0.247	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.46	0.247	6684	59.7
223.48	0.000	0.259	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.48	0.259	6988	60.1
223.50	0.000	0.270	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.50	0.270	7294	60.4
223.52	0.000	0.280	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.52	0.280	7600	60.7
223.54	0.000	0.290	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.54	0.290	7908	61.0
223.56	0.000	0.300	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.56	0.300	8217	61.3
223.58	0.000	0.310	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.58	0.310	8527	61.6
223.60	0.000	0.319	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.60	0.319	8838	61.8
223.62	0.000	0.328	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.62	0.328	9151	62.1
223.64	0.000	0.337	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.64	0.337	9464	62.4
223.66	0.000	0.345	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.66	0.345	9779	62.6
223.68	0.000	0.354	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.68	0.354	10095	62.9
223.70	0.000	0.362	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.70	0.362	10412	63.1
223.72	0.000	0.370	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.72	0.370	10730	63.4
223.74	0.000	0.377	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.74	0.377	11049	63.6
223.76	0.000	0.385	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.76	0.385	11370	63.8
223.78	0.000	0.393	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.78	0.393	11691	64.1
223.80	0.000	0.400	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.80	0.400	12014	64.3
223.82	0.000	0.407	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.82	0.407	12338	64.5
223.84	0.000	0.414	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.84	0.414	12663	64.7
223.86	0.000	0.421	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.86	0.421	12989	64.9
223.88	0.000	0.428	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.88	0.428	13316	65.2
223.90	0.000	0.435	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.90	0.435	13645	65.4
223.92	0.000	0.441	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.92	0.441	13974	65.6
223.94	0.000	0.448	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.94	0.448	14305	65.8

OUTFLOW SUMMARY
SITE POND

Starting Water Level (m) = 223.00
Elevation Increment (m) = 0.02

Shading represents Storage-Discharge pairings used in VO modelling

Upstream Elevation (m)	Low Flow Constriction (m^3/s)	Orifice 1 Outflow (cms)	Orifice 2 Outflow (cms)	Orifice 3 Outflow (cms)	Weir 1 Outflow (cms)	Weir 2 Outflow (cms)	Weir 3 Outflow (cms)	Ditch Inlet Outflow (cms)	Super CB Capacity (m^3/s)	Capture Grate Outflow (cms)	Backwater Elevation (m)	Stage (m)	Total Flow (cms)	Storage (m^3)	Detention Time (hrs)
223.96	0.000	0.454	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.96	0.454	14637	66.0
223.98	0.000	0.461	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	223.98	0.461	14970	66.2
224.00	0.000	0.467	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.00	0.467	15304	66.4
224.02	0.000	0.473	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.02	0.473	15639	66.6
224.04	0.000	0.479	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.04	0.479	15976	66.8
224.06	0.000	0.485	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.06	0.485	16313	67.0
224.08	0.000	0.491	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.08	0.491	16652	67.2
224.10	0.000	0.497	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.10	0.497	16992	67.4
224.12	0.000	0.503	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.12	0.503	17333	67.6
224.14	0.000	0.509	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.14	0.509	17675	67.7
224.16	0.000	0.514	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.16	0.514	18018	67.9
224.18	0.000	0.520	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.18	0.520	18363	68.1
224.20	0.000	0.526	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.20	0.526	18709	68.3
224.22	0.000	0.531	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.22	0.531	19055	68.5
224.24	0.000	0.537	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.24	0.537	19403	68.7
224.26	0.000	0.542	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.26	0.542	19752	68.8
224.28	0.000	0.547	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.28	0.547	20103	69.0
224.30	0.000	0.553	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.30	0.553	20454	69.2
224.32	0.000	0.558	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.32	0.558	20806	69.4
224.34	0.000	0.563	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.34	0.563	21160	69.6
224.36	0.000	0.568	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.36	0.568	21515	69.7
224.38	0.000	0.573	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.38	0.573	21871	69.9
224.40	0.000	0.578	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.40	0.578	22228	70.1
224.42	0.000	0.583	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.42	0.583	22586	70.2
224.44	0.000	0.588	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.44	0.588	22945	70.4
224.46	0.000	0.593	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.46	0.593	23306	70.6
224.48	0.000	0.598	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.48	0.598	23668	70.8
224.50	0.000	0.603	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.50	0.603	24030	70.9
224.52	0.000	0.608	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.52	0.608	24394	71.1
224.54	0.000	0.612	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.54	0.612	24760	71.3
224.56	0.000	0.617	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.56	0.617	25126	71.4
224.58	0.000	0.622	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.58	0.622	25493	71.6
224.60	0.000	0.627	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.60	0.627	25862	71.7
224.62	0.000	0.631	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.62	0.631	26231	71.9
224.64	0.000	0.636	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.64	0.636	26602	72.1
224.66	0.000	0.640	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.66	0.640	26974	72.2
224.68	0.000	0.645	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.68	0.645	27347	72.4
224.70	0.000	0.649	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.70	0.649	27722	72.6
224.72	0.000	0.654	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.72	0.654	28097	72.7
224.74	0.000	0.658	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.74	0.658	28474	72.9
224.76	0.000	0.663	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.76	0.663	28851	73.0
224.78	0.000	0.667	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.78	0.667	29230	73.2
224.80	0.000	0.671	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.80	0.671	29610	73.4
224.82	0.000	0.676	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.82	0.676	29992	73.5
224.84	0.000	0.680	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.84	0.680	30374	73.7
224.86	0.000	0.684	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.86	0.684	30757	73.8

OUTFLOW SUMMARY
SITE POND

Starting Water Level (m) = 223.00
Elevation Increment (m) = 0.02

Shading represents Storage-Discharge pairings used in VO modelling

Upstream Elevation (m)	Low Flow Constriction (m^3/s)	Orifice 1 Outflow (cms)	Orifice 2 Outflow (cms)	Orifice 3 Outflow (cms)	Weir 1 Outflow (cms)	Weir 2 Outflow (cms)	Weir 3 Outflow (cms)	Ditch Inlet Outflow (cms)	Super CB Capacity (m^3/s)	Capture Grate Outflow (cms)	Backwater Elevation (m)	Stage (m)	Total Flow (cms)	Storage (m^3)	Detention Time (hrs)
224.88	0.000	0.688	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.88	0.688	31142	74.0
224.90	0.000	0.693	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.90	0.693	31528	74.1
224.92	0.000	0.697	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.92	0.697	31915	74.3
224.94	0.000	0.701	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.94	0.701	32303	74.4
224.96	0.000	0.705	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.96	0.705	32692	74.6
224.98	0.000	0.709	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	224.98	0.709	33082	74.7
225.00	0.000	0.713	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	225.00	0.713	33474	74.9

Drainage Area Characteristics
BRADFORD CAPITAL
POND 700-2

Weighted Impervious Calculation

Catchment ID	Total Area	Imperviousness	Impervious Area
	(ha)	(%)	(ha)
7020	13.50	50	6.75
7021	15.00	50	7.50
7022	6.30	20	1.26
7023	1.50	0	0.00
7024	2.70	65	1.76
1202	2.73	16	0.43
1203	15.03	8	1.19
2201	23.25	66	15.35
2202	1.44	74	1.07
Total	**81.45**	**43**	**35.30**

BRADFORD CAPITAL POND 700-2
Permanent Pool and Extended Detention Sizing

Bradford Highlands
Project Number: 1791
Date: September 2024
Designer Initials: H.Y.

PERMANENT POOL

Level of Protection = Enhanced (Level 1)

Weighted Impervious = 43 %

Drainage Area = 81.45 ha

SWMP Type = 4. Wet Pond

Required Water Quality Control (including 40m^3/ha for extended detention)= 160.8 m^3/ha
Required Permanent Pool (minus 40m^3/ha for extended detention)= 121 m^3/ha

Required Permanent Pool = 9842 m^3

TABLE 3.2 - WATER QUALITY STORAGE REQUIREMENTS
(FROM MOE SWM PLANNING AND DESIGN MANUAL - 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		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 (Continuous Flow)	90	150	200	240

EXTENDED DETENTION

Using the 25mm - 4 hour Chicago Storm

Erosion Control Volume (V) = Runoff Depth (mm) x Drainage Area (ha) x 10 (m^3) / (mm)(ha)

Erosion Control Volume (V) = 8.285 mm x 81.45 ha x 10 m^3 / mm·ha

Erosion Control Volume (V) = 6748 m^3

Using 40m^3/ha

Extended Detention Volume (V) = 40m^3/ha x Drainage Area (ha)

Extended Detention Volume (V) = 40 m^3/ha 81.45 ha

Extended Detention Volume (V) = 3258 m^3

Governing Volume (V) = 6748 m^3

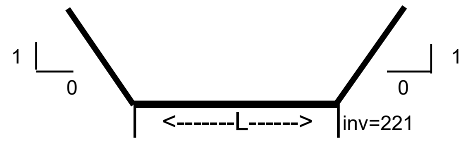
Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

CONTROL STRUCTURE SUMMARY
BRADFORD CAPITAL POND
700-2

Broad Crested Weir (Weir 1)

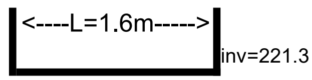
Length =	1.20	m
Elevation =	221.00	m
Crest Breadth =	0.3	m
Side Slope =	0.0	

(0 = vertical, 1 = 1H to 1V, 3 = 3H to 1 v)



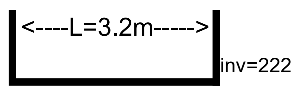
Broad Crested Weir (Weir 2)

Length =	1.60	m
Elevation =	221.30	m
Crest Breadth =	0.90	m



Broad Crested Weir (Weir 3)

Length =	3.20	m
Elevation =	222.00	m
Crest Breadth =	0.90	m



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OUTFLOW SUMMARY
BRADFORD CAPITAL POND
700-2

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

Starting Water Level (m) = 220.50
Elevation Increment (m) = 0.02

Shading represents Storage-Discharge pairings used in VO modelling

Upstream Elevation (m)	Low Flow Constriction (m^3/s)	Orifice 1 Outflow (cms)	Orifice 2 Outflow (cms)	Orifice 3 Outflow (cms)	Weir 1 Outflow (cms)	Weir 2 Outflow (cms)	Weir 3 Outflow (cms)	Ditch Inlet Outflow (cms)	Super CB Capacity (m^3/s)	Capture Grate Outflow (cms)	Backwater Elevation (m)	Stage (m)	Total Flow (cms)	Storage (m^3)	Detention Time (hrs)
220.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.50	0.000	0	0.0
220.52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.52	0.000	243	0.0
220.54	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.54	0.001	489	0.0
220.56	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.56	0.003	735	29.3
220.58	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.58	0.005	984	45.2
220.60	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.60	0.005	1234	57.9
220.62	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.62	0.012	1486	65.8
220.64	0.000	0.017	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.64	0.017	1740	70.6
220.66	0.000	0.021	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.66	0.021	1995	74.3
220.68	0.000	0.024	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.68	0.024	2252	77.4
220.70	0.000	0.027	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.70	0.027	2511	80.2
220.72	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.72	0.030	2771	82.7
220.74	0.000	0.032	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.74	0.032	3033	85.1
220.76	0.000	0.035	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.76	0.035	3297	87.3
220.78	0.000	0.037	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.78	0.037	3563	89.4
220.80	0.000	0.039	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.80	0.039	3830	91.3
220.82	0.000	0.040	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.82	0.040	4099	93.2
220.84	0.000	0.042	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.84	0.042	4369	95.0
220.86	0.000	0.044	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.86	0.044	4641	96.8
220.88	0.000	0.046	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.88	0.046	4915	98.5
220.90	0.000	0.047	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.90	0.047	5191	100.1
220.92	0.000	0.049	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.92	0.049	5468	101.7
220.94	0.000	0.050	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.94	0.050	5747	103.3
220.96	0.000	0.052	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.96	0.052	6028	104.8
220.98	0.000	0.053	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	220.98	0.053	6310	106.3
221.00	0.000	0.055	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00	221.00	0.055	6594	107.8
221.02	0.000	0.056	0.000	0.000	0.005	0.000	0.000	0.00	0.00	0.00	0.00	221.02	0.061	6880	109.2
221.04	0.000	0.057	0.000	0.000	0.014	0.000	0.000	0.00	0.00	0.00	0.00	221.04	0.072	7166	110.4
221.06	0.000	0.059	0.000	0.000	0.026	0.000	0.000	0.00	0.00	0.00	0.00	221.06	0.085	7454	111.4
221.08	0.000	0.060	0.000	0.000	0.041	0.000	0.000	0.00	0.00	0.00	0.00	221.08	0.101	7743	112.2
221.10	0.000	0.061	0.000	0.000	0.057	0.000	0.000	0.00	0.00	0.00	0.00	221.10	0.118	8033	113.0
221.12	0.000	0.062	0.000	0.000	0.075	0.000	0.000	0.00	0.00	0.00	0.00	221.12	0.137	8324	113.6
221.14	0.000	0.063	0.000	0.000	0.094	0.000	0.000	0.00	0.00	0.00	0.00	221.14	0.158	8616	114.2
221.16	0.000	0.065	0.000	0.000	0.115	0.000	0.000	0.00	0.00	0.00	0.00	221.16	0.180	8910	114.7
221.18	0.000	0.066	0.000	0.000	0.137	0.000	0.000	0.00	0.00	0.00	0.00	221.18	0.203	9204	115.1
221.20	0.000	0.067	0.000	0.000	0.161	0.000	0.000	0.00	0.00	0.00	0.00	221.20	0.228	9500	115.5
221.22	0.000	0.068	0.000	0.000	0.188	0.000	0.000	0.00	0.00	0.00	0.00	221.22	0.256	9797	115.8
221.24	0.000	0.069	0.000	0.000	0.214	0.000	0.000	0.00	0.00	0.00	0.00	221.24	0.283	10094	116.1
221.26	0.000	0.070	0.000	0.000	0.242	0.000	0.000	0.00	0.00	0.00	0.00	221.26	0.312	10393	116.4
221.28	0.000	0.071	0.000	0.000	0.270	0.000	0.000	0.00	0.00	0.00	0.00	221.28	0.341	10694	116.6
221.30	0.000	0.072	0.000	0.000	0.325	0.000	0.000	0.00	0.00	0.00	0.00	221.30	0.398	10995	116.9
221.32	0.000	0.073	0.000	0.000	0.358	0.006	0.000	0.00	0.00	0.00	0.00	221.32	0.438	11297	117.1
221.34	0.000	0.074	0.000	0.000	0.393	0.018	0.000	0.00	0.00	0.00	0.00	221.34	0.485	11601	117.3
221.36	0.000	0.075	0.000	0.000	0.428	0.034	0.000	0.00	0.00	0.00	0.00	221.36	0.537	11905	117.4
221.38	0.000	0.076	0.000	0.000	0.464	0.052	0.000	0.00	0.00	0.00	0.00	221.38	0.592	12211	117.6
221.40	0.000	0.077	0.000	0.000	0.537	0.072	0.000	0.00	0.00	0.00	0.00	221.40	0.687	12518	117.7
221.42	0.000	0.078	0.000	0.000	0.578	0.095	0.000	0.00	0.00	0.00	0.00	221.42	0.751	12826	117.8
221.44	0.000	0.079	0.000	0.000	0.620	0.120	0.000	0.00	0.00	0.00	0.00	221.44	0.819	13135	117.9

SCS consulting group ltd

OUTFLOW SUMMARY
BRADFORD CAPITAL POND
700-2

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: H.Y.

Starting Water Level (m) = 220.50
Elevation Increment (m) = 0.02

Shading represents Storage-Discharge pairings used in VO modelling

Upstream Elevation (m)	Low Flow Constriction (m^3/s)	Orifice 1 Outflow (cms)	Orifice 2 Outflow (cms)	Orifice 3 Outflow (cms)	Weir 1 Outflow (cms)	Weir 2 Outflow (cms)	Weir 3 Outflow (cms)	Ditch Inlet Outflow (cms)	Super CB Capacity (m^3/s)	Capture Grate Outflow (cms)	Backwater Elevation (m)	Stage (m)	Total Flow (cms)	Storage (m^3)	Detention Time (hrs)
221.46	0.000	0.080	0.000	0.000	0.663	0.146	0.000	0.00	0.00	0.00	0.00	221.46	0.889	13445	118.0
221.48	0.000	0.081	0.000	0.000	0.706	0.175	0.000	0.00	0.00	0.00	0.00	221.48	0.962	13757	118.1
221.50	0.000	0.082	0.000	0.000	0.768	0.205	0.000	0.00	0.00	0.00	0.00	221.50	1.054	14069	118.2
221.52	0.000	0.083	0.000	0.000	0.814	0.244	0.000	0.00	0.00	0.00	0.00	221.52	1.142	14383	118.3
221.54	0.000	0.084	0.000	0.000	0.862	0.278	0.000	0.00	0.00	0.00	0.00	221.54	1.224	14698	118.4
221.56	0.000	0.085	0.000	0.000	0.910	0.314	0.000	0.00	0.00	0.00	0.00	221.56	1.309	15013	118.4
221.58	0.000	0.085	0.000	0.000	0.959	0.351	0.000	0.00	0.00	0.00	0.00	221.58	1.396	15330	118.5
221.60	0.000	0.086	0.000	0.000	1.009	0.389	0.000	0.00	0.00	0.00	0.00	221.60	1.485	15648	118.6
221.62	0.000	0.087	0.000	0.000	1.066	0.423	0.000	0.00	0.00	0.00	0.00	221.62	1.576	15967	118.6
221.64	0.000	0.088	0.000	0.000	1.118	0.463	0.000	0.00	0.00	0.00	0.00	221.64	1.669	16287	118.7
221.66	0.000	0.089	0.000	0.000	1.171	0.505	0.000	0.00	0.00	0.00	0.00	221.66	1.764	16608	118.7
221.68	0.000	0.090	0.000	0.000	1.225	0.547	0.000	0.00	0.00	0.00	0.00	221.68	1.862	16930	118.8
221.70	0.000	0.090	0.000	0.000	1.279	0.591	0.000	0.00	0.00	0.00	0.00	221.70	1.961	17253	118.8
221.72	0.000	0.091	0.000	0.000	1.334	0.636	0.000	0.00	0.00	0.00	0.00	221.72	2.061	17577	118.9
221.74	0.000	0.092	0.000	0.000	1.390	0.682	0.000	0.00	0.00	0.00	0.00	221.74	2.164	17902	118.9
221.76	0.000	0.093	0.000	0.000	1.447	0.729	0.000	0.00	0.00	0.00	0.00	221.76	2.269	18228	119.0
221.78	0.000	0.094	0.000	0.000	1.505	0.777	0.000	0.00	0.00	0.00	0.00	221.78	2.375	18555	119.0
221.80	0.000	0.095	0.000	0.000	1.571	0.837	0.000	0.00	0.00	0.00	0.00	221.80	2.503	18883	119.0
221.82	0.000	0.095	0.000	0.000	1.631	0.888	0.000	0.00	0.00	0.00	0.00	221.82	2.614	19212	119.1
221.84	0.000	0.096	0.000	0.000	1.691	0.940	0.000	0.00	0.00	0.00	0.00	221.84	2.726	19543	119.1
221.86	0.000	0.097	0.000	0.000	1.751	0.992	0.000	0.00	0.00	0.00	0.00	221.86	2.841	19874	119.1
221.88	0.000	0.098	0.000	0.000	1.813	1.046	0.000	0.00	0.00	0.00	0.00	221.88	2.956	20207	119.2
221.90	0.000	0.098	0.000	0.000	1.875	1.101	0.000	0.00	0.00	0.00	0.00	221.90	3.074	20540	119.2
221.92	0.000	0.099	0.000	0.000	1.938	1.172	0.000	0.00	0.00	0.00	0.00	221.92	3.209	20874	119.2
221.94	0.000	0.100	0.000	0.000	2.001	1.229	0.000	0.00	0.00	0.00	0.00	221.94	3.330	21210	119.3
221.96	0.000	0.101	0.000	0.000	2.066	1.287	0.000	0.00	0.00	0.00	0.00	221.96	3.453	21546	119.3
221.98	0.000	0.101	0.000	0.000	2.130	1.346	0.000	0.00	0.00	0.00	0.00	221.98	3.578	21884	119.3
222.00	0.000	0.102	0.000	0.000	2.196	1.406	0.000	0.00	0.00	0.00	0.00	222.00	3.704	22223	119.3
222.02	0.000	0.103	0.000	0.000	2.262	1.466	0.013	0.00	0.00	0.00	0.00	222.02	3.844	22563	119.4
222.04	0.000	0.104	0.000	0.000	2.329	1.528	0.037	0.00	0.00	0.00	0.00	222.04	3.997	22906	119.4
222.06	0.000	0.104	0.000	0.000	2.397	1.590	0.067	0.00	0.00	0.00	0.00	222.06	4.158	23250	119.4
222.08	0.000	0.105	0.000	0.000	2.465	1.653	0.104	0.00	0.00	0.00	0.00	222.08	4.327	23597	119.4
222.10	0.000	0.106	0.000	0.000	2.534	1.717	0.145	0.00	0.00	0.00	0.00	222.10	4.501	23947	119.4
222.12	0.000	0.106	0.000	0.000	2.603	1.842	0.190	0.00	0.00	0.00	0.00	222.12	4.741	24298	119.5
222.14	0.000	0.107	0.000	0.000	2.673	1.909	0.240	0.00	0.00	0.00	0.00	222.14	4.929	24652	119.5
222.16	0.000	0.108	0.000	0.000	2.744	1.978	0.293	0.00	0.00	0.00	0.00	222.16	5.122	25008	119.5
222.18	0.000	0.108	0.000	0.000	2.815	2.047	0.349	0.00	0.00	0.00	0.00	222.18	5.320	25366	119.5
222.20	0.000	0.109	0.000	0.000	2.887	2.117	0.409	0.00	0.00	0.00	0.00	222.20	5.523	25726	119.5
222.22	0.000	0.110	0.000	0.000	2.959	2.273	0.489	0.00	0.00	0.00	0.00	222.22	5.831	26089	119.6
222.24	0.000	0.110	0.000	0.000	3.032	2.348	0.557	0.00	0.00	0.00	0.00	222.24	6.047	26454	119.6
222.26	0.000	0.111	0.000	0.000	3.106	2.423	0.628	0.00	0.00	0.00	0.00	222.26	6.268	26821	119.6
222.28	0.000	0.112	0.000	0.000	3.180	2.499	0.702	0.00	0.00	0.00	0.00	222.28	6.493	27190	119.6
222.30	0.000	0.112	0.000	0.000	3.255	2.624	0.768	0.00	0.00	0.00	0.00	222.30	6.759	27562	119.6
222.32	0.000	0.113	0.000	0.000	3.330	2.703	0.846	0.00	0.00	0.00	0.00	222.32	6.992	27936	119.6
222.34	0.000	0.114	0.000	0.000	3.406	2.783	0.926	0.00	0.00	0.00	0.00	222.34	7.229	28312	119.7
222.36	0.000	0.114	0.000	0.000	3.483	2.864	1.009	0.00	0.00	0.00	0.00	222.36	7.470	28690	119.7
222.38	0.000	0.115	0.000	0.000	3.560	2.945	1.094	0.00	0.00	0.00	0.00	222.38	7.715	29071	119.7

OUTFLOW SUMMARY
BRADFORD CAPITAL POND
700-2

Starting Water Level (m) = 220.50
Elevation Increment (m) = 0.02

Shading represents Storage-Discharge pairings used in VO modelling

Upstream Elevation (m)	Low Flow Constriction (m^3/s)	Orifice 1 Outflow (cms)	Orifice 2 Outflow (cms)	Orifice 3 Outflow (cms)	Weir 1 Outflow (cms)	Weir 2 Outflow (cms)	Weir 3 Outflow (cms)	Ditch Inlet Outflow (cms)	Super CB Capacity (m^3/s)	Capture Grate Outflow (cms)	Backwater Elevation (m)	Stage (m)	Total Flow (cms)	Storage (m^3)	Detention Time (hrs)
222.40	0.000	0.116	0.000	0.000	3.638	3.027	1.182	0.00	0.00	0.00	0.00	222.40	7.963	29454	119.7
222.42	0.000	0.116	0.000	0.000	3.716	3.110	1.272	0.00	0.00	0.00	0.00	222.42	8.214	29839	119.7
222.44	0.000	0.117	0.000	0.000	3.795	3.194	1.364	0.00	0.00	0.00	0.00	222.44	8.469	30226	119.7
222.46	0.000	0.118	0.000	0.000	3.874	3.278	1.458	0.00	0.00	0.00	0.00	222.46	8.728	30616	119.7
222.48	0.000	0.118	0.000	0.000	3.954	3.363	1.554	0.00	0.00	0.00	0.00	222.48	8.989	31008	119.8
222.50	0.000	0.119	0.000	0.000	4.034	3.449	1.674	0.00	0.00	0.00	0.00	222.50	9.277	31402	119.8

LOW IMPACT DEVELOPMENT MEASURE MATRIX

Project Number: 1791
Date: November 2024
Designer Initials: ETCK

Stormwater Management Practice		Brief Description	Constraints/ Controls /Requirements	Feasible (Yes/No)	RECOMMENDED (Yes/No)
Lot Level Controls	Increased Topsoil Depth	An increase in the restored topsoil depth on lots can be used to promote lot level infiltration and evapotranspiration. Increased topsoil depth will contribute to lot level quality and water balance control.	An increase of topsoil depth from 0.15m to 0.30m.	Yes	Yes
	Bio-Retention	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, and infiltration. By promoting infiltration through bioretention, water quality and quantity control is provided for the volume of water retained.	Bioretention via wetland restoration can be provided within the realigned HDF corridor and environmental compensation areas within the Environmental Protection block. However it is part of the ecological compensation areas and not accounted for in the stormwater management calculations.	Yes	Yes
	Roof Runoff to Retention Cisterns	Directing roof runoff to rainwater retention cisterns (i.e. rain barrels or rainwater re-use) will contribute to water quality and water balance control. The retained rainwater can be harvested for re-use such as irrigation and/or rainwater re-use.	Rain barrels can be provided for private use, (irrigation of landscaped and planted areas), however direct discharge to pervious surface is preffered. Not recommended due to requiring long term homeowner use to be effective.	Yes	No
	Green Roofs	Best suited for flat roofs, greenroofs provide rainwater retention in the growing medium where it is evaporated, evapo-transpirated, or slowly drains away after the rainfall event.	Flat roof areas allowing for rain to accumulate over vegetated areas for evapotranspiration, which are not suitable for low rise residential development.	No	No
	Rooftop and/or Parking Lot Detention Storage	Often employed with large rooftop or parking lot footprints, flow attenuation for quantity or extended detention control can be provided via a flow restriction with stormwater storage provided via ponding either on rooftops or parking lots.	Flat roof and parking areas are required to allow for a maximum ponding depth of 0.30m. This is not suited to low rise residential development	No	No
	Roof Overflow to Grassed Areas	Directing roof leaders to grassed areas will contribute to water quality and water balance control by encouraging stormwater retention.	Roof leaders will be directed to pervious surfaces via splash pads.	Yes	Yes
	Pervious Pavement	By encouraging infiltration and filtration, pervious pavement can contribute to water quality, balance and erosion control.	1.0m of separation from seasonally high ground water is required. Long term maintenance and operation of permeable pavement is cumbersome and unlikely for private home ownership.	No	No
	Vegetated Filter Strip	At source filtration and infiltration may be encouraged through the use of vegetated filter strips by directing sheet flow from impermeable areas to the strip prior to being collected via the storm system. Vegetated filter strips are best suited to parking lot areas with landscaped borders or islands.	There are no parking lot areas with landscaped borders or islands proposed within the site, and is therefore not suitable.	No	No
	Rear Lot Infiltration Trenches	At-source infiltration may be encouraged by use of infiltration trenches collecting flow from the rear roofs via the roof leaders discharging to rear yards and conveyed overland to the infiltration trenches.	1.0m of separation from seasonally high ground water is required. Groundwater Depth Map prepared to illustrate opportunities.	Yes	Yes
Conveyance Controls	Grassed Swales	A grassed swale will promote infiltration, filtration, and evapotranspiration, contributing to water quality and quantity control. Grassed swales need an unimpeded and relatively wide stretch of landscaped area, such as within a wide boulevard with no driveways, to function properly.	A grassed swale is proposed for the SWM pond outlet to provide additional polishing and retention of stormwater runoff.	Yes	Yes
	Exfiltration at Rear Lot Catch basins	Where rear lot catch basins are required due to grading constraints, a perforated pipe system could be incorporated into the rear lot catch basin design to promote infiltration of 'clean' stormwater runoff. By promoting infiltration, water quality and quantity control is provided for the volume of water retained.	1.0m of separation from seasonally high ground water is required.	No	No
	Pervious Street Catch basin System	Pre-treatment provided by catchbasin inserts with low flow directed to an infiltration or filtration trench located in the boulevard.	1.0m of separation from seasonally high ground for infiltration system. Additional piping and infrastructure within the municipal road boulevard requires municipal approval.	Yes	No
End-of-Pipe Controls	Wet Ponds, Wetlands, Dry Ponds	Sized in accordance with the MECP criteria, these end of pipe facilities can provide water quality, quantity, and erosion control treatment.	Adequate drainage area(5 ha) and sufficient outfall is required in order for a stormwater detention facility to be feasible.	No	No
	Manufactured Treatment Device (MTD): Oil-Grit Separator or Stormwater Filter	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.	Opportunities on to implement an MTD are available along the proposed storm sewer or SWM pond outlet.	Yes	Yes

Bradford Highlands
Project Number: 1791
Date: November 2024
Designer Initials: E.A.S.

Rear Yard Infiltration Trench Sizing

Individual Infiltration Trench Sizing - Maximum Trench Depth

		House Product Line		
	Units	**Single**	**Semi-Deatched**	**Notes**
Roof Area to Infiltration Trench	m^2	110.3	62.4	Estimated per zoning (50% coverage, 1/2 of roof)
P - Percolation Rate	mm/h	15.45	15.45	Provided by WSP. Converted from hydraulic conductivity of $1x10^{-7}$ m/s
SF - Safety Factor		2.50	2.50	
n - Media Porosity		0.40	0.40	
t - Detention Time	h	48	48	
D - Maximum Infiltration Trench Depth	m	0.74	0.74	$D = \frac{P * t}{SF * n * 1000}$

Individual Infiltration Trench Design - Provided

		House Product Line		
	Units	**Single**	**Semi-Deatched**	**Notes**
D - Depth	m	0.20	0.20	
W - Width	m	2.0	2.0	
L - Length	m	9.60	5.60	
A - Bottom Area	m^2	19.2	11.2	
Total Volume of the Infiltration Trench	m^3	3.8	2.2	
n - Media Porosity		0.40	0.40	
Total Runoff Storage Volume of the Infiltration Trench	m^3	1.54	0.90	

Summary Table

		House Product Line		
	Units	**Single**	**Semi-Deatched**	**Notes**
Maximum Depth	m	0.74	0.74	
Depth Provided	m	0.20	0.20	
Volume Required	m^3	1.14	1.56	(per Runoff Volume to Infiltration Trench above)
Volume Provided	m^3	1.54	0.90	
Runoff Depth Provided	mm	13.93	14.36	

HYDRAULIC CONDUCTIVITY LINEAR INTERPOLATION

TABLE C1: APPROXIMATE RELATIONSHIPS BETWEEN HYDRAULIC CONDUCTIVITY, PERCOLATION TIME AND INFILTRATION RATE

(FROM LOW IMPACT DEVELOPMENT STORMWATER MANAGEMENT PLANNING AND DESIGN GUIDE - 2010)

Hydraulic Conductivity, K_{fs} (centimeters/second)	Percolation Time, T (minutes/centimetre)	Infiltration Rate, 1/T (millimetres/hour)
0.1	2	300
0.01	3	150
0.001	4	75
0.0001	12	50
0.00001	20	30
0.000001	50	12

Hydraulic Conductivity (K_{fs})	0.00001	centimetres/second
Hydraulic Conductivity Upper Limit (K_{fsu})	0.0001	centimetres/second
Hydraulic Conductivity Lower Limit (K_{fsl})	0.000001	centimetres/second
Percolation Time Upper Limit (T_u)	12	minutes/centimetre
Percolation Time Lower Limit (T_l)	50	minutes/centimetre
Infiltration Rate Upper Limit ($1/T_u$)	50	millimetres/hour
Infiltration Rate Lower Limit ($1/T_l$)	12	millimetres/hour
Interpolated Infiltration Rate (1/T)	**15.45**	**millimetres/hour**

$$y = y_0 + (x - x_0)\frac{y_1 - y_0}{x_1 - x_0}$$

1. Hydraulic Conductivity per Hydrogeological Assessment prepared by WSP (October, 2024)

Weighted Impervious Calculation

Catchment	Total Area (ha)	Imperviousness (%)	Impervious Area (ha)
2101	22.04	63	13.89
2201	23.25	66	15.35
2202	1.44	74	1.07
2103	0.39	63	0.25
2301	0.11	45	0.05
2105	0.51	48	0.24
2106	0.69	48	0.33
2107	0.15	28	0.04
Total	**48.58**	**64**	**31.21**

Required LID Treatment Volumes

Impervious =	64	%
Drainage Area (Entire Site)=	48.58	ha

	Volume Control			SWM CLI-ECA
	Minimum		Target	90th Percentile
Required Depth of Retention (mm)	5	12.5	25	27.5
Impervious Area (ha)	31.21	31.21	31.21	31.21
Required Volume Control Volume (m^3)	**1560.4**	**3901.0**	**7801.9**	**8582.1**

Infiltration Volume Provided

Rear Yard Infiltration Trenches

Lot Type	No. Units	Length (m)	Width (m)	Depth (m)
11.6m frontage (Singles)	2	9.6	2.0	0.20
7.6m frontage (Semi-Detached)	10	5.6	2.0	0.20
Porosity =	0.40			

Trench Volume =	**12.0**	**m^3**

Total Infiltration Volume =	**12.0**	**m^3**
Infiltration Volume Control Depth Provided =	**0.04**	**mm**

SWM Pond + MTD Filtration Volume

Filtration Volume =	**3121.0**	**m^3**

Total Provided

Total Provided Volume =	**3133.0**	**m^3**
Volume Control Depth Provided =	**10.0**	**mm**

Determining Number of Cartridges for Flow Based Systems

Date	**10/30/2024**	**Black Cells =**	**Calculation**

Site Information

Project Name	**Bradford Highlands**		
Project Location	**Bradford, ON**		
OGS ID	**OGS**		
Drainage Area, Ad	**81.36**	ac	(32.94 ha)
Impervious Area, Ai	**34.99**	ac	
Pervious Area, Ap	**46.38**		
% Impervious	**43%**		
Runoff Coefficient, Rc	**0.53**		
Treatment storm flow rate, Q_{treat}	**2.34**	cfs	(66.3 L/s)
Peak storm flow rate, Q_{peak}	**TBD**	cfs	

Filter System

Filtration brand	**StormFilter**	
Cartridge height	**27**	in
Specific Flow Rate	**1.67**	gpm/ft^2
Flow rate per cartridge	**18.79**	gpm

SUMMARY

Number of Cartridges	56
Media Type	Phosphosorb

Event Mean Concentration (EMC)	**120**	mg/L
Annual TSS Removal	**80%**	
Percent Runoff Capture	**90%**	

Recommend offline SF0822

Design notes:

1) 80% TSS removal from upstream SWM pond (wet, quantity) per SCS Consulting

200 Enterprise Drive
Scarborough, ME 04074
Phone 877-907-8676
Fax 207-885-9825

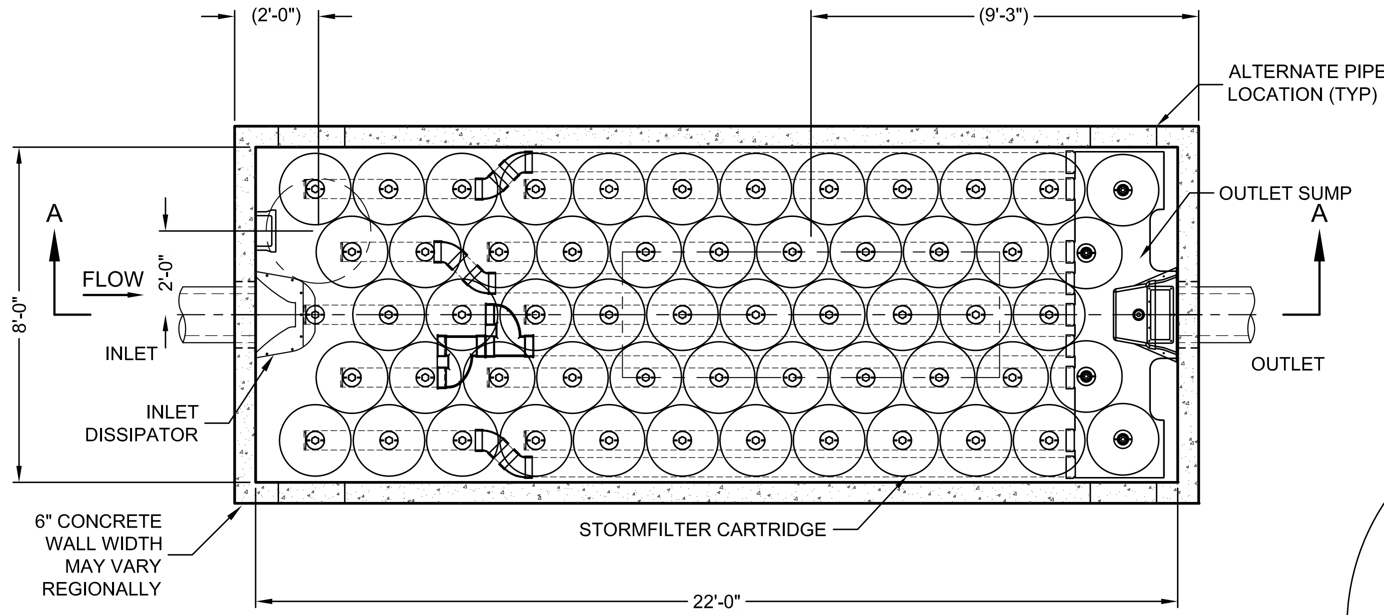
conteches.com

STORMFILTER DESIGN NOTES

STORMFILTER TREATMENTCAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD VAULT STYLE IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (56). VAULT STYLE OPTIONS INCLUDE INLET BAY (49), INLET BAY/OUTLET BAY (46), OUTLET BAY (51), NLET BAY/FULL HEIGHT BAFFLE WALL (41), FULL HEIGHT BAFFLE WALL (46).
STORMFILTER 8X22 PEAK HYDRAULIC CAPACITY IS 1.8 CFS. IF THE SITE CONDITIONS EXCEED 1.8 CFS AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

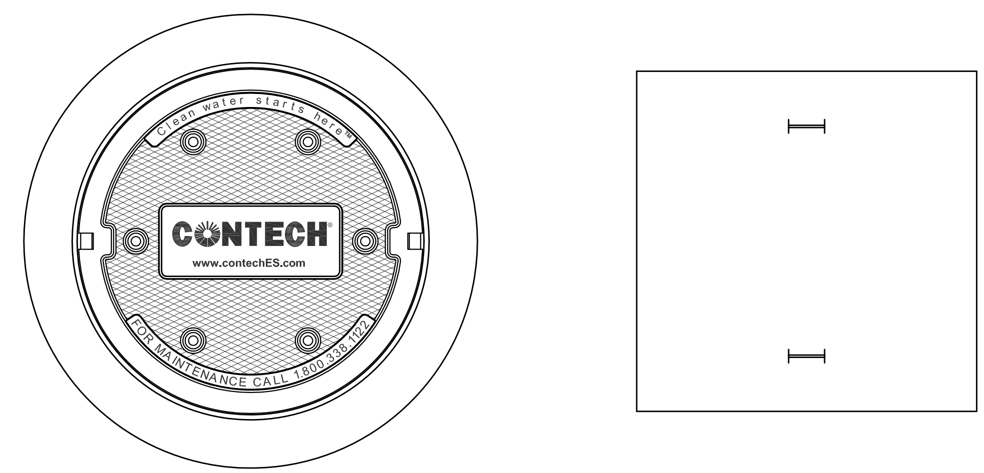
CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"		18"		LOW DROP	
RECOMMENDED HYDRAULIC DROP (H)	3.05'		2.3'		1.8'	
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	15	7.5	10	5



PLAN VIEW

VAULT STYLE: OUTLET SUMP (NIB)



FRAME, COVER, AND HATCH

(SIZE AND CONFIGURATION VARY)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	*
PEAK FLOW RATE (cfs)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
# OF CARTRIDGES REQUIRED	*
CARTRIDGE FLOW RATE	*
MEDIA TYPE (CSF, PERLITE, ZPG, GAC, PHS)	*

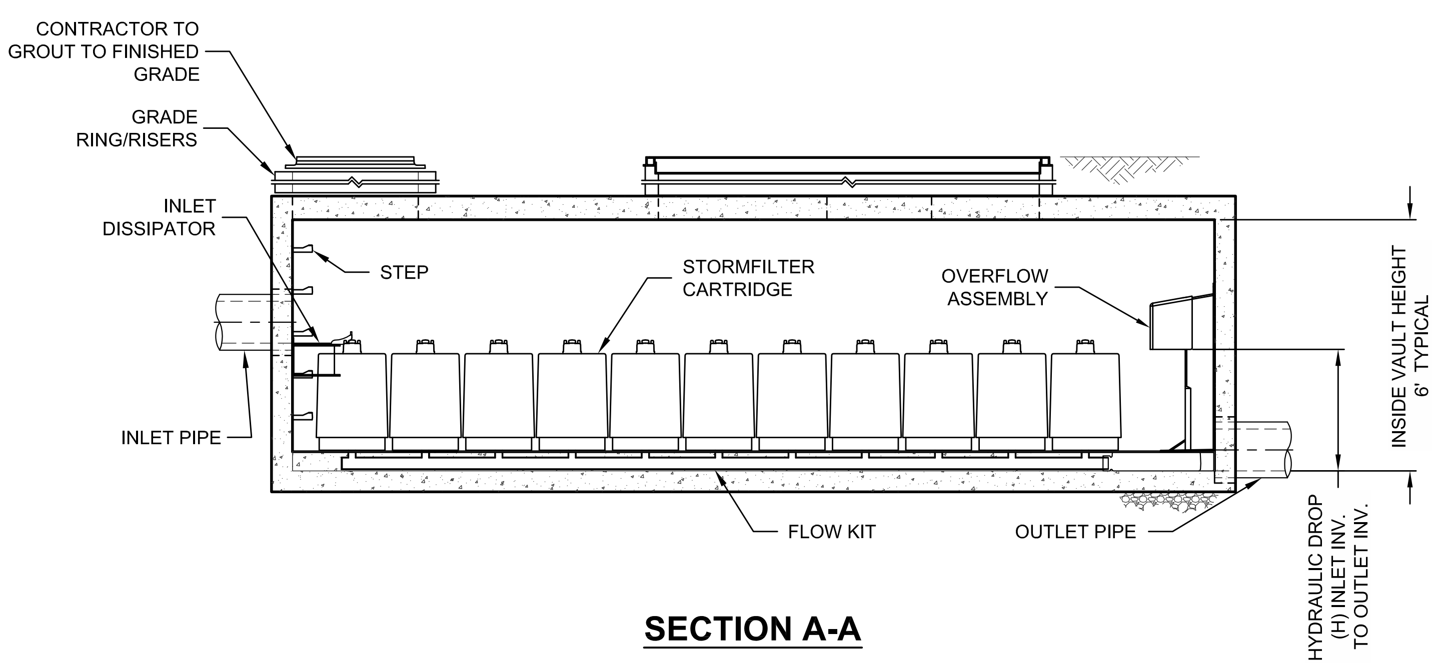
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	*	*	*
INLET PIPE #2	*	*	*
OUTLET PIPE	*	*	*

UPSTREAM RIM ELEVATION	*
DOWNSTREAM RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD



SECTION A-A

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR SITE SPECIFIC DRAWINGS WITH DETAILED VAULT DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECHENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
6. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 39 SECONDS.
7. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

INSTALLATION NOTES
1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
2. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER VAULT (LIFTING CLUTCHES PROVIDED).
3. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL VAULT SECTIONS AND ASSEMBLE VAULT.
4. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
5. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

The Stormwater Management StormFilter®

CONTECH®
ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

SF0822
STORMFILTER
STANDARD DETAIL

\\AD.CONTECH-CPI.COM\ROOT\STORMWATER\COMMOPS\10 STORMFILTER\40 STANDARD DRAWINGS\VAULT\SF0822-DTL.DWG 1/19/2014 4:10 PM

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

The Stormwater Management StormFilter®

Developed by CONTECH Engineered Solutions LLC
Scarborough, Maine, USA

Registration: GPS-ETV_VR2023-06-30_TAPE

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

June 30, 2023
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Verification Overview

This Environmental Technology Verification (ETV) of The Stormwater Management StormFilter® (StormFilter) is the second part of a two-part verification process and entails the verification of performance claims (#3 – 9) based on field testing data collected in accordance with The Washington State Department of Ecology emerging stormwater treatment technologies, in accordance with guidelines identified by Ecology (2011) in the Technology Assessment Protocol – Ecology (TAPE). This complements the first part of the verification which verifies performance test data collected in accordance with the New Jersey Department of Environmental Protection (NJDEP) *Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device (January, 2013)*.

Technology description and application

The Stormwater Management StormFilter® (StormFilter) is a manufactured treatment device that is provided by Contech Engineered Solutions LLC (Contech). The StormFilter improves the quality of stormwater runoff before it enters receiving waterways through the use of its customizable filter media, which removes non-point source pollutants. As illustrated in **Figure 1,** the StormFilter is typically comprised of a vault or manhole structure that houses rechargeable, media-filled filter cartridges. Stormwater entering the system percolates through these media-filled cartridges, which trap particulates and remove pollutants. Once filtered through the media, the treated stormwater is discharged through an outlet pipe to a storm sewer system or receiving water.

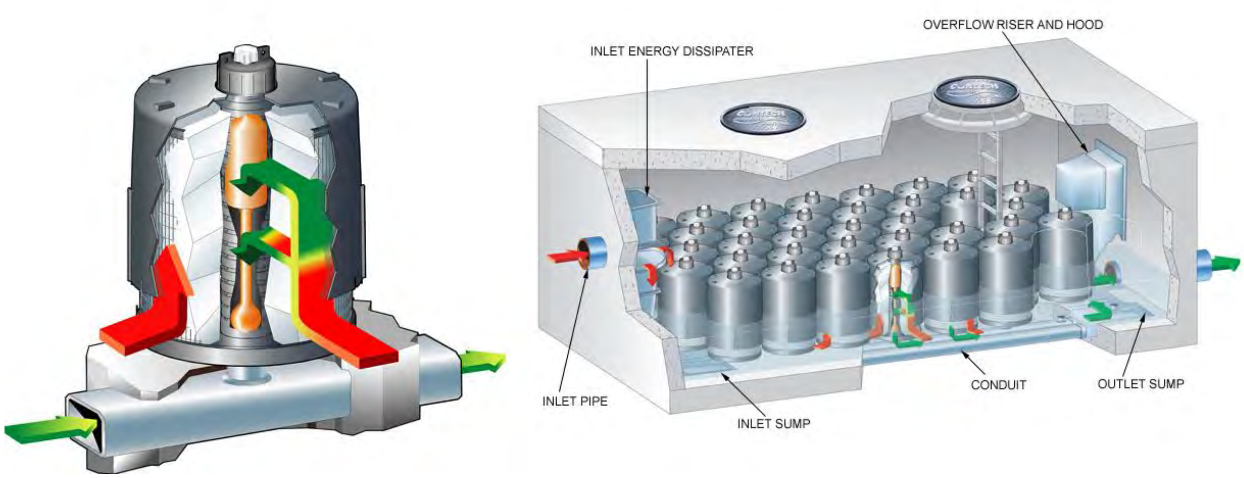


Figure 1 Individual StormFilter Cartridge (Left) and Typical Vault StormFilter Installation (Right)

Depending on the treatment requirements and expected pollutant characteristics at an individual site, the per cartridge filtration flow rate and driving head can be adjusted. The flow rate is individually controlled for each cartridge by a restrictor disc located at the connection point between the cartridge and the underdrain manifold.

Driving head is managed by positioning of the inlet, outlet, and overflow elevations. The StormFilter is typically designed so that the restrictor disc passes the design treatment rate once the water surface reaches the shoulder of the cartridge which is equivalent to the cartridge height. Since the StormFilter uses a restrictor disc to restrict treatment flows below the hydraulic capacity of the media the system typically operates under consistent driving head for the useful life of the media. Site specific head constraints are also addressed by three different cartridge heights (low drop (effective height of 12 inches), 18, and 27 inches) which operate on the same principal and surface area specific loading rates.

The StormFilter requires a minimum of 1.8 ft, 2.3 ft and 3.05 ft of drop between inlet invert and outlet invert to accommodate the low drop, 18 and 27 inch cartridges, respectively, without backing up flow into the upstream piping during operation. When site conditions limit the amount of drop available across the StormFilter then flow is typically backed up into the upstream piping during operation to ensure sufficient driving head is provided. If desirable the StormFilter can be designed to operate under additional driving head.

The StormFilter is offered in multiple configurations including plastic, steel, and concrete catch basins; and precast concrete manholes, and vaults. Other configurations include panel vaults, CON/SPAN®, box culverts, and curb inlets. The filter cartridges operate consistently and act independently regardless of housing which enables linear scaling.

The StormFilter cartridge can house different types of media including perlite, zeolite, granular activated carbon (GAC), CSF® leaf media, MetalRx™, PhosphoSorb® or various media blends such as ZPG™ (perlite, zeolite and GAC). All of the media use processes associated with depth filtration to remove solids. Some media configurations also provide additional treatment mechanisms such as cation exchange, and/or adsorption, chelation, and precipitation. This verification is specific to a field evaluation of the StormFilter with PhosphoSorb® media.

Performance conditions

The data and results published in this Verification Statement were obtained from the field testing conducted on The Stormwater Management StormFilter® device, in accordance with the requirements outlined by the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) as written by the Washington State Department of Ecology, (WADOE, 2011). Prior to starting the performance testing program, a quality assurance project plan (QAPP) was submitted to and approved by the State of Washington Department of Ecology.

Performance claim(s)

Performance Claim 3 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 23 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 89% removal of total suspended solids at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 4 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 23 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 79% removal of total phosphorus at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 5 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 23 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 56% removal of total nitrogen at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 6 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 77% removal of total copper at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 7 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 75% removal of total zinc at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 8 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 70% removal of total lead at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 9 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 80% removal of total aluminium at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance results

Performance Claim 3 (TAPE):
Raw data summarizing the percent removal of total suspended solids (TSS) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent TSS (mg/L)	Average Effluent TSS (mg/L)	Percent Removal (%)
LPR021012	182	63.0	65.4
LPR021412	539	32.0	94.1
LPR021712	387	48.0	87.6
LPR022012	246	5.0	98.0
LPR022412	512	43.0	91.6
LPR031012	360	27.0	92.5
LPR031212a	150	18.0	88.0
LPR032912b	370	47.0	87.3
LPR052412	510	43.0	91.6
LPR060112	780	16.0	98.0
LPR060412	580	32.0	94.5
LPR060712	570	120.0	79.0
LPR110612	40.0	10.0	75.0
LPR112312	110	5.0	95.5
LPR113012	230	17.0	92.6
LPR051713	94.0	6.0	93.6
LPR052113	389	24.0	93.8
LPR062513	308	21.0	93.2
LPR013014	170	17.0	90.0
LPR030314	280	95.0	66.1
LPR030814a	173	26.0	85.0
LPR011815	529	72.8	86.2
LPR020215	397	67.0	83.1
Sum	2022		
N (COUNT)	23		
Median	91.6		
STDEV.s	8.99		
VAR.s	80.7		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	89.0		

Performance Claim 4 (TAPE):

Raw data summarizing the percent removal of total phosphorus (TP) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent TP (mg/L)	Average Effluent TP (mg/L)	Percent Removal (%)
LPR021012	0.141	0.104	26.2
LPR021412	0.220	0.062	71.8
LPR021712	0.310	0.067	78.3
LPR022012	0.163	0.026	84.1
LPR022412	0.424	0.070	83.5
LPR031012	0.140	0.049	65.0
LPR031212a	0.150	0.037	75.3
LPR032912b	0.280	0.081	71.1
LPR052412	0.170	0.070	58.8
LPR060112	0.200	0.035	82.5
LPR060412	0.210	0.043	79.5
LPR060712	0.170	0.140	17.6
LPR110612	0.068	0.025	63.2
LPR112312	0.082	0.025	69.5
LPR113012	0.170	0.025	85.3
LPR051713	0.282	0.029	89.9
LPR052113	0.558	0.050	91.1
LPR062513	0.583	0.045	92.2
LPR013014	0.317	0.053	83.3
LPR030314	0.417	0.133	68.1
LPR030814a	0.261	0.051	80.3
LPR011815	0.649	0.124	80.9
LPR020215	0.693	0.100	85.6
Sum	1683		
N (COUNT)	23		
Median	79.5		
STDEV.s	18.5		
VAR.s	343.7		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	79.0		

Performance Claim 5 (TAPE):

Raw data summarizing the percent removal of total nitrogen (TN) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent TN (mg/L)	Average Effluent TN (mg/L)	Percent Removal (%)
LPR021012	1.06	0.265	75.1
LPR021412	1.20	0.531	55.9
LPR021712	1.58	0.638	59.5
LPR022012	0.696	0.265	61.9
LPR022412	1.11	0.265	76.0
LPR031012	1.72	0.265	84.5
LPR031212a	0.760	0.400	47.4
LPR032912b	1.23	0.265	78.5
LPR052412	1.85	0.400	78.4
LPR060112	2.40	0.872	63.7
LPR060412	1.06	0.327	69.1
LPR060712	0.579	0.555	4.1
LPR110612	0.569	0.555	2.5
LPR112312	0.515	0.515	0.0
LPR113012	1.22	0.515	57.6
LPR051713	1.37	0.250	81.8
LPR052113	0.531	0.248	53.4
LPR062513	0.619	0.253	59.2
LPR013014	0.240	0.212	11.8
LPR030314	0.530	0.230	56.6
LPR030814a	0.432	0.080	81.5
LPR011815	0.180	0.110	38.9
LPR020215	2.32	0.370	84.1
Sum	1281		
N (COUNT)	23		
Median	59.5		
STDEV.s	27.0		
VAR.s	727		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	56.0		

Performance Claim 6 (TAPE):

Raw data summarizing the percent removal of total copper (Cu) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Cu (mg/L)	Average Effluent Cu (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	0.032	0.006	81.3
LPR022012	0.014	0.001	92.9
LPR022412	0.032	0.005	84.4
LPR031012	0.019	0.003	84.2
LPR031212a	0.012	0.003	75.0
LPR032912b	0.023	0.004	82.6
LPR052412	0.050	0.050	0.0
LPR060112	0.040	0.003	92.5
LPR060412	0.021	0.003	85.7
LPR060712	0.028	0.010	64.3
LPR110612	0.006	0.003	50.0
LPR112312	0.006	0.001	83.3
LPR113012	0.016	0.002	87.5
LPR051713	0.016	0.003	81.3
LPR052113	0.027	0.006	77.8
LPR062513	0.029	0.005	82.8
LPR013014	0.021	0.004	81.0
LPR030314	0.019	0.006	68.4
LPR030814a	0.018	0.002	88.9
LPR011815	0.055	0.010	81.8
LPR020215	0.044	0.007	84.1
Sum	1610		
N (COUNT)	21		
Median	82.6		
STDEV.s	20.06		
VAR.s	403		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	77.0		

Performance Claim 7 (TAPE):

Raw data summarizing the percent removal of total zinc (Zn) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Zn (mg/L)	Average Effluent Zn (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	0.151	0.034	77.8
LPR022012	0.076	0.011	85.8
LPR022412	0.191	0.031	84.0
LPR031012	0.120	0.022	81.7
LPR031212a	0.068	0.017	75.0
LPR032912b	0.160	0.029	81.9
LPR052412	0.250	0.250	0.0
LPR060112	0.230	0.012	94.8
LPR060412	0.130	0.015	88.5
LPR060712	0.170	0.048	71.8
LPR110612	0.022	0.014	36.4
LPR112312	0.049	0.010	79.6
LPR113012	0.110	0.016	85.5
LPR051713	0.068	0.010	85.2
LPR052113	0.126	0.021	83.5
LPR062513	0.120	0.017	85.5
LPR013014	0.108	0.026	76.1
LPR030314	0.095	0.029	69.8
LPR030814a	0.088	0.013	84.8
LPR011815	0.151	0.039	74.4
LPR020215	0.192	0.038	80.2
Sum	1582		
N (COUNT)	21		
Median	81.7		
STDEV.s	20.69		
VAR.s	428		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	75.0		

Performance Claim 8 (TAPE):

Raw data summarizing the percent removal of total lead (Pb) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Pb (mg/L)	Average Effluent Pb (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	0.013	0.003	73.7
LPR022012	0.005	0.001	79.6
LPR022412	0.015	0.003	77.3
LPR031012	0.009	0.002	78.5
LPR031212a	0.006	0.002	71.9
LPR032912b	0.012	0.003	75.0
LPR052412	0.025	0.025	0.00
LPR060112	0.016	0.005	68.8
LPR060412	0.013	0.001	90.8
LPR060712	0.013	0.005	62.3
LPR110612	0.001	0.001	0.0
LPR112312	0.002	0.001	50.0
LPR113012	0.005	0.001	80.0
LPR051713	0.004	0.001	74.8
LPR052113	0.009	0.009	0.336
LPR062513	0.009	0.002	82.5
LPR013014	0.006	0.001	80.5
LPR030314	0.007	0.003	62.1
LPR030814a	0.005	0.001	71.5
LPR011815	0.015	0.003	81.4
LPR020215	0.011	0.002	81.0
Sum	1342		
N (COUNT)	21		
Median	74.8		
STDEV.s	28.05		
VAR.s	787		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	70.0		

Performance Claim 9 (TAPE):

Raw data summarizing the percent removal of total aluminium (Al) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Pb (mg/L)	Average Effluent Pb (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	9.15	1.86	79.7
LPR022012	2.62	0.319	87.8
LPR022412	9.65	1.99	79.4
LPR031012	6.20	1.10	82.3
LPR031212a	4.30	0.810	81.2
LPR032912b	6.40	1.70	73.4
LPR052412	9.70	1.30	86.6
LPR060112	11.0	0.370	96.6
LPR060412	12.0	1.00	91.7
LPR060712	9.60	4.10	57.3
LPR110612	1.30	0.300	76.9
LPR112312	1.20	0.190	84.2
LPR113012	3.00	0.440	85.3
LPR051713	1.44	0.134	90.7
LPR052113	3.24	0.358	89.0
LPR062513	3.94	0.466	88.2
LPR013014	3.45	0.796	76.9
LPR030314	2.64	1.13	57.2
LPR030814a	1.67	0.342	79.5
LPR011815	5.32	1.17	78.0
LPR020215	3.85	1.20	68.8
Sum	1691		
N (COUNT)	21		
Mean (AVE)	80.5		
STDEV.s	10.13		
VAR.s	103		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized mean	80.0		

Verification

This verification was completed in June 2020 by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), contracted by GLOBE Performance Solutions, applying the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Contech Engineered Solutions LLC to support the performance claim included the following:

- Performance test report "The Stormwater Management StormFilter® - PhosphoSorb® at a Specific Flow Rate of 1.67 gpm/ft^2 – Performance Evaluation Report" prepared by Contech Engineered Solutions, November 8, 2017. This report is based on a field testing program conducted by Contech personnel at a roadway site in Zigzag, Oregon between January 2012 and February 2015. Testing was conducted in accordance with the 2011 version of the Washington Department of Ecology TAPE (TAPE, 2011).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV) and was developed and published by the International Organization for Standardization (ISO). The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the The Stormwater Management StormFilter® please contact:

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Appendix H Phosphorus Budget

SCS consulting group ltd

Existing Phosphorus Budget

Watershed West Holland River

Land Cover	TP Loading (kg/ha/yr)	Area (ha)	TP Loading (kg/yr)
Sod Farm/Golf Course	0.24	52.21	12.53
Low Intensity Development	0.13	1.65	0.21
Wetland	0.10	4.53	0.45
Open Water	0.26	0.85	0.22
Forest	0.10	0.76	0.08
	TOTAL =	**60.00**	**13.49**

Subwatershed	Phosphorus Export (kg/ha/yr)											
	Cropland	Hay-Pasture	Sod Farm/Golf Course	High Intensity Development		Low Intensity Development	Quarry	Unpaved Road	Forest	Transition	Wetland	Open Water
				Commercial /Industrial	Residential							
Monitored Subwatersheds												
Beaver River	0.22	0.04	0.01	1.82	1.32	0.19	0.06	0.83	0.02	0.04	0.02	0.26
Black River	0.23	0.08	0.02	1.82	1.32	0.17	0.15	0.83	0.05	0.06	0.04	0.26
East Holland River	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Hawkestone Creek	0.19	0.10	0.06	1.82	1.32	0.09	0.10	0.83	0.03	0.04	0.03	0.26
Lovers Creek	0.16	0.07	0.17	1.82	1.32	0.07	0.06	0.83	0.06	0.06	0.05	0.26
Pefferlaw/Uxbridge Brook	0.11	0.06	0.02	1.82	1.32	0.13	0.04	0.83	0.03	0.04	0.04	0.26
Whites Creek	0.23	0.10	0.42	1.82	1.32	0.15	0.08	0.83	0.10	0.11	0.09	0.26
Unmonitored Subwatersheds												
Barrie Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
GeorginaCreeks	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Hewitts Creek	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Innisfil Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Maskinonge River	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Oro Creeks North	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Oro Creeks South	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Ramara Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Talbot/Upper Talbot River	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
West Holland River	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26

Proposed Conditions Phosphorus Budget

Watershed West Holland River

Land Cover	TP Loading (kg/ha/yr)	Area (ha)	TP Loading (kg/yr)	BMP #1 BMP	BMP #1 TP Removal Rate (%)	BMP #1 TP Export (kg/yr)	BMP #2 BMP	BMP #2 TP Removal Rate (%)	BMP #2 TP Export (kg/yr)	Combined Removal Efficiency	Unmitigated P_{load} (kg/year)	Mitigated P_{load} (kg/year)
High Intensity Dev. - Commercial/Industrial	1.82	0.18	0.32	Infiltration Trenches	60%	0.13	Wet Detention Ponds	63%	0.05	85%	0.32	0.048
High Intensity Dev. - Commercial/Industrial	1.82	22.04	40.11	Wet Detention Ponds	63%	14.84	Stormfilter	79%	3.12	92%	40.11	3.117
High Intensity Dev. - Commercial/Industrial	1.82	24.50	44.58	Wet Detention Ponds	63%	16.50	None	0%	16.50	63%	44.58	16.495
High Intensity Dev. - Commercial/Industrial	1.82	3.48	6.33	None	0%	6.33	None	0%	6.33	0%	6.33	6.333
Forest	0.10	0.76	0.08	None	0%	0.08	None	0%	0.08	0%	0.08	0.076
Transitional	0.16	5.27	0.84	None	0%	0.84	None	0%	0.84	0%	0.84	0.843
Wetland	0.10	3.27	0.33	None	0%	0.33	None	0%	0.33	0%	0.33	0.327
Open Water	0.26	0.50	0.13	None	0%	0.13	None	0%	0.13	0%	0.13	0.131
Total	**Total**	60.00								**Total**	92.73	27.37
										Removal Rate		**70%**
										Phosphorus Export Net Change		**13.88**

Subwatershed	Cropland	Hay-Pasture	Sod Farm/Golf Course	High Intensity Development: Commercial /Industrial	High Intensity Development: Residential	Low Intensity Development	Quarry	Unpaved Road	Forest	Transition	Wetland	Open Water
	Phosphorus Export (kg/ha/yr)											
Monitored Subwatersheds												
Beaver River	0.22	0.04	0.01	1.82	1.32	0.19	0.06	0.83	0.02	0.04	0.02	0.26
Black River	0.23	0.08	0.02	1.82	1.32	0.17	0.15	0.83	0.05	0.06	0.04	0.26
East Holland River	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Hawkestone Creek	0.19	0.10	0.06	1.82	1.32	0.09	0.10	0.83	0.03	0.04	0.03	0.26
Lovers Creek	0.16	0.07	0.17	1.82	1.32	0.07	0.06	0.83	0.06	0.06	0.05	0.26
Pefferlaw/Uxbridge Brook	0.11	0.06	0.02	1.82	1.32	0.13	0.04	0.83	0.03	0.04	0.04	0.26
Whites Creek	0.23	0.10	0.42	1.82	1.32	0.15	0.08	0.83	0.10	0.11	0.09	0.26
Unmonitored Subwatersheds												
Barrie Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
GeorginaCreeks	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Hewitts Creek	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Innisfil Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Maskinonge River	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Oro Creeks North	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Oro Creeks South	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Ramara Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Talbot/Upper Talbot River	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
West Holland River	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26

Lake Simcoe Phosphorous Offsetting Policy Calculation

Phosphorus Export =	13.9	kg/yr
Offset Ratio =	2.5	:1
Offsetting Value =	$ 35,770.00	/kg/year
Offsetting Cost =	$ 1,240,808	
Administration Fee =	15%	
	$ 186,121.17	
TOTAL PHOSPHORUS OFFSETTING FEE =	**$ 1,426,929**	

Appendix I Water Balance Report

REPORT

Water Balance Report
Bradford Highlands Golf Course Redevelopment

Submitted to:

Bradford Highlands Joint Venture
111 Creditstone Road
Concord, Ontario
L4K 1N3

Submitted by:

WSP Canada Inc.
6925 Century Avenue, Suite #100 Mississauga, Ontario L5N 7K2 Canada

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November 1, 2024

Distribution List

PDF - Bradford Highlands Joint Venture

PDF - WSP Canada Inc.

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APPENDICES

1.0 INTRODUCTION

Bayview Bradford Highlands Joint Venture Inc. (‘Bayview’ the ‘Client’) has retained WSP to produce geotechnical, hydrogeological and environmental reports to accompany the Client’s application for Draft Plan approval for the proposed redevelopment of the Bradford Highlands Golf Course in Bradford, Ontario (the Site). The purpose of this report is to present the water balance analysis for the pre-development and proposed post-development conditions.

2.0 BACKGROUND

The proposed residential development, hereafter referred to as the Site, is located southeast of the intersection of Concession Road 6 and Brownlee Drive, in the Town of Bradford, Ontario (Figure 1). The site was previously the location of the Bradford Highlands Golf Club; this water balance assessment is focused on the 60 ha proposed for the new development.

The proposed development falls within the Lake Simcoe watershed and within the jurisdiction of the Lake Simcoe Region Conservation Authority (LSRCA). The southwestern Site area flows directly to the Holland River which then discharges to Lake Simcoe. The remainder of the Site first discharges to existing drainage features which connect to the Holland River east of the Site.

A water balance assessment was carried out to compare pre-development, post-development (no mitigation) and post-development (mitigated) water balance conditions, including estimates of average annual infiltration and runoff volumes from the site. All assumed areas and land uses were based on the drainage area information provided by SCS by email in October 2024 (Attachment 2), with infiltration contribution assumed to follow surface catchment contribution. In addition, feature-based water balances were carried out for two surface water features crossing the site and the wetland in the southeast corner of the site.

3.0 METHODOLOGY

The water balance assessment was based on meteorological data from the Meteorological Service of Canada Thornthwaite water budgets (Egbert MOE, Ontario between 1989 to 2016), watershed boundaries, land use data and the existing soil types.

Water balance calculations are based on the following equation:

$$P = S + ET + R + I$$

Where:

P = precipitation;

S = change in groundwater storage;

ET = evapotranspiration;

R = surface runoff; and

I = infiltration (groundwater recharge).

Short-term or seasonal changes in soil moisture storage (S) occur during dry conditions in the summer months and relatively saturated conditions in the winter and spring. Long-term changes (e.g., year to year) in soil moisture storage are generally small and have been assumed to be zero.

Precipitation data collected at the Environment Canada (EC) Egbert MOE monitoring station (1989 to 2016) indicated a mean annual precipitation (P) of 786 mm/yr. Evapotranspiration (ET) refers to water losses from soil surfaces to the atmosphere. The term combines evaporation (i.e., water lost from the soil surface) and transpiration (i.e., water lost to plants and trees) because of the difficulties involved in separating these processes. Potential ET refers to the loss of water from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of ET is typically less than the potential rate under dry conditions (e.g., during the summer months when there is a soil moisture deficit). The mean annual potential ET for the area in question is approximately 607 mm/year based on data (Thornthwaite water budget for Egbert meteorological station) provided by Environment Canada (EC).

Annual water surplus is the difference between the annual P and the annual actual ET and represents the total amount of water, the sum of surface runoff (R) and infiltration (I), that would flow from the catchment area on an annual basis. On a monthly basis, surplus water remains after actual evapotranspiration has been removed from the sum of rainfall and snow-melt and maximum soil storage is exceeded. Maximum soil storage is quantified using a water holding capacity (WHC) specific to the soil type and land use and conceptually represents the difference in water content between the field capacity and the wilting point. The total water surplus is calculated by summing the surplus available from each WHC within the watershed. Tables following the text of this report include the EC water budget for Egbert EC information, considered for the water balance assessment.

Infiltration rates were estimated using the Ontario Ministry of Environment (MECP) Stormwater Management Planning and Design (SWM) Manual (2003). There are three factors which are considered in estimating the fraction of the total annual surplus that infiltrates beyond the surficial soil layer, the factors are topography, soil type and ground cover. The sum of the fractions representing each of these characteristics establishes the total percentage of surplus, which can be infiltrated in areas with sufficient downward gradient. Wetlands and water bodies are assumed to have an upward or negligible downward gradient, resulting in all surpluses being contained in these areas, which provide increased evaporation and limited infiltration.

3.1 Site Water Balance Inputs

The site was assessed based on a single 60 ha catchment, reflecting the land use mapping provided by SCS (Attachment 2). The water balance analysis was completed for three scenarios:

- Pre-development examined the existing drainage patterns and mapped land uses on the study area.
- Post-development (no mitigation) condition based on the proposed land use.
- Post-development considering mitigation measures (i.e., Downspout disconnection and Infiltration Trenches) proposed by SCS.

Based on the borehole logs from the WSP Hydrogeological report (WSP, 2022), the soils below the topsoil layer within the footprint under pre-development conditions were generally silty clay to clayey silt. WHC and infiltration factors for the various land uses were taken from the MOE SWM Manual (MOE, 2003).

Pre-Development Site Land Uses

The pre-development land use for the Site is shown in Table 1. The pre-development Site reflects the recent golf-course land use.

- Forested areas were assigned a WHC of 400 mm and infiltration factor of 0.6, representing flat land, clay loam, and forested land use.
- Pasture and shrub areas were assigned a WHC of 250 mm and infiltration factor of 0.5, representing flat land, clay loam, and cultivated land use.
- Golf course areas were assigned a WHC of 100 mm and an infiltration factor of 0.4, representing rolling land, clay loam, and cultivated land use.
- Impervious areas (paved and roof areas) were assumed to lose 10% of annual precipitation as evaporation, with the remainder assumed as runoff (based on guidance in from the Ontario Conservation Authorities “Hydrogeological Assessment Submissions (Ontario CAs, 2013)), with no infiltration from Paved areas and an infiltration factor of 0.25 for roof areas (assuming roof downspout disconnections for buildings).
- Pond areas were assumed to always have water available at surface for evaporation, and the annual surplus was thus assumed as annual precipitation minus potential evaporation with no infiltration.

Table 1: Pre-Development Site Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Forest	3.4	Clay Loam	400	0.2	0.2	0.2	0.6
Pasture/Shrub	6.8	Clay Loam	250	0.2	0.2	0.1	0.5
Golf Course	48.6	Clay Loam	100	0.1	0.2	0.1	0.4
Paved Road	0.6	Clay Loam	(90% Precip) [1]	-	-	-	0
Roof to Downspout Disconnect	0.1	Clay Loam	(90% Precip) [1]	-	-	-	0.252
Pond	0.5	Clay Loam	(Precip-PET)[3]	-	-	-	0

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

[3] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

Post-Development– No Mitigation Site Land Uses

The post-development land use for the site without mitigation is shown in Table 2. The post-development Site reflect a mix of residential and park land uses, which has been further divided into forest, Grassland (pasture/shrub), landscaped (urban lawn), paved, roof to downspout disconnection, and pond areas.

- Forested areas were assigned a WHC of 400 mm and infiltration factor of 0.6, representing flat land, clay loam, and forested land use.

- Pasture and shrub areas were assigned a WHC of 250 mm and infiltration factor of 0.5, representing rolling land, clay loam, and cultivated land use.
- Landscaped areas were assigned a WHC of 100 mm and an infiltration factor of 0.4, representing rolling land, clay loam, and cultivated land use.
- Impervious areas (paved and roof areas) were assumed to lose 10% of annual precipitation as evaporation, with the remainder assumed as runoff (based on guidance in from the Ontario Conservation Authorities "Hydrogeological Assessment Submissions (Ontario CAs, 2013)), with no infiltration from Paved areas or roof areas.
- Pond areas were assumed to always have water available at surface for evaporation, and the annual surplus was thus assumed as annual precipitation minus potential evaporation with no infiltration

Table 2: Post-Development – No Mitigation Site Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Forest	1.7	Clay Loam	400	0.2	0.2	0.2	0.6
Grassland (pasture/shrub)	6.8	Clay Loam	250	0.2	0.2	0.1	0.5
Landscaped	18.9	Clay Loam	100	0.1	0.2	0.1	0.4
Paved	19.7	Clay Loam	(90% Precip) [1]	-	-	-	-
Roof	10.5	Clay Loam	(90% Precip) [1]	-	-	-	-
Pond	2.6	Clay Loam	(Precip-PET)[2]	-	-	-	-

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

Post-Development – Mitigated Land Uses

The post-development mitigated land use for the site is shown in Table 3. The post-development mitigated site reflects the same land uses as the post-development (no mitigation) site, with the addition of downspout disconnections for the rooftop and infiltration trenches for select areas were groundwater elevations allow.

- For downspout disconnected roof areas, an infiltration factor of 0.25 was used based Table 4.3.1 of the TRCA LID Manual (TRCA, 2010).
- The current development plan proposes to collect and infiltrate the first 25 mm of collected rainfall from 0.1 ha of rooftops. The runoff capture and infiltration for these features was estimated by taking the daily precipitation at the Egbert station for the available period of record (2001 to 2021), estimating daily rainfall (assumed as precipitation on days when the mean temperature was above zero), subtracting an initial 1 mm initial abstraction, and assuming the capture of up to 25 mm for any assumed rainfall above that 1 mm amount. The results suggested that a system designed to thus capture and infiltrate the first 25 mm of runoff event would provide approximately 473.6 mm/yr infiltration for that area.

- Pond areas were assumed to always have water available at surface for evaporation, and the annual surplus was thus assumed as annual precipitation minus potential evaporation with no infiltration

Table 3: Post-Development - Mitigated Site Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Forest	1.7	Clay Loam	400	0.2	0.2	0.2	0.6
Grassland (pasture/shrub)	6.8	Clay Loam	250	0.2	0.2	0.1	0.5
Landscaped	18.9	Clay Loam	100	0.1	0.2	0.1	0.4
Paved	19.7	Clay Loam	(90% Precip) [1]	-	-	-	-
Roof to downspout disconnection	10.4	Clay Loam	(90% Precip) [1]	-	-	-	0.252
Roof to Infiltration	0.1	Clay Loam	(90% Precip) [1]	-	-	-	N/A3
Pond	2.6	Clay Loam	(Precip-PET)[4]	-	-	-	-

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

[3] Infiltration for impervious areas assumed based on capture of 25 mm of historical daily rainfall

[4] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

3.2 Site Water Balance Results

Results from the pre-development and post-development scenarios are described below.

Pre-Development Scenario

Results from the pre-development scenario for the site are shown in Table 4 below. Of the 473,000 m^3/yr precipitation over the Site, 325,000 m^3/yr is lost as evapotranspiration, with the remaining 144,000 m^3/yr surplus being divided into 59,000 m^3/yr infiltration and 86,000 m^3/yr runoff.

Post-Development Scenario - No Mitigation

Results from the post-development scenario are shown in Table 5 below. The precipitation is the same as the pre-development scenario, however the increase in hard surfaces results in decreased evapotranspiration losses and increase in surplus to 280,000 m^3/yr (an increase of 136,000 m^3/yr or 94% compared to the pre-development scenario. The increase in hard surfaces likewise results in a decrease in post-development infiltration to 27,000 m^3/yr (a decrease of 32,000 m^3/yr or 54% compared to the pre-development scenario). The post-development runoff meanwhile increases to 253,000 m^3/yr (167,000 m^3/yr or 194% above pre-development conditions).

Post-Development Scenario - Mitigated

Results from the post-development with mitigation scenario are shown in Table 6 below. The precipitation is roughly the same as the pre-development scenario, however the increase in hard surfaces results in decreased evapotranspiration losses and increase in surplus to 280,000 m^3/yr (an increase of 136,000 m^3/yr or 94%

compared to the pre-development scenario). Despite the downspout disconnection (which provide 18,000 m^3/yr infiltration), the increase in hard surfaces likewise results in a decrease in post-development infiltration to 45,000 m^3/yr (a decrease of 14,000 m^3/yr or 24% compared to the pre-development scenario). The post-development runoff meanwhile increases to 235,000 m^3/yr (149,000 m^3/yr or 173% above pre-development conditions).

Table 4: Pre-Development Site Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Forest	3.4	400	786	27,000	605	21,000	177	6,000	106	4,000	70.8	2,000
Pasture/Shrub	6.8	250	786	54,000	593	41,000	192	13,000	96.0	7,000	96.0	7,000
Golf Course / Urban Lawn	48.6	100	786	382,000	536	260,000	245	119,000	98.0	48,000	147	71,000
Paved Road and Other Impervious	0.6	(90% Precip[1])	786	5,000	78.6	0	707	4,000	0	0	707	4,000
Roof to Downspout Disconnect	0.1	(90% Precip[1])	786	1,000	78.6	0	707	1,000	177[2]	0	531	1,000
Pond	0.5	(Precip-PET[3])	786	4,000	607	3,000	179	1,000	0	0	179	1,000
Total	**60.0**			**473,000**		**325,000**		**144,000**		**59,000**		**86,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

[3] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

Table 5: Post-Development – No Mitigation Site Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Forest	1.7	400	786	13,000	605	10,000	177	3,000	106	2,000	70.8	1,000
Pasture/Shrub	6.8	250	786	54,000	593	41,000	192	13,000	96.0	7,000	96.0	7,000
Golf Course / Urban Lawn	18.9	100	786	148,000	536	101,000	245	46,000	98.0	18,000	147	28,000
Paved Road and Other Impervious	19.7	(90% Precip[1])	786	154,000	78.6	15,000	707	139,000	0	0	707	139,000
Roof	10.5	(90% Precip[1])	786	82,000	78.6	8,000	707	74,000	0	0	707	74,000
Pond	2.6	(Precip-PET[2])	786	20,000	607	16,000	179	5,000	0	0	179	5,000
Total	**60.0**			**471,000**		**191,000**		**280,000**		**27,000**		**253,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

Table 6: Post-Development - Mitigated Site Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Forest	1.7	400	786	13,000	605	10,000	177	3,000	106	2,000	71	1,000
Pasture/shrub	6.8	250	786	54,000	593	41,000	192	13,000	96	7,000	96	7,000
Landscaped	18.9	100	786	148,000	536	101,000	245	46,000	98	18,000	147	28,000
Paved Road	19.7	(90% Precip)[1]	786	154,000	79	15,000	707	139,000	0	0	707	139,000
Roof to Downspout Disconnect	10.4	(90% Precip)[1]	786	82,000	79	8,000	707	74,000	177[2]	18,000	531	55,000
Roof to Infiltration	0.1	(90% Precip)[1]	786	1,000	78.6	0	707	1,000	474[3]	0	234	0
Pond	2.6	(Precip-PET)[4]	786	20,000	607	16,000	179	5,000	0	0	179	5,000
Total	**60.0**			**471,000**		**191,000**		**280,000**		**45,000**		**235,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

[3] Infiltration for impervious areas assumed based on capture of 25 mm of historical daily rainfall

[4] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

3.3 Feature-Based Water Balance Inputs

The site was assessed based on feature catchments, reflecting the land use mapping provided by SCS. The features are two watercourses, the North Feature (HDF-D) and the South Feature (HDF-E), and a wetland. The water balance analysis of the features was completed for three scenarios:

- Pre-development examined the existing drainage patterns and mapped land uses on the study area.
- Post-development (no mitigation) condition based on the proposed land use.
- Post-development considering mitigation measures (i.e., Downspout disconnection and Infiltration Trenches) proposed by SCS.

Based on the borehole logs from the WSP Hydrogeological report (WSP, 2022), the soils below the topsoil layer within the footprint under pre-development conditions were generally silty clay to clayey silt. WHC and infiltration factors for the various land uses were taken from the MOE SWM Manual (MOE, 2003).

Pre-Development Land Uses

The pre-development land use for the watercourses is shown in Table 7, Table 8, and land use for the wetland is shown in Table 9.

- Agricultural areas were assigned a WHC of 200 mm and infiltration factor of 0.4, representing rolling land, clay loam, and cultivated land use.
- Pasture and shrub areas were assigned a WHC of 250 mm and infiltration factor of 0.5, representing flat land, clay loam, and cultivated land use.
- Golf course areas were assigned a WHC of 100 mm and an infiltration factor of 0.4, representing rolling land, clay loam, and cultivated land use.
- Impervious areas (paved and roof areas) were assumed to lose 10% of annual precipitation as evaporation, with the remainder assumed as runoff (based on guidance in from the Ontario Conservation Authorities "Hydrogeological Assessment Submissions (Ontario CAs, 2013)), with no infiltration from Paved areas and an infiltration factor of 0.25 for roof areas (assuming roof downspout disconnections for buildings).
- Pond areas were assumed to always have water available at surface for evaporation, and the annual surplus was thus assumed as annual precipitation minus potential evaporation with no infiltration.

Table 7: Pre-Development HDF-D Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Agricultural	12.56	Clay Loam	200	0.1	0.2	0.1	0.4
Golf Course	12.99	Clay Loam	100	0.1	0.2	0.1	0.4
Paved	1.99	Clay Loam	(90% Precip) [1]	-	-	-	0
Rooftop	1.05	Clay Loam	(90% Precip) [1]	-	-	-	0.25

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

Table 8: Pre-Development HDF-E Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Agricultural	39.00	Clay Loam	200	0.1	0.2	0.1	0.4
Golf Course	3.05	Clay Loam	100	0.1	0.2	0.1	0.4

Table 9: Pre-Development Wetland Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Agricultural	57.2	Clay Loam	200	0.1	0.2	0.1	0.4
Golf Course	28.1	Clay Loam	100	0.1	0.2	0.1	0.4
Forest	3.40	Clay Loam	200	0.2	0.2	0.1	0.5
Pasture/Shrub	6.8	Clay Loam	250	0.2	0.2	0.2	0.6
Pond	0.5	Clay Loam	(Precip-PET)[2]	-	-	-	0
Paved	2.0	Clay Loam	(90% Precip) [1]	-	-	-	0
Rooftop	1.2	Clay Loam	(90% Precip) [1]	-	-	-	0.25[3]

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

[3] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

Post-Development – No Mitigation Land Uses

The post-development land use for the watercourses is shown in Table 10, Table 11 and land use for the wetland is shown in Table 12. The post-development features reflect a mix of residential and park land uses, which has been further divided into Agricultural, forest, grassland (pasture/shrub), landscaped (urban lawn), paved, roof, roof to downspout disconnection, and pond areas.

- Agricultural areas were assigned a WHC of 200 mm and infiltration factor of 0.4, representing rolling land, clay loam, and cultivated land use.
- Pasture and shrub areas were assigned a WHC of 250 mm and infiltration factor of 0.5, representing flat land, clay loam, and cultivated land use.
- Golf course areas were assigned a WHC of 100 mm and an infiltration factor of 0.4, representing rolling land, clay loam, and cultivated land use.
- Impervious areas (paved and roof areas) were assumed to lose 10% of annual precipitation as evaporation, with the remainder assumed as runoff (based on guidance in from the Ontario Conservation Authorities "Hydrogeological Assessment Submissions (Ontario CAs, 2013)), with no infiltration from Paved areas and an infiltration factor of 0.25 for roof areas (assuming roof downspout disconnections for existing buildings).
- Pond areas were assumed to always have water available at surface for evaporation, and the annual surplus was thus assumed as annual precipitation minus potential evaporation with no infiltration.

Table 10: Post-Development – No Mitigation HDF-D Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Agricultural	12.56	Clay Loam	200	0.1	0.2	0.1	0.4
Golf Course	7.8	Clay Loam	100	0.1	0.2	0.1	0.4
Paved	2.0	Clay Loam	(90% Precip) [1]	-	-	-	0
Rooftop	1.0	Clay Loam	(90% Precip) [1]	-	-	-	0.25[2]
Rooftop	0.3	Clay Loam	(90% Precip) [1]	-	-	-	0

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

Table 11 : Post-Development – No Mitigation HDF-E Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Agricultural	39.00	Clay Loam	200	0.1	0.2	0.1	0.4
Rooftop	0.2	Clay Loam	(90% Precip) [1]	-	-	-	0
Landscaped	0.3	Clay Loam	100	0.1	0.2	0.1	0.4

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

Table 12: Post-Development Wetland Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Agricultural	57.2	Clay Loam	200	0.1	0.2	0.1	0.4
Forest	1.7	Clay Loam	200	0.2	0.2	0.2	0.6
Pasture/Shrub	6.8	Clay Loam	250	0.2	0.2	0.1	0.5
Paved	7.7	Clay Loam	(90% Precip) [1]	-	-	-	0
Rooftop	1.2	Clay Loam	(90% Precip) [1]	-	-	-	0.25[2]
Landscaped	20.4	Clay Loam	100	0.1	0.2	0.1	0.4
Rooftop	6.2	Clay Loam	(90% Precip) [1]	-	-	-	0
Pond	2.6	Clay Loam	(Precip-PET)[3]	-	-	-	0

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

[3] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

Post-Development – Mitigated Land Uses

The post-development mitigated land use for the watercourses is shown in Table 13, Table 14 and land use for the wetland is shown in Table 15. The post-development mitigated site reflects the same land uses as the post-development (no mitigation) site, with the addition of downspout disconnections for the rooftops.

- For downspout disconnected roof areas, an infiltration factor of 0.25 was used based Table 4.3.1 of the TRCA LID Manual (TRCA, 2010).

Table 13: Post-Development – Mitigated HDF-D Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Agricultural	12.56	Clay Loam	200	0.1	0.2	0.1	0.4
Golf Course	7.8	Clay Loam	100	0.1	0.2	0.1	0.4
Paved	2.0	Clay Loam	(90% Precip) [1]	-	-	-	0
Rooftop	1.3	Clay Loam	(90% Precip) [1]	-	-	-	0.25[2]

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013
[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

Table 14: Post-Development – Mitigated HDF-E Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Agricultural	39.00	Clay Loam	200	0.1	0.2	0.1	0.4
Rooftop	0.2	Clay Loam	(90% Precip) [1]	-	-	-	0.25[2]
Landscaped	0.3	Clay Loam	100	0.1	0.2	0.1	0.4

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

Table 15: Post-Development -- Mitigated Wetland Land Use

Land Use	Area (ha)	Soil	Water Holding Capacity (mm)	Infiltration Coefficient			
				Slope Factor	Soil Factor	Vegetation Factor	Total
Agricultural	57.18	Clay Loam	200	0.1	0.2	0.1	0.4
Forest	1.7	Clay Loam	200	0.2	0.2	0.2	0.6
Pasture/Shrub	6.8	Clay Loam	250	0.2	0.2	0.1	0.5
Paved	7.7	Clay Loam	(90% Precip) [1]	-	-	-	0
Rooftop	7.4	Clay Loam	(90% Precip) [1]	-	-	-	0.25[2]
Landscaped	20.4	Clay Loam	100	0.1	0.2	0.1	0.4
Pond	2.6	Clay Loam	(Precip-PET)[3]	-	-	-	0

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

[3] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

3.4 Feature-Based Water Balance Results

Average annual water balance assessments were carried out for the portions of the site contributing to i) the north feature watercourse (HDF-D) sub-watershed, ii) the south feature watercourse (HFD-E) sub-watershed and iii) the Wetland. The results for the pre-development, post-development, and mitigated post-development scenarios are presented in this section for each of the three assessments.

Pre-Development Scenario

Watercourses

Results from the pre-development scenario for the watercourses are shown in Table 16 and Table 17 below. Of the 225,000 m^3/yr precipitation over the north feature watercourse (HDF-D) catchment, 146,000 m^3/yr is lost as evapotranspiration. The estimated average annual runoff from the North feature catchment is approximately 54,000 m^3 and the average annual infiltration within this catchment is 25,000 m^3.

Of the 331,000 m^3/yr precipitation over the south watercourse (HDF-E) catchment, 243,000 m^3/yr is lost as evapotranspiration. The estimated average annual runoff from the south feature is approximately 51,000 m^3 and the average annual infiltration within this catchment is approximately 35,000 m^3.

Wetland

Results from the pre-development scenario for the wetland are shown in Table 18 below. Of the 781,000 m^3/yr precipitation over the wetland catchment, 552,000 m^3/yr is lost as evapotranspiration. The estimated average annual runoff contributing to the Wetland is approximately 141,000 m^3 and the average annual infiltration is approximately 87,000 m^3.

Post-Development – No Mitigation Scenario

Watercourses

Results from the post-development scenario for the watercourses are shown in Table 19 and Table 20 below. Of the 186,000 m^3/yr precipitation over the north feature watercourse (HDF-D) catchment, 118,000 m^3/yr is lost as evapotranspiration, with the remaining 67,000 m^3/yr surplus being divided into 20,000 m^3/yr infiltration and 47,000 m^3/yr runoff.

Of the 311,000 m^3/yr precipitation over the south feature watercourse (HFD-E) catchment, 227,000 m^3/yr is lost as evapotranspiration, with the remaining 83,000 m^3/yr surplus being divided into 32,000 m^3/yr infiltration and 51,000 m^3/yr runoff.

Wetland

Results from the post-development scenario for the wetland are shown in Table 21 below. Of the 816,000 m^3/yr precipitation over the wetland catchment, 522,000 m^3/yr is lost as evapotranspiration, with the remaining 294,000 m^3/yr surplus being divided into 77,000 m^3/yr infiltration and 217,000 m^3/yr runoff.

Post-Development – Mitigated Scenario

Watercourses

Results from the post-development with mitigation scenario for the watercourses are shown in Table 22 and Table 23 below. Of the 186,000 m^3/yr precipitation over the north feature watercourse (HDF-D) catchment, 118,000 m^3/yr is lost as evapotranspiration, with the remaining 67,000 m^3/yr surplus being divided into 20,000 m^3/yr infiltration and 47,000 m^3/yr runoff (a decrease of 20% and 13%, respectively, compared to pre-development conditions).

Of the 311,000 m^3/yr precipitation over the south feature watercourse (HFD-E) catchment, 227,000 m^3/yr is lost as evapotranspiration, with the remaining 83,000 m^3/yr surplus being divided into 32,000 m^3/yr infiltration and 51,000 m^3/yr runoff (a decrease of 9% and 0%, respectively, compared to pre-development conditions).

Wetland

Results from the post-development with mitigation scenario for the wetland are shown in Table 24 below. Of the 815,000 m^3/yr precipitation over the wetland catchment, 522,000 m^3/yr is lost as evapotranspiration, with the remaining 293,000 m^3/yr surplus being divided into 88,000 m^3/yr infiltration and 205,000 m^3/yr runoff (an increase of 1% and 45%, respectively, compared to pre-development conditions).

Table 16: Pre-Development HDF-D Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)
Agricultural	12.56	200	786	99,000	582	73,000	202	25,000	80.8	10,000	121	15,000
Golf Course / Urban Lawn	12.99	100	786	102,000	536	70,000	245	32,000	98.0	13,000	147	19,000
Paved Road and Other Impervious	1.99	(90% Precip) [1]	786	16,000	78.6	2,000	707	14,000	0	0	707	14,000
Roof	1.05	(90% Precip) [1]	786	8,000	78.6	1,000	707	7,000	177[2]	2,000	531	6,000
Total	**28.6**			**225,000**		**146,000**		**78,000**		**25,000**		**54,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

Table 17: Pre-Development HDF-E Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)
Agricultural	39.00	200	786	307,000	582	227,000	202	79,000	80.8	32,000	121	47,000
Golf Course / Urban Lawn	3.05	100	786	24,000	536	16,000	245	7,000	98.0	3,000	147	4,000
Total	**42.1**			**331,000**		**243,000**		**86,000**		**35,000**		**51,000**

Table 18: Pre-Development Wetland Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)	(mm/yr)	(m³/yr)
Agricultural	57.2	200	786	449,000	582	333,000	202	116,000	80.8	46,000	121	69,000
Forest	3.4	400	786	27,000	605	21,000	177	6,000	106	4,000	70.8	2,000
Pasture/Shrub	6.8	250	786	54,000	593	41,000	192	13,000	96.0	7,000	96.0	7,000
Golf Course / Urban Lawn	28.1	100	786	221,000	536	151,000	245	69,000	98.0	28,000	147	41,000
Paved Road and Other Impervious	2.0	(90% Precip) [1]	786	16,000	78.6	2,000	707	14,000	0	0	707	14,000
Roof to Downspout Disconnect	1.2	(90% Precip) [1]	786	10,000	78.6	1,000	707	9,000	177[2]	2,000	531	7,000
Pond	0.5	(Precip-PET)[3]	786	4,000	607	3,000	179	1,000	0	0	179	1,000
Total	**99.3**			**781,000**		**552,000**		**228,000**		**87,000**		**141,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013
[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)
[3] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

Table 19: Post-Development – No Mitigation HDF-D Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Agricultural	12.6	200	786	99,000	582	73,000	202	25,000	80.8	10,000	121	15,000
Golf Course / Urban Lawn	7.8	100	786	61,000	536	42,000	245	19,000	98.0	8,000	147	11,000
Paved Road and Other Impervious	2.0	(90% Precip) [1]	786	16,000	78.6	2,000	707	14,000	0	0	707	14,000
Roof	0.3	(90% Precip) [1]	786	2,000	78.6	0	707	2,000	0	0	707	2,000
Roof to Downspout Disconnect	1.0	(90% Precip) [1]	786	8,000	78.6	1,000	707	7,000	177[2]	2,000	531	6,000
Total	**23.7**			**186,000**		**118,000**		**67,000**		**20,000**		**47,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013
[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

Table 20: Post-Development – No Mitigation HDF-E Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Agricultural	39.0	200	786	307,000	582	227,000	202	79,000	80.8	32,000	121	47,000
Roof	0.2	(90% Precip) [1]	786	2,000	78.6	0	707	2,000	0	0	707	2,000
Golf Course / Urban Lawn	0.3	(90% Precip) [1]	786	2,000	78.6	0	707	2,000	0	0	707	2,000
Total	**39.5**			**311,000**		**227,000**		**83,000**		**32,000**		**51,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013

Table 21: Post-Development – No Mitigation Wetland Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Agricultural	57.2	200	786	449,000	582	333,000	202	116,000	80.8	46,000	121	69,000
Forest	1.7	400	786	13,000	605	10,000	177	3,000	106	2,000	70.8	1,000
Pasture/Shrub	6.8	250	786	54,000	593	41,000	192	13,000	96.0	7,000	96.0	7,000
Golf Course / Urban Lawn	20.4	100	786	161,000	536	110,000	245	50,000	98.0	20,000	147	30,000
Paved Road and Other Impervious	7.7	(90% Precip) [1]	786	60,000	78.6	6,000	707	54,000	0	0	707	54,000
Roof	6.2	(90% Precip) [1]	786	49,000	78.6	5,000	707	44,000	0	0	707	44,000
Roof to Downspout Disconnect	1.2	(90% Precip) [1]	786	10,000	78.6	1,000	707	9,000	177[2]	2,000	531	7,000
Pond	2.6	(Precip-PET)[3]	786	20,000	607	16,000	179	5,000	0	0	179	5,000
Total	**103.8**			**816,000**		**522,000**		**294,000**		**77,000**		**217,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013
[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)
[3] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

Table 22: Post-Development – Mitigated HDF-D Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Agricultural	12.6	200	786	99,000	582	73,000	202	25,000	80.8	10,000	121	15,000
Golf Course / Urban Lawn	7.8	100	786	61,000	536	42,000	245	19,000	98.0	8,000	147	11,000
Paved Road and Other Impervious	2.0	(90% Precip) [1]	786	16,000	78.6	2,000	707	14,000	0	0	707	14,000
Roof to Downspout Disconnect	1.3	(90% Precip) [1]	786	10,000	78.6	1,000	707	9,000	177[2]	2,000	531	7,000
Total	**23.7**			**186,000**		**118,000**		**67,000**		**20,000**		**47,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013
[2] **25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)**

Table 23: Post-Development – Mitigated HDF-E Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Agricultural	39.0	200	786	307,000	582	227,000	202	79,000	80.8	32,000	121	47,000
Roof to Downspout Disconnect	0.2	(90% Precip) [1]	786	2,000	78.6	0	707	2,000	177[2]	0	531	1,000
Golf Course / Urban Lawn	0.3	(90% Precip) [1]	786	2,000	78.6	0	707	2,000	0	0	707	2,000
Total	**39.5**			**311,000**		**227,000**		**83,000**		**32,000**		**51,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013
[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)

Table 24: Post-Development Wetland Water Balance Results

Land Use	Area (ha)	WHC (mm)	Precipitation		Actual Evap.		Surplus		Infiltration		Runoff	
			(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Agricultural	57.2	200	786	449,000	582	333,000	202	116,000	80.8	46,000	121	69,000
Forest	1.7	400	786	13,000	605	10,000	177	3,000	106	2,000	70.8	1,000
Pasture/Shrub	6.8	250	786	54,000	593	41,000	192	13,000	96.0	7,000	96.0	7,000
Golf Course / Urban Lawn	20.4	100	786	161,000	536	110,000	245	50,000	98.0	20,000	147	30,000
Paved Road and Other Impervious	7.7	(90% Precip) [1]	786	60,000	78.6	6,000	707	54,000	0	0	707	54,000
Roof to Downspout Disconnect	7.4	(90% Precip) [1]	786	58,000	78.6	6,000	707	52,000	177	13,000	531	39,000
Pond	2.6	(Precip-PET)[3]	786	20,000	607	16,000	179	5,000	0	0	179	5,000
Total	**103.8**			**815,000**		**522,000**		**293,000**		**88,000**		**205,000**

[1] 90% of the total precipitation is available as surplus for impervious areas based on Ontario CAs 2013
[2] 25% of runoff from roof downspouts assumed to infiltrate based on Table 4.3.2 in the TRCA LID manual (TRCA, 2010)
[3] Surplus for open water areas assumed as Precipitation minus Potential Evapotranspiration

4.0 CONCLUSIONS

The water balance assessment for the pre-development, post-development and post-development with mitigation scenarios for the Bradford Highlands Site demonstrates that the proposed development will result in a 32% decrease in average annual infiltration and 194% increase in average annual runoff from the Site in the post-development condition without any mitigation. However, by introducing proposed downspout disconnection and infiltration trenches, the proposed development will result in a 24% decrease in average annual infiltration and 173% increase in average annual runoff from the Site. With respect to the features, the mitigated post-development conditions will results in a 20% and 9% reduction in average annual infiltration for HDF-D and HDF-E, respectively, and a 1% increase in infiltration to the wetland.

Signature Page

WSP Canada Inc.

Mohammadreza Mahdavi
Water Resources Specialist

Christopher Davidson, PEng
Water Resources Engineer

MM/CD/mp

https://wsponline.sharepoint.com/sites/gld-159365/project files/6 deliverables/5.0 - water balance/report/22517668-r-rev2-bradford highlands water balance report-01nov2024.docx

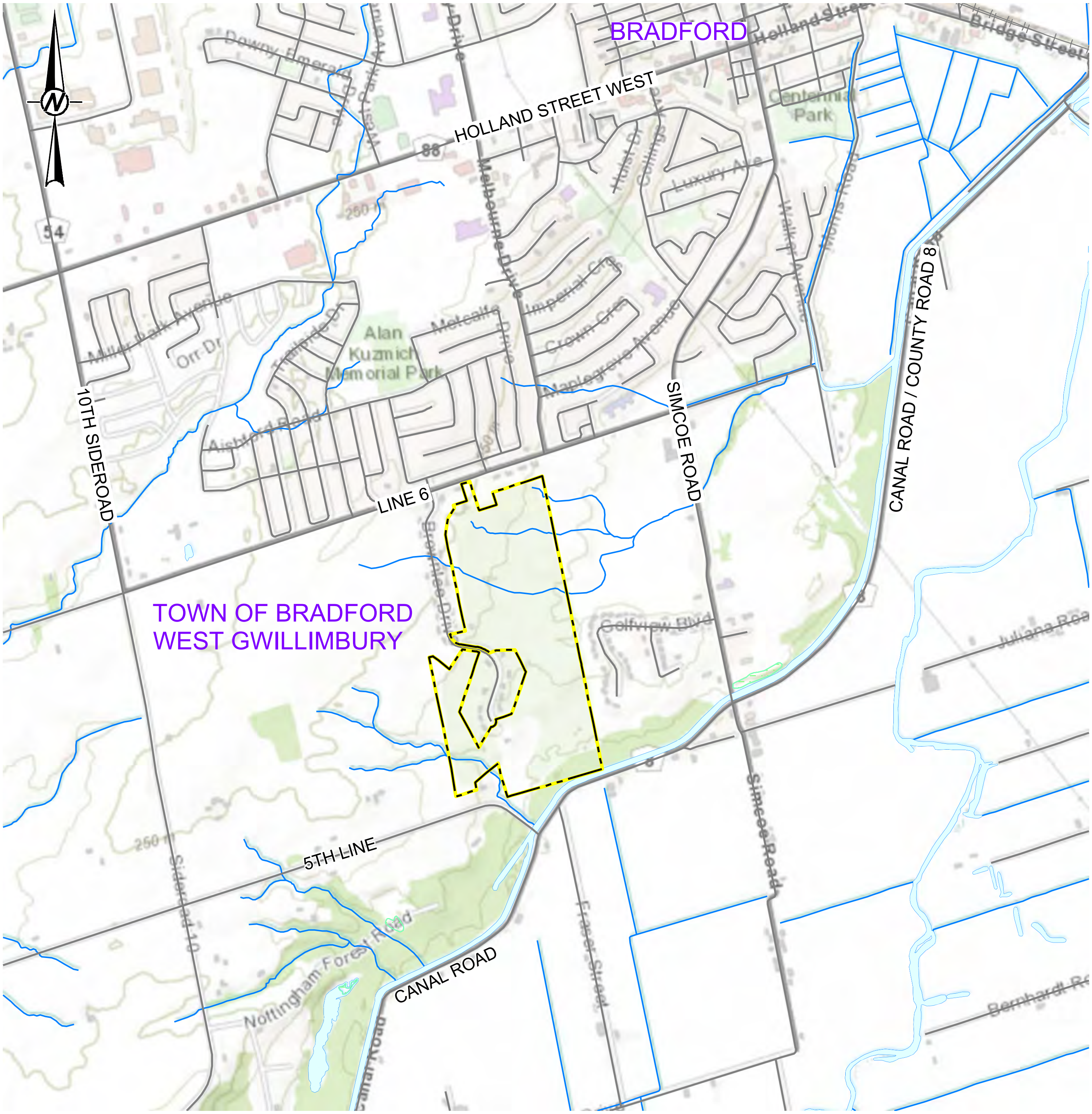
REFERENCES

Ontario Ministry of the Environment (MECP), “Stormwater Management Planning and Design Manual”, 2003.

Toronto and Region Conservation Authority (TRCA), “Low Impact Development Stomrwater Management Planning and Design Guide”, 2010

WSP, “Preliminary Hydrogeological Assessment, Proposed Residential Subdivision, Bradford Highlands Golf Course”, October 2022.

FIGURE



0 500 1,000

1:25,000 METRES

LEGEND

- APPROXIMATE PHASE TWO PROPERTY
- ROAD
- RAILWAY
- WATERCOURSE
- WATER AREA, PERMANENT
- WOODED AREA

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2015

PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2015

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

BRADFORD HIGHLANDS

PROJECT

BRADFORD HIGHLANDS GOLF COURSE REDEVELOPMENT
2789 LINE 6 AND 23 BROWNLEE DRIVE
TOWN OF BRADFORD WEST GWILLIMBURY, ONTARIO

TITLE

KEY PLAN

CONSULTANT

YYYY-MM-DD	2024-10-30
PREPARED	JPR
DESIGN	
REVIEW	
APPROVED	DPD

PROJECT No.	CONTROL	Rev.	FIGURE
22517668	0004	----	1

Path: \\corp.pbwan.net\CA\CAMIS300\CTX_Data\SIM\Clients\Bradford_Highlands\Bradford_Highlands_Golfcourse\99_PROJ\22517668\40_PROD\0004_HydroG_2024\ | File Name: 22517668-0004-CH-0001.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25 mm

0

ATTACHMENT 1

Water Balance Tables

TABLE 1A
CLIMATIC WATER BUDGET: CLIMATE NORMAL 1989-2016 (EGBERT, ON DC 20492)
BRADFORD HIGHLANDS

	Thonthwaite (1948) - 100mm WHC							
Month	Mean Temperature (Deg.C)	Heat Index	Protential Evapotranspiration (mm)	Daylight Correction Value	Actual Evapotranspiration (mm)	Total Precipitation (mm)	Surplus (mm)	Defecit (mm)
January	-6.9	0	1.0	0.76	1.0	49.0	33.0	0.0
February	-6.6	0	1.0	0.85	1.0	44.0	37.0	0.0
March	-1.4	0	9.0	0.98	9.0	49.0	64.0	0.0
April	5.7	1.2	32.0	1.11	32.0	63.0	42.0	0.0
May	12.4	4.0	76.0	1.22	76.0	69.0	10.0	0.0
June	17.5	6.7	111.0	1.27	107.0	82.0	5.0	-4.0
July	19.9	8.1	129.0	1.24	107.0	79.0	0.0	-22.0
August	19.2	7.7	114.0	1.15	82.0	79.0	4.0	-32.0
September	15.2	5.4	78.0	1.02	66.0	78.0	2.0	-12.0
October	8.9	2.4	40.0	0.89	39.0	68.0	2.0	-1.0
November	2.8	0.4	13.0	0.78	13.0	69.0	21.0	0.0
December	-3.4	0	3.0	0.73	3.0	57.0	25.0	0.0
TOTAL	6.9	35.9	607.0		536.0	786.0	245.0	-71.0

TOTAL WATER SURPLUS 179.0 mm

NOTES:
1) Water budget adjusted for latitude and daylight
2) Deg.C represents calculatged mean of dialy temperatures for the month
3) Precipitation and Temperature data from the Egbert MET station located at 44.23N 79.78W
4) Total Water Surplus (Thorthwaite, 1948) is caluclated as total precipitation minus adjusted potential evapotranspiration
5) Total Moisture Surplus (Thornthwaite and Mather, 1957) is calcualted as total precipitation minus actual evapotranspiration for 1989-2016 using a 100mm Water Holding Capacity

TABLE 1B
CLIMATIC WATER BUDGET: CLIMATE NORMAL 1989-2016 (EGBERT, ON DC 20492)
BRADFORD HIGHLANDS

	Thonthwaite (1948) - 250mm WHC							
Month	Mean Temperature (Deg.C)	Heat Index	Protential Evapotranspiration (mm)	Daylight Correction Value	Actual Evapotranspiration (mm)	Total Precipitation (mm)	Surplus (mm)	Defecit (mm)
January	-6.9	0	1.0	0.76	1.0	49.0	16.0	0.0
February	-6.6	0	1.0	0.85	1.0	44.0	30.0	0.0
March	-1.4	0	9.0	0.98	9.0	49.0	56.0	0.0
April	5.7	1.2	32.0	1.11	32.0	63.0	42.0	0.0
May	12.4	4.0	76.0	1.22	76.0	69.0	10.0	0.0
June	17.5	6.7	111.0	1.27	111.0	82.0	5.0	0.0
July	19.9	8.1	129.0	1.24	128.0	79.0	0.0	-1.0
August	19.2	7.7	114.0	1.15	106.0	79.0	4.0	-9.0
September	15.2	5.4	78.0	1.02	73.0	78.0	2.0	-5.0
October	8.9	2.4	40.0	0.89	40.0	68.0	2.0	0.0
November	2.8	0.4	13.0	0.78	13.0	69.0	10.0	0.0
December	-3.4	0	3.0	0.73	3.0	57.0	15.0	0.0
TOTAL	6.9	35.9	607.0		593.0	786.0	192.0	-15.0

TOTAL WATER SURPLUS 179.0 mm

NOTES:

1) Water budget adjusted for latitude and daylight
2) Deg.C represents calculatged mean of dialy temperatures for the month
3) Precipitation and Temperature data from the Egbert MET station located at 44.23N 79.78W
4) Total Water Surplus (Thorthwaite, 1948) is caluclated as total precipitation minus adjusted potential evapotranspiration
5) Total Moisture Surplus (Thornthwaite and Mather, 1957) is calcualted as total precipitation minus actual evapotranspiration for 1989-2016 using a 250mm Water Holding Capacity

TABLE 1C

CLIMATIC WATER BUDGET: CLIMATE NORMAL 1989-2016 (EGBERT, ON DC 20492)

BRADFORD HIGHLANDS

	Thonthwaite (1948) - 400mm WHC							
Month	Mean Temperature (Deg.C)	Heat Index	Protential Evapotranspiration (mm)	Daylight Correction Value	Actual Evapotranspiration (mm)	Total Precipitation (mm)	Surplus (mm)	Defecit (mm)
January	-6.9	0	1.0	0.76	1.0	49.0	13.0	0.0
February	-6.6	0	1.0	0.85	1.0	44.0	26.0	0.0
March	-1.4	0	9.0	0.98	9.0	49.0	52.0	0.0
April	5.7	1.2	32.0	1.11	32.0	63.0	40.0	0.0
May	12.4	4.0	76.0	1.22	76.0	69.0	9.0	0.0
June	17.5	6.7	111.0	1.27	111.0	82.0	5.0	0.0
July	19.9	8.1	129.0	1.24	129.0	79.0	0.0	0.0
August	19.2	7.7	114.0	1.15	114.0	79.0	4.0	-1.0
September	15.2	5.4	78.0	1.02	76.0	78.0	2.0	-1.0
October	8.9	2.4	40.0	0.89	40.0	68.0	2.0	0.0
November	2.8	0.4	13.0	0.78	13.0	69.0	10.0	0.0
December	-3.4	0	3.0	0.73	3.0	57.0	14.0	0.0
TOTAL	6.9	35.9	607.0		605.0	786.0	177.0	-2.0

TOTAL WATER SURPLUS 179.0 mm

NOTES:

1) Water budget adjusted for latitude and daylight
2) Deg.C represents calculatged mean of dialy temperatures for the month
3) Precipitation and Temperature data from the Egbert MET station located at 44.23N 79.78W
4) Total Water Surplus (Thorthwaite, 1948) is caluclated as total precipitation minus adjusted potential evapotranspiration
5) Total Moisture Surplus (Thornthwaite and Mather, 1957) is calcualted as total precipitation minus actual evapotranspiration for 1989-2016 using a 400mm Water Holding Capacity

ATTACHMENT 2

SCS Drawings

Total Site Area Summary

Site Area	60.00	ha
Open Water / Canal / SWM Pond	2.56	ha
Post Development Pervious Area	27.34	ha
Post Development Impervious Area	30.10	ha
Post Development Imperviousness	50.17	%

Rear Yard Infiltration Trecnh (RYIT) Lot Type Area Breakdown

Lot Type	No. of Units	Roof Area per Unit (m^2)	Total Roof Area (m^2)
Detached	2	110.25	220.50
Semi Detached	10	62.40	624.00
Total	**12**	**172.65**	**844.50**

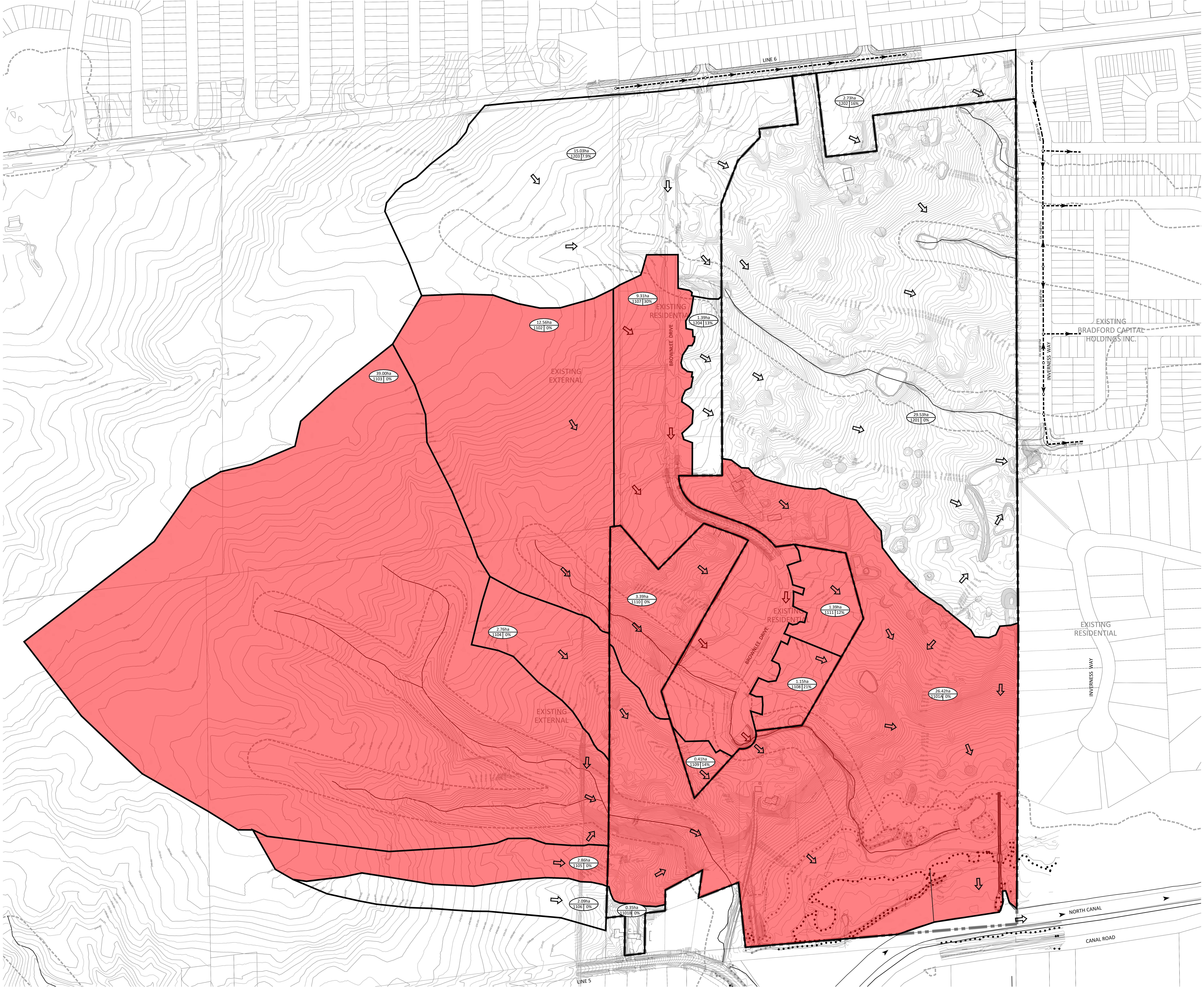
Roof Area to RYIT (ha) =	**0.08**

Roof to Grass Lot Type Area Breakdown

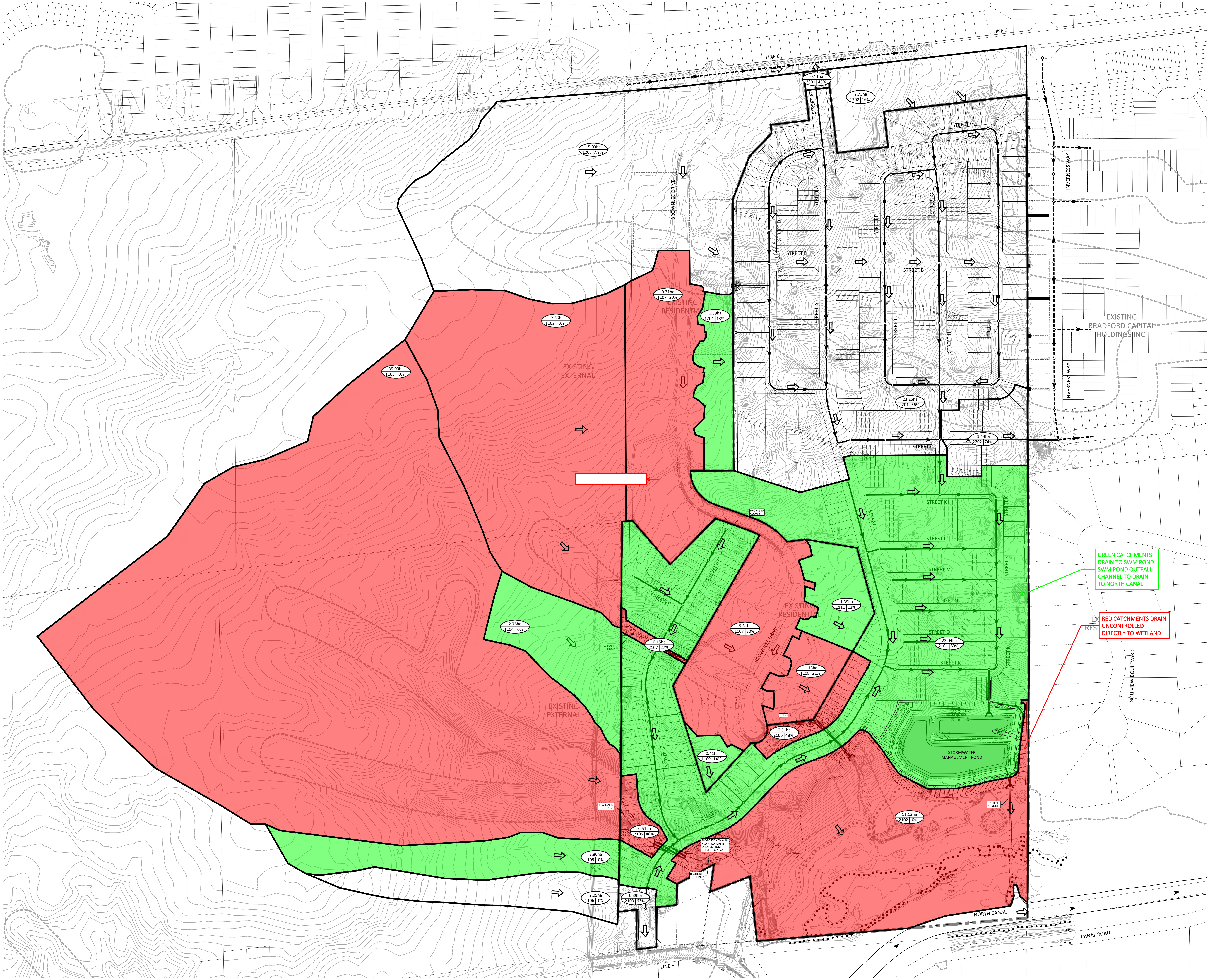
Lot Type	No. of Units with no RYIT	No. Units with Front Roof Only (Rear to RYIT)	Roof Area (ha)
Detached	297	2	6.57
Semi Detached	172	10	2.21
Townhouses (1/2 roof to grass)	208	-	1.59
Total	**677**	**12**	**10.37**

Impervious Area & LID Treatment Breakdown

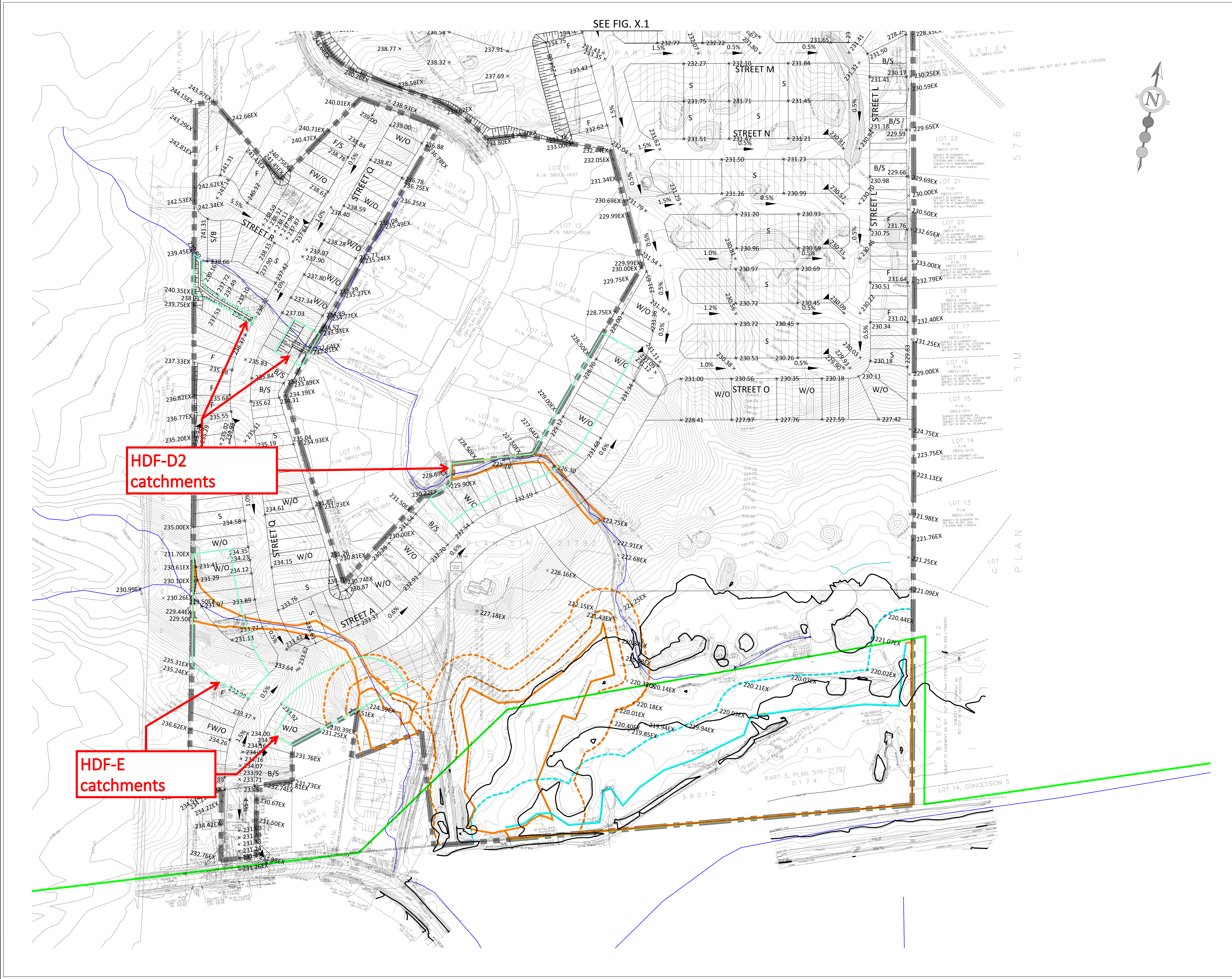
Low Impact Development	Contributing Impervious Area (ha)
Rear Yard Infiltration Trenches	0.08
Roof Leader to Grass	10.37
No LID	19.65
Total	**30.10**



LINE 6
15.03ha
1203 7.9%
2.73ha
1202 16%
9.31ha
1107 30%
EXISTING
RESIDENTIAL
1.39ha
1204 13%
12.56ha
1102 0%
39.00ha
1103 0%
EXISTING
EXTERNAL
BROWNLEE DRIVE
29.53ha
1201 0%
EXISTING
BRADFORD CAPITAL
HOLDINGS INC.
INVERNESS WAY
3.39ha
1110 0%
1.39ha
1111 12%
2.76ha
1104 0%
EXISTING
RESIDENTIAL
BROWNLEE DRIVE
EXISTING
RESIDENTIAL
INVERNESS WAY
1.15ha
1108 21%
26.42ha
1101A 0%
EXISTING
EXTERNAL
0.41ha
1109 14%
2.86ha
1105 0%
2.09ha
1106 0%
0.35ha
1101B 0%
NORTH CANAL
CANAL ROAD
LINE 5



LINE 6
0.11ha 2301 45%
2.73ha 1202 16%
15.03ha 1203 7.9%
STREET G
STREET A
STREET D
STREET E
STREET F
STREET B
STREET H
STREET J
STREET C
BROWNLEE DRIVE
INVERNESS WAY
EXISTING BRADFORD CAPITAL HOLDINGS INC.
23.25ha 2201 66%
1.44ha 2202 74%
9.31ha 1107 30%
EXISTING RESIDENTIAL
1.39ha 1204 13%
12.56ha 1102 0%
EXISTING EXTERNAL
39.00ha 1103 0%
STREET K
STREET L
STREET M
STREET N
STREET O
GREEN CATCHMENTS DRAIN TO SWM POND. SWM POND OUTFALL CHANNEL TO DRAIN TO NORTH CANAL
RED CATCHMENTS DRAIN UNCONTROLLED DIRECTLY TO WETLAND
GOLFVIEW BOULEVARD
2.76ha 1104 0%
0.15ha 2107 27%
1.39ha 1111 12%
22.04ha 2101 63%
1.15ha 1108 21%
0.51ha 2106 48%
STORMWATER MANAGEMENT POND
0.41ha 1109 14%
STREET P
11.13ha 2102 0%
0.51ha 2105 48%
2.86ha 1105 0%
2.09ha 1106 0%
0.39ha 2103 63%
NORTH CANAL
CANAL ROAD
LINE 5



LEGEND:

▬ ▪ ▪ ▬	LIMIT OF DEVELOPMENT
× 223.91	PROPOSED ELEVATION
× 224.35EX	EXISTING ELEVATION
0.5% →	ROAD SLOPE
	MAX 3:1 SLOPE
236.25	EXISTING ELEVATION AND CONTOUR

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

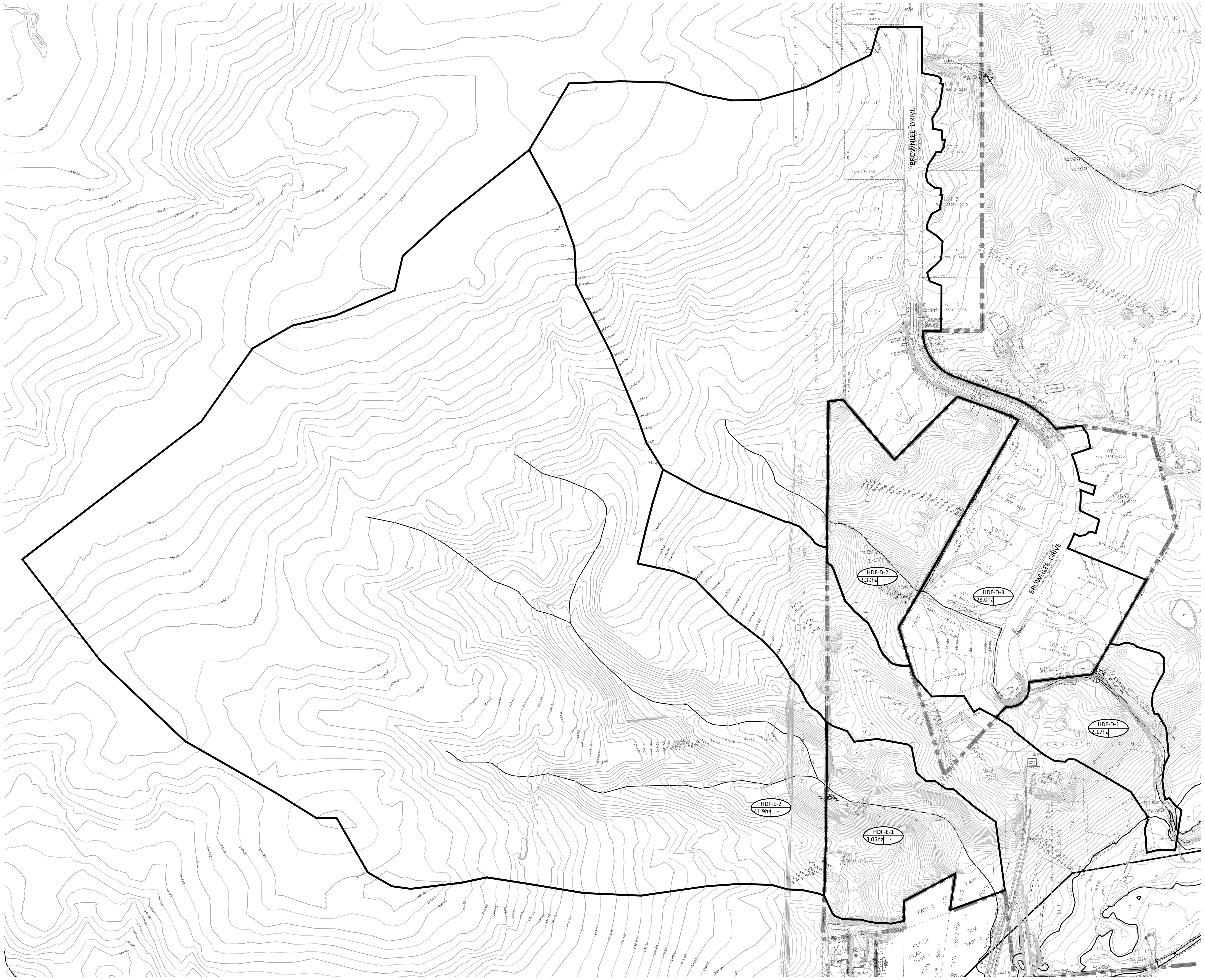
SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

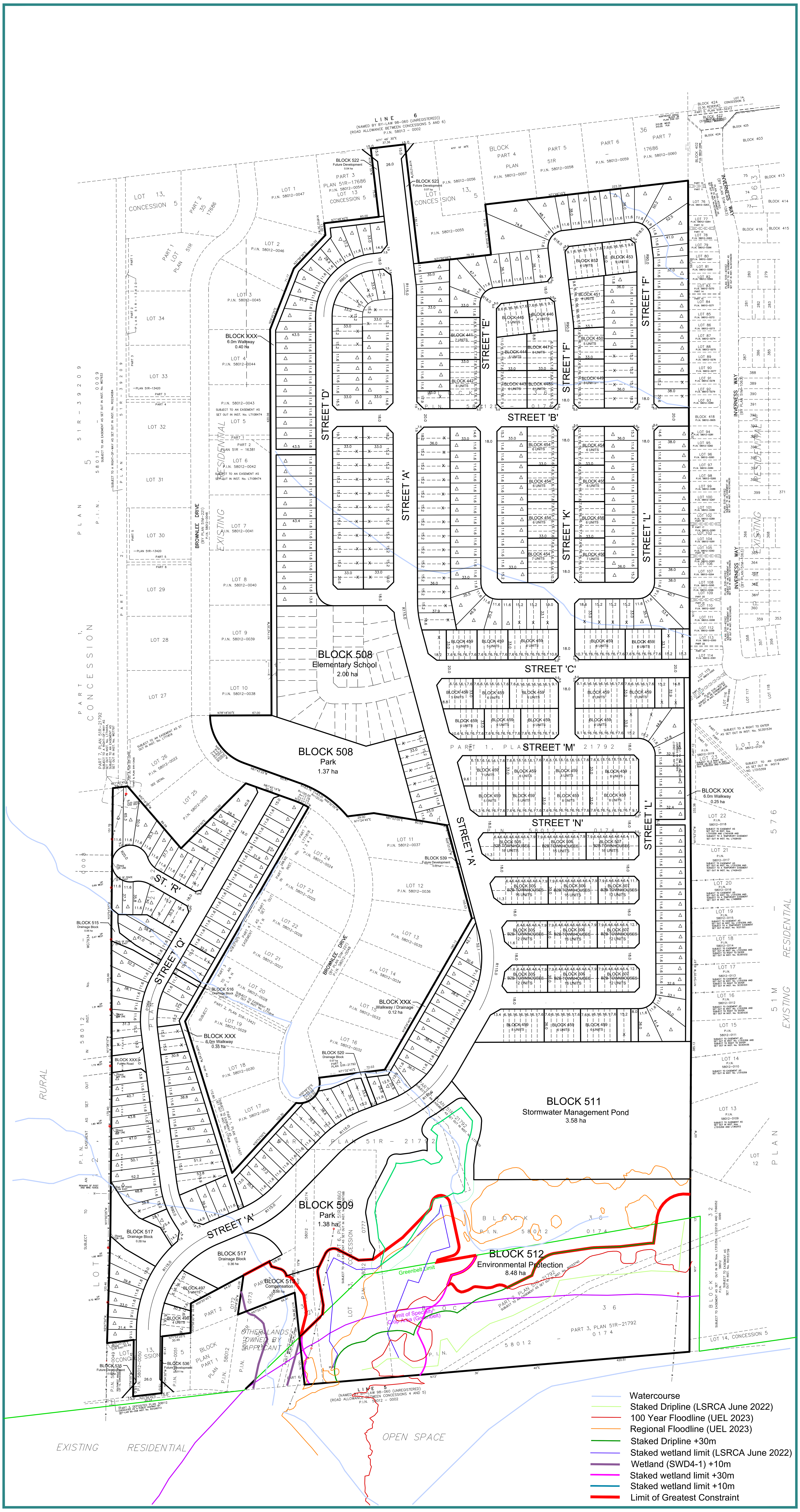
BRADFORD HIGHLANDS

PRELIMINARY GRADING PLAN 2

DESIGNED BY:	H.Y.	CHECKED BY:	P.S.
SCALE:	1:1500	DATE:	SEPTEMBER 2024
PROJECT No:	1791	FIGURE No:	X.2

File: P:\1791 Bradford Highlands\Drawings\FSP\Fig\Report Figures\1791P-X.1-X.2-GRAD.dwg – Revised by <KSCHAEFER> : Wed, Oct 23 2024 – 4:43pm


BROWNLEE DRIVE
HDF-D-2
3.39ha
HDF-D-3
23.0ha
HDF-D-1
2.17ha
HDF-E-2
41.9ha
HDF-E-1
3.05ha



DRAFT PLAN OF SUBDIVISION

OPTION 1

Part of Block 36, Plan 51M-221 and Part of Lot 13, Concession 5
(Geographic Township of West Gwillimbury)
Town of Bradford-West Gwillimbury
County of Simcoe

KEY PLAN

SCHEDULE OF LAND USE

Lot/Block	Land Use			Units	Area(ha)
1-440	Single Detached min. 11.6m (38ft)			299	22.13
	Semi Detached min. 7.6m (25ft)			180	
441-498	Street Townhouses min. 6.1m (20ft)			300	7.89
499-507	B2B Townhouses min. 6.4m (21ft)			172	1.35
508-509	Parks				3.06
510-511	Stormwater Management Ponds				4.76
512	Environmental Protection				7.48
513	Compensation				0.42
514	Pumping Station				0.06
515-521	Drainage Blocks				0.24
522-540	Future Development				1.11
Public Roads	Street 'A'	26.0m ROW	1,550m		13.60
	Streets 'B'-'C'	20.0m ROW	570m		
	Streets 'D'-'S'	18.0m ROW	4,540m		
Total			6,660m	951	60.00

Approved subject to conditions in accordance with section 51(31) of the Planning Act, RSO, Chap. P. 13, as amended

This___day of__________, 20__

Director of Planning, Development and Tourism, County of Simcoe

OWNER'S AUTHORIZATION

We, ICG Golf Inc., Bayview-Wellington (Highlands) Inc. and 2523951 Ontario Inc. hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the County of Simcoe.

ICG Golf Inc. Date

Bayview-Wellington (Highlands) Inc. Date

2523951 Ontario Inc. Date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided as shown on this Plan and their relationship to the adjacent lands are accurately and correctly shown.

ALOKA KUMARANAYAKE October 2, 2023

R-PE Surveying Ltd.
Ontario Land Surveyors
Date

ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT, CHAPTER P.13 (R.S.O. 1990).

(a),(e),(f),(g),(j),(l) - As shown of the Draft Plan.
(b),(c) - As shown on the Draft and Key Plan.
(d) - Land to be used in accordance with the Schedule of Land Use.
(i) - Soil is sands, silts, clay and tills.
(h),(k) - Full municipal services to be provided.

NOTE: Contours relate to Canadian Geodetic Datum.
Contour interval is 1m with .25m interpolated.

Scale: 1:2000

0 25 50 100 150 200m

Date	Revision	By

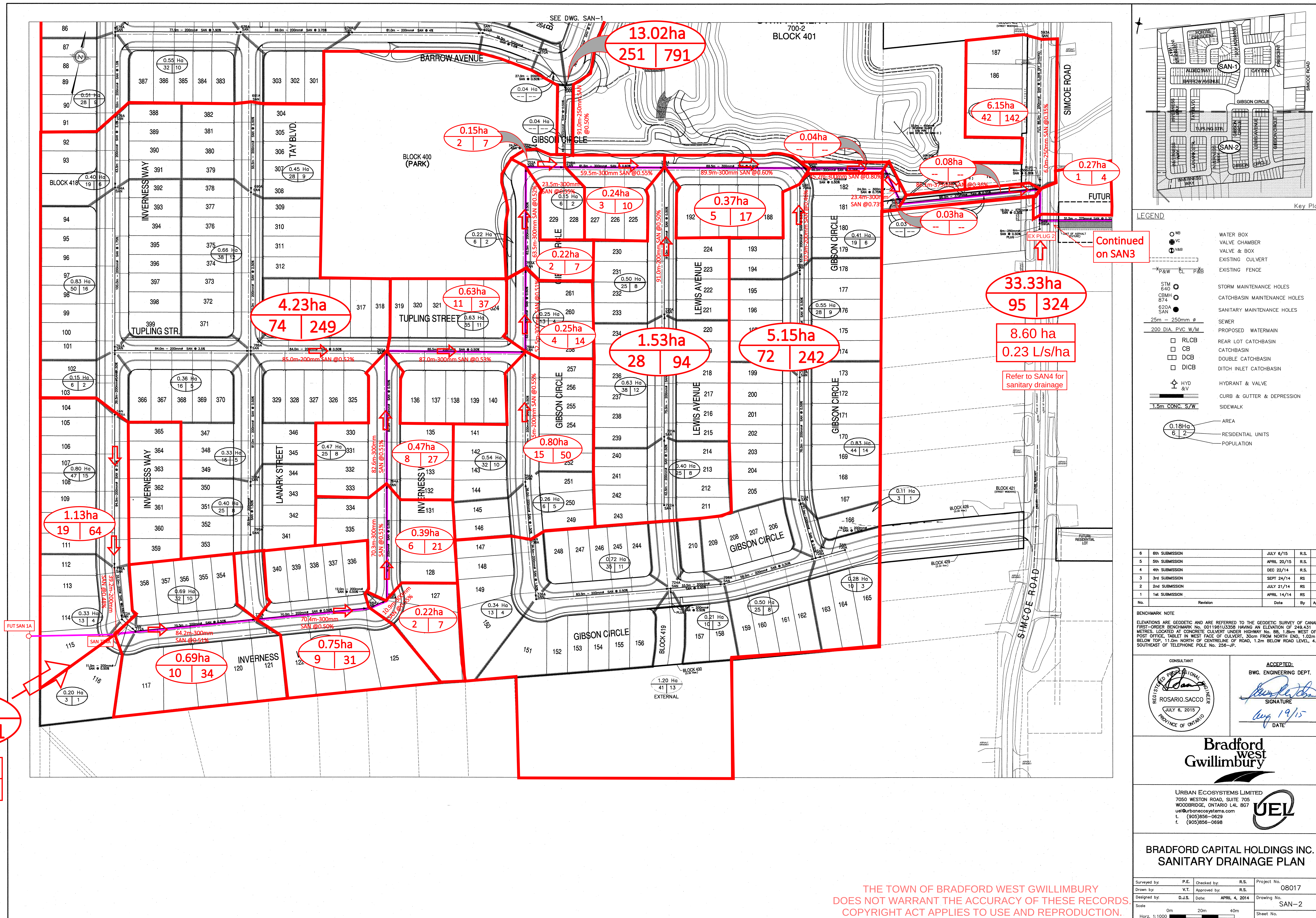
Prepared For:
ICG Golf Inc.
Bayview-Wellington (Highlands) Inc.
2523951 Ontario Inc.
October 7, 2024
MGP File: 15-2422

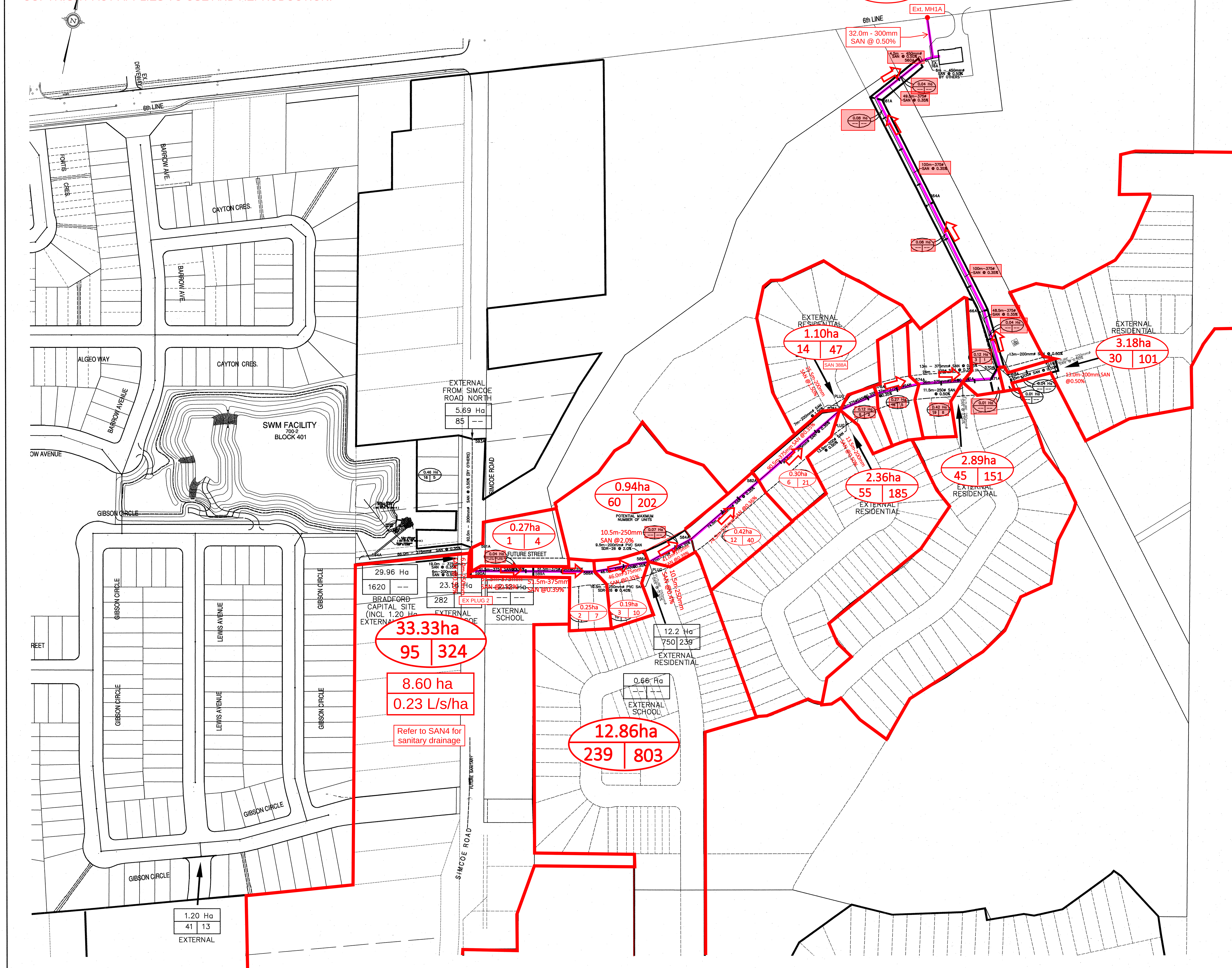
MGP Malone Given Parsons.
140 Renfrew Drive, Suite 201 | Markham, ON L3R 6B3 | 905 513 0170 | mgp.ca

wsp.com

Appendix J Downstream Sanitary Sewer Analysis

SCS consulting group ltd


SEE DWG. SAN-1
BLOCK 401
BARROW AVENUE
BLOCK 400 (PARK)
GIBSON CIRCLE
TAY BLVD.
INVERNESS WAY
TUPLING STREET
TUPLING STR.
LANARK STREET
LEWIS AVENUE
SIMCOE ROAD
BLOCK 418
BLOCK 419
BLOCK 421
13.02ha
251 | 791
0.15ha
2 | 7
0.04ha
0.08ha
0.27ha
1 | 4
6.15ha
42 | 142
0.24ha
3 | 10
0.37ha
5 | 17
0.03ha
0.22ha
2 | 7
4.23ha
74 | 249
0.63ha
11 | 37
0.25ha
4 | 14
1.53ha
28 | 94
5.15ha
72 | 242
33.33ha
95 | 324
8.60 ha
0.23 L/s/ha
Refer to SAN4 for sanitary drainage
Continued on SAN3
0.47ha
8 | 27
0.80ha
15 | 50
1.13ha
19 | 64
0.39ha
6 | 21
0.22ha
2 | 7
0.69ha
10 | 34
0.75ha
9 | 31
BRADFORD HIGHLANDS
43.24 ha
962 | 2981
1.99 ha
0.23 L/s/ha
59.5m-300mm SAN @0.55%
89.9m-300mm SAN @0.60%
85.0m-200mm SAN @0.52%
87.0m-300mm SAN @0.53%
84.2m-300mm SAN @0.51%
70.4m-300mm SAN @0.50%
Key Plan
LEGEND
WATER BOX
VALVE CHAMBER
VALVE & BOX
EXISTING CULVERT
EXISTING FENCE
STORM MAINTENANCE HOLES
CATCHBASIN MAINTENANCE HOLES
SANITARY MAINTENANCE HOLES
SEWER
PROPOSED WATERMAIN
REAR LOT CATCHBASIN
CATCHBASIN
DOUBLE CATCHBASIN
DITCH INLET CATCHBASIN
HYDRANT & VALVE
CURB & GUTTER & DEPRESSION
SIDEWALK
AREA
RESIDENTIAL UNITS
POPULATION
6 6th SUBMISSION JULY 6/15 R.S.
5 5th SUBMISSION APRIL 20/15 R.S.
4 4th SUBMISSION DEC 22/14 R.S.
3 3rd SUBMISSION SEPT 24/14 RS
2 2nd SUBMISSION JULY 21/14 RS
1 1st SUBMISSION APRIL 14/14 RS
BENCHMARK NOTE
ROSARIO.SACCO
JULY 6, 2015
ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
DATE
Bradford west Gwillimbury
URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
t. (905)856-0629
f. (905)856-0698
UEL
BRADFORD CAPITAL HOLDINGS INC.
SANITARY DRAINAGE PLAN
Project No. 08017
Drawing No. SAN-2
Horz. 1:1000



No.	Revision	Date	By	Appr'd
6	6th SUBMISSION	JULY 6/15	R.S.	
5	5th SUBMISSION	APRIL 20/15	R.S.	
4	4th SUBMISSION	DEC 22/14	R.S.	
3	3rd SUBMISSION	SEPT24/14	RS	
2	2nd SUBMISSION	JULY 21/14	RS	
1	1st SUBMISSION	APRIL 14/14	RS	

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE GEODETIC SURVEY OF CANADA FIRST-ORDER BENCHMARK No. 0011961U3358 HAVING AN ELEVATION OF 249.431 METRES. LOCATED AT CONCRETE CULVERT UNDER HIGHWAY No. 88, 1.8km WEST OF POST OFFICE, TABLET IN WEST FACE OF CULVERT, 30cm FROM NORTH END, 1.02m BELOW TOP, 11.0m NORTH OF CENTRELINE OF ROAD, 1.2m BELOW ROAD LEVEL, 4.3m SOUTHEAST OF TELEPHONE POLE No. 256-JP.

CONSULTANT

REGISTERED PROFESSIONAL ENGINEER
ROSARIO.SACCO
JULY 6, 2015
PROVINCE OF ONTARIO

ACCEPTED:
BWG. ENGINEERING DEPT.
SIGNATURE
Aug 19/15
DATE

Bradford west Gwillimbury

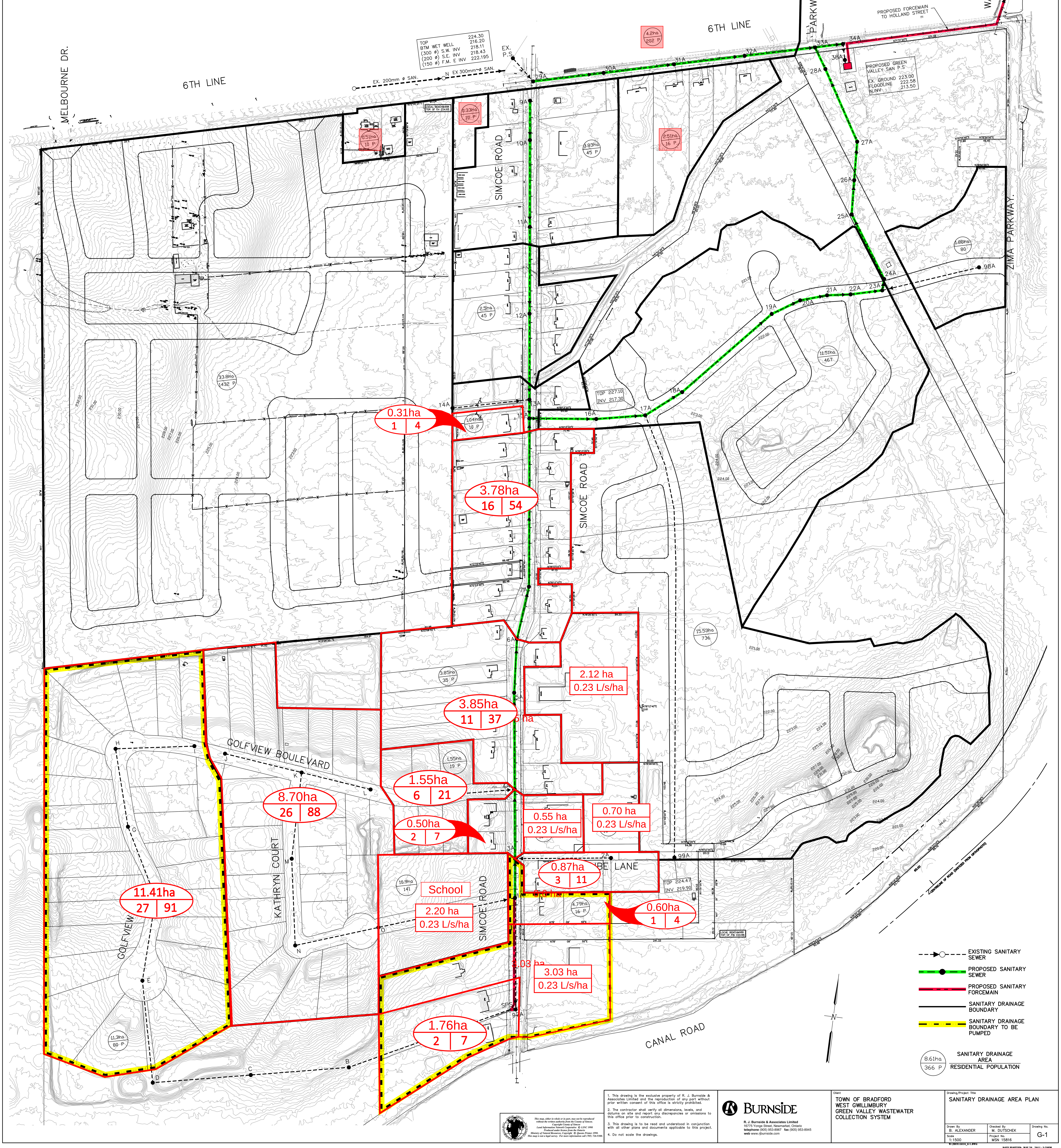
URBAN ECOSYSTEMS LIMITED
7050 WESTON ROAD, SUITE 705
WOODBRIDGE, ONTARIO L4L 8G7
uel@urbanecosystems.com
t. (905)856-0629
f. (905)856-0698

BRADFORD CAPITAL HOLDINGS INC.
EXTERNAL SANITARY DRAINAGE PLAN

Surveyed by: P.E.	Checked by: R.S.	Project No. 08017
Drawn by: V.T.	Approved by: R.S.	
Designed by: D.J.S.	Date: APRIL 4, 2014	Drawing No. SAN-3
Scale Horz. 1:1500 (0m 20m 40m)		Sheet No. – OF –

ID - P:\2008\08017-BRADFORD-WEST\PRINTING\08017-PRINTING-EXTERNAL SAN - SAN3.dwg - Thu, 9 Jul 2015 - 13:07

SAN4



6TH LINE
MELBOURNE DR.
PARKWOOD AVE.
WALKER AVE.
ZIMA PARKWAY
SIMCOE ROAD
GOLFVIEW BOULEVARD
KATHRYN COURT
GOLFVIEW
CANAL ROAD
PROPOSED FORCEMAIN TO HOLLAND STREET
PROPOSED GREEN VALLEY SAN P.S.
0.31ha 1 4
3.78ha 16 54
3.85ha 11 37
2.12 ha 0.23 L/s/ha
1.55ha 6 21
8.70ha 26 88
0.50ha 2 7
0.55 ha 0.23 L/s/ha
0.70 ha 0.23 L/s/ha
0.87ha 3 11
11.41ha 27 91
School
2.20 ha 0.23 L/s/ha
0.60ha 1 4
3.03 ha 0.23 L/s/ha
1.76ha 2 7
EXISTING SANITARY SEWER
PROPOSED SANITARY SEWER
PROPOSED SANITARY FORCEMAIN
SANITARY DRAINAGE BOUNDARY
SANITARY DRAINAGE BOUNDARY TO BE PUMPED
8.61ha 366 P
SANITARY DRAINAGE AREA
RESIDENTIAL POPULATION
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Client
TOWN OF BRADFORD WEST GWILLIMBURY GREEN VALLEY WASTEWATER COLLECTION SYSTEM
Drawing/Project Title
SANITARY DRAINAGE AREA PLAN
Drawn By B. ALEXANDER
Checked By M. DUTSCHEK
Drawing No. G-1
Scale 1:1500
Project No. MSN 15816
W:\MSN15816_G-1.DWG
DATE PLOTTED: MAY 26, 2011 - 3:29PM
Plotted By: ABrideau

Sanitary Design Sheet
Bradford Highlands
FSP
Bradford West Gwillimbury, Simcoe County

Design Equations

$M(r) = 1 + \frac{14}{4 + \sqrt{P}}$ $Q(i) = i \times A$ $Q(d) = \sum (Q(x))$

$M(ind, com) = 2.00$ $Q(r) = \frac{P * q(r) * M}{86400}$

Minimum Sewer Diameter (mm) = 250 **Avg. Domestic Flow (l/cap/day) =** 250
Mannings n = 0.013 **Infiltration Rate (l/s/ha) =** 0.2
Minimum Velocity (m/s) = 0.60 **Max. Harmon Peaking Factor =** 4
Maximum Velocity (m/s) = 3 **Min. Harmon Peaking Factor =** 2.0
Minimum Pipe Slope (%) = 0.50 **NOMINAL PIPE SIZE USED**

Future Development

Project: Bradford Highlands
Project No. 1791
Date: 31-Oct-24
Designed By: M.P/K.A.S
Reviewed By: P.S

P:\1791 Bradford Highlands\Design\Pipe Design\Sanitary\[1791-Sanitary Sheet Design - Existing - MASTER.xlsm]Design

LOCATION			RESIDENTIAL							INDUSTRIAL/COMMERCIAL/INSTITUTIONAL					FLOW CALCULATIONS								PIPE DATA					
STREET	MANHOLE FROM	MANHOLE TO	AREA (ha)	ACCUM. AREA (ha)	UNITS (#)	DENSITY PER UNIT (p/unit)	DENSITY PER HA (p/ha)	RESIDENTIAL POPULATION	ACCUM. RESIDENTIAL POPULATION	AREA (ha)	ACCUM. AREA (ha)	POPULATION DENSITY (p/ha)	FLOW RATE (l/s/ha)	ACCUM. EQUIV. POPULATION	INFILTRATION (L/s)	TOTAL ACCUM. POPULATION	AVG. DOMESTIC FLOW (L/s)	ACCUM. AVG. DOMESTIC FLOW (L/s)	PEAKING FACTOR	PEAKED RESIDENTIAL FLOW (L/s)	ICI FLOW (L/s)	TOTAL FLOW (L/s)	LENGTH (m)	PIPE DIAMETER (mm)	SLOPE (%)	FULL FLOW CAPACITY (L/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)
BRADFORD HIGHLANDS	FUT 1A	774A	43.24	43.24	962	3.10		2981	2981	1.99	1.99	0	0.23	0	9.0	2981	8.6	8.6	3.44	29.7	0.5	39.2	24.0	300	0.50	68.3	0.97	1.00
INVERNESS WAY	776A	774A	1.13	1.13	19	3.36		64	64	0.00	0.00	0	0	0	0.2	64	0.2	0.2	4.00	0.7	0.0	1.0	39.2	200	0.48	22.7	0.72	0.36
INVERNESS WAY	774A	770A	0.69	45.06	10	3.36		34	3078	0.00	1.99	0	0	0	9.4	3078	0.1	8.9	3.43	30.6	0.5	40.4	84.2	300	0.51	69.0	0.98	1.01
INVERNESS WAY	770A	768A	0.75	45.81	9	3.36		30	3108	0.00	1.99	0	0	0	9.6	3108	0.1	9.0	3.43	30.8	0.5	40.9	70.4	300	0.50	68.3	0.97	1.00
INVERNESS WAY	768A	766A	0.22	46.03	2	3.36		7	3115	0.00	1.99	0	0	0	9.6	3115	0.0	9.0	3.43	30.9	0.5	41.0	10.9	300	0.55	71.7	1.01	1.05
INVERNESS WAY	766A	764A	0.39	46.42	6	3.36		20	3135	0.00	1.99	0	0	0	9.7	3135	0.1	9.1	3.43	31.1	0.5	41.2	70.3	300	0.51	69.0	0.98	1.01
INVERNESS WAY	764A	760A	0.47	46.89	8	3.36		27	3162	0.00	1.99	0	0	0	9.8	3162	0.1	9.1	3.42	31.3	0.5	41.5	82.6	300	0.51	69.0	0.98	1.01
TUPLING STREET	786A	760A	4.23	4.23	74	3.36		249	249	0.00	0.00	0	0	0	0.8	249	0.7	0.7	4.00	2.9	0.0	3.7	85.0	200	0.52	23.6	0.75	0.54
TUPLING STREET	760A	754A	0.63	51.75	11	3.36		37	3448	0.00	1.99	0	0	0	10.7	3448	0.1	10.0	3.39	33.8	0.5	45.0	87.0	300	0.53	70.4	1.00	1.06
GIBSON CIRCLE	756A	754A	0.80	0.80	15	3.36		50	50	0.00	0.00	0	0	0	0.2	50	0.1	0.1	4.00	0.6	0.0	0.7	76.5	200	0.55	24.3	0.77	0.33
GIBSON CIRCLE	754A	753A	0.25	52.80	4	3.36		13	3511	0.00	1.99	0	0	0	11.0	3511	0.0	10.2	3.38	34.4	0.5	45.8	52.5	300	0.51	69.0	0.98	1.04
GIBSON CIRCLE	753A	752A	0.22	53.02	2	3.36		7	3518	0.00	1.99	0	0	0	11.0	3518	0.0	10.2	3.38	34.4	0.5	45.9	63.5	300	0.52	69.7	0.99	1.05
GIBSON CIRCLE	752A	749A	0.15	53.17	2	3.36		7	3525	0.00	1.99	0	0	0	11.0	3525	0.0	10.2	3.38	34.5	0.5	46.0	23.5	300	0.55	71.7	1.01	1.07
BARROW AVE	600A	749A	13.02	13.02	251	3.15		791	791	0.00	0.00	0	0	0	2.6	791	2.3	2.3	3.86	8.8	0.0	11.4	91.0	250	0.50	42.0	0.86	0.72
GIBSON CIRCLE	749A	704A	0.24	66.43	3	3.36		10	4326	0.00	1.99	0	0	0	13.7	4326	0.0	12.5	3.30	41.3	0.5	55.5	59.5	300	0.55	71.7	1.01	1.12
LEWIS AVE	720A	704A	1.53	1.53	28	3.36		94	94	0.00	0.00	0	0	0	0.3	94	0.3	0.3	4.00	1.1	0.0	1.4	91.0	200	0.50	23.2	0.74	0.40
GIBSON CIRCLE	704A	598A	0.37	68.33	5	3.36		17	4437	0.00	1.99	0	0	0	14.1	4437	0.0	12.8	3.29	42.3	0.5	56.8	89.9	300	0.60	74.9	1.06	1.16
GIBSON CIRCLE	708A	598A	5.15	5.15	72	3.36		242	242	0.00	0.00	0	0	0	1.0	242	0.7	0.7	4.00	2.8	0.0	3.8	10.9	200	0.46	22.2	0.71	0.53
BRADFORD CAPITALS	598A	596A	0.04	73.52	0	0		0	4678	0.00	1.99	0	0	0	15.1	4678	0.0	13.5	3.27	44.3	0.5	59.8	45.2	300	0.80	86.4	1.22	1.32
BRADFORD CAPITALS	596A	594A	0.03	73.55	0	0		0	4678	0.00	1.99	0	0	0	15.1	4678	0.0	13.5	3.27	44.3	0.5	59.9	23.4	300	0.73	82.6	1.17	1.27
BRADFORD CAPITALS	594A	591A	0.08	73.63	0	0		0	4678	0.00	1.99	0.0	0	0	15.1	4678	0.0	13.5	3.27	44.3	0.5	59.9	86.1	375	0.36	105.1	0.95	0.98
SIMCOE ROAD	EX PLUG 1	591A	6.15	6.15	42	3.36		141	141	0.00	0.00	0	0	0	1.2	141	0.4	0.4	4.00	1.6	0.0	2.9	6.0	250	0.35	35.2	0.72	0.43
SIMCOE ROAD	591A	590A	0.27	80.05	1	3.36		3	4823	0.00	1.99	0	0	0	16.4	4823	0.0	14.0	3.26	45.5	0.5	62.4	19.6	375	0.46	118.9	1.08	1.09
SIMCOE ROAD	EX PLUG 2	590A	33.33	33.33	324	1		324	324	8.60	8.60	0	0.229166667	0	8.4	324	0.9	0.9	4.00	3.8	2.0	14.1	6.0	250	0.50	42.0	0.86	0.76
JONKMAN BLVD	590A	589A	0.04	113.42	0	0		0	5147	0.00	10.59	0	0	0	24.8	5147	0.0	14.9	3.23	48.2	2.4	75.4	51.5	375	0.35	103.7	0.94	1.02
JONKMAN BLVD	589A	588A	0.25	113.67	2	3.36		7	5154	0.00	10.59	0	0	0	24.9	5154	0.0	14.9	3.23	48.2	2.4	75.5	51.5	375	0.39	109.4	0.99	1.07
JONKMAN BLVD	588A	586A	0.19	113.86	3	3.36		10	5164	0.00	10.59	0	0	0	24.9	5164	0.0	14.9	3.23	48.3	2.4	75.6	46.0	375	0.35	103.7	0.94	1.02
JONKMAN BLVD	715A	586A	0.94	0.94	60	3.36		202	202	0.00	0.00	0	0	0	0.2	202	0.6	0.6	4.00	2.3	0.0	2.5	10.5	250	2.00	84.1	1.71	0.73
TIBERINI WAY	EX PLUG 3	586A	12.86	12.86	239	3.36		803	803	0.66	0.66	0	0.229166667	0	2.7	803	2.3	2.3	3.86	9.0	0.2	11.8	10.5	250	0.40	37.6	0.77	0.67
JONKMAN BLVD	586A	584A	0.07	127.73	0	0		0	6168	0.00	11.25	0	0	0	27.8	6168	0.0	17.8	3.16	56.4	2.6	86.8	41.0	375	0.39	109.4	0.99	1.10
JONKMAN BLVD	584A	582A	0.42	128.15	12	3.36		40	6209	0.00	11.25	0	0	0	27.9	6209	0.1	18.0	3.16	56.7	2.6	87.2	74.5	375	0.36	105.1	0.95	1.06
JONKMAN BLVD	582A	578A	0.30	128.45	6	3.36		20	6229	0.00	11.25	0	0	0	27.9	6229	0.1	18.0	3.16	56.9	2.6	87.4	90.5	375	0.35	103.7	0.94	1.05
FERRAGINE CR	EX PLUG 4	578A	2.36	2.36	55	3.36		185	185	0.00	0.00	0	0	0	0.5	185	0.5	0.5	4.00	2.1	0.0	2.6	13.5	200	0.50	23.2	0.74	0.48

SCS consulting group ltd

Sanitary Design Sheet
Bradford Highlands
FSP
Bradford West Gwillimbury, Simcoe County

Design Equations

$M(r) = 1 + \frac{14}{4 + \sqrt{(P)}}$ $Q(i) = i \times A$ $Q(d) = \Sigma (Q(x))$

$M(ind, com) = 2.00$ $Q(r) = \frac{P * q(r) * M}{86400}$

Minimum Sewer Diameter (mm) = 250 **Avg. Domestic Flow (l/cap/day) =** 250
Mannings n = 0.013 **Infiltration Rate (l/s/ha) =** 0.2
Minimum Velocity (m/s) = 0.60 **Max. Harmon Peaking Factor =** 4
Maximum Velocity (m/s) = 3 **Min. Harmon Peaking Factor =** 2.0
Minimum Pipe Slope (%) = 0.50 **NOMINAL PIPE SIZE USED**

Future Development

Project: Bradford Highlands
Project No. 1791
Date: 31-Oct-24
Designed By: M.P/K.A.S
Reviewed By: P.S

P:\1791 Bradford Highlands\Design\Pipe Design\Sanitary\[1791-Sanitary Sheet Design - Existing - MASTER.xlsm]Design

LOCATION			RESIDENTIAL							INDUSTRIAL/COMMERCIAL/INSTITUTIONAL					FLOW CALCULATIONS								PIPE DATA					
STREET	MANHOLE FROM	MANHOLE TO	AREA (ha)	ACCUM. AREA (ha)	UNITS (#)	DENSITY PER UNIT (p/unit)	DENSITY PER HA (p/ha)	RESIDENTIAL POPULATION	ACCUM. RESIDENTIAL POPULATION	AREA (ha)	ACCUM. AREA (ha)	POPULATION DENSITY (p/ha)	FLOW RATE (l/s/ha)	ACCUM. EQUIV. POPULATION	INFILTRATION (L/s)	TOTAL ACCUM. POPULATION	AVG. DOMESTIC FLOW (L/s)	ACCUM. AVG. DOMESTIC FLOW (L/s)	PEAKING FACTOR	PEAKED RESIDENTIAL FLOW (L/s)	ICI FLOW (L/s)	TOTAL FLOW (L/s)	LENGTH (m)	PIPE DIAMETER (mm)	SLOPE (%)	FULL FLOW CAPACITY (L/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)
ARMSON CT	388A	578A	1.10	1.10	14	3.36		47	47	0.00	0.00	0	0	0	0.2	47	0.1	0.1	4.00	0.5	0.0	0.8	25.5	200	1.50	40.1	1.28	0.48
JONKMAN BLVD	578A	576A	0.12	132.03	2	3.36		7	6467	0.00	11.25	0	0	0	28.7	6467	0.0	18.7	3.14	58.8	2.6	90.0	33.0	375	0.36	105.1	0.95	1.07
JONKMAN BLVD	576A	574A	0.27	132.30	5	3.36		17	6484	0.00	11.25	0	0	0	28.7	6484	0.0	18.8	3.14	58.9	2.6	90.2	37.0	375	0.35	103.7	0.94	1.06
JONKMAN BLVD	574A	572A	0.42	132.72	6	3.36		20	6504	0.00	11.25	0	0	0	28.8	6504	0.1	18.8	3.14	59.0	2.6	90.4	36.0	375	0.36	105.1	0.95	1.07
FERRAGINE DR	402A	572A	2.89	2.89	45	3.36		151	151	0.00	0.00	0	0	0	0.6	151	0.4	0.4	4.00	1.8	0.0	2.3	20.0	250	0.50	42.0	0.86	0.44
JONKMAN BLVD	572A	571A	0.12	135.73	1	3.36		3	6659	0.00	11.25	0	0	0	29.4	6659	0.0	19.3	3.13	60.3	2.6	92.2	24.0	375	0.35	103.7	0.94	1.06
JONKMAN BLVD	571A	570A	0.01	135.74	0	0		0	6659	0.00	11.25	0	0	0	29.4	6659	0.0	19.3	3.13	60.3	2.6	92.2	13.0	375	0.38	108.0	0.98	1.10
JONKMAN BLVD	568A	570A	3.18	3.18	30	3.36		101	101	0.00	0.00	0	0	0	0.6	101	0.3	0.3	4.00	1.2	0.0	1.8	13.0	200	0.50	23.2	0.74	0.43
PUMP STATION SANITARY EASEMENT	570A	566A	0.04	138.96	0	0		0	6760	0.00	11.25	0	0	0	30.0	6760	0.0	19.6	3.12	61.0	2.6	93.7	48.5	375	0.35	103.7	0.94	1.06
PUMP STATION SANITARY EASEMENT	566A	564A	0.08	139.04	0	0		0	6760	0.00	11.25	0	0	0	30.1	6760	0.0	19.6	3.12	61.0	2.6	93.7	100.0	375	0.35	103.7	0.94	1.06
PUMP STATION SANITARY EASEMENT	564A	561A	0.08	139.12	0	0		0	6760	0.00	11.25	0	0	0	30.1	6760	0.0	19.6	3.12	61.0	2.6	93.7	100.0	375	0.35	103.7	0.94	1.06
PUMP STATION SANITARY EASEMENT	561A	560A	0.04	139.16	0	0		0	6760	0.00	11.25	0	0	0	30.1	6760	0.0	19.6	3.12	61.0	2.6	93.7	49.5	375	0.35	103.7	0.94	1.06
PUMP STATION SANITARY EASEMENT	560A	16A	0.00	139.16	0	0		0	6760	0.00	11.25	0	0	0	30.1	6760	0.0	19.6	3.12	61.0	2.6	93.7	10.5	450	0.50	201.5	1.27	1.23
6TH LINE	Ext. MH1A	16A	7.55	7.55	238	1		238	238	0.00	0.00	0	0	0	1.5	238	0.7	0.7	4.00	2.8	0.0	4.3	100.0	300	0.50	68.3	0.97	0.52
PUMP STATION SANITARY EASEMENT	16A	UMP STATIO	0.00	146.71	0	0		0	6998	0.00	11.25	0	0	0	31.6	6998	0.0	20.2	3.11	62.9	2.6	97.1	5.0	450	0.50	201.5	1.27	1.24

Appendix K Watermain Hydraulic Analysis

November 1, 2024 Project No. 17002-197

Ms. Nicole Sampogna
Bradford Highlands Joint Venture
111 Creditstone Road
Woodbridge ON
L4K 1N3

Subject: Bradford Highlands Watermain Analysis Revision 1
Town of Bradford West Gwillimbury

Dear Ms. Sampogna,

We are pleased to submit our report entitled "Bradford Highlands Watermain Analysis Update" outlining the results of our water distribution analysis for a residential development in the Town of Bradford West Gwillimbury.

This report is an update to our report dated July 6, 2023. The development was incorporated into the Town of Bradford West Gwillimbury's Watercad model provided in July 2022, revised to suit the updated layout and modeled utilizing the design information provided to Municipal Engineering Solutions. The findings of our analysis are summarized in the following report.

We trust you will find this report satisfactory. Should you have any questions or require further clarification, please call.

Yours truly,

Municipal Engineering Solutions

Per: John C. Bourrie, P.Eng.

/LMC

File Location: D:\Projects\2023\23-010 Bradford Highlands WG UEL 17021-01\3.0 Report\Nov 2024 Final\17002-197_Bradford Highlands Watermain Analysis_20241101.docx

55 Gilbank Drive, Aurora, Ontario L4G 6H9
Tel: 905.726.1016 Cell: 416.434.0186 Fax: 905.726.1225

BRADFORD HIGHLANDS

WATERMAIN ANALYSIS REVISION 1

PREPARED BY:

MUNICIPAL ENGINEERING SOLUTIONS

FOR:

BRADFORD HIGHLANDS JOINT VENTURE
November 2024

Project Number: 17002-197

TABLE OF CONTENTS

Section 1 – INTRODUCTION

Municipal Engineering Solutions ("MES") was retained by Bradford Highlands Joint Venture to conduct a hydraulic water analysis for the proposed Bradford Highlands Development located in the Town of Bradford West Gwillimbury. As part of this hydraulic assessment MES was requested to undertake the following:

1. Calculate/verify water demands for the proposed development using Town of Bradford West Gwillimbury, provincial and industry design standards;
2. Add the subject watermains/development/boundary information to development water model;
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 Bradford Highlands site is located between Line 6 and 5th Line, west of Simcoe Road in the Town of Bradford. The residential development consists of 299 single family homes, 188 semi-detached homes, 475 townhomes and a school block. The demands for the site are shown in **Appendix A**. The proposed development is shown below on **Figure 1**.

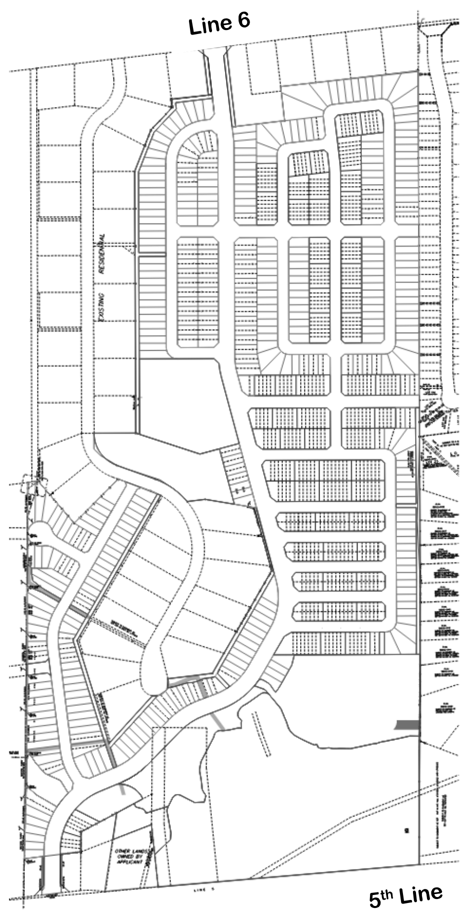


Figure 1 - Proposed Bradford Highlands Development

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 Town of Bradford West Gwillimbury's Engineering Design Criteria Manual, 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 Town of Bradford West Gwillimbury standard population densities as noted in the *"Engineering Design Criteria Manual"*. **Table 1** summarizes the 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 (Persons/Unit)
Single Family	3.36

Source: Town of Bradford West Gwillimbury Engineering Design Criteria Manual

Table 2 - Water Design Factors

Type of Development	Average Daily Demand	Maximum Day Demand Peaking Factor	Minimum Hour Demand Peaking Factor	Peak Hour Demand Peaking Factor
Residential	0.300 m^3 per capita	2.0*	0.5*	3.0*
ICI	0.5 m^3/ha	2.0*	0.5*	3.0*

Source: Town of Bradford West Gwillimbury Engineering Design Criteria Manual, *MECP 3,001-10,000 persons

Section 3 –FLOW DEMANDS

Utilizing the equivalent population data from **Table 1** and the corresponding Average Day, Peak Hour and Maximum Day 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 Bradford Highlands Development

	Average Day Demand (L/S)	Maximum Day Demand (L/S)	Peak Hour Demand (L/S)
Total	11.34	22.68	34.02

3.2 Fire Flow Demands

The Town criteria requests that fire demands be calculated using the Fire Underwriter's Survey where possible with a minimum requirement of 7,000 L/min (117 L/s). As the specifics of the proposed homes within the development are unknown, the fire flows suggested in **Table 4** have been used for this assessment. Once building designs/configurations are known, the fire flows must be confirmed using the FUS formula. Building construction may need to be designed to suit the available flow and pressure. For details on the fire flow demands for each node used to model see **Appendix A**.

Table 4 - Fire Flow Requirements

Type of Development	Fire Flow (L/S)
Single Family/Semidetached Homes	117
Townhomes	133
Schools	250

Source: Town of Bradford West Gwillimbury Engineering Design Criteria Manual

3.3 External Demands

The Watercad model provided contains external demands.

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 Town of Bradford West Gwillimbury. The Town's pressure requirements are outlined in the Engineering Design Criteria Manual and stipulate the following:

1. The minimum system pressure shall not be less than 140 kPa (20 psi) at any point in the water system under fire flow conditions.
2. The minimum Peak Hour pressure shall be 275 kPa (40 psi).
3. The water system shall be designed to maintain as close as possible to a maximum working pressure of 550 kPa (80 psi) as a best management practice.
4. If the pressure in a localized area is above 550 kPa (80 psi) pressure reducing valves shall be installed on individual services.

4.2 Watermain Sizing

The Town of Bradford West Gwillimbury also stipulates minimum pipe sizes 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 250 mm diameter and for residential areas the minimum pipe size shall be 150 mm diameter; 200 mm for single feeds. 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 Town's design criteria and as suggested by the MECP were utilized. The Coefficient of Roughness assigned to each pipe size in summarized in **Table 5** below.

Table 5 - 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
Greater Than 300 mm	120

Source: Town of Bradford West Gwillimbury Engineering Design Criteria Manual

Section 5 – ANALYSIS & MODELING RESULTS

To conduct the hydraulic water analysis for the proposed development the water demands were estimated by MES using the design criteria previously discussed and incorporated the demands into the WaterCAD model. The following sections discusses the model setup and results.

5.1 Model Setup

A copy of the Town's WaterCAD was provided to MES in July 2022. The development is located on the south side of Pressure Zone 1.

The development will be supplied by the existing 300 mm watermain on Line 6 and two connections to Inverness Way to the existing 250 mm watermains. The watermain on Inverness Way is supplied through a pressure reducing valve (PRV) so the Highlands development watermain design needs to consider the pressures with and without pressure reduction to confirm the location of an additional PRV for the reduced zone.

Elevations in the development vary from approximately 230 m to 251 m. Friction factors were assigned to all new pipes in the model according to **Table 5**.

5.2 Watermain Sizing and System Pressures

The analysis was conducted under Average Day, Maximum Day, and Maximum day plus Fire demands to confirm the watermain sizing and meet the pressure requirements. The pipe size and layout are shown in **Appendix B**.

The site was first modeled under average day conditions with only the connection to the Line 6 watermain to assess whether pressure reduction was required (connections to the east were closed). Much of the development would experience pressures above the OBC limit of 80 psi (550 kPa); areas to the southeast would have pressures above 100 psi (690 kPa) see **Figure 2** below, also in the Appendix. Pressure reduction is required on the Line 6 connection.

Figure 2 - Proposed Bradford Highlands Development Average Day Pressures

The model shows a reduced zone to the east of Bradford Highlands with four (4) pressure reducing valves along the pressure district boundary south of Line 6 at Inverness Way, Barrow Avenue, Simcoe Road and Zina Parkway, but only the one located at Inverness Way and Line 6 was active and flowing. All valves in the provided model were set at 80 psi (550 kPa) which would cause some valves to close due the downstream pressure. The Town should confirm the status and setting of the existing pressure reducing valves.

The final location and setting of the proposed Street A PRV must be discussed and confirmed by the Town to ensure that existing areas are not adversely affected by changes to the reduced zone. The setting used for this analysis shows all areas are below 80 psi (550 kPa), but there is a possibility that units on the lower elevations may need individual pressure reduction. The units requiring individual pressure reduction will be reviewed at the detailed design stage when further information is known about the reduced zone pressure settings. System pressures must be confirmed in the field.

Pipes were sized between 150 mm to 300 mm to meet the pressure and flow requirements. Modeled service pressures are summarized in **Table 6**.

Fire flow demand can be met based on the assumptions outlined in this report.

Detailed pipe and node tables for the various scenarios modelled are attached to this report in **Appendix B**.

Table 6 - Modeled Service Pressures

Scenario	Average Day	Maximum Day	Peak Hour	Max. Day + Fire
Existing with Reduced Zone	52.6 to 79.1 psi (363 to 545 kPa)	52.3 to 78.4 psi (361 to 541 kPa)	52.0 to 77.4 psi (359 to 534 kPa)	120 to 379 L/s @ 20 psi (140 kPa)

Section 6 – CONCLUSIONS/RECOMMENDATIONS

The results are summarized below.

- The service pressures are expected to range from 52.0 to 79.1 psi (359 to 545 kPa) with supply through the PRV.
- The existing PRV status and settings must be confirmed by the Town. The proposed PRV location and setting must be discussed and confirmed by the Town to ensure that existing areas are not adversely affected by changes to the reduced zone.
- The setting used for this analysis shows all areas are below 80 psi (550 kPa), but there is a possibility that units on the lower elevations may need individual pressure reduction. The units requiring individual pressure reduction will be reviewed at the detailed design stage when further information is known about the reduced zone pressure settings.
- The available fire flow within the site meets or exceeds the fire flow demands as noted in Table 4 at the minimum pressure of 20 psi (140 kPa) based on the proposed watermain configuration.
- A hydrant test must be conducted to confirm the existing system pressures before building construction starts.
- Once the building designs/configurations are known for the proposed development the FUS fire flows summarized in Table 4 must be reviewed and confirmed by the designer(s), architect, and mechanical consultant as appropriate to ensure the fire flows used within this report are still valid prior to implementation and construction. Based on the modeled fire flows, fire walls and/or other fire protection systems (e.g. sprinkler system) will likely be required in several areas.
- Required fire flows for all proposed buildings must be confirmed with the appropriate designer (architect or mechanical designer) as well as the Town to determine the appropriate level of fire protection required.
- 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.

- 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

Town of Bradford West Gwillimbury Design Criteria

Engineering Design Criteria Manual, 2023 (unless otherwise stated)

Equivalent Population by Unit

Type of Development	Equivalent Population Density
	(Person/Unit)
Single Family or Semi-Detached	3.36
Townhouse	3.36
Apartment	3.36

Water Design Factors

Average Daily Demand (m3/capita)	0.3	
Institutional Average (m3/ha)	5	
Minimum Hour Demand P.F.	0.5	MOECC (3,001 - 10,000 Persons)
Maximum Daily Demand P.F.		
Residential	2	MOECC (3,001 - 10,000 Persons)
I/C/I	2	
Maximum Hourly Demand P.F.		
Residential	*3*	MOECC (3,001 - 10,000 Persons)

Cofficient of Roughness

Size of Pipe (mm Dia.)	Coefficient of Roughness (C)
150	100
200-250	110
300-600	120
Over 600	120

Minimum Pipe Size

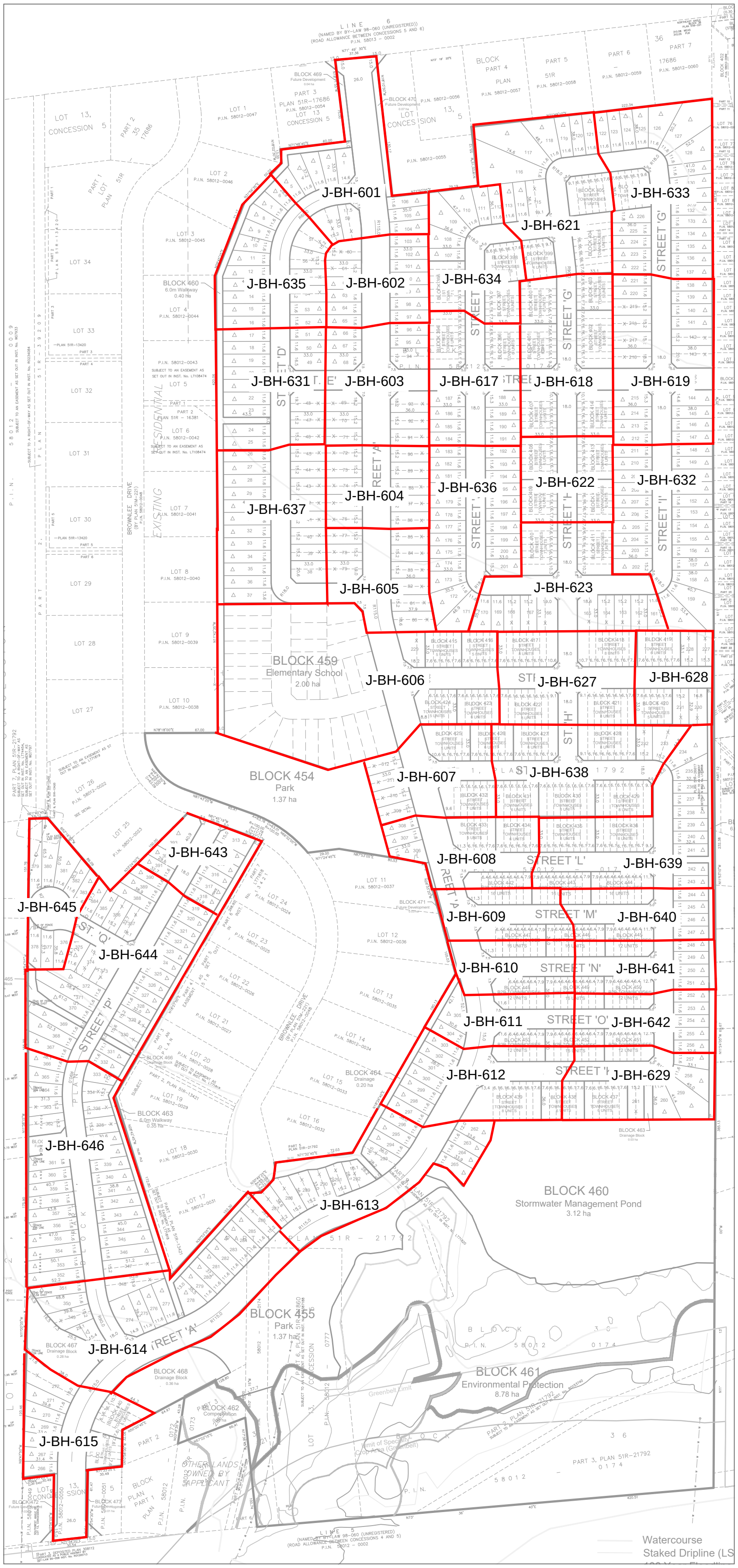
Type of Development	Size of Pipe (mm Dia.)
Residential	150
Commercial/Industrial/Community	250

Working Pressures

Parameter	Pressure
Normal Condition	
Minimum Max Hour Pressure	275 kPa (40 psi)
Maximum (Building Code)	550 kPa (80 psi)
Maximum Min Hour Pressure	550 kPa (80 psi)
Fire Flow Conditions	
Minimum Pressure	140 kPa (20 psi)

Water Demand
Bradford Highlands Development
October 30, 2024

Node	Elevation	Type of Development				Population	Demands			Fire Flow Demands
		Single Family	Semi-Detached	Townhouse	Institutional	Total Population	ADD	MDD	PHD	
	(m)	*(units)*	*(units)*	*(units)*	*(ha)*	*(Residential)*	*(L/s)*	*(L/s)*	*(L/s)*	*(L/s)*
J-BH-600	251.13					0	0.00	0.00	0.00	133
J-BH-601	248.92	*8*	*4*			40	0.14	0.28	0.42	117
J-BH-602	246.70	*11*	*4*			50	0.18	0.35	0.53	117
J-BH-603	245.33	*5*	*14*			64	0.22	0.44	0.67	117
J-BH-604	242.00		*20*			67	0.23	0.47	0.70	117
J-BH-605	239.22		*18*			60	0.21	0.42	0.63	117
J-BH-606	235.49		*2*	*21*	*2.0*	77	0.38	0.77	1.15	250
J-BH-607	233.80		*8*	*15*		77	0.27	0.54	0.81	133
J-BH-608	232.04	*3*		*19*		74	0.26	0.51	0.77	133
J-BH-609	231.30			*24*		81	0.28	0.56	0.84	133
J-BH-610	231.15			*22*		74	0.26	0.51	0.77	133
J-BH-611	231.25	*2*		*20*		74	0.26	0.51	0.77	133
J-BH-612	231.09	*7*		*21*		94	0.33	0.65	0.98	133
J-BH-613	232.00	*7*	*14*			71	0.25	0.49	0.74	117
J-BH-614	233.65	*15*	*6*			71	0.25	0.49	0.74	117
J-BH-615	233.92	*6*	*2*	*9*		57	0.20	0.40	0.60	133
J-BH-616	233.20					0	0.00	0.00	0.00	133
J-BH-617	241.19	*8*		*14*		74	0.26	0.51	0.77	133
J-BH-618	236.99			*37*		124	0.43	0.86	1.30	133
J-BH-619	233.62	*14*	*12*			87	0.30	0.61	0.91	133
J-BH-620	232.28					0	0.00	0.00	0.00	133
J-BH-621	241.85	*8*	*2*	*18*		94	0.33	0.65	0.98	133
J-BH-622	235.60			*24*		81	0.28	0.56	0.84	133
J-BH-623	232.30	*3*	*14*	*14*		104	0.36	0.72	1.09	133
J-BH-627	232.04			*32*		108	0.37	0.75	1.12	133
J-BH-628	230.30		*8*	*11*		64	0.22	0.44	0.67	133
J-BH-629	229.93	*4*	*2*	*19*		84	0.29	0.58	0.88	133
J-BH-631	247.03	*12*	*6*			60	0.21	0.42	0.63	117
J-BH-632	233.00	*23*				77	0.27	0.54	0.81	117
J-BH-633	241.00	*21*		*5*		87	0.30	0.61	0.91	133
J-BH-634	243.24	*6*		*17*		77	0.27	0.54	0.81	133
J-BH-635	248.50	*13*	*8*			71	0.25	0.49	0.74	117
J-BH-636	238.00	*23*				77	0.27	0.54	0.81	133
J-BH-637	244.70	*12*	*16*			94	0.33	0.65	0.98	117
J-BH-638	231.80		*4*	*39*		144	0.50	1.00	1.51	133
J-BH-639	230.94	*10*		*32*		141	0.49	0.98	1.47	133
J-BH-640	230.70	*4*		*22*		87	0.30	0.61	0.91	133
J-BH-641	230.46	*4*		*20*		81	0.28	0.56	0.84	133
J-BH-642	230.22	*5*		*20*		84	0.29	0.58	0.88	133
J-BH-643	238.85	*9*				30	0.11	0.21	0.32	117
J-BH-644	237.97	*24*	*12*			121	0.42	0.84	1.26	117
J-BH-645	241.14	*8*				27	0.09	0.19	0.28	117
J-BH-646	235.00	*24*	*12*			121	0.42	0.84	1.26	117
Total		**299**	**188**	**475**	**2.00**	**3232**	**11.34**	**22.68**	**34.02**	



J-BH-601
J-BH-602
J-BH-603
J-BH-604
J-BH-605
J-BH-606
J-BH-607
J-BH-608
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J-BH-610
J-BH-611
J-BH-612
J-BH-613
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J-BH-615
J-BH-617
J-BH-618
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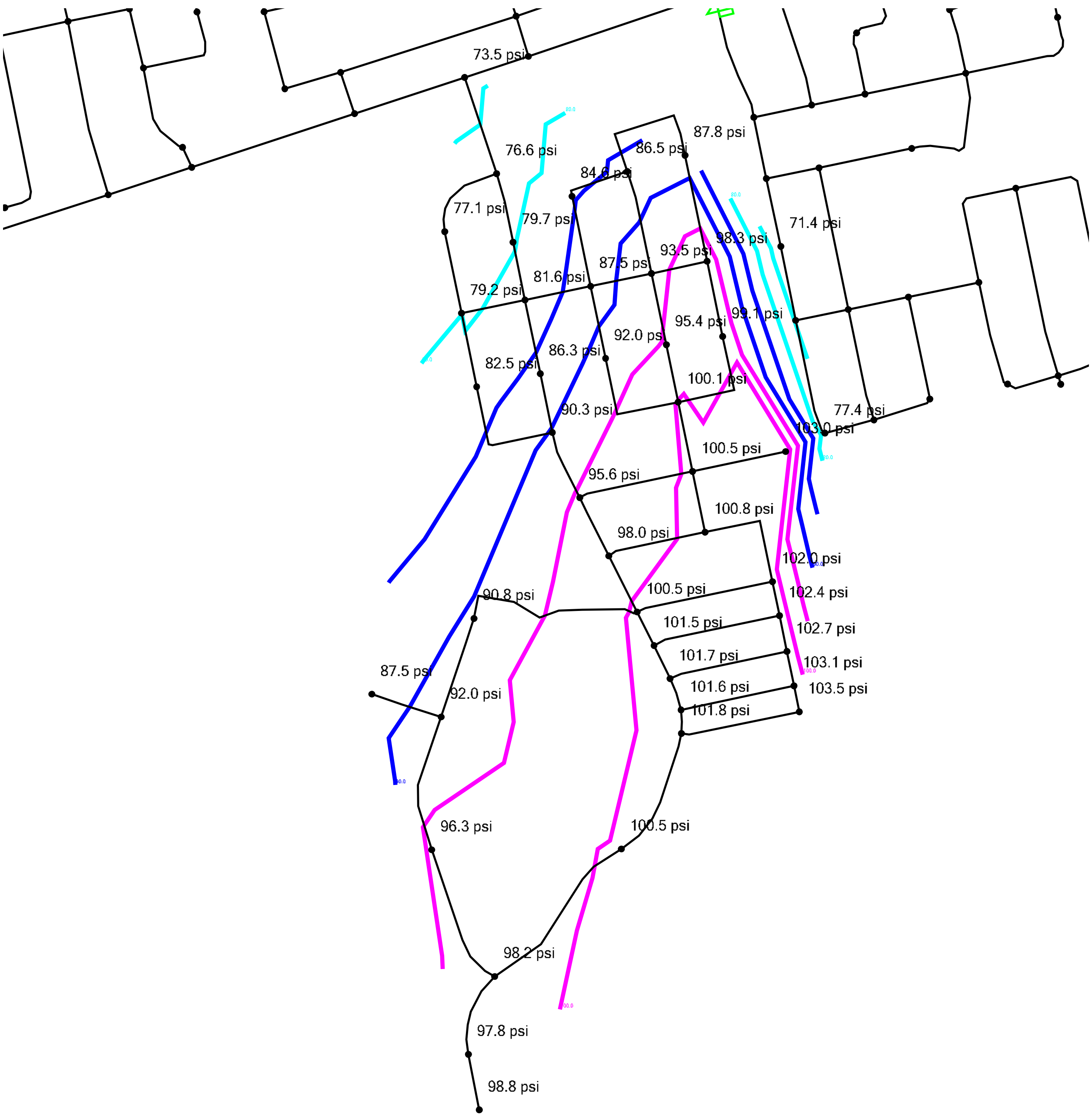
J-BH-621
J-BH-622
J-BH-623
J-BH-627
J-BH-628
J-BH-629
J-BH-631
J-BH-632
J-BH-633
J-BH-634
J-BH-635
J-BH-636
J-BH-637
J-BH-638
J-BH-639
J-BH-640
J-BH-641
J-BH-642
J-BH-643
J-BH-644
J-BH-645
J-BH-646
BLOCK 459
Elementary School
2.00 ha
BLOCK 454
Park
1.37 ha
BLOCK 455
Park
1.37 ha
BLOCK 460
Stormwater Management Pond
3.12 ha
BLOCK 461
Environmental Protection
8.78 ha
STREET 'G'
STREET 'L'
STREET 'M'
STREET 'N'
STREET 'O'
STREET 'P'
BROWNLEE DRIVE
Watercourse
Staked Dripline (LS

Appendix B

Model Results

Average Day Pressure No PRV



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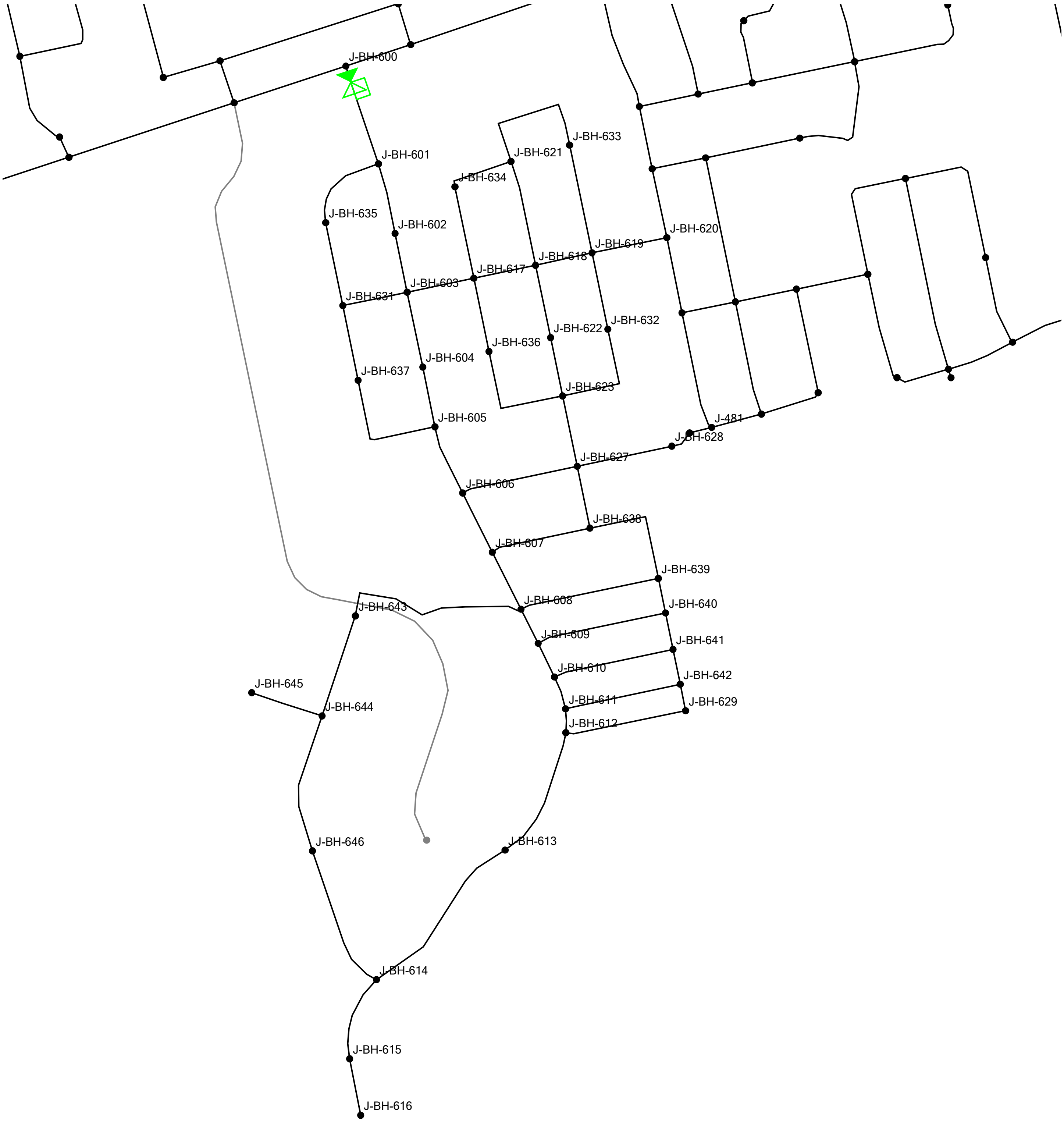
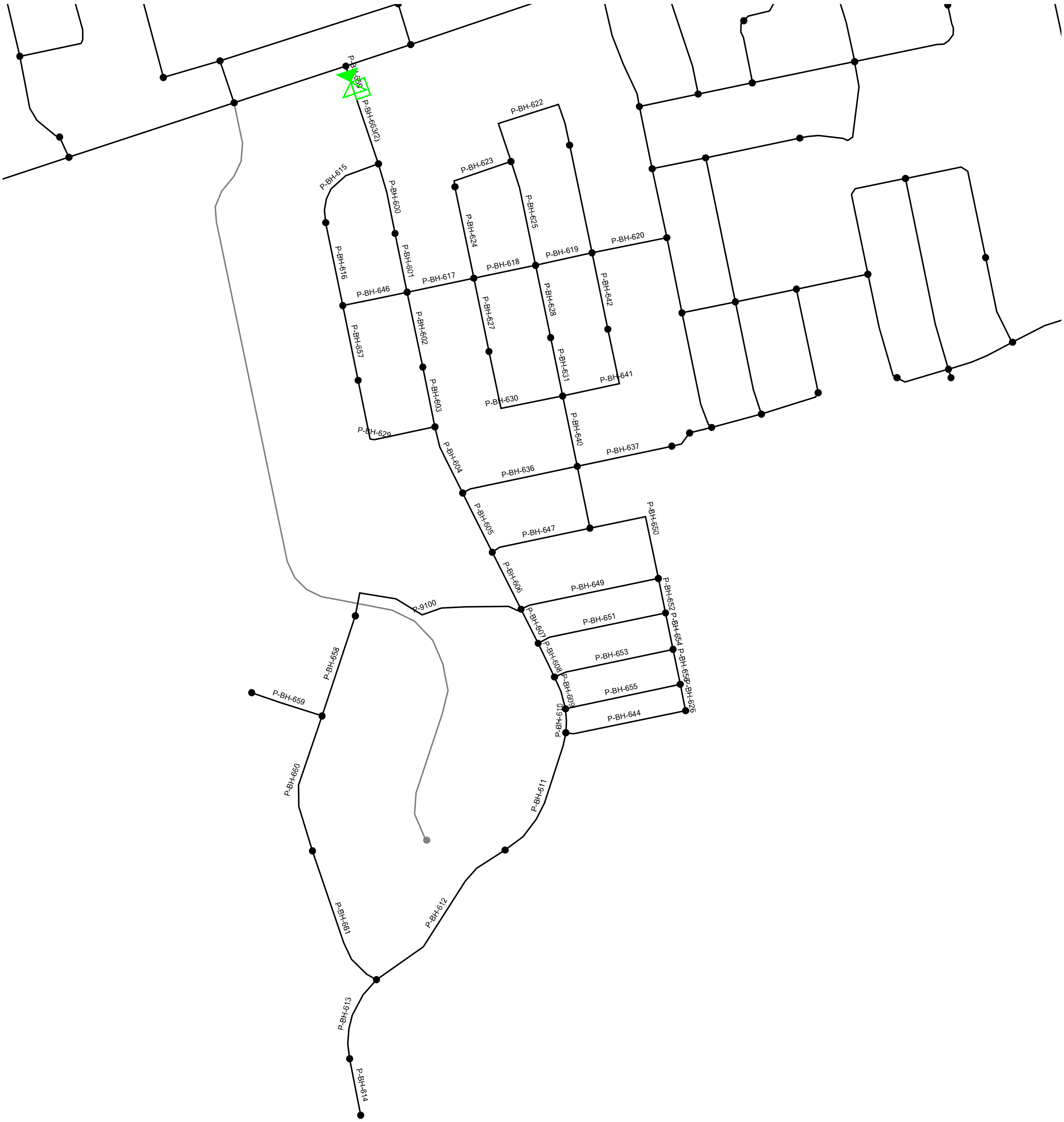
Highlands Oct 2024.wtg

Node Names

Node Names



Pipe Names



P-BH-622
P-BH-623
P-BH-615
P-BH-663(2)
P-BH-600
P-BH-625
P-BH-624
P-BH-620
P-BH-619
P-BH-618
P-BH-617
P-BH-616
P-BH-601
P-BH-646
P-BH-642
P-BH-628
P-BH-627
P-BH-602
P-BH-657
P-BH-603
P-BH-631
P-BH-641
P-BH-630
P-BH-629
P-BH-640
P-BH-637
P-BH-604
P-BH-636
P-BH-605
P-BH-650
P-BH-647
P-BH-606
P-BH-649
P-BH-652
P-9100
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P-BH-607
P-BH-654
P-BH-653
P-BH-608
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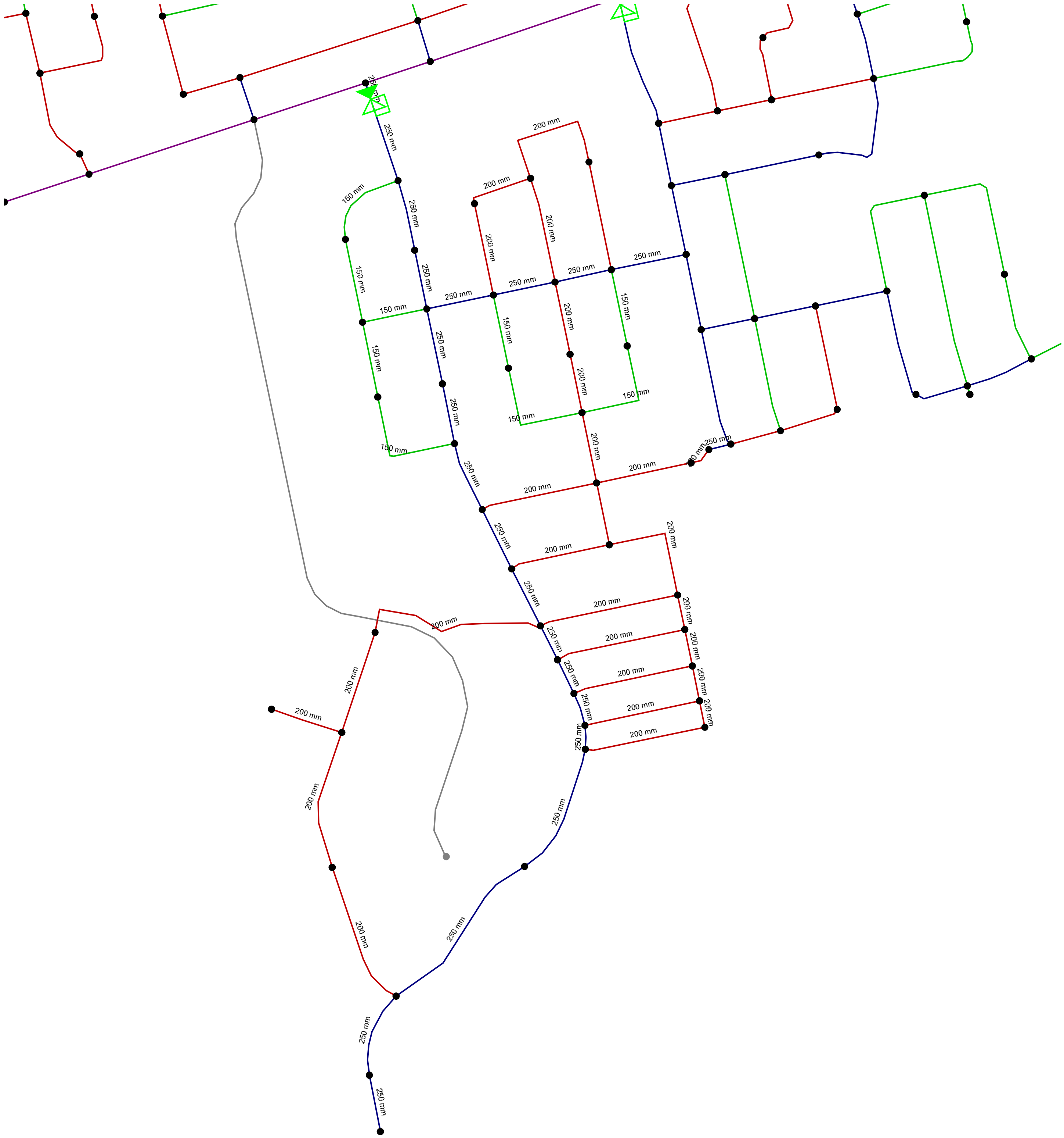
P-BH-655
P-BH-609
P-BH-626
P-BH-659
P-BH-644
P-BH-610
P-BH-660
P-BH-611
P-BH-612
P-BH-661
P-BH-613
P-BH-614

Pipe Diameters



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2024-11-01

Existing Conditions (<3 yrs)
Bradford Highlands Development
November 1, 2024

Municipal Engineering Solutions

Average Day - Existing

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-481	1.14	228.00	285.44	81.70
J-713	0.00	229.13	285.44	80.10
J-BH-600	0.00	251.13	302.67	73.30
J-BH-601	0.14	248.92	285.93	52.60
J-BH-602	0.18	246.70	285.79	55.60
J-BH-603	0.22	245.33	285.68	57.40
J-BH-604	0.23	242.00	285.64	62.10
J-BH-605	0.21	239.22	285.62	66.00
J-BH-606	0.38	235.49	285.58	71.20
J-BH-607	0.27	233.80	285.56	73.60
J-BH-608	0.26	232.04	285.56	76.10
J-BH-609	0.28	231.30	285.56	77.20
J-BH-610	0.26	231.15	285.56	77.40
J-BH-611	0.26	231.25	285.56	77.20
J-BH-612	0.33	231.09	285.56	77.50
J-BH-613	0.25	232.00	285.56	76.20
J-BH-614	0.25	233.65	285.55	73.80
J-BH-615	0.20	233.92	285.55	73.40
J-BH-616	0.00	233.20	285.55	74.50
J-BH-617	0.26	241.19	285.62	63.20
J-BH-618	0.43	236.99	285.60	69.10
J-BH-619	0.30	233.62	285.46	73.70
J-BH-620	0.00	232.28	285.44	75.60
J-BH-621	0.33	241.85	285.59	62.20
J-BH-622	0.28	235.60	285.58	71.10
J-BH-623	0.36	232.30	285.56	75.80
J-BH-627	0.37	232.04	285.55	76.10
J-BH-628	0.22	230.30	285.46	78.50
J-BH-629	0.29	229.93	285.56	79.10
J-BH-631	0.21	247.03	285.69	55.00
J-BH-632	0.27	233.00	285.50	74.70
J-BH-633	0.30	241.00	285.51	63.30
J-BH-634	0.27	243.24	285.60	60.20
J-BH-635	0.25	248.50	285.80	53.10
J-BH-636	0.27	238.00	285.60	67.70
J-BH-637	0.33	244.70	285.66	58.30
J-BH-638	0.50	231.80	285.56	76.50
J-BH-639	0.49	230.94	285.56	77.70
J-BH-640	0.30	230.70	285.56	78.00
J-BH-641	0.28	230.46	285.56	78.40
J-BH-642	0.29	230.22	285.56	78.70
J-BH-643	0.11	238.85	285.56	66.40
J-BH-644	0.42	237.97	285.55	67.70
J-BH-645	0.09	241.14	285.55	63.20
J-BH-646	0.42	235.00	285.55	71.90
MIN		**229.93**		**52.60**
MAX		**251.13**		**79.10**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (L/s)	Velocity (m/s)
P-9100	J-BH-643	J-BH-608	256.44	200	110	-0.87	0.03
P-BH-600	J-BH-601	J-BH-602	95.59	250	110	23.50	0.48
P-BH-601	J-BH-602	J-BH-603	80.02	250	110	23.32	0.48
P-BH-602	J-BH-603	J-BH-604	102.09	250	110	10.22	0.21
P-BH-603	J-BH-604	J-BH-605	81.34	250	110	9.99	0.20
P-BH-604	J-BH-605	J-BH-606	96.16	250	110	11.88	0.24
P-BH-605	J-BH-606	J-BH-607	88.37	250	110	7.40	0.15
P-BH-606	J-BH-607	J-BH-608	85.18	250	110	4.76	0.10
P-BH-607	J-BH-608	J-BH-609	50.96	250	110	2.74	0.06
P-BH-608	J-BH-609	J-BH-610	49.88	250	110	1.95	0.04
P-BH-609	J-BH-610	J-BH-611	45.12	250	110	1.43	0.03
P-BH-610	J-BH-611	J-BH-612	31.95	250	110	1.08	0.02
P-BH-611	J-BH-612	J-BH-613	181.48	250	110	0.87	0.02
P-BH-612	J-BH-613	J-BH-614	248.42	250	110	0.62	0.01
P-BH-613	J-BH-614	J-BH-615	116.64	250	110	0.20	0.00
P-BH-614	J-BH-615	J-BH-616	76.77	250	110	0.00	0.00
P-BH-615	J-BH-601	J-BH-635	119.44	150	100	4.73	0.27
P-BH-616	J-BH-635	J-BH-631	112.94	150	100	4.48	0.25
P-BH-617	J-BH-603	J-BH-617	91.01	250	110	14.72	0.30
P-BH-618	J-BH-617	J-BH-618	84.17	250	110	8.33	0.17
P-BH-619	J-BH-618	J-BH-619	77.22	250	110	0.00	0.00
P-BH-620	J-BH-619	J-BH-620	101.99	250	110	8.50	0.17
P-BH-622	J-BH-633	J-BH-621	193.95	200	110	-6.45	0.21
P-BH-623	J-BH-621	J-BH-634	88.27	200	110	-3.69	0.12
P-BH-624	J-BH-634	J-BH-617	124.56	200	110	-3.96	0.13
P-BH-625	J-BH-621	J-BH-618	142.48	200	110	-3.09	0.10
P-BH-626	J-BH-642	J-BH-629	35.98	200	110	0.41	0.01
P-BH-627	J-BH-636	J-BH-617	99.78	150	100	-2.16	0.12
P-BH-628	J-BH-622	J-BH-618	98.46	200	110	-4.81	0.15
P-BH-629	J-BH-605	J-BH-637	168.19	150	100	-2.11	0.12
P-BH-630	J-BH-636	J-BH-623	161.61	150	100	1.89	0.11
P-BH-631	J-BH-623	J-BH-622	79.57	200	110	-4.53	0.14
P-BH-636	J-BH-606	J-BH-627	157.44	200	110	4.10	0.13
P-BH-637	J-BH-627	J-BH-628	129.14	200	110	8.73	0.28
P-BH-638(1)	J-BH-628	J-713	31.54	200	110	8.51	0.27
P-BH-638(2)	J-713	J-481	30.40	250	110	8.51	0.17
P-BH-640	J-BH-627	J-BH-623	95.87	200	110	-3.14	0.10
P-BH-641	J-BH-623	J-BH-632	152.00	150	100	2.92	0.17
P-BH-642	J-BH-632	J-BH-619	104.06	150	100	2.65	0.15
P-BH-644	J-BH-629	J-BH-612	163.14	200	110	0.12	0.00
P-BH-646	J-BH-631	J-BH-603	87.74	150	100	1.83	0.10
P-BH-647	J-BH-607	J-BH-638	135.17	200	110	2.37	0.08
P-BH-649	J-BH-608	J-BH-639	188.30	200	110	0.89	0.03
P-BH-650	J-BH-639	J-BH-638	160.11	200	110	-0.02	0.00
P-BH-651	J-BH-609	J-BH-640	175.55	200	110	0.51	0.02
P-BH-652	J-BH-640	J-BH-639	47.02	200	110	-0.42	0.01
P-BH-653	J-BH-610	J-BH-641	162.77	200	110	0.26	0.01
P-BH-654	J-BH-641	J-BH-640	49.58	200	110	-0.63	0.02
P-BH-655	J-BH-611	J-BH-642	156.57	200	110	0.10	0.00
P-BH-656	J-BH-642	J-BH-641	47.56	200	110	-0.60	0.02
P-BH-657	J-BH-637	J-BH-631	101.81	150	100	-2.44	0.14
P-BH-658	J-BH-643	J-BH-644	140.75	200	110	0.76	0.02
P-BH-659	J-BH-644	J-BH-645	98.90	200	110	0.09	0.00
P-BH-659	J-BH-600	PRV-85	22.70	250	110	28.37	0.58
P-BH-660	J-BH-644	J-BH-646	188.12	200	110	0.25	0.01
P-BH-661	J-BH-646	J-BH-614	197.13	200	110	-0.17	0.01
P-BH-663(2)	PRV-85	J-BH-601	114.81	250	110	28.37	0.58

ID	Diameter (mm)	Elevation (m)	Upstream Pressure (m)	Downstream Pressure (m)	Flow (L/s)	Velocity (m/s)	Headloss (m)
PRV-84	200	251	302.62	286.17	28.37	0.90	16.46

Existing Conditions (<3 yrs)
Bradford Highlands Development
November 1, 2024

Municipal Engineering Solutions

Maximum Day - Existing

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-481	1.14	228.00	284.93	81.00
J-713	0.00	229.13	284.93	79.40
J-BH-600	0.00	251.13	302.45	73.00
J-BH-601	0.28	248.92	285.73	52.30
J-BH-602	0.35	246.70	285.47	55.10
J-BH-603	0.44	245.33	285.26	56.80
J-BH-604	0.47	242.00	285.20	61.40
J-BH-605	0.42	239.22	285.15	65.30
J-BH-606	0.77	235.49	285.08	70.50
J-BH-607	0.54	233.80	285.05	72.90
J-BH-608	0.51	232.04	285.03	75.40
J-BH-609	0.56	231.30	285.03	76.40
J-BH-610	0.51	231.15	285.03	76.60
J-BH-611	0.51	231.25	285.03	76.50
J-BH-612	0.65	231.09	285.03	76.70
J-BH-613	0.49	232.00	285.02	75.40
J-BH-614	0.49	233.65	285.02	73.10
J-BH-615	0.40	233.92	285.02	72.70
J-BH-616	0.00	233.20	285.02	73.70
J-BH-617	0.51	241.19	285.16	62.50
J-BH-618	0.86	236.99	285.13	68.50
J-BH-619	0.61	233.62	284.95	73.00
J-BH-620	0.00	232.28	284.93	74.90
J-BH-621	0.65	241.85	285.11	61.50
J-BH-622	0.56	235.60	285.09	70.40
J-BH-623	0.72	232.30	285.06	75.00
J-BH-627	0.75	232.04	285.04	75.40
J-BH-628	0.44	230.30	284.95	77.70
J-BH-629	0.58	229.93	285.03	78.40
J-BH-631	0.42	247.03	285.28	54.40
J-BH-632	0.54	233.00	284.99	73.90
J-BH-633	0.61	241.00	285.01	62.60
J-BH-634	0.54	243.24	285.13	59.60
J-BH-635	0.49	248.50	285.48	52.60
J-BH-636	0.54	238.00	285.12	67.00
J-BH-637	0.65	244.70	285.22	57.60
J-BH-638	1.00	231.80	285.04	75.70
J-BH-639	0.98	230.94	285.03	76.90
J-BH-640	0.61	230.70	285.03	77.30
J-BH-641	0.56	230.46	285.03	77.60
J-BH-642	0.58	230.22	285.03	78.00
J-BH-643	0.21	238.85	285.03	65.70
J-BH-644	0.84	237.97	285.02	66.90
J-BH-645	0.19	241.14	285.02	62.40
J-BH-646	0.84	235.00	285.02	71.10
MIN		**229.93**		**52.30**
MAX		**251.13**		**78.40**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (L/s)	Velocity (m/s)
P-9100	J-BH-643	J-BH-608	256.44	200	110	-1.64	0.05
P-BH-600	J-BH-601	J-BH-602	95.59	250	110	32.72	0.67
P-BH-601	J-BH-602	J-BH-603	80.02	250	110	32.37	0.66
P-BH-602	J-BH-603	J-BH-604	102.09	250	110	14.51	0.30
P-BH-603	J-BH-604	J-BH-605	81.34	250	110	14.04	0.29
P-BH-604	J-BH-605	J-BH-606	96.16	250	110	16.45	0.34
P-BH-605	J-BH-606	J-BH-607	88.37	250	110	10.64	0.22
P-BH-606	J-BH-607	J-BH-608	85.18	250	110	7.51	0.15
P-BH-607	J-BH-608	J-BH-609	50.96	250	110	4.46	0.09
P-BH-608	J-BH-609	J-BH-610	49.88	250	110	3.46	0.07
P-BH-609	J-BH-610	J-BH-611	45.12	250	110	2.73	0.06
P-BH-610	J-BH-611	J-BH-612	31.95	250	110	2.17	0.04
P-BH-611	J-BH-612	J-BH-613	181.48	250	110	1.82	0.04
P-BH-612	J-BH-613	J-BH-614	248.42	250	110	1.33	0.03
P-BH-613	J-BH-614	J-BH-615	116.64	250	110	0.40	0.01
P-BH-614	J-BH-615	J-BH-616	76.77	250	110	0.00	0.00
P-BH-615	J-BH-601	J-BH-635	119.44	150	100	6.68	0.38
P-BH-616	J-BH-635	J-BH-631	112.94	150	100	6.19	0.35
P-BH-617	J-BH-603	J-BH-617	91.01	250	110	19.71	0.40
P-BH-618	J-BH-617	J-BH-618	84.17	250	110	11.11	0.23
P-BH-619	J-BH-618	J-BH-619	77.22	250	110	0.00	0.00
P-BH-620	J-BH-619	J-BH-620	101.99	250	110	8.78	0.18
P-BH-622	J-BH-633	J-BH-621	193.95	200	110	-7.43	0.24
P-BH-623	J-BH-621	J-BH-634	88.27	200	110	-4.52	0.14
P-BH-624	J-BH-634	J-BH-617	124.56	200	110	-5.06	0.16
P-BH-625	J-BH-621	J-BH-618	142.48	200	110	-3.56	0.11
P-BH-626	J-BH-642	J-BH-629	35.98	200	110	0.87	0.03
P-BH-627	J-BH-636	J-BH-617	99.78	150	100	-3.04	0.17
P-BH-628	J-BH-622	J-BH-618	98.46	200	110	-6.69	0.21
P-BH-629	J-BH-605	J-BH-637	168.19	150	100	-2.82	0.16
P-BH-630	J-BH-636	J-BH-623	161.61	150	100	2.50	0.14
P-BH-631	J-BH-623	J-BH-622	79.57	200	110	-6.13	0.20
P-BH-636	J-BH-606	J-BH-627	157.44	200	110	5.04	0.16
P-BH-637	J-BH-627	J-BH-628	129.14	200	110	8.66	0.28
P-BH-638(1)	J-BH-628	J-713	31.54	200	110	8.22	0.26
P-BH-638(2)	J-713	J-481	30.40	250	110	8.22	0.17
P-BH-640	J-BH-627	J-BH-623	95.87	200	110	-4.79	0.15
P-BH-641	J-BH-623	J-BH-632	152.00	150	100	3.12	0.18
P-BH-642	J-BH-632	J-BH-619	104.06	150	100	2.58	0.15
P-BH-644	J-BH-629	J-BH-612	163.14	200	110	0.29	0.01
P-BH-646	J-BH-631	J-BH-603	87.74	150	100	2.30	0.13
P-BH-647	J-BH-607	J-BH-638	135.17	200	110	2.58	0.08
P-BH-649	J-BH-608	J-BH-639	188.30	200	110	0.90	0.03
P-BH-650	J-BH-639	J-BH-638	160.11	200	110	-2.00	0.06
P-BH-651	J-BH-609	J-BH-640	175.55	200	110	0.44	0.01
P-BH-652	J-BH-640	J-BH-639	47.02	200	110	-1.92	0.06
P-BH-653	J-BH-610	J-BH-641	162.77	200	110	0.22	0.01
P-BH-654	J-BH-641	J-BH-640	49.58	200	110	-1.75	0.06
P-BH-655	J-BH-611	J-BH-642	156.57	200	110	0.05	0.00
P-BH-656	J-BH-642	J-BH-641	47.56	200	110	-1.40	0.04
P-BH-657	J-BH-637	J-BH-631	101.81	150	100	-3.47	0.20
P-BH-658	J-BH-643	J-BH-644	140.75	200	110	1.43	0.05
P-BH-659	J-BH-644	J-BH-645	98.90	200	110	0.19	0.01
P-BH-659	J-BH-600	PRV-85	22.70	250	110	39.68	0.81
P-BH-660	J-BH-644	J-BH-646	188.12	200	110	0.40	0.01
P-BH-661	J-BH-646	J-BH-614	197.13	200	110	-0.44	0.01
P-BH-663(2)	PRV-85	J-BH-601	114.81	250	110	39.68	0.81

ID	Diameter (mm)	Elevation (m)	Upstream Pressure (m)	Downstream Pressure (m)	Flow (L/s)	Velocity (m/s)	Headloss (m)
PRV-85	200	251	302.51	286.17	39.68	1.26	16.20

Existing Conditions (<3 yrs)
Bradford Highlands Development
November 1, 2024

Municipal Engineering Solutions

Peak Hour - Existing

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-481	1.14	228.00	284.27	80.00
J-713	0.00	229.13	284.28	78.40
J-BH-600	0.00	251.13	302.21	72.60
J-BH-601	0.42	248.92	285.46	52.00
J-BH-602	0.53	246.70	285.05	54.60
J-BH-603	0.67	245.33	284.72	56.00
J-BH-604	0.70	242.00	284.62	60.60
J-BH-605	0.63	239.22	284.55	64.50
J-BH-606	1.15	235.49	284.43	69.60
J-BH-607	0.81	233.80	284.38	71.90
J-BH-608	0.77	232.04	284.36	74.40
J-BH-609	0.84	231.30	284.35	75.50
J-BH-610	0.77	231.15	284.34	75.70
J-BH-611	0.77	231.25	284.34	75.50
J-BH-612	0.98	231.09	284.34	75.70
J-BH-613	0.74	232.00	284.34	74.40
J-BH-614	0.74	233.65	284.33	72.10
J-BH-615	0.60	233.92	284.33	71.70
J-BH-616	0.00	233.20	284.33	72.70
J-BH-617	0.77	241.19	284.57	61.70
J-BH-618	1.30	236.99	284.53	67.60
J-BH-619	0.91	233.62	284.30	72.10
J-BH-620	0.00	232.28	284.27	74.00
J-BH-621	0.98	241.85	284.50	60.70
J-BH-622	0.84	235.60	284.46	69.50
J-BH-623	1.09	232.30	284.42	74.10
J-BH-627	1.12	232.04	284.38	74.40
J-BH-628	0.67	230.30	284.30	76.80
J-BH-629	0.88	229.93	284.34	77.40
J-BH-631	0.63	247.03	284.75	53.70
J-BH-632	0.81	233.00	284.33	73.00
J-BH-633	0.91	241.00	284.38	61.70
J-BH-634	0.81	243.24	284.53	58.70
J-BH-635	0.74	248.50	285.07	52.00
J-BH-636	0.81	238.00	284.50	66.10
J-BH-637	0.98	244.70	284.65	56.80
J-BH-638	1.51	231.80	284.37	74.80
J-BH-639	1.47	230.94	284.35	76.00
J-BH-640	0.91	230.70	284.35	76.30
J-BH-641	0.84	230.46	284.34	76.60
J-BH-642	0.88	230.22	284.34	77.00
J-BH-643	0.32	238.85	284.34	64.70
J-BH-644	1.26	237.97	284.33	65.90
J-BH-645	0.28	241.14	284.33	61.40
J-BH-646	1.26	235.00	284.33	70.20
MIN		**229.93**		**52.00**
MAX		**251.13**		**77.40**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (L/s)	Velocity (m/s)
P-9100	J-BH-643	J-BH-608	256.44	200	110	-2.45	0.08
P-BH-600	J-BH-601	J-BH-602	95.59	250	110	42.03	0.86
P-BH-601	J-BH-602	J-BH-603	80.02	250	110	41.50	0.85
P-BH-602	J-BH-603	J-BH-604	102.09	250	110	18.82	0.38
P-BH-603	J-BH-604	J-BH-605	81.34	250	110	18.12	0.37
P-BH-604	J-BH-605	J-BH-606	96.16	250	110	21.03	0.43
P-BH-605	J-BH-606	J-BH-607	88.37	250	110	14.00	0.29
P-BH-606	J-BH-607	J-BH-608	85.18	250	110	10.67	0.22
P-BH-607	J-BH-608	J-BH-609	50.96	250	110	6.45	0.13
P-BH-608	J-BH-609	J-BH-610	49.88	250	110	5.14	0.10
P-BH-609	J-BH-610	J-BH-611	45.12	250	110	4.11	0.08
P-BH-610	J-BH-611	J-BH-612	31.95	250	110	3.28	0.07
P-BH-611	J-BH-612	J-BH-613	181.48	250	110	2.75	0.06
P-BH-612	J-BH-613	J-BH-614	248.42	250	110	2.01	0.04
P-BH-613	J-BH-614	J-BH-615	116.64	250	110	0.60	0.01
P-BH-614	J-BH-615	J-BH-616	76.77	250	110	0.00	0.00
P-BH-615	J-BH-601	J-BH-635	119.44	150	100	8.66	0.49
P-BH-616	J-BH-635	J-BH-631	112.94	150	100	7.92	0.45
P-BH-617	J-BH-603	J-BH-617	91.01	250	110	24.77	0.50
P-BH-618	J-BH-617	J-BH-618	84.17	250	110	13.90	0.28
P-BH-619	J-BH-618	J-BH-619	77.22	250	110	0.00	0.00
P-BH-620	J-BH-619	J-BH-620	101.99	250	110	9.16	0.19
P-BH-622	J-BH-633	J-BH-621	193.95	200	110	-8.47	0.27
P-BH-623	J-BH-621	J-BH-634	88.27	200	110	-5.38	0.17
P-BH-624	J-BH-634	J-BH-617	124.56	200	110	-6.19	0.20
P-BH-625	J-BH-621	J-BH-618	142.48	200	110	-4.07	0.13
P-BH-626	J-BH-642	J-BH-629	35.98	200	110	1.32	0.04
P-BH-627	J-BH-636	J-BH-617	99.78	150	100	-3.91	0.22
P-BH-628	J-BH-622	J-BH-618	98.46	200	110	-8.53	0.27
P-BH-629	J-BH-605	J-BH-637	168.19	150	100	-3.54	0.20
P-BH-630	J-BH-636	J-BH-623	161.61	150	100	3.10	0.18
P-BH-631	J-BH-623	J-BH-622	79.57	200	110	-7.69	0.24
P-BH-636	J-BH-606	J-BH-627	157.44	200	110	5.89	0.19
P-BH-637	J-BH-627	J-BH-628	129.14	200	110	8.52	0.27
P-BH-638(1)	J-BH-628	J-713	31.54	200	110	7.85	0.25
P-BH-638(2)	J-713	J-481	30.40	250	110	7.85	0.16
P-BH-640	J-BH-627	J-BH-623	95.87	200	110	-6.38	0.20
P-BH-641	J-BH-623	J-BH-632	152.00	150	100	3.32	0.19
P-BH-642	J-BH-632	J-BH-619	104.06	150	100	2.51	0.14
P-BH-644	J-BH-629	J-BH-612	163.14	200	110	0.44	0.01
P-BH-646	J-BH-631	J-BH-603	87.74	150	100	2.76	0.16
P-BH-647	J-BH-607	J-BH-638	135.17	200	110	2.52	0.08
P-BH-649	J-BH-608	J-BH-639	188.30	200	110	1.00	0.03
P-BH-650	J-BH-639	J-BH-638	160.11	200	110	-3.64	0.12
P-BH-651	J-BH-609	J-BH-640	175.55	200	110	0.47	0.01
P-BH-652	J-BH-640	J-BH-639	47.02	200	110	-3.17	0.10
P-BH-653	J-BH-610	J-BH-641	162.77	200	110	0.26	0.01
P-BH-654	J-BH-641	J-BH-640	49.58	200	110	-2.73	0.09
P-BH-655	J-BH-611	J-BH-642	156.57	200	110	0.06	0.00
P-BH-656	J-BH-642	J-BH-641	47.56	200	110	-2.15	0.07
P-BH-657	J-BH-637	J-BH-631	101.81	150	100	-4.52	0.26
P-BH-658	J-BH-643	J-BH-644	140.75	200	110	2.13	0.07
P-BH-659	J-BH-644	J-BH-645	98.90	200	110	0.28	0.01
P-BH-659	J-BH-600	PRV-85	22.70	250	110	51.11	1.04
P-BH-660	J-BH-644	J-BH-646	188.12	200	110	0.59	0.02
P-BH-661	J-BH-646	J-BH-614	197.13	200	110	-0.67	0.02
P-BH-663(2)	PRV-85	J-BH-601	114.81	250	110	51.11	1.04

ID	Diameter (mm)	Elevation (m)	Upstream Pressure (psi)	Downstream Pressure (psi)	Flow (L/s)	Velocity (m/s)	Headloss (m)
PRV-85	200	251	302.07	286.17	51.11	1.63	15.90

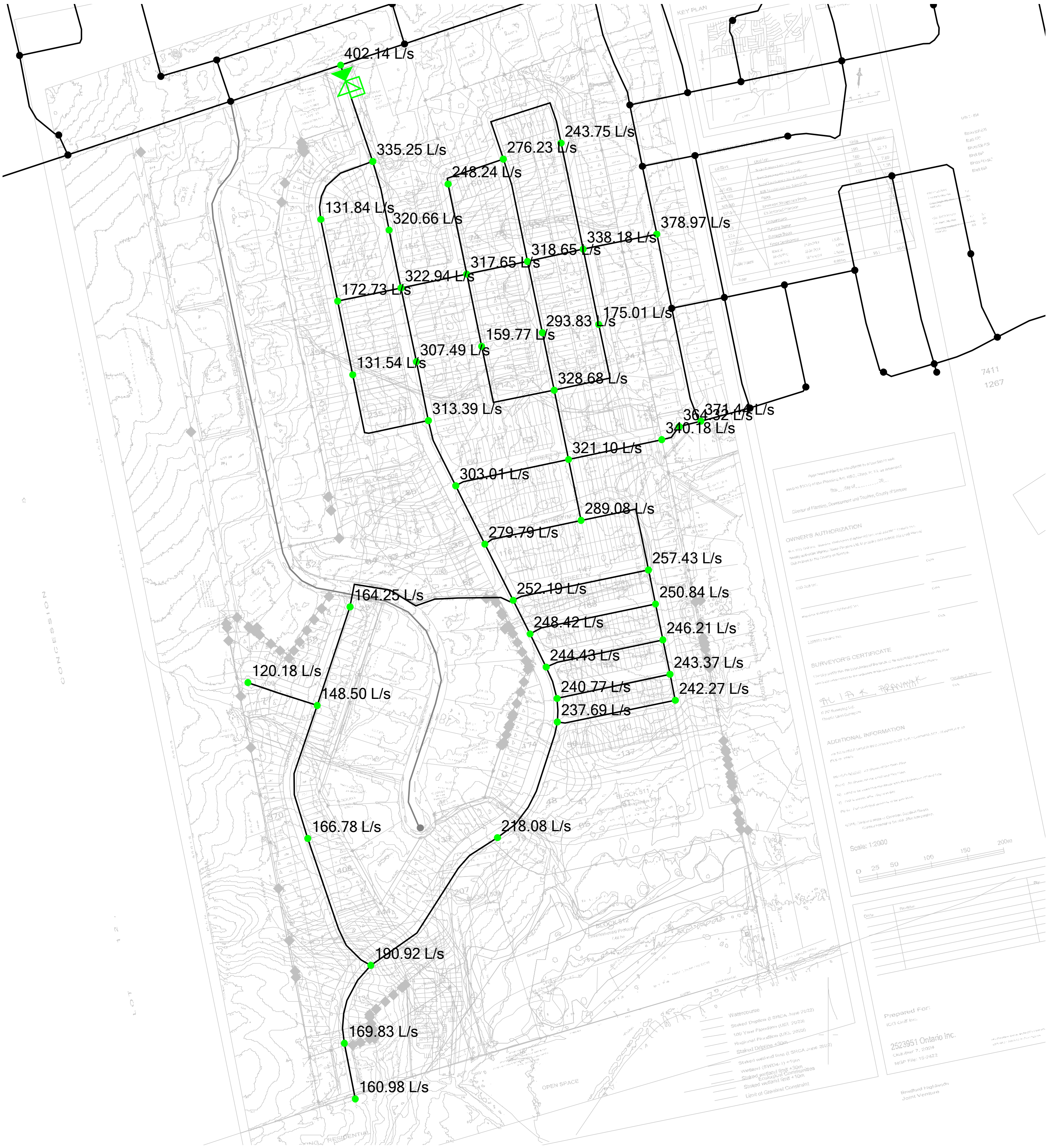
Existing Conditions (<3 yrs)
Bradford Highlands Development
November 1, 2024

Municipal Engineering Solutions

Fire Flow Table			
ID	Total Demand (L/s)	Available Flow (L/s)	Fire Flow Met?
J-BH-601	117.28	334.79	TRUE
J-BH-602	117.36	320.06	TRUE
J-BH-603	117.44	322.08	TRUE
J-BH-604	117.46	306.63	TRUE
J-BH-605	117.42	312.26	TRUE
J-BH-606	250.76	301.69	TRUE
J-BH-607	133.54	278.19	TRUE
J-BH-608	133.52	251.08	TRUE
J-BH-609	133.56	247.40	TRUE
J-BH-610	133.52	243.44	TRUE
J-BH-611	133.52	239.83	TRUE
J-BH-612	133.66	236.99	TRUE
J-BH-613	117.50	217.54	TRUE
J-BH-614	117.50	190.81	TRUE
J-BH-615	133.40	169.80	TRUE
J-BH-616	133.00	160.62	TRUE
J-BH-617	133.52	317.30	TRUE
J-BH-618	133.86	318.59	TRUE
J-BH-619	133.60	338.84	TRUE
J-BH-620	133.00	378.94	TRUE
J-BH-621	133.66	276.50	TRUE
J-BH-622	133.56	293.64	TRUE
J-BH-623	133.72	328.17	TRUE
J-BH-627	133.74	318.89	TRUE
J-BH-628	133.44	324.67	TRUE
J-BH-629	133.58	241.37	TRUE
J-BH-631	117.42	172.96	TRUE
J-BH-632	117.54	175.54	TRUE
J-BH-633	133.60	244.34	TRUE
J-BH-634	133.54	248.37	TRUE
J-BH-635	117.50	132.29	TRUE
J-BH-636	133.54	160.19	TRUE
J-BH-637	117.66	132.11	TRUE
J-BH-638	134.00	288.01	TRUE
J-BH-639	133.98	256.65	TRUE
J-BH-640	133.60	249.81	TRUE
J-BH-641	133.56	245.18	TRUE
J-BH-642	133.58	242.43	TRUE
J-BH-643	117.22	164.02	TRUE
J-BH-644	117.84	148.98	TRUE
J-BH-645	117.18	120.18	TRUE
J-BH-646	117.84	167.20	TRUE
J-BH-643	117.24	201.28	TRUE
J-BH-644	117.80	178.75	TRUE
J-BH-645	117.16	139.99	TRUE
J-BH-646	117.96	193.94	TRUE
J-BH-647	133.00	189.43	TRUE

MIN	**120.18**
MAX	**378.94**

Fire Flows



402.14 L/s
335.25 L/s
243.75 L/s
276.23 L/s
248.24 L/s
131.84 L/s
320.66 L/s
378.97 L/s
338.18 L/s
318.65 L/s
317.65 L/s
322.94 L/s
172.73 L/s
175.01 L/s
293.83 L/s
159.77 L/s
307.49 L/s
131.54 L/s
328.68 L/s
313.39 L/s
371.44 L/s
364.32 L/s
340.18 L/s
321.10 L/s
303.01 L/s
289.08 L/s
279.79 L/s
257.43 L/s
250.84 L/s
252.19 L/s
164.25 L/s
248.42 L/s
246.21 L/s
244.43 L/s
243.37 L/s
120.18 L/s
240.77 L/s
242.27 L/s
148.50 L/s
237.69 L/s
166.78 L/s
218.08 L/s
190.92 L/s
169.83 L/s
160.98 L/s

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