2112 BEL-AIR DRIVE

CONCEPTUAL SITE SERVICING AND STORMWATER MANAGEMENT REPORT

Prepared for:

UNIFORM URBAN DEVELOPMENTS LTD.
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December 6, 2019

Novatech File: 119000
Ref: R-2019-190

NOVATECH
Engineers, Planners & Landscape Architects

December 6, 2019

City of Ottawa
Planning and Growth Management Department
Development Review (Urban Services - West) Branch
Infrastructure Approvals Division
110 Laurier Avenue West, 4th Floor
Ottawa, ON K1P 1J1

Attention: **Laurel McCreight, MCIP, RPP**
Planner

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Engineering Intern

Reference: **2112 Bel-Air Drive**
Conceptual Site Servicing and Stormwater Management Report
Novatech File No.: 119000

In support of the Draft Plan of Subdivision application for the above-noted site, you will find enclosed the Conceptual Site Servicing and Stormwater Management Report for the development at 2112 Bel-Air Drive.

This report addresses the approach to site servicing and stormwater management for the subject site, which been developed based on the requirements of the City of Ottawa and Rideau Valley Conservation Authority.

Should you have any questions, or require additional information, please contact me.

Yours truly,

NOVATECH

Bassam Bahia, M.Eng., P. Eng.
Project Manager | Land Development

/bs

cc: Eric Lalande, Rideau Valley Conservation Authority
Annibale Ferro, Uniform Urban Developments Ltd.

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1.0 INTRODUCTION

1.1 Background

This report addresses the approach to site servicing for the development at 2112 Bel-Air Drive (Subject Site), which is being proposed by Uniform Urban Developments Ltd. (Developer).

The site is located at the south-east corner of the Field Street and Bel-Air Drive intersection, as shown on **Figure 1.1** – Key Plan. The site is bound to the north by Bel-Air Drive, south and east by open space owned by the National Capital Commission (NCC), and to the west by existing residences fronting Field Street.

The existing land usage consists of a vacant church and a gravel parking area, as shown on **Figure 1.2** – Existing Conditions Plan. The grade of the Subject Site generally slopes from east to west towards an existing ditch that runs along the western property line. The Subject Site is approximately 1 metre above grade with respect to Bel-Air Drive.

The existing residences to the west along Field Street are currently serviced with public services (i.e. sanitary and storm sewers, and watermain).

1.2 Development Intent

The Subject Site has an area 0.81 ha, and the proposed subdivision will comprise of 25 row townhome units, as shown in **Table 1.1**. The development will contain a private road with a 6.7-metre-wide paved surface. The proposed site plan is shown on **Figure 1.3** – Site Plan.

Table 1.1: Land Use, Development Potential, and Yield

Unit Type[1]	Number of Units	Area
Row Townhomes	25	0.81 ha

[1] *The development does not consist of singles, semis, or multi-unit residential / apartments.*

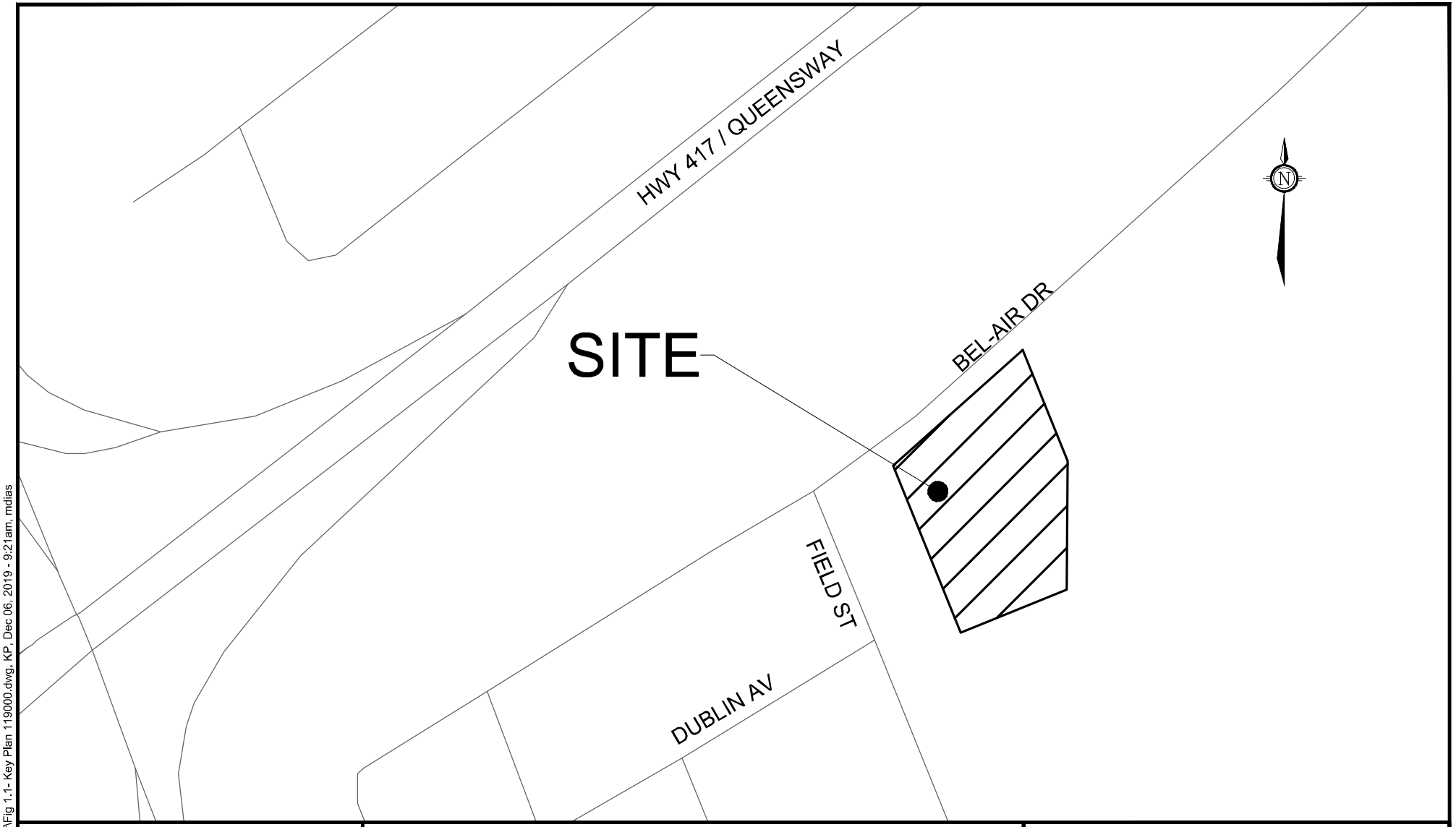
The Subject Site is located within the service area in the City of Ottawa Official Plan; therefore, the site has been designed with city water and sanitary sewage collection.

1.3 Report Objective

This report assesses the adequacy of existing and proposed services to support the proposed development. This report will be provided to the various agencies for approval and to obtain any applicable permits.

The City of Ottawa Applicant Study and Plan Identification List along with proof of a pre-consultation meeting is provided in **Appendix A**.

The City of Ottawa Servicing Study Guidelines for Development Applications checklist has been completed and is provided in **Appendix B**.



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CITY OF OTTAWA
2112 BEL-AIR DRIVE

KEY PLAN

SCALE		
NOT TO SCALE		
DATE: DEC 2019	JOB: 119000	FIGURE: 1.1

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CITY OF OTTAWA
2112 BEL-AIR DRIVE

EXISTING CONDITIONS

SCALE		
NOT TO SCALE		
DATE	JOB	FIGURE
DEC 2019	119000	1.2

SHT8X11.DWG - 216mmx279mm

M:\2019\119000\CAD\Design\Figures\Design Brief\Fig 1.2- Existing Conditions 119000.dwg, FIG 1.2, Nov 14, 2019 - 10:02am, bsweet

NCC LANDS

6m WIDE EASEMENT

BEL-AIR DRIVE

PRIVATE ROAD

NCC LANDS

UP

3m WIDE EASEMENT

M:\2019\119000\CAD\Design\Figures\Design Brief\119000-FIGURES.dwg, FIG 1.3, Dec 05, 2019 - 3:24pm, mdias

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CITY OF OTTAWA
2112 BEL-AIR DRIVE

SITE PLAN

SCALE 1 : 500 (0, 5m, 10m, 20m)

DATE DEC 2019 | JOB 119000 | FIGURE 1.3

SHT11X17.DWG - 279mmX432mm

2.0 REFERENCES AND SUPPORTING DOCUMENTS

2.1 Guidelines and Supporting Studies

The following guidelines and supporting documents were utilized in the preparation of this report:

- **City of Ottawa Official Plan** (OP)
  City of Ottawa, adopted by Council 2003.
- **City of Ottawa Infrastructure Master Plan** (IMP)
  City of Ottawa, November 2013.
- **City of Ottawa Water Distribution Guidelines** (OWDG)
  City of Ottawa, October 2012.
- **Revisions to OWDG** (ISTB-2010-01, ISTB-2014-02, ISTB-2018-02, ISTB-2018-04)
  City of Ottawa, December 2010, May 2014, March 2018, and June 2018.
- **City of Ottawa Sewer Design Guidelines** (OSDG)
  City of Ottawa, October 2012.
- **Revisions to OSDG** (ISTB-2016-01 & ISTB-2018-01)
  City of Ottawa, September 2016 and March 2018.
- **Design Guidelines for Sewage Works and Drinking Water System**
  Ontario's Ministry of the Environment, 2008.
- **Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area**
  (Pinecrest Creek / Westboro Area SWM Guidelines)
  J.F. Sabourin and Associates Inc., October 2012.

  Ministry of the Environment Stormwater Management Planning & Design Manual (MOE SWM Manual)
- Ontario's Ministry of the Environment, March 2003.

2.2 Geotechnical Investigation

Paterson Group Inc. (Paterson) conducted a geotechnical investigation (**Appendix F**) in support of the proposed residential development:

Geotechnical Investigation – Proposed Residential Development 2112 Bel-Air Drive, Ottawa, Ontario; Report No. PG5034-1 (revision 1), Paterson Group Inc., September 23, 2019.

Based on the geotechnical study, it is not anticipated that there will be any significant geotechnical concerns with respect to servicing and developing the site. The borehole locations are provided as **Figure 2.1**. A summary of the geotechnical report findings is provided in **Table 2.1** below.

FIGURE 2.1- GEOTECHNICAL INVESTIGATION- BOREHOLE LOCATIONS

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consulting engineers

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Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

UNIFORM DEVELOPMENTS

GEOTECHNICAL INVESTIGATION
2112 BEL-AIR DRIVE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:500	Date: 08/2019
Drawn by: MPG	Report No.: PG5034-1
Checked by: VD	Dwg. No.: PG5034-1
Approved by: DJG	Revision No.:

11x17

p:\autocad drawings\geotechnical\pg50xx\pg5034\pg5034-1-thtip.dwg

Table 2.1: Summary of Geotechnical Servicing and Grading Considerations

Parameter	Summary
Sub-Soil Conditions	Glacial Till / Gravel, Cobbles and Boulders/ Bedrock
Grade Raise Restriction	TBD as part of the detailed design stage
OHSA Soil Type	Type 2 and 3
Groundwater Considerations	Low groundwater flow / high groundwater level
Bedrock	Shallow bedrock encounter at boreholes
Pipe Bedding / Backfill	Pipe Bedding 150 mm to 300 mm Granular A Pipe Cover 300 mm Granular A Backfill Native Material
Pavement Structure (Parking Areas/ Driveways)	50mm Wear Course (SuperPave 12.5) 150mm Base (Granular A) 300mm Subbase (Granular B Type II)
Pavement Structure (Private Roads)	40mm Wear Course (SuperPave 12.5) 50mm Binder Course (SuperPave 19.0) 150mm Base (Granular A) 450mm Subbase (Granular B Type I or II)
Landscape Consideration	TBD as part of the detailed design stage

3.0 SERVICING AND GRADING

3.1 Bel-Air Drive

In order to service the Subject Site, the following modifications will be required along Bel-Air Drive:

- Extension of the existing watermain to the Subject Site.
- Abandonment and relocation of the existing sanitary sewer running through both the NCC Lands to the east and the Subject Site, from Cline Crescent to Bel-Air Drive.
- Regrading/ abandonment of the existing roadside ditch and culvert where the row townhomes are fronting Bel-Air Drive.

3.2 General Servicing

The Subject Site will be serviced using local storm and sanitary sewers, and watermain. The storm drainage / stormwater management, sanitary and water servicing strategy is discussed in further detail in the following sections.

Refer to **Figure 3.1** – Proposed Servicing Layout Plan.

3.3 General Grading

The proposed grading within the Subject Site will direct overland flows to the Bel-Air Drive right-of-way.

The lots will be graded from front to back to direct surface drainage to the rear yard areas.

Refer to **Figure 3.2** – Macro Grading, Erosion and Sediment Control Plan.

NCC LANDS

PROPOSED SANITARY RELOCATION

6m WIDE EASEMENT

EXISTING SANITARY TO BE ABANDONED

BEL-AIR DRIVE

PRIVATE ROAD

EXISTING CULVERTS TO BE ABANDONED

3m WIDE EASEMENT

STORMTECH CHAMBERS

CONNECT TO EXISTING WM

NCC LANDS

LEGEND

- EXISTING WATERMAIN
- EXISTING HYDRANT
- PROPOSED WATERMAIN
- PROPOSED 50mmØ WATERMAIN
- PROPOSED HYDRANT
- EXISTING SANITARY SEWER
- PROPOSED SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING CULVERT
- PROPOSED STORM SEWER
- GAS — GAS — EXISTING GAS LINE
- EXISTING DITCH

LEGEND

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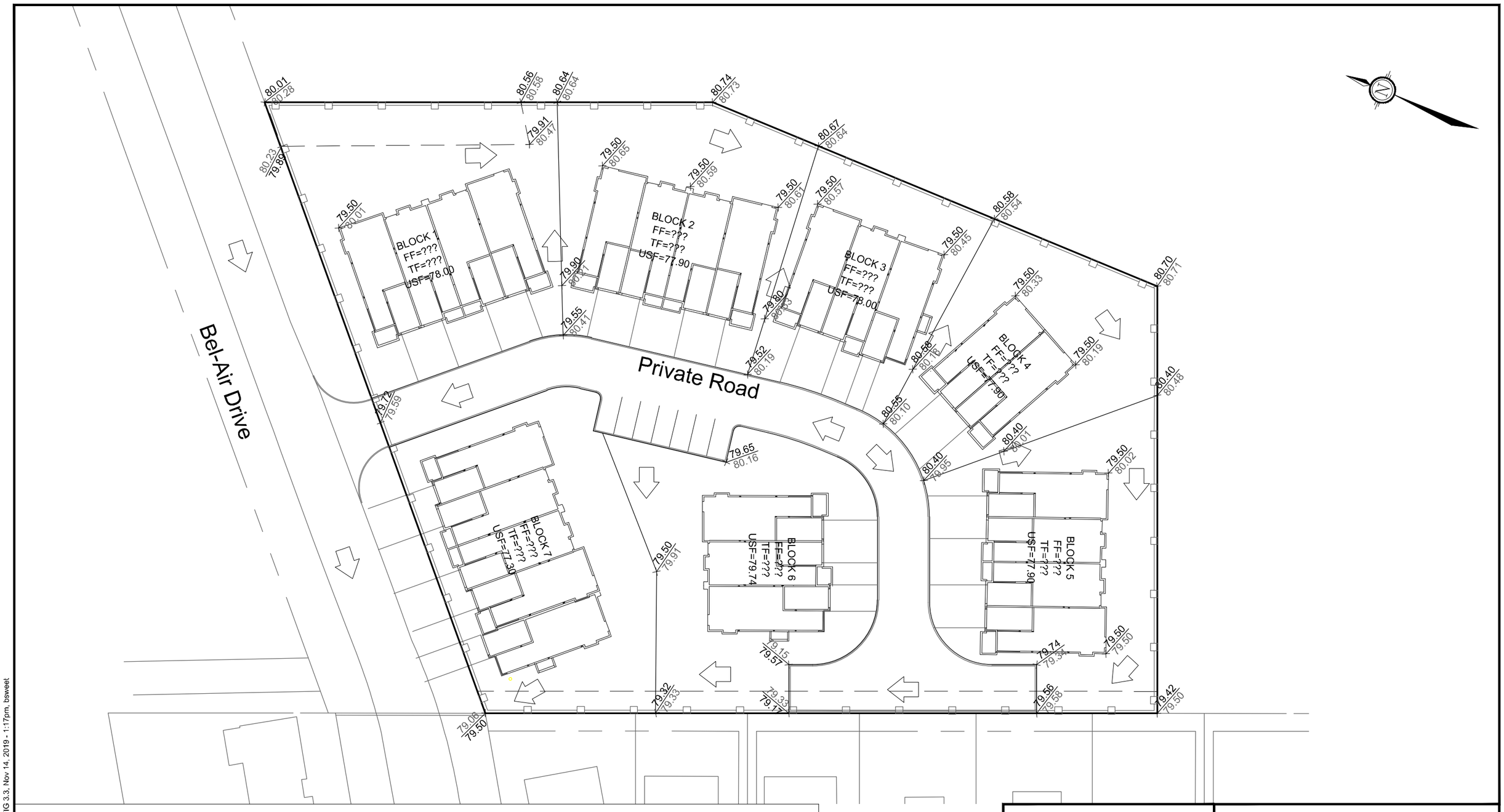
CITY OF OTTAWA
2112 BEL-AIR DRIVE

PROPOSED SERVICING LAYOUT PLAN

SCALE 1 : 500 (0, 5m, 10m, 20m)

DATE DEC 2019 | JOB 119000 | FIGURE 3.1



LEGEND

- EMERGENCY OVERLAND FLOW
- PROPOSED ELEVATION
- *EXISTING ELEVATION*
- 88.10 (HP) PROPOSED HIGH POINT
- 88.10 (LP) PROPOSED LOW POINT
- SILT FENCE
- PROPERTY BOUNDARY

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CITY OF OTTAWA
2112 BEL-AIR DRIVE

MACRO GRADING, EROSION AND SEDIMENT CONTROL PLAN

SCALE 1 : 500 (0, 5m, 10m, 20m)

DATE DEC 2019 | JOB 119000 | FIGURE 3.2

4.0 STORM SEWER SYSTEM AND STORMWATER MANAGEMENT

The Subject Site is located within the Ottawa River West Subwatershed, and is tributary to Pinecrest Creek, which falls under the jurisdiction of the Rideau Valley Conservation Authority (RVCA).

4.1 Stormwater Management Criteria

The following stormwater management criteria has been developed based on the criteria in the the OSDG and subsequent Technical Bulletins and SWM Guidelines for the Pinecrest Creek / Westboro Area. Excerpts from the Pinecrest Creek / Westboro Area SWM Guidelines can be found in **Appendix C**.

4.1.1 Ottawa Sewer Design Guidelines

Minor System (Storm Sewers)

- Storm sewers are to be designed using the Rational Method for a 2-year return period (refer to **Appendix A** for pre-consultation notes);
- Ensure that the hydraulic grade line (HGL) within the storm sewer is at least 0.3 m below the underside of footing (USF) elevations for the proposed development, during the 100-year storm event. In addition, the HGL during the 100-year (+20%) 'stress test' storm event shall be below the USF elevations.

Major System (Overland Flow)

- Overland flows are to be confined within the right-of-ways or defined drainage easements for all storms up to and including the 100-year event;
- Storm runoff will be conveyed overland along defined major system flow routes;
- Maximum depth of flow (static + dynamic) on local roads shall not exceed 0.35 m and shall be confined to the road right-of-ways, as well as not touch any part of the building envelope and must remain below the lowest building opening during the stress test event; and,
- The product of the 100-year flow depth (m) on street and flow velocity (m/s) shall not exceed 0.60.
- There is to be no surface ponding of stormwater during a 2-year event.
- Along front yards, there must be 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.
- Along rear yards, there must be at least 30 cm of vertical clearance (typical) between the spill elevation in the rear yards and the ground elevation at the building envelope that is in the proximity of the flow route or ponding area.

Best Management Practices

- Implement lot level and conveyance Best Management Practices (BMPs) to promote infiltration and treatment of storm runoff.

Quantity Control

- Stormwater quantity control is to meet the criteria shown in Section 8.3.7.3 of the OSDG, based on the current use.
    - The allowable release rate is to be calculated using the Rational Method with the following parameters:
        - Rainfall intensity based on a 2-year storm event with an assumed time-of-concentration (Tc) of 20 minutes (I = 52.03 mm/hr).
        - Runoff coefficient (C) of 0.50 or the actual existing C value of 0.45, whichever is less.
- Allowable release rate (for all storms up-to and including the 100-year event):

$$Q_{allowable} = (2.78) \times (0.81 \text{ ha}) \times (0.45) \times (52.03) \text{ mm/hr}$$
$$= 52.7 \text{ L/s}$$

4.1.2 SWM Requirements: Pinecrest Creek / Westboro Area SWM Guidelines

The stormwater management requirements, as per the Pinecrest Creek / Westboro Area SWM Guidelines are as follows:

Runoff Volume Reduction

- A minimum on-site retention of the 10mm design storm (4-hour Chicago) and 300mm of amended topsoil within landscape areas. Any assumptions for non-viability of infiltration measures must be substantiated.

Erosion Control

- Detain the runoff from the 25mm design storm (4hr Chicago Distribution) such that the peak outflow from the site does not exceed 5.8 L/s/ha.

Water Quality

- On-site removal of 80% of TSS, which is inherent due to the on-site retention in landscape areas and detention of the 25mm storm event.

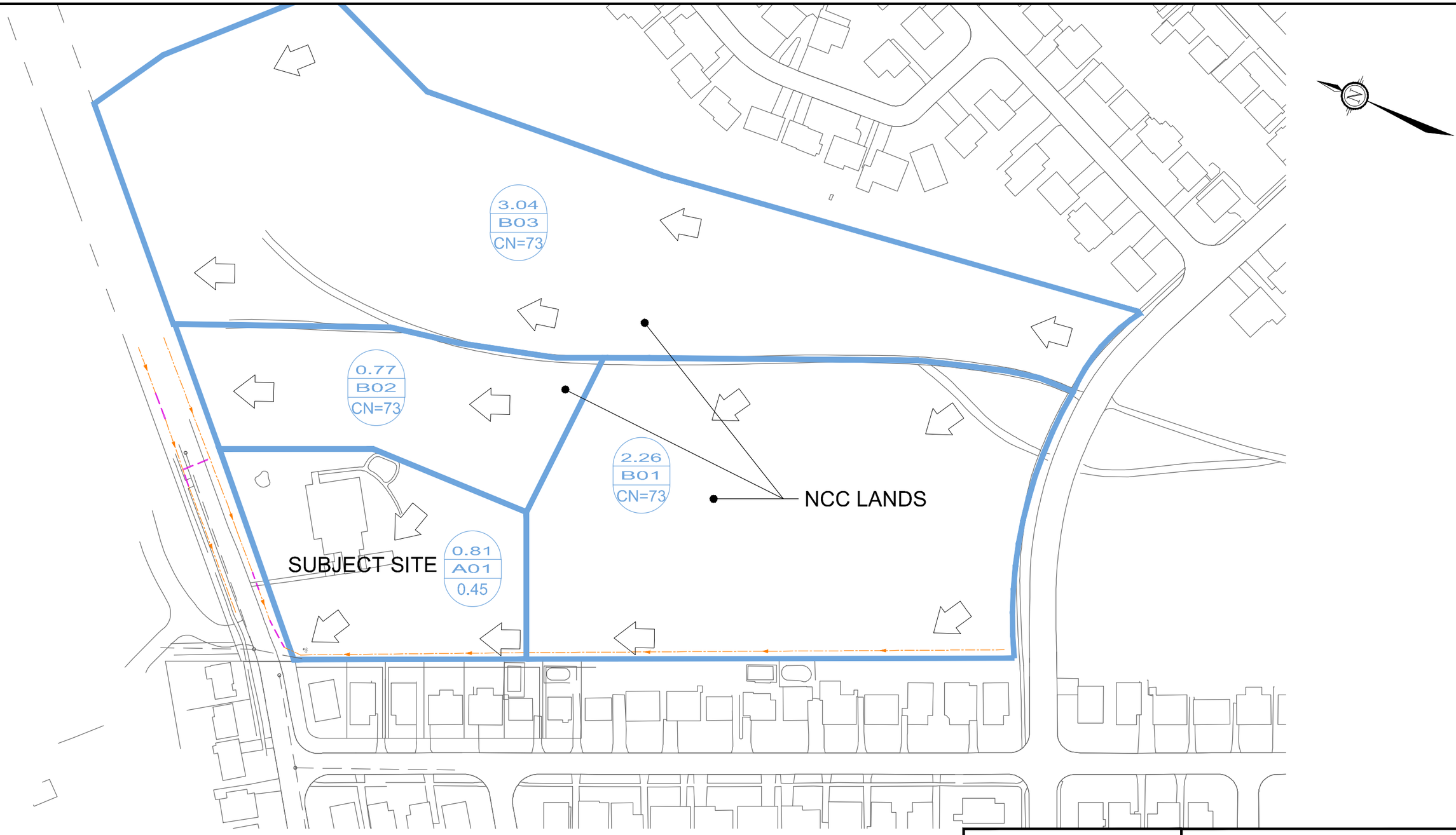
Flood Flow Management (Quantity Control)

- The more stringent of the following criteria:
    - Requirements of Ottawa Sewer Design Guidelines or local sewers (52.7 L/s).
    - 100-year discharge from the site is to not exceed 33.5 L/s/ha (27.1 L/s); or

4.2 Pre-Development Conditions

Refer to **Figure 4.1** – Pre-Development Storm Drainage Area for an illustration of the pre-development drainage areas and the existing ditches.

Under existing conditions, the Subject Site (Area A01) has a C value of 0.45 and drains east to west towards an existing ditch that runs along the western property line and eventually outlets to the existing roadside ditch along Bel-Air Drive.



LEGEND

0.06 / C1 / 0.25 — DRAINAGE AREA (hectares)

MANHOLE TO MANHOLE

RUN-OFF COEFFICIENT

STORM DRAINAGE AREA

EMERGENCY OVERLAND FLOW

EXISTING STORM SEWER AND MH

EXISTING CULVERT

EXISTING DITCH

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CITY OF OTTAWA
2112 BEL-AIR DRIVE

PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE 1:1500

DATE DEC 2019 | JOB 119000 | FIGURE 4.1

A portion of the NCC Lands (Areas B01 – B03) drains through the Subject Site towards the existing ditch that runs along the western property line. The runoff from these lands will need to be managed as part of the stormwater management strategy for the Subject Site. A drainage easement will be provided in favour of the City of Ottawa to protect the overland flow route through the Subject Site.

4.3 Allowable Release Rates

The allowable release rates for the proposed development of the Subject Site have been developed based on select criteria from the Pinecrest Creek/Westboro Area SWM Guidelines and the Ottawa Sewer Design Guidelines as follows:

Retention / Infiltration

The retention requirements from in the Pinecrest/Westboro SWM Guidelines (retain the first 10mm of rainfall) cannot be achieved. There are no identified opportunities for re-use of retained storm runoff and the site is not suitable for infiltration due to the bedrock conditions identified in the Geotechnical Investigation (Patterson Group, 2019). The MOE SWM Manual recommends that infiltration systems for stormwater management be located a minimum of 1.0 m from the seasonally high groundwater table and bedrock.

Water Quality

Water quality control, per the Pinecrest Creek / Westboro Area SWM Guidelines will be provided through the detention of the 25mm design storm to an allowable release rate of 4.7 L/s (0.81 ha x 5.8 L/s/ha).

Water Quantity

The Water quantity control will be provided in accordance with the OSDG. Post-development peak flows will be controlled to pre-development levels for a 2-year storm, calculated using the Rational Method.

An assumed time-of-concentration (Tc) of 20 minutes corresponds to a rainfall intensity of 52.03 mm/hr. Based on a runoff coefficient (C) of 0.50 the corresponding allowable release rate, for all storms up to and including the 100-year event, is 52.7 L/s.

4.4 Proposed Storm Drainage System

Storm servicing for the Subject Site will be provided using a dual drainage system: Runoff from frequent events will be conveyed by storm sewers (minor system), while runoff from larger storm events which exceed the capacity of the minor system will be conveyed overland along defined overland flow routes (major system). Bel-Air Drive will be the outlet for both the minor and major systems.

- Refer to **Figure 3.1** – Proposed Servicing Layout Plan for an illustration of the proposed storm sewers.
- Refer to **Figure 4.2** – Post-Development Storm Drainage Area for the catchment areas used in the design of the storm drainage system.

NCC LANDS

6m WIDE EASEMENT

BEL-AIR DRIVE

450mmØ STM

250mmØ STM

375mmØ STM

PRIVATE ROAD

EXISTING CULVERTS TO BE ABANDONED

0.06 A05 0.5

0.07 A06 0.5

0.06 A07 0.5

0.05 A08 0.5

0.06 A09 0.5

0.07 A02 0.7

0.09 A03 0.7

0.03 A01 0.7

0.07 A12 0.5

0.07 A11 0.5

0.13 A04 0.7

0.04 A10 0.5

3m WIDE EASEMENT

STORMTECH CHAMBERS

NCC LANDS

REFER TO FIGURE 4.1 FOR ADDITIONAL INFORMATION ON THE EXTERNAL PRE-DEVELOPMENT STORM DRAINAGE AREAS

LEGEND

- 0.06 / C1 / 0.25 — DRAINAGE AREA (hectares) / MANHOLE TO MANHOLE / RUN-OFF COEFFICIENT
- STORM DRAINAGE AREA
- EMERGENCY OVERLAND FLOW
- *EXISTING STORM SEWER AND MH*
- *EXISTING CULVERT*
- PROPOSED STORM SEWER AND MH
- *EXISTING DITCH*

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POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

SCALE 1:500
DATE DEC 2019
JOB 119000
FIGURE 4.3

M:\2019\119000\CAD\Design\Figures\Design Brief\119000-FIGURES.dwg, FIG 4.2, Dec 05, 2019 - 3:24pm, mdias

4.4.1 Storm Sewers (Minor System)

The proposed storm sewers have been conceptually designed using the Rational Method. The on-site storm sewers were sized to convey an uncontrolled peak flow corresponding to a 2-year return period. The criteria used to size the storm sewers are summarized in **Table 4.1**. The preliminary storm sewer design sheets are provided in **Appendix C**. During detailed design, the storm sewers may be modified based on the stormwater management strategy.

Table 4.1: Storm Sewer Design Parameters

Parameter	Design Criteria
Local Roads	2-year Return Period
Storm Sewer Design	Rational Method/Modeling
IDF Rainfall Data	OSDG
Initial Time of Concentration (T_c)	10 minutes
Minimum Velocity	0.8 m/s
Maximum Velocity	3.0 m/s
Minimum Diameter	250 mm

The proposed storm drainage systems include the following:

- Approximately 304 m of storm sewers within the road and rear yards to collect and convey runoff to the proposed underground storage system.
- Approximately 108 m of storm sewers within the roadway to convey controlled runoff from the underground storage system to the existing 450 mm storm sewer on Bel-Air Drive. These sewers will also serve as the foundation drain outlet for the proposed residential units.
- Approximately 87 m of bypass storm sewer to collect and convey runoff from the portion of NCC Lands that are currently drained by an existing ditch along the western property line of the Subject Site. The bypass sewer will connect to the existing storm outlet per pre-development conditions.

Hydraulic Grade Line (HGL)

The HGL elevation for a 100-year storm event needs to provide a minimum 0.30 m clearance from the USF elevation. In addition, the HGL during the 100-year (+20%) 'stress test' storm event shall be below the USF elevations. This will be evaluated using a hydraulic model of the proposed storm sewers during the detailed design stage.

4.4.2 Underground Storage (Quantity Control)

Underground storage will be provided to meet the stormwater quality and quantity control criteria (allowable release rates), specified in **Section 4.3**. Storage will be provided in the private road using StormTech SC-740 arch-type chambers (or approved equivalent). Inlet control devices (ICD's) will be installed in MH101 to control outflows from the StormTech chambers to the previously specified allowable release rates.

The StormTech chambers will be privately owned and maintained through a Joint Unit Maintenance Agreement (JUMA) that will be registered on title. Access to the system shall be through reciprocal drainage/ maintenance easements.

4.4.3 Grading & Overland Flow (Major System)

The site will be graded to provide an engineered overland flow route (major system) for large infrequent storms or in the event that the storm sewer / stormwater management system becomes obstructed. Major system flows will be directed to Bel-Air Drive. The proposed works include regrading / abandonment of the existing roadside ditch and culvert where the row townhomes are fronting Bel-Air Drive.

Refer to **Figure 3.2** – Macro Grading, Erosion and Sediment Control Plan for the proposed general grading of the Subject Site.

4.4.4 Best Management Practices and Low Impact Development

The proposed development will implement stormwater management BMPs and low-impact development (LID) techniques to mitigate the reduction in infiltration and groundwater recharge resulting from the proposed development, and to meet the criteria from the Pinecrest/Westboro SWM Guidelines. Proposed LID measures include the following:

- Amended topsoil or equivalent (300mm depth) in landscaped areas to promote the retention of storm runoff and increase evapotranspiration; and,
- Underground storage provided within the private road using StormTech Chambers.

While the underground storage systems will provide additional runoff volume reduction through infiltration, they have not been designed as infiltration systems as they will not meet the applicable MOE SWM Manual criteria due to the shallow depth to bedrock and groundwater in this area.

The selection of BMPs and LIDs will be reviewed during detailed design.

4.5 Proposed Stormwater Management Strategy

4.5.1 Stormwater Quality Control

As per the Pinecrest Creek / Westboro Area SWM Guidelines, stormwater quality control for the Subject Site is to be provided by restricting the peak flow from a 25mm 4-hour Chicago storm to 4.7 L/s (5.8 L/s/ha). The best management practices, described in **Section 4.4.4**, will provide additional treatment of runoff.

4.5.2 Stormwater Quantity Control

The following provides an overview of the proposed stormwater management strategy for controlled and uncontrolled areas:

- *Area A01 (Bel-Air Drive) – Uncontrolled*

  This subcatchment represents the front yard catchment area fronting onto Bel-Air Drive. Drainage from this area will be uncontrolled to the existing catchbasins on Bel-Air Drive.

- *Area A02 – A04 (Private Road) – Controlled*

  These subcatchments represent areas draining towards the private road. Storm runoff will be collected by catchbasins and conveyed to the StormTech chambers.

- *Area A05 – A12 (Rear Yards) – Controlled*

  These subcatchments represent the rear yard areas. The rear yard drainage system will outlet to the StormTech chambers.

Amended Topsoil

All the landscaped areas on the Subject Site will have 300 mm of amended topsoil or equivalent to promote the retention of storm runoff. The amended soil is assumed to have a 0.25 void ratio as per the MOE SWM Manual. The assumed storage volume provided within the amended topsoil is 274 m^3, calculated as follows:

Total pervious area:	3,656 m^2
Depth of amended soils:	300 mm amended topsoil; or 100mm of top soil underlaid by 200mm of coarse sand
Assumed void ratio:	0.25

Total storage provided in amended soils = 3,656 m^2 x 0.30 m x 0.25
= 274 m^3

StormTech Chambers

StormTech chambers (model SC-740 or approved equivalent) will provide quantity control storage for the Subject Site. The road and rear yard drainage systems will connect to the StormTech chambers. The total storage provided by the StormTech chambers is 87 m^3 based on the layout presented on **Figure 4.2**. Supporting documentation is provided in **Appendix C**.

4.6 Hydrologic & Hydraulic Modeling

The OSDG requires hydrologic modeling for all dual drainage systems. The performance of the proposed storm drainage system was evaluated using a conceptual PCSWMM model. The model includes the subcatchments, storm sewer from the StormTech chambers, and conceptual storage nodes to determine the required storage volumes.

PCSWMM model schematics and model output are provided in **Appendix C**.

4.6.1 Design Storms

The model was run using the 3-hour Chicago storm distribution for the 2-year, 5-year, and 100-year events. The 4-hour Chicago storm distribution was used for the 25mm event (water quality event). The model was also stress tested using the 100-year (+20%) event.

4.6.2 Subcatchment Model Parameters

Hydrologic modeling parameters for each subcatchment were developed based on soil type, existing and proposed land use, and topography.

Runoff Coefficient / Impervious Values

Impervious values were assigned to each subcatchment area shown in **Figure 4.2**. The impervious values correspond to the Runoff Coefficients used in the Rational Method calculations, for the storm sewer design sheet, using the following equation:

$$\% \, imp = \frac{C - 0.2}{0.7}$$

Depression Storage

The following default values for depression storage, per the OSDG, were used for all subcatchments.

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

Residential rooftops are assumed to provide no depression storage and all rainfall is converted to runoff. The percentage of rooftop area to total impervious area is represented by the 'zero imperv.' parameter.

Equivalent Width

'Equivalent Width' refers to the width of the subcatchment flow path. This parameter is calculated as described in Section 5.4.5.6 of the OSDG.

Infiltration

Infiltration losses for the subcatchments were 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 following default values, per the OSDG, were used for the subcatchments.

Horton's Equation: $f(t) = f_c + (f_o - f_c)e^{-k(t)}$

Initial infiltration rate: f_o = 76.2 mm/hr

Final infiltration rate: f_c = 13.2 mm/hr

Decay Coefficient: k = 4.14/hr

Runoff for subcatchment (Area B01) was modelled using PCSWMM's Alternative Runoff Method; specifically, the NASH Instantaneous Unit Hydrograph method:

- The SCS Runoff Curve Number was estimated based on a combination of the surficial soils / existing land use.
- The initial abstraction parameter was estimated from the SCS Runoff Curve Number based on 0.10 x S.
- The time-of-concentration parameter was estimated using Uplands Method.

Refer to subcatchment parameters table provided in **Appendix C.**

Amended Topsoil (LID)

The storage provided by the amended topsoil has been represented in the PCSWMM model using LID controls (infiltration trench). The characteristics for the LID controls only include the thickness of the amended topsoil or equivalent (300mm) and the assumed 0.25 void ratio. The LID controls were applied to only the pervious areas for each subcatchment. LID controls were not applied to subcatchment B01.

StormTech Chambers

The storage requirements for the StormTech Chambers is represented in the PCSWMM model as conceptual storage nodes. The storage requirements were estimated as follows:

- The storage requirements for the water quality event was estimated at a 0.60m depth.
- The 2-year storage requirements were estimated at a 1.0m depth or less.
- The total storage required for the 100-year was estimated at a depth 1.3m.

4.6.3 Inlet Control Device Sizing

A flow control structure consisting of two ICDs will be installed in MH101 at the outlet from the StormTech Chambers. The controlled release rates will account for the uncontrolled peak flow from subcatchment A01 to ensure that the overall peak flows from the site will meet the allowable release rates specified in **Section 4.3**.

- A Tempest LMF 'Vortex' Type ICD (or approved equivalent) will be provided at the bottom of the StormTech chambers. This ICD has been sized to meet the water quality control release rate of 4.7 L/s.
- A 200mm Tempest MHF 'Standard' Type ICD (or approved equivalent) will be provided 0.60m above the bottom of the StormTech chambers to adhere to the water quantity control release rate of 52.7 L/s during the 100-year storm event.

4.6.4 Model Results

The peak flows and required storage volumes from the Subject Site are summarized in **Table 4.2**.

Table 4.2: Peak Flows and Storage Requirements

Storm Event*	Allowable Release Rate (L/s)	Peak Flows			Provided / Required Storage Volumes		
		Uncontrolled (L/s)	Controlled (L/s)	Total (L/s)	Amended Soils (m^3)	StormTech Chambers (m^3)	Total (m^3)
***Water Quality** (4-hour Chicago Storm Distribution)*							
25mm	4.7 L/s (5.8 L/s/ha)	2.4	2.5	4.9	274	37	311
***Water Quantity** (3-hour Chicago Storm Distribution)*							
2-year	52.7 L/s (2-yr Q_{pre})	3.3	7.6	10.9	274	46	320
5-year		4.4	18.0	22.4		55	329
100-year		7.6	45.4	53.0		76	350

The overall release rate for the water quality storm event is 0.2 L/s higher than the allowable release rate. The water quality ICD will be required to be a Vortex type ICD with a small orifice size. A controlled release rate of 2.5 L/s (at a head of 0.60m) was chosen in order to prevent clogging.

The total peak flow will adhere to the allowable release rate for the 100-year storm event. Approximately 76 m^3 of storage is required within the StormTech chambers for the 100-year storm event.

By-Pass Sewer (Area B01)

The peak flow from the external area (Area B01) was estimated to be 195.8 L/s. The by-pass sewer was modelled as a 375 mm diameter pipe with a 0.6% slope (Q_{cap} = 141.6 L/s). The model results indicate that this storm sewer will surcharge during the 100-year storm event but will still be able to convey the 100-year peak flow from Area B01.

5.0 SANITARY SEWER SYSTEM

5.1 Existing Sanitary Infrastructure

The sanitary outlet for the Subject Site is an existing 225 mm sanitary sewer (gravity) located within Bel-Air Drive.

The abandonment and relocation of an existing 300 mm sanitary sewer (gravity) running through both the NCC Lands to the east and the Subject Site, from Cline Crescent to Bel-Air Drive, will be required as part of the site servicing.

It should also be noted that there is an existing Supervisory Control and Data Acquisition (SCADA) tower/utility pole located at the north west corner of the Subject Site, fronting Bel-Air Drive. The SCADA tower is used to monitor a sanitary overflow maintenance hole, as it relates to the Woodroffe Pump Station. This structure is owned by the City of Ottawa Wastewater Collection Group and is planned for decommissioning in the near future. Refer to **Appendix A** for the City's correspondence. The tower will be maintained until it is abandoned or relocated (by others); alternatively, an interim monitoring configuration could be accommodated, subject to coordination with the Wastewater Collection and the Developer.

Refer to **Figure 3.1** – Proposed Servicing Layout Plan for an illustration of the proposed sanitary outlet, the abandonment and relocation of the existing sanitary sewer, and layout details.

5.2 Proposed Sanitary Infrastructure

Off-site works

As mentioned above, the proposed off-site works will require abandoning and relocating an existing 300 mm sanitary sewer which is currently running through both the NCC Lands to the east and the Subject Site. The sanitary sewer will be re-routed along the eastern limits of the Subject Site back into Bel-Air Drive. A 6-metre-wide easement will be provided in favour of the City of Ottawa. The sanitary sewer currently services approximately 18.6 Ha of developed land consisting of 235 single family dwellings. The re-routing of existing works will require reinstatement of the existing road to match existing conditions or better along Bel-Air Drive.

The proposed row townhome units fronting Bel-Air Drive will be connected directly to the existing sanitary sewer.

Refer to **Figure 5.1** – External Sanitary Drainage Area Plan for an illustration of the external drainage areas.

On-site works

The proposed on-site works will require approximately 105 m of on-site sanitary sewer (gravity) to collect wastewater flows and to direct flows to the existing 225 mm sanitary sewer located within Bel-Air Drive.

Refer to **Figure 5.2** – Sanitary Drainage Area Plan for an illustration of the proposed drainage areas.

EXTERNAL AREA B2
8.95 Ha, 78 SINGLES
4.96 Ha INSTITUTIONAL
Q = 9.75 L/s

EXTERNAL AREA B1
18.6 Ha, 235 SINGLES
Q = 14.14 L/s

SUBJECT SITE
0.8 Ha

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CITY OF OTTAWA
2112 BEL-AIR DRIVE

EXTERNAL SANITARY DRAINAGE AREA PLAN

SCALE: NOT TO SCALE
DATE: DEC 2019 | JOB: 119000 | FIGURE: 5.1

REFER TO FIGURE 5.1 FOR ADDITIONAL INFORMATION ON THE EXTERNAL SANITARY DRAINAGE AREAS

PROPOSED SANITARY RELOCATION

NCC LANDS

B2 | 7 - 5 | 8.9 | 78

B1 | 11 - 9 | 18.6 | 235

6m WIDE EASEMENT

300mmØ SAN

EXISTING SANITARY TO BE ABANDONED

A4 | 19 - 17 | 0.03 | 2.7

A5 | 17 - 15 | 0.12 | 10.8

A6 | 15 - 13 | 0.06 | 5.4

A7 | 13 - 3 | 0.09 | 8.1

A3 | 21 - 19 | 0.07 | 5.4

BEL-AIR DRIVE

225mmØ SAN

200mmØ SAN

PRIVATE ROAD

A2 | 23 - 21 | 0.11 | 8.1

NCC LANDS

A8 | 3 - 1 | 0.20 | 13.5

225mmØ SAN

UP

200mmØ SAN

A1 | 25 - 23 | 0.17 | 13.5

3m WIDE EASEMENT

LEGEND

C1 | 101-103 | 12 | 3

- AREA ID
- MANHOLE TO MANHOLE
- POPULATION EQUIVALENT
- DRAINAGE AREA (hectares)

- SANITARY DRAINAGE AREA
- *EXISTING SANITARY SEWER*
- PROPOSED SANITARY SEWER

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CITY OF OTTAWA
2112 BEL-AIR DRIVE

SANITARY DRAINAGE AREA PLAN

SCALE 1:500

DATE DEC 2019 | JOB 119000 | FIGURE 5.2

5.3 Sanitary Demand and Design Parameters

The peak design flow parameters in **Table 5.1** has been used in the sewer capacity analysis. Unit and population densities and all other design parameters are specified in the OSDG.

Table 5.1: Sanitary Sewer Design Parameters

Design Component	Design Parameter
Unit Population: Row Townhomes	2.7 people/unit
Residential Flow Rate, Average Daily	280 L/cap/day
Residential Peaking Factor	Harmon Equation (min=2.0, max=4.0) Harmon Correction Factor = 0.8
Extraneous Flow Rate	0.33 L/s/ha
Minimum Pipe Size	200 mm (Res)
Minimum Velocity[1]	0.6 m/s
Maximum Velocity	3.0 m/s
Minimum Pipe Cover	2.5 m (Unless frost protection provided)

[1]A minimum gradient of 0.65% is required for any initial sewer run with less than 10 residential connections.

The preliminary sanitary sewer design sheets, located in **Appendix D**, confirms that the existing sanitary sewers fronting the Subject Site on Bel-Air Drive has adequate capacity to facilitate the proposed development and that the proposed sanitary sewers have been designed per the OSDG design parameters.

6.0 WATER SUPPLY SYSTEM

6.1 Existing Water Infrastructure

The watermain connection point for the proposed site is the existing 150 mm watermain stub located at the Bel-Air Drive/ Field Street intersection.

It should be noted that the City of Ottawa is planning to upgrade the watermain along Bel-Air Drive, with the work targeted to start February 2020.

Refer to **Figure 3.1** – Proposed Servicing Layout Plan for an illustration of the proposed watermain connection point, and layout details.

6.2 Proposed Water Infrastructure

Off-site works

The proposed off-site works will require extending a 150 mm watermain approximately 51 m from the Subject Site to the existing 150 mm watermain stub at Bel-Air Drive.

The proposed row townhome units fronting Bel-Air Drive will be connected directly to the 150 mm watermain being extended as part of the off-site works.

On-site works

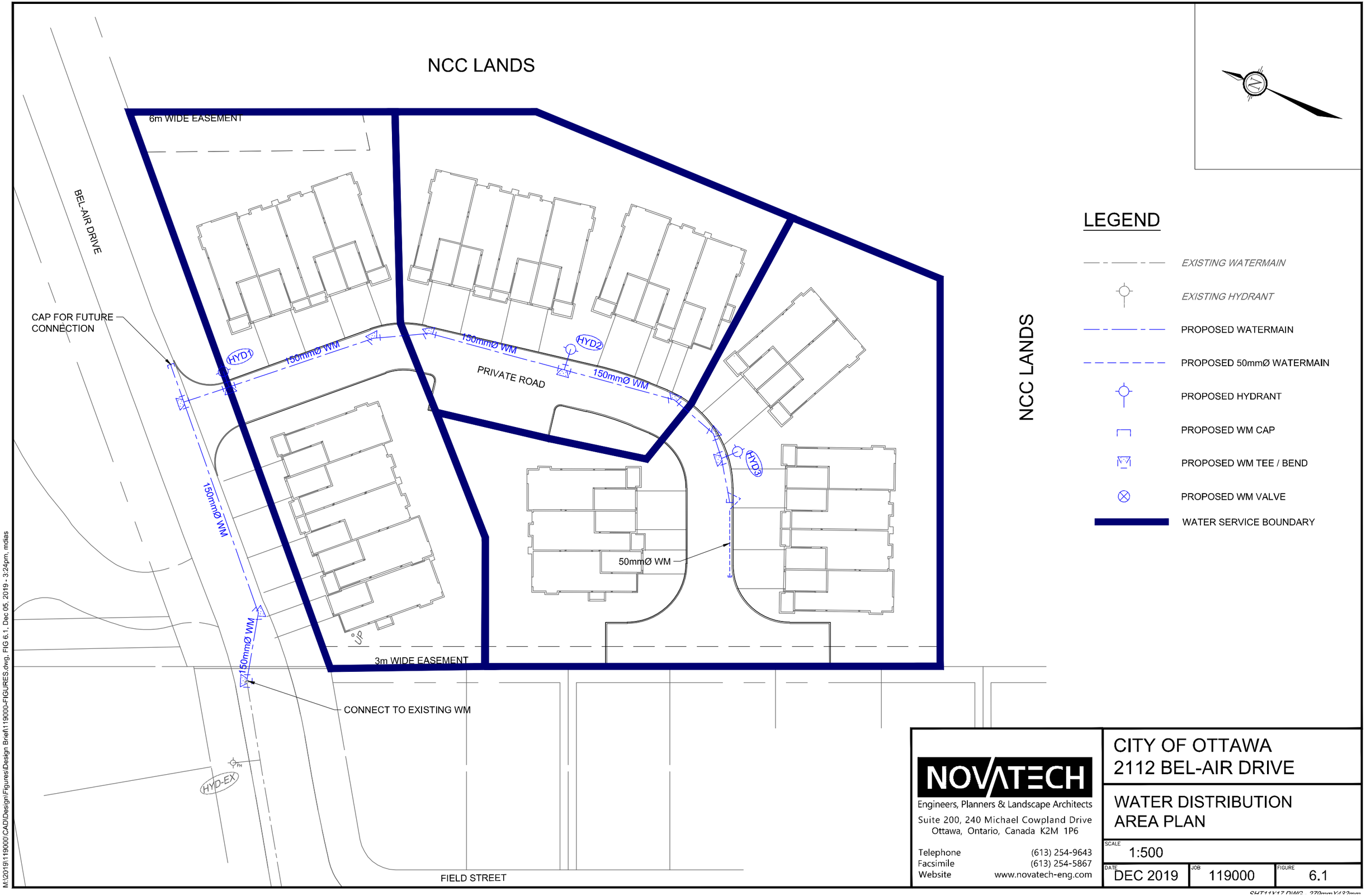
The proposed on-site works will include approximately 88 m and 12 m of 150 mm and 50 mm watermain, respectively. Preliminary hydrants locations has been provided and will be confirmed during the detailed design stage.

The layout of the proposed water supply system is shown in **Figure 6.1** – Water Distribution Plan.

6.3 Watermain Design Parameters

Boundary conditions were provided by the City of Ottawa, based on the OWDG water demand criteria, for both existing conditions and planned conditions (February 2020). For the purpose of this report, both conditions have been analysed and results provided; however, it is assumed that the planned conditions (February 2020) will apply given the timing of the planned works and the build out of the Subject Site. The boundary conditions are included in **Appendix E**.

The domestic demand design parameters, fire fighting demand design scenarios and system pressure criteria design parameters are outlined in **Table 6.1** below. The system pressure design criteria are used to determine the size of the watermains, required within the Subject Site, and are based on a conservative approach that considers three possible scenarios.



M:\2019\119000\CAD\Design\Figures\Design Brief\119000-FIGURES.dwg, FIG 6.1, Dec 05, 2019 - 3:24pm, mdias

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CITY OF OTTAWA
2112 BEL-AIR DRIVE

WATER DISTRIBUTION AREA PLAN

SCALE 1:500

DATE DEC 2019 | JOB 119000 | FIGURE 6.1

SHT11X17.DWG - 279mmX432mm

Table 6.1: Watermain Design Parameters and Criteria

Domestic Demand Design Parameters	Design Parameters
Population: Row Townhome	2.7 people/unit
Basic Day Residential Demand (BSDY)	350 L/c/d
Maximum Day Demand (MXDY)	2.5 x BSDY
Peak Hour Demand (PKHR)	2.2 x MXDY
Fire Demand Design	**Design Flows**
Fire Demand (FF)	167 L/s per FUS / OWDG TB-2014
System Pressure Criteria Design Parameters	**Criteria**
Maximum Pressure (BSDY) Condition	< 80 psi occupied areas < 100 psi unoccupied areas
Minimum Pressure (PKHR) Condition	> 40 psi
Minimum Pressure (MXDY + FF) Condition	> 20 psi

The firefighting water demands for the Subject Site has been estimated per OWDG which refers to the Fire Underwriters Survey (CGI, 1999) document, abbreviated as FUS.

In accordance with the FUS and based on the proposed zoning, there is potential for less than 3m of separation between the single family, semi-detached, and row townhome wood-framed buildings, which would require the fire area in the FUS estimate for multiple buildings to be treated as a contiguous block area. This results in a high fire flow demand which is difficult to attain from the existing system; moreover, it would trigger larger diameter watermain size within the Subject Site, creating system vulnerabilities such as water age issues. As per the ISTB-2014-02, fire flows may be capped at 167 L/s (10,000 L/min) for single family, semi-detached, and row townhome, provided certain site criteria are met. The criteria are:

- For singles: a min separation of 10 m between the backs of adjacent units.
- Traditional side-by-side semi-detached or row townhomes:
    a. Firewalls with a min two-hour rating to separate the block into fire areas of no more than the lesser of 7 dwelling units, or 600 m^2 of building area; and
    b. Min. separation of 10 m between the backs of adjacent units.

The proposed layout of the Subject Site will meet the minimum separation of 10 meters between the backs of adjacent units. As such, the proposed layout shall meet the foregoing criteria allowing the capped fire flow of 167 L/s to be used for these unit types of residential units. Detailed FUS calculations can be found attached in **Appendix E**.

6.4 System Pressure Modeling and Results

System pressures for the Subject Site for both the existing and planned conditions were estimated using the EPANET engine within PCSWMM.

The PCSWMM model layout is demonstrated in **Figure 6.1** – Proposed Watermain Sizing, Layout and Junction IDs and **Figure 6.2** – Ground Elevations (m).

2112 Bel-Air Drive
Job No. 119000
PCSWMM Model Schematic – PLANNED CONDITIONS (FEB 2020)

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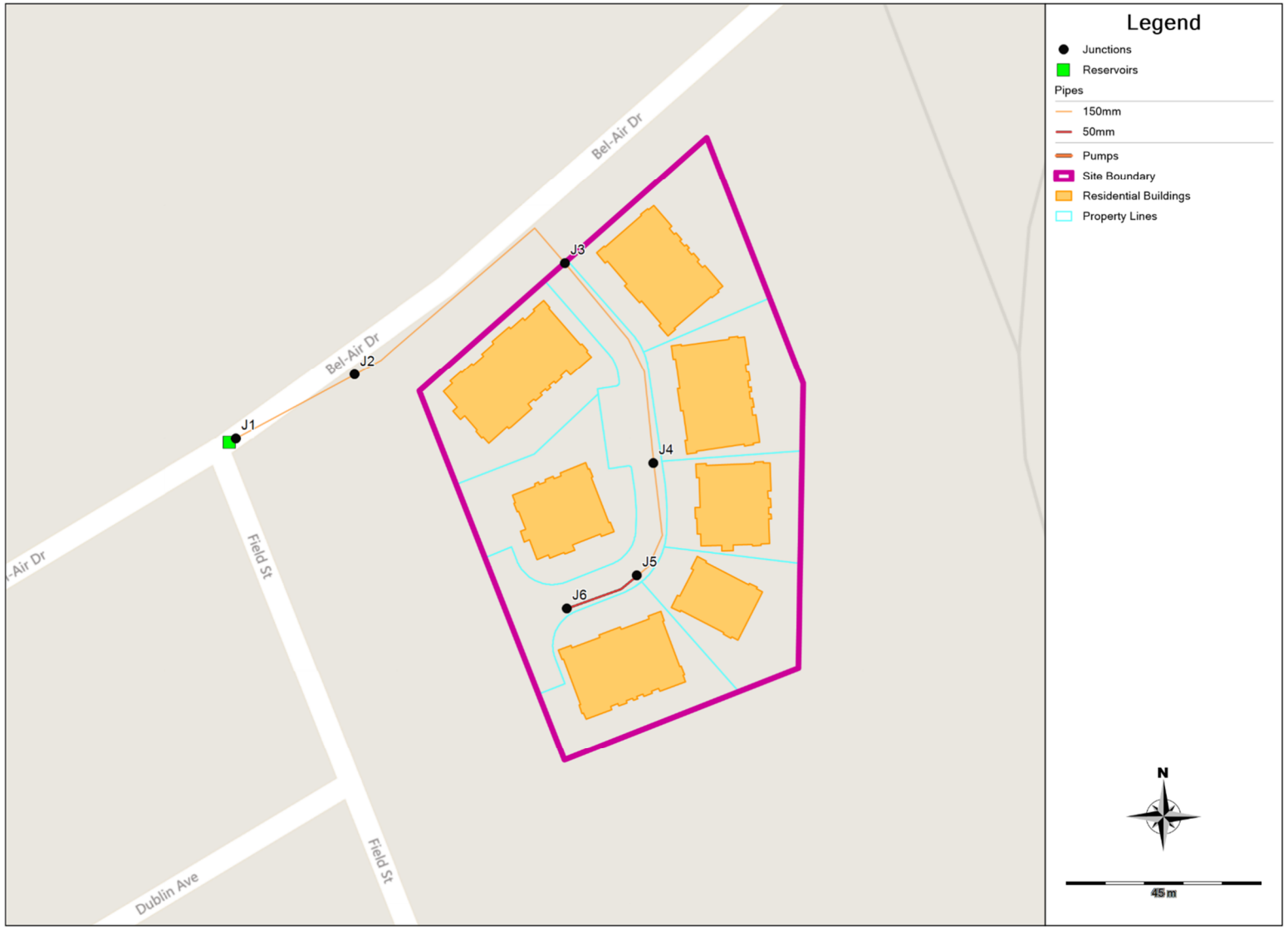
Figure 6.2 – Proposed Watermain Sizing, Layout and Junction IDs



Date: 2019/11/01
M:\2019\119000\DATA\Reports\Design Brief\Conceptual\Figures\Fig 6.2 - Model Schematic.docx

2112 Bel-Air Drive
Job No. 119000
PCSWMM Model Schematic – PLANNED CONDITIONS (FEB 2020)

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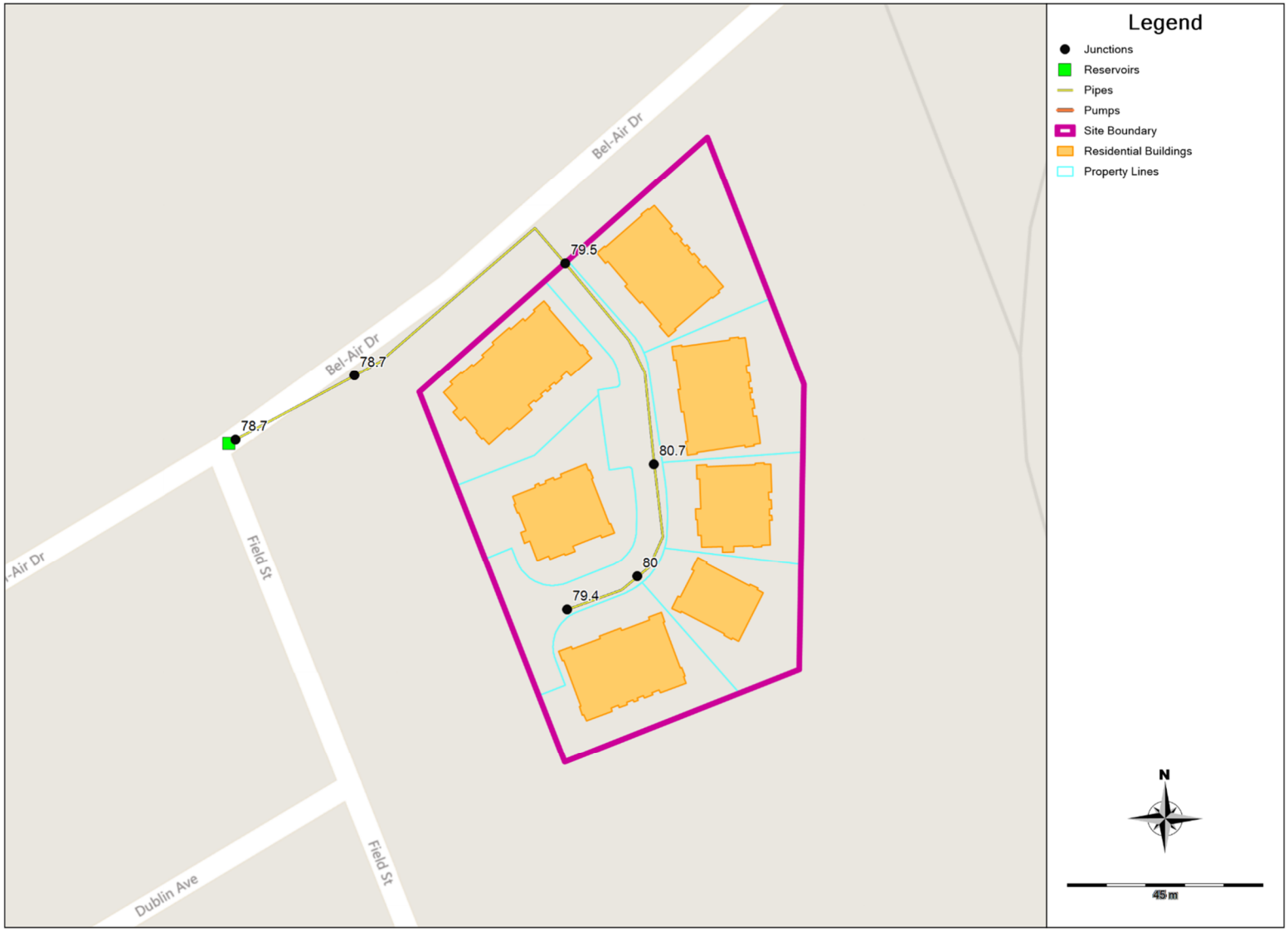
Figure 6.3 – Ground Elevations (m)



Date: 2019/11/01
M:\2019\119000\DATA\Reports\Design Brief\Conceptual\Figures\Fig 6.2 - Model Schematic.docx

Domestic Demand

The water demand summary for the build out of the Subject Site for the basic daily and peak hour demands has been provided in **Table 6.2** below. For detailed results refer to the tables provided in **Appendix E.** The detailed results for the planned conditions are also demonstrated in **Figure 6.3** – Maximum Pressures During BSDY Condition and **Figure 6.4** – Minimum Pressures During PKHR Condition.

Table 6.2: System Pressure (EPANET)

Condition	Demand (L/s)	Allowable Pressure (psi)	Max/Min Pressure (psi)
Existing Conditions			
Basic Day Demand	0.27	80 (Max)	80
Peak Hour Demand	1.50	40 (Min)	70
Planned Conditions (February 2020)			
Average Daily Demand	0.27	80 (Max)	80
Peak Hour Demand	1.50	40 (Min)	71

Fire Demand

Furthermore, an analysis was carried out to determine the available fire flow under maximum day demand while maintaining a residual pressure of 20psi. This was completed using the EPANET fire flow analysis feature within PCSWMM.

To achieve the required fire flow and optimize watermain sizes, the OWDG and its subsequent revisions (specifically ISTB-2018-02) allow for multiple hydrants to be drawn from, as opposed to drawing from a single hydrant to meet the required demand. Upon review of the Subject Site and the proposed hydrant locations, the required fire flows can be achieved for the proposed structures by utilizing multiple hydrants. An excerpt from ISTB-2018-02 of Appendix I: Guideline on Coordination of Hydrant Placement with Required Fire Flow has been included in **Appendix E**, for reference on the maximum flow that can be considered from a given hydrant.

The available aggregate hydrant flow summary for the build out of the Subject Site for the maximum day and fire flow demands has been provided in **Table 6.3** below. For detailed results refer to the tables provided in **Appendix E.** The detailed results are also demonstrated in **Figure 6.5** – Available Flow at 20psi During MXDY+FF Condition.

Figures under existing conditions have been provided in **Appendix E**.

Table 6.3: Summary of Available Aggregate Hydrant Flow

Condition	Available Aggregate Hydrant Flow (L/min)	Min Pressure (psi)
Existing Conditions	6,800	20
Planned Conditions (February 2020)	14,400	20

The hydraulic analysis demonstrates that the proposed watermain sizing meets the design criteria.

2112 Bel-Air Drive
Job No. 119000
PCSWMM Model Schematic – PLANNED CONDITIONS (FEB 2020)

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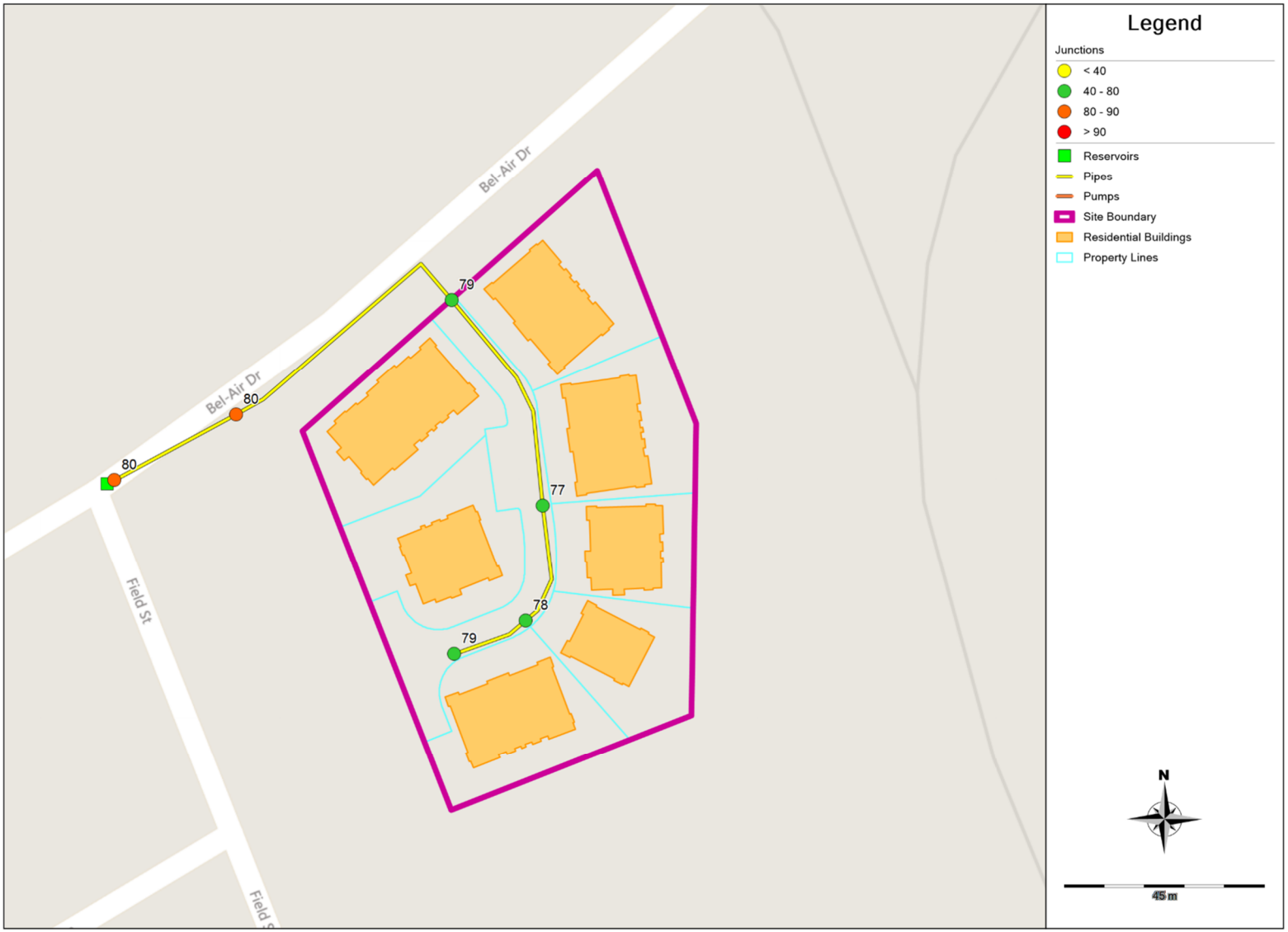
Figure 6.4 – Maximum Pressures During BSDY Conditions



Date: 2019/11/01
M:\2019\119000\DATA\Reports\Design Brief\Conceptual\Figures\Fig 6.2 - Model Schematic.docx

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Job No. 119000
PCSWMM Model Schematic – PLANNED CONDITIONS (FEB 2020)

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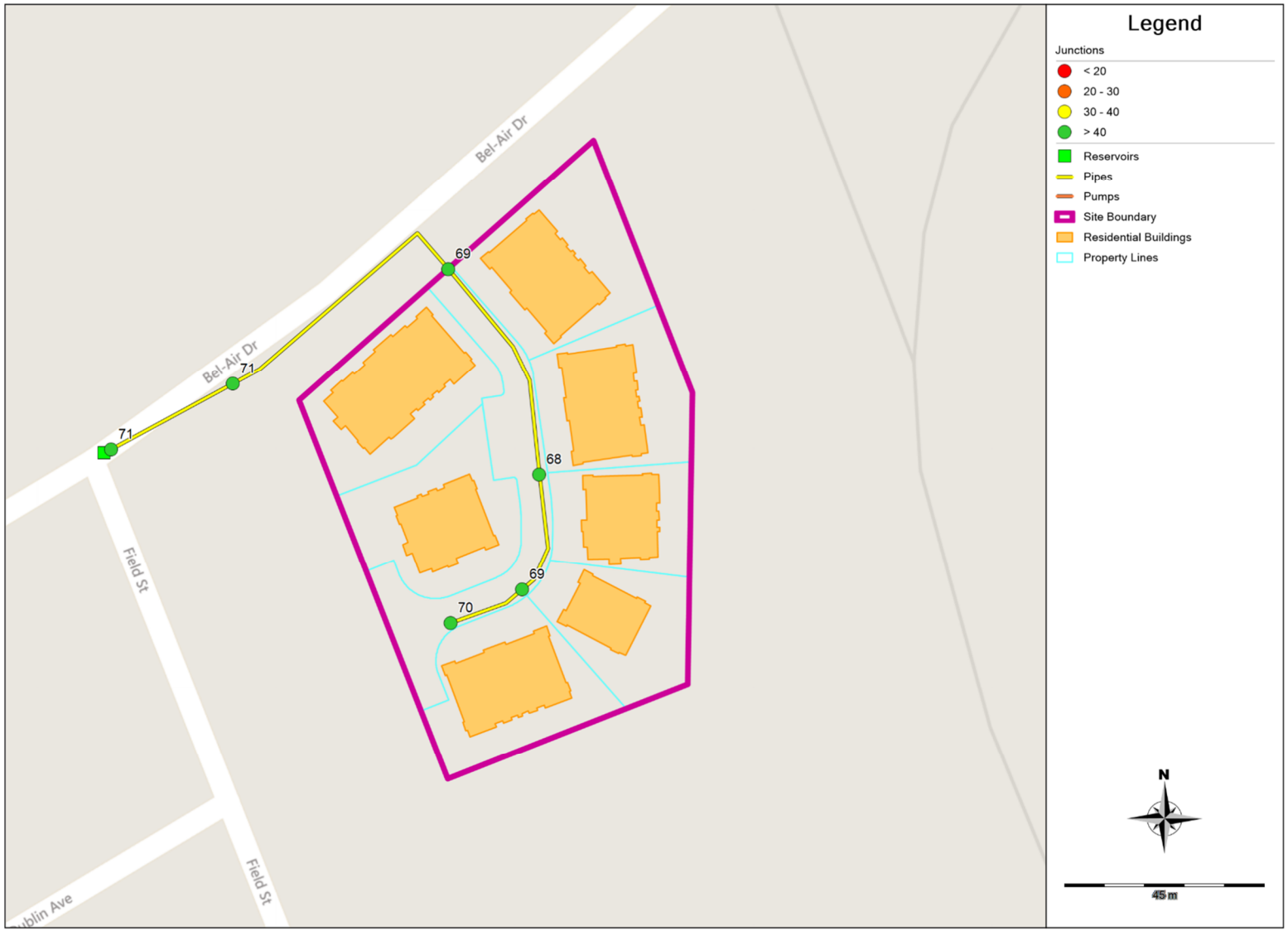
Figure 6.5 – Minimum Pressures During PKHR Conditions



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M:\2019\119000\DATA\Reports\Design Brief\Conceptual\Figures\Fig 6.2 - Model Schematic.docx

2112 Bel-Air Drive
Job No. 119000
PCSWMM Model Schematic – PLANNED CONDITIONS (FEB 2020)

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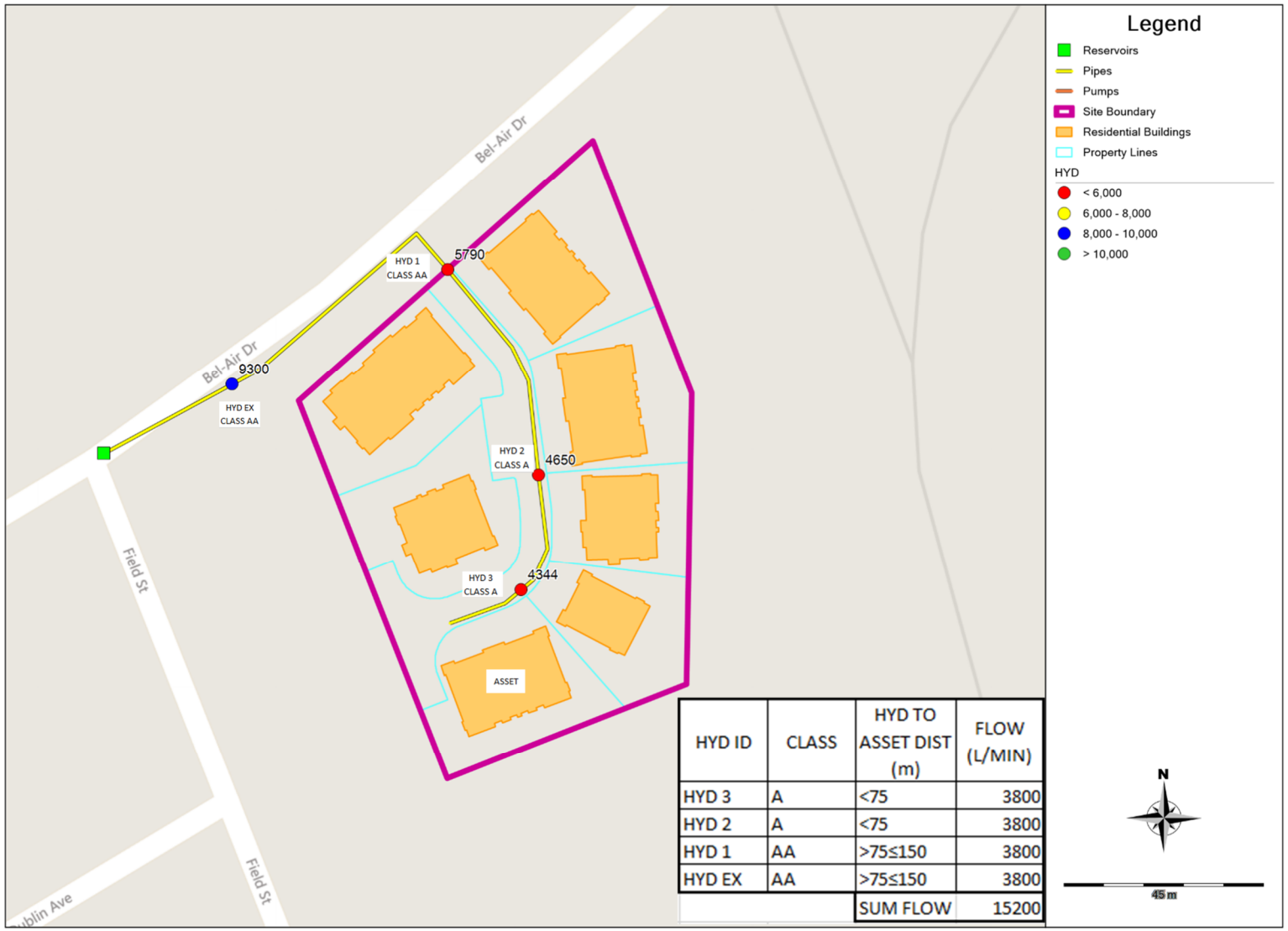
Figure 6.6 – Available Flow at 20psi During MXDY+FF Conditions



HYD ID	CLASS	HYD TO ASSET DIST (m)	FLOW (L/MIN)
HYD 3	A	<75	3800
HYD 2	A	<75	3800
HYD 1	AA	>75≤150	3800
HYD EX	AA	>75≤150	3800
		SUM FLOW	15200

7.0 UTILITIES

The development will be serviced by Hydro Ottawa, Bell Canada, Rogers Communications, and Enbridge Gas Distribution Inc. Furthermore, streetlighting will be provided within the private road, and will be designed with marker lighting whilst ensuring light pollution at the property line meets City of Ottawa policy. The works will be coordinated with local utility companies during the detailed design stage.

The cross section of the utility trench and the connection to the existing services will also be confirmed during the detailed design stage.

The City owned SCADA tower locate at the north-west corner of the site will be maintained until it is abandoned or relocated (by others); alternatively, an interim monitoring configuration could be accommodated, subject to coordination with the Wastewater Collection, the Developer, and Bell Canada, or Rogers Communications.

8.0 EROSION AND SEDIMENT CONTROL AND DEWATERING MEASURES

Temporary 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 will be provided on an Erosion and Sediment Control Plan, prepared as part of the detailed design stage. Erosion and sediment control measures may include:

- Placement of filter fabric under all catch basin and maintenance hatches;
- Tree protection fence around the trees to be maintained
- Silt fence around the area under construction placed as per OPSS 577 / OPSD 219.110
- Light duty straw bale check dam per OPSD 219.180

The erosion and sediment control measures will need to be installed to the satisfaction of the engineer, the City, the Ontario Ministry of Environment Conservation and Parks (MECP), and the RVCA, prior to construction and will remain in place during construction until vegetation is established. The erosion and sediment control measure will also be subject to regular inspection to ensure that measures are operational.

Refer to **Figure 3.2** – Macro Grading, Erosion and Sediment Control Plan.

9.0 NEXT STEPS, COORDINATION, AND APPROVALS

The proposed municipal infrastructure may be subject, but not limited to the following approvals:

- MECP PTTW. Submitted to: MECP. Proponent: Developer.
- MECP Environmental Certificate of Approval (ECA) for the storm / sanitary sewers as a "Direct Submission". Submitted to: City of Ottawa/ MECP, and approved by MECP. Proponent: Developer.
- MECP Pre-authorized watermain alteration and extension program granted as part of City of Ottawa's Drinking Water Works Permit (F-1 Form). Submitted to: City of Ottawa. Proponent: Developer.
- Ministry of Natural Resources and Forestry (MNRF) Butternut and City of Ottawa Tree Cutting Permit. Submitted to MNRF and City of Ottawa. Proponent: Developer, or its contractor/agent.
- Road Cut Permit. Submitted to City of Ottawa. Proponent: Developer, or its contractor/agent.
- Prior to construction, the Developer may apply for MECP Pre-authorized watermain alteration and extension program and Road Cut Permit. This will allow the Developer to obtain building permits for the units fronting Bel-Air Drive.

10.0 SUMMARY AND CONCLUSIONS

This report demonstrates that the proposed development can be adequately serviced with storm and sanitary sewers and watermain. The report is summarized below:

Stormwater Management:

- The Subject Site will be serviced with approximately 412 m of on-site storm sewers ranging from 250 mm to 375 mm in diameter. The on-site storm sewers will outlet to the existing storm sewer on Bel-Air Drive.
- The runoff from the adjacent NCC lands (external area B01) will by-pass the Subject Site through an 87 m storm sewer with a 375 mm diameter.
- Stormwater management will be provided to adhere to the allowable release rates.
- Amended soils will reduce runoff generated from the Subject Site and provide inherent quality control.
- Underground storage will be provided by StormTech model SC-740 (or approved equivalent).

Sanitary and Wastewater Collection System:

- The sanitary outlet for the Subject Site is an existing 225 mm sanitary sewer located within Bel-Air Drive.
- The abandonment and relocation of an existing 300 mm sanitary sewer running through both the NCC Lands to the east and the Subject Site, from Cline Crescent to Bel-Air Drive, will be required as part of the site servicing.
- The proposed on-site works will require approximately 105 m of on-site sanitary 200mm diameter sewers to collect wastewater flows and to direct flows to the sanitary outlet.
- The proposed row townhome units fronting Bel-Air Drive will be connected directly to the existing sanitary sewer.
- The existing sanitary sewers fronting the Subject Site on Bel-Air Drive has adequate capacity to facilitate the proposed development and that the proposed sanitary sewers has been designed per the OSDG design parameters.
- The City owned SCADA tower locate at the north-west corner of the site will be maintained until it is abandoned or relocated (by others); alternatively, an interim monitoring configuration could be accommodated, subject to coordination with the Wastewater Collection, the Developer, and Bell Canada, or Rogers Communications.

Water Supply System

- The watermain connection point for the proposed site is the existing 150 mm watermain stub located at the Bel-Air Drive/ Field Street intersection.
- The proposed off-site works will require extending a 150 mm watermain approximately 51 m from the Subject Site to the existing 150 mm watermain stub at Bel-Air Drive.

- The proposed on-site works will include approximately 88 m and 12 m of 150 mm and 50 mm watermain, respectively. Preliminary hydrants locations have been provided and will be confirmed during the detailed design stage.
- The existing watermain network has adequate capacity to meet system pressure for the Subject Site's domestic demands. Moreover, the City's planned works for upgrades to the existing watermain network will have adequate capacity to meet system pressure for the Subject Site's domestic and fire demands. Given the timing of the planned works (February 2020) and buildout of the Subject Site, it would be reasonable to allow the development to proceed, since domestic demands are met.

Erosion and Sediment Control

- Temporary erosion and sediment control measures will be implemented both prior to commencement and during construction in accordance with the "Guidelines on Erosion and Sediment Control for Urban Construction Sites" (Government of Ontario, May 1987).

Next Steps, Coordination, and Approvals

- MECP PTTW.
- MECP ECA for the storm / sanitary sewers as a "Direct Submission".
- MECP Pre-authorized watermain alteration and extension program granted as part of City of Ottawa's Drinking Water Works Permit (F-1 Form).
- MNRF Butternut and City of Ottawa Tree Cutting Permit.
- Road Cut Permit.
- Prior to construction, the Developer may apply for MECP Pre-authorized watermain alteration and extension program and Road Cut Permit. This will allow the Developer to obtain building permits for the units fronting Bel-Air Drive.

11.0 CLOSURE

This report is respectfully submitted for review and subsequent approval. Please contact the undersigned should you have questions or require additional information.

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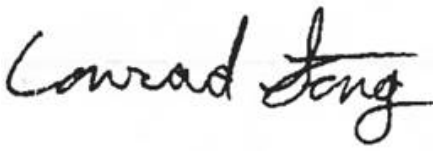
Prepared by:



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Appendix A
Correspondence

Greg Winters

From: McCreight, Laurel <Laurel.McCreight@ottawa.ca>
Sent: Wednesday, January 23, 2019 9:24 AM
To: Robert Tran
Cc: Greg Winters; Sam Bahia
Subject: Pre-Consultation Follow-up: 2112 Bel-Air Drive
Attachments: Plan & Study List.pdf

Hi Robert,

Please refer to the below regarding the Pre-Consultation Meeting held on Monday January 21, 2019 for the property 2112 Bel-Air Drive for a proposed plan of subdivision for a townhouse development. I have also attached the Plans & Study List.

General

- Proposal of three concepts for a townhouse development
  - Concept Plan #2: 22 townhouses on a public street (cul-de-sac) with an 18 metre right-of-way
  - Concept Plan #4: 29 townhouses on a private street with a 6.0 metre right-of-way
  - Concept Plan #7: 22 townhouses on a public street with an 18 metre right-of-way

Planning & Urban Design

- The existing residential subdivision to the west will be most impacted by the proposed development
  - Please be cognizant of the setback proposed against this community
- The site is heavily treed
  - Please retain as many trees where possible

Heritage

- The City is undertaking an Heritage Inventory Project that is currently underway
  - This study is expected to proceed to Council in late Spring 2019
  - The study includes buildings built prior to 1980 that have potential to be added to the Heritage Register and potentially designated
  - The existing church is proposed to be added to the Register
    - If successfully added, 60-days notice will be required prior to demolition
- The Church has been identified as having cultural heritage value
- It is encouraged to retain the Church as part of the proposal
- For any heritage related questions please contact Lesley Collins

Transportation

- Traffic Impact Assessment Screening form submitted. Traffic Impact Assessment will not be required
  - Screening form to be updated if the concept changes from what has been proposed
- Noise Impact Studies required for the following:
  - Road
- On site plan:
  - Show all details of the roads abutting the site up to and including the opposite curb; include such items as pavement markings, accesses and/or sidewalks
  - Turning templates will be required for all accesses showing the largest vehicle to access the site; required for internal movements and at all access (entering and exiting and going in both directions)
  - Show all curb radii measurements; ensure that all curb radii are reduced as much as possible
  - Show lane/aisle widths

- For any transportation related questions please contact Rosanna Baggs

Forestry

- A Tree Conservation Report (TCR) must be supplied for review along with the suite of other plans/reports required by the City; an approved TCR is a requirement of Site Plan or Plan of Subdivision approval
- Any removal of privately-owned trees 10cm or larger in diameter requires a tree permit issued under the Urban Tree Conservation Bylaw; the permit is based on the approved TCR
- The removal of City-owned trees will require the permission of Forestry Services who will also review the submitted TCR
- In this case, the TCR may be combined with the Landscape Plan or it may be a stand-alone plan; a plan form is preferred provided it has all the relevant information.
- The TCR must list all trees on site by species, diameter and health condition – separate stands/groupings of trees may be combined using averages
- The TCR must address all trees with a critical root zone that extends into the developable area – all trees that could be impacted by the construction that are outside the developable area need to be addressed.
- Trees with a trunk that crosses/touches a property line are considered co-owned by both property owners; permission from the adjoining property owner must be obtained prior to the removal of co-owned trees
- If trees are to be removed, the TCR must clearly show where they are, and document the reason they can not be retained – please provide a plan showing retained and removed treed areas
- All retained trees must be shown and all retained trees within the area impacted by the development process must be protected as per City guidelines listed on Ottawa.ca
- Butternut is common in the vicinity of the site – please address any butternut identified within a regulated distance from the property
- The City encourages the retention of healthy trees; if possible, please seek opportunities for retention of trees that will contribute to the design/function of the site.
- Please ensure newly planted trees have an adequate soil volume for their size at maturity. The following is a table of recommended minimum soil volumes:

Tree Type/Size	Single Tree Soil Volume (m3)	Multiple Tree Soil Volume (m3/tree)
Ornamental	15	9
Columnar	15	9
Small	20	12
Medium	25	15
Large	30	18
Conifer	25	15

- For any questions related to forestry please contact Mark Richardson

Engineering

- Consultant to determine what kind of ECA Application is required for site sewer (storm or sanitary) alterations for the development. City to confirm.

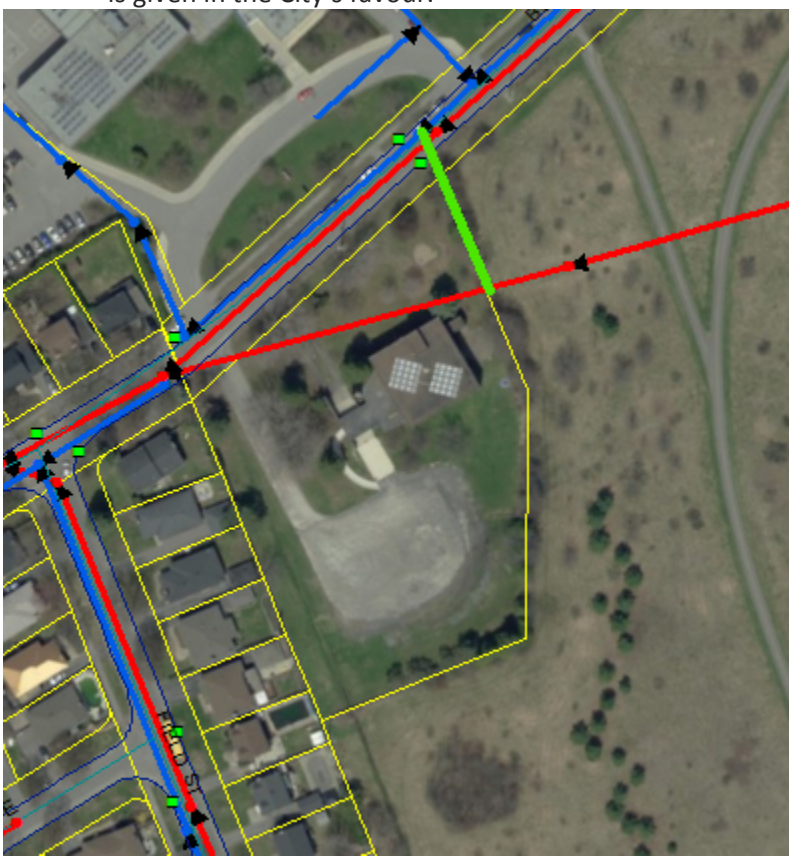
WATER

- Form 1 required to extend watermain down Bel-Air. Full-sized main is required for the extension and depending on development and servicing orientation, the extension may be required across the entire lot frontage. Specifics of watermain extension requirements can be discussed at design stage.
- E-mail Justin to obtain boundary conditions. Provide demand calculations which will be reviewed prior to boundary condition request.

SANITARY

- City sanitary sewer with 6m easement crossing NCC lands as well as 2112 Bel-Air requires relocation. After following up with the City's Asset Management Branch (AMB), a realignment as shown by the green line in the

screenshot below will be supported, provided the relocation is done on 2112 Bel-Air property and an easement is given in the City's favour.



- Sanitary system in the area has high extraneous flows due to the partially separated nature of the system. As such, there is a history of flooding in this area. Contact Eric Tousignant for further info.

STORM

- Uncontrolled storm system with 2-yr level of service.
- Site discharges to Pinecrest Creek – Pinecrest Creek/Westboro Area SWM guidelines to be followed.

For any questions related to engineering please contact Justin Armstrong

Please do not hesitate to contact me with any questions.

Regards,
Laurel

Laurel McCreight MCIP, RPP
Planner
Development Review West
Urbaniste
Examen des demandes d'aménagement ouest

City of Ottawa | Ville d'Ottawa
613.580.2424 ext./poste 16587
ottawa.ca/planning / ottawa.ca/urbanisme

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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	Number of copies	ENGINEERING		S/A	Number of copies
S	5	1. Site Servicing Plan	2. Site Servicing Brief	S	3
S	5	3. Grade Control and Drainage Plan	4. Geotechnical Study	S	3
	2	5. Composite Utility Plan	6. Groundwater Impact Study		6
	5	7. Servicing Options Report	8. Wellhead Protection Study		6
S	4	9. Transportation Impact Brief (if required)	10.Erosion and Sediment Control Plan / Brief	S	3
S	3	11.Storm water Management Brief	12.Hydro geological and Terrain Analysis		8
	3	13.Hydraulic Water main Analysis	14.Noise (road)	S	3
	35/50/55	15.Roadway Modification Design Plan	16.Confederation Line Proximity Study		9
S/A	**Number of copies**	**PLANNING / DESIGN / SURVEY**		**S/A**	**Number of copies**
S	5	17.Draft Plan of Subdivision	18.Plan Showing Layout of Parking Garage		2
	30	19.Draft Plan of Condominium	20.Planning Rationale	S	3
	20	21.Site Plan	22.Minimum Distance Separation (MDS)		3
	20	23.Concept Plan Showing Proposed Land Uses and Landscaping	24.Agrology and Soil Capability Study		5
	3	25.Concept Plan Showing Ultimate Use of Land	26.Cultural Heritage Impact Statement		3
	10	27.Landscape Plan	28.Archaeological Resource Assessment Requirements: **S** (site plan) **A** (subdivision, condo)		3
S	2	29.Survey Plan	30.Shadow Analysis		3
S	3	31.Architectural Building Elevation Drawings (dimensioned)	32.Design Brief (includes the Design Review Panel Submission Requirements)		Available online
	6	33.Wind Analysis			
S/A	**Number of copies**	**ENVIRONMENTAL**		**S/A**	**Number of copies**
S	3	34.Phase 1 Environmental Site Assessment	35.Impact Assessment of Adjacent Waste Disposal/Former Landfill Site		6
	5	36.Phase 2 Environmental Site Assessment (depends on the outcome of Phase 1)	37.Assessment of Landform Features		7
	4	38.Record of Site Condition	39.Mineral Resource Impact Assessment		4
S	3	40.Tree Conservation Report	41.Environmental Impact Statement / Impact Assessment of Endangered Species		5
	4	42.Mine Hazard Study / Abandoned Pit or Quarry Study	43.Integrated Environmental Review (Draft, as part of Planning Rationale)	S	3
S/A	**Number of copies**	**ADDITIONAL REQUIREMENTS**		**S/A**	**Number of copies**
		44.	45.		

Meeting Date: January 21, 2019

Application Type: *Zoning By-Law Amendment & Plan of Subdivision*

File Lead (Assigned Planner): Laurel McCreight

Infrastructure Approvals Project Manager: Justin Armstrong

Site Address (Municipal Address): 2122 Bel-Air Drive

*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.**

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.

Ben Sweet

From: Sam Bahia
Sent: Thursday, December 5, 2019 2:09 PM
To: Ben Sweet
Subject: FW: Woodroffe PS Overflow (Bel-Air at Field St)

Sam Bahia, P.Eng., Project Manager | Land Development
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 x 285 | Fax: 613.254.5867

From: Zaknoun, Hasnaa <hasnaa.zaknoun@ottawa.ca>
Sent: Thursday, January 17, 2019 5:01 PM
To: Sam Bahia <s.bahia@novatech-eng.com>; Robidoux, Robbie <Robbie.Robidoux@ottawa.ca>
Subject: RE: Woodroffe PS Overflow (Bel-Air at Field St)

Hello Sam,
The below site you are referring to is a monitoring manhole that is scheduled to be decommissioned. I cannot comment on the overflow pipe as I am not very familiar with this particular site but I can find out for you.
Thanks

Hasnaa Zaknoun

From: Sam Bahia <s.bahia@novatech-eng.com>
Sent: January 17, 2019 3:49 PM
To: Robidoux, Robbie <Robbie.Robidoux@ottawa.ca>; Zaknoun, Hasnaa <hasnaa.zaknoun@ottawa.ca>
Subject: Woodroffe PS Overflow (Bel-Air at Field St)

Hi Hasnaa/Robbie
I'm doing some due diligence for a client interested in a property within the Woodroffe Area, specifically at the intersection of Bel-air Drive at Field St. Just had a quick question.

The property is fronting a SanMH with what seems to be a connecting overflow to the StmMH on Bel-Air Drive just east of that intersection. Is that an overflow for the Woodroffe PS (1095 Woodroffe), and is the radio pole in the picture below related to it for monitoring (seems recent around 2009 – 2012)?

Thank you in advance for any of your help.
Sam Bahia, P.Eng., Project Manager | Land Development
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 x 285 | Fax: 613.254.5867


prom. Bel-Air Dr.
rue Field St.

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Appendix B
Servicing Report Checklist

NOVATECH
Engineers, Planners & Landscape Architects

Development Servicing Study Checklist

Project Name: 2112 Bel-Air Drive
Project Number: 119000
Date: Nov 1, 2019

4.1 General Content	**Addressed (Y/N/NA)**	**Section**	**Comments**
Executive Summary (for larger reports only).	**NA**		
Date and revision number of the report.	Y	Cover	
Location map and plan showing municipal address, boundary, and layout of proposed development.	Y	Fig 1.1, 1.2, 1.3	
Plan showing the site and location of all existing services.	Y	Fig 3.1	
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.	NA		
Summary of Pre-consultation Meetings with City and other approval agencies.	Y	1	
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.	Y	2	
Statement of objectives and servicing criteria.	Y	1	
Identification of existing and proposed infrastructure available in the immediate area.	Y	4,5,6	
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).	NA		
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 neighboring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.	Y	Fig 3.2	

4.1 General Content	**Addressed (Y/N/NA)**	**Section**	**Comments**
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.	NA		
Proposed phasing of the development, if applicable.	NA		
Reference to geotechnical studies and recommendations concerning servicing.	Y	2.2	
All preliminary and formal site plan submissions should have the following information:			
Metric scale	NA		
North arrow (including construction North)	NA		
Key plan	NA		
Name and contact information of applicant and property owner	NA		
Property limits including bearings and dimensions	NA		
Existing and proposed structures and parking areas	NA		
Easements, road widening and rights-of-way	NA		
Adjacent street names	NA		

4.2 Water	Addressed (Y/N/NA)	Section	Comments
Confirm consistency with Master Servicing Study, if available.	NA		
Availability of public infrastructure to service proposed development.	Y	6	
Identification of system constraints.	Y	6	
Identify boundary conditions.	Y	6	
Confirmation of adequate domestic supply and pressure.	Y	6	
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.	Y	6	
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.	Y	6	
Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design.	NA		
Address reliability requirements such as appropriate location of shut-off valves.	Y	Fig 6.1	
Check on the necessity of a pressure zone boundary modification.	NA		
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.	Y	6	
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.	Y	6, Fig 6.1	
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.	NA		
Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	Y	6	
Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	Y	Fig 6.1	

4.3 Wastewater	**Addressed (Y/N/NA)**	**Section**	**Comments**
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).	Y	5	
Confirm consistency with Master Servicing Study and/or justifications for deviations.	NA		
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.	NA		
Description of existing sanitary sewer available for discharge of wastewater from proposed development.	Y	5	
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)	Y	5	
Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix 'C') format.	N		
Description of proposed sewer network including sewers, pumping stations, and forcemains.	Y	5	
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).	NA		
Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.	NA		
Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	NA		
Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.	NA		
Special considerations such as contamination, corrosive environment etc.	NA		

4.4 Stormwater	Addressed (Y/N/NA)	Section	Comments
Description of drainage outlets and downstream constraints including legality of outlet (i.e. municipal drain, right-of-way, watercourse, or private property).	Y	4	
Analysis of the available capacity in existing public infrastructure.	NA		
A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns and proposed drainage patterns.	Y	Fig 4.1, 4.2	
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.	Y	4	
Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	Y	4	
Description of stormwater management concept with facility locations and descriptions with references and supporting information.	Y	4	
Set-back from private sewage disposal systems.	NA		
Watercourse and hazard lands setbacks.	NA		
Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	NA		
Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.	NA		
Storage requirements (complete with calcs) and conveyance capacity for 5 yr and 100 yr events.	Y	4	
Identification of watercourse within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	Y	4	
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.	Y	4	
Any proposed diversion of drainage catchment areas from one outlet to another.	NA		
Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and SWM facilities.	Y	4	
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.	NA		

4.4 Stormwater	**Addressed (Y/N/NA)**	**Section**	**Comments**
Identification of municipal drains and related approval requirements.	NA		
Description of how the conveyance and storage capacity will be achieved for the development.	Y	4	
100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	Y	4	
Inclusion of hydraulic analysis including HGL elevations.	Y	4	
Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Y	8	
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.	Y	4	
Identification of fill constrains related to floodplain and geotechnical investigation.	NA		

4.5 Approval and Permit Requirements	Addressed (Y/N/NA)	Section	Comments
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.	Y	9	
Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.	Y	9	
Changes to Municipal Drains.	NA		
Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)	Y	9	

4.6 Conclusion	Addressed (Y/N/NA)	Section	Comments
Clearly stated conclusions and recommendations.	Y	10	
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.	NA		
All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario.	Y	11	

Appendix C
Storm Sewer Design Sheets and Stormwater Management Calculations

Table 3.1: SWM Guidelines for the Pinecrest Creek / Westboro Study Area

	Development Type	Runoff Volume Reduction	Water Quality	Water Quantity	
			TSS Removal	Flood Flow Management	Erosion Control
All Locations					
Residential Development *Not* Requiring Site Plan Control Approval					
1	all soil infiltration rates	Provision of a minimum depth of 300mm of amended topsoil over all front yard landscaped areas; and Direction/redirection of downspouts/roof drainage to landscaped areas to minimize runoff.	Inherent TSS removal from on-site retention in landscaped areas.	Not applicable	**Not applicable**
Draining to the Ottawa River					
Commercial/Institutional and Industrial Developments - discharging directly to the Ottawa River *					
2	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	On-site removal of 80% of TSS.	As per City's Sewer Design Guideline(Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS.	As per City's Sewer Design Guideline(Section 8.3.7.3, revised Sept. 2008).	Not applicable
Residential Development Requiring Site Plan Control Approval - discharging directly to the Ottawa River					
3	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	Inherent TSS removal due to on-site retention of the first 10 mm rainfall.	As per City's Sewer Design Guideline(Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	Inherent TSS removal from on-site retention in landscaped areas.	As per City's Sewer Design Guideline(Section 8.3.7.3, revised Sept. 2008).	Not applicable
Draining to Pinecrest Creek					
Commercial/Institutional and Industrial Developments - discharging upstream of the Ottawa River Parkway (ORP) pipe inlet *					
4	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.

Table 3.1: SWM Guidelines for the Pinecrest Creek / Westboro Study Area

	Development Type	Runoff Volume Reduction	Water Quality	Water Quantity	
			TSS Removal	Flood Flow Management	Erosion Control
Commercial/Institutional and Industrial Developments - discharging directly to Ottawa River Parkway (ORP) pipe *					
5	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable
Residential Development Requiring Site Plan Control Approval - discharging upstream of Ottawa River Parkway (ORP) pipe inlet					
6	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	Inherent TSS removal due to on-site retention of the 10 mm and detention of the 25 mm design storms.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	Inherent TSS removal due to on-site retention in landscaped areas and detention of the 25 mm design storm.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.
Residential Development Requiring Site Plan Control Approval - discharging directly to Ottawa River Parkway (ORP) pipe					
7	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	Inherent TSS removal due to on-site retention of the 10 mm design storm.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amended soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	Inherent TSS removal from on-site retention in landscaped areas.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable

*Infiltration measures should not be used on sites or source areas where the land use or activity could generate higher concentrations of hydrocarbons, trace metals or toxicants than are found in typical stormwater runoff (e.g., vehicle refueling, handling areas for hazardous materials, etc.). This would include retail gasoline outlet sites due to the potential for spills. In addition, these measures should be sited so that they will not receive runoff from high traffic areas where large amounts of de-icing salts are used. The design of these systems shall be in accordance with the guidance in the Stormwater Management Planning and Design Manual (MOE, 2003) and the Low Impact Development Stormwater Management Planning and Design Guide (CVC & TRCA, 2010).

Note: For a mixed use property, if surface parking has been provided the site will be considered commercial. If surface parking has not been provided, the site will be considered residential for the purposes of applying the SWM criteria in this table.

STORM SEWER DESIGN SHEET

NOVATECH
Engineers, Planners & Landscape Architects

Novatech Project #: 119000
Project Name: Bel-Air
Date Prepared: 11/1/2019
Date Revised:
Input By: Ben Sweet
Reviewed By: Sam Bahia
Drawing Reference: FIG3.1, FIG4.1 & FIG4.2

Legend:
- PROJECT SPECIFIC INFO
- USER DESIGN INPUT
- CUMILATIVE CELL
- CALCULATED DESIGN CELL OUTPUT
- USER AS-BUILT INPUT

LOCATION			DEMAND														CAPACITY								
			AREA						FLOW								PROPOSED SEWER PIPE SIZING / DESIGN								
												RAIN INTENSITY (mm/hr)					PIPE PROPERTIES								
STREET	FROM MH	TO MH	AREA ID	ROAD	REAR YARD 1 (TOWN)	PARK	TOTAL AREA	WEIGHTED RUNOFF COEFFICIENT	INDIVI 2.78 AR	ACCUM 2.78 AR	TIME OF CONC	2yr	5yr	100yr	PEAK FLOW	TOTAL UNCONTROLLED PEAK FLOW (QDesign)	TOTAL RESTRICTED PEAK FLOW (Q)	LENGTH	SIZE / MATERIAL	ID ACTUAL	ROUGHNESS	DESIGN GRADE	CAPACITY	FULL FLOW VELOCITY	TIME OF FLOW	QPEAK DESIGN / QFULL
				0.70	0.50	0.25	(ha)				(min.)				(L/s)	(L/s)	(L/s)	(m)	(mm / type)	(m)		(%)	(L/s)	(m/s)	(min.)	(%)
TO BEL-AIR DRIVE																										
PRIVATE ROAD	101	24	A2-A12	0.31	0.48		0.79	0.58	1.27	1.27	10.00	76.81			97.58	97.6		17.9	375 PVC	0.381	0.013	0.32	103.5	0.91	0.33	94.3%
							0.00		0.00	0.00	10.00				0.00											
							0.00		0.00	0.00	10.00				0.00											
	24	22					0.00		0.00	1.27	10.33	75.57			96.00	96.0		5.5	375 PVC	0.381	0.013	0.32	103.5	0.91	0.10	92.8%
							0.00		0.00	0.00	10.33				0.00											
							0.00		0.00	0.00	10.33				0.00											
	22	20					0.00		0.00	1.27	10.43	75.19			95.53	95.5		5.8	375 PVC	0.381	0.013	0.32	103.5	0.91	0.11	92.3%
							0.00		0.00	0.00	10.43				0.00											
							0.00		0.00	0.00	10.43				0.00											
	20	18	-				0.00		0.00	1.27	10.54	74.81			95.04	95.0		11.2	375 PVC	0.381	0.013	0.32	103.5	0.91	0.21	91.9%
							0.00		0.00	0.00	10.54				0.00											
							0.00		0.00	0.00	10.54				0.00											
	18	16	-				0.00		0.00	1.27	10.74	74.07			94.10	94.1		25.8	375 PVC	0.381	0.013	0.32	103.5	0.91	0.47	90.9%
							0.00		0.00	0.00	10.74				0.00											
							0.00		0.00	0.00	10.74				0.00											
	16	14	-				0.00		0.00	1.27	11.22	72.43			92.02	92.0		5.7	375 PVC	0.381	0.013	0.32	103.5	0.91	0.10	88.9%
							0.00		0.00	0.00	11.22				0.00											
							0.00		0.00	0.00	11.22				0.00											
	14	12	-				0.00		0.00	1.27	11.32	72.08			91.58	91.6		21.6	375 PVC	0.381	0.013	0.32	103.5	0.91	0.40	88.5%
							0.00		0.00	0.00	11.32				0.00											
							0.00		0.00	0.00	11.32				0.00											
	12	110	-				0.00		0.00	1.27	11.72	70.79			89.93	89.9		14.4	375 PVC	0.381	0.013	0.32	103.5	0.91	0.26	86.9%
							0.00		0.00	0.00	11.72				0.00											
							0.00		0.00	0.00	11.72				0.00											

DEMAND EQUATION
Q = 2.78 AIR

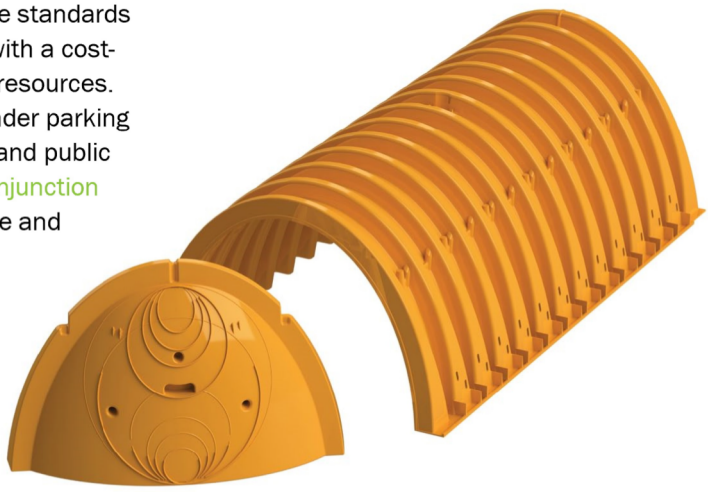
Where : Q = Peak flow in litres per second (L/s)
A = Area in hectares (ha)
R = Weighted runoff coefficient (increased by 25% for 100-year)
I = Rainfall intensity in millimeters per hour (mm/hr)
Rainfall Intensity (I) is based on City of Ottawa IDF data presented in the City of Ottawa Sewer Design Guidelines (Oct. 2012)

CAPACITY EQUATION
Q full= (1/n) A R^(2/3)So^(1/2)

Where : Q full = Capacity (L/s)
n = Manning coefficient of roughness (0.013)
A = Flow area (m^2)
R = Wetter perimenter (m)
So = Pipe Slope/gradient

StormTech SC-740 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots, thus maximizing land usage for private (commercial) and public applications. StormTech chambers can also be used in conjunction with Green Infrastructure, thus enhancing the performance and extending the service life of these practices.



StormTech SC-740 Chamber (not to scale)

Nominal Chamber Specifications

Size (Lx W x H)	85.4" x 51.0" x 30.0" (2,170 x 1,295 x 762 mm)
Chamber Storage	45.9 ft³ (1.30 m³)
Min. Installed Storage*	74.9 ft³ (2.12 m³)
Weight	74.0 lbs (33.6 kg)

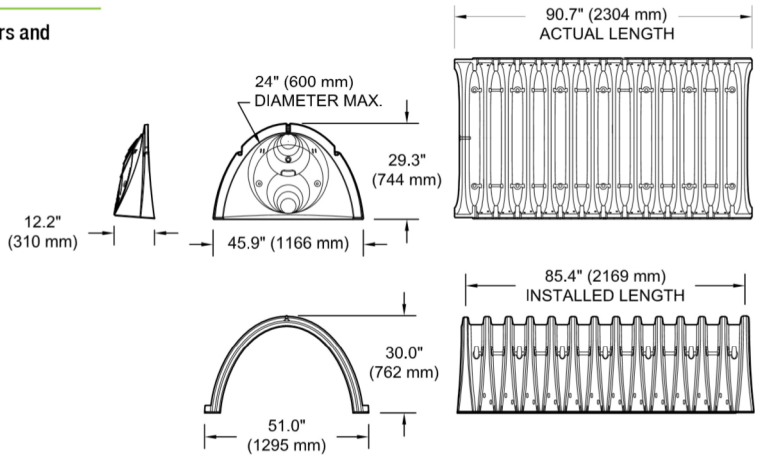
*Assumes 6" (150 mm) stone above, below and between chambers and 40% stone porosity.

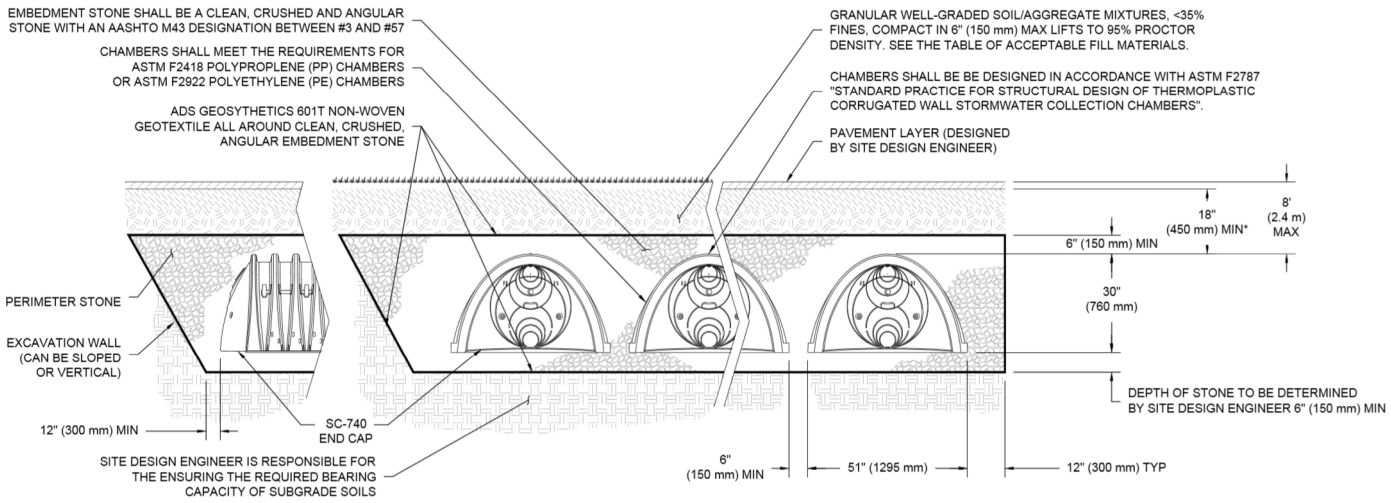
Shipping

30 chambers/pallet

60 end caps/pallet

12 pallets/truck





*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

SC-740 CUMLATIVE STORAGE VOLUMES PER CHAMBER

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (150 mm) Stone Base Under Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
42 (1067)	45.90 (1.300)	74.90 (2.121)
41 (1041)	45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone 45.90 (1.300)	72.64 (2.057)
39 (991)	Cover 45.90 (1.300)	71.52 (2.025)
38 (965)	45.90 (1.300)	70.39 (1.993)
37 (940)	45.90 (1.300)	69.26 (1.961)
36 (914)	45.90 (1.300)	68.14 (1.929)
35 (889)	45.85 (1.298)	66.98 (1.897)
34 (864)	45.69 (1.294)	65.75 (1.862)
33 (838)	45.41 (1.286)	64.46 (1.825)
32 (813)	44.81 (1.269)	62.97 (1.783)
31 (787)	44.01 (1.246)	61.36 (1.737)
30 (762)	43.06 (1.219)	59.66 (1.689)
29 (737)	41.98 (1.189)	57.89 (1.639)
28 (711)	40.80 (1.155)	56.05 (1.587)
27 (686)	39.54 (1.120)	54.17 (1.534)
26 (660)	38.18 (1.081)	52.23 (1.479)
25 (635)	36.74 (1.040)	50.23 (1.422)
24 (610)	35.22 (0.977)	48.19 (1.365)
23 (584)	33.64 (0.953)	46.11 (1.306)
22 (559)	31.99 (0.906)	44.00 (1.246)
21 (533)	30.29 (0.858)	1.85 (1.185)
20 (508)	28.54 (0.808)	39.67 (1.123)
19 (483)	26.74 (0.757)	37.47 (1.061)
18 (457)	24.89 (0.705)	35.23 (0.997)
17 (432)	23.00 (0.651)	32.96 (0.939)
16 (406)	21.06 (0.596)	30.68 (0.869)
15 (381)	19.09 (0.541)	28.36 (0.803)
14 (356)	17.08 (0.484)	26.03 (0.737)
13 (330)	15.04 (0.426)	23.68 (0.670)
12 (305)	12.97 (0.367)	21.31 (0.608)
11 (279)	10.87 (0.309)	18.92 (0.535)
10 (254)	8.74 (0.247)	16.51 (0.468)
9 (229)	6.58 (0.186)	14.09 (0.399)
8 (203)	4.41 (0.125)	11.66 (0.330)
7 (178)	2.21 (0.063)	9.21 (0.264)
6 (152)	0 (0)	6.76 (0.191)
5 (127)	0 (0)	5.63 (0.160)
4 (102)	Stone 0 (0)	4.51 (0.128)
3 (76)	Foundation 0 (0)	3.38 (0.096)
2 (51)	0 (0)	2.25 (0.064)
1 (25)	0 (0)	1.13 (0.032)

Note: Add 1.13 ft³ (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Foundation Depth in. (mm)		
		6 (150)	12 (300)	18 (450)
SC-740 Chamber	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)

Note: Assumes 6" (150 mm) stone above chambers, 6" (150 mm) row spacing and 40% stone porosity.

Amount of Stone Per Chamber

ENGLISH TONS (yds³)	Stone Foundation Depth		
	6"	12"	16"
SC-740	3.8 (2.8)	4.6 (3.3)	5.5 (3.9)
METRIC KILOGRAMS (m³)	150 mm	300 mm	450 mm
SC-740	3,450 (2.1)	4,170 (2.5)	4,490 (3.0)

Note: Assumes 6" (150 mm) of stone above and between chambers.

Volume Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6 (150)	12 (300)	18 (450)
SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)

Note: Assumes 6" (150 mm) of row separation and 18" (450 mm) of cover. The volume of excavation will vary as depth of cover increases.

2112 Bel-Air Drive (119000)
Post-Development Model Parameters

NOVATECH
Engineers, Planners & Landscape Architects

Area ID	Area (ha)	Runoff Coeff. (C)	Percent Impervious (%)	No Depression (%)	Equivalent Width (m)	Average Slope (%)
Subject Site Catchment Areas						
A01	0.03	0.70	71.4%	50%	32	0.50
A02	0.07	0.70	71.4%	50%	68	0.50
A03	0.09	0.70	71.4%	50%	92	0.50
A04	0.13	0.70	71.4%	50%	78	0.50
A05	0.06	0.50	42.9%	90%	25	0.50
A06	0.07	0.50	42.9%	90%	29	0.50
A07	0.06	0.50	42.9%	90%	32	0.50
A08	0.05	0.50	42.9%	90%	24	0.50
A09	0.06	0.50	42.9%	90%	34	0.50
A10	0.04	0.50	42.9%	90%	24	0.50
A11	0.07	0.50	42.9%	90%	41	0.50
A12	0.07	0.50	42.9%	90%	35	0.50
TOTAL:	**0.80**					
Off-Site Catchment Areas						
B01	2.26	CN=73	7.1%	-	185	0.50

2112 Bel-Air Drive (119000)
PCSWMM Model Schematics

NOVATECH
Engineers, Planners & Landscape Architects

Overall Model Schematic

Date: 2019-12-03
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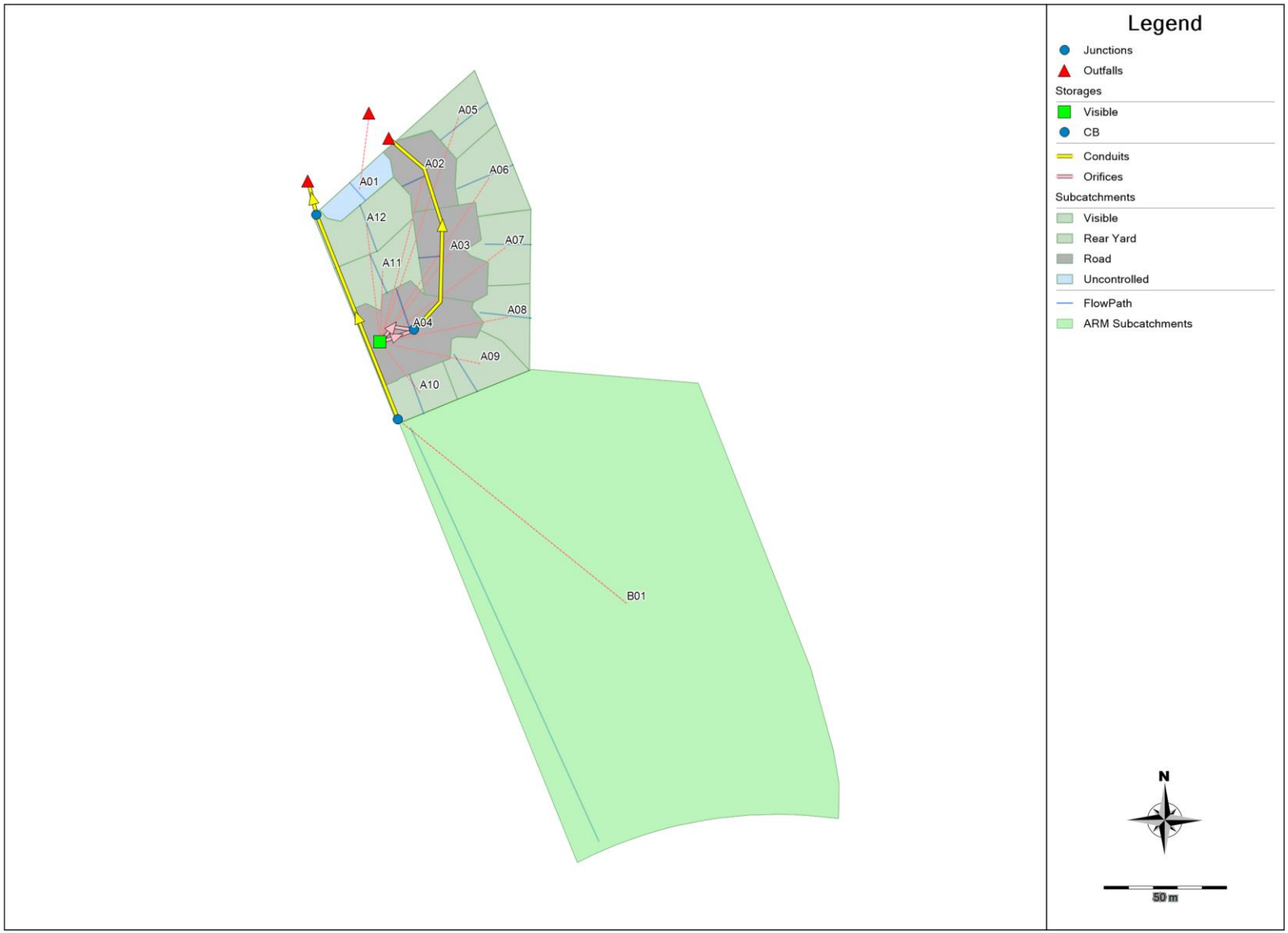
2112 Bel-Air Drive (119000)
PCSWMM Model Schematics

Engineers, Planners & Landscape Architects

Subcatchments and Flow Paths



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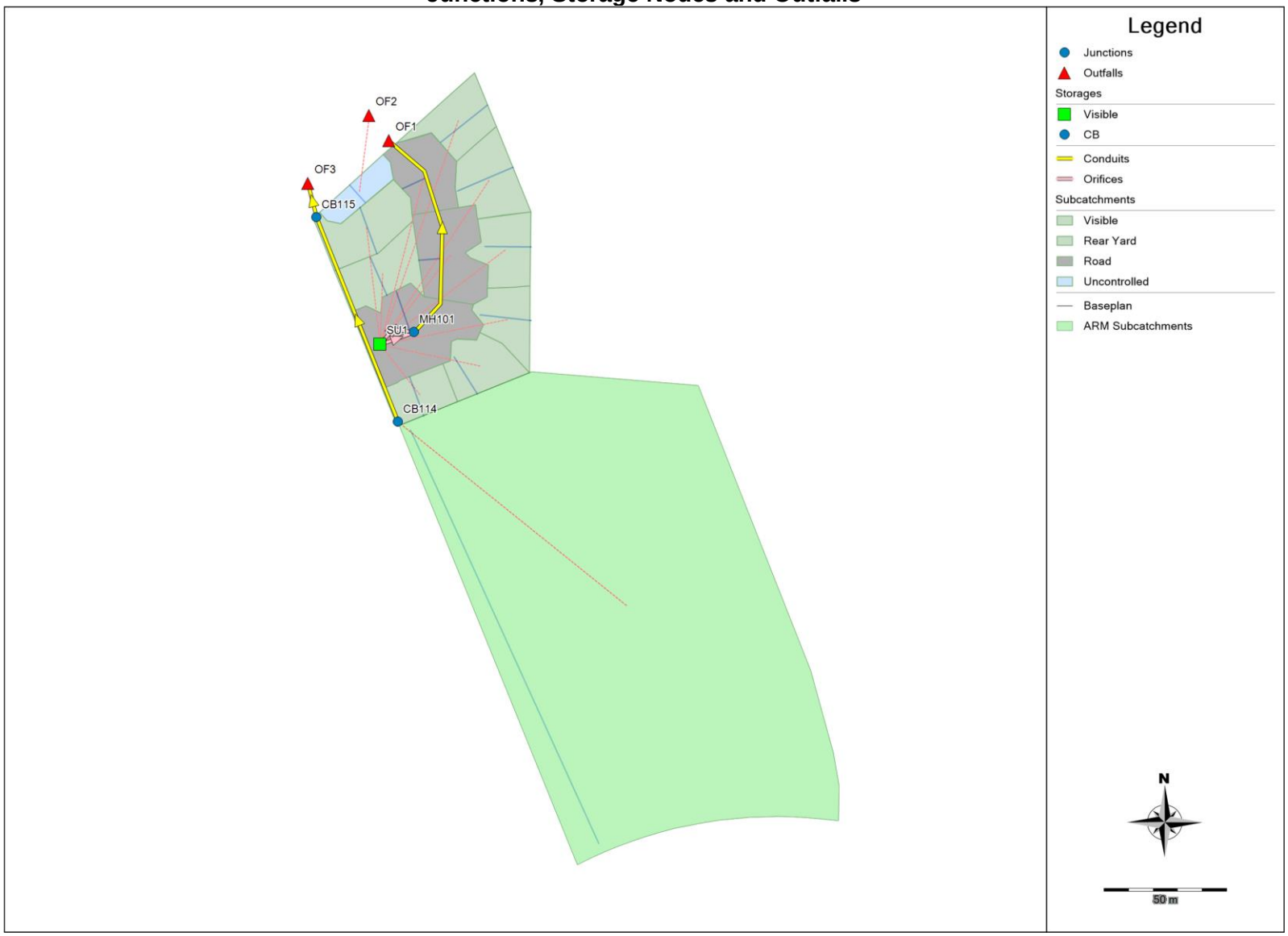
2112 Bel-Air Drive (119000)
PCSWMM Model Schematics

NOVATECH
Engineers, Planners & Landscape Architects

Junctions, Storage Nodes and Outfalls



Date: 2019-12-03
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```
ALTERNATIVE RUNOFF METHOD (ARM) - PCSWMM BETA VERSION 7.2.2785
---------------------------------------------------------------

This is a *BETA* version of ARM - your feedback and suggestions are solicited.
Create a ticket, post on the PCSWMM feature request forum, or email us directly!

Simulation start time:                10/16/2019 00:00:00
Simulation end time:                  10/17/2019 00:00:00
Runoff wet weather time steps:        300 seconds
Report time steps:                    60 seconds
Number of data points:                1441


*****************************
Unit Hydrographs Runoff Method
*****************************

-------------------------------------------------------------------------------------------------------------------------------
                                                                        Area   Time of Concentration  Time to Peak    Time after Pea
Subcatchment         Runoff Method             Raingage                 (ha)   (min)                 (min)           (min)
-------------------------------------------------------------------------------------------------------------------------------
B01                  Nash IUH                  Design_Storms            2.26   21                    14              86


******************
ARM Runoff Summary
******************

-------------------------------------------------------------------------------------
                     Total       Total       Total       Total       Peak        Runoff
                     Precip      Losses      Runoff      Runoff      Runoff      Coeff
Subcatchment         (mm)        (mm)        (mm)        10^6 ltr    LPS         (fraction)
-------------------------------------------------------------------------------------
B01                  25.003      21.163      3.835       0.087       20.022      0.153



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.013)
--------------------------------------------------------------


*************
Element Count
*************
```

```
Number of rain gages ...... 1
Number of subcatchments ... 12
Number of nodes ........... 7
Number of links ........... 5
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                  Data       Recording
Name                 Data Source                  Type       Interval
------------------------------------------------------------------------
Design_Storms        C4hr-25mm                    INTENSITY   10 min.


********************
Subcatchment Summary
********************
Name                        Area     Width   %Imperv    %Slope Rain Gage            Outlet
-------------------------------------------------------------------------------------------
A01                         0.03     32.19     71.40    0.5000 Design_Storms        OF2
A02                         0.07     67.66     71.40    0.5000 Design_Storms        SU1
A03                         0.09     92.12     71.40    0.5000 Design_Storms        SU1
A04                         0.13     78.00     71.40    0.5000 Design_Storms        SU1
A05                         0.06     24.71     42.90    0.5000 Design_Storms        SU1
A06                         0.07     28.66     42.90    0.5000 Design_Storms        SU1
A07                         0.06     32.08     42.90    0.5000 Design_Storms        SU1
A08                         0.05     23.96     42.90    0.5000 Design_Storms        SU1
A09                         0.06     33.88     42.90    0.5000 Design_Storms        SU1
A10                         0.04     23.54     42.90    0.5000 Design_Storms        SU1
A11                         0.07     41.41     42.90    0.5000 Design_Storms        SU1
A12                         0.07     34.81     42.90    0.5000 Design_Storms        SU1


********************
LID Control Summary
********************
                               No. of       Unit        Unit      % Area    % Imperv      % Perv
Subcatchment     LID Control     Units       Area       Width     Covered    Treated     Treated
-----------------------------------------------------------------------------------------------
A01              AmmendedTopsoil     1      86.00       10.00       28.67       0.00      100.00
A02              AmmendedTopsoil     1     200.00       10.00       28.57       0.00      100.00
A03              AmmendedTopsoil     1     257.00       10.00       28.56       0.00      100.00
A04              AmmendedTopsoil     1     372.00       10.00       28.62       0.00      100.00
```

A05	AmmendedTopsoil	1	343.00	10.00	57.17	0.00	100.00
A06	AmmendedTopsoil	1	400.00	10.00	57.14	0.00	100.00
A07	AmmendedTopsoil	1	343.00	10.00	57.17	0.00	100.00
A08	AmmendedTopsoil	1	286.00	10.00	57.20	0.00	100.00
A09	AmmendedTopsoil	1	343.00	10.00	57.17	0.00	100.00
A10	AmmendedTopsoil	1	228.00	10.00	57.00	0.00	100.00
A11	AmmendedTopsoil	1	400.00	10.00	57.14	0.00	100.00
A12	AmmendedTopsoil	1	400.00	10.00	57.14	0.00	100.00

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
CB114	JUNCTION	100.64	2.00	0.0	
CB115	JUNCTION	100.12	2.00	0.0	
MH101	JUNCTION	100.00	1.30	0.0	
OF1	OUTFALL	99.99	0.38	0.0	
OF2	OUTFALL	0.00	0.00	0.0	
OF3	OUTFALL	100.00	0.38	0.0	
SU1	STORAGE	100.00	1.30	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	MH101	OF1	CONDUIT	3.0	0.2000	0.0130
C2	CB114	CB115	CONDUIT	86.8	0.6014	0.0130
C3	CB115	OF3	CONDUIT	19.3	0.6001	0.0130
OR1	SU1	MH101	ORIFICE			
OR2	SU1	MH101	ORIFICE			

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	CIRCULAR	0.38	0.11	0.09	0.38	1	78.41
C2	CIRCULAR	0.38	0.11	0.09	0.38	1	135.98
C3	CIRCULAR	0.38	0.11	0.09	0.38	1	135.83

****
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 ..... LPS
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 10/16/2019 00:00:00
Ending Date 10/17/2019 00:00:00
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 ..... 2.00 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

********** Runoff Quantity Continuity **********	Volume hectare-m	Depth mm
Total Precipitation	0.020	25.003
Evaporation Loss	0.000	0.000
Infiltration Loss	0.005	5.713
Surface Runoff	0.006	7.703
Final Storage	0.009	11.610
Continuity Error (%)	-0.095	

Flow Routing Continuity	Volume hectare-m	Volume 10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.006	0.062
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.009	0.087
External Outflow	0.015	0.148
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	

Time-Step Critical Elements

None

Highest Flow Instability Indexes

All links are stable.

Routing Time Step Summary

Minimum Time Step	:	1.50 sec
Average Time Step	:	2.00 sec
Maximum Time Step	:	2.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.00
Percent Not Converging	:	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 LPS	Runoff Coeff
A01	25.00	0.00	0.00	5.10	12.37	0.00	12.37	0.00	2.41	0.495
A02	25.00	0.00	0.00	5.11	12.39	0.00	12.39	0.01	5.62	0.496
A03	25.00	0.00	0.00	5.11	12.39	0.00	12.39	0.01	7.23	0.496
A04	25.00	0.00	0.00	5.10	12.41	0.00	12.41	0.02	10.43	0.496
A05	25.00	0.00	0.00	6.12	4.58	0.00	4.58	0.00	1.74	0.183
A06	25.00	0.00	0.00	6.12	4.58	0.00	4.58	0.00	2.03	0.183
A07	25.00	0.00	0.00	6.12	4.57	0.00	4.57	0.00	1.74	0.183
A08	25.00	0.00	0.00	6.11	4.57	0.00	4.57	0.00	1.45	0.183
A09	25.00	0.00	0.00	6.12	4.57	0.00	4.57	0.00	1.74	0.183
A10	25.00	0.00	0.00	6.14	4.59	0.00	4.59	0.00	1.16	0.184
A11	25.00	0.00	0.00	6.12	4.57	0.00	4.57	0.00	2.03	0.183
A12	25.00	0.00	0.00	6.12	4.58	0.00	4.58	0.00	2.03	0.183

LID Performance Summary

Subcatchment	LID Control	Total Inflow mm	Evap Loss mm	Infil Loss mm	Surface Outflow mm	Drain Outflow mm	Initial Storage mm	Final Storage mm	Continuity Error %
A01	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A02	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A03	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A04	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A05	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A06	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A07	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A08	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A09	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A10	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A11	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00
A12	AmmendedTopsoil	25.00	0.00	0.00	0.00	0.00	0.00	25.00	-0.00

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
CB114	JUNCTION	0.01	0.10	100.74	0 01:46	0.10
CB115	JUNCTION	0.01	0.10	100.21	0 01:47	0.10
MH101	JUNCTION	0.01	0.05	100.05	0 02:16	0.05
OF1	OUTFALL	0.01	0.05	100.04	0 02:16	0.05
OF2	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
OF3	OUTFALL	0.01	0.10	100.10	0 01:47	0.10
SU1	STORAGE	0.13	0.60	100.60	0 02:16	0.60

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
CB114	JUNCTION	20.02	20.02	0 01:45	0.0867	0.0867	-0.009
CB115	JUNCTION	0.00	20.02	0 01:46	0	0.0867	0.013
MH101	JUNCTION	0.00	2.52	0 02:16	0	0.0579	0.001
OF1	OUTFALL	0.00	2.52	0 02:16	0	0.0579	0.000
OF2	OUTFALL	2.41	2.41	0 01:30	0.00371	0.00371	0.000
OF3	OUTFALL	0.00	20.00	0 01:47	0	0.0867	0.000
SU1	STORAGE	37.17	37.17	0 01:30	0.0579	0.0579	0.000

****
Node Surcharge Summary
****

No nodes were surcharged.

****
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 LPS
SU1	0.006	5	0	0	0.037	30	0 02:16	2.52

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
OF1	37.49	1.79	2.52	0.058
OF2	16.22	0.26	2.41	0.004
OF3	20.55	4.88	20.00	0.087
System	24.75	6.93	20.00	0.148

****
Link Flow Summary
****

Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	2.52	0 02:16	0.33	0.03	0.12
C2	CONDUIT	20.02	0 01:46	0.88	0.15	0.26
C3	CONDUIT	20.00	0 01:47	0.88	0.15	0.26
OR1	ORIFICE	2.52	0 02:16			1.00
OR2	ORIFICE	0.00	0 00:00			0.00

****
Flow Classification Summary

****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.62	0.00
C2	1.00	0.01	0.00	0.00	0.91	0.09	0.00	0.00	0.92	0.00
C3	1.00	0.01	0.00	0.00	0.91	0.08	0.00	0.00	0.86	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Tue Dec 3 14:11:45 2019
Analysis ended on: Tue Dec 3 14:11:45 2019
Total elapsed time: < 1 sec

```
ALTERNATIVE RUNOFF METHOD (ARM) - PCSWMM BETA VERSION 7.2.2785
---------------------------------------------------------------

This is a *BETA* version of ARM - your feedback and suggestions are solicited.
Create a ticket, post on the PCSWMM feature request forum, or email us directly!

Simulation start time:                10/16/2019 00:00:00
Simulation end time:                  10/17/2019 00:00:00
Runoff wet weather time steps:        300 seconds
Report time steps:                    60 seconds
Number of data points:                1441


*****************************
Unit Hydrographs Runoff Method
*****************************

-------------------------------------------------------------------------------------------------------------------------------
                                                                        Area   Time of Concentration  Time to Peak    Time after Pea
Subcatchment         Runoff Method             Raingage                 (ha)   (min)                 (min)           (min)
-------------------------------------------------------------------------------------------------------------------------------
B01                  Nash IUH                  Design_Storms            2.26   21                    14              86


******************
ARM Runoff Summary
******************

-------------------------------------------------------------------------------------
                     Total       Total       Total       Total       Peak        Runoff
                     Precip      Losses      Runoff      Runoff      Runoff      Coeff
Subcatchment         (mm)        (mm)        (mm)        10^6 ltr    LPS         (fraction)
-------------------------------------------------------------------------------------
B01                  71.667      43.521      28.111      0.635       195.808     0.392



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.013)
--------------------------------------------------------------


*************
Element Count
*************
```

```
Number of rain gages ...... 1
Number of subcatchments ... 12
Number of nodes ........... 7
Number of links ........... 5
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                  Data       Recording
Name                 Data Source                  Type       Interval
------------------------------------------------------------------------
Design_Storms        C3hr-100yr                   INTENSITY   10 min.


*******************
Subcatchment Summary
*******************
Name                        Area     Width   %Imperv    %Slope Rain Gage            Outlet
-------------------------------------------------------------------------------------------
A01                         0.03     32.19     71.40    0.5000 Design_Storms        OF2
A02                         0.07     67.66     71.40    0.5000 Design_Storms        SU1
A03                         0.09     92.12     71.40    0.5000 Design_Storms        SU1
A04                         0.13     78.00     71.40    0.5000 Design_Storms        SU1
A05                         0.06     24.71     42.90    0.5000 Design_Storms        SU1
A06                         0.07     28.66     42.90    0.5000 Design_Storms        SU1
A07                         0.06     32.08     42.90    0.5000 Design_Storms        SU1
A08                         0.05     23.96     42.90    0.5000 Design_Storms        SU1
A09                         0.06     33.88     42.90    0.5000 Design_Storms        SU1
A10                         0.04     23.54     42.90    0.5000 Design_Storms        SU1
A11                         0.07     41.41     42.90    0.5000 Design_Storms        SU1
A12                         0.07     34.81     42.90    0.5000 Design_Storms        SU1


*******************
LID Control Summary
*******************
                               No. of       Unit        Unit      % Area    % Imperv      % Perv
Subcatchment     LID Control     Units       Area       Width     Covered    Treated     Treated
-------------------------------------------------------------------------------------------------
A01              AmmendedTopsoil     1      86.00       10.00       28.67       0.00      100.00
A02              AmmendedTopsoil     1     200.00       10.00       28.57       0.00      100.00
A03              AmmendedTopsoil     1     257.00       10.00       28.56       0.00      100.00
A04              AmmendedTopsoil     1     372.00       10.00       28.62       0.00      100.00
```

A05	AmmendedTopsoil	1	343.00	10.00	57.17	0.00	100.00
A06	AmmendedTopsoil	1	400.00	10.00	57.14	0.00	100.00
A07	AmmendedTopsoil	1	343.00	10.00	57.17	0.00	100.00
A08	AmmendedTopsoil	1	286.00	10.00	57.20	0.00	100.00
A09	AmmendedTopsoil	1	343.00	10.00	57.17	0.00	100.00
A10	AmmendedTopsoil	1	228.00	10.00	57.00	0.00	100.00
A11	AmmendedTopsoil	1	400.00	10.00	57.14	0.00	100.00
A12	AmmendedTopsoil	1	400.00	10.00	57.14	0.00	100.00

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
CB114	JUNCTION	100.64	2.00	0.0	
CB115	JUNCTION	100.12	2.00	0.0	
MH101	JUNCTION	100.00	1.30	0.0	
OF1	OUTFALL	99.99	0.38	0.0	
OF2	OUTFALL	0.00	0.00	0.0	
OF3	OUTFALL	100.00	0.38	0.0	
SU1	STORAGE	100.00	1.30	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	MH101	OF1	CONDUIT	3.0	0.2000	0.0130
C2	CB114	CB115	CONDUIT	86.8	0.6014	0.0130
C3	CB115	OF3	CONDUIT	19.3	0.6001	0.0130
OR1	SU1	MH101	ORIFICE			
OR2	SU1	MH101	ORIFICE			

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	CIRCULAR	0.38	0.11	0.09	0.38	1	78.41
C2	CIRCULAR	0.38	0.11	0.09	0.38	1	135.98
C3	CIRCULAR	0.38	0.11	0.09	0.38	1	135.83

****
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 ..... LPS
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 10/16/2019 00:00:00
Ending Date 10/17/2019 00:00:00
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 ..... 2.00 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

********** Runoff Quantity Continuity **********	Volume hectare-m	Depth mm
Total Precipitation	0.057	71.667
Evaporation Loss	0.000	0.000
Infiltration Loss	0.008	10.170
Surface Runoff	0.027	34.338
Final Storage	0.022	27.630
Continuity Error (%)	-0.657	

Flow Routing Continuity	Volume hectare-m	Volume 10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.027	0.275
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.064	0.635
External Outflow	0.091	0.910
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 (%)	-0.011	

Time-Step Critical Elements

Link C1 (13.78%)

Highest Flow Instability Indexes

All links are stable.

Routing Time Step Summary

Minimum Time Step	:	0.55 sec
Average Time Step	:	1.92 sec
Maximum Time Step	:	2.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.00
Percent Not Converging	:	0.01

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 LPS	Runoff Coeff
A01	71.67	0.00	0.00	8.99	36.15	6.22	45.71	0.01	7.58	0.638
A02	71.67	0.00	0.00	9.02	36.20	6.18	45.71	0.03	17.71	0.638
A03	71.67	0.00	0.00	9.01	36.21	6.21	45.74	0.04	22.77	0.638
A04	71.67	0.00	0.00	9.06	36.21	5.98	45.53	0.06	32.86	0.635
A05	71.67	0.00	0.00	10.97	13.16	6.89	26.70	0.02	5.47	0.373
A06	71.67	0.00	0.00	10.98	13.16	6.89	26.70	0.02	6.38	0.373
A07	71.67	0.00	0.00	10.91	13.15	7.02	26.83	0.02	5.47	0.374
A08	71.67	0.00	0.00	10.93	13.14	6.97	26.77	0.01	4.55	0.373
A09	71.67	0.00	0.00	10.90	13.15	7.05	26.85	0.02	5.47	0.375
A10	71.67	0.00	0.00	10.93	13.20	7.10	26.94	0.01	3.66	0.376
A11	71.67	0.00	0.00	10.89	13.16	7.08	26.88	0.02	6.38	0.375
A12	71.67	0.00	0.00	10.93	13.16	6.99	26.79	0.02	6.38	0.374

LID Performance Summary

Subcatchment	LID Control	Total Inflow mm	Evap Loss mm	Infil Loss mm	Surface Outflow mm	Drain Outflow mm	Initial Storage mm	Final Storage mm	Continuity Error %
A01	AmmendedTopsoil	93.36	0.00	0.00	33.35	0.00	0.00	60.00	-0.00
A02	AmmendedTopsoil	93.31	0.00	0.00	33.29	0.00	0.00	60.02	-0.00
A03	AmmendedTopsoil	93.41	0.00	0.00	33.38	0.00	0.00	60.03	-0.00
A04	AmmendedTopsoil	92.58	0.00	0.00	32.54	0.00	0.00	60.04	-0.00
A05	AmmendedTopsoil	83.73	0.00	0.00	23.69	0.00	0.00	60.04	-0.00
A06	AmmendedTopsoil	83.73	0.00	0.00	23.68	0.00	0.00	60.05	-0.00
A07	AmmendedTopsoil	83.96	0.00	0.00	23.92	0.00	0.00	60.04	-0.00
A08	AmmendedTopsoil	83.84	0.00	0.00	23.82	0.00	0.00	60.03	-0.00
A09	AmmendedTopsoil	84.00	0.00	0.00	23.96	0.00	0.00	60.04	-0.00
A10	AmmendedTopsoil	84.12	0.00	0.00	24.10	0.00	0.00	60.02	-0.00
A11	AmmendedTopsoil	84.05	0.00	0.00	24.00	0.00	0.00	60.05	-0.00
A12	AmmendedTopsoil	83.90	0.00	0.00	23.86	0.00	0.00	60.05	-0.00

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
CB114	JUNCTION	0.04	1.69	102.33	0 01:17	1.07
CB115	JUNCTION	0.03	0.78	100.90	0 01:17	0.50
MH101	JUNCTION	0.03	0.20	100.20	0 01:14	0.20
OF1	OUTFALL	0.03	0.20	100.20	0 01:14	0.20
OF2	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
OF3	OUTFALL	0.03	0.38	100.38	0 01:16	0.38
SU1	STORAGE	0.23	0.95	100.95	0 01:14	0.95

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
CB114	JUNCTION	195.79	195.79	0 01:25	0.635	0.635	0.009
CB115	JUNCTION	0.00	195.82	0 01:25	0	0.635	-0.025
MH101	JUNCTION	0.00	45.42	0 01:14	0	0.261	0.001
OF1	OUTFALL	0.00	45.42	0 01:14	0	0.261	0.000
OF2	OUTFALL	7.58	7.58	0 01:10	0.0137	0.0137	0.000
OF3	OUTFALL	0.00	195.83	0 01:25	0	0.635	0.000
SU1	STORAGE	117.11	117.11	0 01:10	0.261	0.261	0.001

****
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
CB114	JUNCTION	0.42	1.314	0.311
CB115	JUNCTION	0.44	0.405	1.220

****
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 LPS
SU1	0.014	11	0	0	0.081	65	0 01:14	45.42

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
OF1	46.93	8.71	45.42	0.261
OF2	17.56	1.24	7.58	0.014
OF3	21.12	52.14	195.83	0.635
System	28.53	62.10	195.83	0.910

****
Link Flow Summary
****

Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	45.42	0 01:14	0.74	0.58	0.55
C2	CONDUIT	195.82	0 01:25	1.77	1.44	1.00

C3	CONDUIT	195.83	0	01:25	1.77	1.44	1.00
OR1	ORIFICE	2.93	0	01:14			1.00
OR2	ORIFICE	42.49	0	01:14			1.00

****
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
C1	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.59	0.00
C2	1.00	0.01	0.00	0.00	0.88	0.11	0.00	0.00	0.93	0.00
C3	1.00	0.01	0.00	0.00	0.89	0.10	0.00	0.00	0.92	0.00

****
Conduit Surcharge Summary
****

	Hours Full			Hours Above Full	Hours Capacity
Conduit	Both Ends	Upstream	Dnstream	Normal Flow	Limited
C2	0.42	0.42	0.44	0.47	0.42
C3	0.44	0.44	0.47	0.47	0.44

Analysis begun on: Tue Dec 3 14:09:03 2019
Analysis ended on: Tue Dec 3 14:09:03 2019
Total elapsed time: < 1 sec

Appendix D
Sanitary Sewer Design Sheets and Sanitary Calculations

SANITARY SEWER DESIGN SHEET

Novatech Project #: 119000
Project Name: Bel-Air
Date Prepared: 11/1/2019
Date Revised:
Input By: Ben Sweet
Reviewed By: Sam Bahia
Drawing Reference: FIG3.1, FIG5.1 & FIG5.2

Legend:
- PROJECT SPECIFIC INFO
- USER DESIGN INPUT
- CUMILATIVE CELL
- CALCULATED DESIGN CELL OUTPUT
- CALCULATED ANNUAL CELL OUTPUT
- CALCULATED RARE CELL OUTPUT
- USER AS-BUILT INPUT

NOVATECH
Engineers, Planners & Landscape Architects

LOCATION				DEMAND														DESIGN CAPACITY							
				RESIDENTIAL FLOW											INDUSTRIAL / COMMERICAL / INSTITUTIONAL FLOW		EXTRANOUS FLOW AREA METHOD		TOTAL DESIGN FLOW	PROPOSED SEWER PIPE SIZING / DESIGN						
STREET	AREA	FROM MH	TO MH	SINGLES	SEMIS/ TOWNS	APARTS	PARK AREA (ha)	POPULATION (in 1000's)	CUMULATIVE POPULATION (in 1000's)	PEAK FACTOR M	AVG POPULATION FLOW Q(q) (L/s)	PEAKED DESIGN POP FLOW Q(p) (L/s)	RESIDENTIAL DRAINAGE AREA (ha.)	CUMULATIVE RES DRAINAGE AREA (ha.)	COMMERICAL / INSTITUTIONAL AREA (ha.)	CUMULATIVE COMMERICAL / INSTITUTIONAL AREA (ha.)	CUMULATIVE EXTRANOUS DRAINAGE AREA (ha.)	DESIGN EXTRAN. FLOW Q(e) (L/s)	TOTAL DESIGN FLOW Q(D) (L/s)	LENGTH (m)	PIPE SIZE (mm) AND MATERIAL	PIPE ID ACTUAL (m)	ROUGH. (n)	DESIGN GRADE (%)	CAPACITY (L/s)	FULL FLOW VELOCITY (m/s)	Qpeak Design / Qcap
TO BEL-AIR DRIVE																											
PRIVATE ROAD	A1	25	23		5			0.014	0.014	4.00	0.04	0.14	0.170	0.170	0.000	0.000	0.170	0.06	0.20	13.1	200 PVC	0.203	0.013	0.65	27.6	0.85	0.7%
	A2	23	21		3			0.008	0.022	4.00	0.07	0.22	0.110	0.280	0.000	0.000	0.280	0.09	0.32	6.7	200 PVC	0.203	0.013	0.32	19.4	0.60	1.6%
	A3	21	19		2			0.005	0.027	4.00	0.09	0.28	0.070	0.350	0.000	0.000	0.350	0.12	0.40	6.7	200 PVC	0.203	0.013	0.32	19.4	0.60	2.0%
	A4	19	17		1			0.003	0.030	4.00	0.10	0.31	0.030	0.380	0.000	0.000	0.380	0.13	0.43	11.6	200 PVC	0.203	0.013	0.32	19.4	0.60	2.2%
	A5	17	15		4			0.011	0.041	4.00	0.13	0.42	0.120	0.500	0.000	0.000	0.500	0.17	0.59	25.8	200 PVC	0.203	0.013	0.32	19.4	0.60	3.0%
	A6	15	13		2			0.005	0.046	4.00	0.15	0.48	0.060	0.560	0.000	0.000	0.560	0.18	0.66	6.9	200 PVC	0.203	0.013	0.32	19.4	0.60	3.4%
	A7	13	3		3			0.008	0.054	4.00	0.18	0.56	0.090	0.650	0.000	0.000	0.650	0.21	0.77	33.0	200 PVC	0.203	0.013	0.32	19.4	0.60	4.0%
EXTERNAL AREA (EXISTING SEWERS *)	B1	11	9	235				0.799	0.799	3.86	2.59	8.00	18.620	18.620	0.000	0.000	18.620	6.14	14.14	28.4	300 PVC	0.305	0.013	0.32	57.1	0.78	24.8%
	-	9	5					0.000	0.799	3.86	2.59	8.00	0.010	18.630	0.000	0.000	18.630	6.15	14.15	10.9	300 PVC	0.305	0.013	0.32	57.1	0.78	24.8%
BEL-AIR DRIVE (EXISTING SEWERS)	B2	7	5	78				0.265	0.265	4.00	0.86	2.75	8.950	8.950	4.960	4.960	13.910	4.59	9.75	8.8	225 CONC	0.225	0.013	0.59	34.5	0.87	28.3%
BEL-AIR DRIVE (EXISTING SEWERS)		5	3					0.000	1.064	3.78	3.45	10.44	0.000	27.580	0.000	4.960	32.540	10.74	22.78	42.5	225 CONC	0.225	0.013	0.59	34.5	0.87	66.1%
BEL-AIR DRIVE (EXISTING SEWERS)	A8	3	1		5			0.014	1.132	3.76	3.67	11.05	0.200	28.430	0.000	4.960	33.390	11.02	23.67	44.2	225 CONC	0.225	0.013	0.59	34.5	0.87	68.6%
TOTALS				313	25																						

DEMAND EQUATION

Design Parameters:

1. Q(D), Q(A), Q(R) = Q(p) + Q(fd) + Q(ici) + Q(e)
2. Q(p) = (P x q x M x K / 86,400)
3. q Avg capita flow = 280 L/per/day (design)
   (L/per/day)= 200 L/per/day (annual and rare)
4. M = Harmon Formula (maximum of 4.0)
5. K = 0.8 (design)
   0.6 (annual and rare)
6. Park flow is considered equivalent to a single unit / ha
   Park Demand = 1 Single Unit Equivalent / Park ha
7. Foundation Drains 0.45 L/s/unit
8. Q(ici) = ICI Area x ICI Flow x ICI Peak
9. Q(e) = 0.33 L/sec/ha (design)
   0.30 L/sec/ha (annual)
   0.55 L/sec/ha (rare)

Definitions:

Q(D) = Peak Design Flow (L/sec) Q(A) = Peak Annual Flow (L/sec) Q(R) = Peak Rare Flow (L/sec)
Q(e) = Extraneous Flow (L/sec)
Q(p) = Population Flow (L/sec)
K = Harmon Correction Factor

	Singles	Semis/Towns	Apts (2-BR)
P = Residential Population	3.4	2.7	2.1
Typ Service Diameter (mm)		135	
Typ Service Length (m)	15	15	
I/I Pipe Rate (L/mm dia/m/hr) =	0.007		

Q(fd) = Foundation Flow (L/sec)
Q(ici) = Industrial / Commercial / Institutional Flow (L/sec)

Institutional / Commercial / Industrial			Industrial	Commercial / Institutional	
	Design =		35000	28000	
	Annual / Rare =		10000	17000	
ICI Peak *	Design =	Std ICI -->	1.0	1.5	* ICI Peak = 1.0 Default, 1.5 if ICI in contributing area is >20% (design only)
	Annual / Rare =	1.0			

CAPACITY EQUATION

Q full= (1/n) A R^(2/3)So^(1/2)
Where : Q full = Capacity (L/s)
n = Manning coefficient of roughness (0.013)
A = Flow area (m^2)
R = Wetter perimeter (m)
So = Pipe Slope/gradient

NOTE(S)
* EXISTING SEWERS INCLUDED IN THE ABANDONMENT AND RELOCATION.

Appendix E
Water Demand Calculations and Hydraulic Modeling

Ben Sweet

From: Armstrong, Justin <justin.armstrong@ottawa.ca>
Sent: Tuesday, March 05, 2019 3:00 PM
To: Sam Bahia
Cc: Kyle Crossman
Subject: RE: Pre-Consultation Follow-up: 2112 Bel-Air Drive
Attachments: 2112 BelAir Feb 2019_revised.pdf; Bel-Air-Private-Towns-CP4.pdf

Hi Sam,

I would have gladly provided this information at the pre-consult, however my first hearing of it came from a conversation with our boundary condition group. The planned work for this replacement is still in the scoping phase and as of now, the work does not include extending the watermain further east.

Below, you can find boundary conditions for current and planned conditions at two locations. The intersection of Bel-Air & Field as per your request as well as further east where the connection will likely be made.

The following are boundary conditions, HGL, for hydraulic analysis at 2112 Bel-Air (zone 2W) assumed to be connected to the 152mm on Bel-Air or at the intersection of Bel-air and Field St (see attached PDF for location). Watermain upgrades are planned for this area that will affect boundary conditions. As such, boundary conditions are provided for both existing and planned conditions. Please note the watermain upgrade project is still in the scoping stage.

Existing conditions:

	Connection 1 (152mm on Bel-Air)	Connection 2 (intersection of Bel-Air/Field St)
Minimum HGL	126.8m	126.8m
Maximum HGL*	134.7m	134.7m
Available Flow @ 20psi	45 L/s	60 L/s

* The maximum pressure is estimated to be close to 80 psi. A pressure check at completion of construction is recommended to determine if pressure control is required

Planned (as of Feb 2019) conditions:

	Connection 1 (future 152mm on Bel-Air)	Connection 2 (intersection of Bel-Air/Field St)
Minimum HGL	127.0m	127.0m
Maximum HGL*	134.8m	134.8m
MaxDay + Fire Flow (167 L/s)	Available flow @20psi = 140 L/s	110.0m

* The maximum pressure is estimated to be close to 80 psi. A pressure check at completion of construction is recommended to determine if pressure control is required

These are for current conditions and are based on computer model simulation.

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.

Regards,

Justin Armstrong, E.I.T.
Engineering Intern
Planning, Infrastructure and Economic Development Department - Services de la planification, de l'infrastructure et du développement économique
Development Review - West Branch
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2400 ext./poste 21746, justin.armstrong@ottawa.ca

From: Sam Bahia
Sent: March 01, 2019 2:50 PM
To: Armstrong, Justin
Cc: Kyle Crossman
Subject: RE: Pre-Consultation Follow-up: 2112 Bel-Air Drive

Hi Justin
It's good you are telling me that the City has a plan to upgrade the WM on Bel-Air, that's the important info that would've been useful at the pre-consult, so my client can make an informed decision. Will Bel-Air be looped fronting our site?

The City usually provides BCs at the intersection when there is a dead end, and asks us to model the existing pipe as part of the network analysis. My intention is to compare and know if there is sufficient fire flow if we provided a looped system back to the intersection, in lieu of placing 2-hour walls everywhere.

If you have questions, please call.

Thanks
Sam Bahia, P.Eng., Project Manager | Land Development
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 x 285 | Fax: 613.254.5867

From: Armstrong, Justin <justin.armstrong@ottawa.ca>
Sent: Friday, March 1, 2019 2:42 PM

To: Sam Bahia <s.bahia@novatech-eng.com>
Cc: Kyle Crossman <k.crossman@novatech-eng.com>
Subject: RE: Pre-Consultation Follow-up: 2112 Bel-Air Drive

Hi Sam,

Can I ask why you are requesting the BC for fire at the intersection? I understand the available flow will be slightly higher there, but will you not be making your connection for the development further east?

Good news is that the City is planning to upgrade the watermain in Bel-Air with the work targeted to start in the next 1-2 years. This will increase your available flow for the development and I can have boundary conditions requested for the future conditions – just looking to determine your reasoning for wanting the BC for fire condition at the intersection first.

Justin

From: Sam Bahia <s.bahia@novatech-eng.com>
Sent: March 01, 2019 9:53 AM
To: Armstrong, Justin <justin.armstrong@ottawa.ca>
Cc: Kyle Crossman <k.crossman@novatech-eng.com>
Subject: RE: Pre-Consultation Follow-up: 2112 Bel-Air Drive

Hi Justin
The available fire flow is low, is likely at the hydrant along the dead end, as I mentioned before it is marked with orange. Per my initial email and the sketch, can I ask you to plz provide the BC for fire condition at the intersection of Bel-Air @ Field St, where it is a looped system?
Thanks
Sam Bahia, P.Eng., Project Manager | Land Development
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 x 285 | Fax: 613.254.5867

From: Armstrong, Justin <justin.armstrong@ottawa.ca>
Sent: Friday, March 1, 2019 9:40 AM
To: Sam Bahia <s.bahia@novatech-eng.com>
Cc: Kyle Crossman <k.crossman@novatech-eng.com>
Subject: RE: Pre-Consultation Follow-up: 2112 Bel-Air Drive

Hi Sam,

See below for boundary conditions as per your request.

The following are boundary conditions, HGL, for hydraulic analysis at 2112 Bel-Air (zone 2W) assumed to be connected to the 152mm on Bel-Air (see attached PDF for location).

Minimum HGL = 126.8m

Maximum HGL = 134.7m

Available Flow @ 20psi = 55 L/s assuming a ground elevation of 78.7m

These are for current conditions and are based on computer model simulation.

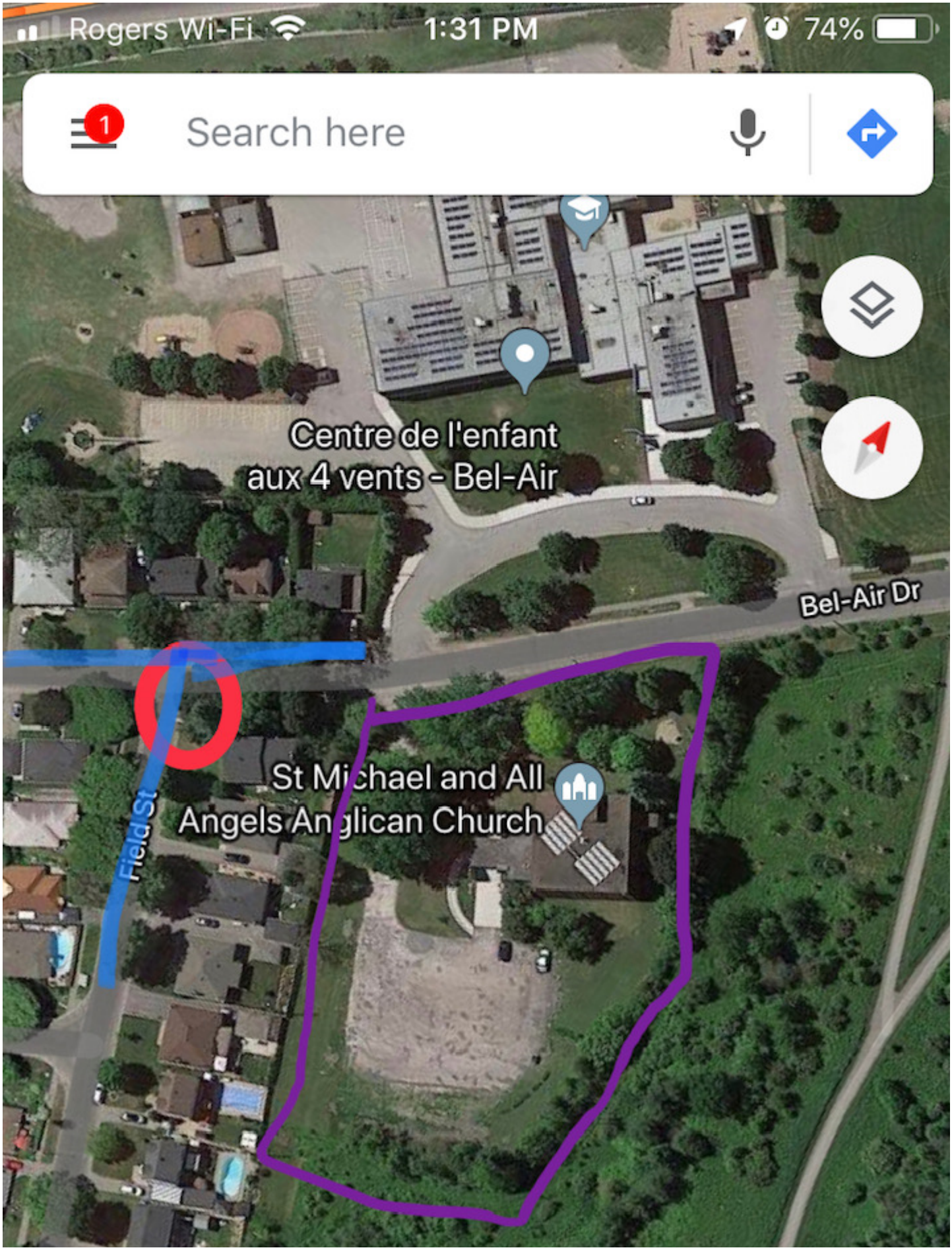
Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation 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.

Regards,

Justin Armstrong, E.I.T.
Engineering Intern
Planning, Infrastructure and Economic Development Department - Services de la planification, de l'infrastructure et du développement économique
Development Review - West Branch
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2400 ext./poste 21746, justin.armstrong@ottawa.ca

From: Sam Bahia <s.bahia@novatech-eng.com>
Sent: February 24, 2019 1:42 PM
To: Armstrong, Justin <justin.armstrong@ottawa.ca>
Cc: Kyle Crossman <k.crossman@novatech-eng.com>
Subject: Re: Pre-Consultation Follow-up: 2112 Bel-Air Drive

Trying again.


Rogers Wi-Fi
1:31 PM
74%
Search here
Centre de l'enfant
aux 4 vents - Bel-Air
Bel-Air Dr
St Michael and All
Angels Anglican Church
Field St

On Feb 24, 2019, at 1:39 PM, Armstrong, Justin <justin.armstrong@ottawa.ca> wrote:

Thanks Sam,

Not sure the attachment was included. Would you be able to re-send?

Justin

From: Sam Bahia <s.bahia@novatech-eng.com>
Sent: Sunday, February 24, 2019 1:36 PM
To: Armstrong, Justin <justin.armstrong@ottawa.ca>
Cc: Kyle Crossman <k.crossman@novatech-eng.com>
Subject: Re: Pre-Consultation Follow-up: 2112 Bel-Air Drive

Justin
Yes this highest domestic. Designed will be governed by fire anyway.

I understand the TB2014 implications, and its subtleties, including unit type and 10m separation.

Attached is a screenshot of the BC location, shown as red circle.

Thanks
Sam Bahia, P.Eng., Project Manager | Land Development
NOVATECH
Tel: 613.254.9643 x 285
The information contained in this email message is confidential and is for exclusive use of the addressee.

On Feb 24, 2019, at 1:25 PM, Armstrong, Justin <justin.armstrong@ottawa.ca> wrote:

Hi Sam,

Has Concept Plan #4 been decided as the proposed layout for the development? Or does it result in the highest domestic demand out of all the potential concept plans? If still undecided, the boundary conditions should be requested for the concept plan that will result in the highest demand.

For the FUS cap of 10000L/min to apply, please keep in mind the following from Water Design Guideline Technical Bulletin ISDTB-2014-02:

A screenshot with the proposed connection point to the City water main should be provided to be accompanied with the boundary condition request as well.

Regards,

Justin Armstrong, E.I.T.
Engineering Intern
Planning, Infrastructure and Economic Development Department - Services de la planification, de l'infrastructure et du développement économique
Development Review - West Branch
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1

613.580.2400 ext./poste 21746, justin.armstrong@ottawa.ca

From: Sam Bahia <s.bahia@novatech-eng.com>
Sent: Thursday, February 21, 2019 2:32 PM
To: Armstrong, Justin <justin.armstrong@ottawa.ca>
Cc: Kyle Crossman <k.crossman@novatech-eng.com>
Subject: FW: Pre-Consultation Follow-up: 2112 Bel-Air Drive

Hi Justin
For this site, we are still in due dillignece, can you please provide me with BCs per the attached layout and domestic/fire demand?
I did note there is a dean end watermain along Bel-Air east of Field St, and the ex hydrant is marked in orange. If you can provide the BC at that location, it would be appreciated.
Thanks
Sam Bahia, P.Eng., Project Manager | Land Development
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 x 285 | Fax: 613.254.5867

From: McCreight, Laurel <Laurel.McCreight@ottawa.ca>
Sent: Wednesday, January 23, 2019 9:24 AM
To: Robert Tran <r.tran@novatech-eng.com>
Cc: Greg Winters <G.Winters@novatech-eng.com>; Sam Bahia <s.bahia@novatech-eng.com>
Subject: Pre-Consultation Follow-up: 2112 Bel-Air Drive

Hi Robert,

Please refer to the below regarding the Pre-Consultation Meeting held on Monday January 21, 2019 for the property 2112 Bel-Air Drive for a proposed plan of subdivision for a townhouse development. I have also attached the Plans & Study List.

General

- Proposal of three concepts for a townhouse development
    - Concept Plan #2: 22 townhouses on a public street (cul-de-sac) with an 18 metre right-of-way
    - Concept Plan #4: 29 townhouses on a private street with a 6.0 metre right-of-way
    - Concept Plan #7: 22 townhouses on a public street with an 18 metre right-of-way

Planning & Urban Design

- The existing residential subdivision to the west will be most impacted by the proposed development
    - Please be cognizant of the setback proposed against this community
- The site is heavily treed
    - Please retain as many trees where possible

Heritage

- The City is undertaking an Heritage Inventory Project that is currently underway
    - This study is expected to proceed to Council in late Spring 2019
    - The study includes buildings built prior to 1980 that have potential to be added to the Heritage Register and potentially designated
    - The existing church is proposed to be added to the Register
        - If successfully added, 60-days notice will be required prior to demolition

- The Church has been identified as having cultural heritage value
- It is encouraged to retain the Church as part of the proposal
- For any heritage related questions please contact Lesley Collins

Transportation

- Traffic Impact Assessment Screening form submitted. Traffic Impact Assessment will not be required
    - Screening form to be updated if the concept changes from what has been proposed
- Noise Impact Studies required for the following:
    - Road
- On site plan:
    - Show all details of the roads abutting the site up to and including the opposite curb; include such items as pavement markings, accesses and/or sidewalks
    - Turning templates will be required for all accesses showing the largest vehicle to access the site; required for internal movements and at all access (entering and exiting and going in both directions)
    - Show all curb radii measurements; ensure that all curb radii are reduced as much as possible
    - Show lane/aisle widths
- For any transportation related questions please contact Rosanna Baggs

Forestry

- A Tree Conservation Report (TCR) must be supplied for review along with the suite of other plans/reports required by the City; an approved TCR is a requirement of Site Plan or Plan of Subdivision approval
- Any removal of privately-owned trees 10cm or larger in diameter requires a tree permit issued under the Urban Tree Conservation Bylaw; the permit is based on the approved TCR
- The removal of City-owned trees will require the permission of Forestry Services who will also review the submitted TCR
- In this case, the TCR may be combined with the Landscape Plan or it may be a stand-alone plan; a plan form is preferred provided it has all the relevant information.
- The TCR must list all trees on site by species, diameter and health condition – separate stands/groupings of trees may be combined using averages
- The TCR must address all trees with a critical root zone that extends into the developable area – all trees that could be impacted by the construction that are outside the developable area need to be addressed.
- Trees with a trunk that crosses/touches a property line are considered co-owned by both property owners; permission from the adjoining property owner must be obtained prior to the removal of co-owned trees
- If trees are to be removed, the TCR must clearly show where they are, and document the reason they can not be retained – please provide a plan showing retained and removed treed areas
- All retained trees must be shown and all retained trees within the area impacted by the development process must be protected as per City guidelines listed on Ottawa.ca
- Butternut is common in the vicinity of the site – please address any butternut identified within a regulated distance from the property
- The City encourages the retention of healthy trees; if possible, please seek opportunities for retention of trees that will contribute to the design/function of the site.
- Please ensure newly planted trees have an adequate soil volume for their size at maturity. The following is a table of recommended minimum soil volumes:

Tree Type/Size	Single Tree Soil Volume (m3)	Multiple Tree Soil Volume (m3/tree)
Ornamental	15	9
Columnar	15	9
Small	20	12
Medium	25	15

Large	30	18
Conifer	25	15

- For any questions related to forestry please contact Mark Richardson

Engineering

- Consultant to determine what kind of ECA Application is required for site sewer (storm or sanitary) alterations for the development. City to confirm.

WATER

- Form 1 required to extend watermain down Bel-Air. Full-sized main is required for the extension and depending on development and servicing orientation, the extension may be required across the entire lot frontage. Specifics of watermain extension requirements can be discussed at design stage.
- E-mail Justin to obtain boundary conditions. Provide demand calculations which will be reviewed prior to boundary condition request.

SANITARY

- City sanitary sewer with 6m easement crossing NCC lands as well as 2112 Bel-Air requires relocation. After following up with the City's Asset Management Branch (AMB), a realignment as shown by the green line in the screenshot below will be supported, provided the relocation is done on 2112 Bel-Air property and an easement is given in the City's favour.

- Sanitary system in the area has high extraneous flows due to the partially separated nature of the system. As such, there is a history of flooding in this area. Contact Eric Tousignant for further info.

STORM

- Uncontrolled storm system with 2-yr level of service.
- Site discharges to Pinecrest Creek – Pinecrest Creek/Westboro Area SWM guidelines to be followed.

For any questions related to engineering please contact Justin Armstrong

Please do not hesitate to contact me with any questions.

Regards,
Laurel

Laurel McCreight MCIP, RPP
Planner
Development Review West
Urbaniste
Examen des demandes d'aménagement ouest

City of Ottawa | Ville d'Ottawa
613.580.2424 ext./poste 16587
ottawa.ca/planning / ottawa.ca/urbanisme

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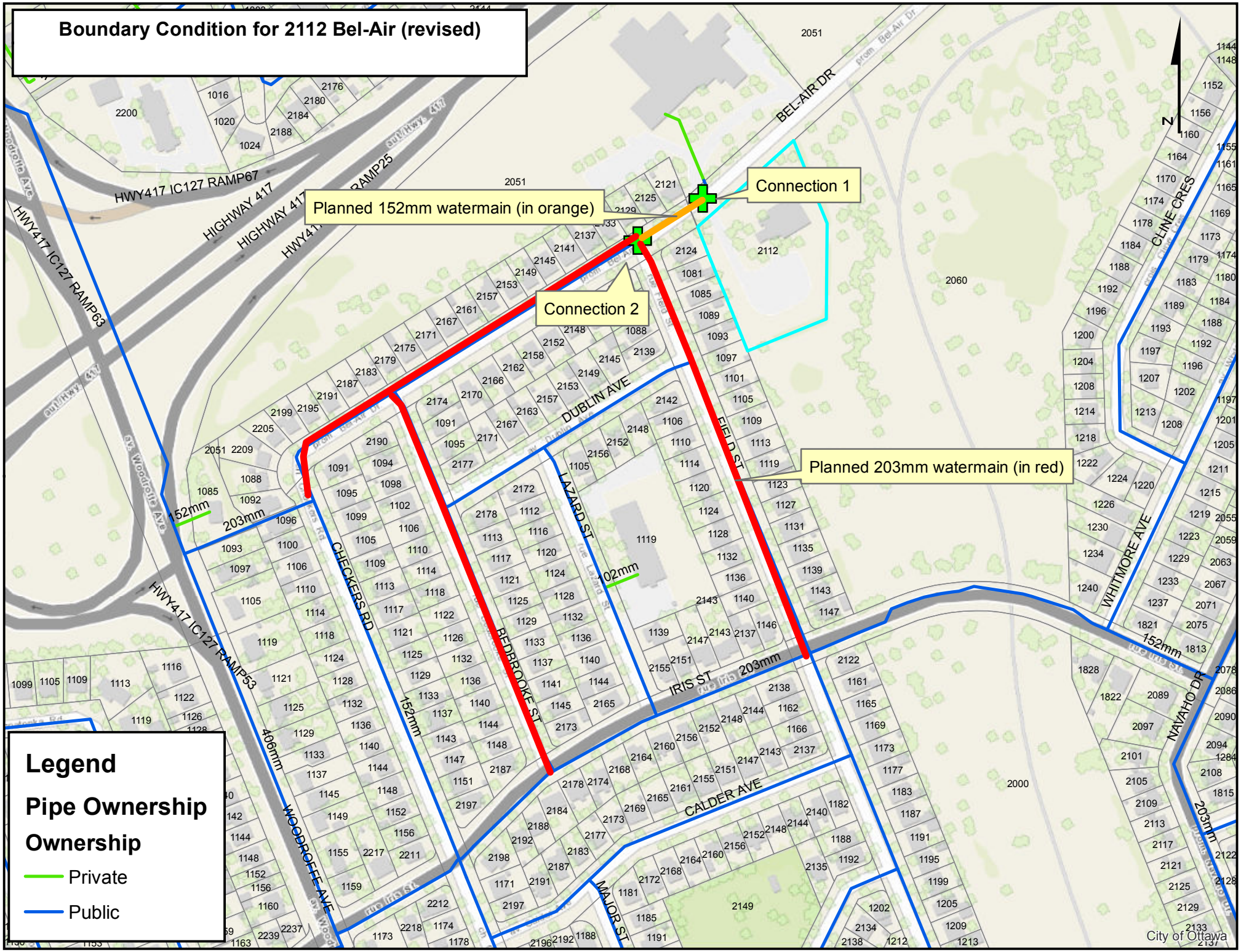
Boundary Condition for 2112 Bel-Air (revised)
Connection 1
Connection 2
Planned 152mm watermain (in orange)
Planned 203mm watermain (in red)
BEL-AIR DR
HWY417 IC127 RAMP67
HIGHWAY 417
HWY417 IC127 RAMP63
HWY417 IC127 RAMP53
DUBLIN AVE
FIELD ST
LAZARD ST
CHECKERS RD
BEDBROOKE ST
IRIS ST
CALDER AVE
MAJOR ST
WOODROFFE AVE
CLINE CRES
WHITMORE AVE
NAVAHO DR
152mm
203mm
406mm
102mm
2112
2060
2051
2000
Legend
Pipe Ownership
Ownership
Private
Public
City of Ottawa

Novatech Project #: 119000
Project Name: 2112 Bel-Air Drive
Date: 11/01/2019
Date Revised:

NOVATECH
Engineers, Planners & Landscape Architects

OVERALL WATER DEMAND

RESIDENTIAL					BASIC DAY DEMAND	MAX. DAY DEMAND	PEAK HOUR DEMAND
NUMBER OF UNITS				POP'N			
SINGLE DWELLING	ROW TOWNHOME	MULTI-RESIDENTIAL	PARK	(pers)	(L/s) RES.	(L/s) RES.	(L/s) RES.
0	25	0	0	68	0.27	0.68	1.50

ASSUMPTIONS:

RESIDENTIAL POPULATIOI	- Single Dwelling	3.4	people/unit
	- Semi-Detached	2.7	people/unit
	- Row Townhome	2.7	people/unit
	- Multi-Residential	2.1	people/unit
	- Park demands, equivalent to Single Dwelling		
BASIC DAY DEMAND:	- Residential	350	L / c / d
MAXIMUM DAY DEMAND:	- Residential	2.50	* basic day
PEAK HOUR DEMAND:	- Residential	2.20	* maximum day
FIRE FLOW DEMAND:	- Low Density Residential	10,000 L/min. =	167 L/s

Novatech Project #: 119000
Project Name: 2112 Bel-Air Drive
Date: 11/01/2019
Date Revised:

Engineers, Planners & Landscape Architects

JUNCTION DEMAND

JUNCTION ID	RESIDENTIAL					BASIC DAY DEMAND	MAX. DAY DEMAND	PEAK HOUR DEMAND	FIRE FLOW DEMAND
	NUMBER OF UNITS				POP'N				
	SINGLE DWELLING	ROW TOWNHOME	MULTI-RESIDENTIAL	PARK	(pers)	(L/s)	(L/s)	(L/s)	(L/s)
J1					0	0.00	0.00	0.00	167
J2		9			24	0.10	0.25	0.54	167
J3		7			19	0.08	0.19	0.42	167
J4		9			24	0.10	0.25	0.54	167
J5					0	0.00	0.00	0.00	167
J6					0	0.00	0.00	0.00	167
TOTAL	**0**	**25**	**0**	**0**	**68**	**0.27**	**0.68**	**1.50**	

ASSUMPTIONS:

RESIDENTIAL POPULATION DENSITY:	- Single Dwelling	3.4 people/unit
	- Semi-Detached	2.7 people/unit
	- Row Townhome	2.7 people/unit
	- Multi-Residential	2.1 people/unit
	- Park demands, equivalent to Single Dwelling	
BASIC DAY DEMAND:	- Residential	350 L / c / d
MAXIMUM DAY DEMAND:	- Residential	2.50 * basic day
PEAK HOUR DEMAND:	- Residential	2.20 * maximum day
FIRE FLOW DEMAND:	- Low Density Residential	10,000 L/min. = 167 L/s

Novatech Project #: 119000
Project Name: 2112 Bel-Air Drive
Date: 11/01/2019
Date Revised:

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EXISTING CONDITIONS - MAX PRESSURES DURING BSDY CONDITIONS

JUNCTION ID	ELEVATION (m)	STATIC DEMAND (L/s)	STATIC HEAD (m)	STATIC PRESSURE (m)	STATIC PRESSURE (psi)
J1	78.70	0.00	134.90	56.20	80
J2	78.70	0.00	134.90	56.20	80
J3	79.50	0.10	134.90	55.40	79
J4	80.70	0.08	134.90	54.20	77
J5	80.00	0.10	134.90	54.90	78
J6	79.40	0.00	134.90	55.50	79

PLANNED CONDITIONS (FEB 2019) - MAX PRESSURES DURING BSDY CONDITIONS

JUNCTION ID	ELEVATION (m)	STATIC DEMAND (L/s)	STATIC HEAD (m)	STATIC PRESSURE (m)	STATIC PRESSURE (psi)
J1	78.70	0.00	134.93	56.23	80
J2	78.70	0.00	134.93	56.23	80
J3	79.50	0.10	134.93	55.43	79
J4	80.70	0.08	134.93	54.23	77
J5	80.00	0.10	134.93	54.93	78
J6	79.40	0.00	134.93	55.53	79

Novatech Project #: 119000
Project Name: 2112 Bel-Air Drive
Date: 11/01/2019
Date Revised:

NOVATECH
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EXISTING CONDITIONS - MIN PRESSURES DURING PKHR CONDITIONS

JUNCTION ID	ELEVATION (m)	STATIC DEMAND (L/s)	STATIC HEAD (m)	STATIC PRESSURE (m)	STATIC PRESSURE (psi)
J1	78.70	0.00	128.14	49.44	70
J2	78.70	0.00	128.14	49.44	70
J3	79.50	0.54	128.13	48.63	69
J4	80.70	0.42	128.13	47.43	67
J5	80.00	0.54	128.13	48.13	68
J6	79.40	0.00	128.13	48.73	69

PLANNED CONDITIONS (FEB 2019) - MIN PRESSURES DURING PKHR CONDITIONS

JUNCTION ID	ELEVATION (m)	STATIC DEMAND (L/s)	STATIC HEAD (m)	STATIC PRESSURE (m)	STATIC PRESSURE (psi)
J1	78.70	0.00	128.36	49.66	71
J2	78.70	0.00	128.36	49.66	71
J3	79.50	0.54	128.35	48.85	69
J4	80.70	0.42	128.35	47.65	68
J5	80.00	0.54	128.35	48.35	69
J6	79.40	0.00	128.35	48.95	70

Novatech Project #: 119000
Project Name: 2112 Bel-Air Drive
Date: 11/01/2019
Date Revised:

NOVATECH
Engineers, Planners & Landscape Architects

EXISTING CONDITIONS - AVAILABLE FLOW AT 20psi DURING MXDY+FF CONDITIONS

JUNCTION ID	ELEVATION (m)	STATIC DEMAND (L/s)	STATIC HEAD (m)	STATIC PRESSURE (m)	STATIC PRESSURE (psi)	FIRE FLOW DEMAND (L/s)	FIRE FLOW DEMAND (L/min)	AVAILABLE FLOW (L/min)
HYD EX	78.70	0.00	132.67	53.97	77	167	10,000	3,318
HYD 1	79.50	0.25	132.67	53.17	76	167	10,000	2,850
HYD 2	80.70	0.19	132.67	51.97	74	167	10,000	2,550
HYD 3	80.00	0.25	132.67	52.67	75	167	10,000	2,502

PLANNED CONDITIONS (FEB 2019) - AVAILABLE FLOW AT 20psi DURING MXDY+FF CONDITIONS

JUNCTION ID	ELEVATION (m)	STATIC DEMAND (L/s)	STATIC HEAD (m)	STATIC PRESSURE (m)	STATIC PRESSURE (psi)	FIRE FLOW DEMAND (L/s)	FIRE FLOW DEMAND (L/min)	AVAILABLE FLOW (L/min)
HYD EX	78.70	0.00	132.82	54.12	77	167	10,000	9,300
HYD 1	79.50	0.25	132.82	53.32	76	167	10,000	5,790
HYD 2	80.70	0.19	132.81	52.11	74	167	10,000	4,650
HYD 3	80.00	0.25	132.81	52.81	75	167	10,000	4,344

2112 Bel-Air Drive
Job No. 119000
PCSWMM Model Schematic – EXISTING CONDITIONS

NOVATECH
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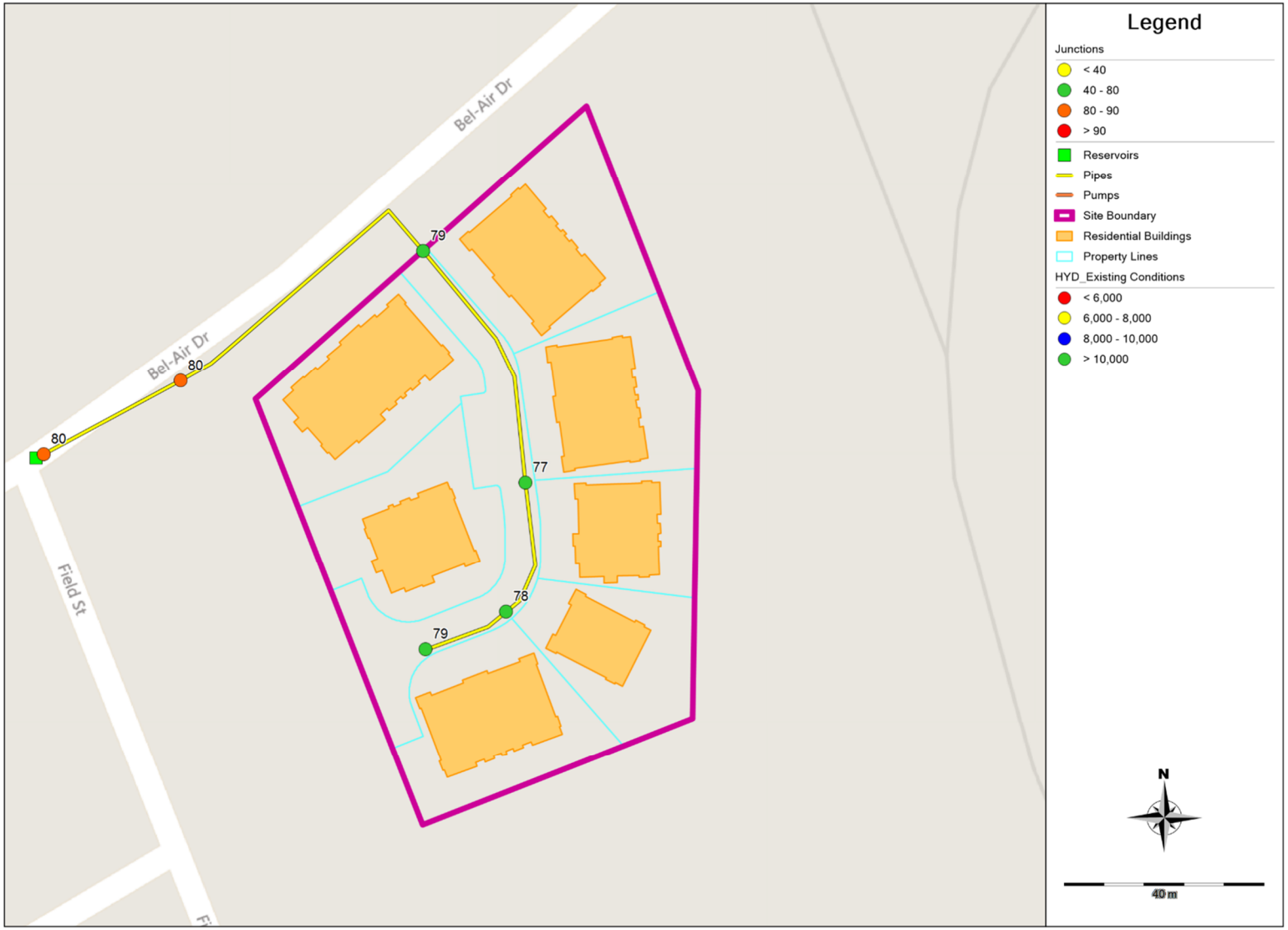
Maximum Pressures During BSDY Conditions



Date: 2019/11/01
M:\2019\119000\DATA\Calculations\Sewer Calcs\Water\20191101_Model Schematic_Existing.docx

2112 Bel-Air Drive
Job No. 119000
PCSWMM Model Schematic – EXISTING CONDITIONS

NOVATECH
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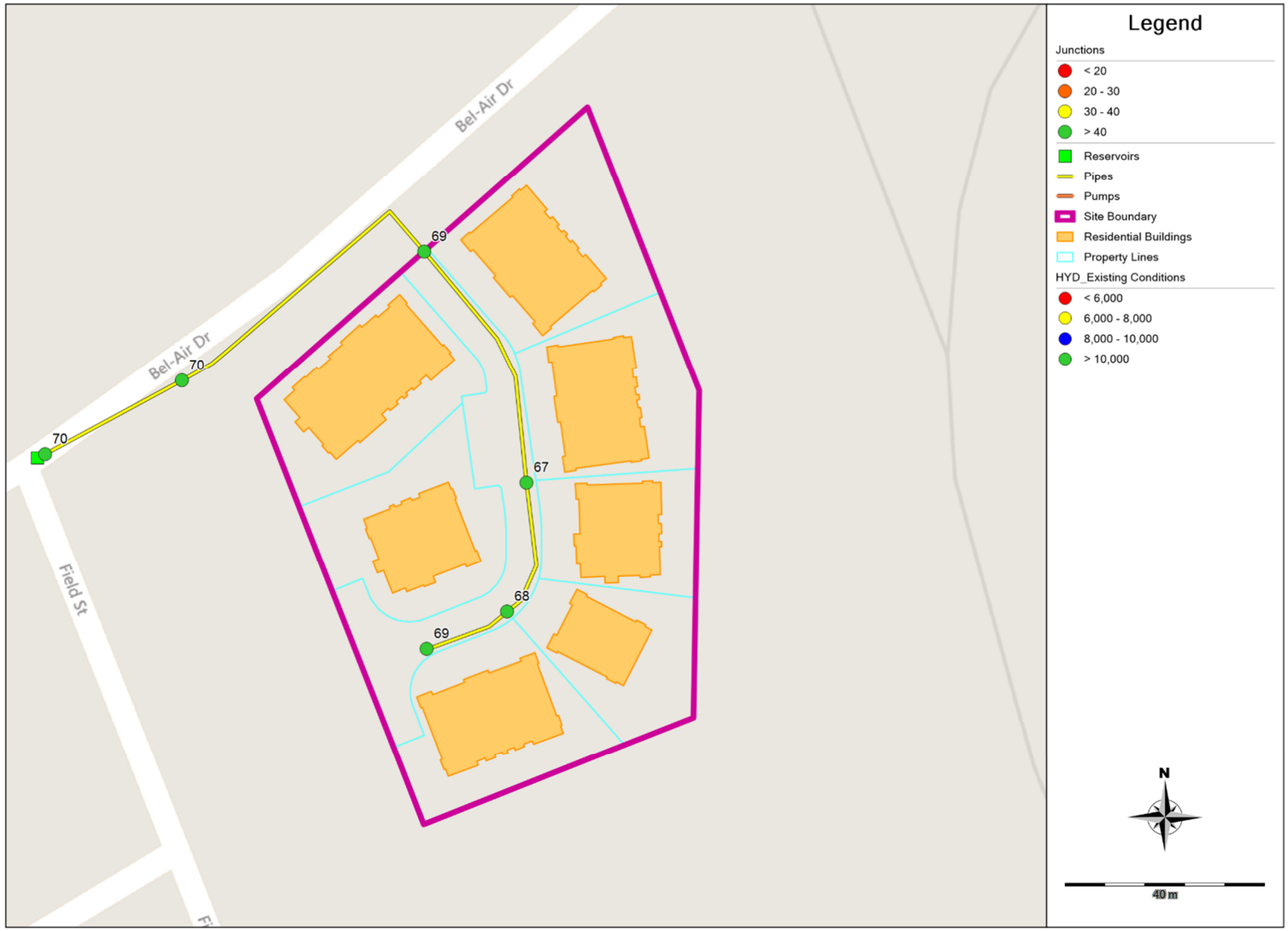
Minimum Pressures During PKHR Conditions



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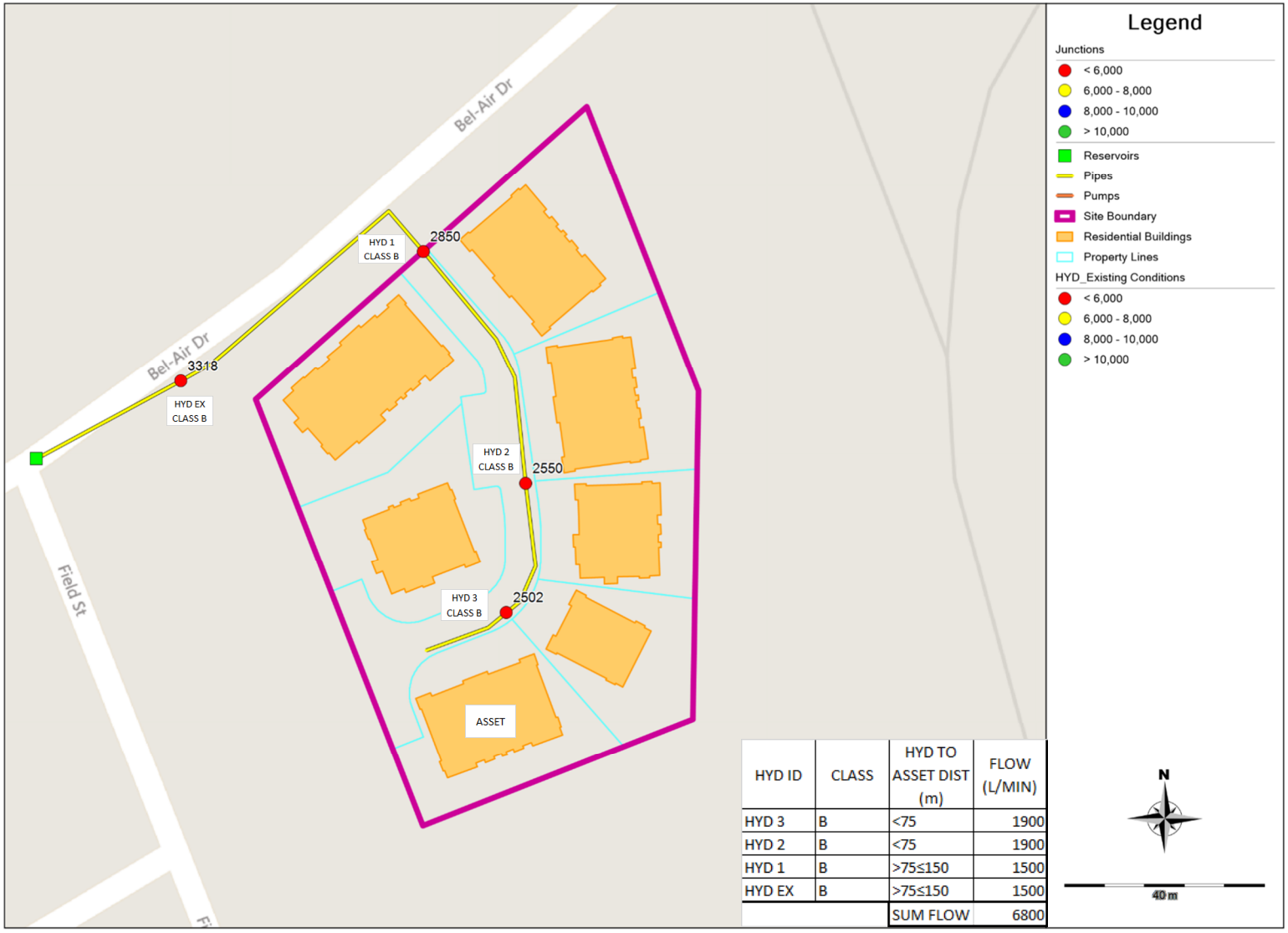
2112 Bel-Air Drive
Job No. 119000
PCSWMM Model Schematic – EXISTING CONDITIONS

NOVATECH
Engineers, Planners & Landscape Architects

Available Flow at 20psi During MXDY+FF Conditions



HYD ID	CLASS	HYD TO ASSET DIST (m)	FLOW (L/MIN)
HYD 3	B	<75	1900
HYD 2	B	<75	1900
HYD 1	B	>75≤150	1500
HYD EX	B	>75≤150	1500
		SUM FLOW	6800

Date: 2019/11/01
M:\2019\119000\DATA\Calculations\Sewer Calcs\Water\20191101_Model Schematic_Existing.docx

FUS - Fire Flow Calculations

As per 1999 Fire Underwriter's Survey Guidelines

NOVATECH
Engineers, Planners & Landscape Architects

Novatech Project #: 119000
Project Name: 2112 Bel-Air Drive
Date: 11/1/2019
Input By: BCS
Reviewed By: BHB

Legend

Building Description: Townhomes East/South of Private Rd (contiguous block basis)
Wood frame

Step			Input		Value Used	Total Fire Flow (L/min)
Base Fire Flow						
1	**Construction Material**			**Multiplier**		
	Coefficient related to type of construction **C**	Wood frame	Yes	1.5	1.5	
		Ordinary construction		1		
		Non-combustible construction		0.8		
		Modified Fire resistive construction (2 hrs)		0.6		
		Fire resistive construction (> 3 hrs)		0.6		
2	**Floor Area**					
	A	Building Footprint (m^2)	1595			
		Number of Floors/Storeys	2			
		Area of structure considered (m^2)			**3,190**	
	F	**Base fire flow without reductions**				**19,000**
		F = 220 C (A)$^{0.5}$				
Reductions or Surcharges						
3	**Occupancy hazard reduction or surcharge**			**Reduction/Surcharge**		
	(1)	Non-combustible		-25%	-15%	**16,150**
		Limited combustible	Yes	-15%		
		Combustible		0%		
		Free burning		15%		
		Rapid burning		25%		
4	**Sprinkler Reduction**			**Reduction**		
	(2)	Adequately Designed System (NFPA 13)	No	-30%		**0**
		Standard Water Supply	No	-10%		
		Fully Supervised System	No	-10%		
				Cumulative Total	**0%**	
5	**Exposure Surcharge (cumulative %)**				**Surcharge**	
	(3)	North Side	> 45.1m		0%	**2,423**
		East Side	> 45.1m		0%	
		South Side	> 45.1m		0%	
		West Side	10.1 - 20 m		15%	
				Cumulative Total	**15%**	
Results						
6	**(1) + (2) + (3)**	**Total Required Fire Flow, rounded to nearest 1000L/min**			**L/min**	**19,000**
		(2,000 L/min < Fire Flow < 45,000 L/min)		or	L/s	**317**
				or	USGPM	5,020
7	**Storage Volume**	Required Duration of Fire Flow (hours)			Hours	4
		Required Volume of Fire Flow (m^3)			m^3	4560

FUS - Fire Flow Calculations

As per 1999 Fire Underwriter's Survey Guidelines

NOVATECH
Engineers, Planners & Landscape Architects

Novatech Project #: 119000
Project Name: 2112 Bel-Air Drive
Date: 11/1/2019
Input By: BCS
Reviewed By: BHB

Legend

Building Description: Townhomes fronting Bel-Air Dr
Wood frame

Step			Input		Value Used	Total Fire Flow (L/min)
Base Fire Flow						
1	**Construction Material**			**Multiplier**		
	Coefficient related to type of construction **C**	Wood frame	Yes	1.5	1.5	
		Ordinary construction		1		
		Non-combustible construction		0.8		
		Modified Fire resistive construction (2 hrs)		0.6		
		Fire resistive construction (> 3 hrs)		0.6		
2	**Floor Area**					
	A	Building Footprint (m^2)	470			
		Number of Floors/Storeys	2			
		Area of structure considered (m^2)			**940**	
	F	**Base fire flow without reductions**				**10,000**
		F = 220 **C** (**A**)$^{0.5}$				
Reductions or Surcharges						
3	**Occupancy hazard reduction or surcharge**			**Reduction/Surcharge**		
	(1)	Non-combustible		-25%	-15%	**8,500**
		Limited combustible	Yes	-15%		
		Combustible		0%		
		Free burning		15%		
		Rapid burning		25%		
4	**Sprinkler Reduction**			**Reduction**		
	(2)	Adequately Designed System (NFPA 13)	No	-30%		**0**
		Standard Water Supply	No	-10%		
		Fully Supervised System	No	-10%		
				Cumulative Total	**0%**	
5	**Exposure Surcharge (cumulative %)**				**Surcharge**	
	(3)	North Side	3.1 - 10 m		20%	**4,675**
		East Side	10.1 - 20 m		15%	
		South Side	20.1 - 30 m		10%	
		West Side	20.1 - 30 m		10%	
				Cumulative Total	**55%**	
Results						
6	**(1) + (2) + (3)**	**Total Required Fire Flow, rounded to nearest 1000L/min**			**L/min**	**13,000**
		(2,000 L/min < Fire Flow < 45,000 L/min)		or	L/s	**217**
				or	USGPM	3,435
7	**Storage Volume**	Required Duration of Fire Flow (hours)			Hours	2.5
		Required Volume of Fire Flow (m^3)			m^3	1950

1. Background

On behalf of the City of Ottawa, the National Research Council of Canada (NRC) evaluated the City's hydrant spacing guidelines in relation to Required Fire Flow (RFF) as calculated using the Fire Underwriters Survey (FUS) methodology. This work lead to the development of a procedure to be used to establish the appropriate sizing of, and hydrant spacing on, dead-end watermains. This procedure may also be used as an optional watermain network design method to optimize watermain sizing based on RFF and standard hydrant spacing.

The procedure is partially based on the NFPA 1: Fire Code (NFPA1) and the City of Ottawa existing hydrant classification practice (refer to **Attachment A** at the end of this appendix for relevant excerpts of the Fire Code).

2. Rationale for Guideline

Given a Required Fire Flow (RFF) for a certain asset/structure/building, proper planning must ensure that there is a sufficient number of hydrants at sufficient proximities to actually provide the RFF. Both the capacity of the hydrants and their proximity to the asset/structure/building must be considered. Pressure losses (due to friction) in firehoses are proportional to the firehose length. Therefore, the actual fire flow delivered by the nozzle at the end of a very long firehose will be less compared to a short firehose connected to the same hydrant. Table 1 provides conservative values for hydrant fire flow capacity adjusted for firehose length.

3. Hydrant Capacity Requirement

For the purposes of this guidelines, the aggregate fire flow capacity of all contributing fire hydrants within 150 m of a building/asset/structure[1], measured in accordance with Table 1, shall be not less than the RFF.

4. Standard Practice

For the vast majority of developments, hydrant spacing as indicated in Section 4.5, Table 4.9, Ottawa Design Guidelines – Water Distribution, are sufficient to meet the RFF. This has been verified by evaluating approved development plans representing a

[1] Although NFPA 1 considers hydrant contribution at distances of up to 1000ft (305 m), Ottawa Fire Services (OFS) would need two pumpers to deliver flow from such a distance (one pumper midway – acting as a booster). Moreover, OFS cautioned that some redundancy is advisable to account for accessibility limitations in emergency situations, wind effects, etc. Therefore 150 m was considered as the maximum contributing distance

range of land uses and configurations. However, in some instances involving dead-end watermains, standard spacing requirements may not be sufficient to meet RFF.

Standard design practice involves systematic checking of design fire flows at every node in hydraulic models of proposed water distribution systems. Normally the entire design fire flow is applied to each node in succession. Nodes are typically at water main junctions rather than actual hydrant locations. This significantly simplifies the design process and the current software packages that are normally used for this purpose have been developed based on this practice. The "point load assumption" produces a conservative design.

Table 1. Maximum flow to be considered from a given hydrant

Hydrant Class	Distance to asset/structure/building (m)[a]	Contribution to required fire flow (L/min)[b]
AA	≤ 75	5,700
	> 75 and ≤ 150	3,800
A	≤ 75	3,800
	> 75 and ≤ 150	2,850
B	≤ 75	1,900
	> 75 and ≤ 150	1,500
C	≤ 75	800
	> 75 and ≤ 150	800

[a] Distance of contributing hydrant from the structure, measured in accordance with NFPA 1 (Appendix A).

[b] Maximum flow contribution to be considered for a given asset/structure/building, at a residual pressure of 20 psi, measured at the location of the main, at ground level.

4. Intended Application of Guideline

The intent of this procedure is to:

- Determine the appropriate sizing of dead end watermains and associated hydrant requirements.
- Provide an optional approach to local watermain network sizing that will assist the designer in determining the minimum pipe sizing needed to meet RFF.

The procedure permits the designer to: (a) reconcile available hydrant flow with computed RFFs, and (b) allow the distribution of RFFs along multiple hydrants, rather

than consider RFF to be a point flow. The application of this protocol may result in reduced watermain diameters compared to those determined based on a traditional design approach. Caution is required in the application of the procedure to ensure that the transmission function of any watermains identified in a Master Servicing Study is not compromised. Normally, watermains 300mm in diameter and larger that are identified in such studies would not be considered for resizing.

5. Application Procedure

5.1 Rated hydrants

The procedure described here would apply to an existing watermain network with existing hydrants (i.e., re-development or infill in existing neighborhoods):

- Identify critical zones within the (re)development area, e.g., high RFF, dead ends, small diameter watermains, low C factor, and/or high geographic elevation zones.
- For the critical zones use Table 1 to examine if there are sufficient hydrants to deliver the RFF (following procedure described in 5.3).
- If hydrant capacity is insufficient, then consider either:
    - adding hydrants as appropriate;
    - determine if the existing hydrants can be upgraded to higher rating; or
    - upgrade existing watermains.

5.2 Un-rated hydrants

There are currently about 24,800 hydrants in the City of Ottawa, of which about 78% are rated. Of the rated hydrants, 96% are AA (Blue), 3% are A (Green). Many of the un-rated hydrants are located in old parts of the City, often installed on water mains with minimum diameter of 6" (150 mm), and would be likely to have a low rating.

Based on a review of hydrants that have been installed as part of recent urban development, approximately 99% of those which were rated are rated AA, and only 1% are rated A.

5.2.1 Un-rated Existing Hydrants

In cases where fire flow is to be evaluated in areas with an established water distribution network and with existing fire hydrants (i.e., re-development or infill in existing neighborhoods), all un-rated hydrants should be tested and rated in accordance with NFPA standard 291. The procedure described in Section 5.1 can then be followed to complete the design.

5.2.2 Planned hydrants

Planned hydrants cannot be tested for rating because they have not been installed yet. Moreover, the rating of a hydrant is an intrinsic property of the hydrant and can therefore not be directly evaluated by simulation. Based on the statistics cited previously, it can be assumed for design purposes that all planned hydrants are AA. However, there could be a situation where the proposed network might not have sufficient capacity to supply 5,700 L/min to a AA-rated hydrant in a specific area. Hydraulic analysis is required to confirm that the distribution network is capable of providing the hydrants with the fire flows in Table 1.

5.3 Hydrant Placement and Watermain Size Optimization

Ottawa design guidelines for watermain sizing and hydrant placement (Section 4) stipulate that the RFF be added to the average hourly rate of a peak day demand. This fire flow is added to hydraulic nodes in the vicinity of the planned development, while ensuring that the residual pressure is at least 140 kPa (measured at the location of the main, at ground level).[2] The following procedure is used to optimize watermain sizing and hydrant placement based on the RFF.

- Place hydrants throughout the development area according to the current Ottawa design guidelines.
- Size water mains and locate hydrants according to standard design procedures. Assume all hydrants are AA-rated.
- Identify the most critical zones in the development area, e.g. highest required fire flows, dead ends, longest distances between junctions, and/or highest elevation. Within these critical zones identify critical structures, i.e. those with highest RFF or greatest distance from proposed hydrant locations. Identify the closest hydrants to these buildings.
- For each critical structure, distribute the RFF according to Table 1 (i.e., assign a flow of 5,700 L/min to all hydrants with a distance of less or equal to 75 m from the test property and 3,800 L/min to all hydrants with a distance of more than 75 m but less or equal to 150 m from the test property) These hydrants are to be represented as hydrant-nodes in the network model, where the hydrant lateral would connect to the proposed water main.

---

[2] At the time when this protocol was proposed, the City of Ottawa had in effect Technical Bulletin ISDTB 2014-02, whereby RFF may be capped at 10,000 L/min for single detached dwellings (with a minimum 10 m separation between the backs of adjacent units and for side-by-side town and row houses that comply with the OBC Div. B, subsection 3.1.10 requirement (compartments of no more than 600 m^2 area).

- For each critical structure, run a single fire flow simulation ensuring that the RFF is provided by hydrants within 150 m distance from the test property, with a minimum residual pressure of 140 kPa.
- If the required residual pressure cannot be achieved, consider either re-sizing of pipes, and/or re-spacing of hydrants.

The above procedure is optional except for dead-end watermains servicing cul-de-sacs because (a) based on standard spacing requirements, there would often be insufficient fire flow provided and (b) the watermain would otherwise could be sized larger than necessary and lead to excessive water age and on-going flushing requirements.

Irrespective of the above, if the RFF is equal to or less than 10,000 L/min, then:

- where the distance between two adjacent hydraulic nodes is greater than the inter-hydrant spacing allowed in the guideline, a hydraulic node should be added halfway between the two nodes, and proceed with fire flow simulations to verify watermain sizing, ensuring that the simulation considers RFF at the new hydraulic node.

Attachment A—Excerpts from NFPA 1 Fire Code (2015 Edition)

18.5 Fire Hydrants.

18.5.1 Fire Hydrant Locations and Distribution. Fire hydrants shall be provided in accordance with Section 18.5 for all new buildings, or buildings relocated into the jurisdiction unless otherwise permitted by 18.5.1.1 or 18.5.1.2.

18.5.1.4* The distances specified in Section 18.5 shall be measured along fire department access roads in accordance with 18.2.3.

18.5.1.5 Where fire department access roads are provided with median dividers incapable of being crossed by fire apparatus, or where fire department access roads have traffic counts of more than 30,000 vehicles per day, hydrants shall be placed on both sides of the fire department access road on an alternating basis, and the distances specified by Section 18.5 shall be measured independently of the hydrants on the opposite side of the fire department access road.

18.5.1.6 Fire hydrants shall be located not more than 12 ft (3.7 m) from the fire department access road.

18.5.2 Detached One- and Two-Family Dwellings. Fire hydrants shall be provided for detached one- and two-family dwellings in accordance with both of the following:

(1) The maximum distance to a fire hydrant from the closest point on the building shall not exceed 600 ft (183 m).

(2) The maximum distance between fire hydrants shall not exceed 800 ft (244 m).

18.5.3 Buildings Other than Detached One- and Two-Family Dwellings. Fire hydrants shall be provided for buildings other than detached one- and two-family dwellings in accordance with both of the following:

(1) The maximum distance to a fire hydrant from the closest point on the building shall not exceed 400 ft (122 m).

(2) The maximum distance between fire hydrants shall not exceed 500 ft (152 m).

18.5.4 Minimum Number of Fire Hydrants for Fire Flow.

18.5.4.1 The minimum number of fire hydrants needed to deliver the required fire flow for new buildings in accordance with Section 18.4 shall be determined in accordance with Section 18.5.4.

18.5.4.2 The aggregate fire flow capacity of all fire hydrants within 1000 ft (305 m) of the building, measured in accordance with 18.5.1.4 and 18.5.1.5, shall be not less than the required fire flow determined in accordance with Section 18.4.

18.5.4.3* The maximum fire flow capacity for which a fire hydrant shall be credited shall be as specified by Table 18.5.4.3. Capacities exceeding the values specified in Table 18.5.4.3 shall be permitted when local fire department operations have the ability to accommodate such values as determined by the fire department.

Table 18.5.4.3 Maximum fire flow hydrant capacity

Distance to buildings[a]		Maximum capacity[b]	
(ft)	(m)	(gpm)	(L/min)
≤ 250	≤ 76	1500	5678
> 250 and ≤ 500	> 76 and ≤ 152	1000	3785
> 500 and ≤ 1000	> 152 and ≤ 305	750	2839

[a] Measured in accordance with 18.5.1.4 and 18.5.1.5.

[b] Minimum 20 psi (139.9 kPa) residual pressure.

18.5.4.4 Fire hydrants required by **18.5.2** and **18.5.3** shall be included in the minimum number of fire hydrants for fire flow required by **18.5.4**.

The City of Ottawa design guidelines on hydrant classification conform to the NFPA Standard #291, which recommends the following:

5.1 Classification of Hydrants. Hydrants should be classified in accordance with their rated capacities [at 20 psi (1.4 bar) residual pressure or other designated value as follows:

(1) Class AA — Rated capacity of 1500 gpm (5700L/min) or greater

(2) Class A — Rated capacity of 1000–1499 gpm (3800– 5699 L/min)

(3) Class B — Rated capacity of 500–999 gpm (1900–3799 L/min)

(4) Class C — Rated capacity of less than 500 gpm (1900 L/min)

Appendix F
Geotechnical Investigation (soft copy)