RICHCRAFT GROUP OF COMPANIES

RICHCRAFT TERRACE FLATS, CRT LANDS (BLOCK 344)

FUNCTIONAL SERVICING REPORT

JULY 07, 2021

COPY

wsp

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COPY

PROJECT NO.: 211-01221-00
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APPENDICES

1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by Richcraft Group of Companies (Richcraft) to complete a Servicing Report for the development of 620 Bobolink Ridge (Block 344) which fronts Embankment Street located in Ottawa, Ontario (See Figure 1). The purpose of this report is to summarize the servicing requirements for the Site Plan Control Agreement Application, including but not limited to the following:

- Transportation System
- Sanitary Servicing
- Potable Water Supply
- Stormwater Management
- Utility Servicing
- Approvals

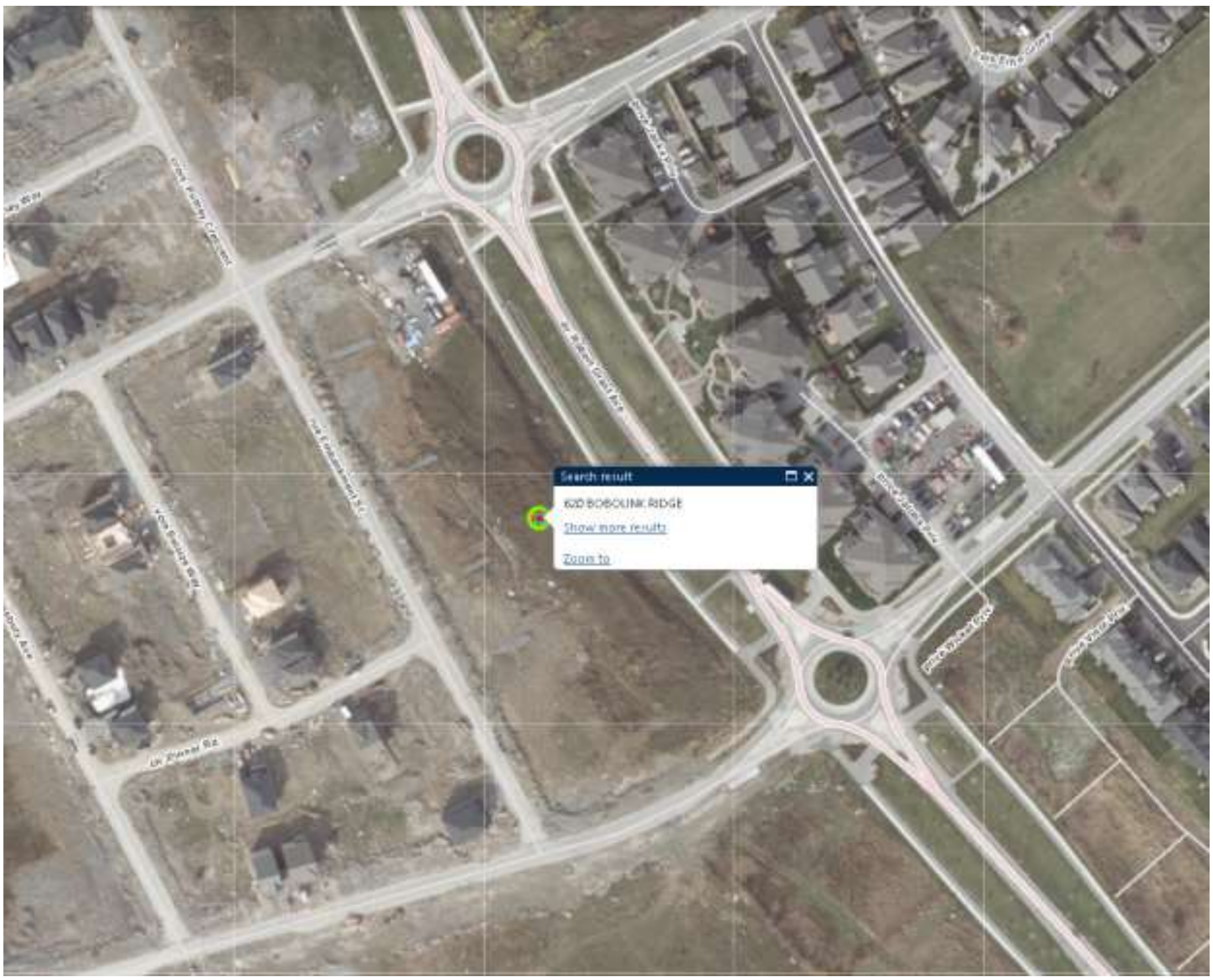

Figure 1: Site Location (Source: GeoOttawa).

2 OBJECTIVE

The objective of the site servicing report is to meet the requirements for the proposed modification of the site while adhering to the stipulations of all relevant master servicing documents and City of Ottawa servicing design guidelines.

3 EXISTING CONDITIONS

3.1 OVERVIEW / EXISTING LAND USE

The site is a greenfield site approximately 1.60 hectares in size and is located between Robert Grant Avenue, Bobolink Ridge, Embankment Street, and Cope Drive. The entire site is described as Block 344 Registered Plan No. 4M-1619 in the City of Ottawa and fronts Embankment Street where there are two (2) access corridors.

The property is currently zoned as “R4Z – Residential Fourth Density Zone” which permits a wide range of residential building forms. Subzone “Z” specifically promotes efficient land use and compact form while showcasing newer design approaches. Refer to Appendix A for the Civil Drawings.

3.2 EXISTING ACCESS AND PARKING

There is currently no existing parking on the site, given its greenfield state. There are however two (2) access corridors which connect Block 344 to Embankment Street. The southern access corridor is located at the intersection of Pinner Road and Embankment Street, while the northern access is approximately 110 m north of the aforementioned intersection.

3.3 EXISTING SANITARY AND WATER SERVICING

Based on as-constructed drawings provided by Richcraft to WSP, sanitary and potable water services have been carried into the site and stubbed for future development connections.

One (1) 200 mm diameter sanitary service stub was previously installed which is located at the site’s southern access corridor (at the intersection of Pinner Street and Embankment Street). The service extends eastward from EXMH189A to the rear limits of adjacent residential lots, a length of approximately 40m. The sanitary service stub is reported (based on as-builts mark-ups provided by Richcraft) to have a pipe invert elevation of 103.59 m. Wastewater from the sanitary service will be routed south down Embankment Street, then west along Cope Drive, then north along Goldhank Drive, ultimately discharging to the 600 mm Fernbank trunk sewer located along Abbott Street.

Two (2) 200 mm diameter potable water service stubs were previously installed, one at each of the site’s access corridors. Similar to the sanitary service, both water services extent eastward from Embankment Street to the rear limits of adjacent residential lots, each with a length of approximately 42 m. The northern and southern water service stubs are reported (based on as-builts mark-ups provided by Richcraft) to have top of pipe elevations of 105.86 m and 105.80 m, respectively. The existing water service stubs are feed by the existing 200 mm diameter watermain currently located along Embankment Street, which is connected to a larger looped system feed by the 400 mm diameter watermain located along Abbott Street.

Refer to Appendix A (Civil Drawings) for information related to existing services.

3.4 EXISTING TOPOGRAPHY & DRAINAGE

The topographic survey (carried out in March 2021 by Annis O’Sullivan Vollebekk Ltd.) shows the existing site draining from north to south towards the south-east corner of the property, with ground elevations ranging from105.85 m to 110.55 m. A ridge of fill material (approximately 150m long and several metres in height) was identified along eastward side of the site.

According to the topographic survey, it appears that stormwater sheet flows to the south-east corner of the site. From here, surface inlets capture the stormwater and route it eastward along Cope Drive via storm sewers (600-2400 mm diameter) to Pond 6 of the Fernbank Crossing development.

4 PROPOSED DEVELOPMENT

The proposed development includes seven (7) new 12-unit townhouses, each with a building area of 412 m^2. In addition, an accessory building with a building area of 154 m^2 will be included for centralized storage and garbage collection services. The site will include both private and communal amenity areas totalling 546 m^2 and 980 m^2, respectively. The construction of this development will not be carried out in phases.

The following studies have been completed to support development on this site:

- Geotechnical Investigation - Proposed Residential Development - Kanata - Block 344 620 Bobolink Ridge Ottawa, Ontario (Paterson Group Inc. | Report, Dated March 9, 2021)
- Phase I Environmental Site Assessment (Paterson Group Inc. | Report dated March 2, 2021)
- Roadway Traffic Noise Assessment (Gradient Wind | Report dated June 18, 2021)

The subject site and its associated development constitute part of the CRT Lands Phase 1 – Fernbank Community. As such, numerous studies have been completed facilitate this development. Refer to IBI Group report titled "Design Brief – CRT Lands Phase 1 – Fernbank Community" dated July 2017 for details related to previous studies.

Pre-consultation with the City of Ottawa was held on February 22nd, 2021. Refer to Appendix B for provided relevant documentation, including the completed Servicing Report Checklist.

4.1 ADHERENCE TO ZONING AND RELATED REQUIREMENTS

The proposed property use will be in conformance with zoning and related requirements prior to approval and construction and is understood to be in conformance with current zoning.

4.2 GEOTECHNICAL STUDY

A geotechnical investigation report has been prepared by Paterson Group (Report PG5701-1, March 9, 2021). Its recommendations have been taken into account in the development of the engineering drawings and specifications.

4.3 ACCESS AND PARKING

Access to the site will be provided via two (2) - 6.7 m wide laneways connected to Embankment Street. Once in the site, 6.0 m wide laneways (possessing 12.0 m centerline radii where required for fire access routing) will provide connectivity between units and parking areas.

Parking for both bicycles and vehicles will be provided, 130 exterior vehicle spaces and 50 interior bicycle spaces are currently proposed. Of the 130 parking spaces, two (2) are barrier-free and three (3) are electric vehicle charging stations.

Refer to Appendix A for the Civil Drawings.

4.4 SANITARY SERVICING

4.4.1 PROPOSED SYSTEM DESCRIPTION

The proposed sanitary servicing system a limited to a series of gravity drainage sewers, laterals and manholes which collect wastewater from each blocks and route it to the site outlet (municipal sanitary sewer at intersection of Pinner Road and Embankment Street).

There are no pump stations, forcemains, or syphons in the proposed design.

4.4.2 DESIGN CRITERA

Private sanitary sewers and service laterals for the subject site were designed in accordance with the following publications:

- Sewer Design Guidelines (October 2012) & Technical Bulletins | City of Ottawa
- Design Brief – CRT Lands Phase 1 – Fernbank Community (July 2017) | IBI Group
- Design Guidelines for Sewage Works (2008) | Ministry of the Environment, Conservation, and Parks

Design sanitary flows and associated peaking factors were calculated using a population/unit-based approach using values summarized in Table 1.

Table 1: Sanitary System - Design Values.

Description	Value Used	Source
Population Density	2.7 persons/ townhouse unit	City of Ottawa / IBI Group
Average Daily Flow / Capita	280 l/cap/day	City of Ottawa
Peaking Factor (Harmon)	Min. 2 – Max. 4*	City of Ottawa
Peaking Factor – Correction Factor	0.8	City of Ottawa
Total Extraneous Flow	0.33 l/s/ha	City of Ottawa

*** Refer to the sanitary sewer design sheet (Appendix C) for calculated Harmon peaking factors .**

Based on a review of the geotechnical report (prepared by Paterson Group) there are no local conditions which would warrant the allocation of additional extraneous flows to size the system.

4.4.3 PROPOSED SEWER SIZING

Total sanitary flow for the site was calculated to be 3.07 l/s, corresponding to a population of 227 persons. Sanitary sewer diameters and slopes were selected such that peak flows corresponded to less than 80% of the pipe's conveyance capacity, as well as velocities within the permissible range of 0.6-3.0 m/s. Steps were introduced into the sewers at all bends to accommodate for hydraulics losses in accordance MECP Design Guidelines of Sewage Works (2008).

Refer to Appendix C for detailed sanitary sewer sizing calculations and associated catchment figure (SAN-SK1-1).

4.4.4 ADEQUACY OF MUNICIPAL INFRASTRUCTURE

The sanitary system outlet for the development is an existing 200mm diameter sanitary sewer running from north to south along Embankment street, which constitutes part of the CRT Lands - Phase 1 subdivision development (designed by IBI). The design of the municipal collection system had assumed a post-development sanitary flow contribution of 2.22 l/s from the subject development. This corresponds to population of 139.5 persons.

Given the proposed peak sanitary flow from the development exceeds the allotted allowance (by 0.85 l/s), a desktop review of IBI sizing calculated was completed to verify the impacts of the immediate downstream sewer system. All downstream sewers are reported to have available capacity in excess of 0.85 l/s. Based on this finding, it presumed that no upgrades to downstream municipal infrastructure will be required to accommodate the development.

Refer to Appendix C for a mark-up of IBI's sizing calculations and associated sanitary catchment map.

4.4.5 PROVISIONS FOR SANITARY FLOW MONITORING

Sanitary manhole SANMH215 - which is located immediately up stream of the site's sanitary system outlet - has been selected to be the City's sanitary flow monitoring station. It was selected based on its location and conductivity for sanitary flow monitoring.

4.5 POTABLE WATER SUPPLY

4.5.1 PROPOSED SYSTEM DESCRIPTION

The proposed potable water supply system is a combination of watermain (ranging from 200mm-300mm), fittings, reducers, hydrants, laterals, blow-offs, and a district metering chambers.

The private system will include two (2) connections to the existing 200mm diameter stubs previous carried into the site. After the connections there will be a metering chambers (see Section 4.5.8), one for each municipal service connection. After the meters, the watermain will run parallel with the site laneway, where branching will occur to supply blocks from parking areas. No looping with the municipal system is proposed based on the presence of check valves within the metering chamber assembly.

Isolation valve, dead-end blow-offs, and fire hydrants will provide in accordance with City of Ottawa water design guides.

Pressure relief valves will be required on townhouse services for Blocks 5, 6, and 7.

4.5.2 DESIGN CRITERIA

Private watermains and water services for the subject site were designed in accordance with the following publications:

- Ottawa Design Guidelines – Water Distribution (July 2010) & Technical Bulletins | City of Ottawa
- Design Brief – CRT Lands Phase 1 – Fernbank Community (July 2017) | IBI Group
- Design Guidelines for Drinking-Water Systems (2008) | Ministry of the Environment, Conservation, and Parks

Domestic water demands and associated peaking factors were calculated using a population/unit-based approach using values summarized in Table 2. Refer to Table 3 for the calculated domestic water demands from each townhouse block and for the entire site.

Table 2: Domestic Demand Design Values.

DESCRIPTION	VALUE USED	SOURCE
Population Density	2.7 persons/ townhouse unit	City of Ottawa / IBI Group
Average Daily Flow / Capita	350 l/cap/day	City of Ottawa / IBI Group
Peaking Factor	Maximum Daily Demand (MDD): 4.02 Maximum Hourly Demand (MHD): 6.04	MECP (Table 3-3) for populations between 0-500. Peaking factors interpolated from table for proposed number of units.

Table 3: Calculated Domestic Water Demands.

	# OF UNITS	AVERAGE DAILY FLOW (L/S)	MAXIMUM DAILY FLOW, MDD (L/S)	MAXIMUM HOURLY DEMAND, MHD (L/S)
Block 1	12	0.13	0.53	0.79
Block 2	12	0.13	0.53	0.79
Block 3	12	0.13	0.53	0.79
Block 4	12	0.13	0.53	0.79
Block 5	12	0.13	0.53	0.79
Block 6	12	0.13	0.53	0.79
Block 7	12	0.13	0.53	0.79
Total	**84**	**0.92 L/s**	**3.69 L/s**	**5.55 L/s**

Refer to Appendix D for detailed water demand calculations.

4.5.3 FIRE FLOW DEMANDS

Required fire flow for the proposed development was determined in accordance with the following two (2) publications. From the two (2) methods used, the highest calculated fire flow was selected for design of the private potable water distribution system.

- Water Supply for Public Fire Protection (1999) | Fire Underwriters Survey (FUS)
- Ontario Building Code (OBC) (2012)

The FUS fire flow was first calculated, as it is typically the governing flow of the two methods. Based on the Architect's building design drawings, WSP has used the following inputs to complete the FUS calculation:

- Wood-Frame Construction
- Limited Combustible Occupancy
- No Sprinklered System
- Worst-Case Building Exposures (found to be Block 3)

Given these inputs, the required fire flow was calculated to be 11,000 l/min (or 183 l/s). As this exceeds the maximum fire flow which can be calculated per OBC (9,000 l/min), FUS was considered to be the governing case and used in the design of the potable water distribution system. Refer to Appendix D for detailed fire flow demand calculations.

4.5.4 WATERMAIN MODELLING & RESULTS

In order to appropriately size the proposed watermains on the site a WaterGEMS (version10.03.01.08) steady-state hydraulic model was constructed.

Five (5) scenarios were simulated to confirm adequacy of the propose watermain design, three (3) of which are related to fire flow analysis for specific areas. All five (5) scenarios have corresponding requirements for residual pressures (under specific demands) in the system which are dictated by the City water distribution design guidelines. Refer to

Table 4 for a summary of model scenarios and associated pressure objectives.

Table 4: Watermain Pressure and Demand Objectives.

ID	SCENARIOS*	System Residual Pressure Thresholds
1	Average Daily Demand (ADD)	345 (50 PSI) - 552 kPa (80 PSI)
2	Maximum Hourly Demand (MHD)	Min. 276 kPa (40 PSI)
3*	Maximum Daily + Fire Flow Demand (MDD+FF) – Block 1 & 2	Min. 140 kPa (20 PSI)
4*	Maximum Daily + Fire Flow Demand (MDD+FF) – Block 3 & 4	Min. 140 kPa (20 PSI)
5*	Maximum Daily + Fire Flow Demand (MDD+FF) – Block 5, 6 & 7	Min. 140 kPa (20 PSI)

*** Refer to Section 4.5.7.**

Boundary conditions for WSP's water model were set through specifying of hydraulic grade lines (HGL) elevations, represented through water levels in reservoirs at the connections to the municipal water distribution system. Refer to Table 5 for HGL elevations provided by the City of Ottawa (refer to Appendix D). It should be noted that watermain boundary condition results provided by the City on May June 22nd, 2021 were based on a single municipal service connection (at the intersection of Pinner Road and Embankment Street) relative to the site's full demand. WSP has conservatively assumed and used the provided boundary condition for both municipal connections, until such a time that revised boundary conditions – based on split demand – are received from the City.

Table 5: Water Model Boundary Conditions.

SCENARIOS	HGL @ EMBANKMENT ST. & PINNER RD. (CONNECTION #1 & 2)*
ADD	161.2
MHD	156.4
MDD+FF	145.0

*** Connections #1 and 2 are possible connection points (on either side of an existing valve) of the private main to the municipal main. Both options resulted in the same boundary condition results.**

The hydraulic analysis concluded that under each demand scenario pressure requirements were satisfied, with the exception of a few areas experiencing pressures slightly higher than 552 kPa (80 PSI) under scenarios #1 (ADD). To accommodate for this, pressure relief valves will be required on all water services for Blocks 5, 6, and 7. Combined available fire flow from hydrant clusters was found to exceed the required fire flow demand (183 l/s), while residual pressures within the system remained above 140 kPa (20 PSI). Refer to Appendix D for model report outputs and associated map figures.

It should be noted that after initial simulations using one municipal connection (at intersection of Pinner Road and Embankment Street), supply for fire flow demands was found to be insufficient. Therefore, a secondary municipal service connection was found to be required to meet fire flow demand and residual pressure requirements.

4.5.5 WATER AGE CHECK

To ensure the size of the proposed watermain did not jeopardize water quality, a high-level "total time of travel" estimate was carried out to solve for the time required to consume/replenish one (1) full pipe system volume at average day demand. With a pipe system volume of approximately 15.9 m^3 and an average day demand of 0.92 l/s (75.9 m^3/day), the resulting "total time of travel" was calculated to be 0.20 days. It should be noted that this is well below the preferred maximum "total travel time" of 5 days outlined in the City's water distribution system design guidelines.

4.5.6 ADEQUACY OF MUNICIPAL INFRASTRUCTURE

As previously stated, the site's water supply will come from the CRT Lands - Phase 1 subdivision water distribution system (designed by IBI). Design of subdivision's water distribution system included two (2) – 200mm diameter watermains (fed from Embankment Street's watermain) to service the subject site, where the allocation of water demand from the site was split between the two services. The associated design brief had assumed the following total post-development water demands for the site (under the respective scenarios) to size the municipal system:

— ADD: 0.56 l/s
— MDD: 1.38 l/s
— MHD: 3.04 l/s

* theoretical equivalent population of 136 persons.

It should be noted that the currently proposed water demands for the proposed development exceed the allotted allowance.

4.5.7 FIRE HYDRANTS

Fire hydrants were proposed in three (3) clusters based on proximity to principal entrances to jointly combat fires in specific townhome blocks. Within these clusters, fire flow demand has been splits based on maximum fire hydrant discharge capacity. The cluster include:

— - Block 1and 2
— - Block 3 and 4
— - Block 5, 6, and 7

In addition, private fire hydrants were also positioned accordance with Section 3.2.5 of the Ontario Building Code (OBC) to ensure that contributing hydrants were within the maximum spacing of 45.0m between the following:

- on-site hydrants to ideal pumping truck parking locations, and
- ideal pumping truck parking locations to further principal entrances.

Proposed fire hydrants shall be rated to supply minimum flow capacity of 5700 l/min (or 91.5 l/s) corresponding to Type AA (Per City of Ottawa design guidelines).

4.5.8 WATER METERING

Two (2) district water meters have been proposed in the design to allow for measurement of water usage within the property. Based on the size of the connecting service (200mm diameter), water meter in accordance with City of Ottawa standard detail W32 have been proposed. Meter assembly dimensions to be specified by the City.

Two (2) meters are required to accommodate the need for two (2) municipal service connections. As previously stated, a secondary municipal service connection was found to be required to supply the site with adequate fire flow to the site's hydrants.

4.5.9 RELIABILITY REQUIREMENTS

Two (2) shut off valves are provided for the private watermain at the site boundaries, which were previously installed during the greater subdivision development. One (1) valve is present at the end of each access corridor to Embankment Street (at property line).

Two (2) isolation valves have been proposed at each "tee" connection and curb stop valves are proposed each of the unit services. As a result of the proposed valve arrangement, all major branches can be isolated for operation and maintenance purposes.

4.5.10 NEED FOR PRESSURE ZONE BOUNDARY MODIFICATION

There is no need for a pressure zone boundary modification.

4.6 STORMWATER MANAGEMENT

Refer to the Stormwater Management Report (located in Appendix E) for details related to the drainage, storm sewers, stormwater management, erosion and sediment control, hydraulic grade line analysis, foundation drainage, etc.

4.7 HYDRO, COMMUNICATIONS, GAS, AND LIGHTING

Hydro, communications, gas, and lighting will be provided as part of the proposed development and will be designed by others in accordance with the applicable codes/standards. Details related to the servicing from these utilities will be completed later in the detailed design phase of the project.

5 MISCELLANOUS CITY VERIFICATIONS

5.1 ENVIRONMENTAL CONSTRAINTS, ENVIRONMENTALLY SIGNIFICANT AREAS, WATERCOURSES, AND MUNICIPAL DRAINS

There are no watercourses, municipal drains or environmentally significant areas on the site. The building program proposed for the site is not subject to any restrictions associated with the surrounding lands.

There are no previously identified environmental constraints that impact the sanitary servicing design in order to preserve the physical condition of watercourses, vegetation, or soil cover, or to manage water quantity or quality.

There is no known need for special considerations for sanitary sewer design related to existing site conditions.

5.2 IMPACTS TO PRIVATE SERVICES

There are no existing domestic private services (i.e. septic system and well) located on the site, nor are there neighbouring properties using these private services.

6 APPROVAL AND PERMIT REQUIREMENTS

The proposed development is subject to site plan approval and building permit approval. No approvals related to municipal drains are required. No permits or approvals are anticipated to be required from the Ontario Ministry of Transportation, National Capital Commission, Parks Canada, Public Works and Government Services Canada, or any other provincial or federal regulatory agency.

7 CONCLUSIONS CHECKLIST

7.1 CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the proposed development can meet all provided servicing constraints and associated requirements. It is recommended that this report be submitted to the City of Ottawa in support of the application for site plan approval.

7.2 COMMENTS RECEIVED FROM REVIEW AGENCIES

Comments received from the City of Ottawa are provided in Appendix F.

APPENDIX

A

CIVIL DRAWINGS

NOTES: **GENERAL**

1. DRAWINGS TO BE READ IN CONJUNCTION WITH ARCHITECTURAL AND LANDSCAPE DRAWINGS.
2. ALL SERVICES, MATERIALS, CONSTRUCTION METHODS AND INSTALLATIONS SHALL BE IN ACCORDANCE WITH THE LATEST STANDARDS AND REGULATIONS OF THE: CITY OF OTTAWA STANDARD SPECIFICATIONS AND DRAWINGS, ONTARIO PROVINCIAL SPECIFICATION STANDARD SPECIFICATION (OPSS) AND ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD), UNLESS OTHERWISE SPECIFIED, TO THE SATISFACTION OF THE CITY AND THE CONSULTANT.
3. THE POSITION OF EXISTING POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND ABOVEGROUND UTILITIES, STRUCTURES AND APPURTENANCES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWING, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL SATISFY THEMSELVES OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM DURING THE COURSE OF CONSTRUCTION. ANY RELOCATION OF EXISTING UTILITIES REQUIRED BY THE DEVELOPMENT OF SUBJECT LANDS IS TO BE UNDERTAKEN AT CONTRACTOR'S EXPENSE.
4. THE CONTRACTOR MUST NOTIFY ALL EXISTING UTILITY COMPANY OFFICIALS FIVE (5) BUSINESS DAYS PRIOR TO START OF CONSTRUCTION AND HAVE ALL EXISTING UTILITIES AND SERVICES LOCATED IN THE FIELD OR EXPOSED PRIOR TO THE START OF CONSTRUCTION, INCLUDING BUT NOT LIMITED TO POWER, COMMUNICATION AND GAS LINES.
5. ALL TRENCHING AND EXCAVATIONS TO BE IN ACCORDANCE WITH THE LATEST REVISIONS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS AND AS PER THE RECOMMENDATIONS INCLUDED IN THE FOLLOWING GEOTECHNICAL REPORT:
   i. REPORT PG5701-1 PREPARED PATERSON GROUP, DATED MARCH 10, 2021 AND TITLED "GEOTECHNICAL INVESTIGATION - PROPOSED RESIDENTIAL DEVELOPMENT - KANATA - BLOCK 344 - 620 BOBOLINK RIDGE, OTTAWA, ONTARIO".
6. REFER TO ARCHITECTS PLANS FOR BUILDING DIMENSIONS, LAYOUT AND REMOVALS. REFER TO LANDSCAPE PLAN FOR LANDSCAPED DETAILS AND OTHER RELEVANT INFORMATION. ALL INFORMATION SHALL BE CONFIRMED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
7. TOPOGRAPHIC SURVEY COMPLETED AND PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. DATED ON APRIL 16, 2021. CONTRACTOR TO VERIFY IN THE FIELD PRIOR TO CONSTRUCTION OF ANY WORK AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
8. ALL ELEVATIONS ARE GEODETIC AND UTILIZE METRIC UNITS. VERIFY THAT JOB BENCHMARKS HAVE NOT BEEN ALTERED OR DISTURBED.
9. ALL GROUND SURFACES SHALL BE EVENLY GRADED WITHOUT PONDING AREAS AND WITHOUT LOW POINTS EXCEPT WHERE APPROVED SWALE OR CATCH BASIN OUTLETS ARE PROVIDED.
10. ALL EDGES OF DISTURBED PAVEMENT SHALL BE SAW CUT TO FORM A NEAT AND STRAIGHT LINE PRIOR TO PLACING NEW PAVEMENT. PAVEMENT REINSTATEMENT SHALL BE WITH STEP JOINTS OF 500MM WIDTH MINIMUM PER DETAIL 2/C1.7.
11. ALL DISTURBED AREAS OUTSIDE PROPOSED GRADING LIMITS ARE TO BE RESTORED TO ORIGINAL ELEVATIONS AND CONDITIONS UNLESS OTHERWISE SPECIFIED. ALL RESTORATION SHALL BE COMPLETED WITH THE GEOTECHNICAL REQUIREMENTS FOR BACKFILL AND COMPACTION.
12. ABUTTING PROPERTY GRADES TO BE MATCHED UNLESS OTHERWISE SHOWN.
13. CONTRACTOR SHALL OBTAIN AND PAY FOR ALL NECESSARY PERMITS AND APPROVALS FROM THE MUNICIPAL AUTHORITIES PRIOR TO COMMENCING CONSTRUCTION, INCLUDING WATER PERMIT AND ROAD CUT PERMIT.
14. MINIMIZE DISTURBANCE TO EXISTING VEGETATION DURING THE EXECUTION OF ALL WORKS.
15. REMOVE FROM SITE ALL EXCESS EXCAVATED MATERIAL UNLESS OTHERWISE DIRECTED FROM THE ENGINEER. EXCAVATE AND REMOVE ALL ORGANIC MATERIAL AND DEBRIS LOCATED WITHIN THE PROPOSED BUILDING, PARKING AND ROADWAY LOCATIONS.
16. AT PROPOSED UTILITY CONNECTION POINTS AND CROSSINGS (I.E. STORM SEWER, SANITARY SEWER, WATER, ETC.) THE CONTRACTOR SHALL DETERMINE THE PRECISE LOCATION AND DEPTH OF EXISTING UTILITIES AND REPORT ANY DISCREPANCIES OR CONFLICTS TO THE ENGINEER BEFORE COMMENCING WORK.
17. CONTRACTOR TO OBTAIN POST-CONSTRUCTION TOPOGRAPHIC SURVEY, COMPLETED BY OLS OR P.ENG CONFIRMING COMPLIANCE WITH DESIGN GRADING AND SERVICING. SURVEY IS TO INCLUDE LOCATION AND INVERTS FOR BURIED UTILITIES.
18. ABIDE BY RECOMMENDATIONS OF GEOTECHNICAL REPORT. REPORT ANY VARIATIONS IN OBSERVED CONDITIONS FROM THOSE INCLUDED IN REPORT.
19. ADDITIONAL REPORT REFERENCES
   i. DESIGN BRIEF, PREPARED BY IBI GROUP, PROJ. NO. 27970-5.2.2, JULY 2017
20. PROVIDE CCTV INSPECTION REPORT FOR ALL SEWERS AND CATCHBASIN LEADS 200MM DIAMETER AND LARGER. REPEAT CCTV INSPECTION FOLLOWING RECTIFICATION OF ANY DEFICIENCIES.
21. SEWER SERVICE CONNECTIONS TO FLEXIBLE MAIN SEWER PIPES AND RIGID MAIN SEWERS PIPES SHALL BE PER RESPECTIVE CITY OF OTTAWA STANDARD S11, S11.1, AND S11.2.
22. COMMON TRENCHES FOR TOWNHOME SERVICING SHALL BE PER CITY OF OTTAWA STANDARD S11.3.
23. CONTRACTOR TO FIELD VERIFY AND REPORT TO ENGINEER OF RECORD THE ELEVATION, MATERIAL, AND DIAMETER OF EXISTING UTILITIES AT ALL PROPOSED CONNECTIONS PRIOR TO CONSTRUCTION.

24. WATERMAIN

1. ALL WATERMAIN AND WATERMAIN APPURTANANCES, MATERIALS, CONSTRUCTION AND TESTING METHODS SHALL CONFORM TO THE CURRENT CITY OF OTTAWA AND MINISTRY OF ENVIRONMENT, CONSERVATION, AND PARKS WATERWORKS GUIDELINES.
2. ALL WATERMAIN 300MM DIAMETER AND SMALLER TO BE POLY VINYL CHLORIDE (PVC) CLASS 150 DR 18 MEETING AWWA SPECIFICATION C900.
3. ALL WATERMAIN TO BE INSTALLED AT MINIMUM COVER OF 2.4M BELOW FINISHED GRADE. WHERE WATERMAINS CROSS OVER OTHER UTILITIES, A MINIMUM 0.30M CLEARANCE SHALL BE MAINTAINED; WHERE WATERMAINS CROSS UNDER OTHER UTILITIES, A MINIMUM 0.50M CLEARANCE SHALL BE MAINTAINED. WHERE THE MINIMUM SEPARATION CANNOT BE ACHIEVED, THE WATERMAIN SHALL BE INSTALLED AS PER CITY OF OTTAWA STANDARDS W25 AND W25.2. WHERE 2.4M MINIMUM DEPTH CANNOT BE ACHIEVED, THERMAL INSULATION SHALL BE PROVIDED AS PER CITY OF OTTAWA STANDARD W22. WHERE A WATERMAIN IS IN CLOSE PROXIMITY TO AN OPEN STRUCTURE, THERMAL INSULATION SHALL BE PROVIDED AS PER CITY OF OTTAWA STANDARD W23.
4. CONCRETE THRUST BLOCKS AND MECHANICAL RESTRAINTS ARE TO BE INSTALLED AT ALL TEES, BENDS, HYDRANTS, REDUCERS, ENDS OF MAINS AND CONNECTIONS 100MM AND LARGER, IN ACCORDANCE WITH CITY OF OTTAWA STANDARDS W25.3 & W25.4.
5. CATHODIC PROTECTION REQUIRED FOR ALL IRON FITTINGS AS PER CITY OF OTTAWA STANDARD W40 & W42.
6. DOMESTIC WATER SERVICES SHALL BE IN ACCORDANCE WITH CITY STANDARD DETAIL W26.
7. ALL VALVES AND VALVE BOXES AND CHAMBERS, HYDRANTS, AND HYDRANT VALVES AND ASSEMBLES SHALL BE INSTALLED AS PER CITY OF OTTAWA STANDARD.
8. FIRE HYDRANT LOCATION AND INSTALLATION AS PER CITY OF OTTAWA STANDARD W18 & W19. CONTRACTOR TO PROVIDE FLOW TEST AND PAINTING OF NEW HYDRANT IN ACCORDANCE WITH CITY STANDARDS.
9. IF WATERMAIN MUST BE DEFLECTED TO MEET ALIGNMENT, ENSURE THAT THE AMOUNT OF DEFLECTION USED IS LESS THAN HALF THAT RECOMMENDED BY THE MANUFACTURER.
10. REFER TO LANDSCAPE DRAWINGS FOR IRRIGATION SYSTEM REQUIREMENTS (IF APPLICABLE).
11. WATERMAIN DEAD ENDS SHALL BE IN ACCORDANCE WITH CITY STANDARD DETAIL W37.2

NOTES: **SANITARY SEWER AND MANHOLES**

10. ALL SANITARY SEWER, SANITARY SEWER APPURTENANCES AND CONSTRUCTION METHODS SHALL CONFORM TO THE CURRENT CITY OF OTTAWA STANDARDS AND SPECIFICATIONS. PROVIDE CCTV INSPECTION REPORTS FOR ALL NEW SANITARY PIPING. PROVIDE DYE TESTING FOR NEW SERVICES.
11. SANITARY SEWER PIPE SIZE 150MM DIAMETER AND GREATER TO BE PVC SDR-35 (UNLESS SPECIFIED OTHERWISE) WITH RUBBER GASKET TYPE JOINTS IN CONFORMANCE WITH CSA B-182.2,3,4.
12. SEWER BEDDING AS PER CITY OF OTTAWA DETAIL S6.
13. ALL SANITARY MANHOLES 1200MM IN DIAMETER TO BE AS PER OPSD 701.01. FRAME AND COVER TO BE AS PER CITY OF OTTAWA STANDARD S25 AND S24.
14. MAINTENANCE HOLE BENCHING AND PIPE OPENING ALTERNATIVES AS PER THE OPSD 701.021
15. ANY NEW OR EXISTING SANITARY SEWER (INCLUDING SERVICE LATERALS) WITH LESS THAN 2.0M COVER REQUIRES THERMAL INSULATION AS PER DETAIL 3/C1.7 OR APPROVED BY THE ENGINEER.
16. SANITARY MANHOLE WHICH RESIDE WITHIN 100-YEAR STORMWATER PONDING AREAS SHALL BE EQUIPPED WITH WATER-TIGHT LIDS IN ACCORDANCE WITH CITY STANDARD.

NOTES: **STORM SEWERS AND STRUCTURES**

1. ALL STORM SEWER MATERIALS AND CONSTRUCTION METHODS SHALL CONFORM TO THE CURRENT CITY OF OTTAWA STANDARDS AND SPECIFICATIONS. PROVIDE CCTV INSPECTION REPORTS FOR ALL NEW STORM SEWERS, SERVICES AND CB LEADS.
2. STORM SEWERS 450MM DIAMETER AND SMALLER SHALL BE PVC SDR-35, WITH RUBBER GASKET PER CSA A-257.3.
3. STORM SEWER LARGER THAN 450MM SHALL BE REINFORCED CONCRETE CLASS 100.
4. SEWER BEDDING AS PER CITY OF OTTAWA DETAIL S6.
16. ALL STORM MANHOLES TO BE AS PER STORM STRUCTURE TABLE ON DRAWING C1.4 AND C1.5. ALL SANITARY MANHOLES SHALL BE PER ONTARIO PROVINCIAL STANDARDS. FRAME AND COVER TO BE AS PER CITY OF OTTAWA STANDARD S24 AND S25, UNLESS OTHERWISE SPECIFIED.
5. ANY NEW OR EXISTING STORM SEWER (INCLULDE SERVICE LATERALS) WITH LESS THAN 2.0M COVER REQUIRES THERMAL INSULATION AS PER DETAIL 3/C1.7 OR APPROVED BY THE ENGINEER.
6. CB IN LANDSCAPE AREAS SHALL BE AS PER CITY OF OTTAWA STANDARD S29, S30 AND S31, UNLESS OTHERWISE SPECIFIED.
7. ALL CATCHBASIN LEADS TO BE MINIMUM 200MM DIAMETER AT MINIMUM 1.0% SLOPE UNLESS OTHERWISE SPECIFIED.
8. STORM CATCHBASINS AS PER OPSD 705.010 AND FRAME/COVER AS PER CITY STANDARD DRAWINGS S19.
9. INSTALLATION OF FLOW CONTROL ICD'S TO BE VERIFIED BY QUALITY VERIFICATION ENGINEER RETAINED BY CONTRACTOR.

NOTES: **PARKING LOT AND WORK IN PUBLIC RIGHTS OF WAY**

1. CONTRACTOR TO REINSTATE ROAD CUTS AS PER CITY OF OTTAWA DETAIL R10.
2. CONTRACTOR TO PREPARE SUBGRADE, INCLUDING PROOFROLLING, TO THE SATISFACTION OF THE GEOTECHNICAL CONSULTANT PRIOR TO THE COMMENCEMENT OF PLACEMENT OF SUB-BASE MATERIAL.
3. FILL TO BE PLACED AND COMPACTED PER THE GEOTECHNICAL REPORT REQUIREMENTS.
4. CONTRACTOR TO SUPPLY, PLACE AND COMPACT SUB-BASE MATERIAL IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE GEOTECHNICAL CONSULTANT. CONTRACTOR TO PROVIDE CONSULTANT WITH SAMPLES OF SUB-BASE MATERIAL FOR TESTING AND CERTIFICATION FROM THE GEOTECHNICAL CONSULTANT THAT THE MATERIAL MEETS THE GRADATION REQUIREMENTS SPECIFIED IN THE GEOTECHNICAL REPORT.
5. BASE MATERIAL TO BE PLACED ONLY UPON APPROVAL BY THE GEOTECHNICAL CONSULTANT OF SUB-BASE PLACEMENT.
6. CONTRACTOR TO SUPPLY, PLACE AND COMPACT BASE MATERIAL IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE GEOTECHNICAL CONSULTANT. CONTRACTOR TO PROVIDE CONSULTANT WITH SAMPLES OF BASE MATERIAL FOR TESTING AND CERTIFICATION FROM THE GEOTECHNICAL CONSULTANT THAT THE MATERIAL MEETS THE GRADATION REQUIREMENTS SPECIFIED IN THE GEOTECHNICAL REPORT.
7. ASPHALT MATERIAL TO BE PLACED ONLY UPON APPROVAL BY THE GEOTECHNICAL CONSULTANT OF BASE PLACEMENT.
8. CONTRACTOR TO SUPPLY, PLACE AND COMPACT ASPHALT MATERIAL IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE GEOTECHNICAL CONSULTANT. CONTRACTOR TO PROVIDE CONSULTANT WITH SAMPLES OF ASPHALT MATERIAL FOR TESTING AND CERTIFICATION FROM THE GEOTECHNICAL CONSULTANT THAT THE MATERIAL MEETS THE REQUIREMENTS SPECIFIED IN THE GEOTECHNICAL REPORT.
9. CONTRACTOR IS RESPONSIBLE FOR ESTABLISHING LINE AND GRADE IN ACCORDANCE WITH THE PLANS, AND FOR PROVIDING THE CONSULTANT WITH VERIFICATION PRIOR TO PLACEMENT.
10. ALL EXCESS MATERIAL TO BE HAULED OFF-SITE AND DISPOSED OF AT AN APPROVED DUMP SITE. SHOULD THE CONTRACTOR DISCOVER ANY HAZARDOUS MATERIAL, CONTRACTOR IS TO NOTIFY CONSULTANT. CONSULTANT TO DETERMINE APPROPRIATE DISPOSAL METHOD/LOCATION.
11. PAVEMENT STRUCTURE (MATERIAL TYPES AND THICKNESS) FOR HEAVY DUTY AND LIGHT DUTY AREAS TO BE AS SPECIFIED IN THE GEOTECHNICAL REPORT AND SHOWN ON THE PLANS.

NOTES: **EROSION AND SEDIMENT CONTROL**

** CONTRACTOR IS RESPONSIBLE FOR ALL INSTALLATION, MONITORING, REPAIR AND REMOVAL OF ALL EROSION AND SEDIMENT CONTROL FEATURES. **

1. PRIOR TO START OF CONSTRUCTION:
   1.1. INSTALL SILT FENCE IN LOCATION SHOWN ON DWG C1.8.
   1.2. INSTALL FILTER FABRIC OR SILT SACK FILTERS IN ALL THE CATCHBASINS AND MANHOLES TO REMAIN DURING CONSTRUCTION WITHIN THE SITE (SEE DETAIL 8/C1.7).
   1.3. INSPECT MEASURES IMMEDIATELY AFTER INSTALLATION.
2. DURING CONSTRUCTION:
   2.1. MINIMIZE THE EXTENT OF DISTURBED AREAS AND THE DURATION OF EXPOSURE AND IMPACTS TO EXISTING GRADING.
   2.2. PERIMETER VEGETATION TO REMAIN IN PLACE UNTIL PERMANENT STORM WATER MANAGEMENT IS IN PLACE. OTHERWISE, IMMEDIATELY INSTALL SILT FENCE WHEN THE EXISTING SITE IS DISTURBED AT THE PERIMETER.
   2.3. PROTECT DISTURBED AREAS FROM OVERLAND FLOW BY PROVIDING TEMPORARY SWALES TO THE SATISFACTION OF THE FIELD ENGINEER. TIE-IN TEMPORARY SWALE TO EXISTING CATCH BASINS AS REQUIRED.
   2.4. PROVIDE TEMPORARY COVER SUCH AS SEEDING OR MULCHING IF DISTURBED AREA WILL NOT BE REHABILITATED WITHIN 30 DAYS.
   2.5. INSPECT SILT FENCES, FILTER FABRIC FILTERS AND CATCH BASIN SUMPS WEEKLY AND WITHIN 24 HOURS AFTER A STORM EVENT. CLEAN AND REPAIR WHEN NECESSARY.
   2.6. SEDIMENT AND EROSION CONTROL PLAN DRAWING TO BE REVIEWED AND REVISED AS REQUIRED DURING CONSTRUCTION.
   2.7. EROSION CONTROL FENCING TO BE INSTALLED AROUND THE BASE OF ALL STOCKPILES.
   2.8. DO NOT LOCATE TOPSOIL PILES AND EXCAVATION MATERIAL CLOSER THAN 2.5M FROM ANY PAVED SURFACE, OR ONE WHICH IS TO BE PAVED BEFORE THE PILE IS REMOVED. ALL TOPSOIL PILES ARE TO BE SEEDED IF THEY ARE TO REMAIN ON-SITE LONG ENOUGH FOR SEEDS TO GROW (LONGER THAN 30 DAYS).
   2.9. CONTROL WIND-BLOWN DUST OFF-SITE BY SEEDING TOPSOIL PILES AND OTHER AREAS TEMPORARILY (PROVIDE WATERING AS REQUIRED AND TO THE SATISFACTION OF THE ENGINEER).
   2.10. NO ALTERNATE METHODS OF EROSION PROTECTION SHALL BE PERMITTED UNLESS APPROVED BY THE FIELD ENGINEER.
   2.11. CITY ROADWAY AND SIDEWALK TO BE CLEANED OF ALL SEDIMENT FROM VEHICULAR TRACKING AS REQUIRED.
   2.12. DURING WET CONDITIONS, TIRES OF ALL VEHICLES/EQUIPMENT LEAVING THE SITE ARE TO BE SCRAPED.
   2.13. ANY MUD/MATERIAL TRACKED ONTO THE ROAD SHALL BE REMOVED IMMEDIATELY BY HAND OR RUBBER TIRE LOADER.
   2.14. TAKE ALL NECESSARY STEPS TO PREVENT BUILDING MATERIAL, CONSTRUCTION DEBRIS OR WASTE BEING SPILLED OR TRACKED ONTO ABUTTING PROPERTIES OR PUBLIC STREETS DURING CONSTRUCTION AND PROCEED IMMEDIATELY TO CLEAN UP ANY AREAS SO AFFECTED.
   2.15. ALL EROSION CONTROL STRUCTURE TO REMAIN IN PLACE UNTIL ALL DISTURBED GROUND SURFACES HAVE BEEN STABILIZED EITHER BY PAVING OR RESTORATION OF VEGETATIVE GROUND COVER.
   2.16. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.

INLET CONTROL DEVICE (ICD) SCHEDULE

HOST STRUCTURE	ICD POSITION (DIRECTION & INLET/ OUTLET)	INVERT ELEV. (m)	ORIFICE DIA. (mm)
CB03	NORTH (OUTLET)	105.91	75
CB04	WEST (OUTLET)	105.80	60
CB06	EAST (OUTLET)	105.95	25
CB07	EAST (OUTLET)	105.95	25
CB08	WEST (OUTLET)	105.69	75
CB10	WEST (OUTLET)	105.80	60
CB11	WEST (OUTLET)	105.83	80
CB12	WEST (OUTLET)	105.81	60
CBMH13	WEST (OUTLET)	105.80	75
CB14	SOUTH (OUTLET)	105.75	32
CB15	NORTH (OUTLET)	105.75	32
CB16	WEST (OUTLET)	105.66	50
MH409	WEST (OUTLET)	104.81	170
RYCB02	SOUTH (OUTLET)	106.18	75
RYCB04	SOUTH (OUTLET)	105.85	60
RYCB09	WEST (OUTLET)	105.69	60
RYCB18	SOUTHWEST (OUTLET)	105.39	120

NOTES:

1. ABLE SHALL BE READ IN CONJUNCTION WITH SITE STORMWATER MANAGEMENT REPORT (DATED JULY 7, 2021, PREPARED BY WSP CANADA INC.).
2. WHERE ICD DIAMETERS ARE LESS THAN 75mm (REQUIRED MINIMUM PER MECP), MANUFACTURED LOW-FLOW ICDS WILL BE REQUIRED WITH SIMILAR DISCHARGE PERFORMANCE NOTED ACTIVE HEAD. PROPOSED DEVICES SHALL BE SUBJECT TO ENGINEER'S REVIEW AND APPROVAL.\
3. UNLESS OTHERWISE SPECIFIED, ALL INLET CONTROL DEVICES (ICD'S) SHALL BE ORIFICE PLATES COMPOSED OF STAINLESS STEEL, BOLTED TO THE INSIDE OF THE REFERENCED STRUCTURES. ANY GAP BETWEEN PLATE PERIMETER AND STRUCTURE WALL SHALL BE SEALED USING A MASTIC SEALANT.

ALIGNMENT DATA

START STATION	END STATION	DESCRIPTION
1+000	1+278.75	STREET A
2+000	2+052.73	NORTH ENTRANCE
3+000	3+052.60	SOUTH ENTRANCE
4+000	4+040.18	NORTH PARKING LOT
5+000	5+040.18	SOUTH PARKING LOT

TEMPORARY BENCH MARKS

TBM #	NORTHING (m)	EASTING (m)	ELEVATION (m)	DESCRIPTION
1	5014544.60	352417.98	109.680	FIRE HYDRANT TOP OF SPINDLE
2	5014377.94	352507.78	109.170	FIRE HYDRANT TOP OF SPINDLE

EXISTING LEGEND:

EDGE OF PAVEMENT
CURB
BOTTOM OF SLOPE
TOP OF SLOPE
99.00 MAJOR CONTOURS
MINOR CONTOURS
OW OVERHEAD WIRE
GUY ANCHOR
W WATERMAIN
ST STORM SEWER
SA SANITARY SEWER
GAS GAS
UG UNDERGROUND
C CABLE
S SWALE
FENCE
PROPERTY BOUNDARY
TBM# SITE TEMPORARY BENCH MARK
TP # TEST PIT LOCATION
UP UTILITY POLE
LS STREET LIGHT
ROAD SIGN
TRANSFORMER
CULVERT
ASPHALT
SIDEWALK
BUILDING

REMOVAL LEGEND:

W WATER SERVICE REMOVAL
CURB REMOVAL
TYPICAL REMOVAL
TYPICAL RELOCATION
PARTIAL DEPTH ASPHALT REMOVAL

ESC LEGEND:

LIGHT DUTY SILT FENCE (OPSD 219.110)
FILTER CLOTH PROTECTION
MUD MAT

PROPOSED LEGEND:

ALIGNMENT
EDGE OF PAVEMENT
CONCRETE BARRIER CURB
W WATERMAIN
WATER SERVICE
ST STORM SEWER
STORM SUBDRAIN
SA SANITARY SEWER
SANITARY SERVICE
JUT JOINT UTILITY TRENCH
GRADING TOP OF SLOPE
GRADING BOTTOM OF SLOPE
S SWALE
SS SWALE c/w SUBDRAIN
100mm LINE PAINTING
STORM MANHOLE
REAR YARD CATCH BASIN/ CLEAN OUT
CATCH BASIN MANHOLE
CATCH BASIN
SANITARY MANHOLE
FIRE HYDRANT
WATERMAIN VALVE
TWSI
BUILDING ENTRANCE
SIGN
105.00 GRADE ELEVATION
105.00 IBI DESIGN GRADE
105.00 (T/B) TOP OF BERM GRADE ELEVATION
FULL DEPTH ASPHALT
PARTIAL DEPTH ASPHALT
CONCRETE SIDEWALK
ASPHALT SIDEWALK
BUILDING
RIVER STONE

FFE = FINISHED FLOOR ELEVATION
T/FD = TOP OF FOUNDATION
USF = UNDER SIDE OF FOOTING
MUSF = MIN. UNDER SIDE OF FOOTING

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1224 GARDINERS ROAD, SUITE 201
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PHONE: 613-634-7373
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CONSULTANT:
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2021.07.07
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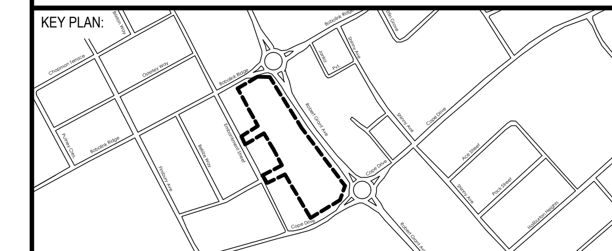
LICENSED PROFESSIONAL ENGINEER
S. P. DAVIDSON
100133944
2021.07.07
PROVINCE OF ONTARIO

CLIENT:
RICHCRAFT
Group Of Companies

CLIENT REF. #:

PROJECT:
TERRACE FLATS

KEY PLAN:



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1		2021-07-07	ISSUED FOR SPA

PROJECT NO: 211-01221-00
DATE: MARCH 2021
ORIGINAL SCALE: N/A
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TITLE: GENERAL NOTES & LEGEND

SHEET NUMBER: C0.1
SHEET #: 1 OF 10

ISSUE: ISSUED FOR SPA
DATE OF: 2021-07-07
REV #: 0

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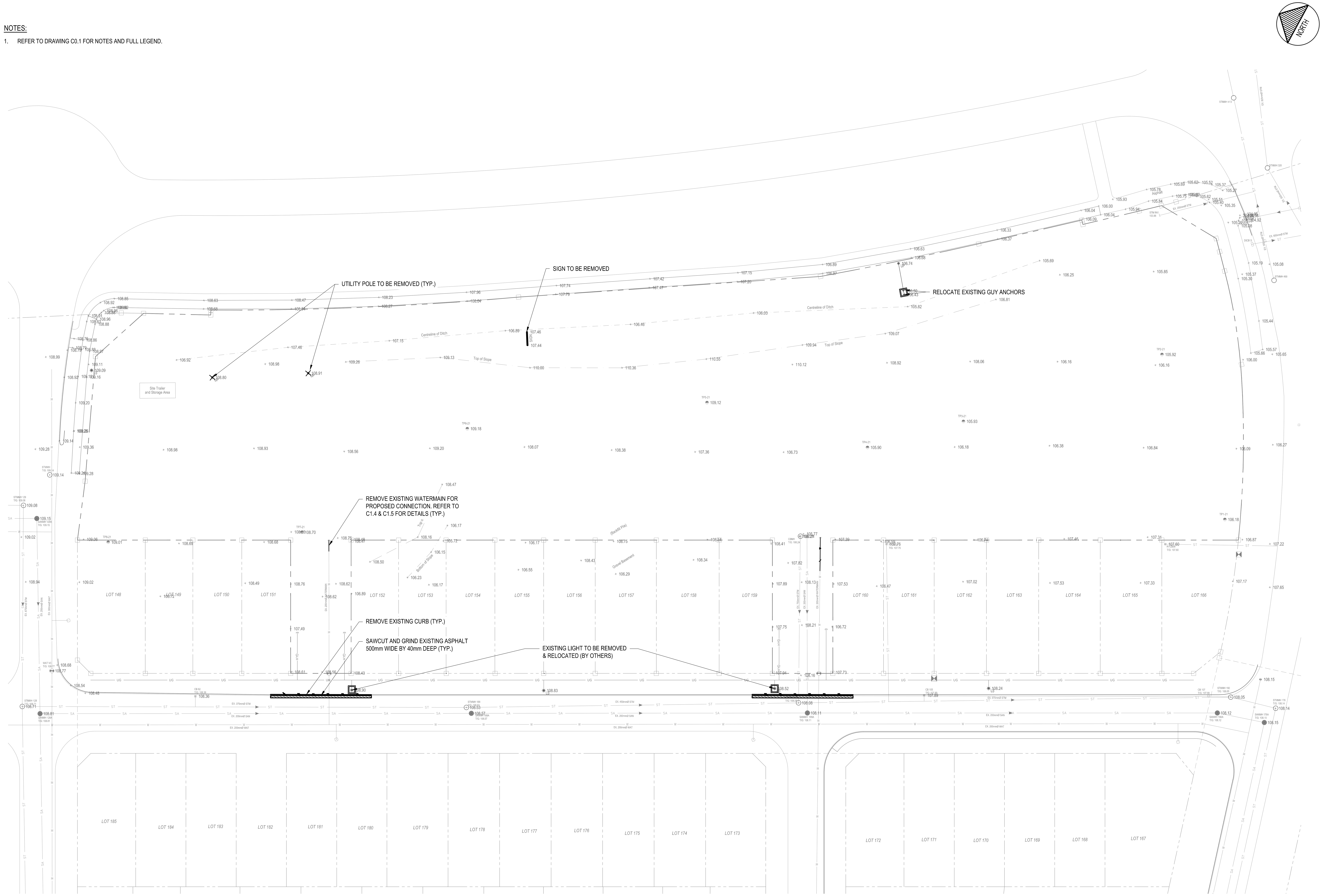
NOTES:

1. REFER TO DRAWING C0.1 FOR NOTES AND FULL LEGEND.



REMOVAL LEGEND:

- WATER SERVICE REMOVAL
- CURB REMOVAL
- TYPICAL REMOVAL
- TYPICAL RELOCATION
- PARTIAL DEPTH ASPHALT REMOVAL

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REMOVAL PLAN

SHEET NUMBER: R1.0
SHEET #: 3 OF 10

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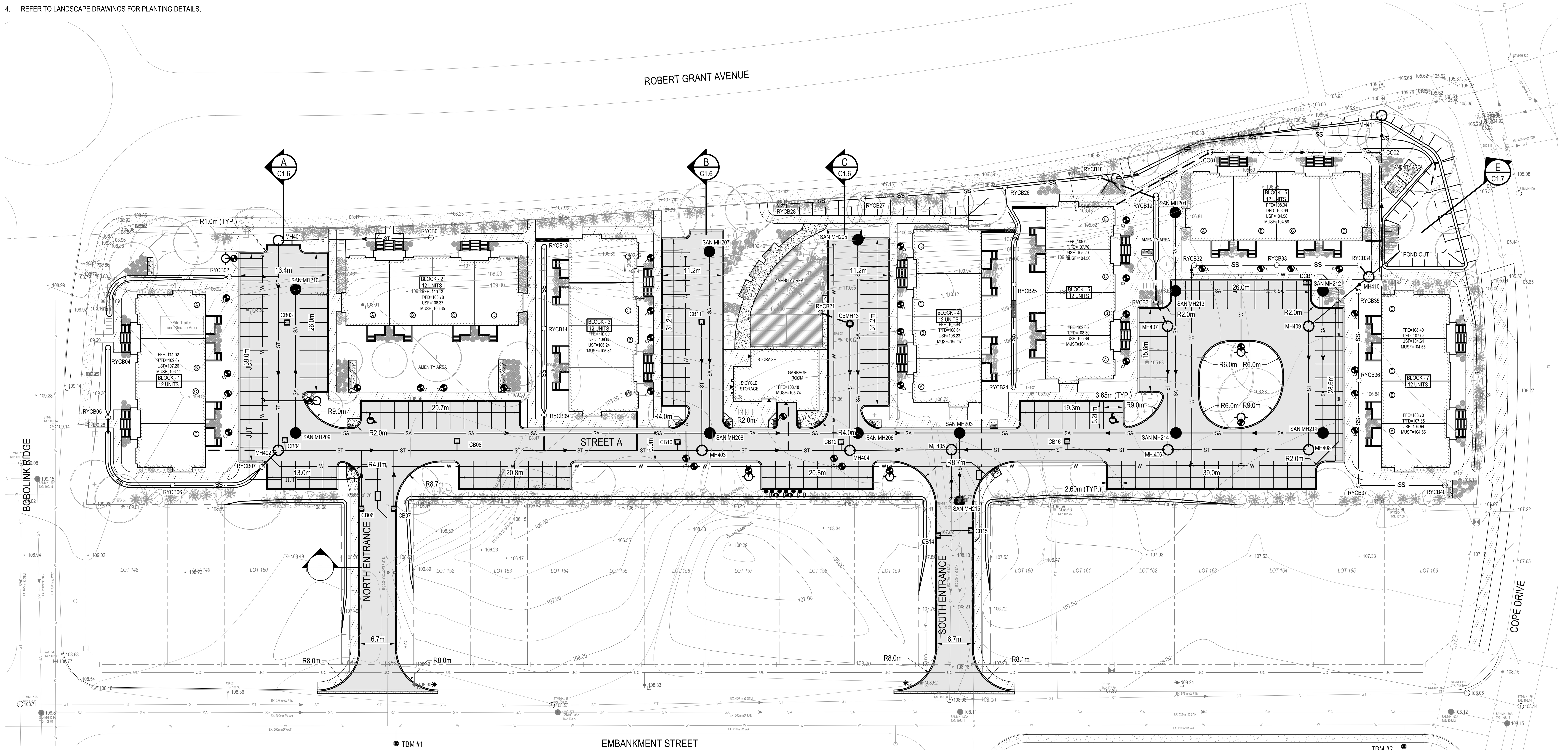
NOTES:

1. REFER TO DRAWING C0.1 FOR NOTES AND FULL LEGEND.
2. ALL CURB RADII SHALL BE 1.0m UNLESS OTHERWISE NOTED.
3. WATER AND SANITARY SERVICES ARE NOT SHOWN FOR CLARITY.
4. REFER TO LANDSCAPE DRAWINGS FOR PLANTING DETAILS.



PROPOSED LEGEND:

ALIGNMENT	CATCH BASIN
EDGE OF PAVEMENT	SANITARY MANHOLE
CONCRETE BARRIER CURB	FIRE HYDRANT
WATERMAIN	WATERMAIN VALVE
WATER SERVICE	TWSII
STORM SEWER	BUILDING ENTRANCE
STORM SUBDRAIN	SIGN
SANITARY SEWER	GRADE ELEVATION
SANITARY SERVICE	IBI DESIGN GRADE
JOINT UTILITY TRENCH	TOP OF BERM GRADE ELEVATION
GRADING TOP OF SLOPE	FULL DEPTH ASPHALT
GRADING BOTTOM OF SLOPE	PARTIAL DEPTH ASPHALT
SWALE	CONCRETE SIDEWALK
SWALE c/w SUBDRAIN	ASPHALT SIDEWALK
100mm LINE PAINTING	BUILDING
STORM MANHOLE	RIVER STONE
REAR YARD CATCH BASIN/ CLEAN OUT	
CATCH BASIN MANHOLE	

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PROJECT:

TERRACE FLATS

KEY PLAN:

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TITLE:

TERRACE FLATS
GENERAL ARRANGEMENT PLAN

SHEET NUMBER: C1.1

SHEET #: 2 OF 10

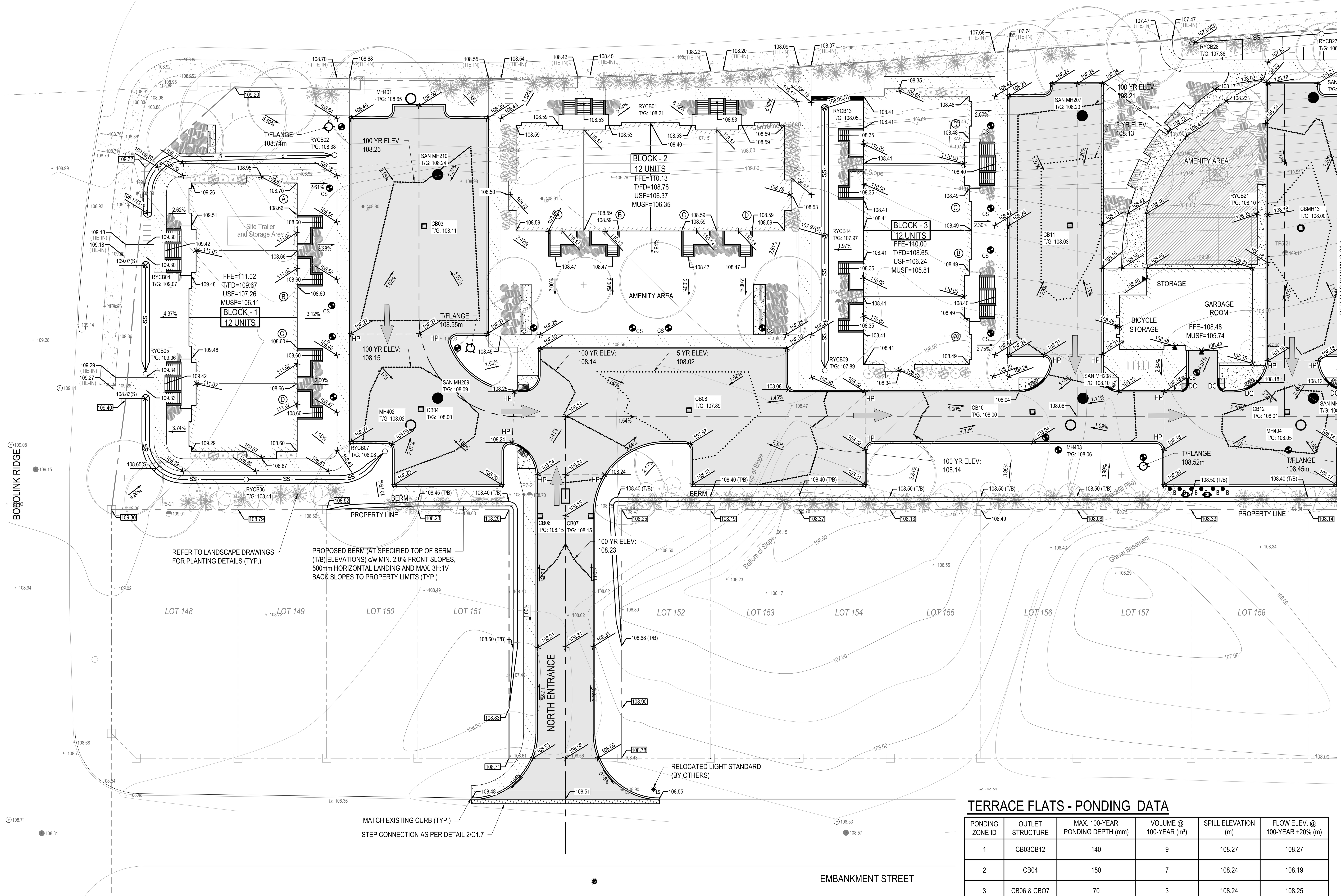
ISSUE: ISSUED FOR SPA
DATE OF: 2021-07-07
REV #: 0

NOTES:

1. REFER TO DRAWING C0.1 FOR NOTES AND FULL LEGEND.
2. REFER TO DRAWING C0.1 FOR INLET CONTROL DEVICE (ICD) SCHEDULE.

PROPOSED LEGEND:

- ALIGNMENT
- EDGE OF PAVEMENT
- CONCRETE BARRIER CURB
- WATERMAIN
- WATER SERVICE
- STORM SEWER
- STORM SUBDRAIN
- SANITARY SEWER
- SANITARY SERVICE
- JOINT UTILITY TRENCH
- GRADING TOP OF SLOPE
- GRADING BOTTOM OF SLOPE
- SWALE
- SWALE c/w SUBDRAIN
- 100mm LINE PAINTING
- STORM MANHOLE
- REAR YARD CATCH BASIN/ CLEAN OUT
- CATCH BASIN MANHOLE
- CATCH BASIN
- SANITARY MANHOLE
- FIRE HYDRANT
- WATERMAIN VALVE
- TWSI
- BUILDING ENTRANCE
- SIGN
- 105.00 GRADE ELEVATION
- 105.00 IBI DESIGN GRADE
- 105.00 (T/B) TOP OF BERM GRADE ELEVATION
- FULL DEPTH ASPHALT
- PARTIAL DEPTH ASPHALT
- CONCRETE SIDEWALK
- ASPHALT SIDEWALK
- BUILDING
- RIVER STONE
- MAJOR FLOW ROUTING



TERRACE FLATS - PONDING DATA

PONDING ZONE ID	OUTLET STRUCTURE	MAX. 100-YEAR PONDING DEPTH (mm)	VOLUME @ 100-YEAR (m^3)	SPILL ELEVATION (m)	FLOW ELEV. @ 100-YEAR +20% (m)
1	CB03CB12	140	9	108.27	108.27
2	CB04	150	7	108.24	108.19
3	CB06 & CBO7	70	3	108.24	108.25
4	CB08	250	27	108.21	108.18
5	CB10	140	5	108.18	108.19
6	CB11	180	20	108.21	108.22

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CLIENT:

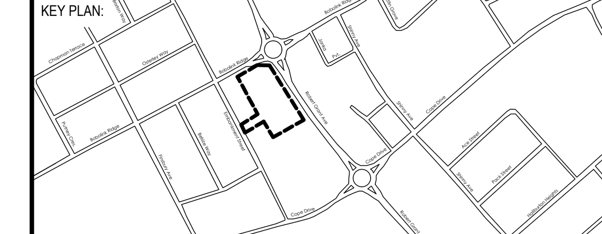
RICHCRAFT Group Of Companies

CLIENT REF. #:

PROJECT:

TERRACE FLATS

KEY PLAN:



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PRELIMINARY
NOT FOR CONSTRUCTION

ISSUED FOR - REVISION:

IS	RE	DATE	DESCRIPTION
1		2021-07-07	ISSUED FOR SPA

PROJECT NO: 211-01221-00
DATE: MARCH 2021
ORIGINAL SCALE: 1:250
IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE.
25mm
DESIGNED BY: DS
DRAWN BY: MH
CHECKED BY: SD
DISCIPLINE: CIVIL

TITLE:

TERRACE FLATS
NORTH GRADING PLAN

SHEET NUMBER: C1.2
SHEET #: 4 OF 10

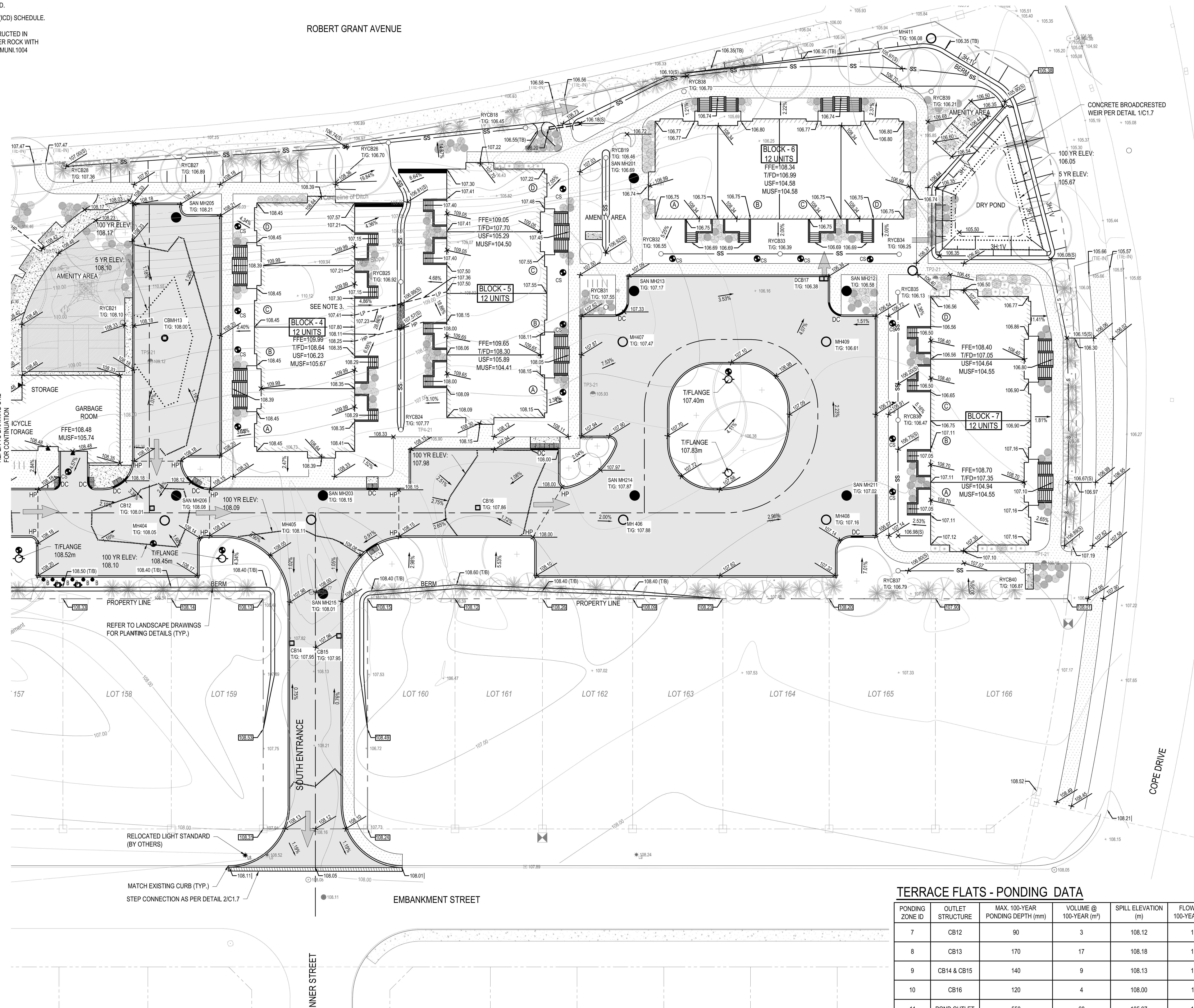
ISSUE: ISSUED FOR SPA
DATE OF: 2021-07-07
REV #: 0

NOTES:

1. REFER TO DRAWING C0.1 FOR NOTES AND FULL LEGEND.
2. REFER TO DRAWING C0.1 FOR INLET CONTROL DEVICE (ICD) SCHEDULE.
3. RIP-RAP PAD SHALL BE 1.0m x 3.0m x 0.3x DEEP, CONSTRUCTED IN ACCORDANCE WITH OPSD 810.010 (TYPE 'B') USING RIVER ROCK WITH GRADATION MATCHING 53mm CLEAR STONE PER OPSS.MUNI.1004

PROPOSED LEGEND:

- ALIGNMENT
- EDGE OF PAVEMENT
- CONCRETE BARRIER CURB
- W — WATERMAIN
- WATER SERVICE
- ST — STORM SEWER
- STORM SUBDRAIN
- SA — SANITARY SEWER
- SANITARY SERVICE
- JUT — JOINT UTILITY TRENCH
- GRADING TOP OF SLOPE
- GRADING BOTTOM OF SLOPE
- S — SWALE
- SS — SWALE c/w SUBDRAIN
- 100mm LINE PAINTING
- STORM MANHOLE
- REAR YARD CATCH BASIN/ CLEAN OUT
- CATCH BASIN MANHOLE
- CATCH BASIN
- SANITARY MANHOLE
- FIRE HYDRANT
- WATERMAIN VALVE
- TWSI
- BUILDING ENTRANCE
- SIGN
- 105.00 — GRADE ELEVATION
- 105.00 — IBI DESIGN GRADE
- 105.00 (T/B) — TOP OF BERM GRADE ELEVATIC
- FULL DEPTH ASPHALT
- PARTIAL DEPTH ASPHALT
- CONCRETE SIDEWALK
- ASPHALT SIDEWALK
- BUILDING
- RIVER STONE
- MAJOR FLOW ROUTING



TERRACE FLATS - PONDING DATA

PONDING ZONE ID	OUTLET STRUCTURE	MAX. 100-YEAR PONDING DEPTH (mm)	VOLUME @ 100-YEAR (m^3)	SPILL ELEVATION (m)	FLOW ELEV. @ 100-YEAR +20% (m)
7	CB12	90	3	108.12	108.13
8	CB13	170	17	108.18	108.19
9	CB14 & CB15	140	9	108.13	108.13
10	CB16	120	4	108.00	108.01
11	POND OUTLET	550	68	105.97	106.16

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LICENSED PROFESSIONAL ENGINEER S. P. DAVIDSON 100133944 2021.07.07 PROVINCE OF ONTARIO

CLIENT:
RICHCRAFT Group Of Companies

CLIENT REF. #:

PROJECT:
TERRACE FLATS

KEY PLAN:

PRELIMINARY
NOT FOR CONSTRUCTION

ISSUED FOR - REVISION:

IS	RE	DATE	DESCRIPTION
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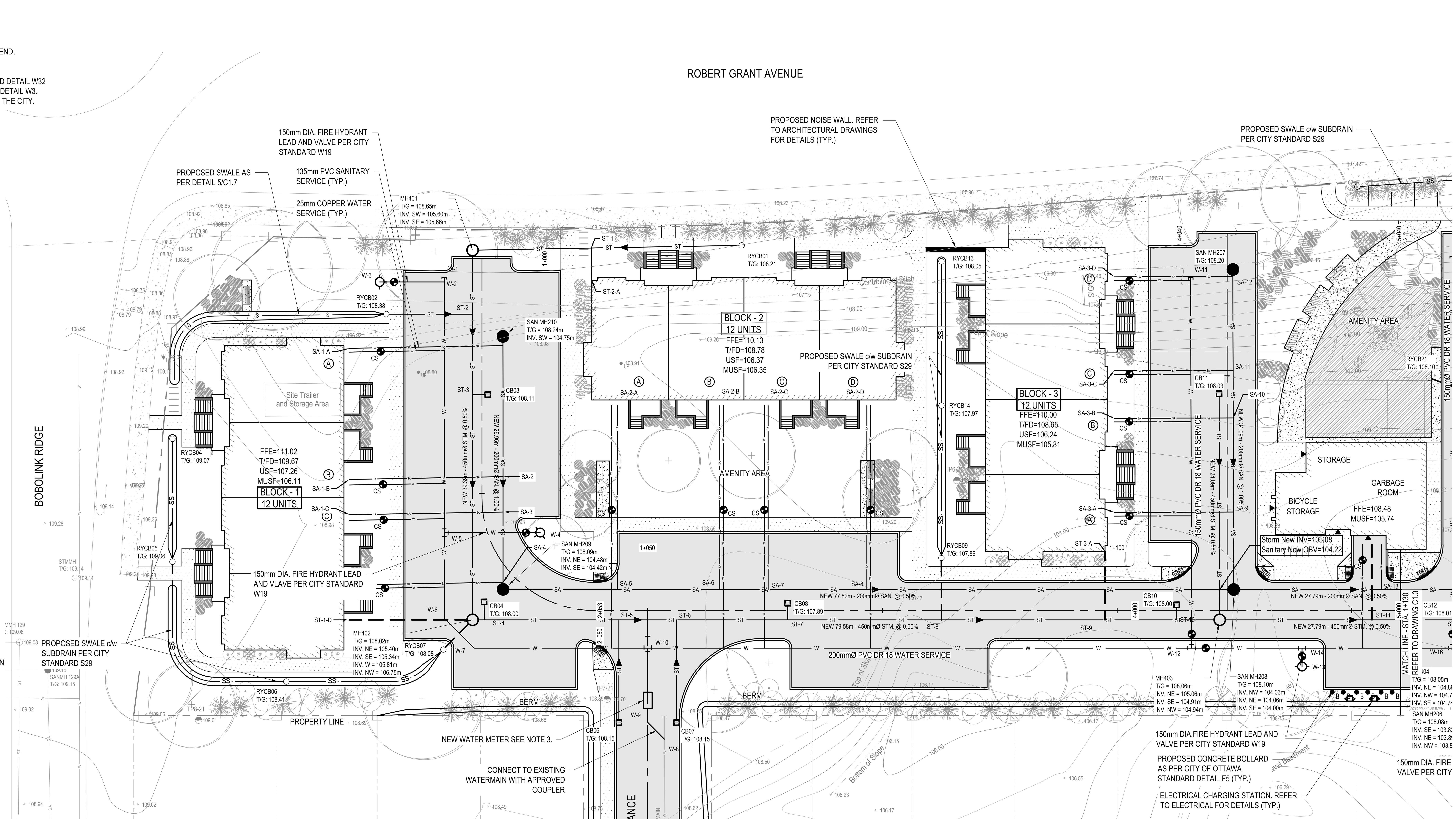
PROJECT NO: 211-01221-00
DATE: MARCH 2021
ORIGINAL SCALE: 1:250
IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE. 25mm
DESIGNED BY: DS
DRAWN BY: MH
CHECKED BY: SD
DISCIPLINE: CIVIL
TITLE: TERRACE FLATS SOUTH GRADING PLAN
SHEET NUMBER: C1.3
SHEET #: 5 OF 10
ISSUE: ISSUED FOR SPA
REV #: 0
DATE OF: 2021-07-07

NOTES:

1. REFER TO DRAWING C0.1 FOR NOTES AND FULL LEGEND.
2. ALL WATER SERVICES SHALL BE 50mmØ COPPER.
3. NEW WATER METER PER CITY OF OTTAWA STANDARD DETAIL W32 HOUSED IN A VALVE CHAMBER PER CITY STANDARD DETAIL W3. METER ASSEMBLY DIMENSIONS TO BE SPECIFIED BY THE CITY.

PROPOSED LEGEND:

- ALIGNMENT
- EDGE OF PAVEMENT
- CONCRETE BARRIER CURB
- WATERMAIN (W)
- WATER SERVICE
- STORM SEWER (ST)
- STORM SUBDRAIN
- SANITARY SEWER (SA)
- SANITARY SERVICE
- JOINT UTILITY TRENCH (JUT)
- GRADING TOP OF SLOPE
- GRADING BOTTOM OF SLOPE
- SWALE (S)
- SWALE c/w SUBDRAIN (SS)
- 100mm LINE PAINTING
- STORM MANHOLE
- REAR YARD CATCH BASIN/ CLEAN OUT
- CATCH BASIN MANHOLE
- CATCH BASIN
- SANITARY MANHOLE
- FIRE HYDRANT
- WATERMAIN VALVE
- TWSI
- BUILDING ENTRANCE
- SIGN
- 105.00 GRADE ELEVATION
- 105.00 IBI DESIGN GRADE
- 105.00 (T/B) TOP OF BERM GRADE ELEVATION
- FULL DEPTH ASPHALT
- PARTIAL DEPTH ASPHALT
- CONCRETE SIDEWALK
- ASPHALT SIDEWALK
- BUILDING
- RIVER STONE



STRUCTURE DATA SANITARY SYSTEM							
NUMBER	STATION	℄ OFFSET (m)	TOP OF GRATE	LOW INVERT	STRUCTURE (OPSD)	GRATE (OPSD)	SUMP (m)
SAN MH207	4+036.3	+0.62	108.198	104.401	701.010	S24	0.00
SAN MH208	1+112.4	-2.23	108.096	103.999	701.010	S24	0.00
SAN MH209	1+034.9	+1.79	108.086	104.419	701.010	S24	0.00
SAN MH210	1+008.3	-2.24	108.244	104.750	701.010	S24	0.00

PIPE DATA SANITARY SYSTEM								
FROM	TO	INLET ELEV. (m)	OUTLET ELEV. (m)	SIZE	LENGTH	SLOPE	CITY STANDARD	MIN. COVER (m)
SA-1-A	SA-1	104.860	104.780	135 mm	16.3 m	0.49%	S6	3.30
SAN MH210	SAN MH209	104.750	104.480	200 mm	27.0 m	1.00%	S6	3.23
SA-1-B	SA-2	104.700	104.620	135 mm	16.3 m	0.49%	S6	3.42
SA-1-C	SA-3	104.685	104.610	135 mm	16.3 m	0.46%	S6	3.47
SA-1-D	SA-4	104.600	104.520	135 mm	16.4 m	0.49%	S6	3.38
SA-3-D	SA-12	104.566	104.440	135 mm	12.6 m	1.00%	S6	3.55
SA-2-A	SA-5	104.521	104.350	135 mm	19.6 m	0.87%	S6	3.70
SA-3-C	SA-11	104.496	104.370	135 mm	12.6 m	1.00%	S6	3.53
SA-2-B	SA-6	104.481	104.310	135 mm	19.6 m	0.87%	S6	3.51
SA-2-C	SA-7	104.451	104.280	135 mm	19.6 m	0.87%	S6	3.51
SA-3-B	SA-10	104.447	104.320	135 mm	12.7 m	1.00%	S6	3.58
SAN MH209	SAN MH208	104.419	104.030	200 mm	77.8 m	0.50%	S6	3.44
SA-2-D	SA-8	104.401	104.230	135 mm	19.6 m	0.87%	S6	3.64
SAN MH207	SAN MH208	104.401	104.060	200 mm	34.1 m	1.00%	S6	3.56
SA-3-A	SA-9	104.337	104.210	135 mm	12.7 m	1.00%	S6	3.78
SAN MH208	SAN MH206	103.999	103.860	200 mm	27.8 m	0.50%	S6	3.89

WATERMAIN SCHEDULE					
NUMBER	DESCRIPTION	STATION	℄ OFFSET (m)	FINISHED GRADE	TOP OF WM
W-1	CAP	1+002.0	+4.01	108.46	106.06
W-2	200x150x200mm TEE	1+002.5	+4.01	108.44	107.04
W-3	FH & VB	1+002.5	+10.90	108.53	107.13
W-4	FIRE HYDRANT	1+032.3	-5.13	108.41	106.01
W-5	200x150x200mm TEE	1+028.2	+4.43	108.22	105.82
W-6	45° BEND	1+033.6	+8.51	108.07	105.67
W-7	45° BEND	1+036.2	+8.51	108.08	105.68
W-8	CONNECT TO EX.	2+039.0	+1.80	108.17	106.77
W-9	45° BEND	2+040.8	0.00	108.15	106.75
W-10	200x200x200mm TEE	1+050.0	+4.00	108.22	106.82
W-11	CAP	4+035.5	-3.88	108.20	105.80
W-12	200x150x200mm TEE	1+107.9	+4.00	108.22	105.82
W-13	FH & VB	1+119.7	+6.00	108.32	105.92
W-14	200x150x200mm TEE	1+119.7	+3.98	108.31	105.91

PIPE DATA STORM SYSTEM								
FROM	TO	INLET ELEV. (m)	OUTLET ELEV. (m)	SIZE	LENGTH	SLOPE	CITY STANDARD	MIN. COVER (m)
RYCB04	RYCB05	108.070	107.880	250 mm	13.1 m	1.45%	S6	0.73
RYCB05	RYCB06	107.880	107.410	250 mm	23.0m	2.04%	S29	0.86
RYCB06	RYCB07	107.410	107.080	250 mm	17.1 m	1.93%	S29	0.73
ST-1-D	MH402	107.010	106.748	250 mm	13.1 m	2.00%	S29	1.00
RYCB13	RYCB14	106.970	106.893	250 mm	15.4 m	0.50%	S29	0.98
RYCB14	RYCB09	106.891	106.810	250 mm	16.2 m	0.50%	S29	1.13
RYCB02	ST-2	106.180	105.810	300 mm	9.2 m	4.03%	S6	1.89
ST-2-A	ST-1	106.104	106.070	250 mm	3.4 m	0.99%	S29	2.20
RYCB09	ST-8	105.960	105.250	300 mm	6.6 m	10.76%	S29	2.06
RYCB07	MH402	105.850	105.806	250 mm	4.4 m	1.00%	S29	1.95
CB03	ST-3	105.816	105.800	300 mm	1.6 m	0.99%	S6	1.99
RYCB01	MH401	105.803	105.660	450 mm	28.7 m	0.50%	S6	1.95
MH401	MH402	105.597	105.400	450 mm	39.4 m	0.50%	S6	2.15
CB06	ST-5	105.540	105.430	300 mm	10.9 m	1.01%	S6	2.30
CB04	ST-4	105.539	105.520	300 mm	1.9 m	0.99%	S6	2.15
CB07	ST-6	105.520	105.410	300 mm	10.9 m	1.01%	S6	2.32
CB08	ST-7	105.368	105.350	300 mm	1.8 m	1.01%	S6	2.21
MH402	MH403	105.340	104.940	450 mm	79.6 m	0.50%	S6	2.22
ST-3-A	ST-9	105.254	105.180	300 mm	7.3 m	1.01%	S29	2.59
CB11	MH403	105.200	105.060	450 mm	24.1 m	0.58%	S6	2.37
ST	ST-11	105.100	105.020	300 mm	8.0 m	1.00%	S6	2.78
MH403	MH404	104.910	104.770	450 mm	27.8 m	0.50%	S6	2.68
CB10	ST-10	104.692	104.675	300 mm	1.6 m	1.09%	S6	3.00

STRUCTURE DATA STORM SYSTEM							
NUMBER	STATION	℄ OFFSET (m)	TOP OF GRATE	LOW INVERT	STRUCTURE (OPSD)	GRATE (OPSD)	SUMP (m)
CB03	1+014.5	-0.62	108.110	105.816	705.010	S19.1	0.60
CB04	1+034.6	+4.17	108.000	105.539	705.010	S19.1	0.60
CB06	2+040.8	-3.06	108.152	105.540	705.010	S19.1	0.60
CB07	2+040.8	+3.08	108.152	105.520	705.010	S19.1	0.60
CB08	1+064.9	-0.78	107.890	105.368	705.010	S19.1	0.60
CB10	1+106.3	-0.61	108.003	104.692	705.010	S19.1	0.60
CB11	4+023.1	-0.85	108.030	105.200	705.010	S19.1	0.60
MH401	1+263.9	+171.59	108.650	105.597	701.010	S24.1	0.30
MH402	1+034.9	+6.38	108.020	105.340	701.010	S24.1	0.30
MH403	1+110.9	+1.00	108.056	104.910	701.010	S24.1	0.30
RYCB01	1+060.0	-38.90	108.210	105.803	S31	S31	0.00
RYCB02	1+005.9	+10.19	108.380	106.180	S30	S30	0.00
RYCB04	1+019.2	+32.97	109.070	108.070	S31	S31	0.00
RYCB05	1+027.3	+33.49	109.058	107.880	S30	S30	0.00
RYCB06	1+031.9	+26.23	108.413	107.410	S30	S30	0.00
RYCB07	1+034.9	+10.82	108.085	105.850	S30	S30	0.00
RYCB09	1+081.3	-5.60	107.890	105.960	S30	S30	0.00
RYCB13	1+081.3	-37.21	108.050	106.970	S30	S30	0.00
RYCB14	1+081.3	-21.83	107.970	106.891	S30	S30	0.00

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LICENSED PROFESSIONAL ENGINEER S. P. DAVIDSON 100133944 2021.07.07 PROVINCE OF ONTARIO

CLIENT:
RICHCRAFT Group Of Companies

CLIENT REF. #:

PROJECT:
TERRACE FLATS

KEY PLAN:

PRELIMINARY
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TITLE:
TERRACE FLATS
NORTH SERVICING PLAN
SHEET NUMBER: C1.4
SHEET #: 6 OF 10
ISSUE: ISSUED FOR SPA
REV #: 0
DATE OF: 2021-07-07

M:\2021\211-01221-00 - Richcraft Terrace Flats Site Plan\Drawings\01. Civil\01. Production\211-01221-00 SERVICING.dwg Jul 07, 2021 - 1:26pm BY (CA)(T07412)

NOTES:

1. REFER TO DRAWING C0.1 FOR NOTES AND FULL LEGEND.
2. ALL WATER SERVICES SHALL BE 50mmØ COPPER.
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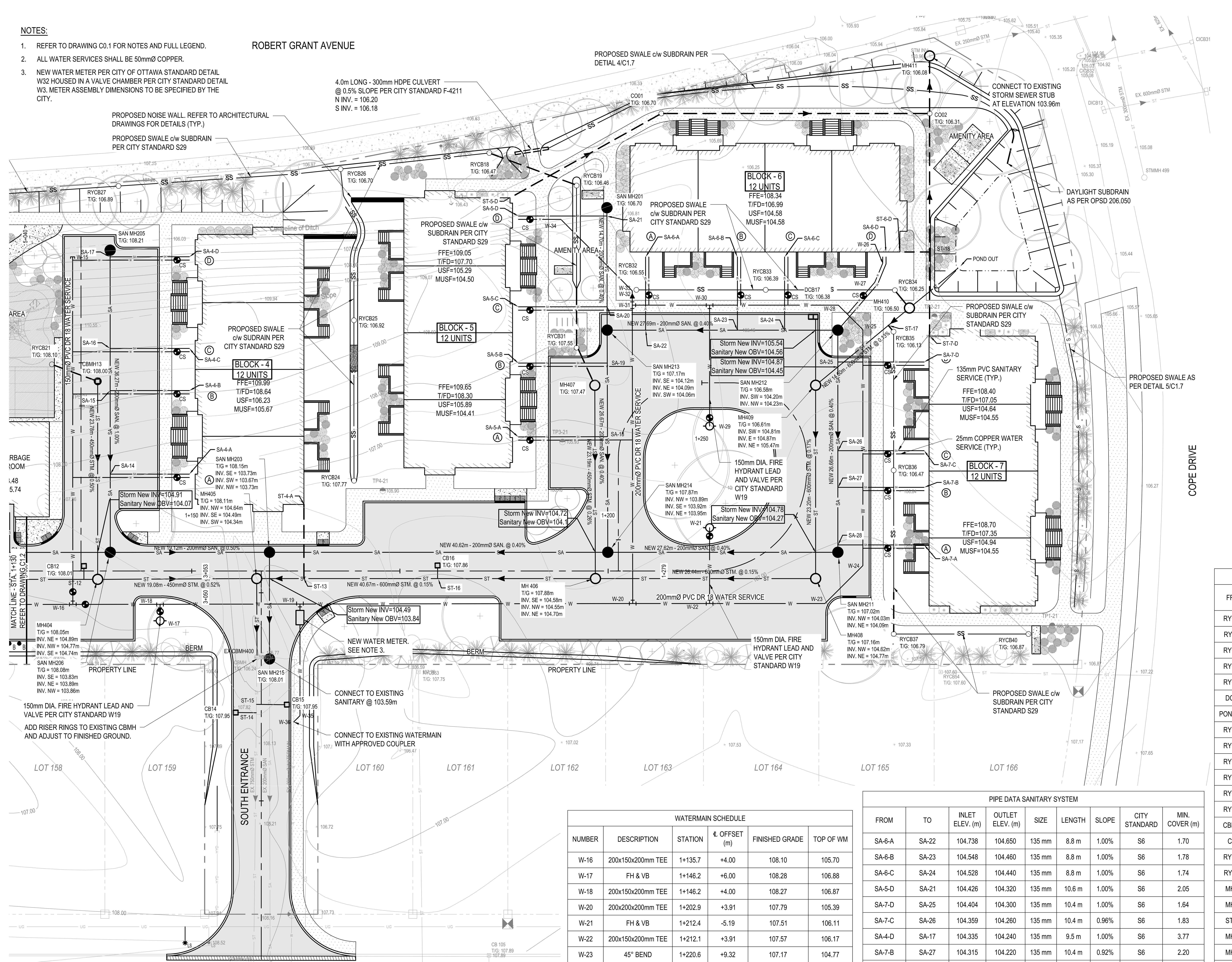

STRUCTURE DATA STORM SYSTEM							
NUMBER	STATION	℄ OFFSET (m)	TOP OF GRATE	LOW INVERT	STRUCTURE (OPSD)	GRATE (OPSD)	SUMP (m)
CB12	1+137.1	-0.60	108.010	104.997	705.010	S19.1	0.60
CB14	3+035.6	-3.06	107.950	104.648	705.010	S19.1	0.60
CB15	3+036.6	+3.08	107.950	104.648	705.010	S19.1	0.60
CB16	1+179.5	-0.67	107.860	104.716	705.010	S19.1	0.60
CBMH13	5+022.8	+1.99	108.000	105.010	701.010	S19.1	0.60
CO01	1+251.8	+32.51	106.700	104.472	S30	S30	0.00
CO02	1+241.7	+38.67	106.311	104.090	S30	S30	0.00
DCB17	1+241.6	+10.69	106.380	105.552	705.020	S19.1	0.60
MH 406	1+198.5	+0.90	107.878	104.550	701.011	S24.1	0.30
MH404	1+138.7	+1.00	108.051	104.740	701.010	S24.1	0.30
MH405	1+157.8	+0.90	108.108	104.340	701.012	S24.1	0.30
MH407	1+259.4	+5.68	107.473	104.760	701.010	S24.1	0.30
MH408	1+221.3	+6.37	107.164	104.620	701.011	S24.1	0.30
MH409	1+238.7	+4.31	106.613	104.810	701.011	S24.1	0.30
MH410	1+238.6	+18.91	106.496	104.889	701.010	S24.1	0.30
MH411	1+242.3	+44.78	106.081	103.960	701.010	S24.1	0.30
RYCB18	1+256.3	+35.04	106.470	105.392	S30	S30	0.00
RYCB19	1+254.7	+26.56	106.456	105.215	S30	S30	0.00
RYCB21	5+024.8	-3.51	108.100	105.980	S31	S31	0.00
RYCB24	1+169.5	-10.84	107.770	106.093	S31	S31	0.00
RYCB25	1+169.5	-30.10	106.920	105.872	S30	S30	0.00
RYCB26	1+259.0	+45.73	106.696	105.630	S30	S30	0.00
RYCB27	1+141.2	-46.22	106.889	105.927	S30	S30	0.00
RYCB31	1+258.4	+10.26	107.545	104.960	S30	S30	0.00
RYCB32	1+254.0	+12.28	106.550	105.345	S31	S31	0.00
RYCB33	1+244.6	+11.56	106.395	105.155	S30	S30	0.00
RYCB34	1+239.5	+19.07	106.252	104.978	S30	S30	0.00
RYCB35	1+238.2	+15.63	106.130	105.110	S30	S30	0.00
RYCB36	1+230.8	+10.45	106.469	105.306	S30	S30	0.00
RYCB37	1+222.1	+17.78	106.790	104.725	S30	S30	0.00
RYCB40	1+225.1	+31.30	106.871	103.632	S31	S31	0.00

PIPE DATA STORM SYSTEM								
FROM	TO	INLET ELEV. (m)	OUTLET ELEV. (m)	SIZE	LENGTH	SLOPE	CITY STANDARD	MIN. COVER (m)
RYCB24	RYCB25	106.093	105.900	250 mm	19.3 m	1.00%	S29	0.76
RYCB21	CBMH13	105.980	105.921	250 mm	5.9 m	1.00%	S29	1.82
RYCB27	RYCB26	105.927	105.660	250 mm	26.7 m	1.00%	S29	0.70
RYCB25	RYCB26	105.872	105.690	250 mm	18.2 m	1.00%	S29	0.75
RYCB26	RYCB18	105.630	105.450	250 mm	18.0 m	1.00%	S29	0.76
DCB17	MH409	105.552	105.470	300 mm	8.2 m	1.00%	S6	0.53
POND OUT	MH410	105.500	105.189	300 mm	8.0 m	3.90%	S6	-0.31
RYCB18	RYCB19	105.392	105.280	250 mm	11.2 m	1.00%	S29	0.82
RYCB32	RYCB33	105.345	105.190	250 mm	15.5 m	1.00%	S29	0.95
RYCB36	RYCB35	105.306	105.140	250 mm	16.6 m	1.00%	S29	0.67
RYCB19	RYCB31	105.215	105.020	250 mm	19.5 m	1.00%	S29	0.98
RYCB33	RYCB34	105.155	105.000	250 mm	15.5 m	1.00%	S29	0.98
RYCB35	ST-17	105.110	105.100	250 mm	1.0 m	1.00%	S29	0.85
CBMH13	MH404	105.010	104.890	450 mm	23.8 m	0.50%	S6	2.53
CB12	ST-12	104.997	104.980	300 mm	1.6 m	1.03%	S6	2.70
RYCB34	MH410	104.978	104.950	250 mm	2.8 m	1.00%	S29	1.02
RYCB31	MH407	104.960	104.910	250 mm	5.0 m	1.00%	S29	2.22
MH410	MH409	104.889	104.870	600 mm	14.6 m	0.13%	S6	0.74
MH409	MH408	104.810	104.770	600 mm	23.2 m	0.17%	S6	1.10
ST-4-A	ST-13	104.790	104.700	300 mm	8.9 m	1.01%	S29	3.10
MH407	MH 406	104.760	104.700	450 mm	23.2 m	0.26%	S6	2.25
MH404	MH405	104.740	104.640	450 mm	19.1 m	0.52%	S6	2.85
RYCB37	RYCB36	104.725	105.340	250 mm	19.7 m	-3.13%	S29	0.87
CB16	ST-16	104.716	104.700	300 mm	1.6 m	1.00%	S6	2.84
ST-5-D	CO01	104.708	104.500	250 mm	20.8 m	1.00%	S29	1.72
CB15	ST-15	104.648	104.572	300 mm	3.7 m	2.07%	S6	2.99
CB14	ST-14	104.648	104.576	300 mm	2.5 m	2.88%	S6	2.99
MH408	MH 406	104.620	104.580	600 mm	26.4 m	0.15%	S6	1.84
MH 406	MH405	104.550	104.490	600 mm	40.7 m	0.15%	S6	2.62
CO01	CO02	104.472	104.150	250 mm	32.2 m	1.00%	S29	1.78
MH405	EX CBMH400	104.340	104.330	750 mm	9.4 m	0.11%	S6	2.80
ST-7-D	CO02	104.340	104.120	250 mm	26.7 m	0.82%	S29	1.79
ST-6-D	ST-18	104.300	104.260	250 mm	3.6 m	1.12%	S29	1.84
CO02	MH411	104.090	104.020	250 mm	6.9 m	1.01%	S29	1.82
RYCB40	RYCB37	103.632	103.416	250 mm	16.2 m	1.34%	S29	2.98

WATERMAIN SCHEDULE					
NUMBER	DESCRIPTION	STATION	℄ OFFSET (m)	FINISHED GRADE	TOP OF WM
W-16	200x150x200mm TEE	1+135.7	+4.00	108.10	105.70
W-17	FH & VB	1+146.2	+6.00	108.28	106.88
W-18	200x150x200mm TEE	1+146.2	+4.00	108.27	106.87
W-20	200x200x200mm TEE	1+202.9	+3.91	107.79	105.39
W-21	FH & VB	1+212.4	-5.19	107.51	106.11
W-22	200x150x200mm TEE	1+212.1	+3.91	107.57	106.17
W-23	45° BEND	1+220.6	+9.32	107.17	104.77
W-24	45° BEND	1+224.1	+9.92	106.94	104.54
W-25	45° BEND	1+239.2	+13.01	106.61	104.21
W-26	22.5° BEND	1+240.5	+20.56	106.72	104.32
W-27	22.5° BEND	1+240.3	+18.18	106.51	104.11
W-28	45° BEND	1+240.9	+13.35	106.44	104.04
W-29	FIRE HYDRANT	1+249.1	-5.20	107.19	104.79
W-30	200x150x200mm TEE	1+249.1	+9.32	106.69	104.29
W-31	200x25x200mm TEE	1+254.4	+10.73	106.94	104.54
W-32	REDUCER	1+254.2	+11.99	106.66	104.26
W-33	45° BEND	1+254.2	+12.34	106.62	104.22
W-34	45° BEND	1+255.6	+23.74	106.90	104.50
W-35	45° BEND	1+163.0	+17.36	108.13	105.73
W-36	CONNECT TO EX.	1+162.3	+18.11	108.12	105.72

STRUCTURE DATA SANITARY SYSTEM							
NUMBER	STATION	℄ OFFSET (m)	TOP OF GRATE	LOW INVERT	STRUCTURE (OPSD)	GRATE (OPSD)	SUMP (m)
SAN MH201	1+254.0	+22.76	106.698	104.149	701.010	S24	0.00
SAN MH203	1+159.3	-2.25	108.145	103.671	701.010	S24	0.00
SAN MH205	5+038.5	+3.49	108.205	104.253	701.010	S24	0.00
SAN MH206	1+140.2	-2.24	108.081	103.826	701.010	S24	0.00
SAN MH211	1+224.0	+6.52	107.023	104.030	701.010	S24	0.00
SAN MH212	1+240.2	+10.93	106.580	104.197	701.010	S24	0.00
SAN MH213	1+256.4	+9.48	107.169	104.057	701.010	S24	0.00
SAN MH214	1+276.5	+1.27	107.872	103.892	701.010	S24	0.00
SAN MH215	3+042.0	+0.98	108.006	103.590	701.010	S24	0.00

PIPE DATA SANITARY SYSTEM								
FROM	TO	INLET ELEV. (m)	OUTLET ELEV. (m)	SIZE	LENGTH	SLOPE	CITY STANDARD	MIN. COVER (m)
SA-6-A	SA-22	104.738	104.650	135 mm	8.8 m	1.00%	S6	1.70
SA-6-B	SA-23	104.548	104.460	135 mm	8.8 m	1.00%	S6	1.78
SA-6-C	SA-24	104.528	104.440	135 mm	8.8 m	1.00%	S6	1.74
SA-5-D	SA-21	104.426	104.320	135 mm	10.6 m	1.00%	S6	2.05
SA-7-D	SA-25	104.404	104.300	135 mm	10.4 m	1.00%	S6	1.64
SA-7-C	SA-26	104.359	104.260	135 mm	10.4 m	0.96%	S6	1.83
SA-4-D	SA-17	104.335	104.240	135 mm	9.5 m	1.00%	S6	3.77
SA-7-B	SA-27	104.315	104.220	135 mm	10.4 m	0.92%	S6	2.20
SA-4-C	SA-16	104.315	104.220	135 mm	9.5 m	1.00%	S6	3.71
SA-5-C	SA-20	104.306	104.200	135 mm	10.6 m	1.00%	S6	2.76
SA-7-A	SA-28	104.298	104.200	135 mm	10.4 m	0.94%	S6	2.40
SA-4-B	SA-15	104.265	104.170	135 mm	9.5 m	1.00%	S6	3.74
SAN MH205	SAN MH206	104.253	103.890	200 mm	36.3 m	1.00%	S6	3.72
SA-5-B	SA-19	104.217	104.110	135 mm	10.7 m	1.00%	S6	3.08
SA-5-A	SA-18	104.177	104.070	135 mm	10.7 m	1.00%	S6	3.43
SA-4-A	SA-14	104.165	104.070	135 mm	9.5 m	1.00%	S6	3.92
SAN MH201	SAN MH213	104.149	104.090	200 mm	14.7 m	0.40%	S6	2.34
SAN MH213	SAN MH214	104.057	103.950	200 mm	26.7 m	0.40%	S6	2.91
SAN MH214	SAN MH203	103.892	103.730	200 mm	40.6 m	0.40%	S6	3.77
SAN MH206	SAN MH203	103.826	103.730	200 mm	19.1 m	0.50%	S6	4.05
SAN MH203	SAN MH215	103.671	103.620	200 mm	12.8 m	0.40%	S6	4.18

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LICENSED PROFESSIONAL ENGINEER S. P. DAVIDSON 100133944 2021.07.07 PROVINCE OF ONTARIO

CLIENT:
RICHCRAFT Group Of Companies

CLIENT REF. #:

PROJECT:
TERRACE FLATS

KEY PLAN:

PRELIMINARY
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ISSUED FOR - REVISION:

IS	RE	DATE	DESCRIPTION
1		2021-07-07	ISSUED FOR SPA

PROJECT NO: 211-01221-00
DATE: MARCH 2021
ORIGINAL SCALE: 1:250
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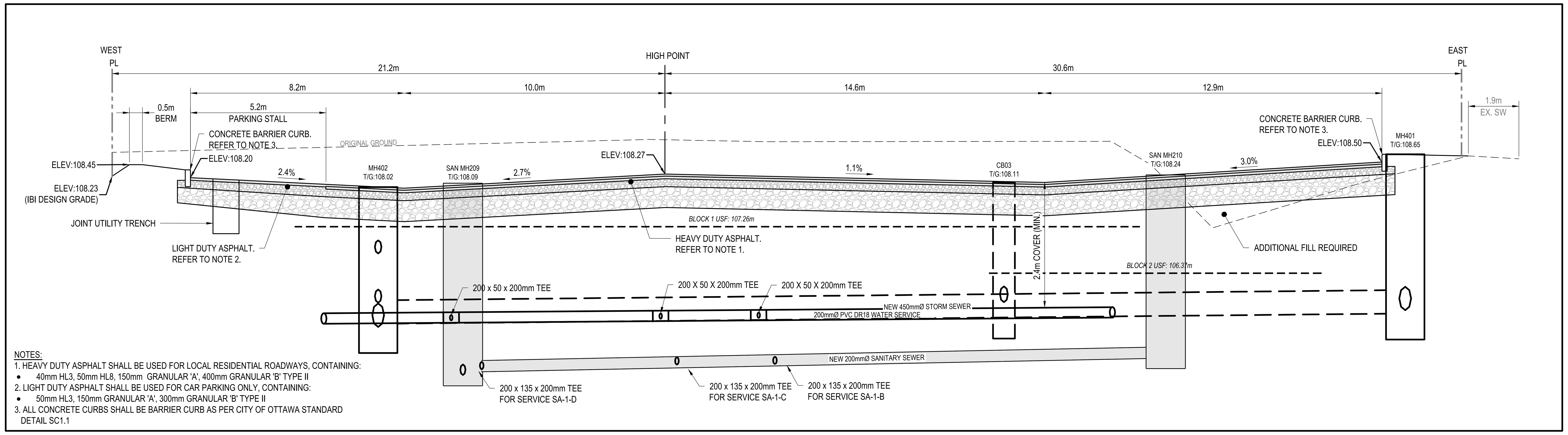
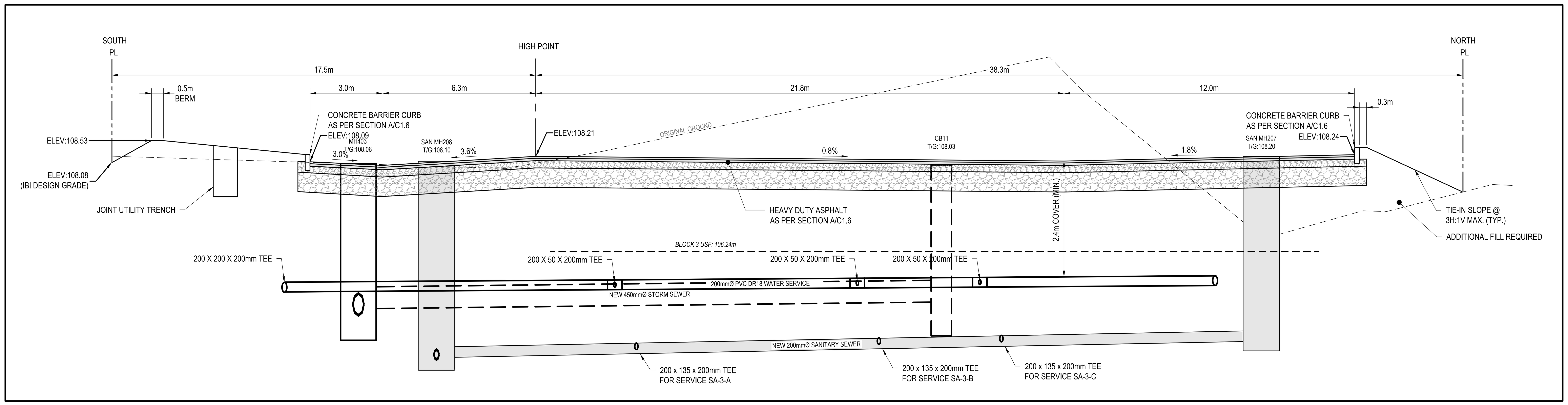
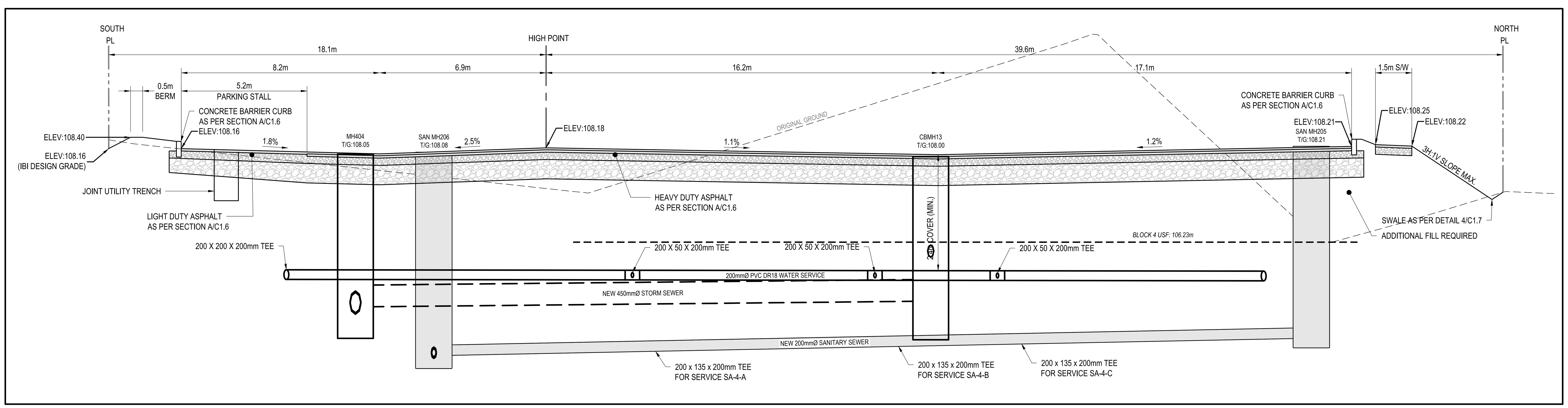
DESIGNED BY: DS
DRAWN BY: MH
CHECKED BY: SD
DISCIPLINE: CIVIL
TITLE:
TERRACE FLATS
SOUTH SERVICING PLAN
SHEET NUMBER: C1.5
SHEET #: 7 OF 10
ISSUE: ISSUED FOR SPA
REV #: 0
DATE OF: 2021-07-07



A
C1.6
SECTION A
SCALE: H 1:100 V 1:50



B
C1.6
SECTION B
SCALE: H 1:100 V 1:50



C
C1.6
SECTION C
SCALE: H 1:100 V 1:50

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S. P. DAVIDSON
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TITLE:
TERRACE FLATS
DETAILS & SECTIONS I

SHEET NUMBER: C1.6
SHEET #: 8 OF 10

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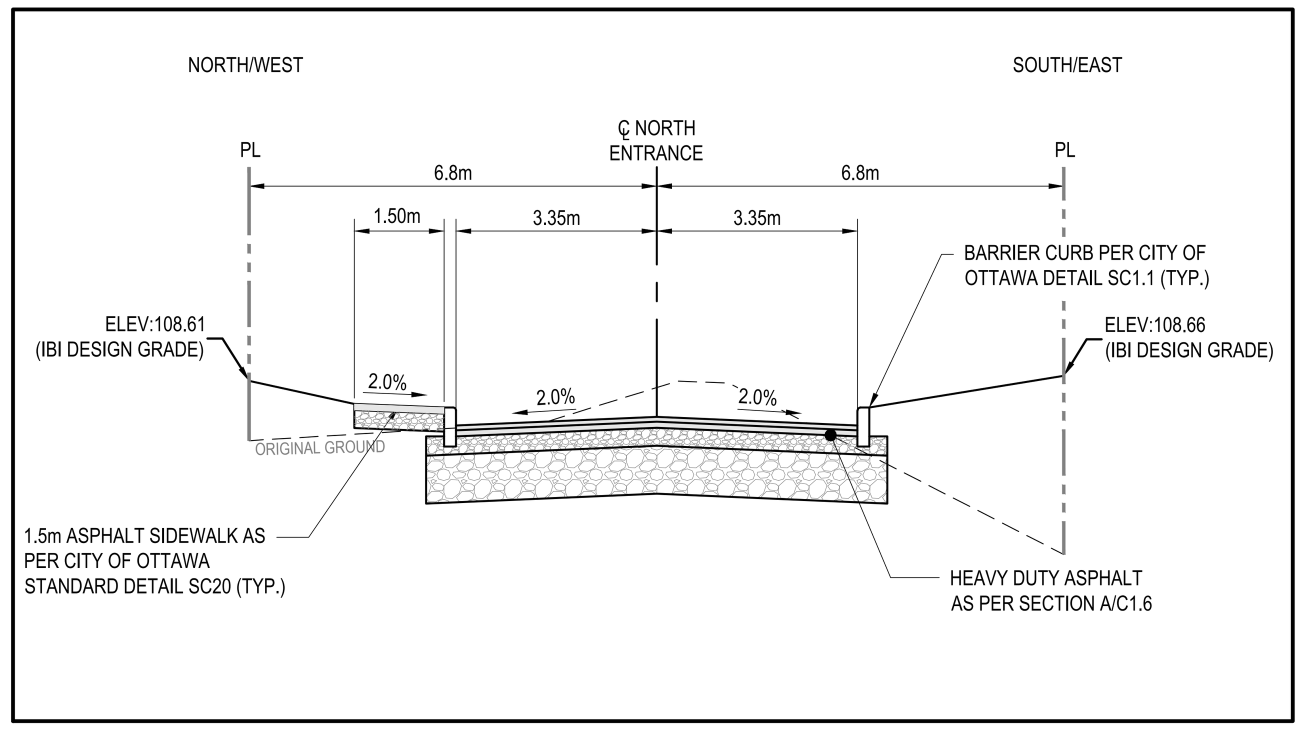
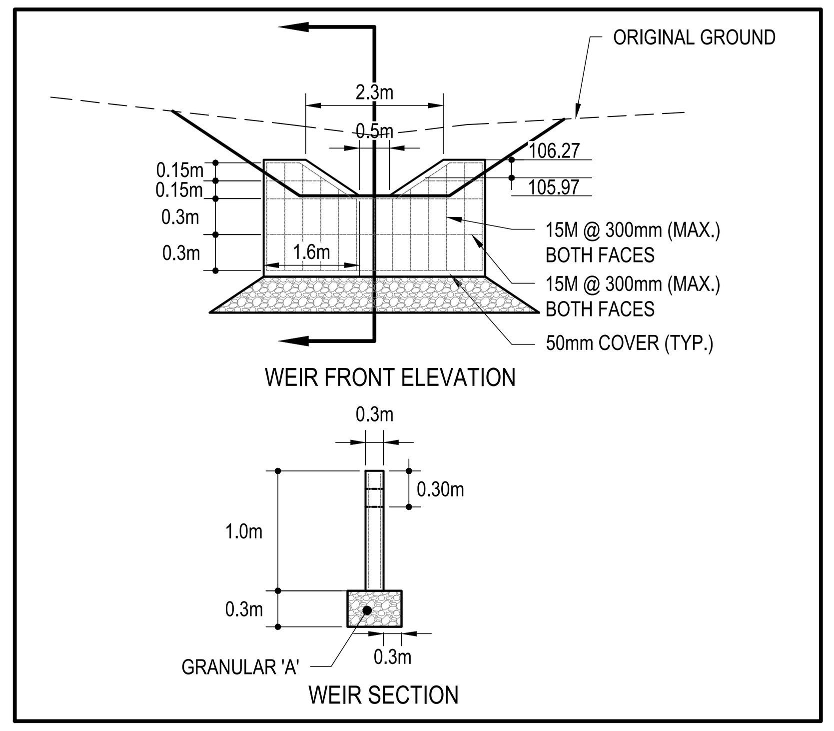
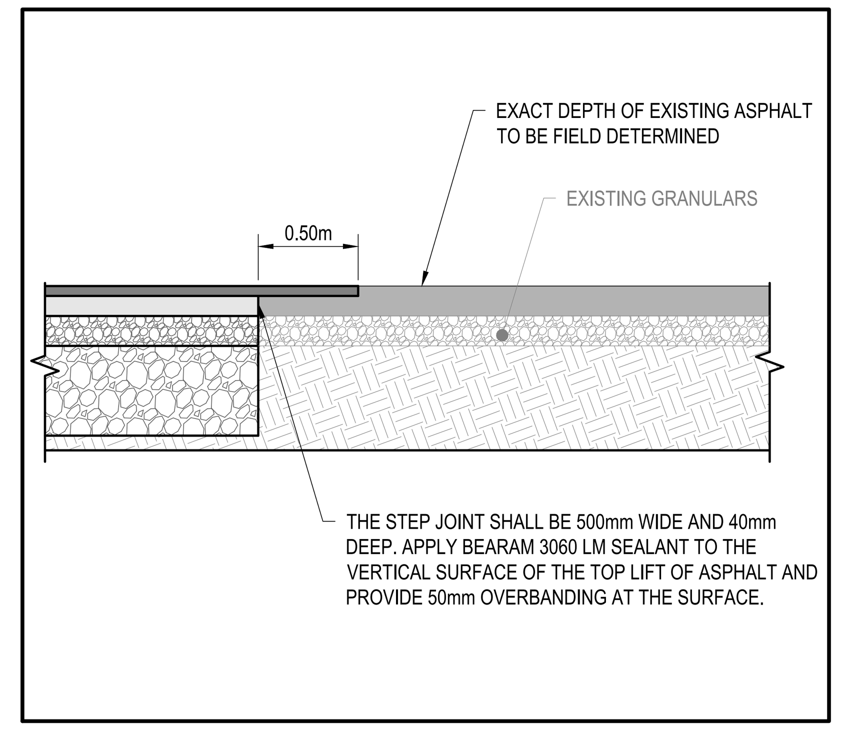


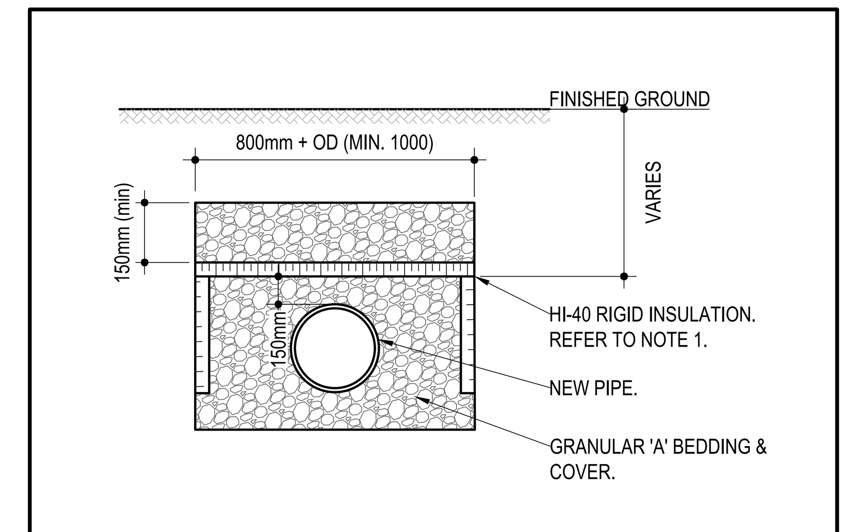
D C1.7 **SECTION D**
SCALE: H 1:100 V 1:50



1 C1.7 **CONCRETE WEIR DETAIL**
SCALE: H 1:100 V 1:50

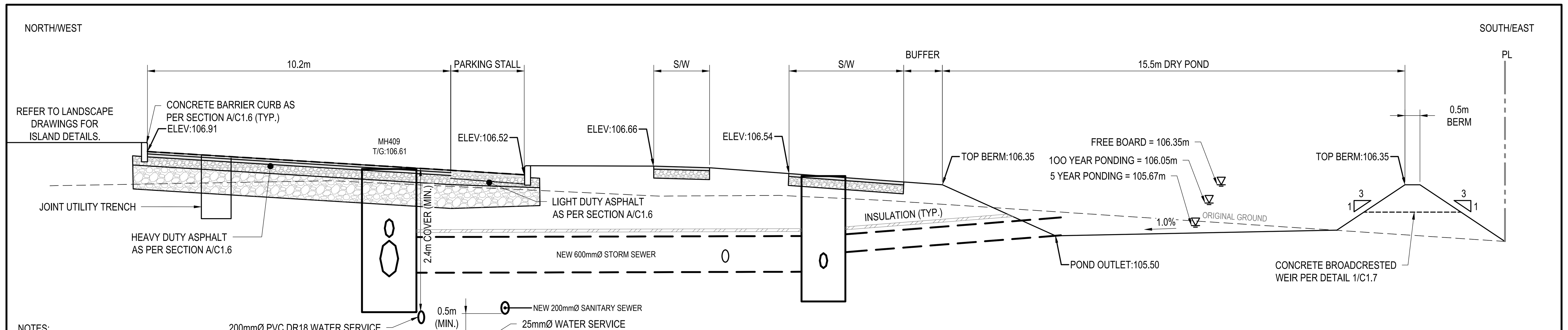


2 C1.7 **TYPICAL STEP CONNECTION**
SCALE: 1:30



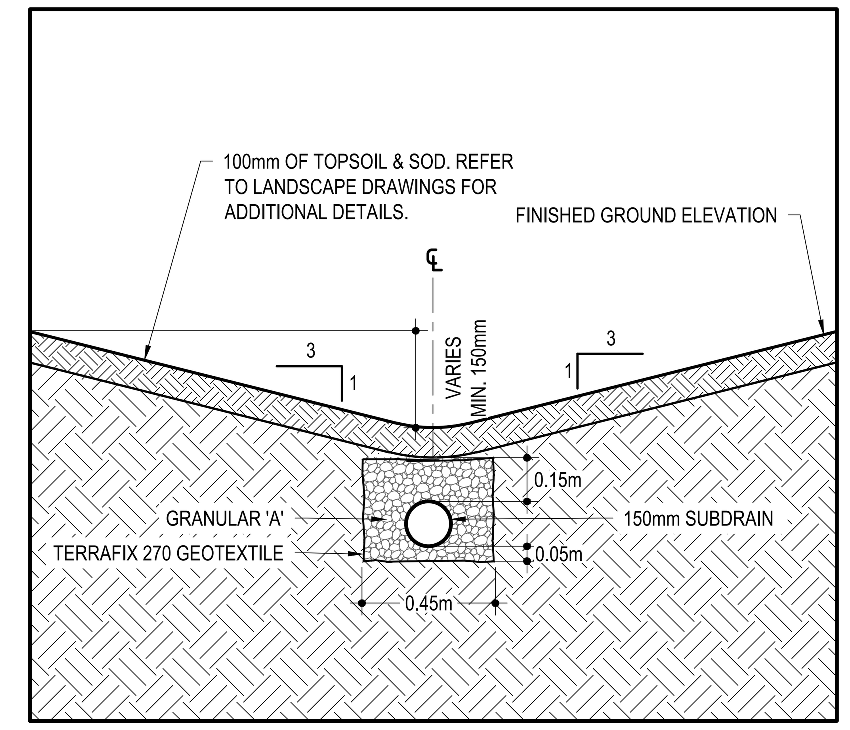
NOTES:
1. INSULATION THICKNESS SHALL BE SUFFICIENT TO COMPENSATE FOR LACK OF COVER WHEN COVER IS LESS THEN 2.0m. COVER DEFICIENCY (IN METERS) SHALL BE DIVIDED BY 0.3m, THEN MULTIPLIED BY 25mm TO DETERMINE MINIMUM THICKNESS OF INSULATION REQUIRED (IN MILLIMETERS). WHERE BETWEEN PREFABRICATED THICKNESS, ROUND UP TO NEXT NOMINAL SIZE (25mm INCREMENTS).
2. STAGGER JOINTS OF MULTIPLE SHEETS.

3 C1.7 **FROST PROTECTION DETAIL (SEWERS)**
SCALE: 1:20

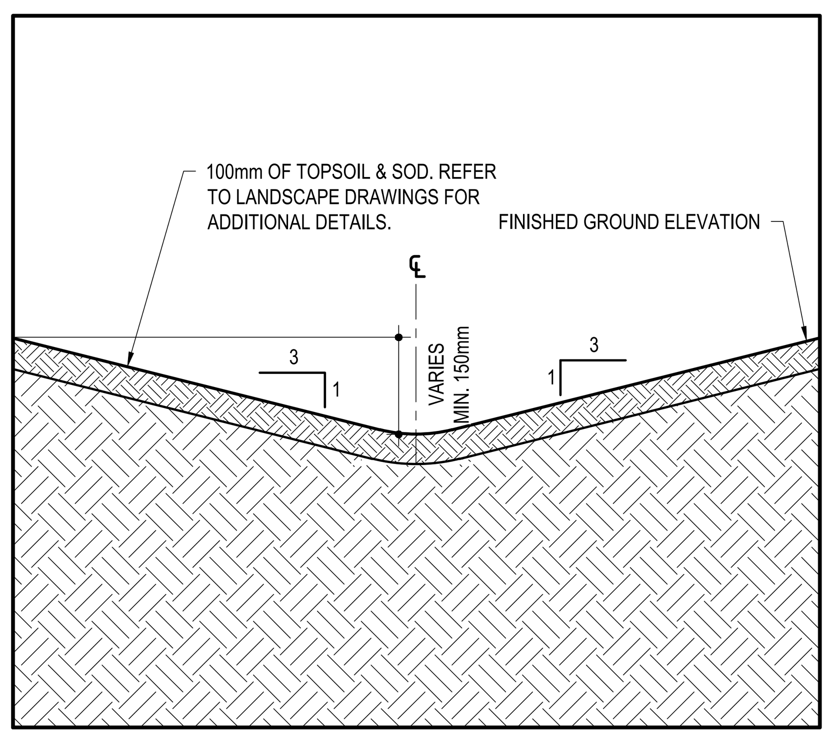


NOTES:
1. HORIZONTAL DIMENSIONS ARE SKEWED FROM SECTION CUT.

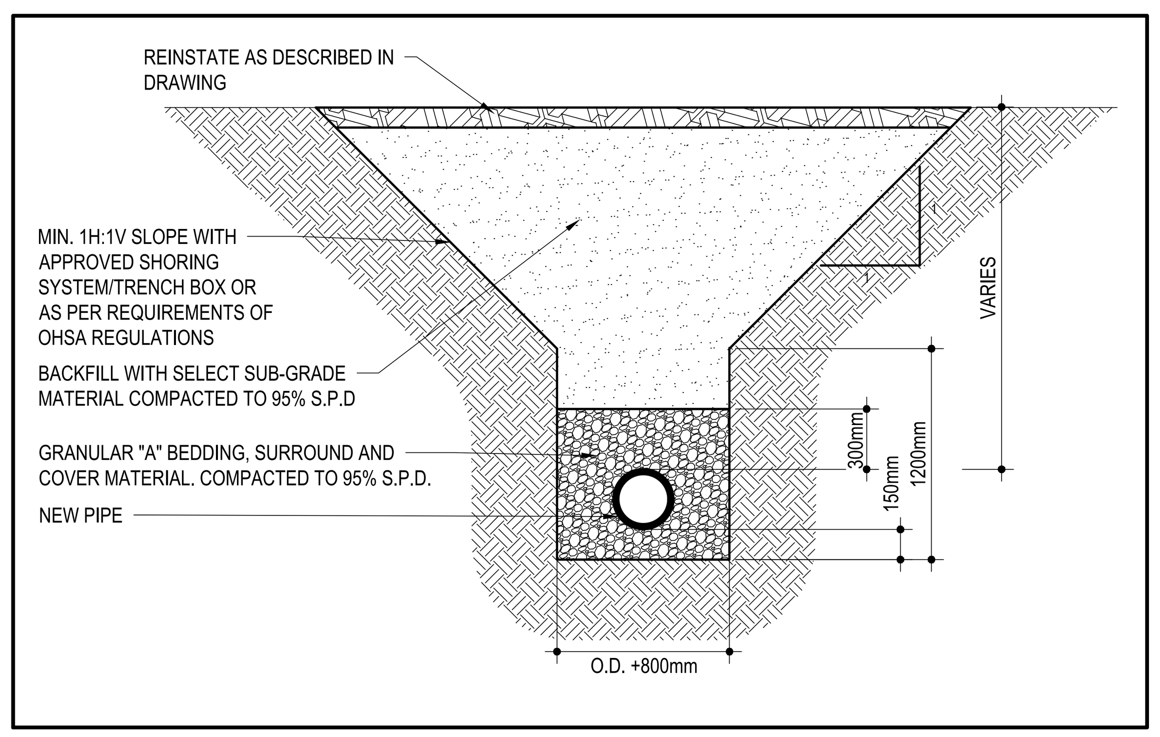
E C1.7 **SECTION E**
SCALE: H 1:100 V 1:50



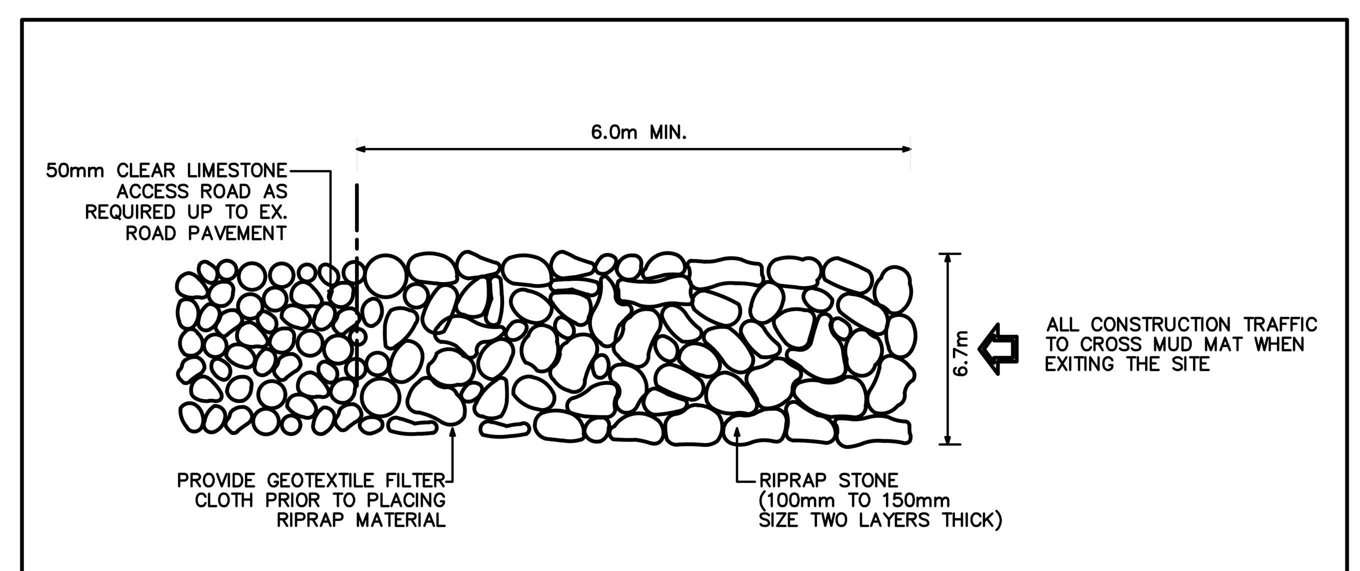
4 C1.7 **TYPICAL SWALE WITH SUBDRAIN**
SCALE: 1:20



5 C1.7 **TYPICAL SWALE WITHOUT SUBDRAIN**
SCALE: 1:20



6 C1.7 **TYPICAL TRENCH DETAIL**
SCALE: NTS



MUD MAT DETAIL - PLAN VIEW
(NTS)

7 C1.7 **MUD MAT DETAIL**
SCALE: NTS

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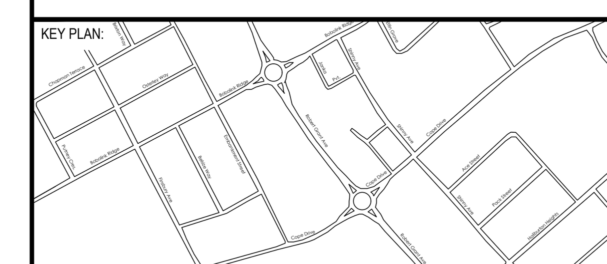
CLIENT REF. #:

PROJECT:
TERRACE FLATS

KEY PLAN:



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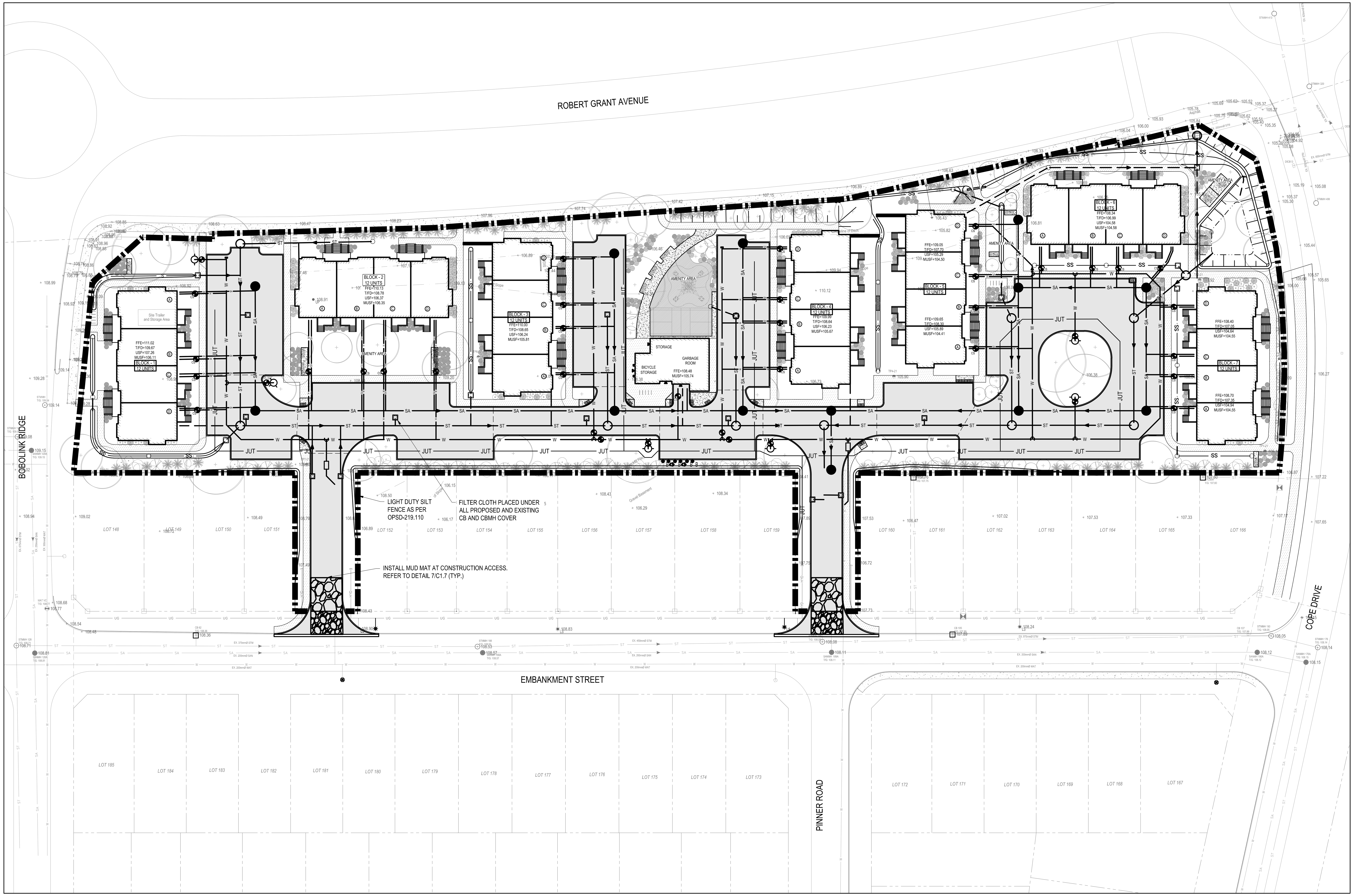
TITLE:
TERRACE FLATS
DETAILS & SECTIONS II

SHEET NUMBER: C1.7
SHEET # 9 OF 10

ISSUE: ISSUED FOR SPA
REV #: 0
DATE OF: 2021-07-07

NOTES:

1. REFER TO DRAWING C0.1 FOR NOTES AND LEGEND.



NORTH

wsp

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CLIENT:

RICHCRAFT Group Of Companies

CLIENT REF. #:

PROJECT:

TERRACE FLATS

KEY PLAN:

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DESIGNED BY: DS
DRAWN BY: MH/JT
CHECKED BY: SD

DISCIPLINE: CIVIL

TITLE:

TERRACE FLATS
SEDIMENT AND EROSION CONTROL PLAN

SHEET NUMBER: C1.8

SHEET #: 10 OF 10

ISSUE: ISSUED FOR SPA
REV #: 0
DATE OF: 2021-07-07

APPENDIX

B

CITY PRE-CONSULTATION DOCUMENTS & CITY SERIVING CHECKLIST

Description:

A Design Brief is the core submission document that illustrates how the development is designed to work with its existing and planned context, to improve its surroundings and also demonstrate how the proposal supports the overall goals of the Official Plan, relevant secondary plans, Council approved plans and design guidelines. The purpose of the Terms of Reference is to assist the applicant to organize and substantiate the design justification in support of the proposed development and to assist staff and the public in the review of the proposal.

Authority to Request a Design Brief:

The *Planning Act* gives municipalities the authority to require that a Design Brief be prepared. Under Sections 22(4), (5) and Section 41(4) of the *Planning Act*, a Council has the authority to request such other information or material that the authority needs in order to evaluate and make a decision on an application. Section 5.2.6 of the Official Plan sets out the general requirement for a Design Brief.

Preparation:

The Design Brief should be signed by an urban designer, licenced architect, landscape architect, or a full member of the Canadian Institute of Planners.

When Required:

A Design Brief is required for a Site Plan Control planning application.

A Scoped Design Brief* is required when the following planning applications are applied for and not accompanied by a Site Plan Control application:

- Official Plan Amendment
- Zoning By-law Amendment (exception: a change in use which does not result in an increase in height or massing)

The requirement and scope of a Design Brief will be determined at the formal pre-application consultation meeting. Should an application be required to go to the Urban Design Review Panel (UDRP), the Design Brief may be submitted as part of the submission materials to the panel.

Contents for Design Brief Submissions:

A Design Brief will contain and/or address the points identified during the pre-consultation meeting. Failure to address the critical elements identified in the pre-consultation meeting may result in the application being considered incomplete.

** A Scoped Design Brief is composed of:*

- *Section 1 should be combined into the Planning Rationale submission, and*
- *Section 2 items will be confirmed in the pre-application consultation meeting.*

SECTION 1 Note: This section will be combined with the Planning Rationale report.

Application Submission:

Not Required	Required	
☐	☒	State the: type of application, legal description, municipal address, purpose of the application and provide an overall vision statement and goals for the proposal.

Response to City Documents:

Not Required	Required	
☐	☒	State the Official Plan land use designation for the subject property and demonstrate how the proposal conforms to the Official Plan as it relates to the design of the subject site. Reference specific policy numbers from the Official Plan to show consistency. Justify areas of non-compliance and explain why there is non-compliance.
☐	☒	State the applicable plans which apply to the subject proposal: community design plan, secondary plan, concept plan and design guideline. Reference the relevant design related polices within the applicable plans/guidelines and provide a comprehensive analysis as to how the proposed development incorporates the objectives or why it does not incorporate the objectives.

Context Plan:

Not Required	Required	
☐	☒	Provide a contextual analysis that discusses/illustrates abutting properties, key destinations and linkages within a 100 meter radius (a larger radius may be requested for larger/more complex projects), such as transit stations, transportation networks for cars, cyclists, and pedestrians, focal points/nodes, gateways; parks/open spaces, topography, views towards the site, the urban pattern (streets, blocks), future and current proposals (if applicable), public art and heritage resources.
☐	☒	Photographs to illustrate existing site conditions and surrounding contexts. Include a map pinpointing (with numbers) where each photo is taken and correspond these numbers with the site photos. Arrows illustrating the direction the photo is taken is also useful.

SECTION 2

<u>Design Proposal</u>:
The purpose of the Design Proposal is to show the building elevations, exterior details, transitions in form, treatment of the public realm and compatibility with adjacent buildings, using 3-D models, illustrations, diagrams, plans, and cross sections. Referencing Official Plan, Section 5.2.1, as determined at time of pre-application consultation meeting, submissions will need to address the following in the form of labelled graphics and written explanation:

Massing and Scale

Not Required	Required	
		Images which show:
		<u>Building massing</u> – from:
☐	☐	• at least two sides set within it current context (showing the entire height and width of the building) **OR**
☐	☒	• all four sides set within it current context (showing the entire height and width of the building).
		<u>Views</u> – of the entire block, from:
☐	☒	• at least two perspectives to show how the proposed building is set within its current context **OR**
☐	☐	• all four perspectives to show how the proposed building is set within its current context.
☒	☐	<u>Building transition</u> – to adjacent uses, with labelled explanation of the transition measures used.
☐	☒	<u>Grading</u> – if grades are an issue.
☐	☒	<u>Alternative building massing</u> – additional imagery and site layouts considered and provide justification for the ultimate proposal sought.

Public Realm

Not Required	Required	
		Labelled graphics and a written explanation which show:
☐	☒	<u>Streetscape</u> – cross sections which illustrate the street design and right of way (referencing the City's design manuals).
☐	☒	<u>Relationship to the public realm</u> – illustrating how the first few storeys of the proposed development responds to and relates to the existing context (e.g. through a podium plan and first floor plan). This is to include detailed explanation on: • Architectural responses • Landscaping details • Public art features (in accordance with Official Plan, Section 4.11) • For developments in Design Priority Areas, detail the building and site features, (in accordance with Official Plan, Section 4.11) which will enhance the public realm. Provide explanation for features which are not provided.

Building Design

Not Required	Required	
☐	☒	Labelled graphics (e.g. building elevations and floor plans) and a written explanation which document the proposed exterior architectural details and design (in accordance with Official Plan, Section 5.2.1).
☒	☐	For high-rise development applications, detail the building design and massing and scale elements and how they relate to the proposed high-rise development (in accordance with Official Plan, Section 5.2.1).

Sustainability

Not Required	Required	
☐	☒	Any sustainable design features to be incorporated, such as green roofs or walls, sun traps, reflective or permeable surfaces.

Heritage

Not Required	Required	
☐	☒	How the building relates to the historic details, materials, site and setting of any existing historic resources on or adjacent to the subject property (if applicable).

Additional Contents:

Some proponents may be requested to provide submission material which complements the Design Brief. These additional requirements could be incorporated into the Design Brief submission for ease of review. These will be identified at the time of application consultation meeting:

X • Site Plan
X • Landscape Plan
X • Plan showing existing and proposed servicing
- Shadow Analysis
- Wind Analysis

Submission Requirements

- Six hard copies and one digital copy

Ottawa

APPLICANT'S STUDY AND PLAN IDENTIFICATION LIST

Legend: **S** indicates that the study or plan is required with application submission.
A indicates that the study or plan may be required to satisfy a condition of approval/draft approval.

For information and guidance on preparing required studies and plans refer to:

http://ottawa.ca/en/development-application-review-process-0/guide-preparing-studies-and-plans

S/A	ENGINEERING		S/A
S	**1. Site Servicing Plan**	2. Assessment of Adequacy of Public Services / Site Servicing Report	
S	**3. Grade Control and Drainage Plan**	**4. Geotechnical Study / Slope Stability Study**	**S**
	5. Composite Utility Plan	6. Groundwater Impact Study	
	7. Servicing Options Report	8. Wellhead Protection Study	
	9. Transportation Impact Assessment Screening Form	**10.Erosion and Sediment Control Plan**	**S**
S	**11.Storm water Management Report**	12.Hydro geological and Terrain Analysis	
S	13.Hydraulic Watermain Analysis	**14.Noise Impact Assessment**	**S**
	15.Roadway Modification Design Plan	16.Confederation Line Proximity Study	
S/A	**PLANNING / DESIGN / SURVEY**		**S/A**
	17.Draft Plan of Subdivision	18.Plan Showing Layout of Parking Garage	**S**
	19.Draft Plan of Condominium	**20.Design Brief/ Planning Rationale**	**S**
S	**21.Site Plan**	22.Minimum Distance Separation (MDS)	
	23.Concept Plan Showing Proposed Land Uses and Landscaping	24.Agrology and Soil Capability Study	
S	25.Concept Site Plan	26.Cultural Heritage Impact Statement	
S	**27.Landscape Plan**	28.Archaeological Resource Assessment	
S	**29.Survey Plan**	30.Shadow Analysis	
S	**31.Architectural Building Elevation Drawings (dimensioned)**	32.Design Brief	
	33.Wind Analysis		
	ENVIRONMENTAL		
S	34. Phase 1 Environmental Site Assessment	35.Impact Assessment of Adjacent Waste Disposal/Former Landfill Site	
	36.Phase 2 Environmental Site Assessment (depends on the outcome of Phase 1)	37.Assessment of Landform Features	
	38.Record of Site Condition	39.Mineral Resource Impact Assessment	
S	40.Tree Conservation Report	41.Assessment of Endangered Species	
	42.Mine Hazard Study / Abandoned Pit or Quarry Study	43.Integrated Environmental Review (Draft, as part of Planning Rationale)	

Site Address 620 Bobolink Ridge

Application Type: Site Plan Control application
Planner : Kathy Rygus
Infrastructure Approvals Project Manager: Eric Surprenant
Date: February 22, 2021

*Preliminary Assessment: 1☐ 2☐ 3☐ 4☒ 5☐

*One (1) indicates that considerable major revisions are required before a planning application is submitted, while five (5) suggests that proposal appears to meet the City's key land use policies and guidelines. **This assessment is purely advisory and does not consider technical aspects of the proposal or in any way guarantee application approval.**

<u>Please note that PDF versions of all the of the listed requirements must be submitted with the application.</u>

It is important to note that the need for additional studies and plans may result during application review. If following the submission of your application, it is determined that material that is not identified in this checklist is required to achieve complete application status, in accordance with the Planning Act and Official Plan requirements, the Planning, Infrastructure and Economic Development Department *will notify you of outstanding material required within the required 30 day period. Mandatory pre-application consultation will not shorten the City's standard processing timelines, or guarantee that an application will be approved. It is intended to help educate and inform the applicant about submission requirements as well as municipal processes, policies, and key issues in advance of submitting a formal development application. This list is valid for one year following the meeting date. If the application is not submitted within this timeframe the applicant must again pre-consult with the* Planning, Infrastructure and Economic Development Department.

PC2021-0051

Pre-Application Consultation Meeting (Via Teams)

Site Plan Control Application: 620 Bobolink Ridge

February 22, 2021, 9-10:am

Attendees

Kathy Rygus - Development Review Planner, City of Ottawa
Eric Surprenant - Project Manager (Infrastructure), City of Ottawa
Randolph Wang - Urban Design Planner, City of Ottawa
Nadia DeSanti –Senior Project Manager, WSP
Samantha Gatchene - Planner, WSP
Daniela Correia – Landscape Architect, WSP
Steve Davidson - Engineer, WSP
Alexander Orakwue – Land Development Manager, Richcraft

Applicant's overview of proposal

- The site is a 1.6-hectare parcel located at 620 Bobolink Ridge in CRT Developments Inc. Phase 1 Westwood subdivision. The property has two access points on Embankment Crescent between Bobolink Ridge and Cope Drive and is currently vacant.
- Zoning is R4Z, permitting low rise apartments and stacked units.
- The proposed site plan is for 7 blocks of back-to-back stacked units, with 84 units total. A central building would provide bicycle storage together with garbage. And recycling facilities. 118 surface parking spaces would be provided as well as a central amenity area..

Process

1. The application type for the proposed development is Site Plan Control, Complex, Manager Approval. The application is subject to public notification through the Devapps website and an onsite sign. The fee is $59,338.80 with additional engineering fees and a $1,040 Conservation Authority fee. Information on process, timeline and fees for the different applications can be found here.
2. Fees are not required to be paid at the time of application submission. An email with instructions for payment of fees will be sent by the assigned planner once a file number has been assigned.
3. Information on process, timeline and fees for the different applications can be found here.
4. The application should be submitted digitally with PDFs of all documents (attached in the e-mail or link to dropbox provided). Please send application to planningcirculations@ottawa.ca. Please cc the Senior Planner in Development Review West, Wendy Tse: Wendy.tse@ottawa.ca
5. A list of required plans and studies is provided.

Planning & Urban Design

Please accept these comments on behalf of PRUD for the proposed Site Plan Control.

1. A Design Brief is required for a site plan control application. The Terms of Reference for the Design Brief is attached for convenience.
2. The site just touches the Design Priority Area designation, but the proposed development is exempted from the review by the Urban Design Review Panel.
3. With respect to the concept plan presented at the meeting, please consider the following (also see attached PDF diagrams for reference):
    a. Organize the 7 building blocks into two clusters;
    b. Create stronger rhythmic building edges along public streets;
    c. Locate the amenity space at the centre of the between the two clusters, clearly visible and easily accessible by all residents;
    d. Create a larger amenity space if possible;
    e. Locate the small accessory building to the edge of the street so that it won't become a visual barrier for residents, making sure the building is designed to be appropriate for street presence.

Please contact Randolph Wang for questions: Randolph.wang@ottawa.ca

Infrastructure

Please note the following information regarding the engineering design submission for the above noted site:

1. The easterly lot line is abutting Robert Grant Avenue. Tie-in of grading is important and noise walls or retaining walls are to be avoided.

2. The site is zoned to accommodate the type of development proposed, so we do not anticipate servicing constraints.

3. The site drains to Fernbank Pond 5, which is operational; there are no anticipated issues however there will be a need to demonstrate that imperviousness ratios are in accordance with Master Servicing study requirements etc and stormwater management on site as required…

4. A request for boundary conditions will need to be submitted.

5. As a residential site plan block, there will be requirements to demonstrate Fire Flow, via FUS methedology. At minimum there will be a need for water-loss leak detection chamber at property line and potential for fire-flow bypass metre at lot line is anticipated with sub-metering at units

6. The Servicing Study Guidelines for Development Applications are available at the following address: http://ottawa.ca/en/development-application-review-process-0/servicing-study-guidelines-development-applications

7. Servicing and site works shall be in accordance with the following documents:

- Ottawa Sewer Design Guidelines (October 2012)
- Ottawa Design Guidelines – Water Distribution (2010)
- Geotechnical Investigation and Reporting Guidelines for Development Applications in the City of Ottawa (2007)
- City of Ottawa Slope Stability Guidelines for Development Applications (revised 2012)
- City of Ottawa Environmental Noise Control Guidelines (January, 2016)
- City of Ottawa Accessibility Design Standards (2012)
- Ottawa Standard Tender Documents (latest version)
- Ontario Provincial Standards for Roads & Public Works (2013)

8. Record drawings and utility plans are also available for purchase from the City (Contact the City's Information Centre by email at InformationCentre@ottawa.ca or by phone at 613- 580-2424 x.44455.

Should you have any questions or require additional information, please contact Eric Surprenant by e-mail: Eric.surprenant@ottawa.ca

Transportation/Noise

1. No TIA is required (less than 90 units)
2. A noise impact assessment is required
3. On site plan, show:
    a. Turning movement diagrams required for all accesses showing the largest vehicle to access/egress the site.
    b. Turning movement diagrams required for internal movements (loading areas, garbage).
    c. All curb radii measurements; ensure that curb radii are reduced
    d. Show lane/aisle widths, access width and throat length

Feel free to contact Mike Giampa for follow-up questions: Mike.giampa@ottawa.ca

.**Tree Conservation**

1. A Tree Conservation Report (TCR) is required.
2. Any removal of privately-owned trees 10 cm or larger in diameter requires a tree permit issued under the Urban Tree Conservation Bylaw.

3. The TCR must list all trees on-site by species, diameter and health condition. Note that TCR must address all trees with a critical root zone that extends into the developable area.
4. If trees are to be removed, the TCR must clearly show where they are and document the reason they cannot be retained.
5. All retained trees must also be shown and all retained trees within the area impacted by the development process must be protected as per the City guidelines listed on Ottawa.ca.
6. The City encourages the retention of healthy trees wherever possible.
7. The removal of City-owned trees will require the permission of Forestry Services who will also review the submitted TCR.

Please contact Mark Richardson Mark.richardson@ottawa.ca for questions.

Please refer to the links to "Guide to preparing studies and plans" and fees for further information. Additional information is available related to building permits, development charges, and the Accessibility Design Standards. Be aware that other fees and permits may be required, outside of the development review process. You may obtain background drawings by contacting informationcentre@ottawa.ca.

These preconsultation comments are valid for one year. If you submit a development application after this time, you may be required to meet for another preconsultation meeting and/or the submission requirements may change. You are as well encouraged to contact us for a follow-up meeting if the plan/concept will be further refined.

Feel free to contact me at Kathy.rygus@ottawa.ca if you have any questions.

Kathy Rygus

Planner, Development Review West

4.1 General Content

☒ Executive Summary (for larger reports only).

Comments: N/A

☒ Date and revision number of the report.

Comments: *Refer to front page of the Report*

☒ Location map and plan showing municipal address, boundary, and layout of proposed development.

Comments: *Refer to Figure 1 Site Location*

☒ Plan showing the site and location of all existing services.

Comments: *Refer to drawing C1.1-C1.5*

☒ Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.

Comments: *Refer to Architectural Site Plan*

☒ Summary of Pre-consultation Meetings with City and other approval agencies.

Comments: Refer to Appendix B for Pre-Consultation Meeting Notes

☒ Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.

Comments: *N/A*

☒ Statement of objectives and servicing criteria.

Comments: Refer to Servicing Report Section 2

☒ Identification of existing and proposed infrastructure available in the immediate area.

Comments: *Refer to Servicing Report Section 3.3 and 3.4. Refer to drawing C1.1-C1.5*

☒ Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).

Comments: Refer to Servicing Report Section 5.1

☒ Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.

Comments: *Refer to drawing C1.2-C1.3*

☒ Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.

Comments: *Refer to Servicing Report Section 5.2*

☒ Proposed phasing of the development, if applicable.

Comments: *N/A*

☒ Reference to geotechnical studies and recommendations concerning servicing.

Comments: Refer to Servicing Report Section 4.2

☒ All preliminary and formal site plan submissions should have the following information:

- ☒ Metric scale
- ☒ North arrow (including construction North)
- ☒ Key plan
- ☒ Name and contact information of applicant and property owner
- ☒ Property limits including bearings and dimensions
- ☒ Existing and proposed structures and parking areas
- ☒ Easements, road widening and rights-of-way
- ☒ Adjacent street names

Comments: *Refer to drawing C1.1-C1.5*

4.2 Development Servicing Report: Water

☒ Confirm consistency with Master Servicing Study, if available

Comments: Refer to Servicing Report Section 4.5.2

☒ Availability of public infrastructure to service proposed development

Comments: Refer to Servicing Report Section 3

☒ Identification of system constraints

Comments: N/A

☒ Identify boundary conditions

Comments: Refer to Servicing Report Section 4.5.4

☒ Confirmation of adequate domestic supply and pressure

Comments: *Refer to Servicing Report Section 4.5.4*

☒ Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.

Comments: *Refer to Servicing Report Section 4.5.3 and 4.5.3*

☒ Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.

Comments: Refer to Servicing Report Section 4.5.4

☒ Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design

Comments: N/A

☒ Address reliability requirements such as appropriate location of shut-off valves

Comments: Refer to Servicing Report Section 4.5.9

☒ Check on the necessity of a pressure zone boundary modification.

Comments: Refer to Servicing Report Section 4.5.10

☒ Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range

Comments: *Refer to Servicing Report Section 4.5*

☒ Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.

Comments: *Refer to Servicing Report Section 4.5.1*

☒ Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.

Comments: N/A

☒ Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.

Comments: *Refer to Servicing Report Section 4.5.2*

☒ Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.

Comments: Refer to Servicing Report - Appendix D

4.3 Development Servicing Report: Wastewater

☒ Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).

Comments: *Refer to Servicing Report Section 4.4.2*

☒ Confirm consistency with Master Servicing Study and/or justifications for deviations.

Comments: Refer to Servicing Report Section 4.4.2

☒ Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and condition of sewers.

Comments: *Refer to Servicing Report Section 4.4.2*

☒ Description of existing sanitary sewer available for discharge of wastewater from proposed development.

Comments: *Refer to Servicing Report Section 3.3*

☒ Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)

Comments: *Refer to Servicing Report Section 4.4.4*

☒ Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.

Comments: N/A

☒ Special considerations such as contamination, corrosive environment etc.

Comments: N/A

4.4 Development Servicing Report: Stormwater

☒ Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)

Comments: *Refer to SWM Report Section 2.2*

☒ Analysis of available capacity in existing public infrastructure.

Comments: *Refer to SWM Report Section 2.2*

☒ A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.

Comments: *Refer to drawing C1.1-C1.5*

☒ Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.

Comments: *Refer to SWM Report Section 1.4*

☒ Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.

Comments: Refer to SWM Report Section 1.4

☒ Description of the stormwater management concept with facility locations and descriptions with references and supporting information.

Comments: *Refer to SWM Report Section 3.2*

☒ Set-back from private sewage disposal systems.

Comments: *Refer to SWM Report Section 3.6*

☒ Watercourse and hazard lands setbacks.

Comments: Refer to SWM Report Section 3.6

☒ Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.

Comments: N/A

☒ Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.

Comments: *Refer to SWM Report Section 1.3 and 1.4*

☒ Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).

Comments: *Refer to SWM Report Section 3.2 and SWM Report - Appendix C*

☒ Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.

Comments: Refer to SWM Report Section 3.5

☒ Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.

Comments: *Refer to SWM Report Section 2 and 3. Also SWM Report - Appendix A-C.*

☒ Any proposed diversion of drainage catchment areas from one outlet to another.

Comments: Refer to SWM Report Section 3.4

☒ Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.

Comments: Refer to SWM Report Section 3, Appendix A - C, and drawing C1.1-C1.5

☒ If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.

Comments: N/A

☒ Identification of potential impacts to receiving watercourses

Comments: Refer to SWM Report Section 3.5

☒ Identification of municipal drains and related approval requirements.

Comments: Refer to SWM Report Section 3.5

☒ Descriptions of how the conveyance and storage capacity will be achieved for the development.

Comments: *Refer to SWM Report Section 3*

☒ 100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.

Comments: Refer to SWM Report Section 3 and drawings C1.1-C1.5

☒ Inclusion of hydraulic analysis including hydraulic grade line elevations.

Comments: Refer to SWM Report Section 3

☒ Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.

Comments: *Refer to SWM Report Section 4*

☒ Identification of floodplains - proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.

Comments: *Refer to SWM Report Section 3.5*

☒ Identification of fill constraints related to floodplain and geotechnical investigation.

Comments: *Refer to SWM Report Section 3.7*

4.5 Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

☐ Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.

Comments: Not applicable.

☐ Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.

Comments: Not applicable.

☐ Changes to Municipal Drains.

Comments: *Not applicable.*

☐ Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)

Comments: *Not applicable.*

4.6 Conclusion Checklist

☒ Clearly stated conclusions and recommendations

Comments:

☐ Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.

Comments: *Further comments to be added following site plan application review.*

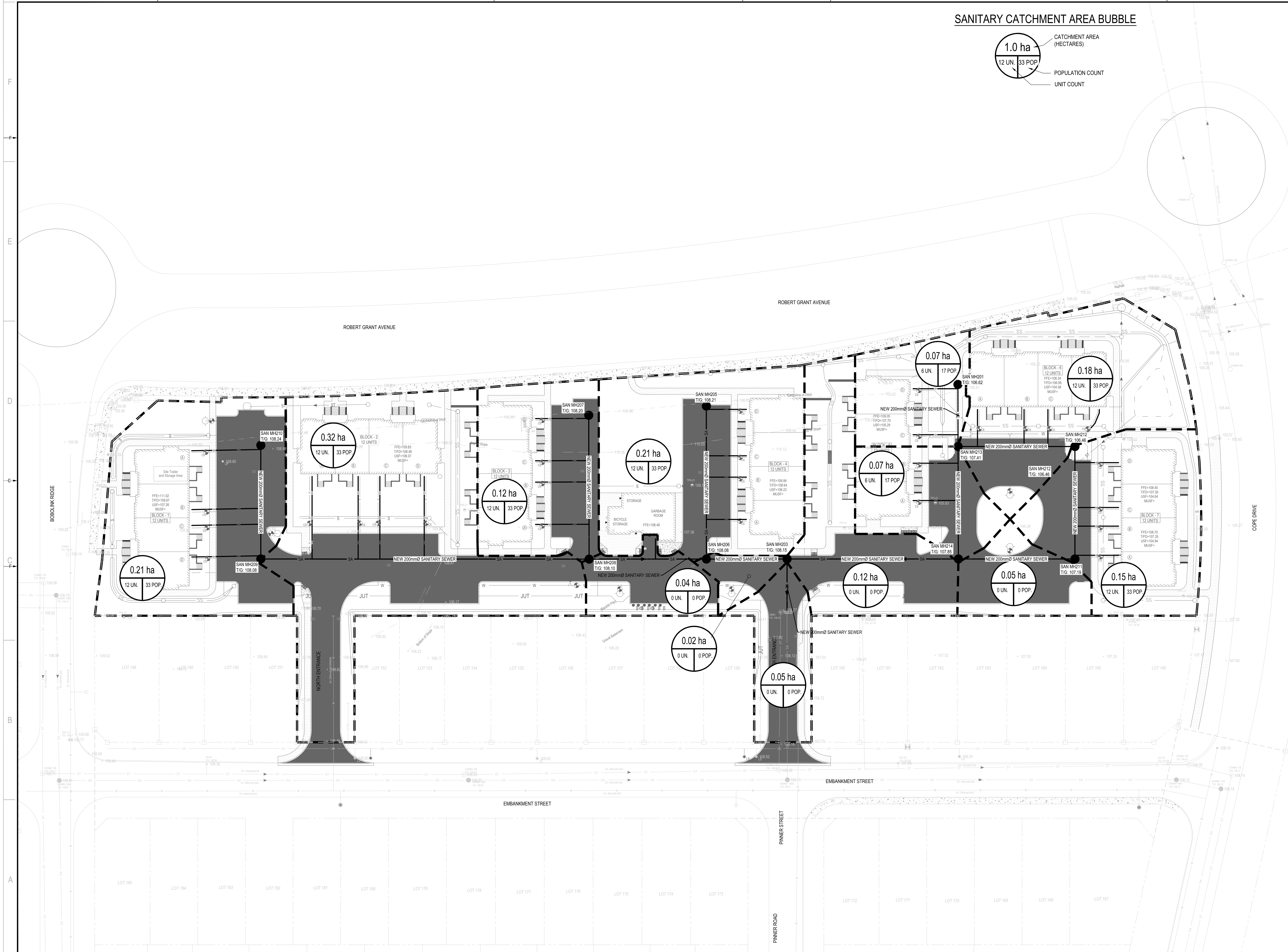
☒ All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario

Comments:

APPENDIX

C

SANITARY SYSTEM CALCULATION



wsp

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PHONE: 613-634-7373
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CONSULTANT:

M. David Blakely Architect Inc.
2200 Prince of Wales Dr. - Suite 101
Ottawa, Ontario K2E 6Z9
Phone (613) 226-6811 Fax (613) 226-7942

SEAL:

NORTH

CLIENT:

RICHCRAFT Group Of Companies

CLIENT REF. #:

PROJECT:

TERRACE FLATS

KEY PLAN:

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THIS DRAWING IS NOT TO BE SCALED.

ISSUED FOR - REVISION:

IS	RE	DATE	DESCRIPTION
1		2021/06/18	ISSUED FOR CLIENT REVIEW

PROJECT NO: 211-01221-00
DATE: MARCH 2021
ORIGINAL SCALE: 1:400
DESIGNED BY: DS
DRAWN BY: MH
CHECKED BY: SD
IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE.
25mm

DISCIPLINE: CIVIL

TITLE: SANITARY SEWER CATCHMENT MAP

SHEET NUMBER: SAN-SK1-1

SHEET #: 1 OF 1

ISSUE: ISSUED FOR DISTRIBUTION
REV #: 0
DATE OF: 2020/06/11

Table A1 - Proposed Development

DESIGNED BY: Daniel Searle, P.Eng.
CHECKED BY: Steve Davidson, P.Eng, OLS(ret.),MBA

Proposed Building Space Allocation

Building Type	Townhomes	Units/TWH	Cap/ Unit	Pop
Townnhouses	7	12	2.7	227
Total	**7**	**12**	**2.7**	**227**

Table A2 - Sanitary Sewer Calculation

DRAINAGE DESCRIPTION												OUTLET PIPE DATA				
AREA DESCRIPTION	From M.H.	To M.H.	Area (ha)	Population	Cumulative Area (ha)	Cumulative Population	Sewege Flow (L/s)	Peaking Factor (Corrected)	Peak Flow (L/s)	Extraneous Flow (L/s)	Total Flow, Q (L/s)	SIZE (mm)	Slope (%)	CAP (L/s)	Q/Qfull (%)	Full Flow Velocity (m/s)
Block 344	SAN MH210	SAN MH209	0.21	32.4	0.21	32	0.11	3.68	0.40	0.07	0.47	**200**	**1.00%**	32.36	**2%**	**1.04**
	SAN MH209	SAN MH208	0.32	32.4	0.53	65	0.21	3.64	0.76	0.17	0.93	**200**	**0.50%**	22.88	**5%**	**0.74**
	SAN MH207	SAN MH208	0.12	32.4	0.12	32	0.11	3.68	0.40	0.04	0.44	**200**	**1.00%**	32.36	**2%**	**1.04**
									0.00	0.00	0.00					
	SAN MH208	SAN MH206	0.04	0.0	0.69	97	0.32	3.60	1.15	0.23	1.38	**200**	**0.50%**	22.88	**7%**	**0.74**
	SAN MH205	SAN MH206	0.21	32.4	0.21	32	0.11	3.68	0.40	0.07	0.47	**200**	**1.00%**	32.36	**2%**	**1.04**
	SAN MH206	SAN MH203	0.02	0.0	0.92	130	0.42	3.57	1.50	0.30	1.80	**200**	**0.50%**	22.88	**8%**	**0.74**
	SAN MH212	SAN MH213	0.18	32.4	0.18	32	0.11	3.68	0.40	0.06	0.46	**200**	**0.40%**	20.46	**3%**	**0.66**
	SAN MH201	SAN MH213	0.07	16.2	0.07	16	0.05	3.72	0.19	0.02	0.21	**200**	**0.40%**	20.46	**2%**	**0.66**
	SAN MH213	SAN MH214	0.07	16.2	0.14	65	0.21	3.64	0.76	0.05	0.81	**200**	**0.40%**	20.46	**4%**	**0.66**
	SAN MH212	SAN MH211	0.15	32.4	0.15	32	0.11	3.68	0.40	0.05	0.45	**200**	**0.40%**	20.46	**3%**	**0.66**
	SAN MH211	SAN MH214	0.05	0.0	0.20	32	0.11	3.68	0.40	0.07	0.47	**200**	**0.40%**	20.46	**3%**	**0.66**
	SAN MH214	SAN MH203	0.12	0.0	0.46	97	0.32	3.60	1.15	0.15	1.30	**200**	**0.40%**	20.46	**7%**	**0.66**
	SAN MH203	EX. STUB	0.05	0.0	1.43	227	0.74	3.51	2.60	0.47	3.07	**200**	**0.40%**	20.46	**16%**	**0.66**

DESIGN PARAMETER

Average Daily Flow=	280 L/cap/day	Industrial Peak Factor=	N/A
Comm/Inst Flow=	N/A L/ha/day	Extraneous Flow (I&I) =	0.33 L/s/ha
Industrial Flow=	N/A L/ha/day	Minimum Velocity=	0.6 m/s
Res. Peak Factor=	2-0 - 4.0	Maximum Velocity =	3 m/s
		Manning n=	0.013
Comm/Inst Peak Factor=	N/A	Harmon - Correction Factor=	0.8

Designed By: Daniel Searle, P.Eng.

Checked By: Steve Davidson, P.Eng, OLS(ret.),MBA

Project Number: 211-01221-00

PROJECT: **Richcraft Terrace Flats**

LOCATION: **620 Bobolink Ridge (Block 344), Fernbank Phase 1 Ottawa, Ontario**

Date: 2021.06.15 | **Ref DWG.:** **SAN-SK1-1**

Notes:
1) Refer to Table A1 for population calculations.

IBI GROUP

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

IBI ASSUMED ALLOWANCE

SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK	PEAK	AREA (Ha)						PEAK	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY	AVAILABLE CAPACITY	
													INSTITUTIONAL		COMMERCIAL		INDUSTRIAL		FLOW									(full)		
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM	FACTOR	FLOW (L/s)	IND	CUM	IND	CUM	IND	CUM	(L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(m/s)	L/s	(%)
EMBANKMENT STREET	128AB	128A	188A	16				0.74	52.8	52.8	4.00	0.86		0.00		0.00		0.00	0.00	0.74	0.74	0.21	1.06	27.59	98.00	200	0.65	0.851	26.52	96.15
EMBANKMENT STREET	188A	188A	189A	11				0.52	36.3	89.1	4.00	1.44		0.00		0.00		0.00	0.00	0.52	1.26	0.35	1.80	27.59	74.80	200	0.65	0.851	25.79	93.49
BLOCK 344	RES.3	192A	189A					1.52	136.8	136.8	4.00	2.22		0.00		0.00		0.00	0.00	1.52	1.52	0.43	2.64	20.24	40.00	200	0.35	0.624	17.60	86.95
EMBANKMENT STREET	189A	189A	190A	14				0.69	46.2	272.1	4.00	4.41		0.00		0.00		0.00	0.00	0.69	3.47	0.97	5.38	20.24	92.53	200	0.35	0.624	14.86	73.42
EMBANKMENT STREET		190A	176A	0				0.00	0.0	272.1	4.00	4.41		0.00		0.00		0.00	0.00	0.00	3.47	0.97	5.38	20.24	10.78	200	0.35	0.624	14.86	73.42
BLOCK 345	INST.2	BULKHEAD	176A	0				0.00	0.0	0.0	4.00	0.00	6.53	6.53		0.00		0.00	5.67	6.53	6.53	1.83	7.50	20.24	21.00	200	0.35	0.624	12.75	62.97
COPE DRIVE	176A	176A	175A	3				0.63	9.9	282.0	4.00	4.57		6.53		0.00		0.00	5.67	0.63	10.63	2.98	13.21	20.24	76.03	200	0.35	0.624	7.03	34.72
COPE DRIVE	175A	175A	174A	5				0.46	16.5	298.5	4.00	4.84		6.53		0.00		0.00	5.67	0.46	11.09	3.11	13.61	20.24	84.94	200	0.35	0.624	6.63	32.76
BELSIZE WAY	127AB	127A	185A	11				0.53	36.3	36.3	4.00	0.59		0.00		0.00		0.00	0.00	0.53	0.53	0.15	0.74	27.59	88.50	200	0.65	0.851	26.85	97.33
BELSIZE WAY	185A	185A	186A	13				0.59	42.9	79.2	4.00	1.28		0.00		0.00		0.00	0.00	0.59	1.12	0.31	1.60	27.59	83.61	200	0.65	0.851	25.99	94.21
PINNER ROAD	191A	191A	186A	3				0.24	9.9	9.9	4.00	0.16		0.00		0.00		0.00	0.00	0.24	0.24	0.07	0.23	27.59	43.00	200	0.65	0.851	27.36	99.17
PINNER ROAD	186A	186A	187A	5				0.35	16.5	105.6	4.00	1.71		0.00		0.00		0.00	0.00	0.35	1.71	0.48	2.19	20.24	70.39	200	0.35	0.624	18.05	89.18
PINNER ROAD		187A	183A	0				0.00	0.0	105.6	4.00	1.71		0.00		0.00		0.00	0.00	0.00	1.71	0.48	2.19	20.24	9.00	200	0.35	0.624	18.05	89.18
FINSBURY AVENUE	182A	182A	183A	16				0.97	52.8	52.8	4.00	0.86		0.00		0.00		0.00	0.00	0.97	0.97	0.27	1.13	32.46	117.13	200	0.90	1.001	31.33	96.53
FINSBURY AVENUE	183A	183A	184A	4				0.33	13.2	171.6	4.00	2.78		0.00		0.00		0.00	0.00	0.33	3.01	0.84	3.62	20.24	65.71	200	0.35	0.624	16.62	82.10
FINSBURY AVENUE		184A	174A	0				0.00	0.0	171.6	4.00	2.78		0.00		0.00		0.00	0.00	0.00	3.01	0.84	3.62	20.24	17.89	200	0.35	0.624	16.62	82.10
COPE DRIVE	174A	174A	173A	7				0.47	23.1	493.2	3.98	7.95		6.53		0.00		0.00	5.67	0.47	14.57	4.08	17.69	31.02	82.90	250	0.25	0.612	13.33	42.96
COPE DRIVE	173A	173A	172A	6				0.41	19.8	513.0	3.97	8.25		6.53		0.00		0.00	5.67	0.41	14.98	4.19	18.11	31.02	76.02	250	0.25	0.612	12.91	41.62
BLOCK 313	INST.1	BULKHEAD	172A	0				0.00	0.0	0.0	4.00	0.00	2.88	2.88		0.00		0.00	2.50	2.88	2.88	0.81	3.31	20.24	16.00	200	0.35	0.624	16.94	83.67
COPE DRIVE	172A	172A	171B	3				0.23	9.9	522.9	3.96	8.40		9.41		0.00		0.00	8.17	0.23	18.09	5.07	21.63	31.02	36.96	250	0.25	0.612	9.39	30.27
COPE DRIVE	171B	171B	171A	2				0.22	6.6	529.5	3.96	8.50		9.41		0.00		0.00	8.17	0.22	18.31	5.13	21.79	31.02	41.21	250	0.25	0.612	9.23	29.75
DAGENHAM STREET	180A	180A	181A	7				0.50	23.1	23.1	4.00	0.37		0.00		0.00		0.00	0.00	0.50	0.50	0.14	0.51	20.24	90.00	200	0.35	0.624	19.73	97.46
DAGENHAM STREET	181A	181A	171A	0				0.11	0.0	23.1	4.00	0.37		0.00		0.00		0.00	0.00	0.11	0.61	0.17	0.55	20.24	67.50	200	0.35	0.624	19.70	97.31
COPE DRIVE	171A	171A	170B	1				0.17	3.3	555.9	3.95	8.90		9.41		0.00		0.00	8.17	0.17	19.09	5.35	22.41	45.12	37.91	300	0.20	0.618	22.71	50.33
COPE DRIVE	170B	170B	170A	3				0.25	9.9	565.8	3.95	9.04		9.41		0.00		0.00	8.17	0.25	19.34	5.42	22.63	45.12	43.98	300	0.20	0.618	22.49	49.84
BLOCK 312	RES.3A	BULKHEAD	sewer	0				3.26	195.6	195.6	4.00	3.17		0.00		0.00		0.00	0.00	3.26	3.26	0.91	4.08	20.24	16.22	200	0.35	0.624	16.16	79.83
COPE DRIVE	170A	170A	110A	6				0.62	19.8	781.2	3.87	12.24		9.41		0.00		0.00	8.17	0.62	23.22	6.50	26.91	45.12	120.00	300	0.20	0.618	18.21	40.36
GOLDHAWK DRIVE	306A	SOUTH	303A	31				1.83	102.3	102.3	4.00	1.66		0.00		0.00		0.00	0.00	1.83	1.83	0.51	2.17							
STREET NO. 26	304A	WEST	303A	14				0.69	46.2	46.2	4.00	0.75		0.00		0.00		0.00	0.00	0.69	0.69	0.19	0.94							
GOLDHAWK DRIVE	303A	303A	302A	10				0.62	33.0	181.5	4.00	2.94		0.00		0.00		0.00	0.00	0.62	3.14	0.88	3.82	20.24	94.58	200	0.35	0.624	16.42	81.13
Future Street	RES.5, 5A, Park3	EAST	302A					23.97	1421.4	1421.4	3.70	21.28		0.00		0.00		0.00	0.00	23.97	23.97	6.71	28.00							
GOLDHAWK DRIVE	302A	302A	301A	10				0.56	33.0	1635.9	3.65	24.20		0.00		0.00		0.00	0.00	0.56	27.67	7.75	31.95	50.44	70.68	300	0.25	0.691	18.49	36.66
GOLDHAWK DRIVE	301A	301A	207A	6				0.37	19.8	1655.7	3.65	24.47		0.00		0.00		0.00	0.00	0.37	28.04	7.85	32.32	50.44	70.00	300	0.25	0.691	18.12	35.93
STREET NO. 2	RES.4	EAST	207A					13.88	832.8	832.8	3.85	12.99		0.00		0.00		0.00	0.00	13.88	13.88	3.89	16.87							
GOLDHAWK DRIVE	207A	207A	206A	17				0.86	56.1	2544.6	3.50	36.10		0.00		0.00		0.00	0.00	0.86	42.78	11.98	48.08	70.84	107.19	375	0.15	0.621	22.76	32.13
GOLDHAWK DRIVE	206A	206A	205A	12				0.69	39.6	2584.2	3.50	36.60		0.00		0.00		0.00	0.00	0.69	43.47	12.17	48.78	70.84	106.61	375	0.15	0.621	22.07	31.15
GOLDHAWK DRIVE	205A	205A	110A	5				0.44	16.5	2600.7	3.49	36.81		0.00		0.00		0.00	0.00	0.44	43.91	12.29	49.11	70.84	100.61	375	0.15	0.621	21.73	30.68

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
   Harmon Formula = 1+(14/(4+P^0.5))
   where P = population in thousands

Designed: J.I.M.

Checked: P.K.

Dwg. Reference: 27970 - 501, 501A, 501B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference: 27970.5.7.1 | **Date:** 2017-07-14 | **Sheet No:** 3 of 4

IBI GROUP

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK FACTOR	PEAK FLOW	AREA (Ha)						PEAK FLOW	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY (full)	AVAILABLE CAPACITY	
													INSTITUTIONAL		COMMERCIAL		INDUSTRIAL													
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM		(L/s)	IND	CUM	IND	CUM	IND	CUM	(L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(m/s)	L/s	(%)
																							0.00							
	LSPS	Allowance						0.00	0.0	0.0													108.00							
	STITTSVILLE 6 PS		110A					0.00	0.0	0.0				0.00		0.00		0.00	0.00				84.00							
Future Street	INST.3	BLKHD	110A					0.00	0.0	0.0			2.47	2.47		0.00		0.00	2.14											
	PARK4	BLKHD	110A					0.83	0.0	0.0				0.00		0.00		0.00	0.00											
	PARK5	BLKHD	110A					1.04	0.0	0.0				0.00		0.00		0.00	0.00											
	RES.9	BLKHD	110A					34.81	2610.8	2610.8				0.00		0.00		0.00	0.00											
	RES.7	BLKHD	110A					4.24	318.0	318.0				0.00		0.00		0.00	0.00											
	RES.13	BLKHD	110A					2.22	133.2	133.2				0.00		0.00		0.00	0.00											
	RES.12	BLKHD	110A					43.89	2633.4	2633.4				0.00		0.00		0.00	0.00											
	INST.4	BLKHD	110A					0.00	0.0	0.0			2.44	2.44		0.00		0.00	2.12											
	COMM.	BLKHD	110A					0.00	0.0	0.0				0.00	0.63	0.63		0.00	0.55											
	HYD.4	BLKHD	110A					3.06	0.0	0.0				0.00		0.00		0.00	0.00											
	RES.8	BLKHD	110A					2.30	172.5	172.5				0.00		0.00		0.00	0.00											
	HYD.5	BLKHD	110A					5.20	0.0	0.0				0.00		0.00		0.00	0.00											
Future Street	RES.11	BLKHD	110A					6.91	414.6	414.6				0.00		0.00		0.00	0.00											
	PARK6	BLKHD	110A					1.19	0.0	0.0				0.00		0.00		0.00	0.00											
	RES.10	BLKHD	110A					1.92	115.2	115.2				0.00		0.00		0.00	0.00											
	HYD.3	BLKHD	110A					6.31	0.0	0.0				0.00		0.00		0.00	0.00											
TOTAL		**BLKHD**	**110A**					**113.92**		**6397.7**	**3.14**	**81.49**		**4.91**		**0.63**		**0.00**	**4.81**	**119.46**	**119.46**	**33.45**	**311.74**	**320.28**	**24.02**	**600**	**0.25**	**1.097**	**8.54**	**2.67**
GOLDHAWK DRIVE		**110A**	**109A**					**0.00**	**0.0**	**9779.6**	**2.96**	**117.43**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**186.59**	**52.25**	**374.66**	**378.96**	**61.28**	**600**	**0.35**	**1.298**	**4.30**	**1.14**
GOLDHAWK DRIVE	**110A**	**1101A**	**1092A**	**1**				**0.18**	**3.3**	**3.3**	**4.00**	**0.05**								**0.18**	**0.18**	**0.05**	**0.10**	**28.63**	**61.28**	**200**	**0.70**	**0.883**	**28.52**	**99.64**
GOLDHAWK DRIVE		**109A**	**108A**					**0.00**	**0.0**	**9782.9**	**2.96**	**117.47**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**186.77**	**52.30**	**374.74**	**378.96**	**57.50**	**600**	**0.35**	**1.298**	**4.22**	**1.11**
GOLDHAWK DRIVE	**109A**	**1091A**	**1082A**	**5**				**0.32**	**16.5**	**16.5**	**4.00**	**0.27**								**0.32**	**0.32**	**0.09**	**0.36**	**28.63**	**57.50**	**200**	**0.70**	**0.883**	**28.27**	**98.75**
GOLDHAWK DRIVE		**108A**	**107A**					**0.00**	**0.0**	**9799.4**	**2.96**	**117.64**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**187.09**	**52.39**	**375.00**	**378.96**	**53.32**	**600**	**0.35**	**1.298**	**3.96**	**1.05**
GOLDHAWK DRIVE	**108A**	**1081A**	**1072A**	**4**				**0.30**	**13.2**	**13.2**	**4.00**	**0.21**							**0.00**	**0.30**	**0.30**	**0.08**	**0.30**	**28.63**	**53.32**	**200**	**0.70**	**0.883**	**28.33**	**98.96**
GOLDHAWK DRIVE		**107A**	**106A**					**0.00**	**0.0**	**9812.6**	**2.96**	**117.77**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**187.39**	**52.47**	**375.22**	**378.96**	**62.94**	**600**	**0.35**	**1.298**	**3.74**	**0.99**
GOLDHAWK DRIVE	**107A**	**1071A**	**1062A**	**7**				**0.31**	**23.1**	**23.1**	**4.00**	**0.37**		**0.00**		**0.00**		**0.00**	**0.00**	**0.31**	**0.31**	**0.09**	**0.46**	**28.63**	**62.94**	**200**	**0.70**	**0.883**	**28.17**	**98.39**
GOLDHAWK DRIVE		**106A**	**105A**					**0.00**	**0.0**	**9835.7**	**2.96**	**118.01**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**187.70**	**52.56**	**375.54**	**378.96**	**60.09**	**600**	**0.35**	**1.298**	**3.42**	**0.90**
GOLDHAWK DRIVE	**106A**	**1061A**	**1052A**	**2**				**0.24**	**6.6**	**6.6**	**4.00**	**0.11**		**0.00**		**0.00**		**0.00**	**0.00**	**0.24**	**0.24**	**0.07**	**0.17**	**28.63**	**60.09**	**200**	**0.70**	**0.883**	**28.45**	**99.39**
		105A	**104A**					**0.00**	**0.0**	**10558.3**	**2.93**	**125.37**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**200.47**	**56.13**	**386.48**	**389.64**	**72.85**	**600**	**0.37**	**1.335**	**3.16**	**0.81**
GOLDHAWK DRIVE	**105A**	**1051A**	**1042A**	**7**				**0.45**	**23.1**	**23.1**	**4.00**	**0.37**								**0.45**	**0.45**	**0.13**	**0.50**	**27.59**	**72.85**	**200**	**0.65**	**0.851**	**27.09**	**98.19**
GOLDHAWK DRIVE		**104A**	**103A**					**0.00**	**0.0**	**10581.4**	**2.93**	**125.60**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**200.92**	**56.26**	**386.84**	**389.64**	**48.77**	**600**	**0.37**	**1.335**	**2.80**	**0.72**
GOLDHAWK DRIVE	**104A**	**1041A**	**1032A**	**9**				**0.47**	**29.7**	**29.7**	**4.00**	**0.48**							**0.00**	**0.47**	**0.47**	**0.13**	**0.61**	**27.59**	**48.77**	**200**	**0.65**	**0.851**	**26.97**	**97.78**
GOLDHAWK DRIVE		**103A**	**102A**					**0.00**	**0.0**	**10611.1**	**2.93**	**125.90**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**201.39**	**56.39**	**387.27**	**389.64**	**45.00**	**600**	**0.37**	**1.335**	**2.37**	**0.61**
GOLDHAWK DRIVE	**103A, HYD1**	**1031A**	**1021A**	**6**				**2.01**	**19.8**	**19.8**	**4.00**	**0.32**							**0.00**	**2.01**	**2.01**	**0.56**	**0.88**	**27.59**	**45.00**	**200**	**0.65**	**0.851**	**26.70**	**96.80**
GOLDHAWK DRIVE	**102A**	**102A**	***FT-24 (EX)***					**0.12**	**0.0**	**10630.9**	**2.93**	**126.10**		**14.32**		**0.63**		**0.00**	**12.98**	**0.12**	**203.52**	**56.99**	**388.07**	**389.64**	**102.59**	**600**	**0.37**	**1.335**	**1.57**	**0.40**
HYDRO EASEMENT		***FT-24 (EX)***	***FT-23 (EX)***					**0.00**	**0.0**	**10650.7**	**2.93**	**126.30**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**205.53**	**57.55**	**388.83**	**400.03**	**107.50**	**600**	**0.39**	**1.371**	**11.20**	**2.80**

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
   Harmon Formula = 1+(14/(4+P^0.5))
   where P = population in thousands

Designed: J.I.M.

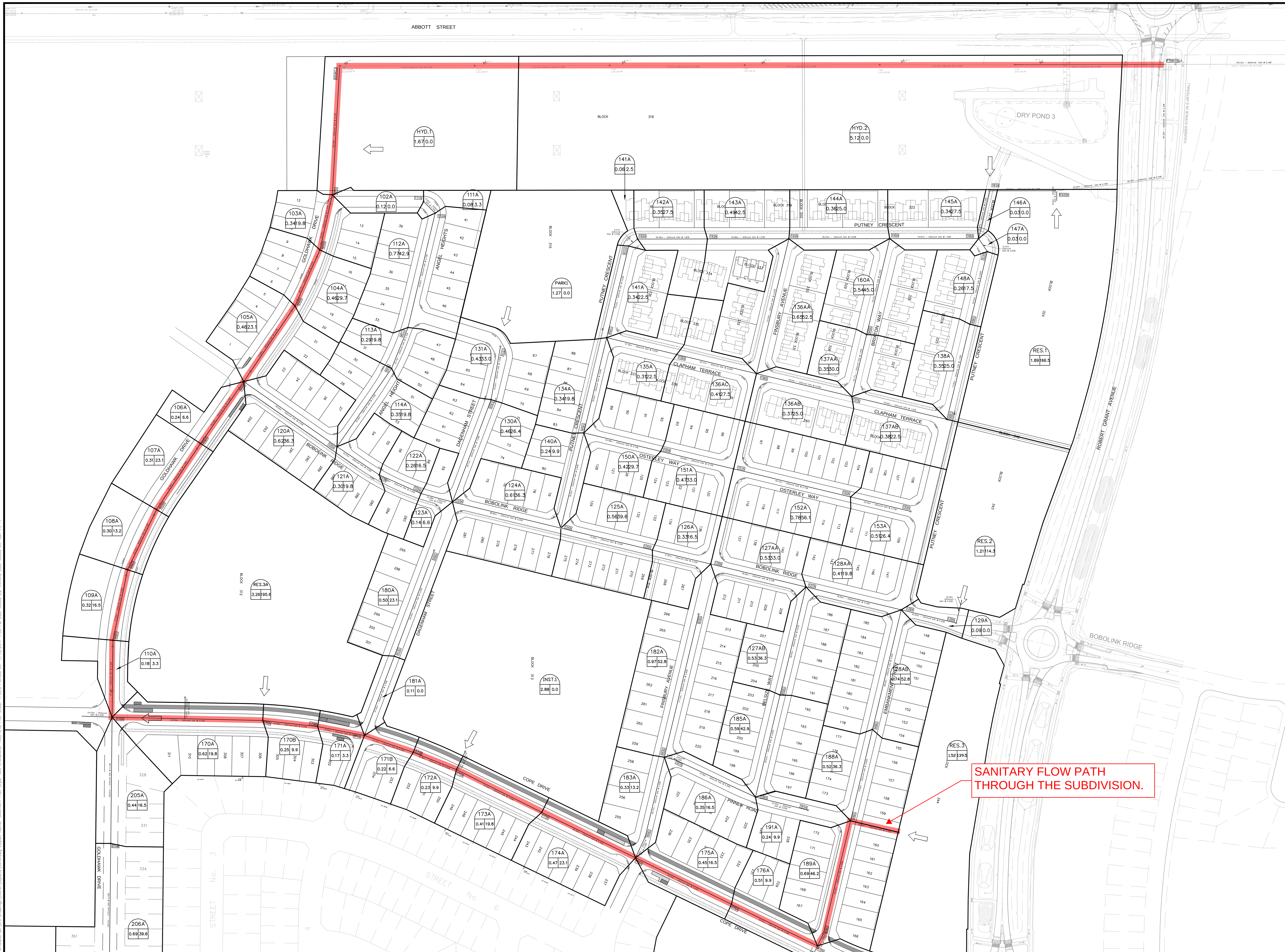
Checked: P.K.

Dwg. Reference: 27970 - 501, 501A, 501B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	4 of 4

ALL SEWERS REPORTING AVAILABLE CAPACITY IN ESCESS OF 0.85 L/S.



CONT'D ON DWG 27970-501B

REVIEWED BY DEVELOPMENT REVIEW SERVICES BRANCH

Signed

Date 2017

Plan Number

LEGEND :

145A — AREA ID #

0.34 — AREA IN HECTARES; 27.5 — POPULATION

⇨ FUTURE MINOR FLOW DIRECTION

NOTES:

1. THIS ALLOWANCE IS FOR OPA66 EXPANSION AREAS 6a, 6b AND 6c.

2. AN ALLOWANCE OF 100l/s HAS BEEN MADE FOR FLOWS TRIBUTARY TO THE LAIRD STREET PUMP STATION.

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

IBI GROUP
400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

SANITARY DRAINAGE
AREA PLAN

Scale 1:1250

Design	Date
J.I.M.	OCTOBER '12
Drawn	**Checked**
M.M.	P.K.
Project No.	**Drawing No.**
27970	501A

D07-16-11-0003

#17366

APPENDIX

D

WATER SYSTEM CALCULATIONS & MODELLING RESULT

Table A4 - Fire Flow Calculation

Richcraft Terrace Flats
FIRE UNDERWRITERS SURVEY FIRE FLOW CALCULATION

A = 813 sq.m 8751 sq.ft (See FUS for high buildings)

Formula F = 220 x c x Sq. Root "A"

F = the required fire flow in litres per minute c = the coefficient related to type of construction
A = Floor Area (See FUS)

STEP 1: TYPE OF CONSTRUCTION TO DETERMINE "c" COEFFICIENT

c: 1.5 for Wood Frame Construction c: 1.0 for Ordinary Construction
c: 0.8 for Non-Combustible Construction c: 0.6 for Fire-Resistive Construction

F= 220 x c 1.5 x Sq. Root "A" 28.5 = 9409.3

STEP 2: INCREASE OR DECREASE FOR OCCUPANCY

Non-Combustible (+ 75%) Charge: Limited Combustible (+ 85%) Charge: Combustible (+ 100%)
Free Burning (+115%) Charge: Rapid Burning (+125%) Charge

"APPLY ONE OF THESE CHARGES TO THE VALUE OBTAINED IN STEP 1 ROUNDED OFF TO THE NEAREST 1000"

Value from Step 1 9000.0 x Charge 0.85 = 7650

STEP 3: DETERMINE THE DECREASE FOR SPRINKLER SYSTEM (See FUS for Details)

For Complete Automatic Sprinkler Protection (full supervision) -50%
For Automatic Sprinkler System Conforming to NFPA 13 -30%

Value from Step 2 7650 x Above Value 0 = 0

Value from Step 2 7650 - Answer from Above 0 = 7650

STEP 4: INCREASE FOR EXPOSURE FROM OTHER BUILDINGS

0 to 3 m (+ 25%); 3.1 to 10 m (+20%), 10.1 to 20 m (+ 15%); 20.1 to 30 m (+ 10%); 30.1 to 45 m (+ 5%)

THE TOTAL % SHALL BE THE SUM OF THE % FOR ALL SIDES, BUT SHALL NOT EXCEED 75%

Value from Step 2	7650	x	North Side Step Charge	0.20	=	1530
Value from Step 2	7650	x	East Side Step Charge	0.00	=	0
Value from Step 2	7650	x	South Side Step Charge	0.15	=	1147.5
Value from Step 2	7650	x	West Side Step Charge	0.10	=	765
**Townhome (Block 3) - Greatest Exposure*						
			Total	0.45	=	3442.5

Value from Step 3 7650 + Total 3442.5 = 11092.5

STEP 5: TO DETERMINE THE FIRE FLOW

Round to nearest 1000

Take Value from Step 4 11000 Divide by 60 = 183.3 L/S

Designed By: Daniel Searle, P.Eng.	**Date:** 2021.06.18
Checked By: Steve Davidson, P.Eng., OLS (Ret.), MBA	**Project Number:** 211-01221-00

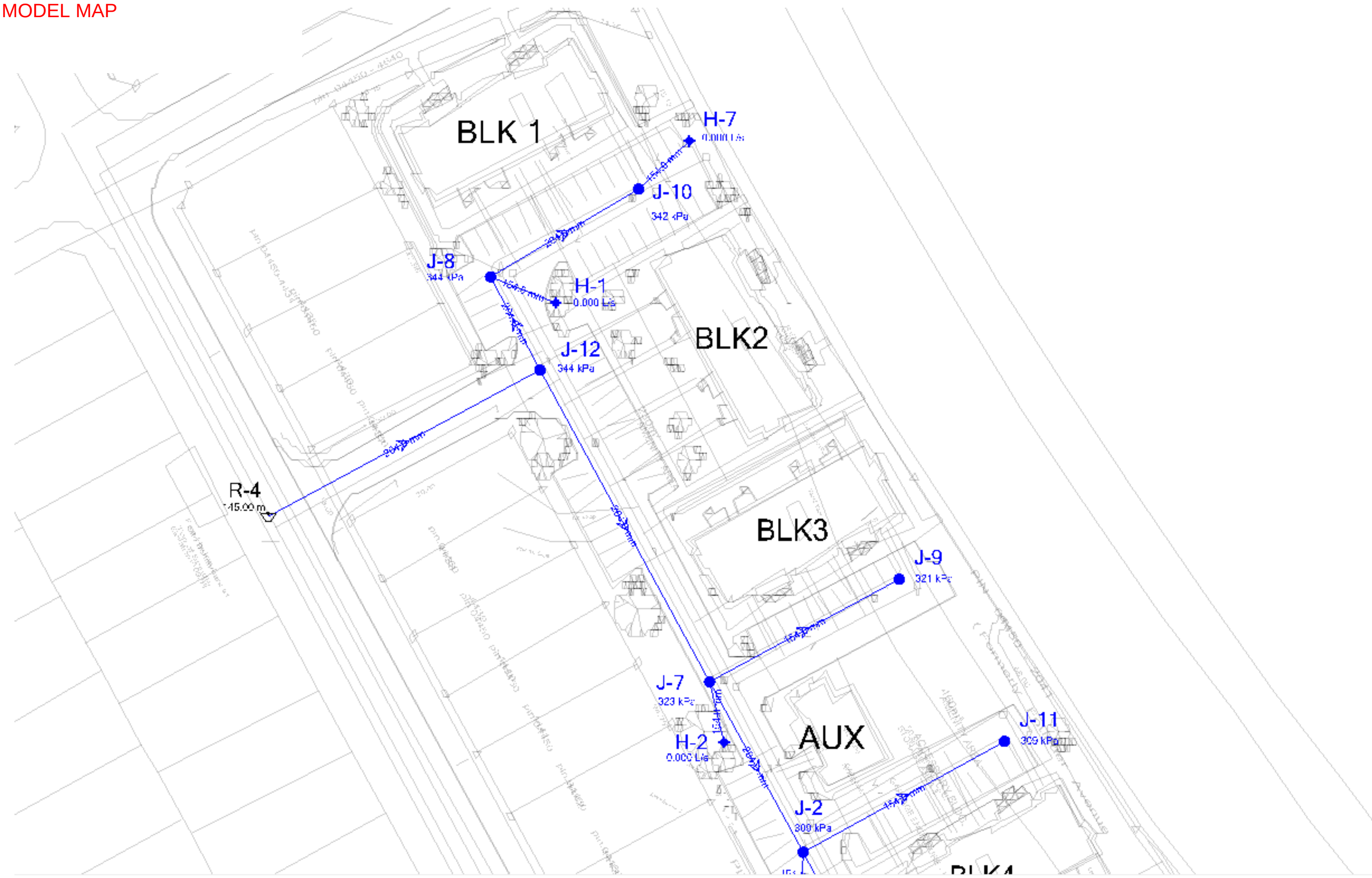
Table A3 - Watermain Demands
Richcraft Terrace Flats

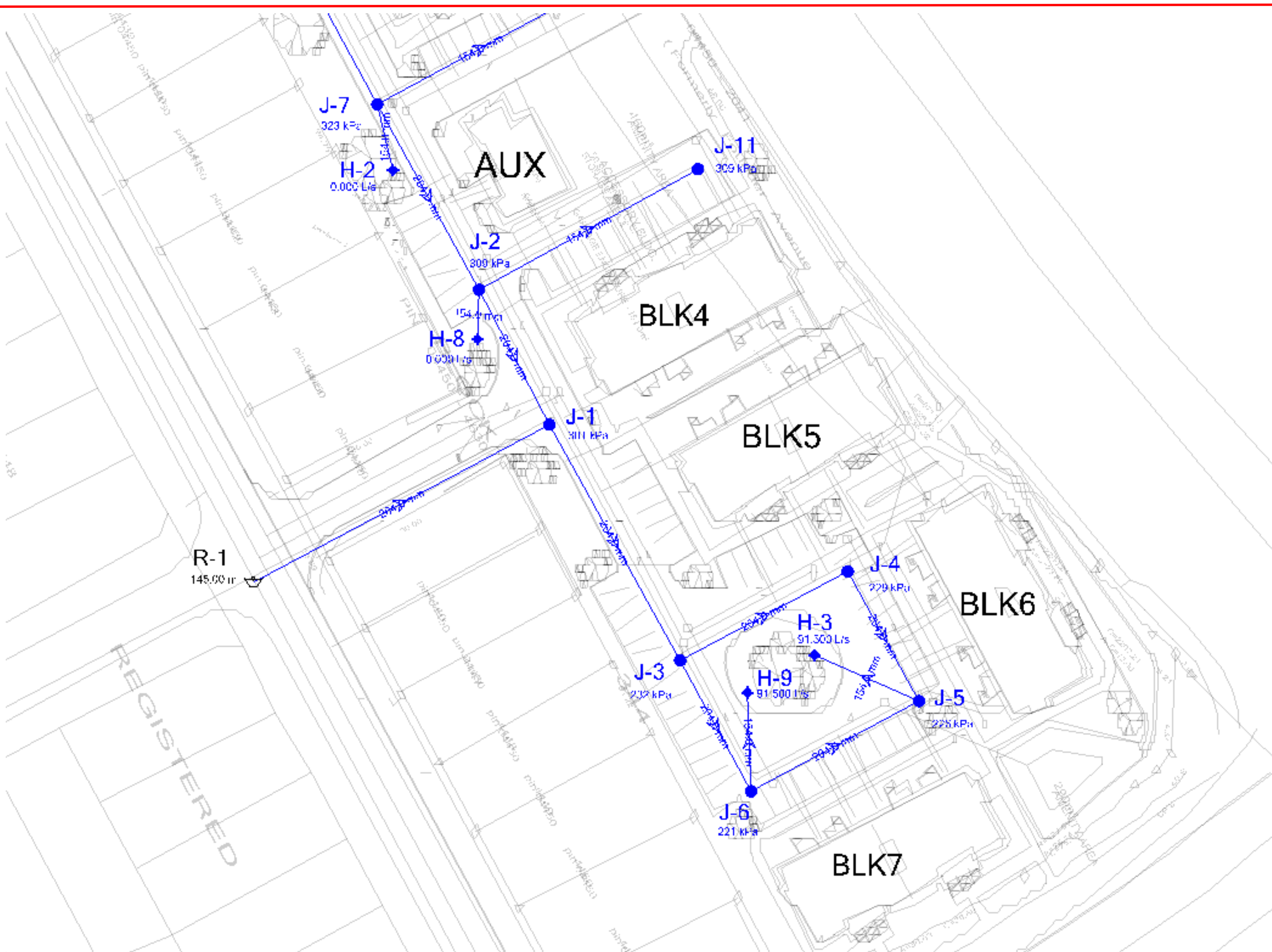
WATERMAIN DEMAND CALCULATIONS				COMMENTS
Average Day Flow:				
				Unit Count = 7 Townhouses @ 12 units = 84 units
				Population Density per Unit (2.7 cap/unit) per Ottawa Design Guidelines - Water Distribution - 2010 (Table 4.1)
ADF =	79,380 L/d	=	0.92 L/s	ADF demand (350 l/c/day) as dedicated by IBI Subdivision Servicing Report (Design Brief - CRT Lands Phase 1 - Fernbank Community) dated July 2017.
ADF_{TOTAL} =	79,380 L/d	=	0.92 L/s	Sum of ADF
Maximum Day Flow:				
Maximum Day Factor =	4.02			MECP Design Guidelines for Drinking-Water Systems, Table 3-3: Peaking Factors (Interpolated)
MDF_{BLDG} =	319,108 L/d	=	3.69 L/s	ADF multiplied by Maximum Day Factor
MDF_{TOTAL} =	319,108 L/d	=	3.69 L/s	Sum of MDF
Peak Hour Flow:				
Peak Hour Factor =	6.04			MECP Design Guidelines for Drinking-Water Systems, Table 3-3: Peaking Factors (Interpolated)
PHF_{BLDG} =	479,455 L/d	=	5.55 L/s	ADF multiplied by Peak Hour Factor
PHF_{TOTAL} =	479,455 L/d	=	5.55 L/s	Sum of PHF

Commentary:
Refer to Section 4.5 of te Servicing Report for details related to water system sizing/modelling.

Designed By: Daniel Searle, P.Eng.	**Project:** Richcraft Terrace Flats
Checked By: Steve Davidson, P.Eng., OLS (Ret.), MBA	**Location:** Block 344, Fernbank Phase 1, Ottawa, Ontario
Project Number: 211-01221-00	**Dwg. Reference:** N/A

MODEL MAP


BLK 1
H-7
J-10
342 kPa
J-8
344 kPa
H-1
0.000 L/s
BLK2
J-12
344 kPa
R-4
145.00 m
BLK3
J-9
321 kPa
J-7
323 kPa
H-2
0.000 L/s
AUX
J-11
309 kPa
J-2
309 kPa


J-7
323 kPa
H-2
0.000 L/s
AUX
J-11
309 kPa
J-2
309 kPa
BLK4
H-8
J-1
BLK5
R-1
145.00 m
J-4
229 kPa
BLK6
H-3
91.300 L/s
H-9
91.500 L/s
J-3
232 kPa
J-5
J-6
221 kPa
BLK7
REGISTERED

Richcraft Terrrace Flats - Water Model

Hydraulic Model Properties

Title	Richcraft Terrace Flats - Block 344
Engineer	Daniel Searle, P.Eng.
Company	WSP Canada Inc.
Date	5/4/2021
Notes	

Scenario Summary

ID	1
Label	Average Day Demand
Notes	
Active Topology	Base Active Topology
User Data Extensions	Base User Data Extensions
Physical	ADD
Demand	Average Day
Initial Settings	Base Initial Settings
Operational	Base Operational
Age	Base Age
Constituent	Base Constituent
Trace	Base Trace
Fire Flow	Base Fire Flow
Energy Cost	Base Energy Cost
Pressure Dependent Demand	Base Pressure Dependent Demand
Transient	Base Transient
Failure History	Base Failure History
SCADA	Base SCADA
Steady State / EPS Solver Calculation Options	Average Day
Transient Solver Calculation Options	Base Calculation Options

Hydraulic Summary

Time Analysis Type	Steady State	Simulation Start Date	1/1/2000
Friction Method	Hazen-Williams	Hydraulic Time Step	1.000
Accuracy	0.001	Duration	24.000
Trials	40	Calculation Type	Hydraulics Only

Junction Table - Time: 0.00 hours

ID	Label	Elevation (m)	Demand (L/s)	Unit Demand Collection <Count>	Demand Adjusted Population (Capita)	Hydraulic Grade (m)
31	J-1	105.43	0.000	0	0	161.20
32	J-2	105.48	0.000	0	0	161.20
33	J-3	105.30	0.000	0	0	161.20
34	J-4	104.53	0.131	1	32	161.20
35	J-5	103.81	0.263	1	65	161.20
36	J-6	104.47	0.000	0	0	161.20
37	J-7	105.42	0.000	0	0	161.20

Richcraft Terrrace Flats - Water Model

Junction Table - Time: 0.00 hours

ID	Label	Elevation (m)	Demand (L/s)	Unit Demand Collection <Count>	Demand Adjusted Population (Capita)	Hydraulic Grade (m)
38	J-8	105.43	0.131	1	32	161.20
54	J-9	105.54	0.131	1	32	161.20
55	J-10	105.56	0.131	1	32	161.20
68	J-11	105.57	0.131	1	32	161.20
117	J-12	105.43	0.000	0	0	161.20

Pressure (kPa)
546
545
547
555
562
555
546
546
545
545
544
546

Pipe Table - Time: 0.00 hours

ID	Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
43	P-2	32	J-2	J-7	204.0	PVC
44	P-3	23	J-1	J-2	204.0	PVC
45	P-4	41	J-1	J-3	204.0	PVC
46	P-5	22	J-3	J-6	204.0	PVC
47	P-6	29	J-6	J-5	204.0	PVC
48	P-7	22	J-4	J-5	204.0	PVC
49	P-8	29	J-3	J-4	204.0	PVC
50	P-9	51	R-1	J-1	204.0	PVC
51	P-10	10	J-7	H-2	154.0	PVC
52	P-11	12	J-8	H-1	154.0	PVC
53	P-12	17	J-5	H-3	154.0	PVC
66	P-13	28	J-8	J-10	204.0	PVC
67	P-14	35	J-7	J-9	154.0	PVC
69	P-15	38	J-2	J-11	154.0	PVC

Hazen-Williams C	Flow (L/s)	Velocity (m/s)
110.0	-0.051	0.00
110.0	0.080	0.00
110.0	0.394	0.01
110.0	0.178	0.01
110.0	0.178	0.01

Richcraft Terrrace Flats - Water Model

Pipe Table - Time: 0.00 hours

Hazen-Williams C	Flow (L/s)	Velocity (m/s)
110.0	0.085	0.00
110.0	0.216	0.01
110.0	0.474	0.01
100.0	0.000	0.00
100.0	0.000	0.00
100.0	0.000	0.00
110.0	0.131	0.00
100.0	0.131	0.01
100.0	0.131	0.01

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Flow (Out net) (L/s)	Hydraulic Grade (m)
30	R-1	161.20	0.474	161.20

Richcraft Terrrace Flats - Water Model

Scenario Summary

ID	57
Label	Maximum Hourly Demand
Notes	
Active Topology	Base Active Topology
User Data Extensions	Base User Data Extensions
Physical	MHD
Demand	Average Day
Initial Settings	Base Initial Settings
Operational	Base Operational
Age	Base Age
Constituent	Base Constituent
Trace	Base Trace
Fire Flow	Base Fire Flow
Energy Cost	Base Energy Cost
Pressure Dependent Demand	Base Pressure Dependent Demand
Transient	Base Transient
Failure History	Base Failure History
SCADA	Base SCADA
Steady State / EPS Solver Calculation Options	MHD
Transient Solver Calculation Options	Base Calculation Options

Hydraulic Summary

Time Analysis Type	Steady State	Simulation Start Date	1/1/2000
Friction Method	Hazen-Williams	Hydraulic Time Step	1.000
Accuracy	0.001	Duration	24.000
Trials	40	Calculation Type	Hydraulics Only

Junction Table - Time: 0.00 hours

ID	Label	Elevation (m)	Demand (L/s)	Unit Demand Collection <Count>	Demand Adjusted Population (Capita)	Hydraulic Grade (m)
31	J-1	105.43	0.000	0	0	156.39
32	J-2	105.48	0.000	0	0	156.39
33	J-3	105.30	0.000	0	0	156.39
34	J-4	104.53	0.793	1	32	156.39
35	J-5	103.81	1.586	1	65	156.39
36	J-6	104.47	0.000	0	0	156.39
37	J-7	105.42	0.000	0	0	156.39
38	J-8	105.43	0.793	1	32	156.39
54	J-9	105.54	0.793	1	32	156.39
55	J-10	105.56	0.793	1	32	156.39
68	J-11	105.57	0.793	1	32	156.39
117	J-12	105.43	0.000	0	0	156.39

Pressure (kPa)

Richcraft Terrrace Flats - Water Model

Junction Table - Time: 0.00 hours

Pressure (kPa)
499
498
500
508
515
508
499
499
498
497
497
499

Pipe Table - Time: 0.00 hours

ID	Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
43	P-2	32	J-2	J-7	204.0	PVC
44	P-3	23	J-1	J-2	204.0	PVC
45	P-4	41	J-1	J-3	204.0	PVC
46	P-5	22	J-3	J-6	204.0	PVC
47	P-6	29	J-6	J-5	204.0	PVC
48	P-7	22	J-4	J-5	204.0	PVC
49	P-8	29	J-3	J-4	204.0	PVC
50	P-9	51	R-1	J-1	204.0	PVC
51	P-10	10	J-7	H-2	154.0	PVC
52	P-11	12	J-8	H-1	154.0	PVC
53	P-12	17	J-5	H-3	154.0	PVC
66	P-13	28	J-8	J-10	204.0	PVC
67	P-14	35	J-7	J-9	154.0	PVC
69	P-15	38	J-2	J-11	154.0	PVC

Hazen-Williams C	Flow (L/s)	Velocity (m/s)
110.0	-0.315	0.01
110.0	0.477	0.01
110.0	2.378	0.07
110.0	1.081	0.03
110.0	1.081	0.03
110.0	0.505	0.02
110.0	1.298	0.04
110.0	2.856	0.09
100.0	0.000	0.00
100.0	0.000	0.00
100.0	0.000	0.00
110.0	0.793	0.02
100.0	0.793	0.04
100.0	0.793	0.04

Richcraft Terrrace Flats - Water Model

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Flow (Out net) (L/s)	Hydraulic Grade (m)
30	R-1	156.40	2.856	156.40

Richcraft Terrrace Flats - Water Model

Scenario Summary

ID	132
Label	Max Day + Split Fire Flow (Block 1 & 2)
Notes	
Active Topology	Base Active Topology
User Data Extensions	Base User Data Extensions
Physical	MDD+FF
Demand	MDD+FF (Split FF - Blk 1 &2)
Initial Settings	Base Initial Settings
Operational	Base Operational
Age	Base Age
Constituent	Base Constituent
Trace	Base Trace
Fire Flow	Base Fire Flow
Energy Cost	Base Energy Cost
Pressure Dependent Demand	Base Pressure Dependent Demand
Transient	Base Transient
Failure History	Base Failure History
SCADA	Base SCADA
Steady State / EPS Solver Calculation Options	MDD+FF (Split HYD Demand)
Transient Solver Calculation Options	Base Calculation Options

Hydraulic Summary

Time Analysis Type	Steady State	Simulation Start Date	1/1/2000
Friction Method	Hazen-Williams	Hydraulic Time Step	1.000
Accuracy	0.001	Duration	24.000
Trials	40	Calculation Type	Hydraulics Only

Junction Table - Time: 0.00 hours

ID	Label	Elevation (m)	Demand (L/s)	Unit Demand Collection <Count>	Demand Adjusted Population (Capita)	Hydraulic Grade (m)	Pressure (kPa)
31	J-1	105.43	0.000	0	0	140.53	
32	J-2	105.48	0.000	0	0	139.63	
33	J-3	105.30	0.000	0	0	140.53	
34	J-4	104.53	0.528	1	32	140.53	
35	J-5	103.81	1.055	1	65	140.53	
36	J-6	104.47	0.000	0	0	140.53	
37	J-7	105.42	0.000	0	0	138.35	
38	J-8	105.43	0.528	1	32	132.29	
54	J-9	105.54	0.528	1	32	138.35	
55	J-10	105.56	0.528	1	32	130.82	
68	J-11	105.57	0.528	1	32	139.63	
117	J-12	105.43	0.000	0	0	136.25	

Richcraft Terrrace Flats - Water Model

Junction Table - Time: 0.00 hours

Pressure (kPa)
343
334
345
352
359
353
322
263
321
247
333
302

Pipe Table - Time: 0.00 hours

ID	Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
43	P-2	32	J-2	J-7	204.0	PVC
44	P-3	23	J-1	J-2	204.0	PVC
45	P-4	41	J-1	J-3	204.0	PVC
46	P-5	22	J-3	J-6	204.0	PVC
47	P-6	29	J-6	J-5	204.0	PVC
48	P-7	22	J-4	J-5	204.0	PVC
49	P-8	29	J-3	J-4	204.0	PVC
50	P-9	51	R-1	J-1	204.0	PVC
51	P-10	10	J-7	H-2	154.0	PVC
52	P-11	12	J-8	H-1	154.0	PVC
53	P-12	17	J-5	H-3	154.0	PVC
66	P-13	28	J-8	J-10	204.0	PVC
67	P-14	35	J-7	J-9	154.0	PVC
69	P-15	38	J-2	J-11	154.0	PVC

Hazen-Williams C	Flow (L/s)	Velocity (m/s)
110.0	75.284	2.30
110.0	75.812	2.32
110.0	1.583	0.05
110.0	0.718	0.02
110.0	0.718	0.02
110.0	0.337	0.01
110.0	0.865	0.03
110.0	77.395	2.37
100.0	0.000	0.00
100.0	91.500	4.91
100.0	0.000	0.00
110.0	92.028	2.82
100.0	0.528	0.03
100.0	0.528	0.03

Richcraft Terrrace Flats - Water Model

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Flow (Out net) (L/s)	Hydraulic Grade (m)
30	R-1	145.00	77.395	145.00

Hydrant Table - Time: 0.00 hours

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
39	H-1	108.86	91.500	127.08	178
40	H-2	108.72	0.000	138.35	290
41	H-3	107.70	0.000	140.53	321
122	H-7	0.00	91.500	125.63	1,230
124	H-8	0.00	0.000	139.63	1,367
126	H-9	0.00	0.000	140.53	1,375

Richcraft Terrrace Flats - Water Model

Scenario Summary

ID	134
Label	Max Day + Split Fire Flow (Block 3 & 4)
Notes	
Active Topology	Base Active Topology
User Data Extensions	Base User Data Extensions
Physical	MDD+FF
Demand	MDD+FF (Split FF - Blk 3 &4)
Initial Settings	Base Initial Settings
Operational	Base Operational
Age	Base Age
Constituent	Base Constituent
Trace	Base Trace
Fire Flow	Base Fire Flow
Energy Cost	Base Energy Cost
Pressure Dependent Demand	Base Pressure Dependent Demand
Transient	Base Transient
Failure History	Base Failure History
SCADA	Base SCADA
Steady State / EPS Solver Calculation Options	MDD+FF (Split HYD Demand)
Transient Solver Calculation Options	Base Calculation Options

Hydraulic Summary

Time Analysis Type	Steady State	Simulation Start Date	1/1/2000
Friction Method	Hazen-Williams	Hydraulic Time Step	1.000
Accuracy	0.001	Duration	24.000
Trials	40	Calculation Type	Hydraulics Only

Junction Table - Time: 0.00 hours

ID	Label	Elevation (m)	Demand (L/s)	Unit Demand Collection <Count>	Demand Adjusted Population (Capita)	Hydraulic Grade (m)
31	J-1	105.43	0.000	0	0	137.86
32	J-2	105.48	0.000	0	0	136.45
33	J-3	105.30	0.000	0	0	137.86
34	J-4	104.53	0.528	1	32	137.86
35	J-5	103.81	1.055	1	65	137.86
36	J-6	104.47	0.000	0	0	137.86
37	J-7	105.42	0.000	0	0	136.44
38	J-8	105.43	0.528	1	32	139.23
54	J-9	105.54	0.528	1	32	136.44
55	J-10	105.56	0.528	1	32	139.23
68	J-11	105.57	0.528	1	32	136.45
117	J-12	105.43	0.000	0	0	139.23

Pressure (kPa)

Richcraft Terrrace Flats - Water Model

Junction Table - Time: 0.00 hours

Pressure (kPa)
317
303
319
326
333
327
304
331
302
329
302
331

Pipe Table - Time: 0.00 hours

ID	Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
43	P-2	32	J-2	J-7	204.0	PVC
44	P-3	23	J-1	J-2	204.0	PVC
45	P-4	41	J-1	J-3	204.0	PVC
46	P-5	22	J-3	J-6	204.0	PVC
47	P-6	29	J-6	J-5	204.0	PVC
48	P-7	22	J-4	J-5	204.0	PVC
49	P-8	29	J-3	J-4	204.0	PVC
50	P-9	51	R-1	J-1	204.0	PVC
51	P-10	10	J-7	H-2	154.0	PVC
52	P-11	12	J-8	H-1	154.0	PVC
53	P-12	17	J-5	H-3	154.0	PVC
66	P-13	28	J-8	J-10	204.0	PVC
67	P-14	35	J-7	J-9	154.0	PVC
69	P-15	38	J-2	J-11	154.0	PVC

Hazen-Williams C	Flow (L/s)	Velocity (m/s)
110.0	4.849	0.15
110.0	96.877	2.96
110.0	1.583	0.05
110.0	0.718	0.02
110.0	0.718	0.02
110.0	0.337	0.01
110.0	0.865	0.03
110.0	98.460	3.01
100.0	91.500	4.91
100.0	0.000	0.00
100.0	0.000	0.00
110.0	0.528	0.02
100.0	0.528	0.03
100.0	0.528	0.03

Richcraft Terrrace Flats - Water Model

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Flow (Out net) (L/s)	Hydraulic Grade (m)
30	R-1	145.00	98.460	145.00

Hydrant Table - Time: 0.00 hours

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
39	H-1	108.86	0.000	139.23	297
40	H-2	108.72	91.500	131.54	223
41	H-3	107.70	0.000	137.86	295
122	H-7	0.00	0.000	139.23	1,363
124	H-8	0.00	91.500	132.18	1,294
126	H-9	0.00	0.000	137.86	1,349

Richcraft Terrrace Flats - Water Model

Scenario Summary

ID	135
Label	Max Day + Split Fire Flow (Block 5 , 6, & 7)
Notes	
Active Topology	Base Active Topology
User Data Extensions	Base User Data Extensions
Physical	MDD+FF
Demand	MDD+FF (Split FF - Blk 5,6, &7)
Initial Settings	Base Initial Settings
Operational	Base Operational
Age	Base Age
Constituent	Base Constituent
Trace	Base Trace
Fire Flow	Base Fire Flow
Energy Cost	Base Energy Cost
Pressure Dependent Demand	Base Pressure Dependent Demand
Transient	Base Transient
Failure History	Base Failure History
SCADA	Base SCADA
Steady State / EPS Solver Calculation Options	MDD+FF (Split HYD Demand)
Transient Solver Calculation Options	Base Calculation Options

Hydraulic Summary

Time Analysis Type	Steady State	Simulation Start Date	1/1/2000
Friction Method	Hazen-Williams	Hydraulic Time Step	1.000
Accuracy	0.001	Duration	24.000
Trials	40	Calculation Type	Hydraulics Only

Junction Table - Time: 0.00 hours

ID	Label	Elevation (m)	Demand (L/s)	Unit Demand Collection <Count>	Demand Adjusted Population (Capita)	Hydraulic Grade (m)	Pressure (kPa)
31	J-1	105.43	0.000	0	0	136.22	
32	J-2	105.48	0.000	0	0	137.10	
33	J-3	105.30	0.000	0	0	128.96	
34	J-4	104.53	0.528	1	32	127.88	
35	J-5	103.81	1.055	1	65	126.87	
36	J-6	104.47	0.000	0	0	127.02	
37	J-7	105.42	0.000	0	0	138.39	
38	J-8	105.43	0.528	1	32	140.55	
54	J-9	105.54	0.528	1	32	138.39	
55	J-10	105.56	0.528	1	32	140.55	
68	J-11	105.57	0.528	1	32	137.10	
117	J-12	105.43	0.000	0	0	140.55	

Richcraft Terrrace Flats - Water Model

Junction Table - Time: 0.00 hours

Pressure (kPa)
301
309
232
229
226
221
323
344
321
342
309
344

Pipe Table - Time: 0.00 hours

ID	Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
43	P-2	32	J-2	J-7	204.0	PVC
44	P-3	23	J-1	J-2	204.0	PVC
45	P-4	41	J-1	J-3	204.0	PVC
46	P-5	22	J-3	J-6	204.0	PVC
47	P-6	29	J-6	J-5	204.0	PVC
48	P-7	22	J-4	J-5	204.0	PVC
49	P-8	29	J-3	J-4	204.0	PVC
50	P-9	51	R-1	J-1	204.0	PVC
51	P-10	10	J-7	H-2	154.0	PVC
52	P-11	12	J-8	H-1	154.0	PVC
53	P-12	17	J-5	H-3	154.0	PVC
66	P-13	28	J-8	J-10	204.0	PVC
67	P-14	35	J-7	J-9	154.0	PVC
69	P-15	38	J-2	J-11	154.0	PVC

Hazen-Williams C	Flow (L/s)	Velocity (m/s)
110.0	-75.561	2.31
110.0	-75.034	2.30
110.0	184.583	5.65
110.0	116.788	3.57
110.0	25.288	0.77
110.0	67.268	2.06
110.0	67.795	2.07
110.0	109.549	3.35
100.0	0.000	0.00
100.0	0.000	0.00
100.0	91.500	4.91
110.0	0.528	0.02
100.0	0.528	0.03
100.0	0.528	0.03

Richcraft Terrrace Flats - Water Model

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Flow (Out net) (L/s)	Hydraulic Grade (m)
30	R-1	145.00	109.549	145.00

Hydrant Table - Time: 0.00 hours

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
39	H-1	108.86	0.000	140.55	310
40	H-2	108.72	0.000	138.39	290
41	H-3	107.70	91.500	120.38	124
122	H-7	0.00	0.000	140.55	1,376
124	H-8	0.00	0.000	137.10	1,342
126	H-9	0.00	91.500	121.05	1,185

Boundary Conditions (2021.06.22)
620 Bobolink Ridge

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	55	0.92
Maximum Daily Demand	221	3.69
Peak Hour	333	5.55
Fire Flow Demand #1	11,000	183.33

Location

Results

Connection 1 – Embankment St.

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	161.2	77.4
Peak Hour	156.4	70.6
Max Day plus Fire 1	145.1	54.4

Ground Elevation = 106.8 m

Connection 2 – Embankment St.

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	161.2	77.3
Peak Hour	156.4	70.5
Max Day plus Fire 1	145.0	54.3

Ground Elevation = 106.8 m

Notes

1. Two service connections with a separation valve in between.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

APPENDIX

E

STORMWATER MANAGEMENT REPORT

RICHCRAFT GROUP OF COMPANIES

RICHCRAFT TERRACE FLATS, CRT LANDS (BLOCK 344)

STORMWATER MANAGEMENT REPORT

JULY 07, 2021

COPY

RICHCRAFT TERRACE FLATS, CRT LANDS (BLOCK 344)

STORMWATER MANAGEMENT REPORT

RICHCRAFT GROUP OF COMPANIES

COPY

PROJECT NO.: 211-01221-00
DATE: JULY 2021
VERSION: 01

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1 INTRODUCTION

1.1 SCOPE

WSP has been retained to provide civil engineering consulting services to support the Site Plan Approval application for greenfield development at 620 Bobolink Ridge, also known as Block 344 of the Phase 1 CRT Lands. This stormwater management (SWM) report examines the potential water quality and quantity impacts of the proposed development and details SWM measures to be provided to address these impacts in accordance with the City of Ottawa Sewer Design Guidelines (2012) and associated Technical Bulletins, Pre-application consultation meeting minutes, and the City of Ottawa Servicing Study Guidelines for Development Applications (2009). Refer to Servicing Report – Appendix B for completed City Servicing Report Checklist.

1.2 SITE LOCATION

The site of the proposed development is located within the City of Ottawa, within the Stittsville Ward, as shown in Figure 1. The site is approximately 1.6 ha and is bounded by Bobolink Ridge (to the north), Embankment Street (to the west), Robert Grant Avenue (to the east), and Cope Drive (to the south).

Figure 1: Project Location (Image Source: GeoOttawa)

1.3 OBJECTIVES

The objectives of this SWM plan are noted below:

- Determine the site-specific stormwater management requirements for the proposed development, as indicated by associated Provincial, Municipal, and Conservation Authority regulations and guidelines, pre-consultation with the City of Ottawa, and IBI Group's (IBI) report titled " Design Brief - CRT Lands Phase 1 - Fernbank Community" dated July 2017 (referred herein as CRT Phase 1 Servicing Report). Refer to Servicing Report – Appendix G for a copy of the CRT Phase 1 Servicing Report.
- In collaboration with the design team and the Developer, develop a strategy to address the SWM criteria on-site. Complete calculations and analyses necessary to determine the required size of the SWM features and demonstrate compliance with the design criteria.
- Prepare a SWM report documenting the above tasks in a manner suitable for review by the City's development review department.
- Address review comments by the City to refine and finalize the SWM report.

1.4 DESIGN CRITERIA

Based on applicable design guidelines and standards, pre-application consultation with the City (Servicing Report - Appendix B), and the CRT Phase 1 Servicing Report, the SWM design criteria for the development have been summarized below:

- Stormwater runoff from all storm events up to and including the 5-year storm (i.e. minor storm) will be captured and conveyed to the Embankment Street storm sewer system; where it ultimately outlet to the CRT Lands Phase 1 – Pond 5.
- Stormwater runoff in excess of the 5-year event and up to the 100-year storm (i.e. major storms), will be attenuated on-site with no overland flow to Embankment Street. During major storm attenuation, stormwater discharge to the Embankment Street storm sewer system shall be restricted to the site's post-development 5-year runoff flow rate. Additionally, up to 39 l/s of major storm flow (corresponding to a 3-hour 100-year Chicago storm event) is permitted to shed onto the Robert Grant Ave./ Cope Dr. Right-of-Ways, as prescribed in the CRT Phase 1 Servicing Report.
- Ponding shall occur in parking lots under the 2-year design storm event.
- 100-year ponding depths in parking lots and laneways shall not exceed 0.35m.
- All stormwater storage provided on-site must be above the Hydraulic Grade Line (HGL) of the receiving storm sewer.
- Maintain 300mm of freeboard between the underside of footing elevations and the 100-year HGL.
- The HGL in the storm sewer must remain below the underside of building footing during the stress test event (100-year + 20%).
- Ponding under the 100 -year + 20% event shall not reach any building envelop, nor breach the lowest building opening.
- Maintain at least 15 cm of vertical clearance between the spill elevation on the street and the ground elevation at the building envelope that is in the proximity of the flow route or ponding area.
- Quality control for stormwater is not required if the site's post-development imperviousness is equal or less than 86% (or runoff coefficient of 0.8), assumed by IBI's the sizing of the subdivision's SWM system. Otherwise, quality control on-site will be required.

2 PRE-DEVELOPMENT CONDITIONS

2.1 EXISTING LAND-USE AND DRAINAGE PATTERNS

The project site is approximately 1.6 ha in area and is currently greenfield. Once water sheet flows off the site it is captured via surface inlets and routed eastward along Cope Drive via storm sewers (600-2400 mm diameter) to Pond 6 of the Fernbank Crossing Development. Refer to Figure 2 for geographic depiction of pre-development drainage patterns.

Figure 2: Pre-Development Stormwater Drainage Pattern (Image Source: GeoOttawa)

Using PCSWMM 2D hydrologic and hydraulic modelling software (PCSWMM), the 5-year and 100-year pre-development runoff flow rates are estimated to be 130 l/s and 280 l/s, respectively. These flows are based on 3-hour Chicago storm distribution (10-minute timestep) using City rainfall Intensity-Duration-Frequency curves (IDF) and the following site -specific parameter:

- Imperviousness = 5% (C-Factor = 0.15)
- Flow Path Length = 300 m

– Catchment slope = 1.2%

Refer to Appendix A for pre-development catchment map, as well as Appendix C for schematic model map and associated scenario model outputs.

2.2 APPROVED OUTLET & ALLOWABLE DISCHARGE RATES

As the subject property is within the boundary of the CRT Lands – Phase 1 development (designed by IBI Group inc.), a portion of the subdivision's stormwater management/collection system has been allocated to the site. As such, allowable runoff release rates for the site are not derived by a comparison to pre-development flows, but rather complying with the requirements specified in IBI's report.

As documented in CRT Phase 1 Servicing Report, the minor storm sewer system was first sized using the rational method where a runoff coefficient of 0.80 (or 86% imperviousness) was assumed for the subject site, resulting in a 5-year site discharge of 306.1 l/s. Following this sizing exercise, the DDSWMM hydrologic modelling was carried out to estimate single event runoff flows and hydraulic performance of the subdivision's dual-drainage system. The single event design storms used in this analysis for the minor and major system were the 5-year and 100-year 3-hour Chicago storm (10 -minute time step).

The DDSWMM modeling, in conjunction with the introduction of inlet flow control devices (IDCs), set the threshold for permissible stormwater flows entering the subdivision's system (including from the subject site) such that hydraulic grade line (HGL) elevations within the subdivision's minor system do not flood developments. From this exercise, 318 l/s of 5-year stormwater discharge (outletting to the Embankment Street storm sewer) was allocated to the subject site. Under the 100-year event (major design storm event), IBI assumed all flow in excess of 318 l/s (to Embankment Street) and 39 l/s (to Robert Grant Ave./Cope Dr.) was to be attenuated on-site. No major storm flow was assumed to enter the CRT Lands – Phase 1 major storm system (i.e. Embankment Street R.O.W.). The allowance for the release of up to 39 l/s to Robert Grant Ave./Cope Dr. was established jointly between the designers of CRT Lands Phase 1 subdivision (IBI) and the designers of Robert Grant Avenue (Novatech) and published in the aforementioned IBI subdivision servicing report.

Refer to Table 1 for a summary of allowable release rates for the site by outlet, as well as Figure 3 for geographic location of dedicated outlets.

Table 1: Allowable Post-Development Runoff Release Rates (by Outlet and Design Storm Event).

Outlet	5-year*	100-year*
Embankment Street (Minor System)	318 l/s	318 l/s
Embankment Street (Major System)	-	-
Robert Grant Ave. / Cope Dr. (Minor System)	-	-
Robert Grant Ave. / Cope Dr. (Major System)	-	39 l/s

***3-hour Chicago Storms (10 min time steps) generated using City of Ottawa IDF curves.**

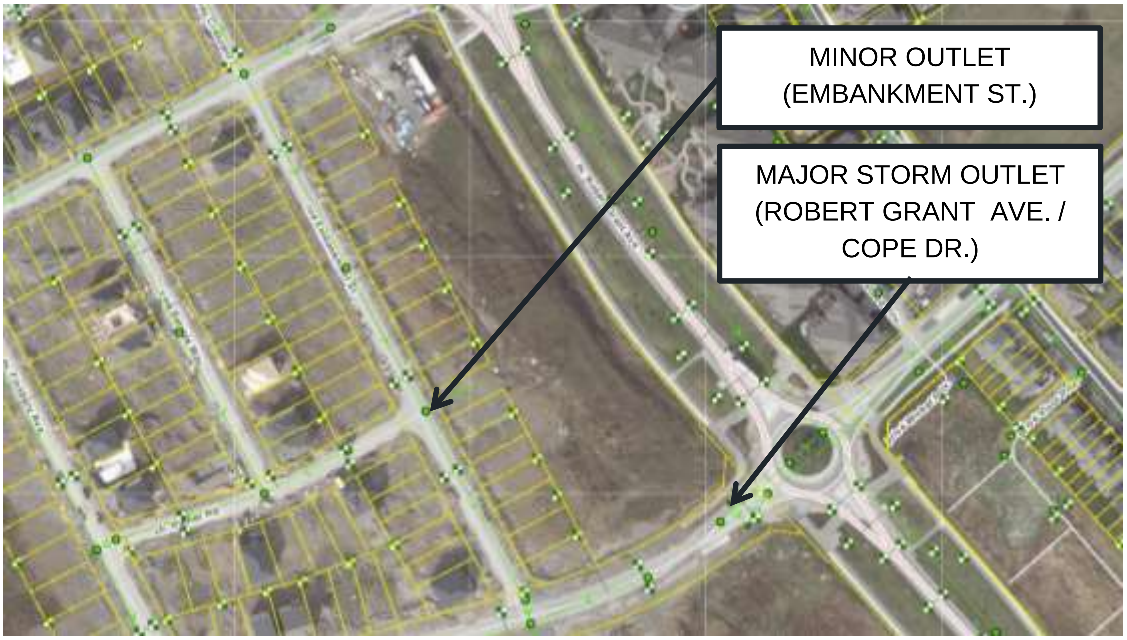


Figure 3: Post-Development Stormwater Outlets.

3 POST-DEVELOPMENT CONDITIONS

The proposed development includes seven (7) new 12-unit townhouses, each with a building area of 412 m^2. In addition, an accessory building with a building area of 154 m^2 with be included for storage and garbage. The site will include both private and communal amenity areas totally 546 m^2 and 980 m^2, respectively. At-grade features also include access laneways, vehicle parking, and asphalt sidewalks. The resulting imperviousness of the site was calculated to be 65% (Runoff coefficient = 0.68).

3.1 PROPOSED MINOR STORM SYSTEM

The proposed minor system constitutes a gravity system comprised of swales, storm sewers, manholes, and catch basins. Stormwater which falls on the site will sheet flow towards to parking lots and laneway areas, where it is directed to catch basins. Catchbasin leads direct the flow to the gravity storm sewer system which routes the flow to the site's minor storm system outlet (located along the southern site access corridor). The outlet is a 750mm storm sewer which drains to the existing 975m storm sewer within Embankment Street, which ultimately drains to the CRT lands Phase 1 Stormwater Management Facility (Pond 5).

The storm sewers (i.e. minor system) were sized using the Rationale method (to establish design flows) and the Manning's equation (for hydraulics), based on the following criteria:

- Design Storm — 1:5 years Return Period (Ottawa IDF Curves)
- Runoff coefficients (C-Factor):
  - Landscaped areas (i.e. Grass) = 0.25
  - Pavement and Concrete Areas = 0.90
  - Roofed Areas = 0.95
- Initial Inlet Time of Concentration = 10 mins.
- Pipe Velocities = 0.80 m/s to 6.0 m/s
- Minimum Pipe Size (Diameter) — 250 mm (Sewers) & 200mm (CB Leads)

Refer to Appendix A for post-development catchment map and Appendix B storm sewer sizing calculation sheet.

3.2 STORMWATER MANAGEMENT

Following the design and sizing of the minor system, hydrodynamic modelling was carried out using PCSWMM software to estimate single event runoff flows and the hydraulic performance of the site's overall stormwater system; including stormwater attenuation complete with the onsite storage areas, and an estimate of the peak hydraulic grade line elevation throughout the entire system.

In addition, the following supplementary checks were completed in order to the comply wit the City of Ottawa design guidelines and associated technical bulletins:

- 2-year Ponding Checks (Refer to Section 3.2.6)
- 100-year HGL to ensure gravity drainage for foundations (Refer to Sections 3.2.4 and 3.2.5)
- 100-year + 20% Stress Test (Refer to Section 3.2.7)

In order to remain consistent with the design of the downstream subdivision system, the single event design storms used in this analysis for the 2-year, 5-year (minor event), 100-year (major event), and 100-year + 20% (stress testing event) were simulated using the 3-hour Chicago storm (10-minute time step) distribution.

3.2.1 BOUNDARY CONDITIONS

Boundary conditions for the stormwater collections where obtained from the CRT Phase 1 Servicing Report. The receiving storm sewer system within Embankment Street is designed for free flow conditions under the 5-year storm event. As such, free flowing condition was assumed within the Embankment Street storm sewer for the purpose of sizing of the minor system within the site and performance assessment simulation of the 5-year Chicago event.

However, under the 100-year event, IBI noted a 100-yr HGL elevation of 105.31m for the receiving storm sewer within Embankment Street. To account for this, our design specifies a fixed tailwater elevation of 105.31m when modelling the 100-year Chicago scenario.

3.2.2 QUANTITY CONTROL & ATTENUATION

As it relates to the minor storm event (5-year), no quantity control is required prior to discharging from the site to the to the storm sewer system on Embankment Street. Post-development 5-year flows (including both the rational and single event modelling methods) yielded peak flows lower than what was specified by IBI to be released from the subject site in the design of the subdivision's stormwater system. Refer to Table 2 for comparison of IBI's specified site post-development flows and WSP's calculated proposed peak flow rates.

Table 2: 5-year Flows (Previously Assumed vs. Proposed)

Outlet	5-year (Rational Method)	5-year (3-hour Chicago)
IBI Design Flows	306 l/s	318 l/s
WSP Modelled Flows	228 l/s	245 l/s

As discussed in Section 1.4 and 2.2, runoff peak flow in excess of the 5 year event (and up to the 100-year event) must be controlled on-site to the release rates defined in Table 1. In order to achieve this, our site design allows for storage within the parking lots, swales and pond storage to achieve the quantity control requirements for the site. Ponding within parking lots has been limited to 350mm in accordance with City of Ottawa Sewer Design Guidelines. In order to control ponding in storage areas, inlet control devices (ICDs) of varying sizes are proposed in dedicated stormwater inlet structures to throttle the flow prior to discharging into the sewer main. Refer to Table 3 for an overview of system quantity control performance as it relates to peak discharge to dedicated outlets, as well as total storage utilized in the system. Refer to Table 4 and *** For parking lot storage zones, maximum depth of ponding is relative to top of grate of primary surface outlet.**

Table 5 for summaries of individual storage cell performance under the 5-year and 100-year storm events, respectively.

It should be noted that discharged from the dry pond (located at the southeast corner of the site) to Robert Grant Ave / Cope Dr.- major system will be controlled through a dedicated outlet structure. A broadcrested weir - with the following characteristics - has been selected as the proposed control structure to ensure proper hydraulic operation and release from the storage facility (refer to Drawing C1.7 located in the Servicing Report - Appendix A for further details):

- Invert Elevation: 105.97m
- Both Width: 0.5m
- Side Slopes: 3H:1V
- Depth (Parallel to Flow Direction): 300mm

Refer to Servicing Report – Appendix A for detailed design drawings (including proposed grading plan) and Appendix C of this report for a model map figure for the purpose of providing geographical context.

Table 3: Proposed Conditions (Controlled) Peak Flows and Total Volume Utilized

Storm Event	Peak Flow Embankment St. Minor System (L/s)	Peak Flow Robert Grant Ave / Cope Dr. Major System (L/s)	Total Storage Utilized (m^3)
5-year	245	-	37
100-year	307	39	173

Table 4: Individual Storage Cell Performance Summary (5-year)

Storage Cell (By Outlet Structure)	Peak Storage (m3)	Max. Depth of Ponding(m)*	Highest Ponding Elevation (m)	Outlet Structure Top of Grate Elevation (m)
CB03	1	-	107.91	108.11
CB04	1	-	107.32	108.00
CB06 & CB07	0	-	107.04	108.16
CB08	5	0.13	108.02	107.89
CB10	1	-	107.27	108.00
CB11	4	0.10	108.13	108.03
CB12	1	-	107.23	108.01
CB13	4	0.10	108.10	108.00
CB14 & CB15	1	-	107.64	107.95
CB16	1	-	107.24	107.86
DCB17	1	-	105.68	106.38
Pond	17	0.16	105.67	105.50

*** For parking lot storage zones, maximum depth of ponding is relative to top of grate of primary surface outlet.**

Table 5: Individual Storage Cell Performance Summary (100-year)

Storage Cell (By Outlet Structure)	Peak Storage (m3)	Max. Depth of Ponding(m)*	Highest Ponding Elevation (m)	Outlet Structure Top of Grate Elevation (m)
CB03	9	0.14	108.25	108.11
CB04	7	0.15	108.15	108.00
CB06 & CB07	3	0.08	108.23	108.16
CB08	27	0.25	108.14	107.89
CB10	5	0.14	108.14	108.00
CB11	20	0.18	108.21	108.03
CB12	3	0.09	108.10	108.01
CB13	17	0.17	108.17	108.00
CB14 & CB15	9	0.14	108.09	107.95
CB16	4	0.12	107.98	107.86
DCB17	1	-	106.07	106.38
Pond	68	0.55	106.05	105.50

*** For parking lot storage zones, maximum depth of ponding is relative to top of grate of primary surface outlet.**

3.2.3 INLET CONTROLS

In order to limit flows into the minor system such that peak flows leaving the site are within allowable limits, ICDs (either stainless steel orifice plates with varying inlet diameters, or a manufactured inlet device such as a Tempest) are proposed throughout the site. ICDs are sized and positioned vertically within PCSWMM model such that maximum ponding depths and release rate to the minor system were optimized. Refer to Table 6 for an inventory of ICDs by host structure, along with peak release and acting head depths for the 2-year and 100-year event. Several ICDs require diameters less than 100mm, as such prefabricated low-flow ICDs (such as a Tempest ICD) with similar drawdown performance will be required to avoid clogging.

Table 6: Inlet Control Device Summary

ICD (By Host Structure)	Diameter * (mm)	Invert Elevation (m)	Peak Cell Release Rate (l/s)*		Acting Head (m)	
			2-Year	100-Year	2-Year	100-Year
CB03	75	105.91	13	19	1.02	2.34
CB04	60	105.80	7	12	0.72	2.35
CB06	25	105.95	3	6	0.58	2.28
CB07	25	105.95	3	6	0.58	2.28
CB08	76	105.69	19	20	2.13	2.45
CB10	60	105.80	7	12	0.74	2.34
CB11	80	105.83	21	22	2.12	2.38
CB12	60	105.81	7	12	0.79	2.29
CB13	75	105.80	18	19	2.11	2.37
CB14	32	105.75	6	9.5	0.95	2.34
CB15	32	105.75	6	9.5	0.95	2.34
CB16	50	105.66	5	9	0.81	2.32
MH409	170	104.81	50	54	0.77	1.24
RYCB02	75	106.18	4	11	0.14	1.15
RYCB04	60	105.85	6	12	0.55	2.66
RYCB09	60	105.69	7	13	0.77	2.93
RYCB18	120	105.39	18	34	0.36	1.17

*** Where ICD diameters are less than 75mm (required minimum per MECP), manufactured low-flow ICDs will be required with equal discharge performance noted active head.**

3.2.4 HGL ANALYSIS & FOUNDATION DRAINAGE (BLOCKS 1 - 4 AND AUXILIARY BUILDING)

In order to ensure gravity drainage for the proposed development's foundation drainage system, minimum underside of footing elevations (USF) elevations for each block are required to be at least 300mm above the 100-year HGL line at the proposed connection location. Refer to Table 7 for a summary of 100-year HGL elevations and foundation drainage details for Blocks 1, 2,3, 4, and the auxiliary building as produced in the PCSWMM hydrodynamic model. Note that foundation drainage for Blocks 5, 6, and 7 will not drain to the site's stormwater connection system, but instead be piped to an alternate existing outlet along Cope Drive with a lower invert and HGL. Refer to the following section for further details.

Table 7:100-year HGL Analysis & Foundation Drainage Summary (Blocks 1- 4 and Auxiliary Building)

Block	100-yr HGL Elevation (m)	Minimum USF Elevation (m)	Proposed USF Elevation (m)	Freeboard (m) *
1	105.81	106.11	107.26	1.45
2	106.05	106.35	106.37	0.32
3	105.51	105.81	106.24	0.73
4	105.37	105.67	106.23	0.86
Auxiliary Bldg.	105.44	105.74	106.53**	0.79

*** Freeboard between 100-yr HGL and Proposed USF elevation.**
****Auxiliary building assumed to possess strip footing foundations at 1.8m below finished ground elevation.**

3.2.5 FOUNDATION DRAINAGE (BLOCKS 5 - 7)

Early in the design process we encountered design challenges while trying to ensure gravity drainage of the foundation systems, in conjunction with the layout and grading of the surrounding lands, all while trying to maintain barrier free connectivity to adjacent streets without the requirement for retaining walls, ramps, etc. In order to maintain barrier free connectivity and comply with the site's design criteria, the units within the southeasterly Blocks 5,6 and 7 would require sump pump systems, which was not desirable or accepted by the developer.

After the initial grading and drainage review, WSP discovered the potential existence of a storm sewer stub located at the southeast corner of the site (northwest corner of the Cope Drive/Robert Grant Avenue turning circle). The storm stub constitutes part of the Fernbank Crossing develop storm water system, ultimately discharging to Fernbank Development Pond 6 (via Cope Drive). In April 2021, WSP and Richcraft Group of Companies (Richcraft) consulted with Eric Surprenant (City of Ottawa liaison) to confirm the City's willingness to allow for Blocks 5,6, and 7 to drain their foundations to the subject storm sewer stub (via third-pipe system) such that gravity drainage could be provide in combination with the preferred grading strategy for barrier free connectivity to adjacent streets..

The City did not appose the proposed use of new stormwater outlet in this manner; however, the City did indicate that two (2) elements must be confirmed prior to approving the connection, which were:

1. Confirmation that the 100-year HGL (in the receiving system) is at least 300mm below the proposed USF elevation for Blocks 5, 6, and 7;
2. Confirmation that the storm sewer stubs exists.

In order to satisfy the first condition, we completed an analysis to infer the 100-year HGL at the subject connection point based on the 100-year HGL boundary condition used for the design of Phase 3 of the Fernbank Crossing Development (prepared by IBI), as well as as-built storm sewer plan and profile drawings prepared by Novatech. Using the provided 100-year HGL elevation for the intersection of Shinny and Cope Drive, and the cumulative fall of upstream sewers up to the connection point, the 100-year HGL was estimated to be 102.71m. Refer to Table 8 for comparison of the 100-year HGL elevations and proposed foundation details from Blocks 5, 6,and 7.

Table 8: HGL Analysis & Foundation Drainage Summary (Blocks 5, 6, and 7)

Block	100-yr HGL Elevation (m)	Minimum USF Elevation (m)	Proposed USF Elevation (m)	Freeboard (m) *
5 (W)	102.71	103.01	105.89	3.18
5 (E)			105.29	2.58
6			104.58	1.87
7 (E)			104.34	1.63
7 (W)			104.94	2.23

*** Freeboard between 100-yr HGL and Proposed USF elevation.**

To satisfy the second condition, Richcraft retaining a CCTV contractor (Clean Water Works Inc.) to inspect the downstream storm sewer (along Cope Drive). During the inspection – which took place on June 2nd, 2021 - a tee connection to the Cope Drive storm sewer was identified which proves the subject storm stub exists.

Refer to Appendix D for correspondence between the City of Ottawa and WSP, as well as the CCTV inspection report and HGL analysis for the downstream system (Cope Drive sewer). Refer to Appendix E for the Fernbank Crossing (Phase 3) Servicing Report.

3.2.6 2-YEAR PONDING CHECKS

In accordance with City of Ottawa Sewer Design Guidelines (2012) (Technical Bulletin PIEDTB-2016-01), no ponding is permitted in parking lots and laneways during the 2-year design storm event. To complete this check, a 2-year 3-hour Chicago storm event was simulated. Results of this analysis determined that there is no ponding within the parking lot storage cells during the 2-year storm event. This was evident based on the maximum HGL elevations reported in the storage nodes remaining below the proposed top of grate elevations. Refer to Appendix C for the model output for the associated scenario.

3.2.7 100-YEAR + 20% STRESS TEST CHECKS & EMERGENCY SPILLWAYS

In accordance with City of Ottawa Sewer Design Guidelines (2012) - Technical Bulletin PIEDTB-2016-01, the stormwater management shall be stress tested under a 100-year + 20% storm event. The following are the two (2) mandatory checks carried out relative to the stress testing event:

- Depth of ponding remains below the lowest building opening
- HGL in the minor system remains below the USF Elevation

A review was carried out to confirm compliance with the two aforementioned criteria and no violations were identified. Refer to Servicing Report – Appendix A for detailed grading plan which communicates lowest building elevations and peak 100-year + 20% ponding elevations. Refer Table 9 and Appendix C of this report for details related to 100-year + 20% event HGL within the minor system relative to proposed building USF elevations. As previously stated in Section 3.2.5, foundation drains from Blocks 5, 6, and 7 are not connection to the site's minor system and therefore were omitted from this analysis.

Table 9: 100-year +20%HGL Analysis & Foundation Drainage Summary (Blocks 1, 2, 3, and 4)

Block	100-yr+20% HGL Elevation (m)	Proposed USF Elevation (m)	Freeboard (m) *
1	105.83	107.26	1.43
2	106.07	106.37	0.3
3	105.63	106.24	0.61
4	105.38	106.23	0.85
Auxiliary Bldg.	105.52	106.53**	1.01

*** Freeboard between 100-yr+20% HGL and Proposed USF elevation.**
****Auxiliary building assumed to possess strip footing foundations at 1.8m below finished ground elevation.**

In addition to the checks carried out relative to the 100-year + 20% stress testing event, WSP has included provisions for emergency spillways. This was achieved through grading where 150mm vertical clearances between ground elevations (at building envelops) and the site's spill elevation to municipal Right-of-Ways were provided.

3.3 QUALITY CONTROL

As noted in Section 1.4, Quality control for the site's stormwater is not required if the site's post-development imperviousness is equal or less than 86% (or runoff coefficient of 0.8), as specified by IBI's sizing of the subdivision's SWM system. Stormwater from the site will be treated in Pond 5 downstream of the development. The post-development site imperviousness was calculated to be 64% (Runoff coefficient = 0.63); therefore, no on-site quality control is required.

3.4 DIVERSION OF DRAINAGE CATCHMENT AREAS

A diversion of a drainage catchment (when comparing pre-development to post-development) is currently proposed; however, the allocation of stormwater flow to the designated outlets is in accordance with the overall Subdivision design criteria as specified in the CRT Phase 1 Servicing Report.

3.5 WATERCOURSES, MUNICIPAL DRAINS, AND FLOODPLAINS

Stormwater from the proposed development will not be directly discharged to a watercourse. As such, no significant negative impacts are anticipated to downstream receiving watercourses due to proposed quantity and quality control measures. All stormwater from the site will ultimately be routed to one the two following stormwater management facilities:

- Pond 6 of the CRT Lands – Phase1 development (up to 39 l/s of major overland flow); and
- Pond 5 of the Fernbank Crossing development.

As such, no significant negative impacts are anticipated to downstream receiving watercourses due to proposed quantity and quality control measures.

There are no municipal drains on the site or associated with the drainage from the site.

There are no designated floodplains on the site of this development.

3.6 SETBACKS FROM SIGNIFICANT FEATURES

There are no private sewage disposal systems, watercourses, and/or hazard lands in the vicinity of the subject site. As such, there are no associated set-backs requirements to adhere to.

3.7 FILL CONSTRAINT

There are no known fill constraints applicable to this site related to any floodplain. No fill constraints related to soil conditions are anticipated, as confirmed in the geotechnical report.

4 SEDIMENT AND EROSION CONTROL

4.1 5.1 GENERAL

During construction, existing storm sewer system can be exposed to sediment loadings. A number of construction techniques designed to reduce unnecessary construction sediment loadings will be used, including:

- Filter cloths, which will remain on open surface structures such as manholes and catch basins until these structures are commissioned and put into use;
- Installation of silt fence, where applicable, around the perimeter of the proposed work area;
- The installation of straw bales within existing drainage features surround the site; and
- Bulkhead barriers will be installed in the outlet pipes.

During construction of the services, any trench dewatering using pumps will be fitted with a “filter sock.” Thus, any pumped groundwater will be filtered prior to release to the existing surface runoff. The contractor will inspect and maintain the filter sock as needed including sediment removal and disposal.

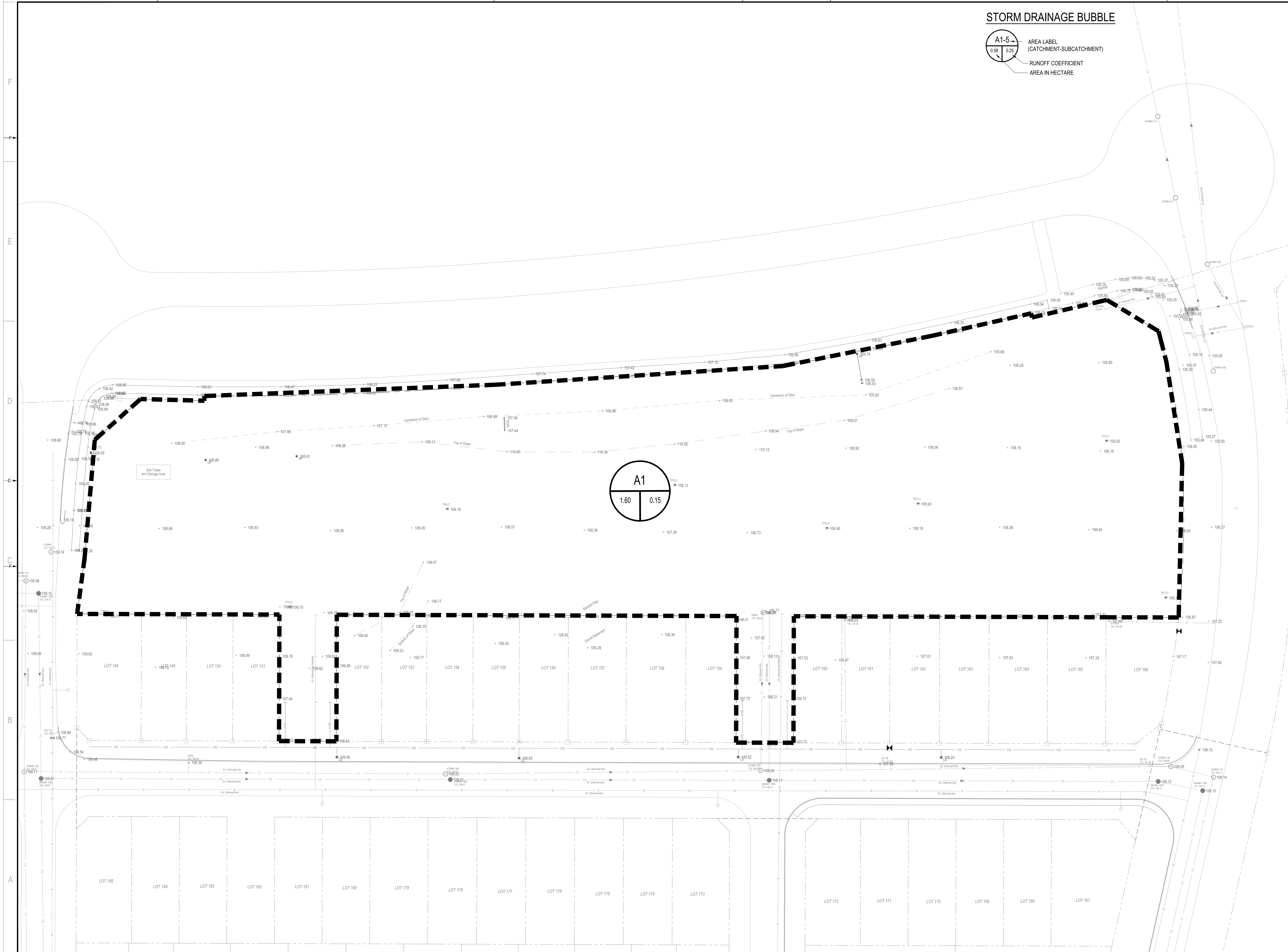
All catch basins, and to a lesser degree, manholes, convey surface water to sewers. Consequently, until the surrounding surface has been completed, these structures will be covered to prevent sediment from entering the minor storm sewer system. These measures will stay in place and be maintained during construction and build-out until it is appropriate to remove them.

During construction of any development both imported and native soils are placed in stockpiles. Mitigative measures and proper management to prevent these materials entering the sewer system are needed. During construction of the deeper watermains and sewers, imported granular bedding materials are temporarily stockpiled on site. These materials are however quickly used up and generally placed before any catch basins are installed. Refer to the Sediment and Erosion Control Plan (drawing C1.8) provided in Servicing Report - Appendix A.

5 CONCLUSIONS

WSP has completed this stormwater management analysis, calculations, and reporting in support of the Site Plan Application for the proposed development at 620 Bobolink Ridge (Block 344). Stormwater management requirements for the site have been determined and associated on-site quantity control infrastructure has been sized. A total of 173 m^3 of storage will be provided (through a combination of parking lot storage, pipe storage, and pond storage) to restrict flow into the minor system during major storm events. Said storge will limit peak flow to dedicated outlets to within allowable limits in accordance with the CRT Lands Phase 1 Servicing Report, as well as comply with all City's SWM criteria.

APPENDIX A – CATCHMENT FIGURES



wsp

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SEAL:

CLIENT:

RICHCRAFT Group Of Companies

CLIENT REF. #:

PROJECT:

TERRACE FLATS

KEY PLAN:

DISCLAIMER: COPYRIGHT:

ISSUED FOR - REVISION:

IS	RE	DATE	DESCRIPTION
1		2021/06/18	ISSUED FOR CLIENT REVIEW

PROJECT NO: 211-01221-00	DATE: MARCH 2021
ORIGINAL SCALE: 1:500	IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE.
DESIGNED BY: DS	
DRAWN BY: MH	
CHECKED BY: SD	25mm

DISCIPLINE: CIVIL

TITLE:

PRE-DEVELOPMENT CATCHMENT MAP

SHEET NUMBER: SWM-SK1-1

SHEET #: 1 OF 2

ISSUE: ISSUED FOR DISTRIBUTION

DATE OF: 2020/06/11

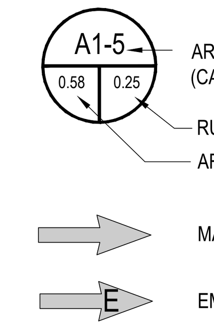
REV #: 0

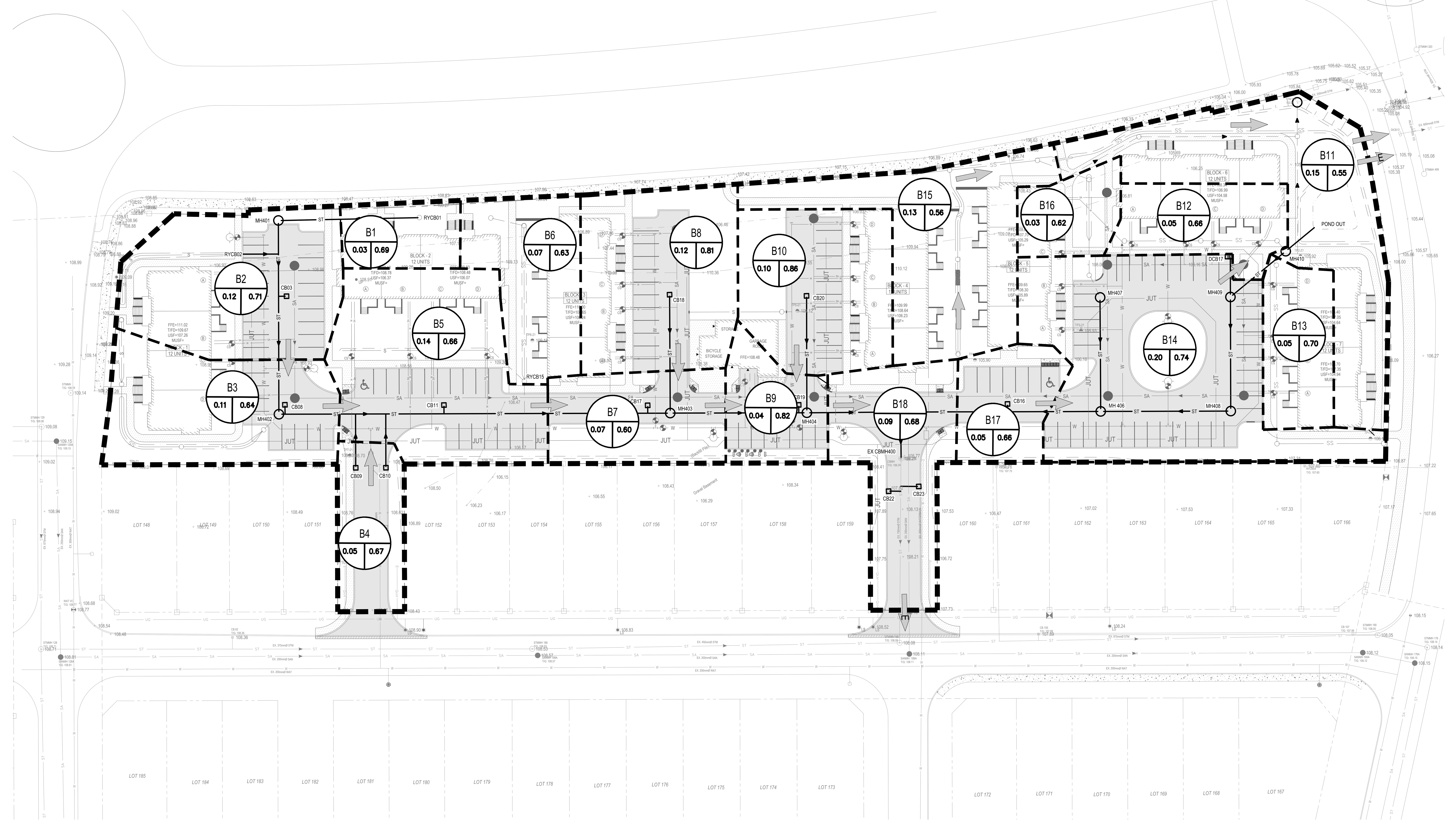
N:\2021\211-01221-00 - Richcraft Terrace Flats Site Plan\Drawings\01. Civil\03. FGS-SKS\02. Sketches\211-01221-00- SWM-SK1-1 (PreDev).dwg Jun 18, 2021-10:30am BY:(daniel.searle)

CATCHMENT CHARATERISTICS

	GRASSED @ C-FACTOR BELOW	GRAVEL @ C-FACTOR BELOW	ASPH/CONC @ C-FACTOR BELOW	ROOFED @ C-FACTOR BELOW			
	0.25	0.65	0.90	0.95			
CATCHMENT ID (B#)	GRASSED AREA (ha)	GRAVEL AREA (ha)	ASPH./CONC AREA (ha)	ROOFED AREA (ha)	TOTAL AREAS (ha)	WEIGHTED C-FACTOR	IMPERVIOUS (%)
1	0.0117	0.0000	0.0015	0.0189	0.0321	0.69	0.64
2	0.0385	0.0000	0.0589	0.0260	0.1234	0.71	0.69
3	0.0437	0.0000	0.0372	0.0250	0.1059	0.64	0.59
4	0.0164	0.0000	0.0299	0.0000	0.0463	0.67	0.65
5	0.0543	0.0000	0.0683	0.0213	0.1439	0.66	0.62
6	0.0318	0.0000	0.0071	0.0322	0.0711	0.63	0.55
7	0.0306	0.0000	0.0346	0.0016	0.0668	0.60	0.54
8	0.0187	0.0000	0.0681	0.0300	0.1168	0.81	0.84
9	0.0061	0.0000	0.0303	0.0081	0.0445	0.82	0.86
10	0.0083	0.0000	0.0641	0.0267	0.0991	0.86	0.92
11	0.0851	0.0000	0.0201	0.0466	0.1518	0.55	0.44
12	0.0216	0.0000	0.0070	0.0250	0.0536	0.66	0.60
13	0.0169	0.0000	0.0050	0.0257	0.0476	0.70	0.64
14	0.0519	0.0000	0.1390	0.0140	0.2049	0.74	0.75
15	0.0699	0.0000	0.0074	0.0489	0.1262	0.56	0.45
16	0.0154	0.0000	0.0065	0.0113	0.0332	0.62	0.54
17	0.0165	0.0000	0.0277	0.0011	0.0453	0.66	0.64
18	0.0309	0.0000	0.0596	0.0018	0.0923	0.68	0.67
TOTAL	0.5683	0.0000	0.6723	0.3642	1.6048	0.68	0.65

STORM DRAINAGE BUBBLE





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SEAL:

NORTH

CLIENT:
RICHCRAFT Group Of Companies

CLIENT REF. #:

PROJECT:
TERRACE FLATS

KEY PLAN:

ISSUED FOR - REVISION:

IS	RE	DATE	DESCRIPTION
1		2021/06/18	ISSUED FOR CLIENT REVIEW

PROJECT NO: 211-01221-00	DATE: MARCH 2021
ORIGINAL SCALE: 1:400	IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE. 25mm
DESIGNED BY: DS	
DRAWN BY: MH	
CHECKED BY: SD	

DISCIPLINE: CIVIL

TITLE: POST-DEVELOPMENT CATCHMENT MAP MINOR STORM SYSTEM

SHEET NUMBER: SWM-SK1-2

SHEET #: 2 OF 2

ISSUE: ISSUED FOR DISTRIBUTION — REV #: 0

DATE OF: 2020/06/11

N:\2021\211-01221-00 - Richcraft Terrace Flats Site Plan\Drawings\01. Civil\03. FIGS-SKS\02. Sketches\211-01221-00- SWM-SK1-2 (PostDev).dwg Jun 29, 2021-8:48am BY:(daniel.searle)

APPENDIX B –

MINOR SYSTEM SIZING CALCULATIONS

STORM SEWER CAPACITY CALCULATIONS - RICHCRAFT TERRACE FLATS

DATE: JUNE 2021 | **PREPARED BY:** Daniel Searle, P.Eng.
PROJECT NO. 211-01221-00 | **CHECKED BY:** Steve Davidson, P.Eng., OLS (Ret.), MBA

1:5 YR STORM EVENT | **REF. FIGURE:** SWM - SK1-2

DRAINAGE AREA			RUNOFF DATA							PIPE DATA					
FROM No.	TO No.	AREA DESCRIPTION	AREA (ha)	RUNOFF COEFFICIENT	AC	Σ AC	Tc (min)	I (mm/hour)	PEAK RUNOFF, Q (L/s)	SIZE (mm)	SLOPE (%)	CAPACITY (L/sec)	Q/Q_{full}	VELOCITY (m/sec)	LENGTH (m)
RYCB01	MH401	B1	0.03	0.69	0.02	0.02	10.00	104.2	6.4	450	0.50%	201.6	0.03	1.27	29.0
MH401	MH402	B2	0.12	0.71	0.09	0.09	10.61	101.1	24.6	450	0.50%	201.6	0.12	1.27	39.0
MH402	MH403	B3,B4,B5, B6	0.37	0.65	0.24	0.33	11.44	97.2	88.1	450	0.50%	201.6	0.44	1.27	80.0
CB11	MH403	B8	0.12	0.81	0.09	0.42	13.13	90.1	105.4	450	0.50%	201.6	0.52	1.27	29.0
MH403	MH404	B7	0.07	0.60	0.04	0.46	13.74	87.9	112.6	450	0.50%	201.6	0.56	1.27	28.0
CB13	MH404	B10	0.10	0.86	0.09	0.55	14.33	85.8	130.2	450	0.50%	201.6	0.65	1.27	24.0
MH404	MH405	B9	0.04	0.82	0.04	0.58	14.84	84.1	136.2	450	0.50%	201.6	0.68	1.27	19.0
POND OUTLET	MH410	B11	0.15	0.55	0.08	0.08	10.00	104.2	24.2	300	3.90%	191.0	0.13	2.70	8.0
MH410	MH409	B12,B13	0.10	0.68	0.07	0.15	10.36	102.3	43.3	600	0.15%	237.8	0.18	0.84	14.6
MH409	MH408	B14	0.20	0.74	0.15	0.30	10.56	101.3	85.6	600	0.15%	237.8	0.36	0.84	23.2
MH408	MH406	-	0.00	0.00	0.00	0.30	10.89	99.7	84.2	600	0.15%	237.8	0.35	0.84	26.4
MH407	MH406	B15,B16	0.16	0.08	0.01	0.32	11.26	98.0	86.1	450	0.25%	142.6	0.60	0.90	23.2
MH406	MH405	B17	0.05	0.66	0.03	0.35	11.61	96.4	92.7	600	0.15%	237.8	0.39	0.84	41.0
MH405	STUB	B18	0.09	0.68	0.06	0.99	15.24	82.8	228.2	750	0.12%	385.7	0.59	0.87	9.5

NOTES:

1. PIPE MANNING'S COEFFICIENT IS "0.013"
2. RAINFALL INTENSITY IN ACCORDANCE WITH CITY OF OTTAWA SEWER DESIGN GUIDELINES.

APPENDIX C –

PCSWMM MODEL MAPS AND OUTPUTS

PRE-DEVELOPMENT - MODEL MAP

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------


*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 1
Number of nodes ........... 1
Number of links ........... 0
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                    Data       Recording
Name                 Data Source                    Type       Interval
------------------------------------------------------------------------
Richcraft            Chicago_3h_5yr_10min           INTENSITY   10 min.


********************
Subcatchment Summary
********************
Name                       Area     Width   %Imperv    %Slope Rain Gage
Outlet
--------------------------------------------------------------------------------
--------------------------
1                          1.60     53.48      5.00    1.2000 Richcraft
2


************
Node Summary
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    Inflow
-------------------------------------------------------------------------------
2                    OUTFALL                0.00      0.00       0.0



*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
```

```
    Rainfall/Runoff ........ YES
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... NO
    Water Quality .......... NO
  Infiltration Method ...... HORTON
  Surcharge Method ......... EXTRAN
  Starting Date ............ 04/21/2021 00:00:00
  Ending Date .............. 04/21/2021 12:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:01:00
  Wet Time Step ............ 00:05:00
  Dry Time Step ............ 00:05:00


  **************************        Volume         Depth
  Runoff Quantity Continuity     hectare-m            mm
  **************************     ---------       -------
  Total Precipitation ......         0.068        42.498
  Evaporation Loss .........         0.000         0.000
  Infiltration Loss ........         0.008         5.054
  Surface Runoff ...........         0.060        37.507
  Final Storage ............         0.000         0.002
  Continuity Error (%) .....        -0.154


  **************************        Volume        Volume
  Flow Routing Continuity        hectare-m      10^6 ltr
  **************************     ---------     ---------
  Dry Weather Inflow .......         0.000         0.000
  Wet Weather Inflow .......         0.060         0.602
  Groundwater Inflow .......         0.000         0.000
  RDII Inflow ..............         0.000         0.000
  External Inflow ..........         0.000         0.000
  External Outflow .........         0.060         0.602
  Flooding Loss ............         0.000         0.000
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.000         0.000
  Continuity Error (%) .....         0.000


  ***************************
  Subcatchment Runoff Summary
  ***************************

  --------------------------------------------------------------------------------
--------------------------------------------
                            Total      Total      Total      Total     Imperv
Perv      Total       Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff
Runoff     Runoff      Runoff   Runoff   Coeff
  Subcatchment                 mm         mm         mm         mm         mm
mm          mm    10^6 ltr      CMS
  --------------------------------------------------------------------------------
--------------------------------------------
```

```
  1                         42.50       0.00        0.00        5.05        2.13
35.38      37.51        0.60     0.13   0.883


  Analysis begun on:  Thu Jun 17 23:03:26 2021
  Analysis ended on:  Thu Jun 17 23:03:26 2021
  Total elapsed time: < 1 sec
```

PRE-DEVELOPMENT - 100YEAR - 3HR CHICAGO

```
  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
  --------------------------------------------------------------


  *************
  Element Count
  *************
  Number of rain gages ...... 1
  Number of subcatchments ... 1
  Number of nodes ........... 1
  Number of links ........... 0
  Number of pollutants ...... 0
  Number of land uses ....... 0


  ****************
  Raingage Summary
  ****************
                                                              Data       Recording
  Name                 Data Source                            Type       Interval
  ------------------------------------------------------------------------
  Richcraft            Chicago_3h_100yr_10min                 INTENSITY   10 min.


  ********************
  Subcatchment Summary
  ********************
  Name                       Area     Width    %Imperv    %Slope Rain Gage
Outlet
  --------------------------------------------------------------------------------
--------------------------
  1                          1.60     53.48       5.00    1.2000 Richcraft
2


  ************
  Node Summary
  ************
                                                   Invert      Max.     Ponded    External
  Name                 Type                         Elev.     Depth       Area    Inflow
  -------------------------------------------------------------------------------
  2                    OUTFALL                       0.00      0.00        0.0


  *********************************************************
  NOTE: The summary statistics displayed in this report are
  based on results found at every computational time step,
  not just on results from each reporting time step.
  *********************************************************

  ****************
  Analysis Options
  ****************
  Flow Units ............... CMS
  Process Models:
```

```
    Rainfall/Runoff ........ YES
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... NO
    Water Quality .......... NO
  Infiltration Method ...... HORTON
  Surcharge Method ......... EXTRAN
  Starting Date ............ 04/21/2021 00:00:00
  Ending Date .............. 04/21/2021 12:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:01:00
  Wet Time Step ............ 00:05:00
  Dry Time Step ............ 00:05:00


  **************************        Volume         Depth
  Runoff Quantity Continuity     hectare-m            mm
  **************************     ---------       -------
  Total Precipitation ......         0.114        71.277
  Evaporation Loss .........         0.000         0.000
  Infiltration Loss ........         0.008         5.212
  Surface Runoff ...........         0.106        66.205
  Final Storage ............         0.000         0.002
  Continuity Error (%) .....        -0.199


  **************************        Volume        Volume
  Flow Routing Continuity        hectare-m      10^6 ltr
  **************************     ---------     ---------
  Dry Weather Inflow .......         0.000         0.000
  Wet Weather Inflow .......         0.106         1.062
  Groundwater Inflow .......         0.000         0.000
  RDII Inflow ..............         0.000         0.000
  External Inflow ..........         0.000         0.000
  External Outflow .........         0.106         1.062
  Flooding Loss ............         0.000         0.000
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.000         0.000
  Continuity Error (%) .....         0.000


  ***************************
  Subcatchment Runoff Summary
  ***************************

  ---------------------------------------------------------------------------------
--------------------------------------------
                            Total      Total      Total      Total     Imperv
Perv      Total       Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff
Runoff     Runoff      Runoff   Runoff   Coeff
  Subcatchment                 mm         mm         mm         mm         mm
mm         mm    10^6 ltr      CMS
  ---------------------------------------------------------------------------------
--------------------------------------------
```

```
  1                         71.28       0.00       0.00       5.21       3.57
62.64      66.21        1.06     0.28   0.929


  Analysis begun on:  Tue Jun 29 08:53:42 2021
  Analysis ended on:  Tue Jun 29 08:53:42 2021
  Total elapsed time: < 1 sec
```

POST-DEVELOPMENT - MODEL MAP

```
  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
  --------------------------------------------------------------

  WARNING 02: maximum depth increased for Node MH410
  WARNING 02: maximum depth increased for Node RYCB02
  WARNING 02: maximum depth increased for Node RYCB04
  WARNING 02: maximum depth increased for Node RYCB09
  WARNING 02: maximum depth increased for Node RYCB18
  WARNING 02: maximum depth increased for Node RYCB19

  *************
  Element Count
  *************
  Number of rain gages ...... 1
  Number of subcatchments ... 21
  Number of nodes ........... 36
  Number of links ........... 51
  Number of pollutants ...... 0
  Number of land uses ....... 0


  ****************
  Raingage Summary
  ****************
                                                              Data       Recording
  Name                 Data Source                            Type       Interval
  ------------------------------------------------------------------------------------
  Richcraft            Chicago_3h_2yr_10min                   INTENSITY    10 min.


  ********************
  Subcatchment Summary
  ********************
  Name                           Area     Width   %Imperv    %Slope Rain Gage
Outlet
  --------------------------------------------------------------------------------
--------------------------
  28                             0.05     15.70     64.00    1.0000 Richcraft
CB06_07_STRG
  B1                             0.03     19.80     63.00    2.0000 Richcraft
RYCB01
  B10                            0.10     50.85     92.00    2.0000 Richcraft
CB13_STRG
  B11_1                          0.07     13.49     44.00    2.0000 Richcraft
DITCH_IN_1
  B11_2                          0.08     12.74     44.00    2.0000 Richcraft
POND_1
  B12                            0.05     16.00     60.00    2.0000 Richcraft
MH410
  B13                            0.04     12.43     64.00    2.0000 Richcraft
MH410
  B14                            0.21     37.73     74.00    3.0000 Richcraft
DCB17_STRG
  B15                            0.13     20.41     44.00    1.0000 Richcraft
RYCB18
  B16                            0.03     16.75     53.00    2.0000 Richcraft
RYCB19
```

B17	0.04	28.40	63.00	2.0000	Richcraft
CB16_STRG					
B18	0.09	29.87	66.00	2.0000	Richcraft
CB14_15_STRG					
B2_1	0.03	9.17	68.00	2.0000	Richcraft
RYCB02					
B2_2	0.09	45.10	68.00	1.0000	Richcraft
CB03_STRG					
B3_1	0.05	9.88	59.00	2.0000	Richcraft
RYCB04					
B3_2	0.06	38.07	59.00	2.0000	Richcraft
CB04_STRG					
B5	0.15	50.87	63.00	2.0000	Richcraft
CB08_STRG					
B6	0.07	14.22	55.00	1.0000	Richcraft
RYCB09					
B7	0.06	27.87	54.00	1.0000	Richcraft
CB10_STRG					
B8	0.12	54.22	84.00	2.0000	Richcraft
CB11_STRG					
B9	0.04	23.17	86.00	2.0000	Richcraft
CB12_STRG					

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
CB11	JUNCTION	105.20	2.89	0.0	
CB13	JUNCTION	105.01	3.02	0.0	
DITCH_IN_1	JUNCTION	106.18	0.67	0.0	
EX_STUB	JUNCTION	104.30	3.65	0.0	
MH401	JUNCTION	105.68	2.97	0.0	
MH402	JUNCTION	105.34	2.68	0.0	
MH403	JUNCTION	104.91	3.12	0.0	
MH404	JUNCTION	104.74	3.30	0.0	
MH405	JUNCTION	104.34	3.66	0.0	
MH406	JUNCTION	104.54	3.43	0.0	
mh407	JUNCTION	104.75	2.60	0.0	
MH408	JUNCTION	104.60	2.53	0.0	
MH409	JUNCTION	104.81	1.79	0.0	
MH409_null	JUNCTION	104.81	1.79	0.0	
MH410	JUNCTION	104.90	1.60	0.0	
RYCB01	JUNCTION	105.98	2.08	0.0	
RYCB02	JUNCTION	106.18	2.50	0.0	
RYCB04	JUNCTION	105.85	2.50	0.0	
RYCB09	JUNCTION	105.69	2.77	0.0	
RYCB18	JUNCTION	105.39	1.31	0.0	
RYCB19	JUNCTION	104.80	2.00	0.0	
14	OUTFALL	104.25	0.75	0.0	
2	OUTFALL	105.38	0.00	0.0	
5	OUTFALL	108.07	0.00	0.0	
CB03_STRG	STORAGE	105.91	4.09	0.0	
CB04_STRG	STORAGE	105.80	4.20	0.0	
CB06_07_STRG	STORAGE	105.95	3.05	0.0	
CB08_STRG	STORAGE	105.69	4.31	0.0	

CB10_STRG	STORAGE	105.80	4.20	0.0
CB11_STRG	STORAGE	105.83	4.17	0.0
CB12_STRG	STORAGE	105.81	4.19	0.0
CB13_STRG	STORAGE	105.80	4.20	0.0
CB14_15_STRG	STORAGE	105.75	2.52	0.0
CB16_STRG	STORAGE	104.66	2.59	0.0
DCB17_STRG	STORAGE	104.57	2.11	0.0
POND_1	STORAGE	105.50	0.75	0.0

****
Link Summary
****

Name	From Node	To Node	Type	Length	% Slope	Roughness
11	POND_1	MH410	CONDUIT	8.0	3.8581	0.0130
13	MH402	MH403	CONDUIT	79.4	0.5036	0.0130
14	RYCB01	MH401	CONDUIT	28.9	0.5193	0.0130
15	mh407	MH406	CONDUIT	23.5	0.2557	0.0130
16	CB11	MH403	CONDUIT	29.2	0.4790	0.0130
17	MH403	MH404	CONDUIT	27.8	0.5042	0.0130
18	MH404	MH405	CONDUIT	19.1	0.5246	0.0130
2	MH401	MH402	CONDUIT	39.3	0.4835	0.0130
2_3	MH408	MH406	CONDUIT	26.4	0.1515	0.0130
3	MH410	MH409_null	CONDUIT	13.6	0.2949	0.0130
39	CB13	MH404	CONDUIT	23.6	0.5095	0.0130
4	MH409	MH408	CONDUIT	23.4	0.1709	0.0130
44	DITCH_IN_1	POND_1	CONDUIT	55.0	0.5091	0.0350
54	DCB17_STRG	MH409_null	CONDUIT	5.8	1.0259	0.0130
7	MH406	MH405	CONDUIT	40.7	0.1474	0.0130
8	MH405	EX_STUB	CONDUIT	9.4	0.1065	0.0130
9	EX_STUB	14	CONDUIT	37.5	0.1334	0.0130
10	CB14_15_STRG	MH405	ORIFICE			
19	RYCB02	MH401	ORIFICE			
21	CB03_STRG	MH401	ORIFICE			
22	RYCB04	MH402	ORIFICE			
24	CB04_STRG	MH402	ORIFICE			
25	CB06_07_STRG	MH402	ORIFICE			
27	RYCB19	mh407	ORIFICE			
28	RYCB18	mh407	ORIFICE			

30	CB10_STRG	MH403	ORIFICE
31	CB11_STRG	CB11	ORIFICE
34	CB12_STRG	MH404	ORIFICE
35	CB13_STRG	CB13	ORIFICE
41	CB16_STRG	MH406	ORIFICE
51	RYCB09	MH402	ORIFICE
52	CB08_STRG	MH402	ORIFICE
53	MH409_null	MH409	ORIFICE
1	CB14_15_STRG	5	WEIR
12	DCB17_STRG	POND_1	WEIR
20	RYCB02	CB03_STRG	WEIR
23	RYCB04	CB04_STRG	WEIR
26	CB06_07_STRG	CB08_STRG	WEIR
29	RYCB09	CB08_STRG	WEIR
32	CB11_STRG	CB10_STRG	WEIR
33	CB08_STRG	CB10_STRG	WEIR
36	CB10_STRG	CB12_STRG	WEIR
37	CB13_STRG	CB12_STRG	WEIR
38	CB12_STRG	CB14_15_STRG	WEIR
40	CB16_STRG	DCB17_STRG	WEIR
42	CB04_STRG	CB08_STRG	WEIR
43	CB03_STRG	CB04_STRG	WEIR
45	RYCB18	DITCH_IN_1	WEIR
46	RYCB19	DITCH_IN_1	WEIR
5	POND_1	2	WEIR
50	MH410	POND_1	WEIR

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
11	CIRCULAR	0.30	0.07	0.07	0.30	1	0.19
13	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
14	CIRCULAR	0.45	0.16	0.11	0.45	1	0.21
15	CIRCULAR	0.45	0.16	0.11	0.45	1	0.14
16	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
17	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
18	CIRCULAR	0.45	0.16	0.11	0.45	1	0.21
2	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
2_3	CIRCULAR	0.60	0.28	0.15	0.60	1	0.24
3	CIRCULAR	0.60	0.28	0.15	0.60	1	0.33
39	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20

4	CIRCULAR	0.60	0.28	0.15	0.60	1	0.25
44	TRAPEZOIDAL	0.30	0.36	0.16	2.10	1	0.22
54	CIRCULAR	0.30	0.07	0.07	0.30	1	0.10
7	CIRCULAR	0.60	0.28	0.15	0.60	1	0.24
8	CIRCULAR	0.75	0.44	0.19	0.75	1	0.36
9	CIRCULAR	0.75	0.44	0.19	0.75	1	0.41

```
*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 04/21/2021 00:00:00
Ending Date .............. 04/21/2021 12:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 0.50 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 4
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.051        31.776
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.018        11.275
Surface Runoff ...........         0.033        20.619
Final Storage ............         0.000         0.011
```

```
  Continuity Error (%) .....        -0.405


  **************************        Volume         Volume
  Flow Routing Continuity        hectare-m       10^6 ltr
  **************************     ---------      ---------
  Dry Weather Inflow .......         0.000          0.000
  Wet Weather Inflow .......         0.033          0.331
  Groundwater Inflow .......         0.000          0.000
  RDII Inflow ..............         0.000          0.000
  External Inflow ..........         0.000          0.000
  External Outflow .........         0.033          0.328
  Flooding Loss ............         0.000          0.000
  Evaporation Loss .........         0.000          0.000
  Exfiltration Loss ........         0.000          0.000
  Initial Stored Volume ....         0.000          0.000
  Final Stored Volume ......         0.000          0.001
  Continuity Error (%) .....         0.657


  ***************************
  Time-Step Critical Elements
  ***************************
  None


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.


  *************************
  Routing Time Step Summary
  *************************
  Minimum Time Step           :     0.50 sec
  Average Time Step           :     0.50 sec
  Maximum Time Step           :     0.50 sec
  Percent in Steady State     :     0.00
  Average Iterations per Step :     2.00
  Percent Not Converging      :     0.00
  Time Step Frequencies       :
      0.500 -  0.500 sec      :   100.00 %
      0.500 -  0.500 sec      :     0.00 %
      0.500 -  0.500 sec      :     0.00 %
      0.500 -  0.500 sec      :     0.00 %
      0.500 -  0.500 sec      :     0.00 %


  ***************************
  Subcatchment Runoff Summary
  ***************************

  ---------------------------------------------------------------------------------
--------------------------------------------
                            Total      Total      Total      Total     Imperv
Perv      Total       Total     Peak  Runoff
```

Subcatchment	Precip mm	Runon mm	Evap mm	Infil mm	Runoff mm	Runoff mm	Runoff mm	Runoff 10^6 ltr	Runoff CMS	Coeff
28	31.78	0.00	0.00	11.42	20.46	0.04	20.50	0.01	0.01	0.645
B1	31.78	0.00	0.00	11.70	19.53	0.12	19.65	0.01	0.00	0.618
B10	31.78	0.00	0.00	2.52	29.36	0.06	29.43	0.03	0.02	0.926
B11_1	31.78	0.00	0.00	17.78	14.06	0.03	14.09	0.01	0.01	0.443
B11_2	31.78	0.00	0.00	17.78	14.07	0.03	14.09	0.01	0.01	0.444
B12	31.78	0.00	0.00	12.68	19.16	0.05	19.20	0.01	0.01	0.604
B13	31.78	0.00	0.00	11.42	20.44	0.05	20.49	0.01	0.01	0.645
B14	31.78	0.00	0.00	8.24	23.67	0.04	23.71	0.05	0.03	0.746
B15	31.78	0.00	0.00	17.78	14.08	0.02	14.10	0.02	0.01	0.444
B16	31.78	0.00	0.00	14.89	16.88	0.08	16.96	0.01	0.00	0.534
B17	31.78	0.00	0.00	11.71	20.06	0.10	20.16	0.01	0.01	0.635
B18	31.78	0.00	0.00	10.78	21.07	0.05	21.12	0.02	0.01	0.665
B2_1	31.78	0.00	0.00	10.14	21.71	0.05	21.76	0.01	0.00	0.685
B2_2	31.78	0.00	0.00	10.14	21.71	0.06	21.76	0.02	0.01	0.685
B3_1	31.78	0.00	0.00	13.01	18.87	0.03	18.90	0.01	0.01	0.595
B3_2	31.78	0.00	0.00	12.98	18.79	0.10	18.89	0.01	0.01	0.594
B5	31.78	0.00	0.00	11.73	20.11	0.05	20.16	0.03	0.02	0.635
B6	31.78	0.00	0.00	14.29	17.60	0.03	17.62	0.01	0.01	0.555
B7	31.78	0.00	0.00	14.59	17.23	0.05	17.28	0.01	0.01	0.544
B8	31.78	0.00	0.00	5.05	26.81	0.06	26.88	0.03	0.02	0.846
B9	31.78	0.00	0.00	4.42	27.43	0.08	27.51	0.01	0.01	0.866

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters

CB11	JUNCTION	0.01	0.10	105.30	0	01:10	0.10
CB13	JUNCTION	0.01	0.09	105.10	0	01:10	0.09
DITCH_IN_1	JUNCTION	0.01	0.08	106.26	0	01:10	0.08
EX_STUB	JUNCTION	0.04	0.33	104.63	0	01:11	0.33
MH401	JUNCTION	0.01	0.10	105.78	0	01:10	0.10
MH402	JUNCTION	0.02	0.18	105.52	0	01:10	0.18
MH403	JUNCTION	0.02	0.21	105.12	0	01:11	0.21
MH404	JUNCTION	0.02	0.24	104.98	0	01:11	0.24
MH405	JUNCTION	0.03	0.33	104.67	0	01:11	0.33
MH406	JUNCTION	0.04	0.22	104.76	0	01:10	0.22
mh407	JUNCTION	0.02	0.11	104.86	0	01:10	0.11
MH408	JUNCTION	0.04	0.20	104.80	0	01:12	0.20
MH409	JUNCTION	0.02	0.19	105.00	0	01:11	0.19
MH409_null	JUNCTION	0.04	0.77	105.58	0	01:10	0.74
MH410	JUNCTION	0.02	0.68	105.58	0	01:10	0.65
RYCB01	JUNCTION	0.00	0.04	106.02	0	01:10	0.04
RYCB02	JUNCTION	0.01	0.14	106.32	0	01:10	0.14
RYCB04	JUNCTION	0.01	0.55	106.40	0	01:10	0.54
RYCB09	JUNCTION	0.02	0.77	106.46	0	01:10	0.77
RYCB18	JUNCTION	0.01	0.20	105.59	0	01:10	0.20
RYCB19	JUNCTION	1.49	1.62	106.42	0	01:10	1.62
14	OUTFALL	0.02	0.27	104.52	0	01:11	0.27
2	OUTFALL	0.00	0.00	105.38	0	00:00	0.00
5	OUTFALL	0.00	0.00	108.07	0	00:00	0.00
CB03_STRG	STORAGE	0.02	1.02	106.93	0	01:10	1.01
CB04_STRG	STORAGE	0.02	0.72	106.52	0	01:10	0.72
CB06_07_STRG	STORAGE	0.02	0.58	106.53	0	01:10	0.58
CB08_STRG	STORAGE	0.05	2.13	107.82	0	01:10	2.12
CB10_STRG	STORAGE	0.02	0.74	106.54	0	01:10	0.74
CB11_STRG	STORAGE	0.05	2.12	107.95	0	01:10	2.11
CB12_STRG	STORAGE	0.02	0.79	106.60	0	01:10	0.79
CB13_STRG	STORAGE	0.05	2.11	107.91	0	01:10	2.10
CB14_15_STRG	STORAGE	0.02	0.95	106.70	0	01:10	0.95
CB16_STRG	STORAGE	0.02	0.81	106.47	0	01:11	0.81
DCB17_STRG	STORAGE	0.60	1.02	105.59	0	01:10	0.99
POND_1	STORAGE	0.01	0.06	105.56	0	01:11	0.06

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
CB11	JUNCTION	0.000	0.021	0	01:10	0	0.0335	-0.001
CB13	JUNCTION	0.000	0.018	0	01:10	0	0.0299	0.032

DITCH_IN_1	JUNCTION	0.007	0.007	0	01:10	0.0105	0.0105	0.006
EX_STUB	JUNCTION	0.000	0.198	0	01:11	0	0.328	0.001
MH401	JUNCTION	0.000	0.021	0	01:10	0	0.0315	-0.003
MH402	JUNCTION	0.000	0.065	0	01:10	0	0.104	0.534
MH403	JUNCTION	0.000	0.093	0	01:10	0	0.148	-0.412
MH404	JUNCTION	0.000	0.118	0	01:11	0	0.19	-0.007
MH405	JUNCTION	0.000	0.199	0	01:11	0	0.329	0.010
MH406	JUNCTION	0.000	0.070	0	01:10	0	0.12	0.065
mh407	JUNCTION	0.000	0.016	0	01:10	0	0.0219	0.050
MH408	JUNCTION	0.000	0.049	0	01:11	0	0.0896	0.053
MH409	JUNCTION	0.000	0.050	0	01:10	0	0.0896	-0.016
MH409_null	JUNCTION	0.000	0.050	0	01:10	0	0.0896	-0.033
MH410	JUNCTION	0.013	0.028	0	01:11	0.0191	0.0412	0.026
RYCB01	JUNCTION	0.004	0.004	0	01:10	0.00584	0.00584	0.001
RYCB02	JUNCTION	0.004	0.004	0	01:10	0.00599	0.00599	0.001
RYCB04	JUNCTION	0.006	0.006	0	01:10	0.00934	0.00934	0.000
RYCB09	JUNCTION	0.008	0.008	0	01:10	0.0115	0.0115	0.000
RYCB18	JUNCTION	0.012	0.012	0	01:10	0.0181	0.0181	0.000
RYCB19	JUNCTION	0.004	0.004	0	01:10	0.00568	0.00568	48.971
14	OUTFALL	0.000	0.199	0	01:11	0	0.328	0.000
2	OUTFALL	0.000	0.000	0	00:00	0	0	0.000 ltr
5	OUTFALL	0.000	0.000	0	00:00	0	0	0.000 ltr
CB03_STRG	STORAGE	0.013	0.013	0	01:10	0.0196	0.0196	0.000
CB04_STRG	STORAGE	0.007	0.007	0	01:10	0.0108	0.0108	0.000
CB06_07_STRG	STORAGE	0.006	0.006	0	01:10	0.00965	0.00965	0.000
CB08_STRG	STORAGE	0.021	0.021	0	01:10	0.0308	0.0308	0.000
CB10_STRG	STORAGE	0.007	0.007	0	01:10	0.0111	0.0111	0.000
CB11_STRG	STORAGE	0.023	0.023	0	01:10	0.0335	0.0335	0.000
CB12_STRG	STORAGE	0.008	0.008	0	01:10	0.0115	0.0115	0.000
CB13_STRG	STORAGE	0.020	0.020	0	01:10	0.0299	0.0299	0.000

CB14_15_STRG	STORAGE	0.013	0.013	0	01:10	0.0189	0.0189	0.000
CB16_STRG	STORAGE	0.006	0.006	0	01:10	0.00859	0.00859	0.000
DCB17_STRG	STORAGE	0.033	0.033	0	01:10	0.0492	0.0492	0.525
POND_1	STORAGE	0.008	0.018	0	01:09	0.0117	0.0222	-0.035

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
MH409_null	JUNCTION	0.10	0.121	1.019

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CMS
CB03_STRG	0.000	0	0	0	0.000	0	0	01:10	0.013
CB04_STRG	0.000	0	0	0	0.000	0	0	01:10	0.007
CB06_07_STRG	0.000	0	0	0	0.000	0	0	01:10	0.006
CB08_STRG	0.000	0	0	0	0.001	0	0	01:10	0.019
CB10_STRG	0.000	0	0	0	0.000	0	0	01:10	0.007
CB11_STRG	0.000	0	0	0	0.001	0	0	01:10	0.021
CB12_STRG	0.000	0	0	0	0.000	0	0	01:10	0.007

CB13_STRG	0.000	0	0	0	0.001	0	0
01:10 0.018							
CB14_15_STRG	0.000	0	0	0	0.000	1	0
01:10 0.012							
CB16_STRG	0.000	0	0	0	0.000	1	0
01:11 0.005							
DCB17_STRG	0.000	5	0	0	0.001	8	0
01:10 0.036							
POND_1	0.001	0	0	0	0.005	5	0
01:11 0.017							

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
14	54.27	0.014	0.199	0.328
2	0.00	0.000	0.000	0.000
5	0.00	0.000	0.000	0.000
System	18.09	0.014	0.199	0.328

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
11	CONDUIT	0.017	0 01:11	1.41	0.09	0.60
13	CONDUIT	0.065	0 01:10	1.10	0.32	0.40
14	CONDUIT	0.004	0 01:10	0.53	0.02	0.10
15	CONDUIT	0.016	0 01:10	0.67	0.11	0.21
16	CONDUIT	0.021	0 01:11	0.82	0.11	0.22
17	CONDUIT	0.093	0 01:11	1.25	0.46	0.47
18	CONDUIT	0.118	0 01:11	1.36	0.57	0.53
2	CONDUIT	0.021	0 01:10	0.81	0.10	0.22
2_3	CONDUIT	0.049	0 01:12	0.68	0.21	0.31
3	CONDUIT	0.027	0 01:12	0.35	0.08	1.00
39	CONDUIT	0.018	0 01:11	0.79	0.09	0.20
4	CONDUIT	0.049	0 01:11	0.77	0.19	0.28
44	CONDUIT	0.006	0 01:11	0.25	0.03	0.18
54	CONDUIT	0.036	0 01:09	1.21	0.36	1.00
7	CONDUIT	0.069	0 01:10	0.88	0.29	0.33
8	CONDUIT	0.198	0 01:11	1.15	0.55	0.41
9	CONDUIT	0.199	0 01:11	1.22	0.49	0.40
10	ORIFICE	0.012	0 01:10			1.00
19	ORIFICE	0.004	0 01:10			1.00
21	ORIFICE	0.013	0 01:10			1.00

22	ORIFICE	0.006	0	01:10	1.00
24	ORIFICE	0.007	0	01:10	1.00
25	ORIFICE	0.006	0	01:10	1.00
27	ORIFICE	0.004	0	01:10	
28	ORIFICE	0.012	0	01:10	1.00
30	ORIFICE	0.007	0	01:10	1.00
31	ORIFICE	0.021	0	01:10	1.00
34	ORIFICE	0.007	0	01:10	1.00
35	ORIFICE	0.018	0	01:10	1.00
41	ORIFICE	0.005	0	01:11	1.00
51	ORIFICE	0.007	0	01:10	1.00
52	ORIFICE	0.019	0	01:10	1.00
53	ORIFICE	0.050	0	01:10	1.00
1	WEIR	0.000	0	00:00	0.00
12	WEIR	0.000	0	00:00	0.00
20	WEIR	0.000	0	00:00	0.00
23	WEIR	0.000	0	00:00	0.00
26	WEIR	0.000	0	00:00	0.00
29	WEIR	0.000	0	00:00	0.00
32	WEIR	0.000	0	00:00	0.00
33	WEIR	0.000	0	00:00	0.00
36	WEIR	0.000	0	00:00	0.00
37	WEIR	0.000	0	00:00	0.00
38	WEIR	0.000	0	00:00	0.00
40	WEIR	0.000	0	00:00	0.00
42	WEIR	0.000	0	00:00	0.00
43	WEIR	0.000	0	00:00	0.00
45	WEIR	0.000	0	00:00	0.00
46	WEIR	0.000	0	00:00	0.00
5	WEIR	0.000	0	00:00	0.00
50	WEIR	0.000	0	00:00	0.00

****
Flow Classification Summary
****

	Adjusted	---------- Fraction of Time in Flow Class ----------								
Conduit	/Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
11	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.01	0.00
13	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.01	0.00
14	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
15	1.00	0.01	0.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00
16	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
17	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	[illegible]

18	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
2_3	1.00	0.02	0.00	0.00	0.13	0.00	0.00	0.86	0.00	0.00
3	1.00	0.00	0.00	0.00	0.12	0.00	0.00	0.88	0.05	0.00
39	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
4	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
44	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
54	1.00	0.03	0.00	0.00	0.02	0.00	0.00	0.95	0.00	0.00
7	1.00	0.01	0.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00
8	1.00	0.00	0.00	0.00	0.12	0.00	0.00	0.88	0.00	0.00
9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
11	0.01	0.01	0.09	0.01	0.01
3	0.09	0.09	0.10	0.01	0.01
54	0.10	0.10	0.12	0.01	0.01

Analysis begun on: Mon Jul 5 14:45:22 2021
Analysis ended on: Mon Jul 5 14:45:34 2021
Total elapsed time: 00:00:12

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

WARNING 02: maximum depth increased for Node MH410
WARNING 02: maximum depth increased for Node RYCB02
WARNING 02: maximum depth increased for Node RYCB04
WARNING 02: maximum depth increased for Node RYCB09
WARNING 02: maximum depth increased for Node RYCB18
WARNING 02: maximum depth increased for Node RYCB19

****
Element Count
****

Number of rain gages 1
Number of subcatchments ... 21
Number of nodes 36
Number of links 51
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
Richcraft	Chicago_3h_5yr_10min	INTENSITY	10 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
28	0.05	15.70	64.00	1.0000	Richcraft	CB06_07_STRG
B1	0.03	19.80	63.00	2.0000	Richcraft	RYCB01
B10	0.10	50.85	92.00	2.0000	Richcraft	CB13_STRG
B11_1	0.07	13.49	44.00	2.0000	Richcraft	DITCH_IN_1
B11_2	0.08	12.74	44.00	2.0000	Richcraft	POND_1
B12	0.05	16.00	60.00	2.0000	Richcraft	MH410
B13	0.04	12.43	64.00	2.0000	Richcraft	MH410
B14	0.21	37.73	74.00	3.0000	Richcraft	DCB17_STRG
B15	0.13	20.41	44.00	1.0000	Richcraft	RYCB18
B16	0.03	16.75	53.00	2.0000	Richcraft	RYCB19

```
  B17                          0.04      28.40      63.00     2.0000 Richcraft
CB16_STRG
  B18                          0.09      29.87      66.00     2.0000 Richcraft
CB14_15_STRG
  B2_1                         0.03       9.17      68.00     2.0000 Richcraft
RYCB02
  B2_2                         0.09      45.10      68.00     1.0000 Richcraft
CB03_STRG
  B3_1                         0.05       9.88      59.00     2.0000 Richcraft
RYCB04
  B3_2                         0.06      38.07      59.00     2.0000 Richcraft
CB04_STRG
  B5                           0.15      50.87      63.00     2.0000 Richcraft
CB08_STRG
  B6                           0.07      14.22      55.00     1.0000 Richcraft
RYCB09
  B7                           0.06      27.87      54.00     1.0000 Richcraft
CB10_STRG
  B8                           0.12      54.22      84.00     2.0000 Richcraft
CB11_STRG
  B9                           0.04      23.17      86.00     2.0000 Richcraft
CB12_STRG


  ************
  Node Summary
  ************
                                                  Invert      Max.    Ponded    External
  Name                    Type                     Elev.     Depth      Area    Inflow
  -------------------------------------------------------------------------------
  CB11                    JUNCTION                105.20      2.89       0.0
  CB13                    JUNCTION                105.01      3.02       0.0
  DITCH_IN_1              JUNCTION                106.18      0.67       0.0
  EX_STUB                 JUNCTION                104.30      3.65       0.0
  MH401                   JUNCTION                105.68      2.97       0.0
  MH402                   JUNCTION                105.34      2.68       0.0
  MH403                   JUNCTION                104.91      3.12       0.0
  MH404                   JUNCTION                104.74      3.30       0.0
  MH405                   JUNCTION                104.34      3.66       0.0
  MH406                   JUNCTION                104.54      3.43       0.0
  mh407                   JUNCTION                104.75      2.60       0.0
  MH408                   JUNCTION                104.60      2.53       0.0
  MH409                   JUNCTION                104.81      1.79       0.0
  MH409_null              JUNCTION                104.81      1.79       0.0
  MH410                   JUNCTION                104.90      1.60       0.0
  RYCB01                  JUNCTION                105.98      2.08       0.0
  RYCB02                  JUNCTION                106.18      2.50       0.0
  RYCB04                  JUNCTION                105.85      2.50       0.0
  RYCB09                  JUNCTION                105.69      2.77       0.0
  RYCB18                  JUNCTION                105.39      1.31       0.0
  RYCB19                  JUNCTION                104.80      2.00       0.0
  14                      OUTFALL                 104.25      0.75       0.0
  2                       OUTFALL                 105.38      0.00       0.0
  5                       OUTFALL                 108.07      0.00       0.0
  CB03_STRG               STORAGE                 105.91      4.09       0.0
  CB04_STRG               STORAGE                 105.80      4.20       0.0
  CB06_07_STRG            STORAGE                 105.95      3.05       0.0
  CB08_STRG               STORAGE                 105.69      4.31       0.0
```

CB10_STRG	STORAGE	105.80	4.20	0.0
CB11_STRG	STORAGE	105.83	4.17	0.0
CB12_STRG	STORAGE	105.81	4.19	0.0
CB13_STRG	STORAGE	105.80	4.20	0.0
CB14_15_STRG	STORAGE	105.75	2.52	0.0
CB16_STRG	STORAGE	105.66	2.59	0.0
DCB17_STRG	STORAGE	104.57	2.11	0.0
POND_1	STORAGE	105.50	0.75	0.0

****
Link Summary
****

Name	From Node	To Node	Type	Length	% Slope	Roughness
11	POND_1	MH410	CONDUIT	8.0	3.8581	0.0130
13	MH402	MH403	CONDUIT	79.4	0.5036	0.0130
14	RYCB01	MH401	CONDUIT	28.9	0.5193	0.0130
15	mh407	MH406	CONDUIT	23.5	0.2557	0.0130
16	CB11	MH403	CONDUIT	29.2	0.4790	0.0130
17	MH403	MH404	CONDUIT	27.8	0.5042	0.0130
18	MH404	MH405	CONDUIT	19.1	0.5246	0.0130
2	MH401	MH402	CONDUIT	39.3	0.4835	0.0130
2_3	MH408	MH406	CONDUIT	26.4	0.1515	0.0130
3	MH410	MH409_null	CONDUIT	13.6	0.2949	0.0130
39	CB13	MH404	CONDUIT	23.6	0.5095	0.0130
4	MH409	MH408	CONDUIT	23.4	0.1709	0.0130
44	DITCH_IN_1	POND_1	CONDUIT	55.0	0.5091	0.0350
54	DCB17_STRG	MH409_null	CONDUIT	5.8	1.0259	0.0130
7	MH406	MH405	CONDUIT	40.7	0.1474	0.0130
8	MH405	EX_STUB	CONDUIT	9.4	0.1065	0.0130
9	EX_STUB	14	CONDUIT	37.5	0.1334	0.0130
10	CB14_15_STRG	MH405	ORIFICE			
19	RYCB02	MH401	ORIFICE			
21	CB03_STRG	MH401	ORIFICE			
22	RYCB04	MH402	ORIFICE			
24	CB04_STRG	MH402	ORIFICE			
25	CB06_07_STRG	MH402	ORIFICE			
27	RYCB19	mh407	ORIFICE			
28	RYCB18	mh407	ORIFICE			

30	CB10_STRG	MH403	ORIFICE
31	CB11_STRG	CB11	ORIFICE
34	CB12_STRG	MH404	ORIFICE
35	CB13_STRG	CB13	ORIFICE
41	CB16_STRG	MH406	ORIFICE
51	RYCB09	MH402	ORIFICE
52	CB08_STRG	MH402	ORIFICE
53	MH409_null	MH409	ORIFICE
1	CB14_15_STRG	5	WEIR
12	DCB17_STRG	POND_1	WEIR
20	RYCB02	CB03_STRG	WEIR
23	RYCB04	CB04_STRG	WEIR
26	CB06_07_STRG	CB08_STRG	WEIR
29	RYCB09	CB08_STRG	WEIR
32	CB11_STRG	CB10_STRG	WEIR
33	CB08_STRG	CB10_STRG	WEIR
36	CB10_STRG	CB12_STRG	WEIR
37	CB13_STRG	CB12_STRG	WEIR
38	CB12_STRG	CB14_15_STRG	WEIR
40	CB16_STRG	DCB17_STRG	WEIR
42	CB04_STRG	CB08_STRG	WEIR
43	CB03_STRG	CB04_STRG	WEIR
45	RYCB18	DITCH_IN_1	WEIR
46	RYCB19	DITCH_IN_1	WEIR
5	POND_1	2	WEIR
50	MH410	POND_1	WEIR

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
11	CIRCULAR	0.30	0.07	0.07	0.30	1	0.19
13	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
14	CIRCULAR	0.45	0.16	0.11	0.45	1	0.21
15	CIRCULAR	0.45	0.16	0.11	0.45	1	0.14
16	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
17	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
18	CIRCULAR	0.45	0.16	0.11	0.45	1	0.21
2	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
2_3	CIRCULAR	0.60	0.28	0.15	0.60	1	0.24
3	CIRCULAR	0.60	0.28	0.15	0.60	1	0.33
39	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20

```
  4              CIRCULAR            0.60     0.28     0.15     0.60        1
0.25
  44             TRAPEZOIDAL         0.30     0.36     0.16     2.10        1
0.22
  54             CIRCULAR            0.30     0.07     0.07     0.30        1
0.10
  7              CIRCULAR            0.60     0.28     0.15     0.60        1
0.24
  8              CIRCULAR            0.75     0.44     0.19     0.75        1
0.36
  9              CIRCULAR            0.75     0.44     0.19     0.75        1
0.41


  *********************************************************
  NOTE: The summary statistics displayed in this report are
  based on results found at every computational time step,
  not just on results from each reporting time step.
  *********************************************************

  ****************
  Analysis Options
  ****************
  Flow Units ............... CMS
  Process Models:
    Rainfall/Runoff ........ YES
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ NO
    Water Quality .......... NO
  Infiltration Method ...... HORTON
  Flow Routing Method ...... DYNWAVE
  Surcharge Method ......... EXTRAN
  Starting Date ............ 04/21/2021 00:00:00
  Ending Date .............. 04/21/2021 12:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:01:00
  Wet Time Step ............ 00:05:00
  Dry Time Step ............ 00:05:00
  Routing Time Step ........ 0.50 sec
  Variable Time Step ....... YES
  Maximum Trials ........... 8
  Number of Threads ........ 4
  Head Tolerance ........... 0.001500 m


  **************************        Volume         Depth
  Runoff Quantity Continuity     hectare-m            mm
  **************************     ---------       -------
  Total Precipitation ......         0.068        42.498
  Evaporation Loss .........         0.000         0.000
  Infiltration Loss ........         0.022        13.451
  Surface Runoff ...........         0.047        29.255
  Final Storage ............         0.000         0.011
```

```
  Continuity Error (%) .....        -0.515


  **************************        Volume        Volume
  Flow Routing Continuity        hectare-m      10^6 ltr
  **************************     ---------     ---------
  Dry Weather Inflow .......         0.000         0.000
  Wet Weather Inflow .......         0.047         0.470
  Groundwater Inflow .......         0.000         0.000
  RDII Inflow ..............         0.000         0.000
  External Inflow ..........         0.000         0.000
  External Outflow .........         0.047         0.467
  Flooding Loss ............         0.000         0.000
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.000         0.001
  Continuity Error (%) .....         0.494


  ***************************
  Time-Step Critical Elements
  ***************************
  None


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.


  *************************
  Routing Time Step Summary
  *************************
  Minimum Time Step           :     0.50 sec
  Average Time Step           :     0.50 sec
  Maximum Time Step           :     0.50 sec
  Percent in Steady State     :     0.00
  Average Iterations per Step :     2.00
  Percent Not Converging      :     0.00
  Time Step Frequencies       :
      0.500 -  0.500 sec      :   100.00 %
      0.500 -  0.500 sec      :     0.00 %
      0.500 -  0.500 sec      :     0.00 %
      0.500 -  0.500 sec      :     0.00 %
      0.500 -  0.500 sec      :     0.00 %


  ***************************
  Subcatchment Runoff Summary
  ***************************

  ----------------------------------------------------------------------------------
---------------------------------------------
                            Total      Total      Total      Total     Imperv
Perv      Total       Total     Peak  Runoff
```

Subcatchment	Precip mm	Runon mm	Evap mm	Infil mm	Runoff mm	Runoff mm	Runoff mm	Runoff 10^6 ltr	Runoff CMS	Runoff Coeff
28	42.50	0.00	0.00	13.58	27.34	1.81	29.15	0.01	0.01	0.686
B1	42.50	0.00	0.00	13.49	26.28	2.41	28.69	0.01	0.01	0.675
B10	42.50	0.00	0.00	2.88	39.24	0.57	39.81	0.04	0.03	0.937
B11_1	42.50	0.00	0.00	21.68	18.79	2.20	20.99	0.02	0.01	0.494
B11_2	42.50	0.00	0.00	21.82	18.80	2.04	20.85	0.02	0.01	0.491
B12	42.50	0.00	0.00	15.01	25.60	2.10	27.70	0.01	0.01	0.652
B13	42.50	0.00	0.00	13.49	27.32	1.91	29.23	0.01	0.01	0.688
B14	42.50	0.00	0.00	9.72	31.64	1.41	33.05	0.07	0.05	0.778
B15	42.50	0.00	0.00	22.09	18.83	1.76	20.58	0.03	0.02	0.484
B16	42.50	0.00	0.00	17.46	22.57	2.68	25.25	0.01	0.01	0.594
B17	42.50	0.00	0.00	13.57	26.82	2.35	29.17	0.01	0.01	0.686
B18	42.50	0.00	0.00	12.66	28.16	1.90	30.06	0.03	0.02	0.707
B2_1	42.50	0.00	0.00	11.90	29.02	1.82	30.83	0.01	0.01	0.726
B2_2	42.50	0.00	0.00	11.88	29.01	1.84	30.85	0.03	0.02	0.726
B3_1	42.50	0.00	0.00	15.63	25.22	1.88	27.09	0.01	0.01	0.637
B3_2	42.50	0.00	0.00	15.06	25.11	2.55	27.67	0.02	0.01	0.651
B5	42.50	0.00	0.00	13.81	26.88	2.03	28.90	0.04	0.03	0.680
B6	42.50	0.00	0.00	17.38	23.52	1.80	25.33	0.02	0.01	0.596
B7	42.50	0.00	0.00	17.34	23.03	2.33	25.36	0.02	0.01	0.597
B8	42.50	0.00	0.00	5.82	35.84	1.07	36.91	0.05	0.03	0.869
B9	42.50	0.00	0.00	5.07	36.66	0.97	37.63	0.02	0.01	0.886

****
Node Depth Summary
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Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters

CB11	JUNCTION	0.01	0.10	105.30	0	01:12	0.10
CB13	JUNCTION	0.01	0.09	105.10	0	01:12	0.09
DITCH_IN_1	JUNCTION	0.01	0.09	106.27	0	01:11	0.09
EX_STUB	JUNCTION	0.04	0.36	104.66	0	01:11	0.36
MH401	JUNCTION	0.01	0.12	105.80	0	01:10	0.12
MH402	JUNCTION	0.02	0.20	105.54	0	01:11	0.20
MH403	JUNCTION	0.02	0.25	105.16	0	01:11	0.25
MH404	JUNCTION	0.02	0.27	105.01	0	01:12	0.27
MH405	JUNCTION	0.04	0.36	104.70	0	01:11	0.36
MH406	JUNCTION	0.04	0.25	104.79	0	01:11	0.25
mh407	JUNCTION	0.02	0.13	104.88	0	01:10	0.13
MH408	JUNCTION	0.05	0.22	104.82	0	01:11	0.22
MH409	JUNCTION	0.03	0.20	105.01	0	01:14	0.20
MH409_null	JUNCTION	0.05	0.87	105.68	0	01:19	0.86
MH410	JUNCTION	0.04	0.77	105.67	0	01:19	0.77
RYCB01	JUNCTION	0.00	0.06	106.04	0	01:10	0.06
RYCB02	JUNCTION	0.01	0.26	106.44	0	01:10	0.26
RYCB04	JUNCTION	0.02	1.03	106.88	0	01:11	1.03
RYCB09	JUNCTION	0.03	1.42	107.11	0	01:11	1.42
RYCB18	JUNCTION	0.01	0.36	105.75	0	01:10	0.36
RYCB19	JUNCTION	1.50	1.63	106.43	0	01:10	1.63
14	OUTFALL	0.03	0.30	104.55	0	01:11	0.30
2	OUTFALL	0.00	0.00	105.38	0	00:00	0.00
5	OUTFALL	0.00	0.00	108.07	0	00:00	0.00
CB03_STRG	STORAGE	0.04	2.00	107.91	0	01:10	2.00
CB04_STRG	STORAGE	0.03	1.52	107.32	0	01:11	1.51
CB06_07_STRG	STORAGE	0.03	1.09	107.04	0	01:11	1.09
CB08_STRG	STORAGE	0.08	2.33	108.02	0	01:12	2.33
CB10_STRG	STORAGE	0.03	1.47	107.27	0	01:11	1.46
CB11_STRG	STORAGE	0.07	2.30	108.13	0	01:12	2.30
CB12_STRG	STORAGE	0.03	1.42	107.23	0	01:11	1.42
CB13_STRG	STORAGE	0.07	2.30	108.10	0	01:12	2.30
CB14_15_STRG	STORAGE	0.04	1.89	107.64	0	01:10	1.88
CB16_STRG	STORAGE	0.04	1.58	107.24	0	01:11	1.58
DCB17_STRG	STORAGE	0.61	1.11	105.68	0	01:19	1.10
POND_1	STORAGE	0.01	0.17	105.67	0	01:13	0.17

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Node Inflow Summary
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Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
CB11	JUNCTION	0.000	0.022	0	01:12	0	0.046	-0.001
CB13	JUNCTION	0.000	0.019	0	01:12	0	0.0405	-0.003

DITCH_IN_1	JUNCTION	0.011	0.011	0	01:10	0.0156	0.0156	0.003
EX_STUB	JUNCTION	0.000	0.245	0	01:11	0	0.467	0.001
MH401	JUNCTION	0.000	0.030	0	01:10	0	0.0448	-0.003
MH402	JUNCTION	0.000	0.086	0	01:11	0	0.148	0.283
MH403	JUNCTION	0.000	0.117	0	01:11	0	0.21	-0.242
MH404	JUNCTION	0.000	0.146	0	01:11	0	0.267	0.026
MH405	JUNCTION	0.000	0.244	0	01:11	0	0.467	0.027
MH406	JUNCTION	0.000	0.083	0	01:10	0	0.173	0.039
mh407	JUNCTION	0.000	0.024	0	01:10	0	0.0331	0.161
MH408	JUNCTION	0.000	0.053	0	01:14	0	0.128	0.030
MH409	JUNCTION	0.000	0.053	0	01:19	0	0.128	-0.012
MH409_null	JUNCTION	0.000	0.053	0	01:19	0	0.128	-0.042
MH410	JUNCTION	0.020	0.058	0	01:20	0.0273	0.0647	0.017
RYCB01	JUNCTION	0.007	0.007	0	01:10	0.00852	0.00852	-0.001
RYCB02	JUNCTION	0.006	0.006	0	01:10	0.00848	0.00848	0.000
RYCB04	JUNCTION	0.009	0.009	0	01:10	0.0134	0.0134	0.000
RYCB09	JUNCTION	0.011	0.011	0	01:10	0.0166	0.0166	0.000
RYCB18	JUNCTION	0.018	0.018	0	01:10	0.0265	0.0265	0.000
RYCB19	JUNCTION	0.007	0.007	0	01:10	0.00846	0.00846	28.339
14	OUTFALL	0.000	0.245	0	01:11	0	0.467	0.000
2	OUTFALL	0.000	0.000	0	00:00	0	0	0.000 ltr
5	OUTFALL	0.000	0.000	0	00:00	0	0	0.000 ltr
CB03_STRG	STORAGE	0.020	0.020	0	01:10	0.0278	0.0278	0.000
CB04_STRG	STORAGE	0.012	0.012	0	01:10	0.0158	0.0158	0.000
CB06_07_STRG	STORAGE	0.010	0.010	0	01:10	0.0137	0.0137	0.000
CB08_STRG	STORAGE	0.032	0.032	0	01:10	0.0441	0.0441	0.001
CB10_STRG	STORAGE	0.012	0.012	0	01:10	0.0163	0.0163	0.000
CB11_STRG	STORAGE	0.033	0.033	0	01:10	0.046	0.046	-0.000
CB12_STRG	STORAGE	0.011	0.011	0	01:10	0.0157	0.0157	0.000
CB13_STRG	STORAGE	0.029	0.029	0	01:10	0.0405	0.0405	-0.001

CB14_15_STRG	STORAGE	0.020	0.020	0	01:10	0.0269	0.0269	0.000
CB16_STRG	STORAGE	0.010	0.010	0	01:10	0.0124	0.0124	0.000
DCB17_STRG	STORAGE	0.049	0.049	0	01:10	0.0686	0.0686	0.389
POND_1	STORAGE	0.012	0.036	0	01:10	0.0173	0.0375	-0.019

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Node Surcharge Summary
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Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
MH409_null	JUNCTION	0.30	0.215	0.925

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Node Flooding Summary
****

No nodes were flooded.

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Storage Volume Summary
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Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
CB03_STRG	0.000	0	0	0	0.001	0	0 01:10	0.018
CB04_STRG	0.000	0	0	0	0.001	0	0 01:11	0.010
CB06_07_STRG	0.000	0	0	0	0.000	0	0 01:11	0.008
CB08_STRG	0.000	0	0	0	0.005	0	0 01:12	0.020
CB10_STRG	0.000	0	0	0	0.001	0	0 01:11	0.010
CB11_STRG	0.000	0	0	0	0.004	1	0 01:12	0.022
CB12_STRG	0.000	0	0	0	0.001	0	0 01:11	0.010

CB13_STRG	0.000	0	0	0	0.004	1	0	01:12	0.019
CB14_15_STRG	0.000	0	0	0	0.001	1	0	01:10	0.017
CB16_STRG	0.000	0	0	0	0.001	1	0	01:11	0.007
DCB17_STRG	0.000	5	0	0	0.001	9	0	01:19	0.048
POND_1	0.001	1	0	0	0.016	16	0	01:13	0.052

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Outfall Loading Summary
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Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
14	54.73	0.020	0.245	0.467
2	0.00	0.000	0.000	0.000
5	0.00	0.000	0.000	0.000
System	18.24	0.020	0.245	0.467

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Link Flow Summary
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Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
11	CONDUIT	0.052	0 01:20	1.48	0.27	0.78
13	CONDUIT	0.086	0 01:11	1.18	0.42	0.47
14	CONDUIT	0.007	0 01:10	0.60	0.03	0.12
15	CONDUIT	0.024	0 01:10	0.76	0.17	0.25
16	CONDUIT	0.022	0 01:12	0.82	0.11	0.22
17	CONDUIT	0.117	0 01:11	1.32	0.58	0.54
18	CONDUIT	0.146	0 01:12	1.46	0.71	0.60
2	CONDUIT	0.030	0 01:10	0.91	0.15	0.26
2_3	CONDUIT	0.053	0 01:15	0.73	0.22	0.34
3	CONDUIT	0.046	0 01:20	0.35	0.14	1.00
39	CONDUIT	0.019	0 01:12	0.80	0.09	0.24
4	CONDUIT	0.053	0 01:14	0.78	0.21	0.29
44	CONDUIT	0.009	0 01:11	0.28	0.04	0.22
54	CONDUIT	0.048	0 01:10	1.23	0.49	1.00
7	CONDUIT	0.082	0 01:11	0.89	0.35	0.38
8	CONDUIT	0.245	0 01:11	1.22	0.67	0.46
9	CONDUIT	0.245	0 01:11	1.30	0.60	0.44
10	ORIFICE	0.017	0 01:10			1.00
19	ORIFICE	0.006	0 01:10			1.00
21	ORIFICE	0.018	0 01:10			1.00

22	ORIFICE	0.008	0	01:11	1.00
24	ORIFICE	0.010	0	01:11	1.00
25	ORIFICE	0.008	0	01:11	1.00
27	ORIFICE	0.007	0	01:10	
28	ORIFICE	0.018	0	01:10	1.00
30	ORIFICE	0.010	0	01:11	1.00
31	ORIFICE	0.022	0	01:12	1.00
34	ORIFICE	0.010	0	01:11	1.00
35	ORIFICE	0.019	0	01:12	1.00
41	ORIFICE	0.007	0	01:11	1.00
51	ORIFICE	0.010	0	01:11	1.00
52	ORIFICE	0.020	0	01:12	1.00
53	ORIFICE	0.053	0	01:19	1.00
1	WEIR	0.000	0	00:00	0.00
12	WEIR	0.000	0	00:00	0.00
20	WEIR	0.000	0	00:00	0.00
23	WEIR	0.000	0	00:00	0.00
26	WEIR	0.000	0	00:00	0.00
29	WEIR	0.000	0	00:00	0.00
32	WEIR	0.000	0	00:00	0.00
33	WEIR	0.000	0	00:00	0.00
36	WEIR	0.000	0	00:00	0.00
37	WEIR	0.000	0	00:00	0.00
38	WEIR	0.000	0	00:00	0.00
40	WEIR	0.000	0	00:00	0.00
42	WEIR	0.000	0	00:00	0.00
43	WEIR	0.000	0	00:00	0.00
45	WEIR	0.000	0	00:00	0.00
46	WEIR	0.000	0	00:00	0.00
5	WEIR	0.000	0	00:00	0.00
50	WEIR	0.000	0	00:00	0.00

****
Flow Classification Summary
****

	Adjusted	---------- Fraction of Time in Flow Class ----------								
	/Actual		Up	Down	Sub	Sup	Up	Down	Norm	Inlet
Conduit	Length	Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd	Ctrl
11	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.01	0.00
13	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.02	0.00
14	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
15	1.00	0.01	0.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00
16	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
17	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.00

18	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
2_3	1.00	0.02	0.00	0.00	0.17	0.00	0.00	0.82	0.00	0.00
3	1.00	0.00	0.00	0.00	0.16	0.00	0.00	0.84	0.06	0.00
39	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.01	0.00
4	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
44	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
54	1.00	0.02	0.00	0.00	0.03	0.00	0.00	0.94	0.00	0.00
7	1.00	0.01	0.00	0.00	0.02	0.00	0.00	0.97	0.00	0.00
8	1.00	0.00	0.00	0.00	0.15	0.00	0.00	0.85	0.00	0.00
9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

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Conduit Surcharge Summary
****

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
11	0.01	0.01	0.30	0.01	0.01
3	0.30	0.30	0.30	0.01	0.01
54	0.30	0.30	0.32	0.01	0.01

Analysis begun on: Mon Jul 5 14:55:07 2021
Analysis ended on: Mon Jul 5 14:55:14 2021
Total elapsed time: 00:00:07

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

WARNING 02: maximum depth increased for Node MH410
WARNING 02: maximum depth increased for Node RYCB02
WARNING 02: maximum depth increased for Node RYCB04
WARNING 02: maximum depth increased for Node RYCB09
WARNING 02: maximum depth increased for Node RYCB18
WARNING 02: maximum depth increased for Node RYCB19

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Element Count
****

Number of rain gages 1
Number of subcatchments ... 21
Number of nodes 36
Number of links 51
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
Richcraft	Chicago_3h_100yr_10min	INTENSITY	10 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
28	0.05	15.70	64.00	1.0000	Richcraft	CB06_07_STRG
B1	0.03	19.80	63.00	2.0000	Richcraft	RYCB01
B10	0.10	50.85	92.00	2.0000	Richcraft	CB13_STRG
B11_1	0.07	13.49	44.00	2.0000	Richcraft	DITCH_IN_1
B11_2	0.08	12.74	44.00	2.0000	Richcraft	POND_1
B12	0.05	16.00	60.00	2.0000	Richcraft	MH410
B13	0.04	12.43	64.00	2.0000	Richcraft	MH410
B14	0.21	37.73	74.00	3.0000	Richcraft	DCB17_STRG
B15	0.13	20.41	44.00	1.0000	Richcraft	RYCB18
B16	0.03	16.75	53.00	2.0000	Richcraft	RYCB19

B17	0.04	28.40	63.00	2.0000	Richcraft	CB16_STRG
B18	0.09	29.87	66.00	2.0000	Richcraft	CB14_15_STRG
B2_1	0.03	9.17	68.00	2.0000	Richcraft	RYCB02
B2_2	0.09	45.10	68.00	1.0000	Richcraft	CB03_STRG
B3_1	0.05	9.88	59.00	2.0000	Richcraft	RYCB04
B3_2	0.06	38.07	59.00	2.0000	Richcraft	CB04_STRG
B5	0.15	50.87	63.00	2.0000	Richcraft	CB08_STRG
B6	0.07	14.22	55.00	1.0000	Richcraft	RYCB09
B7	0.06	27.87	54.00	1.0000	Richcraft	CB10_STRG
B8	0.12	54.22	84.00	2.0000	Richcraft	CB11_STRG
B9	0.04	23.17	86.00	2.0000	Richcraft	CB12_STRG

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Node Summary
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Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
CB11	JUNCTION	105.20	2.89	0.0	
CB13	JUNCTION	105.01	3.02	0.0	
DITCH_IN_1	JUNCTION	106.18	0.67	0.0	
EX_STUB	JUNCTION	104.30	3.65	0.0	
MH401	JUNCTION	105.68	2.97	0.0	
MH402	JUNCTION	105.34	2.68	0.0	
MH403	JUNCTION	104.91	3.12	0.0	
MH404	JUNCTION	104.74	3.30	0.0	
MH405	JUNCTION	104.34	3.66	0.0	
MH406	JUNCTION	104.54	3.43	0.0	
mh407	JUNCTION	104.75	2.60	0.0	
MH408	JUNCTION	104.60	2.53	0.0	
MH409	JUNCTION	104.81	1.79	0.0	
MH409_null	JUNCTION	104.81	1.79	0.0	
MH410	JUNCTION	104.90	1.60	0.0	
RYCB01	JUNCTION	105.98	2.08	0.0	
RYCB02	JUNCTION	106.18	2.50	0.0	
RYCB04	JUNCTION	105.85	2.50	0.0	
RYCB09	JUNCTION	105.69	2.77	0.0	
RYCB18	JUNCTION	105.39	1.31	0.0	
RYCB19	JUNCTION	104.80	2.00	0.0	
14	OUTFALL	104.25	0.75	0.0	
2	OUTFALL	105.38	0.00	0.0	
5	OUTFALL	108.07	0.00	0.0	
CB03_STRG	STORAGE	105.91	4.09	0.0	
CB04_STRG	STORAGE	105.80	4.20	0.0	
CB06_07_STRG	STORAGE	105.95	3.05	0.0	
CB08_STRG	STORAGE	105.69	4.31	0.0	

CB10_STRG	STORAGE	105.80	4.20	0.0
CB11_STRG	STORAGE	105.83	4.17	0.0
CB12_STRG	STORAGE	105.81	4.19	0.0
CB13_STRG	STORAGE	105.80	4.20	0.0
CB14_15_STRG	STORAGE	105.75	2.52	0.0
CB16_STRG	STORAGE	105.66	2.59	0.0
DCB17_STRG	STORAGE	104.57	2.11	0.0
POND_1	STORAGE	105.50	0.75	0.0

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Link Summary
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Name	From Node	To Node	Type	Length	% Slope	Roughness
11	POND_1	MH410	CONDUIT	8.0	3.8581	0.0130
13	MH402	MH403	CONDUIT	79.4	0.5036	0.0130
14	RYCB01	MH401	CONDUIT	28.9	0.5193	0.0130
15	mh407	MH406	CONDUIT	23.5	0.2557	0.0130
16	CB11	MH403	CONDUIT	29.2	0.4790	0.0130
17	MH403	MH404	CONDUIT	27.8	0.5042	0.0130
18	MH404	MH405	CONDUIT	19.1	0.5246	0.0130
2	MH401	MH402	CONDUIT	39.3	0.4835	0.0130
2_3	MH408	MH406	CONDUIT	26.4	0.1515	0.0130
3	MH410	MH409_null	CONDUIT	13.6	0.2949	0.0130
39	CB13	MH404	CONDUIT	23.6	0.5095	0.0130
4	MH409	MH408	CONDUIT	23.4	0.1709	0.0130
44	DITCH_IN_1	POND_1	CONDUIT	55.0	0.5091	0.0350
54	DCB17_STRG	MH409_null	CONDUIT	5.8	1.0259	0.0130
7	MH406	MH405	CONDUIT	40.7	0.1474	0.0130
8	MH405	EX_STUB	CONDUIT	9.4	0.1065	0.0130
9	EX_STUB	14	CONDUIT	37.5	0.1334	0.0130
10	CB14_15_STRG	MH405	ORIFICE			
19	RYCB02	MH401	ORIFICE			
21	CB03_STRG	MH401	ORIFICE			
22	RYCB04	MH402	ORIFICE			
24	CB04_STRG	MH402	ORIFICE			
25	CB06_07_STRG	MH402	ORIFICE			
27	RYCB19	mh407	ORIFICE			
28	RYCB18	mh407	ORIFICE			

30	CB10_STRG	MH403	ORIFICE
31	CB11_STRG	CB11	ORIFICE
34	CB12_STRG	MH404	ORIFICE
35	CB13_STRG	CB13	ORIFICE
41	CB16_STRG	MH406	ORIFICE
51	RYCB09	MH402	ORIFICE
52	CB08_STRG	MH402	ORIFICE
53	MH409_null	MH409	ORIFICE
1	CB14_15_STRG	5	WEIR
12	DCB17_STRG	POND_1	WEIR
20	RYCB02	CB03_STRG	WEIR
23	RYCB04	CB04_STRG	WEIR
26	CB06_07_STRG	CB08_STRG	WEIR
29	RYCB09	CB08_STRG	WEIR
32	CB11_STRG	CB10_STRG	WEIR
33	CB08_STRG	CB10_STRG	WEIR
36	CB10_STRG	CB12_STRG	WEIR
37	CB13_STRG	CB12_STRG	WEIR
38	CB12_STRG	CB14_15_STRG	WEIR
40	CB16_STRG	DCB17_STRG	WEIR
42	CB04_STRG	CB08_STRG	WEIR
43	CB03_STRG	CB04_STRG	WEIR
45	RYCB18	DITCH_IN_1	WEIR
46	RYCB19	DITCH_IN_1	WEIR
5	POND_1	2	WEIR
50	MH410	POND_1	WEIR

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
11	CIRCULAR	0.30	0.07	0.07	0.30	1	0.19
13	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
14	CIRCULAR	0.45	0.16	0.11	0.45	1	0.21
15	CIRCULAR	0.45	0.16	0.11	0.45	1	0.14
16	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
17	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
18	CIRCULAR	0.45	0.16	0.11	0.45	1	0.21
2	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
2_3	CIRCULAR	0.60	0.28	0.15	0.60	1	0.24
3	CIRCULAR	0.60	0.28	0.15	0.60	1	0.33
39	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20

4	CIRCULAR	0.60	0.28	0.15	0.60	1
0.25						
44	TRAPEZOIDAL	0.30	0.36	0.16	2.10	1
0.22						
54	CIRCULAR	0.30	0.07	0.07	0.30	1
0.10						
7	CIRCULAR	0.60	0.28	0.15	0.60	1
0.24						
8	CIRCULAR	0.75	0.44	0.19	0.75	1
0.36						
9	CIRCULAR	0.75	0.44	0.19	0.75	1
0.41						

```
*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 04/21/2021 00:00:00
Ending Date .............. 04/21/2021 12:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 0.50 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 4
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.114        71.277
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.026        16.149
Surface Runoff ...........         0.090        55.746
Final Storage ............         0.000         0.011
```

```
Continuity Error (%) .....        -0.881


**************************        Volume         Volume
Flow Routing Continuity         hectare-m      10^6 ltr
**************************       ---------      ---------
Dry Weather Inflow .......           0.000          0.000
Wet Weather Inflow .......           0.090          0.895
Groundwater Inflow .......           0.000          0.000
RDII Inflow ..............           0.000          0.000
External Inflow ..........           0.000          0.000
External Outflow .........           0.083          0.827
Flooding Loss ............           0.000          0.000
Evaporation Loss .........           0.000          0.000
Exfiltration Loss ........           0.000          0.000
Initial Stored Volume ....           0.001          0.008
Final Stored Volume ......           0.007          0.071
Continuity Error (%) .....           0.661


*************************
Highest Continuity Errors
*************************
Node DITCH_IN_1 (4.46%)
Node MH406 (3.71%)
Node MH408 (3.22%)
Node mh407 (2.90%)
Node MH403 (2.09%)


***************************
Time-Step Critical Elements
***************************
None


********************************
Highest Flow Instability Indexes
********************************
Link 53 (17)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     0.50 sec
Maximum Time Step           :     0.50 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
    0.500 -  0.500 sec      :   100.00 %
    0.500 -  0.500 sec      :     0.00 %
    0.500 -  0.500 sec      :     0.00 %
    0.500 -  0.500 sec      :     0.00 %
    0.500 -  0.500 sec      :     0.00 %
```

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
28	71.28	0.00	0.00	16.23	45.80	9.86	55.66	0.03	0.02	0.781
B1	71.28	0.00	0.00	16.17	44.44	11.08	55.51	0.02	0.01	0.779
B10	71.28	0.00	0.00	3.50	65.74	2.53	68.27	0.07	0.05	0.958
B11_1	71.28	0.00	0.00	25.98	31.47	14.32	45.79	0.03	0.02	0.642
B11_2	71.28	0.00	0.00	26.23	31.49	14.02	45.52	0.04	0.03	0.639
B12	71.28	0.00	0.00	17.95	42.89	11.09	53.98	0.03	0.02	0.757
B13	71.28	0.00	0.00	16.14	45.76	10.02	55.78	0.02	0.02	0.783
B14	71.28	0.00	0.00	11.63	53.00	7.28	60.28	0.13	0.09	0.846
B15	71.28	0.00	0.00	26.77	31.54	13.41	44.94	0.06	0.04	0.631
B16	71.28	0.00	0.00	20.92	37.83	13.37	51.20	0.02	0.01	0.718
B17	71.28	0.00	0.00	16.33	44.96	10.91	55.87	0.02	0.02	0.784
B18	71.28	0.00	0.00	15.16	47.17	9.61	56.79	0.05	0.04	0.797
B2_1	71.28	0.00	0.00	14.25	48.61	9.09	57.70	0.02	0.01	0.809
B2_2	71.28	0.00	0.00	14.24	48.60	9.13	57.73	0.05	0.04	0.810
B3_1	71.28	0.00	0.00	18.67	42.24	10.94	53.18	0.03	0.02	0.746
B3_2	71.28	0.00	0.00	18.12	42.10	12.01	54.11	0.03	0.03	0.759
B5	71.28	0.00	0.00	16.53	45.02	10.40	55.42	0.08	0.07	0.778
B6	71.28	0.00	0.00	20.83	39.41	11.57	50.98	0.03	0.02	0.715
B7	71.28	0.00	0.00	20.72	38.58	12.62	51.21	0.03	0.03	0.718
B8	71.28	0.00	0.00	7.03	60.03	4.85	64.88	0.08	0.06	0.910
B9	71.28	0.00	0.00	6.14	61.43	4.34	65.76	0.03	0.02	0.923

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days	Time of Max Occurrence hr:min	Reported Max Depth Meters
CB11	JUNCTION	0.11	0.30	105.50	0	01:11	0.30
CB13	JUNCTION	0.29	0.42	105.43	0	01:11	0.42
DITCH_IN_1	JUNCTION	0.01	0.14	106.32	0	01:10	0.14
EX_STUB	JUNCTION	0.97	1.04	105.34	0	01:10	1.04
MH401	JUNCTION	0.01	0.14	105.82	0	01:10	0.14
MH402	JUNCTION	0.03	0.26	105.60	0	01:11	0.26
MH403	JUNCTION	0.38	0.59	105.50	0	01:11	0.59
MH404	JUNCTION	0.54	0.68	105.42	0	01:11	0.68
MH405	JUNCTION	0.93	1.01	105.35	0	01:10	1.01
MH406	JUNCTION	0.74	0.82	105.36	0	01:10	0.82
mh407	JUNCTION	0.53	0.62	105.37	0	01:10	0.62
MH408	JUNCTION	0.68	0.77	105.37	0	01:10	0.77
MH409	JUNCTION	0.47	0.56	105.37	0	01:10	0.56
MH409_null	JUNCTION	0.52	1.24	106.05	0	01:15	1.24
MH410	JUNCTION	0.44	1.15	106.05	0	01:13	1.15
RYCB01	JUNCTION	0.01	0.08	106.06	0	01:10	0.08
RYCB02	JUNCTION	0.02	0.85	107.03	0	01:10	0.84
RYCB04	JUNCTION	0.07	2.36	108.21	0	01:10	2.36
RYCB09	JUNCTION	0.09	2.63	108.32	0	01:10	2.63
RYCB18	JUNCTION	0.03	1.17	106.56	0	01:10	1.17
RYCB19	JUNCTION	1.52	1.65	106.45	0	01:10	1.65
14	OUTFALL	1.06	1.06	105.31	0	00:00	1.06
2	OUTFALL	0.00	0.00	105.38	0	00:00	0.00
5	OUTFALL	0.00	0.00	108.07	0	00:00	0.00
CB03_STRG	STORAGE	0.11	2.34	108.25	0	01:13	2.34
CB04_STRG	STORAGE	0.10	2.35	108.15	0	01:13	2.35
CB06_07_STRG	STORAGE	0.07	2.28	108.23	0	01:13	2.28
CB08_STRG	STORAGE	0.20	2.45	108.14	0	01:19	2.45
CB10_STRG	STORAGE	0.10	2.34	108.14	0	01:14	2.34
CB11_STRG	STORAGE	0.16	2.38	108.21	0	01:14	2.38
CB12_STRG	STORAGE	0.08	2.29	108.10	0	01:12	2.29
CB13_STRG	STORAGE	0.15	2.37	108.17	0	01:14	2.37
CB14_15_STRG	STORAGE	0.10	2.34	108.09	0	01:13	2.34
CB16_STRG	STORAGE	0.11	2.32	107.98	0	01:14	2.32
DCB17_STRG	STORAGE	0.78	1.50	106.07	0	01:11	1.50
POND_1	STORAGE	0.03	0.55	106.05	0	01:14	0.55

****
Node Inflow Summary
****

Maximum Lateral	Maximum Total	Time of Max	Lateral Inflow	Total Inflow	Flow Balance

		Inflow	Inflow	Occurrence		Volume	Volume	Error
Node	Type	CMS	CMS	days	hr:min	10^6 ltr	10^6 ltr	Percent
CB11	JUNCTION	0.000	0.022	0	01:14	0	0.0811	0.738
CB13	JUNCTION	0.000	0.019	0	01:14	0	0.0696	2.079
DITCH_IN_1	JUNCTION	0.025	0.029	0	01:10	0.034	0.0344	4.668
EX_STUB	JUNCTION	0.000	0.307	0	01:10	0	0.817	1.332
MH401	JUNCTION	0.000	0.044	0	01:10	0	0.0844	-0.003
MH402	JUNCTION	0.000	0.114	0	01:10	0	0.286	0.079
MH403	JUNCTION	0.000	0.148	0	01:11	0	0.399	2.133
MH404	JUNCTION	0.000	0.180	0	01:12	0	0.487	1.238
MH405	JUNCTION	0.000	0.307	0	01:10	0	0.835	1.150
MH406	JUNCTION	0.000	0.110	0	01:10	0	0.318	3.856
mh407	JUNCTION	0.000	0.049	0	01:10	0	0.0733	2.987
MH408	JUNCTION	0.000	0.055	0	01:15	0	0.222	3.322
MH409	JUNCTION	0.000	0.054	0	01:15	0	0.224	1.774
MH409_null	JUNCTION	0.000	0.093	0	01:10	0	0.247	0.895
MH410	JUNCTION	0.041	0.082	0	01:10	0.0528	0.168	0.921
RYCB01	JUNCTION	0.014	0.014	0	01:10	0.0165	0.0165	-0.005
RYCB02	JUNCTION	0.012	0.012	0	01:10	0.0159	0.0159	0.000
RYCB04	JUNCTION	0.020	0.020	0	01:10	0.0263	0.0263	0.000
RYCB09	JUNCTION	0.024	0.024	0	01:10	0.0333	0.0333	0.000
RYCB18	JUNCTION	0.038	0.038	0	01:10	0.0578	0.0578	0.000
RYCB19	JUNCTION	0.014	0.014	0	01:10	0.0172	0.0172	12.222
14	OUTFALL	0.000	0.307	0	01:10	0	0.806	0.000
2	OUTFALL	0.000	0.039	0	01:14	0	0.0206	0.000
5	OUTFALL	0.000	0.000	0	00:00	0	0	0.000 ltr
CB03_STRG	STORAGE	0.041	0.041	0	01:10	0.0521	0.0521	0.001
CB04_STRG	STORAGE	0.026	0.033	0	01:10	0.0309	0.0322	0.000
CB06_07_STRG	STORAGE	0.020	0.020	0	01:10	0.0262	0.0262	0.000

CB08_STRG	STORAGE	0.067	0.078	0	01:10	0.0846	0.0874	0.001
CB10_STRG	STORAGE	0.026	0.026	0	01:10	0.0328	0.0328	0.000
CB11_STRG	STORAGE	0.060	0.060	0	01:10	0.0809	0.0809	0.001
CB12_STRG	STORAGE	0.020	0.020	0	01:10	0.0274	0.0274	-0.000
CB13_STRG	STORAGE	0.050	0.050	0	01:10	0.0694	0.0694	0.001
CB14_15_STRG	STORAGE	0.040	0.040	0	01:10	0.0509	0.0509	0.000
CB16_STRG	STORAGE	0.020	0.020	0	01:10	0.0238	0.0238	0.001
DCB17_STRG	STORAGE	0.094	0.094	0	01:10	0.125	0.125	0.273
POND_1	STORAGE	0.026	0.129	0	01:10	0.0377	0.115	-0.825

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
EX_STUB	JUNCTION	11.26	0.259	2.611
MH404	JUNCTION	0.56	0.085	2.615
MH405	JUNCTION	11.26	0.260	2.650
MH406	JUNCTION	11.21	0.183	2.607
MH409_null	JUNCTION	1.11	0.589	0.551

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS

CB03_STRG	0.000	0	0	0	0.009	1	0	01:13	0.019
CB04_STRG	0.000	0	0	0	0.007	1	0	01:13	0.012
CB06_07_STRG	0.000	0	0	0	0.003	2	0	01:13	0.012
CB08_STRG	0.001	0	0	0	0.027	3	0	01:19	0.020
CB10_STRG	0.000	0	0	0	0.005	1	0	01:14	0.012
CB11_STRG	0.001	0	0	0	0.020	3	0	01:14	0.022
CB12_STRG	0.000	0	0	0	0.003	1	0	01:12	0.012
CB13_STRG	0.001	0	0	0	0.017	2	0	01:14	0.019
CB14_15_STRG	0.000	0	0	0	0.009	16	0	01:13	0.019
CB16_STRG	0.000	0	0	0	0.004	9	0	01:14	0.009
DCB17_STRG	0.001	6	0	0	0.001	12	0	01:11	0.093
POND_1	0.004	4	0	0	0.068	65	0	01:14	0.046

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
14	40.69	0.046	0.307	0.806
2	2.52	0.019	0.039	0.021
5	0.00	0.000	0.000	0.000
System	14.40	0.065	0.336	0.827

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
11	CONDUIT	0.080	0 01:10	1.18	0.42	1.00
13	CONDUIT	0.114	0 01:11	0.84	0.56	0.79
14	CONDUIT	0.014	0 01:10	0.73	0.07	0.17
15	CONDUIT	0.049	0 01:10	0.31	0.34	1.00
16	CONDUIT	0.024	0 01:15	0.52	0.12	0.82
17	CONDUIT	0.148	0 01:12	0.93	0.73	1.00
18	CONDUIT	0.180	0 01:12	1.13	0.87	1.00

2	CONDUIT	0.044	0	01:10	1.01	0.22	0.32
2_3	CONDUIT	0.055	0	01:14	0.33	0.23	1.00
3	CONDUIT	0.041	0	01:06	0.33	0.12	1.00
39	CONDUIT	0.020	0	01:15	0.46	0.10	0.96
4	CONDUIT	0.055	0	01:15	0.39	0.22	0.96
44	CONDUIT	0.030	0	01:11	0.38	0.14	0.42
54	CONDUIT	0.093	0	01:10	1.32	0.95	1.00
7	CONDUIT	0.110	0	01:10	0.39	0.47	1.00
8	CONDUIT	0.307	0	01:10	0.70	0.85	1.00
9	CONDUIT	0.307	0	01:10	0.70	0.76	1.00
10	ORIFICE	0.019	0	01:13			1.00
19	ORIFICE	0.011	0	01:10			1.00
21	ORIFICE	0.019	0	01:13			1.00
22	ORIFICE	0.012	0	01:10			1.00
24	ORIFICE	0.012	0	01:13			1.00
25	ORIFICE	0.012	0	01:13			1.00
27	ORIFICE	0.014	0	01:10			
28	ORIFICE	0.034	0	01:10			1.00
30	ORIFICE	0.012	0	01:14			1.00
31	ORIFICE	0.022	0	01:14			1.00
34	ORIFICE	0.012	0	01:12			1.00
35	ORIFICE	0.019	0	01:14			1.00
41	ORIFICE	0.009	0	01:14			1.00
51	ORIFICE	0.013	0	01:10			1.00
52	ORIFICE	0.020	0	01:19			1.00
53	ORIFICE	0.054	0	01:15			1.00
1	WEIR	0.000	0	00:00			0.00
12	WEIR	0.000	0	00:00			0.00
20	WEIR	0.000	0	00:00			0.00
23	WEIR	0.007	0	01:10			0.05
26	WEIR	0.000	0	00:00			0.00
29	WEIR	0.011	0	01:10			0.07
32	WEIR	0.000	0	00:00			0.00
33	WEIR	0.000	0	00:00			0.00
36	WEIR	0.000	0	00:00			0.00
37	WEIR	0.000	0	00:00			0.00
38	WEIR	0.000	0	00:00			0.00
40	WEIR	0.000	0	00:00			0.00
42	WEIR	0.000	0	00:00			0.00
43	WEIR	0.000	0	00:00			0.00
45	WEIR	0.004	0	01:10			0.04
46	WEIR	0.000	0	00:00			0.00
5	WEIR	0.039	0	01:14			0.27
50	WEIR	0.000	0	00:00			0.00

```
  ***************************
  Flow Classification Summary
  ***************************

  -----------------------------------------------------------------------------------
----
                      Adjusted    ---------- Fraction of Time in Flow Class -------
---
                       /Actual         Up    Down  Sub   Sup   Up    Down  Norm
Inlet
  Conduit               Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd
Ctrl
```

11	1.00	0.00	0.00	0.00	0.93	0.00	0.00	0.07	0.85	0.00
13	1.00	0.00	0.00	0.00	0.94	0.00	0.00	0.06	0.93	0.00
14	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
15	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.00	0.00
16	1.00	0.00	0.00	0.00	0.94	0.00	0.00	0.06	0.01	0.00
17	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.01	0.00
18	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.01	0.00
2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
2_3	1.00	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.00	0.00
3	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.02	0.00
39	1.00	0.00	0.00	0.00	0.95	0.00	0.00	0.05	0.01	0.00
4	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.00	0.00
44	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.03	0.00
54	1.00	0.02	0.00	0.00	0.93	0.00	0.00	0.05	0.00	0.00
7	1.00	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.00	0.00
8	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.00	0.00
9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

Conduit	--------- Hours Full -------- Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
11	0.62	0.62	1.09	0.01	0.01
13	0.01	0.01	0.47	0.01	0.01
15	11.19	11.19	11.22	0.01	0.01
17	0.55	0.55	11.19	0.01	0.01
18	11.20	11.20	11.26	0.01	0.01
2_3	11.19	11.19	11.21	0.01	0.01
3	1.08	1.08	1.11	0.01	0.01
39	0.01	0.01	0.56	0.01	0.01
54	1.10	1.10	1.16	0.01	0.01
7	11.22	11.22	11.26	0.01	0.01
8	11.26	11.26	11.26	0.01	0.10
9	11.29	11.29	12.00	0.01	0.01

```
Analysis begun on:  Mon Jul  5 14:54:40 2021
Analysis ended on:  Mon Jul  5 14:54:46 2021
Total elapsed time: 00:00:06
```

```
  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
  --------------------------------------------------------------

  WARNING 02: maximum depth increased for Node MH410
  WARNING 02: maximum depth increased for Node RYCB02
  WARNING 02: maximum depth increased for Node RYCB04
  WARNING 02: maximum depth increased for Node RYCB09
  WARNING 02: maximum depth increased for Node RYCB18
  WARNING 02: maximum depth increased for Node RYCB19

  *************
  Element Count
  *************
  Number of rain gages ...... 1
  Number of subcatchments ... 21
  Number of nodes ........... 36
  Number of links ........... 51
  Number of pollutants ...... 0
  Number of land uses ....... 0


  ****************
  Raingage Summary
  ****************
                                                              Data       Recording
  Name                 Data Source                            Type       Interval
  ------------------------------------------------------------------------------
  Richcraft            Chicago_3h_500yr_10minTS               INTENSITY    10 min.


  ********************
  Subcatchment Summary
  ********************
  Name                          Area     Width   %Imperv    %Slope Rain Gage
Outlet
  ------------------------------------------------------------------------------------
--------------------------
  28                            0.05     15.70     64.00    1.0000 Richcraft
CB06_07_STRG
  B1                            0.03     19.80     63.00    2.0000 Richcraft
RYCB01
  B10                           0.10     50.85     92.00    2.0000 Richcraft
CB13_STRG
  B11_1                         0.07     13.49     44.00    2.0000 Richcraft
DITCH_IN_1
  B11_2                         0.08     12.74     44.00    2.0000 Richcraft
POND_1
  B12                           0.05     16.00     60.00    2.0000 Richcraft
MH410
  B13                           0.04     12.43     64.00    2.0000 Richcraft
MH410
  B14                           0.21     37.73     74.00    3.0000 Richcraft
DCB17_STRG
  B15                           0.13     20.41     44.00    1.0000 Richcraft
RYCB18
  B16                           0.03     16.75     53.00    2.0000 Richcraft
RYCB19
```

B17	0.04	28.40	63.00	2.0000	Richcraft
CB16_STRG					
B18	0.09	29.87	66.00	2.0000	Richcraft
CB14_15_STRG					
B2_1	0.03	9.17	68.00	2.0000	Richcraft
RYCB02					
B2_2	0.09	45.10	68.00	1.0000	Richcraft
CB03_STRG					
B3_1	0.05	9.88	59.00	2.0000	Richcraft
RYCB04					
B3_2	0.06	38.07	59.00	2.0000	Richcraft
CB04_STRG					
B5	0.15	50.87	63.00	2.0000	Richcraft
CB08_STRG					
B6	0.07	14.22	55.00	1.0000	Richcraft
RYCB09					
B7	0.06	27.87	54.00	1.0000	Richcraft
CB10_STRG					
B8	0.12	54.22	84.00	2.0000	Richcraft
CB11_STRG					
B9	0.04	23.17	86.00	2.0000	Richcraft
CB12_STRG					

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
CB11	JUNCTION	105.20	2.89	0.0	
CB13	JUNCTION	105.01	3.02	0.0	
DITCH_IN_1	JUNCTION	106.18	0.67	0.0	
EX_STUB	JUNCTION	104.30	3.65	0.0	
MH401	JUNCTION	105.68	2.97	0.0	
MH402	JUNCTION	105.34	2.68	0.0	
MH403	JUNCTION	104.91	3.12	0.0	
MH404	JUNCTION	104.74	3.30	0.0	
MH405	JUNCTION	104.34	3.66	0.0	
MH406	JUNCTION	104.54	3.43	0.0	
mh407	JUNCTION	104.75	2.60	0.0	
MH408	JUNCTION	104.60	2.53	0.0	
MH409	JUNCTION	104.81	1.79	0.0	
MH409_null	JUNCTION	104.81	1.79	0.0	
MH410	JUNCTION	104.90	1.60	0.0	
RYCB01	JUNCTION	105.98	2.08	0.0	
RYCB02	JUNCTION	106.18	2.50	0.0	
RYCB04	JUNCTION	105.85	2.50	0.0	
RYCB09	JUNCTION	105.69	2.77	0.0	
RYCB18	JUNCTION	105.39	1.31	0.0	
RYCB19	JUNCTION	104.80	2.00	0.0	
14	OUTFALL	104.25	0.75	0.0	
2	OUTFALL	105.38	0.00	0.0	
5	OUTFALL	108.07	0.00	0.0	
CB03_STRG	STORAGE	105.91	4.09	0.0	
CB04_STRG	STORAGE	105.80	4.20	0.0	
CB06_07_STRG	STORAGE	105.95	3.05	0.0	
CB08_STRG	STORAGE	105.69	4.31	0.0	

CB10_STRG	STORAGE	105.80	4.20	0.0
CB11_STRG	STORAGE	105.83	4.17	0.0
CB12_STRG	STORAGE	105.81	4.19	0.0
CB13_STRG	STORAGE	105.80	4.20	0.0
CB14_15_STRG	STORAGE	105.75	2.52	0.0
CB16_STRG	STORAGE	105.66	2.59	0.0
DCB17_STRG	STORAGE	104.57	2.11	0.0
POND_1	STORAGE	105.50	0.75	0.0

****
Link Summary
****

Name	From Node	To Node	Type	Length	% Slope	Roughness
11	POND_1	MH410	CONDUIT	8.0	3.8581	0.0130
13	MH402	MH403	CONDUIT	79.4	0.5036	0.0130
14	RYCB01	MH401	CONDUIT	28.9	0.5193	0.0130
15	mh407	MH406	CONDUIT	23.5	0.2557	0.0130
16	CB11	MH403	CONDUIT	29.2	0.4790	0.0130
17	MH403	MH404	CONDUIT	27.8	0.5042	0.0130
18	MH404	MH405	CONDUIT	19.1	0.5246	0.0130
2	MH401	MH402	CONDUIT	39.3	0.4835	0.0130
2_3	MH408	MH406	CONDUIT	26.4	0.1515	0.0130
3	MH410	MH409_null	CONDUIT	13.6	0.2949	0.0130
39	CB13	MH404	CONDUIT	23.6	0.5095	0.0130
4	MH409	MH408	CONDUIT	23.4	0.1709	0.0130
44	DITCH_IN_1	POND_1	CONDUIT	55.0	0.5091	0.0350
54	DCB17_STRG	MH409_null	CONDUIT	5.8	1.0259	0.0130
7	MH406	MH405	CONDUIT	40.7	0.1474	0.0130
8	MH405	EX_STUB	CONDUIT	9.4	0.1065	0.0130
9	EX_STUB	14	CONDUIT	37.5	0.1334	0.0130
10	CB14_15_STRG	MH405	ORIFICE			
19	RYCB02	MH401	ORIFICE			
21	CB03_STRG	MH401	ORIFICE			
22	RYCB04	MH402	ORIFICE			
24	CB04_STRG	MH402	ORIFICE			
25	CB06_07_STRG	MH402	ORIFICE			
27	RYCB19	mh407	ORIFICE			
28	RYCB18	mh407	ORIFICE			

30	CB10_STRG	MH403	ORIFICE
31	CB11_STRG	CB11	ORIFICE
34	CB12_STRG	MH404	ORIFICE
35	CB13_STRG	CB13	ORIFICE
41	CB16_STRG	MH406	ORIFICE
51	RYCB09	MH402	ORIFICE
52	CB08_STRG	MH402	ORIFICE
53	MH409_null	MH409	ORIFICE
1	CB14_15_STRG	5	WEIR
12	DCB17_STRG	POND_1	WEIR
20	RYCB02	CB03_STRG	WEIR
23	RYCB04	CB04_STRG	WEIR
26	CB06_07_STRG	CB08_STRG	WEIR
29	RYCB09	CB08_STRG	WEIR
32	CB11_STRG	CB10_STRG	WEIR
33	CB08_STRG	CB10_STRG	WEIR
36	CB10_STRG	CB12_STRG	WEIR
37	CB13_STRG	CB12_STRG	WEIR
38	CB12_STRG	CB14_15_STRG	WEIR
40	CB16_STRG	DCB17_STRG	WEIR
42	CB04_STRG	CB08_STRG	WEIR
43	CB03_STRG	CB04_STRG	WEIR
45	RYCB18	DITCH_IN_1	WEIR
46	RYCB19	DITCH_IN_1	WEIR
5	POND_1	2	WEIR
50	MH410	POND_1	WEIR

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
11	CIRCULAR	0.30	0.07	0.07	0.30	1	0.19
13	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
14	CIRCULAR	0.45	0.16	0.11	0.45	1	0.21
15	CIRCULAR	0.45	0.16	0.11	0.45	1	0.14
16	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
17	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
18	CIRCULAR	0.45	0.16	0.11	0.45	1	0.21
2	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20
2_3	CIRCULAR	0.60	0.28	0.15	0.60	1	0.24
3	CIRCULAR	0.60	0.28	0.15	0.60	1	0.33
39	CIRCULAR	0.45	0.16	0.11	0.45	1	0.20

4	CIRCULAR	0.60	0.28	0.15	0.60	1	0.25
44	TRAPEZOIDAL	0.30	0.36	0.16	2.10	1	0.22
54	CIRCULAR	0.30	0.07	0.07	0.30	1	0.10
7	CIRCULAR	0.60	0.28	0.15	0.60	1	0.24
8	CIRCULAR	0.75	0.44	0.19	0.75	1	0.36
9	CIRCULAR	0.75	0.44	0.19	0.75	1	0.41

```
*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 04/21/2021 00:00:00
Ending Date .............. 04/21/2021 12:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 0.50 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 4
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.137        85.525
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.027        16.937
Surface Runoff ...........         0.111        69.306
Final Storage ............         0.000         0.011
```

```
Continuity Error (%) .....        -0.851


**************************        Volume         Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.111          1.113
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........         0.000          0.000
External Outflow .........         0.104          1.045
Flooding Loss ............         0.000          0.000
Evaporation Loss .........         0.000          0.000
Exfiltration Loss ........         0.000          0.000
Initial Stored Volume ....         0.001          0.008
Final Stored Volume ......         0.007          0.071
Continuity Error (%) .....         0.507


*************************
Highest Continuity Errors
*************************
Node DITCH_IN_1 (3.71%)
Node MH406 (3.22%)
Node MH408 (2.86%)
Node mh407 (2.35%)
Node CB13 (1.76%)


***************************
Time-Step Critical Elements
***************************
None


********************************
Highest Flow Instability Indexes
********************************
Link 53 (17)


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     0.50 sec
Maximum Time Step           :     0.50 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
    0.500 -  0.500 sec      :   100.00 %
    0.500 -  0.500 sec      :     0.00 %
    0.500 -  0.500 sec      :     0.00 %
    0.500 -  0.500 sec      :     0.00 %
    0.500 -  0.500 sec      :     0.00 %
```

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
28	85.53	0.00	0.00	17.02	54.93	14.32	69.24	0.03	0.03	0.810
B1	85.52	0.00	0.00	16.99	53.41	15.61	69.02	0.02	0.02	0.807
B10	85.53	0.00	0.00	3.69	78.86	3.40	82.25	0.08	0.06	0.962
B11_1	85.53	0.00	0.00	27.18	37.75	21.24	58.99	0.04	0.03	0.690
B11_2	85.53	0.00	0.00	27.41	37.77	20.94	58.71	0.05	0.03	0.686
B12	85.52	0.00	0.00	18.85	51.44	16.04	67.47	0.04	0.03	0.789
B13	85.53	0.00	0.00	16.95	54.89	14.47	69.36	0.03	0.02	0.811
B14	85.53	0.00	0.00	12.22	63.56	10.49	74.05	0.15	0.12	0.866
B15	85.53	0.00	0.00	27.95	37.82	20.30	58.12	0.07	0.05	0.680
B16	85.52	0.00	0.00	21.99	45.38	19.17	64.55	0.02	0.02	0.755
B17	85.53	0.00	0.00	17.19	53.94	15.42	69.36	0.03	0.02	0.811
B18	85.53	0.00	0.00	15.93	56.58	13.81	70.39	0.06	0.05	0.823
B2_1	85.53	0.00	0.00	14.98	58.30	13.04	71.34	0.02	0.02	0.834
B2_2	85.52	0.00	0.00	14.97	58.29	13.07	71.37	0.06	0.05	0.834
B3_1	85.53	0.00	0.00	19.57	50.65	16.02	66.67	0.03	0.03	0.780
B3_2	85.53	0.00	0.00	19.07	50.51	17.03	67.54	0.04	0.03	0.790
B5	85.53	0.00	0.00	17.37	54.00	14.97	68.97	0.11	0.08	0.806
B6	85.53	0.00	0.00	21.79	47.26	17.14	64.39	0.04	0.03	0.753
B7	85.52	0.00	0.00	21.74	46.28	18.31	64.59	0.04	0.03	0.755
B8	85.52	0.00	0.00	7.41	72.01	6.75	78.76	0.10	0.07	0.921
B9	85.53	0.00	0.00	6.47	73.68	5.94	79.62	0.03	0.02	0.931

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days	hr:min	Reported Max Depth Meters
CB11	JUNCTION	0.11	0.32	105.52	0	01:11	0.32
CB13	JUNCTION	0.29	0.43	105.44	0	01:11	0.42
DITCH_IN_1	JUNCTION	0.01	0.17	106.35	0	01:09	0.17
EX_STUB	JUNCTION	0.98	1.04	105.34	0	01:10	1.04
MH401	JUNCTION	0.02	0.15	105.83	0	01:10	0.15
MH402	JUNCTION	0.03	0.29	105.63	0	01:11	0.29
MH403	JUNCTION	0.39	0.61	105.52	0	01:11	0.61
MH404	JUNCTION	0.55	0.69	105.43	0	01:11	0.69
MH405	JUNCTION	0.94	1.01	105.35	0	01:10	1.01
MH406	JUNCTION	0.74	0.83	105.37	0	01:10	0.83
mh407	JUNCTION	0.54	0.63	105.38	0	01:10	0.63
MH408	JUNCTION	0.68	0.77	105.37	0	01:10	0.77
MH409	JUNCTION	0.48	0.57	105.38	0	01:10	0.57
MH409_null	JUNCTION	0.53	1.36	106.17	0	01:10	1.36
MH410	JUNCTION	0.45	1.27	106.17	0	01:10	1.27
RYCB01	JUNCTION	0.01	0.09	106.07	0	01:10	0.09
RYCB02	JUNCTION	0.03	1.24	107.42	0	01:10	1.24
RYCB04	JUNCTION	0.08	2.36	108.21	0	01:10	2.36
RYCB09	JUNCTION	0.11	2.63	108.32	0	01:10	2.63
RYCB18	JUNCTION	0.04	1.17	106.56	0	01:10	1.17
RYCB19	JUNCTION	1.52	1.66	106.46	0	01:10	1.66
14	OUTFALL	1.06	1.06	105.31	0	00:00	1.06
2	OUTFALL	0.00	0.00	105.38	0	00:00	0.00
5	OUTFALL	0.00	0.00	108.07	0	00:00	0.00
CB03_STRG	STORAGE	0.14	2.36	108.27	0	01:14	2.36
CB04_STRG	STORAGE	0.15	2.39	108.19	0	01:14	2.39
CB06_07_STRG	STORAGE	0.09	2.30	108.25	0	01:10	2.30
CB08_STRG	STORAGE	0.28	2.49	108.18	0	01:21	2.49
CB10_STRG	STORAGE	0.15	2.39	108.19	0	01:14	2.39
CB11_STRG	STORAGE	0.18	2.39	108.22	0	01:13	2.39
CB12_STRG	STORAGE	0.12	2.32	108.13	0	01:14	2.32
CB13_STRG	STORAGE	0.18	2.39	108.19	0	01:13	2.39
CB14_15_STRG	STORAGE	0.15	2.38	108.13	0	01:18	2.38
CB16_STRG	STORAGE	0.13	2.35	108.01	0	01:12	2.35
DCB17_STRG	STORAGE	0.79	1.69	106.26	0	01:10	1.68
POND_1	STORAGE	0.04	0.63	106.13	0	01:13	0.63

****
Node Inflow Summary
****

Maximum Lateral	Maximum Total	Time of Max	Lateral Inflow	Total Inflow	Flow Balance

Node	Type	Inflow CMS	Inflow CMS	Occurrence days hr:min	Volume 10^6 ltr	Volume 10^6 ltr	Error Percent
CB11	JUNCTION	0.000	0.022	0 01:13	0	0.0917	0.639
CB13	JUNCTION	0.000	0.020	0 01:13	0	0.0805	1.790
DITCH_IN_1	JUNCTION	0.032	0.048	0 01:10	0.0438	0.0481	3.851
EX_STUB	JUNCTION	0.000	0.323	0 01:10	0	0.995	1.091
MH401	JUNCTION	0.000	0.050	0 01:10	0	0.104	-0.003
MH402	JUNCTION	0.000	0.120	0 01:10	0	0.356	0.078
MH403	JUNCTION	0.000	0.154	0 01:11	0	0.49	1.724
MH404	JUNCTION	0.000	0.186	0 01:11	0	0.598	1.005
MH405	JUNCTION	0.000	0.323	0 01:10	0	1.01	0.945
MH406	JUNCTION	0.000	0.120	0 01:10	0	0.367	3.326
mh407	JUNCTION	0.000	0.053	0 01:10	0	0.0904	2.410
MH408	JUNCTION	0.000	0.059	0 01:10	0	0.249	2.943
MH409	JUNCTION	0.000	0.058	0 01:10	0	0.251	1.585
MH409_null	JUNCTION	0.000	0.115	0 01:10	0	0.286	0.772
MH410	JUNCTION	0.052	0.109	0 01:10	0.0658	0.196	0.796
RYCB01	JUNCTION	0.017	0.017	0 01:10	0.0205	0.0205	-0.005
RYCB02	JUNCTION	0.015	0.015	0 01:10	0.0196	0.0196	0.000
RYCB04	JUNCTION	0.025	0.025	0 01:10	0.0329	0.0329	0.000
RYCB09	JUNCTION	0.031	0.031	0 01:10	0.0421	0.0421	0.000
RYCB18	JUNCTION	0.050	0.050	0 01:10	0.0747	0.0747	0.000
RYCB19	JUNCTION	0.018	0.018	0 01:10	0.0216	0.0216	9.454
14	OUTFALL	0.000	0.323	0 01:10	0	0.983	0.000
2	OUTFALL	0.000	0.102	0 01:13	0	0.061	0.000
5	OUTFALL	0.000	0.001	0 01:18	0	0.000245	0.000
CB03_STRG	STORAGE	0.051	0.051	0 01:10	0.0644	0.0644	0.002
CB04_STRG	STORAGE	0.032	0.045	0 01:10	0.0386	0.0432	0.000
CB06_07_STRG	STORAGE	0.025	0.025	0 01:10	0.0326	0.0326	0.002

CB08_STRG	STORAGE	0.083	0.109	0	01:10	0.105	0.114	0.001
CB10_STRG	STORAGE	0.033	0.041	0	01:12	0.0414	0.048	0.001
CB11_STRG	STORAGE	0.073	0.073	0	01:10	0.0982	0.0982	0.001
CB12_STRG	STORAGE	0.024	0.035	0	01:13	0.0332	0.0417	0.084
CB13_STRG	STORAGE	0.060	0.060	0	01:10	0.0837	0.0837	0.001
CB14_15_STRG	STORAGE	0.050	0.050	0	01:10	0.0631	0.0683	-0.051
CB16_STRG	STORAGE	0.024	0.024	0	01:10	0.0295	0.0295	0.001
DCB17_STRG	STORAGE	0.116	0.116	0	01:10	0.154	0.155	0.220
POND_1	STORAGE	0.035	0.194	0	01:09	0.0486	0.158	-0.929

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
EX_STUB	JUNCTION	11.34	0.262	2.608
MH403	JUNCTION	0.06	0.006	2.514
MH404	JUNCTION	0.74	0.094	2.606
MH405	JUNCTION	11.33	0.264	2.646
MH406	JUNCTION	11.27	0.190	2.600
MH408	JUNCTION	0.03	0.003	1.757
MH409_null	JUNCTION	1.23	0.713	0.427

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS

CB03_STRG	0.000	0	0	0	0.015	2	0	01:14	0.023
CB04_STRG	0.000	0	0	0	0.013	2	0	01:14	0.013
CB06_07_STRG	0.000	0	0	0	0.004	2	0	01:10	0.023
CB08_STRG	0.003	0	0	0	0.045	5	0	01:21	0.020
CB10_STRG	0.000	0	0	0	0.012	3	0	01:14	0.028
CB11_STRG	0.001	0	0	0	0.025	4	0	01:13	0.041
CB12_STRG	0.000	0	0	0	0.007	1	0	01:14	0.031
CB13_STRG	0.001	0	0	0	0.022	3	0	01:13	0.030
CB14_15_STRG	0.001	1	0	0	0.019	34	0	01:18	0.023
CB16_STRG	0.000	0	0	0	0.007	14	0	01:12	0.014
DCB17_STRG	0.001	7	0	0	0.001	14	0	01:10	0.115
POND_1	0.004	4	0	0	0.080	77	0	01:13	0.102

****

Outfall Loading Summary

****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
14	41.06	0.055	0.323	0.983
2	3.39	0.042	0.102	0.061
5	0.68	0.001	0.001	0.000
System	15.04	0.098	0.420	1.045

****

Link Flow Summary

****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
11	CONDUIT	0.107	0	01:10	1.52	0.56	1.00
13	CONDUIT	0.120	0	01:11	0.86	0.59	0.82
14	CONDUIT	0.017	0	01:10	0.78	0.08	0.19
15	CONDUIT	0.052	0	01:10	0.33	0.36	1.00
16	CONDUIT	0.023	0	01:17	0.50	0.12	0.85

17	CONDUIT	0.155	0	01:11	0.97	0.76	1.00
18	CONDUIT	0.186	0	01:11	1.17	0.90	1.00
2	CONDUIT	0.050	0	01:10	1.04	0.25	0.34
2_3	CONDUIT	0.059	0	01:10	0.35	0.25	1.00
3	CONDUIT	0.058	0	01:05	0.33	0.17	1.00
39	CONDUIT	0.020	0	01:14	0.46	0.10	0.97
4	CONDUIT	0.059	0	01:10	0.40	0.23	0.97
44	CONDUIT	0.054	0	01:09	0.43	0.24	0.59
54	CONDUIT	0.115	0	01:10	1.63	1.18	1.00
7	CONDUIT	0.120	0	01:10	0.42	0.51	1.00
8	CONDUIT	0.323	0	01:10	0.73	0.89	1.00
9	CONDUIT	0.323	0	01:10	0.73	0.80	1.00
10	ORIFICE	0.019	0	01:18			1.00
19	ORIFICE	0.014	0	01:10			1.00
21	ORIFICE	0.019	0	01:14			1.00
22	ORIFICE	0.012	0	01:10			1.00
24	ORIFICE	0.013	0	01:14			1.00
25	ORIFICE	0.012	0	01:10			1.00
27	ORIFICE	0.018	0	01:10			
28	ORIFICE	0.034	0	01:10			1.00
30	ORIFICE	0.013	0	01:14			1.00
31	ORIFICE	0.022	0	01:13			1.00
34	ORIFICE	0.012	0	01:14			1.00
35	ORIFICE	0.020	0	01:13			1.00
41	ORIFICE	0.009	0	01:12			1.00
51	ORIFICE	0.013	0	01:10			1.00
52	ORIFICE	0.020	0	01:21			1.00
53	ORIFICE	0.058	0	01:10			1.00
1	WEIR	0.001	0	01:18			0.02
12	WEIR	0.000	0	00:00			0.00
20	WEIR	0.000	0	00:00			0.00
23	WEIR	0.013	0	01:10			0.08
26	WEIR	0.011	0	01:10			0.07
29	WEIR	0.018	0	01:10			0.10
32	WEIR	0.019	0	01:13			0.10
33	WEIR	0.000	0	00:00			0.00
36	WEIR	0.016	0	01:14			0.09
37	WEIR	0.011	0	01:13			0.07
38	WEIR	0.018	0	01:14			0.10
40	WEIR	0.006	0	01:12			0.04
42	WEIR	0.000	0	00:00			0.00
43	WEIR	0.003	0	01:14			0.03
45	WEIR	0.016	0	01:10			0.09
46	WEIR	0.000	0	00:00			0.00
5	WEIR	0.102	0	01:13			0.52
50	WEIR	0.000	0	00:00			0.00

```
  ***************************
  Flow Classification Summary
  ***************************

  ----------------------------------------------------------------------------------
----
                    Adjusted    ---------- Fraction of Time in Flow Class -------
---
                     /Actual         Up    Down  Sub   Sup   Up    Down  Norm
Inlet
```

Conduit	Length	Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd	Ctrl
11	1.00	0.00	0.00	0.00	0.94	0.00	0.00	0.06	0.84	0.00
13	1.00	0.00	0.00	0.00	0.95	0.00	0.00	0.05	0.93	0.00
14	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
15	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.02	0.00	0.00
16	1.00	0.00	0.00	0.00	0.94	0.00	0.00	0.06	0.01	0.00
17	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.01	0.00
18	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.01	0.00
2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
2_3	1.00	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.00	0.00
3	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.02	0.00
39	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.01	0.00
4	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.00	0.00
44	1.00	0.00	0.00	0.00	0.04	0.00	0.00	0.96	0.04	0.00
54	1.00	0.01	0.00	0.00	0.94	0.00	0.00	0.05	0.00	0.00
7	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.00	0.00
8	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.00	0.00
9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

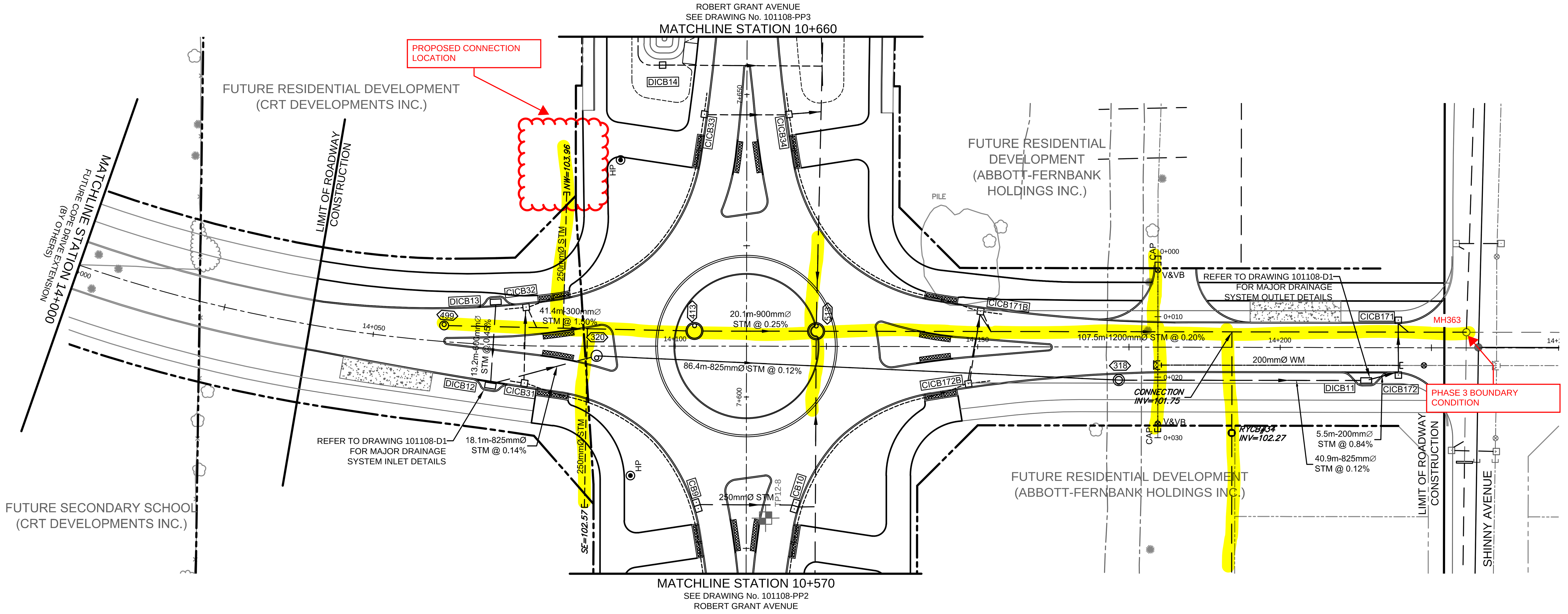
	Hours Full			Hours Above Full	Hours Capacity
Conduit	Both Ends	Upstream	Dnstream	Normal Flow	Limited
11	0.72	0.72	1.21	0.01	0.01
13	0.01	0.01	0.63	0.01	0.01
15	11.26	11.26	11.29	0.01	0.01
16	0.01	0.01	0.06	0.01	0.01
17	0.73	0.73	11.25	0.01	0.01
18	11.27	11.27	11.33	0.01	0.01
2_3	11.25	11.25	11.27	0.01	0.01
3	1.20	1.20	1.23	0.01	0.01
39	0.01	0.01	0.74	0.01	0.01
4	0.01	0.01	0.03	0.01	0.01

54	1.22	1.22	1.27	0.11	0.11
7	11.29	11.29	11.33	0.01	0.01
8	11.33	11.33	11.34	0.01	0.16
9	11.36	11.36	12.00	0.01	0.01

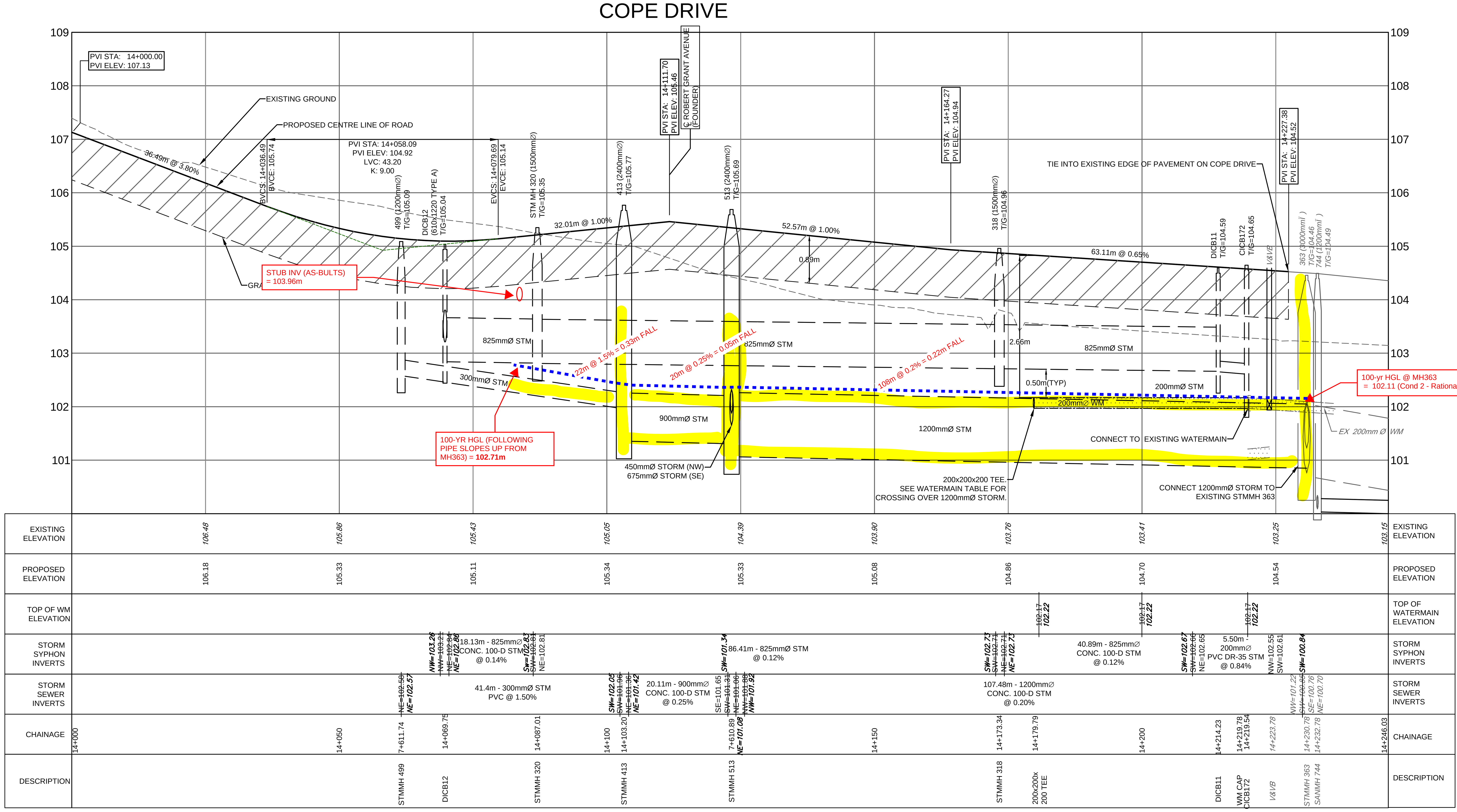
Analysis begun on: Mon Jul 5 14:45:22 2021
Analysis ended on: Mon Jul 5 14:45:33 2021
Total elapsed time: 00:00:11

APPENDIX D –

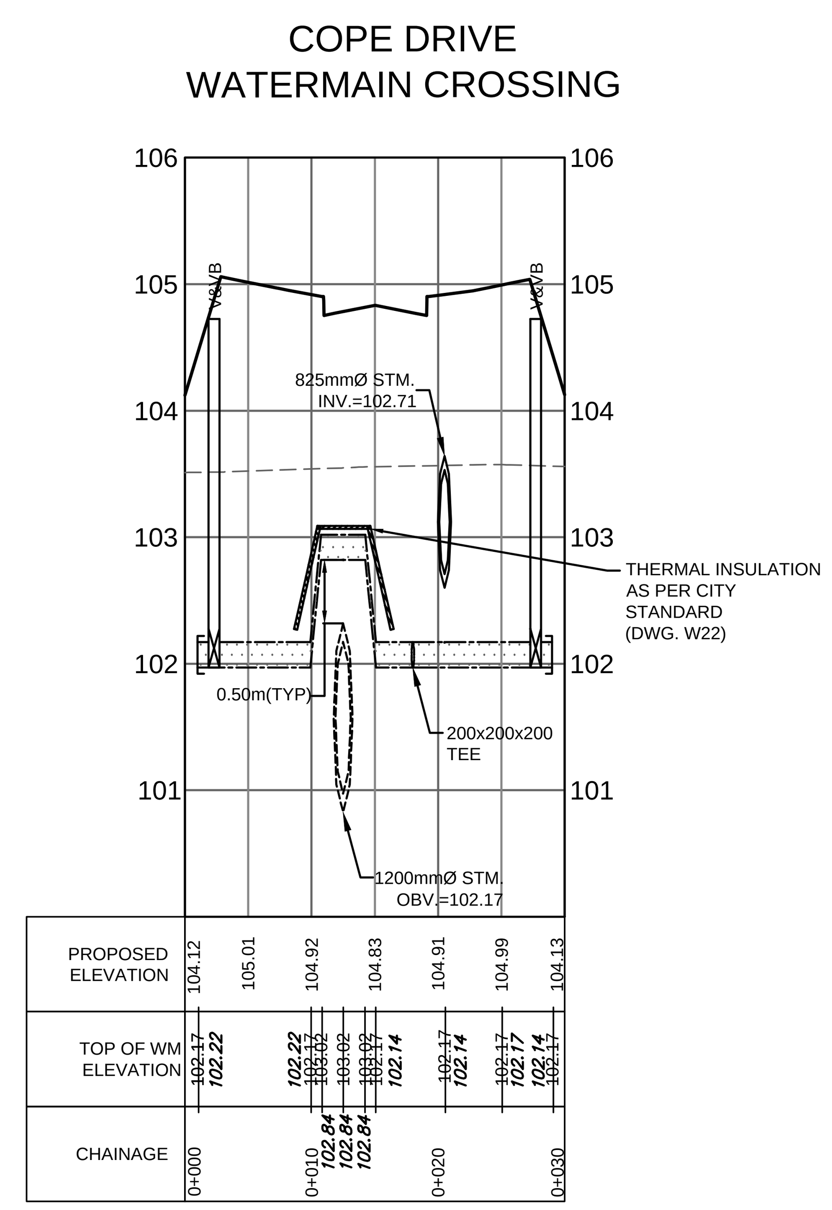
ROBERT GRANT AVE. / COPE DR. HGL ANALYSIS



COPE DRIVE



COPE DRIVE WATERMAIN CROSSING



COPE DRIVE WATERMAIN CROSSING TABLE			
STATION	SURFACE ELEVATION	T/WM ELEVATION	DESCRIPTION
0+001.00	103.89	~~102.17~~ 102.22	CAP
0+002.30	104.31	~~102.17~~ 102.22	VALVE & VALVE BOX
0+009.90	104.72	~~102.17~~ 102.22	45° V. BEND *(INSULATED)*
0+0010.75	104.74	~~103.02~~ 102.84	45° V. BEND *(INSULATED)*
0+012.50	104.78	~~103.02~~ 102.84	CROSSING OVER 1200mmØ STORM
0+014.24	104.81	~~103.02~~ 102.84	45° V. BEND *(INSULATED)*
0+015.09	104.83	~~102.17~~ 102.14	45° V. BEND *(INSULATED)*
0+017.40	104.78	~~102.17~~ 102.14	CROSSING UNDER 825mmØ STORM
0+020.47	104.93	~~102.17~~ 102.14	200x200x200 TEE
0+027.70	104.33	~~102.17~~ 102.14	VALVE & VALVE BOX
0+029.00	103.68	~~102.17~~ 102.14	CAP

NOTE: BARREL TO BARREL SEPARATION SHALL BE 500mm MINIMUM AS PER CITY OF OTTAWA DETAILS W25, AND W25.2.

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AS-BUILT

No.	REVISION	DATE	BY	No.	REVISION	DATE	BY
				8.	ISSUED WITH MOE APPLICATION	NOV 21/13	ERD
				7.	ISSUED FOR CITY OF OTTAWA APPROVAL	NOV 8/13	ERD
14.	ISSUED FOR AS-BUILT	JAN 26/18	ERD	6.	ISSUED TO CONTRACTOR FOR INFORMATION ONLY	NOV 5/13	ERD
13.	ISSUED WITH COMMENCE WORK NOTICE	OCT 13/15	ERD	5.	ISSUED WITH REVISED STORMWATER SERVICING BRIEF	OCT 30/13	ERD
12.	RE-ISSUED TO CONTRACTOR FOR INFORMATION ONLY	JUN 12/15	ERD	4.	ISSUED FOR ADDENDUM 3.0	SEPT 5/13	ERD
11.	RE-ISSUED FOR FRONT-ENDING AGREEMENT	NOV 4/14	ERD	3.	ISSUED FOR ADDENDUM 2.0	SEPT 3/13	ERD
10.	REVISED AS PER FRONT-ENDING AGREEMENT COMMENTS	MAR 12/14	ERD	2.	ISSUED FOR TENDER	AUG 16/13	ERD
9.	ISSUED WITH FRONT-ENDING AGREEMENT	DEC 6/13	ERD	1.	ISSUED FOR CITY OF OTTAWA REVIEW	AUG 16/13	ERD

SCALE
1:500 HORIZONTAL (0 5 10 15 20)
1:50 VERTICAL (0 0.5 1.0 1.5 2.0)

DESIGN SML
CHECKED ERD
DRAWN JPB
CHECKED SML
APPROVED ERD

FOR REVIEW ONLY

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

CITY OF OTTAWA - FERNBANK COMMUNITY
Robert Grant Avenue (Founder)

PLAN AND PROFILE
COPE DRIVE
14+000 TO 14+246

PROJECT No. 101108-07
REV # 14
DRAWING No. 101108-PP6

Ottawa (Head Office)
1800 Bantree Street
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☎ 613.745.2444
613.745.9994
www.cwwcanada.com
1.866.695.0155

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St-Laurent, Quebec H4S 1M2
☎ 514.738.2666
514.738.9762

CLEAN WATER WORKS INC.
INTEGRATED SEWER SOLUTIONS

RICHCRAFT™ Group of Companies

COPER DR - ROBERT GRANT

Ottawa, Ontario

SEWER CCTV INSPECTION REPORT

Report ID
103980ST1

Sewer Use
Storm

Completion Date
June 02, 2021

Inspected Length
25.6 meters

Table of contents

Page

1. Index of pipes

CLEAN WATER WORKS

1 item

Inspected length : 25.60
Total length : 41.40

Pipe	Start/End	Direction	Road	Date	Inspected	Total	Page
499 413	413 --> 499	Against flow	Cope Dr.	02/06/2021 2:19 PM	25.6	41.4	5

2. Structural rating

1 item

0 - No Defects (1 of 1 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
0	0000	0	499 413	413 --> 499	Against flow	Cope Dr.	5

3. O&M rating

1 item

3 - Moderate defect grade (1 of 1 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
3	3100	3	0	499 413	413 --> 499	Against flow	Cope Dr.	5

4. Pipe summary and condition details

Pipe identification

Pipe: 499 413	**Direction of inspection:** 413 --> 499
Direction of flow: 499 --> 413	**Direction:** Against flow

Pipe location

Road: Cope Dr.
Crossroad:
Drainage Area:
City: Ottawa
Location:
Owner: Unknown
Road segment:

UPSTREAM	DOWNSTREAM
Easting (X):	**Easting (X):**
Northing (Y):	**Northing (Y):**
Elevation (Z):	**Elevation (Z):**

GPS Accuracy:
Corrdinate System:
Vertical Datum:

Pipe characteristics

Sewer Use: Stormwater	**Inspected length:** 25.6
Height: 300	**Total length:** 41.4
Width:	**Rim/Inv.:**
Shape: Circular	**Grade/Inv.:**
Material: Polyvinyl Chloride	**Rim/Grade:**
Lining:	**Rim/Inv.:**
Joint length: 4	**Grade/Inv.:**
Year laid:	**Rim/Grade:**
Year renewed:	**Sewer category:**

Additional details

Date: 02/06/2021 2:19 PM	**Location details:**
Project Number:	**Surveyed by:** Derek Jessup
Customer: Richcraft Homes	**Certificate #:** U06180703002192
PO number:	**Pre-Cleaning:** No Pre-Cleaning
Work order:	**Date cleaned:**
Purpose:	**Unit of measurement:** Metric
Weather: Dry	**Media label:**
Flow control: Not Controlled	**Sheet #:**

Structural rating	O&M rating	Overall rating
Peak: 0	**Peak:** 3	**Peak:** 3
Quick rating: 0000	**Quick rating:** 3100	**Quick rating:** 3100
Score: 0	**Score:** 3	**Score:** 3
Index: 0	**Index:** 3	**Index:** 3

Additional information

Other information

REPORT ID: 103980ST1	**Information 6:**
Information 2:	**Information 7:**
Information 3:	**Information 8:**
Information 4:	**Information 9:**
Information 5:	**Information 10:**

4. Pipe summary and condition details

CLEAN WATER WORKS

1 2 3 4 5 6 7

1 / 1

Downstream
413

Invert
NA

1 ↓ **0.00 m**

AMH - Manhole, 413

2 ↓ **0.00 m**

MWL - Water Level, 0%

3 ↓ **19.60 m**

TF - Tap Factory, at 9 o'clock, Dim.1=250

4 ↓ **20.20 m**

TF - Tap Factory, at 2 o'clock, Dim.1=250

5 ↓ **25.20 m**

TF - Tap Factory, at 1 o'clock, Dim.1=200

6 ↓ **25.60 m** 3

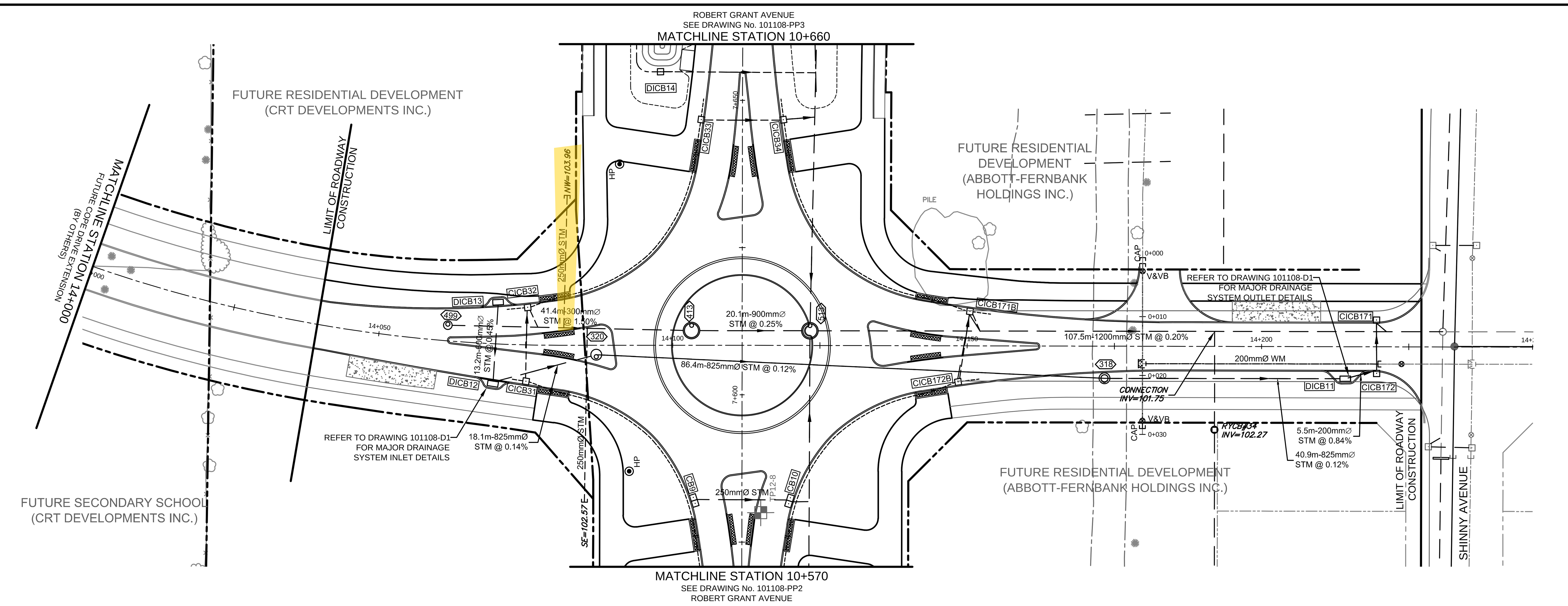
DSF - Deposits Settled Fine, from 4 o'clock to 8 o'clock, 15%

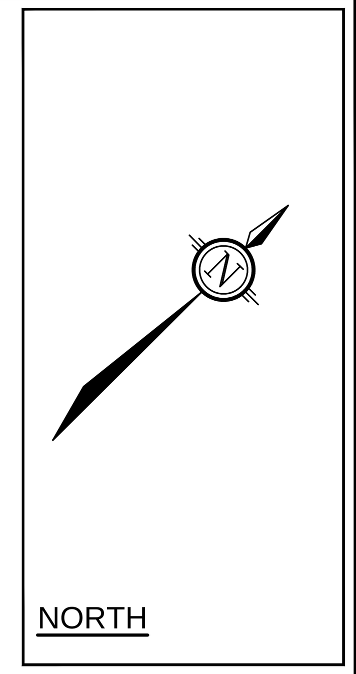
7 ↓ **25.60 m**

MSA - Abandoned Survey, Debris

Invert
NA

Upstream
499



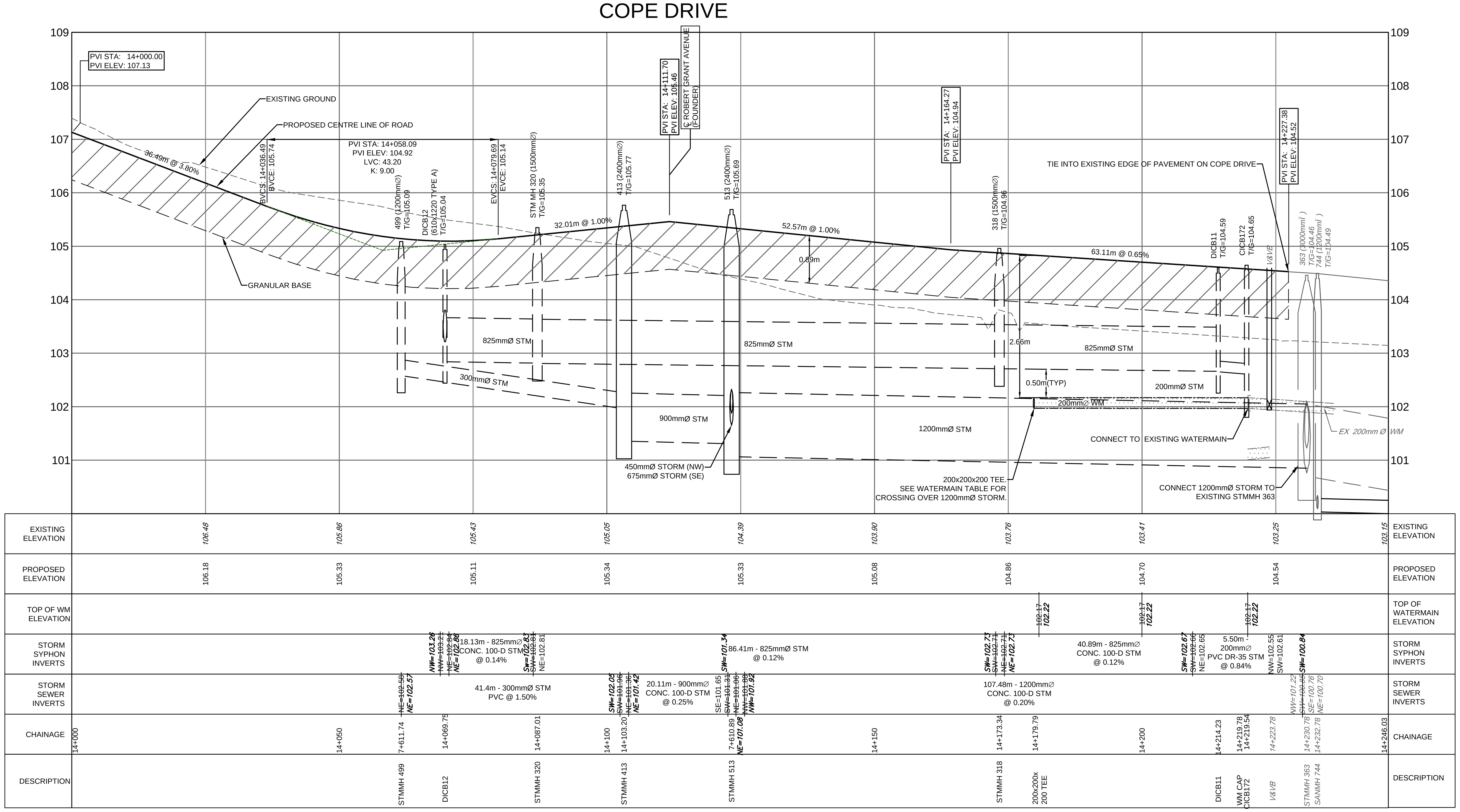


COPE DRIVE WATERMAIN CROSSING TABLE

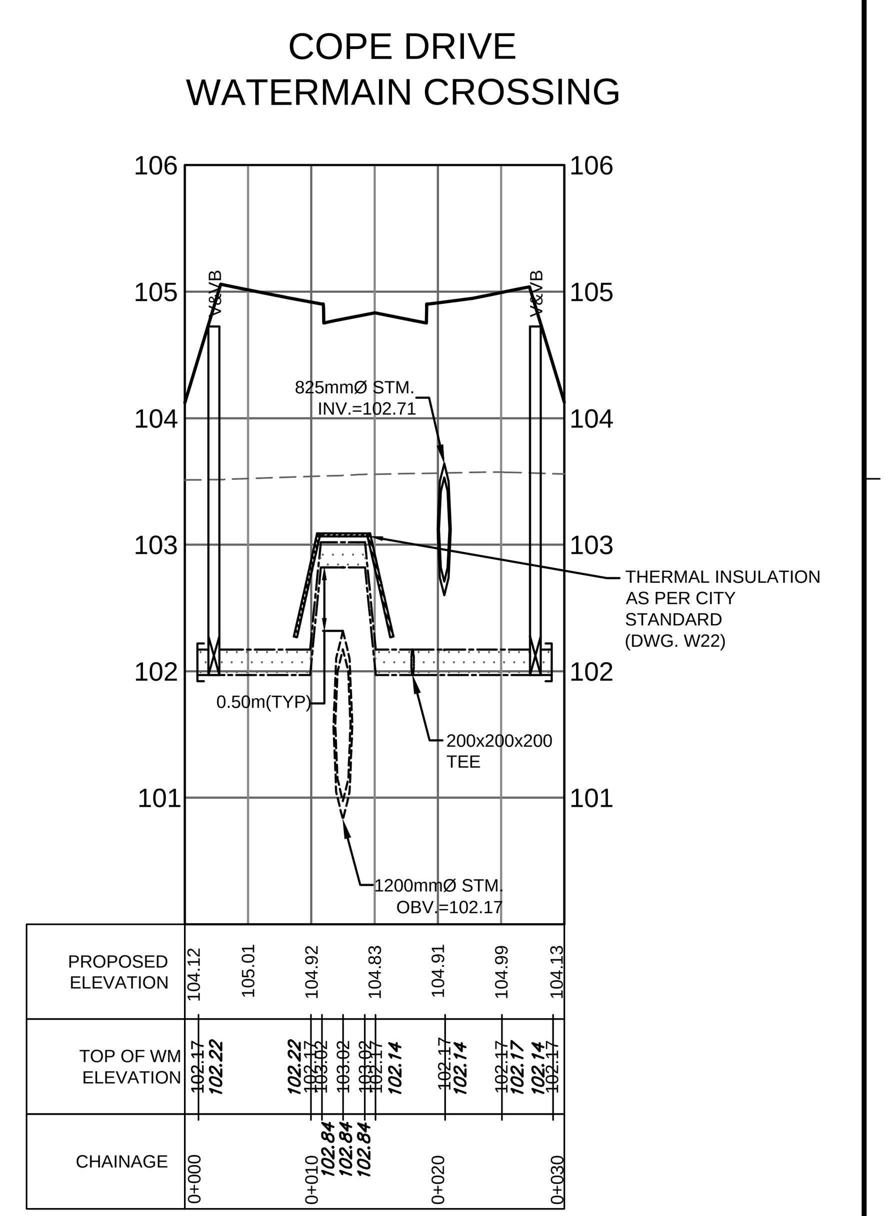
STATION	SURFACE ELEVATION	T/WM ELEVATION	DESCRIPTION
0+001.00	103.89	~~102.17~~ 102.22	CAP
0+002.30	104.31	~~102.17~~ 102.22	VALVE & VALVE BOX
0+009.90	104.72	~~102.17~~ 102.22	45° V. BEND *(INSULATED)*
0+0010.75	104.74	~~103.02~~ 102.84	45° V. BEND *(INSULATED)*
0+012.50	104.78	~~103.02~~ 102.84	CROSSING OVER 1200mmØ STORM
0+014.24	104.81	~~103.02~~ 102.84	45° V. BEND *(INSULATED)*
0+015.09	104.83	~~102.17~~ 102.14	45° V. BEND *(INSULATED)*
0+017.40	104.78	~~102.17~~ 102.14	CROSSING UNDER 825mmØ STORM
0+020.47	104.93	~~102.17~~ 102.14	200x200x200 TEE
0+027.70	104.33	~~102.17~~ 102.14	VALVE & VALVE BOX
0+029.00	103.68	~~102.17~~ 102.14	CAP

NOTE: BARREL TO BARREL SEPARATION SHALL BE 500mm MINIMUM AS PER CITY OF OTTAWA DETAILS W25, AND W25.2.

COPE DRIVE



COPE DRIVE WATERMAIN CROSSING



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AS-BUILT

No.	REVISION	DATE	BY
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4.	ISSUED FOR ADDENDUM 3.0	SEPT 5/13	ERD
3.	ISSUED FOR ADDENDUM 2.0	SEPT 3/13	ERD
2.	ISSUED FOR TENDER	AUG 16/13	ERD
1.	ISSUED FOR CITY OF OTTAWA REVIEW	AUG 16/13	ERD

SCALE
1:500 HORIZONTAL (0 5 10 15 20)
1:50 VERTICAL (0 0.5 1.0 1.5 2.0)

DESIGN	SML
CHECKED	ERD
DRAWN	JPB
CHECKED	SML
APPROVED	ERD

FOR REVIEW ONLY

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

CITY OF OTTAWA - FERNBANK COMMUNITY
Robert Grant Avenue (Founder)

PLAN AND PROFILE
COPE DRIVE
14+000 TO 14+246

PROJECT No. 101108-07
REV: REV # 14
DRAWING No. 101108-PP6

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PLANA1.DWG - 841mmx594mm

Vision Report© Legend

44 46 49 54 60	The numbers sequentially indicate each observation that was picked up throughout the inspection period. This will allow you to sift through the pages and view the accompanying description and photos in each section. Note that when a pipe section contains too many observations, Vision© Report must hide secondary observations in order to optimize the display.*
60	A number with neither a square nor circle indicates a general observation.
46 38 46 11 25	A circled number indicates a structural anomaly. The color of the circle indicates the severity of the anomaly on a scale of 1 to 5, 5 being the most severe: green=1, blue=2, magenta=3, orange=4 and red=5.
44 44 44 44 44	A number in a square indicates an operation and maintenance anomaly. The color of the square indicates the severity of the anomaly on a scale of 1 to 5, 5 being the most severe: green=1, blue=2, magenta=3, orange=4 and red=5.
◀ 3 / 31 ▶	Indicates the current page number of the inspection report.
	The blue square indicates a section of the pipe; this section is covered in detail on the current page of the report.
	The green line indicates the inspected part of the pipe. The remaining white line indicates the uninspected part of the pipe.
	Indicates the hold points on the camera during an inspection.
	Indicates the hold points on the camera during the reverse inspection.
	Indicates that a reverse inspection was carried out, however the camera did not reach the initial inspection hold point. (the hold point of the initial inspection)
	Indicates that a reverse inspection was carried out and that it has joined (has arrived at) the initial inspection hold point.
401-059B	Identifies the start manhole number. Note that this manhole is not necessarily the upstream manhole of the pipe.
401-631	Identifies the end manhole number. Note that this manhole is not necessarily the downstream manhole of the pipe.
ou	A downward arrow indicates that the inspection was carried out in the direction of the current, whereas an upward arrow indicates an inspection against the current. Note that the manhole located on the upper left of the page is always the start manhole, but not necessarily the upstream manhole of the pipe.
	This camera followed by a downward arrow is located on the upper left of the vertical pipe; it indicates that an inspection was done from this manhole.
	When the second camera appears on the bottom left page it means that a reverse inspection was carried out. Information about the reverse inspection is included in the report, thereby combining both inspections.
Invert 3.40	The measurement shown under the word <Invert> indicates the measurements between the frame and the pipe captured during the inspection. This measurement is available at the top left for the start manhole and the bottom left for the end manhole. If the invert was not measured during the inspection, an <NA> mark will be displayed.
1 AMH - R	The downward bold arrow to the right of the observation number indicates that this observation was captured during the initial inspection.
14 MSA - I	The blank arrow pointing upwards and located to the right of the observation number indicates that this observation was taken during the reverse inspection period, thereby confirming that this report combined both inspections.
18.40 m	Located to the right of the observation number is a number identifying the observation distance in relation to the start of the pipe.
SRV - Armature visib	A full description of the observation code according to the protocol used.

*Any hidden observations are readily accessible from the database as well as in other CTSpec report templates.

** CTSpec inc. reserves the right to modify, eliminate or add to the product features described in this pamphlet without notice.

Searle, Daniel

From: Searle, Daniel
Sent: Thursday, May 27, 2021 12:25 PM
To: Surprenant, Eric
Cc: Davidson, Steve; Alexander Orakwue
Subject: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion #2 - Follow Up

Hi Eric,

Thank you again for meeting with us today.

Based on our discussion, it is our understanding that the City does not store/maintain the existing SWM model associated with the Fernbank Pond 6 catchment. Instead, what the City may possess is a smaller excerpts of the model prepared for individual development applications. We understand you will be following up with the associated City technical reviewers today to see if any copies of the model are available for use by WSP.

In the event the City does not possess copies of the applicable model(s), you had suggested we reach out to Novatech to request a copy, or similarly, Novatech provide a memo communicated the 100-yr HGL at the subject connection point. As a third option, you had indicated that WSP could use 100-yr HGL values (for the Cope Drive trunk sewer) from previous development servicing/SWM reports and infer a HGL upstream to our connection point. Provided there is technical backing to the approach, WSP understands this approach is acceptable to the City.

On another note, you had also confirmed that the City is not aware of the intended use for the stub (for the foreseeable future) and that the City no concern with the proposed connection from this perspective.

As was communicated, the project has been on hold for nearly two weeks as the current grading approach is directly contingent on the acceptable use of this storm connection. We appreciate your commitment to providing us with a follow-up email by end of day today confirmed whether a model is available for WSP's use.

Please advise if I have misrepresented your comments/position in any way.

Thanks,

Dan Searle, P.Eng.
Municipal Engineer

T+ 1 613-935-0538

M+ 1 613-618-4825

1345 Rosemount Avenue
Cornwall, Ontario
K6J 3E5 Canada

www.wsp.ca

Searle, Daniel

From: Surprenant, Eric <Eric.Surprenant@ottawa.ca>
Sent: Thursday, May 06, 2021 9:50 AM
To: Davidson, Steve
Cc: Alexander Orakwue; De Santi, Nadia; Searle, Daniel
Subject: Re: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion
Attachments: Robert Grant & Cope.pdf

Hello Steve,

Sorry for the delay, I was trying to locate the Pond 6 design brief, however this pre-dates the electronic files and so you may need to reach out to our records department or designers associated with Pond 6. The other item I was trying to follow up on was the purpose of the storm stub since currently this is the interim Robert Grant cross-section and at some point, the roundabout may transition to a fully signalised intersection when the Middle BRT lanes are implemented and so I was and am still trying to confirm that this wasn't intended for future CBs. I will confirm further on that front and in the meantime have attached the as-built drawing we were looking at during the pre-consult.
Thanks

Eric Surprenant, CET
Sr, Project Manager, Infrastructure Projects, West
Planning, Infrastructure & Economic Development
613 580-2424 ext.: 27794

Please take note that due to current COVID situation, I am working remotely and Phone communication and messaging may not be reliable at this time. Preferred method of communications will be e-mails during this period. If your preference is telephone communication, please indicate this via e-mail and provide a contact telephone number.
Absence alert:

I apologize for any inconvenience.

From: Davidson, Steve <Steve.P.Davidson@wsp.com>
Sent: May 4, 2021 13:13
To: Surprenant, Eric <Eric.Surprenant@ottawa.ca>
Cc: Alexander Orakwue <AOrakwue@richcraft.com>; De Santi, Nadia <nadia.de-santi@wsp.com>; Searle, Daniel <Daniel.Searle@wsp.com>
Subject: RE: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion

Hi Eric,

I’m just checking in to see if you have an update on our request below? Let me know.

Thanks,
SD

Steve Davidson, P.Eng., OLS (Ret.), MBA
Manager, Municipal Engineering – Kingston & Cornwall

1224 Gardiners Road, Suite 201
Kingston, Ontario
K7P 0G2 Canada
T+ 1 613-634-7373
T+ 1 613-856-0307 (Direct)

steve.p.davidson@wsp.com | wsp.com

From: Davidson, Steve
Sent: April-29-21 11:37 AM
To: Eric.surprenant@ottawa.ca
Cc: Alexander Orakwue <AOrakwue@richcraft.com>; De Santi, Nadia <Nadia.De-Santi@wsp.com>; Searle, Daniel <Daniel.Searle@wsp.com>
Subject: RE: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion

Hi Eric,

Thank you again for the call today, we appreciate your time.

As discussed, please provide any available documentation (incl. As-built DWGs, reports, etc.) related to the SWM works along Cope Drive/Robert Grant Ave, specifically those which related to the 250mm storm services which appears to be stubbed in the SE corner of our site (Block 344 - 620 Bobolink Ridge).

Based on our call, it is our understanding that the City would consider allowing our development to have a secondary storm connection (aside from the dedicated service off Embankment Street) for the sole purpose of providing gravity drainage to a few of the townhome foundation drainage systems. Based the grading differential across the site (from Embankment Street to the intersection of Robert Grant/Cope), these few Townhome foundations currently possess an USF elevation below the site’s 100-yr + 300mm HGL. As mentioned, WSP is more then willing to complete an analysis/memo outlining the proposal, which would include a review of the receiving systems HGL as to ensure proper functionality.

If you have any questions or concerns please do not hesitate to reach out.

Regards,
SD

Steve Davidson, P.Eng., OLS (Ret.), MBA
Manager, Municipal Engineering – Kingston & Cornwall

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Kingston, Ontario
K7P 0G2 Canada
T+ 1 613-634-7373
T+ 1 613-856-0307 (Direct)

steve.p.davidson@wsp.com | wsp.com

-----Original Appointment-----
From: Davidson, Steve
Sent: April-28-21 11:49 AM
To: Davidson, Steve; Eric.surprenant@ottawa.ca; Alexander Orakwue; De Santi, Nadia; Searle, Daniel
Subject: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion
When: April-29-21 9:00 AM-10:00 AM (UTC-05:00) Eastern Time (US & Canada).
Where: Microsoft Teams Meeting

The purpose of this meeting is to review some grading/drainage constraints, and we'd like to review a few possible options to see if the City of Ottawa would be in agreeance with our design approach.

If this time doesn't work for anyone, 2-3pm also works for WSP and the City of Ottawa so please let me know if this should be rescheduled to the afternoon.

Regards,
SD

Steve Davidson, P.Eng., OLS (Ret.), MBA
Manager, Municipal Engineering – Kingston & Cornwall

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Kingston, Ontario
K7P 0G2 Canada
T+ 1 613-634-7373
T+ 1 613-856-0307 (Direct)

steve.p.davidson@wsp.com | wsp.com

Microsoft Teams meeting

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APPENDIX E –

FERNBANK CROSSING – PHASE 3 SERVICING REPORT

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- Land / Site Development
- Municipal Infrastructure
- Environmental / Water Resources
- Traffic/ Transportation
- Structural
- Recreational

Planning

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- Wireless Industry

Landscape Architecture

- Urban Design & Streetscapes
- Recreation & Parks Planning
- Environmental Restoration
- Sustainable Design

Abbott-Fernbank Holdings Inc.
Fernbank Crossing – Phase 3

Stormwater Management Report

Engineering excellence. Planning precision. Inspired landscapes.

ABBOTT-FERNBANK HOLDINGS INC.
FERNBANK CROSSING

STORMWATER MANAGEMENT REPORT (PHASE 3)

Prepared By:

NOVATECH
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario
K2M 1P6

March 10, 2015
Revised July 13, 2015

Novatech File: 108180-15
Ref: R-2015-051

July 13, 2015

City of Ottawa
Infrastructure Services and Community Sustainability
110 Laurier Avenue West
Ottawa, ON K1P 1J1

Attention: Ms. Lily Xu

Dear Ms. Xu

Reference: Stormwater Management Report – Phase 3
Abbott-Fernbank Holdings Inc. - Fernbank Crossing
Our File No.: 108180-15

Please find enclosed one (1) copy of the Stormwater Management Report for Phase 3 of the Abbott-Fernbank Holdings Inc. lands within the Fernbank Community – Fernbank Crossing. This report outlines the detailed storm drainage and stormwater management strategy for Phase 3 of the Fernbank Crossing development. The stormwater management design has been developed based on the requirements of the City of Ottawa and Rideau Valley Conservation Authority.

If you have any questions or comments, please do not hesitate to contact us.

Sincerely,

NOVATECH

Michael Petepiece, P.Eng.
Project Manager

cc: Mr. Josh Kardish, Regional Group of Companies (1 copy)
Mr. Eric Surprenant, City of Ottawa (3 copies)

Suite 200, 240 Michael Cowpland Drive, Ottawa ON K2M 1P6 Tel: 613.254.9643 Fax: 613.254.5867 www.novatech-eng.com

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1.0 INTRODUCTION

1.1 Background

Novatech has been retained to prepare a detailed stormwater management report for the proposed Phase 3 development of the Abbott-Fernbank Lands (hereafter referred to as Fernbank Crossing). The subject site is located within the new Fernbank Community on the North side of Fernbank Road and west of Terry Fox Drive as shown in **Figure 1**. The lands will be developed as a low to medium density residential subdivision.

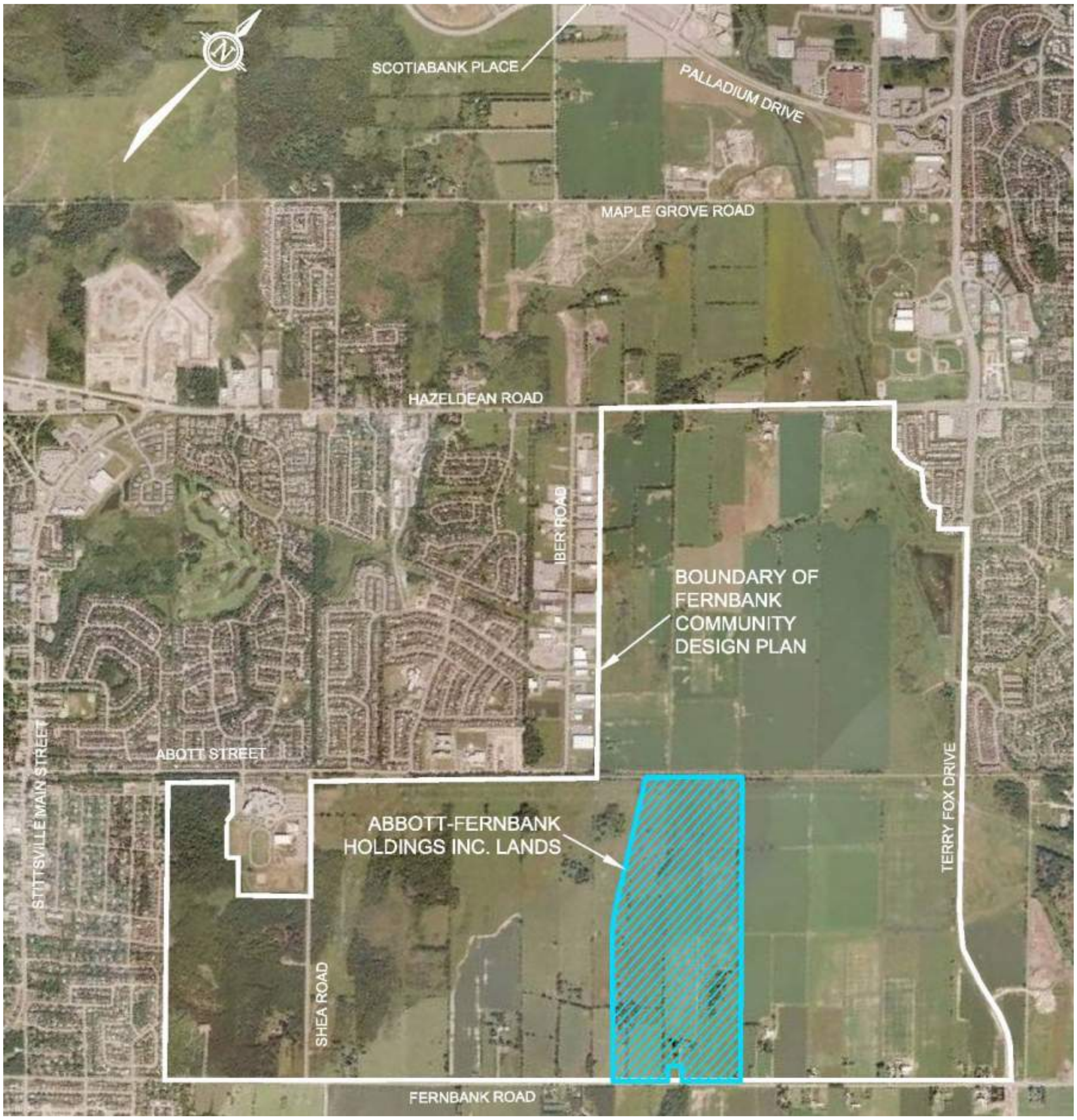

Figure 1: Key Plan

1.2 Land Use

1.2.1 Fernbank Crossing

The Fernbank Crossing subdivision (67.30 ha) will be comprised primarily of low and medium density residential dwellings with a total of 506 singles, 244 towns and 76 stacked units proposed. Medium density residential (6.81ha) and a Community Core Area (7.11ha) are proposed adjacent a new Arterial Road that is to be constructed along the west property line and the hydro corridor. The Community Core is comprised of Mixed-Use land and a Village Green which is a public green space. Two schools (4.95ha) will front onto a Major Collector road which divides the site (North/South). A Park n' Ride facility (1.95ha), and a Paramedic Post (0.71ha) are proposed along Fernbank Road. A Transit Station (1.02ha), Hydro Corridor (3.37ha), a SWM facility (0.93ha) and a Park (1.00ha) make up the remainder of the site. The proposed land use plan is shown in **Figure 2**.

Stormwater Management Draft Conditions are provided in **Appendix A**. The Draft Plan of Subdivision is located in **Appendix D**.

1.2.2 Adjacent Lands

The proposed subdivision will be bordered by future residential lands to the west (CRT Developments Inc.), a hydro corridor and the Trans-Canada Trail to the north, future residential lands to the east (Monarch-Cardel), and agricultural land to the south.

There is ongoing coordination with the both the landowner to the east (Monarch-Cardel) and the landowner to the west (CRT Developments Inc.). The proposed storm drainage system has been designed to accommodate runoff from the adjacent development areas, as well as future phases within the Fernbank Crossing development. The only external area draining to the site is the Phase 5 area which has been included in the modelling.

1.3 Additional Reports

This Stormwater Management Report provides information on the considerations and approach by which Novatech has designed and evaluated the proposed storm drainage system for the Phase 3 lands, and builds upon the recently completed works for the Fernbank Community Design Plan**[**1**]** prepared by Walker, Nott, Dragicevic Associates Limited, the Fernbank Master Servicing Study**[**2**]** prepared by Novatech, and the Fernbank Environmental Management Plan also prepared by Novatech**[**3**]**.

This report should be read in conjunction with the following:

- *Geotechnical Investigation, Fernbank Crossing Residential Subdivision Phase 3 and 4, Ottawa, Ontario* prepared by Houle Chevrier Engineering, dated December 2014 (Ref #14-482).

- *Servicing Design Brief (Phase 3) – Abbott-Fernbank Holdings Inc. Fernbank Crossing* prepared by Novatech Engineering Consultants Ltd., dated June 23, 2015 (R-2014-177).

Figure 2: Conceptual Land Use Plan

1.4 Phasing

The Fernbank Crossing subdivision is being developed in phases as shown in Figure 3. This report includes details of the proposed storm drainage and stormwater management design for Phase 3 which includes 128 single family lots, 68 townhomes, 2 medium-density residential blocks, and a park. A conceptual stormwater analysis for all future phases was modeled to evaluate the storm runoff (major and minor system) onto Cope Drive and will be re-evaluated during detailed design of all future phases.

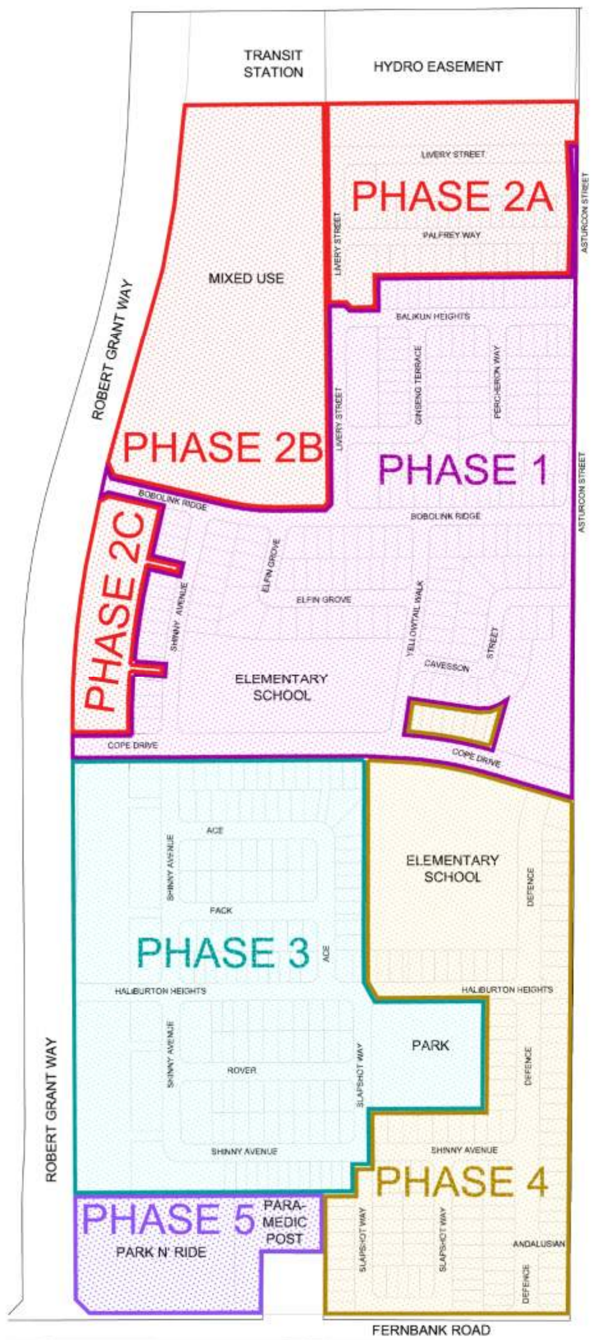

Figure 3: Phasing Plan

2.0 STORMWATER MANAGEMENT CRITERIA

The stormwater management criteria for the proposed development were developed as part of the Fernbank Environmental Management Plan **[**3**]** and are based on the recommendations of the Jock River Reach 2 Subwatershed Study and input from Rideau Valley Conservation Authority.

In additional to the SWM criteria outlined in the Fernbank EMP, the proposed stormwater management strategy will need to adhere to all applicable policies and guidelines of the Rideau Valley Conservation Authority, the City of Ottawa, the Ministry of the Environment, and other approvals agencies.

2.1 Quality Control / Quantity Control / Fish Habitat (Pond 6)

- Fernbank Pond 6 has been designed to control post-development peak flows in the Monahan Drain to pre-development levels and ensure no adverse impacts on the function of the Monahan Drain Constructed Wetlands SWM Facility.
- Fernbank Pond 6 has been designed to provide an *Enhanced* level of water quality protection (80% long term TSS removal), as required for lands tributary to the Monahan Drain (Jock River Subwatershed).
- Fernbank Pond 6 will provide temperature mitigation measures to ensure that the temperature of discharged stormwater does not exceed the target values established as part of the Fernbank EMP:
    - Maximum Discharge Temperature = 25ºC
    - Preferred Discharge Temperature = 22ºC

2.2 Storm Drainage / Conveyance

- Storm sewers are to be designed to convey the 1:5 year post-development peak flow for the proposed development (1:10 year for arterial roads).
- Overland flows are to be confined within the right-of-ways and/or defined drainage easements for all storms up to and including the 1:100 year event.
- ICD flow rates are to be calculated for each drainage area to ensure that the following stormwater management (SWM) objectives are satisfied:
    - Surface water accumulation at street low points, during a 5 year event, shall follow Section 8.3.8.2 of the City of Ottawa Sewer Design Guidelines.
    - Major system storage in backyards is not to be included / accounted for in design computations.
    - Maximum flow depths and elevations on streets shall not exceed 300 mm and shall be confined to the road right-of-way as well as not be within 300 mm (vertical) to the nearest building opening.
        - The maximum flow depth on streets (both public and private and on parking lots) under either static or dynamic conditions shall be 300 mm.
    - The product of the 100 year flow depth (m) on street and flow velocity (m/s) shall not exceed 0.6.
    - The 100 year hydraulic grade line within the storm sewers shall not be within 30 cm (vertical) to adjacent building underside of footing.

2.3 Erosion and Sediment Control

- A qualified inspector should conduct daily visits during construction to ensure that the contractor is working in accord with the design drawings and that mitigation measures are being implemented as specified.
- Silt fencing is to be installed along the upland edge of all fish habitat corridors.
- Straw bale check dams are to be installed at the outlets to roadside ditches.
- Filter fabric is to be placed under all catch basins and storm manhole covers.
- After complete build-out, all sewers are to be inspected and cleaned and all sediment and construction fencing is to be removed.

3.0 EXISTING CONDITIONS

3.1 Topography

The site generally slopes to the northeast at approximately 0.50%. Steeper grades of up to 6.0% are found near the high points along the west and south property boundaries. There is a total elevation differential of approximately 3.75 metres across the site, from a maximum elevation of approximately 106.00 metres in the southwest corner to a minimum elevation of approximately 102.25 metres in the northeast corner.

3.2 Subsurface Conditions

Geotechnical investigations were carried out by Houle Chevrier Engineering **[**4**]** **[**5**]**, and bedrock was encountered between 0.25 and 6.4 metres below the existing ground surface. The area of shallow bedrock is limited to the western boundary of the site, with the shallowest bedrock located in the northwest corner.

3.3 Drainage Outlet

The Fernbank Crossing development is located at the headwaters of the Monahan Drain Subwatershed (part of the Jock River Watershed). **Figure 4** shows the location of the Abbott Fernbank Lands and the existing watershed boundaries.

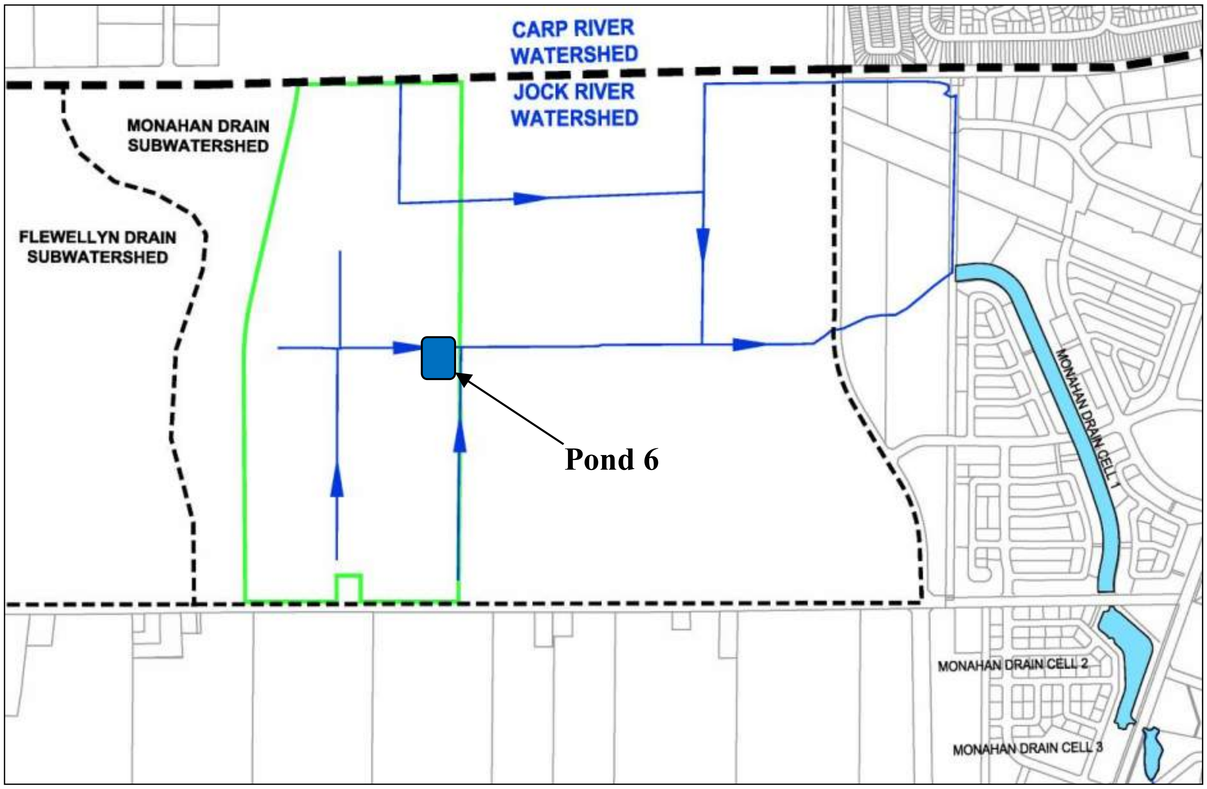

Figure 4: Existing Watershed Boundaries

The Monahan Drain is a municipal drain flowing eastwards towards Terry Fox Drive, with several lateral branches on the north and south sides that connect with the main branch. As specified in the Fernbank Environmental Management Plan, the Monahan Drain upstream of Terry Fox Drive has been classified as an intermittent watercourse that provides indirect habitat supporting tolerant warm/cool water fish communities.

The Monahan Drain has been abandoned upstream of Pond 6, along with the various branch drains within the limits of the Fernbank Community. The branch drains will be filled in as new development within the Fernbank Community proceeds. The main branch between Terry Fox Drive and Pond 6 will be lowered and enhanced using natural channel design techniques to mitigate against the loss of habitat associated with abandoning the various branch drains.

A minimum 40m wide riparian corridor has been designated for the section of the drain to be retained downstream of Pond 6 to protect aquatic habitat and stream function.

4.0 PROPOSED DEVELOPMENT

4.1 Grading Design

The proposed grading for the Abbott Fernbank Lands will closely follow the Grading Plan contained in the Fernbank Master Servicing Study **[3]**. Grade raise constraints are shown in Geotechnical Report **[5]** and are limited to the northeast corner of the site (described as Area 2) where the depth of fill material in the vicinity of structures and in garages should be limited to at most 2.0 metres.

Existing elevations will be met along Fernbank Road, Founder Avenue and Cope Drive. Grading will be coordinated with the proposed development to the east and west. A detailed grading plan can be found in the Phase 3 Servicing Design Brief dated December 12, 2014.

The proposed grading will not impede existing major system flow paths. Interim solutions have been proposed based on the area to be constructed as part of Phase 3. Further details are provided in the Phase 3 Servicing Design Brief.

4.2 Storm Sewer Design (Minor System)

The storm sewer system proposed to service Fernbank Crossing is divided into two main trunks with a north and a south inlet to Pond 6. The design of the trunk sewer outlets to Pond 6 are being coordinated with the City and the adjacent landowners. The overall layout of the proposed storm sewer network is shown on **Figure 5**.

The proposed storm sewers have been designed using the Rational Method to convey peak flows associated with a 5-year return period. The storm sewer design sheets are provided in **Appendix B**. The corresponding Storm Drainage Area Plan (Drawing 108180-15-STM) is provided in **Appendix D**. The design criteria used in sizing the storm sewers are summarized in **Table 4.1** and **Table 4.2**.

Table 4.1: Storm Sewer Design Parameters

Parameter	Design Criteria
Local and Collector Roads	5 Year Return Period
Arterial Roads	10 Year Return Period
Storm Sewer Design	Rational Method/Modeling
IDF Rainfall Data	Ottawa Sewer Design Guidelines
Initial Time of Concentration (T_c)	15 minutes (rear yards) / 10 minutes (roads)
Minimum Velocity	0.8 m/s
Maximum Velocity	3.0 m/s
Minimum Diameter	250 mm

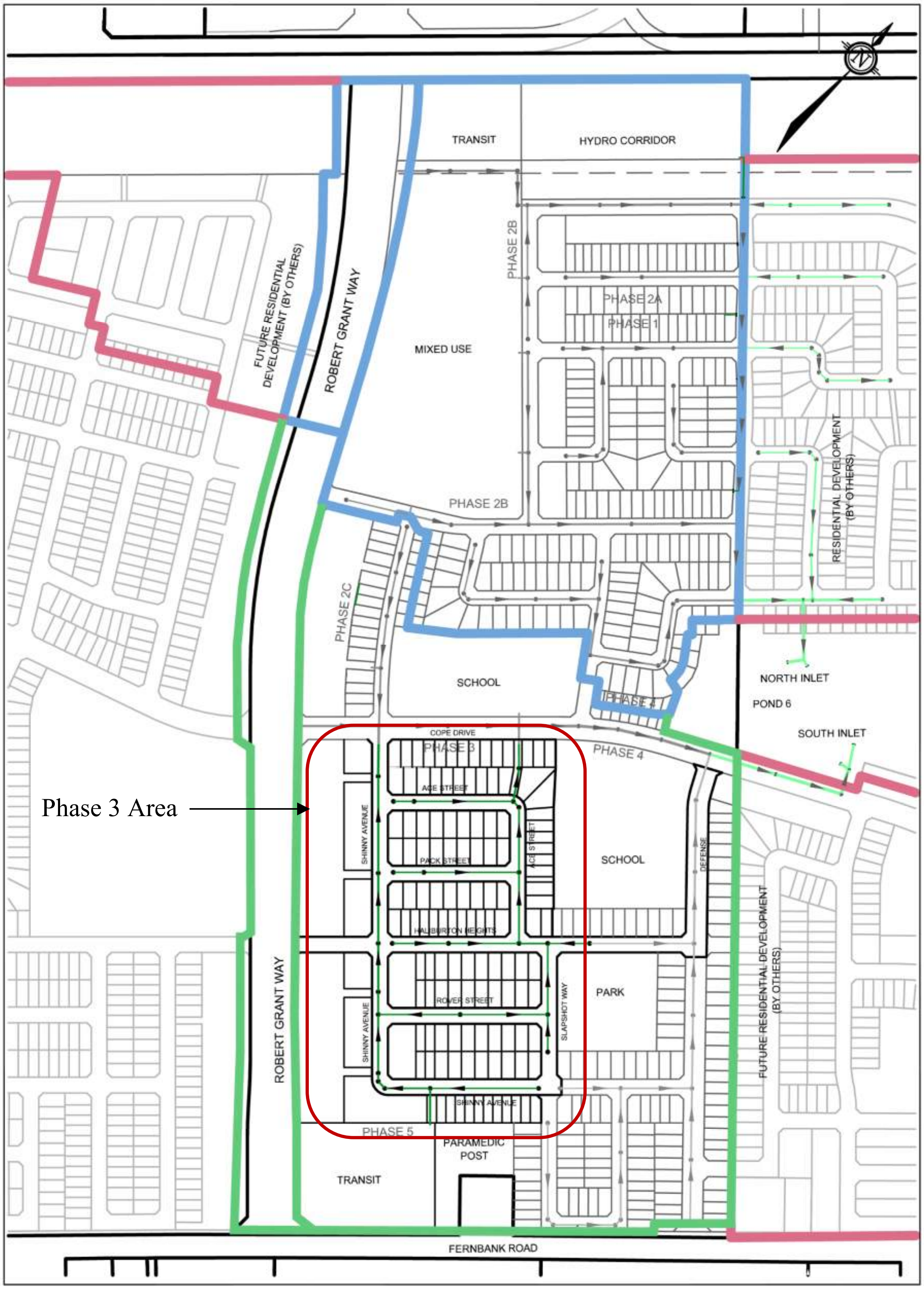

Figure 5: Storm Sewer Network

Table 4.2: Runoff Coefficients

Land Use	Runoff Coefficient
Mixed Use	0.80
Park N' Ride/Paramedic Post	0.80
Arterial Roads	0.90
Schools	0.60
Parks	0.40
Hydro Corridor	0.20
Low Density Front Yards	0.65
Low Density Rear Yards	0.55
Medium Density Front Yards	0.70
Medium Density Rear Yards	0.60

4.2.1 Inlet Control Devices

Inlet control devices (ICDs) will be installed in road and rear yard catch basins as required to limit inflows to the minor system during large (> 1:5 year) storm events. Catch basin leads will typically be interconnected with a single ICD controlling inflow to the storm sewer.

Inlet control devices are proposed at storm sewer inlets as required to ensure inflows to the storm sewer system are regulated to the 5-year peak flow (10-year peak flow for arterial roads and Transitway). ICDs shall be CB lead plug/insertion type and will correspond to the sizes listed in Section 13.1.19 of the Ottawa Sewer Materials Specifications **[7]**.

4.3 Overland Flow Path (Major System)

The rights-of-way have been designed to convey major system overland flow to Pond 6. The road profiles have been graded to ensure that the 100-year peak overland flows are confined within the right-of-way at a maximum flow depth of 0.30 m (static ponding + cascading flow). The major system has been designed to ensure that the product of velocity x depth does not exceed 0.60 during the 100-year event.

4.4 Infiltration Best Management Practices

The Fernbank EMP recommends lot level and infiltration best management practices (BMPs) to mitigate against the potential reduction in infiltration resulting from development. Phase 3 of the Fernbank Crossing subdivision will consist primarily of residential lots. Proposed BMPs for groundwater infiltration include:

- Pipes connecting rear yard CBs will be perforated pipes to promote infiltration of runoff from rear yard areas (as per City of Ottawa Standard Detail S29).
- Roof leaders will be directed to rear yard areas.

By implementing infiltration BMPs as part of the storm drainage design, the impacts of development on the hydrologic cycle can be considerably reduced. Infiltration of clean runoff will have additional benefits for stormwater management. By reducing the volume of "clean" water conveyed to the SWM facility, the end-of-pipe storage requirements can be reduced. The EMP specifies a post-development infiltration target of 110mm of annual rainfall for the site. A water balance was performed which has been included in Appendix B. The water balance indicates the post-development annual infiltration will be 114mm, which exceeds the minimum recommended by the EMP.

5.0 HYDROLOGIC & HYDRAULIC MODELING

The performance of the proposed storm drainage system for Phase 3 of the Fernbank Crossing subdivision was evaluated using the *Autodesk Storm and Sanitary Analysis* (SSA) hydrologic/hydraulic model. This includes confirmation of the minor system sizing and determination of the 100-year HGL.

5.1 Model Capabilities

The following excerpts are taken from *Autodesk Storm and Sanitary Analysis 2012 – Technical Capabilities and Functionalities* (Autodesk, Inc. 2011) and provide an overview of the hydrologic and hydraulic modeling capabilities of the software.

Hydrologic Modeling Capabilities

Autodesk Storm and Sanitary Analysis accounts for various hydrologic processes that produce runoff from urban areas, including:

- *Time-varying rainfall*
- *Evaporation of standing surface water*
- *Snow accumulation and melting*
- *Rainfall interception from depression storage*
- *Infiltration of rainfall into unsaturated soil layers*
- *Percolation of infiltrated water into groundwater layers*
- *Interflow between groundwater and the drainage system*
- *Nonlinear reservoir routing of overland flow*

Spatial variability in all of these processes is achieved by dividing a study area into a collection of smaller, homogeneous subcatchment areas, each containing its own fraction of pervious and impervious sub-areas. Overland flow can be routed between sub-areas, between subcatchments, or between entry points of a drainage system.

Hydraulic Modeling Capabilities

Autodesk Storm and Sanitary Analysis contains a flexible set of hydraulic modeling capabilities used to help route runoff and external inflows through the drainage system network of pipes, channels, storage/treatment units, and diversion structures. The software can simultaneously simulate dual drainage networks (stormwater sewer network and city streets as separate but connected conveyance pathways) and inlet capacity. It can quickly determine the amount of stormwater flow that is intercepted by the stormwater network inlets and the amount of stormwater flow that bypasses and is then routed further downstream to other inlets. Hydraulic network modeling is performed by the Kinematic Wave or Hydrodynamic (in other words, Saint Venant equation) routing methods.

5.2 Design Storms

The hydrologic analysis was completed using the following synthetic design storms and historical storms. The IDF parameters used to generate the design storms were taken from the Ottawa Design Guidelines - Sewer (October 2012).

3 Hour Chicago Storms:
100-year 3hr Chicago storm

4 Hour Chicago Storms:
5-year 4hr Chicago storm
100-year 4hr Chicago storm

12 Hour SCS Type II Storms:
5-year 12 hour SCS Type II storm
100-year 12 hour SCS Type II storm

24 Hour SCS Type II Storms:
100-year 24 hour SCS Type II storm

Historical Storms:
July 1st, 1979 storm
August, 1988 storm
August, 1996 storm

The 4-hour Chicago distribution generates the highest peak flows for both the minor and major systems and was determined to be the critical storm distribution for the design of the storm drainage system.

The proposed drainage system has also been stress tested using a 4-hour Chicago design storm that has a 20% higher intensity and total volume compared to the 100-year event.

Model results from all storm distributions are provided on the enclosed CD.

5.3 Model Development

The 'Autodesk Storm and Sanitary Analysis' *(SSA)* model has been developed to account for both minor and major system flows *(dual drainage),* including the routing of flows through the storm sewer network *(minor system),* and overland along the road network *(major system).* The results of the analysis were used to:

- Ensure no ponding in the rights-of-way following a 5-year event;
- Calculate the storm sewer hydraulic grade line for the 100-year storm event;
- Evaluate overland flow depths and ponding volumes in the right-of-way during the 100-year event; and
- Determine the total major and minor system runoff from the site to Pond 6.

The SSA program uses 'conveyance links' to model all minor and major systems during analysis. The conveyance links allow you to input the appropriate road cross sections in the open channel option so during the analysis the major system is modelled correctly. The conveyance links are connected to ‘junctions’ and ‘storm inlets’ which represent the gutter grades at selected points, catch basins in sags *(low points)* and overtopping points *(high points)*. The major system *(road network)* corresponds to the grading plan of the proposed site. The junctions, inlets and conveyance links are used to determine the flows, velocities and ponding depths at specific points on the road. The road networks on the plan and profile drawings are used to create the major system model using all slopes and grades for the site.

The SSA model is capable of accounting for both static and dynamic storage within the right-of-ways, including the overland flow across all high points and capture/bypass curves for inlets on continuous grade. The 100-year flow depths computed by the model represent the total (static + dynamic) ponding depths at low points for areas in road sags, or the gutter flow depth where the inlets are on a continuous grade.

5.3.1 Storm Drainage Area Plan

The Fernbank Crossing subdivision has been divided into subcatchments based on the drainage areas tributary to each inlet of the proposed storm sewer system. The catchment areas are shown on the Storm Drainage Area Plans provided as Drawings 108180-15-STM in **Appendix D**.

5.3.2 Subcatchment Model Parameters

The hydrologic parameters for each subcatchment were developed based on the Land Use Plan (Figure 2) and the Storm Drainage Area Plan specified above. An overview of the modeling parameters is provided in **Table 5.1**. Supporting calculations are provided in **Appendix B**.

Table 5.1: Hydrologic Modeling Parameters

Area ID	Catchment Area (ha)	Runoff Coefficient (C)	Percent Impervious (%)	Equivalent Width (m)	Average Slope (%)
109b	0.46	0.55	50	100.00	0.50%
624	1.18	0.80	86	53.00	0.50%
625	0.17	0.65	64	18.00	0.50%
627	1.01	0.80	86	53.00	0.50%
628	0.06	0.55	50	16.00	0.50%
629	0.16	0.55	50	40.00	0.50%
630	0.11	0.55	50	30.00	0.50%
632	1.08	0.80	86	88.00	0.50%
633	1.84	0.80	86	120.00	0.50%
634	0.14	0.60	57	28.00	0.50%
638	0.07	0.60	57	25.00	0.50%
639	0.13	0.60	57	40.00	0.50%
641	0.39	0.70	71	50.00	0.50%
642	0.42	0.65	64	48.00	0.50%

Area ID	Catchment Area (ha)	Runoff Coefficient (C)	Percent Impervious (%)	Equivalent Width (m)	Average Slope (%)
643	0.46	0.65	64	48.00	0.50%
663	0.51	0.55	50	100.00	0.50%
664	0.45	0.65	64	48.00	0.50%
666	0.35	0.65	64	48.00	0.50%
667	0.35	0.70	71	50.00	0.50%
668	0.50	0.55	50	100.00	0.50%
670	0.70	0.65	64	48.00	0.50%
671	0.22	0.65	64	38.00	0.50%
672	0.42	0.55	50	100.00	0.50%
673	0.28	0.65	64	38.00	0.50%
674	0.30	0.65	64	38.00	0.50%
675	0.35	0.65	64	48.00	0.50%
704	0.22	0.65	64	22.00	0.50%
708	0.15	0.65	64	25.00	0.50%
713	0.08	0.55	50	40.00	0.50%
716	0.18	0.55	50	40.00	0.50%
717	0.31	0.65	64	48.00	0.50%
718	0.43	0.55	50	100.00	0.50%
719	0.21	0.65	64	38.00	0.50%
720	0.35	0.65	64	48.00	0.50%
721	0.47	0.65	64	48.00	0.50%
722	0.21	0.55	50	40.00	0.50%
723	0.31	0.65	64	38.00	0.50%
730	0.10	0.60	57	25.00	0.50%
739	0.20	0.55	50	40.00	0.50%
700	0.22	0.65	64	25.00	0.50%
TOTAL	15.6	0.68	68	-	-

Infiltration

Infiltration losses for all catchment areas was modeled using Horton's infiltration equation, which defines the infiltration capacity of the soil over the duration of a precipitation event using a decay function that ranges from an initial maximum infiltration rate to a minimum rate as the storm progresses. The default values for the City of Ottawa **[6]** were used for all catchments.

Horton's Equation:	Initial infiltration rate:	$f_o = 76.2$ mm/hr
$f(t) = f_c + (f_o - f_c)e^{-k(t)}$	Final infiltration rate:	$f_c = 13.2$ mm/hr
	Decay Coefficient:	$k = 4.14$/hr

<u>Depression Storage</u>

The default values for depression storage in the City of Ottawa **[6]** were used for all catchments. Residential rooftops were assumed to provide no depression storage.

- Depression Storage (pervious areas): 4.67 mm
- Depression Storage (impervious areas): 1.57 mm

<u>Impervious Values</u>

Impervious (TIMP) values for each subcatchment area were calculated based on the proposed land use plan (Figure 2) and correspond to the Runoff Coefficients used in the Rational Method calculations using the equation:

$$C = 0.90(\%\ IMP) + 0.20(1 - \%\ IMP)$$

To check that the impervious values used in the design are appropriate, the impervious value for a typical lot was calculated for each land use and compared to the values used in the design. The results of this analysis indicate that the Runoff Coefficients and impervious values used in the stormwater management design are slightly higher than the calculated values and therefore represent a slightly conservative design. Supporting calculations are provided in **Appendix B**.

5.3.3 Minor System

Inflows to the storm sewer were modeled based on the characteristics of each inlet.

- For areas where catch basins are located at low points *(represented as junctions),* inflows to the storm sewer are based on the ICD specified for the inlet and the maximum depth of ponding. Storage volumes within the right-of-way are based on the grading design.

- For areas where catch basins are located on a continuous grade *(represented as inlets),* the capture rate is based on the type of grate, the geometry of the road, and the approach flow. Rating curves for approach flow vs. capture rate were input into the model using the appropriate tables from the *Ottawa Design Guidelines – Sewer*:
  - Design Chart 4.04: Gutter Flow Rate for Barrier Curb with Gutter.
  - Design Chart 4.06: Gutter Flow Rate for Mountable Curb with Gutter.
  - Design Chart 4.14: Inlet Capacity for Barrier Curb.
  - Design Chart 4.15: Inlet Capacity for Mountable Curb.
  - Appendix 7-A. Type S22 Curb Inlet Catch Basin with Cross Fall fixed at 3%

5.3.4 Major System

The proposed road network was input into the 'Storm and Sanitary Analysis' model to calculate the total inflow into the storm sewers (minor system), and to calculate the overland flows and flow depths within the right-of-ways (major system).

The roads are represented in the model as open channels. Model input includes:

- Right-of-way cross-sections;
- Length and slope of the road between each high and low point;
- The location of all storm inlets and whether the inlets are in a sag or on-grade.

The elevations used to define the road network are based on the gutter elevations, as opposed to the centerline of road elevations shown on the Grading Plans.

5.3.5 Assumptions for Off-Site / Future Development

The ‘Storm and Sanitary Analysis’ model developed for Phase 3 of the Fernbank Crossing subdivision has to account for inflows from all future phases, as well as inflows from adjacent development. Where detailed information does not exist, the following assumptions were made in developing the model:

- Inflows from all future development have been accounted for based on the 5-year peak flow (10-year peak flow for arterial roads)

- The maximum release rate for the paramedic station and park and ride facility was established as 150L/s/ha as per the community design plan.

5.3.6 Modeling Files / Schematic

The ‘Storm and Sanitary Analysis’ modeling files and model schematics are provided in **Appendix C**. Digital copies of the modeling files and model output for all storm events are provided on the enclosed CD.

5.4 Results of Hydrologic Analysis

The ‘Autodesk Storm and Sanitary Analysis’ hydrologic/hydraulic model was used to evaluate the performance of the proposed storm drainage system for the Phase 3 lands tributary to the South Inlet of Pond 6 and specifically to determine the 100-year hydraulic grade line.

5.4.1 Minor System

The proposed inlet control devices (ICDs) have been sized to allow the capture of the approximate 5-year peak flow at each inlet to the storm sewer. As a result, there will be effectively no ponding within the right-of-ways at the end of the 5-year event. The selection of ICDs takes into account the overland flow that bypasses catch basins on-grade by providing additional capacity at the downstream inlets. The list of ICD sizes and a comparison of storm sewer design sheet peak flow results from modeling peak flow results is provided in **Table 5.2** and **Table 5.3** respectively.

Table 5.2: Inlet Control Device Sizes and Design Flows

Area ID	Structure	ICD Orifice Diameter (mm)	5-year Peak Runoff Rate (L/s)	5-year Inlet Capture Rate (L/s)	100-year Peak Runoff Rate (L/s)	100-year Inlet Capture Rate (L/s)	Excess Runoff Stored and Bypassed (L/s)
109b	RYCBMH-2	152	51	50	128	59	69
625	CB-119	127	30	29	54	35	19
628	RYCB-34	83	7	7	18	18	0
629	RYCB-33	108	19	19	46	37	9
630	RYCB-32	83	13	13	31	18	13
634	RYCB-39	94	18	18	43	25	18
638	RYCB-31	94	12	12	25	25	0
639	RYCB-30	83	21	20	45	22	23
641	CB-129	200 Lead	78	78	141	100	41
642	CB-132	178	75	74	136	78	58
643	CB-134	178	82	81	148	85	63
663	RYCBMH-4	152	52	52	136	62	74
664	CB-125	178	81	81	147	88	59
666	CB-123	178	63	63	115	79	36
667	CB-121	200 Lead	71	71	128	101	27
668	RYCBMH-3	152	52	52	134	64	70
670	CB-97	200 Lead	120	102	218	107	111
671	CB-96	200 Lead	40	40	74	74	0
672	RYCB-24	152	49	48	120	65	55
673	CB-117	152	51	51	93	59	34
674	CB-115	152	54	54	98	58	40
675	CB-93	152	63	63	115	66	49
704	CB-101	108	39	18	71	22	49
708	CB-111	108	27	22	50	22	28
713	E-34	83	13	13	31	18	13
716	RYCB-28	108	20	19	50	35	15
717	CB-91	200 Lead	57	57	104	74	30
718	RYCB-25	127	49	47	121	51	70
719	CB-90	152	38	38	70	48	22
720	CB-87	152	64	64	115	66	49
721	CB-85	200 Lead	85	84	153	97	56
722	RYCBMH-17	127	21	21	55	51	4
723	CB-113	178	55	55	101	85	16
730	RYCB-38	83	15	14	32	16	16
739	RYCB-21	94	21	21	54	27	27
700	CB-127	152	40	40	72	55	17

The Rational Method design sheets (**Appendix B**) were used to calculate the required storm sewer sizes based on capturing the peak flow at each inlet to the storm sewer for a 5-year design return period.

Two sets of storm sewer design sheets are included in **Appendix B**:

- The 'Standard' Rational Method design sheets represent the expected 5-year peak flow in the storm sewers.
- The 'Fixed Tc' Rational Method design sheets represent the expected 100-year peak flow in the storm sewers based on the following assumptions and were used to determine the boundary conditions for the SSA model:
  - Each inlet is restricted to the 5-year peak flow using ICDs;
  - During the 100-year event, each inlet will contribute their maximum design flow (i.e. 5-year peak flow) simultaneously, which is often the case when ICDs operate at or near their maximum rate for a sustained period of time (i.e. duration of ponding).

5.4.2 Major System

During the 100-year event, the available static storage within road sags will be utilized and overland flow will occur as described in **Table 5.4**. Storm runoff that exceeds the available static storage will be conveyed overland within the right-of-ways and/or defined drainage easements to Pond 6. The major system network was evaluated using the 'Autodesk Storm and Sanitary Analysis' model to ensure that the flow depths and velocities conform to City standards.

The results of the 100-year modeling indicate that the overland flow depths on all streets will be less than 0.30m, the product of depth x velocity will be less than 0.60, and major system flows will be confined to the rights-of-way with no encroachment onto private property. The model results for points of maximum overland flow on the site are summarized in **Table 5.3**. Depths recorded in this table reflect depths along the model conduits (i.e. the roadways) and not the depths at the sags.

Table 5.3 also provides the model results for a 20% increase in the 100-year design event. The results of this stress testing indicate that the overland flow depths for the proposed site will be less than or equal to 0.30m. Based on these results, the proposed storm drainage system will not experience any severe flooding even with a 20% increase to the 100-year event. **Table 5.4** describes the ponding depths at roadway sags and the spill flows.

Table 5.3: Maximum Overland Flow Results

Location	Max Static Depth	Chicago 100-year 4 hour				Chicago 100-year 4 hour (+20%)			
		Peak Flow	Velocity	Total Depth (static + dynamic)	Velocity x Depth	Peak Flow	Velocity	Total Depth	Velocity x Depth
		(m^3/s)	(m/s)	(m)	(m^2/s)	(m^3/s)	(m/s)	(m)	(m^2/s)
Catch Basins at Low Points									
Ace Street									
CB 85/86	0.30	0.00	0.00	0.19	0.00	0.02	0.16	0.35	0.06
CB 89/90	0.18	0.01	0.20	0.20	0.04	0.09	0.09	0.24	0.02
CB 95/96	0.14	0.00	0.00	0.08	0.00	0.03	0.05	0.18	0.01
Pack Street									
CB 91/92	0.17	0.00	0.00	0.16	0.00	0.04	0.05	0.23	0.01
Shinny Avenue									
CB 115/116	0.18	0.15	0.46	0.26	0.12	0.17	0.47	0.29	0.14
CB 117/118	0.22	0.00	0.00	0.17	0.00	0.15	0.14	0.30	0.04
CB 121/122	0.16	0.06	0.18	0.22	0.04	0.30	0.28	0.27	0.08
CB 129/130	0.13	0.04	0.27	0.18	0.05	0.06	0.28	0.21	0.06
CB 131/132	0.24	0.00	0.00	0.21	0.00	0.01	0.17	0.26	0.04
CB 133/134	0.24	0.00	0.00	0.15	0.00	0.00	0.00	0.20	0.00
Haliburton Heights									
CB 97/98	0.20	0.00	0.00	0.17	0.00	0.01	0.25	0.22	0.06
Slapshot Way									
CB 101/102	0.13	0.11	0.41	0.20	0.08	0.26	0.40	0.23	0.09
CB 127/128	0.08	0.04	0.45	0.13	0.06	0.11	0.55	0.16	0.09
Rover Street									
CB 123/124	0.18	0.10	0.46	0.24	0.11	0.14	0.43	0.27	0.11
CB 125/126	0.04	0.03	0.10	0.09	0.01	0.12	0.16	0.12	0.02
Catch Basins on Continuous Grade									
Ace Street									
CB 87/88	-	0.04	0.52	0.04	0.02	0.07	0.28	0.05	0.01
Pack Street									
CB 93/94	-	0.04	0.49	0.05	0.02	0.07	0.52	0.06	0.03
High Points with Spill									
Haliburton Heights									
8+350	-	0.11	0.41	0.13	0.05	0.26	0.40	0.15	0.06
Shinny Avenue									
4+345	-	0.15	0.46	0.08	0.04	0.17	0.47	0.11	0.05
4+505	-	0.06	0.18	0.08	0.01	0.30	0.28	0.11	0.03
4+605	-	0.04	0.27	0.05	0.01	0.33	1.30	0.08	0.10
Slapshot Way									
6+095	-	0.04	0.45	0.05	0.02	0.11	0.55	0.08	0.05

Table 5.4: Major System Storage Summary

Structure ID	Top of Grate Elevation (m)	Max Static Ponding Elevation (m)	Max Static Ponding Volume (m^3)	Model Results (5yr Event)		Model Results (100yr Event)		
				Depth Used (m)	Storage Used (m^3)	Depth Used (m)	Storage Used (m^3)	Spill Flow (L/s)
CB 115/116	104.31	104.49	19.28	0.01	0.02	**0.26**	19.28	**146**
CB 117/118	104.48	104.70	35.75	0.00	0.00	0.17	27.63	0
CB 121/122	104.70	104.86	17.86	0.00	0.00	**0.22**	17.86	**62**
CB 129/130	104.88	105.01	6.91	0.00	0.00	**0.18**	6.91	**41**
CB 131/132	104.97	105.21	43.39	0.04	7.23	0.21	37.97	0
CB 133/134	105.07	105.31	47.64	0.01	0.12	0.15	29.77	0
CB 127/128	104.53	104.61	3.02	0.00	0.00	**0.13**	3.02	**37**
CB 125/126	104.39	104.43	2.44	0.00	0.00	**0.09**	2.44	**41**
CB 123/124	104.82	105.00	23.21	0.02	2.58	**0.24**	23.21	**99**
CB 101/102	103.60	103.73	5.58	0.00	0.00	**0.20**	5.58	**109**
CB 97/98	103.74	103.94	25.96	0.03	0.53	0.17	22.07	0
CB 95/96	103.27	103.41	9.42	0.00	0.00	0.08	5.38	0
CB 91/92	103.15	103.32	7.61	0.00	0.00	0.16	7.16	0
CB 89/90	103.14	103.32	15.36	0.00	0.00	**0.20**	15.36	**12**
CB 85/86	103.00	103.30	59.33	0.00	0.00	0.19	37.58	0
RYCBMH-1	103.07	103.30	0	0.00	0	**0.29**	0	**27**
RYCBMH-2	103.16	103.30	0	0.00	0	**0.24**	0	**69**
RYCBMH-3	104.01	104.14	0	0.00	0	**0.23**	0	**68**
RYCBMH-4	104.79	104.87	0	0.00	0	**0.17**	0	**73**
RYCB-21	105.31	105.31	0	0.00	0	**0.07**	0	**26**
RYCB-24	103.26	103.46	0	0.00	0	**0.29**	0	**55**
RYCB-25	103.08	103.28	0	0.00	0	**0.30**	0	**69**
RYCB-30	105.06	105.06	0	0.00	0	**0.05**	0	**22**
RYCB-33	104.48	104.50	0	0.00	0	**0.11**	0	**22**
RYCB-38	105.25	105.35	0	0.00	0	**0.16**	0	**16**
RYCB-39	105.28	105.40	0	0.00	0	**0.17**	0	**18**

5.4.3 Hydraulic Grade Line

Downstream Boundary Condition – Cope Drive Storm Sewer

The proposed Phase 3 development will have a higher imperviousness than originally accounted for in the design of the Cope Drive storm sewer as outlined in the *Fernbank Crossing Phases 1 & 2 SWM report* (Novatech, July 2012). To provide a 5-year level of service for Phase 3, the minor system capture rate has increased and the peak flow entering the existing Cope Drive storm sewer will be higher for both the 5-year and 100-year events - refer to **Section 5.4.4**.

The previously approved Autodesk SSA model for Phases 1 and 2 was updated to reflect the higher flows from Phase 3 and re-evaluate the 100-year HGL in the Cope Drive storm sewer. For the Phase 3 SSA model, the 100-year boundary condition water levels at Cope Drive were established based on the worst-case (highest elevation) condition of:

Condition 1: The pipe obvert where the storm sewer connects to the trunk sewer under Cope Drive;

Condition 2: The HGL in the Cope Drive storm sewer, as calculated using the storm sewer design sheet (fixed 10 minute time of concentration - represents the controlled 100-year minor system flow) – refer to Appendix B; or

Condition 3: The modeled HGL for Cope Drive from the updated SSA model for Phases 1 and 2.

From this evaluation, the boundary elevations at Cope Drive for the Phase 3 model have been established as follows:

MH 363: 102.11m (Condition 2)
MH 341: 100.17m (Condition 3)

HGL Analysis Results – Phase 3

The results of this analysis were used to ensure that a minimum freeboard of 0.30m is provided between the 100-year HGL and the designed underside of footing elevations. The 100-year HGL is indicated on the Plan and Profile Drawings (submitted separately). The 100-year HGL elevations at each storm manhole with the respected range of underside of footing elevations and obvert of pipes are provided below in **Table 5.5.**

Table 5.5: 100-year HGL Elevations

MH ID	Street	Obvert Elevation (m)	T/G Elevation (m)	HGL Elevation (m)	Sur-charge (m)	Clearance from T/G (m)	Minimum USF (m)
309	Haliburton Heights	101.33	103.86	101.41	0.08	2.45	101.71
343	Ace Street	99.69	103.09	100.63	0.94	2.46	100.93
345	Ace Street	101.76	104.26	101.46	0.00	2.80	101.76
347	Ace Street	100.12	103.46	100.98	0.86	2.48	101.28
349	Pack Street	101.06	104.47	101.26	0.20	3.21	101.56
351	Ace Street	100.37	104.05	101.28	0.91	2.77	101.58
353	Haliburton Heights	101.72	104.86	101.42	0.00	3.44	101.72
357	Slapshot Way	102.50	104.65	102.27	0.00	2.38	102.57
359	Rover Street	102.99	105.24	102.56	0.00	2.68	102.86
373	Shinny Avenue	102.25	104.40	102.24	0.00	2.16	102.54
375	Shinny Avenue	102.44	104.76	102.39	0.00	2.37	102.69
377	Shinny Avenue	102.59	104.98	102.49	0.00	2.49	102.79
379	Shinny Avenue	102.73	104.99	102.62	0.00	2.37	102.92
381	Shinny Avenue	102.79	105.14	102.70	0.00	2.44	103.00
383	Shinny Avenue	102.97	105.23	102.92	0.00	2.31	103.22
385	Shinny Avenue	102.99	105.26	102.98	0.00	2.28	103.28
387	Shinny Avenue	103.10	105.17	103.07	0.00	2.10	103.37

MH ID	Street	Obvert Elevation	T/G Elevation	HGL Elevation	Sur-charge	Clearance from T/G	Minimum USF
		(m)	(m)	(m)	(m)	(m)	(m)
389	Shinny Avenue	103.33	105.46	103.17	0.00	2.29	103.47
391	Maintenance Easement	99.55	103.19	100.40	0.85	2.79	100.70
393	Ace Street	101.59	103.91	101.46	0.00	2.45	101.76
395	Ace Street	99.75	103.18	100.73	0.98	2.45	101.03
397	Pack Street	100.55	103.94	101.57	1.02	2.37	101.87
399	Haliburton Heights	101.17	104.22	101.44	0.27	2.78	101.74
417	Slapshot Way	100.50	103.87	101.40	0.90	2.47	101.70
421	Slapshot Way	102.58	104.86	102.56	0.00	2.30	102.86

5.4.4 Comparison to Previous Studies

While all flow from the site eventually discharges to Pond 6, the infrastructure immediately downstream must also be checked to determine if it has the capacity to convey the proposed conditions flows to the pond. **Table 5.6** summarizes the proposed flows as they compare to previous studies.

Table 5.6: Comparison to Previous Studies

Comparison Location	Proposed Flows (L/s)		Phase 1&2 SWM Report (L/s) [8]	
	Minor System	Major System	Minor System	Major System
MH 363	1563	127	1490	1650
MH 341	1165	95	710	530

While the minor system results are increased at MH 341 compared to what had previously been assumed, the total increase to the minor system is 528L/s. As shown in the fixed time of concentration storm sewer design sheet (included in **Appendix B**), the pipe, even under 100-year conditions, has additional capacity of 148 L/s. As such, we can expect that the downstream sewer will exceed capacity by 380 L/s in the 100-year storm. This additional flow was assessed using the approved Phase 1 and 2 SSA model and determined a small increase in HGL as a result of the additional flow. This increased does not have any adverse effect on the upstream or downstream pipe system and does not change established minimum USF elevations in Phase 1. The increase in HGL did, however, necessitate using the Phase 1 and 2 model HGL as the boundary condition for the Phase 3 model at MH 341.

With respect to flows entering Pond 6, they are being significantly reduced as a result of greater than anticipated storage within the proposed subdivision. Comparing the total runoff volumes between the SSA model and IBI's SWMHYMO model used to design the pond, the SWMHYMO model had a runoff volume of 11,139m^3 and the SSA model has a runoff volume of 11,245m^3, which is an increase of 106m^3, or less than 1%. This small increase is within the tolerance of the model. Consequently, Pond 6 will not be adversely affected by any changes in the design.

In addition to the flows reported in Table 5.6, there is major system overland drainage during the 100-year storm to the future Phase 4 area in the amount of 103 L/s east of Haliburton Heights and 26 L/s south of Slapshot Way. These flows are much reduced from the existing conditions flows in these areas and as such are not anticipated to cause adverse impacts downstream before Phase 4 is developed. During the Phase 4 development process, these flows will be considered and incorporated during the detail design modelling of that phase.

Overall, during the 100-year storm, the average site release rate through the minor system is 175L/s/ha and the major system release rate is 23L/s/ha. During the 5-year storm, the average site release rate through the minor system is 135 L/s/ha.

6.0 CHANGES FROM FERNBANK COMMUNITY DESIGN PLAN

Changes in the proposed storm sewer system are defined as *minor* on page 83 of the Fernbank Master Servicing Study **[**2**]** and do not require an amendment to the Environmental Assessment since the results do not appreciably change the expected net impacts associated with the project. A full summary of the changes can be found in the Phase 3 Servicing Design Brief.

7.0 EROSION AND SEDIMENT CONTROL

Erosion and sediment control measures will be implemented during construction in accordance with the "Guidelines on Erosion and Sediment Control for Urban Construction Sites" (Government of Ontario, May 1987). Details are provided on the Erosion and Sediment Control Plan (108180-15-ESC) provided in **Appendix D**.

- All erosion and sediment control measures are to be installed to the satisfaction of the engineer, the municipality and the conservation authority prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and remain present during all phases of site preparation and construction.
- A qualified inspector should conduct daily visits during construction to ensure that the contractor is working in accord with the design drawings and that mitigation measures are being implemented as specified.
    - A light duty silt fence barrier is to be installed in the locations shown on the Erosion and Sediment Control Plan.
    - Straw bale barriers are to be installed in drainage ditches that will remain open as part of Phase 1 development.
    - Filter cloth is to be placed above the grates of all catch basins and structures within the construction area.
    - After complete build-out, all sewers are to be inspected and cleaned and all sediment and construction fencing is to be removed.
- The contractor shall ensure that proper dust control is provided with the application of water (and if required, calcium chloride) during dry periods.
- The contractor shall immediately report to the engineer or inspector any accidental discharges of sediment material into any ditch or sewer system. Appropriate response measures shall be carried out by the contractor without delay.
- The contractor acknowledges that failure to implement erosion and sediment control measures may result in penalties imposed by any applicable regulatory agency.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The servicing design generally conforms to the conclusions and recommendations outlined in the Fernbank Master Servicing Study and the Fernbank Environmental Management Plan both of which were approved by Ottawa City Council on June 24, 2009.

The conclusions based on the results of the stormwater management analysis are as follows:

Storm Drainage / Conveyance

- Storm sewers (minor system) have been designed to convey the greater of:
    - The uncontrolled 5-year peak flow, or
    - The controlled 100-year peak flow.
- Inflows to the minor system will be controlled using inlet control devices (ICDs). Where possible, pairs of road catch basins will be interconnected where possible.
- The site has been graded to provide an overland flow route along the road network.
- Overland flows during the 100-year event will not exceed a maximum flow depth of 0.30m within the right-of-way. The product of depth x velocity will be less than 0.6.
- A minimum clearance of 0.30m will be provided between the 100-year hydraulic grade line (HGL) and the designed underside of footing elevations.

Stormwater Management

- Water quality and quantity control for the Fernbank Crossing subdivision will be provided by Fernbank Pond 6 located at the headwaters of the Monahan Drain.
- Pond 6 will control post-development flows to the Monahan Drain to pre-development levels for all storms up to and including the 1:100 year event.
- Pipes connecting rear yard catch basins will be perforated to promote infiltration and reduce the volume of storm runoff to Pond 6.

The preceding report is respectfully submitted for review and approval. Please contact the undersigned should you have questions or require additional information.

NOVATECH

Prepared by	Reviewed by
LICENSED PROFESSIONAL ENGINEER B. D. E. ORENDORFF 100154163 July 13, 2015 PROVINCE OF ONTARIO	LICENSED PROFESSIONAL ENGINEER M. J. PETEPIECE 100079354 July 13/15 PROVINCE OF ONTARIO
Bryan Orendorff, M.A.Sc., P.Eng. Water Resources Engineer	Michael Petepiece, P.Eng. Project Manager

References

1 "Fernbank Community Design Plan, Walker, Nott, Dragicevic Associates Ltd. [June 24, 2009]

2 "Fernbank Master Servicing Study", Novatech Engineering Consultants Ltd. [June 24, 2009]

3 "Fernbank Environmental Management Plan", Novatech Engineering Consultants Ltd. [June 24, 2009]

4 "Additional Test Pits East Portion of Brookfield Property, Fernbank Community Design, Ottawa, Ontario" Houle Chevrier Engineering Ltd. [Report No. 08-601, December 2008]

5 "Geotechnical Investigation, Fernbank Crossing Residential Subdivision Phase 3 and 4, Ottawa, Ontario" Houle Chevrier Engineering Ltd. [Report No. 14-482, December 2014]

6 "Sewer Design Guidelines", Department of Public Works and Services, City of Ottawa [October 2012]

7 "Standard Tender Documents, Material Specifications and Standard Detail Drawings" City of Ottawa, Department of Infrastructure Services and Community Sustainability [March 31, 2009]

8 "Fernbank Crossing Stormwater Management Report (Phases 1&2)", Novatech Engineering Consultants Ltd. [March 9, 2012]

Appendix A

Draft Conditions (SWM)

Stormwater Management

97.	**SW1**	The Owner shall provide to the General Manager, Planning and Growth Management any and all stormwater reports that may be required by the City for approval prior to the commencement of any works in any phase of the Plan of Subdivision. Such reports shall be in accordance with any watershed or subwatershed studies, conceptual stormwater reports, City or Provincial standards, specifications and guidelines. The reports shall include, but not be limited to, the provision of erosion and sedimentation control measures, implementation or phasing requirements of interim or permanent measures, and all stormwater monitoring and testing requirements. All reports shall be to the satisfaction of the General Manager, Planning and Growth Management.	**OTTAWA Planning and CA**
98.	**SW2**	(a) Prior to the commencement of construction of any phase of this Subdivision (roads, utilities, any off site work, etc.) the Owner shall: i. have a Stormwater Management Plan and an Erosion and Sediment Control Plan prepared by a Professional Engineer in accordance with Current Best Management Practices, ii. have said plans approved by the General Manager, Planning and Growth Management, and iii. provide certification to the General Manager, Planning and Growth Management through a Professional Engineer that the plans has been implemented. (b) Any changes made to the Plan shall be submitted to the satisfaction to the City of Ottawa and the Conservation Authority. (c) The Owner shall implement an inspection and monitoring plan to maintain erosion control measures.	**OTTAWA Planning**
99.	**SW3**	On completion of all stormwater works, the Owner shall provide certification to the General Manager, Planning and Growth Management through a Professional Engineer that all measures have been implemented in conformity with the approved Stormwater Site Management Plan.	**OTTAWA Planning**
100.	**SW4**	Prior to the registration, or the making of an application for a Ministry of Environment Certificate of Approval for any stormwater works, whichever event first occurs, the Owner shall prepare a Stormwater Site Management Plan in accordance with a Conceptual Stormwater Site Management Plan (specified by title of plan, date). The Stormwater Site Management Plan shall identify the sequence of its implementation in relation to the construction of the subdivision and shall be to the satisfaction of the General Manager, Planning and Growth Management and the (Specify) Conservation Authority.	**OTTAWA Planning and CA**

101. SW5	The Owner shall maintain the stormwater management pond in accordance with the recommendations of the Stormwater Management Plan and to the satisfaction of the General Manager, Planning and Growth Management until such time as the stormwater management pond has been given Final Acceptance and assumed by the City of Ottawa.	**OTTAWA Planning**
102. SW6	The Owner shall design and construct, as part of the stormwater management infrastructure, at no cost to the City, a monitoring facility or facilities and vehicular access to the satisfaction of the General Manager, Planning and Growth Management.	**OTTAWA Planning**
103. SW7	The Owner agrees that the development of the Subdivision shall be undertaken in such a manner as to prevent any adverse effects, and to protect, enhance or restore any of the existing or natural environment, through the preparation of any storm water management reports, as required by the City. All reports are to be approved by the General Manager, Planning and Growth Management prior to the commencement of any Works.	**OTTAWA Planning**
104. SW8	The Owner covenants and agrees that the following clause shall be incorporated into all agreements of purchase and sale for the whole or any part of a lot or block on the Plan of Subdivision, and registered separately against the title: "The Owner acknowledges that some of the rear yards within this subdivision are used for on-site storage of infrequent storm events. Pool installation and/or grading alterations on some of the lots may not be permitted and/or revisions to the approved Subdivision Stormwater Management Plan Report may be required to study the possibility of pool installation on any individual lot. The Owner must obtain approval of the General Manager, Planning and Growth Management of the City of Ottawa prior to undertaking any grading alterations."	**OTTAWA Legal**
105.	The Owner shall acknowledge and agree in the subdivision agreement that the agricultural tile drains encountered during construction shall be decommissioned/removed in accordance with the direction provided in the Fernbank Community Design Plan Environmental Management Plan, as approved by Council June 24, 2009.	**OTTAWA Planning**

106.	The Owner acknowledges and agrees that prior to early servicing and prior to final approval and registration, a detailed stormwater site management plan in accordance with the Fernbank Community Design Plan, Master Servicing Study and Environmental Management Plan, as approved by Council June 24, 2009 shall be prepared and accepted by the City of Ottawa and Rideau Valley Conservation Authority. The final design shall satisfy the requirements for the receiving stream flow quantity and quality as they relate to natural channel design and the protection of fish habitat and maintenance of the existing hydrological characteristics. The final design shall also account for upstream drainage, including areas serviced by agricultural tiles drains in accordance with the Fernbank Community Design Plan, Master Servicing Study and Environmental Management Plan, as approved by Council June 24, 2009	**OTTAWA Planning**
107.	Prior to early servicing and final approval and registration, the Owner shall provide an implementation/staging plan that clearly describes the coordination between the construction of the Pond 6 stormwater management facility and its outlet, related stormwater infrastructure and the undertaking of modifications and improvement works to the Monahan Drain as described in Section 11.9, 11.9.1 & 11.9.2 of the Fernbank Community Design Plan Environmental Management Plan, as approved by Council June 24, 2009.	**OTTAWA Planning**
108.	The Owner acknowledges and agrees that the proposed stormwater Pond identified as Pond 6 and the outlet to the downstream Monahan Drain shall require an application and approval under Ontario Regulation 174/06 under Section 28 of the Conservation Authorities Act "Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation" prior to undertaking said works. Any applications received in this regard would be assessed within the context of approved policies for the administration of the regulation, including those for the protection of fish habitat.	**OTTAWA Planning RVCA**
109.	The Owner acknowledges and agrees that the design and construction of the stormwater management facility identified as Pond 6 requires the concurrence and coordination with the adjacent landowner to the west. The Owner shall provide the General Manager, Planning and Growth Management written verification from the abutting owner that there is an agreement with respect to design and construction of Pond 6.	**OTTAWA Planning**

110.	Prior to early servicing and final approval and registration, a report documenting the process for undertaking the construction of the stormwater management facility identified as Pond 6 in coordination with the adjacent landowner to the west shall be prepared to the satisfaction of the Rideau Valley Conservation Authority and the City of Ottawa.	**OTTAWA Planning RVCA**
111.	The Owner acknowledges and agrees that the stormwater management facility identified as Pond 6 is constructed and operational prior to the commissioning of the stormsewers within the plan of subdivision.	**OTTAWA Planning**

Appendix B

SWM Calculations & Design Sheets

Typical Storm Sewer Design Sheet
Fixed Tc Storm Sewer Design Sheet
Catch basin Inlet Curves
Typical Lot Impervious Calculations
Water Balance Calculations

Fernbank Crossing (Phase 3)- Storm Sewer Design Sheet (Traditional Rational Method)

LOCATION			AREA												FLOW							PROPOSED SEWER							
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area	Weighted Runoff Coefficient	Indivi 2.78 AR	Accum 2.78 AR	Time of Concentration	Rain Intensity (mm/hr) 5yr	Rain Intensity (mm/hr) 10yr	Peak Flow	Total Peak Flow (Q)	Pipe	Size	Grade	Length	Capacity	Full Flow Velocity	Time of Flow	Q/Qfull
			0.80	0.80	0.90	0.60	0.40	0.20	0.65	0.55	0.70	0.60	(ha)							(L/s)	(L/s)	Type	(mm)	(%)	(m)	(l/s)	(m/s)	(min.)	(%)
South Outlet																													
643	389	387							0.46				0.46	0.65	0.83	0.83	10.00	104.2		86.6	**86.6**	PVC	450	0.19	123.5	129.6	0.79	2.61	66.8%
													0.00		0.00	0.00	10.00			0.0									
633, 632, 739, 730	387A	387		2.92						0.20		0.10	3.22	0.78	6.97	6.97	10.00	104.2		725.9	**725.9**	CONC	900	0.20	41.5	844.6	1.29	0.54	85.9%
													0.00		0.00	0.00	10.00			0.0									
642	387	385							0.43				0.43	0.65	0.78	8.57	12.61	92.2		790.5	**790.5**	CONC	900	0.20	51.8	844.6	1.29	0.67	93.6%
													0.00		0.00	0.00	12.61			0.0									
	385	383											0.00	0.00	0.00	8.57	13.28	89.6		768.0	**768.0**	CONC	900	0.20	10.9	844.6	1.29	0.14	90.9%
													0.00		0.00	0.00	13.28			0.0									
634	383	419										0.14	0.14	0.60	0.23	8.81	13.42	89.0		784.3	**784.3**	CONC	900	0.25	9.3	944.3	1.44	0.11	83.1%
													0.00		0.00	0.00	13.42			0.0									
641	419	381									0.39		0.39	0.70	0.76	9.57	13.53	88.6		848.1	**848.1**	CONC	900	0.25	66.9	944.3	1.44	0.78	89.8%
													0.00		0.00	0.00	13.53			0.0									
666	359	381							0.35				0.35	0.65	0.63	0.63	10.00	104.2		65.9	**65.9**	PVC	375	0.25	93.3	91.5	0.80	1.94	72.1%
													0.00		0.00	0.00	10.00			0.0									
639	381	379										0.13	0.13	0.60	0.22	10.42	14.30	85.9		894.6	**894.6**	CONC	975	0.24	25.9	1145.4	1.49	0.29	78.1%
													0.00		0.00	0.00	14.30			0.0									
627	379A	379		1.01									1.01	0.80	2.25	2.25	10.00	104.2		234.0	**234.0**	CONC	600	0.25	7.5	320.3	1.10	0.11	73.1%
													0.00		0.00	0.00	10.00			0.0									
667	379	377									0.35		0.35	0.70	0.68	13.34	14.59	84.9		1132.9	**1132.9**	CONC	1050	0.25	55.3	1424.4	1.59	0.58	79.5%
													0.00		0.00	0.00	14.59			0.0									
625, 638, 630	423	377									0.17	0.18	0.35	0.65	0.63	0.63	15.17	83.0		52.4	**52.4**	PVC	300	1.00	40.0	100.9	1.38	0.48	51.9%
													0.00		0.00	0.00	15.17			0.0									
673	377	375									0.28		0.28	0.70	0.54	14.52	15.65	81.5		1183.4	**1183.4**	CONC	1200	0.17	80.1	1677.0	1.44	0.93	70.6%
													0.00		0.00	0.00	15.65			0.0									
674, 629	375	373									0.30	0.16	0.46	0.67	0.85	15.37	16.58	78.8		1210.7	**1210.7**	CONC	1200	0.18	110.5	1725.6	1.48	1.25	70.2%
													0.00		0.00	0.00	16.58			0.0									
624	373A	373		1.18									1.18	0.80	2.62	2.62	10.00	104.2		273.4	**273.4**	CONC	600	0.25	7.5	320.3	1.10	0.11	85.4%
													0.00		0.00	0.00	10.00			0.0									
723, 628	373	363									0.31	0.06	0.37	0.68	0.70	18.70	17.83	75.4		1410.0	**1410.0**	CONC	1350	0.20	58.9	2490.2	1.69	0.58	56.6%
													0.00		0.00	0.00	17.83			0.0									
108	363	361							0.21				0.21	0.65	0.38	6.14	18.96	72.6		445.8	**1723.3**	CONC	1350	1.74	78.6	7344.9	4.97	0.26	23.5%
													0.00		0.00	15.03	18.96		85.0	1277.5									
109a	361	341							0.33				0.33	0.65	0.60	6.73	19.22	72.0		485.0	**1751.5**	CONC	1350	1.74	81.1	7344.9	4.97	0.27	23.8%
													0.00		0.00	15.03	19.22		84.3	1266.6									
708	309	417							0.25				0.25	0.65	0.45	0.45	10.00	104.2		47.1	**47.1**	PVC	300	0.65	47.6	81.3	1.11	0.71	57.9%
													0.00		0.00	0.00	10.00			0.0									
700, 699, 663	421	357							0.18	0.61			0.79	0.57	1.26	1.26	10.00	104.2		131.1	**131.1**	PVC	450	0.35	42.8	176.0	1.07	0.67	74.5%
													0.00		0.00	0.00	10.00			0.0									
664	359	357							0.45				0.45	0.65	0.81	0.81	10.00	104.2		84.7	**84.7**	PVC	375	0.50	99.9	129.3	1.13	1.47	65.5%
													0.00		0.00	0.00	10.00			0.0									
704, 668	357	417							0.22	0.50			0.72	0.58	1.16	3.23	11.47	97.0		313.7	**313.7**	CONC	525	2.39	81.2	693.6	3.10	0.44	45.2%
													0.00		0.00	0.00	11.47			0.0									
	417	351											0.00	0.00	0.00	3.68	11.90	95.1		350.5	**350.5**	CONC	675	0.60	32.8	679.3	1.84	0.30	51.6%
													0.00		0.00	0.00	11.90			0.0									

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Engineers, Planners & Landscape Architects

Fernbank Crossing (Phase 3)- Storm Sewer Design Sheet (Traditional Rational Method)

LOCATION			AREA												FLOW							PROPOSED SEWER							
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area	Weighted Runoff Coefficient	Indivi 2.78 AR	Accum 2.78 AR	Time of Concentration	Rain Intensity (mm/hr) 5yr	Rain Intensity (mm/hr) 10yr	Peak Flow	Total Peak Flow (Q)	Pipe	Size	Grade	Length	Capacity	Full Flow Velocity	Time of Flow	Q/Qfull
			0.80	0.80	0.90	0.60	0.40	0.20	0.65	0.55	0.70	0.60	(ha)							(L/s)	(L/s)	Type	(mm)	(%)	(m)	(l/s)	(m/s)	(min.)	(%)
	353	399											0.00	0.00	0.00	0.00	10.00			0.0	0.0	PVC	300	1.00	64.0	100.9	1.38	0.77	0.0%
													0.00		0.00	0.00	10.00			0.0									
670	399	351							0.70				0.70	0.65	1.26	1.26	10.77	100.3		126.9	126.9	PVC	450	1.00	80.5	297.4	1.81	0.74	42.6%
													0.00		0.00	0.00	10.77			0.0									
671, 672	351	347							0.22	0.42			0.64	0.58	1.04	5.99	12.20	93.8		562.1	562.1	CONC	750	0.38	81.1	715.9	1.57	0.86	78.5%
													0.00		0.00	0.00	12.20			0.0									
	349	397											0.00	0.00	0.00	0.00	10.00			0.0	0.0	PVC	300	1.50	34.8	123.6	1.69	0.34	0.0%
													0.00		0.00	0.00	10.00			0.0									
675,717	397	347							0.66				0.66	0.65	1.19	1.19	10.34	102.4		122.1	122.1	PVC	450	0.52	108.5	214.5	1.31	1.38	56.9%
													0.00		0.00	0.00	10.34			0.0									
713, 719, 716, 718	347	395							0.21	0.69			0.90	0.57	1.43	8.62	13.06	90.4		778.9	778.9	CONC	900	0.34	74.2	1101.2	1.68	0.74	70.7%
													0.00		0.00	0.00	13.06			0.0									
	395	343											0.00	0.00	0.00	8.62	13.80	87.6		755.2	755.2	CONC	900	0.50	9.4	1335.4	2.03	0.08	56.6%
													0.00		0.00	0.00	13.80			0.0									
	345	393											0.00	0.00	0.00	0.00	10.00			0.0	0.0	PVC	300	0.65	26.9	81.3	1.11	0.40	0.0%
													0.00		0.00	0.00	10.00			0.0									
720,721	393	343							0.82				0.82	0.65	1.48	1.48	10.40	102.1		151.3	151.3	PVC	450	0.60	109.7	230.4	1.40	1.30	65.7%
													0.00		0.00	0.00	10.40			0.0									
	343	391											0.00	0.00	0.00	10.10	13.88	87.4		882.3	882.3	CONC	900	0.37	38.3	1148.8	1.75	0.36	76.8%
													0.00		0.00	0.00	13.88			0.0									
109b,722	391	341								0.67			0.67	0.55	1.02	11.12	14.24	86.1		957.6	957.6	CONC	900	0.40	48.2	1194.4	1.82	0.44	80.2%
													0.00		0.00	0.00	14.24			0.0									
110	341A	341				2.12							2.12	0.60	3.54	3.54	10.00	104.2		368.4	368.4	CONC	675	0.25	12.5	438.5	1.19	0.18	84.0%
													0.00		0.00	0.00	10.00			0.0									
728, 729	341	339							0.28				0.28	0.65	0.51	21.90	19.49	71.4		1563.3	2818.8	CONC	1650	0.40	67.8	6013.7	2.72	0.41	46.9%
													0.00		0.00	15.03	19.49		83.5	1255.5									

Q = 2.78 AIR WHERE : Q = PEAK FLOW IN LITRES PER SECOND (L/s)
A = AREA IN HECTARES (ha)
I = RAINFALL INTENSITY IN MILLIMETERS PER HOUR (mm/hr)
R = WEIGHTED RUNOFF COEFFICIENT

Q = (1/n) A R(2/3)So(1/2) WHERE : Q = CAPACITY (L/s)
n = MANNING COEFFICIENT OF ROUGHNESS (0.013)
A = FLOW AREA (m2)

Project: Fernbank Crossing (108180-15)
Designed: LRW
Checked: MAB
Date: July 13 2015

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2015.07.13
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Engineers, Planners & Landscape Architects

Fernbank Crossing - Storm Sewer Design Sheet (Fixed Tc)

LOCATION			AREA														FLOW									PROPOSED SEWER							
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area (10 min)	Total Area (15 min)	Weighted Runoff Coefficient	Weighted Runoff Coefficient	2.78 AR	2.78 AR	Rain Intensity (mm/hr) 5yr		10yr		Peak Flow (10 min)	Peak Flow (15 min)	Total Peak Flow (Q)	Pipe	Size	Grade	Length	Capacity	Full Flow Velocity	Time of Flow	Q/Qfull
			0.80	0.80	0.90	0.60	0.40	0.20	0.65	0.55	0.70	0.60	(ha)	(ha)	(10 min)	(15 min)	(10 min)	(15 min)	(10 min)	(15 min)	(10 min)	(15 min)	(L/s)	(L/s)	(L/s)	Type	(mm)	(%)	(m)	(l/s)	(m/s)	(min.)	(%)
South Outlet																																	
107	FUT	363		5.15					3.90	1.36			9.05	1.36	0.74	0.55	18.50	2.08	104.19	83.56			1927.66	173.75	2101.4	CONC	1350	0.20	58.8	2490.2	1.69	0.58	84.4%
														0.00		0.00	0.00	0.00			122.14	97.85		0.00									
105	391	363							0.22				0.22	0.00	0.65	0.00	0.40	0.00	104.19	83.56			41.42	0.00	1847.2	CONC	1050	0.50	120.4	2014.4	2.25	0.89	91.7%
				0.82	5.18								6.00			0.89	14.78	0.00			122.14	97.85	1805.75	0.00									
101	371	369							0.42	0.09			0.42	0.09	0.65	0.55	0.76	0.14	104.19	83.56			79.08	11.50	90.6	PVC	375	0.65	53.5	147.5	1.29	0.69	61.4%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	369	367											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	90.6	CONC	450	0.20	50.9	133.0	0.81	1.05	68.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
102	367	365							0.35	0.18			0.35	0.18	0.65	0.55	0.63	0.28	104.19	83.56			65.90	23.00	179.5	CONC	600	0.15	59.8	248.1	0.85	1.17	72.3%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
103	365A	365		1.39									1.39	0.00	0.80	0.00	3.09	0.00	104.19	83.56			322.10	0.00	322.1	CONC	600	0.30	8.7	350.8	1.20	0.12	91.8%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
104	365	363							0.18	0.08			0.18	0.08	0.65	0.55	0.33	0.12	104.19	83.56			33.89	10.22	545.7	CONC	825	0.15	66.1	580.0	1.05	1.05	94.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
108	363	361							0.20				0.20	0.00	0.65	0.00	0.36	0.00	104.19	83.56			37.66	0.00	4531.9	CONC	1350	1.74	78.6	7344.9	4.97	0.26	61.7%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
109	361	341							0.34	0.36			0.34	0.36	0.65	0.55	0.61	0.55	104.19	83.56			64.01	45.99	4641.9	CONC	1350	1.74	81.1	7344.9	4.97	0.27	63.2%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
111	FUT	341							3.23	1.67			3.23	1.67	0.65	0.55	5.84	2.55	104.19	83.56			608.13	213.36	821.5	CONC	825	1.88	86.2	2053.3	3.72	0.39	40.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
110	341A	341				2.12							2.12	0.00	0.60	0.00	3.54	0.00	104.19	83.56			368.44	0.00	368.4	CONC	675	0.25	12.5	438.5	1.19	0.18	84.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
112	341	339							0.18				0.18	0.00	0.65	0.00	0.33	0.00	104.19	83.56			33.89	0.00	5865.8	CONC	1650	0.40	67.8	6013.7	2.72	0.41	97.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
113	339	337							0.11				0.11	0.00	0.65	0.00	0.20	0.00	104.19	83.56			20.71	0.00	5886.5	CONC	1800	0.25	45.2	5995.9	2.28	0.33	98.2%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
114	337	335							0.29				0.29	0.00	0.65	0.00	0.52	0.00	104.19	83.56			54.60	0.00	5941.1	CONC	1800	0.25	50.8	5995.9	2.28	0.37	99.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
115	335A	335				2.83							2.83	0.00	0.60	0.00	4.72	0.00	104.19	83.56			491.84	0.00	491.8	CONC	750	0.25	17.9	580.7	1.27	0.23	84.7%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
116	335	301							0.21				0.21	0.00	0.65	0.00	0.38	0.00	104.19	83.56			39.54	0.00	6472.4	CONC	1800	0.30	57.7	6568.2	2.50	0.38	98.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
117	FUT	301					1.20		5.13	1.57			5.13	2.77	0.65	0.49	9.27	3.73	104.19	83.56			965.86	312.08	1277.9	CONC	975	0.61	54.7	1826.0	2.37	0.38	70.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
118	301	**M97**									0.30		0.30	0.00	0.70	0.00	0.58	0.00	104.19	83.56			60.83	0.00	7811.2	CONC	1950	0.30	78.3	8131.0	2.64	0.49	96.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
119	M97	M98								0.94	0.40		0.40	0.94	0.70	0.55	0.78	1.44	104.19	83.56			81.10	120.09	8012.4	CONC	2100	0.20	78.0	8089.5	2.26	0.57	99.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	M98	**M99**											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	8012.4	CONC	2400	0.15	29.6	10002.3	2.14	0.23	80.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									

Q = 2.78 AIR WHERE : Q = PEAK FLOW IN LITRES PER SECOND (L/s)
A = AREA IN HECTARES (ha)
I = RAINFALL INTENSITY IN MILLIMETERS PER HOUR (mm/hr)
R = WEIGHTED RUNOFF COEFFICIENT

Q = (1/n) A R(2/3)So(1/2) WHERE : Q = CAPACITY (L/s)
n = MANNING COEFFICIENT OF ROUGHNESS (0.013)
A = FLOW AREA (m2)

Project: Fernbank Crossing (108180-10)
Designed: KJM
Checked: MAB
Date: August 17, 2012

This design sheet is included in support of the downstream boundary conditions for the SSA modelling.

M:\2008\108180\DATA\Calculations\STM\20120817-Storm Design Sheet

NOVATECH ENGINEERING CONSULTANTS LTD.

Fernbank Crossing - Storm Sewer Design Sheet (Fixed Tc)

LOCATION: Location	From node	To node	AREA: Mixed Use 0.80	Park N' Ride Paramedic Post Medium Block 0.80	Arterial Road ROW 0.90	Schools 0.60	Parks 0.40	Hydro Corridor 0.20	Singles Front Yards 0.65	Singles Rear Yard 0.55	Towns Front Yard 0.70	Towns Rear Yard 0.60	Total Area (10 min) (ha)	Total Area (15 min) (ha)	Weighted Runoff Coefficient (10 min)	Weighted Runoff Coefficient (15 min)	FLOW: 2.78 AR (10 min)	2.78 AR (15 min)	Rain Intensity (mm/hr) 5yr (10 min)	5yr (15 min)	10yr (10 min)	10yr (15 min)	Peak Flow (10 min) (L/s)	Peak Flow (15 min) (L/s)	Total Peak Flow (Q) (L/s)	PROPOSED SEWER: Pipe Type	Size (mm)	Grade (%)	Length (m)	Capacity (l/s)	Full Flow Velocity (m/s)	Time of Flow (min.)	Q/Qfull (%)
North Outlet																			10.00	15.00	10.00	15.00											
CRT	CRT	287						2.91					0.00	13.95		0.38	0.00	14.54	104.2	83.6			0.0	1215.2	**1215.2**	PVC							
														0.00			0.00	0.00			122.1	97.85		0.0									
1	287	285											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56				0.00	**2257.9**	CONC	1200	0.35	76.7	2406.2	2.06	0.62	93.8%
				0.34	3.11								3.45	0.00	0.89	0.00	8.54	0.00	104.19		122.14	97.85	1042.77	0.00									
	285	283											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	**2257.9**	CONC	1200	0.35	76.7	2406.2	2.06	0.62	93.8%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
2	283	281		1.11									1.11	0.00	0.80	0.00	2.47	0.00	104.19	83.56			257.22	0.00	**2515.1**	CONC	1350	0.25	41.5	2784.1	1.88	0.37	90.3%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
3	281	275	2.00										2.00	0.00	0.80	0.00	4.45	0.00	104.19	83.56			463.45	0.00	**2978.6**	CONC	1350	0.30	11.0	3049.8	2.06	0.09	97.7%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
4	279	277									0.20		0.20	0.00	0.70	0.00	0.39	0.00	104.19	83.56			40.55	0.00	**40.6**	PVC	250	0.65	69.8	50.0	0.99	1.18	81.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
5	277	275									0.14		0.14	0.00	0.70	0.00	0.27	0.00	104.19	83.56			28.39	0.00	**68.9**	PVC	375	0.30	83.0	100.2	0.88	1.57	68.8%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
6	275	273									0.35		0.35	0.00	0.70	0.00	0.68	0.00	104.19	83.56			70.97	0.00	**3118.5**	CONC	1350	0.35	82.8	3294.2	2.23	0.62	94.7%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
7	273	271									0.36		0.36	0.00	0.70	0.00	0.70	0.00	104.19	83.56			72.99	0.00	**3191.5**	CONC	1350	0.35	80.5	3294.2	2.23	0.60	96.9%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
8	271A	271		0.85									0.85	0.00	0.80	0.00	1.89	0.00	104.19	83.56			196.97	0.00	**197.0**	CONC	525	0.25	8.5	224.3	1.00	0.14	87.8%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
9,10	271	**M40**									0.50		0.50	0.00	0.70	0.00	0.97	0.00	104.19	83.56			101.38	0.00	**3489.8**	CONC	1350	0.40	82.6	3521.6	2.38	0.58	99.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
11	269A	**M40**						2.91					0.00	2.91	0.00	0.20	0.00	1.62	104.19	83.56			0.00	135.19	**135.2**	CONC	450	0.25	54.5	148.7	0.91	1.00	90.9%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
13	267	265							0.30				0.30	0.00	0.65	0.00	0.54	0.00	104.19	83.56			56.48	0.00	**56.5**	PVC	300	0.65	86.6	81.3	1.11	1.29	69.4%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
14	265	**M41**							0.78	0.40			0.78	0.40	0.65	0.55	1.41	0.61	104.19	83.56			146.86	51.10	**254.4**	CONC	525	0.50	115.4	317.2	1.42	1.35	80.2%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
16	261	259								0.15			0.00	0.15	0.00	0.55	0.00	0.23	104.19	83.56			0.00	19.16	**19.2**	PVC	250	0.65	34.9	50.0	0.99	0.59	38.3%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	259	257											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	**19.2**	PVC	250	0.65	10.4	50.0	0.99	0.18	38.3%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
17	257	253							0.79				0.79	0.00	0.65	0.00	1.43	0.00	104.19	83.56			148.74	0.00	**167.9**	CONC	525	0.30	115.2	245.7	1.10	1.75	68.3%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
18	255	253							0.19	0.15			0.19	0.15	0.65	0.55	0.34	0.23	104.19	83.56			35.77	19.16	**54.9**	PVC	300	0.65	45.3	81.3	1.11	0.68	67.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
19	253	251							0.21	0.38			0.21	0.38	0.65	0.55	0.38	0.58	104.19	83.56			39.54	48.55	**310.9**	CONC	600	0.30	80.5	350.8	1.20	1.12	88.6%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
20	251	**M42**							0.61				0.61	0.00	0.65	0.00	1.10	0.00	104.19	83.56			114.85	0.00	**425.8**	CONC	600	0.50	77.2	452.9	1.55	0.83	94.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									

This design sheet is included in support of the downstream boundary conditions for the SSA modelling.

NOVATECH ENGINEERING CONSULTANTS LTD.

Fernbank Crossing - Storm Sewer Design Sheet (Fixed Tc)

LOCATION			AREA														FLOW								Total Peak Flow (Q)	PROPOSED SEWER							
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area (10 min)	Total Area (15 min)	Weighted Runoff Coefficient	Weighted Runoff Coefficient	2.78 AR	2.78 AR	Rain Intensity (mm/hr) 5yr		10yr		Peak Flow (10 min)	Peak Flow (15 min)		Pipe	Size	Grade	Length	Capacity	Full Flow Velocity	Time of Flow	Q/Qfull
			0.80	0.80	0.90	0.60	0.40	0.20	0.65	0.55	0.70	0.60	(ha)	(ha)	(10 min)	(15 min)	(10 min)	(15 min)	(10 min)	(15 min)	(10 min)	(15 min)	(L/s)	(L/s)	(L/s)	Type	(mm)	(%)	(m)	(l/s)	(m/s)	(min.)	(%)
21	245	243								0.32			0.00	0.32	0.00	0.55	0.00	0.49	104.19	83.56			0.00	40.88	**40.9**	PVC	250	0.65	66.9	50.0	0.99	1.13	81.7%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	243	241							0.35				0.35	0.00	0.65	0.00	0.63	0.00	104.19	83.56			65.90	0.00	**106.8**	PVC	375	0.65	12.9	147.5	1.29	0.17	72.4%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
22	241	**M44**							0.30	0.30			0.30	0.30	0.65	0.55	0.54	0.46	104.19	83.56			56.48	38.33	**201.6**	CONC	450	1.00	67.3	297.4	1.81	0.62	67.8%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
24	233A	233	3.32										3.32	0.00	0.80	0.00	7.38	0.00	104.19	83.56			769.33	0.00	**769.3**	CONC	825	0.45	8.5	1004.6	1.82	0.08	76.6%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
25	233	231									0.35		0.35	0.00	0.70	0.00	0.68	0.00	104.19	83.56			70.97	0.00	**840.3**	CONC	825	0.45	114.0	1004.6	1.82	1.04	83.6%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
26	231	229									0.24		0.24	0.00	0.70	0.00	0.47	0.00	104.19	83.56			48.66	0.00	**889.0**	CONC	825	0.50	82.0	1058.9	1.92	0.71	84.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
27	237A	237	1.58										1.58	0.00	0.80	0.00	3.51	0.00	104.19	83.56			366.13	0.00	**366.1**	CONC	600	0.50	9.0	452.9	1.55	0.10	80.8%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
28	237	235									0.15		0.15	0.00	0.70	0.00	0.29	0.00	104.19	83.56			30.41	0.00	**396.5**	CONC	600	1.40	49.0	757.9	2.60	0.31	52.3%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
29	235	229							0.37				0.37	0.00	0.65	0.00	0.67	0.00	104.19	83.56			69.66	0.00	**466.2**	CONC	600	1.85	88.1	871.3	2.99	0.49	53.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
30	229	227							0.57				0.57	0.00	0.65	0.00	1.03	0.00	104.19	83.56			107.32	0.00	**1462.5**	CONC	975	0.50	117.4	1653.2	2.15	0.91	88.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
31	227	**M45**							0.73	0.47			0.73	0.47	0.65	0.55	1.32	0.72	104.19	83.56			137.44	60.05	**1660.0**	CONC	975	0.65	120.0	1884.9	2.45	0.82	88.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	223	221											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	**0.0**	PVC	250	0.65	57.1	50.0	0.99	0.96	0.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	221	219											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	**0.0**	PVC	250	0.65	8.6	50.0	0.99	0.15	0.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
33	219	217							0.41	0.50			0.41	0.50	0.65	0.55	0.74	0.76	104.19	83.56			77.19	63.88	**141.1**	PVC	375	1.00	76.8	182.9	1.60	0.80	77.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
34	217	213							0.48				0.48	0.00	0.65	0.00	0.87	0.00	104.19	83.56			90.37	0.00	**231.4**	CONC	450	1.00	71.7	297.4	1.81	0.66	77.8%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
35	215	213								0.41			0.00	0.41	0.00	0.55	0.00	0.63	104.19	83.56			0.00	52.38	**52.4**	PVC	300	0.65	42.6	81.3	1.11	0.64	64.4%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
36	213	211							0.25	0.14			0.25	0.14	0.65	0.55	0.45	0.21	104.19	83.56			47.07	17.89	**348.8**	CONC	600	0.50	64.9	452.9	1.55	0.70	77.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
37	211	209							0.25	0.30			0.25	0.30	0.65	0.55	0.45	0.46	104.19	83.56			47.07	38.33	**434.2**	CONC	675	0.30	78.4	480.3	1.30	1.00	90.4%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	209	207											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	**434.2**	CONC	675	0.30	8.7	480.3	1.30	0.11	90.4%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
38	207	205							0.41	0.21			0.41	0.21	0.65	0.55	0.74	0.32	104.19	83.56			77.19	26.83	**538.2**	CONC	675	0.45	65.8	588.3	1.59	0.69	91.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	205	203											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	**538.2**	CONC	675	0.45	6.0	588.3	1.59	0.06	91.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	203	**M46**							0.21				0.21	0.00	0.65	0.00	0.38	0.00	104.19	83.56			39.54	0.00	**577.7**	CONC	750	0.25	66.3	580.7	1.27	0.87	99.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									

This design sheet is included in support of the downstream boundary conditions for the SSA modelling.

NOVATECH ENGINEERING CONSULTANTS LTD.

Fernbank Crossing - Storm Sewer Design Sheet (Fixed Tc)

LOCATION			AREA														FLOW									PROPOSED SEWER							
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area (10 min)	Total Area (15 min)	Weighted Runoff Coefficient	Weighted Runoff Coefficient	2.78 AR	2.78 AR	Rain Intensity (mm/hr) 5yr		10yr		Peak Flow (10 min)	Peak Flow (15 min)	Total Peak Flow (Q)	Pipe	Size	Grade	Length	Capacity	Full Flow Velocity	Time of Flow	Q/Qfull
			0.80	0.80	0.90	0.60	0.40	0.20	0.65	0.55	0.70	0.60	(ha)	(ha)	(10 min)	(15 min)	(10 min)	(15 min)	(10 min)	(15 min)	(10 min)	(15 min)	(L/s)	(L/s)	(L/s)	Type	(mm)	(%)	(m)	(l/s)	(m/s)	(min.)	(%)
South Outlet																																	
107	FUT	363		5.15					3.90	1.36			9.05	1.36	0.74	0.55	18.50	2.08	104.19	83.56			1927.66	173.75	**2101.4**	CONC	1350	0.20	58.8	2490.2	1.69	0.58	84.4%
														0.00		0.00	0.00	0.00			122.14	97.85		0.00									
105	391	363							0.22				0.22	0.00	0.65	0.00	0.40	0.00	104.19	83.56			41.42	0.00	**1847.2**	CONC	1050	0.50	120.4	2014.4	2.25	0.89	91.7%
				0.82	5.18								6.00			0.89	14.78	0.00			122.14	97.85	1805.75	0.00									
101	371	369							0.42	0.09			0.42	0.09	0.65	0.55	0.76	0.14	104.19	83.56			79.08	11.50	**90.6**	PVC	375	0.65	53.5	147.5	1.29	0.69	61.4%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	369	367											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	**90.6**	CONC	450	0.20	50.9	133.0	0.81	1.05	68.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
102	367	365							0.35	0.18			0.35	0.18	0.65	0.55	0.63	0.28	104.19	83.56			65.90	23.00	**179.5**	CONC	600	0.15	59.8	248.1	0.85	1.17	72.3%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
103	365A	365		1.39									1.39	0.00	0.80	0.00	3.09	0.00	104.19	83.56			322.10	0.00	**322.1**	CONC	600	0.30	8.7	350.8	1.20	0.12	91.8%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
104	365	363							0.18	0.08			0.18	0.08	0.65	0.55	0.33	0.12	104.19	83.56			33.89	10.22	**545.7**	CONC	825	0.15	66.1	580.0	1.05	1.05	94.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
108	363	361							0.20				0.20	0.00	0.65	0.00	0.36	0.00	104.19	83.56			37.66	0.00	**4531.9**	CONC	1350	1.74	78.6	7344.9	4.97	0.26	61.7%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
109	361	341							0.34	0.36			0.34	0.36	0.65	0.55	0.61	0.55	104.19	83.56			64.01	45.99	**4641.9**	CONC	1350	1.74	81.1	7344.9	4.97	0.27	63.2%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
111	FUT	341							3.23	1.67			3.23	1.67	0.65	0.55	5.84	2.55	104.19	83.56			608.13	213.36	**821.5**	CONC	825	1.88	86.2	2053.3	3.72	0.39	40.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
110	341A	341				2.12							2.12	0.00	0.60	0.00	3.54	0.00	104.19	83.56			368.44	0.00	**368.4**	CONC	675	0.25	12.5	438.5	1.19	0.18	84.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
112	341	339							0.18				0.18	0.00	0.65	0.00	0.33	0.00	104.19	83.56			33.89	0.00	**5865.8**	CONC	1650	0.40	67.8	6013.7	2.72	0.41	97.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
113	339	337							0.11				0.11	0.00	0.65	0.00	0.20	0.00	104.19	83.56			20.71	0.00	**5886.5**	CONC	1800	0.25	45.2	5995.9	2.28	0.33	98.2%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
114	337	335							0.29				0.29	0.00	0.65	0.00	0.52	0.00	104.19	83.56			54.60	0.00	**5941.1**	CONC	1800	0.25	50.8	5995.9	2.28	0.37	99.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
115	335A	335				2.83							2.83	0.00	0.60	0.00	4.72	0.00	104.19	83.56			491.84	0.00	**491.8**	CONC	750	0.25	17.9	580.7	1.27	0.23	84.7%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
116	335	301							0.21				0.21	0.00	0.65	0.00	0.38	0.00	104.19	83.56			39.54	0.00	**6472.4**	CONC	1800	0.30	57.7	6568.2	2.50	0.38	98.5%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
117	FUT	301					1.20		5.13	1.57			5.13	2.77	0.65	0.49	9.27	3.73	104.19	83.56			965.86	312.08	**1277.9**	CONC	975	0.61	54.7	1826.0	2.37	0.38	70.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
118	301	**M97**									0.30		0.30	0.00	0.70	0.00	0.58	0.00	104.19	83.56			60.83	0.00	**7811.2**	CONC	1950	0.30	78.3	8131.0	2.64	0.49	96.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
119	M97	M98								0.94	0.40		0.40	0.94	0.70	0.55	0.78	1.44	104.19	83.56			81.10	120.09	**8012.4**	CONC	2100	0.20	78.0	8089.5	2.26	0.57	99.0%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									
	M98	**M99**											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	**8012.4**	CONC	2400	0.15	29.6	10002.3	2.14	0.23	80.1%
														0.00		0.90	0.00	0.00			122.14	97.85		0.00									

Q = 2.78 AIR WHERE : Q = PEAK FLOW IN LITRES PER SECOND (L/s)
A = AREA IN HECTARES (ha)
I = RAINFALL INTENSITY IN MILLIMETERS PER HOUR (mm/hr)
R = WEIGHTED RUNOFF COEFFICIENT

Q = (1/n) A R(2/3)So(1/2) WHERE : Q = CAPACITY (L/s)
n = MANNING COEFFICIENT OF ROUGHNESS (0.013)
A = FLOW AREA (m2)

Project: Fernbank Crossing (108180-10)
Designed: KJM
Checked: MAB
Date: August 17, 2012

This design sheet is included in support of the downstream boundary conditions for the SSA modelling.

NOVATECH ENGINEERING CONSULTANTS LTD.

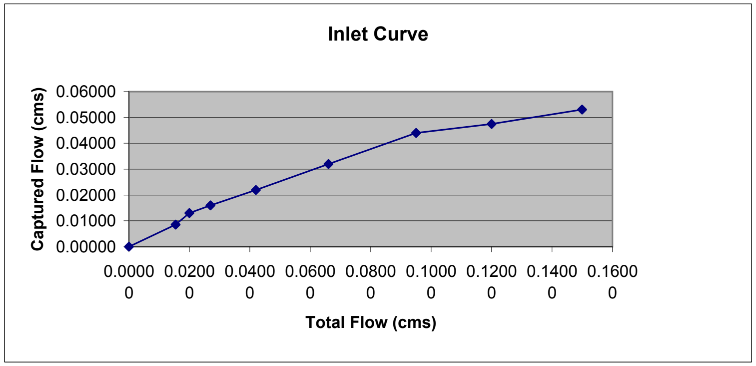
M:\2008\108180\DATA\Calculations\STM\20120817-Storm Design Sheet

Fernbank Crossings
Inlet Curves

Mountable Curb with Gutter
Gutter Grade= 0.008

Sx= 0.03		
T m	Qg m^3/s	Qc m^3/s
0.00	0	0
0.50	0.0155	0.0085
0.75	0.02	0.013
1.00	0.027	0.016
1.50	0.042	0.022
2.00	0.066	0.032
2.50	0.095	0.044
2.70	0.12	0.0475
3.00	0.15	0.053

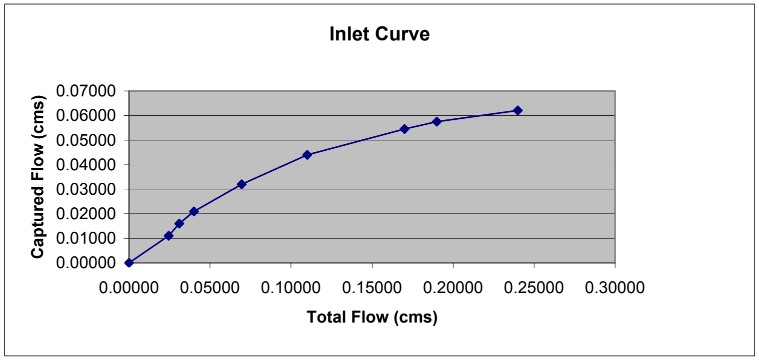
	Q Captured	Q Bypass	=	QTOTAL Total	
[	0.00000	0.00000	=	0.00000	]
[	0.00850	0.00700	=	0.01550	]
[	0.01300	0.00700	=	0.02000	]
[	0.01600	0.01100	=	0.02700	]
[	0.02200	0.02000	=	0.04200	]
[	0.03200	0.03400	=	0.06600	]
[	0.04400	0.05100	=	0.09500	]
[	0.04750	0.07250	=	0.12000	]
[	0.05300	0.09700	=	0.15000	]



Barrier Curb with Gutter
Gutter Grade= 0.03

Sx= 0.03		
T m	Qg m^3/s	Qc m^3/s
0.00	0	0
0.50	0.0245	0.011
0.75	0.031	0.016
1.00	0.04	0.021
1.50	0.0695	0.032
2.00	0.11	0.044
2.50	0.17	0.0545
2.70	0.19	0.0575
3.00	0.24	0.062

	QIDi Captured	QIDii Bypass	=	QTOTAL Total	
[	0.00000	0.00000	=	0.00000	]
[	0.01100	0.01350	=	0.02450	]
[	0.01600	0.01500	=	0.03100	]
[	0.02100	0.01900	=	0.04000	]
[	0.03200	0.03750	=	0.06950	]
[	0.04400	0.06600	=	0.11000	]
[	0.05450	0.11550	=	0.17000	]
[	0.05750	0.13250	=	0.19000	]
[	0.06200	0.17800	=	0.24000	]

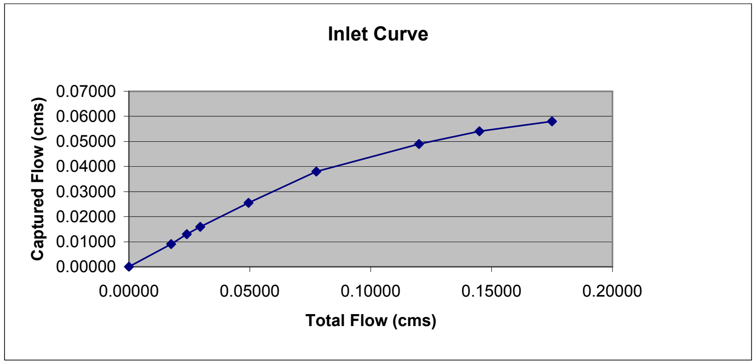


Fernbank Crossings
Inlet Curves

Barrier Curb with Gutter
Gutter Grade= 0.015

Sx=	0.03	
T m	Qg m^3/s	Qc m^3/s
0.00	0	0
0.50	0.0175	0.009
0.75	0.024	0.013
1.00	0.0295	0.016
1.50	0.0495	0.0255
2.00	0.0775	0.038
2.50	0.12	0.049
2.70	0.145	0.054
3.00	0.175	0.058

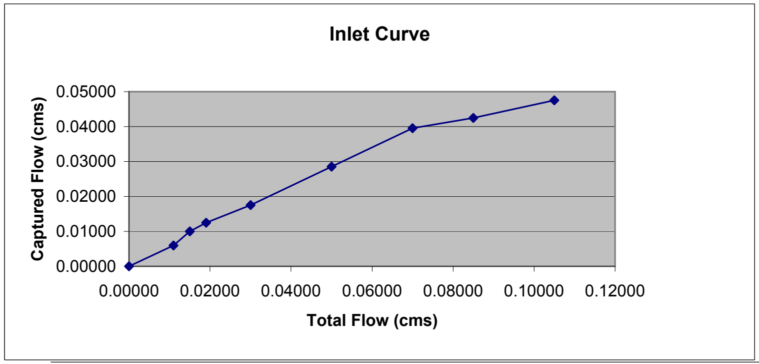
	QIDi Captured	QIDii Bypass	=	QTOTAL Total	
[	0.00000	0.00000	=	0.00000	]
[	0.00900	0.00850	=	0.01750	]
[	0.01300	0.01100	=	0.02400	]
[	0.01600	0.01350	=	0.02950	]
[	0.02550	0.02400	=	0.04950	]
[	0.03800	0.03950	=	0.07750	]
[	0.04900	0.07100	=	0.12000	]
[	0.05400	0.09100	=	0.14500	]
[	0.05800	0.11700	=	0.17500	]

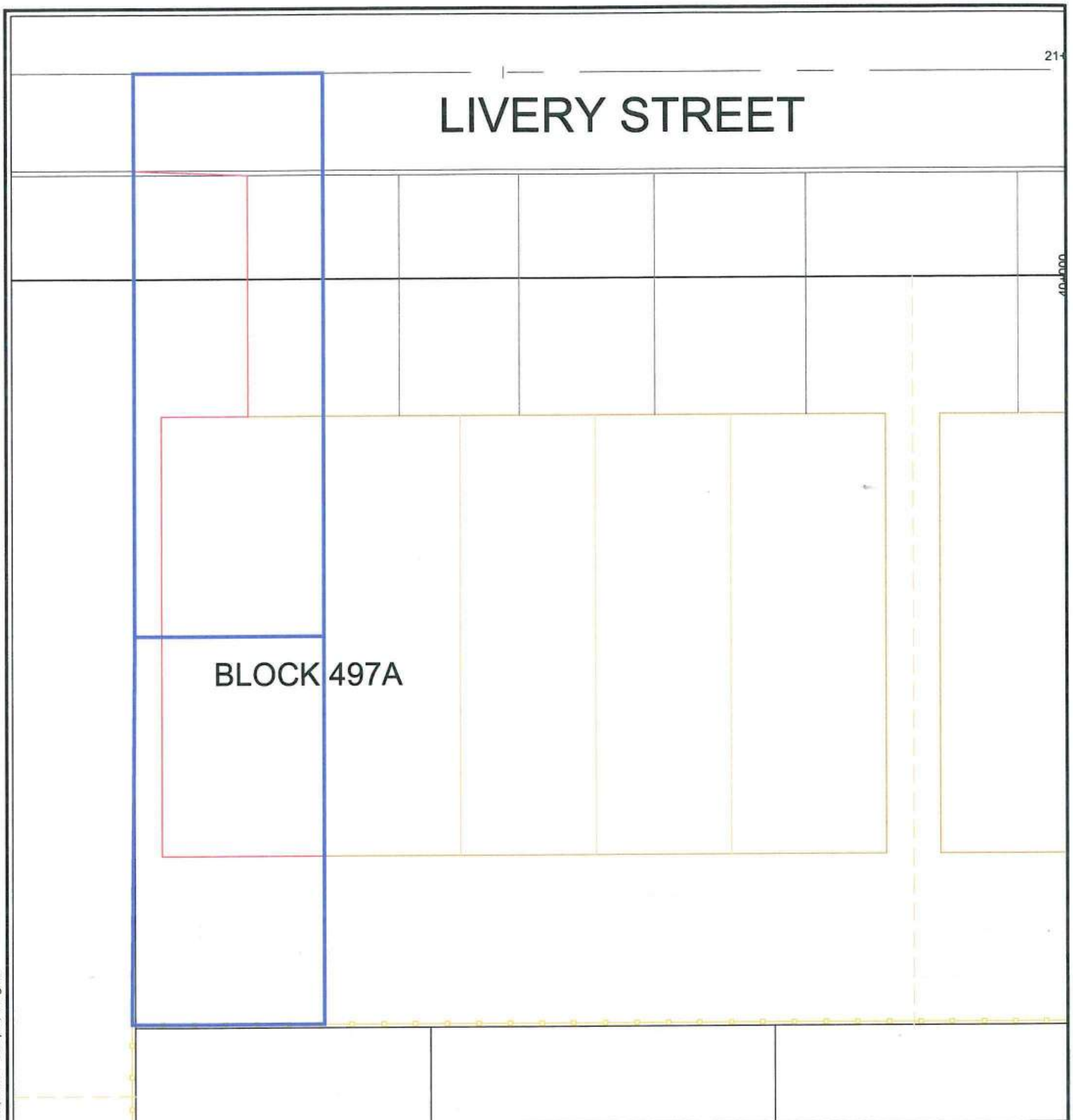


Barrier Curb with Gutter
Gutter Grade= 0.0065

Sx=	0.03	
T m	Qg m^3/s	Qc m^3/s
0.00	0	0
0.50	0.011	0.006
0.75	0.015	0.01
1.00	0.019	0.0125
1.50	0.03	0.0175
2.00	0.05	0.0285
2.50	0.07	0.0395
2.70	0.085	0.0425
3.00	0.105	0.0475

	QIDi Captured	QIDii Bypass	=	QTOTAL Total	
[	0.00000	0.00000	=	0.00000	]
[	0.00600	0.00500	=	0.01100	]
[	0.01000	0.00500	=	0.01500	]
[	0.01250	0.00650	=	0.01900	]
[	0.01750	0.01250	=	0.03000	]
[	0.02850	0.02150	=	0.05000	]
[	0.03950	0.03050	=	0.07000	]
[	0.04250	0.04250	=	0.08500	]
[	0.04750	0.05750	=	0.10500	]





FRONTYARD AREA = 207.151 m²
AREA OF IMPERVIOUSNESS = 141.718 m²
TOTAL IMPERVIOUSNESS = 68.4 %

REARYARD AREA = 144.070 m²
AREA OF IMPERVIOUSNESS = 69.418 m²
TOTAL IMPERVIOUSNESS = 48.2 %

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FERNBANK LANDS

EXAMPLE LOT 1 - TOWNS

JULY 2012	108180	TOWN 1

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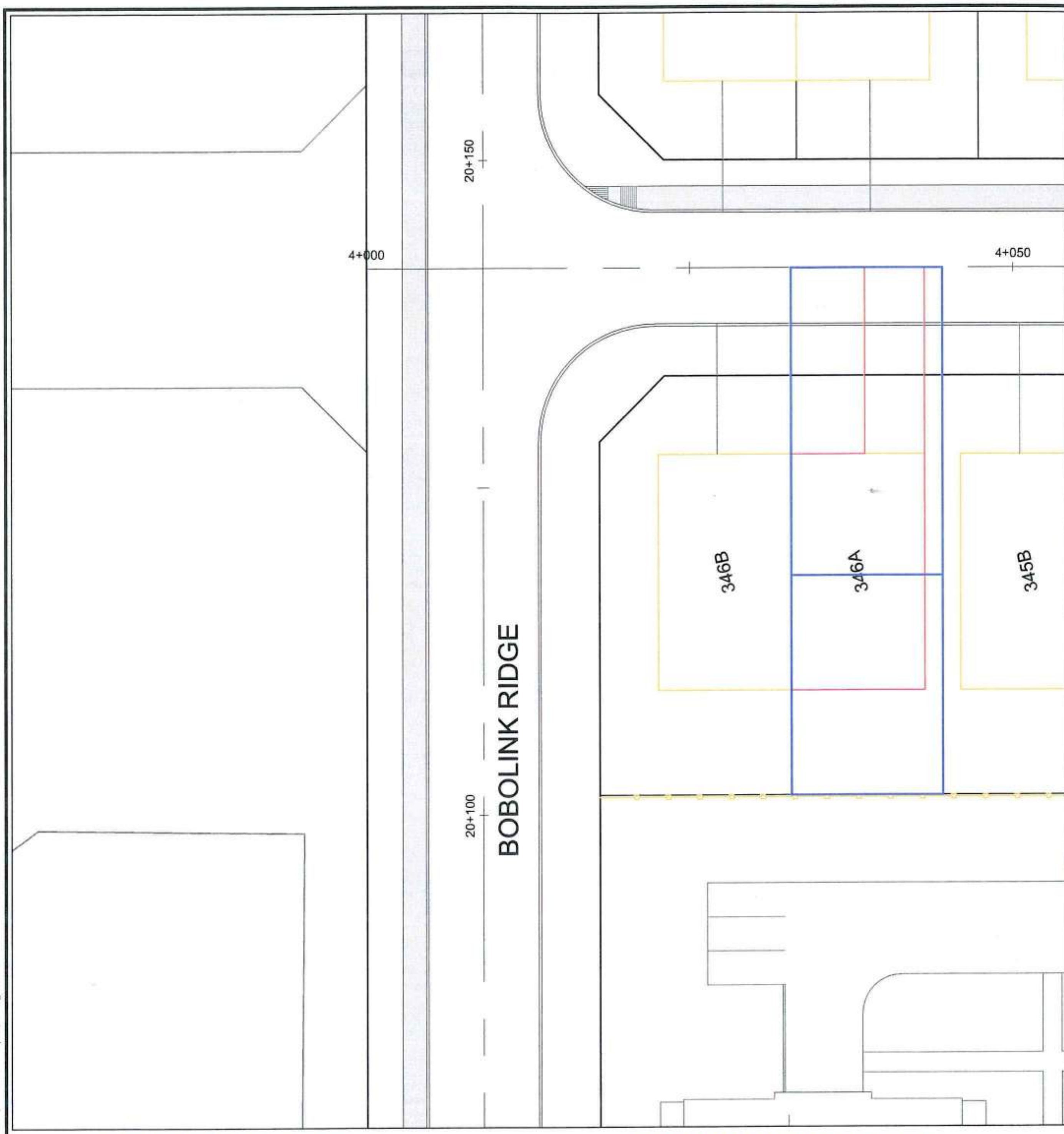

REARYARD AREA = 196.103 m²
AREA OF IMPERVIOUSNESS = 90.238 m²
TOTAL IMPERVIOUSNESS = 46.0 %

FRONTYARD AREA = 274.822 m²
AREA OF IMPERVIOUSNESS = 160.712 m²
TOTAL IMPERVIOUSNESS = 58.5 %

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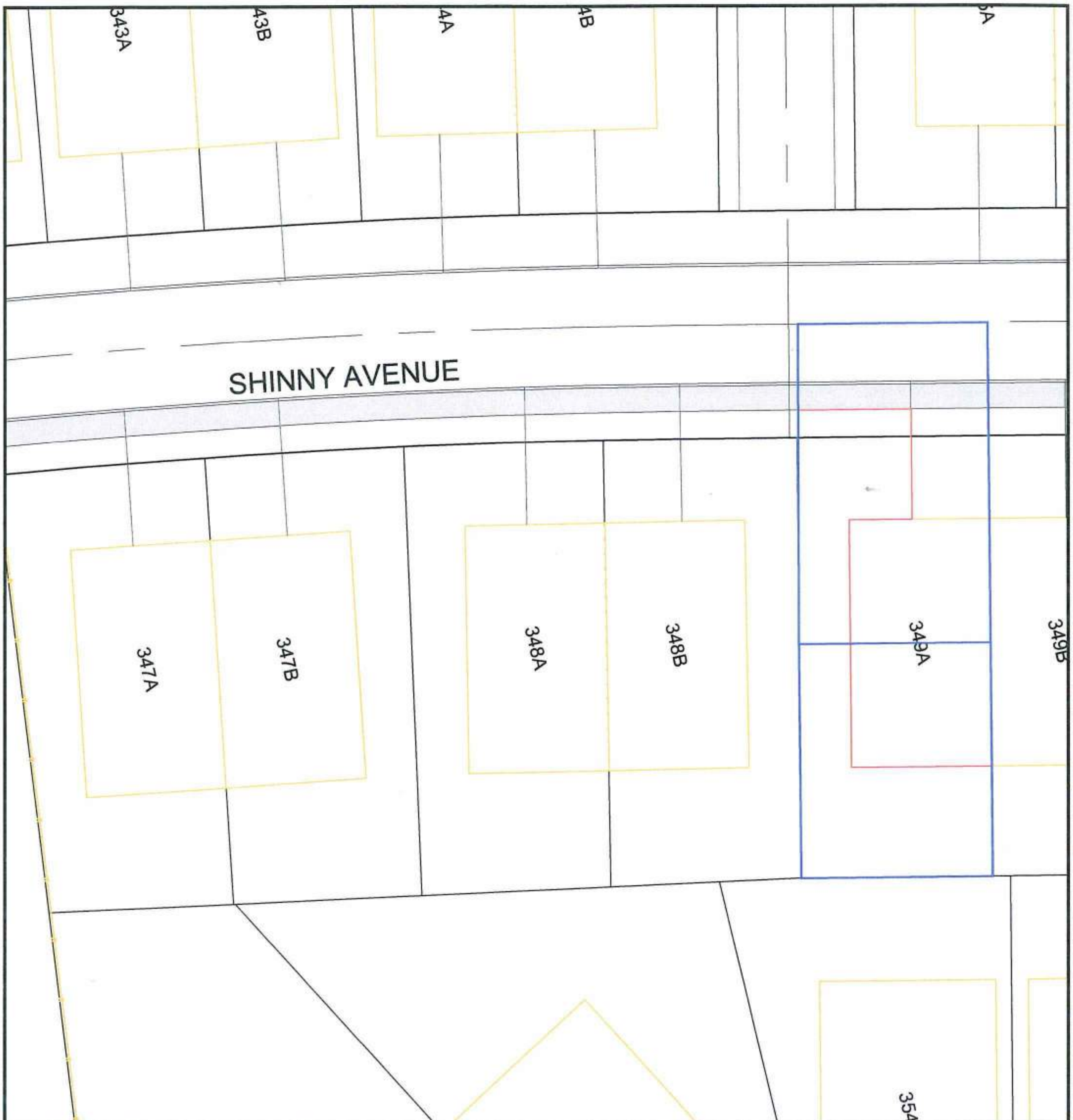
EXAMPLE LOT 2 - TOWNS

JULY 2012	108180	TOWN 2



REARYARD AREA = 238.850m²
AREA OF IMPERVIOUSNESS = 92.700 m²
TOTAL IMPERVIOUSNESS = 38.8 %

FRONTYARD AREA = 325.1 m²
AREA OF IMPERVIOUSNESS = 225.272 m²
TOTAL IMPERVIOUSNESS = 69.3 %

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FERNBANK LANDS

EXAMPLE LOT 3 - TOWNS

JULY 2012	108180	TOWN 3

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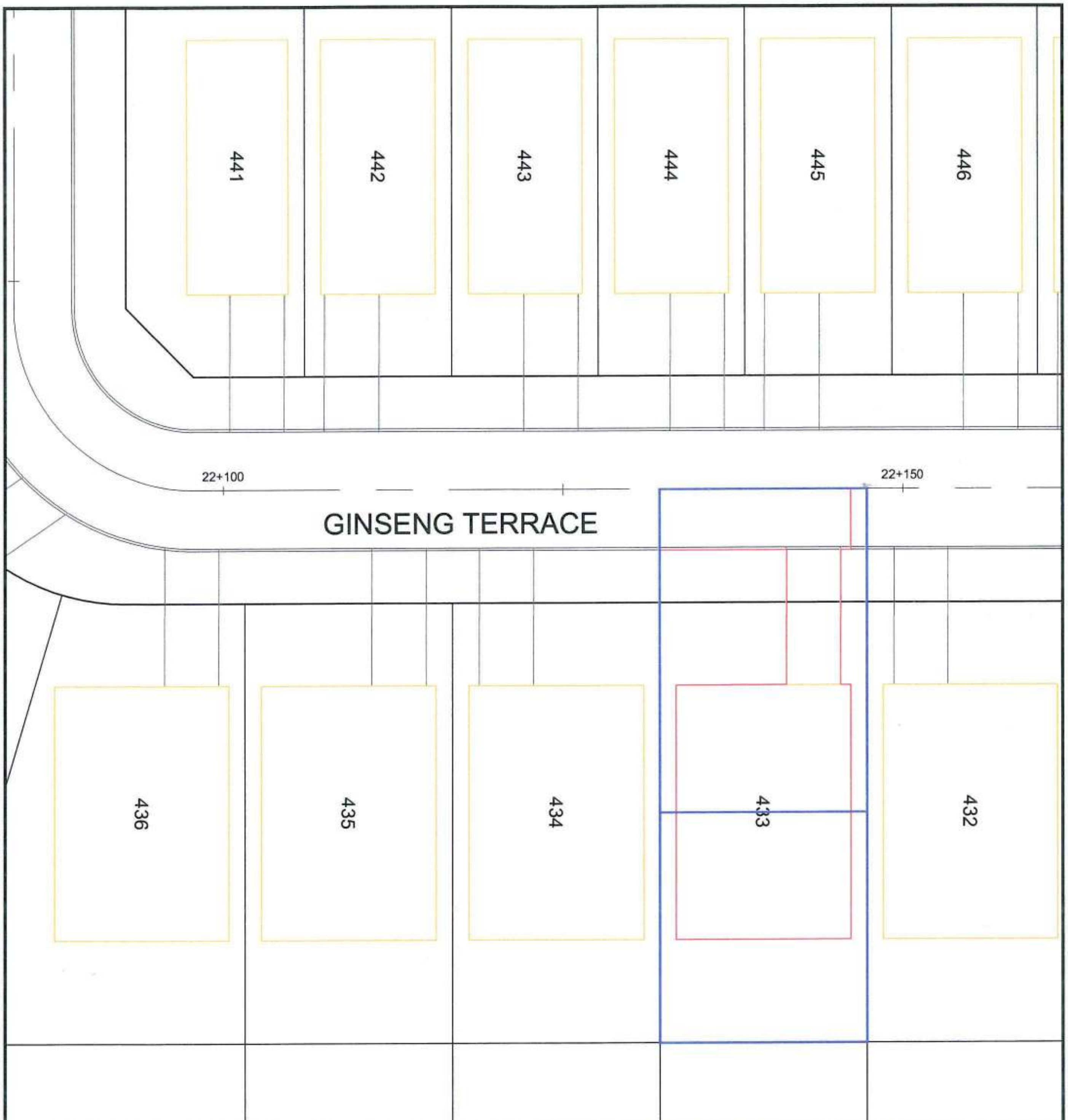

REARYARD AREA = 255.437 m²
AREA OF IMPERVIOUSNESS =118.863 m²
TOTAL IMPERVIOUSNESS = 46.6 %

FRONTYRARD AREA = 358.375 m²
AREA OF IMPERVIOUSNESS = 220.602 m²
TOTAL IMPERVIOUSNESS = 61.6 %

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FERNBANK LANDS

EXAMPLE LOT- SINGLE

JULY 2012	108180	SINGLE

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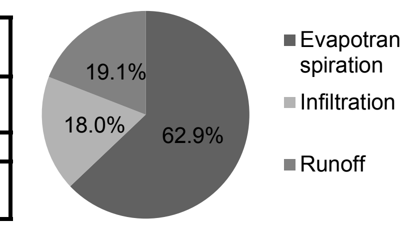
SHT8X11.DWG - 216mmX278mm

Water Balance Calculations: Stittsville South (Area 6) - Faulkner Drain Upstream Flewellyn Road

Pre-Development

Landuse	% of Watershed (Drainage Area)	Water Holding Capacity (HSG "C")	Land Cover (Infiltration Factor Classification)	Soils (Varied)	Topography (Rolling Land)	Infiltration Factor
Mature Forest	10.0%	400 mm	0.20	0.20	0.20	0.49
Pasture/Meadow	85.0%	250 mm	0.10	0.20	0.20	
Urban Lawns	0.0%	125 mm	0.10	0.20	0.20	**Runoff Factor**
Imp. Areas	5.0%	0 mm	0.00	0.00	0.00	0.52
Average		**253 mm**	**0.11**	**0.19**	**0.19**	

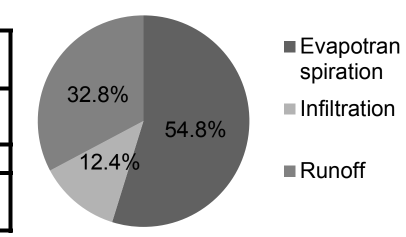


Ottawa CDA (6105976) 1971-2000

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Total Precipitation (mm)	**P**	64	52	65	68	81	91	89	88	87	79	77	74	**914**
Potential Evapotranspiration (mm)	**PE**	0	0	0	0	112	129	140	115	72	43	0	0	**610**
Total Precip. - Potential ET (mm)	P-PE	64	52	65	68	-31	-38	-51	-27	15	36	77	74	
Soil Moisture Storage (mm)	ST	253	253	253	253	224	192	157	141	156	192	253	253	
Change in Soil Moisture Storage (mm)	ΔST	0	0	0	0	-29	-31	-35	-16	15	36	61	0	
Deficit (mm)	D	0	0	0	0	2	7	16	11	0	0	0	0	**35**
Actual Evapotranspiration (mm)	**AE**	0	0	0	0	110	122	124	104	72	43	0	0	**575**
Water Surplus (mm)	**S**	64	52	65	68	0	0	0	0	0	0	16	74	**339**
Annual Infiltration (mm)	**I**													**164**
Annual Runoff (mm)	**R**													**175**

Post-Development

Landuse	% of Watershed	Water Holding Capacity (HSG "B")	Land Cover (Infiltration Factor Classification)	Soils (Varied)	Topography (Rolling Land)	Infiltration Factor
Mature Forest	0.0%	400 mm	0.20	0.20	0.20	0.28
Pasture/Meadow	0.0%	250 mm	0.10	0.20	0.20	
Urban Lawns	50.0%	75 mm	0.10	0.25	0.20	**Runoff Factor**
Imp. Areas	50.0%	0 mm	0.00	0.00	0.00	0.73
Average		**38 mm**	**0.05**	**0.13**	**0.10**	



Ottawa CDA (6105976) 1971-2000

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Total Precipitation (mm)	**P**	64	52	65	68	81	91	89	88	87	79	77	74	**914**
Potential Evapotranspiration (mm)	**PE**	0	0	0	0	112	129	140	115	72	43	0	0	**610**
Total Precip. - Potential Evap. (mm)	P-PE	64	52	65	68	-31	-38	-51	-27	15	36	77	74	
Soil Moisture Storage (mm)	ST	38	38	38	38	16	6	1	1	16	38	38	38	
Change in Soil Moisture Storage (mm)	ΔST	0	0	0	0	-21	-11	-4	-1	15	22	0	0	
Deficit (mm)	D	0	0	0	0	10	27	46	26	0	0	0	0	**109**
Actual Evapotranspiration (mm)	**AE**	0	0	0	0	102	102	93	88	72	43	0	0	**501**
Water Surplus (mm)	**S**	64	52	65	68	0	0	0	0	0	14	77	74	**413**
Annual Infiltration (mm)	**I**													**114**
Annual Runoff (mm)	**R**													**300**

Notes:
1) Uses measured average monthly total precipitation and potential evaporation data (converted to evapotranspiration based on a cover coefficient of 1.0).
2) Actual evapotranspiration and water surplus calculated using the Thornthwaite & Mather (1957) methodology.
3) Runoff and infiltration calculated as per the MOE SWM Planning and Design Manual (2003) methodology.
4) Impervious areas consist of rooftops, roads, and driveways.

Annual Summary

Scenario	Precipitation	Evapotranspiration		Water Surplus		Infiltration		Runoff	
Pre-Development	914 mm	575 mm	62.9%	339 mm	37.1%	164 mm	18.0%	175 mm	19.1%
Post-Development	914 mm	501 mm	54.8%	413 mm	45.2%	114 mm	12.4%	300 mm	32.8%
Difference (Post - Pre)	0 mm	-74 mm	-8.1%	74 mm	8.1%	-51 mm	-5.5%	125 mm	13.7%

Thornthwaite, C.W., and Mather, J.R. 1957. Instructions and tables for computing potential evapotranspiration and the water balance.
Centerton, N.J., Laboratory of Climatology, Publications in Climatology, v.10, no.3, p.185-311

Prepared by Novatech
Date: 10/03/2015

Appendix C

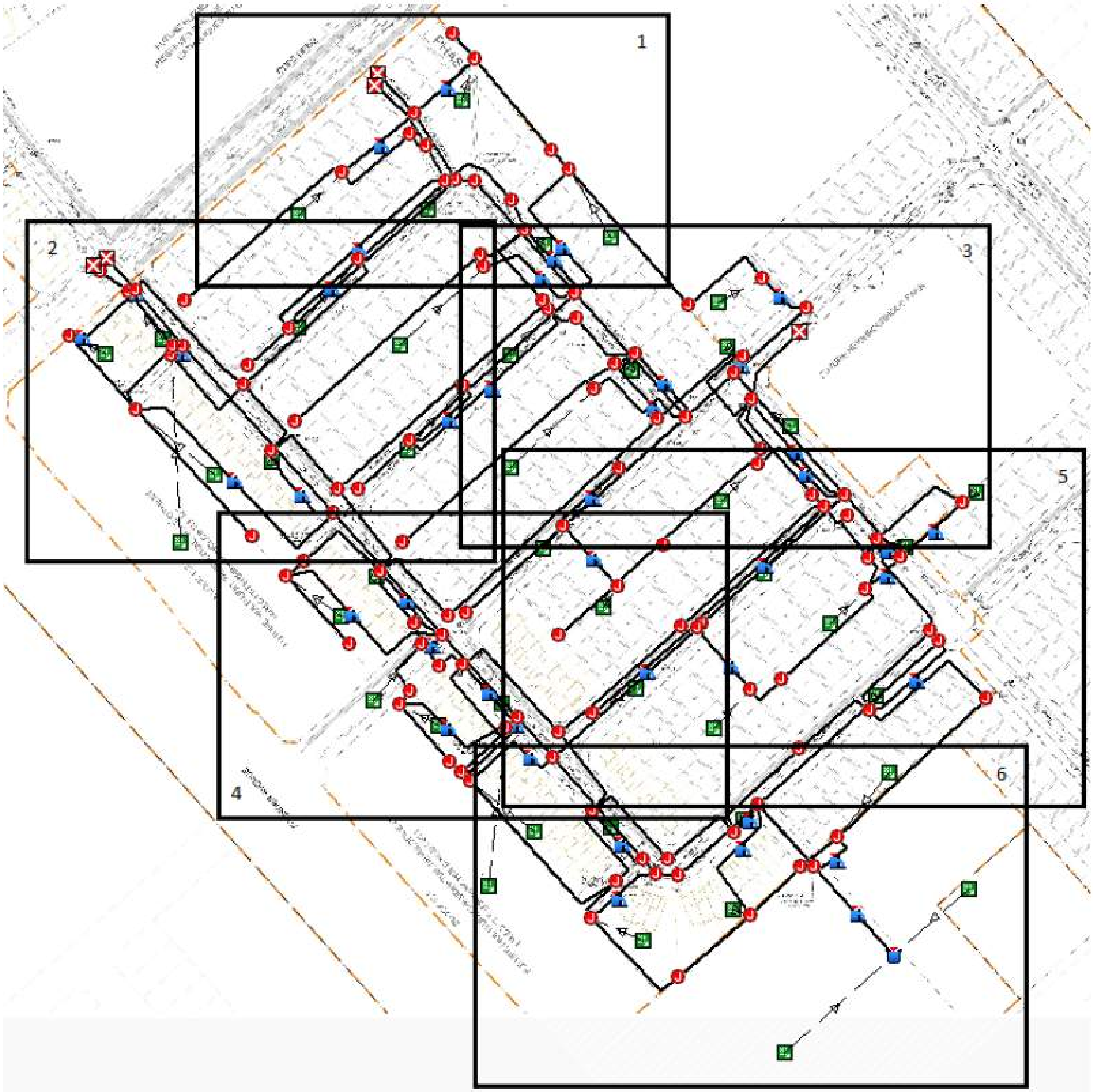
Autodesk Storm and Sanitary Analysis Model

Schematics:

Figure C-1: Overall Model Schematic
Figure C-2: Model Schematic 1
Figure C-3: Model Schematic 2
Figure C-4: Model Schematic 3
Figure C-5: Model Schematic 4
Figure C-6: Model Schematic 5
Figure C-7: Model Schematic 6

Model Results:

Chicago 100yr-4hr Design Storm Output Results



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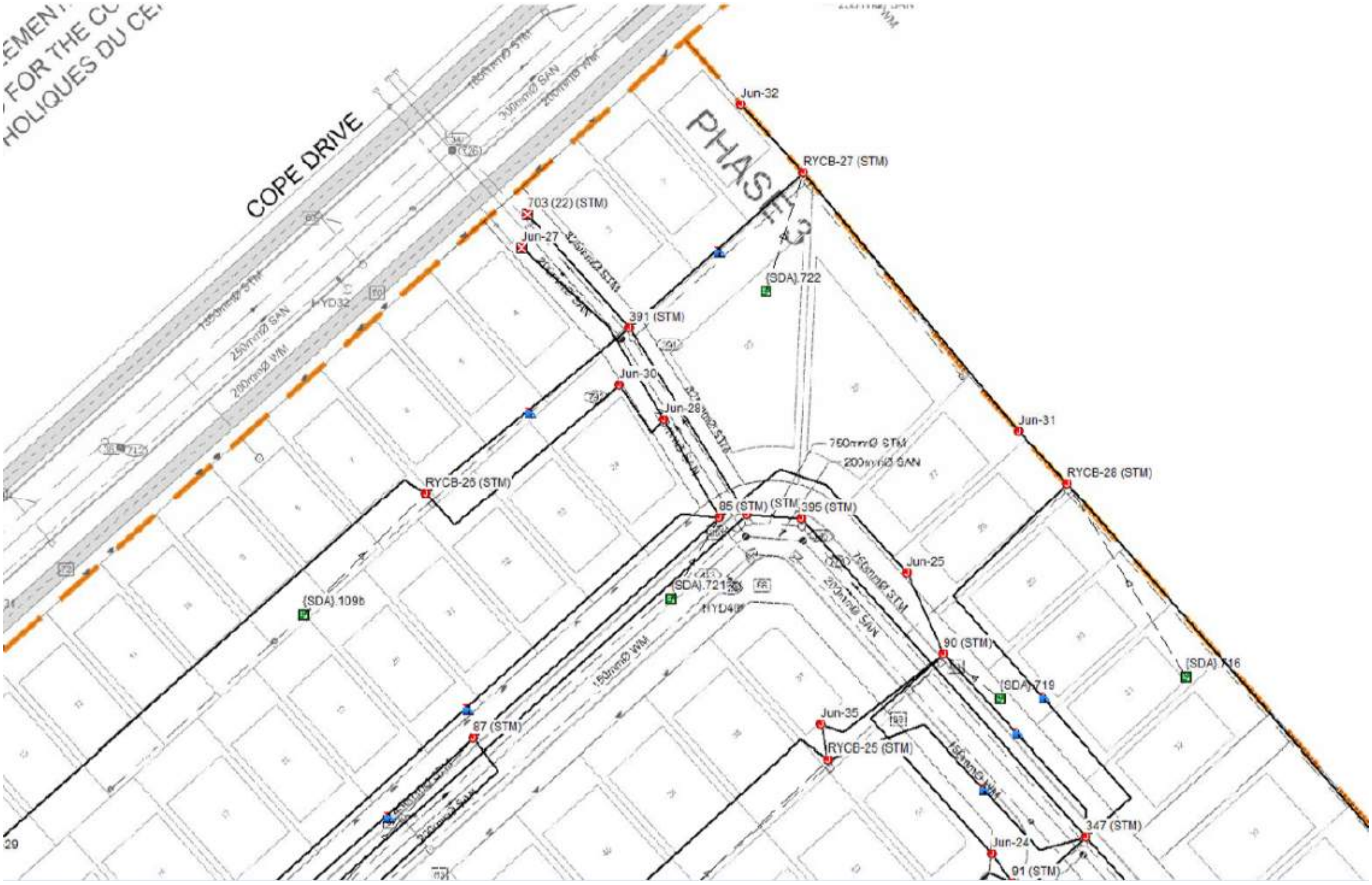
FERNBANK CROSSING
PHASE 3

MODEL SCHEMATIC
KEY PLAN

DEC 2014	108180	FIGURE C1



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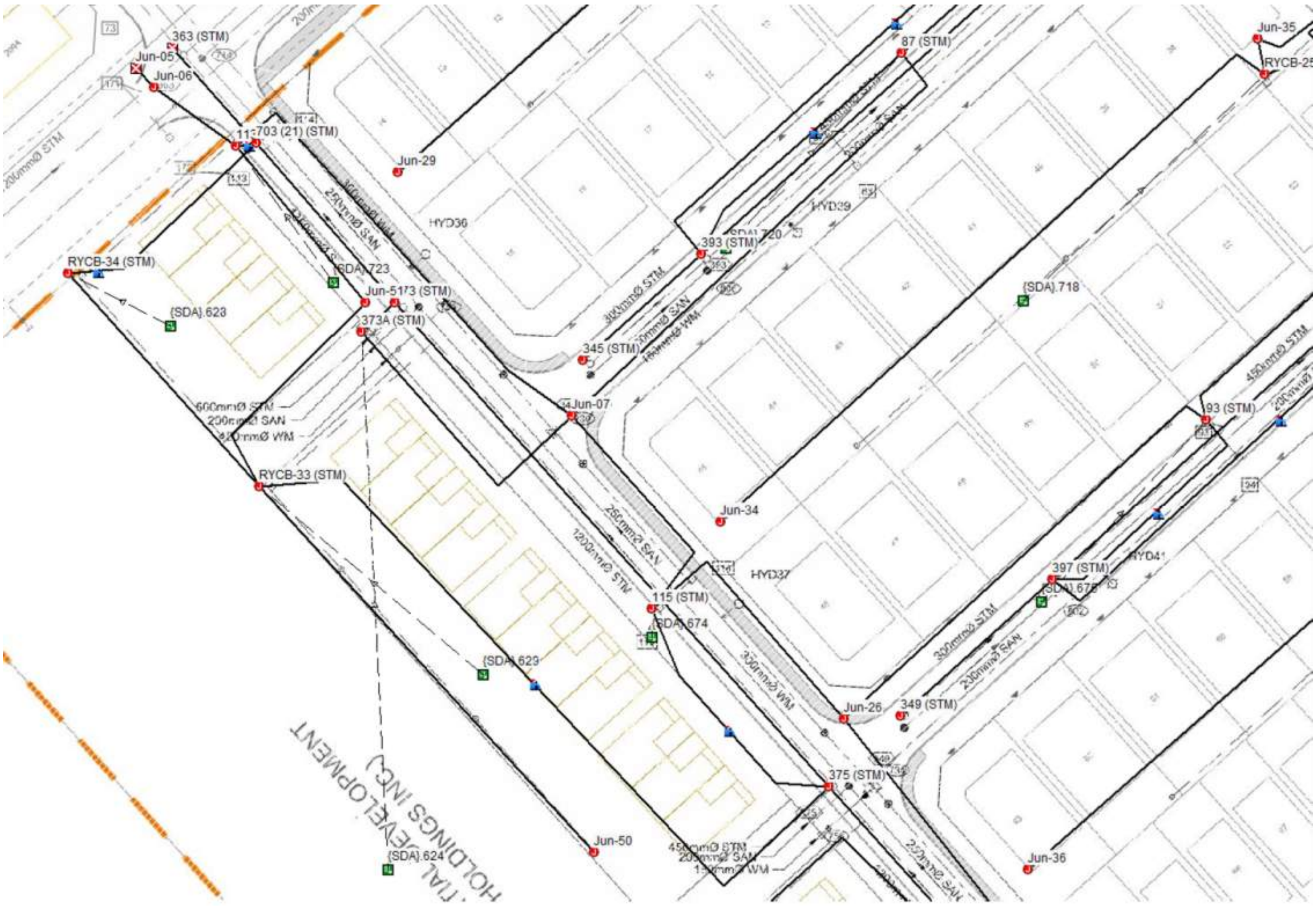
FERNBANK CROSSING
PHASE 3

MODEL SCHEMATIC
SHEET 1

DEC 2014	108180	FIGURE C2



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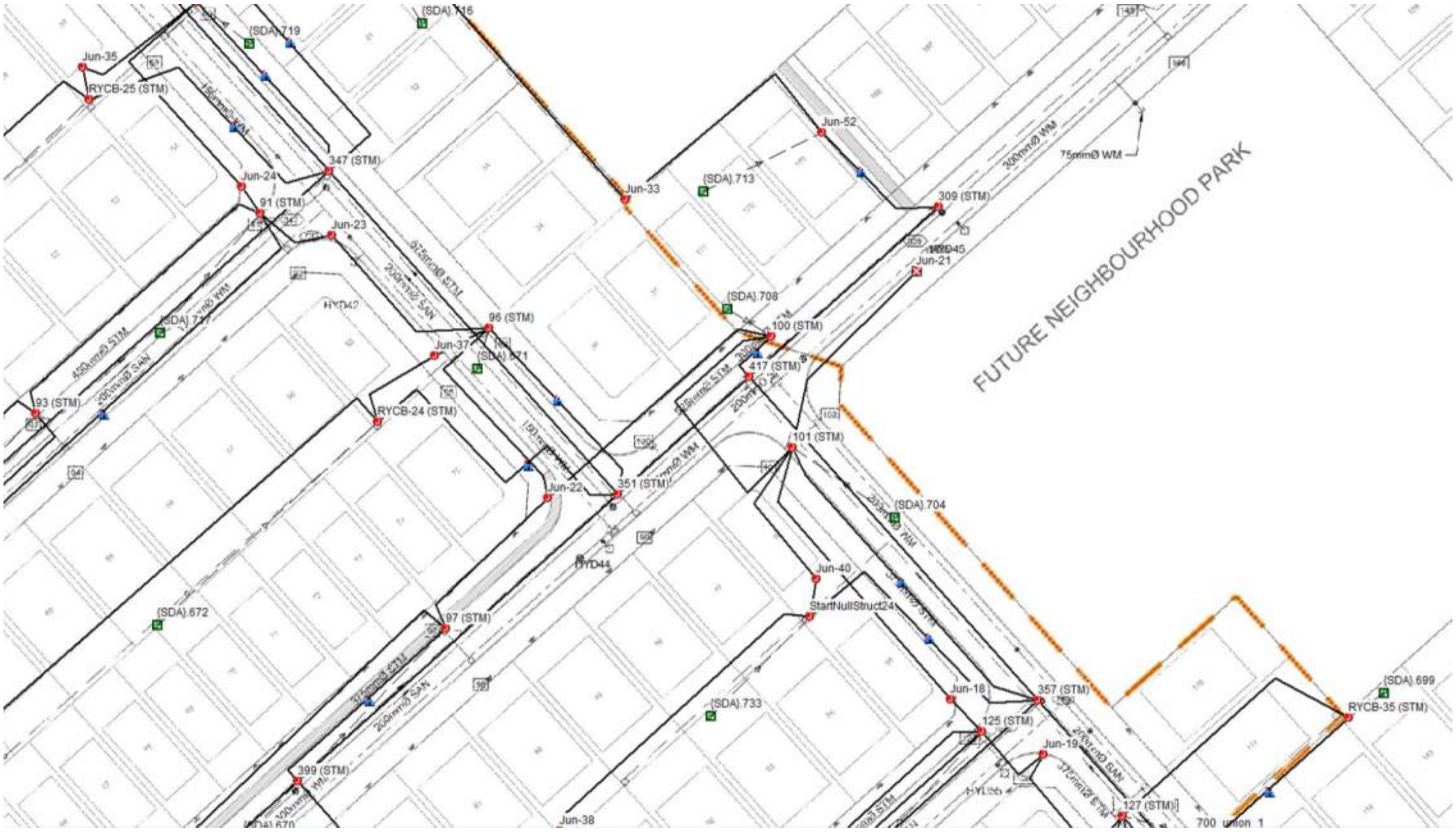
FERNBANK CROSSING
PHASE 3

MODEL SCHEMATIC
SHEET 2

DEC 2014	108180	FIGURE C3



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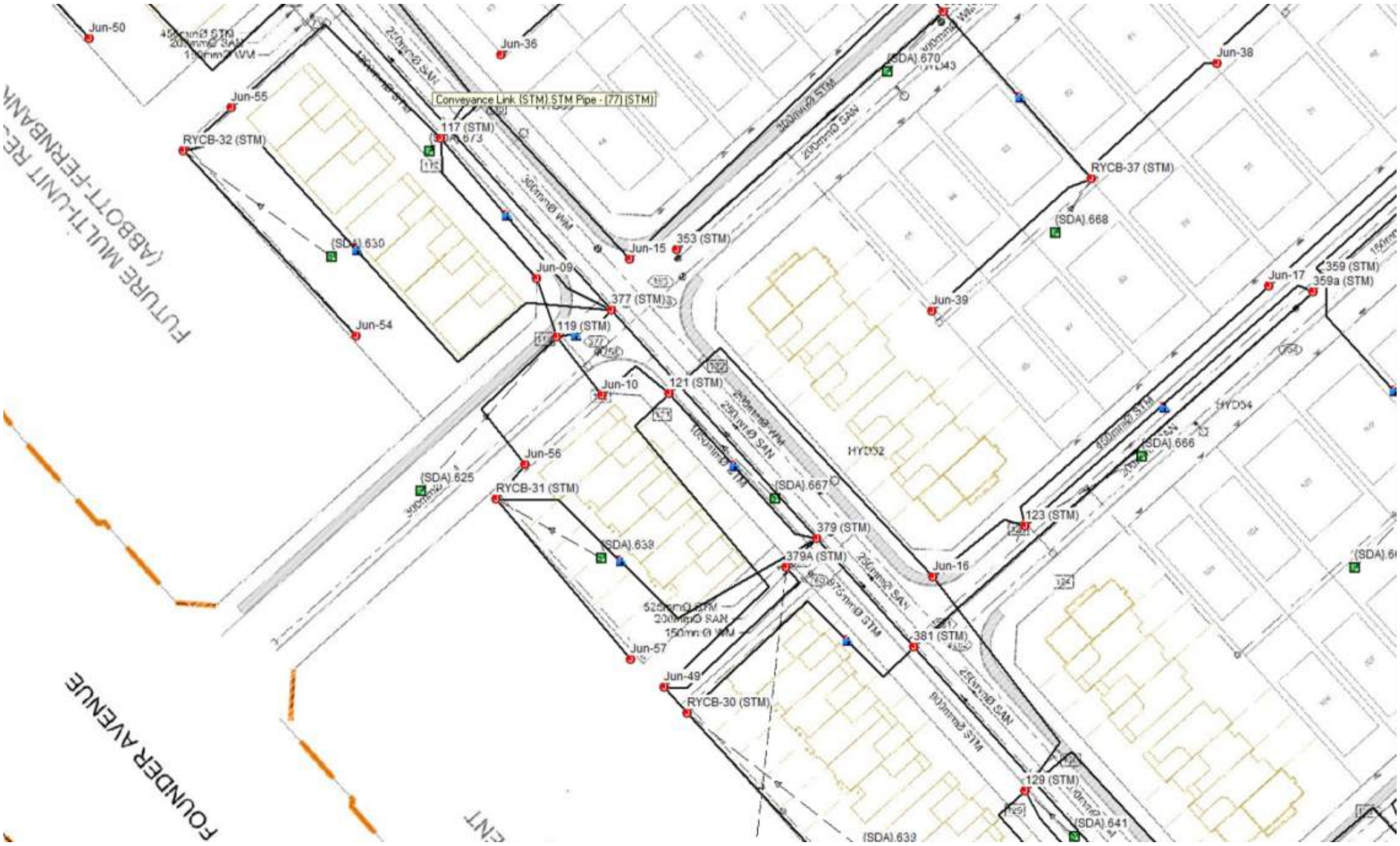
FERNBANK CROSSING
PHASE 3

MODEL SCHEMATIC
SHEET 3

DEC 2014	108180	FIGURE C4



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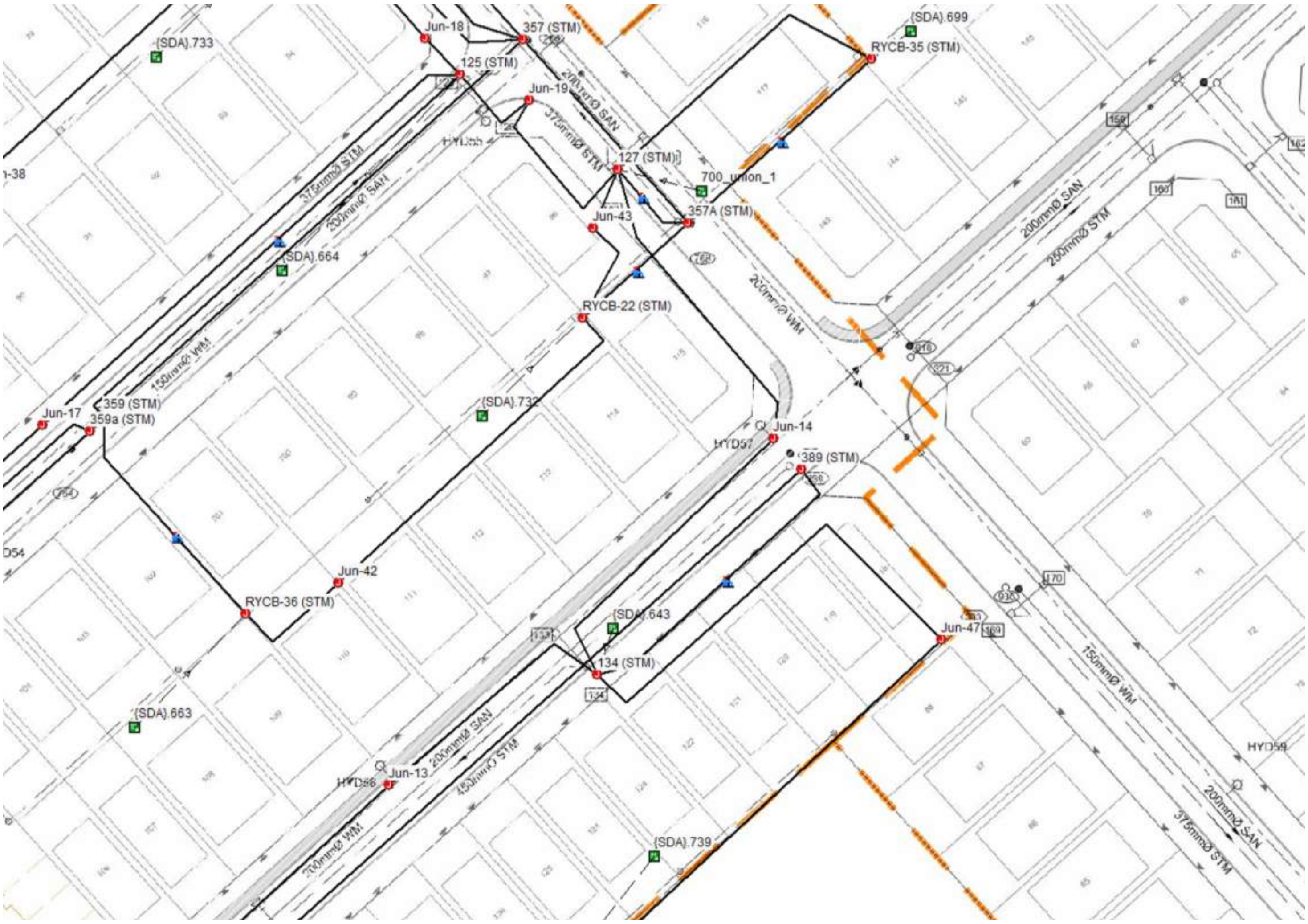
FERNBANK CROSSING PHASE 3

MODEL SCHEMATIC SHEET 4

DEC 2014	108180	FIGURE C5



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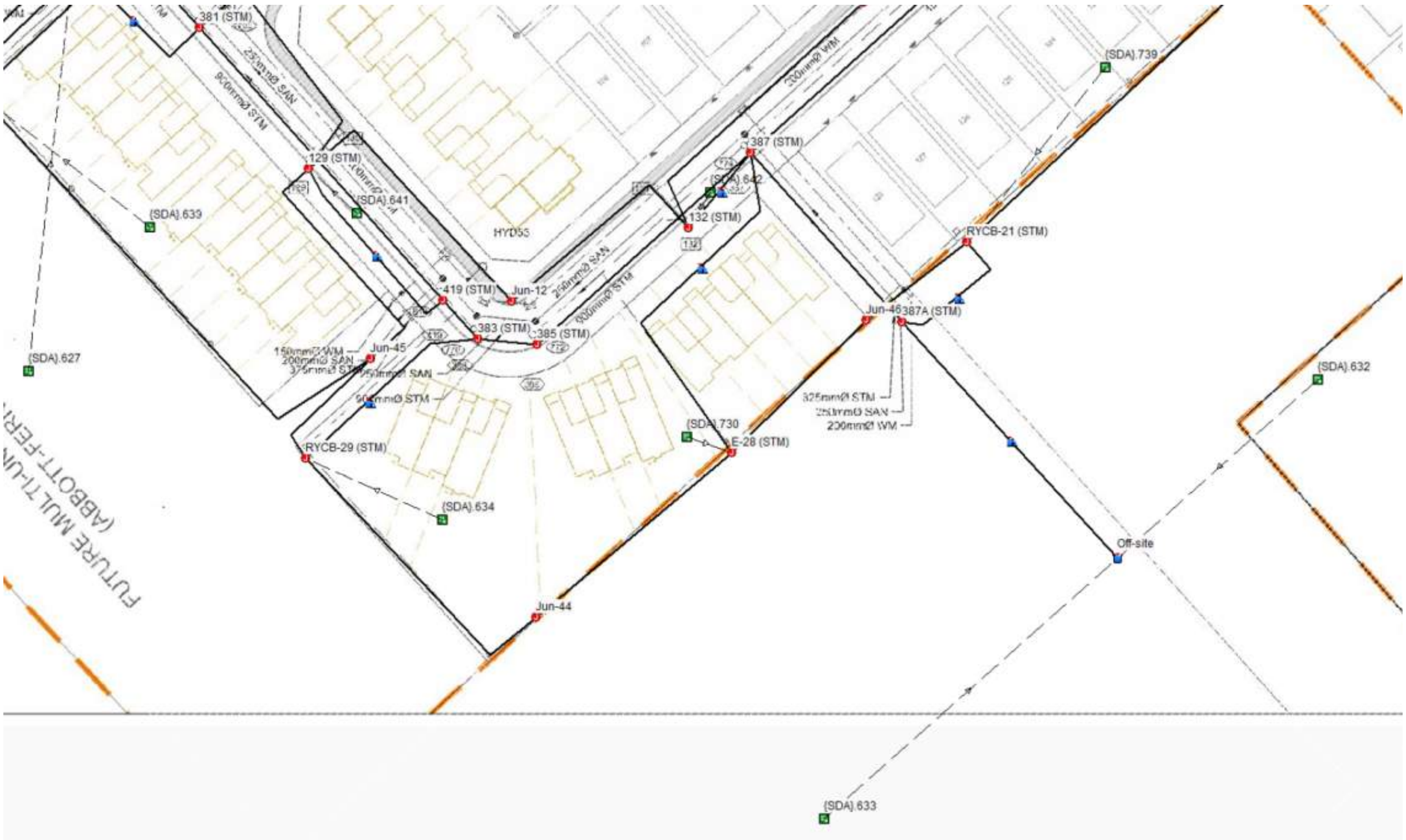
FERNBANK CROSSING PHASE 3

MODEL SCHEMATIC SHEET 5

DEC 2014	108180	FIGURE C6



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FERNBANK CROSSING
PHASE 3

MODEL SCHEMATIC
SHEET 6

DEC 2014	108180	FIGURE C7

Autodesk® Storm and Sanitary Analysis 2013 - Version 7.1.2186 (Build 1)

****
Project Description
****

File Name .... Phase 3 SSA - 20150708.SPF
Description .... C:\Users\borendorff.NOVATECH\Desktop\108180-15-STM.dwg

****
Analysis Options
****

Flow Units .... LPS
Subbasin Hydrograph Method. EPA SWMM
Infiltration Method .... Horton
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date NOV-25-2014 00:00:00
Ending Date NOV-25-2014 23:59:00
Antecedent Dry Days 0.0
Report Time Step 00:05:00
Wet Time Step 00:05:00
Dry Time Step 01:00:00
Routing Time Step .... 5.00 sec

****
Element Count
****

Number of rain gages 1
Number of subbasins 40
Number of nodes 98
Number of links 133
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Recording Interval min
Rain Gage-01	C100-4	INTENSITY	10.00

****
Subbasin Summary
****

Subbasin ID	Total Area hectares	Equiv. Width m	Imperv. Area %	Average Slope %	Raingage
{SDA}.109b	0.46	100.00	50.00	0.5000	Rain Gage-01
{SDA}.624	1.18	53.00	86.00	0.5000	Rain Gage-01
{SDA}.625	0.17	18.00	64.00	0.5000	Rain Gage-01
{SDA}.627	1.01	53.00	86.00	0.5000	Rain Gage-01
{SDA}.628	0.06	16.00	50.00	0.5000	Rain Gage-01
{SDA}.629	0.16	40.00	50.00	0.5000	Rain Gage-01
{SDA}.630	0.11	30.00	50.00	0.5000	Rain Gage-01
{SDA}.632	1.08	88.00	86.00	0.5000	Rain Gage-01
{SDA}.633	1.84	120.00	86.00	0.5000	Rain Gage-01
{SDA}.634	0.14	28.00	57.00	0.5000	Rain Gage-01
{SDA}.638	0.07	25.00	57.00	0.5000	Rain Gage-01
{SDA}.639	0.13	40.00	57.00	0.5000	Rain Gage-01
{SDA}.641	0.39	50.00	71.00	0.5000	Rain Gage-01
{SDA}.642	0.42	48.00	64.00	0.5000	Rain Gage-01

{SDA}.643	0.46	48.00	64.00	0.5000	Rain Gage-01
{SDA}.663	0.51	100.00	50.00	0.5000	Rain Gage-01
{SDA}.664	0.45	48.00	64.00	0.5000	Rain Gage-01
{SDA}.666	0.35	48.00	64.00	0.5000	Rain Gage-01
{SDA}.667	0.35	50.00	71.00	0.5000	Rain Gage-01
{SDA}.668	0.50	100.00	50.00	0.5000	Rain Gage-01
{SDA}.670	0.70	48.00	64.00	0.5000	Rain Gage-01
{SDA}.671	0.22	38.00	64.00	0.5000	Rain Gage-01
{SDA}.672	0.42	100.00	50.00	0.5000	Rain Gage-01
{SDA}.673	0.28	38.00	64.00	0.5000	Rain Gage-01
{SDA}.674	0.30	38.00	64.00	0.5000	Rain Gage-01
{SDA}.675	0.35	48.00	64.00	0.5000	Rain Gage-01
{SDA}.704	0.22	22.00	64.00	0.5000	Rain Gage-01
{SDA}.708	0.15	25.00	64.00	0.5000	Rain Gage-01
{SDA}.713	0.08	40.00	50.00	0.5000	Rain Gage-01
{SDA}.716	0.18	40.00	50.00	0.5000	Rain Gage-01
{SDA}.717	0.31	48.00	64.00	0.5000	Rain Gage-01
{SDA}.718	0.43	100.00	50.00	0.5000	Rain Gage-01
{SDA}.719	0.21	38.00	64.00	0.5000	Rain Gage-01
{SDA}.720	0.35	48.00	64.00	0.5000	Rain Gage-01
{SDA}.721	0.47	48.00	64.00	0.5000	Rain Gage-01
{SDA}.722	0.21	40.00	50.00	0.5000	Rain Gage-01
{SDA}.723	0.31	38.00	64.00	0.5000	Rain Gage-01
{SDA}.730	0.10	25.00	57.00	0.5000	Rain Gage-01
{SDA}.739	0.20	40.00	50.00	0.5000	Rain Gage-01
700_union_1	0.22	25.00	64.00	0.5000	Rain Gage-01

****
Node Summary
****

Node ID	Element Type	Invert Elevation m	Maximum Elev. m	Ponded Area m²	External Inflow
10+053	JUNCTION	103.16	103.46	0.00	
11+001	JUNCTION	104.63	104.93	0.00	
12+001	JUNCTION	104.55	104.85	0.00	
12+185	JUNCTION	103.32	103.62	0.00	
12+228	JUNCTION	103.32	103.62	0.00	
12+254	JUNCTION	103.41	103.71	0.00	
12+309	JUNCTION	103.94	104.24	0.00	
309 (STM)	JUNCTION	100.73	103.86	0.00	
343 (STM)	JUNCTION	98.71	103.09	0.00	
345 (STM)	JUNCTION	101.46	104.26	0.00	
347 (STM)	JUNCTION	99.08	103.46	0.00	
349 (STM)	JUNCTION	100.76	104.47	0.00	
351 (STM)	JUNCTION	99.61	104.05	0.00	
353 (STM)	JUNCTION	101.42	104.86	0.00	
357 (STM)	JUNCTION	101.97	104.65	0.00	
357A (STM)	JUNCTION	102.34	104.86	0.00	
359 (STM)	JUNCTION	102.53	105.24	0.00	
359A (STM)	JUNCTION	102.63	105.24	0.00	
373 (STM)	JUNCTION	100.88	104.40	0.00	
373A (STM)	JUNCTION	101.65	104.85	0.00	
375 (STM)	JUNCTION	101.22	104.76	0.00	
377 (STM)	JUNCTION	101.37	104.98	0.00	
379 (STM)	JUNCTION	101.66	104.99	0.00	
379A (STM)	JUNCTION	102.13	105.60	0.00	
381 (STM)	JUNCTION	101.80	105.14	0.00	
383 (STM)	JUNCTION	102.06	105.23	0.00	
385 (STM)	JUNCTION	102.08	105.26	0.00	
387 (STM)	JUNCTION	102.19	105.17	0.00	
387A (STM)	JUNCTION	102.34	105.19	0.00	
389 (STM)	JUNCTION	102.87	105.46	0.00	
391 (STM)	JUNCTION	98.64	103.19	0.00	
393 (STM)	JUNCTION	101.13	103.91	0.00	
395 (STM)	JUNCTION	98.79	103.18	0.00	
397 (STM)	JUNCTION	100.09	103.94	0.00	
399 (STM)	JUNCTION	100.71	104.22	0.00	

4+345	JUNCTION	104.49	104.79	0.00
4+420	JUNCTION	104.70	105.00	0.00
4+510	JUNCTION	104.74	105.16	0.00
4+568	JUNCTION	105.00	105.31	0.00
4+665	JUNCTION	105.21	105.51	0.00
4+750	JUNCTION	105.31	105.61	0.00
4+828	JUNCTION	105.41	105.71	0.00
417 (STM)	JUNCTION	99.89	103.87	0.00
419 (STM)	JUNCTION	102.04	105.17	0.00
6+088	JUNCTION	104.43	104.73	0.00
6+102	JUNCTION	104.61	104.91	0.00
7+096	JUNCTION	105.19	105.49	0.00
703 (STM)	JUNCTION	100.80	106.80	0.00
8+128	JUNCTION	104.86	105.16	0.00
8+150	JUNCTION	104.77	105.07	0.00
CB101-102 (STM)	JUNCTION	102.90	103.90	0.00
CB111-112	JUNCTION	103.02	104.12	0.00
CB113-114 (STM)	JUNCTION	102.61	104.42	0.00
CB115-116 (STM)	JUNCTION	102.99	104.61	0.00
CB117-118 (STM)	JUNCTION	103.20	104.78	0.00
CB119-120 (STM)	JUNCTION	103.81	105.04	0.00
CB121-122 (STM)	JUNCTION	103.40	105.25	0.00
CB123-124 (STM)	JUNCTION	103.54	105.12	0.00
CB125-126 (STM)	JUNCTION	102.60	104.74	0.00
CB127-128 (STM)	JUNCTION	103.35	104.83	0.00
CB129-130 (STM)	JUNCTION	103.58	105.30	0.00
CB131-132 (STM)	JUNCTION	103.73	105.50	0.00
CB133-134 (STM)	JUNCTION	103.57	105.37	0.00
CB85-86 (STM)	JUNCTION	101.80	103.60	0.00
CB87-88 (STM)	JUNCTION	101.54	103.86	0.00
CB89-90 (STM)	JUNCTION	102.29	103.44	0.00
CB91-92 (STM)	JUNCTION	102.46	103.45	0.00
CB93-94 (STM)	JUNCTION	101.69	103.89	0.00
CB95-96 (STM)	JUNCTION	102.48	103.57	0.00
CB97-98 (STM)	JUNCTION	102.24	104.04	0.00
E-34	JUNCTION	102.52	104.26	0.00
Jun-35	JUNCTION	103.28	103.58	0.00
Jun-37	JUNCTION	103.46	103.76	0.00
Jun-40	JUNCTION	104.14	104.44	0.00
Jun-43	JUNCTION	104.87	105.17	0.00
Jun-51	JUNCTION	104.45	104.75	0.00
RYCB-21 (STM)	JUNCTION	102.98	105.60	0.00
RYCB-22 (STM)	JUNCTION	102.99	104.91	0.00
RYCB-23 (STM)	JUNCTION	102.21	104.31	0.00
RYCB-24 (STM)	JUNCTION	101.36	103.45	0.00
RYCB-25 (STM)	JUNCTION	100.85	103.32	0.00
RYCB-27 (STM)	JUNCTION	101.23	103.70	0.00
RYCB-28 (STM)	JUNCTION	101.16	103.75	0.00
RYCB-30 (STM)	JUNCTION	102.52	105.30	0.00
RYCB-31 (STM)	JUNCTION	102.83	105.86	0.00
RYCB-32 (STM)	JUNCTION	102.84	105.00	0.00
RYCB-33 (STM)	JUNCTION	101.90	104.80	0.00
RYCB-34 (STM)	JUNCTION	102.16	105.27	0.00
RYCB-38 (STM)	JUNCTION	103.92	105.65	0.00
RYCB-39 (STM)	JUNCTION	103.68	105.70	0.00
RYCBMH-2 (STM)	JUNCTION	101.60	103.60	0.00
EX341 (STM)	OUTFALL	98.53	99.44	0.00
EX363 (STM)	OUTFALL	100.40	102.13	0.00
MAJ-Easement	OUTFALL	103.00	103.30	0.00
MAJ-Haliburton	OUTFALL	103.73	104.03	0.00
MAJ-Shinny	OUTFALL	104.12	104.43	0.00
MAJ-Slapshot	OUTFALL	105.10	105.50	0.00
Off-site	STORAGE	102.36	104.79	0.00

****
Link Summary
****

Link	From Node	To Node	Element	Length	Slope	Manning's

```
  ID                                                Type                m         %
Roughness

-------------------------------------------------------------------------------------------------
  {STM}.STM Pipe - (190) (STM)387A (STM)      387 (STM)       CONDUIT           41.5
0.1928      0.0130
  {STM}.STM Pipe - (199) (STM)357A (STM)      357 (STM)       CONDUIT           41.1
0.8996      0.0130
  {STM}.STM Pipe - (390) (STM)357 (STM)       417 (STM)       CONDUIT           81.2
2.4755      0.0130
  {STM}.STM Pipe - (69) (1) (1) (STM)343 (STM)       391 (STM)       CONDUIT           38.3
  0.1825      0.0130
  {STM}.STM Pipe - (69) (1) (STM)391 (STM)       EX341 (STM)     CONDUIT           26.7
0.4118      0.0130
  {STM}.STM Pipe - (70) (1) (STM)347 (STM)       395 (STM)       CONDUIT           74.2
0.3504      0.0130
  {STM}.STM Pipe - (70) (STM)395 (STM)       343 (STM)       CONDUIT            9.4
0.5308      0.0130
  {STM}.STM Pipe - (71) (STM)351 (STM)       347 (STM)       CONDUIT           81.1
0.3515      0.0130
  {STM}.STM Pipe - (72) (1) (STM)309 (STM)       417 (STM)       CONDUIT           47.6
1.9336      0.0130
  {STM}.STM Pipe - (72) (STM)417 (STM)       351 (STM)       CONDUIT           32.8
0.6284      0.0130
  {STM}.STM Pipe - (75) (2) (1) (STM)373 (STM)       703 (STM)       CONDUIT           35.9
  0.2173      0.0130
  {STM}.STM Pipe - (75) (STM)703 (STM)       EX363 (STM)     CONDUIT           21.5
0.1860      0.0130
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0.1756      0.0130
  {STM}.STM Pipe - (77) (STM)377 (STM)       375 (STM)       CONDUIT           80.1
0.1847      0.0130
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0.9999      0.0130
  {STM}.STM Pipe - (80) (STM)399 (STM)       351 (STM)       CONDUIT           80.5
1.0005      0.0130
  {STM}.STM Pipe - (81) (STM)379 (STM)       377 (STM)       CONDUIT           55.3
0.2530      0.0130
  {STM}.STM Pipe - (82) (STM)381 (STM)       379 (STM)       CONDUIT           25.9
0.2434      0.0130
  {STM}.STM Pipe - (83) (1) (STM)383 (STM)       419 (STM)       CONDUIT            9.3
0.2583      0.0130
  {STM}.STM Pipe - (83) (STM)419 (STM)       381 (STM)       CONDUIT           66.9
0.2495      0.0130
  {STM}.STM Pipe - (84) (STM)385 (STM)       383 (STM)       CONDUIT           10.9
0.2016      0.0130
  {STM}.STM Pipe - (85) (STM)387 (STM)       385 (STM)       CONDUIT           52.3
0.2006      0.0130
  {STM}.STM Pipe - (86) (STM)389 (STM)       387 (STM)       CONDUIT          120.0
0.2000      0.0130
  {STM}.STM Pipe - (87) (STM)359A (STM)      381 (STM)       CONDUIT           96.6
0.2381      0.0130
  {STM}.STM Pipe - (88) (STM)359 (STM)       357 (STM)       CONDUIT           93.7
0.5339      0.0130
  Link-02          359A (STM)       359 (STM)        CONDUIT             2.9    0.0105
0.0130
  Link-07          MAJ-Shinny       CB113-114 (STM)  CHANNEL            17.1    0.0583
0.0130
  Link-09          4+828            CB133-134 (STM)  CHANNEL            63.0    0.5333
0.0130
  Link-10          4+750            CB133-134 (STM)  CHANNEL            39.0    0.6051
0.0130
```

Link-101	Jun-51	CB113-114 (STM)	CHANNEL	10.0	3.2800	0.0350
Link-106	RYCB-32 (STM)	RYCB-33 (STM)	CHANNEL	20.0	1.0000	0.0350
Link-11	4+750	CB131-132 (STM)	CHANNEL	48.0	0.6292	0.0130
Link-112	RYCB-34 (STM)	RYCB-33 (STM)	CHANNEL	10.0	4.7000	0.0350
Link-113	379A (STM)	4+568	CHANNEL	25.0	1.2000	0.0130
Link-114	373A (STM)	4+345	CHANNEL	10.0	0.6000	0.0130
Link-115	11+001	CB93-94 (STM)	CHANNEL	76.4	1.3609	0.0130
Link-116	8+150	CB97-98 (STM)	CHANNEL	107.8	0.9579	0.0130
Link-117	12+001	CB87-88 (STM)	CHANNEL	87.5	1.1314	0.0130
Link-118	RYCB-39 (STM)	CB129-130 (STM)	CHANNEL	10.0	4.0000	0.0350
Link-119	RYCB-27 (STM)	10+053	CHANNEL	10.0	2.4000	0.0350
Link-12	4+665	CB131-132 (STM)	CHANNEL	36.0	0.5611	0.0130
Link-120	10+053	MAJ-Easement	CHANNEL	26.2	0.6102	0.0350
Link-13	4+665	CB129-130 (STM)	CHANNEL	45.0	0.7267	0.0130
Link-14	4+568	CB129-130 (STM)	CHANNEL	42.0	0.3024	0.0130
Link-16	8+128	CB121-122 (STM)	CHANNEL	17.8	0.9291	0.0130
Link-17	8+128	CB119-120 (STM)	CHANNEL	7.5	1.6000	0.0130
Link-18	4+510	CB119-120 (STM)	CHANNEL	8.2	1.4616	0.0130
Link-19	4+510	CB117-118 (STM)	CHANNEL	45.0	0.5778	0.0130
Link-22	4+345	CB115-116 (STM)	CHANNEL	20.0	0.9000	0.0130
Link-23	4+345	CB113-114 (STM)	CHANNEL	74.0	0.4973	0.0130
Link-25	4+568	CB121-122 (STM)	CHANNEL	52.0	0.5865	0.0130
Link-26	4+568	CB123-124 (STM)	CHANNEL	25.0	0.7360	0.0130
Link-30	7+096	CB123-124 (STM)	CHANNEL	61.0	0.6130	0.0130
Link-31	7+096	CB125-126 (STM)	CHANNEL	91.8	0.8661	0.0130
Link-32	6+088	CB125-126 (STM)	CHANNEL	8.4	0.4177	0.0130
Link-33	4+828	CB127-128 (STM)	CHANNEL	50.0	1.7520	0.0130
Link-34	6+102	CB127-128 (STM)	CHANNEL	10.0	0.7600	0.0130
Link-35	6+102	CB125-126 (STM)	CHANNEL	14.0	0.5000	0.0130
Link-38	6+088	CB101-102 (STM)	CHANNEL	59.0	1.4068	0.0130
Link-40	12+309	CB97-98 (STM)	CHANNEL	36.0	0.5639	0.0130
Link-44	CB111-112	CB101-102 (STM)	CHANNEL	25.8	0.8544	0.0130
Link-45	MAJ-Haliburton	CB101-102 (STM)	CHANNEL	12.0	1.0833	0.0130
Link-47	12+309	CB95-96 (STM)	CHANNEL	33.5	1.9970	0.0130
Link-48	12+254	CB95-96 (STM)	CHANNEL	20.0	0.7000	0.0130

Link-49	12+254	CB91-92 (STM)	CHANNEL	14.1	1.8434	0.0130
Link-51	12+228	CB91-92 (STM)	CHANNEL	11.0	1.5364	0.0130
Link-52	12+228	CB89-90 (STM)	CHANNEL	32.0	0.5625	0.0130
Link-53	12+185	CB89-90 (STM)	CHANNEL	13.0	1.3846	0.0130
Link-54	4+420	CB117-118 (STM)	CHANNEL	27.0	0.8148	0.0130
Link-55	4+420	CB115-116 (STM)	CHANNEL	60.0	0.6500	0.0130
Link-57	CB93-94 (STM)	CB91-92 (STM)	CHANNEL	56.6	0.7753	0.0130
Link-59	CB87-88 (STM)	CB85-86 (STM)	CHANNEL	57.9	0.9751	0.0130
Link-60	12+185	CB85-86 (STM)	CHANNEL	22.0	1.4773	0.0130
Link-61	CB85-86 (STM)	10+053	CHANNEL	28.0	0.5000	0.0350
Link-64	RYCBMH-2 (STM)	10+053	CHANNEL	10.0	1.4000	0.0350
Link-70	RYCB-28 (STM)	RYCB-27 (STM)	CHANNEL	10.0	0.5000	0.0350
Link-71	E-34	RYCB-28 (STM)	CHANNEL	50.0	1.0200	0.0350
Link-72	Jun-35	RYCB-25 (STM)	CHANNEL	9.7	2.6832	0.0350
Link-74	Jun-35	CB89-90 (STM)	CHANNEL	19.9	0.9839	0.0350
Link-75	Jun-37	RYCB-24 (STM)	CHANNEL	10.3	3.0039	0.0350
Link-77	Jun-37	CB95-96 (STM)	CHANNEL	19.4	1.3378	0.0350
Link-80	Jun-40	RYCB-23 (STM)	CHANNEL	12.6	1.0317	0.0350
Link-82	Jun-40	CB101-102 (STM)	CHANNEL	19.4	2.7878	0.0350
Link-85	Jun-43	RYCB-22 (STM)	CHANNEL	15.9	1.6332	0.0350
Link-86	Jun-43	CB127-128 (STM)	CHANNEL	10.6	3.1758	0.0350
Link-91	RYCB-38 (STM)	CB131-132 (STM)	CHANNEL	10.0	1.5000	0.0350
Link-93	RYCB-21 (STM)	MAJ-Slapshot	CHANNEL	10.0	1.0000	0.0350
Link-96	RYCB-30 (STM)	CB121-122 (STM)	CHANNEL	10.0	0.5000	0.0350
Link-97	RYCB-31 (STM)	CB121-122 (STM)	CHANNEL	10.0	6.1000	0.0350
Link-99	RYCB-33 (STM)	Jun-51	CHANNEL	10.0	0.5000	0.0350
{STM}.CBL109 (STM)	CB113-114 (STM)	703 (STM)	ORIFICE			
{STM}.CBL111 (STM)	CB115-116 (STM)	375 (STM)	ORIFICE			
{STM}.CBL113 (STM)	CB117-118 (STM)	377 (STM)	ORIFICE			
{STM}.CBL115 (STM)	CB119-120 (STM)	377 (STM)	ORIFICE			
{STM}.CBL117 (STM)	CB121-122 (STM)	379 (STM)	ORIFICE			
{STM}.CBL119 (STM)	CB123-124 (STM)	359A (STM)	ORIFICE			
{STM}.CBL123 (STM)	CB127-128 (STM)	357A (STM)	ORIFICE			
{STM}.CBL125 (STM)	CB129-130 (STM)	419 (STM)	ORIFICE			
{STM}.CBL128 (STM)	CB131-132 (STM)	387 (STM)	ORIFICE			
{STM}.CBL130 (STM)	CB133-134 (STM)	389 (STM)	ORIFICE			
{STM}.CBL85 (STM)	CB89-90 (STM)	347 (STM)	ORIFICE			
{STM}.CBL87 (STM)	CB91-92 (STM)	397 (STM)	ORIFICE			
{STM}.CBL91 (STM)	CB95-96 (STM)	351 (STM)	ORIFICE			
{STM}.CBL93 (STM)	CB97-98 (STM)	399 (STM)	ORIFICE			
{STM}.CBL97 (STM)	CB101-102 (STM)	357 (STM)	ORIFICE			
{STM}.STM Pipe - (182) (STM)	373A (STM)	373 (STM)	ORIFICE			
{STM}.STM Pipe - (183) (STM)	379A (STM)	379 (STM)	ORIFICE			
{STM}.STM Pipe - (389) (STM)	CB87-88 (STM)	393 (STM)	ORIFICE			

{STM}.STM Pipe - (391) (STM)	CB85-86 (STM)	393 (STM)	ORIFICE
{STM}.STM Pipe - (392) (STM)	CB93-94 (STM)	397 (STM)	ORIFICE
{STM}.STM Pipe - (393) (STM)	CB125-126 (STM)	359 (STM)	ORIFICE
{STM}.STM Pipe - (397) (STM)	RYCB-21 (STM)	387A (STM)	ORIFICE
{STM}.STM Pipe - (400) (STM)	RYCB-22 (STM)	357A (STM)	ORIFICE
{STM}.STM Pipe - (403) (STM)	RYCB-23 (STM)	357 (STM)	ORIFICE
{STM}.STM Pipe - (406) (STM)	RYCB-24 (STM)	351 (STM)	ORIFICE
{STM}.STM Pipe - (409) (STM)	RYCB-25 (STM)	347 (STM)	ORIFICE
{STM}.STM Pipe - (412) (STM)	RYCBMH-2 (STM)	391 (STM)	ORIFICE
{STM}.STM Pipe - (414) (STM)	RYCB-27 (STM)	391 (STM)	ORIFICE
{STM}.STM Pipe - (417) (STM)	RYCB-28 (STM)	347 (STM)	ORIFICE
{STM}.STM Pipe - (419) (STM)	RYCB-38 (STM)	387A (STM)	ORIFICE
{STM}.STM Pipe - (421) (STM)	RYCB-39 (STM)	383 (STM)	ORIFICE
{STM}.STM Pipe - (425) (STM)	RYCB-30 (STM)	381 (STM)	ORIFICE
{STM}.STM Pipe - (427) (STM)	RYCB-31 (STM)	377 (STM)	ORIFICE
{STM}.STM Pipe - (429) (STM)	RYCB-32 (STM)	377 (STM)	ORIFICE
{STM}.STM Pipe - (433) (STM)	RYCB-33 (STM)	375 (STM)	ORIFICE
{STM}.STM Pipe - (435) (STM)	RYCB-34 (STM)	703 (STM)	ORIFICE
Link-01	Off-site	387A (STM)	ORIFICE
Link-102	E-34	309 (STM)	ORIFICE
O-111	CB111-112	417 (STM)	ORIFICE

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Cross Section Summary
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Link ID	Shape	Depth/ Diameter m	Width m	No. of Barrels	Cross Sectional Area m²	Full Flow Hydraulic Radius m	Design Flow Capacity LPS
{STM}.STM Pipe - (190) (STM)	CIRCULAR	0.91	0.91	1	0.66	0.23	828.28
{STM}.STM Pipe - (199) (STM)	CIRCULAR	0.46	0.46	1	0.16	0.11	281.79
{STM}.STM Pipe - (390) (STM)	CIRCULAR	0.53	0.53	1	0.22	0.13	704.54
{STM}.STM Pipe - (69) (1) (1) (STM)	CIRCULAR	0.91	0.91	1	0.66	0.23	806.02
{STM}.STM Pipe - (69) (1) (STM)	CIRCULAR	0.91	0.91	1	0.66	0.23	1210.53
{STM}.STM Pipe - (70) (1) (STM)	CIRCULAR	0.91	0.91	1	0.66	0.23	1116.74
{STM}.STM Pipe - (70) (STM)	CIRCULAR	0.91	0.91	1	0.66	0.23	1374.48
{STM}.STM Pipe - (71) (STM)	CIRCULAR	0.76	0.76	1	0.46	0.19	688.61
{STM}.STM Pipe - (72) (1) (STM)	CIRCULAR	0.30	0.30	1	0.07	0.08	140.53
{STM}.STM Pipe - (72) (STM)	CIRCULAR	0.69	0.69	1	0.37	0.17	695.73
{STM}.STM Pipe - (75) (2) (1) (STM)	CIRCULAR	1.37	1.37	1	1.48	0.34	2597.59
{STM}.STM Pipe - (75) (STM)	CIRCULAR	1.37	1.37	1	1.48	0.34	2403.74
{STM}.STM Pipe - (76) (STM)	CIRCULAR	1.22	1.22	1	1.17	0.30	1703.53
{STM}.STM Pipe - (77) (STM)	CIRCULAR	1.22	1.22	1	1.17	0.30	1747.31
{STM}.STM Pipe - (78) (1) (STM)	CIRCULAR	0.30	0.30	1	0.07	0.08	81.54
{STM}.STM Pipe - (78) (STM)	CIRCULAR	0.46	0.46	1	0.16	0.11	210.00
{STM}.STM Pipe - (79) (1) (STM)	CIRCULAR	0.30	0.30	1			

```
0.07         0.08        123.53
  {STM}.STM Pipe - (79) (STM) CIRCULAR          0.46         0.46             1
0.16         0.11        209.62
  {STM}.STM Pipe - (80) (1) (STM) CIRCULAR          0.30         0.30             1
0.07         0.08        101.06
  {STM}.STM Pipe - (80) (STM) CIRCULAR          0.46         0.46             1
0.16         0.11        297.17
  {STM}.STM Pipe - (81) (STM) CIRCULAR          1.07         1.07             1
0.89         0.27       1433.75
  {STM}.STM Pipe - (82) (STM) CIRCULAR          0.99         0.99             1
0.77         0.25       1154.69
  {STM}.STM Pipe - (83) (1) (STM) CIRCULAR          0.91         0.91             1
0.66         0.23        958.70
  {STM}.STM Pipe - (83) (STM) CIRCULAR          0.91         0.91             1
0.66         0.23        942.25
  {STM}.STM Pipe - (84) (STM) CIRCULAR          0.91         0.91             1
0.66         0.23        847.10
  {STM}.STM Pipe - (85) (STM) CIRCULAR          0.91         0.91             1
0.66         0.23        845.04
  {STM}.STM Pipe - (86) (STM) CIRCULAR          0.46         0.46             1
0.16         0.11        132.87
  {STM}.STM Pipe - (87) (STM) CIRCULAR          0.46         0.46             1
0.16         0.11        144.96
  {STM}.STM Pipe - (88) (STM) CIRCULAR          0.46         0.46             1
0.16         0.11        217.08
  Link-02          CIRCULAR           0.45         0.45            1         0.16
0.11        29.18
  Link-07          IRREGULAR          0.30        18.00            1         2.83
0.17      1599.37
  Link-09          IRREGULAR          0.30        18.00            1         2.83
0.17      4835.64
  Link-10          IRREGULAR          0.30        18.00            1         2.83
0.17      5150.85
  Link-101         IRREGULAR          0.30        10.00            1         1.50
0.15      2182.86
  Link-106         IRREGULAR          0.30        10.00            1         1.50
0.15      1205.28
  Link-11          IRREGULAR          0.30        18.00            1         2.83
0.17      5252.16
  Link-112         IRREGULAR          0.30        10.00            1         1.50
0.15      2612.99
  Link-113         IRREGULAR          0.30        18.00            1         2.83
0.17      7253.46
  Link-114         IRREGULAR          0.30        18.00            1         2.83
0.17      5128.97
  Link-115         IRREGULAR          0.30        18.00            1         2.83
0.17      7724.46
  Link-116         IRREGULAR          0.30        18.00            1         2.83
0.17      6480.60
  Link-117         IRREGULAR          0.30        18.00            1         2.83
0.17      7043.17
  Link-118         IRREGULAR          0.30        10.00            1         1.50
0.15      2410.57
  Link-119         IRREGULAR          0.30        10.00            1         1.50
0.15      1867.22
  Link-12          IRREGULAR          0.30        18.00            1         2.83
0.17      4959.97
  Link-120         IRREGULAR          0.30         7.00            1         0.92
0.16       615.70
  Link-13          IRREGULAR          0.30        18.00            1         2.83
0.17      5644.46
  Link-14          IRREGULAR          0.30        18.00            1         2.83
0.17      3641.10
  Link-16          IRREGULAR          0.30        18.00            1         2.83
0.17      6382.27
  Link-17          IRREGULAR          0.20        20.00            1         2.00
0.10      4181.01
  Link-18          IRREGULAR          0.30        18.00            1         2.83
0.17      8005.23
  Link-19          IRREGULAR          0.30        18.00            1         2.83
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						0.17	5033.10
Link-22	IRREGULAR	0.30	18.00	1	2.83	0.17	6281.68
Link-23	IRREGULAR	0.30	18.00	1	2.83	0.17	4669.42
Link-25	IRREGULAR	0.30	18.00	1	2.83	0.17	5071.11
Link-26	IRREGULAR	0.30	18.00	1	2.83	0.17	5680.59
Link-30	IRREGULAR	0.30	18.00	1	2.83	0.17	5184.30
Link-31	IRREGULAR	0.30	18.00	1	2.83	0.17	6162.27
Link-32	IRREGULAR	0.30	18.00	1	2.83	0.17	4279.24
Link-33	IRREGULAR	0.30	18.00	1	2.83	0.17	8764.39
Link-34	IRREGULAR	0.30	18.00	1	2.83	0.17	5772.47
Link-35	IRREGULAR	0.20	20.00	1	2.00	0.10	2337.25
Link-38	IRREGULAR	0.30	18.00	1	2.83	0.17	7853.58
Link-40	IRREGULAR	0.30	18.00	1	2.83	0.17	4972.23
Link-44	IRREGULAR	0.30	18.00	1	2.83	0.17	6120.37
Link-45	IRREGULAR	0.30	18.00	1	2.83	0.17	6891.85
Link-47	IRREGULAR	0.30	18.00	1	2.83	0.17	9357.20
Link-48	IRREGULAR	0.30	18.00	1	2.83	0.17	5539.93
Link-49	IRREGULAR	0.30	18.00	1	2.83	0.17	8990.14
Link-51	IRREGULAR	0.30	18.00	1	2.83	0.17	8207.33
Link-52	IRREGULAR	0.30	18.00	1	2.83	0.17	4966.11
Link-53	IRREGULAR	0.30	18.00	1	2.83	0.17	7791.47
Link-54	IRREGULAR	0.30	18.00	1	2.83	0.17	5977.01
Link-55	IRREGULAR	0.30	18.00	1	2.83	0.17	5338.41
Link-57	IRREGULAR	0.30	18.00	1	2.83	0.17	5830.45
Link-59	IRREGULAR	0.30	18.00	1	2.83	0.17	6538.68
Link-60	IRREGULAR	0.30	18.00	1	2.83	0.17	8047.95
Link-61	IRREGULAR	0.30	7.00	1	0.92	0.16	557.33
Link-64	IRREGULAR	0.30	10.00	1	1.50	0.15	1426.11
Link-70	IRREGULAR	0.30	10.00	1	1.50	0.15	852.26
Link-71	IRREGULAR	0.30	10.00	1	1.50	0.15	1217.28
Link-72	IRREGULAR	0.30	10.00	1	1.50	0.15	1974.30
Link-74	IRREGULAR	0.30	10.00	1	1.50	0.15	1195.56
Link-75	IRREGULAR	0.30	10.00	1	1.50	0.15	2088.96
Link-77	IRREGULAR	0.30	10.00	1	1.50	0.15	1394.08
Link-80	IRREGULAR	0.30	10.00	1	1.50	0.15	1224.27
Link-82	IRREGULAR	0.30	10.00	1	1.50		

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0.15      2012.43
  Link-85            IRREGULAR          0.30         10.00            1          1.50
0.15      1540.30
  Link-86            IRREGULAR          0.30         10.00            1          1.50
0.15      2147.91
  Link-91            IRREGULAR          0.30         10.00            1          1.50
0.15      1476.16
  Link-93            IRREGULAR          0.30         10.00            1          1.50
0.15      1205.28
  Link-96            IRREGULAR          0.30         10.00            1          1.50
0.15       852.26
  Link-97            IRREGULAR          0.30         10.00            1          1.50
0.15      2976.83
  Link-99            IRREGULAR          0.30         10.00            1          1.50
0.15       852.26


  ****************
  Transect Summary
  ****************

  Transect 18m ROW
  Area:
             0.0005     0.0018     0.0041     0.0073     0.0114
             0.0165     0.0224     0.0293     0.0370     0.0457
             0.0553     0.0658     0.0773     0.0896     0.1029
             0.1171     0.1321     0.1481     0.1651     0.1829
             0.2016     0.2211     0.2405     0.2600     0.2795
             0.2993     0.3200     0.3413     0.3634     0.3863
             0.4099     0.4342     0.4593     0.4852     0.5117
             0.5391     0.5671     0.5960     0.6255     0.6558
             0.6869     0.7187     0.7513     0.7846     0.8186
             0.8534     0.8889     0.9252     0.9622     1.0000
  Hrad:
             0.0176     0.0351     0.0527     0.0702     0.0878
             0.1053     0.1229     0.1405     0.1580     0.1756
             0.1931     0.2107     0.2282     0.2458     0.2634
             0.2809     0.2985     0.3160     0.3336     0.3511
             0.3687     0.3990     0.4334     0.4678     0.5021
             0.5361     0.5683     0.5989     0.6277     0.6551
             0.6811     0.7058     0.7292     0.7514     0.7726
             0.7928     0.8120     0.8304     0.8479     0.8647
             0.8808     0.8962     0.9109     0.9251     0.9388
             0.9519     0.9646     0.9768     0.9886     1.0000
  Width:
             0.0240     0.0479     0.0719     0.0959     0.1199
             0.1438     0.1678     0.1918     0.2158     0.2397
             0.2637     0.2877     0.3117     0.3356     0.3596
             0.3836     0.4076     0.4315     0.4555     0.4795
             0.5035     0.5098     0.5102     0.5107     0.5111
             0.5307     0.5502     0.5698     0.5893     0.6089
             0.6284     0.6480     0.6676     0.6871     0.7067
             0.7262     0.7458     0.7653     0.7849     0.8044
             0.8240     0.8436     0.8631     0.8827     0.9022
             0.9218     0.9413     0.9609     0.9804     1.0000

  Transect Backyard Swale
  Area:
             0.0004     0.0016     0.0036     0.0064     0.0100
             0.0144     0.0196     0.0256     0.0324     0.0400
             0.0484     0.0576     0.0676     0.0784     0.0900
             0.1024     0.1156     0.1296     0.1444     0.1600
             0.1764     0.1936     0.2116     0.2304     0.2500
             0.2704     0.2916     0.3136     0.3364     0.3600
             0.3844     0.4096     0.4356     0.4624     0.4900
             0.5184     0.5476     0.5776     0.6084     0.6400
             0.6724     0.7056     0.7396     0.7744     0.8100
             0.8464     0.8836     0.9216     0.9604     1.0000
  Hrad:
             0.0200     0.0400     0.0600     0.0800     0.1000
```

	0.1200	0.1400	0.1600	0.1800	0.2000
	0.2200	0.2400	0.2600	0.2800	0.3000
	0.3200	0.3400	0.3600	0.3800	0.4000
	0.4200	0.4400	0.4600	0.4800	0.5000
	0.5200	0.5400	0.5600	0.5800	0.6000
	0.6200	0.6400	0.6600	0.6800	0.7000
	0.7200	0.7400	0.7600	0.7800	0.8000
	0.8200	0.8400	0.8600	0.8800	0.9000
	0.9200	0.9400	0.9600	0.9800	1.0000
Width:					
	0.0200	0.0400	0.0600	0.0800	0.1000
	0.1200	0.1400	0.1600	0.1800	0.2000
	0.2200	0.2400	0.2600	0.2800	0.3000
	0.3200	0.3400	0.3600	0.3800	0.4000
	0.4200	0.4400	0.4600	0.4800	0.5000
	0.5200	0.5400	0.5600	0.5800	0.6000
	0.6200	0.6400	0.6600	0.6800	0.7000
	0.7200	0.7400	0.7600	0.7800	0.8000
	0.8200	0.8400	0.8600	0.8800	0.9000
	0.9200	0.9400	0.9600	0.9800	1.0000

Transect Outlet Swale

Area:					
	0.0004	0.0016	0.0035	0.0062	0.0097
	0.0140	0.0191	0.0249	0.0315	0.0389
	0.0471	0.0560	0.0658	0.0763	0.0876
	0.0996	0.1125	0.1261	0.1405	0.1557
	0.1716	0.1884	0.2059	0.2242	0.2432
	0.2631	0.2837	0.3051	0.3273	0.3503
	0.3740	0.3985	0.4238	0.4499	0.4768
	0.5044	0.5328	0.5620	0.5920	0.6227
	0.6542	0.6866	0.7203	0.7556	0.7924
	0.8308	0.8708	0.9123	0.9554	1.0000
Hrad:					
	0.0183	0.0365	0.0548	0.0730	0.0913
	0.1095	0.1278	0.1461	0.1643	0.1826
	0.2008	0.2191	0.2373	0.2556	0.2738
	0.2921	0.3104	0.3286	0.3469	0.3651
	0.3834	0.4016	0.4199	0.4382	0.4564
	0.4747	0.4929	0.5112	0.5294	0.5477
	0.5660	0.5842	0.6025	0.6207	0.6390
	0.6572	0.6755	0.6938	0.7120	0.7303
	0.7485	0.7727	0.8072	0.8396	0.8701
	0.8989	0.9261	0.9520	0.9765	1.0000
Width:					
	0.0171	0.0343	0.0514	0.0686	0.0857
	0.1029	0.1200	0.1371	0.1543	0.1714
	0.1886	0.2057	0.2229	0.2400	0.2571
	0.2743	0.2914	0.3086	0.3257	0.3429
	0.3600	0.3771	0.3943	0.4114	0.4286
	0.4457	0.4629	0.4800	0.4971	0.5143
	0.5314	0.5486	0.5657	0.5829	0.6000
	0.6171	0.6343	0.6514	0.6686	0.6857
	0.7029	0.7257	0.7600	0.7943	0.8286
	0.8629	0.8971	0.9314	0.9657	1.0000

Transect ROW Crown

Area:					
	0.0004	0.0016	0.0036	0.0064	0.0100
	0.0144	0.0196	0.0256	0.0324	0.0400
	0.0484	0.0576	0.0676	0.0784	0.0900
	0.1024	0.1156	0.1296	0.1444	0.1600
	0.1764	0.1936	0.2116	0.2304	0.2500
	0.2704	0.2916	0.3136	0.3364	0.3600
	0.3844	0.4096	0.4356	0.4624	0.4900
	0.5184	0.5476	0.5776	0.6084	0.6400
	0.6724	0.7056	0.7396	0.7744	0.8100
	0.8464	0.8836	0.9216	0.9604	1.0000
Hrad:					
	0.0200	0.0400	0.0600	0.0800	0.1000

```
            0.1200      0.1400      0.1600      0.1800      0.2000
            0.2200      0.2400      0.2600      0.2800      0.3000
            0.3200      0.3400      0.3600      0.3800      0.4000
            0.4200      0.4400      0.4600      0.4800      0.5000
            0.5200      0.5400      0.5600      0.5800      0.6000
            0.6200      0.6400      0.6600      0.6800      0.7000
            0.7200      0.7400      0.7600      0.7800      0.8000
            0.8200      0.8400      0.8600      0.8800      0.9000
            0.9200      0.9400      0.9600      0.9800      1.0000
Width:
            0.0200      0.0400      0.0600      0.0800      0.1000
            0.1200      0.1400      0.1600      0.1800      0.2000
            0.2200      0.2400      0.2600      0.2800      0.3000
            0.3200      0.3400      0.3600      0.3800      0.4000
            0.4200      0.4400      0.4600      0.4800      0.5000
            0.5200      0.5400      0.5600      0.5800      0.6000
            0.6200      0.6400      0.6600      0.6800      0.7000
            0.7200      0.7400      0.7600      0.7800      0.8000
            0.8200      0.8400      0.8600      0.8800      0.9000
            0.9200      0.9400      0.9600      0.9800      1.0000


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         1.181        76.023
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.269        17.285
Surface Runoff ...........         0.911        58.618
Final Surface Storage ....         0.010         0.660
Continuity Error (%) .....        -0.710


**************************        Volume        Volume
Flow Routing Continuity        hectare-m       Mliters
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.911         9.109
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.066         0.662
External Outflow .........         0.972         9.717
Surface Flooding .........         0.000         0.000
Evaporation Loss .........         0.000         0.000
Initial Stored Volume ....         0.040         0.405
Final Stored Volume ......         0.045         0.452
Continuity Error (%) .....         0.070


**************************************************
EPA SWMM Time of Concentration Computations Report
**************************************************

        Tc = (0.94 * (L^0.6) * (n^0.6)) / ((i^0.4) * (S^0.3))

        Where:

        Tc = Time of Concentration (min)
        L  = Flow Length (ft)
        n  = Manning's Roughness
        i  = Rainfall Intensity (in/hr)
        S  = Slope (ft/ft)

----------------------
Subbasin {SDA}.109b
----------------------

        Flow length (m):                             46.40
        Pervious Manning's Roughness:              0.25000
```

```
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     35.44

---------------------
Subbasin {SDA}.624
---------------------

        Flow length (m):                           222.64
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     54.42

---------------------
Subbasin {SDA}.625
---------------------

        Flow length (m):                            91.67
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     46.41

---------------------
Subbasin {SDA}.627
---------------------

        Flow length (m):                           191.32
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     49.69

---------------------
Subbasin {SDA}.628
---------------------

        Flow length (m):                            38.75
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     31.81

---------------------
Subbasin {SDA}.629
---------------------

        Flow length (m):                            40.25
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     32.55

---------------------
Subbasin {SDA}.630
---------------------
```

```
        Flow length (m):                              35.00
        Pervious Manning's Roughness:               0.25000
        Impervious Manning's Roughness:             0.01300
        Pervious Rainfall Intensity (mm/hr):       19.00583
        Impervious Rainfall Intensity (mm/hr):     19.00583
        Slope (%):                                  0.50000
        Computed TOC (minutes):                       29.93

---------------------
Subbasin {SDA}.632
---------------------

        Flow length (m):                             122.95
        Pervious Manning's Roughness:               0.25000
        Impervious Manning's Roughness:             0.01300
        Pervious Rainfall Intensity (mm/hr):       19.00583
        Impervious Rainfall Intensity (mm/hr):     19.00583
        Slope (%):                                  0.50000
        Computed TOC (minutes):                       38.11

---------------------
Subbasin {SDA}.633
---------------------

        Flow length (m):                             153.00
        Pervious Manning's Roughness:               0.25000
        Impervious Manning's Roughness:             0.01300
        Pervious Rainfall Intensity (mm/hr):       19.00583
        Impervious Rainfall Intensity (mm/hr):     19.00583
        Slope (%):                                  0.50000
        Computed TOC (minutes):                       43.45

---------------------
Subbasin {SDA}.634
---------------------

        Flow length (m):                              50.00
        Pervious Manning's Roughness:               0.25000
        Impervious Manning's Roughness:             0.01300
        Pervious Rainfall Intensity (mm/hr):       19.00583
        Impervious Rainfall Intensity (mm/hr):     19.00583
        Slope (%):                                  0.50000
        Computed TOC (minutes):                       34.77

---------------------
Subbasin {SDA}.638
---------------------

        Flow length (m):                              27.60
        Pervious Manning's Roughness:               0.25000
        Impervious Manning's Roughness:             0.01300
        Pervious Rainfall Intensity (mm/hr):       19.00583
        Impervious Rainfall Intensity (mm/hr):     19.00583
        Slope (%):                                  0.50000
        Computed TOC (minutes):                       24.34

---------------------
Subbasin {SDA}.639
---------------------

        Flow length (m):                              32.50
        Pervious Manning's Roughness:               0.25000
        Impervious Manning's Roughness:             0.01300
        Pervious Rainfall Intensity (mm/hr):       19.00583
        Impervious Rainfall Intensity (mm/hr):     19.00583
        Slope (%):                                  0.50000
        Computed TOC (minutes):                       26.85

---------------------
Subbasin {SDA}.641
```

Flow length (m): 78.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 38.51

Subbasin {SDA}.642

Flow length (m): 86.67
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 44.87

Subbasin {SDA}.643

Flow length (m): 95.21
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 47.48

Subbasin {SDA}.663

Flow length (m): 51.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 37.51

Subbasin {SDA}.664

Flow length (m): 94.58
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 47.29

Subbasin {SDA}.666

Flow length (m): 72.50
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 40.32

Subbasin {SDA}.667

```
        Flow length (m):                             70.20
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      36.15
```

Subbasin {SDA}.668

```
        Flow length (m):                             50.00
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      37.07
```

Subbasin {SDA}.670

```
        Flow length (m):                            145.83
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      61.32
```

Subbasin {SDA}.671

```
        Flow length (m):                             57.89
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      35.23
```

Subbasin {SDA}.672

```
        Flow length (m):                             42.40
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      33.58
```

Subbasin {SDA}.673

```
        Flow length (m):                             73.95
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
```

```
        Computed TOC (minutes):                      40.80

---------------------
Subbasin {SDA}.674
---------------------

        Flow length (m):                             78.16
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      42.17

---------------------
Subbasin {SDA}.675
---------------------

        Flow length (m):                             72.08
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      40.18

---------------------
Subbasin {SDA}.704
---------------------

        Flow length (m):                            100.00
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      48.90

---------------------
Subbasin {SDA}.708
---------------------

        Flow length (m):                             59.60
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      35.84

---------------------
Subbasin {SDA}.713
---------------------

        Flow length (m):                             20.75
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
        Impervious Rainfall Intensity (mm/hr):    19.00583
        Slope (%):                                 0.50000
        Computed TOC (minutes):                      21.87

---------------------
Subbasin {SDA}.716
---------------------

        Flow length (m):                             45.00
        Pervious Manning's Roughness:              0.25000
        Impervious Manning's Roughness:            0.01300
        Pervious Rainfall Intensity (mm/hr):      19.00583
```

```
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     34.80

---------------------
Subbasin {SDA}.717
---------------------

        Flow length (m):                            65.00
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     37.76

---------------------
Subbasin {SDA}.718
---------------------

        Flow length (m):                            42.60
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     33.67

---------------------
Subbasin {SDA}.719
---------------------

        Flow length (m):                            54.74
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     34.06

---------------------
Subbasin {SDA}.720
---------------------

        Flow length (m):                            72.71
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     40.39

---------------------
Subbasin {SDA}.721
---------------------

        Flow length (m):                            98.75
        Pervious Manning's Roughness:             0.25000
        Impervious Manning's Roughness:           0.01300
        Pervious Rainfall Intensity (mm/hr):     19.00583
        Impervious Rainfall Intensity (mm/hr):   19.00583
        Slope (%):                                0.50000
        Computed TOC (minutes):                     48.53

---------------------
Subbasin {SDA}.722
---------------------

        Flow length (m):                            52.50
        Pervious Manning's Roughness:             0.25000
```

```
        Impervious Manning's Roughness:          0.01300
        Pervious Rainfall Intensity (mm/hr):    19.00583
        Impervious Rainfall Intensity (mm/hr):  19.00583
        Slope (%):                               0.50000
        Computed TOC (minutes):                    38.17

  ---------------------
  Subbasin {SDA}.723
  ---------------------

        Flow length (m):                           80.53
        Pervious Manning's Roughness:            0.25000
        Impervious Manning's Roughness:          0.01300
        Pervious Rainfall Intensity (mm/hr):    19.00583
        Impervious Rainfall Intensity (mm/hr):  19.00583
        Slope (%):                               0.50000
        Computed TOC (minutes):                    42.94

  ---------------------
  Subbasin {SDA}.730
  ---------------------

        Flow length (m):                           40.00
        Pervious Manning's Roughness:            0.25000
        Impervious Manning's Roughness:          0.01300
        Pervious Rainfall Intensity (mm/hr):    19.00583
        Impervious Rainfall Intensity (mm/hr):  19.00583
        Slope (%):                               0.50000
        Computed TOC (minutes):                    30.41

  ---------------------
  Subbasin {SDA}.739
  ---------------------

        Flow length (m):                           50.25
        Pervious Manning's Roughness:            0.25000
        Impervious Manning's Roughness:          0.01300
        Pervious Rainfall Intensity (mm/hr):    19.00583
        Impervious Rainfall Intensity (mm/hr):  19.00583
        Slope (%):                               0.50000
        Computed TOC (minutes):                    37.18

  -----------------------
  Subbasin 700_union_1
  -----------------------

        Flow length (m):                           88.00
        Pervious Manning's Roughness:            0.25000
        Impervious Manning's Roughness:          0.01300
        Pervious Rainfall Intensity (mm/hr):    19.00583
        Impervious Rainfall Intensity (mm/hr):  19.00583
        Slope (%):                               0.50000
        Computed TOC (minutes):                    45.29


  ***********************
  Subbasin Runoff Summary
  ***********************

---------------------------------------------------------------------------------------------
------------
  Subbasin            Total      Total      Total      Total      Total       Peak       Runoff
      Time of
  ID               Rainfall      Runon      Evap.     Infil.     Runoff     Runoff  Coefficient
Concentration
                         mm         mm         mm         mm         mm        LPS
days  hh:mm:ss

---------------------------------------------------------------------------------------------
```

{SDA}.109b	76.02	0.00	0.00	30.69	46.00	128.03	0.605	0 00:35:26
{SDA}.624	76.02	0.00	0.00	7.12	68.52	439.00	0.901	0 00:54:25
{SDA}.625	76.02	0.00	0.00	18.38	57.12	53.70	0.751	0 00:46:24
{SDA}.627	76.02	0.00	0.00	7.03	68.64	389.72	0.903	0 00:49:41
{SDA}.628	76.02	0.00	0.00	30.44	46.26	18.04	0.609	0 00:31:48
{SDA}.629	76.02	0.00	0.00	30.49	46.21	46.38	0.608	0 00:32:32
{SDA}.630	76.02	0.00	0.00	30.31	46.40	31.31	0.610	0 00:29:55
{SDA}.632	76.02	0.00	0.00	6.83	68.53	446.34	0.901	0 00:38:06
{SDA}.633	76.02	0.00	0.00	6.93	68.39	734.36	0.900	0 00:43:27
{SDA}.634	76.02	0.00	0.00	27.35	49.40	42.73	0.650	0 00:34:46
{SDA}.638	76.02	0.00	0.00	26.84	49.92	25.30	0.657	0 00:24:20
{SDA}.639	76.02	0.00	0.00	26.95	49.81	44.80	0.655	0 00:26:50
{SDA}.641	76.02	0.00	0.00	14.40	61.38	141.30	0.807	0 00:38:30
{SDA}.642	76.02	0.00	0.00	18.30	57.51	135.96	0.756	0 00:44:52
{SDA}.643	76.02	0.00	0.00	18.44	57.36	148.32	0.754	0 00:47:28
{SDA}.663	76.02	0.00	0.00	30.84	45.84	136.12	0.603	0 00:37:30
{SDA}.664	76.02	0.00	0.00	18.43	57.37	147.42	0.755	0 00:47:17
{SDA}.666	76.02	0.00	0.00	18.05	57.77	115.18	0.760	0 00:40:18
{SDA}.667	76.02	0.00	0.00	14.30	61.49	128.10	0.809	0 00:36:09
{SDA}.668	76.02	0.00	0.00	30.80	45.87	134.43	0.603	0 00:37:04
{SDA}.670	76.02	0.00	0.00	19.16	56.59	218.44	0.744	0 01:01:19
{SDA}.671	76.02	0.00	0.00	17.78	58.05	73.94	0.764	0 00:35:13
{SDA}.672	76.02	0.00	0.00	30.56	46.14	120.34	0.607	0 00:33:34
{SDA}.673	76.02	0.00	0.00	18.08	57.74	92.88	0.759	0 00:40:47
{SDA}.674	76.02	0.00	0.00	18.15	57.66	97.79	0.758	0 00:42:10
{SDA}.675	76.02	0.00	0.00	18.05	57.77	114.56	0.760	0 00:40:10
{SDA}.704	76.02	0.00	0.00	18.52	56.97	71.12	0.749	0 00:48:53
{SDA}.708	76.02	0.00	0.00	17.81	58.02	49.98	0.763	0 00:35:50
{SDA}.713	76.02	0.00	0.00	29.83	46.91	30.76	0.617	0 00:21:52
{SDA}.716	76.02	0.00	0.00	30.64	46.05	50.16	0.606	0 00:34:47
{SDA}.717	76.02	0.00	0.00	17.92	57.91	104.03	0.762	0 00:37:45
{SDA}.718	76.02	0.00	0.00	30.56	46.13	120.74	0.607	0 00:33:40
{SDA}.719	76.02	0.00	0.00	17.72	58.12	70.17	0.764	0 00:34:03
{SDA}.720	76.02	0.00	0.00	18.06	57.76	115.48	0.760	0 00:40:23
{SDA}.721	76.02	0.00	0.00	18.50	57.30	153.40	0.754	

								0	00:48:31
{SDA}.722	76.02	0.00	0.00	30.89	45.79	55.44	0.602	0	00:38:10
{SDA}.723	76.02	0.00	0.00	18.20	57.62	100.54	0.758	0	00:42:56
{SDA}.730	76.02	0.00	0.00	27.12	49.64	32.20	0.653	0	00:30:24
{SDA}.739	76.02	0.00	0.00	30.81	45.86	53.94	0.603	0	00:37:10
700_union_1	76.02	0.00	0.00	18.32	57.48	71.82	0.756	0	00:45:17

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Node Depth Summary
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Node ID	Average Depth Attained m	Maximum Depth Attained m	Maximum HGL Attained m	Time of Max Occurrence days	hh:mm	Total Flooded Volume ha-mm	Total Time Flooded minutes	Retention Time hh:mm:ss
10+053	0.00	0.16	103.32	0	01:56	0	0	0:00:00
11+001	0.00	0.00	104.63	0	00:00	0	0	0:00:00
12+001	0.00	0.00	104.55	0	00:00	0	0	0:00:00
12+185	0.00	0.02	103.34	0	02:00	0	0	0:00:00
12+228	0.00	0.02	103.34	0	02:01	0	0	0:00:00
12+254	0.00	0.00	103.41	0	00:00	0	0	0:00:00
12+309	0.00	0.00	103.94	0	00:00	0	0	0:00:00
309 (STM)	0.31	0.68	101.41	0	01:56	0	0	0:00:00
343 (STM)	1.47	1.92	100.63	0	01:56	0	0	0:00:00
345 (STM)	0.00	0.01	101.46	0	01:55	0	0	0:00:00
347 (STM)	1.11	1.90	100.98	0	01:56	0	0	0:00:00
349 (STM)	0.01	0.50	101.26	0	01:55	0	0	0:00:00
351 (STM)	0.58	1.67	101.28	0	01:56	0	0	0:00:00
353 (STM)	0.00	0.00	101.42	0	01:47	0	0	0:00:00
357 (STM)	0.05	0.30	102.27	0	01:56	0	0	0:00:00
357A (STM)	0.01	0.22	102.56	0	02:08	0	0	0:00:00
359 (STM)	0.02	0.27	102.80	0	01:56	0	0	0:00:00
359A (STM)	0.01	0.17	102.80	0	01:56	0	0	0:00:00
373 (STM)	1.24	1.36	102.24	0	01:56	0	0	0:00:00
373A (STM)	0.52	3.00	104.65	0	01:50	0	0	0:00:00
375 (STM)	0.90	1.17	102.39	0	01:56	0	0	0:00:00
377 (STM)	0.75	1.12	102.49	0	01:56	0	0	0:00:00
379 (STM)	0.46	0.96	102.62	0	01:57	0	0	0:00:00
379A (STM)	0.10	3.26	105.39	0	01:50	0	0	0:00:00
381 (STM)	0.33	0.91	102.70	0	01:58	0	0	0:00:00
383 (STM)	0.09	0.86	102.92	0	01:59	0	0	0:00:00
385 (STM)	0.08	0.90	102.98	0	02:00	0	0	0:00:00
387 (STM)	0.06	0.89	103.07	0	02:00	0	0	0:00:00
387A (STM)	0.06	0.79	103.13	0	02:00	0	0	0:00:00
389 (STM)	0.02	0.30	103.17	0	02:00	0	0	0:00:00
391 (STM)	1.53	1.76	100.40	0	01:56	0	0	0:00:00
393 (STM)	0.02	0.34	101.46	0	01:55	0	0	0:00:00
395 (STM)	1.39	1.94	100.73	0	01:56	0	0	0:00:00
397 (STM)	0.10	1.48	101.57	0	01:43	0	0	0:00:00
399 (STM)	0.02	0.73	101.44	0	01:47	0	0	0:00:00
4+345	0.00	0.08	104.57	0	01:53	0	0	0:00:00
4+420	0.00	0.00	104.70	0	00:00	0	0	0:00:00
4+510	0.00	0.05	104.79	0	01:55	0	0	0:00:00
4+568	0.00	0.07	105.07	0	01:50	0	0	0:00:00
4+665	0.00	0.00	105.21	0	00:00	0	0	0:00:00
4+750	0.00	0.00	105.31	0	00:00	0	0	0:00:00
4+828	0.00	0.00	105.41	0	00:00	0	0	0:00:00
417 (STM)	0.31	1.51	101.40	0	01:56	0	0	0:00:00
419 (STM)	0.11	0.82	102.86	0	01:59	0	0	0:00:00

6+088	0.00	0.04	104.47	0	01:52	0	0	0:00:00
6+102	0.00	0.05	104.66	0	01:57	0	0	0:00:00
7+096	0.00	0.00	105.19	0	00:00	0	0	0:00:00
703 (STM)	1.31	1.37	102.17	0	01:56	0	0	0:00:00
8+128	0.00	0.05	104.91	0	01:55	0	0	0:00:00
8+150	0.00	0.00	104.77	0	00:00	0	0	0:00:00
CB101-102 (STM)	0.18	0.90	103.80	0	01:56	0	0	0:00:00
CB111-112	0.03	0.84	103.86	0	01:50	0	0	0:00:00
CB113-114 (STM)	0.04	1.63	104.24	0	01:54	0	0	0:00:00
CB115-116 (STM)	0.06	1.58	104.57	0	01:54	0	0	0:00:00
CB117-118 (STM)	0.05	1.45	104.65	0	02:01	0	0	0:00:00
CB119-120 (STM)	0.03	1.10	104.91	0	01:54	0	0	0:00:00
CB121-122 (STM)	0.04	1.51	104.91	0	01:54	0	0	0:00:00
CB123-124 (STM)	0.05	1.52	105.06	0	01:56	0	0	0:00:00
CB125-126 (STM)	0.05	1.90	104.49	0	01:51	0	0	0:00:00
CB127-128 (STM)	0.04	1.31	104.66	0	01:57	0	0	0:00:00
CB129-130 (STM)	0.04	1.48	105.06	0	01:54	0	0	0:00:00
CB131-132 (STM)	0.05	1.45	105.18	0	01:56	0	0	0:00:00
CB133-134 (STM)	0.05	1.65	105.22	0	01:54	0	0	0:00:00
CB85-86 (STM)	0.04	1.39	103.19	0	01:54	0	0	0:00:00
CB87-88 (STM)	0.05	2.06	103.60	0	01:50	0	0	0:00:00
CB89-90 (STM)	0.04	1.05	103.34	0	02:00	0	0	0:00:00
CB91-92 (STM)	0.03	0.85	103.31	0	01:54	0	0	0:00:00
CB93-94 (STM)	0.04	1.95	103.64	0	01:50	0	0	0:00:00
CB95-96 (STM)	0.02	0.87	103.35	0	01:58	0	0	0:00:00
CB97-98 (STM)	0.06	1.67	103.91	0	01:57	0	0	0:00:00
E-34	0.03	1.49	104.01	0	01:52	0	0	0:00:00
Jun-35	0.00	0.10	103.38	0	01:55	0	0	0:00:00
Jun-37	0.00	0.09	103.55	0	01:55	0	0	0:00:00
Jun-40	0.00	0.08	104.22	0	01:55	0	0	0:00:00
Jun-43	0.00	0.08	104.95	0	01:55	0	0	0:00:00
Jun-51	0.00	0.05	104.50	0	01:55	0	0	0:00:00
RYCB-21 (STM)	0.35	2.40	105.38	0	01:55	0	0	0:00:00
RYCB-22 (STM)	0.35	1.97	104.96	0	01:55	0	0	0:00:00
RYCB-23 (STM)	0.35	2.03	104.24	0	01:55	0	0	0:00:00
RYCB-24 (STM)	0.43	2.19	103.55	0	01:55	0	0	0:00:00
RYCB-25 (STM)	0.36	2.54	103.39	0	01:55	0	0	0:00:00
RYCB-27 (STM)	0.04	2.23	103.46	0	01:55	0	0	0:00:00
RYCB-28 (STM)	0.34	2.38	103.54	0	01:55	0	0	0:00:00
RYCB-30 (STM)	0.35	2.57	105.09	0	01:51	0	0	0:00:00
RYCB-31 (STM)	0.32	2.07	104.90	0	01:51	0	0	0:00:00
RYCB-32 (STM)	0.33	1.91	104.75	0	01:55	0	0	0:00:00
RYCB-33 (STM)	0.34	2.69	104.59	0	01:55	0	0	0:00:00
RYCB-34 (STM)	0.32	1.83	103.99	0	01:55	0	0	0:00:00
RYCB-38 (STM)	0.33	1.49	105.41	0	01:55	0	0	0:00:00
RYCB-39 (STM)	0.04	1.77	105.45	0	01:55	0	0	0:00:00
RYCBMH-2 (STM)	0.34	1.80	103.40	0	01:55	0	0	0:00:00
EX341 (STM)	1.64	1.64	100.17	0	00:00	0	0	0:00:00
EX363 (STM)	1.71	1.71	102.11	0	00:00	0	0	0:00:00
MAJ-Easement	0.00	0.16	103.16	0	01:56	0	0	0:00:00
MAJ-Haliburton	0.02	0.06	103.79	0	01:56	0	0	0:00:00
MAJ-Shinny	0.00	0.00	104.12	0	00:00	0	0	0:00:00
MAJ-Slapshot	0.00	0.00	105.10	0	00:00	0	0	0:00:00
Off-site	0.12	2.38	104.74	0	02:02	0	0	0:00:00

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Node Flow Summary
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Node ID	Element Type	Maximum Lateral Inflow LPS	Peak Inflow LPS	Time of Peak Inflow Occurrence days	Time of Peak Inflow Occurrence hh:mm	Maximum Flooding Overflow LPS	Time of Peak Flooding Occurrence days	Time of Peak Flooding Occurrence hh:mm
10+053	JUNCTION	0.00	116.76	0	01:55	0.00		
11+001	JUNCTION	0.00	0.00	0	00:00	0.00		
12+001	JUNCTION	0.00	0.00	0	00:00	0.00		
12+185	JUNCTION	0.00	16.98	0	01:55	0.00		

12+228	JUNCTION	0.00	17.13	0	01:56	0.00
12+254	JUNCTION	0.00	0.00	0	00:00	0.00
12+309	JUNCTION	0.00	0.00	0	00:00	0.00
309 (STM)	JUNCTION	0.00	19.11	0	01:47	0.00
343 (STM)	JUNCTION	0.00	1056.66	0	01:56	0.00
345 (STM)	JUNCTION	0.00	0.12	0	01:48	0.00
347 (STM)	JUNCTION	0.00	890.41	0	01:56	0.00
349 (STM)	JUNCTION	0.00	21.59	0	01:43	0.00
351 (STM)	JUNCTION	0.00	615.76	0	01:59	0.00
353 (STM)	JUNCTION	0.00	0.22	0	01:47	0.00
357 (STM)	JUNCTION	0.00	328.42	0	01:55	0.00
357A (STM)	JUNCTION	0.00	117.23	0	01:55	0.00
359 (STM)	JUNCTION	0.00	126.09	0	01:44	0.00
359A (STM)	JUNCTION	0.00	80.89	0	01:56	0.00
373 (STM)	JUNCTION	0.00	1465.43	0	01:57	0.00
373A (STM)	JUNCTION	439.00	439.00	0	01:50	0.00
375 (STM)	JUNCTION	0.00	1298.54	0	01:57	0.00
377 (STM)	JUNCTION	0.00	1201.13	0	01:57	0.00
379 (STM)	JUNCTION	0.00	1072.64	0	02:01	0.00
379A (STM)	JUNCTION	389.72	389.72	0	01:50	0.00
381 (STM)	JUNCTION	0.00	830.64	0	02:01	0.00
383 (STM)	JUNCTION	0.00	672.93	0	02:11	0.00
385 (STM)	JUNCTION	0.00	655.59	0	02:11	0.00
387 (STM)	JUNCTION	0.00	639.85	0	02:02	0.00
387A (STM)	JUNCTION	0.00	476.90	0	02:02	0.00
389 (STM)	JUNCTION	0.00	84.54	0	01:54	0.00
391 (STM)	JUNCTION	0.00	1166.12	0	01:56	0.00
393 (STM)	JUNCTION	0.00	166.56	0	01:53	0.00
395 (STM)	JUNCTION	0.00	890.41	0	01:56	0.00
397 (STM)	JUNCTION	0.00	141.46	0	01:54	0.00
399 (STM)	JUNCTION	0.00	106.97	0	01:57	0.00
4+345	JUNCTION	0.00	269.92	0	01:50	0.00
4+420	JUNCTION	0.00	0.00	0	00:00	0.00
4+510	JUNCTION	0.00	55.53	0	01:54	0.00
4+568	JUNCTION	0.00	245.28	0	01:50	0.00
4+665	JUNCTION	0.00	0.00	0	00:00	0.00
4+750	JUNCTION	0.00	0.00	0	00:00	0.00
4+828	JUNCTION	0.00	0.00	0	00:00	0.00
417 (STM)	JUNCTION	0.00	372.97	0	02:04	0.00
419 (STM)	JUNCTION	0.00	767.22	0	02:02	0.00
6+088	JUNCTION	0.00	42.99	0	01:51	0.00
6+102	JUNCTION	0.00	44.16	0	01:56	0.00
7+096	JUNCTION	0.00	0.00	0	00:00	0.00
703 (STM)	JUNCTION	0.00	1565.99	0	01:56	0.00
8+128	JUNCTION	0.00	62.75	0	01:52	0.00
8+150	JUNCTION	0.00	0.00	0	00:00	0.00
CB101-102 (STM)	JUNCTION	71.12	175.33	0	01:51	0.00
CB111-112	JUNCTION	49.98	49.98	0	01:50	0.00
CB113-114 (STM)	JUNCTION	100.54	249.88	0	01:53	0.00
CB115-116 (STM)	JUNCTION	97.79	244.87	0	01:50	0.00
CB117-118 (STM)	JUNCTION	92.88	97.85	0	01:54	0.00
CB119-120 (STM)	JUNCTION	53.70	257.60	0	02:05	0.00
CB121-122 (STM)	JUNCTION	128.10	237.25	0	01:50	0.00
CB123-124 (STM)	JUNCTION	115.18	214.44	0	01:50	0.00
CB125-126 (STM)	JUNCTION	147.42	147.42	0	01:50	0.00
CB127-128 (STM)	JUNCTION	71.82	115.60	0	01:52	0.00
CB129-130 (STM)	JUNCTION	141.30	194.73	0	01:50	0.00
CB131-132 (STM)	JUNCTION	135.96	149.91	0	01:50	0.00
CB133-134 (STM)	JUNCTION	148.32	148.32	0	01:50	0.00
CB85-86 (STM)	JUNCTION	153.40	193.96	0	01:50	0.00
CB87-88 (STM)	JUNCTION	115.48	115.48	0	01:50	0.00
CB89-90 (STM)	JUNCTION	70.17	117.79	0	01:51	0.00
CB91-92 (STM)	JUNCTION	104.03	146.01	0	01:50	0.00
CB93-94 (STM)	JUNCTION	114.56	114.56	0	01:50	0.00
CB95-96 (STM)	JUNCTION	73.94	103.23	0	01:52	0.00
CB97-98 (STM)	JUNCTION	218.44	218.44	0	01:50	0.00
E-34	JUNCTION	30.76	30.76	0	01:50	0.00
Jun-35	JUNCTION	0.00	69.68	0	01:55	0.00
Jun-37	JUNCTION	0.00	55.24	0	01:55	0.00
Jun-40	JUNCTION	0.00	69.90	0	01:55	0.00

Jun-43	JUNCTION	0.00	73.35	0	01:55	0.00
Jun-51	JUNCTION	0.00	21.74	0	01:55	0.00
RYCB-21 (STM)	JUNCTION	53.94	53.94	0	01:55	0.00
RYCB-22 (STM)	JUNCTION	136.12	136.12	0	01:55	0.00
RYCB-23 (STM)	JUNCTION	134.43	134.43	0	01:55	0.00
RYCB-24 (STM)	JUNCTION	120.34	120.34	0	01:55	0.00
RYCB-25 (STM)	JUNCTION	120.74	120.74	0	01:55	0.00
RYCB-27 (STM)	JUNCTION	55.44	78.89	0	01:55	0.00
RYCB-28 (STM)	JUNCTION	50.16	60.04	0	01:55	0.00
RYCB-30 (STM)	JUNCTION	44.80	44.80	0	01:50	0.00
RYCB-31 (STM)	JUNCTION	25.30	25.30	0	01:50	0.00
RYCB-32 (STM)	JUNCTION	31.31	31.31	0	01:55	0.00
RYCB-33 (STM)	JUNCTION	46.38	59.21	0	01:55	0.00
RYCB-34 (STM)	JUNCTION	18.04	18.04	0	01:55	0.00
RYCB-38 (STM)	JUNCTION	32.20	32.20	0	01:55	0.00
RYCB-39 (STM)	JUNCTION	42.73	42.73	0	01:55	0.00
RYCBMH-2 (STM)	JUNCTION	128.03	128.03	0	01:55	0.00
EX341 (STM)	OUTFALL	0.00	1166.13	0	01:56	0.00
EX363 (STM)	OUTFALL	0.00	1566.02	0	01:56	0.00
MAJ-Easement	OUTFALL	0.00	105.29	0	01:56	0.00
MAJ-Haliburton	OUTFALL	0.00	113.37	0	01:56	0.00
MAJ-Shinny	OUTFALL	0.00	128.49	0	01:54	0.00
MAJ-Slapshot	OUTFALL	0.00	26.54	0	01:55	0.00
Off-site	STORAGE	1180.70	1180.70	0	01:50	0.00

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Storage Node Summary
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Storage Node ID	Maximum Ponded Volume 1000 m³	Maximum Ponded Volume (%)	Time of Max Ponded Volume days hh:mm	Average Ponded Volume 1000 m³	Average Ponded Volume (%)	Maximum Storage Node Outflow LPS	Maximum Exfiltration Rate cmm	Time of Max. Exfiltration Rate hh:mm:ss	Total Exfiltrated Volume 1000 m³
Off-site	0.438	73	0 02:02	0.010	2	448.44	0.00	0:00:00	0.000

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Outfall Loading Summary
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Outfall Node ID	Flow Frequency (%)	Average Flow LPS	Peak Inflow LPS
EX341 (STM)	100.00	46.87	1166.13
EX363 (STM)	79.33	80.10	1566.02
MAJ-Easement	3.39	23.58	105.29
MAJ-Haliburton	99.99	7.70	113.37
MAJ-Shinny	1.62	66.10	128.49
MAJ-Slapshot	1.52	14.26	26.54
System	47.64	238.62	3100.89

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Link Flow Summary
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Link ID	Element Type	Time of Peak Flow Occurrence (days hh:mm)	Maximum Velocity Attained (m/sec)	Length Factor	Peak Flow during Analysis (LPS)	Design Flow Capacity (LPS)	Ratio of Maximum /Design Flow	Ratio of Maximum Flow Depth	Total Time Surcharged (minutes)	Reported Condition
{STM}.STM Pipe - (190) (STM)	CONDUIT	0 02:14	1.10	1.00	482.39	828.28	0.58	0.88	0	Calculated
{STM}.STM Pipe - (199) (STM)	CONDUIT	0 01:55	1.42	1.00	117.25	281.79	0.42	0.56	0	Calculated
{STM}.STM Pipe - (390) (STM)	CONDUIT	0 02:04	1.81	1.00	332.11	704.54	0.47	0.78	0	Calculated
{STM}.STM Pipe - (69) (1) (1) (STM)	CONDUIT	0 01:56	1.61	1.00	1056.68	806.02	1.31	1.00	1439	SURCHARGED
{STM}.STM Pipe - (69) (1) (STM)	CONDUIT	0 01:56	1.78	1.00	1166.13	1210.53	0.96	1.00	1439	SURCHARGED
{STM}.STM Pipe - (70) (1) (STM)	CONDUIT	0 01:56	1.36	1.00	890.41	1116.74	0.80	1.00	1438	SURCHARGED
{STM}.STM Pipe - (70) (STM)	CONDUIT	0 01:57	1.36	1.00	890.46	1374.48	0.65	1.00	1439	SURCHARGED
{STM}.STM Pipe - (71) (STM)	CONDUIT	0 01:59	1.35	1.00	616.50	688.61	0.90	1.00	40	SURCHARGED
{STM}.STM Pipe - (72) (1) (STM)	CONDUIT	0 02:04	0.41	1.00	26.38	140.53	0.19	1.00	13	SURCHARGED
{STM}.STM Pipe - (72) (STM)	CONDUIT	0 02:04	1.01	1.00	372.63	695.73	0.54	1.00	35	SURCHARGED
{STM}.STM Pipe - (75) (2) (1) (STM)	CONDUIT	0 01:57	0.99	1.00	1465.53	2597.59	0.56	1.00	0	Calculated
{STM}.STM Pipe - (75) (STM)	CONDUIT	0 01:56	1.06	1.00	1566.02	2403.74	0.65	0.99	0	Calculated
{STM}.STM Pipe - (76) (STM)	CONDUIT	0 01:57	1.12	1.00	1298.78	1703.53	0.76	0.97	0	Calculated
{STM}.STM Pipe - (77) (STM)	CONDUIT	0 01:57	1.06	1.00	1201.30	1747.31	0.69	0.94	0	Calculated
{STM}.STM Pipe - (78) (1) (STM)	CONDUIT	0 01:48	0.01	1.00	0.12	81.54	0.00	0.32	0	Calculated
{STM}.STM Pipe - (78) (STM)	CONDUIT	0 01:55	1.40	1.00	166.37	210.00	0.79	0.68	0	Calculated
{STM}.STM Pipe - (79) (1) (STM)	CONDUIT	0 01:43	0.57	1.00	21.59	123.53	0.17	1.00	17	SURCHARGED
{STM}.STM Pipe - (79) (STM)	CONDUIT	0 01:54	0.86	1.00	141.43	209.62	0.67	1.00	29	SURCHARGED
{STM}.STM Pipe - (80) (1) (STM)	CONDUIT	0 01:47	0.01	1.00	0.22	101.06	0.00	0.50	0	Calculated
{STM}.STM Pipe - (80) (STM)	CONDUIT	0 02:12	1.01	1.00	135.97	297.17	0.46	1.00	19	SURCHARGED
{STM}.STM Pipe - (81) (STM)	CONDUIT	0 02:03	1.27	1.00	1073.54	1433.75	0.75	0.90	0	Calculated
{STM}.STM Pipe - (82) (STM)	CONDUIT	0 02:04	1.23	1.00	836.15	1154.69	0.72	0.90	0	Calculated
{STM}.STM Pipe - (83) (1) (STM)	CONDUIT	0 02:10	1.16	1.00	676.78	958.70	0.71	0.92	0	Calculated
{STM}.STM Pipe - (83) (STM)	CONDUIT	0 02:06	1.31	1.00	766.51	942.25	0.81	0.91	0	Calculated
{STM}.STM Pipe - (84) (STM)	CONDUIT	0 02:11	1.06	1.00	657.15	847.10	0.78	0.96	0	Calculated
{STM}.STM Pipe - (85) (STM)	CONDUIT	0 02:11	1.04	1.00	655.59	845.04	0.78	0.98	0	Calculated
{STM}.STM Pipe - (86) (STM)	CONDUIT	0 02:08	0.80	1.00	84.27	132.87	0.63	0.82	0	Calculated
{STM}.STM Pipe - (87) (STM)	CONDUIT	0 01:56	0.77	1.00	43.99					

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144.96      0.30      0.52          0  Calculated
  {STM}.STM Pipe - (88) (STM) CONDUIT      0  01:57      1.33    1.00      124.75
217.08      0.57      0.56          0  Calculated
  Link-02              CONDUIT      0  02:07      0.97    1.00       48.64      29.18
1.67      0.38           0  > CAPACITY
  Link-07              CHANNEL      0  01:54      0.37    1.00      128.49    1599.37
0.08      0.33           0  Calculated
  Link-09              CHANNEL      0  00:00      0.00    1.00        0.00    4835.64
0.00      0.24           0  Calculated
  Link-10              CHANNEL      0  00:00      0.00    1.00        0.00    5150.85
0.00      0.24           0  Calculated
  Link-101             CHANNEL      0  01:55      0.18    1.00       21.68    2182.86
0.01      0.29           0  Calculated
  Link-106             CHANNEL      0  01:55      0.25    1.00       12.84    1205.28
0.01      0.24           0  Calculated
  Link-11              CHANNEL      0  00:00      0.00    1.00        0.00    5252.16
0.00      0.29           0  Calculated
  Link-112             CHANNEL      0  00:00      0.00    1.00        0.00    2612.99
0.00      0.14           0  Calculated
  Link-113             CHANNEL      0  01:50      1.20    1.00      245.28    7253.46
0.03      0.25           0  Calculated
  Link-114             CHANNEL      0  01:50      1.04    1.00      269.92    5128.97
0.05      0.28           0  Calculated
  Link-115             CHANNEL      0  00:00      0.00    1.00        0.00    7724.46
0.00      0.08           0  Calculated
  Link-116             CHANNEL      0  00:00      0.00    1.00        0.00    6480.60
0.00      0.28           0  Calculated
  Link-117             CHANNEL      0  00:00      0.00    1.00        0.00    7043.17
0.00      0.07           0  Calculated
  Link-118             CHANNEL      0  01:55      0.46    1.00       17.89    2410.57
0.01      0.18           0  Calculated
  Link-119             CHANNEL      0  01:55      0.14    1.00       27.73    1867.22
0.01      0.37           0  Calculated
  Link-12              CHANNEL      0  00:00      0.00    1.00        0.00    4959.97
0.00      0.29           0  Calculated
  Link-120             CHANNEL      0  01:56      0.41    1.00      105.29     615.70
0.17      0.53           0  Calculated
  Link-13              CHANNEL      0  00:00      0.00    1.00        0.00    5644.46
0.00      0.29           0  Calculated
  Link-14              CHANNEL      0  01:50      0.27    1.00       42.23    3641.10
0.01      0.37           0  Calculated
  Link-16              CHANNEL      0  01:52      0.11    1.00       62.75    6382.27
0.01      0.44           0  Calculated
  Link-17              CHANNEL      0  01:55      0.18    1.00       89.71    4181.01
0.02      0.54           0  Calculated
  Link-18              CHANNEL      0  02:05      0.61    1.00      241.66    8005.23
0.03      0.36           0  Calculated
  Link-19              CHANNEL      0  01:55      0.14    1.00       49.35    5033.10
0.01      0.36           0  Calculated
  Link-22              CHANNEL      0  01:50      0.47    1.00      150.01    6281.68
0.02      0.57           0  Calculated
  Link-23              CHANNEL      0  01:53      0.49    1.00      162.91    4669.42
0.03      0.33           0  Calculated
  Link-25              CHANNEL      0  01:50      0.43    1.00       91.45    5071.11
0.02      0.45           0  Calculated
  Link-26              CHANNEL      0  01:50      0.46    1.00      102.45    5680.59
0.02      0.49           0  Calculated
  Link-30              CHANNEL      0  00:00      0.00    1.00        0.00    5184.30
0.00      0.40           0  Calculated
  Link-31              CHANNEL      0  00:00      0.00    1.00        0.00    6162.27
0.00      0.16           0  Calculated
  Link-32              CHANNEL      0  01:51      0.27    1.00       42.99    4279.24
0.01      0.22           0  Calculated
  Link-33              CHANNEL      0  00:00      0.00    1.00        0.00    8764.39
0.00      0.22           0  Calculated
  Link-34              CHANNEL      0  01:56      0.16    1.00       44.16    5772.47
0.01      0.29           0  Calculated
  Link-35              CHANNEL      0  01:57      0.45    1.00       43.82    2337.25
0.02      0.22           0  Calculated
  Link-38              CHANNEL      0  01:52      0.09    1.00       39.54    7853.58
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0.01      0.40               0  Calculated
  Link-40                   CHANNEL       0  00:00       0.00     1.00         0.00      4972.23
0.00      0.28               0  Calculated
  Link-44                   CHANNEL       0  01:50       0.16     1.00        27.40      6120.37
0.00      0.38               0  Calculated
  Link-45                   CHANNEL       0  01:56       0.41     1.00       113.37      6891.85
0.02      0.44               0  Calculated
  Link-47                   CHANNEL       0  00:00       0.00     1.00         0.00      9357.20
0.00      0.14               0  Calculated
  Link-48                   CHANNEL       0  00:00       0.00     1.00         0.00      5539.93
0.00      0.14               0  Calculated
  Link-49                   CHANNEL       0  00:00       0.00     1.00         0.00      8990.14
0.00      0.27               0  Calculated
  Link-51                   CHANNEL       0  02:01       0.23     1.00        10.26      8207.33
0.00      0.29               0  Calculated
  Link-52                   CHANNEL       0  01:56       0.05     1.00        17.13      4966.11
0.00      0.38               0  Calculated
  Link-53                   CHANNEL       0  01:55       0.05     1.00        16.98      7791.47
0.00      0.38               0  Calculated
  Link-54                   CHANNEL       0  00:00       0.00     1.00         0.00      5977.01
0.00      0.29               0  Calculated
  Link-55                   CHANNEL       0  00:00       0.00     1.00         0.00      5338.41
0.00      0.44               0  Calculated
  Link-57                   CHANNEL       0  01:50       0.27     1.00        42.67      5830.45
0.01      0.33               0  Calculated
  Link-59                   CHANNEL       0  01:50       0.57     1.00        41.31      6538.68
0.01      0.38               0  Calculated
  Link-60                   CHANNEL       0  02:00       0.19     1.00        10.32      8047.95
0.00      0.33               0  Calculated
  Link-61                   CHANNEL       0  01:55       0.18     1.00        20.53       557.33
0.04      0.37               0  Calculated
  Link-64                   CHANNEL       0  01:55       2.54     1.00        68.96      1426.11
0.05      0.42               0  Calculated
  Link-70                   CHANNEL       0  01:55       0.26     1.00        23.60       852.26
0.03      0.25               0  Calculated
  Link-71                   CHANNEL       0  01:52       0.21     1.00        11.08      1217.28
0.01      0.22               0  Calculated
  Link-72                   CHANNEL       0  01:55       0.13     1.00        69.68      1974.30
0.04      0.67               0  Calculated
  Link-74                   CHANNEL       0  01:55       0.18     1.00        68.99      1195.56
0.06      0.59               0  Calculated
  Link-75                   CHANNEL       0  01:55       0.12     1.00        55.24      2088.96
0.03      0.65               0  Calculated
  Link-77                   CHANNEL       0  01:55       0.31     1.00        54.61      1394.08
0.04      0.39               0  Calculated
  Link-80                   CHANNEL       0  01:55       0.17     1.00        69.90      1224.27
0.06      0.53               0  Calculated
  Link-82                   CHANNEL       0  01:55       0.20     1.00        69.24      2012.43
0.03      0.48               0  Calculated
  Link-85                   CHANNEL       0  01:55       0.12     1.00        73.35      1540.30
0.05      0.64               0  Calculated
  Link-86                   CHANNEL       0  01:55       0.45     1.00        72.70      2147.91
0.03      0.35               0  Calculated
  Link-91                   CHANNEL       0  01:55       0.35     1.00        16.36      1476.16
0.01      0.18               0  Calculated
  Link-93                   CHANNEL       0  01:55       0.35     1.00        26.54      1205.28
0.02      0.23               0  Calculated
  Link-96                   CHANNEL       0  01:51       0.27     1.00        22.29       852.26
0.03      0.23               0  Calculated
  Link-97                   CHANNEL       0  00:00       0.00     1.00         0.00      2976.83
0.00      0.00               0  Calculated
  Link-99                   CHANNEL       0  01:55       1.13     1.00        21.74       852.26
0.03      0.23               0  Calculated
  {STM}.CBL109 (STM)        ORIFICE       0  01:54                              84.04
         1.00
  {STM}.CBL111 (STM)        ORIFICE       0  01:54                              60.59
         1.00
  {STM}.CBL113 (STM)        ORIFICE       0  02:01                              57.96
         1.00
  {STM}.CBL115 (STM)        ORIFICE       0  01:54                              35.09
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     1.00
{STM}.CBL117 (STM)   ORIFICE      0  01:54                        101.49
     1.00
{STM}.CBL119 (STM)   ORIFICE      0  01:56                         80.89
     1.00
{STM}.CBL123 (STM)   ORIFICE      0  01:57                         54.90
     1.00
{STM}.CBL125 (STM)   ORIFICE      0  01:54                        100.39
     1.00
{STM}.CBL128 (STM)   ORIFICE      0  01:56                         78.96
     1.00
{STM}.CBL130 (STM)   ORIFICE      0  01:54                         84.54
     1.00
{STM}.CBL85 (STM)    ORIFICE      0  02:00                         48.82
     1.00
{STM}.CBL87 (STM)    ORIFICE      0  01:54                         74.14
     1.00
{STM}.CBL91 (STM)    ORIFICE      0  01:58                         75.23
     1.00
{STM}.CBL93 (STM)    ORIFICE      0  01:57                        106.97
     1.00
{STM}.CBL97 (STM)    ORIFICE      0  01:56                         22.95
     1.00
{STM}.STM Pipe - (182) (STM) ORIFICE      0  01:42                        169.12
             1.00
{STM}.STM Pipe - (183) (STM) ORIFICE      0  01:41                        148.87
             1.00
{STM}.STM Pipe - (389) (STM) ORIFICE      0  01:50                         69.60
             1.00
{STM}.STM Pipe - (391) (STM) ORIFICE      0  01:54                         97.13
             1.00
{STM}.STM Pipe - (392) (STM) ORIFICE      0  01:50                         67.55
             1.00
{STM}.STM Pipe - (393) (STM) ORIFICE      0  01:51                         88.17
             1.00
{STM}.STM Pipe - (397) (STM) ORIFICE      0  01:55                         27.05
             1.00
{STM}.STM Pipe - (400) (STM) ORIFICE      0  01:55                         62.40
             1.00
{STM}.STM Pipe - (403) (STM) ORIFICE      0  01:55                         63.53
             1.00
{STM}.STM Pipe - (406) (STM) ORIFICE      0  01:55                         64.87
             1.00
{STM}.STM Pipe - (409) (STM) ORIFICE      0  01:55                         50.81
             1.00
{STM}.STM Pipe - (412) (STM) ORIFICE      0  01:55                         58.83
             1.00
{STM}.STM Pipe - (414) (STM) ORIFICE      0  01:55                         50.74
             1.00
{STM}.STM Pipe - (417) (STM) ORIFICE      0  01:55                         35.43
             1.00
{STM}.STM Pipe - (419) (STM) ORIFICE      0  01:55                         15.78
             1.00
{STM}.STM Pipe - (421) (STM) ORIFICE      0  01:55                         24.76
             1.00
{STM}.STM Pipe - (425) (STM) ORIFICE      0  01:51                         21.97
             1.00
{STM}.STM Pipe - (427) (STM) ORIFICE      0  01:51                         24.76
             1.00
{STM}.STM Pipe - (429) (STM) ORIFICE      0  01:55                         18.46
             1.00
{STM}.STM Pipe - (433) (STM) ORIFICE      0  01:52                         37.00
             1.00
{STM}.STM Pipe - (435) (STM) ORIFICE      0  01:55                         17.94
             1.00
Link-01              ORIFICE      0  02:18                        448.44
     1.00
Link-102             ORIFICE      0  01:52                         17.72
     1.00
O-111                ORIFICE      0  01:50                         22.08
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1.00

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Flow Classification Summary
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Link	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
{STM}.STM Pipe - (190) (STM)	0.00	0.00	0.00	0.06	0.00	0.00	0.94	0.45	0.0001
{STM}.STM Pipe - (199) (STM)	0.00	0.02	0.00	0.97	0.01	0.00	0.00	0.12	0.0000
{STM}.STM Pipe - (390) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.26	0.0001
{STM}.STM Pipe - (69) (1) (1) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.0003
{STM}.STM Pipe - (69) (1) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.0002
{STM}.STM Pipe - (70) (1) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.0002
{STM}.STM Pipe - (70) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.0002
{STM}.STM Pipe - (71) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.0003
{STM}.STM Pipe - (72) (1) (STM)	0.00	0.84	0.00	0.15	0.00	0.00	0.00	0.01	0.0000
{STM}.STM Pipe - (72) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.03	0.0002
{STM}.STM Pipe - (75) (2) (1) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.0001
{STM}.STM Pipe - (75) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.0001
{STM}.STM Pipe - (76) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.0001
{STM}.STM Pipe - (77) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.0001
{STM}.STM Pipe - (78) (1) (STM)	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.00	0.0000
{STM}.STM Pipe - (78) (STM)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.58	0.0001
{STM}.STM Pipe - (79) (1) (STM)	0.00	0.00	0.00	0.04	0.00	0.00	0.96	0.00	0.0000
{STM}.STM Pipe - (79) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.0002
{STM}.STM Pipe - (80) (1) (STM)	0.88	0.03	0.00	0.04	0.00	0.00	0.06	0.00	0.0000
{STM}.STM Pipe - (80) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.03	0.0001
{STM}.STM Pipe - (81) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.03	0.0001
{STM}.STM Pipe - (82) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.04	0.0001
{STM}.STM Pipe - (83) (1) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.12	0.0001
{STM}.STM Pipe - (83) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.08	0.0001
{STM}.STM Pipe - (84) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.12	0.0001
{STM}.STM Pipe - (85) (STM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.17	0.0001
{STM}.STM Pipe - (86) (STM)	0.00	0.00	0.00	0.04	0.00	0.00	0.96	0.34	0.0001
{STM}.STM Pipe - (87) (STM)	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.31	0.0000
{STM}.STM Pipe - (88) (STM)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.54	0.0001
Link-02	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.23	0.0002
Link-07	0.98	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.0000
Link-09	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-10	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-101	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.07	0.0000
Link-106	0.99	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0000
Link-11	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-112	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-113	0.00	0.98	0.00	0.00	0.01	0.00	0.00	0.03	0.0000
Link-114	0.00	0.98	0.00	0.01	0.01	0.00	0.00	0.02	0.0000
Link-115	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-116	0.97	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-117	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-118	0.99	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.0000
Link-119	0.00	0.99	0.00	0.01	0.00	0.00	0.00	0.00	0.0000
Link-12	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-120	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.0000
Link-13	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-14	0.98	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.0000
Link-16	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.06	0.0000

Link-17	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.13	0.0000
Link-18	0.98	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.0000
Link-19	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.0000
Link-22	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.52	0.0000
Link-23	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.36	0.0000
Link-25	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.36	0.0000
Link-26	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.42	0.0000
Link-30	0.97	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-31	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-32	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.24	0.0000
Link-33	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-34	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.09	0.0000
Link-35	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.12	0.0000
Link-38	0.00	0.00	0.00	0.07	0.00	0.00	0.93	0.37	0.0000
Link-40	0.97	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-44	0.93	0.05	0.00	0.02	0.00	0.00	0.00	0.00	0.0000
Link-45	0.00	0.00	0.00	0.06	0.00	0.00	0.94	1.11	0.0000
Link-47	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-48	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-49	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-51	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.25	0.0000
Link-52	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.12	0.0000
Link-53	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.12	0.0000
Link-54	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-55	0.97	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-57	0.98	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.0000
Link-59	0.98	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.0000
Link-60	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.15	0.0000
Link-61	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-64	0.00	0.98	0.00	0.02	0.00	0.00	0.00	0.01	0.0000
Link-70	0.99	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.0000
Link-71	0.99	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0000
Link-72	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.10	0.0000
Link-74	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.05	0.0000
Link-75	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.09	0.0000
Link-77	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.06	0.0000
Link-80	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.06	0.0000
Link-82	0.00	0.00	0.00	0.07	0.00	0.00	0.93	0.09	0.0000
Link-85	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.05	0.0000
Link-86	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.09	0.0000
Link-91	0.99	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.0000
Link-93	0.98	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.0000
Link-96	0.99	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.0000
Link-97	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-99	0.00	0.99	0.00	0.01	0.00	0.00	0.00	0.00	0.0000

****
Highest Continuity Errors
****
Node 4+568 (-3.17%)
Node CB87-88 (STM) (-1.97%)
Node CB93-94 (STM) (-1.66%)
Node Jun-51 (1.22%)
Node CB91-92 (STM) (1.19%)

****
Highest Flow Instability Indexes
****
Link {STM}.STM Pipe - (182) (STM) (20)
Link Link-01 (15)
Link {STM}.STM Pipe - (75) (2) (1) (STM) (9)
Link {STM}.STM Pipe - (76) (STM) (6)
Link {STM}.STM Pipe - (75) (STM) (3)

****
Routing Time Step Summary
****

```
  Minimum Time Step          :     5.00 sec
  Average Time Step          :     5.00 sec
  Maximum Time Step          :     5.00 sec
  Percent in Steady State    :     0.00
  Average Iterations per Step :    7.26
```

```
  WARNING 107 : Initial water surface elevation defined for Junction 379A (STM) is below
junction invert elevation.
                Assumed initial water surface elevation equal to invert elevation.
  WARNING 108 : Surcharge elevation defined for Junction 4+420 is below junction maximum
elevation. Assumed surcharge elevation equal to maximum elevation.
  WARNING 118 : Orifice crest elevation defined for Orifice O-111 is below upstream node
invert elevation.
                Assumed orifice crest elevation equal to upstream node invert elevation.
  WARNING 116 : Conduit inlet invert elevation defined for Conduit
{STM}.STM Pipe - (199) (STM) is below upstream node invert elevation.
                Assumed conduit inlet invert elevation equal to upstream node invert
elevation.
  WARNING 116 : Conduit inlet invert elevation defined for Conduit
{STM}.STM Pipe - (71) (STM) is below upstream node invert elevation.
                Assumed conduit inlet invert elevation equal to upstream node invert
elevation.
  WARNING 116 : Conduit inlet invert elevation defined for Conduit
{STM}.STM Pipe - (72) (STM) is below upstream node invert elevation.
                Assumed conduit inlet invert elevation equal to upstream node invert
elevation.
  WARNING 004 : Minimum elevation drop used for Conduit Link-02.
  WARNING 117 : Conduit outlet invert elevation defined for Conduit Link-113 is below
downstream node invert elevation.
                Assumed conduit outlet invert elevation equal to downstream node invert
elevation.
```

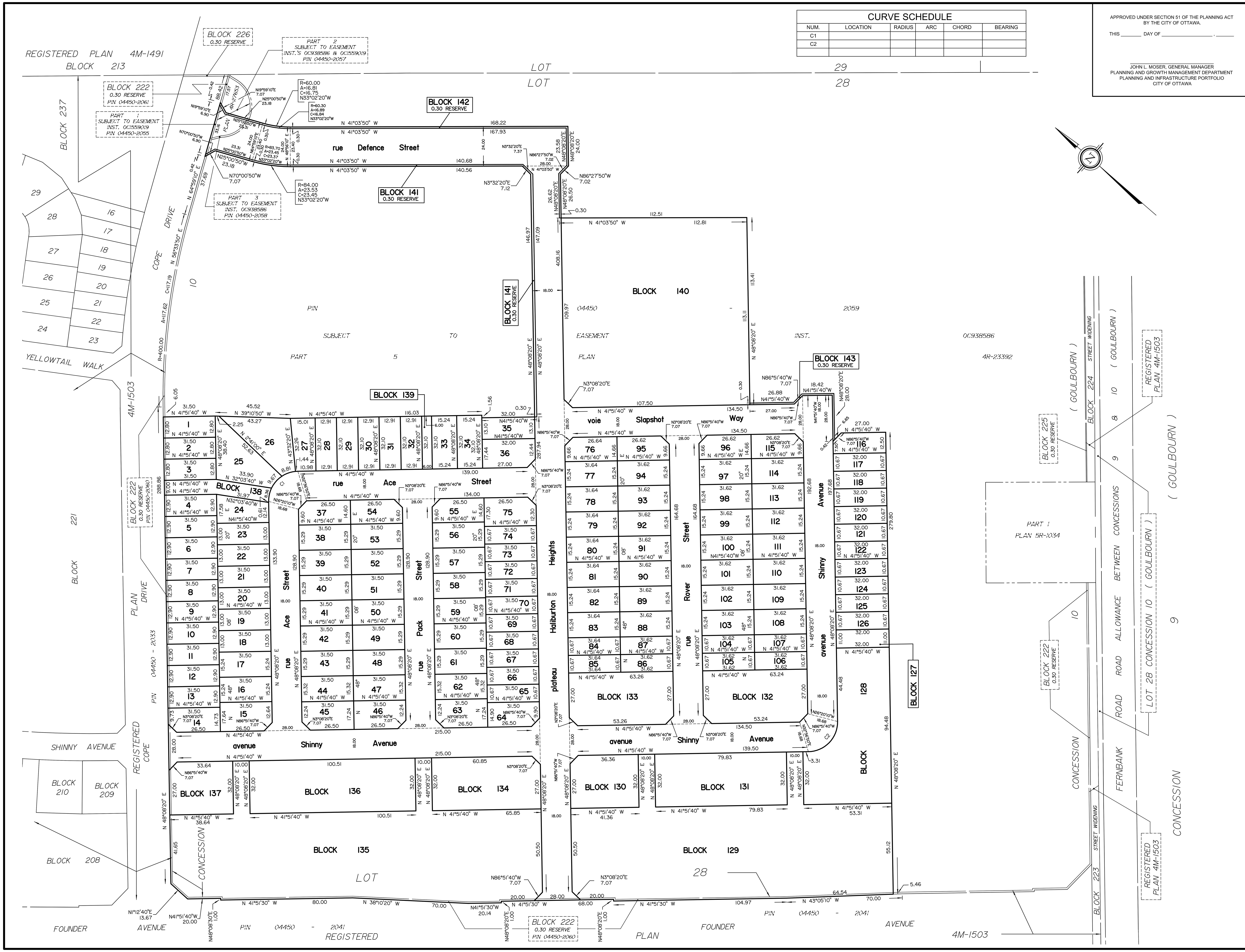
WARNING 117 : Conduit outlet invert elevation defined for Conduit Link-114 is below downstream node invert elevation.
Assumed conduit outlet invert elevation equal to downstream node invert elevation.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 10+053.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 11+001.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+001.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+185.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+228.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+254.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+309.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 373A (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 379A (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+345.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+420.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+510.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+568.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+665.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+750.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+828.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 6+088.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 6+102.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 7+096.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 8+128.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 8+150.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB101-102 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB111-112.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB113-114 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB115-116 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB117-118 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB119-120 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB121-122 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB123-124 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB125-126 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB127-128 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB129-130 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB131-132 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB133-134 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB85-86 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB87-88 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB89-90 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB91-92 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB93-94 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB95-96 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB97-98 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node E-34.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-35.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-37.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-40.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-43.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-51.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-21 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-22 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-23 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-24 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-25 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-27 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-28 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-30 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-31 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-32 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-33 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-34 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-38 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-39 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCBMH-2 (STM).

Analysis began on: Tue Jul 14 09:13:37 2015
Analysis ended on: Tue Jul 14 09:13:43 2015
Total elapsed time: 00:00:06

Appendix D
Drawings

Draft Plan of Subdivision	*(Annis, O'Sullivan, Vollebekk)*
Storm Drainage Area Plans	*108180-15-STM*
Erosion and Sediment Control Plan	*108180-15-ESC*



CURVE SCHEDULE

NUM.	LOCATION	RADIUS	ARC	CHORD	BEARING
C1					
C2					

APPROVED UNDER SECTION 51 OF THE PLANNING ACT BY THE CITY OF OTTAWA.

THIS _______ DAY OF _______________, ______

JOHN L. MOSER, GENERAL MANAGER
PLANNING AND GROWTH MANAGEMENT DEPARTMENT
PLANNING AND INFRASTRUCTURE PORTFOLIO
CITY OF OTTAWA

PLAN 4M-

I CERTIFY THAT THIS PLAN IS REGISTERED IN THE LAND REGISTRY OFFICE FOR THE LAND TITLES DIVISION OF OTTAWA-CARLETON NO. 4 AT _____ O'CLOCK ON THE ____ DAY OF ___________ AND ENTERED IN THE PARCEL REGISTER FOR PROPERTY IDENTIFIERS ______________________

AND THE REQUIRED CONSENTS ARE REGISTERED AS PLAN DOCUMENT NO. ___________

LAND REGISTRAR

This plan comprises part of the land identified by PIN's 04450-2059 and 04450-2060.

PLAN OF SUBDIVISION OF

PART OF LOT 28
CONCESSION 10

Geographic Township of Goulbourn
And

PART OF BLOCK 222
REGISTERED PLAN 4M-1503
CITY OF OTTAWA

Surveyed by Annis, O'Sullivan, Vollebekk Ltd.

Scale 1 : 1000

40 30 20 10 0 20 40 Metres

Metric

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

SURVEYOR'S CERTIFICATE

I CERTIFY THAT :

1. This survey and plan are correct and in accordance with the Surveys Act, the Surveyors Act and the Land Titles Act and the regulations made under them.
2. The Survey was completed on the day of 2015.

Date ____________ Edward M. Lancaster, Ontario Land Surveyor

OWNER'S CERTIFICATE

THIS IS TO CERTIFY THAT :

1. Lots 1 to 126, both inclusive, Blocks 127 to 140, both inclusive, the Streets, namely, rue Ace Street, rue Defence Street, plateau Haliburton Heights, rue Pack Street, rue Rover Street, avenue Shinny Avenue and voie Slapshot Way and the Reserves, namely, Blocks 141, 142 and 143 have been laid out in accordance with my instructions.
2. The Streets are dedicated as public highways.

Dated the ____ day of ________ 2015

Steven Gordon, President
Abbott - Fernbank Holdings Inc.
I have the authority to bind the corporation.

NOTES AND LEGEND

—□—	denotes	Survey Monument Planted.
—■—	"	Survey Monument Found
SIB	"	Standard Iron Bar.
SSIB	"	Short Standard Iron Bar.
CC	"	Cut Cross.
IB	"	Iron Bar.
CLF	"	Chain Link Fence
BF	"	Board Fence
(AOG)	"	Annis, O'Sullivan, Vollebekk Ltd.
(P1)	"	Plan
(P2)	"	Plan

All planted survey monuments are IB's unless otherwise noted.

Distances shown on curved limits are Arc distances unless otherwise noted.

Distances shown on this plan are ground distances and can be converted to grid distances by multiplying by the combined scale factor of 0.999xx.

Bearings are grid bearings, derived from....

Coordinates are derived from Can-Net 3.0 Real Time Network GPS observations on monument A and B, shown hereon, and are referred to the Central Meridian of MTM Zone 9 (76°30' West Longitude) NAD-83 (original).

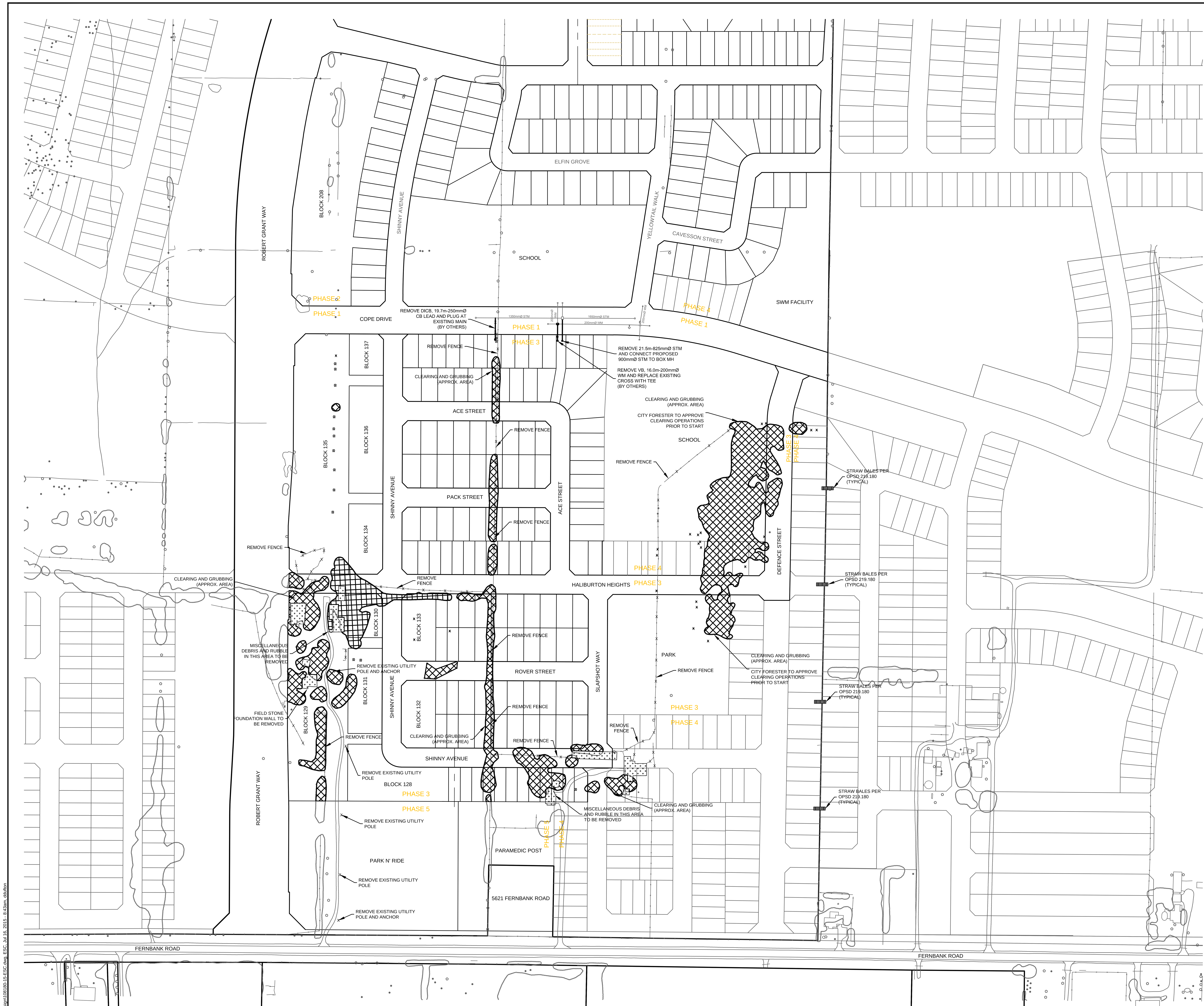
Coordinate values are to urban accuracy in accordance with O. Reg. 216/10.

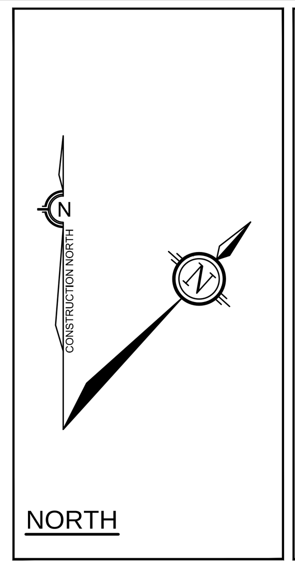
. Point A Northing   Easting
. Point B Northing   Easting

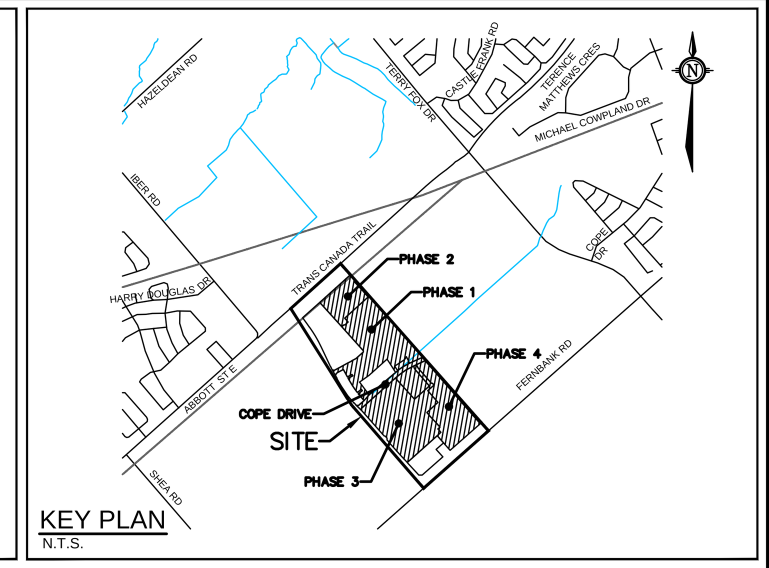
Caution: Coordinates cannot, in themselves, be used to re-establish corners or boundaries shown on this plan.

ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
14 Concourse Gate, Suite 500
Nepean, Ont. K2E 7S6
Phone: (613) 727-0850 / Fax: (613) 727-1079
Email: Nepean@aovltd.com
Ontario Land Surveyors

Job No. 15474-14 Reg Grp Pt Lt 28 C10 GO SUB D3







LEGEND

SILT FENCE PER OPSD 219.110
STRAW BALE FLOW CHECK PER OPSD 219.180
DEBRIS AND RUBBLE FROM DEMOLISHED STRUCTURE
CLEARING, GRUBBING & TOPSOIL STRIPPING
X	REMOVALS

EROSION AND SEDIMENT CONTROL NOTES :

1. ALL EROSION AND SEDIMENT CONTROLS ARE TO BE INSTALLED TO THE SATISFACTION OF THE ENGINEER, THE MUNICIPALITY AND THE CONSERVATION AUTHORITY. THEY ARE TO BE APPROPRIATE TO THE SITE CONDITIONS, PRIOR TO UNDERTAKING ANY SITE ALTERATIONS (FILLING, GRADING, REMOVAL OF VEGETATION, ETC.) AND DURING ALL PHASES OF SITE PREPARATION AND CONSTRUCTION. THESE PRACTICES ARE TO BE IMPLEMENTED IN ACCORDANCE WITH THE CURRENT BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL AND SHOULD INCLUDE AS A MINIMUM THOSE MEASURES INDICATED ON THE PLAN.

2. TO PREVENT SURFACE EROSION FROM ENTERING THE DITCH OR STORM SYSTEM DURING CONSTRUCTION, FILTER CLOTH WILL BE PLACED UNDER GRATES OF ALL PROPOSED AND EXISTING CATCHBASINS AND STRUCTURES. A LIGHT DUTY SILT FENCE BARRIER WILL ALSO BE INSTALLED IN SELECTED LOCATIONS SHOWN ON THIS PLAN, AND STRAW BALE BARRIERS WILL BE INSTALLED WITHIN THE OUTLET DITCHES. THESE CONTROL MEASURES WILL REMAIN IN PLACE UNTIL VEGETATION HAS BEEN ESTABLISHED AND CONSTRUCTION COMPLETE.

3. THE SEDIMENT CONTROL MEASURES SHALL ONLY BE REMOVED WHEN, IN THE OPINION OF THE ENGINEER, THE MEASURES ARE NO LONGER REQUIRED. NO CONTROL MEASURES MAY BE PERMANENTLY REMOVED WITHOUT PRIOR AUTHORIZATION FROM THE ENGINEER.

4. THE CONTRACTOR SHALL IMMEDIATELY REPORT TO THE ENGINEER ANY ACCIDENTAL DISCHARGES OF SEDIMENT MATERIAL INTO ANY DITCH OR STORM SEWER SYSTEM. APPROPRIATE RESPONSE MEASURES, INCLUDING ANY REPAIRS TO EXISTING CONTROL MEASURES OR THE IMPLEMENTATION OF ADDITIONAL CONTROL MEASURES, SHALL BE CARRIED OUT BY THE CONTRACTOR WITHOUT DELAY.

5. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.

6. THE CONTRACTOR SHALL ENSURE PROPER DUST CONTROL IS PROVIDED WITH THE APPLICATION OF WATER (AND IF REQUIRED, CALCIUM CHLORIDE) DURING DRY PERIODS.

REMOVALS NOTES :

1. ALL HYDRANTS, VALVES AND OTHER APPURTENANCES TO BE REMOVED SHALL BE SALVAGED AND DELIVERED TO CITY OF OTTAWA MAINTENANCE YARD AT CLYDE AVENUE.

2. THE CONTRACTOR SHALL PROTECT ALL SURVEY MONUMENTS.

3. REMOVAL OF ALL ABOVE GROUND TRAFFIC PLANT AND STREETLIGHTING TO BE DONE BY OTHERS. CONTRACTOR SHALL PROTECT AND MAINTAIN EXISTING STREETLIGHTING, HYDRO POLES AND OVERHEAD LINES DURING CONSTRUCTION.

4. ALL BELL AND HYDRO OTTAWA MAINTENANACE HOLE ADJUSTMENTS SHALL BE PERFORMED BY AN APPROVED CONTRACTOR ONLY.

5. ALL TOPSOIL AND ANY SOFT, WET OR DELETERIOUS MATERIAL SHALL BE REMOVED FROM IMPROVED AREAS UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

6. FORESTRY TO BE CONTACTED PRIOR TO ANY SELECTIVE PRUNING OR REMOVALS WITHIN THE AREAS OF TRESS SURROUNDING THE TRANS CANADA TRAIL AND TREES THAT ARE TO REMAIN ARE TO HAVE PROPER TREE PROTECTION FENCING.

PLAN #16229

REVIEWED BY DEVELOPMENT REVIEW BRANCH

Signed ____________

Date ____________ 2015

Plan Number 16229

M:\2008\108180\CAD\Design\108180-15-ESC.dwg, ESC, Jul 16, 2015 - 8:43am, dduffus

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

FERNBANK · CROSSING · the Heart of the Community

ABBOTT-FERNBANK HOLDINGS INC.

REGIONAL
THE REGIONAL GROUP
Corporate Head Office
1737 Woodward Drive, 2nd Floor
Ottawa, Ontario K2C 0P9
Telephone: 613-230-2100
Fax: 613-230-2962

No.	REVISION	DATE	BY
5.	ISSUED FOR MOE	JUL 13/15	MAB
4.	REVISED PER CITY COMENTS	JUN 23/15	MAB
3.	ISSUED FOR APPROVAL	MAY 5/15	MAB
2.	ISSUED FOR APPROVAL	MAR 10/15	MAB
1.	ISSUED FOR APPROVAL	DEC 19/14	MAB

SCALE 1:1500

1:1500
0 15 30 45 60

DESIGN LRW
CHECKED MAB
DRAWN DTD
CHECKED MAB
APPROVED JGR

FOR REVIEW ONLY

REGISTERED PROFESSIONAL ENGINEER J.G. RIDDELL PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER M.A. BISSETT 2015.07.13 PROVINCE OF ONTARIO

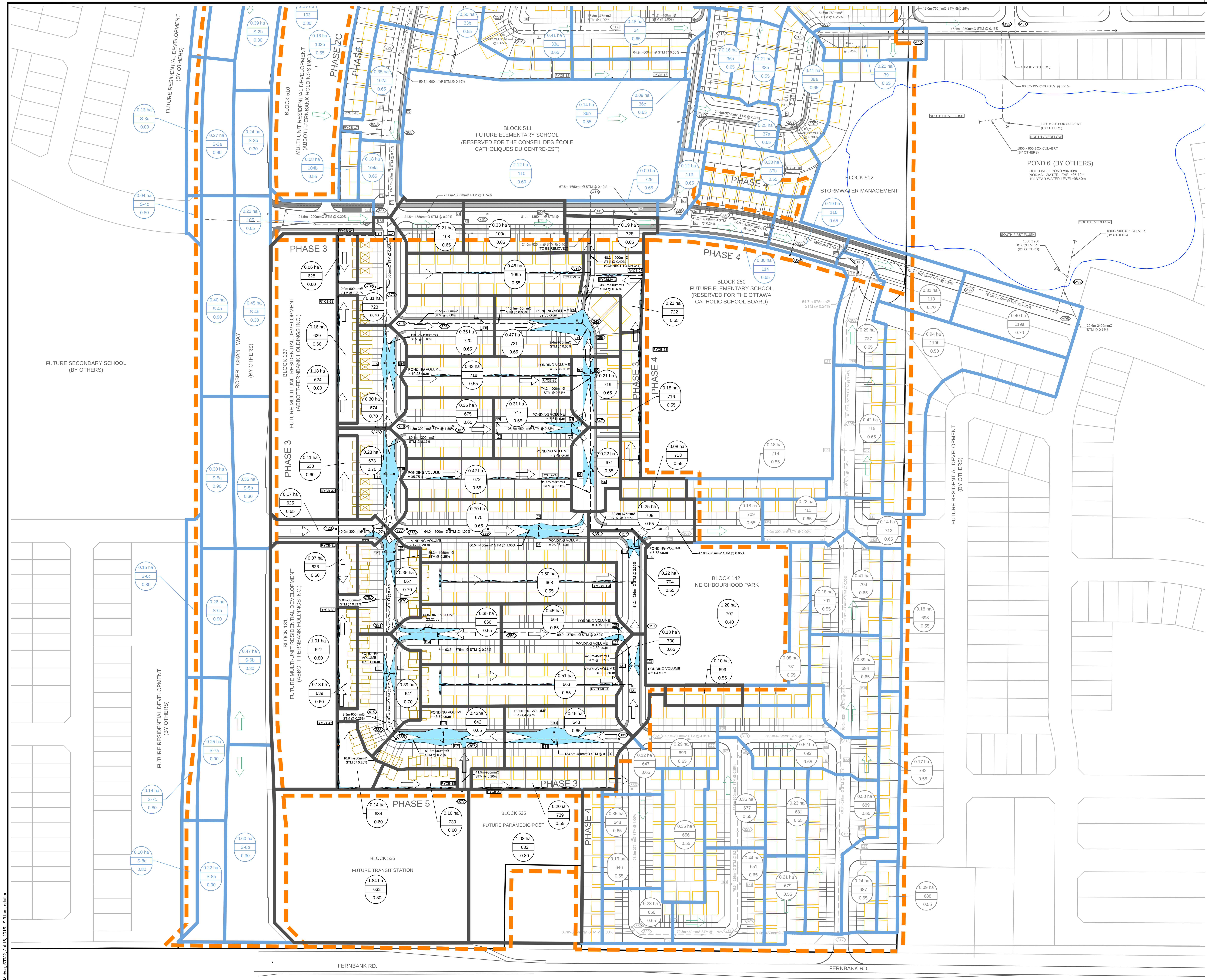
NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

CITY OF OTTAWA
FERNBANK CROSSING

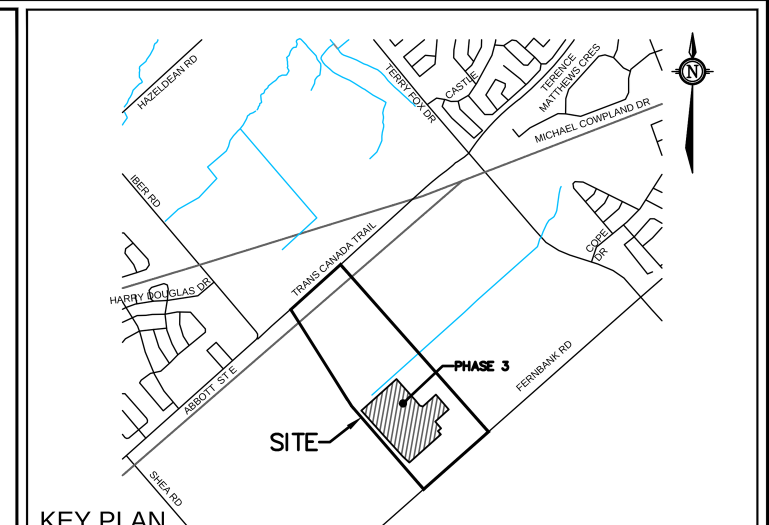
EROSION AND SEDIMENT CONTROL PLAN & REMOVALS

PROJECT No. 108180-15
REV # 5
DRAWING No. 108180-15-ESC

PLANB1.DWG - 1000mmx707mm



NORTH



KEY PLAN
N.T.S.

LEGEND

- 0.24 ha — PHASE 3 AREA (hectares)
- 88a — PHASE 3 AREA ID
- 0.65 — PHASE 3 RUN-OFF COEFFICIENT
- 0.24 ha — FUTURE/EXISTING DRAINAGE AREA (hectares)
- 88a — FUTURE/EXISTING AREA ID
- 0.65 — FUTURE/EXISTING RUN-OFF COEFFICIENT
- STORM DRAINAGE AREA BOUNDARY
- EXISTING STORM DRAINAGE AREA BOUNDARY
- PROPOSED STORM MANHOLE & SEWER WITH DIRECTION OF FLOW
- PROPOSED ROAD CATCHBASIN
- MAJOR SYSTEM FLOW ROUTE
- PONDING AREA

STM MANHOLE TABLE (PH3)

MANHOLE ID	OBVERT
309	NE=101.68 SW=100.79
343	NW=99.61 E=99.64 SW=100.93
345	NE=101.75
347	NW=99.98 SE=99.98 SW=99.98
349	NE=101.06
351	NW=100.28 NE=100.28 SW=100.28
353	NE=101.72
357	NW=102.42 SW=102.42 SE=102.42
359	SW=103.00 NE=102.92
373	NW=102.23 SE=102.23 SW=102.23
375	NW=102.43 SE=102.43 SW=102.43
377	NW=102.57 SE=102.57 SW=102.57
379	NW=102.71 SE=102.71 SW=102.71
381	NW=102.77 SE=102.77 NE=102.77
383	NW=102.96 E=102.96
385	W=102.98 NE=102.98
387	SW=103.08 NE=103.08 SE=103.14
389	SW=103.32
391	NW=99.46 SE=99.46
393	NE=101.61 SW=101.61
395	W=99.69 SE=99.72
397	NE=100.54 SW=100.54
399	NE=101.08 SW=101.08
417	SW=100.48 NE=100.48 SE=100.48
419	NW=102.94 SE=102.94 SW=102.94
421	NW=102.57
423	NE=102.97

D07-16-09-0034

PLAN #16229

REVIEWED BY DEVELOPMENT REVIEW BRANCH

Signed ______

Date ______ 2015

Plan Number 16229

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

FERNBANK · CROSSING · the Heart of the Community

ABBOTT-FERNBANK HOLDINGS INC.

REGIONAL
THE REGIONAL GROUP

No.	REVISION	DATE	BY
5.	ISSUED FOR MOE	JUL 13/15	MAB
4.	REVISED PER CITY COMMENTS	JUN 23/15	MAB
3.	ISSUED FOR APPROVAL	MAY 5/15	MAB
2.	ISSUED FOR APPROVAL	MAR 10/15	MAB
1.	ISSUED FOR APPROVAL	DEC 19/14	MAB

SCALE 1:1250

1:1250
0 10 20 30 40 50

DESIGN LRW
CHECKED MAB
DRAWN DTD
CHECKED MAB
APPROVED JGR

FOR REVIEW ONLY

REGISTERED PROFESSIONAL ENGINEER J.G. RIDDELL PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER M.A. BISSETT 2015.07.13 PROVINCE OF ONTARIO

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CITY OF OTTAWA
FERNBANK CROSSING - PHASE 3

STORM DRAINAGE AREA PLAN

PROJECT No. 108180-15
REV REV # 5
DRAWING No. 108180-15-STM

PLANB1.DWG - 1000mmx707mm

APPENDIX

F

CITY COMMENTS

APPENDIX

G

CRT PHASE 1 SERVICING REPORT

REPORT
PROJECT: 27970-5.2.2

DESIGN BRIEF
CRT LANDS PHASE 1
FERNBANK COMMUNITY

Prepared for CRT DEVELOPMENT INC.
by IBI GROUP

JULY 2017

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FIGURES:

APPENDICES:

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1 INTRODUCTION

1.1 Background

In 2009, the City of Ottawa completed the Fernbank Community Design Plan (FCDP).The FCDP covers approximately 675 gross hectares of land between the established communities of Stittsville, Kanata West and Kanata South. The community extends from Hazeldean Road to the north, the Carp River and Terry Fox Drive to the east, Fernbank Road to the south and the existing Urban Area of Stittsville to the west.

In conjunction with preparation of the Community Design Plan, several Class Environmental Assessment Studies/Master Plans were also prepared. Two of those were the Master Servicing Study (MSS) for water and sanitary and an Environmental Management Plan (EMP) for the natural environment and stormwater management. Those reports identify planning level solutions for on-site storm drainage, wastewater collection and water supply and distribution to the community. Those reports recommended a Preliminary Demonstration Plan on which the recommended major infrastructure servicing will be based. A copy of the Preliminary Demonstration Plan is included in **Figure 1.1**.

1.2 Objective

The purpose of this Design Brief is to provide stakeholder regulators with the project background together with the design philosophy and criteria incorporated in the subdivision design. This report will provide a logical framework to assist reviewers with evaluation of the design of the development.

Land is now being assembled in the Fernbank Community and development applications are being brought forward for approvals. This report is being prepared in support of development approval for the CRT Lands. This report will provide a recommended servicing plan for the major municipal infrastructure needed to support development of the subject property. The review will be a macro level detail study with further details to be confirmed and provided during the design process in the form of detail designs and design briefs. This report will demonstrate how proposed municipal servicing is in conformance with the MSS recommendations. Any deviation from the MSS documents will also be identified with rationalization for the change.

This report was prepared in accordance with the November 2009 Servicing Study Guidelines for Development Applications in the City of Ottawa. **Appendix A** contains a customized copy of those guidelines which can be used as a quick reference for the location of each of the guideline items within the study report.

1.3 Subject Property

The current draft plan for the subject property, which is located in the Fernbank Community, is identified on **Figure 1.2**, which is located in **Appendix A**. The property covers a total area of about 53 ha and is bounded by Fernbank Road to the south, Abbott Street and the Trans Canada Trail to the north, future CRT lands to the west and Robert Grant Avenue to the east. The upper reaches of the Flewellyn Drain also extend north of Fernbank Road into the property.

The proposed land use for the subject property, which is in general conformance with the FCDP, will include a residential mix of single family units, townhouses and stacked townhouses. The draft plan also provides land for both an elementary and secondary school and both a neighbourhood and community park. Also as per the FCDP, an east-west collector road (Cope Drive) is proposed to bisect the property.

1.4 Phasing

The total land holdings purchased by the CRT group cover about 165 ha. The proposed draft plan shown in **Figure 1.2** includes about 53 ha. However, the owners are proposing to develop the lands covered by the draft plan in at least two phases. **Figure 1.3** identifies the current phasing plan as envisioned by the Owners.

Phase 1, which includes construction of the first phase of the stormwater management facility covers about 53 ha. It includes the northern portion of the property including two school sites, one park and Cope Drive, the east-west collector street. Phase 1A, within Phase 1, is also identified in **Figure 1.3**. That area, covering about 7 ha, is the only portion of the draft plan with stormwater runoff tributary to Pond 6 which is located on the Fernbank Crossing lands east of Robert Grant Avenue.

It is the Owner's intent to develop Phase 1, including 1A, immediately upon receipt of approvals. The timing of development of Phase 2 will be market determined.

1.5 Previous Studies

The Fernbank Community development process included a number of background studies that are pertinent to the subject site. Three integrated Class Environmental Assessment Studies/Master Plans were prepared in support of the FCDP which include:

- Transportation Master Plan;
- Environmental Management Plan (EMP);
- Master Servicing Study (MSS).

In 2011, IBI Group completed a Conceptual Site Servicing Plan for the CRT Lands. That report was designed to assist the City in preparation of draft conditions for development of the subject property.

In January 2012, Novatech Engineering Consultants Ltd. completed the Fernbank Community Sanitary Trunk Sewer Design Report of the Fernbank Trunk Sewer. That sewer was identified in the 2009 MSS report. The 2012 report built upon previous design elements and included some changes to the proposed sewer design originally identified in the 2009 document. It is the latter report that will provide the design framework for the sanitary sewer design for the subject site.

Subsequent development applications under the Planning Act will be supported by these studies/plans. These studies were prepared and followed integration with the Planning Act provision of the Municipal Engineers Association Class Environmental Assessment Process

The subject property will follow closely the recommendations of those three reports. With respect to the provision of water supply, wastewater disposal and treatment of stormwater runoff, the recommendations of the EMP, MSS and the 2012 Fernbank Sewer Report will provide the development criteria on which the subject property will develop. Any deviations from the previous report criteria will be identified in later sections of this report.

1.6 Environmental Issues

The total property purchased by the CRT group includes some natural environment features as shown on Figure 3.2 in the EMP report which is included in **Appendix B** for reference. These include remnant higher quality trees, deciduous hedgerows, meadow habitat and wooded areas. The upper reaches of the Flewellyn Drain also extend about 950 meters into the property from Fernbank Road. In August 2011, under By-Law No. 2011-311, the City of Ottawa formally closed that portion of the Drain and it is no longer recognized as a Municipal Drain as per the provincial Drainage Act. A copy of the By-Law is attached in **Appendix B**.

A permit from the Rideau Valley Conservation Authority is required to fill the former Municipal Drains located north of Fernbank Road within the subject property. Two previously acquired permits have both expired. The owners have recently applied for an amendment to the expired permits.

It is also proposed to lower about 650 m of the existing Flewellyn Drain south of Fernbank Road. That work is required to achieve the herein recommended operating levels of the SWM Facility Pond 5. Additionally, the City of Ottawa has requested that the balance of Flewellyn Drain to Flewellyn Road also be upgraded. Therefore, an additional 800 m of existing drain will also be improved as part of the development of the CRT lands.

1.7 Pre-Consultation

There have been several consultations with City officials including project planners, engineers and municipal drain staff. Although no formal notes of these meetings were recorded, some of the issues reviewed include:

- Phasing;
- Wood lots;
- EIS and Tree Preservation Plan;
- Geotechnical Report;
- Traffic Impact Study;
- Park & Ride;
- Municipal Drain Closure.

During the recent City review of this report, the City advised that the City's 2013 Wastewater IMP and subsequent 2016 Update were completed. In accordance with the recommendations from these reports, the City requested that future flows through the CRT property be updated to include the following external flows:

• Liard Street Pump Station	108 l/s
• OPA 76 Area 6 Pump Station	84 l/s
• Future Developments	100 l/s
	292 l/s

IBI advised that the proposed sub-trunk sanitary sewer through the CRT lands could not accept the 100 l/s for future developments without significantly impacting the development of the CRT property. The City subsequently dropped the requirement for capacity provision for the 100 l/s for future developments. Therefore, the proposed sub-trunk sewer through the CRT property will be sized to provide capacity for external flow from both the existing Liard Street Pump Station and the Area 6 Pump Station. A copy of a relevant e-mail dated January 31, 2017 is included in **Appendix B**.

There also has been some previous correspondence with the provincial Ministry of Environment (MOE) and the Rideau Valley Conservation Authority (RVCA) regarding the development of Phase 1. Copies of e-mail correspondence from 2013 from those agents is also included in **Appendix B**.

1.8 Geotechnical Considerations

A Geotechnical Investigative Report entitled "Geotechnical Investigation Proposed Residential Development CRT Lands – Phase 1, Fernbank Road Ottawa, Ontario", number PG2236-2R, and dated July 23, 2014, was prepared by Paterson Group Inc. The objectives of the investigation include:

- Determination of the subsoil and groundwater conditions;
- Provision of preliminary geotechnical recommendations pertaining to the design and development of the subject site including construction considerations.

Among other items, the report will comment on the following:

- Site grading;
- Foundation design;
- Pavement structure;
- Infrastructure construction;
- Groundwater control;
- Grading;
- Tree planting.

Among other considerations, the report confirmed that there are limited locations where a maximum grade raise limit of 2.5 m is recommended. These limitations exist only in areas where silty clays are located below proposed footing elevations. **Figure 1.4** indicates these areas. The proposed maximum grade raises in the limitation areas are in the 2.2 m range. There are no grade raise limitations for the balance of the subject site.

The Owners have also obtained a Permit To Take Water for Phase 1. The PTTW No. 3238-9TLP82, which covers water taking for the subdivision, Pond 5 and the Flewellyn Drain improvements is included in **Appendix B**.

2 WATER SUPPLY

2.1 Existing Condition

The Fernbank Community is located within the City's 3W Pressure Zone which includes most of Kanata and Stittsville and is one of the most rapidly growing areas in the City. Potable water to this area is pressurized at the Glen Cairn Pump Station where a major water storage reservoir (Glen Cairn Reservoir) is located. Two of the major watermains in this pressure zone from the pump station are located along Hazeldean Road and Terry Fox Drive. As part of the development to the east of the site a 300 mm watermain has been extended from the Trans Canada Trail watermain along Livery Street and Bobolink Ridge crossing Robert Crescent Avenue to the limit of Phase 1. Another main adjacent to the subject site is located in Abbott Street and the Trans Canada Trail. **Figure 2.1** indicates the limits of existing watermains in the vicinity of the subject property.

2.2 Master Servicing Study

The Master Servicing Study recommended a conceptual water plan for the FCDP. A copy of the recommended plan, Watermain Layout Drawing No. 101108-WM, Revision 3, is included in **Appendix C**. For the subject property to be properly serviced with a reliable water supply, two connections to an existing 400 mm diameter main are recommended: one at Abbott Street west of Iber Road and the second along the Trans Canada Trail east of Iber Road. To complete a loop, an additional main is proposed along Bobolink Ridge. The 2009 MSS report recommended that all these mains be 300 mm diameter.

The connection to the existing 400 mm diameter main in the Trans Canada Trail has been completed by the adjacent Fernbank Crossing development which is located immediately east of Robert Grant Avenue and extended westward to Bobolink Ridge.

2.3 Design Criteria

2.3.1 Water Demands

Water demands have been calculated for the Phase 1. Per unit population density and consumption rates are taken from Tables 4.1 and 4.2 at the Ottawa Design Guidelines – Water Distribution and are summarized as follows:

- Single Family 3.4 person per unit
- Townhouse and Semi-Detached 2.7 person per unit
- Average Apartment 1.8 person per unit
- Residential Average Day Demand 350 l/cap/day
- Residential Peak Daily Demand 875 l/cap/day
- Residential Peak Hour Demand 1,925 l/cap/day
- ICI Average Day Demand 50,000 l/gross ha/day
- ICI Peak Daily Demand 75,000 l/gross ha/day
- ICI Peak Hour Demand 135,000 l/gross ha/day

Residential units in Phase 1 consist of single family and street townhouses. There are two school sites, Blocks 325 and 357, which are included in the hydraulic analysis and three future high density residential sites, Blocks 336, 355 and 356. A population of 90 persons per hectare is used to calculate the water demands for the future high density sites. A watermain demand calculation sheet is included in **Appendix C** and the total water demands are summarized as follows:

- Average Day 13.39 l/s
- Maximum Day 28.04 l/s
- Peak Hour 58.41 l/s

2.3.2 System Pressure

The Ottawa Design Guidelines – Water Distribution (WDG001), July 2010, City of Ottawa, Clause 4.2.2 states that the preferred practice for design of a new distribution system is to have normal operating pressures range between 345 kPa (50 psi) and 552 kPa (80 psi) under maximum daily flow conditions. Other pressure criteria identified in Clause 4.2.2 of the guidelines are as follows:

Minimum Pressure	Minimum system pressure under peak hour demand conditions shall not be less than 276 kPa (40 psi)
Fire Flow	During the period of maximum day demand, the system pressure shall not be less than 140 kPa (20 psi) during a fire flow event.
Maximum Pressure	Maximum pressure at any point in the distribution system shall not exceed 689 kPa (100 psi). In accordance with the Ontario Building/Plumbing Code, the maximum pressure should not exceed 552 kPa (80 psi). Pressure reduction controls will be required for buildings where it is not possible/feasible to maintain the system pressure below 552 kPa.

2.3.3 Fire Flow Rates

In the recent Technical Bulletin 'ISDTB-2014-02, Revisions to Ottawa Design Guidelines – Water', the fire flow requirements for single detached dwellings and traditional town and row houses can be capped at 10,000 l/min providing that there is a minimum separation of 10 meters between the backs of adjacent units and that the town and row house blocks are limited to 600 square meters of building areas and seven dwelling units. As the residential units in the Phase 1 meet the requirements of ISDTB-2014-02, the fire flow rate of 10,000 l/min (166.7 l/s) is used in the fire flow analysis.

As there are no details for the institutional land, a fire flow rate of 13,500 l/min (225 l/s) will be used in the fire flow analysis. This value should be considered conservative for a school with a sprinkler system.

2.3.4 Boundary Conditions

CRT LANDS PHASE 1 - WATER BOUNDARY CONDITIONS

The City of Ottawa has provided hydraulic boundary conditions at two locations along the Trans Canada Trail 400 mm watermain. Two separate boundary conditions are given for the max day + fire scenario, one for a fire flow rate of 204 l/s which is used to calculate the residential units and one for a fire flow of 262 l/s which is used in the institutional lands analysis. A copy of the boundary condition is included in **Appendix C** and summarized as follows:

	CONNECTION 1	CONNECTION 2
Max HGL (Basic Day)	161.1 m	161.4 m
Peak Hour	154.7 m	154.8 m
Max Day + Fire (204 l/s Fire Flow)	152.8 m	153.0 m
Max Day + Fire (262 l/s Fire Flow)	150.6 m	150.9 m

2.3.5 Hydraulic Model

A computer model Phase 1 has been developed using the H20 MAP Version 6.0 program produced by MWH Soft Inc. The model includes the existing watermains and boundary conditions identified in Section 2.3.4.

2.4 Proposed Water Plan

2.4.1 Modeling Results

The hydraulic model was run under basic day, maximum day with fire flows and under peak hour conditions for Phase 1. Water pipes are sized to provide sufficient pressure and to deliver the required fire flows.

Results of the hydraulic model are include in **Appendix C** and summarized as follows:

Scenario

Basic Day (Max HGL) Pressure Range	508.7 to 544.5 kPa
Peak Hour Pressure Range	441.4 to 477.1 kPa
Max Day + 204 l/s Fire Flow Minimum Flow	184.7 l/s
Max Day + 262 l/s Fire Flow Minimum Flow	243.4 l/s

A comparison of the results and design criteria is summarized as follows:

Maximum Pressure	All notes have basic day pressures under 552 kPa, therefore pressure reducing control is not required for this development.
Minimum Pressure	All nodes in the model exceed the minimum value of 276 kPa (40 psi).
Fire Flow	The lowest fire flow for the residential lands is 184.4 l/s which exceeds the requirement of 166.7 l/s while the lowest fire flow for the institutional blocks is 243.4 l/s which exceeds the requirement of 225 l/s.

2.4.2 Watermain Layout

The proposed watermain layout for Phase 1 is shown on Figure 2.2. In accordance with the Master Servicing Study, a 300 mm watermain is extended on Bobolink Ridge connecting to the existing 300 mm main. A 300 mm watermain is also installed on Goldhawk Drive and Angel Heights extending across the Hydro One corridor and Trans Canada Trail to connect to the existing 400 mm watermain providing two connections to the Phase 1 development. All other mains are 150 mm and 200 mm.

3 WASTEWATER DISPOSAL

3.1 Existing Conditions

The Hazeldean Pump Station (HPS) is the recommended wastewater outlet for all lands in the FCDP, including the subject site. Among other areas in Kanata, including Bridlewood, Kanata South Business Park and the Glen Cairn Community, the HPS also serves most developed lands in Stittsville west of Terry Fox Drive and south of Hazeldean Road. Flows are directed towards the station via the existing 750 mm diameter Stittsville Trunk Sewer which is located in Abbott Street and the Trans Canada Trail.

The 900Ø South Glen Cairn Trunk and 750Ø Glamorgan Trunk Sewer also contribute wastewater flows to the HPS. A 525Ø sub-trunk sewer in Cope Drive near the south west section of the FCDP, west of Terry Fox Drive, also directs flows to the South Glen Cairn Trunk sewer.

The design of the station did not consider the Fernbank Community. Recognizing the need to complete upgrades to the HPS in order to accommodate new growth from the Fernbank Community, the City, in 2014, completed upgrades to the HPS and increased its capacity to 1225 l/s. The Fernbank Trunk Sewer was subsequently completed and is terminated at MH FT24 which is located in the Hydro One easement within the subject site.

Figure 2.1 shows the location of the existing sanitary sewer system in the vicinity of the subject site.

3.2 Master Servicing Studies

The June 24, 2009 Master Servicing Study was completed in support of the FCDP. The MSS Report recommended a wastewater collection and disposal system for the FCDP, including the subject site. Subsequent to completion of the 2009 MSS report, Novatech Consulting Engineers Ltd completed the Fernbank Community Sanitary Trunk Sewer Design Report in 2012. The latter report recommended construction of the Fernbank Trunk Sewer in the Hydro One easement adjacent to the Trans Canada Trail. The upper reach of the Trunk Sewer is designed as a 600 mm dia pipe at 0.39% slope and is proposed to be constructed immediately north of the subject site and will provide an outlet capacity at MH-FT24. Copies of the Drainage Area Plan and design sheet from the 2012 Fernbank Trunk Sewer report are included in **Appendix D**.

The following is a comparison of the proposed tributary areas and population projections from the 2012 report and the CRT Phase 2 design.

Table 3.1 Elements Tributary to MH-FT24

DESIGN	AREA (HA)	POPULATION
2012	200.11	10436
CRT Phase 1*	203.44	10400

** The areas and populations for the MH-FT24 outlet have been adjusted to account for OPA Expansion Area 6.*

Table 3.2 Elements Tributary to MH-FT18

DESIGN	AREA (HA)	POPULATION
2012	13.19	538
CRT Phase 1*	12.21	524

** The areas and populations for the MH-FT24 outlet have been adjusted to account for OP Expansion Area 6.*

As is evident from these tables, the areas and population estimates for each outlet are relatively consistent. There are to be some minor differences expected between final design, when final lotting is known, and the more macro focused master study estimates. Therefore, the sanitary design is in general conformance with the 2012 Trunk Sewer Report.

There are some changes now recommended to the sanitary drainage area boundaries, especially along the west side of Robert Grant Avenue and the drainage divide along the Phase 1A limits. The changes are identified in **Figure 3.1**. The significant change is that the school site, Block 361, adjacent to Robert Grant Avenue is now proposed to be serviced from Cope Drive and be tributary to the proposed 600 mm Ø sub-trunk sewer in Goldhawk Drive. The MSS report recommended that the school site be tributary eastward to the Fernbank Crossing development. The change is recommended because of ownership boundaries.

Upstream of MH-FT24 on the Fernbank Trunk Sewer, the 2009 MSS document recommended construction of a 525 mm diameter sub-trunk sewer along Goldhawk Drive and a 450 mm diameter sewer oversized for external lands west of Shea Road. A copy of the 2009 MSS Sanitary Drainage Area Plan (Drawing 101108-SAN) is included in **Appendix D**. Since the 2009 MSS report was completed, the City of Ottawa has requested that the CRT sanitary sewer be oversized to account for wastewater flows to the existing Laird Street Pump Station and also expected flow from the 2012 OPA Area 6 expansion lands. The latter areas were brought into the urban envelope in 2012 as part of the last Official Plan review by the City.

In accordance with recent instructions from the City of Ottawa, an allowance for external flows of 192 l/s has been provided in the proposed 600 mm Ø sub-trunk sewer in the subject property, 108 l/s for the Liard Street Pump Station and 84 l/s for the OPA 76 Area 6 lands. Refer to an e-mail string last dated January 31, 2017 from the City located in **Appendix B**.

Therefore, the recommended sanitary sewer extension through the CRT Phase 1 site to accommodate the revised design criteria is now a 600 mm diameter pipe as opposed to the 450/525 pipe recommended in the MSS report.

As recently agreed with the City, the proposed 600 mm diameter sanitary sub-trunk sewer through the CRT property has been sized to accommodate the following external flows:

• Liard Street Pump Station	108 l/s
• OPA 76 Area 6 Pump Station	84 l/s
	192 l/s

Those flows are in addition to other upstream flows from future developments within the Fernbank CDP area.

3.3 Design Criteria

The sanitary sewers for the subject site will be based on the recommendations of the 2009 MSS and the standards of both the City of Ottawa and the provincial Ministry of the Environment. Some of the key criteria will include the following:

Average Day Residential Flow	350 l/cap/day
Residential Peaking Factor	Harmon Formula: (min. -2.0, max, -4.0)
Industrial Flow Rate	50,000 l/day/ha
Commercial & Institutional Flow Rate	35,000 l/day/ha
ICI Peaking Factor	1.5
Infiltration Rate	0.28 l/s/ha
Single Unit Population Density	3.3 ppu
Townhouse Unit Population Density	2.5 ppu
Mixed Use Residential Area Density	1.8 ppu
Velocities	Min 0.6 m/s Max 3.0 m/s

Table 3.3 Minimum Allowable Slopes

DIAMETER (MM)	SLOPE (%)
200	0.320
250	0.240
300	0.816
375	0.140
450	0.111
525 and larger	0.100

Where practical and where there are less than 10 residential connections, the first lengths of sanitary sewers are designed as 200 mm diameter pipes with a minimum slope of 0.65%. The population densities used for the wastewater design for the subject lands are those recommended in the 2009 MSS document which are:

Low Density	3.3 pers/unit
Medium Density	2.5 pers/unit
High Density	1.8 pers/unit

For the purpose of this Design Brief document, single family units are considered low density and townhouse units are considered medium density.

3.4 Recommended Wastewater Plan

The recommended wastewater plan for the CRT Lands is shown in **Figure 3.2**. Sanitary sewer sizes are included only for the sewers 250 mm Ø and larger. To accommodate the expanded external wastewater drainage limits, construction of a 600Ø sub-trunk sewer is now proposed in Goldhawk Drive south to Cope Drive. That sub-trunk sewer will be oversized for future developments west of Goldhawk Drive, including the Laird Street Pump Station sewer shed and OPA Expansion Area 6. With the exception of Area 1A identified on **Figure 1.3**, all wastewater flows for the draft plan area will be directed to the proposed Goldhawk Drive 600Ø sub-trunk sewer. Drainage from Area 1A will outlet directly to the Fernbank Trunk Sewer at MHFT18 near Robert Grant Avenue.

The balance of Goldhawk Drive within the draft plan will include 375Ø and 300Ø sewers. Most of the remaining sanitary sewers within the subject site will be 250Ø and 200Ø.

3.5 Wastewater Outlet

The recommended wastewater plan for the FCDP includes construction of a new Fernbank Trunk Sewer to be located in the Trans Canada Trail and hydro easement adjacent to the existing developments in Stittsville. The new trunk sewer, which is now installed up to MHFT24, outlets directly to the HPS. With the exception of about 25 ha in the extreme south-east of the FCDP, the new Fernbank Trunk Sewer will provide an outlet for the FCDP lands located south of the Trans Canada Trail.

The 2009 MSS Report also completed a sanitary hydraulic gradient analysis (HGL). The recommended Hazeldean Pump Station overflow system included a diversion to the Monahan Constructed Wetlands Stormwater Management Facility. The predicted HGL at the station was 95.0 meters. The overflow will protect all development lands in the FCDP and most of the existing sewershed. A copy of Figure 6.1 Hydraulic Grade Line Analysis and the Sanitary Sewer Hydraulic Grade line Analysis (2031) from the 2009 MSS report is attached in **Appendix D**.

The City recently advised that the current sanitary hydraulic grade line (HGL) at the Hazeldean Pump Station is now 95.30 m as opposed to the 95.0 m HGL predicted in the 2009 MSS review. Because the proposed sanitary sewer system through the subject property, as well as the new completed Fernbank Trunk Sewer, are to carry the 192 l/s external flow (Liard Street Pump Station and Area 6 Expansion Lands) recently requested by the City, we have completed another review of the sanitary HGL along the Fernbank Trunk Sewer as well as into the CRT development. The detailed analysis is included in **Appendix D**.

The static analysis is based on the Darcy–Weisbach formula. Table 3.4 shows a comparison of the current analysis based on the sewer as-built design, and the MSS analysis.

Table 3.4 Sanitary HGL Analysis along the Fernbank Trunk Sewer

FERNBANK TRUNK SEWER			
AS-BUILT SEWER		MSS DESIGN	
LOCATION	HGL	LOCATION	HGL
MH FT-01	95.39	974	95.09
MH FT-08	95.60	972	95.91
MH FT-18*	97.50	934	97.96
MH FT-24**	99.93	924	100.75

* CRT East connection point
**CRT West connection point

The sewer locations in the above table represent common locations. This analysis indicates that the sanitary HGL along the trunk sewer is lower than previously predicted in the MSS document even though more wastewater is included in the current analysis. This seems to be related to the different hydraulic loss coefficients used in the analysis. The current review used the hydraulic loss coefficients as per Appendix 6-B.1 from the City of Ottawa Sewer Design Guidelines and Section 1.7 from the MOE Guidelines which are both located in **Appendix D**. The difference however appears to be a moot matter. The current analysis indicates that the proposed basements are several meters above either sanitary HGL.

From MH FT-18 (MSS node 934) the hydraulic analysis was carried to MH 146A in Putney Crescent which is the nearest MH in Phase 1A. The estimated sanitary HGL at MH 146A is 100.96 meters and the lowest basement footings at this location are designed to be near 103.66 meters.

There is a similar situation immediately upstream from the Fernbank Trunk Sewer MH FT-24 where the analysis was extended to MH 103A in Goldhawk Drive. The HGL at MH 103A is predicted to be 100.60 meters and the nearest basement footings are designed to be near the 105.75 elevation. Based on this analysis, the logical conclusion is that the Fernbank Trunk Sewer hydraulic gradient will not impact building construction in the CRT development.

3.6 Local Extraneous Flows

All sanitary sewers will be constructed to City of Ottawa standards, including testing prior to being put into service. There are no unusual local conditions within the subject site that are expected to contribute extraneous flows higher than those noted in the City's guidelines.

3.7 Sewer Calculations

Detailed sanitary sewer design sheets, using recommendations from the MSS, and criteria of the City of Ottawa and the provincial Ministry of Environment, and Sanitary Drainage Area Plans (Drawings 27970-501, 501A and 501B) are provided in **Appendix D**.

3.8 Environmental Constraints

There are no significant environmental constraints associated with development of the subject site. The upper reaches of the former Flewellyn Municipal Drain on the Owners property will be filled as part of the Phase 1 development. The wood lot identified in the EMP report is in a future phase and not covered by the current draft plan. The City has the option to purchase the wood lot.

3.9 Emergency Overflow

The wastewater outlet for the CRT Lands will be the Hazeldean Pump Station. Most sanitary pump stations in urban locations include overflows as an additional redundant operational system. The HPS includes an overflow to the Monahan Drain.

4 MINOR STORM SEWER SYSTEM

4.1 Existing Conditions

The subject property is located within the Fernbank Community Development area north of Fernbank Road and south of Abbott Street/Trans Canada Trail and immediately west of Robert Grant Avenue. The approved MSS and EMP recommend construction of nine stormwater management facilities and associated storm sewer services to provide stormwater management for the Fernbank Community. As outlined in the MSS, the majority of the subject property is tributary to Pond 5 and a small portion is tributary to Pond 6. The draft plan covers an area of about 53 ha within the overall development.

The site's topography is generally between the 109 and 105 contours with most of the site draining towards the south into Flewellyn Drain. Although a portion of the plan is farmed, most of it consists of uncultivated grass lands. The north-east corner of the site, about 7 ha, drains to the east and runoff from this area will be tributary to Pond 6 which is located in the neighbouring development east of Robert Grant Avenue. **Figure 4.1** indicates the existing drainage patterns for the subject site.

The geotechnical report indicates that most of the site consists of about 0.2 to 0.3 meters of topsoil over glacial till. Bedrock is generally shallow being about 0.5 to 1.0 m below surface towards the north of the site and between 1.60 m and 3.15 m deep for the remainder of the site. These are also pockets of silty clay at varying depths.

BEDROCK

A portion of the Flewellyn Drain is located within the Owner's property. As outlined within **Section 1.6**, about 950 m of the upper reaches of the drain north of Fernbank Road were formally closed as municipal drains in a 2011 City By-Law (No. 2011-311) and a permit to fill those ditches was previously issued by the RVCA. However, because the permit expired in February 2016, the Owners will seek an extension to the permit. This work is to be coordinated with the City of Ottawa and the Rideau Valley Conservation Authority.

4.2 Master Servicing Studies

The 2009 EMP and MSS reports made preliminary recommendations for design of the stormwater management system for the FCDP. These recommendations included preliminary sizing of the stormwater management facilities complete with operating levels.

The MSS report recommended construction of Pond 5 on the subject site with an outlet to the existing Flewellyn Drain. In an effort to limit storm sewer hydraulic gradients and significant grade raising, the MSS report recommend that the 1:100 operating level of Pond 5 be about 104.4 m. To accomplish that elevation, about 375 meters of the Flewellyn Drain south of Fernbank Road was recommended to be lowered.

The 2011 Conceptual Site Servicing Study report completed a further analysis with respect to grade raising and recommended that the 1:100 year operating level of Pond 5 be lowered to about 103.9 m. It was also recommended that the Flewellyn Drain be lowered south of Fernbank Road for a distance of about 600 meters in order to accommodate the proposed operating levels.

It is also proposed to modify the drainage limits between Ponds 5 and 6. **Figure 4.2** shows these adjustments. There is a modest change to the drainage limits towards the north-east of the property as well as along the western limit of Robert Grant Avenue, which are now confirmed based on final lotting and the final design of the arterial road. Also, the secondary school site is recommended to be serviced by Pond 5, the construction of which is in control of the CRT Owners. These changes are fairly minor and will not impact the overall designs of either Pond 5 or 6. Additionally, the drainage split between Pond 5 and 6 at the north east corner of Phase 1 has now been finalized. These drainage limits were originally identified in the "West Park Pond 6

Stormwater Management Report and Design Brief Report" which was completed in support of the Pond 6 design. A copy of Figure 2 from that report is included in **Appendix E** for reference.

The minor storm sewers recommended in the 2009 MSS are now proposed to be larger. This is mostly due to the change in design criteria issued by the City in 2012. A copy of the Storm Drainage Area Plan Minor System Drainage (dwg 101108STM1) from the 2009 MSS report is included in **Appendix E**. A copy of the CRT Phase 1 storm design sheet and drainage area plans **27970-500**, **500A** and **500B** are also included in **Appendix E**. The following **Table 4.1** indicates some of the significant sewers size changes now recommended for Phase 1.

Table 4.1 Minor Storm Sewer Size Changes

LOCATION		SEWER SIZES (MM Ø)	
DESIGN	MSS NODE	2009 MSS	CURRENT DESIGN
Bobolink Ridge	(535-529)	975	1500
Goldhawk Drive	(529-523)	1650	2100
Cope Drive	(525-523)	1500	1950
Goldhawk Drive	(523-519)	1950	2700

4.3 Minor Storm Sewer Design Criteria

In keeping with guidelines published by the City of Ottawa for storm sewers in Greenfield developments, the storm drainage system proposed for the CRT Phase 1 lands will follow the principles of dual drainage.

The minor storm flow estimates were reviewed by the rational method. Some of the significant criteria used in the minor storm sewer design are:

- Intensity — 1.5 year curve (local and collector roads)
- Initial Time of Concentration — 10 min
- Runoff Coefficients:
  Singles/Townhouses — Front yards = 0.75
  Rear yards = 0.5
- Velocities — 0.80 m/s to 6.0 m/s
- Manning roughness coefficient — 0.013 (smooth wall pipes)
- Minimal allowable slopes — Refer to below table

Table 4.2 Minimal Allowable Slopes

DIAMETER (MM)	SLOPE (%)
250	0.432
300	0.340
375	0.250
450	0.195
525	0.160
600	0.132
750 and larger	0.100

- Minimum depth of cover of 2.0 m
- Inlet-control rate to capture 5 year peak flows

- 100 year Hydraulic Grade Line (HGL) separation to be greater than 0.30 m from the underside of footing
- HGL analysis calculated with XPSWMM

4.4 Proposed Minor Storm Sewer Plan

The minor storm sewer design sheet and the storm drainage area plans are included in **Appendix E**. The proposed minor storm sewer plan for the CRT Phase 1 lands is indicated on **Figure 4.3**. Only sewer sizes 750 mm diameter and larger are indicated.

All drainage form the subject site will be directed into the proposed SWMF Pond 5 via large storm sewers in Goldhawk Drive. Most of the storm sewers were designed based on the rational method; however, the sewer sections MH 303 to MH 207 on Goldhawk Street and Street No. 26 and MH 207 to MH 300 on Street No. 25 were sized based on stormwater management criteria which are discussed in detail in the “Fernbank Pond 5 Stormwater Management Facility Report and Design Brief, March 2016”. Essentially, the proposed 1500 mm diameter sewer in Street No. 25 is a first flush pipe and the 2100 mm diameter sewer south of MH 207 is a dual purpose pipe serving as a minor storm pipe during most events but as an overflow conveyance during rare events. The overflow pipe provides flow separation, allowing the first flush to be diverted to the sediment forebay via the 1500 diameter first flush pipe, and minor flow in excess of the first flush to be conveyed directly to the wet well. During less frequent events, overflows will bypass the sediment forebay, thus preventing re-suspension of sediment. During these events, the 1500 mm diameter first flush pipe will continue to function concurrently.

4.5 Robert Grant Avenue Drainage

Phase 1 of the CRT lands abuts the arterial road Robert Grant Avenue which is located to the east of the subject site. The natural topography of the CRT property in the vicinity of the arterial road slopes from west to east towards the road. **Figure 4.1** provides an indication of the existing drainage pattern for the subject site.

Since there are two projects that were each designed by different engineers and abut and impact each other, IBI has discussed, reviewed and agreed with the roadway designers, Novatech Engineering, on the limits of runoff that can be accommodated by the arterial roadway drainage design. **Figure 4.4** indicates these limits in terms of location, areas and flows. The significant limitation to development of the CRT lands adjacent to the Robert Grant Avenue is that no minor storm runoff in the 1:5 yr. event can cross the roadway sidewalk. The only minor runoff from the subject site that can be accommodated by the arterial road drainage system is from short sections of three side streets: Bobolink Ridge; Cope Drive and a future street opposite Haliburton.

There will be some major storm runoff from the edges of most developments along Robert Grant Avenue as well as the three side streets.

5 SITE STORMWATER MANAGEMENT

5.1 Synopsis of Previous Reports

The post-development drainage strategy for the Fernbank Community Development, including the subject site, was presented in the 2009 EMP and MSS. The conceptual post-development servicing of the lands tributary to Pond was presented in the 2011 Conceptual Site Servicing Study. In May 2016, IBI completed the “Fernbank Pond 5 Stormwater Management Facility Report and Design Brief”, outlining the design of the Pond 5 SWM Facility to which the majority of the development is tributary. The end-of-pipe SWM facility is designed to provide water quantity and quality control and outlet to the Flewellyn Drain.

This report builds upon the recommendations and findings of the 2009 EMP, 2009 MSS, 2011 Conceptual Site Servicing, and the 2016 Pond 5 Design Brief. It is intended to aid in the review and approval of the servicing for the proposed Phase 1 development.

5.2 Objective

The purpose of this report section is to present the dual drainage design, including the minor and major system, for the CRT Development Inc. Phase 1 development in the Fernbank Community. The design includes the sizing of inlet control devices, maximum depth and velocity of flow on the surface, and hydraulic grade line analysis. The stormwater system concept is discussed in subsequent sections and has been developed based on the October 2012 City of Ottawa Sewer Design Guidelines and February 2014 City of Ottawa Technical Bulletin ISDTB-2014-01.

5.3 Dual Drainage Design

The site was designed with dual drainage features, accommodating minor and major system flow. During frequent storm events, the effective runoff of a catchment area is directly released via catchbasin inlets to the network of storm sewers, called the minor system. During less frequent storm events, the balance of the flow (in excess of the minor flow) is accommodated by a system of rear yard swales and street segments, called the major system.

The streets within Phase 1 feature a mix of sawtooth and continuous grade profiles. The sawtooth profile facilitates surface storage on subdivision streets. In accordance with City of Ottawa guidelines, rear yard storage has not been accounted for. Inlet control devices (ICDs) are proposed across the site to maximize the use of available on-site storage and control surcharge of the minor system during infrequent storm events. The dual drainage system has been evaluated using the DDSWMM hydrological model, which offers single storm event flow generation and routing. The minor system hydraulic grade line analysis has been evaluated using the XPSWMM dynamic model.

There are two minor system outlets from Phase 1. The majority of the site is tributary to proposed Pond 5 to the south. The northern corner of the site, referred to as Phase 1A, is tributary to the existing Pond 6 to the east. Subsequently in this section, ‘Phase 1’ refers to those lands tributary to Pond 5.

ICDs were initially sized based on the 5 year 3 hour Chicago design storm event. In some instances, the proposed ICD release rates and minor system sewer sizing were optimized to protect lots from surface flooding. This was accomplished by increasing ICD release rates above the 5 year storm event. For Phase 1A, the minor system restriction was set to respect the allowable release rate of the existing outlet. DDSWMM input parameters, including ICD restrictions, are summarized in **Table 5.1**.

The major system flow pattern includes the following outlet locations: future Phase 2 to the south via Dagenham Street and via Goldhawk Drive; the existing Dry Pond 3 located southwest of the corner of Abbott Street and Robert Grant Avenue.

The DDSWMM drainage area plan is presented on **Drawings 27970-750A** and **750B** (enclosed in **Appendix F**).

Model files are enclosed on CD in **Appendix F**. It should be noted that due to the limitation of the modeling software, separate DDSWMM models were created for Phase 1 and Phase 1A. They read into one overall XPSWMM model.

5.4 Stormwater Evaluation

5.4.1 Hydrological Evaluation

Land use, selected modeling routines, and input parameters for the subject site are discussed in the following sections.

Land Use

Phase 1 and 1A will be developed with a mixture of townhouses, single family units, one park and two school sites. Higher density residential is proposed for the eastern portion of the site.

Storms and Drainage Area Parameters

The main hydrology parameters are summarized below and in **Table 5.1**.

- **Design storms:** The site was evaluated using the following storms:
    - 5 and 100 year 3 hour Chicago storm event with a 10 minute time step
    - 100 year 3 hour Chicago storm event + 20% increase in intensity with a 10 minute time step
    - July 1 1979, August 4 1988 and August 8 1996 historical storms with a 5 minute time step

  For consistency with the Pond 5 design, Phase 1 was also simulated with the following storms:
    - 100 year 24 hour SCS Type II storm event with a 12 minute time step, the design storm for the pond
    - 100 year 24 hour SCS design storm event with a 20% increase in intensity, 12 minute time step, stress test
- **Infiltration:** The selected infiltration losses are consistent with the City of Ottawa Sewer Design Guidelines. The Horton values are as follows: f_o = 76.2 mm/h, f_c = 13.2 mm/h, k = 0.00115 s^{-1}.
- **Area:** The catchment areas are based on the rational method spreadsheet, with some minor modifications for modeling purposes.
- **Imperviousness:** The imperviousness values are based on the runoff coefficients, which were determined by obtaining the footprint of the model units intended for the site and placing the maximum footprint on the lots.
- **Catchment Width:** The catchment width was based on the conveyance route length of the drainage area and multiplied by two. The multiplier of two was only used if the drainage area had runoff contribution from both sides of the drainage area.

- **Slope:** The ground slope was based upon the average slope for both impervious and pervious area. Generally, the slope is approximately 2% (0.02 m/m). This assumes a slope of approximately 1% for impervious or road surfaces and 3% for pervious surfaces (lot grading).

- **Initial Abstraction (Depression Storage):** The depression storage used for impervious areas was 1.57 mm and for pervious areas 4.67 mm, which is consistent with the City of Ottawa Sewer Design Guidelines values.

- **Manning's Roughness:** Manning's roughness coefficients of 0.013 and 0.25 were used for impervious and pervious areas, respectively.

- **Baseflow:** No baseflow components were assumed for any of the areas contributing runoff to the minor system.

- **Major system storage and routing:** The subject site is comprised of both continuous grade and sawtooth road profiles. For drainage areas with sawtoothing, available surface storage has been calculated based on the grading plan. Flow is attenuated within low points with potential overflow cascading to the next segment downstream. The total volume at each low point, up to the overflow depth, is the maximum static storage. Rear yard segments have a sawtooth pattern with some storage available, but the storage is not accounted for as part of the analysis.

  For street segments with ponding, minor system capture is set to fully utilize storage during the 100 year design storm, while minimizing ponding during the 5 year event. Cascading overflow from a low point to a downstream segment utilizes the static storage available plus an additional amount of storage equivalent to the depth required for the flow to cascade over the downstream high point. The attenuation in street sags was evaluated to account for static storage and, if overflow occurs, dynamic storage. Within this report it is referred to as double routing.

  DDSWMM does not have a direct way of coding double routing since it does not allow the user to code dynamic storage over the high point. For this analysis, the method employed is that recommended in the February 2014 City of Ottawa Technical Bulletin ISDTB-2014-01. It accounts for overflow from a street segment (regular static storage at a sag) being conveyed to a downstream dummy segment. In other words, a regular low point segment is provided with a downstream dummy segment for further flow attenuation to account for the dynamic ponding during overflow.

  There are no drainage area attributes associated with the dummy segment since it is a segment solely for routing. In addition, there is no inflow to the minor system from these dummy segments. The overflow hydrograph from the upstream catchment is routed in the dummy segment to the next "real" downstream segment. The dummy segments have the following specific characteristics:

  - Segment Length: Equivalent to the length of the maximum static storage from the street segment contributing to it.

  - Road Type: Equivalent to the right-of-way characteristics from the segment contributing to it, but with a longitudinal slope of 0.01% (0.0001 m/m).

The dummy segments for major system routing have been applied to the analysis of the subject site. The segments are referenced as D1, D2, D3, etc. within the DDSWMM modeling file. The drainage area plan presented in **Drawing 27970-750A** and **750B** does not show the dummy segments, but the DDSWMM output file shows the dummy segments immediately following the corresponding major segment which cascades into that dummy segment.

For street segments with continuous grade, simulations were based on the approach-capture characteristics of the catchbasin with the constraint that during the 100 year design storm the maximum cascading flow does not exceed 0.3 m.

For street segments with sawtoothing, simulations were based on the constraint that during the 100 year design storm the maximum depth of ponding (including cascading flow where applicable) does not exceed 0.3 m. Where surface storage is available, the storage-outflow characteristics for each low point were taken into consideration. The evaluation was undertaken assuming static conditions. The ponding plan for the subject site is presented on **Drawings 27970-751A and 751B** (enclosed in **Appendix F**).

Rear yards were considered independently of street segments and rear yard catch basins were incorporated in the DDSWMM model. Simulations were based on the total interception of runoff by the storm inlets. This was done by specifying a one-to-one relationship between approach flow and capture flow. Storage volume in rear yards was not accounted for as available on-site storage. Overflow from the rear yards cascades to a major system road segment via swales.

The two schools and higher density residential at the eastern edge of the site have been simulated with sufficient storage to contain the 100 year 3 hour Chicago storm event, with a provision for emergency overflow as indicated on **Drawings 27970-750A** and **750B**. For the higher density residential blocks, the required storage could consist of roof top storage, parking lot storage and/or underground storage. As discussed in **Section 4.5**, some major flow from the eastern edge of the residential blocks will cascade to the Robert Grant Way right-of-way. The information is illustrated on **Figure 4.4** and has been coordinated with the designers of the arterial road. The development of these blocks will be in accordance with the relevant constraints.

MAJOR

- **Minor system capture:** The minor system capture is based on the 5 year 3 hour Chicago storm event for maximum ponding conditions. ICDs are incorporated into the design to protect the minor system from surcharge during infrequent storm events and to utilize the available on-site storage. The size of the inlet control devices (ICDs) was optimized using DDSWMM.

  The minor system inflow rate was optimized to account for continuous grade. Specifically, the model incorporates the actual flow entering the minor system on continuous grade based on approach-capture curves derived from the 1984 MTO Drainage Manual (specifically, Charts E4-7D and Chart E4-7H). Minor system capture was set to correspond to either the 5 year simulated flow, or the maximum capture during unrestricted 100 year flow conditions, whichever was less. This is due to the fact that based on the approach-capture curve, the actual capture may be less than the 5 year simulated flow. This results in there being cascading flow on the surface during both the 5 and 100 year events. Therefore, at receiving low points, ICDs have been sized to fully capture the cascading flow from upstream street segments on continuous grade during the 5 year event, while minimizing ponding at the low point.

  The exception to this is the downstream low point within Phase 1A (S145B). The minor system restriction at this location was restricted to below the 5 year flow to meet the allowable release rate of 1200 l/s to the existing receiving trunk. The engineering consultant for the trunk storm sewer, Novatech Engineering, provided the maximum allowable release rate to the sewer as well as the boundary condition (refer to correspondence in **Appendix F**).

Areas where the capture rates have been revised for site optimization are noted in **Table 5.1**.

The main hydrological parameters used in the DDSWWM model are summarized in the below table. ICD restrictions are also summarized in tabular form on **Drawing DETAILS-1**.

Table 5.1 DDSWMM Parameters

AREA ID	AREA (HA)	MH	D/S SEGMENT	IMP RATIO	LENGTH (M)	WIDTH (M)	AVAIL. STORAGE (CU-M)	5 YEAR SIMULATED FLOW (L/S) *07-PH1-5CH.OUT & 07-PH1A-5CH.OUT*	ICD RESTRICTION (L/S)
Phase 1 Minor system tributary to Pond 5									
S153	0.12	MH153	S149A	0.79	32	64	N/A	25	17.07(1)
S149A	0.08	MH149	S149B	0.79	38	76	N/A	17	17(1)
RES2A	0.66	MH129	S149C	0.86	74.25	148.5	64.6(2)	133	133
S149C	0.09	MH149	S149B	0.79	99	99	1.09(6)	19	21.64(4)
S149B	0.05	MH149	S128A	0.79	46	46	N/A	10	10(1)
RES2B	0.56	MH129	RES1	0.86	63	126	70(2)	113.14	113.14
S128A	0.18	MH128A	S127B	0.79	58	116	9.63	35	107(3)
S127B	0.26	MH127B	S191B	0.79	72	144	37.78	53	59.65(3)
S191B	0.37	MH191	S186	0.79	101	202	0.38 (6)	76	84.73(4)
S128B	0.33	MH128B	S188	0.79	73	146	35.6	67	74.28(3)
R128B	0.08	MH128B	RES3	0.50	48	48	N/A	10.83	10.83
S188	0.33	MH188	S191A	0.79	80	160	N/A	67	37.29(1)
R188A	0.08	MH188	RES3	0.50	43	43	N/A	10.75	10.75
R188B	0.08	MH188	RES3	0.50	51	51	N/A	10.87	10.87
R127B	0.19	MH127B	R127C	0.50	46	92	N/A	25.35	25.35
R127C	0.22	MH127B	R191A	0.50	54	108	N/A	29.37	29.37
R191A	0.19	MH191	S191A	0.50	45	90	N/A	25.31	25.31
R189	0.07	MH189	RES3	0.50	46	46	N/A	9.53	9.53
R177	0.07	MH177	RES3	0.50	45	45	N/A	9.52	9.52
RES3	1.58	MH189	RG	0.86	178	356	185(2)	318.71	318.71
S189	0.3	MH189	S191A	0.79	126	199	4.73	62	69.75(4)
S191A	0.23	MH191	S186	0.79	91	162	14.04	45	186.15(3)
R182A	0.3	MH182	R186	0.50	75	150	N/A	40.11	40.11
R186	0.23	MH186	S186	0.50	62	124	N/A	30.9	30.9
S186	0.23	MH186	S183	0.79	71	142	9.26	48	141.24(3)
R175	0.36	MH175	R183	0.50	73	146	N/A	47.4	47.4
R183	0.22	MH183	S183	0.50	57	114	N/A	29.48	29.48
S152A	0.3	MH152	S151B	0.79	80	160	42.07	61	68.54(4)
S152B	0.1	MH152	S151B	0.79	77	77	0.69(6)	21	23.49(4)
R128A	0.14	MH128A	R127A	0.50	35	70	N/A	18.72	18.72
R127A	0.19	MH127A	R151B	0.50	45	90	N/A	25.31	25.31
R151B	0.20	MH151B	S151B	0.50	49	98	N/A	26.70	26.70
S151B	0.25	MH151B	S182A	0.79	140	217	1.02	52.98	52.98
S127A	0.17	MH127A	S182A	0.79	46	92	N/A	35	23.51(1)
S182A	0.29	MH182	S182B	0.79	76	152	44.83	58	141.61(3)
S182B	0.29	MH182	S183	0.79	75	150	6.67	59	66.27(3)
S183	0.24	MH183	S174	0.79	76	152	66.51	50	132.73(3)
R182B	0.16	MH182	R182C	0.50	55	55	N/A	20.78	20.78
R182C	0.12	MH182	R174	0.50	58	58	N/A	16	16
R174	0.12	MH174	S174	0.50	58	58	N/A	16	16
S190	0.06	MH190	S176	0.79	71	71	0.55(6)	13	14.48(4)

AREA ID	AREA (HA)	MH	D/S SEGMENT	IMP RATIO	LENGTH (M)	WIDTH (M)	AVAIL. STORAGE (CU-M)	5 YEAR SIMULATED FLOW (L/S) *07-PH1-5CH.OUT & 07-PH1A-5CH.OUT*	ICD RESTRICTION (L/S)
S177	0.14	MH177	RG	0.79	49	98	N/A	29	9.4(1)
S176	0.14	MH176	S175	0.79	96	96	N/A	29	7.62(1)
INST2	6.57	MH176	S175	0.50	739	1478	618(2)	822	801.37
S175	0.42	MH175	S174	0.79	109	218	9.23	82	118.66(4)
S174	0.25	MH174	S173	0.79	68	136	14.44	51	57.18(4)
S173	0.75	MH173	S172	0.79	80	160	14.78	140	156.12(4)
INST1	2.88	MH172	S172	0.86	324	648	326(2)	582	579.45
S172	0.23	MH172	PH2	0.79	65	130	18.32	47	52.88(4)
S135A	0.14	MH135	S135B	0.79	75	75	N/A	29	16.77(1)
S135B	0.12	MH135	S134A	0.79	81	81	0.95(6)	23	46.36(4)
S134C	0.06	MH134	S134A	0.79	60	60	N/A	13	9.26(1)
S136A	0.11	MH136A	S134B	0.79	82	82	N/A	23	14.42(1)
S134B	0.14	MH134	S134A	0.79	77	77	N/A	27	22.21(1)
R151A	0.18	MH151A	R134	0.50	48	96	N/A	24.17	24.17
R134	0.21	MH134	S134A	0.50	56	112	N/A	28.2	28.2
S134A	0.19	MH134	S140	0.79	58	116	5.87	35	75.86(4)
S151A	0.1	MH151A	S150A	0.79	80	80	N/A	21	13.53(1)
S150A	0.28	MH150	S140	0.79	74	148	N/A	54	35.75(1)
S150B	0.04	MH150	S140	0.79	22	22	0.40(6)	8	9.17(4)
R125B	0.19	MH125	R140	0.50	47	94	N/A	25.39	25.39
R140	0.21	MH140	S140	0.50	50	100	N/A	27.98	27.98
S140	0.25	MH140	S124	0.79	78	156	17.74	50	104.9(4)
S125	0.39	MH125	S124	0.79	103	206	19.83	80	88.89(4)
R131	0.2	MH131	R130A	0.50	51	102	N/A	26.78	26.78
R130A	0.16	MH130	R130B	0.50	39	78	N/A	21.36	21.36
R130B	0.17	MH130	S130	0.50	38	76	N/A	22.55	22.55
S124	0.26	MH124	S180A	0.79	69	138	15.52	53	59.47(4)
S130	0.35	MH130	S180A	0.79	100	200	15.27	72	80.28(4)
R125A	0.16	MH125	R124B	0.50	78	78	N/A	21.33	21.33
R124B	0.16	MH124	S180A	0.50	86	86	N/A	21.47	21.47
R180A	0.09	MH180	R181	0.50	43	43	N/A	12	12
S180A	0.19	MH180	S180B	0.79	65	65	9.97	37	103.71(3)
R181	0.09	MH181	S181	0.50	43	43	N/A	12	12
S180B	0.18	MH180	S181	0.79	65	65	10.67	36	101.83(3)
S181	0.14	MH181	PH2	0.79	69	138	30.43	30	93.49(3)
S170A	0.27	MH170	S171	0.79	75	150	17.58	55	61.9(3)
RES3A	3.26	MH170	S171	0.66	367	734	81.50(7)	522	583
S171	0.26	MH171	PH2	0.79	74	148	29.26	54	259.83(3)
PARK1	1.27	MH132	S132	0.00	143	286	N/A	29.66	29.66
R112A	0.12	MH112	R112B	0.50	62	62	N/A	16.07	16.07
R112B	0.06	MH112	S132	0.50	28	28	N/A	7.99	7.99
S132	0.24	MH132	S113	0.79	32.5	65	44.45	54	116.8(3)
S112	0.27	MH112	S113	0.79	70	140	10.79	55	61.57(4)
S113	0.27	MH113	S114	0.79	70	140	4.29	55	61.57(4)
S114	0.24	MH114	S120	0.79	70	140	19.69	50	55.33(4)
R114A	0.32	MH114	R114B	0.50	65	130	N/A	42.14	42.14
R114B	0.18	MH114	S114	0.50	30	60	N/A	23.33	23.33
S122	0.31	MH122	S120	0.79	82	164	34.71	63	70.84(4)
R102	0.21	MH102	R103B	0.50	56	112	N/A	28.2	28.2
R103B	0.16	MH103	R104B	0.50	36	72	N/A	21.24	21.24
R104B	0.19	MH104	R104C	0.50	38	76	N/A	24.99	24.99
R104C	0.17	MH104	S104	0.50	39	78	N/A	21.36	21.36
S120	0.28	MH120	S105A	0.79	85	170	41.25	58	111.71(3)
S110	0.09	MH110C	S103	0.79	80	80	2.96	19	19(1)
S102	0.09	MH102	S103	0.79	80	80	3.02	19	21.31(4)

AREA ID	AREA (HA)	MH	D/S SEGMENT	IMP RATIO	LENGTH (M)	WIDTH (M)	AVAIL. STORAGE (CU-M)	5 YEAR SIMULATED FLOW (L/S) *07-PH1-5CH.OUT & 07-PH1A-5CH.OUT*	ICD RESTRICTION (L/S)
R103A	0.34	MH103	R104A	0.50	77	154	N/A	45.14	45.14
S103	0.34	MH103	S104	0.79	81	162	55.49	69	77.01(4)
R104A	0.23	MH104	S105A	0.50	57	114	N/A	30.73	30.73
S104	0.30	MH104	S105A	0.79	80	160	11.06	61	68.60(4)
R122	0.07	MH122	R121	0.50	35	35	N/A	9.36	9.36
R121	0.13	MH121	R105	0.50	60	60	N/A	17.27	17.27
R105	0.13	MH105	S105A	0.50	65	65	N/A	17.37	17.37
S105A	0.4	MH105	S105B	0.79	65	65	16	72	110.18(4)
S105B	0.51	MH105	S107	0.79	70	70	15.71	89	129.60(4)
S107	0.61	MH107	S109	0.79	80	80	29.42	106	141.24(3)
S109	0.52	MH109	EXT110	0.79	79	79	4.18	92	103.19(4)
S170B	0.06	MH170	EXT110	0.79	40	40	0.3(6)	13	13.99(4)
EXT110	0.47	MH110	PH1OVF	0.79	53	106	9.6	88	98.49(4)
Phase 1A Minor system tributary to Pond 6									
R142B	0.19	MH142	R143	0.50	75	150	N/A	26.13	26.13
R136A	0.27	MH136	S136E	0.50	128	256	N/A	37.39	37.39
S143	0.32	MH143	S136E	0.79	93	186	N/A	66	41.87(1)
S136E	0.17	MH136C	S144	0.79	55	55	N/A	30.48	30.48(1)
S136B	0.27	MH136C	S144	0.79	80	160	N/A	56	36.99(1)
S144	0.25	MH144	S145A	0.79	80	80	N/A	49	45.32(1)
R137A	0.11	MH137A	R144C	0.50	28	56	N/A	14.73	14.73
R144C	0.26	MH144	S160B	0.50	65	130	N/A	34.74	34.74
S160B	0.13	MH160	S145A	0.79	50	50	N/A	26	14.77(1)
S136D	0.07	MH136B	S160A	0.79	48	48	N/A	15	9.58(1)
S160A	0.3	MH160	S145A	0.79	86	172	N/A	62	36.92(1)
S145A	0.27	MH145	S145B	0.79	80	80	N/A	51	51(1)
S136C	0.11	MH136B	S137A	0.79	77	77	N/A	23	13.42(1)
R136B	0.23	MH136B	R137B	0.50	52	104	N/A	30.53	30.53
R137B	0.3	MH137A	S137A	0.50	72	144	N/A	39.97	39.97
S137A	0.14	MH137A	S137B	0.79	67	67	N/A	28	22.8(1)
S137B	0.13	MH137A	S138	0.79	90	90	1.1	27	61.15(4)
S138	0.15	MH138	S148	0.79	120	120	N/A	32	18.01(1)
S148	0.22	MH148	S145B	0.79	72	144	N/A	45	35.33(1)
R138	0.14	MH138	R145	0.50	35	70	N/A	18.72	18.72
R145	0.3	MH145	S145B	0.50	75	150	N/A	40.09	40.09
S145B	0.28	MH145	BLK335	0.79	60	120	35.13	55	90(5)
R142A	0.14	MH142	R143A	0.50	70	70	N/A	18.7	18.7
R143A	0.16	MH143	R144A	0.50	75	75	N/A	21.27	21.27
R144A	0.15	MH144	R146	0.50	63	63	N/A	19.79	19.79
R146	0.14	MH146	BLK335	0.50	63	63	N/A	18.57	18.57
RES1	1.89	MH162	DP	0.86	212.5	425	233(2)	381.83	381.83
HYD2	5.12	N/A	DP	0.00	576	1152	N/A	N/A	N/A

(1) Continuous grade, ICD set to correspond to lower of the 5 year simulated flow and the maximum capture during unrestricted 100 year flow conditions
(2) Assumed ponding volume. Assumes that on-site storage will be provided up to the 100 year 3 hour Chicago event
(3) Minor flow restrictions have been increased based on optimization of the system
(4) The minor flow restriction has been increased in sags to allow full capture of overflow from upstream segments on continuous grade during the 5 year storm event without ponding and/or to maintain ponding depths within the maximum depth during the 100 year storm event.
(5) Over-controlled to meet allowable release rate to existing receiving storm trunk
(6) Due to the limitation of the DDSWMM modeling software (specifically the allowable number of storage-release curves) the ponding was either discounted or merged to that of an adjacent drainage area.
(7) Assumed ponding volume.

5.4.2 Results of Hydrological Modeling

Minor system hydrographs generated by DDSWMM were exported to XPSWMM for the hydraulic grade line analysis (refer to **Section 5.4.3**). The results of the DDSWMM major system evaluation are summarized in the following sections.

5.4.2.1 Cascading Flow

The cascading flow across the site was evaluated to confirm that depth and velocity were in accordance with City guidelines. To determine velocity of cascading overflow at critical locations, SWMHYMO was used. The applicable right-of-way (ROW) sections were entered into the model with the corresponding longitudinal slopes to obtain the maximum velocity of flow using the Route Channel routine. The resulting depths were also applied for street segments with continuous grade. To determine depth of the cascading overflow for street segments with ponding, the calculation sheet from the February 2014 City of Ottawa Technical Bulletin ISDTB-2014-01 was employed. The major system flow results are summarized in **Table 5.2** and **Table 5.3** and presented in full in **Appendix F**, along with supporting model files.

At one location, R137B, major flow from rear yards cascades to the street between units, utilizing the side lot. At the City's request, the cross-section of the side lot is enclosed in **Appendix F**, with the resulting water level during the 100 year event indicated, as well as the top of foundation wall. The top of foundation wall is greater than 0.15 m above the 100 year water level. It should be noted that 3H:1V side slopes were applied to the side lot cross-sections, considered a conservative approach.

Major flow from the majority of Phase 1 cascades south to future phases of development via Dagenham Street and Goldhawk Drive. The total major flow at each of these outlets is presented in the below tables. The flow has been accounted for in the overall CRT modeling at MH 207, along with flow from future phases of development.

The major flow outlet from Phase 1A is a walkway block to the existing Dry Pond 3. As previously noted, due to the allowable release rate to the existing storm sewer, minor system flow upstream of the walkway block was over-controlled. This results in the ponding at S145B being fully utilized during the 5 year event, with 185 l/s cascading to the dry pond. The designers of the existing dry pond, Novatech Engineering, were provided the hydrographs to the dry pond and have confirmed the dry pond's performance (refer to correspondence in **Appendix F**).

Table 5.2 Summary of Cascading Flow during the 100 year 3 hour Chicago Storm (Model files: 07-PH1-100CH.OUT, 07-PH1A-100CH.OUT and 27970VXD.OUT)

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
Phase 1							
S153	1.33	29	0.62	0	0.037	0.037	0.02
S149A	0.53	43	0.49	0	0.052	0.052	0.03
S149C	0.53	104	0.90	0.080	0.083	0.163	0.08
S149B	0.55	71	0.66	0	0.081	0.081	0.05
S128A(D1)	0.51	0	N/A	0.140	0	0.140	N/A
S127B(D2)	0.69	0	N/A	0.220	0	0.220	N/A
S191B	0.69	57	0.58	0.060	0.054	0.114	0.03
S128B(D3)	0.53	0	N/A	0.210	0	0.210	N/A
S188	0.53	88	0.58	0	0.067	0.067	0.04
S189(D4)	0.54	36	0.46	0.110	0.061	0.171	0.03
S191A(D5)	0.97	45	0.61	0.150	0.066	0.216	0.04

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
S186(D6)	1.14	58	0.70	0.140	0.072	0.212	0.05
S152A(D7)	0.69	0	N/A	0.220	0	0.220	N/A
S152B	0.52	32	0.54	0.060	0.060	0.120	0.03
S151B(D8)	0.61	113	0.65	0.050	0.094	0.144	0.06
S127A	0.51	41	0.48	0	0.051	0.051	0.02
S182A(D9)	1.04	49	0.64	0.230	0.068	0.298	0.04
S182B(D10)	1.14	42	0.64	0.130	0.064	0.194	0.04
S183(D11)	0.7	0	N/A	0.280	0	0.280	N/A
S190	0.62	10	0.43	0.050	0.038	0.088	0.02
S177	0.52	45	0.57	0	0.067	0.067	0.04
S176	0.52	53	0.61	0	0.072	0.072	0.04
S175(D12)	0.55	141	0.70	0.110	0.102	0.212	0.07
S174(D13)	0.55	98	0.67	0.155	0.089	0.244	0.06
S173(D14)	0.81	143	0.83	0.145	0.102	0.247	0.08
S172(D15)	0.73	134	0.79	0.165	0.101	0.266	0.08
S135A	0.56	37	0.57	0	0.063	0.063	0.04
S135B	0.91	70	0.80	0.070	0.072	0.142	0.06
S134C	0.51	15	0.44	0	0.045	0.045	0.02
S136A	0.56	29	0.54	0	0.057	0.057	0.03
S134B	0.56	57	0.64	0	0.073	0.073	0.05
S134A(D16)	1	123	0.80	0.115	0.096	0.211	0.08
S151A	0.52	25	0.51	0	0.055	0.055	0.03
S150A	0.79	91	0.68	0	0.063	0.063	0.04
S150B	1	12	0.53	0.060	0.036	0.096	0.02
S140(D17)	0.86	188	0.84	0.180	0.113	0.293	0.09
S125(D18)	0.55	8	0.32	0.160	0.035	0.195	0.01
S124(D19)	0.66	185	0.76	0.160	0.113	0.273	0.09
S130(D20)	0.66	71	0.60	0.170	0.079	0.249	0.05
S180A(D21)	1.17	186	0.95	0.140	0.112	0.252	0.11
S180B(D22)	1.12	97	0.79	0.150	0.088	0.238	0.07
S181(D23)	0.73	0	N/A	0.230	0	0.230	N/A
S170A(D24)	0.92	5	0.39	0.155	0.029	0.184	0.01
S171(D25)	0.73	69	0.72	0.205	0.078	0.283	0.06
Total Major Flow to Phase 2 via Dagenham*	0.73	195	0.80	0	0.085	0.085	0.07
S132(D26)	0.67	0	N/A	0.240	0	0.240	N/A
S112(D27)	0.67	21	0.44	0.140	0.050	0.190	0.02
S113(D28)	0.99	36	0.58	0.095	0.061	0.156	0.04
S114(D29)	0.83	101	0.71	0.180	0.089	0.269	0.06
S122(D30)	0.83	0	N/A	0.200	0	0.200	N/A
S120(D31)	0.7	36	0.51	0.220	0.061	0.281	0.03
S110(D32)	0.55	20	0.49	0.120	0.049	0.169	0.02
S102(D33)	0.55	14	0.45	0.120	0.043	0.163	0.02
S103(D34)	0.71	0	N/A	0.230	0	0.230	N/A
S104(D35)	0.7	114	0.69	0.140	0.095	0.235	0.06
S105A(D36)	0.55	203	0.73	0.160	0.117	0.277	0.09

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
S105B(D37)	0.6	164	0.71	0.160	0.108	0.268	0.08
S107(D38)	0.6	122	0.66	0.200	0.097	0.297	0.06
S109(D39)	0.68	106	0.67	0.110	0.092	0.202	0.06
S170B	0.68	9	0.36	0.050	0.026	0.076	0.01
Total Major Flow to Phase 2 via Goldhawk*	0.65	168	0.74	0.200	0.082	0.282	0.06
Phase 1A Major flow tributary to existing Dry Pond 3							
S143	1.65	82	0.88	0	0.053	0.053	0.05
S136E	0.83	143	0.78	0	0.074	0.074	0.06
S136B	2.58	67	0.97	0	0.045	0.045	0.04
S144	0.83	392	1.00	0	0.108	0.108	0.11
S160B	0.89	82	0.69	0	0.059	0.059	0.04
S136D	0.78	18	0.53	0	0.044	0.044	0.02
S160A	1.25	96	0.82	0	0.059	0.059	0.05
S145A	2.75	547	1.12	0	0.121	0.121	0.14
S136C	0.78	30	0.61	0	0.055	0.055	0.03
S137A	0.51	125	0.75	0	0.100	0.100	0.07
S137B(D1)	1.61	99	1.08	0.070	0.088	0.158	0.09
S138	1.61	128	1.15	0	0.082	0.082	0.09
S148	1.43	160	0.98	0	0.069	0.069	0.07
S145B	3.30	688	1.48	0.190	0.107	0.297	0.16
Total Major Flow to Dry Pond 3 via BLK335	2.00	741	1.50	0	0.111	0.111	0.17

** Street cross-section and profile assumed, to be confirmed at detailed design*

Table 5.3 Summary of Cascading Flow during the 100 year 3 hour Chicago Storm + 20% (Model file: 07-PH1-120CH.OUT, 07-PH1A-120CH.OUT and 27970VXD.OUT)

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
Phase 1							
S153	1.33	40	0.67	0	0.042	0.042	0.03
S149A	0.53	62	0.53	0	0.059	0.059	0.03
S149C	0.53	182	1.04	0.080	0.103	0.183	0.11
S149B	0.55	118	0.75	0	0.097	0.097	0.07
S128A(D1)	0.51	55	0.51	0.140	0.072	0.212	0.04
S127B(D2)	0.69	44	0.54	0.220	0.066	0.286	0.04
S191B	0.69	93	0.65	0.060	0.065	0.125	0.04
S128B(D3)	0.53	16	0.37	0.210	0.045	0.255	0.02
S188	0.53	119	0.63	0.000	0.075	0.075	0.05
S189(D4)	0.54	63	0.53	0.110	0.076	0.186	0.04
S191A(D5)	0.97	164	0.85	0.150	0.107	0.257	0.09
S186(D6)	1.14	241	0.99	0.140	0.124	0.264	0.12
S152A(D7)	0.69	13	0.39	0.220	0.042	0.262	0.02
S152B	0.52	50	0.60	0.060	0.070	0.130	0.04
S151B(D8)	0.61	189	0.74	0.050	0.114	0.164	0.08
S127A	0.51	58	0.51	0	0.057	0.057	0.03
S182A(D9)	1.04	156	0.86	0.230	0.105	0.335	0.09
S182B (D10)	1.14	158	0.89	0.130	0.106	0.236	0.09
S183(D11)	0.7	357	0.91	0.280	0.145	0.425	0.13
S190	0.62	16	0.48	0.050	0.045	0.095	0.02
S177	0.52	59	0.61	0	0.075	0.075	0.05
S176	0.52	72	0.65	0	0.081	0.081	0.05
S175(D12)	0.55	362	0.86	0.110	0.146	0.256	0.13
S174(D13)	0.55	531	0.94	0.155	0.168	0.323	0.16
S173(D14)	0.81	483	1.06	0.145	0.161	0.306	0.17
S172(D15)	0.73	812	1.16	0.165	0.192	0.357	0.22
S135A	0.56	50	0.61	0	0.070	0.070	0.04
S135B	0.91	118	0.91	0.070	0.088	0.158	0.08
S134C	0.51	21	0.48	0	0.051	0.051	0.02
S136A	0.56	39	0.58	0	0.064	0.064	0.04
S134B	0.56	80	0.69	0	0.083	0.083	0.06
S134A (D16)	1	214	0.92	0.115	0.118	0.233	0.11
S151A	0.52	35	0.55	0	0.062	0.062	0.03
S150A	0.79	125	0.73	0	0.070	0.070	0.05
S150B	1	20	0.61	0.060	0.044	0.104	0.03
S140(D17)	0.86	332	0.97	0.180	0.140	0.320	0.14
S125(D18)	0.55	65	0.55	0.160	0.077	0.237	0.04
S124(D19)	0.66	388	0.92	0.160	0.146	0.306	0.13
S130(D20)	0.66	119	0.68	0.170	0.096	0.266	0.07
S180A (D21)	1.17	453	1.18	0.140	0.153	0.293	0.18
S180B (D22)	1.12	355	1.09	0.150	0.141	0.291	0.15

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
S181(D23)	0.73	268	0.87	0.230	0.130	0.360	0.11
S170A (D24)	0.92	38	0.69	0.155	0.062	0.217	0.04
S171(D25)	0.73	422	0.99	0.205	0.155	0.360	0.15
Total Major Flow to Phase 2 via Dagenham*	0.73	1346	1.44	0	0.171	0.171	0.25
S132(D26)	0.67	144	0.72	0.240	0.103	0.343	0.07
S112(D27)	0.67	48	0.55	0.140	0.068	0.208	0.04
S113(D28)	0.99	131	0.81	0.095	0.098	0.193	0.08
S114(D29)	0.83	208	0.85	0.180	0.117	0.297	0.10
S122(D30)	0.83	13	0.42	0.200	0.041	0.241	0.02
S120(D31)	0.7	133	0.71	0.220	0.100	0.320	0.07
S110(D32)	0.55	34	0.56	0.120	0.060	0.180	0.03
S102(D33)	0.55	32	0.55	0.120	0.059	0.179	0.03
S103(D34)	0.71	33	0.51	0.230	0.059	0.289	0.03
S104(D35)	0.7	196	0.79	0.140	0.116	0.256	0.09
S105A (D36)	0.55	411	0.87	0.160	0.153	0.313	0.13
S105B (D37)	0.6	367	0.87	0.160	0.147	0.307	0.13
S107(D38)	0.6	330	0.85	0.200	0.141	0.341	0.12
S109(D39)	0.68	327	0.90	0.110	0.140	0.250	0.13
S170B	0.68	15	0.41	0.050	0.032	0.082	0.01
Total Major Flow to Phase 2 via Goldhawk*	0.65	369	0.90	0.200	0.110	0.310	0.10
Phase 1A Major flow tributary to existing Dry Pond 3							
S143	1.65	112	0.94	0	0.059	0.059	0.06
S136E	0.83	210	0.85	0	0.085	0.085	0.07
S136B	2.58	93	1.07	0	0.051	0.051	0.06
S144	0.83	574	1.10	0	0.125	0.125	0.14
S160B	0.89	124	0.77	0	0.069	0.069	0.05
S136D	0.78	25	0.58	0	0.051	0.051	0.03
S160A	1.25	131	0.89	0	0.066	0.066	0.06
S145A	2.75	805	1.27	0	0.138	0.138	0.18
S136C	0.78	40	0.66	0	0.061	0.061	0.04
S137A	0.51	191	0.83	0	0.118	0.118	0.10
S137B(D1)	1.61	172	1.24	0.070	0.108	0.178	0.13
S138	1.61	213	1.31	0	0.099	0.099	0.13
S148	1.43	262	1.11	0	0.084	0.084	0.09
S145B	3.3	1054	1.61	0.190	0.132	0.322	0.21
Total Major Flow to Dry Pond 3 via BLK335	2.00	1147	1.64	0	0.137	0.137	0.22

** Street cross-section and profile assumed, to be confirmed at detailed design*

During the 100 year 3 hour Chicago design storm, the maximum depth of cascading flow on the street is less than the maximum allowable 300 mm, and the velocity by depth product is less than the allowable 0.6 m^2/s.

During the 100 year Chicago design storm event increased by 20%, the maximum depth of cascading flow is less than 0.30 m across the majority of the site. However, there are locations where the total depth exceeds 0.30 m. The following table summarizes the elevation of the cascading flow at these critical locations and compares it to the adjacent property line elevation as well as critical elevations (such as garage opening, rear yard building envelope, or park).

Table 5.4 Critical Ponding Locations during the Stress Test and Adjacent Property Elevations

CRITICAL PONDING LOCATION	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	(1) CORRESPONDING ELEVATION (M)	(2) ADJACENT PROPERTY LINE ELEVATION (M)	DIFFERENCE (2) – (1)	(3) ADJACENT CRITICAL ELEVATION (M)		DIFFERENCE (3) – (1)
S182A	0.335	108.20	108.16	-0.04	Garage	108.35	0.15
S183	0.425	107.79	107.66	-0.13	Garage	107.88	0.09
S174	0.323	107.70	107.63	-0.07	Garage	107.9	0.20
S173	0.306	107.55	107.5	-0.05	Garage	107.75	0.20
S172	0.357	107.44	107.35	-0.09	Garage	107.55	0.11
S140	0.320	108.06	108.05	-0.01	RY	108.33	0.27
S124	0.306	107.95	107.91	-0.04	Garage	108.16	0.21
S181	0.360	107.38	107.27	-0.11	Park	107.32	-0.06
S171	0.360	107.39	107.31	-0.08	Garage	107.55	0.16
S132	0.343	107.83	107.88	0.05	RY	108.27	0.44
S120	0.320	107.67	107.65	-0.02	Garage	107.85	0.18
S105A	0.313	107.73	107.72	-0.01	RY	107.91	0.18
S105B	0.307	107.67	107.66	-0.01	Park	107.66	-0.01
S107	0.341	107.58	107.54	-0.04	Park	107.54	-0.04
S145B	0.322	105.68	105.60	-0.08	Garage	105.95	0.27

At three locations (S181, S105B, and S107) major flow will cascade to the adjacent park area during the stress test. Otherwise, across the remainder of the site, the maximum depth of flow will encroach the lowest property line but remains below the adjacent garage elevation during the stress test.

5.4.3 Hydraulic Grade Line Analysis

The existing XPSWMM hydraulic model for Pond 5 has been revised to include the detailed design of Phase 1, which is tributary to Pond 5, and Phase 1A, tributary to Pond 6. Minor system hydrographs generated from the DDSWMM model were exported to the XPSWMM model. Minor system losses were accounted for in accordance with Appendix 6-B of the City of Ottawa Sewer Design Guidelines (October 2012).

Simulations were performed for various storms to confirm the hydraulic grade line (HGL) through Phase 1 and Phase 1A of the development. With respect to Phase 1, simulations were also performed to evaluate the impact on the receiving Pond 5.

Phase 1A ties into an existing storm sewer, the design of which was completed by Novatech. Novatech provided IBI the boundary condition for this node, as well as the maximum allowable release rate to the sewer. Correspondence is enclosed in **Appendix F**.

The XPSWMM model schematic is enclosed in **Appendix F**.

5.4.4 Results of Hydraulic Evaluation

The hydraulic grade line was analyzed using the XPSWMM dynamic model for the 100 year 3 hour Chicago storm. A sensitivity analysis was completed with the 100 year 3 hour Chicago storm + 20% increase in intensity, as well as three historical storms (July 1979, August 1988 and August 1996). The results of the 100 year 3 hour Chicago storm, stress test and July 1979 events are presented in the below **Table 5.5**, results of the remaining storm events are enclosed in **Appendix F**, along with model files. For the evaluation of the impact on the downstream Pond 5, the 100 year 24 hour SCS Type II event was also simulated, as it is the design storm for the SWM facility. A comparison of HGL values at locations along the storm trunk for the 100 year 24 hour SCSC Type II storm are presented in **Table 5.6**. The complete results are enclosed in **Appendix F**.

The HGL elevations are presented in the following **Table 5.5**, along with a comparison of underside of footing (USF) elevations, where available, and proposed ground elevations otherwise. Locations at which there is no surcharge are indicated with 'N/A.' Freeboard is calculated from either USF or proposed ground elevation.

Table 5.5 Summary of Hydraulic Grade Line Elevations

MH	USF (*PROPOSED GROUND)* (M)	100 YEAR 3 HOUR CHICAGO *27970PH1O_100CH_2017-07-11_REV.OUT*		STRESS TEST *27970PH1O_120CH_2017-07-11_REV.OUT*		JULY 1979 *27970PH1O_JUL79_2017-07-11_REV.OUT*	
		HGL	CLEARANCE (M)	HGL	CLEARANCE (M)	HGL	CLEARANCE (M)
PHASE 1							
MH110	*107.52*	104.69	2.83	104.75	2.77	104.71	2.81
MH109	*107.45*	104.71	2.74	104.77	2.68	104.72	2.73
MH107	*107.41*	104.73	2.68	104.80	2.61	104.75	2.66
MH105	105.65	104.76	0.89	104.83	0.82	104.79	0.86
MH104	105.85	104.80	1.05	104.87	0.98	104.83	1.02
MH103	105.75	104.81	0.94	104.89	0.86	104.85	0.90
MH102	105.95	104.82	1.13	104.89	1.06	104.85	1.10
MH110C	*107.93*	N/A	N/A	N/A	N/A	N/A	N/A
MH170	105.50	104.86	0.64	104.94	0.56	104.87	0.63
MH171	105.35	104.96	0.39	105.04	0.31	104.96	0.39
MH172	105.50	105.03	0.47	105.12	0.38	105.03	0.47
MH173	105.65	105.07	0.58	105.17	0.48	105.08	0.57
MH174	105.80	105.13	0.67	105.24	0.56	105.14	0.66
MH175	106.00	105.18	0.82	105.28	0.72	105.19	0.81
MH176	106.10	105.23	0.87	105.33	0.77	105.24	0.86
MH177	*106.55*	105.28	1.27	105.34	1.21	105.30	1.25
MH181	105.65	105.19	0.46	105.28	0.37	105.06	0.59
MH180	105.85	105.42	0.43	105.52	0.33	105.18	0.67
MH184	105.68	105.19	0.49	105.30	0.38	105.20	0.48
MH183	105.95	105.32	0.63	105.42	0.53	105.34	0.61
MH182	106.19	105.83	0.36	105.96	0.23	105.86	0.33
MH187	105.75	105.37	0.38	105.47	0.28	105.39	0.36
MH186	106.05	105.53	0.52	105.68	0.37	105.57	0.48
MH191	106.02	105.61	0.41	105.78	0.24	105.67	0.35
MH185	106.45	105.66	0.79	105.82	0.63	105.72	0.73
MH127	106.70	105.80	0.90	105.99	0.71	105.87	0.83
MH190	106.35	105.26	1.09	105.36	0.99	105.26	1.09
MH189	106.05	105.31	0.74	105.41	0.64	105.31	0.74
MH188	106.55	105.44	1.11	105.58	0.97	105.46	1.09

MH	USF *(PROPOSED GROUND)* (M)	100 YEAR 3 HOUR CHICAGO *27970PH1O_100CH_2017-07-11_REV.OUT*		STRESS TEST *27970PH1O_120CH_2017-07-11_REV.OUT*		JULY 1979 *27970PH1O_JUL79_2017-07-11_REV.OUT*	
		HGL	CLEARANCE (M)	HGL	CLEARANCE (M)	HGL	CLEARANCE (M)
MH128	106.65	N/A	N/A	105.78	0.87	N/A	N/A
MH120	105.70	104.87	0.83	104.95	0.75	104.90	0.80
MH121	105.70	104.88	0.82	104.96	0.74	104.92	0.78
MH122	105.90	N/A	N/A	104.98	0.92	104.94	0.96
MH123	106.00	N/A	N/A	105.01	0.99	104.97	1.03
MH124	106.10	N/A	N/A	105.07	1.03	N/A	N/A
MH125	106.20	N/A	N/A	105.13	1.07	N/A	N/A
MH126	106.35	N/A	N/A	105.17	1.18	N/A	N/A
MH129	*109.23*	N/A	N/A	N/A	N/A	N/A	N/A
MH114	106.00	104.97	1.03	105.08	0.92	105.03	0.97
MH113	106.05	105.09	0.96	105.21	0.84	105.17	0.88
MH112	106.10	105.16	0.94	105.28	0.82	105.25	0.85
MH111	*108.19*	N/A	N/A	105.28	2.91	105.25	2.94
MH132	106.15	N/A	N/A	105.34	0.81	105.30	0.85
MH130	106.25	105.02	1.23	105.12	1.13	105.09	1.16
MH131	106.15	N/A	N/A	105.14	1.01	105.13	1.03
MH140	106.25	N/A	N/A	N/A	N/A	N/A	N/A
MH134	106.40	N/A	N/A	N/A	N/A	N/A	N/A
MH141	*108.40*	N/A	N/A	N/A	N/A	N/A	N/A
MH135	106.76	N/A	N/A	N/A	N/A	N/A	N/A
MH150	106.65	N/A	N/A	N/A	N/A	N/A	N/A
MH152	107.40	N/A	N/A	N/A	N/A	N/A	N/A
MH153	107.25	N/A	N/A	N/A	N/A	N/A	N/A
MH151	107.00	N/A	N/A	N/A	N/A	N/A	N/A
MH149	106.71	N/A	N/A	N/A	N/A	N/A	N/A
PHASE 1A							
CRT1	*103.30*	100.89	N/A	100.89	N/A	100.89	N/A
MH162	*N/A*	N/A	N/A	N/A	N/A	N/A	N/A
MH161	*104.20*	N/A	N/A	N/A	N/A	N/A	N/A
MH146	103.61	N/A	N/A	N/A	N/A	N/A	N/A
MH147	104.06	N/A	N/A	N/A	N/A	N/A	N/A
MH148	104.56	N/A	N/A	N/A	N/A	N/A	N/A
MH138	106.01	N/A	N/A	N/A	N/A	N/A	N/A
MH145	103.61	102.75	0.86	102.76	0.85	N/A	N/A
MH160	105.53	N/A	N/A	N/A	N/A	N/A	N/A
MH137	106.61	N/A	N/A	N/A	N/A	N/A	N/A
MH136	106.71	N/A	N/A	N/A	N/A	N/A	N/A
MH144	104.81	N/A	N/A	N/A	N/A	N/A	N/A
MH143	105.11	N/A	N/A	N/A	N/A	N/A	N/A
MH142	106.11	N/A	N/A	N/A	N/A	N/A	N/A

The above table indicates that minimum 0.3 m clearance between the USF and HGL is maintained across the subject site during the 100 year 3 hour Chicago storm event. It should be noted that the above results also indicate that there would be no severe flooding to properties during the 100 year 3 hour Chicago storm with a 20% increase in intensity, nor during the July 1 1979 historical storms. The results indicate that the HGL would be above the 0.3 m freeboard at three locations during the stress test, but below the USF across the site. The results of the remainder of the storm events are presented in **Appendix F**.

Phase 1, tributary to Pond 5, was also simulated with the 100 year 24 hour SCS Type II storm event, the design storm of the SWM facility. A comparison of HGL along the storm trunk is presented in **Table 5.6**. There is negligible impact on the HGL as a result of the revisions related to Phase 1 detailed design.

Table 5.6 100 year 24 hour SCS Type II HGL Comparison: Pond 5 Submission and Phase 1 Detailed Design

LOCATION		HGL (M)			
		100 YEAR 24 HOUR SCS TYPE II		100 YEAR 24 HOUR SCS TYPE II + 20%	
		POND 5 SUBMISSION MAY 2016	PHASE 1 DETAILED DESIGN *27970PH1_100SCS_2017-07-11_REV.OUT*	POND 5 SUBMISSION MAY 2016	PHASE 1 DETAILED DESIGN *27970PH1_120SCS_2017-07-11_REV.OUT*
Pond 5	D/S Cell	104.32	104.26	104.52	104.47
	U/S Cell	104.33	104.26	104.53	104.48
MH300		104.37	104.26	104.58	104.49
MH207		104.45	104.49	104.63	104.67
MH206		104.48	104.53	104.64	104.72
MH205		104.52	104.57	104.67	104.78
MH110 (Phase 1)		104.58	104.64	104.74	104.86

In addition, an evaluation of the hydraulic grade line was undertaken assuming that those storm sewer pipes that are partially permanently submerged have 25% accumulation of sediment. At the request of the City, the evaluation was undertaken using the 100 year 3 hour Chicago storm event. The results of the hydraulic evaluation are presented in **Table 5.7**.

Table 5.7 Hydraulic Grade Line for 25% Sediment Accumulation in Permanently Partially Submerged Storm Sewers (Phase 1)

MH	USF (*PROPOSED GROUND*) (M)	100 YEAR 3 HOUR CHICAGO *27970PH1O_100CH_2017-07-11_REV_SED.XP*	
		HGL	CLEARANCE (M)
MH110	*107.52*	105.35	2.17
MH109	*107.45*	105.38	2.07
MH107	*107.41*	105.43	1.98
MH105	105.65	105.48	0.17
MH104	105.85	105.54	0.31
MH103	105.75	105.61	0.14
MH102	105.95	105.67	0.28
MH110C	*107.93*	105.82	2.11
MH170	105.50	105.56	-0.06
MH171	105.35	105.67	-0.32
MH172	105.50	105.75	-0.25
MH173	105.65	105.80	-0.15
MH174	105.80	105.87	-0.07
MH175	106.00	105.91	0.09
MH176	106.10	105.96	0.14
MH177	*106.55*	106.04	0.51
MH181	105.65	105.90	-0.25
MH180	105.85	106.14	-0.29
MH184	105.68	105.92	-0.24
MH183	105.95	106.05	-0.10
MH182	106.19	106.55	-0.36

MH	USF (*PROPOSED GROUND)* (M)	100 YEAR 3 HOUR CHICAGO *27970PH1O_100CH_2017-07-11_REV_SED.XP*	
		HGL	CLEARANCE (M)
MH187	105.75	106.10	-0.35
MH186	106.05	106.26	-0.21
MH191	106.02	106.35	-0.33
MH185	106.45	106.44	0.01
MH127	106.70	106.68	0.02
MH190	106.35	105.98	0.37
MH189	106.05	106.04	0.01
MH188	106.55	106.35	0.20
MH120	105.70	105.67	0.03
MH121	105.70	105.71	-0.01
MH122	105.90	105.74	0.16
MH123	106.00	105.79	0.21
MH124	106.10	105.92	0.18
MH125	106.20	106.14	0.06
MH126	106.35	106.31	0.04
MH128	106.65	106.91	-0.26
MH129	*109.23*	106.91	2.32
MH114	106.00	105.79	0.21
MH113	106.05	105.90	0.15
MH112	106.10	106.06	0.04
MH111	*108.19*	106.08	2.11
MH132	106.15	106.06	0.09
MH130	106.25	105.89	0.36
MH131	106.15	106.09	0.06
MH140	106.25	106.00	0.25
MH134	106.40	106.39	0.01
MH141	*108.40*	106.56	1.84
MH135	106.76	106.33	0.43
MH136	106.71	106.39	0.32
MH150	106.65	106.22	0.43
MH152	107.40	106.39	1.01
MH153	107.25	106.59	0.66
MH151	107.00	106.60	0.40
MH149	106.71	106.80	-0.09

The modeling results of the permanently partially submerged storm sewers assuming 25% sediment accumulation indicate that the HGL is below the USF but the clearance between the USF and HGL is less than 0.3 m at 21 locations (indicated in red). At nine locations, the HGL is above the USF but below the basement slab (indicated in yellow). And at three locations, the HGL is above the basement slab. It should be emphasized that the sediment accumulation simulation has been completed under the 100 year storm event, considered a compounding sensitivity analysis. It is recommended that regular sewer clean out be performed prior to 25% accumulation.

5.5 Summary of Model Output Files

The following is a reference list of the model output files including file names and storm event evaluated. The files are included on the CD enclosed in **Appendix F**.

DDSWMM:

- 5 year 3 hour Chicago: 07-PH1-5CH.DAT, 07-PH1A-5CH.DAT
- 100 year 3 hour Chicago: 07-PH1-100CH.DAT, 07-PH1A-100CH.DAT
- 100 year 3 hour Chicago +20%: 07-PH1-120CH.DAT, 07-PH1A-120CH.DAT
- July 1979: 07-PH1-JUL79.DAT, 07-PH1A-JUL79.DAT
- August 1988: 07-PH1-AUG88.DAT, 07-PH1A-AUG88.DAT
- August 1996: 07-PH1-Aug96.DAT, 07-PH1A-Aug96.DAT

SWMHYMO:

- 27970VXD.OUT

XPSWMM:

- 100 year 3 hour Chicago: 27970PH1O_100CH_2017-07-11_REV.xp
- 100 year 3 hour Chicago +20% increase in intensity: 27970PH1O_120CH_2017-07-11_REV.xp
- July 1979: 27970PH1O_JUL79_2017-07-11_REV.xp
- August 1988: 27970PH1O_AUG88_2017-07-11_REV.xp
- August 1996: 27970PH1O_AUG96_2017-07-11_REV.xp
- 100 year 24 hour SCS Type II: 27970PH1_100SCS_2017-07-11.xp
- 100 year 24 hour SCS Type II + 20%: 27970PH1_120SCS_2017-07-11.xp
- 25% Sediment Accumulation: 27970PH1O_100CH_2017-07-11_REV_SED.xp

5.6 Erosion and Sedimentation Control

Development of a subdivision such as CRT Lands Phase 1 can potentially create deleterious material which can enter the natural environment and gain access to fish habitat. In order to prevent site generated sediments from entering the environment, an Erosion and Sedimentation Control Plan will be implemented prior to development.

The erosion and sedimentation strategy for the subject site will include erection of silt fences around the entire perimeter of the subject site. The silt fences will ensure protection of both adjacent developments and the natural environment.

A copy of the Erosion and Sedimentation Control Plan is included in **Appendix G**.

5.7 Miscellaneous Elements

The following section includes brief comments for items indicated in the current Servicing Study Guidelines for which the proposed development will have little or no impact. These include:

- Setbacks
- Drainage catchment diversions
- Municipal Drains
- 100 year flood lands

- Floodplains

There are no watercourses or hazard land setbacks applicable to the development. Mitigation measures of potential impacts to downstream watercourses such as Flewellyn Drain will include implementation of an Erosion and Sedimentation Control Plan.

There are no drainage catchment diversions proposed by the development.

Any runoff from the site, as with all developments in the Fernbank Community, has end-of-pipe quality and quantity treatment. Any impacts to receiving watercourses have been previously addressed.

The only municipal drain in the vicinity of the subject development is Flewellyn Drain. The drain is proposed to be deepened for about 650 m downstream of Fernbank Road and improved for about another 800 m up to Flewellyn Road. Permit No. RV5-11/15T dated July 9, 2015 from the Rideau Valley Conservation Authority has been obtained by the Owners. The drain improvements have been approved by the MOECC.

There are no flood plains in the vicinity of the CRT Lands.

6 APPROVALS AND PERMIT REQUIREMENTS

6.1 City of Ottawa

The City of Ottawa reviews all development documents including this report and working drawings. Upon completion, the City will approve the local watermains, under Permit NO. 008-202, submit the sewer MOE application to the province, and eventually issue a Commence Work Notification.

6.2 Province of Ontario

The Ministry of Environment and Climate Change (MOECC) will approve the local sewers and the stormwater facilities under Section 53 of the Ontario Water Resources Act and issue the Environment Compliance Approvals. A Permit To Take Water will also be required from the MOE.

6.3 Conservation Authority

Flewellyn Drain will be impacted by the proposed development. About 1450 m of the municipal drain is proposed to be improved. The Rideau Valley Conservation Authority has issued a permit (Permit No.RV5-11/15T) for the proposed improvements.

6.4 Federal Government

There are no permits, authorizations or approvals needed expressly for this development from the federal government.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This report and the accompanying working drawings clearly indicate that the proposed development meets the requirements of the stakeholder regulators, including the City of Ottawa, provincial MOECC and RVCA. With minor exceptions, the proposed development is in general conformance with the 2009 Master Servicing Report and current City of Ottawa design standards. Because of the 2012 change in the City of Ottawa's stormwater management criteria, most minor storm sewers are now proposed to be larger than those recommended in the 2009 Master Servicing Studies.

Downstream sanitary sewers were designed with the proposed development area included. There is a reliable water supply available adjacent to the proposed development.

7.2 Recommendations

It is recommended that the regulators review this submission with an aim of providing the requisite approvals to permit the owners to proceed to the development stage of the subject site.

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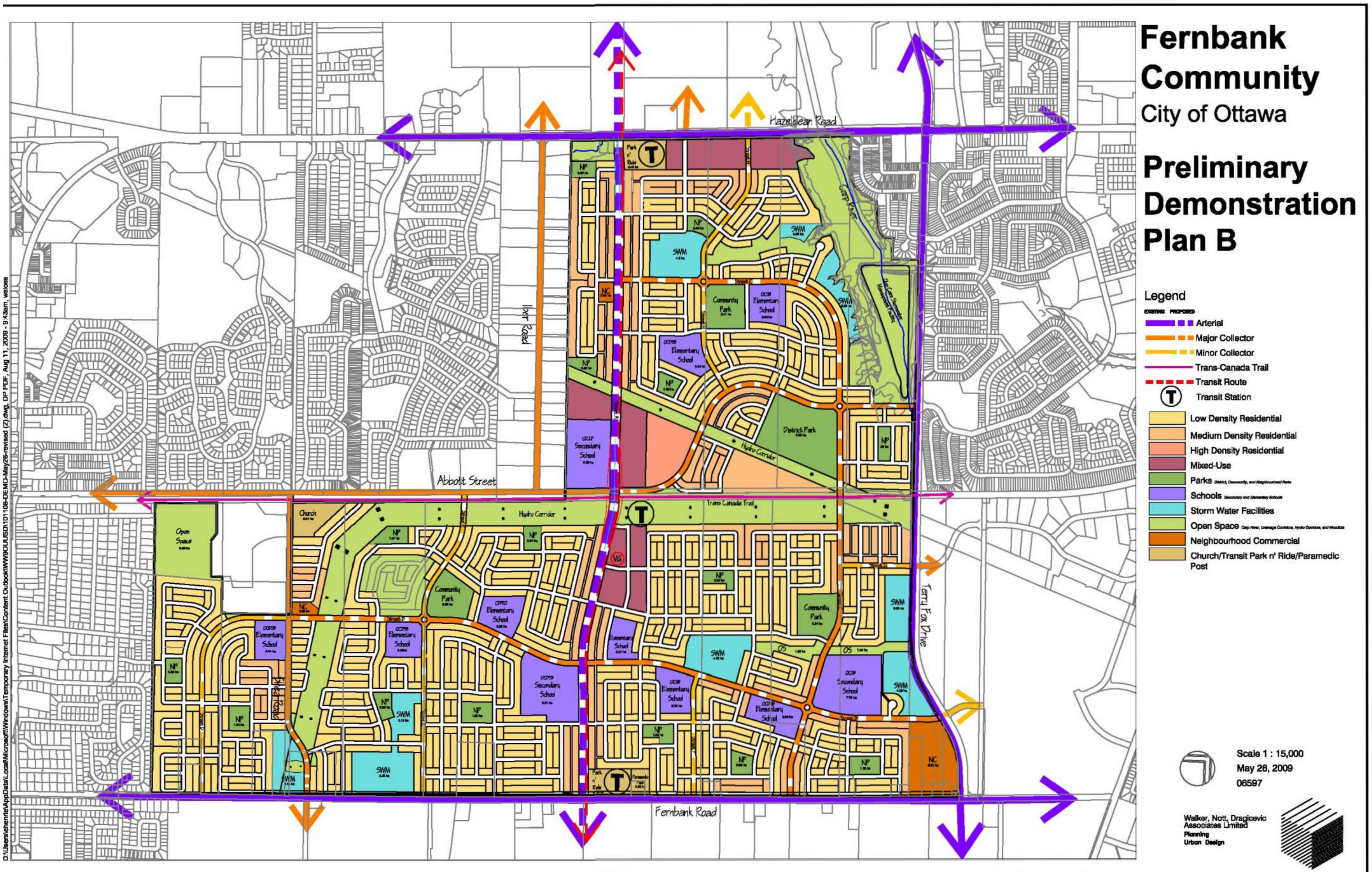
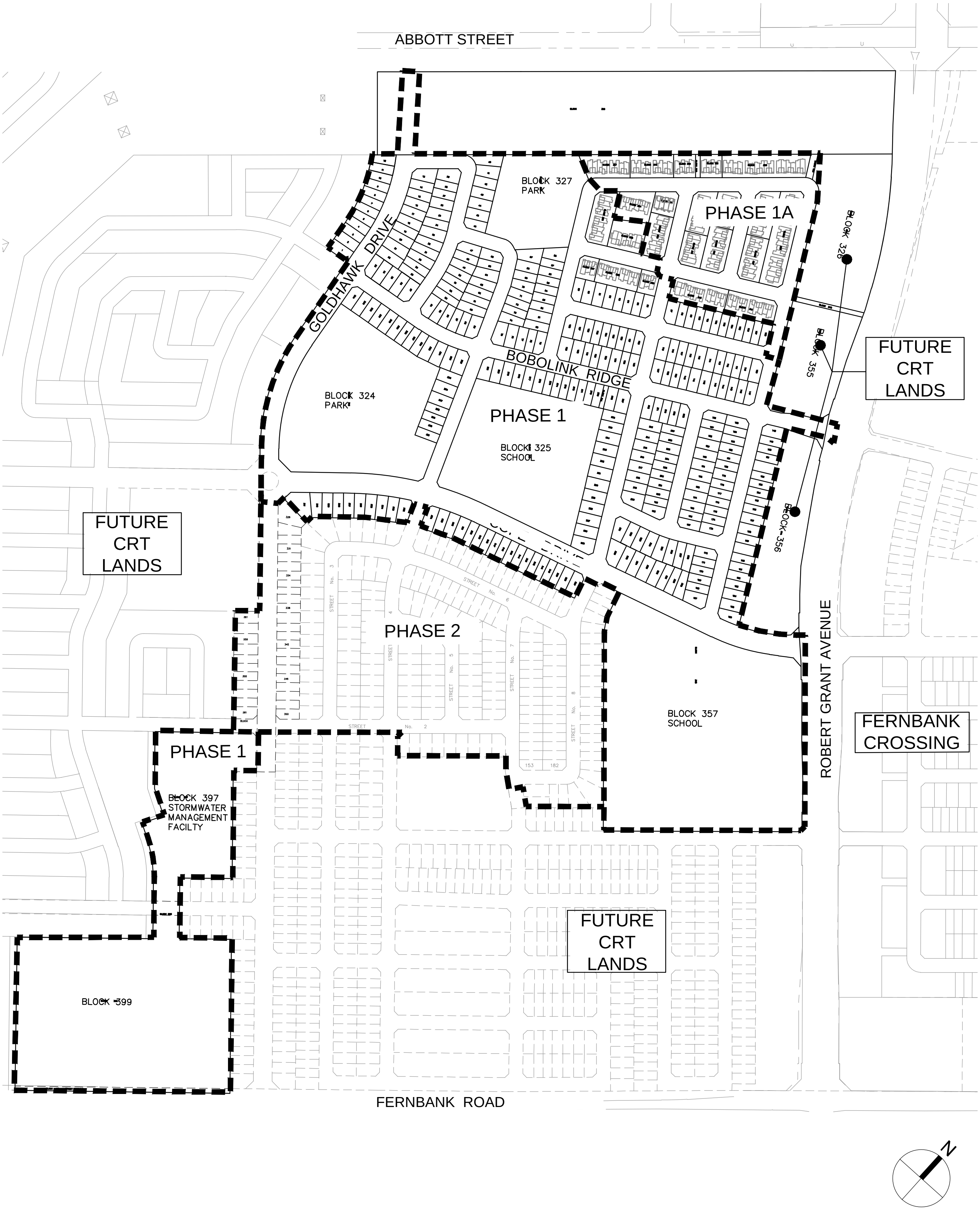


Sheet No.
FIGURE 1.1

Drawing Title
FERNBANK COMMUNITY
PRELIMINARY DEMONSTRATION
PLAN

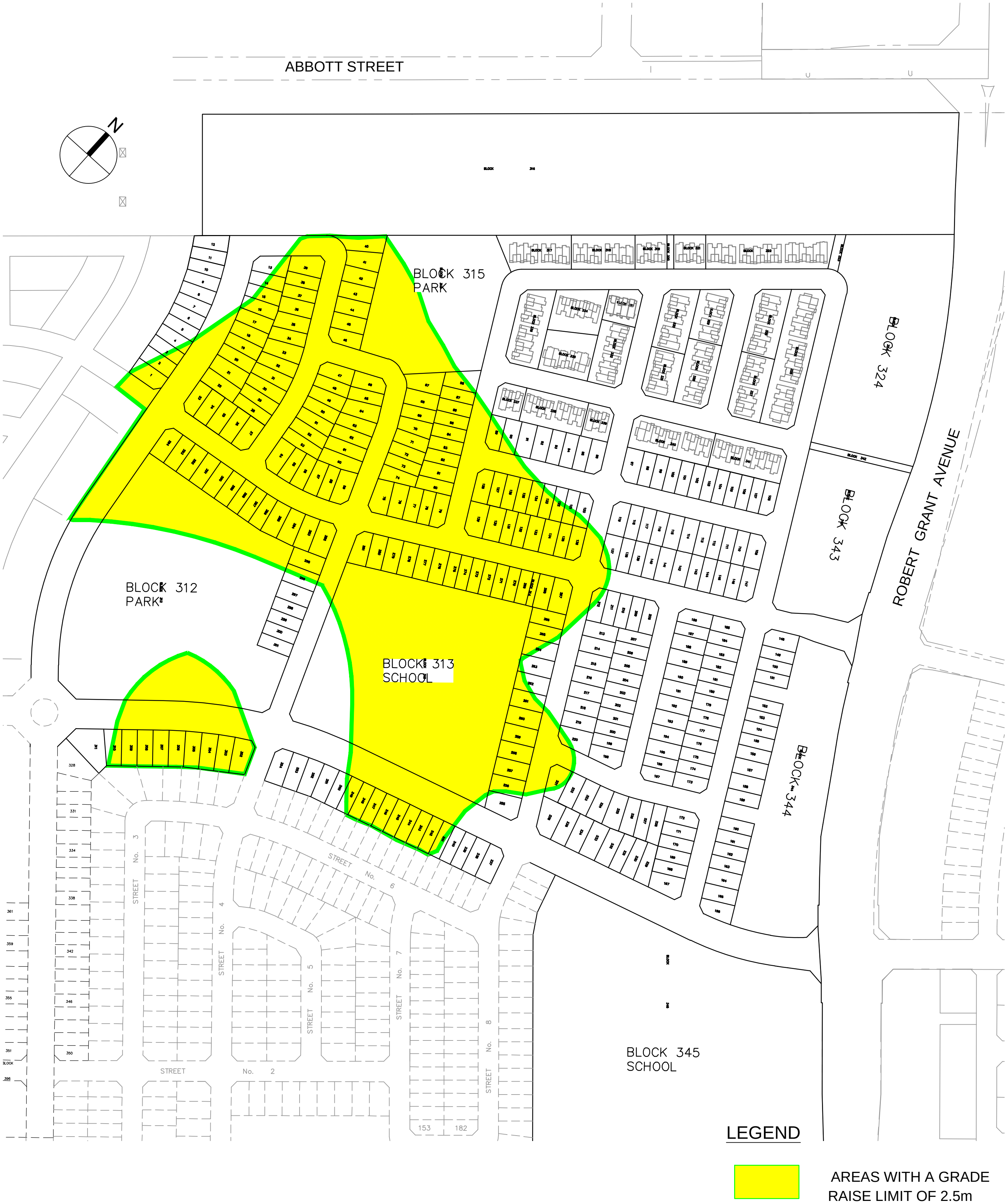
Project Title
DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Scale
N.T.S.



J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig1.3 PHASING PLAN.dwg Layout Name: Figure 1.3

Project Title	Drawing Title	Sheet No.
DESIGN DRIEF CRT LANDS-PHASE 1 FERNBANK COMMUNITY	PHASING PLAN	FIGURE 1.3



J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig1.4 GRADE RAISE LIMITS.dwg Layout Name: Figure 1.4

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Project Title

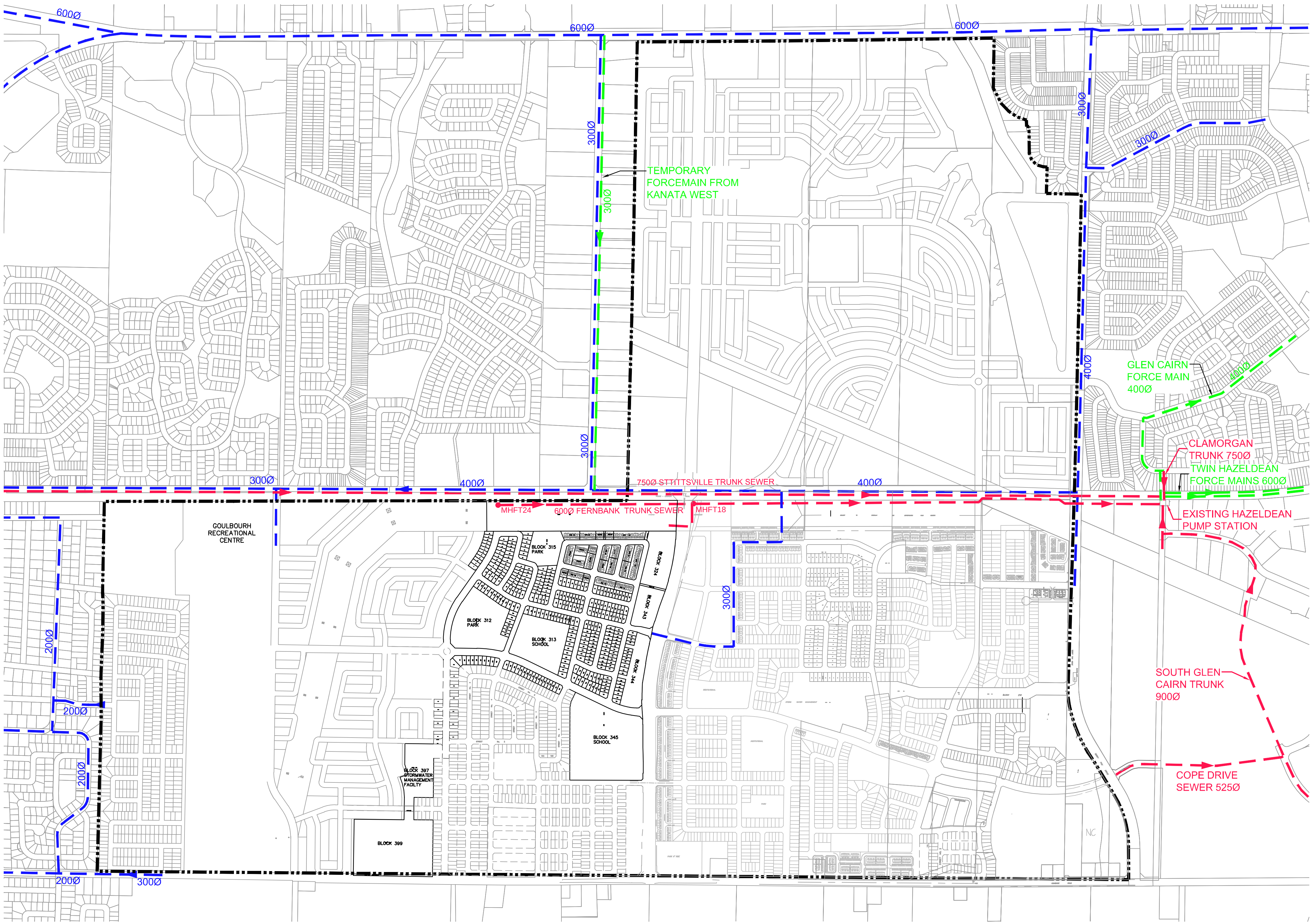
DESIGN DRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title

GRADE RAISE
LIMITS

Sheet No.

FIGURE 1.4



LEGEND:

300Ø — EXISTING WATERMAIN AND DIAMETER

300Ø — EXISTING SANITARY SEWER, SIZE AND FLOW DIRECTION

300Ø — EXISTING FORCEMAINS, SIZE AND FLOW DIRECTION

LIMITS OF FERNBANK COMMUNITY CONCEPT PLAN

Scale

N.T.S.

Project Title

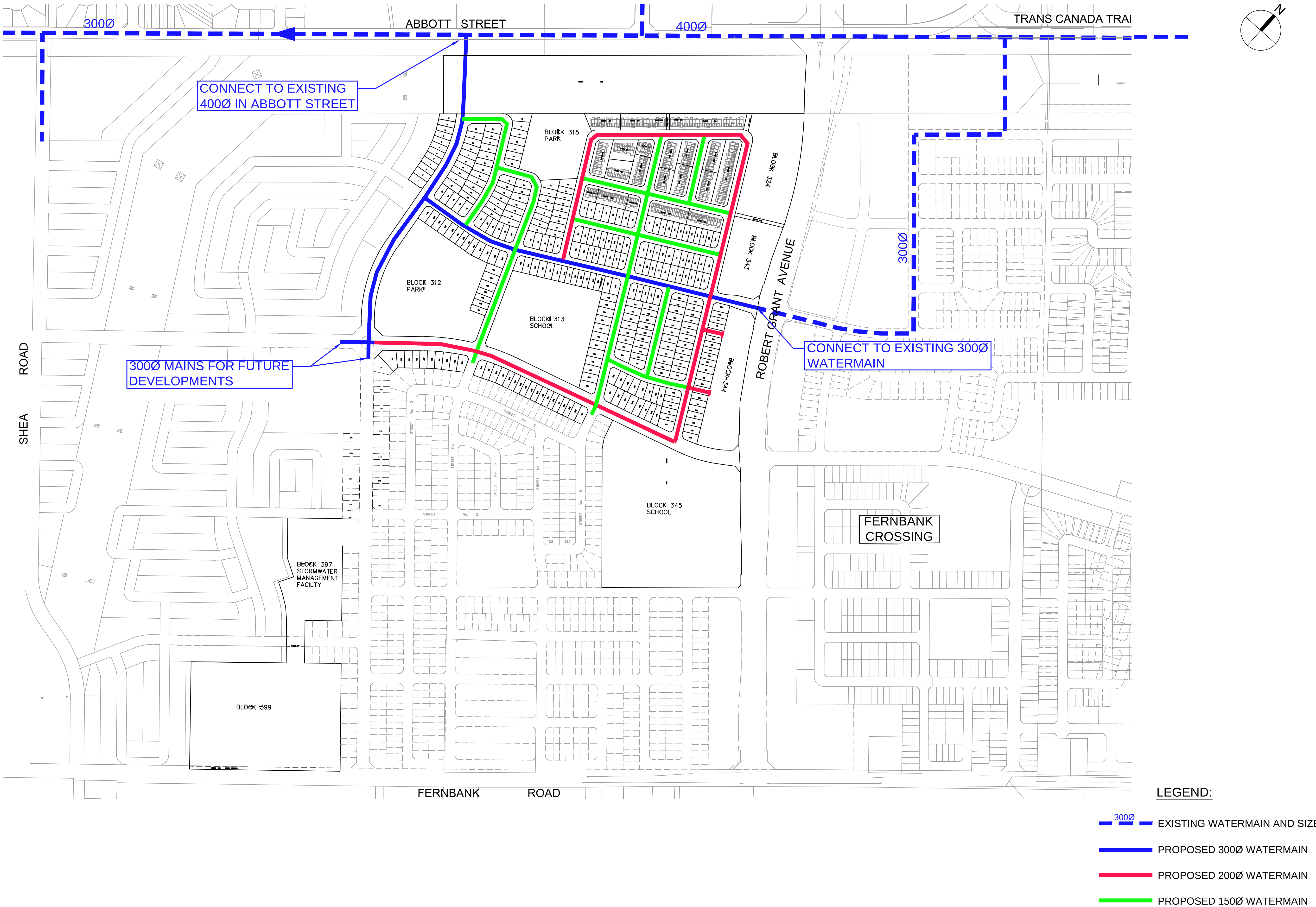
DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title

EXISTING WATERMAINS
AND
SANITARY SEWERS

Sheet No.

FIGURE 2.1



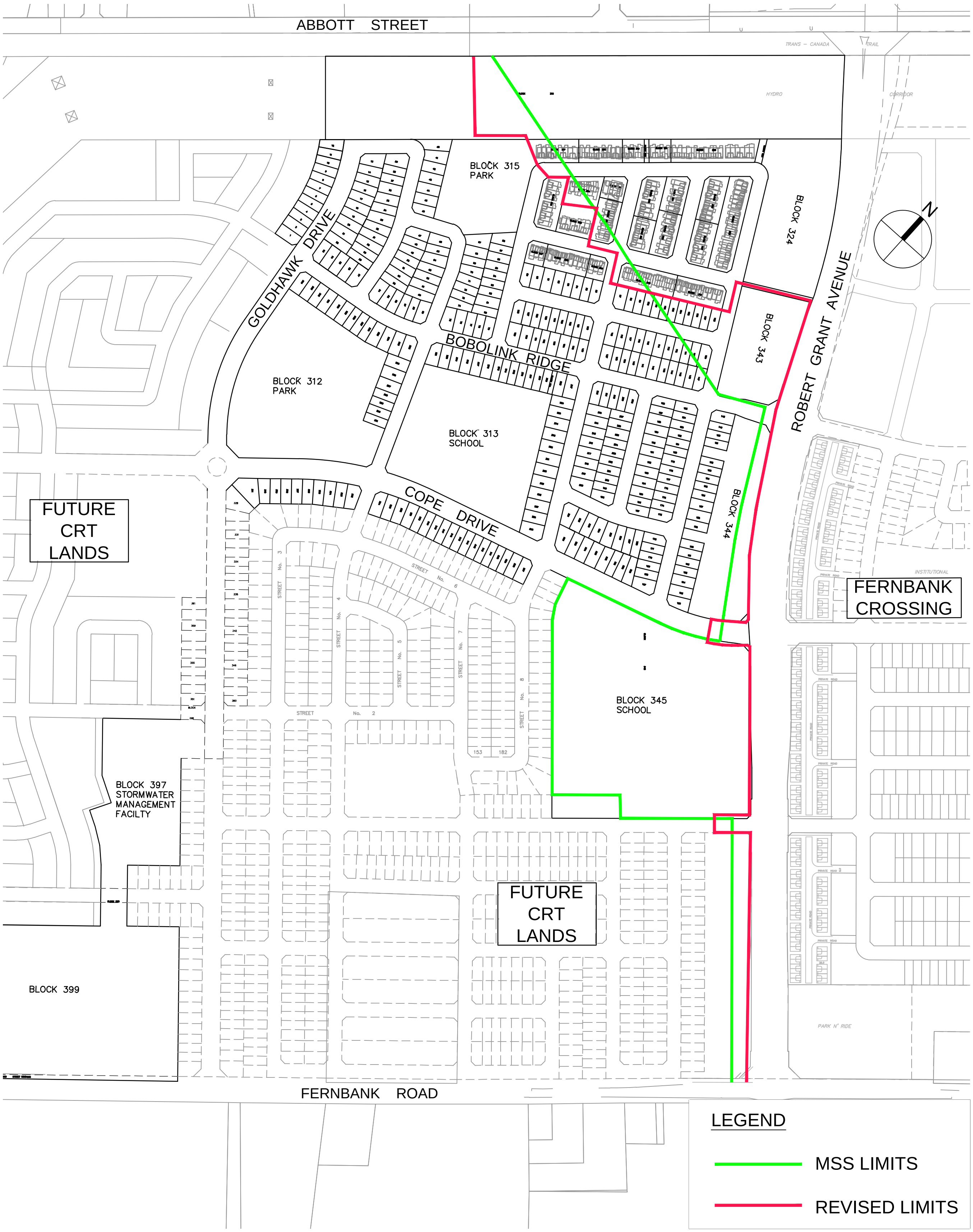
Scale: N.T.S.

Project Title: DESIGN BRIEF CRT LANDS-PHASE 1 FERNBANK COMMUNITY

Drawing Title: PROPOSED WATER PLAN

Sheet No.: FIGURE 2.2

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig2.2 PROPOSED WATER PLAN.dwg Layout Name: Figure 2.2 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 7/13/2017 11:50 AM Last Saved By: mmilne
Last Saved At: Jul. 13, 17



Project Title

DESIGN DRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

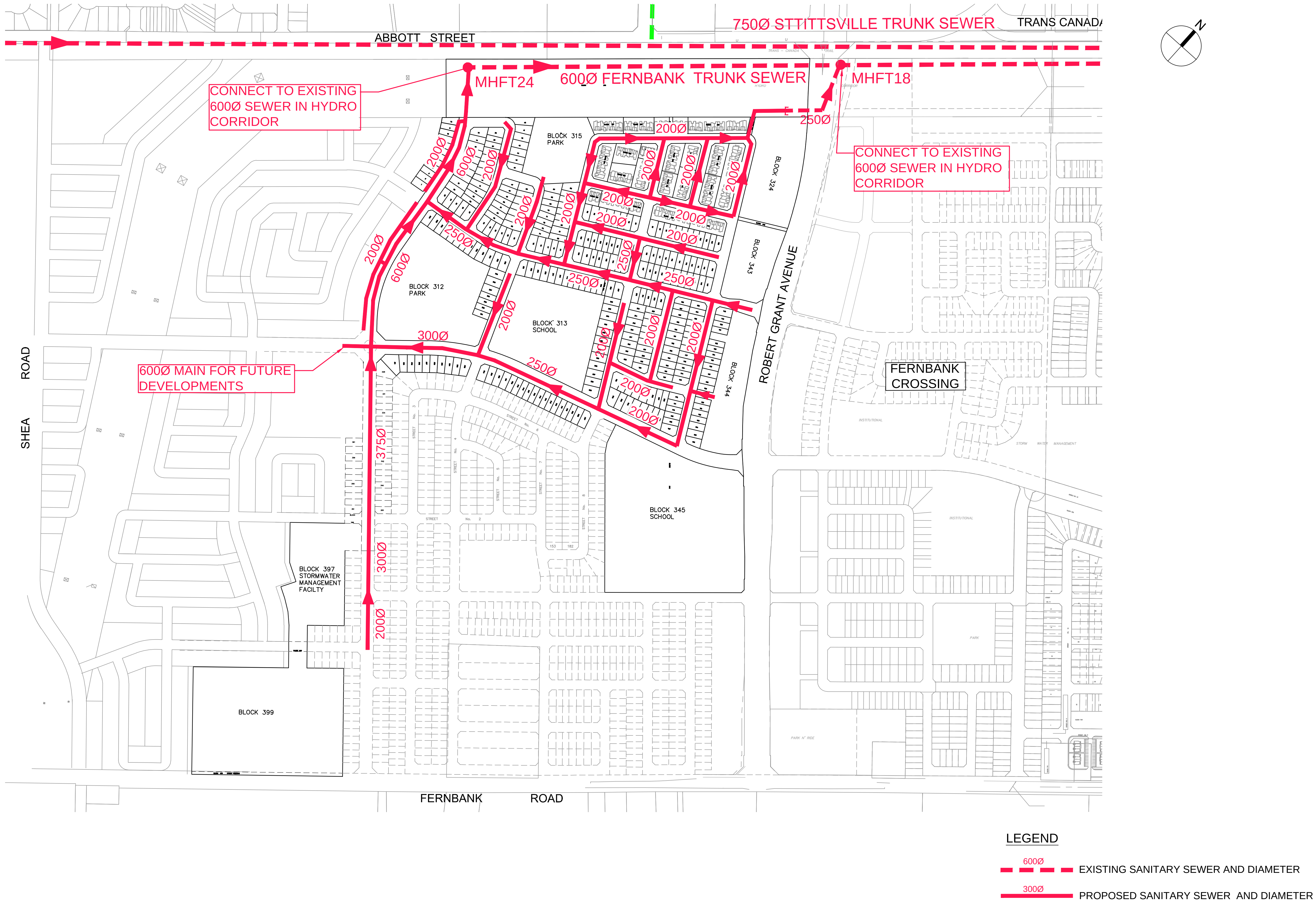
Drawing Title

PROPOSED CHANGES
TO SANITARY DRAINAGE
LIMITS

Sheet No.

FIGURE 3.1

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig3.1 SANITARY DRAINAGE LIMITS.dwg Layout Name: Figure 3.2



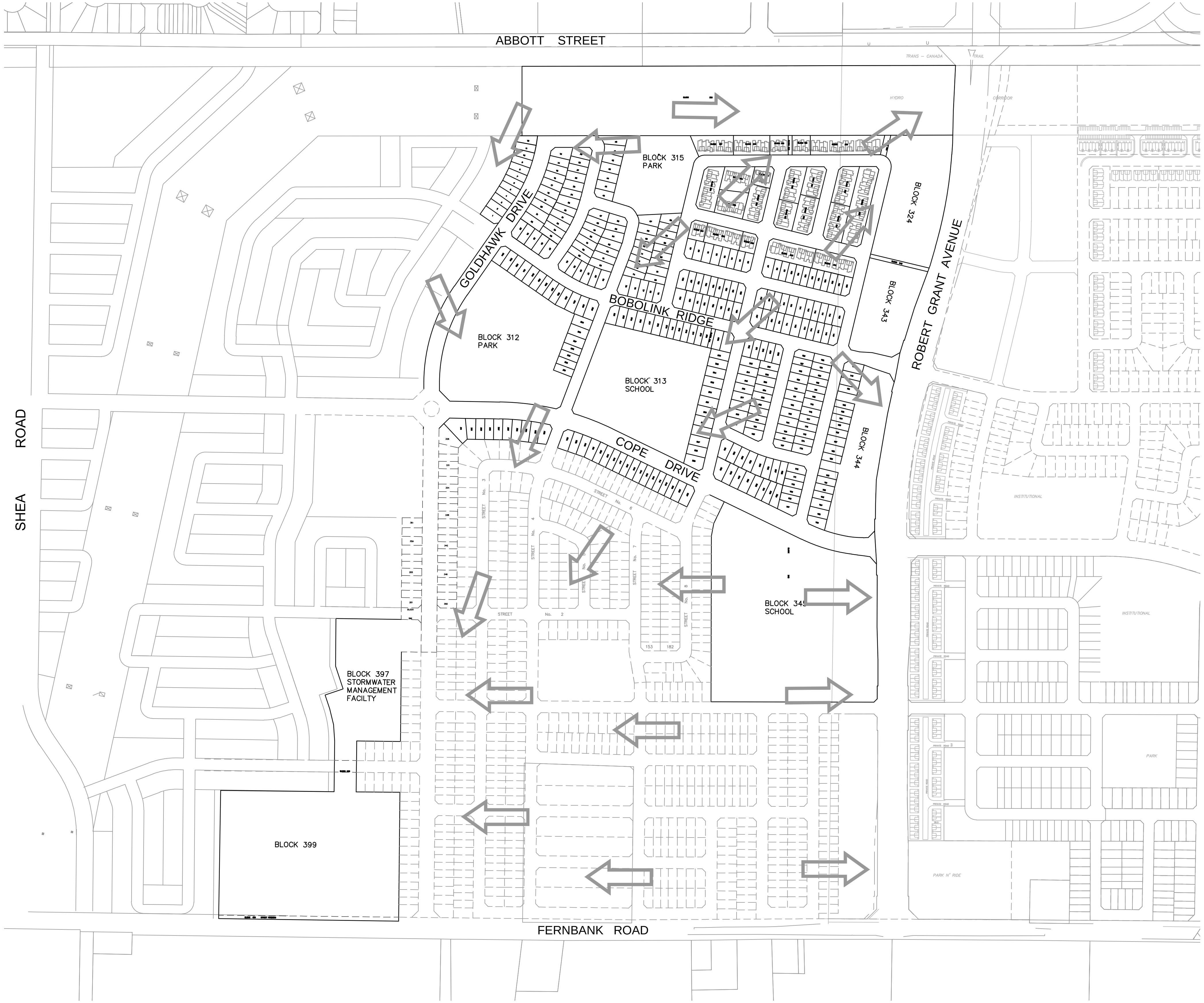
Scale: N.T.S.

Project Title: DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title: PROPOSED WASTEWATER PLAN

Sheet No.: FIGURE 3.2

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig3.2 PROPOSED WASTEWATER.dwg Layout Name: Figure 3.2 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 7/13/2017 11:54 AM Last Saved By: mmilne Last Saved At: Jul. 13, 17



LEGEND

EXISTING SURFACE FLOW DIRECTION

EXISTIING DRAINAGE PATTERNS

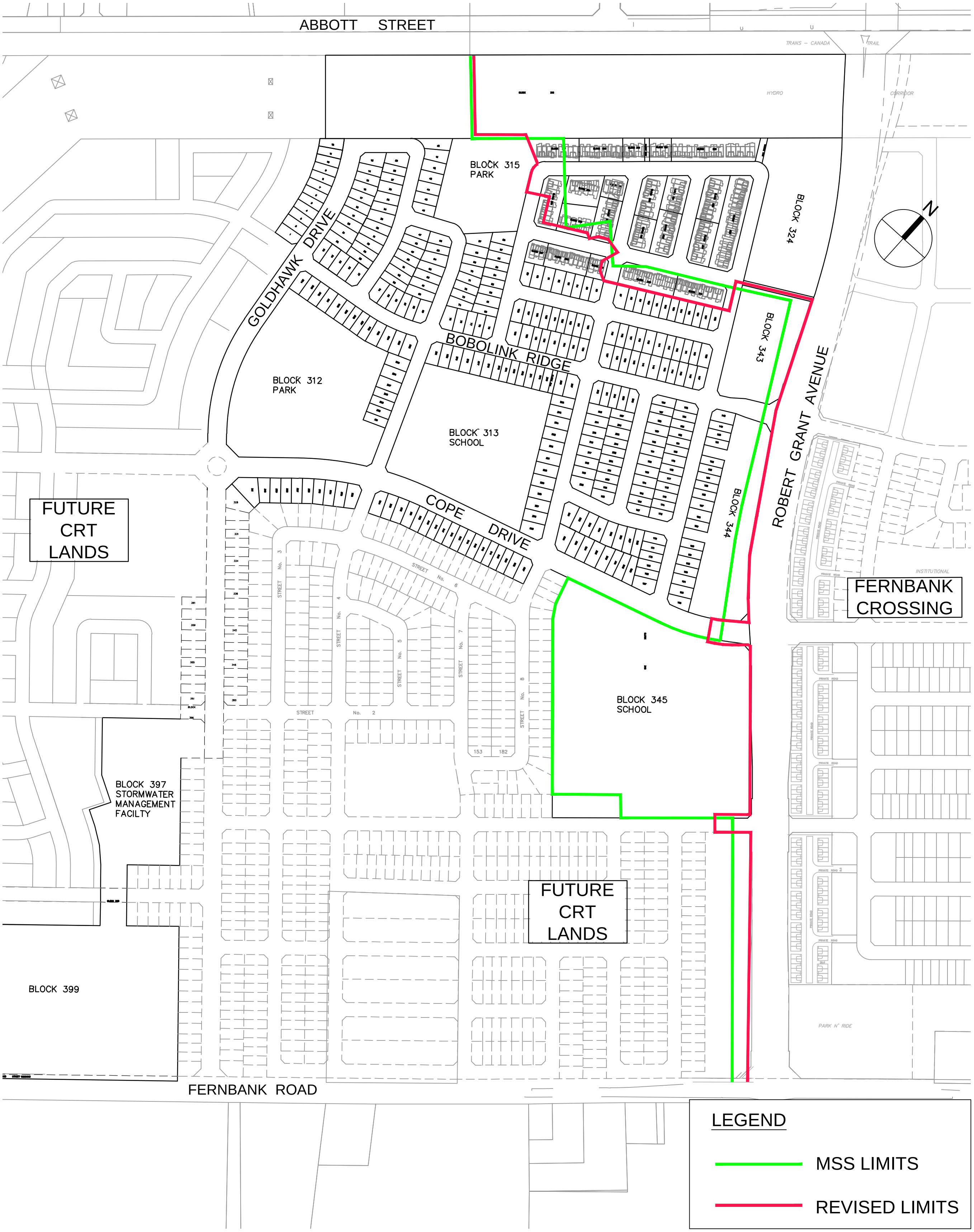
Scale
N.T.S.

Project Title
DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title
EXISTING DRAINAGE
PATTERNS

Sheet No.
FIGURE 4.1

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig4.1 EXISTING DRAINAGE PATTERNS.dwg Layout Name: Figure 4.1 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 7/13/2017 11:59 AM Last Saved By: mmline Last Saved At: Jul. 13, 17



J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-02-10\27970-Fig4.2 MINOR STORM DRAINAGE LIMITS.dwg Layout Name: Figure 4.2

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Project Title

DESIGN DRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

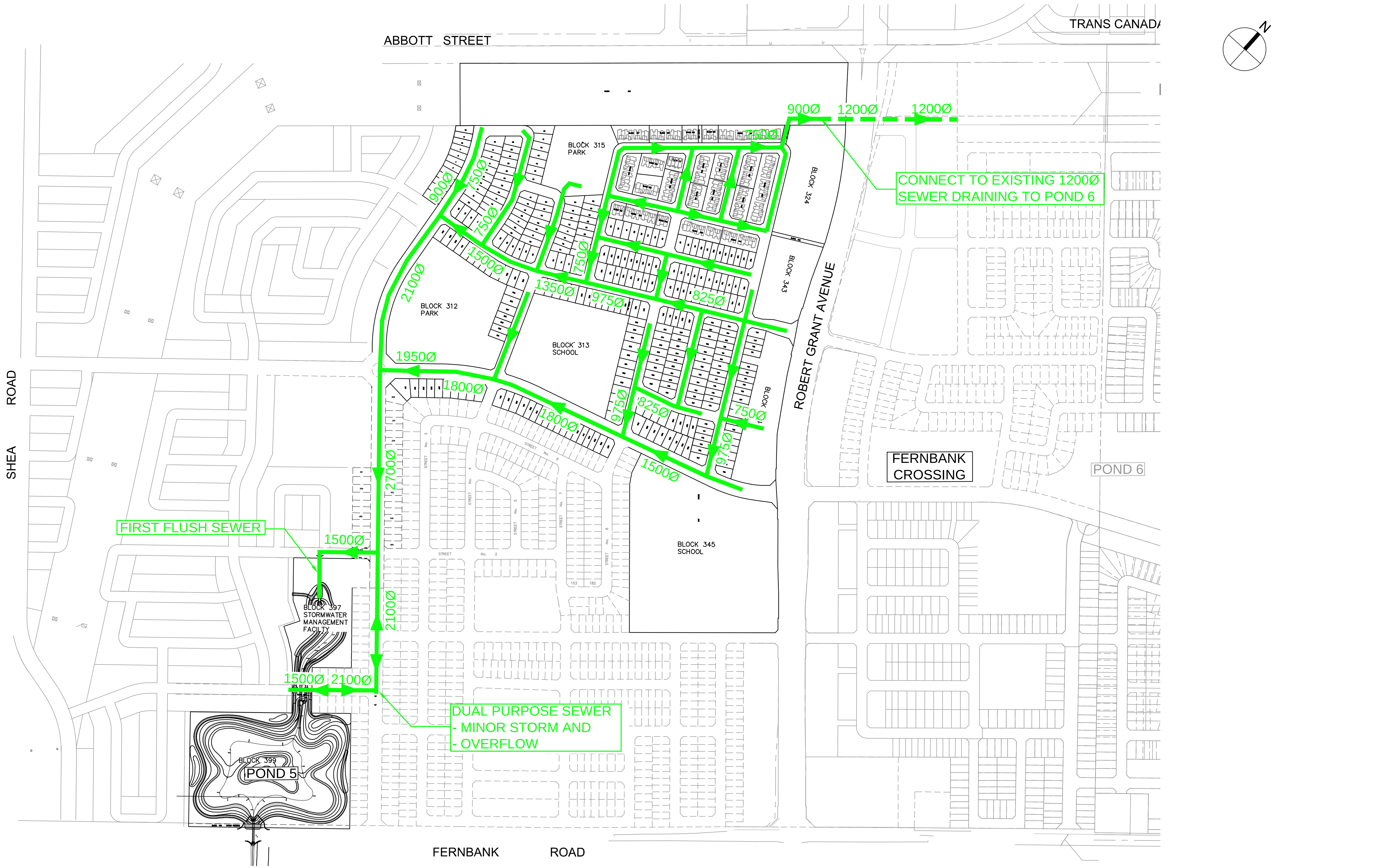
Drawing Title

PROPOSED CHANGES TO MINOR STORM DRAINAGE LIMITS

Sheet No.

FIGURE 4.2

PROPOSED CHANGE TO MINOR STORM LIMITS



Scale: N.T.S.

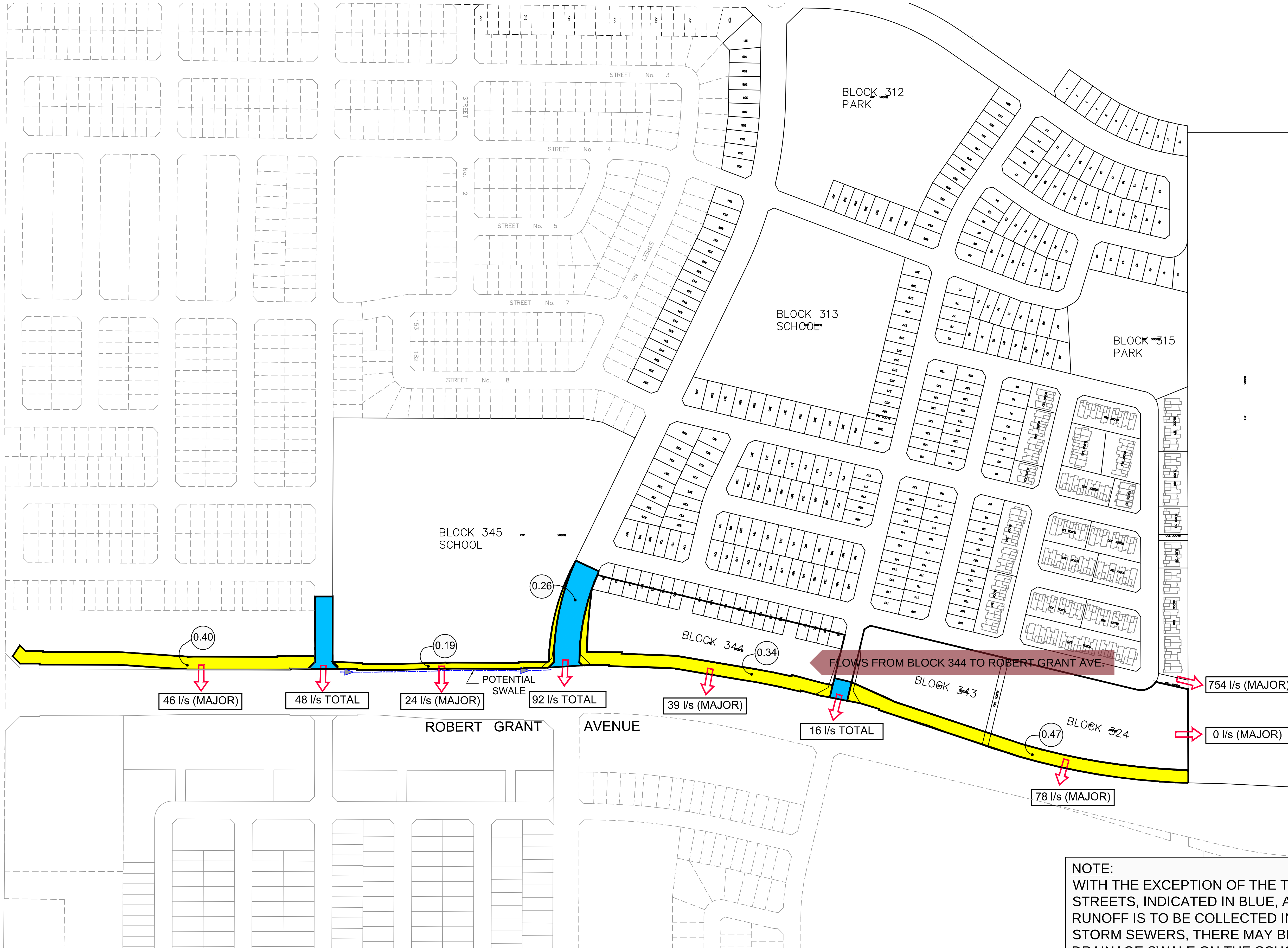
Project Title: DESIGN BRIEF CRT LANDS-PHASE 1 FERNBANK COMMUNITY

Drawing Title: PROPOSED MINOR STORM PLAN

Sheet No. FIGURE 4.3

PROPOSED MINOR STORM PLAN

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig4.3 PROPOSED MINOR STORM PLAN.dwg Layout Name: Figure 4.3 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 7/13/2017 1:06 PM Last Saved By: mmiline Last Saved At: Jul. 13, 17



NOTE:
WITH THE EXCEPTION OF THE THREE SIDE STREETS, INDICATED IN BLUE, ALL MINOR STORM RUNOFF IS TO BE COLLECTED IN THE CRT MINOR STORM SEWERS, THERE MAY BE A FUTURE DRAINAGE SWALE ON THE SCHOOL BLOCK 357 DIRECTED TOWARDS THE ROBERT GRANT AVENUE MINOR SYSTEM. FLOWS CORRESPOND TO THE 100 YEAR 3 HOUR CHICAGO STORM EVENT.

Scale: N.T.S.

Project Title: DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title: DRAINAGE FROM CRT LANDS TO ROBERT GRANT AVENUE

Sheet No.: FIGURE 4.4

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig4.4 DRAINAGE TO ROBERT GRANT.dwg Layout Name: FIGURE 4.4 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 7/13/2017 1:01 PM Last Saved By: mmiline Last Saved At: Jul. 13, 17

APPENDIX A

- **Development Servicing Study Checklist**
- **Figure 1.2 – Draft Plan**

General Content

	ITEM DESCRIPTION	LOCATION
	Executive Summary (for larger reports only)	N/A
√	Date and revision number of the report	Front Cover
√	Location Map and plan showing municipal address, boundary, and layout of proposed development.	Figure 1 and 3
√	Plan showing the site and location of all existing services.	Figure 4
√	Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	Section 1.3, 2.3, 3.3 & 4.3
√	Summary of Pre-consultation Meeting with City and other approval agencies.	Appendix B
√	Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.	Section 1.5
√	Statement of objectives and servicing criteria	Section 2.3, 3.3 & 4.3
√	Identification of existing and proposed infrastructure available in the immediate area.	Figure 4
√	Identification of Environmentally Significant Areas, Watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).	Section 1.6
√	Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.	Grading Plans
	Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.	N/A
√	Proposed phasing of the development, if applicable.	Figure 3
√	Reference to geotechnical studies and recommendations concerning servicing.	Section 1.8
√	All preliminary and formal site plan submissions should have the following information: • Metric scale • North arrow (including construction North) • Key plan • Name and contact information of applicant and property owner • Property limits including bearings and dimensions • Existing and proposed structures and parking areas • Easements, road widening and rights-of-way • Adjacent street names	Design Drawings

Development Servicing Report: Water

	ITEM DESCRIPTION	LOCATION
√	Confirm consistency with Master Servicing Study, if available	Section 2.2
√	Availability of public infrastructure to service proposed development	Section 2.1, 2.4
√	Identification of system constraints – external water needed	Section 2.1
√	Identify boundary conditions	Section 2.3
√	Confirmation of adequate domestic supply and pressure	Section 2.4
√	Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.	Section 2.3
√	Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.	Section 2.3
√	Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defining phases of the project including the ultimate design.	Section 2.4
√	Address reliability requirements such as appropriate location of shut-off valves.	Design Drawings
	Check on the necessity of a pressure zone boundary modification.	N/A
√	Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range.	Section 2.3 Appendix C
√	Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.	Section 2.4 Figure 5 Appendix C
√	Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities and timing of implementation.	Section 2.1 Figure 5
√	Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	Section 2.3
√	Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	Section 2.4 Appendix C

Development Servicing Report: Wastewater

	ITEM DESCRIPTION	LOCATION
√	Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).	Section 3.3
√	Confirm consistency with Master Servicing Study and/or justifications for deviations.	Section 3.2
√	Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age condition of sewers.	Section 3.6
√	Description of existing sanitary sewer available for discharge of wastewater from proposed development.	Section 3.2, 3.4 Figure 4
√	Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)	Section 3.2, 3.4
√	Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix “C”) format.	Section 3.3 & 3.7 Appendix D
√	Description of proposed sewer network including sewers, pumping stations and forcemains.	Section 3.4 Figure 6
√	Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).	Section 1.6, 3.8
√	Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.	Section 3.5
	Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	N/A
√	Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.	Section 3.9
√	Special considerations such as contamination, corrosive environment, check soils, etc.	Section 1.8

Development Servicing Report: Stormwater Checklist

	ITEM DESCRIPTION	LOCATION
√	Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)	Section 1.6, 4.1
	Analysis of available capacity in existing public infrastructure.	Section 4.5
√	A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.	Figure 2.8 Grading Plans
√	Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.	Section 5.3
√	Water quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	Section 5.3
√	Description of the stormwater management concept with facility locations and descriptions with references and supporting information.	Section 5
	Set-back from private sewage disposal systems.	N/A
	Watercourse and hazard lands setbacks.	N/A
√	Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	Section 1.6
√	Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.	Section 4.2
√	Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).	Section 5.5
√	Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	Section 1.6, 6.3
√	Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.	Section 5.3, 5.5
√	Any proposed diversion of drainage catchment areas from one outlet to another.	Section 4.2
√	Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	Section 4.4 Design Drawings
	If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.	N/A
√	Identification of potential impacts to receiving watercourses	Section 1.6, 6.3
√	Identification of municipal drains and related approval requirements.	Section 1.6, 6.3

√	Descriptions of how the conveyance and storage capacity will be achieved for the development.	Section 5.4, 5.6
√	100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	Grading Plans
√	Inclusion of hydraulic analysis including hydraulic grade line elevations.	Section 5.6
√	Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Section 5.6
√	Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.	Section 5.7
	Identification of fill constraints related to floodplain and geotechnical investigation.	N/A

Approval and Permit Requirements: Checklist

	ITEM DESCRIPTION	LOCATION
√	Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.	Section 6.3
√	Application for Certification of Approval (CofA) under the Ontario Water resources Act.	Section 6.2
√	Changes to Municipal Drains	Section 1.6
√	Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)	Section 6.4

Conclusion Checklist

	ITEM DESCRIPTION	LOCATION
√	Clearly stated conclusions and recommendations	Section 7
	Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.	N/A
√	All draft and final reports shall be signed and stamped by professional Engineer registered in Ontario.	Done

IBI

Scale

1:3000

Project Title

DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title

DRAFT PLAN

Sheet No.

FIGURE 1.2

APPENDIX B

- **Figure 3.2 Existing Conditions – Fernbank Community Design Plan – Environmental Management Plan**
- **Municipal Drain By-Law**
- **January 31, 2017 E-mail from City of Ottawa**
- **December 9, 2013 E-mail from Rideau Valley Conservation Authority**
- **November 28, 2013 E-mail with the provincial Ministry of Environment Ottawa Office**
- **PTTW No. 3238-9TLP82**

FERNBANK COMMUNITY DESIGN PLAN

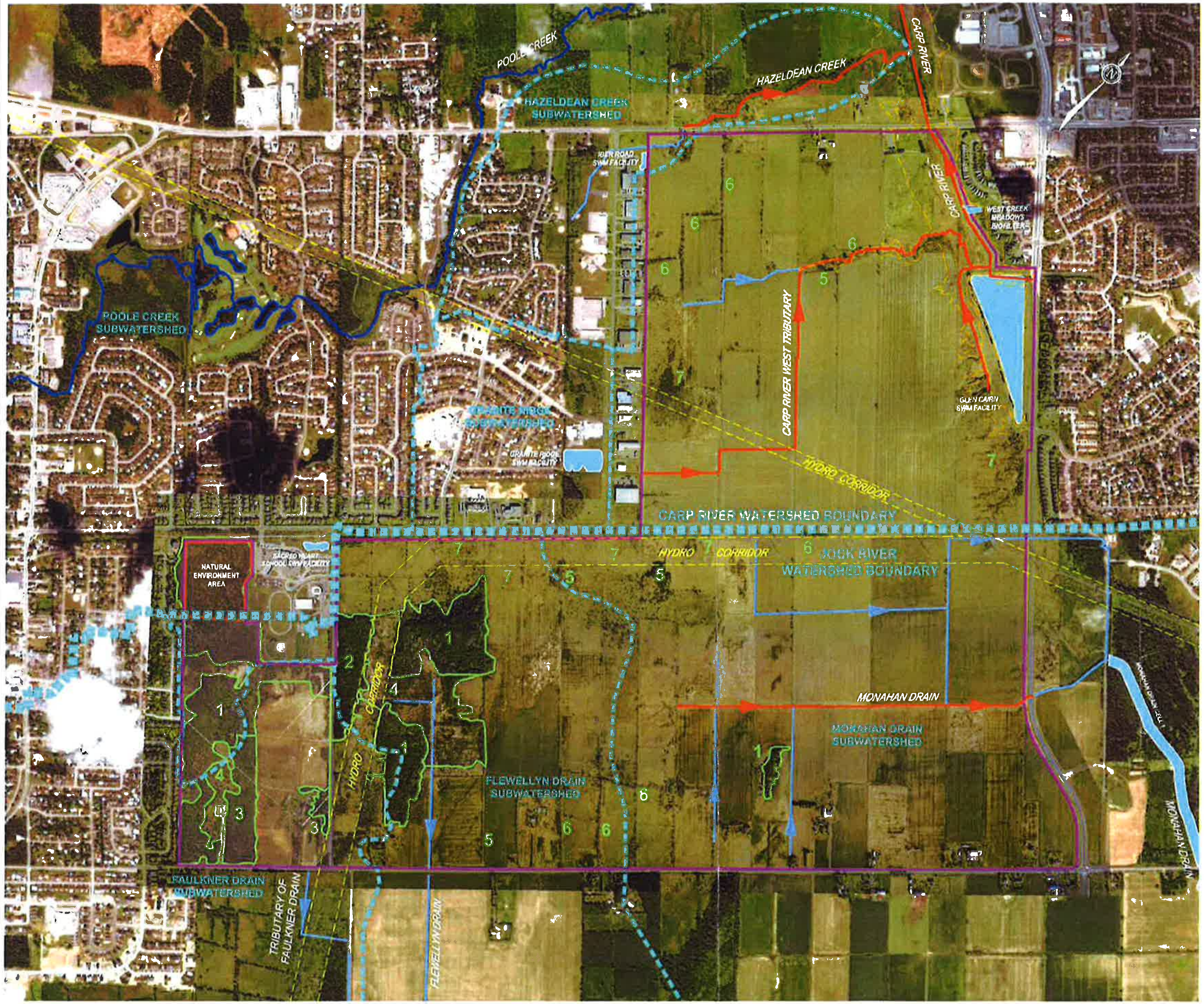
City of Ottawa

ENVIRONMENTAL MANAGEMENT PLAN

FIGURE 3.2

Existing Conditions

Natural Environment Features



STUDY AREA

AQUATIC FEATURES

WARM WATER FORAGE FISH HABITAT

DRAINAGE CHANNEL

NOTE: OTHER ON-SITE CHANNELS CONTRIBUTE FLOW TO DOWNSTREAM FISH HABITAT

CARP RIVER FLOOD PLAIN

WATERSHED BOUNDARY

TERRESTRIAL FEATURES

NATURAL ENVIRONMENT AREA

AREA OF TERRESTRIAL FEATURE

1 WOODED AREA (CONIFEROUS)
2 WOODED AREA (MIXED SPECIES)
3 PINE PLANTATION
4 SCRUB AND THICKET
5 REMNANT HIGHER QUALITY TREES MAPLE, ASH and BASSWOOD
6 DECIDUOUS HEDGEROWS
7 MEADOW HABITAT USED BY FIELD SPECIES SUCH AS BOBOLINK, SAVANNAH SPARROWS, and UPLAND SANDPIPERS

SOURCE AND DATE OF AERIAL PHOTOS:
a) FERNBANK CDP LANDS: BASE MAPPING CO. (JUNE 2008)
b) BACKGROUND COMMUNITY: GOOGLE EARTH MAP (YEAR VARIES)

SCALE: 1:6000 -B1 Sheet
SCALE: Not to Scale -Report

SEPTEMBER 2008

NOVATECH ENGINEERING CONSULTANTS LTD.
ENGINEERS & PLANNERS

BY-LAW NO. 2011 - 311

A by-law of the City of Ottawa to provide for the partial abandonment of drainage works in the City of Ottawa - Flewellyn Municipal Drain.

WHEREAS the Flewellyn Municipal Drain By-law, being By-law 12-71 of the former Township of Goulbourn was passed pursuant to the *Drainage Act* (now R.S.O. 1990, D.17);

AND WHEREAS the lands of the former Township of Goulbourn are now included in the City of Ottawa by virtue of the *City of Ottawa Act, 1999*, S.O. 1999, c.14, Sch.E;

AND WHEREAS every by-law of the Township of Goulbourn is deemed to be a by-law of the City of Ottawa pursuant to Section 5(6) of the said *City of Ottawa Act, 1999*;

AND WHEREAS the City of Ottawa has received a request under Subsection 84(1) of the *Drainage Act* from not less than three-quarters of the owners of land assessed for benefit and owning not less than three-quarters of the area assessed for benefit, as shown in the Flewellyn Municipal Drain By-law, being By-law 12-71, asking for the abandonment of part of the drainage works, being that part of Branch #1 of the Flewellyn Municipal Drain between Stations 0+00 and 31+00;

AND WHEREAS all of the owners of the land assessed for the drainage works have been notified of the City's intention to abandon part of the drainage works pursuant to Subsection 84(1) of the *Drainage Act*;

AND WHEREAS no request for an engineer's report with respect to the part of the drainage works that is to be abandoned has been received pursuant to Subsections 84(1) and 84(3) of the *Drainage Act*;

AND WHEREAS Subsection 84(5) of the *Drainage Act* states that if no request for an engineer's report on the proposed abandonment is received by the clerk of the municipality, the council may by by-law abandon the drainage works and thereafter the municipality has no further obligation with respect to the abandoned drainage works;

AND WHEREAS there are no costs associated with respect to the part of the drainage works that is to be abandoned;

THEREFORE the Council of the City of Ottawa enacts as follows:

1. Branch #1 of the Flewellyn Municipal Drain from Station 0+00 and 31+00 is hereby abandoned and, pursuant to Subsection 84(5) of the *Drainage Act*, the City of Ottawa has no further obligation with respect thereto.

2. This by-law comes into force on the passing thereof and may be cited as the "Abandonment of Part of the Flewellyn Municipal Drain By-law, 2011".

ENACTED AND PASSED this 25th day of August, 2011.

CITY CLERK MAYOR

BY-LAW NO. 2011 - 311

-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-

A by-law of the City of Ottawa to provide for the partial abandonment of drainage works in the City of Ottawa – Flewellyn Municipal Drain.

-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-

Enacted by City Council at its meeting of August 25, 2011.

-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-

LEGAL SERVICES
CLC/ G04-01 DRAIN

COUNCIL AUTHORITY:
Drainage Act, R.S.O. 1990, c. D.17, s. 84
(as amended by 2010, c.16, Sched.1, s.2)

SKETCH #1

RIDEAU/GOULBOURN WARD/
CITY OF OTTAWA

25

FLEWELLYN MUNICIPAL DRAIN

FROM: GRAHAM, BERMAN & ASSOCIATES LIMITED
1970

Jim Moffatt

To: Jim Moffatt
Subject: FW: 27970 - PDFs and Design sheet for City

Jim Moffatt

From: Balima, Nadege [mailto:Nadege.Balima@ottawa.ca]
Sent: Tuesday, January 31, 2017 3:39 PM
To: Jim Moffatt <Jmoffatt@IBIGroup.com>
Cc: Jim Burghout <jim.burghout@claridgehomes.com>; Shawn Malhotra <shawn.malhotra@claridgehomes.com>; Karlinda Hinds <Karlinda.Hinds@ibigroup.com>; Shepherd, Jennifer <Jennifer.Shepherd@ottawa.ca>; Sweet, Louise <louise.sweet@ottawa.ca>
Subject: RE: 27970 - PDFs and Design sheet for City

Good morning Jim,
Sorry for the delay in responding. Below are the answers following our conversation a couple of weeks ago:

I – Sanitary Flows
The future flow allowance must consider at least 192 l/s (Liard PS rated capacity =108 l/s plus Area 6/Stittsville South Pump station rated capacity of 84 l/s). The total flow that was provided considered future flows beyond the current urban boundary.
CRT may therefore proceed if the future flow allowance is reduced to 192 l/s to alleviate current issues with the design.

Please let me know if you have questions.
Regards,

Nadège Balima, P.Eng., M.P.M., LEED Green Assoc.
Project Manager, Infrastructure Approvals
Development Review Services (West)
✆ 613.580.2424 ext. 13477

Jim Moffatt

From: Jim Moffatt
Sent: Monday, December 09, 2013 1:03 PM
To: 'Hal Stimson'
Cc: Jim Burghout
Subject: RE: CRT Developments

The planner on the file is Louise Sweet-Lindsey and the engineer reviewer is Eris Surprenant.
The City has the stormwater management report which includes the proposed pond 5 and improvements to the Flewellyn Drain. The first submission comments included the one relating to contact with the CA. The drain is a municipal drain and we have started the engineer's update report process. Thanks.
We'll make application for an extension of the current permit.

Jim Moffatt
Associate

IBI Group
400-333 Preston Street
Ottawa ON K1S 5N4 Canada

tel 613 225 1311
fax 613 225 9868
email jmoffatt@IBIGroup.com
web www.ibigroup.com

From: Hal Stimson [mailto:hal.stimson@rvca.ca]
Sent: Thursday, December 05, 2013 2:22 PM
To: Jim Moffatt
Cc: Jim Burghout
Subject: RE: CRT Developments

Hi Jim,
I have forwarded your e-mail to our Planning department staff in regard to the request from the City for assurance that RVCA has been involved. I'll let you know if there are any outstanding issues. Is there a particular contact person at the City?

In regards to the permits for drainage. The work for the new application would be an Alteration to a Watercourse application (assumes there is an existing watercourse) otherwise drainage & ditching if new and outleting to an existing watercourse. Based on the project description the fee should fall in the Major Project category of our Schedule B fee schedule ($2,185.00) which includes multiple residential units and stormwater management pond/cell. There could be additional technical report review fees depending on the need to review stormwater or other reports (if we haven't already). There is the possibility of breaking projects into multiple applications depending on timing of phasing/construction (pond, downstream channel improvements, etc.) Has the City reviewed the proposal to deepen the channel downstream of Fernbank? Is this still the Flewellyn Municipal Drain downstream? If so, it could require amendment to the engineers drainage report.

To reactive a permit that has expired I will need a new application form and submission of a letter confirming the project has not changed and all design drawings are the same as previously approved. The review fee is half of the current level for that type of project – in this instance $1,092.50.

As the previous permit was for abandonment and/or infill of the drains, one possible option would be to place plugs in the drains prior to the expiry of the permit. We would then consider them abandoned, however, this may not be feasible if outlet drainage is still required as a plug could result in standing water possibly impacting development or on-going agriculture. Just an option to think about – otherwise we can easily issue a new permit.

I hope this helps.

Regards,

Hal Stimson
Inspector,
Rideau Valley Conservation Authority
Box 599, 3889 Rideau Valley Drive
MANOTICK, Ont K4M 1A5
e-mail: hal.stimson@rvca.ca
613-692-3571 ext 1127 1-800-267-3504

From: Jim Moffatt [mailto:jmoffatt@IBIGroup.com]
Sent: Thursday, December 05, 2013 9:07 AM
To: Hal Stimson
Cc: Jim Burghout
Subject: CRT Developemnts

Hi Hal. As per my voice message, we have submitted our design package to the City for the first phase of the CRT Lands in Fernbank. Among other comments, the City wants insurances that the CA has reviewed the design package and are aware of the development. We are currently revising the drawings in accordance with the city comments and will copy you with the new package. I assume there are some draft conditions that RVCA in time must clear.
The works include a residential development consisting of about 350 units, a stormwater facility (Pond 5 as per the Fernbank MSS documents) and improvements to the outlet watercourse which is the Flewellyn Drain. As per the MSS report, the drain is proposed to be deepened for a distance of about 550m south of Fernbank Road to accommodate the development.
We are completing an application for the drain improvements, and am not sure what box to check in the Description of Works section: Drainage Works and ditching? Alteration to a watercourse? Etc. Also what the review fee might be.
We had earlier obtained a permit (No. RV5-04/12T) to fill existing ditches within the Flewellyn drainage basin north of Fernbank Road. That permit has an expire date of Feb 16, 2014. Since no works have yet started on the development we propose to apply for an extension and would like to confirm that process.
If any questions, just contact me.
Thanks.

Jim Moffatt
Associate

IBI Group
400-333 Preston Street
Ottawa ON K1S 5N4 Canada

tel 613 225 1311

Jim Moffatt

From: Jim Moffatt
Sent: Thursday, November 28, 2013 2:15 PM
To: 'Larkin, Lance (ENE)'
Subject: RE: CRT Development Fernbank Community Ottawa

Thanks. Appreciated.

Jim Moffatt
Associate

IBI Group
400-333 Preston Street
Ottawa ON K1S 5N4 Canada

tel 613 225 1311
fax 613 225 9868
email jmoffatt@IBIGroup.com
web www.ibigroup.com

From: Larkin, Lance (ENE) [mailto:Lance.Larkin@ontario.ca]
Sent: Thursday, November 28, 2013 11:22 AM
To: Jim Moffatt
Cc: MacDonald, Tara (ENE)
Subject: RE: CRT Development Fernbank Community Ottawa

Jim,

I believe one of our Drinking Water Inspectors provided some advice to IBI. I will look into to it will have someone call you back within 1 week. As for the PTTW, approval, I will flag the appropriate District Environmental Officer about this application.

Regards,

Lance Larkin | Senior Environmental Officer / Agent principal de l'environnement (#723)

Ontario Ministry of the Environment / Ministère de l'environnement de l'Ontario

Ottawa District Office / Bureau du district d'Ottawa

2430 Don Reid Drive / 2430, promenade Don Reid, Ottawa ON K1H 1E1

☎ 613-521-3450 x229 | 🖷 613-521-5437 | Toll free / sans frais: 1-800-860-2195 | Spill or Emergencies/ déversements ou urgences : 1 800 268-6060 | Pollution Hotline/ Ligne-info antipollution : 1 866 MOE-TIPS (1 866 663-8477)

From: Jim Moffatt [mailto:jmoffatt@IBIGroup.com]
Sent: November 26, 2013 8:27 AM
To: Larkin, Lance (ENE)
Cc: Surprenant, Eric; Jim Burghout
Subject: CRT Development Fernbank Community Ottawa

Hi Lance, you were referenced to me as a local MOE contact. IBI Group is assisting CRT Development Inc. (Claridge, Richcraft and Tamarack) with plans to develop its property in the Fernbank Community in Stittsville. Please refer to the attached information. We recently submitted engineering documents in support of the development application seeking approvals for sewers, watermains and a stormwater facility, including improvements to Flewellyn Drain, which is the proposed outlet for the pond. The works are in general accordance with the MSS document completed for the Fernbank Community. The City has asked that IBI contact the local MOE office to confirm what approvals are needed from the MOE for this development. We assume that the pond and Flewellyn Drain will need an ECA as a direct submission and that the sewers will require an ECA through the transfer program and that the watermains can be approved by the City as per Form 1 under MOE authorization 008-202. We are also in the process of submitting an application for a PTTW. If you like we can provide you with relevant background information and can meet with you as needed.
Cheers.

Jim Moffatt
Associate

IBI Group
400-333 Preston Street
Ottawa ON K1S 5N4 Canada

tel 613 225 1311
fax 613 225 9868
email jmoffatt@IBIGroup.com
web www.ibigroup.com

Ontario

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

PERMIT TO TAKE WATER
Surface and Ground Water
NUMBER 3238-9TLP82

Pursuant to Section 34.1 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

CRT Development Inc.
Suite 2001 - 210 Gladstone Avenue
Ottawa, Ontario K2P 0Y6
Canada

For the water taking from:
Excavation Sump — Site Servicing — Phase 1,
Stormwater Management Pond,
Excavation Sump — Residential Basement Excavations,
Miscellaneous Site Ponding,
Excavation Sump — Site Servicing — Phase 2,
Excavation Sump — Site Servicing — Phase 3,
Excavation Sump — Site Servicing — Phase 4,
Excavation Sump — Site Servicing — Phase 5,
Excavation Sump — Site Servicing — Phase 6.

Located at: Lot 26 27 and 28, Concession 10 Goulbourn, Geographic Township of Goulbourn Ottawa

For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment and Climate Change.

(d) "District Office" means the Ottawa District Office.

(e) "Permit" means this Permit to Take Water No. 3238-9TLP82 including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means CRT Development Inc..

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated September 30, 2014 and signed by Subhash Malhotra, and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

2. General Conditions and Interpretation

2.1 Inspections
The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act* , R.S.O. 1990, the *Pesticides Act* , R.S.O. 1990, or the *Safe Drinking Water Act,* S. O. 2002.

2.2 Other Approvals
The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act* , and the *Environmental Protection Act* , and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information
The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action
The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability
The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts
Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

3. Water Takings Authorized by This Permit

3.1 **Expiry**
This Permit expires on **February 10, 2025**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

Table A

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	Excavation Sump — Site Servicing — Phase 1	Pond Dugout	Construction	Dewatering Construction	12,000	24	1,500,000	275	18 429650 5013140
2	SWMP	Pond Dugout	Construction	Dewatering Construction	10,000	24	4,500,000	250	18 429800 5012130
3	Excavation Sump — Residential Basement Excavations	Pond Dugout	Construction	Dewatering Construction	2,800	24	150,000	275	18 429650 5013140
4	Misc. Site Ponding	Pond Dugout	Construction	Dewatering Construction	2,800	24	150,000	175	18 429650 5013140
5	Excavation Sump — Site Servicing — Phase 2	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 429875 5012805
6	Excavation Sump — Site Servicing — Phase 3	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 430120 5012640
7	Excavation Sump — Site Servicing — Phase 4	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 429090 5012965
8	Excavation Sump — Site Servicing — Phase 5	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 429320 5012540
9	Excavation Sump — Site Servicing — Phase 6	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 429475 5012340
						Total Taking:	7,300,000		

3.3 Notwithstanding Table A above, the Permit Holder shall ensure the total combined rate of water taking for all Phase 1 and the SWMP water takings do not exceed 7,300,000 litres per day.

3.4 Notwithstanding Table A above the Permit Holder shall ensure the total combined rate of water taking for Phase 2, Phase 3, Phase 4, Phase 5 and Phase 6 does not exceed 1,300,000 litres per day.

4. Monitoring

4.1 The Permit Holder shall maintain a record of all water takings. This record shall include the dates and times of water takings, the rates of taking and an estimated calculation of the total amounts of water taken per day for each day that water is taken under the authorization of this Permit. A separate record shall be maintained for each source. The Permit Holder shall keep all required records up to date and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request.

5. Impacts of the Water Taking

5.1 Notification

The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 For Surface-Water Takings

The taking of water (including the taking of water into storage and the subsequent or simultaneous withdrawal from storage) shall be carried out in such a manner that streamflow is not stopped and is not reduced to a rate that will cause interference with downstream uses of water or with the natural functions of the stream.

For Groundwater Takings

If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

5.3 Prevention of Adverse Effects:
The Permit Holder shall ensure the taking of water under authority of this Permit does not result in an adverse effect in area waters.

5.4 The taking of water shall be carried out in such a manner as to prevent the disruption or removal of any fish, invertebrates or sediment from the watercourse.

5.5 Prevention of Structural Adverse Effects:
The Permit Holder shall take all measures necessary to prevent damage to buildings, bridges, structures, roads and/or railway lines that may be impacted either directly or indirectly by this taking.

5.6 Discharge Control Measures:
Any discharge of water to the land surface shall use a multi-barrier approach to control erosion and run-off prior to the discharge water entering a watercourse. Siltation control measures shall be installed at the discharge site(s) and shall be sufficient to control the volumes. Continuous care shall be taken to properly maintain the siltation control devices.

5.7 The discharge of water shall be controlled in such a way as to avoid erosion and sedimentation in any receiving stream.

5.8 The Permit Holder shall ensure that any water discharged to the natural environment does not result in scouring, erosion or physical alteration of stream channels or banks and that there is no flooding in the receiving area or water body, downstream water bodies, ditches or properties caused or worsened by this discharge.

5.9 The Permit Holder shall not discharge turbid water to any watercourse. Turbid water shall be defined as any discharge water from the excavation or diverted water with a maximum increase of 8 NTUs above the receiving stream's background levels.

5.10 Discharged Water to the Sanitary or Storm Sewer System:
The Permit Holder shall ensure that any water that is taken for dewatering purposes and discharged to the City of Ottawa sewer system is in accordance with a City of Ottawa Sewer Use Agreement.

6. Director May Amend Permit
The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce

the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act* , Section 100 (4).

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

*In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Environmental Commissioner, **Environmental Bill of Rights**, R.S.O. 1993, Chapter 28, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended provides that the Notice requiring a hearing shall state:*

1. The portions of the Permit or each term or condition in the Permit 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.

In addition to these legal requirements, the Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

This notice must be served upon:

The Secretary Environmental Review Tribunal 655 Bay Street, 15th Floor Toronto ON M5G 1E5 Fax: (416) 314-4506 Email: ERTTribunalsecretary@ontario.ca	*AND*	*The Environmental Commissioner 1075 Bay Street 6th Floor, Suite 605 Toronto, Ontario M5S 2W5*	*AND*	*The Director, Section 34.1, Ministry of the Environment and Climate Change 1259 Gardiners Rd, PO Box 22032 Kingston, ON K7P 3J6*

Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:

by telephone at (416) 314-4600 ***by fax at (416) 314-4506*** ***by e-mail at www.ert.gov.on.ca***

*This instrument is subject to Section 38 of the **Environmental Bill of Rights** that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek to appeal for 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry, you can determine when the leave to appeal period ends.*

Dated at Kingston this 13th day of March, 2015.

Greg Faaren
Director, Section 34.1
Ontario Water Resources Act, R.S.O. 1990

Schedule A

This Schedule "A" forms part of Permit To Take Water 3238-9TLP82, dated March 13, 2015.

APPENDIX C

- **MSS Water Plan**
- **Hydraulic Analysis**
- **Boundary Conditions**

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

No.	REVISION	DATE	BY
3	ISSUED WITH MASTER SERVICING STUDY	MAY 25/09	MAB
2	UPDATED WITH DRAFT MASTER SERVICING STUDY	SEP 12/08	MAB
1	ISSUED WITH DRAFT MASTER SERVICING STUDY	MAY 02/08	MAB

LICENSED PROFESSIONAL ENGINEER M.A. BISSETT PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER J.G. RIDDELL PROVINCE OF ONTARIO

NOVATECH ENGINEERING CONSULTANTS LTD.
ENGINEERS & PLANNERS
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Email: novainfo@novatech-eng.com

DESIGN	KJM
CHECKED	MAB
DRAWN	KJM
CHECKED	MAB
APPROVED	JGR

SCALE 1 : 5000

CITY OF OTTAWA
FERNBANK CDP
WATERMAIN LAYOUT

PROJECT No. 101108-00
DATE OCTOBER 2007
DRAWING No. 101108-WM

PLANBLDWG - 1000mmX707mm

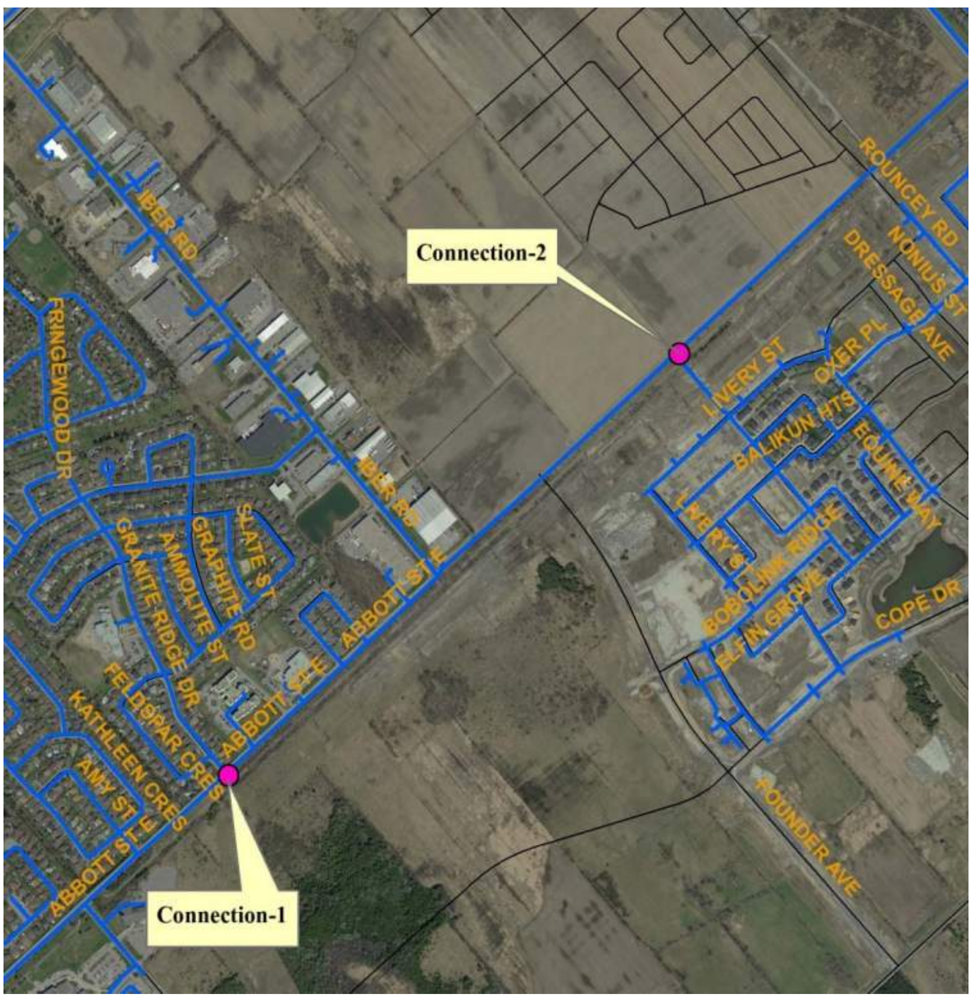
Boundary Conditions at CRT Lands

Information Provided:

Date provided: 16 Nov 2016

Criteria	Demand (L/s)
Average Demand	16.9
Maximum Daily Demand	36.9
Peak Hourly Demand	77.8
Fire Flow Demand	167
Fire Flow Demand	225
Maximum Daily + Fire Flow Demand	204 & 262

Location:



Results

Connection1:

Criteria	Head (m)	Pressure (psi)
Max HGL	161.1	75.8
PKHR	154.7	66.7
MXDY + Fire Flow (204 L/s)	152.8	64
MXDY + Fire Flow (262 L/s)	150.6	60.9

Connection2:

Criteria	Head (m)	Pressure (psi)
Max HGL	161.4	85.4
PKHR	154.8	76.0
MXDY + Fire Flow (204 L/s)	153	73.4
MXDY + Fire Flow (262 L/s)	150.9	70.5

Considerations

1. According to the City of Ottawa Water Design Guidelines as well as the Ontario Building Code, the maximum pressure at any point within a distribution system shall not exceed 80 psi in occupied areas. Measures should be taken to try to reduce the residual pressure below 80 psi without the use of special pressure control equipment. In circumstances where the residual pressure cannot be reduced below 80 psi without the use of pressure control equipment, a pressure reducing valve (**PRV**) should be installed at site.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

IBI GROUP
333 PRESTON STREET
OTTAWA, ON
K1S 5N4

WATERMAIN DEMAND CALCULATION SHEET

PROJECT : CRT LANDS
LOCATION : CITY OF OTTAWA
DEVELOPER : CRT DEVELOPMENT INC.

FILE: 27970.5.7
DATE: 2/9/2017
DESIGN: LME

NODE	RESIDENTIAL			NON-RESIDENTIAL			AVERAGE DAILY DEMAND (l/s)			MAXIMUM DAILY DEMAND (l/s)			MAXIMUM HOURLY DEMAND (l/s)			FIRE DEMAND
	UNITS		POP'N	COM	IND	INS										
	SF	TH		(Ha)	(Ha)	(Ha)	Res.	Non-res.	Total	Res.	Non-res.	Total	Res.	Non-res.	Total	(l/s)
CLA-02	15		51				0.21		0.21	0.52		0.52	1.14		1.14	166.7
CLA-03	14		48				0.19		0.19	0.48		0.48	1.06		1.06	166.7
CLA-04	9		31				0.12		0.12	0.31		0.31	0.68		0.68	166.7
CLA-05	8		27				0.11		0.11	0.28		0.28	0.61		0.61	166.7
CLA-06		17	46				0.19		0.19	0.46		0.46	1.02		1.02	166.7
CLA-07	2	15	47				0.19		0.19	0.48		0.48	1.05		1.05	166.7
CLA-08	17		58				0.23		0.23	0.59		0.59	1.29		1.29	166.7
CLA-09	9		31				0.12		0.12	0.31		0.31	0.68		0.68	166.7
CLA-10	17		58				0.23		0.23	0.59		0.59	1.29		1.29	166.7
CLA-11	16		54				0.22		0.22	0.55		0.55	1.21		1.21	166.7
CLA-12	11		37				0.15		0.15	0.38		0.38	0.83		0.83	166.7
CLA-13	20		68				0.28		0.28	0.69		0.69	1.52		1.52	166.7
CLA-14		28	76				0.31		0.31	0.77		0.77	1.68		1.68	166.7
CLA-15		30	81				0.33		0.33	0.82		0.82	1.80		1.80	166.7
CLA-16			170				0.69		0.69	1.72		1.72	3.79		3.79	166.7
CLA-20		24	65				0.26		0.26	0.66		0.66	1.44		1.44	166.7
CLA-21		13	35				0.14		0.14	0.36		0.36	0.78		0.78	166.7
CLA-22	14		48				0.19		0.19	0.48		0.48	1.06		1.06	166.7
CLA-23		9	24				0.10		0.10	0.25		0.25	0.54		0.54	166.7
CLA-24	13		44				0.18		0.18	0.45		0.45	0.98		0.98	166.7
CLA-25	6		20				0.08		0.08	0.21		0.21	0.45		0.45	166.7
CLA-26			109				0.44		0.44	1.10		1.10	2.43		2.43	166.7
CLA-27	9		31				0.12		0.12	0.31		0.31	0.68		0.68	166.7
CLA-28	18		61				0.25		0.25	0.62		0.62	1.36		1.36	166.7
CLA-28A			68				0.28		0.28	0.69		0.69	1.52		1.52	
CLA-29	7		24				0.10		0.10	0.24		0.24	0.53		0.53	166.7
CLA-30	10		34				0.14		0.14	0.34		0.34	0.76		0.76	166.7
CLA-31	12		41				0.17		0.17	0.41		0.41	0.91		0.91	166.7
CLA-32	15		51				0.21		0.21	0.52		0.52	1.14		1.14	166.7
CLA-32A			68				0.28		0.28	0.69		0.69	1.52		1.52	
CLA-33	12		41				0.17		0.17	0.41		0.41	0.91		0.91	166.7
CLA-34	16		54				0.22		0.22	0.55		0.55	1.21		1.21	166.7
CLA-35	5		17				0.07		0.07	0.17		0.17	0.38		0.38	166.7
CLA-36	13		44			2.88	0.18	1.67	1.85	0.45	2.50	2.95	0.98	4.50	5.48	225.0
CLA-37	16		54				0.22		0.22	0.55		0.55	1.21		1.21	166.7
CLA-38	8		27			6.53	0.11	3.78	3.89	0.28	5.67	5.94	0.61	10.20	10.81	225.0
CLA-54	11		37				0.15		0.15	0.38		0.38	0.83		0.83	166.7
CLA-55		30	81				0.33		0.33	0.82		0.82	1.80		1.80	166.7
TOTALS	**323**	**166**	**1962**			**9.41**			**13.39**			**28.04**			**58.41**	

ASSUMPTIONS

RESIDENTIAL DENSITIES
- SF 3.4 p/p/u
- TH 2.7 p/p/u
- High Density 90.0 p/p/ha

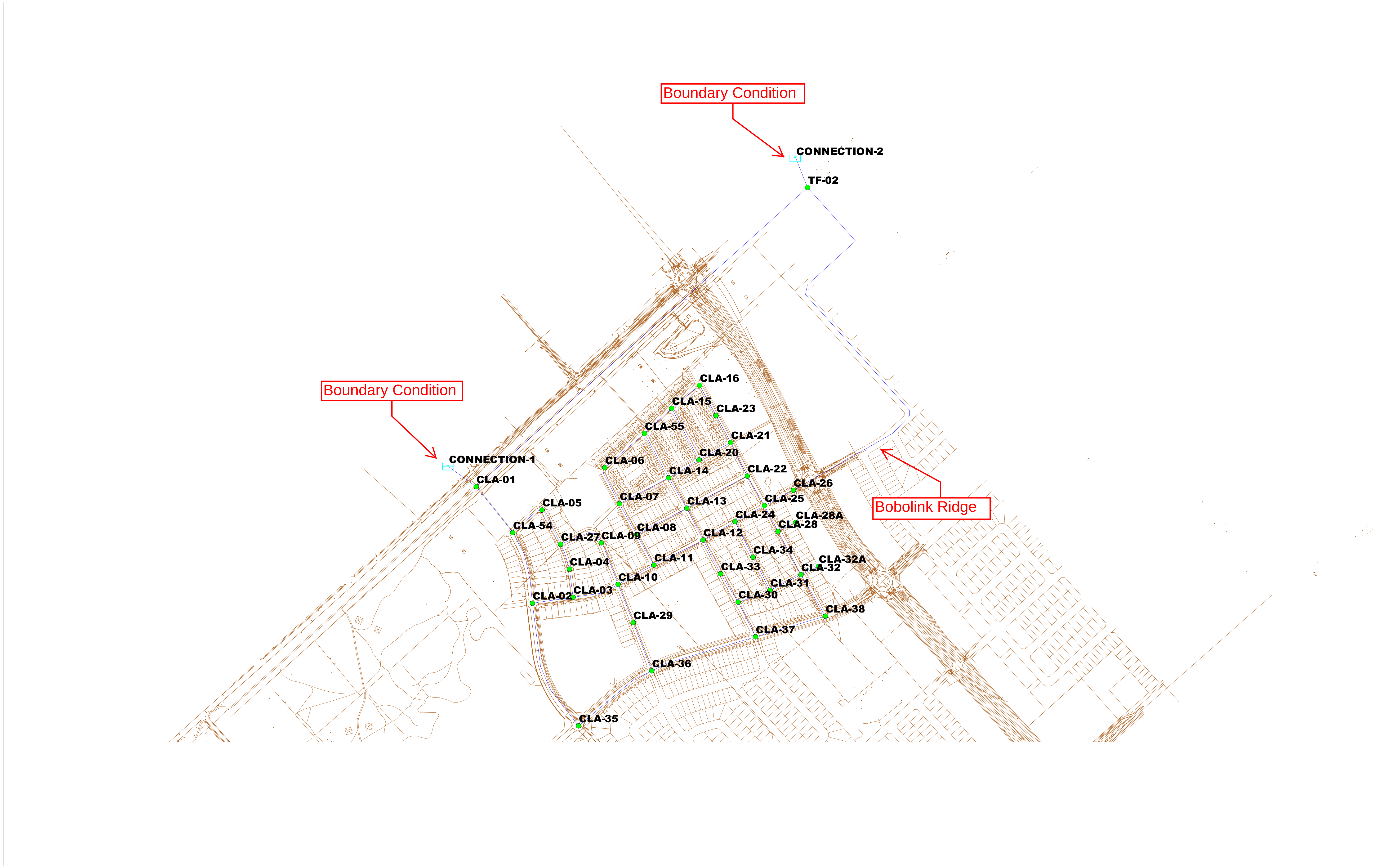
AVERAGE DAILY DEMAND
- Residential 350 l/cap/day
- Commercial 30,000 l/ha/day
- Industrial 35,000 l/ha/day
- Institutional 50,000 l/ha/day

MAXIMUM DAILY DEMAND
- Residential 875 l/cap/day
- Commercial 45,000 l/ha/day
- Industrial 52,500 l/ha/day
- Institutional 75,000 l/ha/day

MAXIMUM HOURLY DEMAND
- Residential 1,925 l/cap/day
- Commercial 81,000 l/ha/day
- Industrial 94,500 l/ha/day
- Institutional 135,000 l/ha/day

FIRE DEMANDS
- SF 166.7 l/s
- TH 166.7 l/s
- ICI 225.0 l/s

Phase 1 Node ID's

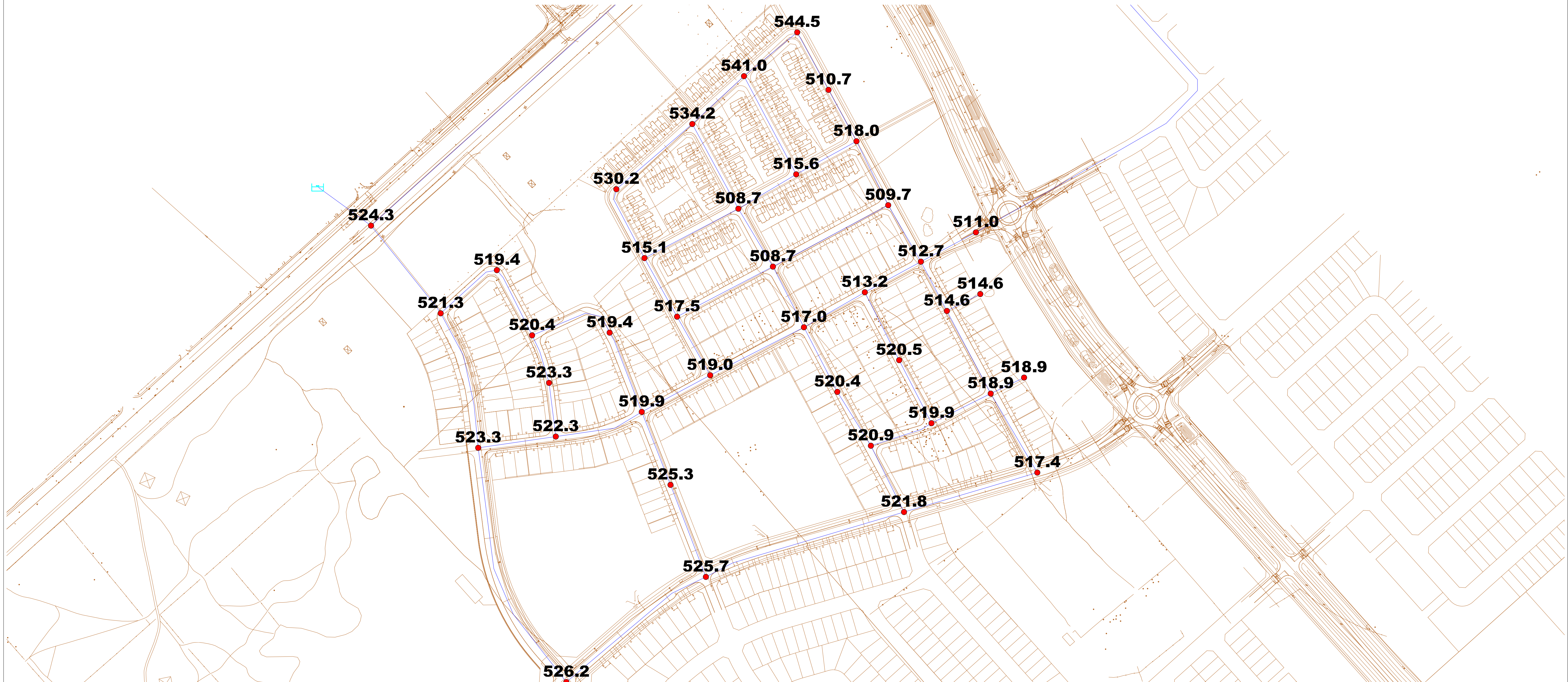


Date: Thursday, February 09, 2017

Phase 1 Pipe Sizes

Date: Thursday, February 09, 2017

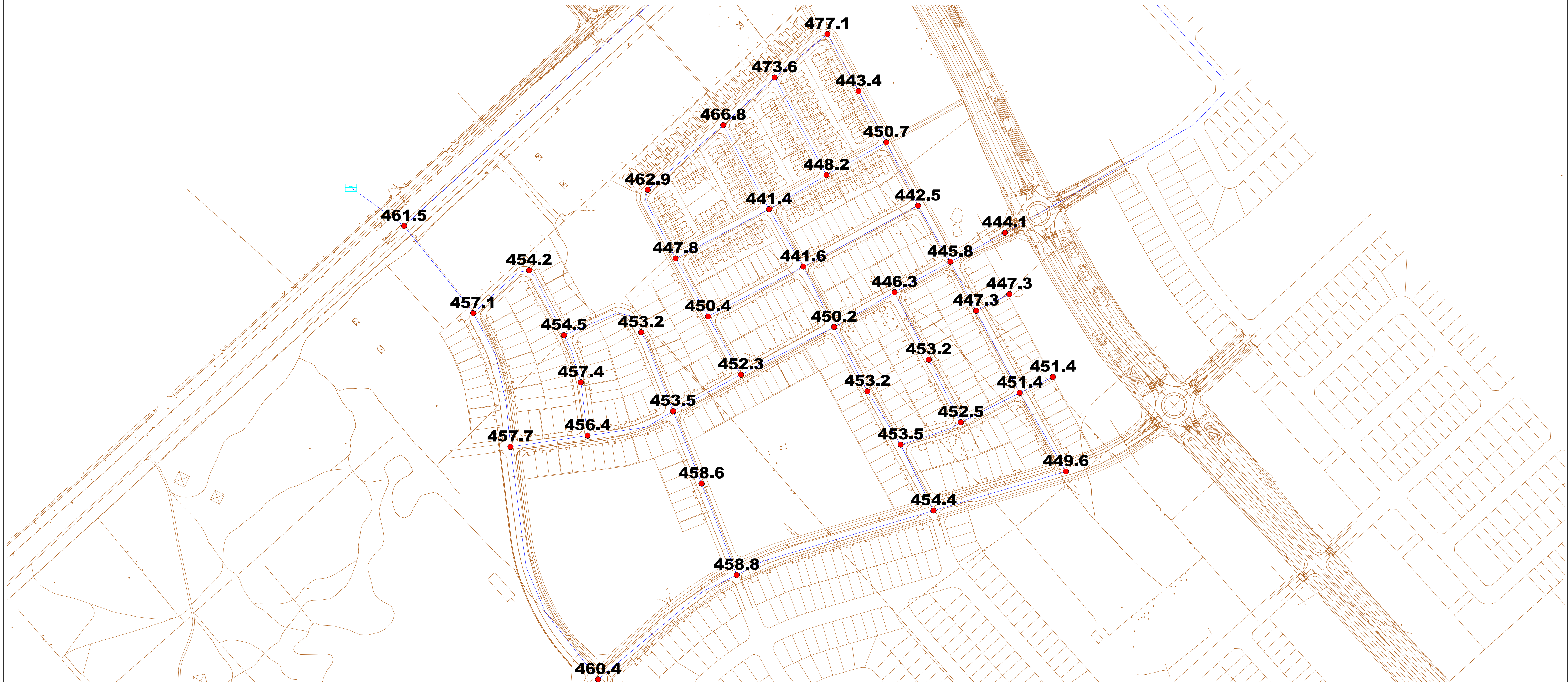
Basic Day (MAX HGL) Pressures (kPa)



Prepared By:

Date: Thursday, February 09, 2017

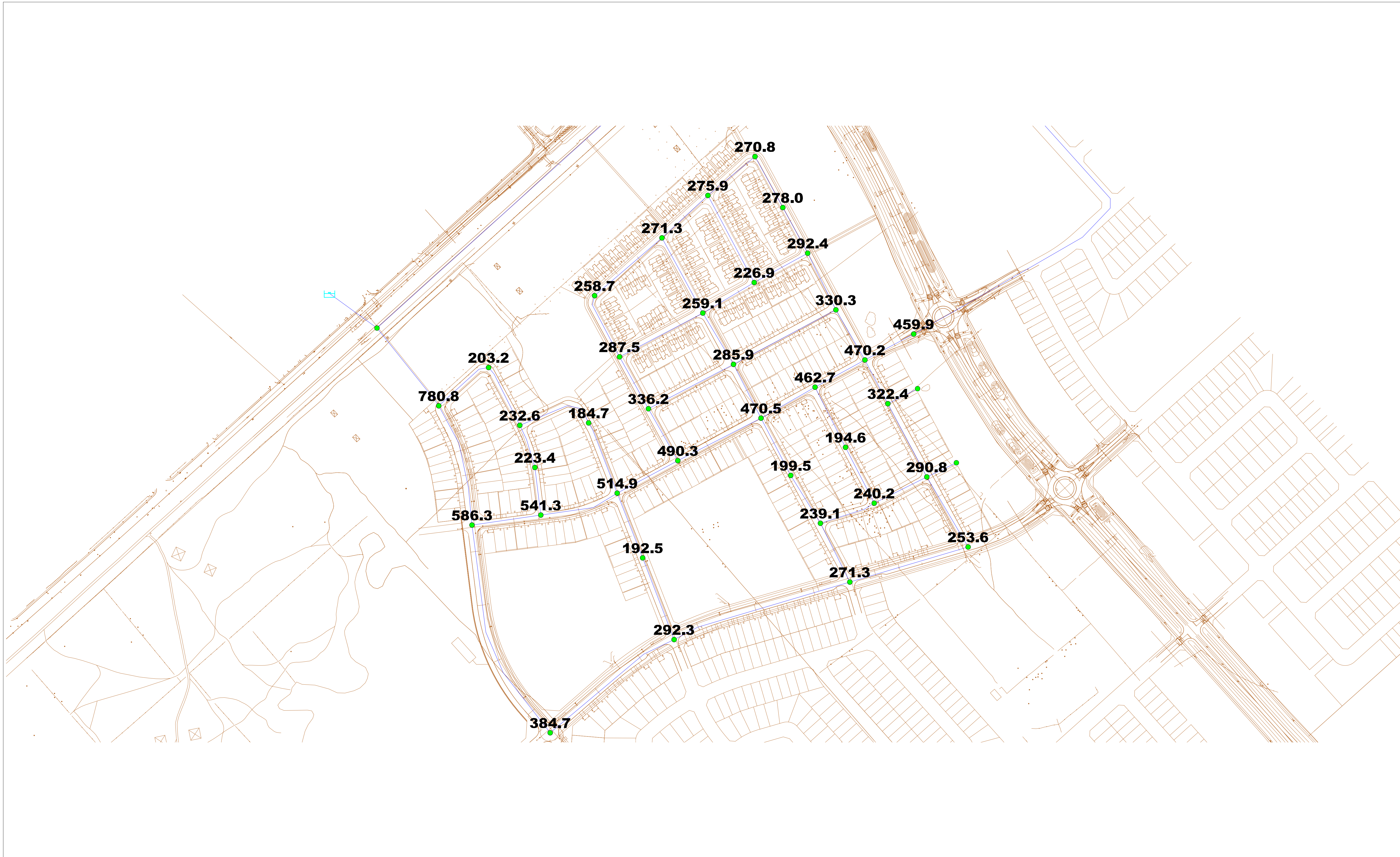
Peak Hour Pressures (kPa)



Prepared By:

Date: Thursday, February 09, 2017

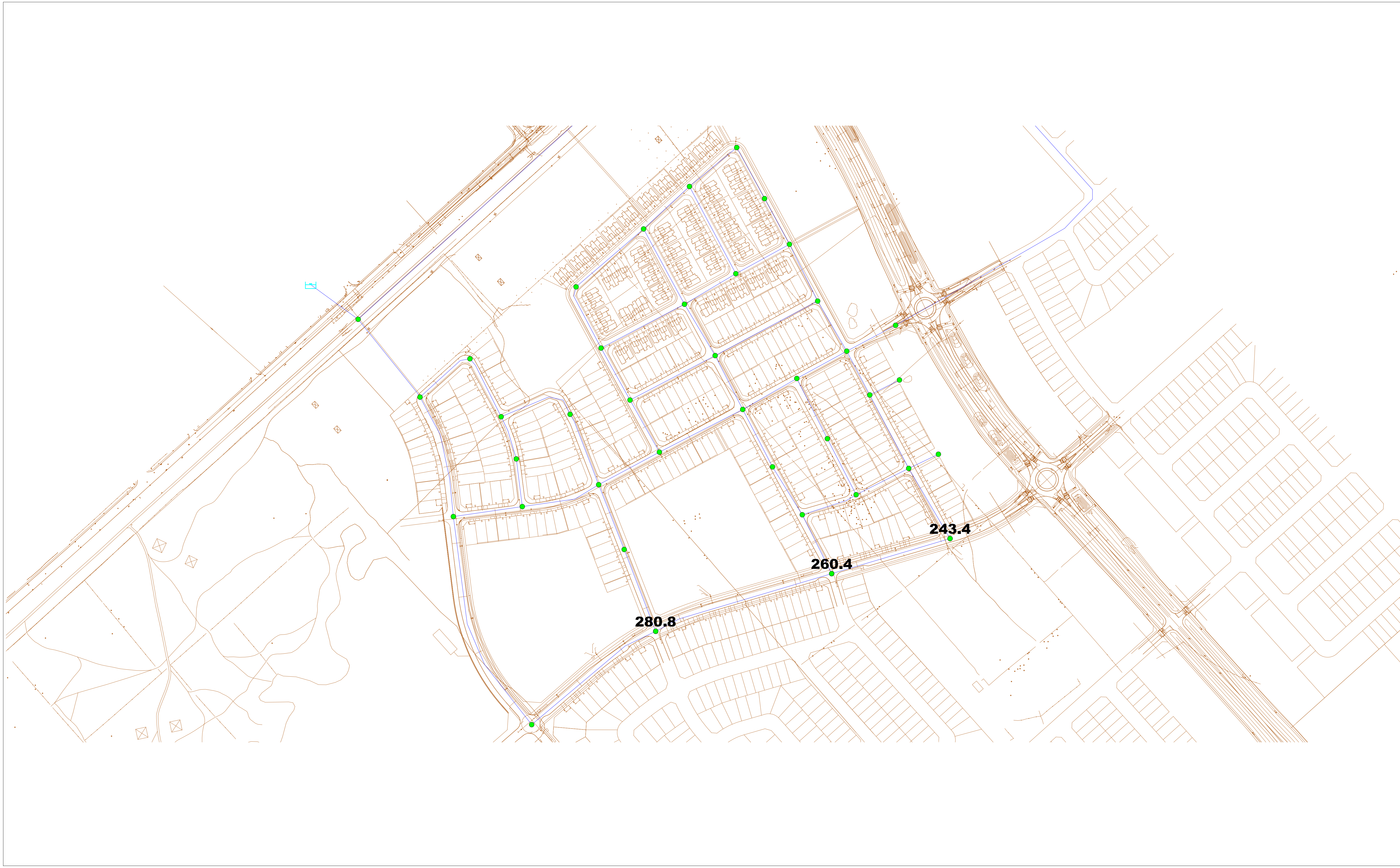
Max Day + Fire - Residential Fire Flows (l/s)



Prepared By:

Date: Thursday, February 09, 2017

Max Day + Fire ICI - Fireflow Design Report (l/s)



Date: Thursday, February 09, 2017

Basic Day (Max HGL) - Junction Report

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
1		CLA-01	0.00	107.60	161.10	524.26
2		CLA-02	0.21	107.70	161.10	523.30
3		CLA-03	0.19	107.80	161.10	522.34
4		CLA-04	0.12	107.70	161.10	523.32
5		CLA-05	0.11	108.10	161.10	519.38
6		CLA-06	0.19	107.00	161.11	530.24
7		CLA-07	0.19	108.55	161.11	515.05
8		CLA-08	0.23	108.30	161.11	517.50
9		CLA-09	0.12	108.10	161.10	519.40
10		CLA-10	0.23	108.05	161.11	519.91
11		CLA-11	0.22	108.15	161.11	518.97
12		CLA-12	0.15	108.35	161.11	517.05
13		CLA-13	0.28	109.20	161.11	508.70
14		CLA-14	0.31	109.20	161.11	508.69
15		CLA-15	0.33	105.90	161.11	541.03
16		CLA-16	0.69	105.55	161.11	544.46
17		CLA-20	0.26	108.50	161.11	515.55
18		CLA-21	0.14	108.25	161.11	518.03
19		CLA-22	0.19	109.10	161.12	509.72
20		CLA-23	0.10	109.00	161.11	510.67
21		CLA-24	0.18	108.75	161.12	513.17
22		CLA-25	0.08	108.80	161.12	512.74
23		CLA-26	0.44	109.00	161.14	510.95
24		CLA-27	0.12	108.00	161.10	520.37
25		CLA-28	0.25	108.60	161.12	514.62
26		CLA-28A	0.28	108.60	161.12	514.62
27		CLA-29	0.10	107.50	161.10	525.27
28		CLA-30	0.14	107.95	161.11	520.89
29		CLA-31	0.17	108.05	161.11	519.92
30		CLA-32	0.21	108.15	161.11	518.94
31		CLA-32A	0.28	108.15	161.11	518.94
32		CLA-33	0.17	108.00	161.11	520.43
33		CLA-34	0.22	108.00	161.11	520.45
34		CLA-35	0.07	107.40	161.10	526.24
35		CLA-36	1.85	107.45	161.10	525.72
36		CLA-37	0.22	107.85	161.10	521.81
37		CLA-38	3.89	108.30	161.10	517.38
38		CLA-54	0.15	107.90	161.10	521.33
39		CLA-55	0.33	106.60	161.11	534.17
40		TF-02	0.00	108.00	161.40	523.27

Peak Hour - Junction Report

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
1		CLA-01	0.00	107.60	154.70	461.54
2		CLA-02	1.14	107.70	154.41	457.73
3		CLA-03	1.06	107.80	154.37	456.39
4		CLA-04	0.68	107.70	154.38	457.38
5		CLA-05	0.61	108.10	154.46	454.25
6		CLA-06	1.02	107.00	154.24	462.93
7		CLA-07	1.05	108.55	154.25	447.82
8		CLA-08	1.29	108.30	154.27	450.45
9		CLA-09	0.68	108.10	154.35	453.20
10		CLA-10	1.29	108.05	154.33	453.53
11		CLA-11	1.21	108.15	154.30	452.27
12		CLA-12	0.83	108.35	154.29	450.21
13		CLA-13	1.52	109.20	154.26	441.56
14		CLA-14	1.68	109.20	154.24	441.38
15		CLA-15	1.80	105.90	154.24	473.65
16		CLA-16	3.79	105.55	154.24	477.08
17		CLA-20	1.44	108.50	154.24	448.21
18		CLA-21	0.78	108.25	154.25	450.74
19		CLA-22	1.06	109.10	154.26	442.54
20		CLA-23	0.54	109.00	154.24	443.36
21		CLA-24	0.98	108.75	154.29	446.28
22		CLA-25	0.45	108.80	154.29	445.80
23		CLA-26	2.43	109.00	154.32	444.12
24		CLA-27	0.68	108.00	154.38	454.49
25		CLA-28	1.36	108.60	154.25	447.33
26		CLA-28A	1.52	108.60	154.25	447.31
27		CLA-29	0.53	107.50	154.30	458.61
28		CLA-30	0.76	107.95	154.23	453.47
29		CLA-31	0.91	108.05	154.23	452.48
30		CLA-32	1.14	108.15	154.21	451.37
31		CLA-32A	1.52	108.15	154.21	451.36
32		CLA-33	0.91	108.00	154.25	453.20
33		CLA-34	1.21	108.00	154.25	453.17
34		CLA-35	0.38	107.40	154.39	460.42
35		CLA-36	5.48	107.45	154.27	458.83
36		CLA-37	1.21	107.85	154.22	454.38
37		CLA-38	10.81	108.30	154.18	449.60
38		CLA-54	0.83	107.90	154.55	457.11
39		CLA-55	1.80	106.60	154.24	466.80
40		TF-02	0.00	108.00	154.80	458.60

Max Day + Fire - Fireflow Design Report

		ID	Total Demand (L/s)	Critical Node 1 ID	Critical Node 1 Pressure (kPa)	Critical Node 1 Head (m)	Adjusted Fire-Flow (L/s)	Available Flow @Hydrant (L/s)	Critical Node 2 ID	Critical Node 2 Pressure (kPa)	Critcal Node 2 Head (m)	Adjusted Available Flow (L/s)	Design Flow (L/s)
1		CLA-02	167.19	CLA-14	396.31	148.14	630.98	586.28	CLA-02	139.97	121.98	586.28	586.28
2		CLA-03	167.15	CLA-14	392.70	147.87	586.75	541.31	CLA-03	139.97	122.08	541.31	541.31
3		CLA-04	166.98	CLA-04	263.96	134.64	223.39	223.39	CLA-04	139.96	121.98	223.39	223.39
4		CLA-05	166.95	CLA-05	229.91	131.56	203.20	203.20	CLA-05	139.96	122.38	203.20	203.20
5		CLA-06	167.13	CLA-06	306.72	138.30	258.66	258.68	CLA-06	139.96	121.28	258.69	258.66
6		CLA-07	167.15	CLA-07	320.91	141.30	287.47	287.47	CLA-07	139.96	122.83	287.47	287.47
7		CLA-08	167.26	CLA-08	349.21	143.94	336.17	336.17	CLA-08	139.96	122.58	336.17	336.17
8		CLA-09	166.98	CLA-09	190.07	127.50	184.72	184.72	CLA-09	139.96	122.38	184.72	184.72
9		CLA-10	167.26	CLA-14	387.92	147.64	541.97	514.93	CLA-10	139.96	122.33	514.94	514.94
10		CLA-11	167.22	CLA-14	382.73	147.21	500.77	490.29	CLA-11	139.96	122.43	490.29	490.29
11		CLA-12	167.05	CLA-13	381.53	147.28	491.15	470.51	CLA-12	139.96	122.63	470.52	470.52
12		CLA-13	167.36	CLA-13	316.09	141.46	285.92	285.92	CLA-13	139.96	123.48	285.92	285.92
13		CLA-14	167.44	CLA-14	294.92	139.30	259.10	259.13	CLA-14	139.96	123.48	259.13	259.10
14		CLA-15	167.49	CLA-15	327.60	139.33	275.89	275.89	CLA-15	139.96	120.18	275.89	275.89
15		CLA-16	168.39	CLA-16	324.52	138.67	270.80	270.83	CLA-16	139.96	119.83	270.83	270.80
16		CLA-20	167.33	CLA-20	263.36	135.38	226.86	226.86	CLA-20	139.96	122.78	226.87	226.86
17		CLA-21	167.03	CLA-21	325.97	141.51	292.36	292.36	CLA-21	139.96	122.53	292.36	292.36
18		CLA-22	167.15	CLA-22	340.75	143.87	330.26	330.26	CLA-22	139.96	123.38	330.26	330.26
19		CLA-23	166.92	CLA-23	311.50	140.79	278.00	278.00	CLA-23	139.96	123.28	278.00	278.00
20		CLA-24	167.12	CLA-24	381.05	147.64	462.70	462.70	CLA-24	139.96	123.03	462.71	462.70
21		CLA-25	166.88	CLA-22	380.75	147.65	480.81	470.21	CLA-25	139.96	123.08	470.21	470.21
22		CLA-26	167.77	CLA-26	378.99	147.68	459.94	459.94	CLA-26	139.96	123.28	459.95	459.94
23		CLA-27	166.98	CLA-27	275.17	136.08	232.57	232.57	CLA-27	139.96	122.28	232.57	232.57
24		CLA-28	167.29	CLA-28	340.36	143.33	322.37	322.37	CLA-28	139.96	122.88	322.37	322.37
25		CLA-29	166.91	CLA-29	209.30	128.86	192.54	192.54	CLA-29	139.96	121.78	192.54	192.54
26		CLA-30	167.01	CLA-30	281.56	136.68	239.14	239.15	CLA-30	139.96	122.23	239.15	239.14
27		CLA-31	167.08	CLA-31	282.20	136.85	240.23	240.24	CLA-31	139.96	122.33	240.24	240.23
28		CLA-32	167.19	CLA-32	324.59	141.27	290.82	290.82	CLA-32	139.96	122.43	290.82	290.82
29		CLA-33	167.08	CLA-33	221.78	130.63	199.47	199.47	CLA-33	139.96	122.28	199.47	199.47
30		CLA-34	167.22	CLA-34	211.63	129.60	194.61	194.61	CLA-34	139.96	122.28	194.61	194.61
31		CLA-35	166.84	CLA-35	375.23	145.69	384.66	384.65	CLA-35	139.96	121.68	384.66	384.66
32		CLA-36	227.95	CLA-36	249.80	132.94	292.31	292.31	CLA-36	139.96	121.73	292.32	292.31
33		CLA-37	225.55	CLA-37	224.01	130.71	271.34	271.34	CLA-37	139.96	122.13	271.34	271.34
34		CLA-38	230.94	CLA-38	186.04	127.29	253.61	253.61	CLA-38	139.96	122.58	253.61	253.61
35		CLA-54	167.05	CLA-14	408.38	149.57	855.64	780.75	CLA-54	139.97	122.18	780.76	780.76
36		CLA-55	167.49	CLA-55	319.77	139.23	271.31	271.31	CLA-55	139.96	120.88	271.31	271.31

Max Day + Fire ICI Lands - Fireflow Design Report

		ID	Total Demand (L/s)	Critical Node 1 ID	Critical Node 1 Pressure (kPa)	Critical Node 1 Head (m)	Adjusted Fire-Flow (L/s)	Available Flow @Hydrant (L/s)	Critical Node 2 ID	Critical Node 2 Pressure (kPa)	Critcal Node 2 Head (m)	Adjusted Available Flow (L/s)	Design Flow (L/s)
1		CLA-36	227.95	CLA-36	228.55	130.77	280.83	280.83	CLA-36	139.96	121.73	280.83	280.83
2		CLA-37	225.55	CLA-37	202.79	128.54	260.40	260.41	CLA-37	139.96	122.13	260.41	260.40
3		CLA-38	230.94	CLA-38	164.84	125.12	243.39	243.39	CLA-38	139.96	122.58	243.39	243.39

Peak Hour - Pipe Report

		ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
1		11	CLA-01	CLA-54	128.85	297.00	120.00	36.06	0.52	0.15	1.18
2		113	CLA-20	CLA-15	127.90	155.00	100.00	0.77	0.04	0.00	0.03
3		115	CLA-14	CLA-55	110.97	155.00	100.00	0.96	0.05	0.01	0.05
4		117	CLA-15	CLA-16	79.32	204.00	110.00	0.15	0.00	0.0000	0.000
5		125	CLA-21	CLA-23	67.41	204.00	110.00	1.98	0.06	0.00	0.04
6		127	CLA-22	CLA-23	71.93	155.00	100.00	2.20	0.12	0.02	0.22
7		13	CLA-02	CLA-03	90.19	297.00	120.00	20.27	0.29	0.04	0.41
8		131	CLA-28	CLA-32	107.62	204.00	110.00	6.37	0.19	0.04	0.35
9		135	CLA-29	CLA-10	90.22	155.00	100.00	-2.83	0.15	0.03	0.35
10		141	CLA-27	CLA-09	106.28	155.00	100.00	2.58	0.14	0.03	0.30
11		147	CLA-04	CLA-03	62.23	155.00	100.00	0.69	0.04	0.00	0.03
12		149	CLA-04	CLA-27	58.21	155.00	100.00	-1.37	0.07	0.01	0.09
13		15	CLA-03	CLA-10	104.89	297.00	120.00	19.90	0.29	0.04	0.39
14		151	CLA-06	CLA-55	115.19	204.00	110.00	2.02	0.06	0.00	0.04
15		159	CLA-01	TF-02	980.24	393.00	120.00	-20.02	0.17	0.10	0.10
16		161	CONNECTION-2	TF-02	1.00	393.00	130.00	42.34	0.35	0.000	0.35
17		17	CLA-10	CLA-11	89.30	297.00	120.00	17.68	0.26	0.03	0.32
18		19	CLA-10	CLA-09	98.50	155.00	100.00	-1.90	0.10	0.02	0.17
19		191	TF-02	CLA-26	980.99	297.00	120.00	22.32	0.32	0.48	0.49
20		193	CLA-54	CLA-02	162.86	297.00	120.00	29.99	0.43	0.14	0.84
21		195	CLA-54	CLA-05	83.15	155.00	100.00	5.23	0.28	0.09	1.10
22		197	CLA-07	CLA-06	88.38	204.00	110.00	3.04	0.09	0.01	0.09
23		199	CLA-55	CLA-15	81.06	204.00	110.00	1.18	0.04	0.00	0.02
24		205	CLA-34	CLA-24	87.49	155.00	100.00	-3.56	0.19	0.05	0.54
25		207	CLA-25	CLA-26	71.68	297.00	120.00	-19.89	0.29	0.03	0.39
26		21	CLA-11	CLA-08	77.39	204.00	110.00	7.48	0.23	0.04	0.47
27		211	CLA-23	CLA-16	75.34	204.00	110.00	3.64	0.11	0.01	0.12
28		213	CLA-33	CLA-12	83.72	155.00	100.00	-3.52	0.19	0.04	0.53
29		215	CLA-28A	CLA-28	43.13	204.00	110.00	-1.52	0.05	0.00	0.02
30		217	CLA-32A	CLA-32	42.54	204.00	110.00	-1.52	0.05	0.00	0.02
31		219	CONNECTION-1	CLA-01	1.00	393.00	120.00	16.04	0.13	0.0000	0.07
32		23	CLA-08	CLA-07	77.03	204.00	110.00	5.18	0.16	0.02	0.24
33		25	CLA-27	CLA-05	85.51	155.00	100.00	-4.62	0.24	0.08	0.88
34		29	CLA-07	CLA-14	122.11	155.00	100.00	1.09	0.06	0.01	0.06
35		31	CLA-14	CLA-20	77.44	155.00	100.00	0.78	0.04	0.00	0.03
36		33	CLA-20	CLA-21	79.13	155.00	100.00	-1.43	0.08	0.01	0.10
37		35	CLA-14	CLA-13	77.51	155.00	100.00	-2.33	0.12	0.02	0.25
38		37	CLA-08	CLA-13	124.48	155.00	100.00	1.01	0.05	0.01	0.05
39		39	CLA-11	CLA-12	121.20	297.00	120.00	8.99	0.13	0.01	0.09
40		41	CLA-12	CLA-13	78.38	155.00	100.00	3.06	0.16	0.03	0.41
41		43	CLA-12	CLA-24	80.77	297.00	120.00	1.57	0.02	0.000	0.00
42		45	CLA-24	CLA-25	73.62	297.00	120.00	-2.97	0.04	0.000	0.01
43		47	CLA-25	CLA-22	75.05	204.00	110.00	7.23	0.22	0.03	0.44
44		49	CLA-22	CLA-13	150.36	155.00	100.00	-0.22	0.01	0.000	0.00
45		51	CLA-21	CLA-22	82.10	204.00	110.00	-4.19	0.13	0.01	0.16
46		53	CLA-30	CLA-33	72.99	155.00	100.00	-2.61	0.14	0.02	0.31
47		55	CLA-30	CLA-31	74.77	155.00	100.00	0.53	0.03	0.00	0.02
48		57	CLA-31	CLA-34	81.48	155.00	100.00	-2.35	0.12	0.02	0.25
49		59	CLA-31	CLA-32	76.20	155.00	100.00	1.97	0.10	0.01	0.18
50		61	CLA-25	CLA-28	64.06	204.00	110.00	9.25	0.28	0.04	0.70
51		63	CLA-32	CLA-38	105.48	204.00	110.00	5.68	0.17	0.03	0.28
52		67	CLA-30	CLA-37	85.27	155.00	100.00	1.32	0.07	0.01	0.09
53		69	CLA-37	CLA-38	159.94	204.00	110.00	5.13	0.16	0.04	0.23
54		71	CLA-37	CLA-36	240.46	204.00	110.00	-5.02	0.15	0.05	0.22
55		73	CLA-36	CLA-29	113.49	155.00	100.00	-2.30	0.12	0.03	0.24
56		75	CLA-02	CLA-35	296.18	297.00	120.00	8.58	0.12	0.02	0.08
57		77	CLA-35	CLA-36	202.13	204.00	110.00	8.20	0.25	0.11	0.56

APPENDIX D

- **Fernbank Trunk Sewer Design**
- **MSS Sanitary Drainage Area Plan, (Drawing 101108-SAN)**
- **Figure 6.1 – MSS Sanitary HGL**
- **Sanitary Sewer Hydraulic Grade Line Analysis (2031) from MSS Report**
- **2017 Sanitary Sewer HGL Analysis**
- **Appendix 6 – B.1 City of Ottawa Sewer Design Guidelines**
- **Section 1.7 – MOE Design Guidelines**
- **Sanitary Sewer Design Sheets**
- **Drainage Area Plans 27970-501, 501A and 501B**

FERNBANK CDP LANDS - SANITARY TRUNK SEWER
PEAK FLOW DESIGN SHEET

AREA ID	AREA From	AREA To	RESIDENTIAL LOW DENSITY Area (ha)	LOW DENSITY Pop.	MEDIUM DENSITY Area (ha)	MEDIUM DENSITY Pop.	HIGH DENSITY Area (ha)	HIGH DENSITY Pop.	MIXED USE Area (ha)	MIXED USE Pop.	TOTAL Pop.	TOTAL Accum. Pop.	TOTAL Peak Factor	TOTAL Peak Flow (l/s)	MIXED USE Area (ha)	MIXED USE Accum. Area (ha)	COMMERCIAL Area (ha)	COMMERCIAL Accum. Area (ha)	INSTITUTIONAL Area (ha)	INSTITUTIONAL Accum. Area (ha)	C+I Peak Flow (l/s)	INFILTRATION Total Area (ha)	INFILTRATION Accum. Area (ha)	INFILTRATION Infil. Flow (l/s)	Total Flow (l/s)	PIPE Size (mm)	PIPE Type	PIPE Slope (%)	PIPE Length (m)	PIPE Capacity (l/s)	PIPE Full Flow Vel. (m/s)	PIPE Q/Qfull (%)	PIPE Actual Vel. (m/s)
F1			99.45	9189	8.31	1247	0.00	0	0.00	0	10436	10436	2.9	124.1	0.00	0.00	0.63	0.63	23.23	23.23	20.7	200.11	200.11	56.0	200.9								
	FT24	FT23									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT23	FT22									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT22	FT21									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT21	FT20									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT20	FT19									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT19	FT18									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	1.87	120.0	876.0	3.00	22.9%	2.34
F2			2.90	268	1.80	270	0.00	0	0.00	0	538	538	4.0	8.6	0.00	0.00	0.00	0.00	0.40	0.40	0.3	13.19	13.19	3.7	12.7								
F3			15.95	1474	14.90	2235	0.00	0	10.57	856	4565	4565	3.3	60.7	10.57	10.57	0.60	0.60	11.57	11.57	15.2	77.57	77.57	21.7	97.6								
	FT18	FT17									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.4	519.4	1.14	56.1%	1.17
	FT17	FT16									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT16	FT15									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT15	FT14									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT14	FT13									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT13	FT12									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT12	FT11									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT11	FT10									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT10	FT09									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.58	84.1	884.5	1.94	33.0%	1.72
	FT09	FT08									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.58	40.9	884.5	1.94	33.0%	1.72
F4			60.08	5551	16.71	2506	0.00	0	5.62	455	6512	8512	3.0	104.3	5.62	5.62	0.00	0.00	19.62	19.62	[illegible]	164.76	164.76	46.1	169.9								
F5			7.70	711	2.90	435	0.00	0	6.70	543	1689	1689	3.6	24.9	6.70	6.70	0.00	0.00	0.79	0.79	[illegible]	22.81	22.81	6.4	34.9								
F6			29.70	2744	9.95	1493	5.04	680	0.00	0	4917	4917	3.3	64.3	0.00	0.00	0.00	0.00	16.15	16.15	14.0	89.34	80.34	25.0	105.8								
	FT08	FT07									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	77.5	1819.0	1.56	29.6%	1.32
	FT07	FT06									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	77.5	1819.0	1.56	29.6%	1.32
	FT06	FT05									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	24.6	1819.0	1.56	29.6%	1.32
	FT05	FT04									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	96.0	1819.0	1.56	29.6%	1.32
	FT04	FT03									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	95.0	1819.0	1.56	29.6%	1.32
	FT03	FT02									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	107.5	1819.0	1.56	29.6%	1.32
	FT02	FT01									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	107.5	1819.0	1.56	29.6%	1.32
	FT01	OTT1									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	61.4	1819.0	1.56	29.6%	1.32
	OTT1	GC									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	19.1	1819.0	1.56	29.6%	1.32

Design Parameters:

Avg Flow/Person = 350 l/day
Comm./Inst. Flow = 50,000 l/ha/day
Infiltration = 0.28 l/s/ha

Pipe Friction n = 0.013
Residential Peaking Factor = Harmon Equation (max 4, min 2)
Peaking Factor Comm./Inst. = 1.5

	Units/Net ha	Pop/Unit	
Low Density Residential =	28	3.30	
Medium Density Residential =	60	2.50	(Multi Family Residential)
High Density Residential =	75	1.80	
Mixed Use =	90	1.80	(50% of mixed use area is residential)

Project: Fernbank Sanitary Trunk (108180-08)
Designed: KJM
Checked: MAB
Dwg. Reference: 108180-FTS
Date: January 27, 2012

LICENSED PROFESSIONAL ENGINEER
K.J. MURPHY
100123021
JAN. 26 /12
PROVINCE OF ONTARIO

M:\2008\108180\DATA\Calculations\SAN\Trunk Sewer\Trunk Sewer Design Sheets (20120127).xlsx

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

No.	REVISION	DATE	BY
3	ISSUED WITH MASTER SERVICING STUDY	MAY 25/09	MAB
2	UPDATED WITH DRAFT MASTER SERVICING STUDY	SEP 12/08	MAB
1	ISSUED WITH DRAFT MASTER SERVICING STUDY	MAY 02/08	MAB

LICENSED PROFESSIONAL ENGINEER M.A. BISSETT PROVINCE OF ONTARIO

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DESIGN	KJM	SCALE	1 : 5000
CHECKED	MAB		
DRAWN	KJM		
CHECKED	MAB		
APPROVED	JGR		

CITY OF OTTAWA
FERNBANK CDP
SANITARY DRAINAGE AREA PLAN

PROJECT No. 101108-0
DATE AUGUST 2007
DRAWING No. 101108-SAN

TABLE D-2: FERNBANK CDP LANDS - NEW TRUNK SEWER
SANITARY SEWER HYDRAULIC GRADE LINE ANALYSIS (2031)

This spreadsheet uses the Darcy-Weisbach equation to calculate hydraulic losses through a pipe network with a specified flow rate. Minor losses are accounted for including both pipe bend losses and structure losses
The spreadsheet returns the upstream hydraulic grade line if surcharged, or the pipe obvert if free flow conditions exist. The HGL slope is calculated and the minimum USF is established +0.30m above the HGL.

Bend Coefficients

0	45	90	<---Bend (in degrees)
0.00	0.29	1.02	900 mm pipe or greater (benched)
0.00	0.40	1.32	825 mm pipe or smaller (sump)

MANHOLE U/S	MANHOLE D/S	INVERT ELEV. U/S (m)	INVERT ELEV. D/S (m)	OBVERT ELEV. U/S (m)	OBVERT ELEV. D/S (m)	GROUND ELEV. U/S (m)	COVER U/S (m)	PIPE PARAMETERS Dia (N) (mm)	Dia (A) (m)	Length (m)	'n'	TOTAL FLOW (m^3/s)	Q_{cap} (m^3/s)	Q_a/Q_{cap}	COMPUTATIONAL COLUMNS Pipe Area (m^2)	L/D	Friction Factor (f)	Velocity V (m/s)	$V^2/2g$	HEAD LOSS HL (m)	SURCHARGE U/S (m)	HGL U/S (m)	HGL D/S (m)	HGL Slope (%)	PIPE Slope (%)
Hazeldean Pump Station																						95.00	<- 100yr Starting HGL		
974	HPS	90.88	90.74	91.70	91.57	99.50	7.80	825	838	66	0.013	0.528	0.677	0.78	0.552	79	0.02245	0.96	0.05	0.09	3.39	95.09	95.00	0.14%	0.20%
972	974	92.04	90.88	92.87	91.70	100.25	7.38	825	838	586	0.013	0.528	0.668	0.79	0.552	699	0.02245	0.96	0.05	0.82	3.04	95.91	95.09	0.14%	0.20%
970	972	92.54	92.27	93.14	92.87	99.65	6.51	600	610	178	0.013	0.133	0.249	0.53	0.292	292	0.02496	0.46	0.01	0.09	2.86	96.00	95.91	0.05%	0.15%
968	970	93.20	92.94	93.40	93.14	98.20	4.80	200	203	82	0.013	0.014	0.019	0.73	0.032	406	0.03600	0.43	0.01	0.15	2.75	96.15	96.00	0.18%	0.32%
968	970	92.98	92.61	93.51	93.14	98.35	4.84	525	533	249	0.013	0.122	0.173	0.70	0.223	466	0.02610	0.55	0.02	0.21	2.71	96.21	96.00	0.08%	0.15%
964	966	96.24	93.26	96.49	93.51	100.45	3.96	250	254	298	0.013	0.030	0.062	0.48	0.051	1171	0.03342	0.59	0.02	0.73	0.45	96.94	96.21	0.24%	1.00%
962	964	97.90	96.24	98.15	96.49	102.40	4.25	250	254	479	0.013	0.030	0.037	0.82	0.051	1884	0.03342	0.59	0.02	1.12	0.00	98.15	96.94	0.25%	0.35%
960	966	93.18	93.06	93.63	93.51	98.25	4.62	450	457	82	0.013	0.072	0.114	0.63	0.164	179	0.02747	0.44	0.01	0.05	2.63	96.26	96.21	0.06%	0.15%
958	960	93.45	93.18	93.90	93.63	97.95	4.05	450	457	177	0.013	0.060	0.116	0.51	0.164	387	0.02747	0.36	0.01	0.07	2.43	96.33	96.26	0.04%	0.15%
956	958	94.27	93.45	94.72	93.90	99.00	4.28	450	457	411	0.013	0.060	0.133	0.45	0.164	899	0.02747	0.36	0.01	0.18	1.79	96.51	96.33	0.04%	0.20%
954	956	94.83	94.34	95.21	94.72	98.15	2.95	375	381	330	0.013	0.035	0.070	0.50	0.114	866	0.02920	0.31	0.00	0.12	1.43	96.64	96.51	0.04%	0.15%
952	972	93.95	92.42	94.40	92.87	99.95	5.55	450	457	282	0.013	0.167	0.219	0.76	0.164	617	0.02747	1.02	0.05	0.98	2.48	96.88	95.91	0.35%	0.54%
950	952	94.28	93.95	94.73	94.40	100.30	5.57	450	457	221	0.013	0.097	0.115	0.85	0.164	483	0.02747	0.59	0.02	0.24	2.39	97.12	96.88	0.11%	0.15%
948	950	94.57	94.28	95.02	94.73	101.00	5.98	450	457	195	0.013	0.085	0.115	0.74	0.164	427	0.02747	0.52	0.01	0.17	2.27	97.29	97.12	0.09%	0.15%
946	948	95.86	94.64	96.24	95.02	100.60	4.36	375	381	243	0.013	0.085	0.130	0.66	0.114	638	0.02920	0.75	0.03	0.58	1.63	97.87	97.29	0.24%	0.50%
944	946	96.88	95.86	97.26	96.24	101.40	4.15	375	381	511	0.013	0.064	0.082	0.79	0.114	1340	0.02920	0.57	0.02	0.65	1.27	98.52	97.87	0.13%	0.20%
942	944	101.65	97.01	101.90	97.26	106.00	4.11	250	254	516	0.013	0.041	0.059	0.70	0.051	2033	0.03342	0.81	0.03	2.31	0.00	101.90	98.52	0.65%	0.90%
940	952	96.42	94.10	96.72	94.40	101.40	4.68	300	305	310	0.013	0.058	0.087	0.66	0.073	1017	0.03145	0.79	0.03	1.03	1.20	97.92	96.88	0.33%	0.75%
938	940	96.97	96.42	97.27	96.72	101.95	4.68	300	305	156	0.013	0.045	0.060	0.76	0.073	512	0.03145	0.62	0.02	0.36	1.00	98.27	97.92	0.23%	0.35%
938	938	98.10	97.02	98.35	97.27	102.20	3.85	250	254	108	0.013	0.019	0.062	0.30	0.051	425	0.03342	0.37	0.01	0.10	0.02	98.37	98.27	0.09%	1.00%
934	972	94.86	92.27	95.46	92.87	103.00	7.54	600	610	1007	0.013	0.283	0.325	0.87	0.292	1652	0.02496	0.97	0.05	2.05	2.50	97.96	95.91	0.20%	0.26%
932	934	95.39	94.93	95.92	95.46	103.80	7.88	525	533	455	0.013	0.098	0.143	0.68	0.223	853	0.02610	0.44	0.01	0.22	2.26	98.18	97.96	0.05%	0.10%
930	932	95.81	95.47	96.26	95.92	103.40	7.14	450	457	308	0.013	0.077	0.099	0.78	0.164	673	0.02747	0.47	0.01	0.21	2.13	98.39	98.18	0.07%	0.11%
928	930	99.91	96.06	100.11	96.26	103.20	3.09	200	203	55	0.013	0.031	0.091	0.34	0.032	271	0.03600	0.95	0.05	0.47	0.00	100.11	98.39	3.12%	7.00%
926	930	96.62	95.88	97.00	96.26	102.50	5.51	375	381	530	0.013	0.039	0.068	0.57	0.114	1391	0.02920	0.34	0.01	0.25	1.64	98.64	98.39	0.05%	0.14%
924	934	100.22	94.93	100.75	95.46	108.20	7.46	525	533	669	0.013	0.190	0.399	0.48	0.223	1254	0.02610	0.85	0.04	1.26	0.00	100.75	97.96	0.42%	0.79%
922	924	100.89	100.22	101.42	100.75	107.95	6.54	525	533	290	0.013	0.190	0.216	0.88	0.223	544	0.02810	0.85	0.04	0.53	0.00	101.42	100.75	0.23%	0.23%
920	922	101.37	100.89	101.90	101.42	107.60	5.70	525	533	265	0.013	0.169	0.191	0.89	0.223	497	0.02610	0.76	0.03	0.43	0.00	101.90	101.42	0.18%	0.18%
918	920	104.73	101.65	104.98	101.90	108.30	3.32	250	254	363	0.013	0.019	0.057	0.34	0.051	1430	0.03342	0.38	0.01	0.35	0.00	104.98	101.90	0.85%	0.85%
916	920	102.15	101.52	102.53	101.90	107.30	4.77	375	381	314	0.013	0.050	0.082	0.60	0.114	824	0.02920	0.43	0.01	0.24	0.00	102.53	101.90	0.20%	0.20%
914	916	102.61	102.23	102.91	102.53	107.25	4.34	300	305	152	0.013	0.032	0.050	0.63	0.073	498	0.03145	0.44	0.01	0.16	0.00	102.91	102.53	0.25%	0.25%
912	920	101.76	101.45	102.21	101.90	107.70	5.49	450	457	207	0.013	0.112	0.115	0.98	0.164	453	0.02747	0.68	0.02	0.35	0.04	102.25	101.90	0.17%	0.15%
910	912	102.73	101.96	102.98	102.21	107.10	4.12	250	254	320	0.013	0.021	0.030	0.69	0.051	1258	0.03342	0.41	0.01	0.37	0.00	102.98	102.25	0.23%	0.24%
908	912	104.32	101.91	104.62	102.21	111.70	7.08	300	305	396	0.013	0.076	0.079	0.97	0.073	1299	0.03145	1.04	0.06	2.35	0.00	104.62	102.25	0.60%	0.61%
906	908	109.97	104.37	110.22	104.62	113.65	3.43	250	254	373	0.013	0.017	0.076	0.23	0.051	1470	0.03342	0.34	0.01	0.30	0.00	110.22	104.62	1.50%	1.50%
904	908	105.05	104.32	105.35	104.62	110.20	4.85	300	305	306	0.013	0.048	0.049	0.97	0.073	1002	0.03145	0.66	0.02	0.70	0.00	105.35	104.62	0.24%	0.24%
902	904	105.47	105.10	105.72	105.35	109.60	3.88	250	254	154	0.013	0.020	0.030	0.66	0.051	605	0.03342	0.40	0.01	0.18	0.00	105.72	105.35	0.24%	0.24%

MANHOLE LOSS

MANHOLE U/S	MANHOLE D/S	Diameter (mm) U/S MH	Pipe In	Pipe Out	Bend Angle	K_o	C_D	K_B	K_{MH}	HL_{MH} (m)
974	HPS	1500	825	825	0	0.18	1.00	0.00	0.18	0.01
972	974	1500	600	825	90	0.18	2.60	1.32	1.79	0.08
970	972	1200	525	600	90	0.20	1.49	1.32	1.62	0.02
968	970	1200	200	200	0	0.60	1.00	0.00	0.60	0.01
968	970	1200	450	525	90	0.23	1.59	1.32	1.68	0.03
964	966	1200	250	250	90	0.48	1.00	1.32	1.80	0.03
962	964	1200	250	250	0	0.48	1.00	0.00	0.48	0.01
960	966	1200	450	450	0	0.27	1.00	0.00	0.27	0.00
958	960	1200	450	450	0	0.27	1.00	0.00	0.27	0.00
956	958	1200	375	450	90	0.27	1.73	1.32	1.78	0.01
954	956	1200	300	375	0	0.32	1.95	0.00	0.63	0.00
952	972	1200	450	450	90	0.27	1.00	1.32	1.59	0.08
950	952	1200	450	450	0	0.27	1.00	0.00	0.27	0.00
948	950	1200	375	450	0	0.27	1.73	0.00	0.46	0.01
946	948	1200	375	375	90	0.32	1.00	1.32	1.64	0.05
944	946	1200	250	375	0	0.32	3.38	0.00	1.08	0.02
942	944	1200	250	250	0	0.48	1.00	0.00	0.48	0.02
940	952	1200	300	300	0	0.40	1.00	0.00	0.40	0.01
938	940	1200	250	300	90	0.40	1.73	1.32	2.01	0.04
938	938	1200	250	250	0	0.48	1.00	0.00	0.48	0.00
934	972	1200	525	600	90	0.20	1.49	1.32	1.62	0.08
932	934	1200	450	525	0	0.23	1.59	0.00	0.36	0.00
930	932	1200	375	450	0	0.27	1.73	0.00	0.46	0.01
928	930	1200	200	200	0	0.60	1.00	0.00	0.60	0.03
926	930	1200	300	375	0	0.32	1.95	0.00	0.63	0.00
924	934	1200	525	525	90	0.23	1.00	1.32	1.55	0.06
922	924	1200	525	525	0	0.23	1.00	0.00	0.23	0.01
920	922	1200	450	525	90	0.23	1.59	1.32	1.68	0.05
918	920	1200	250	250	0	0.48	1.00	0.00	0.48	0.00
916	920	1200	300	375	0	0.32	1.95	0.00	0.63	0.01
914	916	1200	300	300	0	0.40	1.00	0.00	0.40	0.00
912	920	1200	300	450	90	0.27	3.38	1.32	2.22	0.05
910	912	1200	250	250	0	0.48	1.00	0.00	0.48	0.00
908	912	1200	300	300	90	0.40	1.00	1.32	1.72	0.10
906	908	1200	250	250	90	0.48	1.00	1.32	1.80	0.01
904	908	1200	250	300	0	0.40	1.73	0.00	0.69	0.02
902	904	1200	250	250	90	0.48	1.00	1.32	1.80	0.01

Average Daily Flow=	350 L/cap/day	Industrial Peak Factor= per MOE graph		HGL=Major + Minor Losses	Designed: KJM	PROJECT: Fernbank CDP
Comm/Inst Flow=	50000 L/ha/day	Extraneous Flow=	0.28	Major Loss= Pipe Friction (Darcy-Weisbach)		
Industrial Flow=	35000 L/ha/day	Minimum Velocity=	0.60	Minor Loss= Head loss correction for flow through MH, changes in pipe size, and pipe bends	Checked: MAB	CLIENT:
Max Res Peak Factor=	4.00	Manning's n=	0.013	Friction Factor= 8g/c^2, where c=(1/n)*(D/4)^1/6		
Comm Peak Factor=	1.50					
Indst Peak Factor=	1.50				Dwg. Reference: 101106-SAN	Date: May 8, 2009

M:\2003\103106\Data\Calculations\20090113 Preferred Internal SAN Design Sheets.xls

SANITARY HYDRAULIC GRADE LINE DESIGN SHEET
CRT LANDS - FERNBANK SANITARY TRUNK SEWER
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DESIGN: WY

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	HPS	FT01	
INVERT ELEVATION (m)	90.340	90.450	
OBVERT ELEVATION (m)	91.559	91.669	
DIAMETER (mm)			1219.2
LENGTH (m)			55.71
FLOW (l/s)			725.0
HGL (m) ***	95.371	95.389	0.018
MANHOLE COEF K= 0.05	LOSS (m)	0.0010	
TOTAL HGL (m)		95.390	
MAX. SURCHARGE (mm)		3721	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.200	0.305	1.55	1806.41

HYDRAULIC SLOPE = 0.03 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow $K_L = 0.05$
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT01	FT02	
INVERT ELEVATION (m)	90.440	90.620	
OBVERT ELEVATION (m)	91.659	91.839	
DIAMETER (mm)			1219.2
LENGTH (m)			107.50
FLOW (l/s)			725.0
HGL (m) ***	95.390	95.424	0.034
MANHOLE COEF K= 0.05	LOSS (m)	0.0010	
TOTAL HGL (m)		95.425	
MAX. SURCHARGE (mm)		3586	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.170	0.305	1.43	1663.48

HYDRAULIC SLOPE = 0.03 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow $K_L = 0.05$
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT02	FT03	
INVERT ELEVATION (m)	90.840	90.910	
OBVERT ELEVATION (m)	91.859	92.129	
DIAMETER (mm)			1219.2
LENGTH (m)			107.5
FLOW (l/s)			725.0
HGL (m) ***	95.425	95.459	0.034
MANHOLE COEF K= 0.05	LOSS (m)	0.001	
TOTAL HGL (m)		95.460	
MAX. SURCHARGE (mm)		3331	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.250	0.305	1.75	2037.34

HYDRAULIC SLOPE = 0.03 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow $K_L = 0.05$
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT03	FT04	
INVERT ELEVATION (m)	90.920	91.100	
OBVERT ELEVATION (m)	92.139	92.319	
DIAMETER (mm)			1219.2
LENGTH (m)			95.00
FLOW (l/s)			725.0
HGL (m) ***	95.460	95.490	0.030
MANHOLE COEF K= 0.05	LOSS (m)	0.001	
TOTAL HGL (m)		95.491	
MAX. SURCHARGE (mm)		3172	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.190	0.30	1.52	1769.541032

HYDRAULIC SLOPE = 0 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow $K_L = 0.05$
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2/ 2g$

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FRICTION LOSS		FROM MH	TO MH	PIPE ID
FERNBANK ROAD		FT04	FT05	
INVERT ELEVATION (m)		91.110	91.250	
OBVERT ELEVATION (m)		92.329	92.469	
DIAMETER (mm)				1219.2
LENGTH (m)				89.00
FLOW (l/s)				725.0
HGL (m)	***	95.491	95.520	0.028
MANHOLE COEF K=	0.40	LOSS (m)	0.008	
TOTAL HGL (m)			95.527	
MAX. SURCHARGE (mm)			3058	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.160	0.30	1.38	1612.334705
HYDRAULIC SLOPE =		0.04 %				

Head loss in manhole simplified method p. 71 (MWDM)
45 degree bend K_L=0.40
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS		FROM MH	TO MH	PIPE ID
FERNBANK ROAD		FT05	FT06	
INVERT ELEVATION (m)		91.320	91.370	
OBVERT ELEVATION (m)		92.539	92.589	
DIAMETER (mm)				1219.2
LENGTH (m)				24.60
FLOW (l/s)				725.0
HGL (m)	***	95.527	95.535	0.008
MANHOLE COEF K=	0.40	LOSS (m)	0.008	
TOTAL HGL (m)			95.543	
MAX. SURCHARGE (mm)			2954	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
1.2192	1.17	3.83	0.200	0.30	1.57	1832.751722
HYDRAULIC SLOPE =		0.06 %				

Head loss in manhole simplified method p. 71 (MWDM)
45 degree bend K_L=0.40
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS		FROM MH	TO MH	PIPE ID
FERNBANK ROAD		FT06	FT07	
INVERT ELEVATION (m)		91.400	91.510	
OBVERT ELEVATION (m)		92.619	92.729	
DIAMETER (mm)				1219.2
LENGTH (m)				83.50
FLOW (l/s)				725.0
HGL (m)	***	95.543	95.570	0.027
MANHOLE COEF K=	0.05	LOSS (m)	0.001	
TOTAL HGL (m)			95.571	
MAX. SURCHARGE (mm)			2841	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
1.2192	1.17	3.83	0.130	0.30	1.26	1475.500267
HYDRAULIC SLOPE =		0.03 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow K_L=0.05
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS		FROM MH	TO MH	PIPE ID
FERNBANK ROAD		FT07	FT08	
INVERT ELEVATION (m)		91.520	91.690	
OBVERT ELEVATION (m)		92.739	92.909	
DIAMETER (mm)				1219.2
LENGTH (m)				77.50
FLOW (l/s)				725.0
HGL (m)	***	95.571	95.595	0.025
MANHOLE COEF K=	0.05	LOSS (m)	0.001	
TOTAL HGL (m)			95.596	
MAX. SURCHARGE (mm)			2687	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel (m/s)	Q (l/s)
1.2192	1.17	3.83	0.220	0.30	1.63	1903.968667
HYDRAULIC SLOPE =		0.03 %				

Head loss in manhole simplified method p. 71 (MWDM)
Straight through K_L= 0.05
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2 / 2g$

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FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT08	FT09	
INVERT ELEVATION (m)	92.120	92.350	
OBVERT ELEVATION (m)	92.882	93.112	
DIAMETER (mm)			762
LENGTH (m)			40.90
FLOW (l/s)			479.8
HGL (m) ***	95.596	95.666	0.070
MANHOLE COEF K= 1.32	LOSS (m)	0.075	
TOTAL HGL (m)		95.741	
MAX. SURCHARGE (mm)		2629	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.560	0.19	1.91	870.4994435

HYDRAULIC SLOPE = 0.35 %

Head loss in manhole simplified method p. 71 (MWDM)
45 degree bend K_b = 0.40
from figure 1.7.2, Qu =480, Qo =725; Qu/Qo = 0.660 K_L = 0.92
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT09	FT10	
INVERT ELEVATION (m)	92.400	92.780	
OBVERT ELEVATION (m)	93.162	93.542	
DIAMETER (mm)			762
LENGTH (m)			84.06
FLOW (l/s)			479.8
HGL (m) ***	95.741	95.884	0.144
MANHOLE COEF K= 0.40	LOSS (m)	0.023	
TOTAL HGL (m)		95.907	
MAX. SURCHARGE (mm)		2365	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.450	0.19	1.71	780.48

HYDRAULIC SLOPE = 0.20 %

Head loss in manhole simplified method p. 71 (MWDM)
45 degree bend K_L=0.40
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT10	FT11	
INVERT ELEVATION (m)	92.780	92.960	
OBVERT ELEVATION (m)	93.542	93.722	
DIAMETER (mm)			762
LENGTH (m)			100.79
FLOW (l/s)			479.8
HGL (m) ***	95.907	96.079	0.172
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.082	
MAX. SURCHARGE (mm)		2360	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.180	0.19	1.08	490.56

HYDRAULIC SLOPE = 0.17 %

Head loss in manhole simplified method p. 71 (MWDM)
Straight through K_L=0.05
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT11	FT12	
INVERT ELEVATION (m)	92.960	93.160	
OBVERT ELEVATION (m)	93.722	93.922	
DIAMETER (mm)			762
LENGTH (m)			108.60
FLOW (l/s)			479.8
HGL (m) ***	96.082	96.267	0.186
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.270	
MAX. SURCHARGE (mm)		2348	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.180	0.19	1.09	498.18

HYDRAULIC SLOPE = 0.17 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through K_L=0.05
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/2g$

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FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT12	FT13	
INVERT ELEVATION (m)	93.170	93.450	
OBVERT ELEVATION (m)	93.932	94.212	
DIAMETER (mm)			762
LENGTH (m)			129.2
FLOW (l/s)			479.8
HGL (m) ***	96.270	96.491	0.221
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.494	
MAX. SURCHARGE (mm)		2282	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.220	0.19	1.19	540.40
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT13	FT14	
INVERT ELEVATION (m)	93.460	93.660	
OBVERT ELEVATION (m)	94.222	94.422	
DIAMETER (mm)			762
LENGTH (m)			115.27
FLOW (l/s)			479.8
HGL (m) ***	96.494	96.691	0.197
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.694	
MAX. SURCHARGE (mm)		2272	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.170	0.19	1.06	483.53
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT14	FT15	
INVERT ELEVATION (m)	93.670	93.880	
OBVERT ELEVATION (m)	94.432	94.642	
DIAMETER (mm)			762
LENGTH (m)			118.1
FLOW (l/s)			479.8
HGL (m) ***	96.694	96.896	0.202
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.898	
MAX. SURCHARGE (mm)		2256	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.762	0.46	2.39	0.180	0.19	1.07	489.50
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT15	FT16	
INVERT ELEVATION (m)	93.890	94.170	
OBVERT ELEVATION (m)	94.652	94.932	
DIAMETER (mm)			762
LENGTH (m)			110.6
FLOW (l/s)			479.8
HGL (m) ***	98.898	97.087	0.189
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		97.090	
MAX. SURCHARGE (mm)		2158	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.250	0.19	1.28	584.07
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2 / 2g$

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FRICTION LOSS		FROM MH	TO MH	PIPE ID
FERNBANK ROAD		FT16	FT17	
INVERT ELEVATION (m)		94.190	94.480	
OBVERT ELEVATION (m)		94.952	95.242	
DIAMETER (mm)				762
LENGTH (m)				126.4
FLOW (l/s)				479.8
HGL (m) ***		97.090	97.306	0.216
MANHOLE COEF K=	0.05	LOSS (m)	0.003	
TOTAL HGL (m)			97.309	
MAX. SURCHARGE (mm)			2067	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.762	0.48	2.39	0.230	0.19	1.22	556.02

HYDRAULIC SLOPE = 0.17 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS		FROM MH	TO MH	PIPE ID
FERNBANK ROAD		FT17	FT18	
INVERT ELEVATION (m)		94.510	94.690	
OBVERT ELEVATION (m)		95.272	95.452	
DIAMETER (mm)				762
LENGTH (m)				88.5
FLOW (l/s)				479.8
HGL (m) ***		97.309	97.460	0.151
MANHOLE COEF K=	0.63	LOSS (m)	0.036	
TOTAL HGL (m)			97.495	
MAX. SURCHARGE (mm)			2043	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.762	0.48	2.39	0.200	0.19	1.15	523.52

HYDRAULIC SLOPE = 0.21 %

Head loss in manhole simplified method p. 71 (MWDM)
from figure 1.7.2, Qu =387, Qo =480; Qu/Qo = 0.80 $K_L = 0.63$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2 / 2g$

BRANCH FROM MH FT18 TO MH 221

FRICTION LOSS		FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE		FT18	MH 221	
INVERT ELEVATION (m)		98.294	98.610	
OBVERT ELEVATION (m)		98.548	98.864	
DIAMETER (mm)				254
LENGTH (m)				90.3
FLOW (l/s)				11.6
HGL (m) ***		98.548	98.579	0.031
MANHOLE COEF K=	1.50	LOSS (m)	0.004	
TOTAL HGL (m)			98.583	
MAX. SURCHARGE (mm)			-281	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.254	0.05	0.80	0.350	0.06	0.72	36.68

HYDRAULIC SLOPE = 0.04 %

Head loss in manhole simplified method p. 71 (MWDM)
outlet at right angles to inlet $K_L = 1.5$
Velocity = Flow / Area = 0.23 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS		FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE		MH 221	MH 211	
INVERT ELEVATION (m)		98.771	99.000	
OBVERT ELEVATION (m)		99.025	99.254	
DIAMETER (mm)				254
LENGTH (m)				32.8
FLOW (l/s)				11.6
HGL (m) ***		99.025	99.036	0.011
MANHOLE COEF K=	1.50	LOSS (m)	0.004	
TOTAL HGL (m)			99.040	
MAX. SURCHARGE (mm)			-214	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.254	0.05	0.80	0.700	0.06	1.02	51.83

HYDRAULIC SLOPE = 0.05 %

Head loss in manhole simplified method p. 71 (MWDM)
outlet at right angles to inlet $K_L = 1.5$
Velocity = Flow / Area = 0.23 m/s
$HL = K_L * V^2 / 2g$

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CITY OF OTTAWA
CLARIDGE HOMES

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DATE: February 09 2017
DESIGN: WY

FRICTION LOSS	FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE	MH 211	MH 209	
INVERT ELEVATION (m)	99.010	99.368	
OBVERT ELEVATION (m)	99.264	99.642	
DIAMETER (mm)			254
LENGTH (m)			54.0
FLOW (l/s)			11.6
HGL (m) ***	99.040	99.059	0.019
MANHOLE COEF K= 0.05	LOSS (m)	0.000	
TOTAL HGL (m)		99.060	
MAX. SURCHARGE (mm)		-582	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.254	0.05	0.80	0.700	0.06	1.02	51.86
HYDRAULIC SLOPE =		0.04 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through — $K_L = 0.05$
Velocity = Flow / Area = 0.23 m/s
HL = K_L * V^2/ 2g

FRICTION LOSS	FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE	MH 209	MH 161A	
INVERT ELEVATION (m)	100.315	100.690	
OBVERT ELEVATION (m)	100.518	100.893	
DIAMETER (mm)			203.2
LENGTH (m)			53.6
FLOW (l/s)			8.3
HGL (m) ***	100.518	100.550	0.032
MANHOLE COEF K= 0.83	LOSS (m)	0.003	
TOTAL HGL (m)		100.552	
MAX. SURCHARGE (mm)		-341	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.2032	0.03	0.64	0.700	0.05	0.88	28.61
HYDRAULIC SLOPE =		0.06 %				

Head loss in manhole simplified method p. 71 (MWDM)
from figure 1.7.2, Qu =8.3, Qo =11.6; Qu/Qo = 0.72 — $K_L = 0.83$
Velocity = Flow / Area = 0.26 m/s
HL = K_L * V^2/ 2g

FRICTION LOSS	FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE	MH 161A	MH 146A	
INVERT ELEVATION (m)	100.741	101.014	
OBVERT ELEVATION (m)	100.944	101.217	
DIAMETER (mm)			203.2
LENGTH (m)			39.0
FLOW (l/s)			6.8
HGL (m) ***	100.944	100.959	0.015
MANHOLE COEF K= 1.62	LOSS (m)	0.004	
TOTAL HGL (m)		100.963	
MAX. SURCHARGE (mm)		-254	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.2032	0.03	0.64	0.700	0.05	0.88	28.62
HYDRAULIC SLOPE =		0.05 %				

Head loss in manhole simplified method p. 71 (MWDM)
from figure 1.7.2, Qu =6.8, Qo =8.3; Qu/Qo = 0.82 — $K_L = 0.62$
outlet at 77 degree bend to inlet — Kb = 1.00
Velocity = Flow / Area = 0.21 m/s
HL = K_L * V^2/ 2g

BRANCH FROM MH FT18 TO FT19

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT18	FT19	
INVERT ELEVATION (m)	94.800	95.930	
OBVERT ELEVATION (m)	95.410	96.540	
DIAMETER (mm)			609.6
LENGTH (m)			124.5
FLOW (l/s)			387.0
HGL (m) ***	97.495	97.950	0.455
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		97.955	
MAX. SURCHARGE (mm)		1415	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.910	0.15	2.09	609.95
HYDRAULIC SLOPE =		0.37 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through — $K_L = 0.05$
Velocity = Flow / Area = 1.33 m/s
HL = K_L * V^2/ 2g

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FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT19	FT20	
INVERT ELEVATION (m)	95.950	96.420	
OBVERT ELEVATION (m)	96.560	97.030	
DIAMETER (mm)			609.6
LENGTH (m)			103.8
FLOW (l/s)			387.0
HGL (m) ***	97.955	98.333	0.379
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		98.338	
MAX. SURCHARGE (mm)		1308	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.6096	0.29	1.91	0.450	0.15	1.48	431.23

HYDRAULIC SLOPE = 0.37 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT20	FT21	
INVERT ELEVATION (m)	96.460	96.940	
OBVERT ELEVATION (m)	97.070	97.550	
DIAMETER (mm)			609.6
LENGTH (m)			106.34
FLOW (l/s)			387.0
HGL (m) ***	98.338	98.726	0.389
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		98.731	
MAX. SURCHARGE (mm)		1181	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.6096	0.29	1.91	0.450	0.15	1.47	430.14

HYDRAULIC SLOPE = 0.37 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT21	FT22	
INVERT ELEVATION (m)	96.960	97.350	
OBVERT ELEVATION (m)	97.570	97.960	
DIAMETER (mm)			609.6
LENGTH (m)			108.6
FLOW (l/s)			387.0
HGL (m) ***	98.731	99.128	0.397
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		99.132	
MAX. SURCHARGE (mm)		1173	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.360	0.15	1.32	363.67

HYDRAULIC SLOPE = 0.37 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT22	FT23	
INVERT ELEVATION (m)	97.370	97.780	
OBVERT ELEVATION (m)	97.980	98.390	
DIAMETER (mm)			609.6
LENGTH (m)			106.2
FLOW (l/s)			387.0
HGL (m) ***	99.132	99.520	0.388
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		99.525	
MAX. SURCHARGE (mm)		1135	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim (m)	Slope (%)	Hyd R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.390	0.15	1.36	397.80

HYDRAULIC SLOPE = 0.37 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2 / 2g$

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FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT23	FT24	
INVERT ELEVATION (m)	97.790	98.160	
OBVERT ELEVATION (m)	98.400	98.770	
DIAMETER (mm)			609.6
LENGTH (m)			108.9
FLOW (l/s)			387.0
HGL (m) ***	99.525	99.923	0.398
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		99.927	
MAX. SURCHARGE (mm)		1157	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.340	0.15	1.28	373.19
HYDRAULIC SLOPE =		0.37 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2/2g$

BRANCH FROM MH FT24 TO MH 102A

FRICTION LOSS	FROM MH	TO MH	PIPE ID
GOLDHAWK DRIVE	FT24	MH 102A	
INVERT ELEVATION (m)	98.180	98.842	
OBVERT ELEVATION (m)	98.790	99.452	
DIAMETER (mm)			609.6
LENGTH (m)			102.59
FLOW (l/s)			387.0
HGL (m) ***	99.927	100.302	0.375
MANHOLE COEF K= 1.50	LOSS (m)	0.135	
TOTAL HGL (m)		100.436	
MAX. SURCHARGE (mm)		985	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.645	0.15	1.76	514.30
HYDRAULIC SLOPE =		0.50 %				

Head loss in manhole simplified method p. 71 (MWDM)
outlet at right angles to inlet $K_L = 1.5$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
GOLDHAWK DRIVE	MH 102A	MH 103A	
INVERT ELEVATION (m)	98.872	99.030	
OBVERT ELEVATION (m)	99.482	99.640	
DIAMETER (mm)			609.6
LENGTH (m)			45.00
FLOW (l/s)			385.0
HGL (m) ***	100.438	100.599	0.163
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		100.604	
MAX. SURCHARGE (mm)		964	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.351	0.15	1.30	379.37
HYDRAULIC SLOPE =		0.37 %				

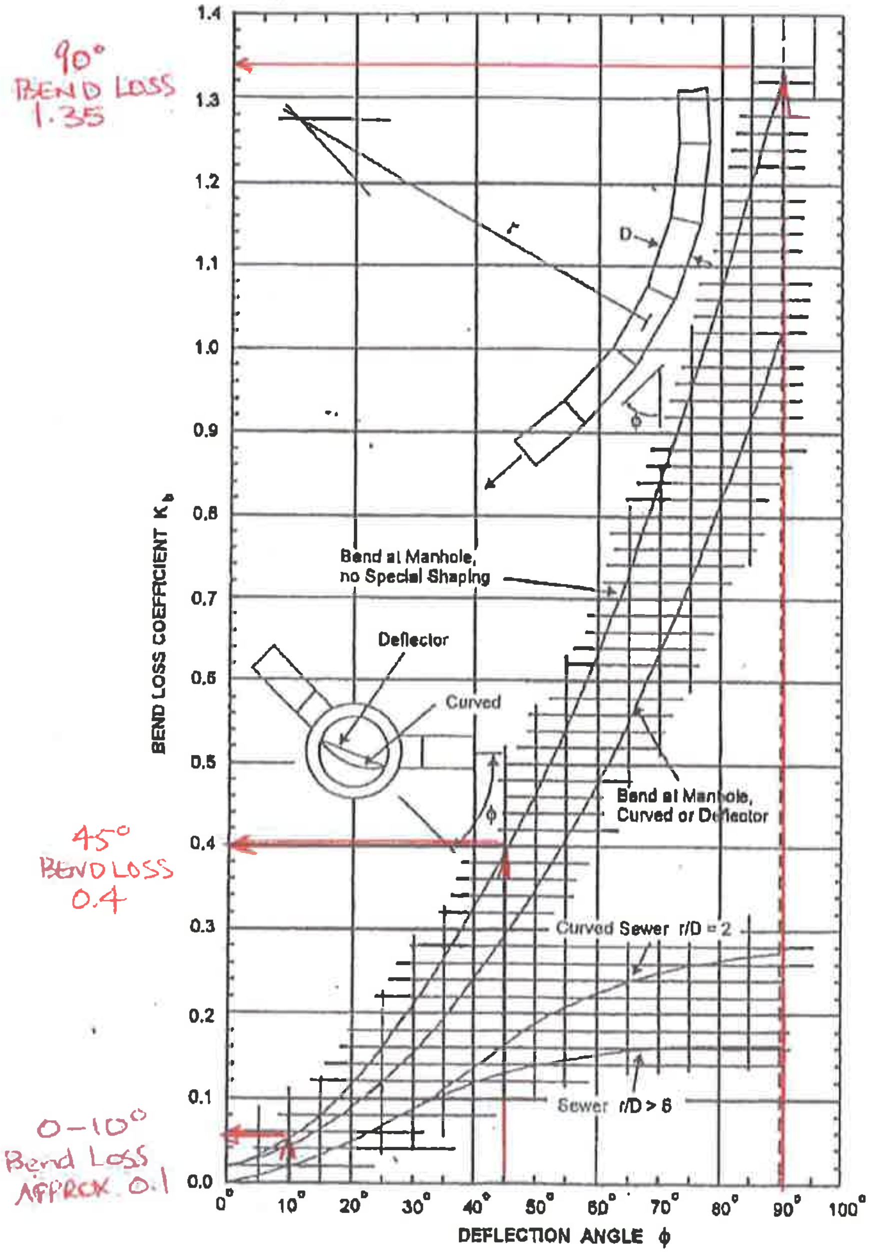
Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.32 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
GOLDHAWK DRIVE	MH 103A	MH 104A	
INVERT ELEVATION (m)	99.060	99.230	
OBVERT ELEVATION (m)	99.670	99.840	
DIAMETER (mm)			609.6
LENGTH (m)			48.77
FLOW (l/s)			385.0
HGL (m) ***	100.604	100.780	0.178
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		100.784	
MAX. SURCHARGE (mm)		945	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.349	0.15	1.30	377.99
HYDRAULIC SLOPE =		0.37 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.32 m/s
$HL = K_L * V^2/2g$

Design Chart : Sewer Bend Loss Coefficients

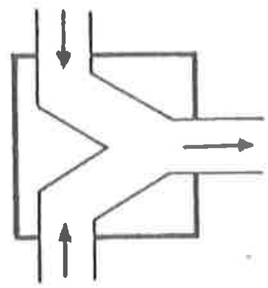


Source: American Iron and Steel Institute (1980)

1.7.3.2 <u>Junctions</u>

Tee - outlet at right angles to inlets and no deflector between inlets $K_L = 1.5$

- deflector between inlets for full height and width of incoming flows $K_L = 1.0$



Side and Cross Junctions - value of K_L is obtained from the following graph:

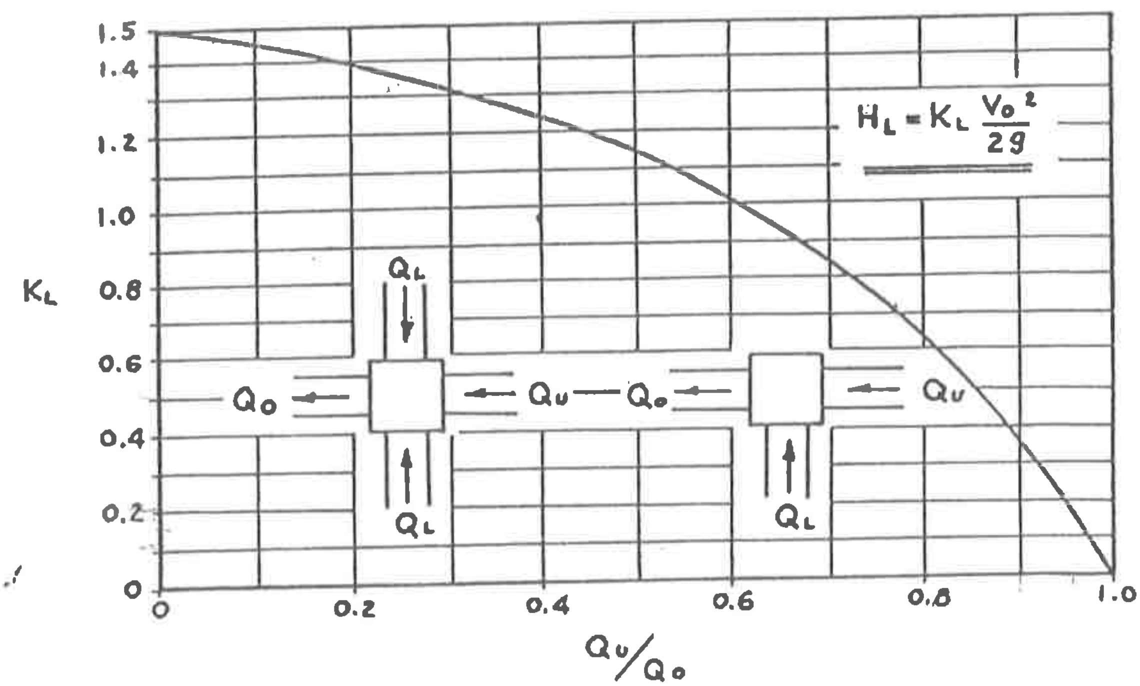
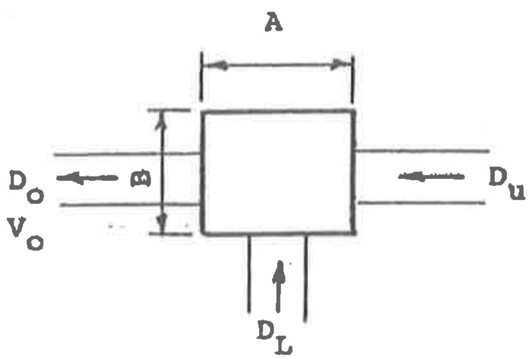


FIGURE 1.7.2.

1.7.4 Accurate Method of Head Loss Calculations

In this method, the head loss is calculated for each incoming sewer and is allowed for in the individual sewers as outlined in Section 1.7.2.2.

1.7.4.1 Manhole Abbreviations



1.7.4.2 Upstream In-line Sewer Head Loss

$$H_L = K_u \frac{V_o^2}{2g}$$

$$= \bar{K}_u \times \frac{K_u}{\bar{K}_u} \times \frac{V_o^2}{2\,g}$$

$\bar{K}_u$ is obtained from Figure 1.7.3

$\frac{K_u}{\bar{K}_u}$ is obtained from Figure 1.7.4

$\frac{V_o^2}{2\,g}$ is obtained from Figure 1.7.5

1.7.4.3 Upstream Lateral Sewer Head Loss

$$H_L = K_L \frac{V_o^2}{2\,g}$$

$$= \bar{K}_L \left[1 - \left(\frac{Qu}{Qo} \cdot \frac{Do}{Du} \right)^{\frac{2\,Do}{D_L}} \right] \frac{V_o^2}{2\,g}$$

1.7 HEAD LOSSES IN MANHOLES, CURVED SEWERS AND JUNCTION CHAMBERS

1.7.1 General

Where a manhole is placed on a sewer line, where two or more sewers meet in a manhole, where sewers meet in a specially designed junction chamber or where a sewer is placed on a curve there is a loss of energy greater than that of a straight length of sewer. These losses can be negligible as in the cases of small diameter sanitary sewers flowing partially full at minimum velocities or substantial as in the case of large diameter storm sewers turning 90° in a manhole at a high velocity.

The designer's responsibility is to ensure that he provides additional head energy in the sewer design to allow for the losses to be incurred. In cases where the head available is limited, he will have to adjust the design to provide for a system which is hydraulically smoother. This will require less head to be provided to overcome the energy losses.

The most complete study of this subject which has been undertaken to date has been done by Sangster, Wood, Smerdon and Bossy at the University of Missouri and published in their Bulletin No. 41 entitled "Pressure Changes at Storm Drain Junctions" and in the A.S.C.E. Journal of the Hydraulics Division entitled "Pressure Changes at Open Junctions in Conduits" - HY6 - #2057.

To facilitate the rapid determination of head losses in manholes, a number of typical manhole bends and junctions were studied. From this, a "simplified method" was established. This method has been found to be quite adequate for the vast majority of manholes and is outlined in Section 1.7.3.

An "accurate method" is also outlined in Section 1.7.4. This method is taken directly from the study with the addition of curves which aid in the solution of the formulas.

The head losses in radius pipe and in junction chambers are also described in Sections 1.7.5 and 1.7.6. For this purpose, a junction chamber is considered to be a manhole where two or more sewers enter the manhole with one or more entering at an angle other than 90° or 180° to the outlet sewer.

1.7.2 Addition of Energy to the System

1.7.2.1 Change in Pipe Size

In addition of energy to systems, the first point to keep in mind is that no energy is added when the crown of the inlet and outlet sewers are at the same elevation. Therefore, at changes in sewer size, the crown(s) of the incoming sewer(s) are to be at the same elevation where no energy is added or higher than the crown of the outgoing sewer where energy is to be added.

1.7.2.2 Addition of Energy

Energy is added to a system in two ways:

- Small Losses - where the head loss is 0.15m or less, the crown of the outlet pipe is dropped below the lowest incoming crown by the amount of the head loss.
- Larger Losses - where the head loss is greater than 0.15m, the crown of the outlet pipe is dropped below the lowest incoming crown by the amount of the head loss, and the upstream incoming crowns are dropped to the same elevation as the outlet crown. Sewers entering the manhole at 90° to the outlet need not be lowered.

The upstream sewers will be on a grade equal to the grade required to overcome the friction in the sewer plus the grade required to overcome the head loss in the downstream manhole.

1.7.3 Simplified Method of Head Loss Calculation

The head loss coefficient (K_L) for the particular bend or junction in the manhole is multiplied by the velocity head of the outlet sewer.

$$H_L = K_L \frac{Vo^2}{2g}$$

Head loss coeficients (K_L) to be used are:

900mm > Benched
< 900mm not Benched
If 1 pipe @ junction is > 900mm, then benched

1.7.3.1 Bends

90° - No benching or deflector, or where they are only up to the springline	$K_L = 1.5$
90° - Benching or deflector to crown of sewers	$K_L = 1.0$

Less than 90° - Multiply the head loss coefficient for a 90° bend by a head loss ratio factor from the following curve:

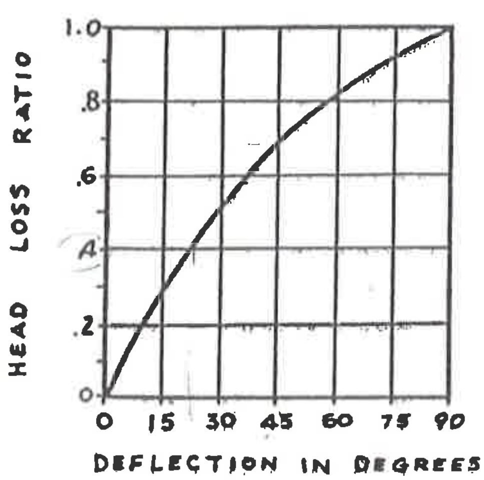


Figure 1.7.1.

IBI GROUP

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK	PEAK	AREA (Ha)						PEAK	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY	AVAILABLE	
											FACTOR	FLOW	INSTITUTIONAL		COMMERCIAL		INDUSTRIAL		FLOW									(full)	CAPACITY	
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM		(L/s)	IND	CUM	IND	CUM	IND	CUM	(L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(m/s)	L/s	(%)
PUTNEY CRESCENT	141A	141A	142A			1		0.06	2.5	2.5	4.00	0.04		0.00		0.00		0.00	0.00	0.06	0.06	0.02	0.06	24.19	9.07	200	0.50	0.746	24.14	99.76
PUTNEY CRESCENT	142A	142A	143A			11		0.35	27.5	30.0	4.00	0.49		0.00		0.00		0.00	0.00	0.35	0.41	0.11	0.60	47.16	55.56	200	1.90	1.454	46.56	98.73
PUTNEY CRESCENT	143A	143A	144A			17		0.49	42.5	72.5	4.00	1.17		0.00		0.00		0.00	0.00	0.49	0.90	0.25	1.43	41.91	64.86	200	1.50	1.292	40.48	96.60
FINSBURY AVENUE	136AA	136A	144A			21		0.65	52.5	52.5	4.00	0.85		0.00		0.00		0.00	0.00	0.65	0.65	0.18	1.03	53.56	110.44	200	2.45	1.652	52.52	98.07
PUTNEY CRESCENT	144A	144A	145A			10		0.36	25.0	150.0	4.00	2.43		0.00		0.00		0.00	0.00	0.36	1.91	0.53	2.97	32.46	80.25	200	0.90	1.001	29.50	90.86
CLAPHAM TERRACE	136AB	136A	137A			10		0.37	25.0	25.0	4.00	0.41		0.00		0.00		0.00	0.00	0.37	0.37	0.10	0.51	24.19	78.00	200	0.50	0.746	23.69	97.90
BRIXTON WAY	137AA	137A	160A			12		0.35	30.0	55.0	4.00	0.89		0.00		0.00		0.00	0.00	0.35	0.72	0.20	1.09	41.91	50.77	200	1.50	1.292	40.81	97.39
BRIXTON WAY	160A	160A	145A			18		0.54	45.0	100.0	4.00	1.62		0.00		0.00		0.00	0.00	0.54	1.26	0.35	1.97	52.45	78.53	200	2.35	1.617	50.48	96.24
PUTNEY CRESCENT	145A	145A	146A			11		0.34	27.5	277.5	4.00	4.50		0.00		0.00		0.00	0.00	0.34	3.51	0.98	5.48	39.76	70.87	200	1.35	1.226	34.28	86.22
CLAPHAM WAY	137AB	137A	138A			9		0.38	22.5	22.5	4.00	0.36		0.00		0.00		0.00	0.00	0.38	0.38	0.11	0.47	37.48	78.00	200	1.20	1.156	37.01	98.74
PUTNEY CRESCENT	138A	138A	148A			10		0.35	25.0	47.5	4.00	0.77		0.00		0.00		0.00	0.00	0.35	0.73	0.20	0.97	40.49	77.95	200	1.40	1.248	39.51	97.59
PUTNEY CRESCENT	148A	148A	147A			7		0.26	17.5	65.0	4.00	1.05		0.00		0.00		0.00	0.00	0.26	0.99	0.28	1.33	55.70	59.50	200	2.65	1.718	54.37	97.61
PUTNEY CRESCENT	147A	147A	146A			0		0.03	0.0	65.0	4.00	1.05		0.00		0.00		0.00	0.00	0.03	1.02	0.29	1.34	55.70	12.47	200	2.65	1.718	54.36	97.60
BLOCK 323	146A	146A	161A			0		0.03	0.0	342.5	4.00	5.55		0.00		0.00		0.00	0.00	0.03	4.56	1.28	6.83	28.63	38.97	200	0.70	0.883	21.80	76.15
BLOCK 316	HYD. 2	161A	*Ex.209*			0		5.12	0.0	342.5	4.00	5.55		0.00		0.00		0.00	0.00	5.12	9.68	2.71	8.26	28.63	53.67	200	0.70	0.883	20.37	71.15
BLOCK 324	RES.1	BULKHEAD	*Ex.209*					1.89	170.1	170.1	4.00	2.76		0.00		0.00		0.00	0.00	1.89	1.89	0.53	3.29	43.87	8.00	250	0.50	0.866	40.58	92.51

Refer to ECA No. 9079-9LNNZC dated July 9, 2014 for description of existing sewers.

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
   Harmon Formula = 1+(14/(4+P^0.5))
   where P = population in thousands

Designed: J.I.M.

Checked: P.K.

Dwg. Reference: 27970 - 501, 501A, 501B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	1 of 4

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK	PEAK	AREA (Ha)						PEAK	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY	AVAILABLE CAPACITY	
													INSTITUTIONAL		COMMERCIAL		INDUSTRIAL													
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM	FACTOR	FLOW (L/s)	IND	CUM	IND	CUM	IND	CUM	FLOW (L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(full) (m/s)	L/s	(%)
CLAPHAM TERRACE	136AC	136A	135A			11		0.41	27.5	27.5	4.00	0.45		0.00		0.00		0.00	0.00	0.41	0.41	0.11	0.56	27.59	65.31	200	0.65	0.851	27.03	97.97
CLAPHAM TERRACE	135A	135A	134A			9		0.31	22.5	50.0	4.00	0.81		0.00		0.00		0.00	0.00	0.31	0.72	0.20	1.01	27.59	57.36	200	0.65	0.851	26.57	96.33
PUTNEY CRESCENT	141A	141A	134A			9		0.34	22.5	22.5	4.00	0.36		0.00		0.00		0.00	0.00	0.34	0.34	0.10	0.46	32.46	75.02	200	0.90	1.001	32.00	98.58
PUTNEY CRESCENT	134A	134A	140A	6				0.34	19.8	92.3	4.00	1.50		0.00		0.00		0.00	0.00	0.34	1.40	0.39	1.89	32.46	78.00	200	0.90	1.001	30.57	94.18
OSTERLEY WAY	153A	153A	152A	8				0.51	26.4	26.4	4.00	0.43		0.00		0.00		0.00	0.00	0.51	0.51	0.14	0.57	29.63	49.25	200	0.75	0.914	29.06	98.07
OSTERLEY WAY	152A	152A	151A	17				0.78	56.1	82.5	4.00	1.34		0.00		0.00		0.00	0.00	0.78	1.29	0.36	1.70	29.63	95.75	200	0.75	0.914	27.93	94.27
OSTERLEY WAY	151A	151A	150A	10				0.47	33.0	115.5	4.00	1.87		0.00		0.00		0.00	0.00	0.47	1.76	0.49	2.36	29.63	59.68	200	0.75	0.914	27.27	92.02
OSTERLEY WAY	150A	150A	140A	9				0.42	29.7	145.2	4.00	2.35		0.00		0.00		0.00	0.00	0.42	2.18	0.61	2.96	29.63	62.98	200	0.75	0.914	26.67	90.00
PUTNEY CRESCENT	140A	140A	124A	3				0.24	9.9	247.4	4.00	4.01		0.00		0.00		0.00	0.00	0.24	3.82	1.07	5.08	32.46	78.00	200	0.90	1.001	27.38	84.36
BLOCK 343	RES.2	BLKHD	129A					1.21	108.9	108.9	4.00	1.76		0.00		0.00		0.00	0.00	1.21	1.21	0.34	2.10	20.24	19.00	200	0.35	0.624	18.14	89.61
BOBOLINK RIDGE	129A	129A	128A	0				0.09	0.0	108.9	4.00	1.76		0.00		0.00		0.00	0.00	0.09	1.30	0.36	2.13	31.02	45.00	250	0.25	0.612	28.89	93.14
BOBOLINK RIDGE	128AA	128A	127A	6				0.41	19.8	128.7	4.00	2.09		0.00		0.00		0.00	0.00	0.41	1.71	0.48	2.56	31.02	78.00	250	0.25	0.612	28.46	91.73
BOBOLINK RIDGE	127AA	127A	126A	10				0.53	33.0	161.7	4.00	2.62		0.00		0.00		0.00	0.00	0.53	2.24	0.63	3.25	31.02	78.00	250	0.25	0.612	27.77	89.53
BOBOLINK RIDGE	126A	126A	125A	5				0.33	16.5	178.2	4.00	2.89		0.00		0.00		0.00	0.00	0.33	2.57	0.72	3.61	31.02	47.81	250	0.25	0.612	27.41	88.37
BOBOLINK RIDGE	125A	125A	124A	12				0.56	39.6	217.8	4.00	3.53		0.00		0.00		0.00	0.00	0.56	3.13	0.88	4.41	31.02	74.85	250	0.25	0.612	26.61	85.80
BOBOLINK RIDGE	124A	124A	123A	11				0.61	36.3	501.5	3.97	8.07		0.00		0.00		0.00	0.00	0.61	7.56	2.12	10.19	31.02	88.85	250	0.25	0.612	20.83	67.15
DAGENHAM STREET	PARK1, 131A	131A	130A	7				1.70	23.1	23.1	4.00	0.37		0.00		0.00		0.00	0.00	1.70	1.70	0.48	0.85	34.22	43.00	200	1.00	1.055	33.37	97.51
DAGENHAM STREET	130A	130A	123A	8				0.46	26.4	49.5	4.00	0.80		0.00		0.00		0.00	0.00	0.46	2.16	0.60	1.41	34.22	87.11	200	1.00	1.055	32.81	95.89
BOBOLINK RIDGE	123A	123A	122A	2				0.14	6.6	557.6	3.95	8.92		0.00		0.00		0.00	0.00	0.14	9.86	2.76	11.68	31.02	25.98	250	0.25	0.612	19.34	62.34
BOBOLINK RIDGE	122A	122A	121A	5				0.26	16.5	574.1	3.94	9.17		0.00		0.00		0.00	0.00	0.26	10.12	2.83	12.00	31.02	36.36	250	0.25	0.612	19.02	61.31
BOBOLINK RIDGE	121A	121A	120A	6				0.30	19.8	593.9	3.93	9.47		0.00		0.00		0.00	0.00	0.30	10.42	2.92	12.38	31.02	40.43	250	0.25	0.612	18.64	60.08
ANGEL HEIGHTS	111A	111A	112A	1				0.08	3.3	3.3	4.00	0.05		0.00		0.00		0.00	0.00	0.08	0.08	0.02	0.08	28.63	12.92	200	0.70	0.883	28.55	99.73
ANGEL HEIGHTS	112A	112A	113A	13				0.77	42.9	46.2	4.00	0.75		0.00		0.00		0.00	0.00	0.77	0.85	0.24	0.99	28.63	95.21	200	0.70	0.883	27.64	96.55
ANGEL HEIGHTS	113A	113A	114A	6				0.29	19.8	66.0	4.00	1.07		0.00		0.00		0.00	0.00	0.29	1.14	0.32	1.39	28.63	38.92	200	0.70	0.883	27.24	95.15
ANGEL HEIGHTS	114A	114A	120A	6				0.35	19.8	85.8	4.00	1.39		0.00		0.00		0.00	0.00	0.35	1.49	0.42	1.81	28.63	70.46	200	0.70	0.883	26.82	93.69
BOBOLINK RIDGE	120A	120A	105A	11				0.62	36.3	716.0	3.89	11.28		0.00		0.00		0.00	0.00	0.62	12.53	3.51	14.79	36.70	90.60	250	0.35	0.724	21.91	59.71

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

Designed: J.I.M.

Checked: P.K.

Dwg. Reference: 27970 - 501, 501A, 501B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	2 of 4

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK	PEAK	AREA (Ha)						PEAK	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY	AVAILABLE	
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM	FACTOR	FLOW (L/s)	INSTITUTIONAL IND	INSTITUTIONAL CUM	COMMERCIAL IND	COMMERCIAL CUM	INDUSTRIAL IND	INDUSTRIAL CUM	FLOW (L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(full) (m/s)	CAPACITY L/s	CAPACITY (%)
EMBANKMENT STREET	128AB	128A	188A	16				0.74	52.8	52.8	4.00	0.86		0.00		0.00		0.00	0.00	0.74	0.74	0.21	1.06	27.59	98.00	200	0.65	0.851	26.52	96.15
EMBANKMENT STREET	188A	188A	189A	11				0.52	36.3	89.1	4.00	1.44		0.00		0.00		0.00	0.00	0.52	1.26	0.35	1.80	27.59	74.80	200	0.65	0.851	25.79	93.49
BLOCK 344	RES.3	192A	189A					1.52	136.8	136.8	4.00	2.22		0.00		0.00		0.00	0.00	1.52	1.52	0.43	2.64	20.24	40.00	200	0.35	0.624	17.60	86.95
EMBANKMENT STREET	189A	189A	190A	14				0.69	46.2	272.1	4.00	4.41		0.00		0.00		0.00	0.00	0.69	3.47	0.97	5.38	20.24	92.53	200	0.35	0.624	14.86	73.42
EMBANKMENT STREET		190A	176A	0				0.00	0.0	272.1	4.00	4.41		0.00		0.00		0.00	0.00	0.00	3.47	0.97	5.38	20.24	10.78	200	0.35	0.624	14.86	73.42
BLOCK 345	INST.2	BULKHEAD	176A	0				0.00	0.0	0.0	4.00	0.00	6.53	6.53		0.00		0.00	5.67	6.53	6.53	1.83	7.50	20.24	21.00	200	0.35	0.624	12.75	62.97
COPE DRIVE	176A	176A	175A	3				0.63	9.9	282.0	4.00	4.57		6.53		0.00		0.00	5.67	0.63	10.63	2.98	13.21	20.24	76.03	200	0.35	0.624	7.03	34.72
COPE DRIVE	175A	175A	174A	5				0.46	16.5	298.5	4.00	4.84		6.53		0.00		0.00	5.67	0.46	11.09	3.11	13.61	20.24	84.94	200	0.35	0.624	6.63	32.76
BELSIZE WAY	127AB	127A	185A	11				0.53	36.3	36.3	4.00	0.59		0.00		0.00		0.00	0.00	0.53	0.53	0.15	0.74	27.59	88.50	200	0.65	0.851	26.85	97.33
BELSIZE WAY	185A	185A	186A	13				0.59	42.9	79.2	4.00	1.28		0.00		0.00		0.00	0.00	0.59	1.12	0.31	1.60	27.59	83.61	200	0.65	0.851	25.99	94.21
PINNER ROAD	191A	191A	186A	3				0.24	9.9	9.9	4.00	0.16		0.00		0.00		0.00	0.00	0.24	0.24	0.07	0.23	27.59	43.00	200	0.65	0.851	27.36	99.17
PINNER ROAD	186A	186A	187A	5				0.35	16.5	105.6	4.00	1.71		0.00		0.00		0.00	0.00	0.35	1.71	0.48	2.19	20.24	70.39	200	0.35	0.624	18.05	89.18
PINNER ROAD		187A	183A	0				0.00	0.0	105.6	4.00	1.71		0.00		0.00		0.00	0.00	0.00	1.71	0.48	2.19	20.24	9.00	200	0.35	0.624	18.05	89.18
FINSBURY AVENUE	182A	182A	183A	16				0.97	52.8	52.8	4.00	0.86		0.00		0.00		0.00	0.00	0.97	0.97	0.27	1.13	32.46	117.13	200	0.90	1.001	31.33	96.53
FINSBURY AVENUE	183A	183A	184A	4				0.33	13.2	171.6	4.00	2.78		0.00		0.00		0.00	0.00	0.33	3.01	0.84	3.62	20.24	65.71	200	0.35	0.624	16.62	82.10
FINSBURY AVENUE		184A	174A	0				0.00	0.0	171.6	4.00	2.78		0.00		0.00		0.00	0.00	0.00	3.01	0.84	3.62	20.24	17.89	200	0.35	0.624	16.62	82.10
COPE DRIVE	174A	174A	173A	7				0.47	23.1	493.2	3.98	7.95		6.53		0.00		0.00	5.67	0.47	14.57	4.08	17.69	31.02	82.90	250	0.25	0.612	13.33	42.96
COPE DRIVE	173A	173A	172A	6				0.41	19.8	513.0	3.97	8.25		6.53		0.00		0.00	5.67	0.41	14.98	4.19	18.11	31.02	76.02	250	0.25	0.612	12.91	41.62
BLOCK 313	INST.1	BULKHEAD	172A	0				0.00	0.0	0.0	4.00	0.00	2.88	2.88		0.00		0.00	2.50	2.88	2.88	0.81	3.31	20.24	16.00	200	0.35	0.624	16.94	83.67
COPE DRIVE	172A	172A	171B	3				0.23	9.9	522.9	3.96	8.40		9.41		0.00		0.00	8.17	0.23	18.09	5.07	21.63	31.02	36.96	250	0.25	0.612	9.39	30.27
COPE DRIVE	171B	171B	171A	2				0.22	6.6	529.5	3.96	8.50		9.41		0.00		0.00	8.17	0.22	18.31	5.13	21.79	31.02	41.21	250	0.25	0.612	9.23	29.75
DAGENHAM STREET	180A	180A	181A	7				0.50	23.1	23.1	4.00	0.37		0.00		0.00		0.00	0.00	0.50	0.50	0.14	0.51	20.24	90.00	200	0.35	0.624	19.73	97.46
DAGENHAM STREET	181A	181A	171A	0				0.11	0.0	23.1	4.00	0.37		0.00		0.00		0.00	0.00	0.11	0.61	0.17	0.55	20.24	67.50	200	0.35	0.624	19.70	97.31
COPE DRIVE	171A	171A	170B	1				0.17	3.3	555.9	3.95	8.90		9.41		0.00		0.00	8.17	0.17	19.09	5.35	22.41	45.12	37.91	300	0.20	0.618	22.71	50.33
COPE DRIVE	170B	170B	170A	3				0.25	9.9	565.8	3.95	9.04		9.41		0.00		0.00	8.17	0.25	19.34	5.42	22.63	45.12	43.98	300	0.20	0.618	22.49	49.84
BLOCK 312	RES.3A	BULKHEAD	sewer	0				3.26	195.6	195.6	4.00	3.17		0.00		0.00		0.00	0.00	3.26	3.26	0.91	4.08	20.24	16.22	200	0.35	0.624	16.16	79.83
COPE DRIVE	170A	170A	110A	6				0.62	19.8	781.2	3.87	12.24		9.41		0.00		0.00	8.17	0.62	23.22	6.50	26.91	45.12	120.00	300	0.20	0.618	18.21	40.36
GOLDHAWK DRIVE	306A	SOUTH	303A	31				1.83	102.3	102.3	4.00	1.66		0.00		0.00		0.00	0.00	1.83	1.83	0.51	2.17							
STREET NO. 26	304A	WEST	303A	14				0.69	46.2	46.2	4.00	0.75		0.00		0.00		0.00	0.00	0.69	0.69	0.19	0.94							
GOLDHAWK DRIVE	303A	303A	302A	10				0.62	33.0	181.5	4.00	2.94		0.00		0.00		0.00	0.00	0.62	3.14	0.88	3.82	20.24	94.58	200	0.35	0.624	16.42	81.13
Future Street	RES.5, 5A, Park3	EAST	302A					23.97	1421.4	1421.4	3.70	21.28		0.00		0.00		0.00	0.00	23.97	23.97	6.71	28.00							
GOLDHAWK DRIVE	302A	302A	301A	10				0.56	33.0	1635.9	3.65	24.20		0.00		0.00		0.00	0.00	0.56	27.67	7.75	31.95	50.44	70.68	300	0.25	0.691	18.49	36.66
GOLDHAWK DRIVE	301A	301A	207A	6				0.37	19.8	1655.7	3.65	24.47		0.00		0.00		0.00	0.00	0.37	28.04	7.85	32.32	50.44	70.00	300	0.25	0.691	18.12	35.93
STREET NO. 2	RES.4	EAST	207A					13.88	832.8	832.8	3.85	12.99		0.00		0.00		0.00	0.00	13.88	13.88	3.89	16.87							
GOLDHAWK DRIVE	207A	207A	206A	17				0.86	56.1	2544.6	3.50	36.10		0.00		0.00		0.00	0.00	0.86	42.78	11.98	48.08	70.84	107.19	375	0.15	0.621	22.76	32.13
GOLDHAWK DRIVE	206A	206A	205A	12				0.69	39.6	2584.2	3.50	36.60		0.00		0.00		0.00	0.00	0.69	43.47	12.17	48.78	70.84	106.61	375	0.15	0.621	22.07	31.15
GOLDHAWK DRIVE	205A	205A	110A	5				0.44	16.5	2600.7	3.49	36.81		0.00		0.00		0.00	0.00	0.44	43.91	12.29	49.11	70.84	100.61	375	0.15	0.621	21.73	30.68

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

Designed: J.I.M.

Checked: P.K.

Dwg. Reference: 27970 - 501, 501A, 501B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	3 of 4

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK	PEAK	AREA (Ha)						PEAK	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY	AVAILABLE	
													INSTITUTIONAL		COMMERCIAL		INDUSTRIAL		FLOW									(full)	CAPACITY	
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM	FACTOR	FLOW (L/s)	IND	CUM	IND	CUM	IND	CUM	(L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(m/s)	L/s	(%)
																							0.00							
	LSPS	Allowance						0.00	0.0	0.0													108.00							
	STITTSVILLE 6 PS		110A					0.00	0.0	0.0				0.00		0.00		0.00	0.00				84.00							
Future Street	INST.3	BLKHD	110A					0.00	0.0	0.0			2.47	2.47		0.00		0.00	2.14											
	PARK4	BLKHD	110A					0.83	0.0	0.0				0.00		0.00		0.00	0.00											
	PARK5	BLKHD	110A					1.04	0.0	0.0				0.00		0.00		0.00	0.00											
	RES.9	BLKHD	110A					34.81	2610.8	2610.8				0.00		0.00		0.00	0.00											
	RES.7	BLKHD	110A					4.24	318.0	318.0				0.00		0.00		0.00	0.00											
	RES.13	BLKHD	110A					2.22	133.2	133.2				0.00		0.00		0.00	0.00											
	RES.12	BLKHD	110A					43.89	2633.4	2633.4				0.00		0.00		0.00	0.00											
	INST.4	BLKHD	110A					0.00	0.0	0.0			2.44	2.44		0.00		0.00	2.12											
	COMM.	BLKHD	110A					0.00	0.0	0.0				0.00	0.63	0.63		0.00	0.55											
	HYD.4	BLKHD	110A					3.06	0.0	0.0				0.00		0.00		0.00	0.00											
	RES.8	BLKHD	110A					2.30	172.5	172.5				0.00		0.00		0.00	0.00											
	HYD.5	BLKHD	110A					5.20	0.0	0.0				0.00		0.00		0.00	0.00											
Future Street	RES.11	BLKHD	110A					6.91	414.6	414.6				0.00		0.00		0.00	0.00											
	PARK6	BLKHD	110A					1.19	0.0	0.0				0.00		0.00		0.00	0.00											
	RES.10	BLKHD	110A					1.92	115.2	115.2				0.00		0.00		0.00	0.00											
	HYD.3	BLKHD	110A					6.31	0.0	0.0				0.00		0.00		0.00	0.00											
TOTAL		**BLKHD**	**110A**					**113.92**		**6397.7**	**3.14**	**81.49**		**4.91**		**0.63**		**0.00**	**4.81**	**119.46**	**119.46**	**33.45**	**311.74**	**320.28**	**24.02**	**600**	**0.25**	**1.097**	**8.54**	**2.67**
GOLDHAWK DRIVE		**110A**	**109A**					**0.00**	**0.0**	**9779.6**	**2.96**	**117.43**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**186.59**	**52.25**	**374.66**	**378.96**	**61.28**	**600**	**0.35**	**1.298**	**4.30**	**1.14**
GOLDHAWK DRIVE	**110A**	**1101A**	**1092A**	**1**				**0.18**	**3.3**	**3.3**	**4.00**	**0.05**								**0.18**	**0.18**	**0.05**	**0.10**	**28.63**	**61.28**	**200**	**0.70**	**0.883**	**28.52**	**99.64**
GOLDHAWK DRIVE		**109A**	**108A**					**0.00**	**0.0**	**9782.9**	**2.96**	**117.47**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**186.77**	**52.30**	**374.74**	**378.96**	**57.50**	**600**	**0.35**	**1.298**	**4.22**	**1.11**
GOLDHAWK DRIVE	**109A**	**1091A**	**1082A**	**5**				**0.32**	**16.5**	**16.5**	**4.00**	**0.27**								**0.32**	**0.32**	**0.09**	**0.36**	**28.63**	**57.50**	**200**	**0.70**	**0.883**	**28.27**	**98.75**
GOLDHAWK DRIVE		**108A**	**107A**					**0.00**	**0.0**	**9799.4**	**2.96**	**117.64**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**187.09**	**52.39**	**375.00**	**378.96**	**53.32**	**600**	**0.35**	**1.298**	**3.96**	**1.05**
GOLDHAWK DRIVE	**108A**	**1081A**	**1072A**	**4**				**0.30**	**13.2**	**13.2**	**4.00**	**0.21**							**0.00**	**0.30**	**0.30**	**0.08**	**0.30**	**28.63**	**53.32**	**200**	**0.70**	**0.883**	**28.33**	**98.96**
GOLDHAWK DRIVE		**107A**	**106A**					**0.00**	**0.0**	**9812.6**	**2.96**	**117.77**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**187.39**	**52.47**	**375.22**	**378.96**	**62.94**	**600**	**0.35**	**1.298**	**3.74**	**0.99**
GOLDHAWK DRIVE	**107A**	**1071A**	**1062A**	**7**				**0.31**	**23.1**	**23.1**	**4.00**	**0.37**		**0.00**		**0.00**		**0.00**	**0.00**	**0.31**	**0.31**	**0.09**	**0.46**	**28.63**	**62.94**	**200**	**0.70**	**0.883**	**28.17**	**98.39**
GOLDHAWK DRIVE		**106A**	**105A**					**0.00**	**0.0**	**9835.7**	**2.96**	**118.01**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**187.70**	**52.56**	**375.54**	**378.96**	**60.09**	**600**	**0.35**	**1.298**	**3.42**	**0.90**
GOLDHAWK DRIVE	**106A**	**1061A**	**1052A**	**2**				**0.24**	**6.6**	**6.6**	**4.00**	**0.11**		**0.00**		**0.00**		**0.00**	**0.00**	**0.24**	**0.24**	**0.07**	**0.17**	**28.63**	**60.09**	**200**	**0.70**	**0.883**	**28.45**	**99.39**
		105A	**104A**					**0.00**	**0.0**	**10558.3**	**2.93**	**125.37**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**200.47**	**56.13**	**386.48**	**389.64**	**72.85**	**600**	**0.37**	**1.335**	**3.16**	**0.81**
GOLDHAWK DRIVE	**105A**	**1051A**	**1042A**	**7**				**0.45**	**23.1**	**23.1**	**4.00**	**0.37**								**0.45**	**0.45**	**0.13**	**0.50**	**27.59**	**72.85**	**200**	**0.65**	**0.851**	**27.09**	**98.19**
GOLDHAWK DRIVE		**104A**	**103A**					**0.00**	**0.0**	**10581.4**	**2.93**	**125.60**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**200.92**	**56.26**	**386.84**	**389.64**	**48.77**	**600**	**0.37**	**1.335**	**2.80**	**0.72**
GOLDHAWK DRIVE	**104A**	**1041A**	**1032A**	**9**				**0.47**	**29.7**	**29.7**	**4.00**	**0.48**							**0.00**	**0.47**	**0.47**	**0.13**	**0.61**	**27.59**	**48.77**	**200**	**0.65**	**0.851**	**26.97**	**97.78**
GOLDHAWK DRIVE		**103A**	**102A**					**0.00**	**0.0**	**10611.1**	**2.93**	**125.90**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**201.39**	**56.39**	**387.27**	**389.64**	**45.00**	**600**	**0.37**	**1.335**	**2.37**	**0.61**
GOLDHAWK DRIVE	**103A, HYD1**	**1031A**	**1021A**	**6**				**2.01**	**19.8**	**19.8**	**4.00**	**0.32**							**0.00**	**2.01**	**2.01**	**0.56**	**0.88**	**27.59**	**45.00**	**200**	**0.65**	**0.851**	**26.70**	**96.80**
GOLDHAWK DRIVE	**102A**	**102A**	***FT-24 (EX)***					**0.12**	**0.0**	**10630.9**	**2.93**	**126.10**		**14.32**		**0.63**		**0.00**	**12.98**	**0.12**	**203.52**	**56.99**	**388.07**	**389.64**	**102.59**	**600**	**0.37**	**1.335**	**1.57**	**0.40**
HYDRO EASEMENT		***FT-24 (EX)***	***FT-23 (EX)***					**0.00**	**0.0**	**10650.7**	**2.93**	**126.30**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**205.53**	**57.55**	**388.83**	**400.03**	**107.50**	**600**	**0.39**	**1.371**	**11.20**	**2.80**

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:

1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
   Harmon Formula = 1+(14/(4+P^0.5))
   where P = population in thousands

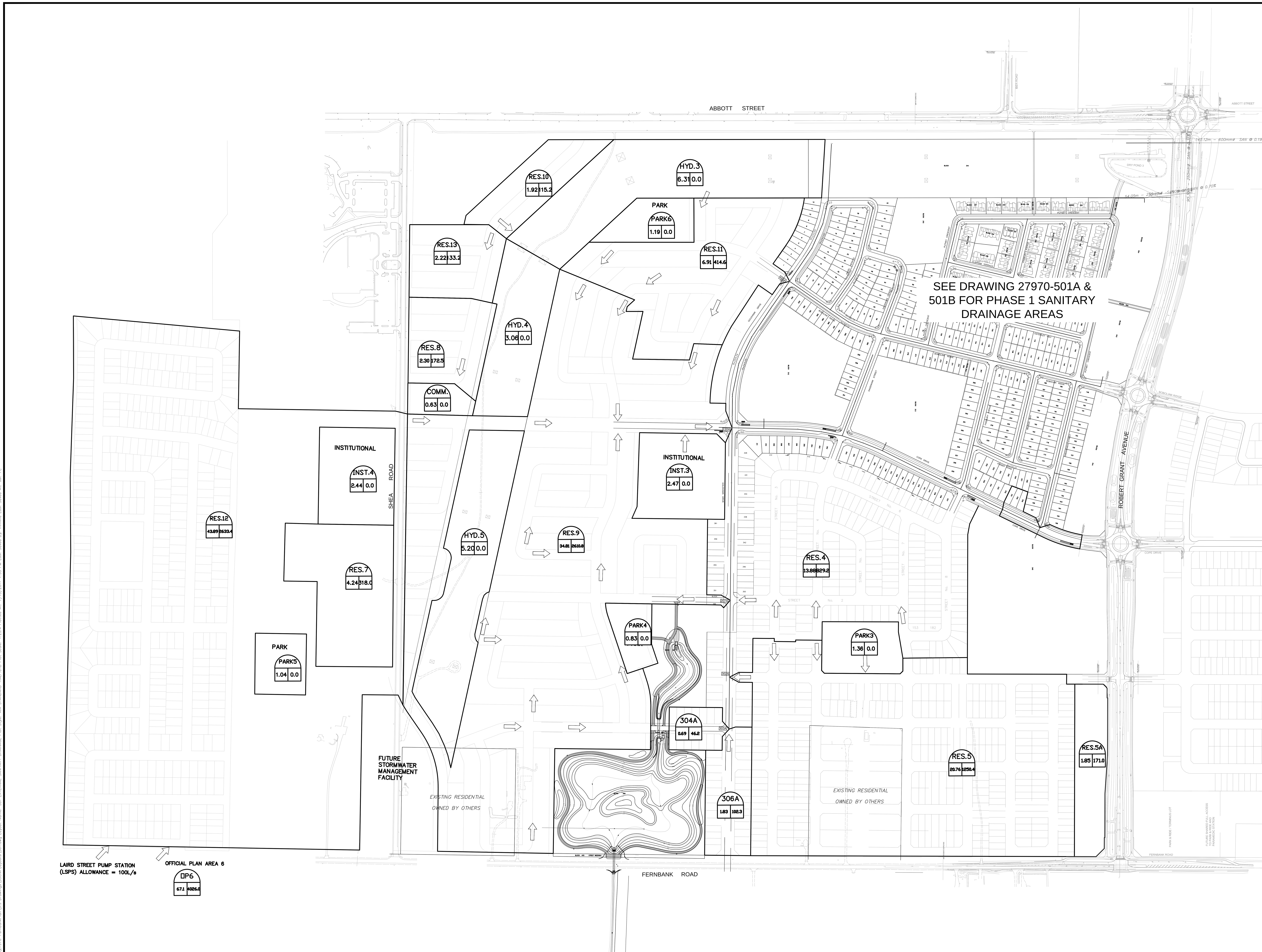
Designed: J.I.M.

Checked: P.K.

Dwg. Reference: 27970 - 501, 501A, 501B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	4 of 4



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND :

145A / 0.38 / 27.5 — AREA IDENTIFICATION / POPULATION / AREA IN HECTARES

FUTURE MINOR FLOW DIRECTION

POPULATION :

SINGLE FAMILY = 3.4 PPU
TOWNHOUSE / SEMIS = 2.7 PPU

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

IBI GROUP
400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

EXTERNAL SANITARY DRAINAGE

AREA PLAN

Scale 1:3000

Design	Date
J.I.M.	OCTOBER '12
Drawn	**Checked**
M.M.	P.K.
Project No.	**Drawing No.**
27970	501

D07-16-11-0003

#17366

CONT'D ON DWG
27970-501B

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND :

145A — AREA ID #
0.34 | 27.5 — POPULATION
— AREA IN HECTARES
⇨ FUTURE MINOR FLOW DIRECTION

NOTES:

1. THIS ALLOWANCE IS FOR OPA66 EXPANSION AREAS 6a, 6b AND 6c.

2. AN ALLOWANCE OF 100l/s HAS BEEN MADE FOR FLOWS TRIBUTARY TO THE LAIRD STREET PUMP STATION.

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
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3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

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400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

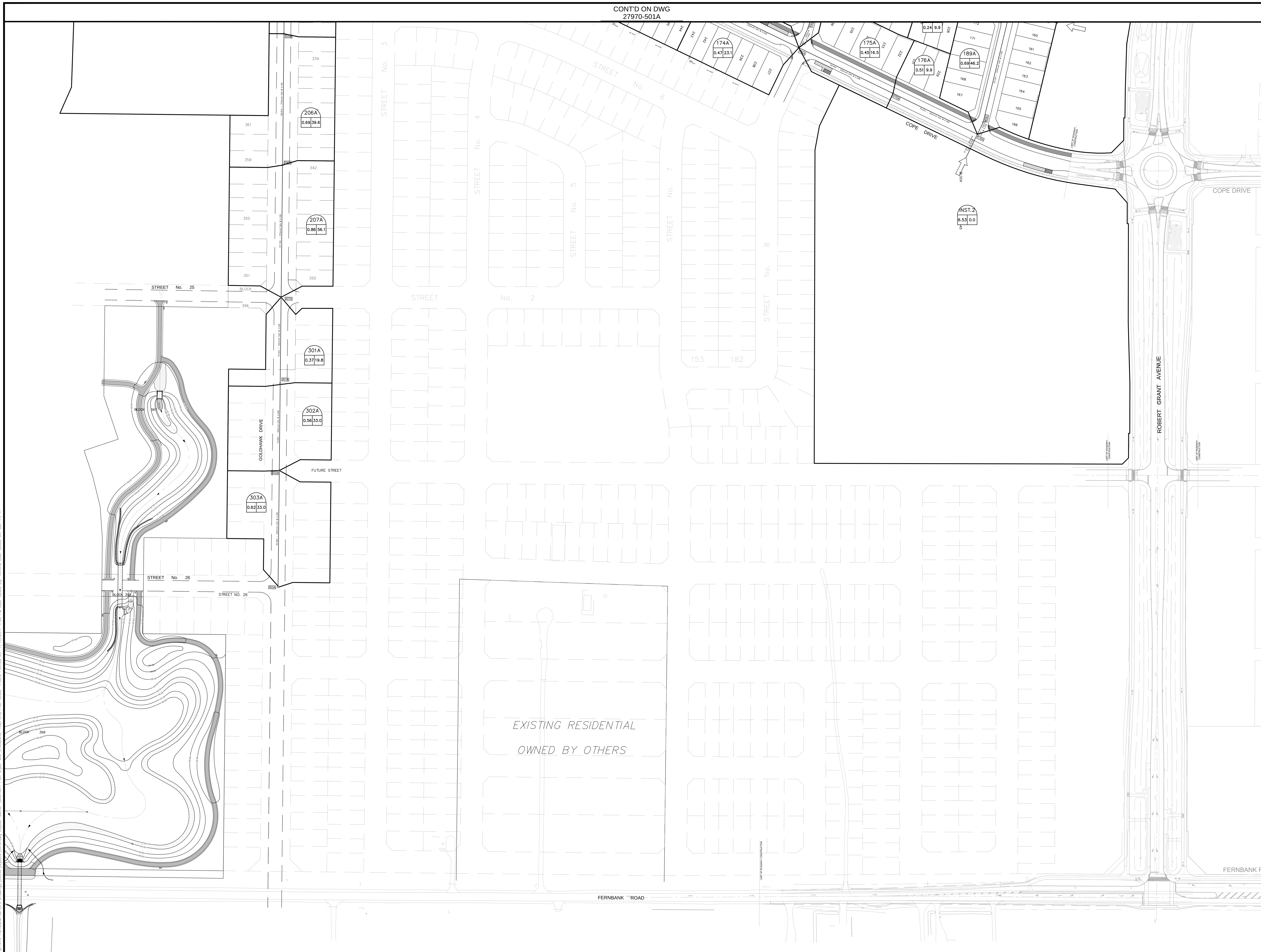
SANITARY DRAINAGE
AREA PLAN

Scale
1:1250

Design	Date
J.I.M.	OCTOBER '12
Drawn	Checked
M.M.	P.K.
Project No.	Drawing No.
27970	501A

D07-16-11-0003

#17366



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND :

145A — AREA ID #
0.34 27.5 — POPULATION
— AREA IN HECTARES
⇨ FUTURE MINOR FLOW DIRECTION

NOTES:

1. THIS ALLOWANCE IS FOR OPA66 EXPANSION AREAS 6a, 6b AND 6c.

2. AN ALLOWANCE OF 100l/s HAS BEEN MADE FOR FLOWS TRIBUTARY TO THE LAIRD STREET PUMP STATION.

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

IBI GROUP
400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

Project Title

CRT LANDS FERNBANK COMMUNITY PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

N

Drawing Title

SANITARY DRAINAGE AREA PLAN

Scale 1:1250

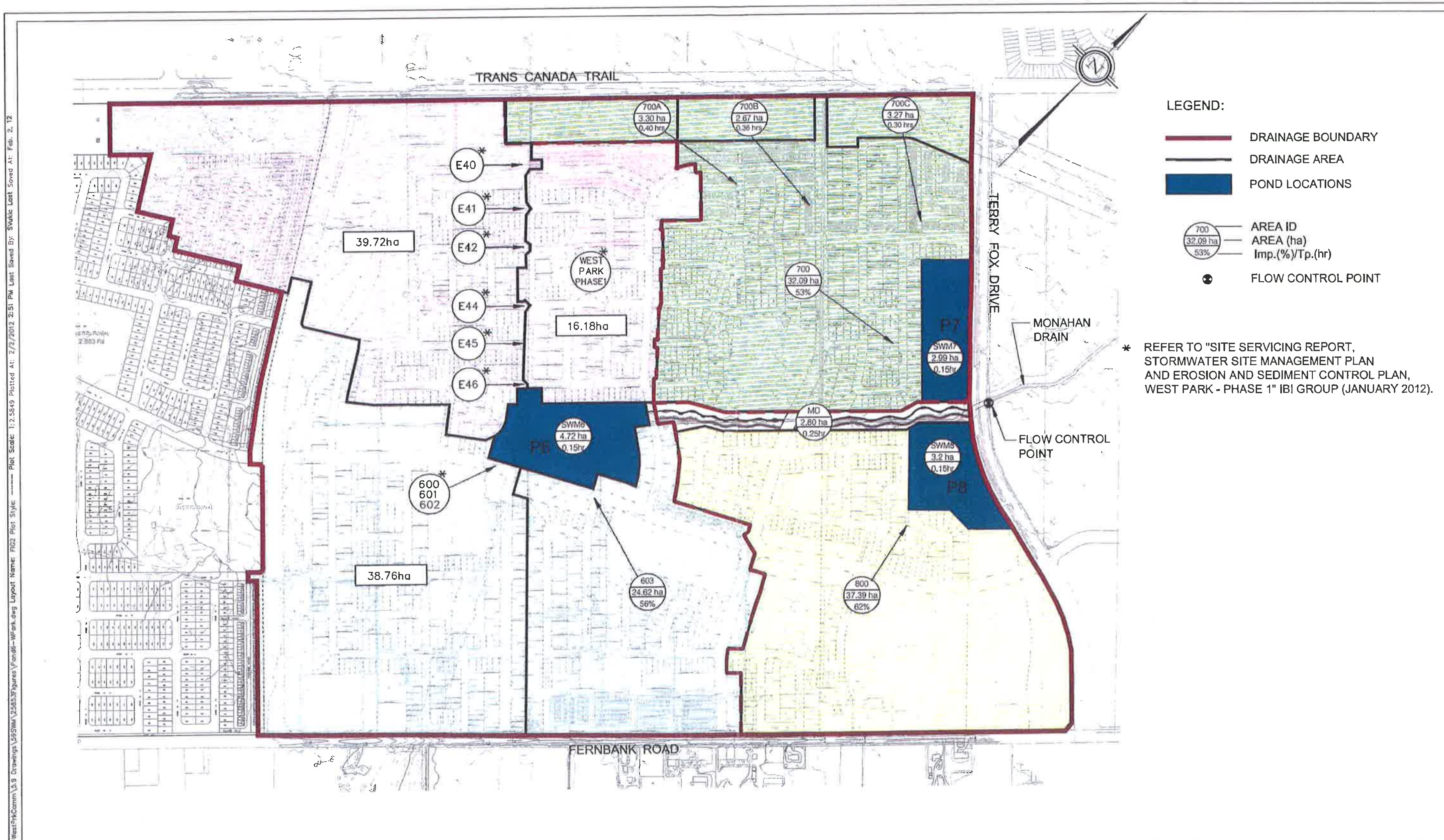
Design	Date
J.I.M.	OCTOBER '12
Drawn: M.M.	Checked: P.K.
Project No.: 27970	Drawing No.: 501B

D07-16-11-0003

#17366

APPENDIX E

- **Figure 2 – West Park Pond 6 Stormwater Management Report and Design Brief**
- **MSS Storm Drainage Area Plan Minor System Drainage (Drawing 101108-STM1)**
- **Storm Sewer Design Sheets**
- **Drainage Area Plans 500, 500A and 500B**



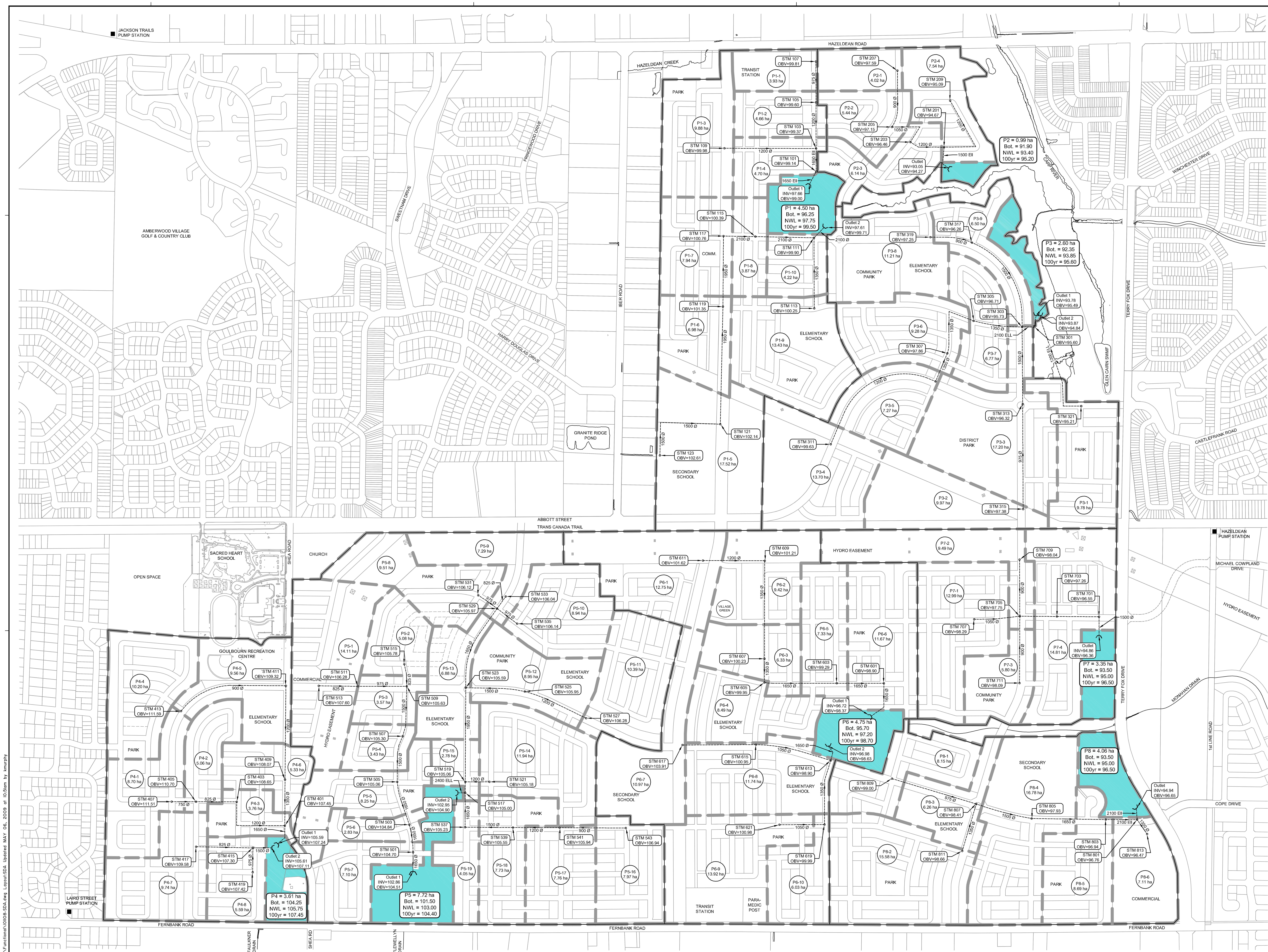
IBI GROUP

Scale
1:7500

Project Title
WEST PARK POND 6
STORMWATER MANAGEMENT
REPORT AND DESIGN BRIEF

Drawing Title
POST-DEVELOPMENT
DRAINAGE AREA PLAN

Sheet No.
FIGURE 2



NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

No.	REVISION	DATE	BY
3	ISSUED WITH MASTER SERVICING STUDY	MAY 25/09	MAB
2	UPDATED WITH DRAFT MASTER SERVICING STUDY	SEP 12/08	MAB
1	ISSUED WITH DRAFT MASTER SERVICING STUDY	MAY 02/08	MAB

LICENSED PROFESSIONAL ENGINEER — M.A. BISSETT — PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER — J.G. RIDDELL — PROVINCE OF ONTARIO

NOVATECH ENGINEERING CONSULTANTS LTD.
ENGINEERS & PLANNERS
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada
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DESIGN	KJM	SCALE	
CHECKED	MAB	1 : 5000	
DRAWN	KJM		
CHECKED	MAB		
APPROVED	JGR		

CITY OF OTTAWA

FERNBANK CDP

STORM DRAINAGE AREA PLAN
MINOR SYSTEM DRAINAGE

PROJECT No. 101108-0

DATE AUGUST 2007

DRAWING No. 101108-STM1

PLANBLDWG - 1000mmX707mm

Drawing:M:\2001\101108\CAD\design\Functional\101108-SDA.dwg Layout:SDA Updated MAY 06, 2009 at 10:56am by kmurphy

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

STORM SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				AREA (Ha)										RATIONAL DESIGN FLOW													SEWER DATA								
STREET	AREA ID	FROM MH	TO MH	C= 0.20	C= 0.55	C= 0.65	C= 0.66	C= 0.75	C= 0.80	C= 0.90	C=	C=	C=	IND 2.78AC	CUM 2.78AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (5) (mm/hr)	i (10) (mm/hr)	i (100) (mm/hr)	5yr PEAK FLOW (L/s)	10yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE SIZE (mm) DIA	W	H	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (5yr) (L/s)	(%)
PUTNEY CRESCENT	---	141	142					0.00						0.00	0.00	10.00	0.12	10.12	104.19	122.14	178.56	0.00				0.00	62.04	8.84	250			1.00	1.224	62.04	100.00%
PUTNEY CRESCENT	R142A, B	142	143		0.33									0.50	0.50	10.12	0.48	10.60	103.56	121.40	177.47	52.25				52.25	139.06	54.71	300			1.90	1.906	86.80	62.42%
PUTNEY CRESCENT	S143	143	144					0.32						0.67	1.17	10.60	0.68	11.28	101.13	118.54	173.26	118.50				118.50	266.03	65.86	450			0.80	1.620	147.53	55.45%
FINSBURY AVENUE	S136B, E, R136A	136	144		0.27			0.44						1.33	1.33	10.00	0.87	10.87	104.19	122.14	178.56	138.60				138.60	154.65	110.07	300			2.35	2.119	16.05	10.38%
PUTNEY CRESCENT	S144, R144A, B, C	144	145		0.57			0.25						1.39	3.89	11.28	0.74	12.02	97.90	114.73	167.68	381.31				381.31	401.29	80.25	525			0.80	1.796	19.98	4.98%
CLAPHAM TERRACE	S136C, D, R136B	136	137		0.23			0.18						0.73	0.73	10.00	0.94	10.94	104.19	122.14	178.56	75.75				75.75	100.88	77.99	300			1.00	1.383	25.14	24.92%
BRIXTON WAY	R137A	137	160		0.11									0.17	0.90	10.94	0.42	11.36	99.48	116.59	170.40	89.05				89.05	224.02	50.00	375			1.50	1.965	134.97	60.25%
BRIXTON WAY	S160A, B	160	145					0.43						0.90	1.79	11.36	0.54	11.90	97.50	114.26	166.98	174.69				174.69	280.40	78.98	375			2.35	2.459	105.71	37.70%
PUTNEY CRESCENT	S145A, B, R145	145	146		0.30			0.55						1.61	7.29	12.02	0.70	12.72	94.61	110.85	161.98	689.86				689.86	821.24	75.47	750			0.50	1.801	131.38	16.00%
CLAPHAM TERRACE	S137A, B, R137B	137	138		0.30			0.27						1.02	1.02	10.00	1.19	11.19	104.19	122.14	178.56	106.45				106.45	129.34	81.01	375			0.50	1.134	22.89	17.70%
PUTNEY CRESCENT	S138, R138	138	148		0.14			0.15						0.53	1.55	11.19	0.67	11.86	98.30	115.20	168.37	152.21				152.21	220.25	78.01	375			1.45	1.932	68.04	30.89%
PUTNEY CRESCENT	S148	148	147					0.22						0.46	2.01	11.86	0.38	12.24	95.28	111.65	163.15	191.25				191.25	297.76	59.30	375			2.65	2.612	106.51	35.77%
PUTNEY CRESCENT	---	147	146					0.00						0.00	2.01	12.24	0.10	12.34	93.68	109.76	160.37	188.02				188.02	332.54	12.13	450			1.25	2.026	144.52	43.46%
BLOCK 324		146	161											0.00	9.30	12.72	0.40	13.12	91.73	107.47	157.01	853.01				853.01	944.29	34.88	900			0.25	1.438	91.28	9.67%
BLOCK 324	R146	161	*Ex. 180*		0.14									0.21	9.51	13.12	0.56	13.68	90.15	105.61	154.28	857.65				857.65	944.29	48.00	900			0.25	1.438	86.65	9.18%
BLOCK 324	RES.1, RES. 2B	BULKHEAD	*Ex. 180*						2.45					5.45	5.45	13.00	0.07	13.07	90.63	106.17	155.11	493.82				493.82	731.45	5.00	900			0.15	1.114	237.62	32.49%
														Refer to ECA No. 9079-9LNNZC dated July 9, 2014 for description of existing sewers.																					

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1174.184 / (TC+6.014)^0.816] 10 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed: J.I.M.
Checked: P.K.
Dwg. Reference: 27970 - 500, 500A, 500B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	1 of 3

IBI GROUP

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

STORM SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				AREA (Ha)										RATIONAL DESIGN FLOW													SEWER DATA								
STREET	AREA ID	FROM MH	TO MH	C= 0.20	C= 0.55	C= 0.65	C= 0.66	C= 0.75	C= 0.80	C= 0.90	C=	C=	C=	IND 2.78AC	CUM 2.78AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (5) (mm/hr)	i (10) (mm/hr)	i (100) (mm/hr)	5yr PEAK FLOW (L/s)	10yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE SIZE (mm) DIA	W	H	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (5yr) (L/s)	(%)
CLAPHAM TERRACE	S136A	136	135					0.17						0.35	0.35	10.00	1.03	11.03	104.19	122.14	178.56	36.93				36.93	50.02	61.00	250			0.65	0.987	13.09	26.16%
CLAPHAM TERRACE	S135A, B	135	134					0.26						0.54	0.90	11.03	1.08	12.11	99.05	116.08	169.66	88.80				88.80	108.21	61.66	375			0.35	0.949	19.41	17.94%
PUTNEY CRESCENT	---	141	134		0.00									0.00	0.00	10.00	1.31	11.31	104.19	122.14	178.56	0.00				0.00	108.21	74.74	375			0.35	0.949	108.21	100.00%
PUTNEY CRESCENT	S134A, B, C, R134	134	140		0.21			0.39						1.13	2.03	12.11	1.10	13.21	94.22	110.39	161.31	191.34				191.34	265.43	78.10	525			0.35	1.188	74.09	27.91%
OSTERLEY WAY	S153	153	152					0.12						0.25	0.25	10.00	1.04	11.04	104.19	122.14	178.56	26.07				26.07	43.87	53.80	250			0.50	0.866	17.80	40.57%
OSTERLEY WAY	S152A, B	152	151					0.40						0.83	1.08	11.04	1.82	12.85	99.02	116.05	169.61	107.36				107.36	148.72	98.72	450			0.25	0.906	41.36	27.81%
OSTERLEY WAY	S151A, R151A	151	150		0.18			0.10						0.48	1.57	12.85	0.96	13.81	91.21	106.85	156.10	143.00				143.00	170.86	59.71	450			0.33	1.041	27.86	16.30%
OSTERLEY WAY	S150A, B	150	140					0.32						0.67	2.24	13.81	0.91	14.72	87.62	102.63	149.90	195.83				195.83	257.73	63.00	525			0.33	1.153	61.90	24.02%
PUTNEY CRESCENT	S140, R140	140	124		0.21			0.25						0.84	5.11	14.72	0.91	15.63	84.48	98.93	144.48	431.53				431.53	636.13	76.57	750			0.30	1.395	204.60	32.16%
PUTNEY CRESCENT	S149A, B, S129C	149	128					0.22						0.46	0.46	10.00	0.61	10.61	104.19	122.14	178.56	47.79				47.79	62.04	45.00	250			1.00	1.224	14.25	22.96%
BLOCK 343	RES.2A	BULKHEAD	129						0.65					1.45	1.45	13.00	0.27	13.27	90.63	106.17	155.11	131.01				131.01	303.78	13.50	675			0.12	0.822	172.76	56.87%
BOBOLINK RIDGE		129	128					0.00						0.00	1.45	13.00	0.91	13.91	90.63	106.17	155.11	131.01				131.01	303.78	45.00	675			0.12	0.822	172.76	56.87%
BOBOLINK RIDGE	S128A, R128A	128	127		0.14			0.18						0.59	2.49	13.91	1.57	15.49	87.25	102.19	149.26	217.56				217.56	473.55	81.00	825			0.10	0.858	255.99	54.06%
BOBOLINK RIDGE	S127A, R127A	127	126		0.19			0.17						0.64	3.14	15.49	1.51	17.00	82.02	96.05	140.25	257.44				257.44	473.55	78.00	825			0.10	0.858	216.11	45.64%
FINSBURY AVENUE	S151B, C, R151B	151	126		0.20			0.25						0.83	0.83	10.00	0.79	10.79	104.19	122.14	178.56	86.17				86.17	117.21	76.50	300			1.35	1.606	31.04	26.48%
BOBOLINK RIDGE	---	126	125					0.00						0.00	3.97	17.00	0.81	17.81	77.61	90.86	132.63	307.77				307.77	597.22	44.30	900			0.10	0.909	289.46	48.47%
BOBOLINK RIDGE	S125, R125A, B	125	124		0.35			0.39						1.35	5.31	17.81	1.39	19.20	75.45	88.32	128.91	400.95				400.95	739.33	80.07	975			0.10	0.959	338.38	45.77%
BOBOLINK RIDGE	S124, R124A, B	124	123		0.32			0.26						1.03	11.45	19.20	1.23	20.44	72.05	84.32	123.05	825.24				825.24	1,760.81	88.10	1350			0.10	1.192	935.57	53.13%
DAGENHAM STREET	R131	131	130		0.20									0.31	0.31	10.00	0.84	10.84	104.19	122.14	178.56	31.86				31.86	59.68	41.39	300			0.35	0.818	27.82	46.61%
DAGENHAM STREET	S130, R130A, B	130	123		0.33			0.36						1.26	1.56	10.84	1.75	12.59	99.94	117.13	171.20	156.00				156.00	179.46	84.37	525			0.16	0.803	23.46	13.07%
BOBOLINK RIDGE	---	123	122		0.00									0.00	13.01	20.44	0.30	20.74	69.31	81.11	118.33	902.05				902.05	1,760.81	21.46	1350			0.10	1.192	858.77	48.77%
BOBOLINK RIDGE	S122, R122	122	121		0.17			0.31						0.91	13.92	20.74	0.39	21.13	68.68	80.36	117.24	956.05				956.05	3,040.59	39.49	1500			0.17	1.667	2084.54	68.56%
BOBOLINK RIDGE	R121	121	120		0.13									0.20	14.12	21.13	0.37	21.50	67.86	79.41	115.84	958.22				958.22	3,040.59	36.84	1500			0.17	1.667	2082.37	68.49%
ANGEL HEIGHTS	---	111	112		0.00									0.00	0.00	10.00	0.27	10.27	104.19	122.14	178.56	0.00				0.00	42.08	13.58	250			0.46	0.830	42.08	100.00%
ANGEL HEIGHTS	S112, R112A, B	112	113		0.20			0.27						0.87	0.87	10.27	1.68	11.95	102.77	120.47	176.10	89.29				89.29	139.51	85.60	450			0.22	0.850	50.22	36.00%
DAGENHAM STREET	PARK1	DICB	132	1.27										0.71	0.71	12.00	0.29	12.29	94.70	110.96	162.13	66.87				66.87	100.88	23.70	300			1.00	1.383	34.02	33.72%
DAGENHAM STREET	S132	132	113					0.24						0.50	1.21	12.29	0.55	12.83	93.49	109.54	160.05	112.80				112.80	210.32	42.00	450			0.50	1.281	97.52	46.37%
ANGEL HEIGHTS	S113	113	114					0.30						0.63	1.49	12.83	0.85	13.68	91.29	106.94	156.24	136.40				136.40	248.09	43.13	600			0.15	0.850	111.69	45.02%
ANGEL HEIGHTS	S114, R114	114	120		0.50			0.24						1.26	2.76	13.68	1.43	15.11	88.09	103.18	150.72	243.05				243.05	367.27	69.17	750			0.10	0.805	124.22	33.82%
BOBOLINK RIDGE	S120	120	105					0.28						0.58	17.46	21.50	0.96	22.45	67.13	78.54	114.57	1,172.18				1,172.18	3,040.59	95.64	1500			0.17	1.667	1868.41	61.45%
ANGEL HEIGHTS	S101	101	102					0.20						0.42	0.42	10.00	0.52	10.52	104.19	122.14	178.56	43.45				43.45	129.34	35.48	375			0.50	1.134	85.89	66.41%
GOLDHAWK DRIVE	R102	102	103		0.21									0.32	0.74	10.52	0.83	11.35	101.52	118.99	173.93	74.93				74.93	126.19	38.36	450			0.18	0.769	51.26	40.62%
GOLDHAWK DRIVE	S103, R103A, B	103	104		0.50			0.34						1.47	2.21	11.35	1.01	12.36	97.55	114.32	167.07	215.73				215.73	303.78	49.62	675			0.12	0.822	88.05	28.98%
GOLDHAWK DRIVE	S104, R104A, B, C	104	105		0.59			0.30						1.53	3.74	12.36	1.35	13.71	93.19	109.19	159.53	348.45				348.45	473.55	69.59	825			0.10	0.858	125.10	26.42%
GOLDHAWK DRIVE	S105A, S105B, R105	105	107		0.13	0.90								1.83	23.03	22.45	1.31	23.77	65.29	76.38	111.40	1,503.33				1,503.33	5,720.16	126.10	2100			0.10	1.600	4216.82	73.72%
GOLDHAWK DRIVE	S107	107	109			0.61								1.10	24.13	23.77	1.17	24.94	62.94	73.62	107.36	1,518.58				1,518.58	5,720.16	112.64	2100			0.10	1.600	4201.58	73.45%
GOLDHAWK DRIVE	S109	109	110			0.52								0.94	25.07	24.94	0.67	25.62	60.99	71.33	104.01	1,528.92				1,528.92	5,720.16	64.64	2100			0.10	1.600	4191.24	73.27%

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1174.184 / (TC+6.014)^0.816] 10 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed: J.I.M.
Checked: P.K.
Dwg. Reference: 27970 - 500, 500A, 500B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	2 of 3

IBI GROUP

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

STORM SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				AREA (Ha)										RATIONAL DESIGN FLOW													SEWER DATA								
STREET	AREA ID	FROM MH	TO MH	C= 0.20	C= 0.55	C= 0.65	C= 0.66	C= 0.75	C= 0.80	C= 0.90	C=	C=	C=	IND 2.78AC	CUM 2.78AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (5) (mm/hr)	i (10) (mm/hr)	i (100) (mm/hr)	5yr PEAK FLOW (L/s)	10yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE SIZE (mm) DIA	W	H	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (5yr) (L/s)	(%)
EMBANKMENT STREET	S128B, R128B	128	188		0.09			0.31						0.78	0.78	10.00	1.76	11.76	104.19	122.14	178.56	81.68				81.68	108.21	100.00	375			0.35	0.949	26.53	24.52%
EMBANKMENT STREET	S188, R188A, B	188	189		0.19			0.30						0.92	1.70	11.76	0.97	12.72	95.75	112.20	163.96	162.77				162.77	210.32	74.32	450			0.50	1.281	47.54	22.61%
BLOCK 344	RES.3	BULKHEAD	189						1.58					3.51	3.51	*13.95*	0.66	14.61	87.11	102.03	149.03	306.10	5YR FLOW - BLOCK 344			306.10	402.33	35.00	750			0.12	0.882	96.23	23.92%
EMBANKMENT STREET	S189, R189	189	190		0.09			0.28						0.72	5.94	14.61	1.69	16.30	84.83	99.35	145.10	503.52				503.52	739.33	97.00	975			0.10	0.959	235.81	31.89%
EMBANKMENT STREET	S190	190	176					0.05						0.10	6.04	16.30	0.20	16.50	79.59	93.19	136.05	480.69				480.69	739.33	11.54	975			0.10	0.959	258.64	34.98%
COPE DRIVE	S177, R177	177	176		0.08			0.14						0.41	0.41	10.00	1.17	11.17	104.19	122.14	178.56	43.16				43.16	59.68	57.46	300			0.35	0.818	16.52	27.69%
BLOCK 345 (SCHOOL)	INST.2	BULKHEAD	176						6.57					14.61	14.61	12.00	0.15	12.15	94.70	110.96	162.13	1,383.66				1,383.66	1,575.26	12.00	1200			0.15	1.349	191.60	12.16%
COPE DRIVE	S176	176	175					0.14						0.29	21.36	16.50	1.05	17.55	79.01	92.51	135.05	1,687.52				1,687.52	2,332.02	80.65	1500			0.10	1.278	644.51	27.64%
COPE DRIVE	S175, R175	175	174		0.36			0.42						1.43	22.78	17.55	1.12	18.67	76.14	89.13	130.09	1,734.64				1,734.64	2,332.02	86.28	1500			0.10	1.278	597.38	25.62%
FINSBURY AVENUE	S182A,B, R182A,B,C	182	183		0.58			0.58						2.10	2.10	10.00	1.57	11.57	104.19	122.14	178.56	218.40				218.40	283.76	119.30	525			0.40	1.270	65.35	23.03%
PINNER ROAD	S191, R191A	191	186		0.19			0.60						1.54	1.54	10.00	0.55	10.55	104.19	122.14	178.56	160.61				160.61	378.96	43.00	600			0.35	1.298	218.35	57.62%
BELSIZE WAY	S127B, R127B, C	127	185		0.41			0.26						1.17	1.17	10.00	1.31	11.31	104.19	122.14	178.56	121.80				121.80	188.11	90.00	450			0.40	1.146	66.31	35.25%
BELSIZE WAY	---	185	186											0.00	1.17	11.31	1.29	12.60	97.75	114.56	167.42	114.27				114.27	175.96	82.92	450			0.35	1.072	61.69	35.06%
PINNER ROAD	S186, R186	186	187		0.23			0.23						0.83	3.54	12.60	1.38	13.97	92.21	108.04	157.85	326.60				326.60	473.55	70.83	825			0.10	0.858	146.95	31.03%
PINNER ROAD	---	187	183					0.00						0.00	3.54	13.97	0.19	14.17	87.03	101.93	148.88	308.22				308.22	473.55	10.00	825			0.10	0.858	165.33	34.91%
FINSBURY AVENUE	S183, R183	183	184		0.22			0.24						0.84	6.47	14.17	1.14	15.30	86.34	101.13	147.71	559.05				559.05	900.87	68.70	1050			0.10	1.008	341.82	37.94%
FINSBURY AVENUE	---	184	174					0.00						0.00	6.47	15.30	0.32	15.62	82.59	96.71	141.22	534.72				534.72	900.87	19.07	1050			0.10	1.008	366.15	40.64%
COPE DRIVE	S174, R174	174	173		0.12			0.25						0.70	29.96	18.67	0.94	19.61	73.30	85.80	125.21	2,196.41				2,196.41	3,792.13	81.44	1800			0.10	1.444	1595.72	42.08%
COPE DRIVE	S173	173	172					0.29						0.60	30.57	19.61	0.84	20.46	71.11	83.22	121.43	2,173.69				2,173.69	3,792.13	73.01	1800			0.10	1.444	1618.44	42.68%
BLOCK 313 (SCHOOL)	INST.1	BULKHEAD	172						2.88					6.41	6.41	12.00	0.25	12.25	94.70	110.96	162.13	606.54				606.54	755.43	17.02	900			0.16	1.150	148.90	19.71%
COPE DRIVE	S172	172	171					0.23						0.48	37.45	20.46	0.93	21.39	69.27	81.05	118.25	2,594.13				2,594.13	3,792.13	80.84	1800			0.10	1.444	1198.00	31.59%
DAGENHAM STREET	S180A,B, R180A	180	181		0.09			0.37						0.91	0.91	10.00	1.42	11.42	104.19	122.14	178.56	94.72				94.72	245.74	94.00	525			0.30	1.100	151.02	61.46%
DAGENHAM STREET	S181, R181	181	171		0.09			0.14						0.43	1.34	11.42	1.23	12.66	97.23	113.94	166.51	130.14				130.14	286.47	72.50	600			0.20	0.982	156.32	54.57%
COPE DRIVE	S171	171	170					0.26						0.54	39.33	21.39	0.94	22.33	67.34	78.79	114.94	2,648.73				2,648.73	3,792.13	81.06	1800			0.10	1.444	1143.40	30.15%
BLOCK 312	RES.3A	CBMH549	sewer				3.26							5.98	5.98	12.00	0.22	12.22	94.70	110.96	162.13	566.42				566.42	844.60	16.74	900			0.20	1.286	278.18	32.94%
COPE DRIVE	S170A,B	170	110					0.33						0.69	46.00	22.33	1.33	23.66	65.53	76.66	111.82	3,014.45				3,014.45	4,694.42	121.89	1950			0.10	1.523	1679.97	35.79%
GOLDHAWK DRIVE	S110B	110	205			0.47								0.85	71.92	25.62	0.83	26.45	59.93	70.09	102.19	4,310.29				4,310.29	11,180.46	94.32	2700			0.10	1.892	6870.17	61.45%
														0.00																					
GOLDHAWK DRIVE	INST.3	BULKHEAD	205						2.47					5.49	5.49	12.00	0.17	12.17	94.70	110.96	162.13	520.19				520.19	620.09	17.00	675			0.50	1.679	99.90	16.11%
GOLDHAWK DRIVE	205A, 205B	205	206			1.46								2.64	80.05	26.45	0.94	27.39	58.68	68.62	100.04	4,697.53				4,697.53	11,180.46	107.00	2700			0.10	1.892	6482.93	57.98%
GOLDHAWK DRIVE	S206	206	207			0.84								1.52	81.57	27.39	0.90	28.29	57.33	67.04	97.72	4,676.48				4,676.48	11,726.17	107.16	2700			0.11	1.984	7049.69	60.12%
														0.00																					
STREET NO. 2	RES. 4, 6 & 7		207			22.96			1.89					45.69	45.69	10.00	0.83	10.83	104.19	122.14	178.56	4,760.80				4,760.80	5,720.16	80.00	2100			0.10	1.600	959.36	16.77%
STREET NO. 2	S305	305	CULVERT			0.03								0.05	0.05												13,335.43	22.00	1500			3.27	7.311	13335.43	100.00%
STREET NO. 26	S304	304	CULVERT			0.03								0.05	0.05												12,579.97	22.00	1500			2.91	6.896	12579.97	100.00%
FUTURE STREET	S304B	304	303			0.69								1.25	1.25												5,720.16	98.94	2100			0.10	1.600	5720.16	100.00%
GOLDHAWK DRIVE	S303, S306	303	302			3.19								5.76	7.01												5,720.16	94.58	2100			0.10	1.600	5720.16	100.00%
GOLDHAWK DRIVE	S302,Park3,Res 5	302	301	1.36		10.06								18.93	25.95	These pipes are sized by stormwater modeling (See Design Brief-Fernbank Pond 5 Stormwater Management Facility Report)											5,720.16	70.65	2100			0.10	1.600	5720.16	100.00%
GOLDHAWK DRIVE	S301	301	207			0.49								0.89	26.83												5,720.16	70.00	2100			0.10	1.600	5720.16	100.00%
STREET NO. 25	---	207	300											0.00	154.09												2,332.02	93.73	1500			0.10	1.278	2332.02	100.00%
POND		300	HEADWALL	9.21		52.74								100.42	254.51												3,006.86	75.63	1650			0.10	1.362	3006.86	100.00%

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1174.184 / (TC+6.014)^0.816] 10 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed: J.I.M.
Checked: P.K.
Dwg. Reference: 27970 - 500, 500A, 500B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	3 of 3

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ____________________

Date ____________________ 2017

Plan Number ____________________

LEGEND :

AREA NUMBER
RUN OFF COEFFICIENT
AREA IN HECTARES
FUTURE MINOR FLOW DIRECTION

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

IBI GROUP
400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
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ibigroup.com

Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

EXTERNAL STORM DRAINAGE

AREA PLAN

Scale 1:2500

Design	Date
J.I.M.	OCTOBER '12
Drawn: M.M.	Checked: P.K.
Project No.: 27970	Drawing No.: 500

D07-16-11-0003

#17366

CONT'D ON DWG
27970-500B

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND :

S145 — AREA ID #
0.34 | 0.75 — RUN OFF COEFFICIENT; AREA IN HECTARES
⇨ FUTURE MINOR FLOW DIRECTION

NOTES:

1. THIS ALLOWANCE IS FOR OPA66 EXPANSION AREAS 6a, 6b AND 6c.

2. AN ALLOWANCE OF 100l/s HAS BEEN MADE FOR FLOWS TRIBUTARY TO THE LAIRD STREET PUMP STATION.

No.	REVISIONS	By	Date
14			
13			
12			
11			
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9			
8	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
7	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
6	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
5	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
4	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
3	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
2	REVISIONS AS PER RELOCATION OF FOUNDER AVENUE	JIM	13:12:12
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

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Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

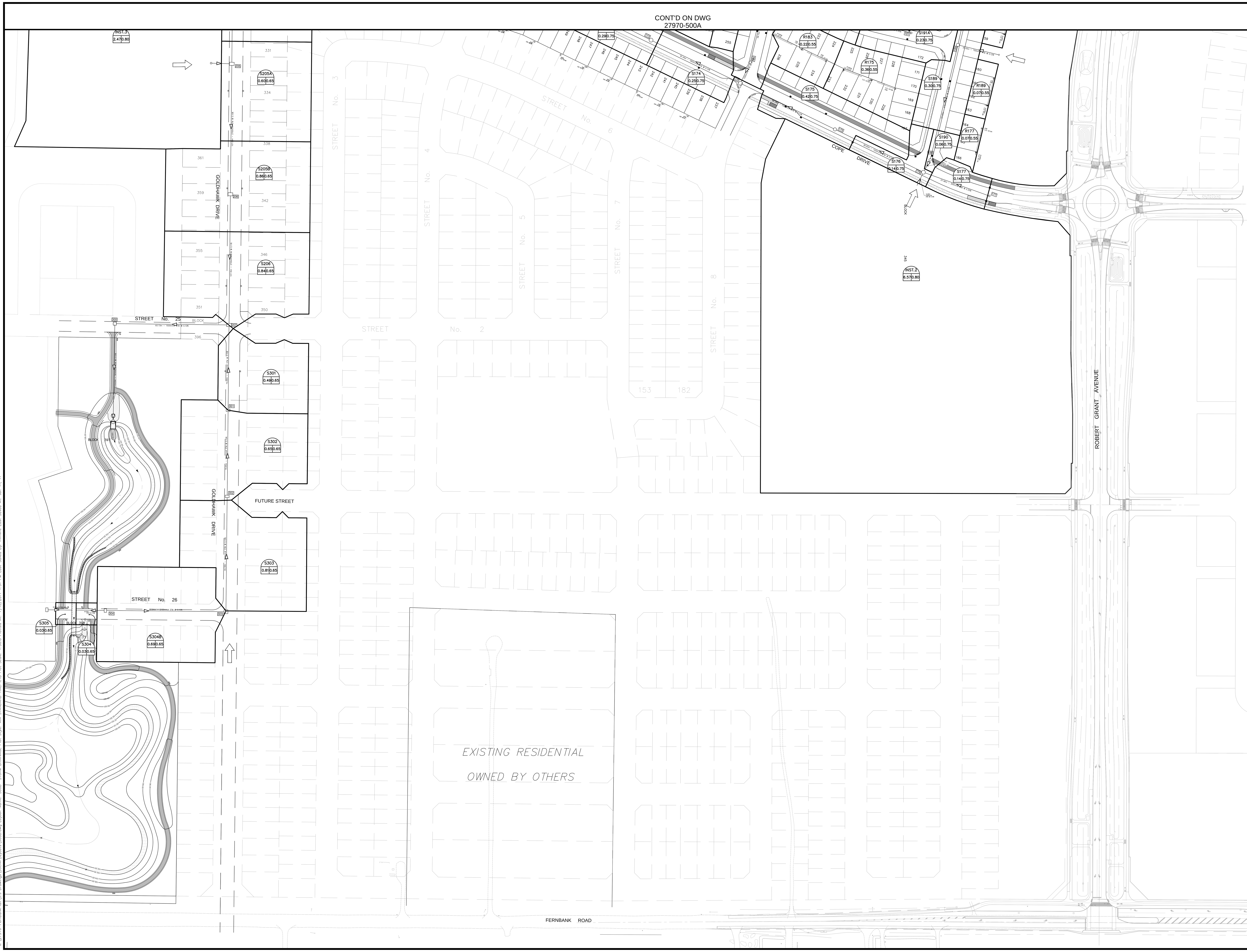
STORM DRAINAGE
AREA PLAN

Scale: 1:1250

Design	Date
J.I.M.	OCTOBER '12
Drawn	**Checked**
M.M.	P.K.
Project No.	**Drawing No.**
27970	500A

D07-16-11-0003

#17366



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND :

S145 — AREA ID #

0.34 — RUN OFF COEFFICIENT

0.75 — AREA IN HECTARES

FUTURE MINOR FLOW DIRECTION

NOTES:

1. THIS ALLOWANCE IS FOR OPA66 EXPANSION AREAS 6a, 6b AND 6c.

2. AN ALLOWANCE OF 100l/s HAS BEEN MADE FOR FLOWS TRIBUTARY TO THE LAIRD STREET PUMP STATION.

No.	REVISIONS	By	Date
14			
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7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

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Project Title

CRT LANDS FERNBANK COMMUNITY PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

N

Drawing Title

STORM DRAINAGE AREA PLAN

Scale: 1:1250

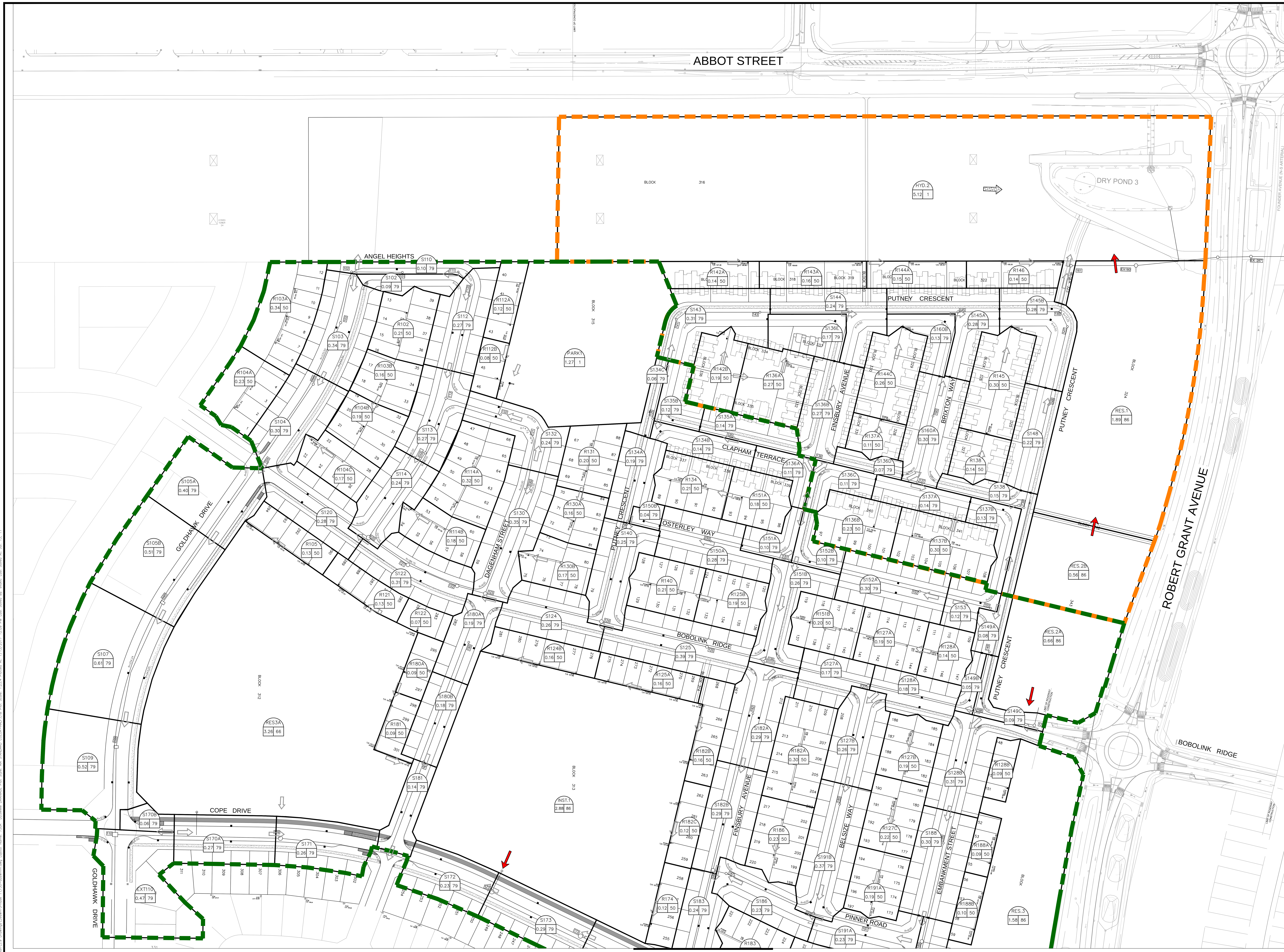
Design	Date
J.I.M.	OCTOBER '12
Drawn	Checked
M.M.	P.K.
Project No.	Drawing No.
27970	500B

D07-16-11-0003

#17366

APPENDIX F

- Drawings 27970-750A, 750B, 751A, 751B
- Phase 1A: Correspondence with Novatech confirming maximum allowable release rate and boundary condition
- Depth and Velocity Results
- Cross-sections of side lots
- XPSWMM schematic
- Summary of HGL
- CD of model files



CONT'D ON DWG
27970-750B

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ____________________

Date ____________________ 2017

Plan Number ____________________

LEGEND:

- DRAINAGE BOUNDARIES
- S188 / 0.30 75 — AREA ID; Imp.(%); AREA (ha)
- MINOR SYSTEM: DRAINAGE AREA TRIBUTARY TO POND 5 - PHASE 1A
- MINOR SYSTEM: DRAINAGE AREA TRIBUTARY TO POND 6 - PHASE 1
- MAJOR FLOW
- TOTAL FLOW
- EMERGENCY FLOW

No.	REVISIONS	By	Date
14			
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3	RESUBMISSION FOR MOE APPROVAL	M.B.	17:07:14
2	SUBMISSION FOR MOE APPROVAL	M.B.	17:02:10
1	SUBMISSION No. 5 FOR CITY REVIEW	M.B.	16/11/10

CRT DEVELOPMENT INC.

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Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER M.S.BLACK 100101736 2017/07/14 PROVINCE OF ONTARIO

N

Drawing Title

DDSWMM DRAINAGE
AREA PLAN

Scale 1:1250

Design	Date
M.B.	NOV. 2016
Drawn	**Checked**
S.V.	P.S.
Project No.	**Drawing No.**
27970	750A

D07-16-11-0003

#17366

CONT'D ON DWG
27970-750A

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND:

- DRAINAGE BOUNDARIES
- S188 / 0.30 / 75 — AREA ID / Imp.(%) / AREA (ha)
- MINOR SYSTEM: DRAINAGE AREA TRIBUTARY TO POND 5 - PHASE 1A
- MINOR SYSTEM: DRAINAGE AREA TRIBUTARY TO POND 6 - PHASE 1
- MAJOR FLOW
- TOTAL FLOW
- EMERGENCY FLOW

No.	REVISIONS	By	Date
14			
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4			
3	RESUBMISSION FOR MOE APPROVAL	M.B.	17:07:14
2	SUBMISSION FOR MOE APPROVAL	M.B.	17:02:10
1	SUBMISSION No. 5 FOR CITY REVIEW	M.B.	16/11/10

CRT DEVELOPMENT INC.

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ibigroup.com

Project Title
CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
M.S.BLACK
100101736
2017/07/14
PROVINCE OF ONTARIO

N

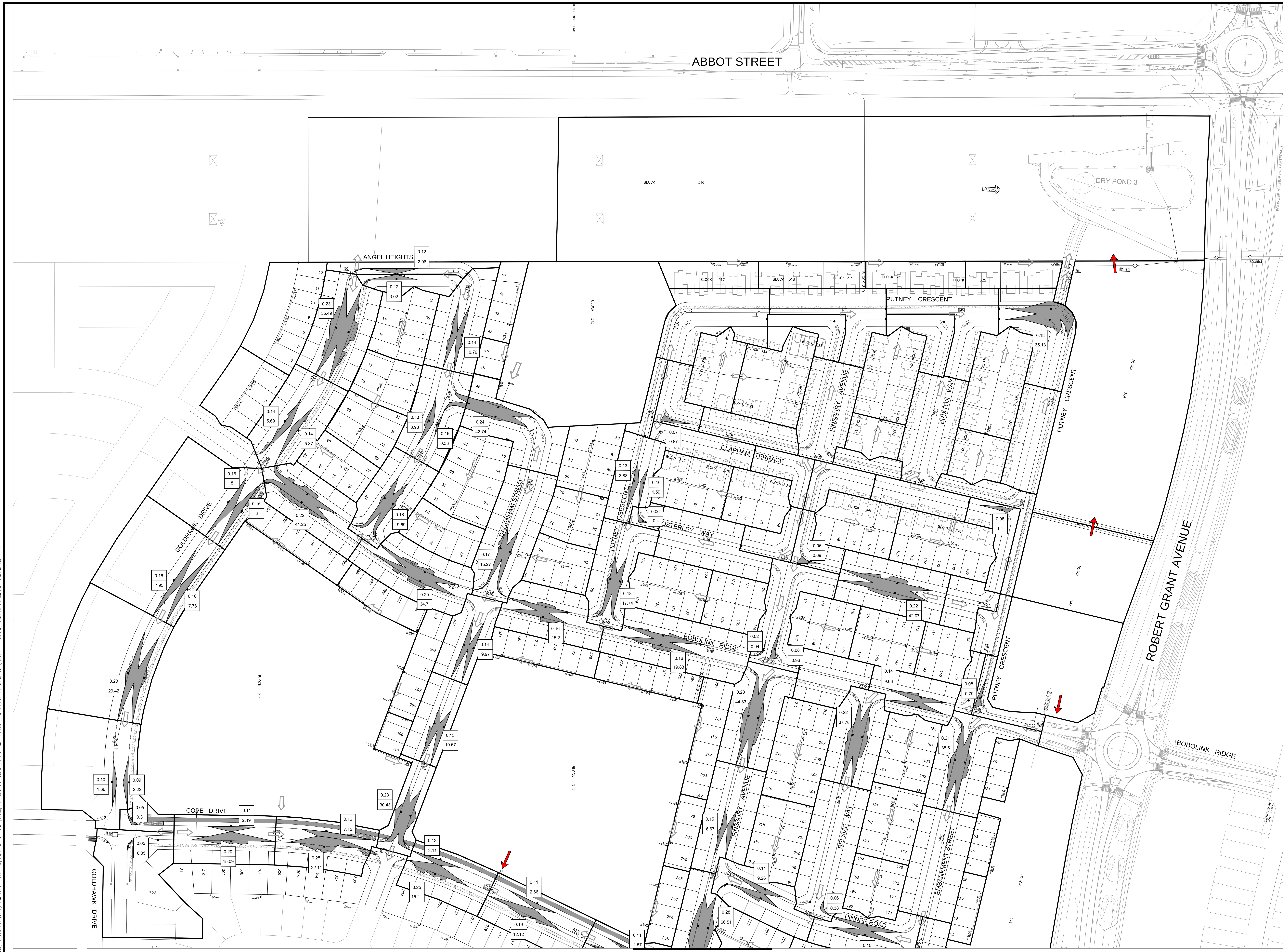
Drawing Title
DDSWMM DRAINAGE AREA PLAN

Scale
1:1250

Design	Date
M.B.	NOV. 2016
Drawn	Checked
S.V.	P.S.
Project No.	Drawing No.
27970	750B

D07-16-11-0003

#17366



CONT'D ON DWG
27970-751B

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ____________________

Date ____________________ 2017

Plan Number ____________________

LEGEND:

DRAINAGE BOUNDARIES

0.12 — DEPTH (m)

3.02 — VOLUME (m^3)

STATIC PONDING

MAJOR FLOW

TOTAL FLOW

EMERGENCY FLOW

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6			
5			
4			
3	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
2	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
1	SUBMISSION No. 5 FOR CITY REVIEW	M.B.	16/11/10

CRT DEVELOPMENT INC.

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Project Title

CRT LANDS FERNBANK COMMUNITY PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

PONDING

Scale: 1:1250

Design: J.I.M.

Date: NOV. 2016

Drawn: S.V.

Checked: J.I.M.

Project No.: 27970

Drawing No.: 751A

D07-16-11-0003

#17366

CONT'D ON DWG
27970-751A

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ____________________

Date ____________________ 2017

Plan Number ____________________

LEGEND:

- DRAINAGE BOUNDARIES
- 0.12 DEPTH (m)
- 3.02 VOLUME (m³)
- STATIC PONDING
- MAJOR FLOW
- TOTAL FLOW
- EMERGENCY FLOW

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6			
5			
4			
3	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
2	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
1	SUBMISSION No. 5 FOR CITY REVIEW	JIM	16/11/10

CRT DEVELOPMENT INC.

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Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

N

Drawing Title

PONDING

Scale

1:1250

Design	Date
J.I.M.	NOV. 2016

Drawn	Checked
S.V.	J.I.M.

Project No.	Drawing No.
27970	751B

D07-16-11-0003

#17366

Meghan Black

From: Mike Petepiece <m.petepiece@novatech-eng.com>
Sent: Monday, November 07, 2016 1:59 PM
To: Meghan Black
Subject: RE: Major flow hydrograph to dry pond

Hi Meghan,
I added your major system hydrograph to our model and can confirm that the dry pond will have sufficient storage to accommodate the major system runoff volume and peak flow. Let me know what you need from us to satisfy the City's review requirements.
Regards,

Michael Petepiece, P.Eng Project Manager
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 x235 | Fax: 613.254.5867

From: Meghan Black [mailto:mblack@IBIGroup.com]
Sent: Monday, November 07, 2016 12:45 PM
To: Mike Petepiece <m.petepiece@novatech-eng.com>
Subject: Major flow hydrograph to dry pond

Hi Mike,

Please find attached the major flow hydrograph to the existing dry pond (100 year peak flow 1.25 cms). Can you please confirm this flow is acceptable?

With respect to the minor system, PH1A is restricted to 1200 l/s, the allowable release rate to the existing storm outlet. The corresponding boundary condition is 100.59 m.

Thank you,
Meghan

Meghan Black P.Eng., LEED® AP

Associate | Manager, Water/Wastewater
email mblack@IBIGroup.com web www.ibigroup.com

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Ottawa ON K1S 5N4 Canada
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IBI Defining the cities of tomorrow

Velocity x Depth Calculation

Iteration equation:

Velocity:

$$v_x = v_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}}(v_{\max} - v_{\min})$$

Depth:

$$d_x = d_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}}(d_{\max} - d_{\min})$$

100 Year 3 Hour Chicago Storm Phase 1																				
					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area					Continuous Grade Profile: SWMHYMO PH1VXD.out					
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S153	18	1.33	**29**	**0.029**	0.011	0.032	0.488	0.639	**0.617**	0.029	0.036	0.055	0.060	**0.055**	0.026	0.039	**0.037**	0.000	**0.037**	0.023
S149A	18	0.53	**43**	**0.043**	0.043	0.078	0.489	0.566	**0.489**	0.042	0.051	0.065	0.070	**0.066**	0.052	0.064	**0.052**	0.000	**0.052**	0.025
S149C	18	0.53	**104**	**0.104**	0.096	0.119	0.886	0.935	**0.903**	0.100	0.115	0.090	0.095	**0.091**	0.081	0.088	**0.083**	0.080	**0.163**	0.075
S149B	18	0.55	**71**	**0.071**	0.057	0.072	0.621	0.658	**0.656**	0.061	0.073	0.075	0.080	**0.079**	0.074	0.081	**0.081**	0.000	**0.081**	0.053
S128A(D1)	18	0.51	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.140	**0.140**	N/A
S127B(D2)	18	0.69	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.220	**0.220**	N/A
S191B	18	0.69	**57**	**0.057**	0.049	0.089	0.558	0.646	**0.576**	0.051	0.061	0.070	0.075	**0.073**	0.052	0.064	**0.054**	0.060	**0.114**	0.031
S128B(D3)	18	0.53	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.210	**0.210**	N/A
S188	18	0.53	**88**	**0.088**	0.078	0.127	0.566	0.639	**0.581**	0.086	0.100	0.085	0.090	**0.086**	0.064	0.077	**0.067**	0.000	**0.067**	0.039
S189(D4)	18	0.54	**36**	**0.036**	0.020	0.043	0.403	0.489	**0.463**	0.034	0.042	0.060	0.065	**0.061**	N/A	N/A	**N/A**	0.110	**0.171**	0.028
S191A(D5)	18	0.97	**45**	**0.045**	0.027	0.058	0.543	0.658	**0.610**	0.043	0.053	0.065	0.070	**0.066**	N/A	N/A	**N/A**	0.150	**0.216**	0.040
S186(D6)	18	1.14	**58**	**0.058**	0.029	0.063	0.592	0.717	**0.699**	0.053	0.063	0.070	0.075	**0.072**	N/A	N/A	**N/A**	0.140	**0.212**	0.051
S152A(D7)	18	0.69	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.220	**0.220**	N/A
S152B	18	0.52	**32**	**0.032**	0.024	0.033	0.502	0.543	**0.538**	0.027	0.034	0.055	0.060	**0.059**	0.054	0.061	**0.060**	0.060	**0.120**	0.032
S151B(D8)	18	0.61	**113**	**0.113**	0.084	0.137	0.607	0.686	**0.650**	0.100	0.115	0.090	0.095	**0.094**	N/A	N/A	**N/A**	0.050	**0.144**	0.061
S127A	18	0.51	**41**	**0.041**	0.020	0.042	0.396	0.479	**0.475**	0.034	0.042	0.060	0.065	**0.064**	0.039	0.052	**0.051**	0.000	**0.051**	0.024
S182A(D9)	18	1.04	**49**	**0.049**	0.028	0.060	0.565	0.685	**0.644**	0.043	0.053	0.065	0.070	**0.068**	N/A	N/A	**N/A**	0.230	**0.298**	0.044
S182B(D10)	18	1.14	**42**	**0.042**	0.029	0.063	0.592	0.717	**0.640**	0.035	0.043	0.060	0.065	**0.064**	N/A	N/A	**N/A**	0.130	**0.194**	0.041
S183(D11)	18	0.7	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.280	**0.280**	N/A
S190	18	0.62	**10**	**0.010**	0.007	0.012	0.395	0.446	**0.426**	0.008	0.011	0.035	0.040	**0.038**	0.034	0.040	**0.038**	0.050	**0.088**	0.016
S177	26	0.52	**45**	**0.045**	0.030	0.064	0.528	0.621	**0.569**	0.042	0.051	0.065	0.070	**0.067**	0.059	0.078	**0.067**	0.000	**0.067**	0.038
S176	26	0.52	**53**	**0.053**	0.051	0.063	0.600	0.633	**0.606**	0.051	0.061	0.070	0.075	**0.071**	0.071	0.077	**0.072**	0.000	**0.072**	0.044
S175(D12)	26	0.55	**141**	**0.141**	0.115	0.198	0.682	0.755	**0.705**	0.132	0.150	0.100	0.105	**0.102**	N/A	N/A	**N/A**	0.110	**0.212**	0.072
S174(D13)	26	0.55	**98**	**0.098**	0.065	0.115	0.639	0.682	**0.667**	0.086	0.100	0.085	0.090	**0.089**	N/A	N/A	**N/A**	0.155	**0.244**	0.060
S173(D14)	26	0.81	**143**	**0.143**	0.140	0.241	0.828	0.917	**0.831**	0.136	0.155	0.100	0.105	**0.102**	N/A	N/A	**N/A**	0.145	**0.247**	0.085
S172(D15)	26	0.73	**134**	**0.134**	0.133	0.228	0.786	0.870	**0.787**	0.132	0.150	0.100	0.105	**0.101**	N/A	N/A	**N/A**	0.165	**0.266**	0.079
S135A	18	0.56	**37**	**0.037**	0.034	0.045	0.559	0.599	**0.570**	0.034	0.042	0.060	0.065	**0.062**	0.061	0.067	**0.063**	0.000	**0.063**	0.036
S135B	18	0.91	**70**	**0.070**	0.058	0.074	0.764	0.814	**0.802**	0.063	0.075	0.075	0.080	**0.078**	0.067	0.074	**0.072**	0.070	**0.142**	0.058
S134C	18	0.51	**15**	**0.015**	0.011	0.017	0.407	0.452	**0.437**	0.011	0.016	0.040	0.045	**0.044**	0.040	0.047	**0.045**	0.000	**0.045**	0.020
S136A	18	0.56	**29**	**0.029**	0.025	0.034	0.516	0.559	**0.535**	0.027	0.034	0.055	0.060	**0.057**	0.054	0.061	**0.057**	0.000	**0.057**	0.031
S134B	18	0.56	**57**	**0.057**	0.045	0.058	0.599	0.639	**0.636**	0.051	0.061	0.070	0.075	**0.073**	0.067	0.074	**0.073**	0.000	**0.073**	0.047
S134A(D16)	18	1	**123**	**0.123**	0.108	0.175	0.778	0.878	**0.800**	0.119	0.136	0.095	0.100	**0.096**	N/A	N/A	**N/A**	0.115	**0.211**	0.077

100 Year 3 Hour Chicago Storm Phase 1

Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		SWMHYMO PH1VXD.out: Flowrate (cms)		SWMHYMO PH1VXD.out: Velocity (m/s)			Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area: Flowrate (cms)		Sawtooth Profile: Dynamic Depth (m)			Continuous Grade Profile: SWMHYMO PH1VXD.out: Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S151A	18	0.52	**25**	**0.025**	0.024	0.033	0.502	0.543	**0.507**	0.021	0.027	0.050	0.055	**0.053**	0.054	0.061	**0.055**	0.000	**0.055**	0.028
S150A	18	0.79	**91**	**0.091**	0.053	0.096	0.597	0.691	**0.680**	0.088	0.103	0.085	0.090	**0.086**	0.052	0.064	**0.063**	0.000	**0.063**	0.043
S150B	18	1	**12**	**0.012**	0.010	0.015	0.505	0.571	**0.531**	0.012	0.016	0.040	0.045	**0.040**	0.034	0.040	**0.036**	0.060	**0.096**	0.019
S140(D17)	18	0.86	**188**	**0.188**	0.162	0.245	0.814	0.902	**0.842**	0.176	0.198	0.110	0.115	**0.113**	N/A	N/A	**N/A**	0.180	**0.293**	0.095
S125(D18)	18	0.55	**8**	**0.008**	0.007	0.021	0.316	0.415	**0.323**	0.005	0.008	0.030	0.035	**0.035**	N/A	N/A	**N/A**	0.160	**0.195**	0.011
S124(D19)	18	0.66	**185**	**0.185**	0.142	0.214	0.713	0.791	**0.760**	0.170	0.192	0.110	0.115	**0.113**	N/A	N/A	**N/A**	0.160	**0.273**	0.086
S130(D20)	18	0.66	**71**	**0.071**	0.048	0.087	0.545	0.632	**0.596**	0.061	0.073	0.075	0.080	**0.079**	N/A	N/A	**N/A**	0.170	**0.249**	0.047
S180A(D21)	18	1.17	**186**	**0.186**	0.116	0.189	0.841	0.950	**0.946**	0.176	0.198	0.110	0.115	**0.112**	N/A	N/A	**N/A**	0.140	**0.252**	0.106
S180B(D22)	18	1.12	**97**	**0.097**	0.063	0.114	0.710	0.823	**0.785**	0.088	0.103	0.085	0.090	**0.088**	N/A	N/A	**N/A**	0.150	**0.238**	0.069
S181(D23)	18	0.73	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.230	**0.230**	N/A
S170A(D24)	26	0.92	**5**	**0.005**	0.002	0.014	0.338	0.536	**0.388**	0.003	0.006	0.025	0.030	**0.029**	N/A	N/A	**N/A**	0.155	**0.184**	0.011
S171(D25)	26	0.73	**69**	**0.069**	0.036	0.075	0.625	0.736	**0.719**	0.061	0.073	0.075	0.080	**0.078**	N/A	N/A	**N/A**	0.205	**0.283**	0.056
S132(D26)	18	0.67	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.240	**0.240**	N/A
S112(D27)	18	0.67	**21**	**0.021**	0.008	0.022	0.344	0.450	**0.442**	0.021	0.027	0.050	0.055	**0.050**	N/A	N/A	**N/A**	0.140	**0.190**	0.022
S113(D28)	18	0.99	**36**	**0.036**	0.028	0.059	0.554	0.671	**0.584**	0.035	0.043	0.060	0.065	**0.061**	N/A	N/A	**N/A**	0.095	**0.156**	0.035
S114(D29)	18	0.83	**101**	**0.101**	0.098	0.159	0.708	0.800	**0.713**	0.088	0.103	0.085	0.090	**0.089**	N/A	N/A	**N/A**	0.180	**0.269**	0.064
S122(D30)	18	0.83	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.200	**0.200**	N/A
S120(D31)	18	0.7	**36**	**0.036**	0.023	0.049	0.460	0.558	**0.509**	0.034	0.042	0.060	0.065	**0.061**	N/A	N/A	**N/A**	0.220	**0.281**	0.031
S110(D32)	18	0.55	**20**	**0.020**	0.017	0.025	0.473	0.516	**0.489**	0.016	0.021	0.045	0.050	**0.049**	N/A	N/A	**N/A**	0.120	**0.169**	0.024
S102(D33)	18	0.55	**14**	**0.014**	0.012	0.017	0.427	0.473	**0.445**	0.011	0.016	0.040	0.045	**0.043**	N/A	N/A	**N/A**	0.120	**0.163**	0.019
S103(D34)	24	0.71	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.230	**0.230**	N/A
S104(D35)	24	0.7	**114**	**0.114**	0.071	0.129	0.613	0.711	**0.686**	0.100	0.115	0.090	0.095	**0.095**	N/A	N/A	**N/A**	0.140	**0.235**	0.065
S105A(D36)	24	0.55	**203**	**0.203**	0.186	0.280	0.712	0.789	**0.726**	0.192	0.215	0.115	0.120	**0.117**	N/A	N/A	**N/A**	0.160	**0.277**	0.085
S105B(D37)	24	0.6	**164**	**0.164**	0.119	0.194	0.658	0.743	**0.709**	0.150	0.170	0.105	0.110	**0.108**	N/A	N/A	**N/A**	0.160	**0.268**	0.077
S107(D38)	24	0.6	**122**	**0.122**	0.119	0.194	0.658	0.743	**0.661**	0.115	0.132	0.095	0.100	**0.097**	N/A	N/A	**N/A**	0.200	**0.297**	0.064
S109(D39)	24	0.68	**106**	**0.106**	0.071	0.129	0.613	0.711	**0.672**	0.100	0.115	0.090	0.095	**0.092**	N/A	N/A	**N/A**	0.110	**0.202**	0.062
S170B	26	0.68	**9**	**0.009**	0.002	0.011	0.244	0.387	**0.355**	0.008	0.011	0.035	0.040	**0.036**	0.015	0.029	**0.026**	0.050	**0.076**	0.009

Velocity x Depth Calculation

Iteration equation:

Velocity:

$$v_x = v_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}} (v_{\max} - v_{\min})$$

Depth:

$$d_x = d_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}} (d_{\max} - d_{\min})$$

Phase 1A
100 Year 3 Hour Chicago Storm

					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area					Continuous Grade Profile: SWMHYMO PH1VXD.out					
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S143	18	1.65	**82**	**0.082**	0.076	0.138	0.862	0.999	**0.875**	0.078	0.091	0.080	0.085	**0.082**	0.052	0.064	**0.053**	0.000	**0.053**	0.047
S136E	18	0.83	**143**	**0.143**	0.098	0.159	0.708	0.800	**0.776**	0.136	0.155	0.100	0.105	**0.102**	0.064	0.077	**0.074**	0.000	**0.074**	0.057
S136B	18	2.58	**67**	**0.067**	0.044	0.095	0.890	1.078	**0.975**	0.065	0.078	0.075	0.080	**0.076**	0.039	0.052	**0.045**	0.000	**0.045**	0.044
S144	18	0.83	**392**	**0.392**	0.343	0.470	0.969	1.048	**0.999**	0.390	0.430	0.145	0.150	**0.145**	0.103	0.116	**0.108**	0.000	**0.108**	0.108
S160B	18	0.89	**82**	**0.082**	0.056	0.101	0.633	0.734	**0.691**	0.075	0.088	0.080	0.085	**0.083**	0.052	0.064	**0.059**	0.000	**0.059**	0.041
S136D	18	0.78	**18**	**0.018**	0.014	0.021	0.504	0.558	**0.535**	0.016	0.021	0.045	0.050	**0.047**	0.040	0.047	**0.044**	0.000	**0.044**	0.024
S160A	18	1.25	**96**	**0.096**	0.066	0.120	0.751	0.869	**0.817**	0.091	0.106	0.085	0.090	**0.087**	0.052	0.064	**0.059**	0.000	**0.059**	0.048
S145A	18	2.75	**547**	**0.547**	0.486	0.647	1.085	1.170	**1.117**	0.533	0.580	0.160	0.165	**0.162**	0.116	0.129	**0.121**	0.000	**0.121**	0.135
S136C	18	0.78	**30**	**0.030**	0.029	0.040	0.609	0.659	**0.614**	0.028	0.035	0.055	0.060	**0.057**	0.054	0.061	**0.055**	0.000	**0.055**	0.034
S137A	18	0.51	**125**	**0.125**	0.106	0.127	0.716	0.749	**0.746**	0.115	0.132	0.095	0.100	**0.098**	0.094	0.101	**0.100**	0.000	**0.100**	0.075
S137B(D1)	18	1.61	**99**	**0.099**	0.099	0.125	1.083	1.147	**1.083**	0.091	0.106	0.085	0.090	**0.088**	N/A	N/A	**N/A**	0.070	**0.158**	0.095
S138	18	1.61	**128**	**0.128**	0.125	0.154	1.147	1.210	**1.154**	0.123	0.141	0.095	0.100	**0.096**	0.081	0.088	**0.082**	0.000	**0.082**	0.094
S148	18	1.43	**160**	**0.160**	0.129	0.209	0.930	1.050	**0.977**	0.141	0.160	0.100	0.105	**0.105**	0.064	0.077	**0.069**	0.000	**0.069**	0.067
S145B	18	3.3	**688**	**0.688**	0.638	0.739	1.458	1.502	**1.480**	0.680	0.734	0.175	0.180	**0.176**	0.103	0.111	**0.107**	0.190	**0.297**	0.158
BLK335	N/A	2	**741**	**0.741**	0.739	0.848	1.502	1.543	**1.503**	0.734	0.789	0.180	0.185	**0.181**	0.111	0.118	**0.111**	0.000	**0.111**	0.167

Velocity x Depth Calculation

Iteration equation:

Velocity:

$$v_x = v_{min} + \frac{Q_x - Q_{min}}{Q_{max} - Q_{min}} (v_{max} - v_{min})$$

Depth:

$$d_x = d_{min} + \frac{Q_x - Q_{min}}{Q_{max} - Q_{min}} (d_{max} - d_{min})$$

100 Year 3 Hour Chicago Storm + 20% Phase 1																				
					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area						Continuous Grade Profile: SWMHYMO PH1VXD.out				
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S153	18	1.33	40	0.040	0.032	0.068	0.639	0.774	0.669	0.036	0.045	0.060	0.065	0.062	0.039	0.052	0.042	0.000	0.042	0.028
S149A	18	0.53	62	0.062	0.043	0.078	0.489	0.566	0.531	0.061	0.073	0.075	0.080	0.075	0.052	0.064	0.059	0.000	0.059	0.031
S149C	18	0.53	182	0.182	0.175	0.207	1.028	1.073	1.038	0.170	0.192	0.110	0.115	0.113	0.101	0.108	0.103	0.080	0.183	0.106
S149B	18	0.55	118	0.118	0.108	0.130	0.730	0.764	0.745	0.115	0.132	0.095	0.100	0.096	0.094	0.101	0.097	0.000	0.097	0.072
S128A(D1)	18	0.51	55	0.055	0.042	0.077	0.479	0.555	0.507	0.051	0.061	0.070	0.075	0.072	N/A	N/A	N/A	0.140	0.212	0.036
S127B(D2)	18	0.69	44	0.044	0.023	0.049	0.460	0.558	0.539	0.042	0.051	0.065	0.070	0.066	N/A	N/A	N/A	0.220	0.286	0.036
S191B	18	0.69	93	0.093	0.089	0.145	0.646	0.729	0.652	0.086	0.100	0.085	0.090	0.088	0.064	0.077	0.065	0.060	0.125	0.042
S128B(D3)	18	0.53	16	0.016	0.007	0.020	0.308	0.403	0.374	0.016	0.021	0.045	0.050	0.045	N/A	N/A	N/A	0.210	0.255	0.017
S188	18	0.53	119	0.119	0.078	0.127	0.566	0.639	0.627	0.115	0.132	0.095	0.100	0.096	0.064	0.077	0.075	0.000	0.075	0.047
S189(D4)	18	0.54	63	0.063	0.043	0.078	0.489	0.566	0.533	0.061	0.073	0.075	0.080	0.076	N/A	N/A	N/A	0.110	0.186	0.040
S191A(D5)	18	0.97	164	0.164	0.105	0.171	0.762	0.860	0.850	0.155	0.176	0.105	0.110	0.107	N/A	N/A	N/A	0.150	0.257	0.091
S186(D6)	18	1.14	241	0.241	0.187	0.282	0.937	1.039	0.995	0.222	0.247	0.120	0.125	0.124	N/A	N/A	N/A	0.140	0.264	0.123
S152A(D7)	18	0.69	13	0.013	0.008	0.023	0.351	0.460	0.387	0.011	0.016	0.040	0.045	0.042	N/A	N/A	N/A	0.220	0.262	0.016
S152B	18	0.52	50	0.050	0.044	0.057	0.583	0.621	0.601	0.042	0.051	0.065	0.070	0.069	0.067	0.074	0.070	0.060	0.130	0.042
S151B(D8)	18	0.61	189	0.189	0.137	0.206	0.686	0.760	0.742	0.170	0.192	0.110	0.115	0.114	N/A	N/A	N/A	0.050	0.164	0.085
S127A	18	0.51	58	0.058	0.042	0.077	0.479	0.555	0.514	0.051	0.061	0.070	0.075	0.073	0.052	0.064	0.057	0.000	0.057	0.030
S182A(D9)	18	1.04	156	0.156	0.110	0.178	0.793	0.895	0.862	0.155	0.176	0.105	0.110	0.105	N/A	N/A	N/A	0.230	0.335	0.091
S182B(D10)	18	1.14	158	0.158	0.115	0.187	0.830	0.937	0.894	0.155	0.176	0.105	0.110	0.106	N/A	N/A	N/A	0.130	0.236	0.094
S183(D11)	18	0.7	357	0.357	0.313	0.428	0.884	0.956	0.912	0.356	0.390	0.145	0.150	0.145	N/A	N/A	N/A	0.280	0.425	0.132
S190	18	0.62	16	0.016	0.012	0.018	0.446	0.494	0.478	0.016	0.021	0.045	0.050	0.045	0.040	0.047	0.045	0.050	0.095	0.021
S177	26	0.52	59	0.059	0.030	0.064	0.528	0.621	0.607	0.051	0.061	0.070	0.075	0.074	0.059	0.078	0.075	0.000	0.075	0.046
S176	26	0.52	72	0.072	0.063	0.077	0.633	0.665	0.654	0.061	0.073	0.075	0.080	0.080	0.077	0.083	0.081	0.000	0.081	0.053
S175(D12)	26	0.55	362	0.362	0.320	0.486	0.837	0.920	0.858	0.356	0.390	0.145	0.150	0.146	N/A	N/A	N/A	0.110	0.256	0.125
S174(D13)	26	0.55	531	0.531	0.486	0.703	0.920	1.002	0.937	0.504	0.556	0.165	0.170	0.168	N/A	N/A	N/A	0.155	0.323	0.157
S173(D14)	26	0.81	483	0.483	0.388	0.590	1.015	1.116	1.063	0.479	0.520	0.160	0.165	0.161	N/A	N/A	N/A	0.145	0.306	0.171
S172(D15)	26	0.73	812	0.812	0.810	1.159	1.155	1.289	1.156	0.791	0.856	0.190	0.195	0.192	N/A	N/A	N/A	0.165	0.357	0.221
S135A	18	0.56	50	0.050	0.045	0.058	0.599	0.639	0.614	0.042	0.051	0.065	0.070	0.069	0.067	0.074	0.070	0.000	0.070	0.043
S135B	18	0.91	118	0.118	0.116	0.141	0.910	0.956	0.914	0.103	0.119	0.090	0.095	0.095	0.088	0.094	0.088	0.070	0.158	0.081
S134C	18	0.51	21	0.021	0.017	0.024	0.452	0.493	0.475	0.021	0.027	0.050	0.055	0.050	0.047	0.054	0.051	0.000	0.051	0.024
S136A	18	0.56	39	0.039	0.034	0.045	0.559	0.599	0.577	0.034	0.042	0.060	0.065	0.063	0.061	0.067	0.064	0.000	0.064	0.037
S134B	18	0.56	80	0.080	0.074	0.091	0.677	0.714	0.690	0.073	0.086	0.080	0.085	0.083	0.081	0.088	0.083	0.000	0.083	0.058
S134A(D16)	18	1	214	0.214	0.175	0.264	0.878	0.973	0.920	0.198	0.222	0.115	0.120	0.118	N/A	N/A	N/A	0.115	0.233	0.109

100 Year 3 Hour Chicago Storm + 20% Phase 1																				
					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area					Continuous Grade Profile: SWMHYMO PH1VXD.out					
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S151A	18	0.52	**35**	**0.035**	0.033	0.044	0.543	0.583	**0.550**	0.034	0.042	0.060	0.065	**0.061**	0.061	0.067	**0.062**	0.000	**0.062**	0.034
S150A	18	0.79	**125**	**0.125**	0.096	0.155	0.691	0.780	**0.735**	0.119	0.136	0.095	0.100	**0.097**	0.064	0.077	**0.070**	0.000	**0.070**	0.052
S150B	18	1	**20**	**0.020**	0.015	0.023	0.571	0.632	**0.609**	0.016	0.021	0.045	0.050	**0.049**	0.040	0.047	**0.044**	0.060	**0.104**	0.027
S140(D17)	18	0.86	**332**	**0.332**	0.245	0.349	0.902	0.986	**0.972**	0.304	0.335	0.135	0.140	**0.140**	N/A	N/A	**N/A**	0.180	**0.320**	0.136
S125(D18)	18	0.55	**65**	**0.065**	0.044	0.080	0.502	0.582	**0.549**	0.061	0.073	0.075	0.080	**0.077**	N/A	N/A	**N/A**	0.160	**0.237**	0.042
S124(D19)	18	0.66	**388**	**0.388**	0.306	0.419	0.864	0.935	**0.916**	0.377	0.417	0.145	0.150	**0.146**	N/A	N/A	**N/A**	0.160	**0.306**	0.134
S130(D20)	18	0.66	**119**	**0.119**	0.087	0.142	0.632	0.713	**0.679**	0.115	0.132	0.095	0.100	**0.096**	N/A	N/A	**N/A**	0.170	**0.266**	0.065
S180A(D21)	18	1.17	**453**	**0.453**	0.407	0.558	1.151	1.244	**1.179**	0.430	0.473	0.150	0.155	**0.153**	N/A	N/A	**N/A**	0.140	**0.293**	0.180
S180B(D22)	18	1.12	**355**	**0.355**	0.279	0.399	1.030	1.126	**1.091**	0.351	0.390	0.140	0.145	**0.141**	N/A	N/A	**N/A**	0.150	**0.291**	0.153
S181(D23)	18	0.73	**268**	**0.268**	0.225	0.322	0.831	0.909	**0.866**	0.240	0.269	0.125	0.130	**0.130**	N/A	N/A	**N/A**	0.230	**0.360**	0.112
S170A(D24)	26	0.92	**38**	**0.038**	0.014	0.040	0.536	0.702	**0.689**	0.035	0.043	0.060	0.065	**0.062**	N/A	N/A	**N/A**	0.155	**0.217**	0.043
S171(D25)	26	0.73	**422**	**0.422**	0.368	0.560	0.964	1.060	**0.991**	0.390	0.425	0.150	0.155	**0.155**	N/A	N/A	**N/A**	0.205	**0.360**	0.153
S132(D26)	18	0.67	**144**	**0.144**	0.142	0.214	0.713	0.791	**0.715**	0.132	0.150	0.100	0.105	**0.103**	N/A	N/A	**N/A**	0.240	**0.343**	0.074
S112(D27)	18	0.67	**48**	**0.048**	0.048	0.087	0.545	0.632	**0.545**	0.042	0.051	0.065	0.070	**0.068**	N/A	N/A	**N/A**	0.140	**0.208**	0.037
S113(D28)	18	0.99	**131**	**0.131**	0.108	0.175	0.778	0.878	**0.812**	0.119	0.136	0.095	0.100	**0.098**	N/A	N/A	**N/A**	0.095	**0.193**	0.080
S114(D29)	18	0.83	**208**	**0.208**	0.159	0.240	0.800	0.886	**0.852**	0.198	0.222	0.115	0.120	**0.117**	N/A	N/A	**N/A**	0.180	**0.297**	0.100
S122(D30)	18	0.83	**13**	**0.013**	0.009	0.025	0.385	0.505	**0.415**	0.012	0.016	0.040	0.045	**0.041**	N/A	N/A	**N/A**	0.200	**0.241**	0.017
S120(D31)	18	0.7	**133**	**0.133**	0.089	0.145	0.646	0.729	**0.711**	0.132	0.150	0.100	0.105	**0.100**	N/A	N/A	**N/A**	0.220	**0.320**	0.071
S110(D32)	18	0.55	**34**	**0.034**	0.034	0.045	0.559	0.599	**0.559**	0.034	0.042	0.060	0.065	**0.060**	N/A	N/A	**N/A**	0.120	**0.180**	0.034
S102(D33)	18	0.55	**32**	**0.032**	0.025	0.034	0.516	0.559	**0.549**	0.027	0.034	0.055	0.060	**0.059**	N/A	N/A	**N/A**	0.120	**0.179**	0.032
S103(D34)	24	0.71	**33**	**0.033**	0.033	0.071	0.507	0.613	**0.507**	0.027	0.034	0.055	0.060	**0.059**	N/A	N/A	**N/A**	0.230	**0.289**	0.030
S104(D35)	24	0.7	**196**	**0.196**	0.129	0.210	0.711	0.803	**0.787**	0.192	0.215	0.115	0.120	**0.116**	N/A	N/A	**N/A**	0.140	**0.256**	0.091
S105A(D36)	24	0.55	**411**	**0.411**	0.400	0.548	0.862	0.933	**0.867**	0.390	0.425	0.150	0.155	**0.153**	N/A	N/A	**N/A**	0.160	**0.313**	0.133
S105B(D37)	24	0.6	**367**	**0.367**	0.293	0.418	0.824	0.901	**0.870**	0.356	0.390	0.145	0.150	**0.147**	N/A	N/A	**N/A**	0.160	**0.307**	0.128
S107(D38)	24	0.6	**330**	**0.330**	0.293	0.418	0.824	0.901	**0.847**	0.324	0.356	0.140	0.145	**0.141**	N/A	N/A	**N/A**	0.200	**0.341**	0.119
S109(D39)	24	0.68	**327**	**0.327**	0.316	0.452	0.890	0.973	**0.897**	0.324	0.356	0.140	0.145	**0.140**	N/A	N/A	**N/A**	0.110	**0.250**	0.126
S170B	26	0.68	**15**	**0.015**	0.011	0.033	0.387	0.507	**0.409**	0.011	0.016	0.040	0.045	**0.044**	0.029	0.044	**0.032**	0.050	**0.082**	0.013

Velocity x Depth Calculation

Iteration equation:

Velocity:

$$v_x = v_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}}\left(v_{\max} - v_{\min}\right)$$

Depth:

$$d_x = d_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}}\left(d_{\max} - d_{\min}\right)$$

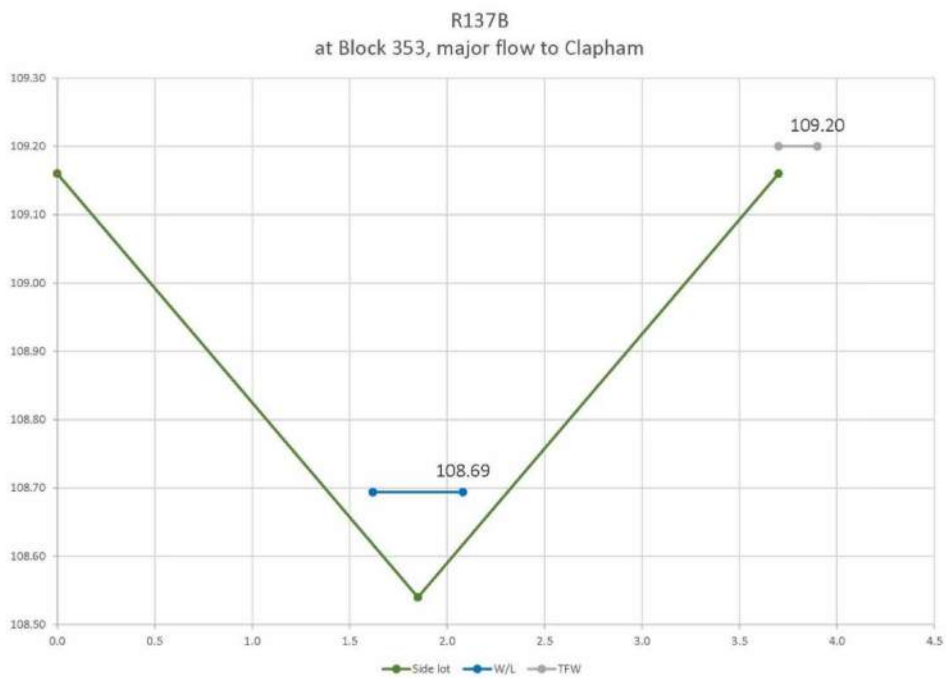
Phase 1A
100 Year 3 Hour Chicago Storm + 20%

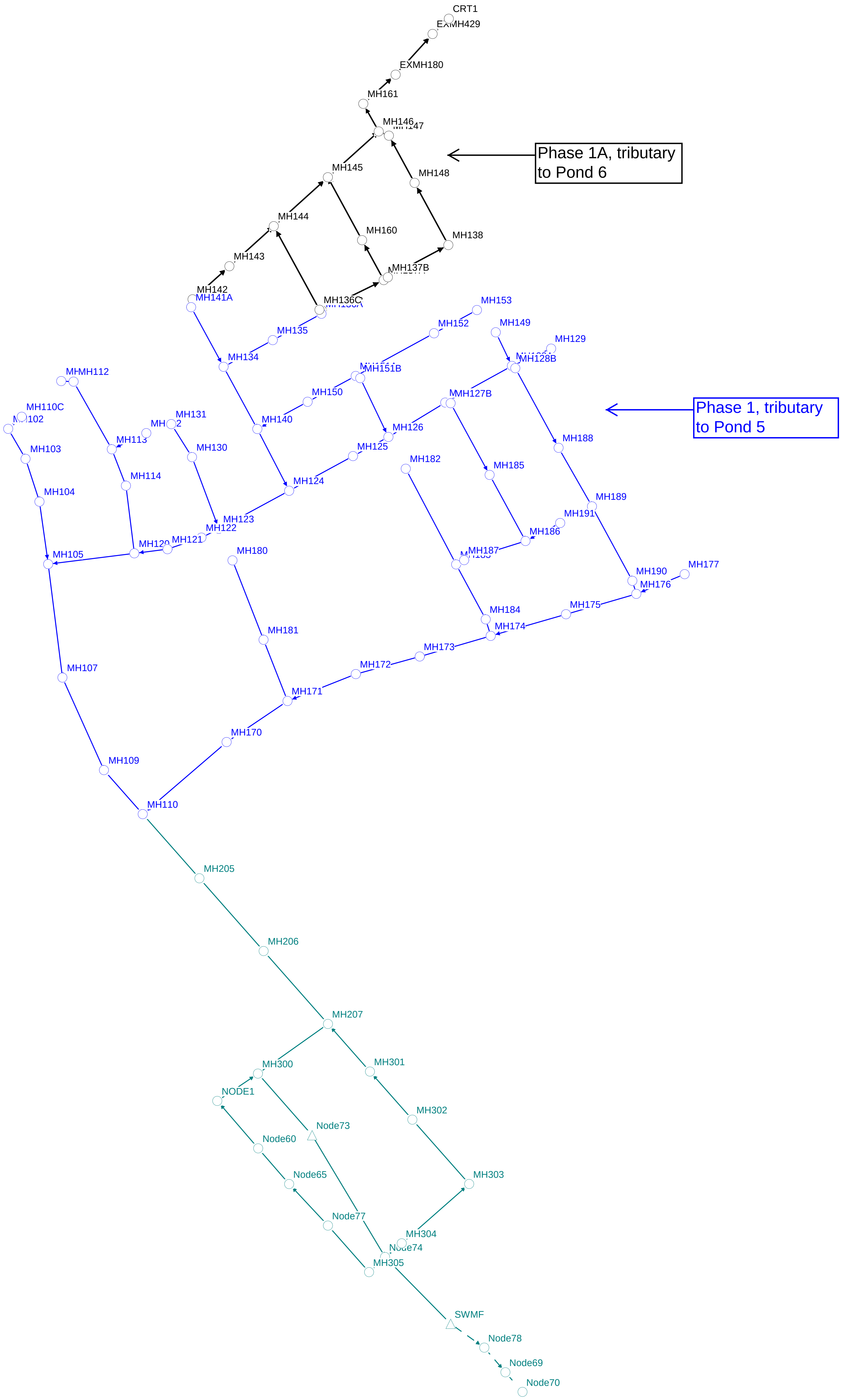
					SWMHYMO PH1VXD.out					**Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area**					**Continuous Grade Profile: SWMHYMO PH1VXD.out**					
			Overflow Flowrate		**Flowrate (cms)**		**Velocity (m/s)**			**Flowrate (cms)**		**Dynamic Depth (m)**			**Dynamic Depth (m)**			**Ponding Depth (m)**		**Velocity x Depth**
Area ID (Dummy Segment, if applicable)	**ROW (for Street Segments)**	**Longitudinal Slope (%)**	**Qx (l/s)**	**Qx (cms)**	**Qmin**	**Qmax**	**vmin**	**vmax**	**vx**	**Qmin**	**Qmax**	**dmin**	**dmax**	**dx**	**dmin**	**dmax**	**dx**	**Static**	**Maximum**	**(m^2/s)**
S143	18	1.65	**112**	**0.112**	0.076	0.138	0.862	0.999	**0.942**	0.106	0.123	0.090	0.095	**0.092**	0.052	0.064	**0.059**	0.000	**0.059**	0.056
S136E	18	0.83	**210**	**0.210**	0.159	0.240	0.800	0.886	**0.854**	0.198	0.222	0.115	0.120	**0.118**	0.077	0.090	**0.085**	0.000	**0.085**	0.073
S136B	18	2.58	**93**	**0.093**	0.044	0.095	0.890	1.078	**1.071**	0.091	0.106	0.085	0.090	**0.086**	0.039	0.052	**0.051**	0.000	**0.051**	0.055
S144	18	0.83	**574**	**0.574**	0.470	0.625	1.048	1.130	**1.103**	0.563	0.610	0.165	0.170	**0.166**	0.116	0.129	**0.125**	0.000	**0.125**	0.138
S160B	18	0.89	**124**	**0.124**	0.101	0.165	0.734	0.828	**0.768**	0.119	0.136	0.095	0.100	**0.096**	0.064	0.077	**0.069**	0.000	**0.069**	0.053
S136D	18	0.78	**25**	**0.025**	0.021	0.029	0.558	0.609	**0.584**	0.021	0.028	0.050	0.055	**0.053**	0.047	0.054	**0.051**	0.000	**0.051**	0.029
S160A	18	1.25	**131**	**0.131**	0.120	0.195	0.869	0.982	**0.886**	0.123	0.141	0.095	0.100	**0.097**	0.064	0.077	**0.066**	0.000	**0.066**	0.058
S145A	18	2.75	**805**	**0.805**	0.647	0.875	1.170	1.320	**1.274**	0.789	0.846	0.185	0.190	**0.186**	0.129	0.142	**0.138**	0.000	**0.138**	0.176
S136C	18	0.78	**40**	**0.040**	0.040	0.053	0.659	0.707	**0.659**	0.035	0.043	0.060	0.065	**0.063**	0.061	0.067	**0.061**	0.000	**0.061**	0.040
S137A	18	0.51	**191**	**0.191**	0.178	0.207	0.815	0.846	**0.829**	0.170	0.192	0.110	0.115	**0.115**	0.115	0.121	**0.118**	0.000	**0.118**	0.098
S137B(D1)	18	1.61	**172**	**0.172**	0.154	0.188	1.210	1.272	**1.243**	0.160	0.181	0.105	0.110	**0.108**	N/A	N/A	**N/A**	0.070	**0.178**	0.134
S138	18	1.61	**213**	**0.213**	0.188	0.226	1.272	1.331	**1.311**	0.204	0.229	0.115	0.120	**0.117**	0.094	0.101	**0.099**	0.000	**0.099**	0.129
S148	18	1.43	**262**	**0.262**	0.209	0.315	1.050	1.164	**1.107**	0.255	0.287	0.125	0.130	**0.126**	0.077	0.090	**0.084**	0.000	**0.084**	0.092
S145B	18	3.3	**1054**	**1.054**	0.966	1.093	1.583	1.621	**1.609**	1.032	1.098	0.205	0.210	**0.207**	0.126	0.134	**0.132**	0.190	**0.322**	0.212
BLK335	N/A	2	**1147**	**1.147**	1.093	1.228	1.621	1.658	**1.636**	1.098	1.166	0.210	0.215	**0.214**	0.134	0.142	**0.137**	0.000	**0.137**	0.224

Appendix F

Major flow at side lots

There is one location, R137B, where major flow from rear yards cascades to the street via a side lot. The water surface elevation has been evaluated and is presented below at the cross-section of the side lot. Top of foundation wall elevation is indicated. The water surface elevation is more than the 0.15 m below top of foundation wall, the requested clearance. It should be noted that a conservative 3H:1V has been applied to the cross-section side slopes.





SWMM

Version 9.12

27970 CRT

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10/25/16

HGL SUMMARY PHASE 1 AND PHASE 1A

PHASE	MH	USF or Proposed Ground		100 year 3 hour Chicago		100 year 3 hour Chicago + 20%		July 1979		August 1988		August 1996	
			Elevation (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)
Trunk to Pond 5	MH207	Proposed Ground	107.17	104.53	2.64	104.58	2.59	104.55	2.62	104.54	2.63	104.23	2.94
	MH206	Proposed Ground	107.15	104.57	2.58	104.63	2.52	104.60	2.55	104.58	2.57	104.25	2.90
	MH205	Proposed Ground	107.28	104.62	2.66	104.68	2.60	104.64	2.64	104.62	2.66	104.28	3.00
1	MH110	Proposed Ground	107.52	104.69	2.83	104.75	2.77	104.71	2.81	104.69	2.83	104.33	3.19
1	MH109	Proposed Ground	107.45	104.71	2.74	104.77	2.68	104.72	2.73	104.71	2.74	104.33	3.12
1	MH107	Proposed Ground	107.41	104.73	2.68	104.80	2.61	104.75	2.66	104.73	2.68	Free flow	N/A
1	MH105	USF	105.65	104.76	0.89	104.83	0.82	104.79	0.86	104.77	0.88	Free flow	N/A
1	MH104	USF	105.85	104.80	1.05	104.87	0.98	104.83	1.02	104.81	1.04	Free flow	N/A
1	MH103	USF	105.75	104.81	0.94	104.89	0.86	104.85	0.90	104.83	0.92	Free flow	N/A
1	MH102	USF	105.95	104.82	1.13	104.89	1.06	104.85	1.10	104.84	1.11	Free flow	N/A
1	MH110C	Proposed Ground	107.93	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH170	USF	105.50	104.86	0.64	104.94	0.56	104.87	0.63	104.86	0.64	104.43	1.07
1	MH171	USF	105.35	104.96	0.39	105.04	0.31	104.96	0.39	104.96	0.39	104.48	0.87
1	MH172	USF	105.50	105.03	0.47	105.12	0.38	105.03	0.47	105.05	0.45	Free flow	N/A
1	MH173	USF	105.65	105.07	0.58	105.17	0.48	105.08	0.57	105.10	0.55	Free flow	N/A
1	MH174	USF	105.80	105.13	0.67	105.24	0.56	105.14	0.66	105.18	0.62	Free flow	N/A
1	MH175	USF	106.00	105.18	0.82	105.28	0.72	105.19	0.81	105.22	0.78	Free flow	N/A
1	MH176	USF	106.10	105.23	0.87	105.33	0.77	105.24	0.86	105.27	0.83	Free flow	N/A
1	MH177	Proposed Ground	106.55	105.28	1.27	105.34	1.21	105.30	1.25	105.34	1.21	Free flow	N/A
1	MH181	USF	105.65	105.19	0.46	105.28	0.37	105.06	0.59	105.06	0.59	Free flow	N/A
1	MH180	USF	105.85	105.42	0.43	105.52	0.33	105.18	0.67	105.19	0.66	Free flow	N/A
1	MH184	USF	105.68	105.19	0.49	105.30	0.38	105.20	0.48	105.24	0.44	Free flow	N/A
1	MH183	USF	105.95	105.32	0.63	105.42	0.53	105.34	0.61	105.38	0.57	Free flow	N/A
1	MH182	USF	106.19	105.83	0.36	105.96	0.23	105.86	0.33	105.92	0.27	Free flow	N/A
1	MH187	USF	105.75	105.37	0.38	105.47	0.28	105.39	0.36	105.44	0.31	Free flow	N/A
1	MH186	USF	106.05	105.53	0.52	105.68	0.37	105.57	0.48	105.63	0.42	Free flow	N/A
1	MH191	USF	106.02	105.61	0.41	105.78	0.24	105.67	0.35	105.73	0.29	Free flow	N/A
1	MH185	USF	106.45	105.66	0.79	105.82	0.63	105.72	0.73	105.77	0.68	Free flow	N/A
1	MH127	USF	106.70	105.80	0.90	105.99	0.71	105.87	0.83	105.92	0.78	Free flow	N/A
1	MH190	USF	106.35	105.26	1.09	105.36	0.99	105.26	1.09	105.30	1.05	Free flow	N/A
1	MH189	USF	106.05	105.31	0.74	105.41	0.64	105.31	0.74	105.34	0.71	Free flow	N/A
1	MH188	USF	106.55	105.44	1.11	105.58	0.97	105.46	1.09	105.49	1.06	Free flow	N/A
1	MH128	USF	106.65	Free flow	N/A	105.78	0.87	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH120	USF	105.70	104.87	0.83	104.95	0.75	104.90	0.80	104.87	0.83	Free flow	N/A
1	MH121	USF	105.70	104.88	0.82	104.96	0.74	104.92	0.78	104.88	0.82	Free flow	N/A
1	MH122	USF	105.90	Free flow	N/A	104.98	0.92	104.94	0.96	Free flow	N/A	Free flow	N/A
1	MH123	USF	106.00	Free flow	N/A	105.01	0.99	104.97	1.03	Free flow	N/A	Free flow	N/A
1	MH124	USF	106.10	Free flow	N/A	105.07	1.03	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH125	USF	106.20	Free flow	N/A	105.13	1.07	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH126	USF	106.35	Free flow	N/A	105.17	1.18	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH129	Proposed Ground	109.23	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH114	USF	106.00	104.97	1.03	105.08	0.92	105.03	0.97	104.98	1.02	Free flow	N/A
1	MH113	USF	106.05	105.09	0.96	105.21	0.84	105.17	0.88	105.12	0.93	Free flow	N/A
1	MH112	USF	106.10	105.16	0.94	105.28	0.82	105.25	0.85	105.19	0.91	Free flow	N/A
1	MH111	Proposed Ground	108.19	Free flow	N/A	105.28	2.91	105.25	2.94	105.20	2.99	Free flow	N/A
1	MH132	USF	106.15	Free flow	N/A	105.34	0.81	105.30	0.85	Free flow	N/A	Free flow	N/A
1	MH130	USF	106.25	105.02	1.23	105.12	1.13	105.09	1.16	105.02	1.23	Free flow	N/A
1	MH131	USF	106.15	Free flow	N/A	105.14	1.01	105.13	1.03	Free flow	N/A	Free flow	N/A
1	MH140	USF	106.25	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH134	USF	106.40	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A

HGL SUMMARY PHASE 1 AND PHASE 1A

PHASE	MH	USF or Proposed Ground		100 year 3 hour Chicago		100 year 3 hour Chicago + 20%		July 1979		August 1988		August 1996	
			Elevation (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)
1	MH141	Proposed Ground	108.40	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH135	USF	106.76	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH150	USF	106.65	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH152	USF	107.40	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH153	USF	107.25	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH151	USF	107.00	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH149	USF	106.71	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	CRT1	Proposed Ground	103.30	100.89	N/A	100.89	N/A	100.89	N/A	100.89	N/A	100.89	N/A
1A	MH162	Proposed Ground	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH161	Proposed Ground	104.20	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH146	USF	103.61	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH147	USF	104.06	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH148	USF	104.56	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH138	USF	106.01	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH145	USF	103.61	102.75	0.86	102.76	0.85	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH160	USF	105.53	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH137	USF	106.26	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH136	USF	106.71	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH144	USF	104.81	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH143	USF	105.11	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH142	USF	106.11	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A

HGL SUMMARY PHASE 1
(TRIB. TO POND 5)

PHASE	MH	USF or Proposed Ground		100 year 24 hour SCS		100 year 24 hour SCS + 20%	
			Elevation (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)
Trunk to Pond 5	MH207	Proposed Ground	107.17	104.49	2.68	104.67	2.50
	MH206	Proposed Ground	107.15	104.53	2.62	104.73	2.42
	MH205	Proposed Ground	107.28	104.57	2.71	104.78	2.50
1	MH110	Proposed Ground	107.52	104.64	2.88	104.86	2.66
1	MH109	Proposed Ground	107.45	104.65	2.80	104.88	2.57
1	MH107	Proposed Ground	107.41	104.68	2.73	104.90	2.51
1	MH105	USF	105.65	104.71	0.94	104.94	0.71
1	MH104	USF	105.85	104.75	1.10	104.98	0.87
1	MH103	USF	105.75	104.76	0.99	105.00	0.75
1	MH102	USF	105.95	Free flow	N/A	105.00	0.95
1	MH110C	Proposed Ground	107.93	Free flow	N/A	105.01	2.92
1	MH170	USF	105.50	104.79	0.71	105.05	0.45
1	MH171	USF	105.35	104.87	0.48	105.16	0.19
1	MH172	USF	105.50	104.93	0.57	105.23	0.27
1	MH173	USF	105.65	104.97	0.68	105.28	0.37
1	MH174	USF	105.80	105.02	0.78	105.35	0.45
1	MH175	USF	106.00	105.06	0.94	105.39	0.61
1	MH176	USF	106.10	105.10	1.00	105.44	0.66
1	MH177	Proposed Ground	106.55	Free flow	N/A	105.45	1.10
1	MH181	USF	105.65	105.00	0.65	105.40	0.25
1	MH180	USF	105.85	105.23	0.62	105.63	0.22
1	MH184	USF	105.68	105.06	0.62	105.41	0.27
1	MH183	USF	105.95	105.14	0.81	105.54	0.41
1	MH182	USF	106.19	105.62	0.57	106.05	0.14
1	MH187	USF	105.75	105.16	0.59	105.59	0.16
1	MH186	USF	106.05	105.27	0.78	105.76	0.29
1	MH191	USF	106.02	105.33	0.69	105.84	0.18
1	MH185	USF	106.45	105.42	1.03	105.91	0.54
1	MH127	USF	106.70	Free flow	N/A	106.05	0.65
1	MH190	USF	106.35	105.13	1.22	105.47	0.88
1	MH189	USF	106.05	105.17	0.88	105.52	0.53
1	MH188	USF	106.55	Free flow	N/A	105.67	0.88
1	MH128	USF	106.65	Free flow	N/A	105.90	0.75
1	MH120	USF	105.70	104.81	0.89	105.05	0.65
1	MH121	USF	105.70	Free flow	N/A	105.07	0.63
1	MH122	USF	105.90	Free flow	N/A	105.09	0.81
1	MH123	USF	106.00	Free flow	N/A	105.12	0.88
1	MH124	USF	106.10	Free flow	N/A	105.16	0.94
1	MH125	USF	106.20	Free flow	N/A	105.21	0.99
1	MH126	USF	106.35	Free flow	N/A	105.25	1.10
1	MH129	Proposed Ground	109.23	Free flow	N/A	Free flow	N/A
1	MH114	USF	106.00	104.93	1.07	105.18	0.82
1	MH113	USF	106.05	105.05	1.00	105.32	0.73
1	MH112	USF	106.10	105.12	0.98	105.39	0.71
1	MH111	Proposed Ground	108.19	Free flow	N/A	105.40	2.79
1	MH132	USF	106.15	Free flow	N/A	105.46	0.69
1	MH130	USF	106.25	104.98	1.27	105.22	1.03
1	MH131	USF	106.15	Free flow	N/A	105.26	0.89
1	MH140	USF	106.25	Free flow	N/A	105.33	0.92
1	MH134	USF	106.40	Free flow	N/A	Free flow	N/A
1	MH141	Proposed Ground	108.40	Free flow	N/A	Free flow	N/A
1	MH135	USF	106.76	Free flow	N/A	Free flow	N/A
1	MH150	USF	106.65	Free flow	N/A	Free flow	N/A
1	MH152	USF	107.40	Free flow	N/A	Free flow	N/A
1	MH153	USF	107.25	Free flow	N/A	Free flow	N/A
1	MH151	USF	107.00	Free flow	N/A	Free flow	N/A
1	MH149	USF	106.71	Free flow	N/A	Free flow	N/A

HGL SUMMARY PHASE 1
(TRIB. TO POND 5)
25% SEDIMENT ACCUMULATION

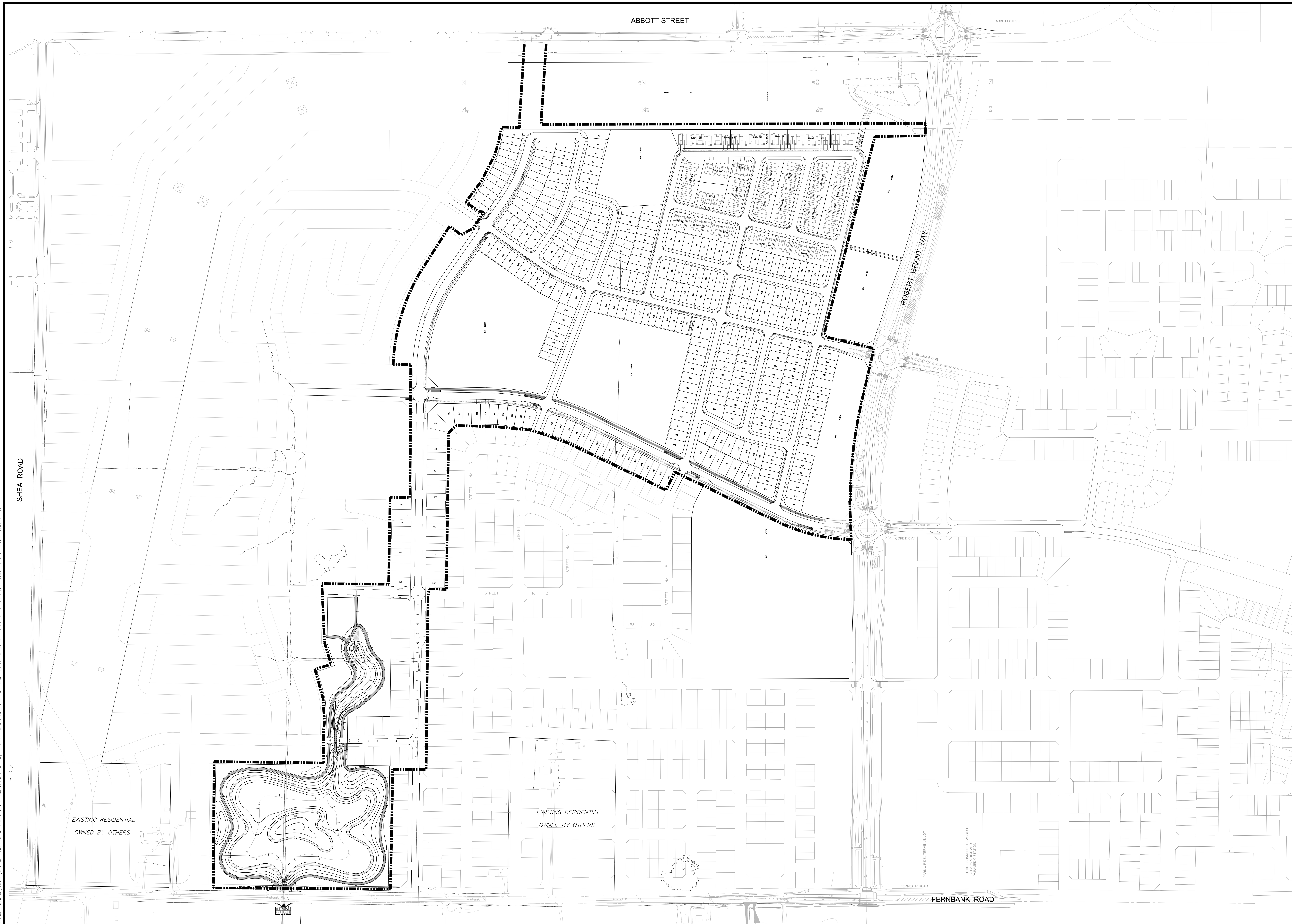
PHASE	MH	USF or Proposed Ground		100 year 3 hour Chicago	
			Elevation (m)	HGL (m)	Freeboard (m)
Trunk to Pond 5	MH207	Proposed Ground	107.17	105.00	2.17
	MH206	Proposed Ground	107.15	105.10	2.05
	MH205	Proposed Ground	107.28	105.20	2.08
1	MH110	Proposed Ground	107.52	105.35	2.17
1	MH109	Proposed Ground	107.45	105.38	2.07
1	MH107	Proposed Ground	107.41	105.43	1.98
1	MH105	USF	105.65	105.48	0.17
1	MH104	USF	105.85	105.54	0.31
1	MH103	USF	105.75	105.61	0.14
1	MH102	USF	105.95	105.67	0.28
1	MH110C	Proposed Ground	107.93	105.82	2.11
1	MH170	USF	105.50	105.56	-0.06
1	MH171	USF	105.35	105.67	-0.32
1	MH172	USF	105.50	105.75	-0.25
1	MH173	USF	105.65	105.80	-0.15
1	MH174	USF	105.80	105.87	-0.07
1	MH175	USF	106.00	105.91	0.09
1	MH176	USF	106.10	105.96	0.14
1	MH177	Proposed Ground	106.55	106.04	0.51
1	MH181	USF	105.65	105.90	-0.25
1	MH180	USF	105.85	106.14	-0.29
1	MH184	USF	105.68	105.92	-0.24
1	MH183	USF	105.95	106.05	-0.10
1	MH182	USF	106.19	106.55	-0.36
1	MH187	USF	105.75	106.10	-0.35
1	MH186	USF	106.05	106.26	-0.21
1	MH191	USF	106.02	106.35	-0.33
1	MH185	USF	106.45	106.44	0.01
1	MH127	USF	106.70	106.68	0.02
1	MH190	USF	106.35	105.98	0.37
1	MH189	USF	106.05	106.04	0.01
1	MH188	USF	106.55	106.35	0.20
1	MH120	USF	105.70	105.67	0.03
1	MH121	USF	105.70	105.71	-0.01
1	MH122	USF	105.90	105.74	0.16
1	MH123	USF	106.00	105.79	0.21
1	MH124	USF	106.10	105.92	0.18
1	MH125	USF	106.20	106.14	0.06
1	MH126	USF	106.35	106.31	0.04
1	MH128	USF	106.65	106.91	-0.26
1	MH129	Proposed Ground	109.23	106.91	2.32
1	MH114	USF	106.00	105.79	0.21
1	MH113	USF	106.05	105.90	0.15
1	MH112	USF	106.10	106.06	0.04
1	MH111	Proposed Ground	108.19	106.08	2.11
1	MH132	USF	106.15	106.06	0.09
1	MH130	USF	106.25	105.89	0.36
1	MH131	USF	106.15	106.09	0.06
1	MH140	USF	106.25	106.00	0.25

HGL SUMMARY PHASE 1
(TRIB. TO POND 5)
25% SEDIMENT ACCUMULATION

PHASE	MH	USF or Proposed Ground		100 year 3 hour Chicago	
			Elevation (m)	HGL (m)	Freeboard (m)
1	MH134	USF	106.40	106.39	0.01
1	MH141	Proposed Ground	108.40	106.56	1.84
1	MH135	USF	106.76	106.33	0.43
1	MH136	USF	106.71	106.39	0.32
1	MH150	USF	106.65	106.22	0.43
1	MH152	USF	107.40	106.39	1.01
1	MH153	USF	107.25	106.59	0.66
1	MH151	USF	107.00	106.60	0.40
1	MH149	USF	106.71	106.80	-0.09

APPENDIX G

- **Erosion and Sedimentation Control Plan - (Drawing 27970-900)**



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND:

LIGHT DUTY SILT FENCE PER OPSD 219.110

STRAW BALE BARRIER PER OPSD 219.100

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JM	13:08:29

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Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

EROSION & SEDIMENTATION CONTROL PLAN

Scale 1:1500

Design	Date
J.I.M.	OCTOBER '12
Drawn	Checked
M.M.	P.K.
Project No.	Drawing No.
27970	900

D07-16-11-0003

#17366