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FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

FOR

CAMPANALE HOMES
5 ORCHARD DRIVE

CITY OF OTTAWA

PROJECT NO.: 18-1006

DECEMBER 2018 - REV 2

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1.0 INTRODUCTION

David Schaeffer Engineering Ltd. (DSEL) has been retained by Campanale Homes to prepare a Functional Servicing and Stormwater Management Report in support of the Draft Plan of Subdivision (DPS) for the proposed development at 5 Orchard Drive.

The subject property is located within the City of Ottawa urban boundary, in the Stittsville ward. As illustrated in ***Figure 1***, the subject property is facing Hazeldean Road to the north, Fringewood Drive to the east, a local restaurant to the west and existing residential development to the south. The subject property measures approximately ***3.97 ha*** and is designated Arterial Mainstreet (AM9) under the current City of Ottawa zoning by-law.

Figure 1: Site Location

The proposed development consists of ***1.84 ha*** of commercial space and ***2.13 ha*** of residential land, comprised of 65 townhouse units, 2 semi-detached units, and 7 single lots.

The objective of this report is to support the application for Draft Plan of Subdivision by providing sufficient detail to demonstrate that the proposed development is supported by existing and proposed municipal servicing infrastructure and to demonstrate that the site design conforms to current City of Ottawa design standards.

1.1 Existing Conditions

The subject site is currently undeveloped. Two existing parallel ditches run from the south side of the property toward two ditch-inlet catch basins (DICBs) at the north edge of the property along Hazeldean Road. The existing DICBs outlet into the existing 675 mm diameter stormwater on Hazeldean Road. There is also a ditch along the southern property line which collects storm water runoff from the existing residential units on the adjacent property and outlets into the western most ditch of the two previously mentioned ditches. Note that in existing conditions there is a drop in elevation between the gravel shoulder and the subject property, to the north along Hazeldean Road. Sewer system and watermain distribution mapping collected from the City of Ottawa indicate that the following services exist across the property frontages within the adjacent municipal right-of-ways:

Hazeldean Road:

- 762 mm watermain;
- 675 mm storm sewer;
- 450 mm storm sewer;
- 150 mm sanitary sewer at northwest corner of site; and
- 675 mm sanitary sewer northeast of site.

Fringewood Drive:

- 200 mm watermain.

1.2 Required Permits / Approvals

Development of the site is subject to the City of Ottawa Planning and Development Approvals process. The City of Ottawa must approve detailed engineering design drawings and reports prepared to support the proposed development plan before issuing approval.

The subject property contains existing trees. Development, which may require removal of existing trees, may be subject to the City of Ottawa Urban Tree Conservation By-law No. 2009-200.

1.3 Pre-consultation

Pre-consultation correspondence and the servicing guidelines checklist are located in ***Appendix A***.

Further pre-consultation with City Staff has been completed via email. Associated correspondence is located in ***Appendix A***.

2.0 GUIDELINES, PREVIOUS STUDIES, AND REPORTS

2.1 Existing Studies, Guidelines, and Reports

The following studies were utilized in the preparation of this report:

- **Ottawa Sewer Design Guidelines,**
  City of Ottawa, October 2012.
  (City Standards)

  - **Technical Bulletin ISDTB-2014-01**
    City of Ottawa, February 5, 2014.
    (ITSB-2014-01)

  - **Technical Bulletin PIEDTB-2016-01**
    City of Ottawa, September 6, 2016.
    (PIEDTB-2016-01)

  - **Technical Bulletin ISTB-2018-01**
    City of Ottawa, March 21, 2018.
    (ISTB-2018-01)

- **Ottawa Design Guidelines – Water Distribution**
  City of Ottawa, July 2010.
  (Water Supply Guidelines)

  - **Technical Bulletin ISD-2010-2**
    City of Ottawa, December 15, 2010.
    (ISDTB-2010-2)

  - **Technical Bulletin ISDTB-2014-02**
    City of Ottawa, May 27, 2014.
    (ISDTB-2014-02)

  - **Technical Bulletin ISDTB-2018-02**
    City of Ottawa, March 21, 2018.
    (ISDTB-2018-02)

- **Stormwater Planning and Design Manual,**
  Ministry of the Environment, March 2003.
  (SWMP Design Manual)

- **Ontario Building Code Compendium**
  Ministry of Municipal Affairs and Housing Building Development Branch, January 1, 2010 Update.
  (OBC)

- **West End Pumping Stations Decommissioning & By-Pass Sewers Fringewood Drive By-Pass Sewer Design**
  Novatech, May 2018.
  (Fringewood By-Pass Sewer Design)

- **Hunting Properties Development / Proposed Realignment of Channel on 2 and 3 Iber Road**
  JF Sabourin and Associates Inc., March 2017.
  (JFSA Channel Realignment)

- **Hazeldean Road Widening Poole Creek to Terry Fox Drive Stormwater Management**
  IBI Group, November 2009
  (Hazeldean SWM Report)

- **5 Orchard Stormwater Management Strategy**
  DSEL, December 2018
  (5 Orchard SWM Memo)

- **5 Orchard Drive – Stormwater Functional Servicing Analysis**
  JF Sabourin and Associates Inc., December 2018
  (5 Orchard JFSA Memo)

3.0 WATER SUPPLY SERVICING

3.1 Existing Water Supply Services

The subject property lies within the City of Ottawa 3W pressure zone, as shown by the Pressure Zone map in ***Appendix B.*** Watermains exist within Hazeldean Road and Fringewood Drive.

3.2 Water Supply Servicing Design

The subject property is proposed to be serviced through two connections to the existing 203 mm watermain within Fringewood Drive.

Table 1, below, summarizes the ***Water Supply Guidelines*** employed in the preparation of the water demand estimate.

Table 1
Water Supply Design Criteria

Design Parameter	Value
Commercial-Floor space	2.5 L/m^2/d
Single Family House	3.4 P/unit
Semi-Detached House	2.7 P/unit
Townhouse	2.7 P/unit
Average Daily Demand	280 L/d/per
Residential Maximum Daily Demand	3.6 x Average Daily *
Residential Maximum Hourly	5.4 x Average Daily *
Commercial Maximum Daily Demand	1.5 x avg. day L/gross ha/d
Commercial Maximum Hour Demand	1.8 x avg. day L/gross ha/d
Minimum Watermain Size	150 mm diameter
Minimum Depth of Cover	2.4 m from top of watermain to finished grade
During normal operating conditions desired operating pressure is within	350 kPa and 480 kPa
During normal operating conditions pressure must not drop below	275 kPa
During normal operating conditions pressure shall not exceed	552 kPa
During fire flow operating pressure must not drop below	140 kPa
** Residential Max. Daily and Max. Hourly peaking factors per MOE Guidelines for Drinking-Water Systems Table 3-3 for 0 to 500 persons.* *** Table updated to reflect ISD-2010-2*	

Table 2, below, summarizes the anticipated water demand and boundary conditions for the proposed development; calculated using the ***Water Supply Guidelines.***

Table 2
Proposed Water Demand

Design Parameter	Anticipated Demand[1] (L/min)	Boundary Conditions[2] Fringewood Dr. (South of valve) (m H_2O / kPa)	Boundary Conditions[2] Fringewood Drive (North of valve) (m H_2O / kPa)
Average Daily Demand	71.2	56.4 / 553.7	56.0 / 549.3
Max Day + Fire Flow (@10,000L/min)	190.9+10,000 = 10,190.9	40.8 / 400.6	53.3 / 522.8
Max Day + Fire Flow (@15,000L/min)	190.9+15,000 = 15,190.9	26.1 / 256.4	52.4 / 513.9
Peak Hour	300.3	52.6 / 516.4	52.7 / 516.9

1) Water demand calculation per ***Water Supply Guidelines***. See ***Appendix B*** for detailed calculations.
2) Boundary conditions supplied by the City of Ottawa for the demands indicated in the correspondence; assumed ground elevation 104.56m for connection 1 and 105.01m for connection 2 to the municipal watermain. See ***Appendix A.***

The residential component of the development is contemplated to meet the criteria for the ***10,000 L/min*** maximum fire flow cap, as per ***ISDTB-2014-02.*** As the commercial component is considered a future development and details have not yet been established, maximum fire flow for the commercial component was assumed to be ***15,000 L/min***, as per ***ISDTB-2014-02.***

The City provided both the anticipated minimum and maximum water pressures, as well as, the estimated water pressure during fire flow as indicated by the correspondence located in ***Appendix A***.

3.3 Watermain Modelling

EPANet was utilized to model the proposed watermain system during peak hour, average day and max daily water demand, plus fire flow scenarios. The model was developed to assess pipe sizing.

EPANET uses pipe length, pipe diameter, elevation and friction loss factors based on pipe diameter obtained from ***Water Supply Guidelines, Table 4.4***. Minor loss coefficients based on bends, valves and tees in the pipe were also utilized in the model. EPANet calculated pressure drop using the Hazen-Williams equation and is used to assess the pressure that is being provided to each node.

To model the maximum daily flow scenario, ***10,000L/min*** was applied to each of the proposed hydrants for the residential part of the site and ***15,000L/min*** at the connection to the future commercial component of the property.

Table 3, below, summarizes pressures reported during average day, peak hour and maximum daily plus fire flow scenarios for nodes at points of interest.

Table 3
Model Simulation Output Summary

Node ID	Average Day (kPa)	Peak Hour (kPa)	Max Day + Fire Flow (10,000L/min) (kPa)	Max Day + Fire Flow (15,000L/min) (kPa)
10	553.3	516.4	399.6	255.4
12	551.8	516.7	401.3	252.0
14	552.0	516.6	395.3	251.1
15	552.4	517.0	330.5	232.1
17	551.5	516.8	409.5	253.2
18	552.2	516.8	381.3	247.2
19	551.6	516.8	396.0	175.1
20	552.4	517.2	303.3	203.9
21	552.6	517.3	269.8	214.2
23	552.8	517.5	284.8	209.8
25	552.1	516.4	395.9	251.7

The pressures modeled in average day scenario are close to or exceed the maximum allowable per ***Table 2***. Pressures which exceed the desired operation pressure in the peak hour scenario, however, do not exceed the maximum allowable pressure. It is recommended a pressure check is performed during construction to determine if pressure reducing valves are required.

The pressures during maximum daily plus fire flow scenarios fall within the required pressure range outlined in ***Table 2***. For the residential area, the node yielding the lowest pressure during fire flow scenario at ***10,000L/min*** is node 21. For the commercial area of the development, the fire flow scenario of ***15,000 L/min*** was modeled through node 19. The pressure at both of these critical nodes fall above the minimum required pressure indicated in ***Table 1***.

Model output reports, as well as, figures for each model scenario are found in ***Appendix B***.

3.4 Water Supply Conclusion

It is proposed to service the development from two connections to the existing 203 mm watermain within Fringewood Drive.

The contemplated development was analyzed using 10,000 L/min max fire flow for the residential components and assuming 15,000 L/min maximum fire flows for the future commercial component.

Water modeling was completed to confirm that adequate pressure is available to service the ultimate proposed development based on boundary conditions received from the ***City of Ottawa***. Fire flow scenario pressures fall within the guidelines outline in ***Table 2***, however, pressure check should be completed during construction to determine if pressure reducing valves will be required. The municipal system is capable of delivering water within the ***Water Supply Guidelines*** pressure range.

The design of the water distribution system conforms to all relevant City Guidelines and Policies.

4.0 WASTEWATER SERVICING

4.1 Existing Wastewater Services

The subject property lies within the future Kanata West Pump Station catchment area, per the Kanata West Master Servicing Plan.

There is an existing 675 mm diameter sanitary sewer within Hazeldean Road. There currently is no sanitary sewer services within Fringewood Drive on the section of the road directly adjacent to the subject property.

Pre-consultation with the City of Ottawa indicates that the Hazeldean Road sanitary sewer has been sized to convey additional flows from the proposed subdivision, upon completion of the Kanata West Pumping Station (KWPS), which is slated for completion in June 2018. It is anticipated the contemplated development will proceed after the completion of the KWPS, therefore, the downstream system will have capacity to convey flow from the subject property

4.2 Wastewater Design

The proposed development will be serviced via a connection to the existing 675 mm diameter sanitary sewer within Hazeldean Road through a future 250 mm diameter sanitary sewer within Fringewood Drive, running along the east end of the property.

Table 4, below, summarizes the ***City Standards*** employed in the calculation of wastewater flow rates for the proposed development.

Table 4
Wastewater Design Criteria

Design Parameter	Value
Average Daily Demand	280 L/d/per
Single Family House	3.4 P/unit
Semi-Detached House	2.7 P/unit
Townhouse	2.7 P/unit
Peaking Factor	Harmon’s Peaking Factor. Max 3.8, Min 2.0
Commercial Floor Space	28,000 L/ha/d
Infiltration and Inflow Allowance	0.33 L/s/ha
Sanitary sewers are to be sized employing the Manning’s Equation	$Q = \frac{1}{n} A R^{2/3} S^{1/2}$
Commercial Peaking Factor	1.50 per City of Ottawa Sewer Design Guidelines Appendix 4B
Minimum Sanitary Sewer Lateral	135 mm diameter
Minimum Manning’s ‘n’	0.013
Minimum Depth of Cover	2.5 m from crown of sewer to grade
Minimum Full Flowing Velocity	0.6 m/s
Maximum Full Flowing Velocity	3.0 m/s

Extracted from Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, October 2012 updated per **ISTB-2018-01**

Table 5, below, demonstrates the anticipated peak flow from the proposed development. See ***Appendix C*** for associated calculations.

Table 5
Summary of Proposed Wastewater Flows

Design Parameter	Anticipated Sanitary Flow (L/s)
Average Dry Weather Flow Rate	**1.26**
Peak Dry Weather Flow Rate	**3.24**
Peak Wet Weather Flow Rate	**4.51**

The estimated sanitary flow for the contemplated development anticipates a peak wet weather flow of ***4.51 L/s***.

A future sanitary sewer is contemplated to be constructed within Fringewood Drive starting in May 2019. A gravity sanitary connection from the existing subdivision to the north will by-pass the existing Fringewood Pump Station thus directing wastewater flows from the proposed development to the existing 675 mm sanitary sewer within Hazeldean Road.

In the design of the bypass sewer, the subject property was estimated to have a total anticipated peak flow equal to ***6.22 L/s*** as indicated in the ***Fringewood By-Pass Sewer Design (FBPSD)***, calculation shown in ***Appendix C***. The contemplated development results in a reduction of ***1.71L/s*** flow to the future sanitary sewer than that anticipated in the ***(FBPSD)***, therefore, the future sewer has sufficient capacity to convey the wastewater flow from the subject site. Refer to ***Appendix C*** for a copy of ***FSPSD,*** including future sanitary design sheets and sanitary drainage figure.

4.3 Wastewater Servicing Conclusions

The site is tributary to the existing sanitary sewer within Hazeldean Road.

A future sanitary sewer is contemplated to be constructed adjacent to the subject property within Fringewood Drive. The proposed development results in a decrease in wastewater flow of ***1.71L/s*** to the future sanitary sewer contemplated in the ***Fringewood By-Pass Sewer Design.*** The proposed future Fringewood Drive sanitary sewer has sufficient capacity to convey wastewater flow from the subject property to the existing sanitary sewer with Hazeldean Road.

The proposed wastewater design conforms to all relevant ***City Standards***.

5.0 STORMWATER MANAGEMENT

5.1 Existing Stormwater Services

Stormwater runoff from the subject property is tributary to the Carp River sub-watershed via Poole Creek and City of Ottawa storm sewer system and is reviewed by the Mississippi Valley Conservation Authority (MVCA). Runoff from the subject site is collected and conveyed by storm sewers within Hazeldean Road to an interim stormwater wetland located on Hazeldean Road, east of the intersection of Hazeldean Road and Huntmar Drive. The interim wetland discharges to a ditch that conveys flow along the north edge of the existing commercial development on Hazeldean, eventually discharging to the Carp River.

Two parallel ditches currently exist on the subject property that lead to two existing DICBs; refer to ***DICB 1*** and ***DICB 2*** on drawing ***EX-SWM-1,*** located in ***Drawings/Figures***. The majority of the flow from the subject site is picked up by the ditch draining to ***DICB 1*** with flow from the east portion of the site directed to ***DICB 2***. A portion of flow from the west of the site is directed to Poole Creek, denoted as U1 on the drawing ***EX-SWM-1,*** located in ***Drawings/Figures***.

Based on the topographic survey of Hazeldean Road, adjacent to the site, major overland flow is directed east and south down Fringewood Drive. The Major overland flow route for this area, shown as ***MH400, MH405 & MH413*** on drawing ***EX-SWM-1***, would enter the site and be captured by ***DICB 2***. It is anticipated spill to the site would only occur in major storm events (greater than 5-year storm event) as the existing catch basins and storm sewers within Hazeldean Road are anticipated to capture flows from minor system events.

The runoff from the rear yards of the Cloverloft Court properties that bound the south edge of the subject property, shown as ***EX2*** and ***EX3*** in ***EX-SWM-1***, flow into a rear yard ditch that runs along the south property line of the subject property. Drainage area ***EX2*** drains to the ***DICB 1,*** whereas, ***EX3*** drains to ***DICB 2***.

Drainage from the existing subdivision to the south of the subject property drains east towards the intersection of Fringewood Drive and Cloverloft Court. Note that a culvert crossing Fringewood Drive at Cloverloft Court is perched and would not accept flow from ***EX5***, it is assumed all ***EX5*** drainage by-passes this culvert and is directed north to ***DICB 2.***

Both ***DICB 1*** and ***DICB 2*** discharge to the existing 675 mm diameter storm sewer within Hazeldean Road. The stormwater discharge is conveyed through the existing storm sewer within Hazeldean road to ditches north of Hazeldean Road, west of Huntmar Drive that convey directly to the Carp River.

The estimated pre-development peak flows from the subject site and external areas for the 2, 5, and 100-year events are summarized in ***Table 6*** and ***Table 7,*** below***:***

Table 6
Summary of Existing Peak Storm Flow Rates from Subject Property

City of Ottawa Design Storm	Estimated Peak Flow Rate to DICB1 (3.14 Ha) (L/s)	Estimated Peak Flow Rate to DICB2 (0.78 Ha) (L/s)	Estimate Peak Flow to Poole Creek (0.05 Ha) (L/s)
2-year	72.1	15.6	3.5
5-year	96.9	21.0	4.7
100-year	206.0	44.6	10.0

Table 7
Summary of Existing Peak Storm Flow Rates from External Area

City of Ottawa Design Storm	External Peak Flow Rate to DICB1 (EX2 0.422 Ha) (L/s)	Estimated Peak Flow Rate to DICB2 (MH400, MH405, MH413*, EX3, EX4, EX5 4.114 Ha) (L/s)
2-year	30.9	189.1
5-year	41.9	254.8
100-year	89.8	542.7
* Only Major System Contributions from MH400, MH405 & MH413		

Based on field investigation by DSEL in May 2018, no stormwater management controls for flow attenuation exist on-site.

A capacity analysis of the existing DICB capture rate and DICB leads was completed to determine if the existing DICB are capable of capturing the 100-year storm in the 100-year storm event. DICB elevation, head and capture rate are summarized in ***Table 8,*** below:

Table 8
Summary of Existing DICB Capture Rate

Parameter	DICB 1	DICB 2
DICB Grate Invert Elevation (m)	103.98	103.65
DICB Lead Invert (m)	102.94	102.71
Ponding Level[1] (m)	104.57	104.57
Assumed Downstream HGL[2] (m)	103.08	102.77
Total Head[3] (m)	1.49	1.80
DICB Grate Capture Rate[4] (L/s)	1700	1700
375mm DICB Lead Capture[5] (L/s)	364	400

1) 2H:1V slope for DICB, Top of DICB Grate 450mm above invert
2) Downstream HGL assumed equal to obvert of Ex. 675mm Storm within Hazeldean Road
3) Total Head equal to Ponding Level less the downstream HGL
4) DICB capture rate determined from Design Chart 4.20 from the MTO Drainage Management Manual, 1997 assuming 450mm of ponding, capture rate multiplied by 2 to account for 1200mm x 600mm grate
5) Orifice equation used per the ***City Standards***, refer to ***Appendix D*** for orifice equation

Per the above, the flow through the DICB lead will restrict flow to ***364 L/s*** and ***400 L/s*** to ***DICB 1*** and ***DICB 2***, respectively.

Based on the topographic survey, overland spill would occur once ponding reached an elevation of 104.57 m, where it would spill over Fringewood Drive to the east side of the ROW. Based on the capture rate summarized above, it is anticipated that the DICBs would be able to capture the flow in the pre-development 100-year storm event from the subject property excluding external area.

Due to the large external area directed to ***DICB 2*** spill may occur during the 100-year storm event over Fringewood Drive.

5.2 Post-development Stormwater Management Target

Based on City of Ottawa standards, stormwater management requirements for the proposed development are as follows:

- Allowable release rate determined based on the *Hazeldean SWM Report* the 100-year flow from the “External Area” equal to ***628 L/s***, refer to extracted SWMHYMO modeling in *Appendix D*.
- Subject property accounts for ***3.08 Ha*** or ***80.2%*** of the “External Area” described in the *Hazeldean SWM Report*, therefore, the allowable release rate is equal to ***503.7 L/s***.
- As stormwater quality control is constrained on the residential portion of the subject site a larger portion of the allowable release rate is allocated to this block of ***400 L/s,*** the remaining ***103.7 L/s*** is the release rate for the commercial block.
- Uncontrolled Flow to Poole Creek is less than during the existing condition in the 5-Year and 100-Year event.
- All storms, up to and including the City of Ottawa 100-year design event, are to be attenuated on site;
- Quality controls are required as per correspondence with the MVCA, 70% TSS removal will be necessary. Refer to ***Appendix A*** for correspondence.
- Refer to ***5 Orchard SWM Memo*** included in ***Appendix D*** for further discussion on the ***Hazeldean SWM Report*** and the quality and quantity controls for the subject property.

5.3 Proposed Stormwater Management System

It is proposed that the stormwater for the development will be serviced by the existing 675 mm diameter storm sewer on Hazeldean Road via a new storm sewer extended south on Fringewood Drive.

It is proposed to service the residential component of the development with a proposed 450 mm diameter storm sewer that would connect to a proposed 675 mm diameter storm sewer within Fringewood Drive. The commercial component of the site would connect independently to the proposed storm sewer within Fringewood Drive. The existing swale along Fringewood Drive would be regraded to flow towards the existing ***DICB 2***.

It is contemplated to re-grade the existing roadside ditch south of the subject property to re-direct flow from ***EX5*** to the Hazeldean Tributary on the 2 Iber Road lands on the east side of Fringewood Drive. Refer to drawing ***SWM-1,*** located in ***Drawings and Figures,*** for storm servicing and stormwater management details.

Drainage to existing ***DICB 2*** would include major system flow from a portion of Hazeldean Road (Area ***MH400, MH405, MH413***) and major and minor system flow from Fringewood Drive (Area ***EX4***). A 100-year flow rate of ***162.3 L/s*** is contemplated to continue to discharge to ***DICB 2***.

5.4 Proposed Quantity Controls

Quantity controls are proposed in accordance with the allowable release rate of ***503.7 L/s*** described in ***Section 5.1.***

Table 9, below, summarizes post-development flow rates and anticipated storage for the development of the property.

Table 9
Stormwater Flowrate and Storage Summary

Control Area	5-Year Release Rate	5-Year Storage	100-Year Release Rate	100-Year Storage
	(L/s)	(m^3)	(L/s)	(m^3)
Unattenuated Areas to Poole Creek	0.6	0.0	1.2	0.0
Residential Areas	233.4	88.2	400.0	249.0
Commercial Areas	60.5	337.3	103.7	663.0
Total Comm + Res to Hazeldean*	**293.9**	**425.5**	**503.7**	**911.9**
* Total Flow does not include Flow to Poole Creek				

It is anticipated that ***249.0 m^3*** of storage will be required for the residential development and ***663.0 m^3*** of storage will be needed for the future commercial development in order to attenuate flows to the target flow rate of ***503.7 L/s*** in the 100-year storm event. Refer to storage calculations that are contained within ***Appendix D***.

To achieve the allowable release rate, the proposed development will employ a combination of Low Impact Development (LID) practice infiltration chambers in rear yards of the residential units only, as well as, take advantage of surface ponding on the streets. Proposed surface ponding will be designed in accordance with ***City Standards***. The commercial block is contemplated to use similar stormwater management techniques to attenuate to the allowable release rate.

A preliminary stormwater analysis was completed by JFSA, summarized in the ***5 Orchard JFSA Memo***, which reviewed the impacts of the development on the water levels within the Carp River using the City of Ottawa's PCSWMM model of the Carp River. The analysis conservatively assumed no on-site controls were contemplated in the post-development condition resulting in a higher peak flow to the Carp River compared to our proposed release rate of ***503.7 L/s***. The analysis concluded that there are no impacts from the development to the 100-year water levels within the Carp River, refer to ***Appendix D*** for ***5 Orchard JFSA Memo***.

A detailed hydrologic model will be completed during the detailed design phase to confirm the conclusions from the ***5 Orchard JFSA Memo*** and confirm storage requirements. During detailed design, efforts will be made to reduce the LID infiltration chambers within the rear yards and maximize surface ponding within the right-of-way.

The unattenuated area directed to Poole Creek, U1 on drawing ***SWM-1***, is less than the flow to Poole Creek in the pre-development condition shown in ***Table 7*** for the 5 and 100-year storm events. The drainage area consists of rear yard area, which is considered clean water, therefore, quality controls are not anticipated for the uncontrolled area draining to Poole Creek.

Due to the depth of the existing storm sewer within Hazeldean Road, the proposed four blocks of townhomes units closest to Fringewood Drive will be required to use sump pumps discharging to the surface to service the foundation drains, refer to ***CSP-1,*** in ***Drawings and Figures,*** for units proposed to be sump pumped.

Please refer to ***5 Orchard SWM Memo*** located in ***Appendix D*** for further information on Quantity control for the subject property.

5.5 Proposed Quality Control

Quality controls are proposed to be provided by the interim Wetland located approximately 380m north-east from the intersection of Huntmar Drive and Hazeldean Road. As discussed in ***Section 5.1***, a portion of the 5 Orchard site was contemplated to drain to the interim Wetland. Per the ***Hazeldean SWM Report,*** a total of ***3.84 Ha*** of External Drainage and ***3.51 Ha*** of Hazeldean Road runoff was contemplated to drain to the interim Wetland. ***3.08 Ha*** of the subject property at 5 Orchard Drive was allocated to drain to the interim Wetland.

The total proposed drainage area to the interim pond includes ***3.96 Ha*** from the subject site; ***0.87 Ha*** of external drainage from Fringewood Drive, Existing Residential and an Existing Restaurant on Hazeldean Road; ***3.51 Ha*** of Hazeldean Road widening and ***0.57 Ha*** of external area north of Hazeldean for a total of ***8.91 Ha***.

The pond sizing was reviewed to confirm it can accommodate the additional site drainage and external flow not contemplated in the ***Hazeldean SWM Report***, summarized in ***Table 10,*** refer to ***Appendix D*** for quality control calculations.

Table 10
Interim Wetland Quality Control

	Area (Ha)	Impervious (%)	Required Extended Detention (m^3)	Required Permanent Pool (m^3)
Per ***Hazeldean SWM Report***	7.35	77%	294	331
Per 5 Orchard FSR	8.91	75%	356	386
Provided Volumes in Interim SWM Pond per ***Hazeldean SWM Report***			406	432

The interim Wetland facility has sufficient permanent pool and extended detention volume to treat the drainage area from the development and external area to the required ***70% TSS Removal***.

5.6 Stormwater Management Conclusions

Post development stormwater runoff will be required to be restricted to the allowable target release rate for storm events up to and including the 100-year storm, in accordance with City of Ottawa, ***City Standards***. The post-development allowable release rate to the sewer within Hazeldean Road was calculated to be ***503.7 L/s***, with an estimated ***249.0 m³*** of storage is required for the residential development and ***663.0 m³*** of storage is required in the future commercial development to meet this release rate.

Four blocks of townhomes will be required to be sump pumped due to the shallow connection to the existing storm sewer within Hazeldean Road.

Please refer to ***5 Orchard SWM Memo*** located in ***Appendix D*** for further information on Quantity and Quality control for the subject property.

The proposed stormwater design conforms to all relevant ***City Standards*** and Policies for approval.

6.0 UTILITIES

Utility servicing will be coordinated with the individual utility companies prior to site development.

7.0 EROSION AND SEDIMENT CONTROL

Soil erosion occurs naturally and is a function of soil type, climate and topography. The extent of erosion losses is exaggerated during construction where vegetation has been removed and the top layer of soil becomes agitated.

Prior to topsoil stripping, earthworks or underground construction, erosion and sediment controls will be implemented and will be maintained throughout construction.

Silt fence will be installed around the perimeter of the site and will be cleaned and maintained throughout construction. Silt fence will remain in place until the working areas have been stabilized and re-vegetated.

Catch basins will have SILTSACKs installed under the grate during construction to protect from silt entering the storm sewer system.

A mud mat will be installed at the construction access in order to prevent mud tracking onto adjacent roads.

Erosion and sediment controls must be in place during construction. The following recommendations to the contractor will be included in contract documents:

- Limit extent of exposed soils at any given time;
- Re-vegetate exposed areas as soon as possible;
- Minimize the area to be cleared and grubbed;
- Protect exposed slopes with plastic or synthetic mulches;
- Install silt fence to prevent sediment from entering existing ditches;
- No refueling or cleaning of equipment near existing watercourses;
- Provide sediment traps and basins during dewatering;
- Install filter cloth between catch basins and frames;
- Plan construction at proper time to avoid flooding; and
- Establish material stockpiles away from watercourses, so that barriers and filters may be installed.

The contractor will, at every rainfall, complete inspections and guarantee proper performance. The inspection is to include:

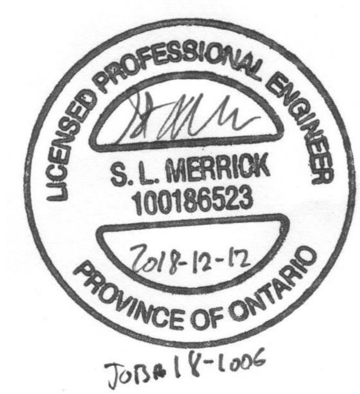
- Verification that water is not flowing under silt barriers; and
- Clean and change filter cloth at catch basins.

8.0 CONCLUSION AND RECOMMENDATIONS

David Schaeffer Engineering Ltd. (DSEL) has been retained to prepare a Functional Servicing and Stormwater Management report in support of the application for Draft Plan of Subdivision for the proposed development at 5 Orchard Drive. The preceding report outlines the following:

- Based on boundary conditions provided by the City the existing municipal water infrastructure is capable of providing the proposed development with water within the City's required pressure range. Pressure reducing valves will be required;
- The proposed development is anticipated to have a peak wet weather flow of ***4.51*** **L/s** directed to the Stittsville Trunk Sewer, the property has been contemplated in the sizing of the future sewer to be installed within Fringewood Drive;
- Based on the *City Standards*, the proposed development will be required to attenuate post development flows to an equivalent release rate of ***503.7 L/s*** to the sewer within Hazeldean Road, for all storms up to and including the 100-year storm event;
- It is anticipated that ***249.0 m³*** of storage will be required for the residential development and ***663.0 m³*** of storage will be needed for the future commercial development so that the stormwater release rate can be attenuated to the allowable release rate to the storm sewer within Hazeldean Road; and
- Utility services would need to be coordinated with utility companies prior to development.

Prepared by,
David Schaeffer Engineering Ltd.



Per: Steven L. Merrick, P.Eng

Reviewed by,
David Schaeffer Engineering Ltd.

Per: Stephen Pichette, P.Eng.

z:\projects\18-1006_campanale_5-orchard\b_design\b3_reports\b3-2_servicing (dsel)\fsr-subm2\fsr-2018-12-07_1006_ggg.docx

APPENDIX A

Pre-Consultation

DEVELOPMENT SERVICING STUDY CHECKLIST

15-812 11/12/2015

4.1 General Content		
☐	Executive Summary (for larger reports only).	N/A
☒	Date and revision number of the report.	Report Cover Sheet
☒	Location map and plan showing municipal address, boundary, and layout of proposed development.	Drawings/Figures
☒	Plan showing the site and location of all existing services.	Figure 1
☒	Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	Section 1.0
☒	Summary of Pre-consultation Meetings with City and other approval agencies.	Section 1.3
☒	Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.	Section 2.1
☒	Statement of objectives and servicing criteria.	Section 1.0
☒	Identification of existing and proposed infrastructure available in the immediate area.	Sections 3.1, 4.1, 5.1
☐	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).	N/A
☒	Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.	GP-1
☐	Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.	N/A
☐	Proposed phasing of the development, if applicable.	N/A
☒	Reference to geotechnical studies and recommendations concerning servicing.	Section 1.4
☒	All preliminary and formal site plan submissions should have the following information: -Metric scale -North arrow (including construction North) -Key plan -Name and contact information of applicant and property owner -Property limits including bearings and dimensions -Existing and proposed structures and parking areas -Easements, road widening and rights-of-way -Adjacent street names	SSP-1

4.2 Development Servicing Report: Water		
☐	Confirm consistency with Master Servicing Study, if available	N/A
☒	Availability of public infrastructure to service proposed development	Section 3.1
☒	Identification of system constraints	Section 3.1
☒	Identify boundary conditions	Section 3.1, 3.2
☒	Confirmation of adequate domestic supply and pressure	Section 3.3

*Extracted from the City of Ottawa-Servicing Study Guidelines for Development Applications

☒	Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.	Section 3.2
☐	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.	N/A
☐	Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design	N/A
☐	Address reliability requirements such as appropriate location of shut-off valves	N/A
☐	Check on the necessity of a pressure zone boundary modification	N/A
☒	Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range	Section 3.2, 3.3
☐	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.	N/A
☐	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.	N/A
☒	Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	Section 3.2
☐	Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	N/A

4.3 Development Servicing Report: Wastewater

☒	Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).	Section 4.2
☐	Confirm consistency with Master Servicing Study and/or justifications for deviations.	N/A
☐	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.	N/A
☒	Description of existing sanitary sewer available for discharge of wastewater from proposed development.	Section 4.1
☒	Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)	Section 4.2
☒	Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix 'C') format.	Section 4.2, Appendix C
☒	Description of proposed sewer network including sewers, pumping stations, and forcemains.	Section 4.2
☐	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).	N/A

*Extracted from the City of Ottawa-Servicing Study Guidelines for Development Applications

☐	Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.	N/A
☐	Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	N/A
☐	Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.	N/A
☐	Special considerations such as contamination, corrosive environment etc.	N/A

4.4 Development Servicing Report: Stormwater Checklist

☒	Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)	Section 5.1
☒	Analysis of available capacity in existing public infrastructure.	Section 5.1, Appendix D
☒	A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.	Drawings/Figures
☒	Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.	Section 5.2
☒	Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	Section 5.2
☒	Description of the stormwater management concept with facility locations and descriptions with references and supporting information	Section 5.3
☐	Set-back from private sewage disposal systems.	N/A
☐	Watercourse and hazard lands setbacks.	N/A
☒	Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	Appendix A
☐	Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.	N/A
☒	Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).	Section 5.3
☐	Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	N/A
☒	Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.	Section 5.1, 5.3
☐	Any proposed diversion of drainage catchment areas from one outlet to another.	N/A
☐	Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	N/A
☐	If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.	N/A
☐	Identification of potential impacts to receiving watercourses	N/A
☐	Identification of municipal drains and related approval requirements.	N/A

*Extracted from the City of Ottawa-Servicing Study Guidelines for Development Applications

☒	Descriptions of how the conveyance and storage capacity will be achieved for the development.	Section 5.3
☐	100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	N/A
☐	Inclusion of hydraulic analysis including hydraulic grade line elevations.	N/A
☒	Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Section 6.0
☐	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.	N/A
☐	Identification of fill constraints related to floodplain and geotechnical investigation.	N/A

4.5 Approval and Permit Requirements: Checklist

☒	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 ct. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.	Section 1.2
☐	Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.	N/A
☐	Changes to Municipal Drains.	N/A
☐	Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)	N/A

4.6 Conclusion Checklist

☒	Clearly stated conclusions and recommendations	Section 8.0
☐	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.	
☐	All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario	

*Extracted from the City of Ottawa-Servicing Study Guidelines for Development Applications

Steve Merrick

From: Moodie, Derrick <Derrick.Moodie@ottawa.ca>
Sent: Tuesday, January 17, 2017 4:44 PM
To: Adam Fobert
Cc: Steve Pichette
Subject: RE: 5 Orchard Drive

Further to your conversation with Steve Pichette earlier today, please find below a summary of our servicing inquiries.

1) Water: We have discussed water connections with Santhosh. He has confirmed that we cannot connect to the existing 762mm diameter watermain. We anticipate that the contemplated development will involve more than 50units and therefore requires a looped connection. Santosh has indicated that Sweetnam is available, however connecting to this location involves crossing Poole Creek. We propose that we make a looped connection to Fringewood. Note that the Fringewood main is part of robust looped system with connections to Sweetnam and Iber, via Harry Douglas as well as Abott via Granite Ridge.
   Agree, As long as the applicant/consultant demonstrate that the connection to water main on Fringewood meet the water demand and pressure requirements

2) Storm: There is limited background information available for the existing storm sewers on Hazeldean. Santhosh is providing us with a report that was an earlier version of the materials submitted to the MOE. However, the materials are not the final approved plans / report. We are in possession of a background report for the Hazeldean Road widening, the appendices have been scanned and are not legible. DSEL have completed a review of the drainage on the site. It appears that drainage from the existing site is being picked up by ditch inlet catchbasins. Our preliminary analysis of the capacity of the sewers shows that the site has been accommodated for. We require confirmation that no additional quality treatment is necessary and that the site can be temporarily accommodated within the existing temporary facilitate on Hazeldean (250m east of Huntmar). Ultimately this site is part of the drainage area tributary to the future Pond 5 on Richcraft's lands per the KWMS.
   Storm - Based on the available information, I am not sure if the existing storm sewer on Hazeldean Rd. is adequately sized to receive flow from this site. The applicant/consultant needs to clearly demonstrate that the existing storm sewer on Hazeldean Road is adequately sized to receive flow from this site, based on the approved drainage area plan and storm sewer design sheet for the Hazeldean Road widening project.
   Quality treatment – The applicant/consultant needs to consult with Conservation Authority to determine if any quality treatment is required.
   Existing temporary storm pond – The applicant/Consultant needs to demonstrate that the subject land is located within the catchment area of the existing temporary storm pond
   Future pond 5 – The applicant/consultant needs to demonstrate that the subject land/site is located within the catchment area of the future pond 5

3) Sanitary (DC Charges): Can you confirm that no additional fees or charges are required to connect to the Hazeldean sanitary sewer, other than development charges?
   If this site is located within the sanitary catchment area of the Hazeldean sanitary sewer, I don't believe there is a connection fee applicable to this site.

Thank you for your time. Please feel free to contact either myself or Steve Pichette.

Adam Fobert, P.Eng.
Manager of Site Plan Design

DSEL
david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

office: (613) 836-0856
direct: (613) 836-0626
cell: (613) 222-9493
email: afobert@DSEL.ca

Steve Merrick

To: Adam Fobert
Subject: RE: Pre-Consultation Follow-Up: 5 Orchard Drive

From: McCreight, Laurel [mailto:Laurel.McCreight@ottawa.ca]
Sent: Wednesday, January 10, 2018 4:09 PM
To: Cody Campanale
Subject: Pre-Consultation Follow-Up: 5 Orchard Drive

Hi Cody,

Please refer to the below regarding our Pre-Consultation Meeting on Monday January 8, 2018 on 5 Orchard Drive. I have also attached the Plans & Study List.

General

- Mixed use development of free-hold residential townhomes and semi-detached dwellings on a public road, combined with a commercial component fronting Hazeldean Road
- The commercial component would have two drive-throughs
- Ideally would like to taylor the development to future tenants and configure the concept based on tenants
- Discussion around how to proceed with applications
    - Recommended to file a subdivision application to create the residential lots and one commercial block
    - When a more defined concept has evolved for the commercial block, a site plan application can be filed
    - The site plan can be phased so long as zoning is met
- If the gross floor area of the commercial component exceeds 1,858 square metres (20,000 square feet) the site plan application will be subject to the Urban Design Review Panel because Hazeldean is an Arterial Mainstreet
- Please refer to the link for "Guide to Preparing Studies and Plans" in the attached plan/study list for proper submission requirements
- Digital copies of all plans and studies are to be submitted with the application
- It is suggested to contact the Ward Councillor, Shad Qadri (shad.qadri@ottawa.ca) of your proposal

Planning

- The proposal will be reviewed on OP policies related to General Urban Area (2.5.1 and 4.11) and Arterial Mainstreets (3.6.3) and on following zoning provisions.
- OP section 3.6.1.6 (b, d) is looking for connections for pedestrians and cyclists
- A pedestrian connection from the proposed subdivision to the commercial block should be provided
    - This will provide pedestrians and faster means to access Hazeldean
- Regard for compatibility with existing residential development to the south
- The addition of semi-detached dwellings are not permitted under the current zoning
    - A zoning by-law amendment would be required to add this use
- The treatment of the end units along Fringewood will be an important element
- Attempt to avoid as much of a noise wall as possible along Fringewood
- Please be cognisant of street trees in the townhome scenario (ex. Space and soil volume)
- A possibility could be the introduction of bungalow townhomes
- Parkland dedication is based on 1.0 ha /300 units for residential and 2% of the land value for commercial development

Engineering

- I understand the DSEL has spoken with Santhosh Kuruvilla (please continue to contact Santhosh for engineering matters on this project Santhosh.kuruvilla@ottawa.ca)
- The allowable stormwater release rate must be controlled to the 2-year, 5-year or 10-year pre-development level depending on the design return period of the receiving sewer
- Please demonstrate Hazeldean Road Storm sewers are adequately sized to receive stormwater runoff from this site
- The plans or reports for the Hazeldean Road widening project can be obtained by contacting the City of Ottawa information Centre at informationcentre@ottawa.ca or contact the design consultant McCormick Rankin Corporation
- Hazeldean sanitary sewers are sized to receive flows from this site, however, the sanitary sewers are not operational until the Kanata west pumping station construction is complete (planned to be commissioned in June 2018, subject to change)
    - As an interim solution, you may direct 5 L/S of sanitary flow to the Sweetnam Drive sewer
    - However, this flow needs to be redirected to Hazeldean Rd. sewer once the Kanata west pumping station construction is complete.
- As the Fringewood pumping station is at or near capacity, no sanitary flow can be directed to Fringewood Drive sanitary sewer
- A slope stability analysis may be required to determine the required setback for any proposed buildings from the Poole Creek
- Please contact or pre-consult with the Conservation Authority to determine the stormwater treatment requirement
    - Include the correspondence in the stormwater management/site servicing report.
- Please contact the Ministry of the Environment (MOE) to determine if Environmental Compliance Approval (ECA) is required and ensure that this correspondence is included in the stormwater management/site servicing report.
- Engineering plans must be submitted on standard A1 size (594mm x 841mm) sheets
    - All engineering plans and reports must be signed, sealed, and dated by the engineer of record

Transportation

- Show all road details for Hazeldean and Fringewood when submitting drawings (ie curb line work, pavement markings, median locations, sidewalks, etc)
- Denote lane widths, radii, etc
- ROW protection on Hazeldean 37.5 metres
- Private access minimum distance to signalized intersection as per TAC design
    - On Hazeldean 70 metres
    - On Fringewood 15 metres
- Clear throat length for the commercial block as per TAC design
    - Drive-in >200 square metres needs a 40 metres length clear throat off of an arterial
    - The other two building will be a minimum of 15-2 5metres length clear throat off of an arterial depending on what the uses will be
- Transportation Impact Assessment (TIA) guidelines have been revised
    - Need to see if the development will trigger the need for a TIA to be prepared
- The proposal may require a signalled intersection if placed at Cedarow Court to allow for all directional access-will be need to be addressed in the TIS
- Road modification may be needed if a eastbound right-turn lane is required off of Hazeldean (TIS to confirm)

- Road noise analysis required for residential
- Noise study required for commercial if any of the tenants will be noise sensitive users (ie day care, offices, etc)
- Stationary noise analysis required if there are any exposed mechanical on the commercial building and their impacts to the surrounding noise sensitive land uses.
- Please contact Rosanna Baggs (rosanna.baggs@ottawa.ca) for any transportation related questions

Environmental

- Poole Creek is type 1-2 cold fish habitat
- Please note that setback requirements from Poole Creek is whichever of the following is greater: 30m normal high water mark, floodplain, geotechnical hazard, meaderbelt (65 metres)
- The Poole Creek corridor should be enhanced with native vegetation to supplement existing natural vegetation
    - Please use a naturalization planting plan
- Discussion regarding the spillway (floodplain) onto the property and this could be addressed with MVCA
- An Environmental Impact Statement is required.
    - Please have the report address the potential of endangered and threatened species habitat (e.g., butternut trees, turtles) and wildlife linkage along the Poole Creek corridor
    - Please contact MNRF Kemptville District office to obtain a complete list
- There is a portion of the site that is zoned O1R (Parks & Open Space)
    - This zoning dates back to the Township of Goulbourn and was zoned EPA (Environmental Protection Area) (please see attached screen capture from Township of Goulbourn Zoning By-law 40-99)
    - Based on the development proposed, part of the development is within this zone, which is not permitted (not even backyards)
    - Should you wish to amend this zone, a Zoning By-law Amendment is required
    - The removal of this zone would have to be rationalized in the EIS
- OP sections 2.4.5 and 4.6.3.4: Public access to shorelines along all waterways which is accomplished by requiring that the land be dedicated
    - The dedicates lands should be accessible from a public road
- Tree retention along creek corridor is required
    - Please consider tree retention near rear property lines, future parklands, and where appropriate.
- A tree permit is needed to remove trees 10 cm in diameter or larger
- A Tree Conservation Report can be combined with the Environmental Impact Statement.
- The information required in a Tree Conservation Report:
    - Tree species, diameter and health condition
    - Trees proposed for retention or removal
    - Protection details of retained trees
- For more information on the process or help with tree retention options, contact Mark Richardson mark.richardson@ottawa.ca

Mississippi Valley Conservation Authority

- Meeting held with the applicant and MVCA prior to the Christmas holidays
- Email from Niall Oddie attached

Please do not hesitate to contact me if you have 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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Genavieve Melatti

From: Nader Nakhaei <NNakhaei@mvc.on.ca>
Sent: Tuesday, June 5, 2018 9:32 AM
To: Genavieve Melatti
Cc: Steve Merrick
Subject: RE: 5 Orchard Drive

Hi Genavieve,

The stormwater quality target for the Carp River is a 'Normal' Level of Protection (i.e. 70% TSS removal). Please let me know if you have any further question or concern.

Cheers,

Nader Nakhaei, Ph.D. | Postdoctoral Felllow / Water Resources Engineer (EIT) | Mississippi Valley Conservation Authority
www.mvc.on.ca | t. 613 253 0006 ext. 259 | f. 613 253 0122 | NNakhaei@mvc.on.ca

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From: Genavieve Melatti [mailto:GMelatti@dsel.ca]
Sent: Tuesday, June 5, 2018 9:14 AM
To: Nader Nakhaei <NNakhaei@mvc.on.ca>
Cc: Steve Merrick <SMerrick@dsel.ca>
Subject: 5 Orchard Drive

Good morning Nader,

We wanted to touch base with you regarding 5 Orchard Drive.

The development proposes a residential component consisting of 65 townhomes, 2 semi-detached homes and 7 single family residences. It also contemplates a future commercial component. The development will discharge stormwater into the existing 675 mm diameter storm sewer within Hazeldean Road. Stormwater collected form site travels approximately 0.7 km before discharging into a pond on the north side of Hazeldean Road show below. Discharge from the pond travels an additional 0.97m through an open ditch to Carp River.

Can you please confirm the TSS removal required and what quality controls may be required?

Please feel free to let me know if you have any questions or would like to discuss.

Thank you,

Genavieve Melatti
Project Coordinator/ Junior Designer

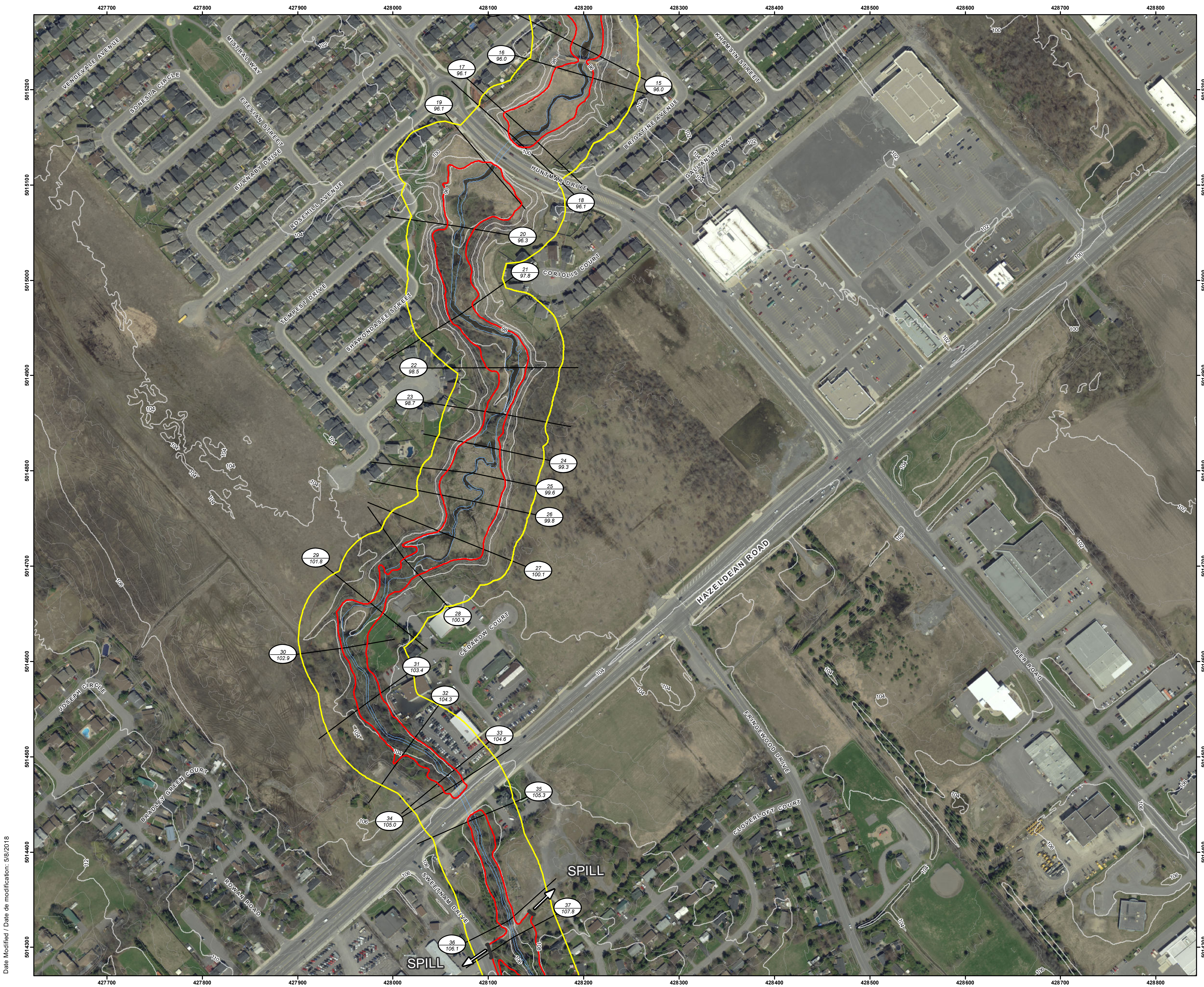
DSEL
david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

phone: (613) 836-0856 ext. 569
email: gmelatti@DSEL.ca

MAP No.
CARTE No. 2

FLOOD RISK MAP
POOLE CREEK
CARTE DU RISQUE D'INONDATION



Date Modified / Date de modification: 5/8/2018

LEGEND / LÉGENDE

- Regulatory Floodplain / La Crue Régulatrice
- Regulatory Limit / Limite Réglementaire
- Contours / Courbes
- Stream / Ruisseau
- Cross Sections / La coupe traversale

Cross Section Number — 1 — Nombre de la coupe traversale
Regulatory Flood Elevation (m) — 102.11 — Niveau de la crue regulatrice (m)

INDEX CONTOUR INTERVAL 2 METRES
WITH 0.5 METRE INTERMEDIATE CONTOUR
NORTH AMERICAN DATUM 1983

COURBES DE NIVEAU PRINCIPALES DE 2.0 MÈTRE
AVEC COURBES DE NIVEAU INTERMÉDIAIRES DE 0.5 MÈTRES
SYSTÈME DE RÉFÉRENCE GÉODÉSIQUE NORD-AMÉRIQUE 1983

GENERAL INFORMATION

Vertical Datum: Mean sea level
Horizontal Datum: North American 1983
Map Projection: Ottawa Transverse Mercator Projection

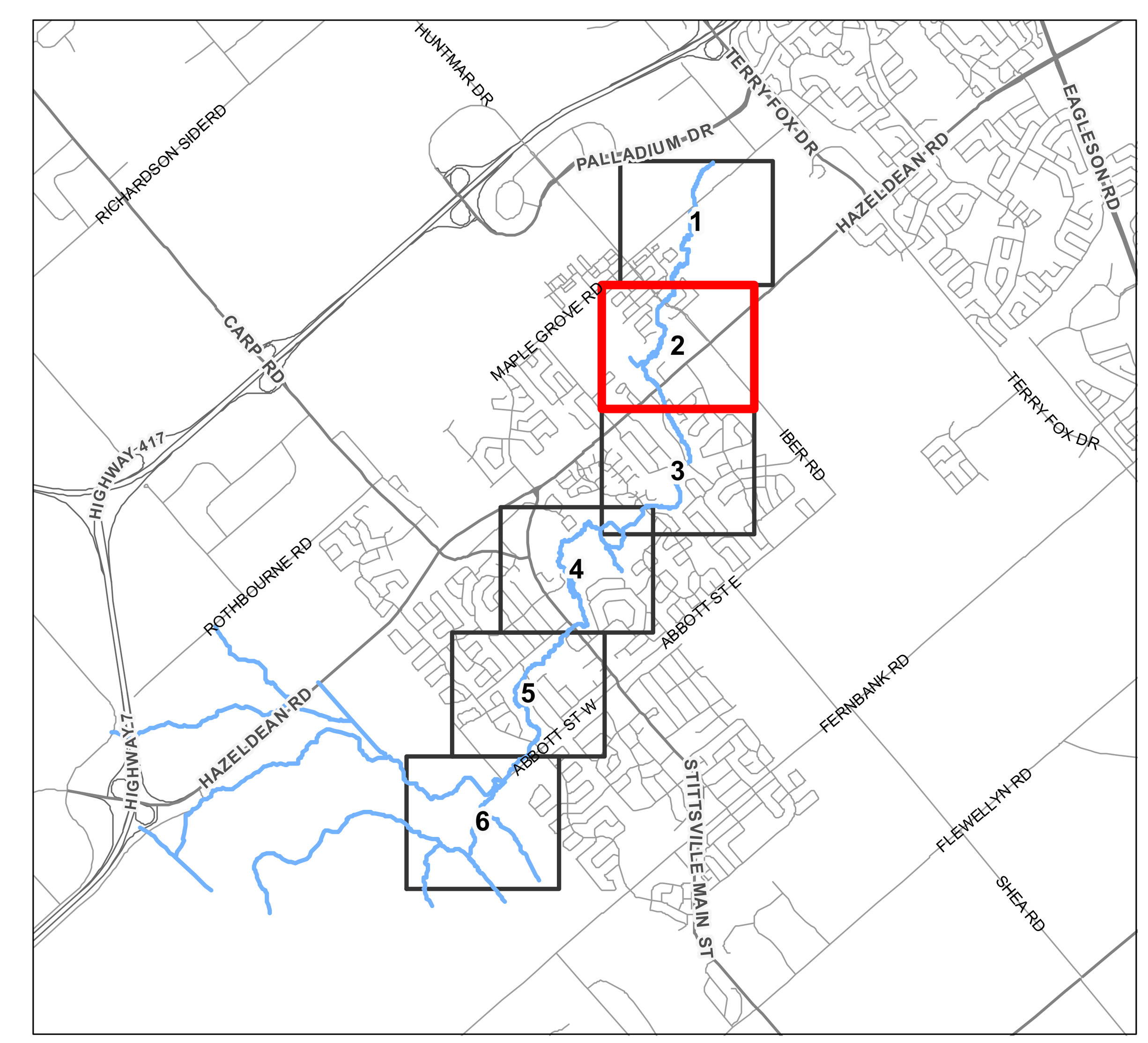
RENSEIGNMENTS GÉNÉRAUX

Niveau de référence vertical: Niveau moyen de la mer
Niveau de référence horizontal: Nord-americain 1983
Projection cartographique: Projection Mercator Transverse d'Ottawa

Mississippi Valley Conservation Authority

Ottawa

SHEET INDEX / TABLEAU D'ASSEMBLAGE



Revision #	Issue
1 - Nov. 14, 2014	Public review
2 - Dec. 4, 2014	Board approval
3 - Jan. 21, 2015	Final
4 - Sept. 24, 2015	Re-print for DRAPE 2014

Engineers stamp and seal
LICENSED PROFESSIONAL ENGINEER
J. S. A. PRICE
Nov. 31/15
PROVINCE OF ONTARIO

N S W E

SCALE 1:2000 ÉCHELLE
0 25 50 100 150 200
Meters / Mètres

MAP No.
CARTE No. 3

FLOOD RISK MAP
POOLE CREEK
CARTE DU RISQUE D'INONDATION

Date Modified / Date de modification: 5/8/2018

LEGEND / LÉGENDE

- Regulatory Floodplain / La Crue Régulatrice
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WITH 0.5 METRE INTERMEDIATE CONTOUR
NORTH AMERICAN DATUM 1983

COURBES DE NIVEAU PRINCIPALES DE 2.0 MÈTRE
AVEC COURBES DE NIVEAU INTERMÉDIAIRES DE 0.5 MÈTRES
SYSTÈME DE RÉFÉRENCE GÉODÉSIQUE NORD-AMÉRIQUE 1983

GENERAL INFORMATION

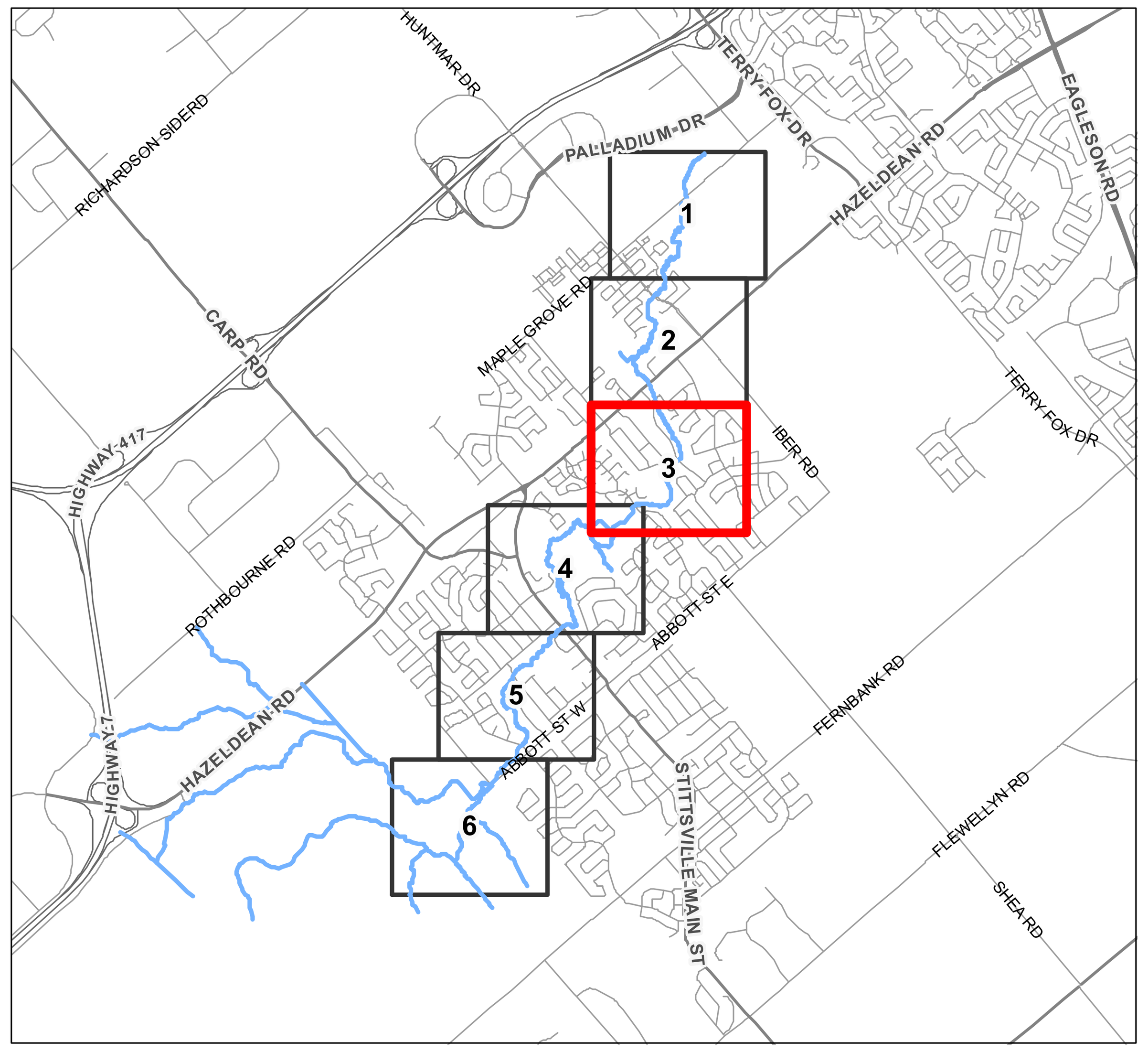
Vertical Datum: Mean sea level
Horizontal Datum: North American 1983
Map Projection: Ottawa Transverse Mercator Projection

RENSEIGNMENTS GÉNÉRAUX

Niveau de référence vertical: Niveau moyen de la mer
Niveau de référence horizontal: Nord-americain 1983
Projection cartographique: Projection Mercator Transverse d'Ottawa

Mississippi Valley Conservation Authority
Ottawa

SHEET INDEX / TABLEAU D'ASSEMBLAGE



This map and the associated information displayed are to be used for general illustrative purposes only. Although best efforts have been made to create accuracy; due to the complex and extensive nature of the data, all representations and/or information provided herein are approximate and to be verified by user. User hereby acknowledges that this map is not intended for true and accurate navigational purposes and hereby accepts and assumes all inherent risks associated with the use of this map.

This map is produced in part with data provided by the Ontario Geographic Data Exchange under Licence with the Ontario Ministry of Natural Resources and the Queen's Printer for Ontario, 2015

N W E S

SCALE 1:2000 ÉCHELLE
0 25 50 100 150 200
Meters / Mètres

Cette carte et les renseignements connexes qui sont affichés sont fournis à titre d'exemple général seulement. En dépit de tous les efforts consentis pour en garantir l'exactitude, les représentations ou renseignements que l'on trouvera ici demeurent approximatifs du fait de la nature complexe et de l'étendue des données, et doivent donc être vérifiés par l'utilisateur. L'utilisateur reconnait par la présente que cette carte n'est pas conçue pour une navigation exacte et véridique, accepte et endosse les risques connexes associés à son utilisation.

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Revision #	Issue	Engineers stamp and seal
1 - Nov. 14, 2014	Public review	LICENSED PROFESSIONAL ENGINEER J. S. A. PRICE PROVINCE OF ONTARIO Nov. 31/15
2 - Dec. 4, 2014	Board approval	
3 - Jan. 21, 2015	Final	
4 - Sept. 24, 2015	Re-print for DRAPE 2014	

APPENDIX B

Water Supply

2016 Water Distribution System

Department of Infrastructure Services

This map was compiled from existing & collected engineering Information from the City of Ottawa Geographic Information System and is protected by copyright. The location of Infrastructure is approximate and should not be used for construction purposes.

Scale 1:2500

Ottawa

Legend

- Public Hydrant
- Private Hydrant
- Summer only Flusher Hydrant
- Flusher Hydrant
- Acoustic Fibre Optic
- Gate Valve
- Tapping Valve
- Butterfly Valve
- Buried Valve
- Drain Pipe
- Check Valve
- Closed Valve
- Drain-Out Valve
- Left Hand Valve
- Spot Elevation
- Pressure Reducing Valve
- Air Relief Valve
- Bypass Valve
- Feedermain Valve
- Inspection Plate
- Cap
- Reducer
- Jump
- Water Meter
- Water Service
- Backbone Pipe
- 203 PVC-1981 — Watermain with Pipe Diameter, Material and Install Year
- Pipe Casing
- 2W — Pressure Zone Delineation and Identifier
- Well
- Elevated Tank
- Water Pumping Station
- Water Reservoir
- Water Treatment Plant

Pipe Equivalents

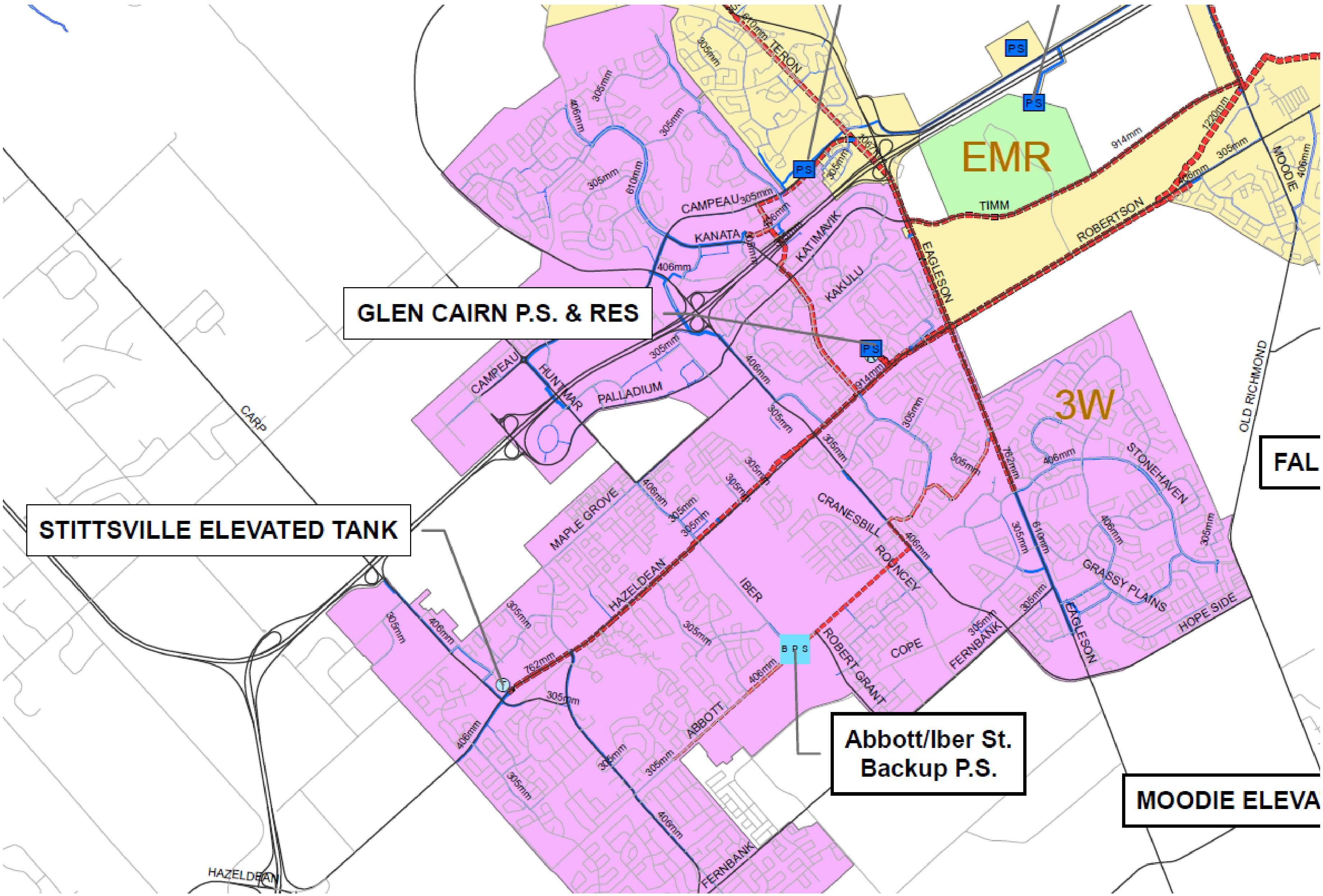
nominal (mm)	actual (inches)	nominal (mm)	actual (inches)	nominal (mm)	actual (inches)
100	4	675	27	1800	72
150	6	750	30	1950	78
200	8	825	33	2025	80
250	10	900	36	2100	84
300	12	975	39	2250	90
375	15	1050	42	2400	96
400	16	1200	48	2550	102
450	18	1350	54	2700	108
525	21	1500	60	2850	114
600	24	1650	66	3000	120

Pipe Materials

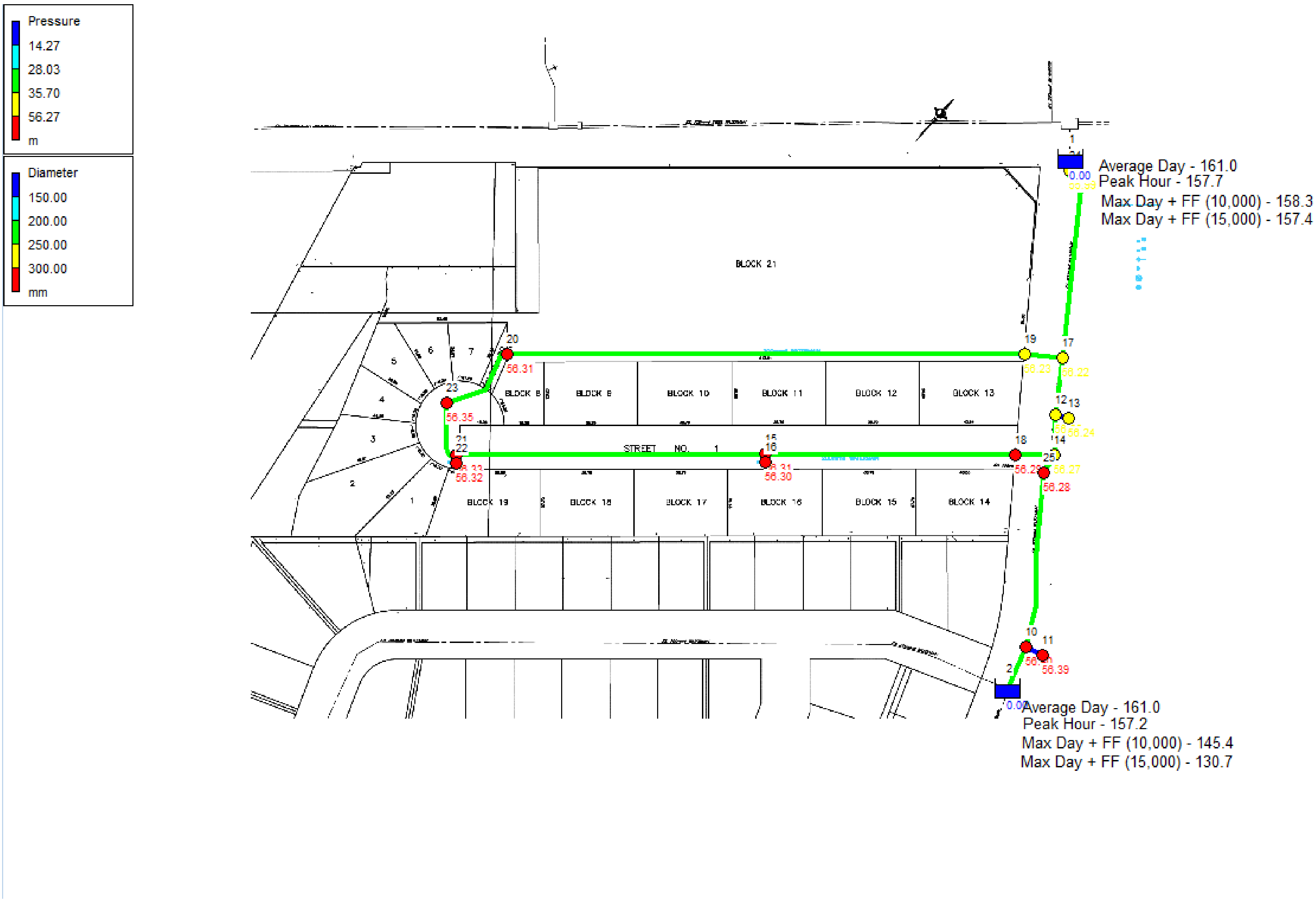
A - ASBESTOS
CI - CAST IRON
CO - COPPER
CO0 - AWWA C300
CO1 - AWWA C301
CO2 - AWWA C302
CO3 - AWWA C303
DI - DUCTILE IRON
PE - POLYETHYLENE (DR11 TO DR21)
PVC - POLYVINYL CHLORIDE
STC - CONCRETE LINED STEEL PIPE
UCI - UNLINED CAST IRON
UNK - UNKNOWN MATERIAL

348-016	350-016	352-016
348-015	350-015	352-015
348-014	350-014	352-014

Pressure Zone Map



Average Day


Pressure
14.27
28.03
35.70
56.27
m
Diameter
150.00
200.00
250.00
300.00
mm
BLOCK 21
BLOCK 9
BLOCK 8
BLOCK 10
BLOCK 11
BLOCK 12
BLOCK 13
STREET NO. 1
BLOCK 19
BLOCK 18
BLOCK 17
BLOCK 16
BLOCK 15
BLOCK 14
Average Day - 161.0
Peak Hour - 157.7
Max Day + FF (10,000) - 158.3
Max Day + FF (15,000) - 157.4
Average Day - 161.0
Peak Hour - 157.2
Max Day + FF (10,000) - 145.4
Max Day + FF (15,000) - 130.7
56.31
56.35
56.32
56.30
56.23
56.22
56.24
56.27
56.28
56.39

```
**********************************************************************
*                           E P A N E T                              *
*                   Hydraulic and Water Quality                      *
*                   Analysis for Pipe Networks                       *
*                         Version 2.0                                *
**********************************************************************
```

Input File: 2018-05-29_1006_avg-day_ggm.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
1	1	24	1	200
2	24	17	79.9	200
3	17	19	16.23	200
4	19	20	213.04	200
5	20	23	35.73	200
6	23	21	24.78	200
7	21	22	1000	12
8	21	15	127.54	200
9	15	16	1000	12
10	15	18	103.24	200
11	18	14	15.79	200
12	17	12	24.29	200
13	12	13	1000	12
14	12	14	16.35	200
15	14	25	8.96	200
16	25	10	72.63	200
17	10	11	1000	12
18	10	2	18.42	200

Node Results:

Node ID	Demand LPM	Head m	Pressure m	Quality
10	0.00	161.00	56.40	0.00
11	0.00	161.00	56.39	0.00
12	0.00	161.00	56.25	0.00
13	0.00	161.00	56.24	0.00
14	0.00	161.00	56.27	0.00
15	10.03	161.00	56.31	0.00
16	0.00	161.00	56.30	0.00

17	0.00	161.00	56.22	0.00	
18	10.03	161.00	56.29	0.00	
19	31.10	161.00	56.23	0.00	
20	0.00	161.00	56.31	0.00	
21	10.03	161.00	56.33	0.00	
22	0.00	161.00	56.32	0.00	

Page 2
Node Results: (continued)

Node ID	Demand LPM	Head m	Pressure m	Quality	
23	10.03	161.00	56.35	0.00	
24	0.00	161.00	55.99	0.00	
25	0.00	161.00	56.28	0.00	
1	-38.32	161.00	0.00	0.00	Reservoir
2	-32.91	161.00	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPM	VelocityUnit m/s	Headloss m/km	Status
1	38.32	0.02	0.00	Open
2	38.32	0.02	0.01	Open
3	41.95	0.02	0.01	Open
4	10.85	0.01	0.00	Open
5	10.85	0.01	0.00	Open
6	0.82	0.00	0.00	Open
7	0.00	0.00	0.00	Open
8	-9.21	0.00	0.00	Open
9	0.00	0.00	0.00	Open
10	-19.25	0.01	0.00	Open
11	-29.28	0.02	0.00	Open
12	-3.63	0.00	0.00	Open
13	0.00	0.00	0.00	Open
14	-3.63	0.00	0.00	Open
15	-32.91	0.02	0.01	Open
16	-32.91	0.02	0.00	Open
17	0.00	0.00	0.00	Open
18	-32.91	0.02	0.00	Open

```
******************************************************************
*                           E P A N E T                          *
*                  Hydraulic and Water Quality                   *
*                  Analysis for Pipe Networks                    *
*                         Version 2.0                            *
******************************************************************
```

Input File: 2018-05-29_1006_avg-day_ggm.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
1	1	24	1	200
2	24	17	79.9	200
3	17	19	16.23	200
4	19	20	213.04	200
5	20	23	35.73	200
6	23	21	24.78	200
7	21	22	2.13	150
8	21	15	127.54	200
9	15	16	2.13	150
10	15	18	103.24	200
11	18	14	15.79	200
12	17	12	24.29	200
13	12	13	2.94	150
14	12	14	16.35	200
15	14	25	8.96	200
16	25	10	72.63	200
17	10	11	3	150
18	10	2	18.42	200

Node Results:

Node ID	Demand LPM	Head m	Pressure m	Quality hours
10	0.00	161.00	56.40	0.00
11	0.00	161.00	56.39	0.00
12	0.00	161.00	56.25	0.00
13	0.00	161.00	56.24	0.00
14	0.00	161.00	56.27	0.00
15	10.03	161.00	56.31	0.00
16	0.00	161.00	56.30	0.00

17	0.00	161.00	56.22	0.00
18	10.03	161.00	56.29	0.00
19	31.10	161.00	56.23	0.00
20	0.00	161.00	56.31	0.00
21	10.03	161.00	56.33	0.00
22	0.00	161.00	56.32	0.00

Page 2

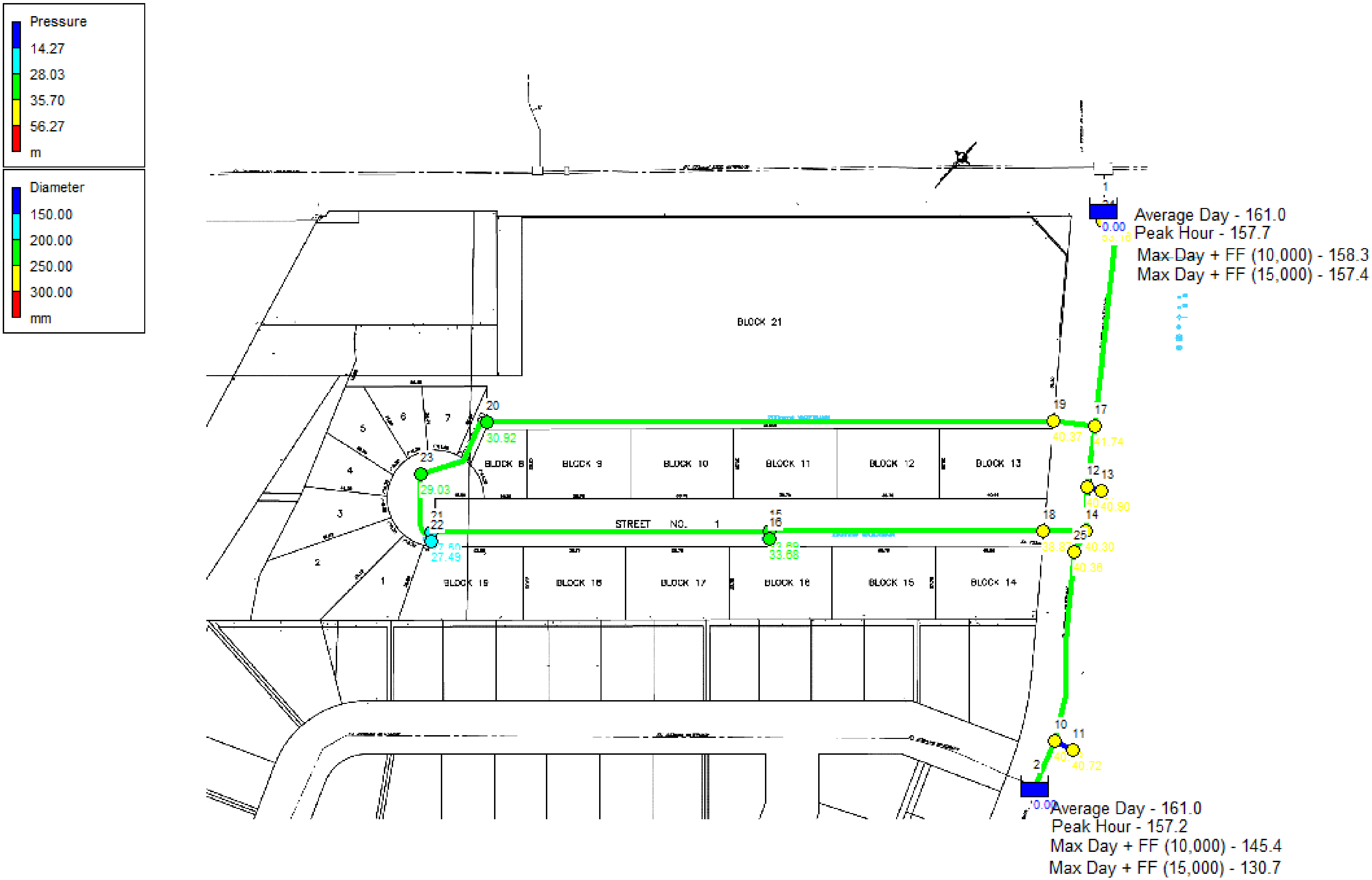
Node Results: (continued)

Node ID	Demand LPM	Head m	Pressure m	Quality hours	
23	10.03	161.00	56.35	0.00	
24	0.00	161.00	55.99	0.00	
25	0.00	161.00	56.28	0.00	
1	-38.32	161.00	0.00	0.00	Reservoir
2	-32.91	161.00	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPM	VelocityUnit m/s	Headloss m/km	Status
1	38.32	0.02	0.00	Open
2	38.32	0.02	0.01	Open
3	41.95	0.02	0.01	Open
4	10.85	0.01	0.00	Open
5	10.85	0.01	0.00	Open
6	0.82	0.00	0.00	Open
7	0.00	0.00	0.00	Open
8	-9.22	0.00	0.00	Open
9	0.00	0.00	0.00	Open
10	-19.25	0.01	0.00	Open
11	-29.28	0.02	0.00	Open
12	-3.63	0.00	0.00	Open
13	0.00	0.00	0.00	Open
14	-3.63	0.00	0.00	Open
15	-32.91	0.02	0.01	Open
16	-32.91	0.02	0.00	Open
17	0.00	0.00	0.00	Open
18	-32.91	0.02	0.00	Open

Max Daily Demand + Fire Flow (10,000L/min)



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**********************************************************************
*                           E P A N E T                              *
*                   Hydraulic and Water Quality                      *
*                   Analysis for Pipe Networks                       *
*                          Version 2.0                               *
**********************************************************************
```

Input File: 2018-05-29_1006_max-day+ff-10000_ggm.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
1	1	24	1	200
2	24	17	79.9	200
3	17	19	16.23	200
4	19	20	213.04	200
5	20	23	35.73	200
6	23	21	24.78	200
7	21	22	2.13	150
8	21	15	127.54	200
9	15	16	2.13	150
10	15	18	103.24	200
11	18	14	15.79	200
12	17	12	24.29	200
13	12	13	2.94	150
14	12	14	16.35	200
15	14	25	8.96	200
16	25	10	72.63	200
17	10	11	3	150
18	10	2	18.42	200

Node Results:

Node ID	Demand LPM	Head m	Pressure m	Quality hours
10	0.00	145.33	40.73	0.00
11	0.00	145.33	40.72	0.00
12	0.00	145.66	40.91	0.00
13	0.00	145.66	40.90	0.00
14	0.00	145.03	40.30	0.00
15	36.05	138.38	33.69	0.00
16	0.00	138.38	33.68	0.00

17	0.00	146.52	41.74	0.00
18	36.05	143.58	38.87	0.00
19	46.70	145.14	40.37	0.00
20	0.00	135.61	30.92	0.00
21	10036.05	132.17	27.50	0.00
22	0.00	132.17	27.49	0.00

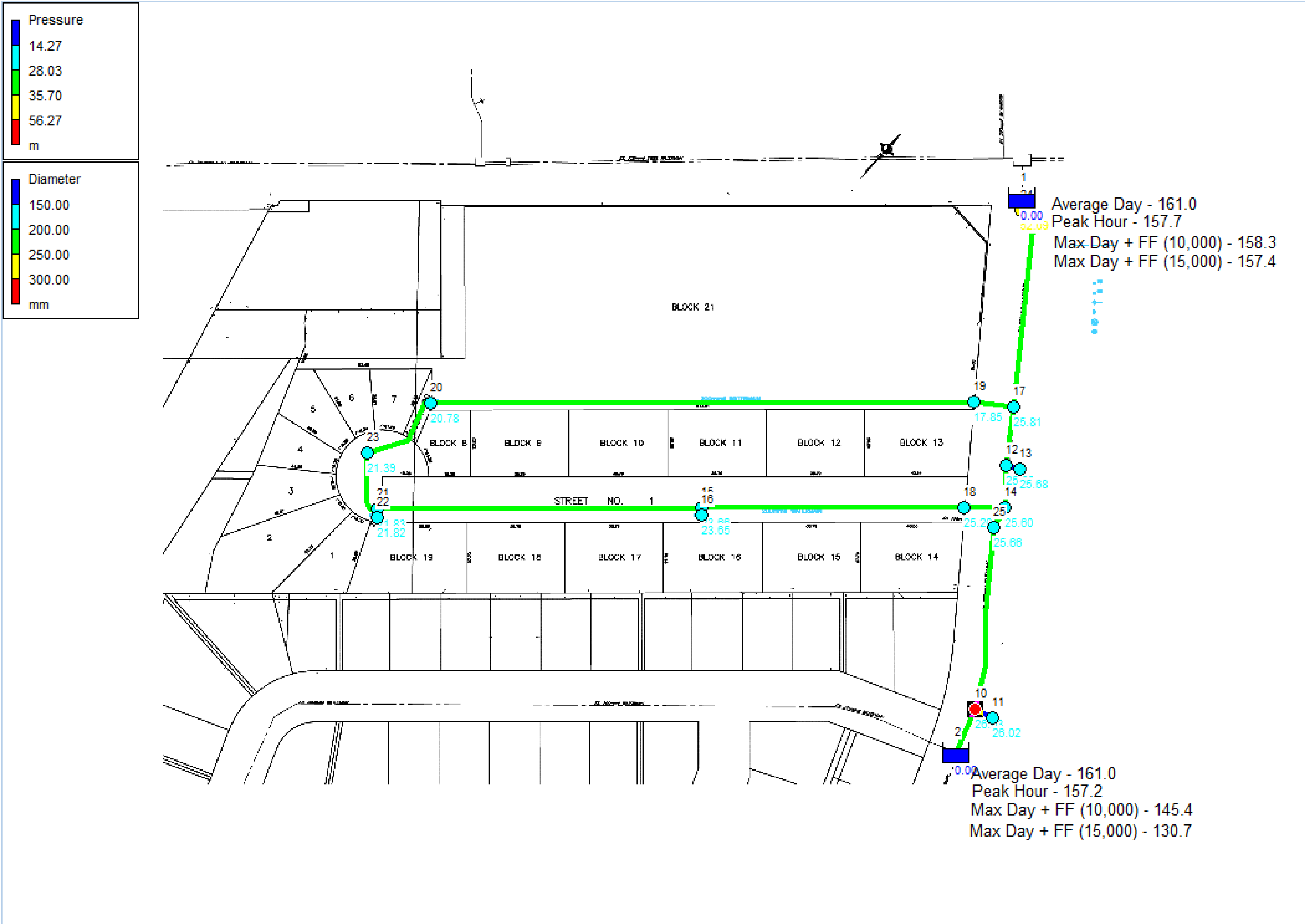
Page 2
Node Results: (continued)

Node ID	Demand LPM	Head m	Pressure m	Quality hours	
23	36.05	133.68	29.03	0.00	
24	0.00	158.17	53.16	0.00	
25	0.00	145.08	40.36	0.00	
1	-9012.55	158.30	0.00	0.00	Reservoir
2	-1178.35	145.40	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPM	VelocityUnit m/s	Headloss m/km	Status
1	9012.55	4.78	134.06	Open
2	9012.55	4.78	145.72	Open
3	5008.78	2.66	85.06	Open
4	4962.08	2.63	44.72	Open
5	4962.08	2.63	54.27	Open
6	4926.03	2.61	60.64	Open
7	0.00	0.00	0.00	Open
8	-5110.02	2.71	48.63	Open
9	0.00	0.00	0.00	Open
10	-5146.07	2.73	50.43	Open
11	-5182.12	2.75	91.99	Open
12	4003.78	2.12	35.51	Open
13	0.00	0.00	0.00	Open
14	4003.77	2.12	38.27	Open
15	-1178.35	0.63	5.32	Open
16	-1178.35	0.63	3.43	Open
17	0.00	0.00	0.00	Open
18	-1178.35	0.63	3.75	Open

Max Daily Demand + Fire Flow (15,000L/min)



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**********************************************************************
*                             E P A N E T                            *
*                     Hydraulic and Water Quality                    *
*                     Analysis for Pipe Networks                     *
*                            Version 2.0                             *
**********************************************************************
```

Input File: 2018-05-29_1006_max-day+ff-15000_ggm.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
1	1	24	1	200
2	24	17	79.9	200
3	17	19	16.23	200
4	19	20	213.04	200
5	20	23	35.73	200
6	23	21	24.78	200
7	21	22	2.13	150
8	21	15	127.54	200
9	15	16	2.13	150
10	15	18	103.24	200
11	18	14	15.79	200
12	17	12	24.29	200
13	12	13	2.94	150
14	12	14	16.35	200
15	14	25	8.96	200
16	25	10	72.63	200
17	10	11	3	150
18	10	2	18.42	200

Node Results:

Node ID	Demand LPM	Head m	Pressure m	Quality hours
10	0.00	130.63	26.03	0.00
11	0.00	130.63	26.02	0.00
12	0.00	130.44	25.69	0.00
13	0.00	130.44	25.68	0.00
14	0.00	130.33	25.60	0.00
15	36.05	128.35	23.66	0.00
16	0.00	128.35	23.65	0.00

17	0.00	130.59	25.81	0.00
18	36.05	129.91	25.20	0.00
19	15046.70	122.62	17.85	0.00
20	0.00	125.47	20.78	0.00
21	36.05	126.50	21.83	0.00
22	0.00	126.50	21.82	0.00

Page 2

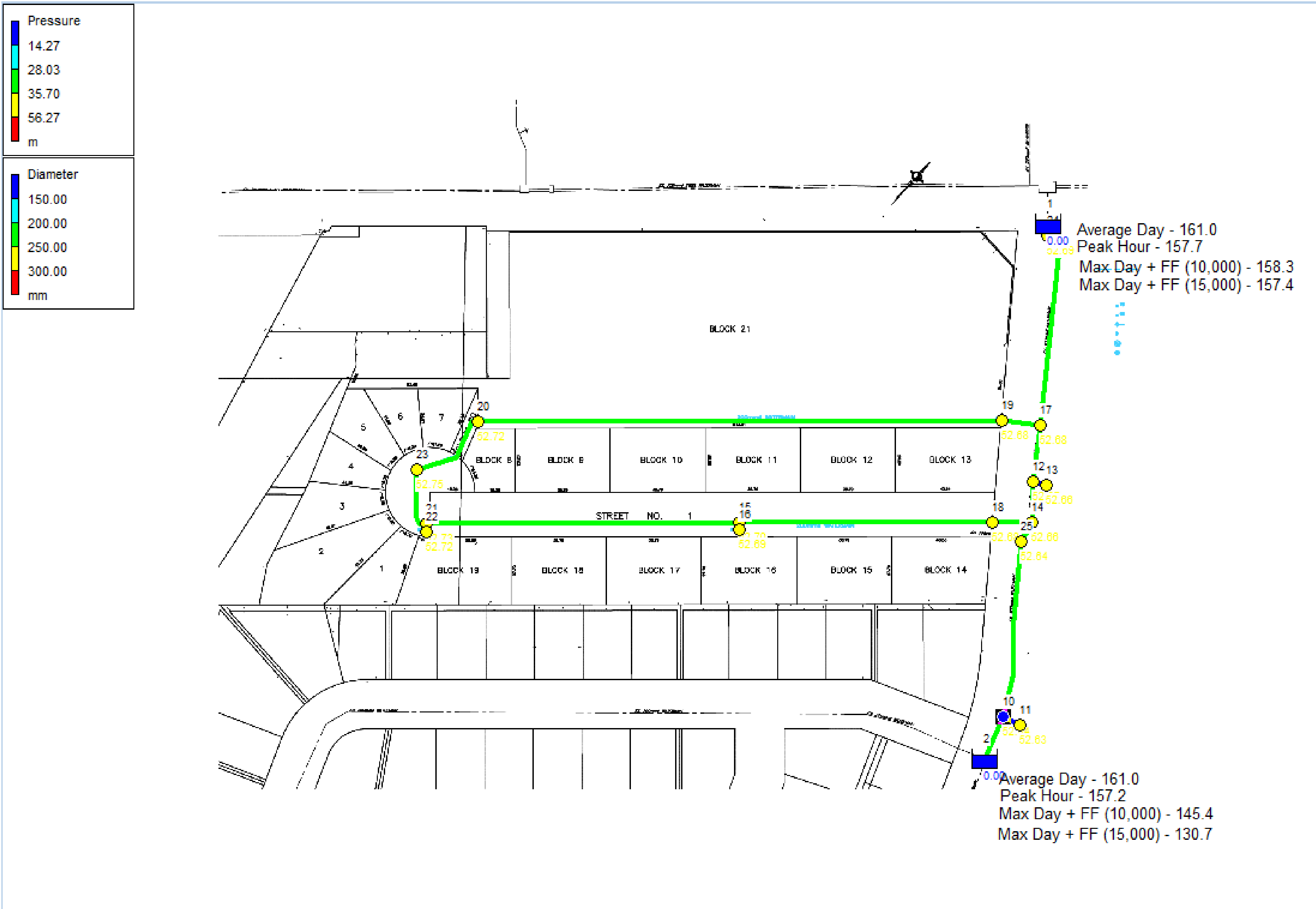
Node Results: (continued)

Node ID	Demand LPM	Head m	Pressure m	Quality hours	
23	36.05	126.04	21.39	0.00	
24	0.00	157.10	52.09	0.00	
25	0.00	130.38	25.66	0.00	
1	-14012.95	157.40	0.00	0.00	Reservoir
2	-1177.95	130.70	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPM	VelocityUnit m/s	Headloss m/km	Status
1	14012.95	7.43	303.59	Open
2	14012.95	7.43	331.79	Open
3	12458.20	6.61	490.96	Open
4	-2588.50	1.37	13.39	Open
5	-2588.50	1.37	15.99	Open
6	-2624.55	1.39	18.43	Open
7	0.00	0.00	0.00	Open
8	-2660.60	1.41	14.47	Open
9	0.00	0.00	0.00	Open
10	-2696.65	1.43	15.16	Open
11	-2732.70	1.45	26.91	Open
12	1554.75	0.82	6.03	Open
13	0.00	0.00	0.00	Open
14	1554.75	0.82	6.45	Open
15	-1177.95	0.62	5.32	Open
16	-1177.95	0.62	3.42	Open
17	0.00	0.00	0.00	Open
18	-1177.95	0.62	3.74	Open

Peak Hour


Pressure
14.27
28.03
35.70
56.27
m
Diameter
150.00
200.00
250.00
300.00
mm
Average Day - 161.0
Peak Hour - 157.7
Max Day + FF (10,000) - 158.3
Max Day + FF (15,000) - 157.4
Average Day - 161.0
Peak Hour - 157.2
Max Day + FF (10,000) - 145.4
Max Day + FF (15,000) - 130.7
BLOCK 21
STREET NO. 1

```
**********************************************************************
*                           E P A N E T                              *
*                   Hydraulic and Water Quality                      *
*                   Analysis for Pipe Networks                       *
*                         Version 2.0                                *
**********************************************************************
```

Input File: 2018-06-04_1006_peak-hour_ggm.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
1	1	24	1	200
2	24	17	79.9	200
3	17	19	16.23	200
4	19	20	213.04	200
5	20	23	35.73	200
6	23	21	24.78	200
7	21	22	2.13	150
8	21	15	127.54	200
9	15	16	2.13	150
10	15	18	103.24	200
11	18	14	15.79	200
12	17	12	24.29	200
13	12	13	2.94	150
14	12	14	16.35	200
15	14	25	8.96	200
16	25	10	72.63	200
17	10	11	3	150
18	10	2	18.42	200

Node Results:

Node ID	Demand LPM	Head m	Pressure m	Quality hours
10	0.00	157.24	52.64	0.00
11	0.00	157.24	52.63	0.00
12	0.00	157.42	52.67	0.00
13	0.00	157.42	52.66	0.00
14	0.00	157.39	52.66	0.00
15	54.08	157.39	52.70	0.00
16	0.00	157.39	52.69	0.00

17	0.00	157.46	52.68	0.00
18	54.08	157.39	52.68	0.00
19	84.00	157.45	52.68	0.00
20	0.00	157.41	52.72	0.00
21	54.08	157.40	52.73	0.00
22	0.00	157.40	52.72	0.00

Page 2

Node Results: (continued)

Node ID	Demand LPM	Head m	Pressure m	Quality hours	
23	54.08	157.40	52.75	0.00	
24	0.00	157.70	52.69	0.00	
25	0.00	157.36	52.64	0.00	
1	-1123.27	157.70	0.00	0.00	Reservoir
2	822.95	157.20	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPM	VelocityUnit m/s	Headloss m/km	Status
1	1123.27	0.60	2.83	Open
2	1123.27	0.60	3.02	Open
3	339.29	0.18	0.49	Open
4	255.29	0.14	0.18	Open
5	255.29	0.14	0.21	Open
6	201.21	0.11	0.15	Open
7	0.00	0.00	0.00	Open
8	147.13	0.08	0.07	Open
9	0.00	0.00	0.00	Open
10	93.05	0.05	0.03	Open
11	38.97	0.02	0.01	Open
12	783.98	0.42	1.67	Open
13	0.00	0.00	0.00	Open
14	783.98	0.42	1.78	Open
15	822.95	0.44	2.68	Open
16	822.95	0.44	1.75	Open
17	0.00	0.00	0.00	Open
18	822.95	0.44	1.91	Open

Campanale Homes
5 Orchard Drive
Proposed Site Conditions

Water Demand Design Flows per Unit Count
City of Ottawa - Water Distribution Guidelines, July 2010

Domestic Demand

Type of Housing	Per / Unit	Units	Pop
Single Family	3.4	7	24
Semi-detached	2.7	2	6
Townhouse	2.7	65	176
Apartment			0
Bachelor	1.4		0
1 Bedroom	1.4		0
2 Bedroom	2.1		0
3 Bedroom	3.1		0
Average	1.8		0

	Pop	Avg. Daily		Max Day		Peak Hour	
		m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Total Domestic Demand	206	57.7	40.1	207.6	144.2	311.5	216.3

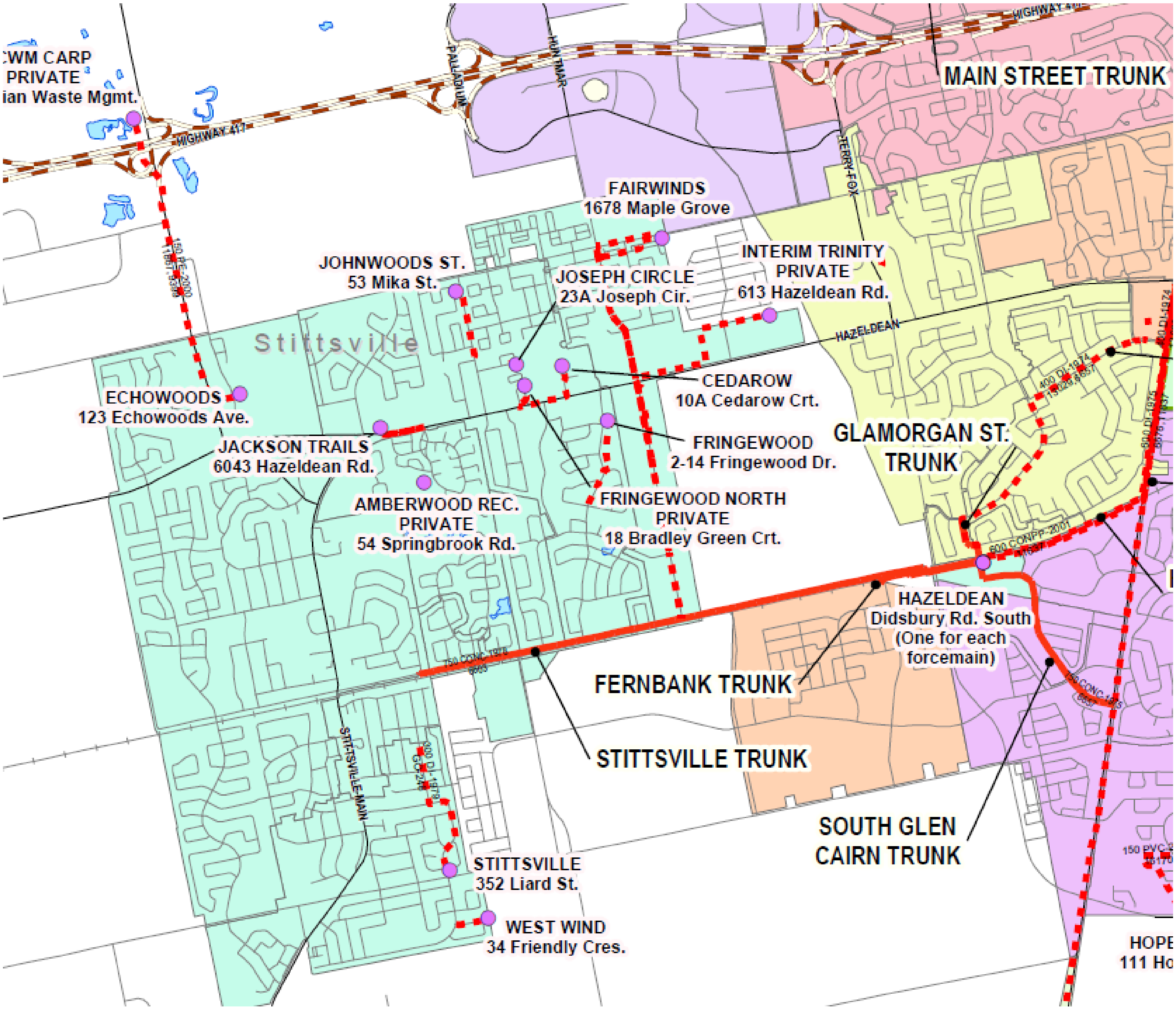
Institutional / Commercial / Industrial Demand

Property Type	Unit Rate		Units	Avg. Daily		Max Day		Peak Hour	
				m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Commercial Space	28,000.0	L/ha/d	2	44.80	31.1	67.2	46.7	121.0	84.0
Office	75	$L/9.3m^2/d$		0.00	0.0	0.0	0.0	0.0	0.0
Industrial - Light	35,000	L/gross ha/d		0.00	0.0	0.0	0.0	0.0	0.0
Industrial - Heavy	55,000	L/gross ha/d		0.00	0.0	0.0	0.0	0.0	0.0
			Total I/CI Demand	44.8	31.1	67.2	46.7	121.0	84.0
			Total Demand	**102.5**	**71.2**	**274.8**	**190.9**	**432.4**	**300.3**

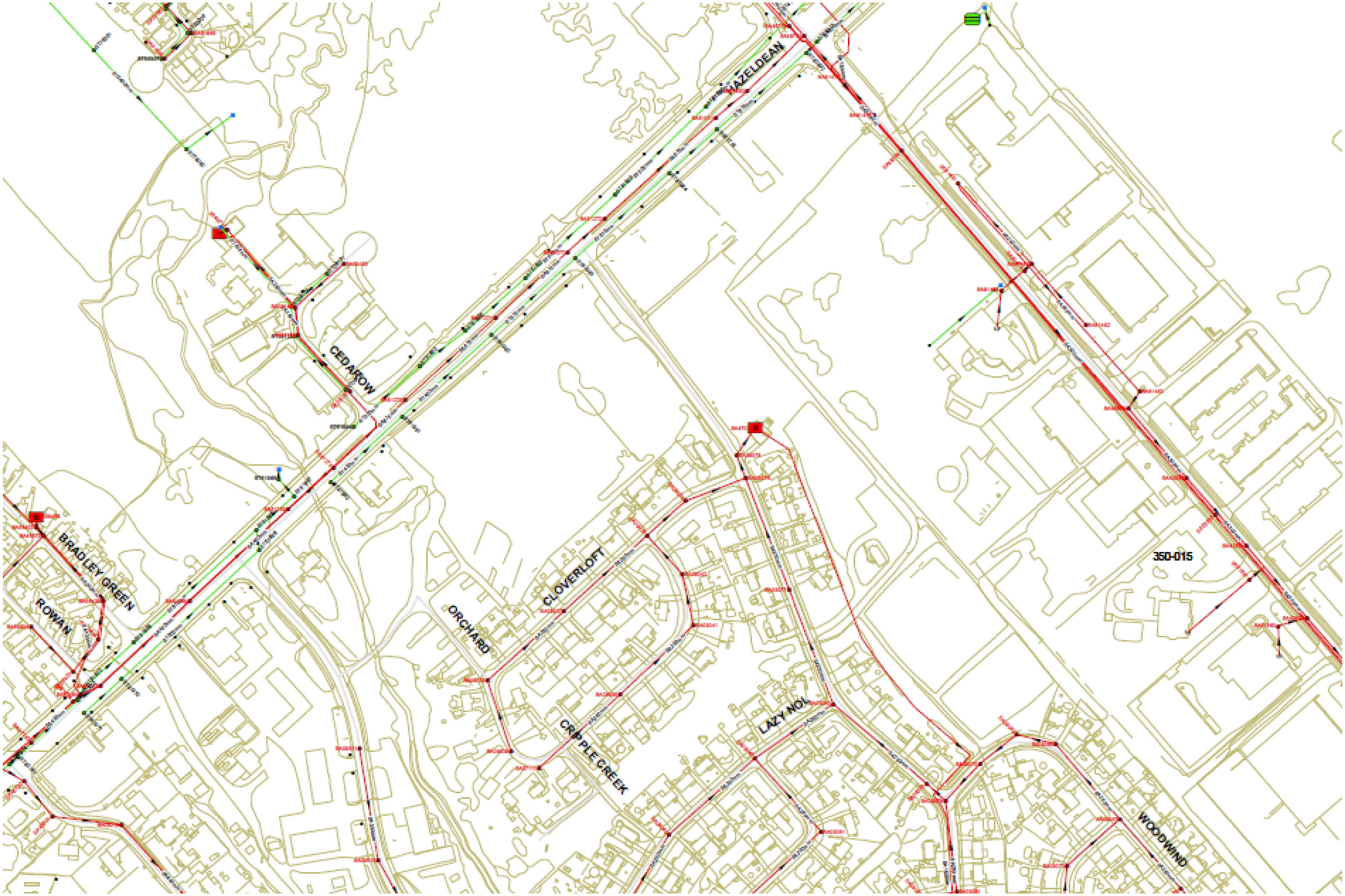
APPENDIX C

Wastewater Collection

Trunk Sanitary Sewers and Collection Areas Map



Existing Sanitary Map



5 Orchard Drive
Contemplated Flow to Fut. Fringewood Sanitary Sewer

Wastewater Design Flows per Unit Count
City of Ottawa Sewer Design Guidelines, 2012

Site Area 4.060 **ha**

Extraneous Flow Allowances

Infiltration / Inflow **1.30 L/s**

Domestic Contributions

Unit Type	Unit Rate	Units	Pop
Single Family	3.4		0
Semi-detached and duplex	2.7		0
Townhouse	2.7		0
Stacked Townhouse	2.3		0
Apartment			
Bachelor	1.4		0
1 Bedroom	1.4		0
2 Bedroom	2.1		0
3 Bedroom	3.1		0
Average	1.8		0

Total Pop **362**

Average Domestic Flow **1.17 L/s**

Peaking Factor **3.43**

Peak Domestic Flow **4.03 L/s**

Institutional / Commercial / Industrial Contributions

Property Type	Unit Rate		No. of Units	Avg Wastewater (L/s)
Commercial floor space	28,000	L/ha/d	1.83	0.59
Pool	40	$L/9.3m^2/d$		0.00
Office	75	$L/9.3m^2/d$		0.00
Ex. Industrial - Light**	35,000	L/gross ha/d		0.00
Industrial - Light**	35,000	L/gross ha/d		0.00
Industrial - Heavy**	55,000	L/gross ha/d		0.00

Average I/C/I Flow **0.59**

Peak Institutional / Commercial Flow 0.89
Peak Industrial Flow** 0.00
Peak I/C/I Flow **0.89**

** assuming a 12 hour commercial operation*
*** peak industrial flow per City of Ottawa Sewer Design Guidelines Appendix 4B*

Total Estimated Average Dry Weather Flow Rate	**1.77 L/s**
Total Estimated Peak Dry Weather Flow Rate	**4.92 L/s**
Total Estimated Peak Wet Weather Flow Rate	**6.22 L/s**

Wastewater Design Flows per Unit Count
City of Ottawa Sewer Design Guidelines, 2012

Site Area 3.980 **ha**

Extraneous Flow Allowances

Infiltration / Inflow **1.27 L/s**

Domestic Contributions

Unit Type	Unit Rate	Units	Pop
Single Family	3.4	7	24
Semi-detached and duplex	2.7	2	6
Townhouse	2.7	65	176
Stacked Townhouse	2.3		0
Apartment			
Bachelor	1.4		0
1 Bedroom	1.4		0
2 Bedroom	2.1		0
3 Bedroom	3.1		0
Average	1.8		0

Total Pop **206**

Average Domestic Flow **0.67 L/s**

Peaking Factor **3.51**

Peak Domestic Flow **2.35 L/s**

Institutional / Commercial / Industrial Contributions

Property Type	Unit Rate		No. of Units	Avg Wastewater (L/s)
Commercial floor space	28,000	L/ha/d	1.83	0.59
Pool	40	L/9.3m^2/d		0.00
Office	75	L/9.3m^2/d		0.00
Ex. Industrial - Light**	35,000	L/gross ha/d		0.00
Industrial - Light**	35,000	L/gross ha/d		0.00
Industrial - Heavy**	55,000	L/gross ha/d		0.00

Average I/C/I Flow **0.59**

Peak Institutional / Commercial Flow 0.89
Peak Industrial Flow** 0.00
Peak I/C/I Flow **0.89**

*** peak industrial flow per City of Ottawa Sewer Design Guidelines Appendix 4B*

Total Estimated Average Dry Weather Flow Rate	**1.26**	**L/s**
Total Estimated Peak Dry Weather Flow Rate	**3.24**	**L/s**
Total Estimated Peak Wet Weather Flow Rate	**4.51**	**L/s**

SANITARY SEWER CALCULATION SHEET

CLIENT: **Campanale Homes**
LOCATION: **5 Orchard Drive**
FILE REF: **18-1016**
DATE: **12-Dec-18**

DESIGN PARAMETERS

Avg. Daily Flow Res.	280 L/p/d	Peak Fact Res. Per Harmons: Min = 2.0, Max =3.8				Infiltration / Inflow	0.33 L/s/ha
Avg. Daily Flow Comm	28,000 L/ha/d	Peak Fact. Comm. If (Q_c/Q_{TOTAL}>20%)	1.5	Peak Fact. Comm.	1	Min. Pipe Velocity	0.60 m/s full flowing
Avg. Daily Flow Instit.	28,000 L/ha/d	Peak Fact. Instit. If (Q_i/Q_{TOTAL}>20%)	1.5	Peak Fact. Instit.	1	Max. Pipe Velocity	3.00 m/s full flowing
Avg. Daily Flow Indust	35,000 L/ha/d	Peak Fact. Indust. per MOE graph				Mannings N	0.013
		Correction Factor K	0.8				

Location			Residential Area and Population										Commercial		Institutional		Industrial			Infiltration				Pipe Data							
Area ID	Up	Down	Area	Number of Units by type				Pop.	Cumulative		Peak. Fact.	Q_{res}	Area	Accu. Area	Area	Accu. Area	Area	Accu. Area	Q_{C+I+I}	Total Area	Accu. Area	Infiltration Flow	Total Flow	DIA	Slope	Length	$A_{hydraulic}$	R	Velocity	Q_{cap}	Q / Q full
			(ha)	Singles	Semi's	Town's	Apt's		Area (ha)	Pop.	(-)	(L/s)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(mm)	(%)	(m)	(m^2)	(m)	(m/s)	(L/s)	(-)
SAN1	SAN101	SAN102	1.30	7	2	30		110.0	1.3	110.0	3.59	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.0	1.298	1.298	0.428	1.71	200	0.70	117.5	0.031	0.050	0.87	27.4	0.06
SAN2	SAN102	FUT.SAN103A	0.85			35		95.0	2.146	205.0	3.52	2.34		0.00		0.00		0.00	0.0	0.848	2.146	0.708	3.04	200	1.50	117.6	0.031	0.050	1.28	40.2	0.08
	FUT.SAN103	FUT.SAN103A	0.000					0.0	0.000	0.0	3.80	0.00		0.00		0.00		0.00	0.0	0.000	0.000	0.000	0.00	250	0.78	47.7	0.049	0.063	1.07	52.5	0.00
	FUT.SAN103A	FUT.SAN104	0.00					0.0	2.146	205.0	3.52	2.34		0.00		0.00		0.00	0.0	0.000	2.146	0.708	3.04	250	0.78	41.0	0.049	0.063	1.07	52.5	0.06
SAN3	COMMERCIAL	FUT.SAN104	0.00					0.0	0.000	0.0	3.80	0.00	1.83	1.83	0.00	0.00	0.00	0.00	0.9	1.828	1.828	0.603	1.49	200	2.00	14.2	0.031	0.050	1.48	46.4	0.03
	FUT.SAN104	FUT.SAN105	0.00					0.0	2.146	205.0	3.52	2.34		1.83		0.00		0.00	0.9	0.000	3.974	1.311	4.54	250	0.80	21.2	0.049	0.063	1.08	53.2	0.09
	FUT.SAN105	FUT.SAN106	0.00					0.0	2.146	205.0	3.52	2.34		3.66		0.00		0.00	1.8	0.000	5.802	1.915	6.03	250	0.76	45.0	0.049	0.063	1.06	51.8	0.12

NOVATECH
Engineers, Planners & Landscape Architects

M E M O R A N D U M

DATE: MAY 16, 2018

TO: JEFF DELOYDE, CITY OF OTTAWA

FROM: KRISTYN BOEHME, NOVATECH

RE: WEST END PUMPING STATIONS DECOMMISSIONING & BY-PASS SEWERS
FRINGEWOOD DRIVE BY-PASS SEWER DESIGN

CC: BOB DOWDALL, NOVATECH

1.0 Introduction & Purpose

Novatech has been retained by the City of Ottawa to decommission five (5) pump stations in the Stitsville area, including the facility currently servicing Fringewood Drive and the adjacent streets. As part of the Fringewood pump station decommissioning, a by-pass sewer is required to divert flows from the pump station to the Hazeldean Trunk Sewer. This memo is intended to provide an overview of the new by-pass sewer design.

2.0 Design Criteria

Based on discussions with the City, peak design flows to be for sizing by-pass sewers should consider the following peak flows:

1. Measured Wet Weather Peak Flows (2014 WWF Event)
2. Pump Stations Capacity (from MOE C of A's)
3. Rationale Method using Drainage Areas and Populations

The greatest flow was used to establish the peak design flow to size the sewers.

2.1 Wet Weather Peak Flows

The peak wet weather flows (WWF) from the event of June 24, 2014 was provided by the City of Ottawa. The event peak flow at Fringewood pump station was 33.2L/s.

2.2 Pump Station Capacity

The capacity of the pump station was specified in the corresponding Certificates of Approvals (C of A). The C of A for Fringewood Pump Station is 27L/s.

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

2.3 Drainage Areas and Population / Occupancy

Existing Development

The Fringewood area was divided into 14 drainage areas based on placement of the existing sanitary sewers flowing to the pump station and the vacant lands to the west, refer to **Appendix A: Drainage Areas**. Each drainage area was assigned unique Drainage Area ID's for the purposes of identification. Within each drainage area, each building type was defined by single family, semi-detached, duplex, townhouse, or apartment. Based on the building type, a general population density was applied to estimate the existing population. The total flow of the existing sanitary sewers was then calculated using the population of each drainage area, refer to **Appendix B: Sewer Design Sheets**. The total flow based on the existing population is 47.4L/s.

Potential Future Development

As part of the sanitary sewer design, a review of the potential future development within the project limits has been completed to project anticipated users of the underground sanitary sewer system and to ensure the new sewer will accommodate existing, as well as future development users.

The Fringewood area is designated as General Urban Area on Schedule B of the City of Ottawa Official Plan which permits all types and densities of housing, as well as employment, retail uses, service, industrial, cultural, leisure, greenspace, entertainment and institutional uses. However, it is not within the boundaries of a Community Design Plan (CDP) or Secondary Plan. Since the Official Plan designation permits a wide range of uses, existing zoning has been used to determine growth potential.

Fringewood Drive and the neighbouring side streets are an established residential neighbourhood characterized by single detached dwellings. Zoning primarily consists of R1L, with exception to one property with zoning L1 and the lands to the west with zoning AM9. R1 zones permit only single detached dwellings, as well as ancillary uses and generally permitted uses such as secondary suites, group homes, bed and breakfasts, etc. L1 zones permit only recreational uses such as community centres, day care, emergency services, park, etc. AM zones permit a broad range of uses including retail, service commercial, offices, residential and institutional uses in mixed-use buildings, or side by side in separate buildings.

As each lot in the R1 residential zone is currently occupied by a single-detached dwelling, the potential future development was considered negligible and the existing development population was used for future sizing. However, the vacant lands to the west (zoning AM) may undergo significant development in the nearby future. Through discussions with City Planning, it was noted that the lands north of Fringewood Drive (5734/5754 Hazldean Road) have an approved sanitary outlet to the Iber Road sewer system. The development plans for the lands to the south (5 Orchard Drive) are unknown at this time and these flows may be conveyed to the new by-pass sewer. As such, future population growth was estimated for this area.

The subject lands are located adjacent to Hazeldean Road. Given that Hazeldean is a Transit Priority Street, it was assumed the subject sites will develop similar to those neighbouring lands identified in the Fernbank Community Design Plan (CDP). The Fernbank CDP considers land use area for Mixed Use to be 55% residential and 50% commercial. Given the discrepancy, it was assumed 55%

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residential and 45% commercial. **Table 1** below documents the assumptions used to estimate the total projected population of the Subject Lands.

Table 1: Projected Population Assumptions from Fernbank CDP

	Target/gross ha
Land Use Designation	Mixed Use
Land Use: Mixed Use (Residential)	55% of lands
Land Use: Mixed Use (Commercial)	45% of lands
Residential Units	90 (units / ha)
Residential Population per Mixed Use Unit	1.8 (people per unit)
Neighbourhood Commercial	50 (jobs / ha)

The total flow based on the future population is 52.4L/s, refer to **Appendix C: Planning Input.**

3.0 By-Pass Sewer Design

Based on the foregoing analysis, the future drainage areas and population/density resulted with the highest peak flow of 52.4L/s and was used for sizing purposes. A 250mm dia. sanitary sewer can adequately accommodate these flows, refer to **Appendix B: Sewer Design Sheets**.

The proposed alignment will drain northwest on Fringewood Drive from the existing maintenance hole (MHSA 09075) to tie-in to the existing 250mm dia. stub approximately 10m southeast of Hazeldean Road that connects to the Hazeldean Trunk Sewer. The approximate length is 190m with a fixed slope of 0.96% between the upstream invert of MHSA 09075 (102.41m) and the downstream invert of the stub (100.93m).

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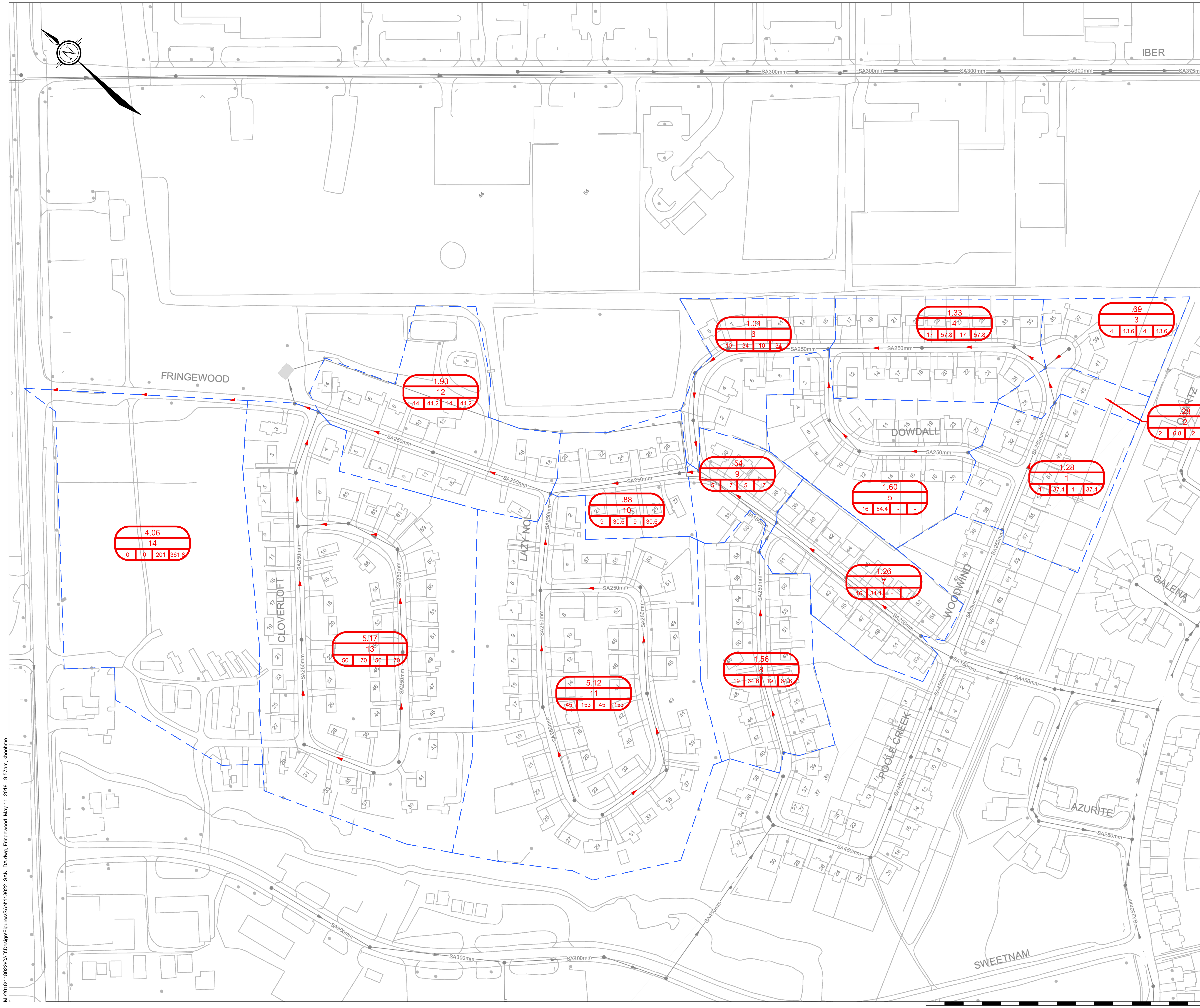
Appendix A

Drainage Areas



CITY OF OTTAWA

WEST END PUMP STATION
DECOMMISSIONING AND BY-PASS SEWERS

SANITARY DRAINAGE AREA PLAN
FRINGEWOOD PUMP STATION

ALAIN C. GONTHIER, P.Eng. *DIRECTOR*	JEFF DELOYDE, P.Eng. *SENIOR ENGINEER*

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Kanata, Ontario, Canada
K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Email: novainfo@novatech-eng.com

Contract No. ISD18-XXXX	Dwg. No. XXX
Sheet XX of XX	
Asset No.	
Asset Group ISD	
Des. KB	Chk'd. RJD
Dwn. ERA	Chk'd. KB
Utility Circ. No.	Index No.
Const. Inspector	
Scale:	

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

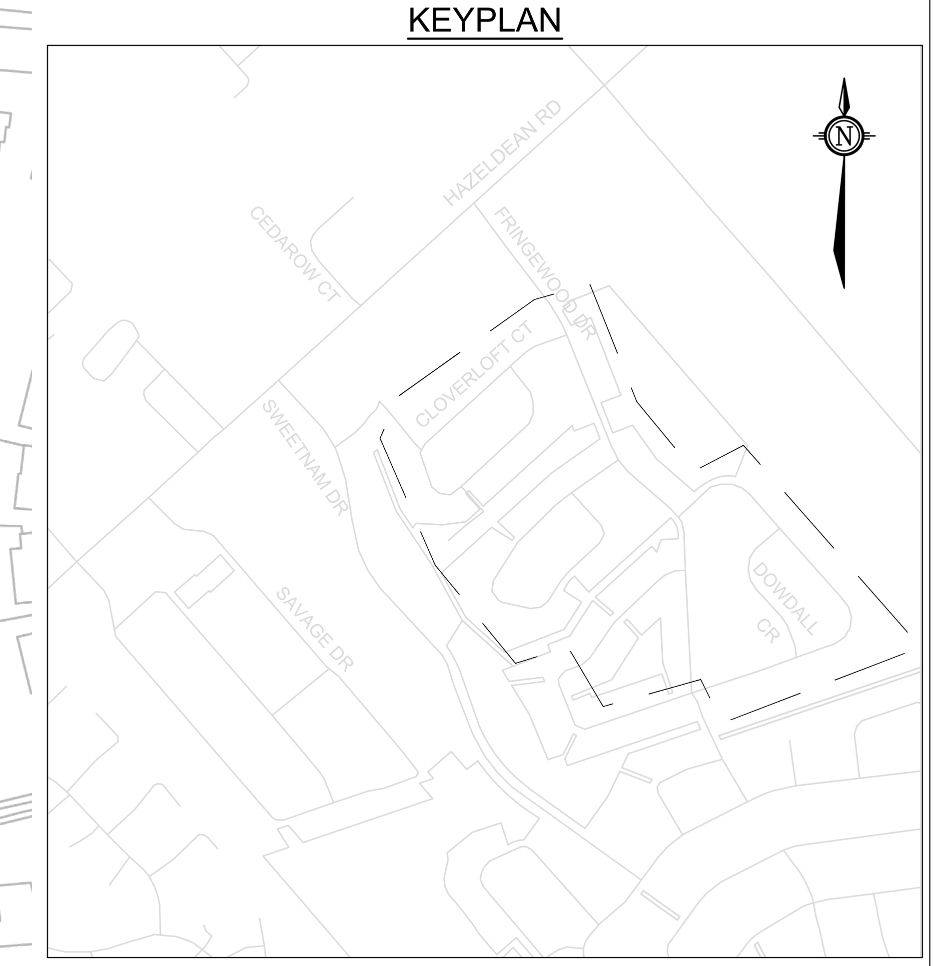
No.	Description	By	Date (dd/mm/yy)

NOT FOR CONSTRUCTION

LEGEND

AREA			
ID			
E.U.	E.P.	F.U.	F.P.

KEYPLAN



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Appendix B

Sewer Design Sheets

SAN 1 - SANITARY SEWER DESIGN SHEET
POPULATION ESTIMATE
JOB# 118022

Engineers, Planners & Landscape Architects

Sanitary Area #1 - Fringewood

Address	Type	Pop. Factor	Units	Population
Woodwind Cres				
57	Single Family	3.4	1	3.4
55	Single Family	3.4	1	3.4
53	Single Family	3.4	1	3.4
51	Single Family	3.4	1	3.4
49	Single Family	3.4	1	3.4
47	Single Family	3.4	1	3.4
45	Single Family	3.4	1	3.4
36	Single Family	3.4	1	3.4
32	Single Family	3.4	1	3.4
30	Single Family	3.4	1	3.4
Dowdall Cres				
22	Single Family	3.4	1	3.4
		Total	11	37.4

Sanitary Area #2 - Fringewood

Address	Type	Pop. Factor	Units	Population
Woodwind Cres				
43	Single Family	3.4	1	3.4
28	Single Family	3.4	1	3.4
		Total	2	6.8

Sanitary Area #3 - Fringewood

Address	Type	Pop. Factor	Units	Population
Woodwind Cres				
41	Single Family	3.4	1	3.4
39	Single Family	3.4	1	3.4
37	Single Family	3.4	1	3.4
35	Single Family	3.4	1	3.4
		Total	4	13.6

Summary Charts

Fringewood	Total	
Sanitary Area	**Units**	**Population**
1	11	37.4
2	2	6.8
3	4	13.6
4	17	57.8
5	16	54.4
6	10	34
7	16	54.4
8	19	64.6
9	5	17
10	9	30.6
11	45	153
12	14	44.2
13	50	170
14	0	0
Total	218	737.8

Sanitary Area	Area(m^2)	Area (ha)
1	12836.17	1.28
2	2800.882	0.28
3	6859.468	0.69
4	13284.591	1.33
5	15989.287	1.60
6	10100.535	1.01
7	12626.086	1.26
8	15575.105	1.56
9	5396.262	0.54
10	8788.172	0.88
11	51152.337	5.12
12	19323.086	1.93
13	51670.735	5.17
14	40600	4.06
Total	**267002.72**	26.70

SAN 1 - SANITARY SEWER DESIGN SHEET
POPULATION ESTIMATE
JOB# 118022

NOVATECH
Engineers, Planners & Landscape Architects

Sanitary Area #4 - Fringewood

Address	Type	Pop. Factor	Units	Population
Woodwind Cres				
26	Single Family	3.4	1	3.4
24	Single Family	3.4	1	3.4
22	Single Family	3.4	1	3.4
20	Single Family	3.4	1	3.4
18	Single Family	3.4	1	3.4
16	Single Family	3.4	1	3.4
14	Single Family	3.4	1	3.4
12	Single Family	3.4	1	3.4
33	Single Family	3.4	1	3.4
31	Single Family	3.4	1	3.4
29	Single Family	3.4	1	3.4
27	Single Family	3.4	1	3.4
25	Single Family	3.4	1	3.4
23	Single Family	3.4	1	3.4
21	Single Family	3.4	1	3.4
19	Single Family	3.4	1	3.4
17	Single Family	3.4	1	3.4
		Total	17	57.8

Sanitary Area #5 - Fringewood

Address	Type	Pop. Factor	Units	Population
Dowdall Cres				
27	Single Family	3.4	1	3.4
23	Single Family	3.4	1	3.4
20	Single Family	3.4	1	3.4
19	Single Family	3.4	1	3.4
18	Single Family	3.4	1	3.4
16	Single Family	3.4	1	3.4
15	Single Family	3.4	1	3.4
14	Single Family	3.4	1	3.4
12	Single Family	3.4	1	3.4
11	Single Family	3.4	1	3.4
10	Single Family	3.4	1	3.4
8	Single Family	3.4	1	3.4
7	Single Family	3.4	1	3.4
6	Single Family	3.4	1	3.4
4	Single Family	3.4	1	3.4
2	Single Family	3.4	1	3.4
		Total	16	54.4

SAN 1 - SANITARY SEWER DESIGN SHEET
POPULATION ESTIMATE
JOB# 118022

NOVATECH
Engineers, Planners & Landscape Architects

Sanitary Area #6 - Fringewood

Address	Type	Pop. Factor	Units	Population
Woodwind Cres				
15	Single Family	3.4	1	3.4
13	Single Family	3.4	1	3.4
11	Single Family	3.4	1	3.4
9	Single Family	3.4	1	3.4
8	Single Family	3.4	1	3.4
7	Single Family	3.4	1	3.4
6	Single Family	3.4	1	3.4
5	Single Family	3.4	1	3.4
4	Single Family	3.4	1	3.4
2	Single Family	3.4	1	3.4
		Total	10	34

Sanitary Area #7 - Fringewood

Address	Type	Pop. Factor	Units	Population
Fringewood Dr				
54	Single Family	3.4	1	3.4
53	Single Family	3.4	1	3.4
52	Single Family	3.4	1	3.4
51	Single Family	3.4	1	3.4
50	Single Family	3.4	1	3.4
49	Single Family	3.4	1	3.4
48	Single Family	3.4	1	3.4
47	Single Family	3.4	1	3.4
46	Single Family	3.4	1	3.4
45	Single Family	3.4	1	3.4
44	Single Family	3.4	1	3.4
43	Single Family	3.4	1	3.4
42	Single Family	3.4	1	3.4
41	Single Family	3.4	1	3.4
40	Single Family	3.4	1	3.4
38	Single Family	3.4	1	3.4
		Total	16	54.4

SAN 1 - SANITARY SEWER DESIGN SHEET
POPULATION ESTIMATE
JOB# 118022

NOVATECH
Engineers, Planners & Landscape Architects

Sanitary Area #8 - Fringewood

Address	Type	Pop. Factor	Units	Population
Poole Creek Cres				
40	Single Family	3.4	1	3.4
41	Single Family	3.4	1	3.4
42	Single Family	3.4	1	3.4
43	Single Family	3.4	1	3.4
44	Single Family	3.4	1	3.4
45	Single Family	3.4	1	3.4
46	Single Family	3.4	1	3.4
47	Single Family	3.4	1	3.4
48	Single Family	3.4	1	3.4
49	Single Family	3.4	1	3.4
50	Single Family	3.4	1	3.4
51	Single Family	3.4	1	3.4
52	Single Family	3.4	1	3.4
53	Single Family	3.4	1	3.4
54	Single Family	3.4	1	3.4
55	Single Family	3.4	1	3.4
56	Single Family	3.4	1	3.4
58	Single Family	3.4	1	3.4
60	Single Family	3.4	1	3.4
		Total	19	64.6

Sanitary Area #9 - Fringewood

Address	Type	Pop. Factor	Units	Population
Fringewood Dr				
36	Single Family	3.4	1	3.4
34	Single Family	3.4	1	3.4
33	Single Family	3.4	1	3.4
32	Single Family	3.4	1	3.4
30	Single Family	3.4	1	3.4
		Total	5	17

Sanitary Area #10 - Fringewood

Address	Type	Pop. Factor	Units	Population
Fringewood Dr				
28	Single Family	3.4	1	3.4
27	Single Family	3.4	1	3.4
26	Single Family	3.4	1	3.4
25	Single Family	3.4	1	3.4
24	Single Family	3.4	1	3.4
23	Single Family	3.4	1	3.4
22	Single Family	3.4	1	3.4
21	Single Family	3.4	1	3.4
20	Single Family	3.4	1	3.4
		Total	9	30.6

SAN 1 - SANITARY SEWER DESIGN SHEET
POPULATION ESTIMATE
JOB# 118022

NOVATECH
Engineers, Planners & Landscape Architects

Sanitary Area #11 - Fringewood

Address	Type	Pop. Factor	Units	Population
Lazy Nol Crt				
1	Single Family	3.4	1	3.4
2	Single Family	3.4	1	3.4
3	Single Family	3.4	1	3.4
4	Single Family	3.4	1	3.4
5	Single Family	3.4	1	3.4
7	Single Family	3.4	1	3.4
8	Single Family	3.4	1	3.4
9	Single Family	3.4	1	3.4
10	Single Family	3.4	1	3.4
11	Single Family	3.4	1	3.4
12	Single Family	3.4	1	3.4
14	Single Family	3.4	1	3.4
15	Single Family	3.4	1	3.4
16	Single Family	3.4	1	3.4
17	Single Family	3.4	1	3.4
18	Single Family	3.4	1	3.4
19	Single Family	3.4	1	3.4
20	Single Family	3.4	1	3.4
21	Single Family	3.4	1	3.4
22	Single Family	3.4	1	3.4
23	Single Family	3.4	1	3.4
25	Single Family	3.4	1	3.4
27	Single Family	3.4	1	3.4
29	Single Family	3.4	1	3.4
31	Single Family	3.4	1	3.4
32	Single Family	3.4	1	3.4
33	Single Family	3.4	1	3.4
35	Single Family	3.4	1	3.4
37	Single Family	3.4	1	3.4
39	Single Family	3.4	1	3.4
40	Single Family	3.4	1	3.4
41	Single Family	3.4	1	3.4
42	Single Family	3.4	1	3.4
43	Single Family	3.4	1	3.4
44	Single Family	3.4	1	3.4
45	Single Family	3.4	1	3.4
46	Single Family	3.4	1	3.4
47	Single Family	3.4	1	3.4
48	Single Family	3.4	1	3.4
49	Single Family	3.4	1	3.4
51	Single Family	3.4	1	3.4
52	Single Family	3.4	1	3.4
53	Single Family	3.4	1	3.4
55	Single Family	3.4	1	3.4
57	Single Family	3.4	1	3.4
		Total	45	153

SAN 1 - SANITARY SEWER DESIGN SHEET
POPULATION ESTIMATE
JOB# 118022

NOVATECH
Engineers, Planners & Landscape Architects

Sanitary Area #12 - Fringewood

Address	Type	Pop. Factor	Units	Population
Fringewood Dr				
18	Single Family	3.4	1	3.4
17	Single Family	3.4	1	3.4
16	Single Family	3.4	1	3.4
15	Single Family	3.4	1	3.4
14	Commercial	FALSE	1	0
12	Single Family	3.4	1	3.4
11	Single Family	3.4	1	3.4
10	Single Family	3.4	1	3.4
9	Single Family	3.4	1	3.4
8	Single Family	3.4	1	3.4
7	Single Family	3.4	1	3.4
6	Single Family	3.4	1	3.4
5	Single Family	3.4	1	3.4
4	Single Family	3.4	1	3.4
		Total	14	44.2

Sanitary Area #13 - Fringewood

Address	Type	Pop. Factor	Units	Population
Cloverloft Crt				
3	Single Family	3.4	1	3.4
4	Single Family	3.4	1	3.4
5	Single Family	3.4	1	3.4
6	Single Family	3.4	1	3.4
7	Single Family	3.4	1	3.4
9	Single Family	3.4	1	3.4
10	Single Family	3.4	1	3.4
11	Single Family	3.4	1	3.4
15	Single Family	3.4	1	3.4
16	Single Family	3.4	1	3.4
17	Single Family	3.4	1	3.4
18	Single Family	3.4	1	3.4
19	Single Family	3.4	1	3.4
20	Single Family	3.4	1	3.4
21	Single Family	3.4	1	3.4
22	Single Family	3.4	1	3.4
23	Single Family	3.4	1	3.4
24	Single Family	3.4	1	3.4
25	Single Family	3.4	1	3.4
26	Single Family	3.4	1	3.4
27	Single Family	3.4	1	3.4
28	Single Family	3.4	1	3.4

SAN 1 - SANITARY SEWER DESIGN SHEET
POPULATION ESTIMATE
JOB# 118022

NOVATECH
Engineers, Planners & Landscape Architects

29	Single Family	3.4	1	3.4
31	Single Family	3.4	1	3.4
33	Single Family	3.4	1	3.4
35	Single Family	3.4	1	3.4
37	Single Family	3.4	1	3.4
38	Single Family	3.4	1	3.4
39	Single Family	3.4	1	3.4
41	Single Family	3.4	1	3.4
43	Single Family	3.4	1	3.4
44	Single Family	3.4	1	3.4
45	Single Family	3.4	1	3.4
46	Single Family	3.4	1	3.4
47	Single Family	3.4	1	3.4
48	Single Family	3.4	1	3.4
49	Single Family	3.4	1	3.4
50	Single Family	3.4	1	3.4
51	Single Family	3.4	1	3.4
52	Single Family	3.4	1	3.4
53	Single Family	3.4	1	3.4
54	Single Family	3.4	1	3.4
55	Single Family	3.4	1	3.4
56	Single Family	3.4	1	3.4
57	Single Family	3.4	1	3.4
59	Single Family	3.4	1	3.4
61	Single Family	3.4	1	3.4
63	Single Family	3.4	1	3.4
65	Single Family	3.4	1	3.4
Fringewood Dr				
3	Single Family	3.4	1	3.4
		Total	50	170

Sanitary Area #14 - Fringewood

Orchard Drive				
5		FALSE	0	0
		Total	0	0

SAN 2 - SANITARY SEWER DESIGN SHEET
FUTURE POPULATION ESTIMATE
JOB# 118022

NOVATECH
Engineers, Planners & Landscape Architects

Sanitary Area	Area (ha)	Existing Units	Total		Future Units		Total	
		Sing. Family	Units	Pop.	Apart.	Sing. Family	Units	Pop.
Fringewood								
1	1.28	11	11	37.4	0	11	11	37.4
2	0.28	2	2	6.8	0	2	2	6.8
3	0.69	4	4	13.6	0	4	4	13.6
4	1.33	17	17	57.8	0	17	17	57.8
5	1.60	16	16	54.4	0	16	16	54.4
6	1.01	10	10	34	0	10	10	34.0
7	1.26	16	16	54.4	0	16	16	54.4
8	1.56	19	19	64.6	0	19	19	64.6
9	0.54	5	5	17	0	5	5	17.0
10	0.88	9	9	30.6	0	9	9	30.6
11	5.12	45	45	153	0	45	45	153.0
12	1.93	14	14	44.2	0	14	14	47.6
13	5.17	50	50	170	0	50	50	170.0
14	4.06	0	0	0	201	0	201	361.8

[1] Forecasted dwelling units are calculated based on growth projections prepared by Novatech's planning staff. The number of dwelling units applies a unit factor per hectare to determine the number of units based on expected development potential in the project area. The factors were provided from planning staff for each area.

SAN 3 - SANITARY SEWER DESIGN SHEET
JOB# 118022

NOVATECH
Engineers, Planners & Landscape Architects

EXISTING FLOW

LOCATION				RESIDENTIAL AREA AND POPULATION						COMMERCIAL/INSTITUTIONAL			INFILTRATION				OTHER EXTRANEOUS FLOWS			FLOW	SEWER DATA							
STREET	MANHOLES FROM	MANHOLES TO	AREA ID	Area (ha)	Pop.	Cumulative Area (ha)	Cumulative Pop.	Peak Factor	Peak Flow (l/s)	Area (ha)	Peak Factor	Peak Flow (l/s)	Total Area (ha)	Infiltration Flow (l/s)	Found. Drain Allowance (l/s)	Combined Add. Flow (l/s)	Rev. Slope Driveways (l/s)	Flat Roofs (l/s)	Combined Ext Flows (l/s)	Total Flow (l/s)	Type of Pipe	Length (m)	Diameter Actual (mm)	Diameter Nominal (mm)	SLOPE	Velocity (Full) (m/s)	Capacity (Full) (l/s)	Ratio Q/Qfull (%)
Woodwind			1	1.28	37.4	1.28	37.4	4.00	0.48				1.28	0.36	1.80	2.16				2.64	PVC	156.9	254	250	1.00	1.22	62.0	4%
			2	0.28	6.8	1.56	44.20	4.00	0.57				0.28	0.08	0.39	0.47				3.20	PVC	41.6	254	250	1.00	1.22	62.0	5%
			3	0.69	13.6	0.69	13.6	4.00	0.18				0.69	0.19	0.96	1.15				1.33	PVC	34.2	254	250	1.00	1.22	62.0	2%
			4	1.33	57.8	3.58	115.60	4.00	1.50				1.33	0.37	1.86	2.23				7.51	PVC	255.2	254	250	1.00	1.22	62.0	12%
Dowdall			5	1.60	54.4	1.60	54.4	4.00	0.71				1.60	0.45	2.24	2.69				3.39	PVC	255.0	254	250	1.00	1.22	62.0	5%
Woodwind			6	1.01	34	6.19	204.00	4.00	2.64				1.01	0.28	1.41	1.70				13.04	PVC	227.3	254	250	1.00	1.22	62.0	21%
Fringewood			7	1.26	54.4	1.26	54.4	4.00	0.71				1.26	0.35	1.77	2.12				2.83	PVC	210.3	254	250	0.60	0.95	48.0	6%
Poole Creek			8	1.56	64.6	1.56	64.6	4.00	0.84				1.56	0.44	2.18	2.62				3.45	PVC	272.0	254	250	1.00	1.22	62.0	6%
Fringewood			9	0.54	17	3.36	136.00	4.00	1.76				0.54	0.15	0.76	0.91				17.80	PVC	106.3	254	250	0.60	0.95	48.0	37%
			10	0.88	30.6	10.43	370.60	4.00	4.80				0.88	0.25	1.23	1.48				22.32	PVC	141.9	254	250	0.40	0.77	39.2	57%
Lazy Nol			11	5.12	153	5.12	153	4.00	1.98				5.12	1.43	7.16	8.59				10.58	PVC	772.8	254	250	1.00	1.22	62.0	17%
Fringewood			12	1.93	44.2	17.47	567.80	3.95	7.26	0.02	1.5	0.01	1.95	0.55	2.73	3.27				36.65	PVC	281.2	254	250	0.40	0.77	39.2	93%
Cloverloft			13	5.17	170	5.17	170	4.00	2.20				5.17	1.45	7.23	8.68				10.88	PVC	835.1	254	250	1.00	1.22	62.0	18%
Fringewood			14																									
			Outlet			22.64	737.80	3.88	9.28											47.35	PVC	190.0	254	250	0.96	1.20	60.7	78%

FUTURE FLOW (PEAK DESIGN FLOW)

LOCATION				RESIDENTIAL AREA AND POPULATION						COMMERCIAL/INSTITUTIONAL			INFILTRATION				OTHER EXTRANEOUS FLOWS			FLOW	SEWER DATA							
STREET	MANHOLES FROM	MANHOLES TO	AREA ID	Area (ha)	Pop.	Cumulative Area (ha)	Cumulative Pop.	Peak Factor	Peak Flow (l/s)	Area (ha)	Peak Factor	Peak Flow (l/s)	Total Area (ha)	Infiltration Flow (l/s)	Found. Drain Allowance (l/s)	Combined Add. Flow (l/s)	Rev. Slope Driveways (l/s)	Flat Roofs (l/s)	Combined Ext Flows (l/s)	Total Flow (l/s)	Type of Pipe	Length (m)	Diameter Actual (mm)	Diameter Nominal (mm)	SLOPE	Velocity (Full) (m/s)	Capacity (Full) (l/s)	Ratio Q/Qfull (%)
Woodwind			1	1.28	37.4	1.28	37.4	4.00	0.48				1.28	0.36	1.80	2.16				2.64	PVC	156.9	254	250	1.00	1.22	62.0	4%
			2	0.28	6.8	1.56	44.20	4.00	0.57				0.28	0.08	0.39	0.47				3.20	PVC	41.6	254	250	1.00	1.22	62.0	5%
			3	0.69	13.6	0.69	13.6	4.00	0.18				0.69	0.19	0.96	1.15				1.33	PVC	34.2	254	250	1.00	1.22	62.0	2%
			4	1.33	57.8	3.58	115.60	4.00	1.50				1.33	0.37	1.86	2.23				7.51	PVC	255.2	254	250	1.00	1.22	62.0	12%
Dowdall			5	1.60	54.4	1.60	54.4	4.00	0.71				1.60	0.45	2.24	2.69				3.39	PVC	255.0	254	250	1.00	1.22	62.0	5%
Woodwind			6	1.01	34	6.19	204.00	4.00	2.64				1.01	0.28	1.41	1.70				13.04	PVC	227.3	254	250	1.00	1.22	62.0	21%
Fringewood			7	1.26	54.4	1.26	54.4	4.00	0.71				1.26	0.35	1.77	2.12				2.83	PVC	210.3	254	250	0.60	0.95	48.0	6%
Poole Creek			8	1.56	64.6	1.56	64.6	4.00	0.84				1.56	0.44	2.18	2.62				3.45	PVC	272.0	254	250	1.00	1.22	62.0	6%
Fringewood			9	0.54	17	3.36	136.00	4.00	1.76				0.54	0.15	0.76	0.91				17.80	PVC	106.3	254	250	0.60	0.95	48.0	37%
			10	0.88	30.6	10.43	370.60	4.00	4.80				0.88	0.25	1.23	1.48				22.32	PVC	141.9	254	250	0.40	0.77	39.2	57%
Lazy Nol			11	5.12	153	5.12	153	4.00	1.98				5.12	1.43	7.16	8.59				10.58	PVC	772.8	254	250	1.00	1.22	62.0	17%
Fringewood			12	1.93	47.6	17.47	571.20	3.94	7.30	0.02	1.5	0.01	1.95	0.55	2.73	3.27				36.69	PVC	281.2	254	250	0.40	0.77	39.2	94%
Cloverloft			13	5.17	170	5.17	170	4.00	2.20				5.17	1.45	7.23	8.68				10.88	PVC	835.1	254	250	1.00	1.22	62.0	18%
Fringewood			14	4.06	361.8	26.70	1103.00	3.77	13.48	1.83	1.5	0.89								52.44	PVC	190.0	254	250	0.96	1.20	60.7	86%
			Outlet			26.70	1103.00	3.77	13.48											52.44	PVC	190.0	254	250	0.96	1.20	60.7	86%

DESIGN PARAMETERS

DEFINITIONS:

Residential Flow = 280L/person/day

Commercial/Institutional Flow = 28,000L/gross ha/day

Harmon Equation: $PF = 1 + \left(\frac{14}{4 + \left(\frac{P}{1000}\right)^{\frac{1}{2}}}\right) * K$, where

P = Population

K = Correction Factor (0.8)

*If the commercial/institutional area <20 % of total area, then K = 1.0

Infiltration Flow = 0.33L/s/effective gross ha

Foundation Drain Allowance = 1.4L/s/gross ha (less than 10 ha.)

Extraneous Flows: Q = 2.78 CIA (l/s), where

A = Area (ha)

I = Rainfall Intensity (mm/hr)

C = Runoff Coefficient

NOTES:

1) Design Flow Rates are based on the formulas located in the City of Ottawa Sewer Design Guidelines.

2) Population totals are based on current and anticipated residential intensification rates. (Refer to Section 4.0: Development Review of the Preliminary Design Report.)

3) Existing sanitary sewers are indicated in italics.

4) Peak Factors were calculated using the Harmon Equation.

5) Extraneous Flows are based on City of Ottawa IDF Curve 5 Year intensity with Minimum Time of Concentration of 10 min.

PROJECT INFORMATION

SANITARY DESIGN: NOVATECH

PROJECT: West End PS Decommissioning and By-Pass Sewers

CLIENT: City of Ottawa

DATE: May 16, 2018

DESIGNED: KB

CHECKED: RJD

DWG. REFERENCE: 118022_SAN_DA.dwg

Appendix C

Planning Input

Fringewood Properties

May 16, 208 Teresa Thomas

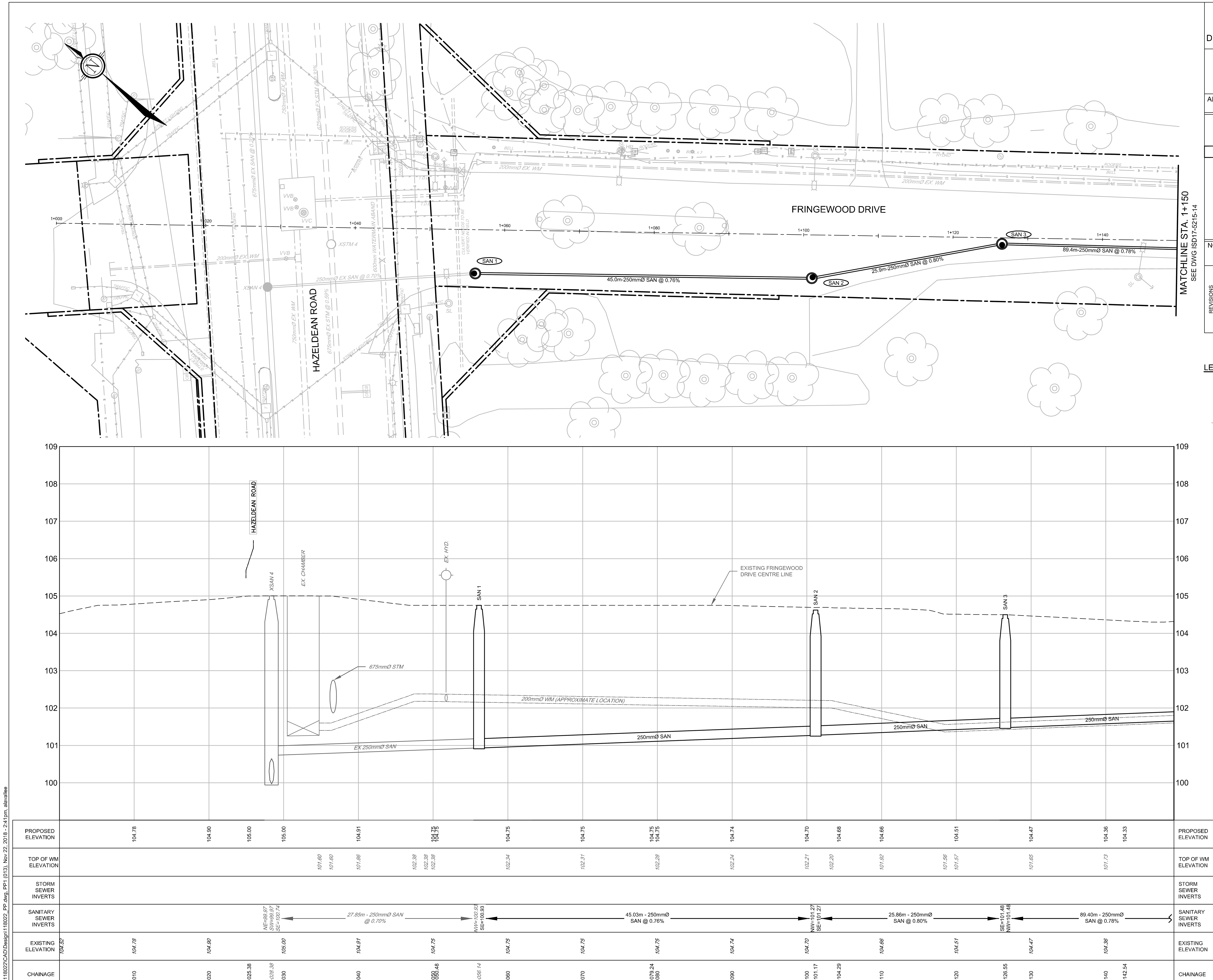
				Current Zoning			Projected Growth and Development					
Drainage Study Area ID	Property ID	Property Area (net ha)	Drainage Study Area (gross ha)	Zoning	Height Limit	Highest Density Permitted Use as per Zoning By-law	Anticipated Future Land Use* - based on current zoning or policy plans	Density, Residential (Units / Gross Ha Mixed Use*)	Residential Area	Commercial Area	Residential Population	Assumptions
14	PIN 044630331	3.8595	4.06	AM9	15m	Mixed Use with mid-rise apartment	Mixed Use (55% residential, 45% commercial/gross ha)	201	2.23	1.83	362	1, 2, 3
	Remainder Drainage Area	0.2005		AM9								

Assumptions

1 Given that Hazeldean is a Transit Priority Street we assume the Subject Sites will develop similarly to those neighbouring lands identified in the Fernbank CDP.

2 The fernbank CDP considers land use area for Mixed Use to be 55% residential and 50% commercial. Given the discrepancy, we have assumed 55% residential and 45% commercial.

3 People per Mixed Use unit taken from Fernbank CDP (1.8ppl/unit)



CITY OF OTTAWA

WEST END PUMP STATION DECOMMISSIONING AND BY-PASS SEWERS

PLAN AND PROFILE

FRINGEWOOD DRIVE - STA. 1+000 TO 1+150

Contract No. ISD17-5215	Dwg. No. 13
Sheet 13 of 39	
Asset No.	
Asset Group	ISD
Des. KB	Chk'd. RJD
Dwn. AJL	Chk'd. KB
Utility Circ. No.	Index No.
Const. Inspector	

Scale: HORIZONTAL 1:250, VERTICAL 1:50

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Email: novainfo@novatech-eng.com

FOR REVIEW ONLY | FOR REVIEW ONLY

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

No.	Description	By	Date (dd/mm/yy)
1.	ISSUED FOR PRELIMINARY DESIGN CIRCULATION	RJD	25/07/18

NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED SANITARY MANHOLE
- EXISTING SANITARY MANHOLE
- EXISTING STORM MANHOLE
- EXISTING SANITARY SERVICE
- EXISTING FIRE HYDRANT
- VB EXISTING VALVE BOX

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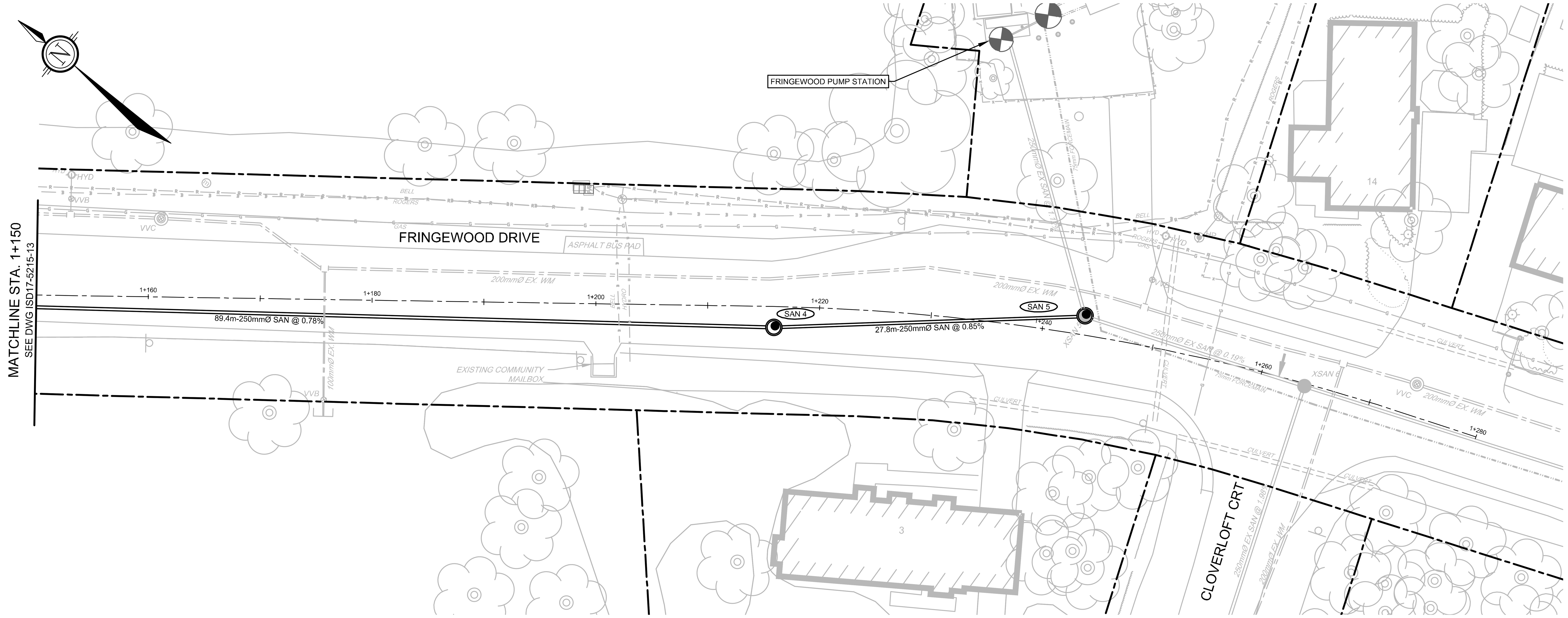

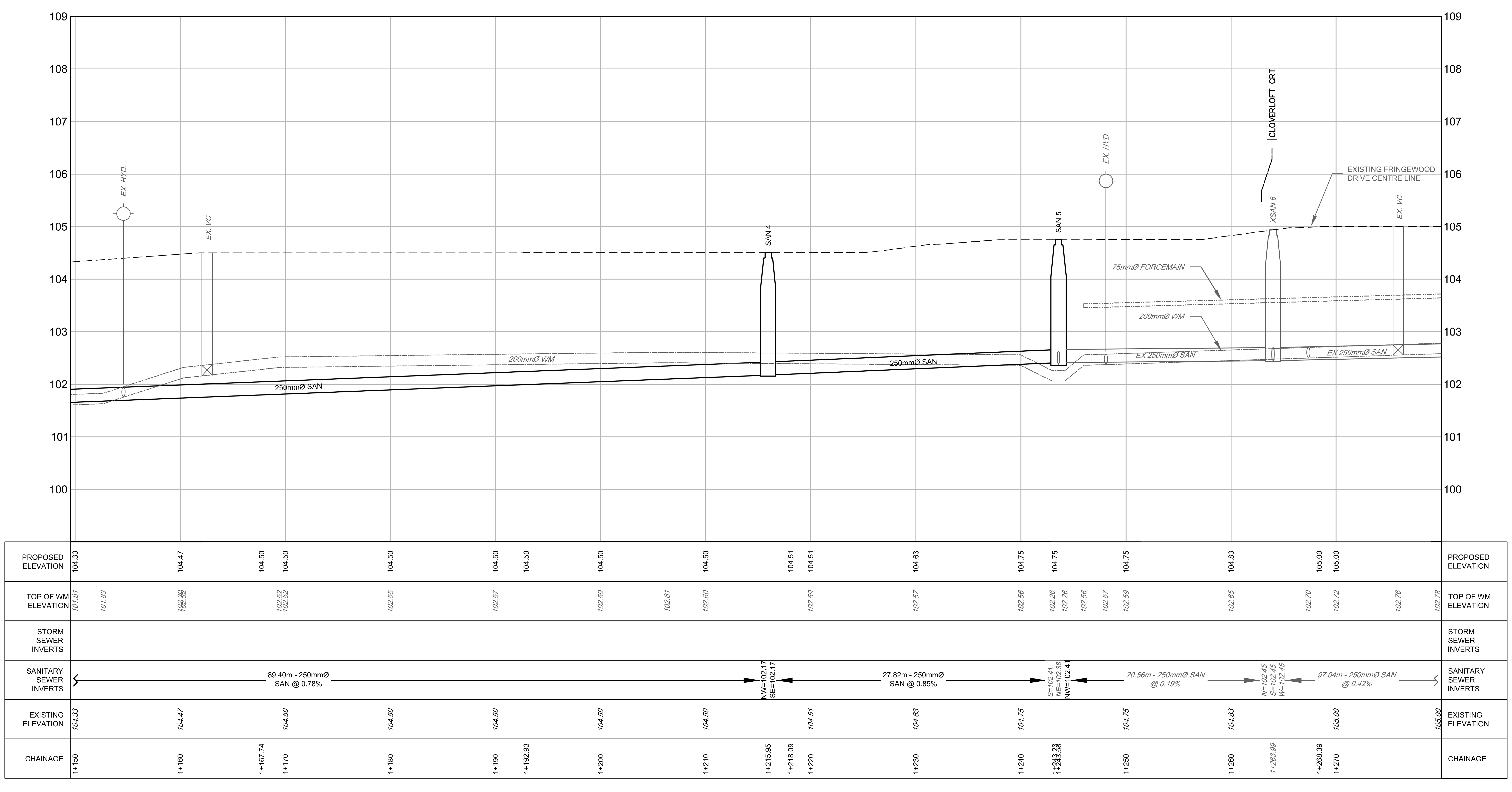

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CITY OF OTTAWA
WEST END PUMP STATION DECOMMISSIONING AND BY-PASS SEWERS

Ottawa

Contract No.	Dwg. No.
ISD17-5215	14

Sheet 14 of 39

PLAN AND PROFILE
FRINGEWOOD DRIVE - STA. 1+150 TO 1+300

Asset No.

Asset Group: ISD

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Des.	Chk'd.
KB	RJD
Dwn.	**Chk'd.**
AJL	KB
Utility Circ. No.	Index No.

FOR REVIEW ONLY | FOR REVIEW ONLY

Const. Inspector

Scale: HORIZONTAL 1:250 (0 2 4 6 8 10); VERTICAL 1:50 (0 0.4 0.8 1.2 1.6 2)

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

No.	Description	By	Date (dd/mm/yy)
1.	ISSUED FOR PRELIMINARY DESIGN CIRCULATION	RJD	25/07/18

NOT FOR CONSTRUCTION

LEGEND:

- PROPOSED SANITARY MANHOLE
- EXISTING SANITARY MANHOLE
- EXISTING STORM MANHOLE
- EXISTING SANITARY SERVICE
- EXISTING FIRE HYDRANT
- VB EXISTING VALVE BOX

APPENDIX D

Stormwater Management

Estimated Peak Stormwater Flow Rate
City of Ottawa Sewer Design Guidelines, 2012

Tc Calculation / Peak Flow to DICB1 (DICB1)

Area	3.14	ha
C	0.26	Rational Method runoff coefficient
L	287.2	m
Up Elev	107.88	m
Dn Elev	103.98	m
Slope	1.4	%
Tc	41.9	min

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1-C)L^{0.5}}{S^{0.333}}$$

tc, in minutes
C, rational method coefficient, (-)
L, length in ft
S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year	
i	31.8	42.7	72.7	mm/hr
Q	72.1	96.9	206.0	L/s

Tc Calculation / Peak Flow to DICB2 (DICB2)

Area	0.78	ha
C	0.22	Rational Method runoff coefficient
L	151	m
Up Elev	104.68	m
Dn Elev	103.65	m
Slope	0.7	%
Tc	40.0	min

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1-C)L^{0.5}}{S^{0.333}}$$

tc, in minutes
C, rational method coefficient, (-)
L, length in ft
S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year	
i	32.8	44.1	75.1	mm/hr
Q	15.6	21.0	44.6	L/s

Tc Calculation / Peak Flow to Poole's Creek (Area P1)

Area	0.05	ha
C	0.36	Rational Method runoff coefficient
L	15	m
Up Elev	107.25	m
Dn Elev	106.74	m
Slope	3.4	%
Tc	10.0	min

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1-C)L^{0.5}}{S^{0.333}}$$

tc, in minutes
C, rational method coefficient, (-)
L, length in ft
S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year	
i	76.8	104.2	178.6	mm/hr
Q	3.5	4.7	10.0	L/s

Runoff Coefficient Calculations for Existing Drainage Areas

DICB1

	Perv.	Imperv.	Total
Area	3.01	0.29	3.30
C	0.20	0.90	0.26

DICB2

	Perv.	Imperv.	Total
Area	0.76	0.02	0.78
C	0.20	0.90	0.22

MH400, MH405 & MH413

	Perv.	Imperv.	Total
Area	0.00	0.59	0.59
C	0.20	0.70	0.70

EX2

	Perv.	Imperv.	Total
Area	0.33	0.09	0.42
C	0.20	0.90	0.35

EX3

	Perv.	Imperv.	Total
Area	0.09	0.02	0.11
C	0.20	0.90	0.34

EX4

	Perv.	Imperv.	Total
Area	0.03	0.16	0.19
C	0.20	0.90	0.79

EX5

	Perv.	Imperv.	Total
Area	2.06	1.15	3.21
C	0.20	0.90	0.45

U1

	Perv.	Imperv.	Total
Area	0.04	0.01	0.05
C	0.20	0.90	0.32

Composite RC for 100-Year Storm(DICB1)

	Perv.	Imperv.	Total
Area	3.34	0.38	3.72
C	0.20	0.90	0.27

Composite RC for 100-Year Storm(DICB2)

	Perv.	Imperv.	Total
Area	2.93	1.35	4.29
C	0.20	0.90	0.42

Estimated Peak Stormwater Flow Rate
City of Ottawa Sewer Design Guidelines, 2012

DSEL

Tc Calculation / Peak Flow from EX 6

Area	0.150	ha
C	0.55	Rational Method runoff coefficient
L	33	m
Up Elev	106.6	m
Dn Elev	105.2	m
Slope	4.2	%
Tc	10.0	min

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1 - C)L^{0.5}}{S^{0.333}}$$

tc, in minutes
C, rational method coefficient, (-)
L, length in ft
S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year	
i	76.8	104.2	178.6	mm/hr
Q	17.6	23.9	51.1	L/s

Tc Calculation / Peak Flow from EX2

Area	0.422	ha
C	0.35	Rational Method runoff coefficient
L	38	m
Up Elev	106.25	m
Dn Elev	105.09	m
Slope	3.1	%
Tc	10.4	min

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1 - C)L^{0.5}}{S^{0.333}}$$

tc, in minutes
C, rational method coefficient, (-)
L, length in ft
S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year	
i	75.3	102.2	175.0	mm/hr
Q	30.9	41.9	89.8	L/s

Tc Calculation / Peak Flow from EX3

Area	0.112	ha
C	0.34	Rational Method runoff coefficient
L	50	m
Up Elev	105.5	m
Dn Elev	104.21	m
Slope	2.6	%
Tc	12.8	min

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1 - C)L^{0.5}}{S^{0.333}}$$

tc, in minutes
C, rational method coefficient, (-)
L, length in ft
S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year	
i	67.6	91.5	156.6	mm/hr
Q	7.1	9.7	20.7	L/s

Tc Calculation / Peak Flow from EX4

Area	0.192	ha
C	0.79	Rational Method runoff coefficient
L	120	m
Up Elev	104.82	m
Dn Elev	104.44	m
Slope	0.3	%
Tc	16.2	min

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1 - C)L^{0.5}}{S^{0.333}}$$

tc, in minutes
C, rational method coefficient, (-)
L, length in ft
S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year	
i	59.0	79.8	136.3	mm/hr
Q	24.9	33.6	71.8	L/s

Tc Calculation / Peak Flow from EX5

Area	3.210	ha
C	0.45	Rational Method runoff coefficient
L	405	m
Up Elev	110	m
Dn Elev	103.75	m
Slope	1.5	%
Tc	36.9	min

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1 - C)L^{0.5}}{S^{0.333}}$$

tc, in minutes
C, rational method coefficient, (-)
L, length in ft
S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year	
i	34.8	46.8	79.6	mm/hr
Q	139.5	187.6	399.0	L/s

Tc Calculation / Peak Flow from MH 400, MH 405 and MH 413

Area	0.600	ha
C	0.70	Rational Method runoff coefficient
L	233	m
Up Elev	106.23	m
Dn Elev	104.2	m
Slope	0.9	%
Tc	20.8	min

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1 - C)L^{0.5}}{S^{0.333}}$$

tc, in minutes
C, rational method coefficient, (-)
L, length in ft
S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year	
i	50.7	68.5	116.9	mm/hr
Q	59.2	79.9	170.4	L/s

Post-Development Flow Directed to DICB2

Area EX4	0.190	ha
C	0.79	Rational Method runoff coefficient
Area MH400, MH405 and MH413	0.600	ha
C	0.70	Rational Method runoff coefficient

Estimated Peak Flow

	2-year	5-year	100-year	
Q	84.0	113.5	242.2	L/s

Estimated DICB Release Rate
City of Ottawa Sewer Design Guidelines, 2012

Orifice Equation DICB1			**Orifice Equation DICB2**		
Diameter of DICB Lead	0.375	m	Diameter of DICB Lead	0.375	m
Area of Orfice	0.110447	m2	Area of Orfice	0.110447	m2
Head	1.49	m	Head	1.8	m
Q=	364	L/s	Q=	400	L/s

Stormwater - Proposed Development
City of Ottawa Sewer Design Guidelines, 2012

Target Flow Rate - Per Hazeldean Road Widening Poole Creek to Terry Fox Drive Stormwater Management prepared by IBI Group November 2009

	External Area Per IBI Report	Subject Site contemplated in IBI Report	
Total External Area (Ha)	3.84	3.08	
Chicago 3 Hr - 100 Year Flow (L/s)	628.0	503.7	<--- 80% of Total Flow per Percentage of Subject Site

Estimated Post Development Peak Flow from Unattenuated Areas

Area ID U1
Total Area 0.01 ha
C 0.20 Rational Method runoff coefficient

	5-year					100-year				
t_c (min)	i (mm/hr)	Q_{actual} (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)	i (mm/hr)	Q_{actual}* (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)
10.0	104.2	0.6	0.6	0.0	0.0	178.6	1.2	1.2	0.0	0.0

Note:
C value for the 100-year storm is increased by 25%, to a maximum of 1.0 per Ottawa Sewer Design Guidelines (5.4.5.2.1)

Estimated Post Development Peak Flow from Attenuated Areas

Area ID Residential
Total Area 2.12 ha
C 0.62 Rational Method runoff coefficient

	5-year					100-year				
t_c (min)	i (mm/hr)	Q_{actual} (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)	i (mm/hr)	Q_{actual} (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)
10	104.2	380.4	233.4	147.0	88.2	178.6	814.9	400.0	414.9	249.0
15	83.6	305.1	233.4	71.7	64.5	142.9	652.2	400.0	252.2	226.9
20	70.3	256.5	233.4	23.1	27.7	120.0	547.4	400.0	147.4	176.9
25	60.9	222.3	233.4	0.0	0.0	103.8	473.9	400.0	73.9	110.9
30	53.9	196.9	233.4	0.0	0.0	91.9	419.3	400.0	19.3	34.7
35	48.5	177.1	233.4	0.0	0.0	82.6	376.9	400.0	0.0	0.0
40	44.2	161.3	233.4	0.0	0.0	75.1	343.0	400.0	0.0	0.0
45	40.6	148.3	233.4	0.0	0.0	69.1	315.1	400.0	0.0	0.0
50	37.7	137.5	233.4	0.0	0.0	64.0	291.9	400.0	0.0	0.0
55	35.1	128.2	233.4	0.0	0.0	59.6	272.1	400.0	0.0	0.0
60	32.9	120.3	233.4	0.0	0.0	55.9	255.1	400.0	0.0	0.0
65	31.0	113.3	233.4	0.0	0.0	52.6	240.3	400.0	0.0	0.0
70	29.4	107.2	233.4	0.0	0.0	49.8	227.2	400.0	0.0	0.0
75	27.9	101.8	233.4	0.0	0.0	47.3	215.7	400.0	0.0	0.0
80	26.6	97.0	233.4	0.0	0.0	45.0	205.3	400.0	0.0	0.0
85	25.4	92.6	233.4	0.0	0.0	43.0	196.0	400.0	0.0	0.0
90	24.3	88.7	233.4	0.0	0.0	41.1	187.6	400.0	0.0	0.0
95	23.3	85.1	233.4	0.0	0.0	39.4	180.0	400.0	0.0	0.0
100	22.4	81.8	233.4	0.0	0.0	37.9	173.0	400.0	0.0	0.0
105	21.6	78.8	233.4	0.0	0.0	36.5	166.6	400.0	0.0	0.0
110	20.8	76.0	233.4	0.0	0.0	35.2	160.7	400.0	0.0	0.0

Note:
C value for the 100-year storm is increased by 25%, to a maximum of 1.0 per Ottawa Sewer Design Guidelines (5.4.5.2.1)

5-year $Q_{attenuated}$	**233.41**	**L/s**	**100-year $Q_{attenuated}$**	**400.00**	**L/s**
5-year Max. Storage Required	**88.2**	**m^3**	**100-year Max. Storage Required**	**249.0**	**m^3**

Estimated Post Development Peak Flow from Attenuated Areas

Area ID Commercial (A4)
Total Area 1.82 ha
C 0.90 Rational Method runoff coefficient

	5-year					100-year				
t_c (min)	i (mm/hr)	Q_{actual} (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)	i (mm/hr)	Q_{actual} (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)
10	104.2	474.1	60.5	413.6	248.2	178.6	902.7	103.7	799.1	479.4
15	83.6	380.2	60.5	319.7	287.7	142.9	722.4	103.7	618.8	556.9
20	70.3	319.6	60.5	259.2	311.0	120.0	606.4	103.7	502.8	603.3
25	60.9	277.1	60.5	216.6	324.9	103.8	525.0	103.7	421.3	632.0
30	53.9	245.4	60.5	184.9	332.8	91.9	464.4	103.7	360.8	649.4
35	48.5	220.8	60.5	160.3	336.6	82.6	417.5	103.7	313.8	659.0
40	44.2	201.0	60.5	140.6	337.3	75.1	379.9	103.7	276.2	663.0
45	40.6	184.9	60.5	124.4	335.8	69.1	349.1	103.7	245.4	662.7
50	37.7	171.3	60.5	110.8	332.5	64.0	323.3	103.7	219.7	659.0
55	35.1	159.8	60.5	99.3	327.8	59.6	301.4	103.7	197.8	652.7
60	32.9	149.9	60.5	89.4	321.9	55.9	282.6	103.7	178.9	644.1
65	31.0	141.2	60.5	80.8	315.0	52.6	266.2	103.7	162.5	633.8
70	29.4	133.6	60.5	73.2	307.3	49.8	251.7	103.7	148.1	621.8
75	27.9	126.9	60.5	66.4	298.8	47.3	238.9	103.7	135.2	608.6
80	26.6	120.9	60.5	60.4	289.8	45.0	227.5	103.7	123.8	594.2
85	25.4	115.4	60.5	54.9	280.2	43.0	217.2	103.7	113.5	578.8
90	24.3	110.5	60.5	50.0	270.1	41.1	207.8	103.7	104.2	562.6
95	23.3	106.0	60.5	45.6	259.7	39.4	199.4	103.7	95.7	545.5
100	22.4	102.0	60.5	41.5	248.8	37.9	191.6	103.7	88.0	527.8
105	21.6	98.2	60.5	37.7	237.6	36.5	184.5	103.7	80.9	509.4
110	20.8	94.7	60.5	34.3	226.1	35.2	178.0	103.7	74.3	490.5

Note:
C value for the 100-year storm is increased by 25%, to a maximum of 1.0 per Ottawa Sewer Design Guidelines (5.4.5.2.1)

5-year $Q_{attenuated}$ **60.49 L/s** **100-year $Q_{attenuated}$** **103.66 L/s**
5-year Max. Storage Required **337.3 m^3** **100-year Max. Storage Required** **663.0 m^3**

Summary of Release Rates and Storage Volumes

Control Area	5-Year Release Rate (L/s)	5-Year Storage (m^3)	100-Year Release Rate (L/s)	100-Year Storage (m^3)
Unattenuated Areas to Poole Creek	0.6	0.0	1.2	0.0
Residential Areas	233.4	88.2	400.0	249.0
Commercial Areas	60.5	337.3	103.7	663.0
Total Comm + Res to Hazeldean	**293.9**	**425.5**	**503.7**	**911.9**

Campanale Homes
5 Orchard Drive
Stormwater Calculation Sheet

Area ID	Up	Down	Area	C	Indiv AxC	Acc AxC	T_C	I	Q	DIA	Slope	Length	$A_{hydraulic}$	R	Velocity	Qcap	Time Flow	Q / Q full
			(ha)	(-)			(min)	(mm/hr)	(L/s)	(mm)	(%)	(m)	(m^2)	(m)	(m/s)	(L/s)	(min)	(-)
A1	STM101	STM102	1.00	0.60	0.60	0.60	10.00	104.19	173.66	450.00	0.70	89.50	0.16	0.11	1.50	238.54	0.99	0.73
EX2			0.42	0.35	0.15	0.15												
A2	STM102	STM103	0.47	0.65	0.31	1.05	10.99	99.22	290.07	525.00	0.70	61.50	0.22	0.13	1.66	359.82	0.62	0.81
EX3			0.11	0.34	0.04	0.04												
A3	STM103	STM104	0.65	0.65	0.42	1.51	11.61	96.39	404.94	525.00	1.20	90.00	0.22	0.13	2.18	471.11	0.69	0.86
	STM104	STM105	0.00	0.00	0.00	1.51	12.30	93.43	392.52	675.00	0.40	8.20	0.36	0.17	1.49	531.63	0.09	0.74
	STM105	STM106	0.00	0.00	0.00	1.51	12.39	93.05	400.00	675.00	0.40	41.00	0.36	0.17	1.49	531.63	0.46	0.75
A4	CTRL MH	STM106	1.84	0.90	1.66	1.66	10.00	104.19	103.66	675.00	0.50	9.40	0.36	0.17	1.66	594.39	0.09	0.17
	STM106	STM107	0.00	0.00	0.00	3.17	22.95	64.38	503.66	675.00	0.40	26.00	0.36	0.17	1.49	531.63	0.29	0.95
	STM107	EX STM MH	0.00	0.00	0.00	3.17	23.24	63.86	503.66	675.00	0.40	56.00	0.36	0.17	1.49	531.63	0.63	0.95

100-Year total attenuated flow used to determine pipe sizes
Note: Information highlighted in green is using publically available invert information from GeoOttawa
Remaining pipe information from as-built information

```
*
*
*
*#                 JOB # 3809
*#*****************************************************************
*#        HAZELDEAN ROAD WIDENING AND BRIDGE DESIGN
*#        MAJOR OVERFLOW ANALYSIS (100 YEAR 3 HR CHICAGO)
*#                    SEPTEMBER 2009
*#*****************************************************************
*
*
*
*#=================================================================
*#                             100 YEAR EVENT
*#                      3 HOUR CHICAGO - 10 MIN TIME STEP
*#*****************************************************************
*
*
--------------------
| READ STORM       |    Filename: D:\SWMHYMO\3809\CHI310M1.STM
| Ptotal=  71.68 mm|    Comments: CHICAGO 3 HOUR 10 MIN 100 YEAR STORM
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   6.050 |   1.00 178.560 |   1.83  11.050 |   2.67   5.760
               .33   7.540 |   1.17  54.040 |   2.00   9.280 |   2.83   5.280
               .50  10.170 |   1.33  27.310 |   2.17   8.020 |   3.00   4.880
               .67  15.980 |   1.50  18.230 |   2.33   7.080 |
               .83  40.760 |   1.67  13.730 |   2.50   6.340 |

-------------------------------------------------------------------------------
001:0003-----------------------------------------------------------------------
*
*
*# NORTHERN PORTION OF HAZELDEAN ROAD DRAINING TO LOW POINT
*
*# AREA APPROACHING LOW POINT FROM WEST
*
*# R402 - MH 402 TO MH 408
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .13
| 01:000102 DT= 1.00 |   Total Imp(%)=   76.00   Dir. Conn.(%)=   70.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .10          .03
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=      70.20        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       110.65
               over (min)        3.00         9.00
     Storage Coeff.  (min)=       2.66 (ii)    9.43 (ii)
     Unit Hyd. Tpeak (min)=       3.00         9.00
     Unit Hyd. peak  (cms)=        .41          .12
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .04          .01          .048 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.12         1.000
     RUNOFF VOLUME    (mm)=      70.88        35.94        60.395
     TOTAL RAINFALL   (mm)=      71.68        71.68        71.677
     RUNOFF COEFFICIENT   =        .99          .50          .843

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0004--------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .028  (cms)
 | TotalHyd 01:000102 |   Number of inlets in system [NINLET] =      1
 ----------------------   Total minor system capacity         =    .028  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.   01:000102        .13      .048     1.000   60.395     .000
      ======================================================================
      MAJOR SYST   05:000102        .01      .020     1.000   60.395     .000
      MINOR SYST   09:000105        .12      .028      .900   60.395     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ----------------------------------------------------------------------------
 001:0005--------------------------------------------------------------------
 *
 *# R408 - MH 408 TO MH 410
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .06
 | 01:000102 DT= 1.00 |   Total Imp(%)=   86.00   Dir. Conn.(%)=   82.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .05          .01
      Dep. Storage     (mm)=        .80         1.50
      Average Slope     (%)=        .20         2.00
      Length            (m)=      40.60        40.00
      Mannings n          =        .013         .250

      Max.eff.Inten.(mm/hr)=     178.56       115.74
                 over (min)        2.00         9.00
      Storage Coeff.  (min)=       1.91 (ii)    8.57 (ii)
      Unit Hyd. Tpeak (min)=       2.00         9.00
      Unit Hyd. peak  (cms)=        .57          .13
                                                           *TOTALS*
      PEAK FLOW       (cms)=        .02          .00          .025 (iii)
      TIME TO PEAK    (hrs)=       1.00         1.10         1.000
      RUNOFF VOLUME    (mm)=      70.88        36.46        64.681
      TOTAL RAINFALL   (mm)=      71.68        71.68        71.677
      RUNOFF COEFFICIENT   =        .99          .51          .902

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ----------------------------------------------------------------------------
 001:0006--------------------------------------------------------------------
 *
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .06      .025    1.00  64.68    .000
                +ID2 05:000102      .01      .020    1.00  60.39    .000
                 =======================================================
```

```
                 SUM 10:000415      .07     .045    1.00  63.83    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0007----------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .012  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
 ----------------------   Total minor system capacity         =    .012  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.   10:000415       .07      .045     1.000   63.832     .000
      ======================================================================
      MAJOR SYST   06:000102       .02      .033     1.000   63.832     .000
      MINOR SYST   07:000105       .05      .012      .867   63.832     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0008----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 07:000105      .05     .012     .87  63.83    .000
               +ID2 09:000105      .12     .028     .90  60.39    .000
                 ==================================================
                 SUM 02:000415      .17     .040     .90  61.41    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0009----------------------------------------------------------------------
 *
 *# R410  - MH 410 TO MH 417
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .17
 | 01:000102 DT= 1.00 |   Total Imp(%)=   74.00   Dir. Conn.(%)=   64.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .12          .04
      Dep. Storage     (mm)=        .80         1.50
      Average Slope     (%)=        .20         2.00
      Length            (m)=      97.00        40.00
      Mannings n          =        .013         .250

      Max.eff.Inten.(mm/hr)=     178.56       125.38
                 over (min)        3.00        10.00
      Storage Coeff.  (min)=       3.22 (ii)    9.67 (ii)
      Unit Hyd. Tpeak (min)=       3.00        10.00
      Unit Hyd. peak  (cms)=        .36          .12
                                                           *TOTALS*
      PEAK FLOW       (cms)=        .05          .01          .056 (iii)
      TIME TO PEAK    (hrs)=       1.00         1.12         1.000
      RUNOFF VOLUME    (mm)=      70.88        37.83        58.979
      TOTAL RAINFALL   (mm)=      71.68        71.68        71.677
      RUNOFF COEFFICIENT   =        .99          .53          .823

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
```

```
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -------------------------------------------------------------------------------
 001:0010-----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 01:000102      .17     .056    1.00  58.98    .000
                 +ID2 06:000102      .02     .033    1.00  63.83    .000
                  ==================================================
                  SUM 10:000415      .19     .089    1.00  59.58    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0011-----------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .035  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
 ----------------------   Total minor system capacity         =    .035  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                   ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.   10:000415        .19      .089     1.000   59.576     .000
      ===================================================================
      MAJOR SYST   05:000102        .04      .054     1.000   59.576     .000
      MINOR SYST   09:000105        .15      .035      .883   59.576     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0012-----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 02:000415      .17     .040     .90  61.41    .000
                 +ID2 09:000105      .15     .035     .88  59.58    .000
                  ==================================================
                  SUM 07:000415      .32     .075     .90  60.54    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0013-----------------------------------------------------------------------
 *
 *# R417 - MH 417 TO MH 423
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .21
 | 01:000102 DT= 1.00 |   Total Imp(%)=   85.00   Dir. Conn.(%)=   81.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .18           .03
      Dep. Storage     (mm)=        .80          1.50
      Average Slope     (%)=        .20          2.00
      Length            (m)=     105.00         40.00
      Mannings n          =       .013          .250

      Max.eff.Inten.(mm/hr)=     178.56        108.76
```

```
                  over (min)        3.00         10.00
      Storage Coeff.  (min)=        3.38 (ii)    10.21 (ii)
      Unit Hyd. Tpeak (min)=        3.00         10.00
      Unit Hyd. peak  (cms)=         .35           .11
                                                                *TOTALS*
      PEAK FLOW       (cms)=         .08           .01             .082 (iii)
      TIME TO PEAK    (hrs)=        1.00          1.13            1.000
      RUNOFF VOLUME    (mm)=       70.88         36.18           64.285
      TOTAL RAINFALL   (mm)=       71.68         71.68           71.677
      RUNOFF COEFFICIENT   =         .99           .50             .897

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0014----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .21     .082    1.00  64.28    .000
                +ID2 05:000102      .04     .054    1.00  59.58    .000
                 ==================================================
                 SUM 10:000415      .25     .135    1.00  63.55    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0015----------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .048  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
 ----------------------   Total minor system capacity         =    .048  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.   10:000415        .25      .135     1.000   63.549     .000
      ===================================================================
      MAJOR SYST   06:000102        .06      .087     1.000   63.549     .000
      MINOR SYST   08:000105        .19      .048      .900   63.549     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0016----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 07:000415      .32     .075     .90  60.54    .000
                +ID2 08:000105      .19     .048     .90  63.55    .000
                 ==================================================
                 SUM 02:000415      .50     .123     .90  61.65    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0017----------------------------------------------------------------------
 *
 *# R423 - MH 423 TO MH 431
```

```
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .22
| 01:000102 DT= 1.00 |   Total Imp(%)=   90.00   Dir. Conn.(%)=   87.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .02
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     100.00        40.00
     Mannings n          =       .013          .250

     Max.eff.Inten.(mm/hr)=     178.56       113.39
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       3.28 (ii)   10.00 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .35          .11
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .09          .00           .094 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.13          1.000
     RUNOFF VOLUME    (mm)=      70.88        36.66         66.429
     TOTAL RAINFALL   (mm)=      71.68        71.68         71.677
     RUNOFF COEFFICIENT   =        .99          .51           .927

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0018-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .22     .094    1.00  66.43    .000
                +ID2 06:000102      .06     .087    1.00  63.55    .000
                 ==================================================
                 SUM 10:000415      .28     .181    1.00  65.83    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0019-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .046  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity         =    .046  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .28      .181     1.000   65.830     .000
     ======================================================================
     MAJOR SYST   05:000102        .09      .135     1.000   65.830     .000
     MINOR SYST   09:000105        .19      .046      .883   65.830     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0020-----------------------------------------------------------------------
*
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| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 02:000415      .50     .123     .90  61.65    .000
                 +ID2 09:000105      .19     .046     .88  65.83    .000
                  ====================================================
                  SUM 08:000415      .69     .169     .90  62.80    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0021-----------------------------------------------------------------------
*
*# R16 - MH 16 TO MH 4
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .34
| 01:000102 DT= 1.00 |   Total Imp(%)=   60.00   Dir. Conn.(%)=   48.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .14
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     109.50        40.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       113.39
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       3.47 (ii)   10.18 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .34          .11
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .08          .03            .092 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.13           1.000
     RUNOFF VOLUME    (mm)=      70.88        36.66          53.086
     TOTAL RAINFALL   (mm)=      71.68        71.68          71.677
     RUNOFF COEFFICIENT   =        .99          .51            .741

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0022-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 01:000102      .34     .092    1.00  53.09    .000
                 +ID2 05:000102      .09     .135    1.00  65.83    .000
                  ====================================================
                  SUM 10:000415      .43     .227    1.00  55.81    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0023-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .050  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity         =    .050  (cms)
                         Total major system storage [TMJSTO] =       0.(cu.m.)

```

```
                 ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                 (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.  10:000415        .43      .227     1.000   55.805     .000
     ==================================================================
     MAJOR SYST  05:000102        .15      .177     1.000   55.805     .000
     MINOR SYST  09:000105        .28      .050      .883   55.805     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0024----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 08:000415      .69      .169     .90  62.80    .000
                +ID2 09:000105      .28      .050     .88  55.81    .000
                 ==================================================
                 SUM 02:000415      .98      .219     .90  60.77    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0025----------------------------------------------------------------------
 *
 *# R4 - MH 4 TO MH 7
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .15
 | 01:000102 DT= 1.00 |   Total Imp(%)=   86.00   Dir. Conn.(%)=   81.00
 ----------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .13          .02
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=      62.70        40.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       126.09
                over (min)        2.00         9.00
     Storage Coeff.  (min)=       2.48 (ii)    8.91 (ii)
     Unit Hyd. Tpeak (min)=       2.00         9.00
     Unit Hyd. peak  (cms)=        .48          .13
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .06          .00           .062 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.10          1.000
     RUNOFF VOLUME    (mm)=      70.88        37.46         64.527
     TOTAL RAINFALL   (mm)=      71.68        71.68         71.677
     RUNOFF COEFFICIENT   =        .99          .52           .900

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0026----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .15      .062    1.00  64.53    .000
                +ID2 05:000102      .15      .177    1.00  55.81    .000
                 ==================================================
                 SUM 10:000415      .30      .239    1.00  60.18    .000
```

```

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------
001:0027-------------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .027  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity         =    .027  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .30      .239     1.000   60.183     .000
     ===================================================================
     MAJOR SYST   05:000102        .17      .212     1.000   60.183     .000
     MINOR SYST   09:000105        .13      .027      .867   60.183     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------
001:0028-------------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 02:000415      .98     .219     .90  60.77    .000
                +ID2 09:000105      .13     .027     .87  60.18    .000
                 ======================================================
                 SUM 08:000415     1.11     .246     .90  60.70    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------
001:0029-------------------------------------------------------------------------
*
*# R7 - MH 7 TO MH 18
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .08
| 01:000102 DT= 1.00 |   Total Imp(%)=   80.00   Dir. Conn.(%)=   75.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .06          .02
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=      35.30        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       114.55
                over (min)        2.00         8.00
     Storage Coeff.  (min)=       1.76 (ii)    8.44 (ii)
     Unit Hyd. Tpeak (min)=       2.00         8.00
     Unit Hyd. peak  (cms)=        .61          .14
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .03          .00           .032 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.08          1.000
     RUNOFF VOLUME    (mm)=      70.88        35.94         62.142
     TOTAL RAINFALL   (mm)=      71.68        71.68         71.677
     RUNOFF COEFFICIENT   =        .99          .50           .867

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0030-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .08     .032    1.00  62.14    .000
                +ID2 05:000102      .17     .212    1.00  60.18    .000
                 ======================================================
                 SUM 10:000415      .25     .244    1.00  60.82    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0031-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .012  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity          =    .012  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .25      .244     1.000   60.816     .000
     =====================================================================
     MAJOR SYST   05:000102        .18      .232     1.000   60.816     .000
     MINOR SYST   09:000105        .06      .012      .867   60.816     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0032-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 08:000415     1.11     .246     .90  60.70    .000
                +ID2 09:000105      .06     .012     .87  60.82    .000
                 ======================================================
                 SUM 02:000415     1.17     .258     .90  60.70    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0033-----------------------------------------------------------------------
*
*# R18 - MH 18 TO MH 19
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .22
| 01:000102 DT= 1.00 |   Total Imp(%)=   80.00   Dir. Conn.(%)=   75.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .18          .04
     Dep. Storage     (mm)=         .80         1.50
     Average Slope     (%)=         .20         2.00
     Length            (m)=       95.00        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=      178.56       106.46
                over (min)         3.00        10.00
```

```
     Storage Coeff.  (min)=       3.18 (ii)   10.07 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .36          .11
                                                        *TOTALS*
     PEAK FLOW       (cms)=        .08          .01         .083 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.13        1.000
     RUNOFF VOLUME    (mm)=      70.88        35.94       62.142
     TOTAL RAINFALL   (mm)=      71.68        71.68       71.677
     RUNOFF COEFFICIENT   =        .99          .50         .867

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -------------------------------------------------------------------------------
 001:0034-----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 01:000102      .22      .083    1.00  62.14    .000
                 +ID2 05:000102      .18      .232    1.00  60.82    .000
                  ======================================================
                  SUM 10:000415      .40      .315    1.00  61.54    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0035-----------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .036  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
 ----------------------   Total minor system capacity         =    .036  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                   ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415         .40      .315     1.000   61.538     .000
     ======================================================================
     MAJOR SYST   05:000102         .22      .279     1.000   61.538     .000
     MINOR SYST   09:000105         .18      .036      .867   61.538     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0036-----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 02:000415     1.17      .258     .90  60.70    .000
                 +ID2 09:000105      .18      .036     .87  61.54    .000
                  ======================================================
                  SUM 08:000415     1.35      .294     .90  60.82    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0037-----------------------------------------------------------------------
 *
 *# R19 - MH 19 TO MH 20
 *
```

```
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .27
| 01:000102 DT= 1.00 |   Total Imp(%)=   63.00   Dir. Conn.(%)=   53.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17          .10
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     103.30        40.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       109.25
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       3.35 (ii)   10.16 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .35          .11
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .07          .02          .078 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.13         1.000
     RUNOFF VOLUME    (mm)=      70.88        36.24        54.595
     TOTAL RAINFALL   (mm)=      71.68        71.68        71.677
     RUNOFF COEFFICIENT   =        .99          .51          .762

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0038----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .27     .078    1.00  54.60    .000
                +ID2 05:000102      .22     .279    1.00  61.54    .000
                 ====================================================
                 SUM 10:000415      .49     .357    1.00  57.73    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0039----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .034  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity         =    .034  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .49      .357     1.000   57.734     .000
     =================================================================
     MAJOR SYST   04:000102        .29      .323     1.000   57.734     .000
     MINOR SYST   09:000105        .21      .034      .867   57.734     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0040----------------------------------------------------------------------
*
*# MAJOR OVERFLOW TO HAZELDEAN CREEK
*
```

```
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .268  (cms)
| TotalHyd 04:000102 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity         =    .268  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   04:000102        .29      .323     1.000   57.734     .000
     ========================================================================
     MAJOR SYST   05:000102        .01      .055     1.000   57.734     .000
     MINOR SYST   02:000105        .27      .268      .967   57.734     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0041-----------------------------------------------------------------------
*
*#  OUTLET NO. 1 TO INTERIM HAZELDEAN POND
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 08:000415     1.35     .294     .90  60.82    .000
                +ID2 09:000105      .21     .034     .87  57.73    .000
                 ==================================================
                 SUM 02:000415     1.56     .328     .90  60.41    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0042-----------------------------------------------------------------------
*
--------------------
| SAVE HYD         |   AREA      (ha)=    1.560
| ID=02 (000415)   |   QPEAK    (cms)=     .328 (i)
| DT= 1.00 PCYC=-1 |   TPEAK    (hrs)=     .900
--------------------   VOLUME     (mm)=   60.405
  Filename: D:\SWMHYMO\3809\H-000415.001
  Comments:   ID=2  -1  1

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
-------------------------------------------------------------------------------
001:0043-----------------------------------------------------------------------
*
*
*# R102 - MH 102 TO MH 103
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .30
| 01:000102 DT= 1.00 |   Total Imp(%)=   77.00   Dir. Conn.(%)=   70.00
----------------------
                            IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       .23          .07
     Dep. Storage     (mm)=       .80         1.50
     Average Slope     (%)=       .20         2.00
     Length            (m)=    136.80        40.00
     Mannings n           =      .013         .250

     Max.eff.Inten.(mm/hr)=    178.56       107.70
                over (min)       4.00        11.00
     Storage Coeff.  (min)=      3.96 (ii)   10.81 (ii)
     Unit Hyd. Tpeak (min)=      4.00        11.00
     Unit Hyd. peak  (cms)=       .28          .10
                                                              *TOTALS*
     PEAK FLOW       (cms)=       .09          .01             .102 (iii)
```

```
     TIME TO PEAK    (hrs)=      1.00          1.15          1.017
     RUNOFF VOLUME    (mm)=     70.88         36.73         60.631
     TOTAL RAINFALL   (mm)=     71.68         71.68         71.677
     RUNOFF COEFFICIENT   =       .99           .51           .846

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0044----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .30      .102    1.02  60.63    .000
                +ID2 05:000102      .01      .055    1.00  57.73    .000
                 ==================================================
                 SUM 10:000415      .32      .157    1.00  60.50    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0045----------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .076  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
 ----------------------   Total minor system capacity         =    .076  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .32      .157     1.000   60.500     .000
     =====================================================================
     MAJOR SYST   05:000102        .03      .081     1.000   60.500     .000
     MINOR SYST   09:000105        .29      .076      .933   60.500     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0046----------------------------------------------------------------------
 *
 *
 *# R103 - MH 103 TO MH 104
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .25
 | 01:000102 DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   56.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .16           .08
     Dep. Storage     (mm)=        .80          1.50
     Average Slope     (%)=        .20          2.00
     Length            (m)=     101.50         40.00
     Mannings n           =       .013          .250

     Max.eff.Inten.(mm/hr)=     178.56        112.57
                over (min)        3.00         10.00
     Storage Coeff.  (min)=       3.31 (ii)   10.04 (ii)
     Unit Hyd. Tpeak (min)=       3.00         10.00
     Unit Hyd. peak  (cms)=        .35           .11
                                                               *TOTALS*
```

```
    PEAK FLOW       (cms)=        .06          .02          .074 (iii)
    TIME TO PEAK    (hrs)=       1.00         1.13         1.000
    RUNOFF VOLUME    (mm)=      70.88        36.58        55.786
    TOTAL RAINFALL   (mm)=      71.68        71.68        71.677
    RUNOFF COEFFICIENT   =        .99          .51          .778

      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
          CN* =  75.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0047-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .25     .074    1.00  55.79    .000
                +ID2 05:000102      .03     .081    1.00  60.50    .000
                 ==================================================
                 SUM 10:000415      .27     .155    1.00  56.27    .000

  NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0048-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .044  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity        =    .044  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.     DWF
                                  (ha)     (cms)     (hrs)     (mm)   (cms)
    TOTAL HYD.   10:000415        .27      .155     1.000   56.275    .000
    =====================================================================
    MAJOR SYST   05:000102        .05      .111     1.000   56.275    .000
    MINOR SYST   08:000105        .22      .044      .900   56.275    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0049-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 08:000105      .22     .044     .90  56.27    .000
                +ID2 09:000105      .29     .076     .93  60.50    .000
                 ==================================================
                 SUM 02:000415      .51     .120     .93  58.67    .000

  NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0050-----------------------------------------------------------------------
*
*# R104 - MH 104 TO MH 105
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:000102 DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   56.00
----------------------
```

```
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17          .09
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     104.10        40.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       112.57
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       3.36 (ii)   10.09 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .35          .11
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .07          .02          .076 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.13         1.000
     RUNOFF VOLUME    (mm)=      70.88        36.58        55.786
     TOTAL RAINFALL   (mm)=      71.68        71.68        71.677
     RUNOFF COEFFICIENT   =        .99          .51          .778

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0051-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 01:000102      .25      .076    1.00  55.79    .000
               +ID2 05:000102      .05      .111    1.00  56.27    .000
                ======================================================
                SUM 10:000415      .31      .187    1.00  55.87    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0052-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .041  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity         =    .041  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                 ID: NHYD       AREA     QPEAK     TPEAK     R.V.      DWF
                                (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415       .31      .187     1.000   55.873     .000
     =====================================================================
     MAJOR SYST   05:000102       .09      .146     1.000   55.873     .000
     MINOR SYST   09:000105       .22      .041      .900   55.873     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0053-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 02:000415      .51      .120     .93  58.67    .000
               +ID2 09:000105      .22      .041     .90  55.87    .000
                ======================================================
```

```
                 SUM 07:000415      .73     .161     .93  57.83    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0054----------------------------------------------------------------------
 *
 *# R105 - MH 105 TO MH 106
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .25
 | 01:000102 DT= 1.00 |   Total Imp(%)=   70.00   Dir. Conn.(%)=   61.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .18           .08
     Dep. Storage     (mm)=        .80          1.50
     Average Slope     (%)=        .20          2.00
     Length            (m)=     105.00         40.00
     Mannings n           =       .013          .250

     Max.eff.Inten.(mm/hr)=     178.56        113.39
                over (min)        3.00         10.00
     Storage Coeff.  (min)=       3.38 (ii)   10.09 (ii)
     Unit Hyd. Tpeak (min)=       3.00         10.00
     Unit Hyd. peak  (cms)=        .35           .11
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .07           .01          .082 (iii)
     TIME TO PEAK    (hrs)=       1.00          1.13         1.000
     RUNOFF VOLUME    (mm)=      70.88         36.66        57.534
     TOTAL RAINFALL   (mm)=      71.68         71.68        71.677
     RUNOFF COEFFICIENT   =        .99           .51          .803

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0055----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .25     .082    1.00  57.53    .000
                +ID2 05:000102      .09     .146    1.00  55.87    .000
                 =======================================================
                 SUM 10:000415      .34     .227    1.00  57.11    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0056----------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .038  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
 ----------------------   Total minor system capacity         =    .038  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .34      .227     1.000   57.115     .000
     ====================================================================
     MAJOR SYST   05:000102        .13      .189     1.000   57.115     .000
```

```
      MINOR SYST   09:000105        .21      .038      .883   57.115     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0057-----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 07:000415      .73      .161     .93  57.83    .000
                +ID2 09:000105      .21      .038     .88  57.11    .000
                 =====================================================
                 SUM 02:000415      .94      .199     .93  57.66    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0058-----------------------------------------------------------------------
 *
 *# R106 - MH 106 TO MH 107
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .25
 | 01:000102 DT= 1.00 |   Total Imp(%)=   71.00   Dir. Conn.(%)=   63.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .18          .07
      Dep. Storage     (mm)=        .80         1.50
      Average Slope     (%)=        .20         2.00
      Length            (m)=     105.30        40.00
      Mannings n           =       .013         .250

      Max.eff.Inten.(mm/hr)=     178.56       110.03
                 over (min)        3.00        10.00
      Storage Coeff.  (min)=       3.39 (ii)   10.18 (ii)
      Unit Hyd. Tpeak (min)=       3.00        10.00
      Unit Hyd. peak  (cms)=        .35          .11
                                                            *TOTALS*
      PEAK FLOW       (cms)=        .08          .01           .083 (iii)
      TIME TO PEAK    (hrs)=       1.00         1.13          1.000
      RUNOFF VOLUME    (mm)=      70.88        36.32         58.090
      TOTAL RAINFALL   (mm)=      71.68        71.68         71.677
      RUNOFF COEFFICIENT   =        .99          .51           .810

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 -------------------------------------------------------------------------------
 001:0059-----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .25      .083    1.00  58.09    .000
                +ID2 05:000102      .13      .189    1.00  57.11    .000
                 =====================================================
                 SUM 10:000415      .38      .273    1.00  57.77    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0060-----------------------------------------------------------------------
```

```
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .036  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
 ----------------------   Total minor system capacity         =    .036  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                   ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.   10:000415        .38      .273     1.000   57.765     .000
      ======================================================================
      MAJOR SYST   05:000102        .17      .237     1.000   57.765     .000
      MINOR SYST   09:000105        .21      .036      .883   57.765     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0061-----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 02:000415      .94     .199     .93  57.66    .000
                 +ID2 09:000105      .21     .036     .88  57.77    .000
                  ==================================================
                  SUM 07:000415     1.15     .235     .93  57.68    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -------------------------------------------------------------------------------
 001:0062-----------------------------------------------------------------------
 *
 *# R107 - MH 107 TO MH 108
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .21
 | 01:000102 DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   56.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .14          .07
      Dep. Storage     (mm)=        .80         1.50
      Average Slope     (%)=        .20         2.00
      Length            (m)=      86.40        40.00
      Mannings n          =       .013         .250

      Max.eff.Inten.(mm/hr)=     178.56       112.57
                 over (min)        3.00        10.00
      Storage Coeff.  (min)=       3.01 (ii)    9.74 (ii)
      Unit Hyd. Tpeak (min)=       3.00        10.00
      Unit Hyd. peak  (cms)=        .37          .12
                                                               *TOTALS*
      PEAK FLOW       (cms)=        .06          .01             .064 (iii)
      TIME TO PEAK    (hrs)=       1.00         1.12            1.000
      RUNOFF VOLUME    (mm)=      70.88        36.58           55.786
      TOTAL RAINFALL   (mm)=      71.68        71.68           71.677
      RUNOFF COEFFICIENT   =        .99          .51             .778

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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 001:0063-----------------------------------------------------------------------
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*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .21     .064    1.00  55.79    .000
                +ID2 05:000102      .17     .237    1.00  57.77    .000
                 ======================================================
                 SUM 10:000415      .38     .301    1.00  56.69    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0064---------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .024  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity          =    .024  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .38      .301     1.000   56.686     .000
     ========================================================================
     MAJOR SYST   05:000102        .22      .277     1.000   56.686     .000
     MINOR SYST   09:000105        .16      .024      .867   56.686     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0065---------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 07:000415     1.15     .235     .93  57.68    .000
                +ID2 09:000105      .16     .024     .87  56.69    .000
                 ======================================================
                 SUM 02:000415     1.31     .259     .93  57.56    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0066---------------------------------------------------------------------
*
*
*# R110 - MH 110 TO MH 109
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .23
| 01:000102 DT= 1.00 |   Total Imp(%)=   85.00   Dir. Conn.(%)=   81.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .20          .03
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     118.70        40.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       102.76
                over (min)        4.00        11.00
     Storage Coeff.  (min)=       3.64 (ii)   10.62 (ii)
     Unit Hyd. Tpeak (min)=       4.00        11.00
     Unit Hyd. peak  (cms)=        .30          .11
                                                               *TOTALS*
```

```
     PEAK FLOW       (cms)=        .08          .01          .088 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.15         1.000
     RUNOFF VOLUME    (mm)=      70.88        36.18        64.285
     TOTAL RAINFALL   (mm)=      71.68        71.68        71.677
     RUNOFF COEFFICIENT   =        .99          .50          .897

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0067------------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .23     .088    1.00  64.28    .000
                +ID2 05:000102      .22     .277    1.00  56.69    .000
                 =====================================================
                 SUM 10:000415      .45     .365    1.00  60.53    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0068------------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .041  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity          =    .041  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .45      .365     1.000   60.533     .000
     ======================================================================
     MAJOR SYST   08:000102        .25      .324     1.000   60.533     .000
     MINOR SYST   09:000105        .20      .041      .883   60.533     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0069------------------------------------------------------------------------
*
*
*# APPROACH MAJOR FLOW FROM EAST TO LOW POINT
*
*# R112 - MH 112 TO MH 111
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .28
| 01:000102 DT= 1.00 |   Total Imp(%)=   85.00   Dir. Conn.(%)=   81.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .23          .04
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     145.00        40.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       102.76
                over (min)        4.00        11.00
     Storage Coeff.  (min)=       4.10 (ii)   11.08 (ii)
```

```
     Unit Hyd. Tpeak (min)=       4.00        11.00
     Unit Hyd. peak  (cms)=        .28          .10
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .10          .01             .103 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.15            1.017
     RUNOFF VOLUME    (mm)=      70.88        36.18           64.285
     TOTAL RAINFALL   (mm)=      71.68        71.68           71.677
     RUNOFF COEFFICIENT   =        .99          .50             .897

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0070-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .059  (cms)
| TotalHyd 01:000102 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity          =    .059  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                   ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   01:000102        .28      .103     1.017   64.285     .000
     ========================================================================
     MAJOR SYST   06:000102        .03      .044     1.017   64.285     .000
     MINOR SYST   07:000105        .24      .059      .900   64.285     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0071-----------------------------------------------------------------------
*
*
*# R111 - MH 111 TO MH 110
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .13
| 01:000102 DT= 1.00 |   Total Imp(%)=   91.00   Dir. Conn.(%)=   91.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .12          .01
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=      69.00        40.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56        69.69
                over (min)       3.00        11.00
     Storage Coeff.  (min)=       2.63 (ii)   10.78 (ii)
     Unit Hyd. Tpeak (min)=       3.00        11.00
     Unit Hyd. peak  (cms)=        .41          .10
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .06          .00             .059 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.15            1.000
     RUNOFF VOLUME    (mm)=      70.88        31.80           67.360
     TOTAL RAINFALL   (mm)=      71.68        71.68           71.677
     RUNOFF COEFFICIENT   =        .99          .44             .940

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
```

```
           THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0072-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .13     .059    1.00  67.36    .000
                +ID2 06:000102      .03     .044    1.02  64.28    .000
                 ====================================================
                 SUM 10:000415      .17     .103    1.00  66.76    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0073-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .033  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity          =    .033  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .17      .103     1.000   66.758     .000
     ======================================================================
     MAJOR SYST   06:000102        .05      .070     1.000   66.758     .000
     MINOR SYST   03:000105        .12      .033      .883   66.758     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0074-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 03:000105      .12     .033     .88  66.76    .000
                +ID2 07:000105      .24     .059     .90  64.28    .000
                 ====================================================
                 SUM 04:000415      .36     .092     .90  65.09    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0075-----------------------------------------------------------------------
*
*# ADD MINOR FLOW FROM R110
*
--------------------
| ADD HYD (000422) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 09:000105      .20     .041     .88  60.53    .000
                +ID2 04:000415      .36     .092     .90  65.09    .000
                +ID3 02:000415     1.31     .259     .93  57.56    .000
                 ====================================================
                 SUM 07:000422     1.87     .392     .93  59.34    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0076-----------------------------------------------------------------------
```

```
 *
 --------------------
 | SAVE HYD          |   AREA       (ha)=    1.873
 | ID=07 (000422)    |   QPEAK     (cms)=     .392 (i)
 | DT= 1.00 PCYC=-1 |   TPEAK     (hrs)=     .933
 --------------------   VOLUME     (mm)=   59.337
   Filename: D:\SWMHYMO\3809\H-000422.001
   Comments:   ID=7  -1  1

      (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
 ------------------------------------------------------------------------------
 001:0077----------------------------------------------------------------------
 *
 *# TOTAL MAJOR FLOW
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 08:000102      .25      .324    1.00  60.53    .000
                 +ID2 06:000102      .05      .070    1.00  66.76    .000
                  ====================================================
                  SUM 04:000415      .30      .394    1.00  61.53    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0078----------------------------------------------------------------------
 *
 *
 *# SOUTHERN PORTION OF HAZELDEAN ROAD DRAINING TO LOW POINT
 *
 *# AREA APPROACHING LOW POINT FROM WEST
 *
 *# R400 - MH 400 TO MH 405
 *
 ----------------------
 | CALIB STANDHYD      |   Area    (ha)=     .20
 | 01:000102 DT= 1.00 |   Total Imp(%)=   92.00   Dir. Conn.(%)=   89.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=        .19          .02
      Dep. Storage     (mm)=        .80         1.50
      Average Slope     (%)=        .20         2.00
      Length            (m)=     131.00        40.00
      Mannings n          =       .013         .250

      Max.eff.Inten.(mm/hr)=     178.56       124.00
                 over (min)       4.00        10.00
      Storage Coeff.  (min)=       3.86 (ii)   10.34 (ii)
      Unit Hyd. Tpeak (min)=       4.00        10.00
      Unit Hyd. peak  (cms)=        .29          .11
                                                             *TOTALS*
      PEAK FLOW       (cms)=        .08          .00            .083 (iii)
      TIME TO PEAK    (hrs)=       1.00         1.13           1.000
      RUNOFF VOLUME    (mm)=      70.88        37.70          67.227
      TOTAL RAINFALL   (mm)=      71.68        71.68          71.677
      RUNOFF COEFFICIENT   =        .99          .53            .938

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0079----------------------------------------------------------------------
```

```
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .048  (cms)
| TotalHyd 01:000102 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity         =    .048  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   01:000102        .20      .083     1.000   67.227     .000
     ======================================================================
     MAJOR SYST   05:000102        .02      .035     1.000   67.227     .000
     MINOR SYST   09:000105        .18      .048      .900   67.227     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0080-----------------------------------------------------------------------
*
*# R405 - MH 405 TO MH 413
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 01:000102 DT= 1.00 |   Total Imp(%)=   87.00   Dir. Conn.(%)=   84.00
----------------------
                                   IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=          .15          .02
     Dep. Storage     (mm)=          .80         1.50
     Average Slope     (%)=          .20         2.00
     Length            (m)=       117.90        40.00
     Mannings n          =          .013         .250

     Max.eff.Inten.(mm/hr)=       178.56        98.11
                over (min)          4.00        11.00
     Storage Coeff.  (min)=         3.62 (ii)   10.74 (ii)
     Unit Hyd. Tpeak (min)=         4.00        11.00
     Unit Hyd. peak  (cms)=          .30          .10
                                                             *TOTALS*
     PEAK FLOW       (cms)=          .07          .00          .068 (iii)
     TIME TO PEAK    (hrs)=         1.00         1.15         1.000
     RUNOFF VOLUME    (mm)=        70.88        35.65        65.240
     TOTAL RAINFALL   (mm)=        71.68        71.68        71.677
     RUNOFF COEFFICIENT   =          .99          .50          .910

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0081-----------------------------------------------------------------------
*
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .17     .068    1.00  65.24    .000
                +ID2 05:000102      .02     .035    1.00  67.23    .000
                 ======================================================
                 SUM 10:000415      .20     .103    1.00  65.48    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
```

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001:0082-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .038  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity         =    .038  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .20      .103     1.000   65.483     .000
     ======================================================================
     MAJOR SYST   06:000102        .05      .065     1.000   65.483     .000
     MINOR SYST   07:000105        .15      .038      .900   65.483     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0083-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 07:000105      .15     .038     .90  65.48    .000
                +ID2 09:000105      .18     .048     .90  67.23    .000
                 =====================================================
                 SUM 02:000415      .33     .086     .90  66.43    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0084-----------------------------------------------------------------------
*
*# R413  - MH 413 TO MH 421
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .12
| 01:000102 DT= 1.00 |   Total Imp(%)=   97.00   Dir. Conn.(%)=   96.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .12          .00
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=      85.00        40.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       118.08
               over (min)        3.00        10.00
     Storage Coeff.  (min)=       2.98 (ii)    9.58 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .38          .12
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .06          .00              .056 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.12             1.000
     RUNOFF VOLUME    (mm)=      70.88        37.13            69.527
     TOTAL RAINFALL   (mm)=      71.68        71.68            71.677
     RUNOFF COEFFICIENT   =        .99          .52              .970

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
```

```
001:0085-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .12     .056    1.00  69.53    .000
                +ID2 06:000102      .05     .065    1.00  65.48    .000
                 =======================================================
                 SUM 10:000415      .17     .121    1.00  68.42    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0086-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .018  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity          =    .018  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .17      .121     1.000   68.416     .000
     ======================================================================
     MAJOR SYST   05:000102        .08      .103     1.000   68.416     .000
     MINOR SYST   09:000105        .09      .018      .867   68.416     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0087-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 02:000415      .33     .086     .90  66.43    .000
                +ID2 09:000105      .09     .018     .87  68.42    .000
                 =======================================================
                 SUM 07:000415      .42     .104     .90  66.86    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0088-----------------------------------------------------------------------
*
*# R421 - MH 421 TO MH 426
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .09
| 01:000102 DT= 1.00 |   Total Imp(%)=   62.00   Dir. Conn.(%)=   51.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .05          .03
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=      44.00        40.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       116.28
                over (min)       2.00         9.00
     Storage Coeff.  (min)=      2.01 (ii)    8.65 (ii)
     Unit Hyd. Tpeak (min)=      2.00         9.00
     Unit Hyd. peak  (cms)=       .56          .13
                                                             *TOTALS*
```

```
     PEAK FLOW       (cms)=        .02          .01           .026 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.10          1.000
     RUNOFF VOLUME    (mm)=      70.88        36.51         54.039
     TOTAL RAINFALL   (mm)=      71.68        71.68         71.677
     RUNOFF COEFFICIENT   =        .99          .51           .754

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0089----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .09      .026    1.00  54.04    .000
                +ID2 05:000102      .08      .103    1.00  68.42    .000
                 ==================================================
                 SUM 10:000415      .16      .129    1.00  60.80    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0090----------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .000  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
 ----------------------   Total minor system capacity         =    .000  (cms)
                          Total major system storage [TMJSTO] =       0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .16      .129     1.000   60.800     .000
     =================================================================
     MAJOR SYST   06:000102        .16      .129     1.000   60.800     .000
     MINOR SYST   08:000105        .00      .000      .000     .000     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0091----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 07:000415      .42      .104     .90  66.86    .000
                +ID2 08:000105      .00      .000     .00    .00    .000 **DRY**
                 ==================================================
                 SUM 02:000415      .42      .104     .90  66.86    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0092----------------------------------------------------------------------
 *
 *# R426 - MH 426 TO MH 430
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .17
 | 01:000102 DT= 1.00 |   Total Imp(%)=   64.00   Dir. Conn.(%)=   54.00
 ----------------------
```

```
                                IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=         .11          .06
      Dep. Storage     (mm)=         .80         1.50
      Average Slope     (%)=         .20         2.00
      Length            (m)=       78.00        40.00
      Mannings n           =        .013         .250

      Max.eff.Inten.(mm/hr)=      178.56       110.30
                 over (min)         3.00        10.00
      Storage Coeff.  (min)=        2.83 (ii)    9.62 (ii)
      Unit Hyd. Tpeak (min)=        3.00        10.00
      Unit Hyd. peak  (cms)=         .39          .12
                                                             *TOTALS*
      PEAK FLOW       (cms)=         .05          .01           .053 (iii)
      TIME TO PEAK    (hrs)=        1.00         1.12          1.000
      RUNOFF VOLUME    (mm)=       70.88        36.34         54.992
      TOTAL RAINFALL   (mm)=       71.68        71.68         71.677
      RUNOFF COEFFICIENT   =         .99          .51           .767

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0093-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .17      .053    1.00  54.99    .000
                +ID2 06:000102      .16      .129    1.00  60.80    .000
                 ======================================================
                 SUM 10:000415      .34      .182    1.00  57.80    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0094-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .021  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity          =    .021  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.   10:000415       .34      .182     1.000   57.804     .000
      ======================================================================
      MAJOR SYST   05:000102       .17      .161     1.000   57.804     .000
      MINOR SYST   09:000105       .17      .021      .850   57.804     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0095-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 02:000415      .42      .104     .90  66.86    .000
                +ID2 09:000105      .17      .021     .85  57.80    .000
                 ======================================================
```

```
                 SUM 08:000415      .59     .125     .90  64.26    .000
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
001:0096-----------------------------------------------------------------------
*
*# R6 - MH 6 TO MH 7A
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .31
| 01:000102 DT= 1.00 |   Total Imp(%)=   82.00   Dir. Conn.(%)=   77.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .25          .06
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     166.00        40.00
     Mannings n          =       .013         .250
     Max.eff.Inten.(mm/hr)=     178.56       104.21
                over (min)        4.00        11.00
     Storage Coeff.  (min)=       4.45 (ii)   11.39 (ii)
     Unit Hyd. Tpeak (min)=       4.00        11.00
     Unit Hyd. peak  (cms)=        .26          .10
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .10          .01           .110 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.15          1.017
     RUNOFF VOLUME    (mm)=      70.88        36.35         62.934
     TOTAL RAINFALL   (mm)=      71.68        71.68         71.677
     RUNOFF COEFFICIENT   =        .99          .51           .878
       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
-------------------------------------------------------------------------------
001:0097-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .31     .110    1.02  62.93    .000
                +ID2 05:000102      .17     .161    1.00  57.80    .000
                 =====================================================
                 SUM 10:000415      .48     .270    1.00  61.11    .000
   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
-------------------------------------------------------------------------------
001:0098-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .038  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity         =    .038  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)
                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .48      .270     1.000   61.113     .000
     ======================================================================
     MAJOR SYST   05:000102        .24      .232     1.000   61.113     .000
```

```
     MINOR SYST   09:000105        .24      .038      .867   61.113     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0099----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 08:000415      .59     .125     .90  64.26    .000
                 +ID2 09:000105      .24     .038     .87  61.11    .000
                  =====================================================
                  SUM 02:000415      .83     .163     .90  63.35    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0100----------------------------------------------------------------------
 *
 *# R7A - MH 7A TO MH 8
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .17
 | 01:000102 DT= 1.00 |   Total Imp(%)=   82.00   Dir. Conn.(%)=   77.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .14          .03
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=      78.00        40.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       110.30
                over (min)       3.00        10.00
     Storage Coeff.  (min)=       2.83 (ii)    9.62 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .39          .12
                                                            *TOTALS*
     PEAK FLOW       (cms)=        .06          .01            .066 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.12           1.000
     RUNOFF VOLUME    (mm)=      70.88        36.34          62.934
     TOTAL RAINFALL   (mm)=      71.68        71.68          71.677
     RUNOFF COEFFICIENT   =        .99          .51            .878

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0101----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 01:000102      .17     .066    1.00  62.93    .000
                 +ID2 05:000102      .24     .232    1.00  61.11    .000
                  =====================================================
                  SUM 10:000415      .41     .298    1.00  61.86    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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 001:0102----------------------------------------------------------------------
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 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .018  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
 ----------------------   Total minor system capacity         =    .018  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.   10:000415        .41      .298     1.000   61.864     .000
      ======================================================================
      MAJOR SYST   05:000102        .29      .280     1.000   61.864     .000
      MINOR SYST   09:000105        .12      .018      .850   61.864     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0103----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 02:000415      .83      .163     .90  63.35    .000
                +ID2 09:000105      .12      .018     .85  61.86    .000
                 ==================================================
                 SUM 08:000415      .95      .181     .90  63.16    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0104----------------------------------------------------------------------
 *
 *# R8 - MH 8 TO MH 9
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .22
 | 01:000102 DT= 1.00 |   Total Imp(%)=   71.00   Dir. Conn.(%)=   62.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
      Surface Area     (ha)=       .16          .06
      Dep. Storage     (mm)=       .80         1.50
      Average Slope     (%)=       .20         2.00
      Length            (m)=     95.00        40.00
      Mannings n          =       .013         .250

      Max.eff.Inten.(mm/hr)=    178.56       114.84
                 over (min)       3.00        10.00
      Storage Coeff.  (min)=      3.18 (ii)    9.86 (ii)
      Unit Hyd. Tpeak (min)=      3.00        10.00
      Unit Hyd. peak  (cms)=       .36          .11
                                                            *TOTALS*
      PEAK FLOW       (cms)=       .06          .01           .072 (iii)
      TIME TO PEAK    (hrs)=      1.00         1.12          1.000
      RUNOFF VOLUME    (mm)=     70.88        36.81         57.931
      TOTAL RAINFALL   (mm)=     71.68        71.68         71.677
      RUNOFF COEFFICIENT   =       .99          .51           .808

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0105----------------------------------------------------------------------
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*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .22      .072    1.00  57.93    .000
                +ID2 05:000102      .29      .280    1.00  61.86    .000
                 =====================================================
                 SUM 10:000415      .51      .352    1.00  60.18    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0106------------------------------------------------------------------------
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .017  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity         =    .017  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .51      .352     1.000   60.176     .000
     ======================================================================
     MAJOR SYST   05:000102        .38      .335     1.000   60.176     .000
     MINOR SYST   09:000105        .14      .017      .850   60.176     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0107------------------------------------------------------------------------
*
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 08:000415      .95      .181     .90  63.16    .000
                +ID2 09:000105      .14      .017     .85  60.18    .000
                 =====================================================
                 SUM 02:000415     1.08      .198     .90  62.78    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0108------------------------------------------------------------------------
*
*# MAJOR OVERFLOW TO HAZELDEAN CREEK
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .277  (cms)
| TotalHyd 05:000102 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity         =    .277  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   05:000102        .38      .335     1.000   60.176     .000
     ======================================================================
     MAJOR SYST   09:000102        .02      .058     1.000   60.176     .000
     MINOR SYST   07:000105        .36      .277      .967   60.176     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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001:0109------------------------------------------------------------------------
*
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*# R9 - MH 9 TO MH 10
*
----------------------
| CALIB STANDHYD      |   Area    (ha)=     .19
| 01:000102 DT= 1.00 |   Total Imp(%)=   71.00   Dir. Conn.(%)=   62.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .13          .06
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=      95.00        40.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       114.84
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       3.18 (ii)    9.86 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .36          .11
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .06          .01             .062 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.12            1.000
     RUNOFF VOLUME    (mm)=      70.88        36.81           57.931
     TOTAL RAINFALL   (mm)=      71.68        71.68           71.677
     RUNOFF COEFFICIENT   =        .99          .51             .808

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0110---------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .19     .062    1.00  57.93    .000
                +ID2 09:000102      .02     .058    1.00  60.18    .000
                 ==================================================
                 SUM 10:000415      .21     .120    1.00  58.13    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0111---------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .017  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity        =    .017  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .21      .120     1.000   58.128     .000
     ======================================================================
     MAJOR SYST   06:000102        .08      .103     1.000   58.128     .000
     MINOR SYST   09:000105        .13      .017      .850   58.128     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0112---------------------------------------------------------------------
*
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```
*
*
*#  OUTLET NO. 1 TO INTERIM HAZELDEAN POND
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 02:000415     1.08     .198     .90  62.78    .000
                +ID2 09:000105      .13     .017     .85  58.13    .000
                 ==========================================================
                 SUM 08:000415     1.21     .215     .90  62.28    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0113-----------------------------------------------------------------------
*
*# ADD NORTHERN PORTION FLOW
*
--------------------
| READ HYD         |   AREA       (ha)=    1.560
| ID=10 (000101)   |   QPEAK     (cms)=     .328
| DT= 1.00 PCYC= 1 |   TPEAK     (hrs)=     .900
--------------------   VOLUME     (mm)=   60.403
  Filename: D:\SWMHYMO\3809\H-000415.001
  Comments:   ID=2  -1  1
```

TIME hrs	FLOW cms	TIME hrs	FLOW cms	TIME hrs	FLOW cms	TIME hrs	FLOW cms	TIME hrs	FLOW cms
.00	.000	.83	.144	1.67	.074	2.50	.031	3.33	.001
.02	.000	.85	.188	1.68	.072	2.52	.031	3.35	.001
.03	.000	.87	.267	1.70	.070	2.53	.030	3.37	.001
.05	.000	.88	.327	1.72	.067	2.55	.030	3.38	.001
.07	.000	.90	.328	1.73	.064	2.57	.029	3.40	.001
.08	.000	.92	.328	1.75	.063	2.58	.029	3.42	.001
.10	.000	.93	.328	1.77	.061	2.60	.029	3.43	.001
.12	.000	.95	.328	1.78	.060	2.62	.029	3.45	.001
.13	.000	.97	.328	1.80	.059	2.63	.028	3.47	.001
.15	.002	.98	.328	1.82	.058	2.65	.028	3.48	.001
.17	.006	1.00	.328	1.83	.058	2.67	.028	3.50	.001
.18	.010	1.02	.328	1.85	.056	2.68	.028	3.52	.000
.20	.014	1.03	.328	1.87	.055	2.70	.028	3.53	.000
.22	.018	1.05	.328	1.88	.053	2.72	.027	3.55	.000
.23	.020	1.07	.328	1.90	.052	2.73	.027	3.57	.000
.25	.022	1.08	.326	1.92	.050	2.75	.027	3.58	.000
.27	.023	1.10	.317	1.93	.050	2.77	.026	3.60	.000
.28	.024	1.12	.308	1.95	.049	2.78	.026	3.62	.000
.30	.025	1.13	.300	1.97	.048	2.80	.026	3.63	.000
.32	.025	1.15	.293	1.98	.048	2.82	.026	3.65	.000
.33	.025	1.17	.288	2.00	.047	2.83	.026	3.67	.000
.35	.027	1.18	.273	2.02	.046	2.85	.026	3.68	.000
.37	.028	1.20	.252	2.03	.045	2.87	.025	3.70	.000
.38	.030	1.22	.230	2.05	.044	2.88	.025	3.72	.000
.40	.032	1.23	.212	2.07	.043	2.90	.025	3.73	.000
.42	.033	1.25	.197	2.08	.042	2.92	.024	3.75	.000
.43	.034	1.27	.186	2.10	.042	2.93	.024	3.77	.000
.45	.034	1.28	.177	2.12	.041	2.95	.024	3.78	.000
.47	.035	1.30	.170	2.13	.041	2.97	.024	3.80	.000
.48	.035	1.32	.164	2.15	.040	2.98	.024	3.82	.000
.50	.035	1.33	.159	2.17	.040	3.00	.024	3.83	.000
.52	.037	1.35	.152	2.18	.040	3.02	.022	3.85	.000
.53	.041	1.37	.143	2.20	.039	3.03	.019	3.87	.000
.55	.045	1.38	.133	2.22	.038	3.05	.015	3.88	.000
.57	.049	1.40	.126	2.23	.037	3.07	.013	3.90	.000
.58	.051	1.42	.120	2.25	.037	3.08	.011	3.92	.000
.60	.053	1.43	.115	2.27	.036	3.10	.009	3.93	.000

```
    .62    .054|   1.45    .111|   2.28    .036|   3.12    .008|   3.95    .000
    .63    .055|   1.47    .108|   2.30    .036|   3.13    .007|   3.97    .000
    .65    .056|   1.48    .105|   2.32    .035|   3.15    .006|   3.98    .000
    .67    .056|   1.50    .103|   2.33    .035|   3.17    .005|   4.00    .000
    .68    .064|   1.52    .099|   2.35    .035|   3.18    .004|   4.02    .000
    .70    .079|   1.53    .095|   2.37    .034|   3.20    .004|   4.03    .000
    .72    .098|   1.55    .090|   2.38    .033|   3.22    .003|   4.05    .000
    .73    .111|   1.57    .086|   2.40    .033|   3.23    .003|   4.07    .000
    .75    .121|   1.58    .083|   2.42    .032|   3.25    .003|   4.08    .000
    .77    .128|   1.60    .081|   2.43    .032|   3.27    .002|   4.10    .000
    .78    .134|   1.62    .079|   2.45    .032|   3.28    .002|   4.12    .000
    .80    .138|   1.63    .077|   2.47    .032|   3.30    .002|   4.13    .000
    .82    .141|   1.65    .075|   2.48    .031|   3.32    .002|
-------------------------------------------------------------------------------
001:0114-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000012) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 10:000101     1.56      .328     .90  60.40    .000
                +ID2 08:000415     1.21      .215     .90  62.28    .000
                 ==================================================
                 SUM 02:000012     2.77      .543     .90  61.23    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0115-----------------------------------------------------------------------
*
*
*# external area from between Poole Creek and Iber Road (additive to
*# storm sewer flow (full 100 year capture)
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=    3.84
| 01:000102 DT= 1.00 |   Total Imp(%)=   36.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.38          2.46
     Dep. Storage     (mm)=        .80          1.50
     Average Slope     (%)=        .20          2.00
     Length            (m)=     382.00         40.00
     Mannings n          =        .013          .250

     Max.eff.Inten.(mm/hr)=     178.56         57.58
                over (min)        7.00         16.00
     Storage Coeff.  (min)=       7.34 (ii)    16.14 (ii)
     Unit Hyd. Tpeak (min)=       7.00         16.00
     Unit Hyd. peak  (cms)=        .16           .07
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .49           .24            .628 (iii)
     TIME TO PEAK    (hrs)=       1.05          1.23           1.083
     RUNOFF VOLUME    (mm)=      70.87         31.80          45.871
     TOTAL RAINFALL   (mm)=      71.68         71.68          71.677
     RUNOFF COEFFICIENT   =        .99           .44            .640

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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001:0116-----------------------------------------------------------------------

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| ADD HYD (000012) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102     3.84     .628    1.08  45.87    .000
                +ID2 02:000012     2.77     .543     .90  61.23    .000
                 =====================================================
                 SUM 10:000012     6.61    1.170    1.07  52.31    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0117-----------------------------------------------------------------------
*
*
*# R202 - MH 202 TO MH 203
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .34
| 01:000102 DT= 1.00 |   Total Imp(%)=   56.00   Dir. Conn.(%)=   44.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .19          .15
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     145.00        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       103.55
                over (min)        4.00        11.00
     Storage Coeff.  (min)=       4.10 (ii)   11.06 (ii)
     Unit Hyd. Tpeak (min)=       4.00        11.00
     Unit Hyd. peak  (cms)=        .28          .10
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .07          .03             .084 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.15            1.017
     RUNOFF VOLUME    (mm)=      70.88        36.27           51.498
     TOTAL RAINFALL   (mm)=      71.68        71.68           71.677
     RUNOFF COEFFICIENT   =        .99          .51             .718

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0118-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------                (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .34     .084    1.02  51.50    .000
                +ID2 06:000102      .08     .103    1.00  58.13    .000
                 =====================================================
                 SUM 10:000415      .42     .185    1.00  52.72    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0119-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .078  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity         =    .078  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)
```

```
                 ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                 (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415       .42      .185     1.000   52.725     .000
     ======================================================================
     MAJOR SYST   05:000102       .06      .107     1.000   52.725     .000
     MINOR SYST   09:000105       .36      .078      .917   52.725     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0120---------------------------------------------------------------------
*
*
*# R203 - MH 203 TO MH 204
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .25
| 01:000102 DT= 1.00 |   Total Imp(%)=   50.00   Dir. Conn.(%)=   36.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .13          .13
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     101.00        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       110.60
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       3.30 (ii)   10.08 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .35          .11
                                                             *TOTALS*
     PEAK FLOW       (cms)=        .04          .02            .058 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.13           1.017
     RUNOFF VOLUME    (mm)=      70.88        36.38          48.797
     TOTAL RAINFALL   (mm)=      71.68        71.68          71.677
     RUNOFF COEFFICIENT   =        .99          .51            .681

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
001:0121---------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                ID1 01:000102      .25      .058    1.02  48.80    .000
               +ID2 05:000102      .06      .107    1.00  52.72    .000
                ===================================================
                SUM 10:000415      .32      .164    1.00  49.55    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-----------------------------------------------------------------------------
001:0122---------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .040  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity         =    .040  (cms)
```

```
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .32      .164     1.000   49.549     .000
     ======================================================================
     MAJOR SYST   05:000102        .08      .124     1.000   49.549     .000
     MINOR SYST   02:000105        .24      .040      .917   49.549     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0123-----------------------------------------------------------------------
*
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 02:000105      .24     .040     .92  49.55    .000
                +ID2 09:000105      .36     .078     .92  52.72    .000
                 ====================================================
                 SUM 08:000415      .60     .118     .92  51.47    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0124-----------------------------------------------------------------------
*
*
*# R204 - MH 204 TO MH 205
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .26
| 01:000102 DT= 1.00 |   Total Imp(%)=   56.00   Dir. Conn.(%)=   43.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .15          .12
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     104.00        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       112.76
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       3.36 (ii)   10.09 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .35          .11
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .05          .02             .066 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.13            1.017
     RUNOFF VOLUME    (mm)=      70.88        36.60           51.338
     TOTAL RAINFALL   (mm)=      71.68        71.68           71.677
     RUNOFF COEFFICIENT   =        .99          .51             .716

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0125-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
```

```
                 ID1 01:000102      .26     .066    1.02  51.34    .000
                +ID2 05:000102      .08     .124    1.00  49.55    .000
                 ======================================================
                 SUM 10:000415      .34     .191    1.00  50.92    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0126-----------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .040  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
 ----------------------   Total minor system capacity         =    .040  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .34      .191     1.000   50.922     .000
     =========================================================================
     MAJOR SYST   05:000102        .10      .151     1.000   50.922     .000
     MINOR SYST   09:000105        .24      .040      .900   50.922     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0127-----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000314) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 09:000105      .24     .040     .90  50.92    .000
                +ID2 08:000415      .60     .118     .92  51.47    .000
                 ======================================================
                 SUM 07:000314      .84     .158     .92  51.31    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0128-----------------------------------------------------------------------
 *
 *# R205 - MH 205 TO MH 206
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .26
 | 01:000102 DT= 1.00 |   Total Imp(%)=   50.00   Dir. Conn.(%)=   36.00
 ----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .13          .13
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     105.10        40.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       110.60
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       3.38 (ii)   10.16 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .35          .11
                                                              *TOTALS*
     PEAK FLOW       (cms)=        .04          .02              .060 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.13             1.017
     RUNOFF VOLUME    (mm)=      70.88        36.38            48.797
     TOTAL RAINFALL   (mm)=      71.68        71.68            71.677
     RUNOFF COEFFICIENT   =        .99          .51              .681
```

```

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 --------------------------------------------------------------------------------
 001:0129------------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .26      .060    1.02  48.80    .000
                +ID2 05:000102      .10      .151    1.00  50.92    .000
                 =======================================================
                 SUM 10:000415      .37      .210    1.00  49.39    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0130------------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .033  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
 ----------------------   Total minor system capacity         =    .033  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .37      .210     1.000   49.390     .000
     =========================================================================
     MAJOR SYST   05:000102        .14      .177     1.000   49.390     .000
     MINOR SYST   02:000105        .23      .033      .900   49.390     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0131------------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 02:000105      .23      .033     .90  49.39    .000
                +ID2 07:000415      .84      .158     .92  51.31    .000
                 =======================================================
                 SUM 07:000415     1.06      .191     .92  50.90    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 --------------------------------------------------------------------------------
 001:0132------------------------------------------------------------------------
 *
 *# R206 - MH 206 TO MH 207
 *
 ----------------------
 | CALIB STANDHYD     |   Area    (ha)=     .26
 | 01:000102 DT= 1.00 |   Total Imp(%)=   52.00   Dir. Conn.(%)=   39.00
 ----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .14          .13
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     105.00        40.00
```

```
      Mannings n           =        .013         .250

      Max.eff.Inten.(mm/hr)=      178.56       109.33
                 over (min)        3.00        10.00
      Storage Coeff.  (min)=        3.38 (ii)   10.19 (ii)
      Unit Hyd. Tpeak (min)=        3.00        10.00
      Unit Hyd. peak  (cms)=         .35          .11
                                                               *TOTALS*
      PEAK FLOW       (cms)=         .05          .02            .063 (iii)
      TIME TO PEAK    (hrs)=        1.00         1.13           1.017
      RUNOFF VOLUME    (mm)=       70.88        36.24          49.751
      TOTAL RAINFALL   (mm)=       71.68        71.68          71.677
      RUNOFF COEFFICIENT   =         .99          .51            .694

        (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN* =  75.0    Ia = Dep. Storage  (Above)
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 001:0133----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD      AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102       .26      .063    1.02  49.75    .000
                +ID2 05:000102       .14      .177    1.00  49.39    .000
                 ==================================================
                 SUM 10:000415       .40      .240    1.00  49.63    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0134----------------------------------------------------------------------
 *
 *
 ----------------------
 | COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .033  (cms)
 | TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
 ----------------------   Total minor system capacity         =    .033  (cms)
                          Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD         AREA     QPEAK     TPEAK     R.V.      DWF
                                   (ha)     (cms)     (hrs)     (mm)    (cms)
      TOTAL HYD.   10:000415        .40      .240     1.000   49.626     .000
      =================================================================
      MAJOR SYST   05:000102        .18      .207     1.000   49.626     .000
      MINOR SYST   09:000105        .23      .033      .900   49.626     .000

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------
 001:0135----------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD      AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------               (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 07:000415      1.06      .191     .92  50.90    .000
                +ID2 09:000105       .23      .033     .90  49.63    .000
                 ==================================================
                 SUM 02:000415      1.29      .224     .92  50.67    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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001:0136----------------------------------------------------------------------
*
*# R207 - MH 207 TO MH 208
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .17
| 01:000102 DT= 1.00 |   Total Imp(%)=   56.00   Dir. Conn.(%)=   43.00
----------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .10          .08
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=      68.50        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       117.14
                over (min)        3.00         9.00
     Storage Coeff.  (min)=       2.62 (ii)    9.24 (ii)
     Unit Hyd. Tpeak (min)=       3.00         9.00
     Unit Hyd. peak  (cms)=        .41          .12
                                                           *TOTALS*
     PEAK FLOW       (cms)=        .04          .02           .046 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.10          1.000
     RUNOFF VOLUME    (mm)=      70.88        36.60         51.338
     TOTAL RAINFALL   (mm)=      71.68        71.68         71.677
     RUNOFF COEFFICIENT   =        .99          .51           .716

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
001:0137----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .17     .046    1.00  51.34    .000
                +ID2 05:000102      .18     .207    1.00  49.63    .000
                 ==================================================
                 SUM 10:000415      .35     .253    1.00  50.47    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
001:0138----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .023  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity         =    .023  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .35      .253     1.000   50.475     .000
     ====================================================================
     MAJOR SYST   05:000102        .20      .230     1.000   50.475     .000
     MINOR SYST   09:000105        .15      .023      .883   50.475     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

------------------------------------------------------------------------------
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001:0139-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 02:000415     1.29     .224     .92  50.67    .000
                +ID2 09:000105      .15     .023     .88  50.48    .000
                 ==================================================
                 SUM 07:000415     1.44     .247     .92  50.65    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0140-----------------------------------------------------------------------
*
*# R209 - MH 209 TO MH 210
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .26
| 01:000102 DT= 1.00 |   Total Imp(%)=   66.00   Dir. Conn.(%)=   56.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .17          .09
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     136.70        40.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       106.36
                over (min)        4.00        11.00
     Storage Coeff.  (min)=       3.96 (ii)   10.85 (ii)
     Unit Hyd. Tpeak (min)=       4.00        11.00
     Unit Hyd. peak  (cms)=        .28          .10
                                                         *TOTALS*
     PEAK FLOW       (cms)=        .06          .02           .075 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.15          1.017
     RUNOFF VOLUME    (mm)=      70.88        36.58         55.786
     TOTAL RAINFALL   (mm)=      71.68        71.68         71.677
     RUNOFF COEFFICIENT   =        .99          .51           .778

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0141-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .26     .075    1.02  55.79    .000
                +ID2 05:000102      .20     .230    1.00  50.47    .000
                 ==================================================
                 SUM 10:000415      .46     .304    1.00  53.48    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0142-----------------------------------------------------------------------
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .060  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =       1
```

```
----------------------   Total minor system capacity         =    .060  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .46      .304     1.000   53.483     .000
     =======================================================================
     MAJOR SYST   06:000102        .18      .244     1.000   53.483     .000
     MINOR SYST   09:000105        .28      .060      .917   53.483     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0143-----------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 07:000415     1.44     .247     .92  50.65    .000
                +ID2 09:000105      .28     .060     .92  53.48    .000
                 ====================================================
                 SUM 02:000415     1.72     .307     .92  51.11    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
001:0144-----------------------------------------------------------------------
*
*
*
*
*# APPROACH MAJOR FLOW FROM EAST TO LOW POINT
*
*# R212 - MH 212 TO MH 211
*
---------------------
| CALIB STANDHYD     |   Area    (ha)=     .20
| 01:000102 DT= 1.00 |   Total Imp(%)=   76.00   Dir. Conn.(%)=   69.00
---------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .15          .05
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=        .20         2.00
     Length            (m)=     104.00        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       112.23
                over (min)        3.00        10.00
     Storage Coeff.  (min)=       3.36 (ii)   10.10 (ii)
     Unit Hyd. Tpeak (min)=       3.00        10.00
     Unit Hyd. peak  (cms)=        .35          .11
                                                               *TOTALS*
     PEAK FLOW       (cms)=        .06          .01              .069 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.13             1.000
     RUNOFF VOLUME    (mm)=      70.88        36.54            60.234
     TOTAL RAINFALL   (mm)=      71.68        71.68            71.677
     RUNOFF COEFFICIENT   =        .99          .51              .840

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0145-----------------------------------------------------------------------
```

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*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .050  (cms)
| TotalHyd 01:000102 |   Number of inlets in system [NINLET] =       1
----------------------   Total minor system capacity         =    .050  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   01:000102        .20      .069     1.000   60.234     .000
     =========================================================================
     MAJOR SYST   03:000102        .01      .019     1.000   60.234     .000
     MINOR SYST   07:000105        .19      .050      .917   60.234     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0146------------------------------------------------------------------------
*
*# R211 - MH 211 TO MH 210
*
----------------------
| CALIB STANDHYD     |   Area    (ha)=     .22
| 01:000102 DT= 1.00 |   Total Imp(%)=   75.00   Dir. Conn.(%)=   68.00
----------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=         .16           .05
     Dep. Storage     (mm)=         .80          1.50
     Average Slope     (%)=         .20          2.00
     Length            (m)=      110.00         40.00
     Mannings n           =        .013          .250

     Max.eff.Inten.(mm/hr)=      178.56        110.60
                over (min)         3.00         10.00
     Storage Coeff.  (min)=        3.48 (ii)    10.26 (ii)
     Unit Hyd. Tpeak (min)=        3.00         10.00
     Unit Hyd. peak  (cms)=         .34           .11
                                                             *TOTALS*
     PEAK FLOW       (cms)=         .07           .01           .074 (iii)
     TIME TO PEAK    (hrs)=        1.00          1.13          1.000
     RUNOFF VOLUME    (mm)=       70.88         36.38         59.837
     TOTAL RAINFALL   (mm)=       71.68         71.68         71.677
     RUNOFF COEFFICIENT   =         .99           .51           .835

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0147------------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 01:000102      .22     .074    1.00  59.84    .000
                +ID2 03:000102      .01     .019    1.00  60.23    .000
                 ======================================================
                 SUM 10:000415      .23     .093    1.00  59.86    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0148------------------------------------------------------------------------
```

```
*
*
----------------------
| COMPUTE DUALHYD    |   Average inlet capacities   [CINLET] =    .050  (cms)
| TotalHyd 10:000415 |   Number of inlets in system [NINLET] =      1
----------------------   Total minor system capacity         =    .050  (cms)
                         Total major system storage [TMJSTO] =      0.(cu.m.)

                  ID: NHYD        AREA     QPEAK     TPEAK     R.V.      DWF
                                  (ha)     (cms)     (hrs)     (mm)    (cms)
     TOTAL HYD.   10:000415        .23      .093     1.000   59.855     .000
     ========================================================================
     MAJOR SYST   05:000102        .03      .043     1.000   59.855     .000
     MINOR SYST   08:000105        .20      .050      .917   59.855     .000

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0149------------------------------------------------------------------------
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 08:000105     .20      .050     .92  59.86    .000
                +ID2 07:000105     .19      .050     .92  60.23    .000
                 ==================================================
                 SUM 04:000415     .39      .100     .92  60.04    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0150------------------------------------------------------------------------
*
*# ADD MINOR FLOW FROM R209
*
--------------------
| ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
--------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                 ID1 04:000415     .39      .100     .92  60.04    .000
                +ID2 02:000415    1.72      .307     .92  51.11    .000
                 ==================================================
                 SUM 07:000415    2.10      .407     .92  52.75    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0151------------------------------------------------------------------------
*
*# TOTAL MINOR FLOW TO TRINITY POND
*
--------------------
| READ HYD         |   AREA      (ha)=    1.873
| ID=10 (000101)   |   QPEAK    (cms)=     .392
| DT= 1.00 PCYC= 1 |   TPEAK    (hrs)=     .933
--------------------   VOLUME    (mm)=   59.336
  Filename: D:\SWMHYMO\3809\H-000422.001
  Comments:   ID=7  -1  1

  TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW |  TIME    FLOW
   hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms |   hrs     cms
    .00    .000|    .85    .199|   1.70    .083|   2.55    .035|   3.40    .001
    .02    .000|    .87    .268|   1.72    .080|   2.57    .035|   3.42    .001
    .03    .000|    .88    .342|   1.73    .077|   2.58    .034|   3.43    .001
    .05    .000|    .90    .375|   1.75    .075|   2.60    .034|   3.45    .001
    .07    .000|    .92    .386|   1.77    .073|   2.62    .034|   3.47    .001
    .08    .000|    .93    .392|   1.78    .072|   2.63    .033|   3.48    .001
```

```
     .10    .000|    .95    .392|   1.80    .070|   2.65    .033|   3.50    .001
     .12    .000|    .97    .392|   1.82    .069|   2.67    .033|   3.52    .001
     .13    .000|    .98    .392|   1.83    .068|   2.68    .033|   3.53    .001
     .15    .002|   1.00    .392|   1.85    .067|   2.70    .032|   3.55    .001
     .17    .005|   1.02    .392|   1.87    .065|   2.72    .032|   3.57    .000
     .18    .009|   1.03    .392|   1.88    .063|   2.73    .032|   3.58    .000
     .20    .014|   1.05    .392|   1.90    .062|   2.75    .031|   3.60    .000
     .22    .018|   1.07    .392|   1.92    .060|   2.77    .031|   3.62    .000
     .23    .021|   1.08    .390|   1.93    .059|   2.78    .031|   3.63    .000
     .25    .023|   1.10    .384|   1.95    .058|   2.80    .031|   3.65    .000
     .27    .025|   1.12    .371|   1.97    .057|   2.82    .030|   3.67    .000
     .28    .026|   1.13    .360|   1.98    .056|   2.83    .030|   3.68    .000
     .30    .027|   1.15    .351|   2.00    .056|   2.85    .030|   3.70    .000
     .32    .028|   1.17    .343|   2.02    .055|   2.87    .030|   3.72    .000
     .33    .029|   1.18    .332|   2.03    .054|   2.88    .029|   3.73    .000
     .35    .030|   1.20    .317|   2.05    .052|   2.90    .029|   3.75    .000
     .37    .031|   1.22    .289|   2.07    .051|   2.92    .029|   3.77    .000
     .38    .033|   1.23    .265|   2.08    .050|   2.93    .028|   3.78    .000
     .40    .035|   1.25    .245|   2.10    .049|   2.95    .028|   3.80    .000
     .42    .037|   1.27    .230|   2.12    .049|   2.97    .028|   3.82    .000
     .43    .038|   1.28    .218|   2.13    .048|   2.98    .028|   3.83    .000
     .45    .039|   1.30    .208|   2.15    .048|   3.00    .028|   3.85    .000
     .47    .040|   1.32    .200|   2.17    .047|   3.02    .027|   3.87    .000
     .48    .040|   1.33    .192|   2.18    .047|   3.03    .024|   3.88    .000
     .50    .040|   1.35    .184|   2.20    .046|   3.05    .020|   3.90    .000
     .52    .042|   1.37    .175|   2.22    .045|   3.07    .017|   3.92    .000
     .53    .045|   1.38    .164|   2.23    .044|   3.08    .014|   3.93    .000
     .55    .050|   1.40    .154|   2.25    .043|   3.10    .012|   3.95    .000
     .57    .054|   1.42    .146|   2.27    .043|   3.12    .010|   3.97    .000
     .58    .057|   1.43    .140|   2.28    .042|   3.13    .009|   3.98    .000
     .60    .059|   1.45    .135|   2.30    .042|   3.15    .008|   4.00    .000
     .62    .061|   1.47    .130|   2.32    .042|   3.17    .007|   4.02    .000
     .63    .062|   1.48    .126|   2.33    .041|   3.18    .006|   4.03    .000
     .65    .063|   1.50    .123|   2.35    .041|   3.20    .005|   4.05    .000
     .67    .064|   1.52    .119|   2.37    .040|   3.22    .005|   4.07    .000
     .68    .071|   1.53    .114|   2.38    .039|   3.23    .004|   4.08    .000
     .70    .083|   1.55    .109|   2.40    .039|   3.25    .004|   4.10    .000
     .72    .101|   1.57    .104|   2.42    .038|   3.27    .003|   4.12    .000
     .73    .118|   1.58    .100|   2.43    .038|   3.28    .003|   4.13    .000
     .75    .131|   1.60    .097|   2.45    .037|   3.30    .002|   4.15    .000
     .77    .140|   1.62    .094|   2.47    .037|   3.32    .002|   4.17    .000
     .78    .148|   1.63    .092|   2.48    .037|   3.33    .002|   4.18    .000
     .80    .154|   1.65    .090|   2.50    .037|   3.35    .002|   4.20    .000
     .82    .159|   1.67    .088|   2.52    .036|   3.37    .002|
     .83    .163|   1.68    .086|   2.53    .036|   3.38    .001|
 -----------------------------------------------------------------------------
 001:0152---------------------------------------------------------------------
 *
 --------------------
 | ADD HYD (000154) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
 --------------------              (ha)     (cms)   (hrs)   (mm)   (cms)
                  ID1 07:000415     2.10      .407     .92  52.75    .000
                 +ID2 10:000101     1.87      .392     .93  59.34    .000
                  ===================================================
                  SUM 02:000154     3.98      .799     .93  55.85    .000

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 -----------------------------------------------------------------------------
 001:0153---------------------------------------------------------------------
 *
 *
 *# TOTAL MAJOR FLOW SOUTHERN PORTION
 *
 --------------------
 | ADD HYD (000415) | ID: NHYD     AREA     QPEAK   TPEAK   R.V.     DWF
```

```
--------------------                 (ha)     (cms)   (hrs)   (mm)   (cms)
              ID1 05:000102      .03     .043    1.00  59.86    .000
             +ID2 06:000102      .18     .244    1.00  53.48    .000
              ======================================================
              SUM 04:000415      .21     .287    1.00  54.26    .000

   NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
001:0154------------------------------------------------------------------------
*
*
*# HAZELDEAN ROAD - ROUTE CHANNEL - 0.55% LONGITUDNAL SLOPE
*
--------------------
| ROUTE CHANNEL    |     Routing time step (min) =  1.00
|  IN> 08:000105   |     Number of SEGMENTS =  3
| OUT< 07:000154   |     Slopes (%), CHANNEL= .5500  FLOODPLAIN= .5500
--------------------                 LENGTH = 1306.00    (m)

              <------ DATA FOR SECTION (   5.0) ------>
              Distance      Elevation       Manning
                   .00           .33          .0250
                  8.99           .15     .0250 / .0130  Main Channel
                  9.00           .00          .0130     Main Channel
                 18.25           .19     .0130 / .0250  Main Channel
                 20.75           .24          .0250

   <---------------------------- TRAVEL TIME TABLE --------------------------->
    DEPTH    ELEV   X-VOLUME  S-VOLUME  FLOW RATE  VELOCITY  TRAV.TIME   D x V
     (m)      (m)   (cu.m.)   (cu.m.)     (cms)     (m/s)     (min)   (m2/s)
     .012     .012  .435E+01  .350E-02      .001      .181    120.10     .002
     .023     .023  .174E+02  .280E-01      .004      .288     75.66     .007
     .035     .035  .392E+02  .944E-01      .011      .377     57.74     .013
     .046     .046  .696E+02  .224E+00      .024      .457     47.66     .021
     .058     .058  .109E+03  .437E+00      .044      .530     41.07     .031
     .069     .069  .157E+03  .755E+00      .072      .598     36.37     .041
     .081     .081  .213E+03  .120E+01      .108      .663     32.82     .054
     .092     .092  .279E+03  .179E+01      .155      .725     30.02     .067
     .104     .104  .353E+03  .255E+01      .212      .784     27.76     .081
     .115     .115  .435E+03  .350E+01      .280      .841     25.87     .097
     .127     .127  .527E+03  .465E+01      .362      .896     24.28     .114
     .138     .138  .627E+03  .604E+01      .456      .950     22.91     .132
     .150     .150  .736E+03  .768E+01      .564     1.002     21.72     .150
     .164     .164  .888E+03  .101E+02      .719     1.058     20.57     .174
     .178     .178  .107E+04  .132E+02      .901     1.103     19.73     .197
     .193     .193  .127E+04  .170E+02     1.137     1.169     18.61     .225
     .207     .207  .150E+04  .216E+02     1.429     1.244     17.50     .257
     .221     .221  .176E+04  .270E+02     1.755     1.304     16.70     .288
     .235     .235  .204E+04  .334E+02     2.115     1.353     16.09     .318

 X-VOLUME= Total X-Section volume over given CHANNEL LENGTH at specified DEPTH.
 S-VOLUME= Volume that can be stored in channel at specified ELEVATION.

                                   <---- hydrograph ---->   <-pipe / channel->
                              AREA    QPEAK   TPEAK   R.V.   MAX DEPTH  MAX VEL
                              (ha)    (cms)   (hrs)   (mm)      (m)      (m/s)
   INFLOW : ID= 8:000105       .20     .050     .92 59.855      .060      .543
   OUTFLOW: ID= 7:000154       .20     .018    1.23 59.854      .041      .416


--------------------------------------------------------------------------------
001:0155------------------------------------------------------------------------
*
*# HAZELDEAN ROAD - ROUTE CHANNEL - 1% LONGITUDNAL SLOPE
*
```

```
 --------------------
 | ROUTE CHANNEL    |     Routing time step (min) =  1.00
 |  IN> 08:000105   |     Number of SEGMENTS =  3
 | OUT< 07:000154   |     Slopes (%), CHANNEL=1.0000  FLOODPLAIN=1.0000
 --------------------                 LENGTH =  321.00    (m)

               <------ DATA FOR SECTION (   5.0) ------>
               Distance      Elevation       Manning
                    .00            .33         .0250
                   8.99            .15     .0250 / .0130  Main Channel
                   9.00            .00         .0130      Main Channel
                  18.25            .19     .0130 / .0250  Main Channel
                  20.75            .24         .0250

   <---------------------------- TRAVEL TIME TABLE -------------------------->
    DEPTH    ELEV   X-VOLUME  S-VOLUME  FLOW RATE  VELOCITY  TRAV.TIME   D x V
      (m)     (m)   (cu.m.)   (cu.m.)      (cms)     (m/s)     (min)   (m2/s)
     .012    .012  .107E+01  .192E-02       .001      .244     21.89     .003
     .023    .023  .428E+01  .154E-01       .005      .388     13.79     .009
     .035    .035  .963E+01  .519E-01       .015      .508     10.52     .018
     .046    .046  .171E+02  .123E+00       .033      .616      8.69     .028
     .058    .058  .267E+02  .240E+00       .060      .715      7.49     .041
     .069    .069  .385E+02  .415E+00       .097      .807      6.63     .056
     .081    .081  .524E+02  .660E+00       .146      .894      5.98     .072
     .092    .092  .685E+02  .984E+00       .209      .978      5.47     .090
     .104    .104  .867E+02  .140E+01       .285     1.057      5.06     .110
     .115    .115  .107E+03  .192E+01       .378     1.134      4.72     .131
     .127    .127  .129E+03  .256E+01       .487     1.209      4.43     .153
     .138    .138  .154E+03  .332E+01       .615     1.281      4.18     .177
     .150    .150  .181E+03  .422E+01       .761     1.351      3.96     .203
     .164    .164  .218E+03  .558E+01       .970     1.427      3.75     .234
     .178    .178  .262E+03  .728E+01      1.214     1.488      3.60     .265
     .193    .193  .312E+03  .936E+01      1.534     1.577      3.39     .304
     .207    .207  .369E+03  .119E+02      1.927     1.677      3.19     .347
     .221    .221  .432E+03  .149E+02      2.366     1.758      3.04     .388
     .235    .235  .502E+03  .184E+02      2.851     1.825      2.93     .429

  X-VOLUME= Total X-Section volume over given CHANNEL LENGTH at specified DEPTH.
  S-VOLUME= Volume that can be stored in channel at specified ELEVATION.

                                         <---- hydrograph ---->   <-pipe / channel->
                               AREA    QPEAK   TPEAK   R.V.    MAX DEPTH  MAX VEL
                               (ha)    (cms)   (hrs)   (mm)       (m)      (m/s)
    INFLOW : ID= 8:000105       .20     .050     .92 59.855      .054      .676
    OUTFLOW: ID= 7:000154       .20     .043    1.08 59.854      .051      .651


 ------------------------------------------------------------------------------
 001:0156----------------------------------------------------------------------
 *
       FINISH
 ------------------------------------------------------------------------------
 ******************************************************************************
      WARNINGS / ERRORS / NOTES
      -------------------------
    Simulation ended on 2009-09-21     at 12:25:54
 ==============================================================================


```

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December 12, 2018 DSEL File No.: 18-1006

City of Ottawa
Planning and Growth Management Department
110 Laurier Avenue West
Ottawa, ON K1P 1J1

Attention: Santhosh Kuruvilla
Project Manager
Development Review (Suburban Services)
Planning, Infrastructure and Economic Development
City of Ottawa

Re: 5 Orchard Stormwater Management Strategy

The following technical memorandum describes the impacts to the proposed stormwater management strategy in the *Functional Servicing and Stormwater Management Report for 5 Orchard Drive,* prepared by DSEL, dated December 2018 (**5 Orchard FSR**) based on new information received from IBI contained within the *Hazeldean Widening Poole Creek to Terry Fox Drive Stormwater Management Report,* prepared by IBI, dated November 2009 (***Hazeldean SWM Report***).

The ***Hazeldean SWM Report*** includes details on the quantity and quality control for the Hazeldean Road Widening, constructed in 2010, and the external area. The ***Hazeldean SWM Report,*** allocated ***3.08 Ha*** of the subject property at 5 Orchard Drive to drain to the Hazeldean storm sewer. Based on the actual property boundaries and drainage areas for 5 Orchard Drive, the ***5 Orchard FSR*** proposed that ***3.96 Ha*** of the subject property will drain to the Hazeldean storm sewer.

The total proposed drainage area to the interim pond includes ***3.96 Ha*** from the subject site; ***0.87 Ha*** of external drainage from Fringewood Drive, Existing Residential and an Existing Restaurant on Hazeldean Road; ***3.51 Ha*** of Hazeldean Road widening and ***0.57 Ha*** of external area north of Hazeldean for a total of ***8.91 Ha***. Refer to the Hazeldean widening and external area drainage boundaries extracted from the ***Hazeldean SWM Report*** in ***Attachments***.

Quality Control

The ***Hazeldean SWM Report*** describes quality control provided for the segment of Hazeldean Road between Poole Creek and the interim SWM Pond, which is located approximately 380 m north-east from the intersection of Huntmar Drive and Hazeldean Road. As discussed above, a portion of the 5 Orchard site was contemplated in the interim SWM Pond. The pond sizing was reviewed to confirm it can accommodate the additional site drainage and external flow not contemplated in the ***Hazeldean SWM Report***, summarized in ***Table 1,*** below:

Table 1: Allocated, Proposed and Provided Quality Control Volumes

	Area (Ha)	Impervious (%)	Required Extended Detention (m^3)	Required Permanent Pool (m^3)
Per Hazeldean SWM Report	7.35	77%	294	331
Per 5 Orchard FSR	8.91	75%	356	386
Provided Volumes in Interim SWM Pond			406	432

The proposed drainage to the interim SWM facility is greater than allocated for in the ***Hazeldean SWM Report,*** however, there is sufficient volume in the extended detention and permanent pool to provide the required 70% TSS Removal. Refer to ***Attachments*** for permanent pool and extended detention calculations based on the drainage areas from ***5 Orchard FSR***.

It is proposed that a future North-South Arterial will be constructed at the location of the interim pond. At time of completion of the North-South arterial, the interim SWM pond will be replaced with an oil-grit separator (OGS) unit. Based on the proposed drainage area of ***8.91 Ha*** and a 70% TSS removal treatment, a Stormceptor EFO12 (or approved equivalent) is required, refer to Stormceptor sizing report in ***Attachments***.

Quantity Control

The interim SWM pond described in the ***Hazeldean SWM Report*** was contemplated to provide quantity controls for Hazeldean Road and includes the pre-development flow from the external area described earlier in this memo. The storm sewers and interim pond were sized to convey the 100-year flow from the external area of ***628 L/s***. The external area represents 80% of the flow to the interim SWM pond, therefore, the proportional allowable release rate for the subject property is ***503 L/s***. The allowable release rate from the ***5 Orchard FSR*** anticipated controlling flow to ***250.6 L/s***.

J.F. Sabourin and Associates Inc. (JFSA), prepared an analysis of the impacts of the subject property drainage to the Carp River, utilizing the City of Ottawa Carp River model in PCSWMM. The analysis is summarized in the *5 Orchard Drive – Stormwater Functional Servicing Analysis* by JFSA, dated December 6, 2018 (***JFSA SWM Analysis***) and found in the ***Attachments*** of this memorandum. It was determined that the post-development 100-year uncontrolled flow from the subject property would not have an impact on the water levels within the Carp River. Table 2, below, summarizes the flows contemplated in the JFSA analysis, ***5 Orchard FSR*** and ***Hazeldean SWM Report:***

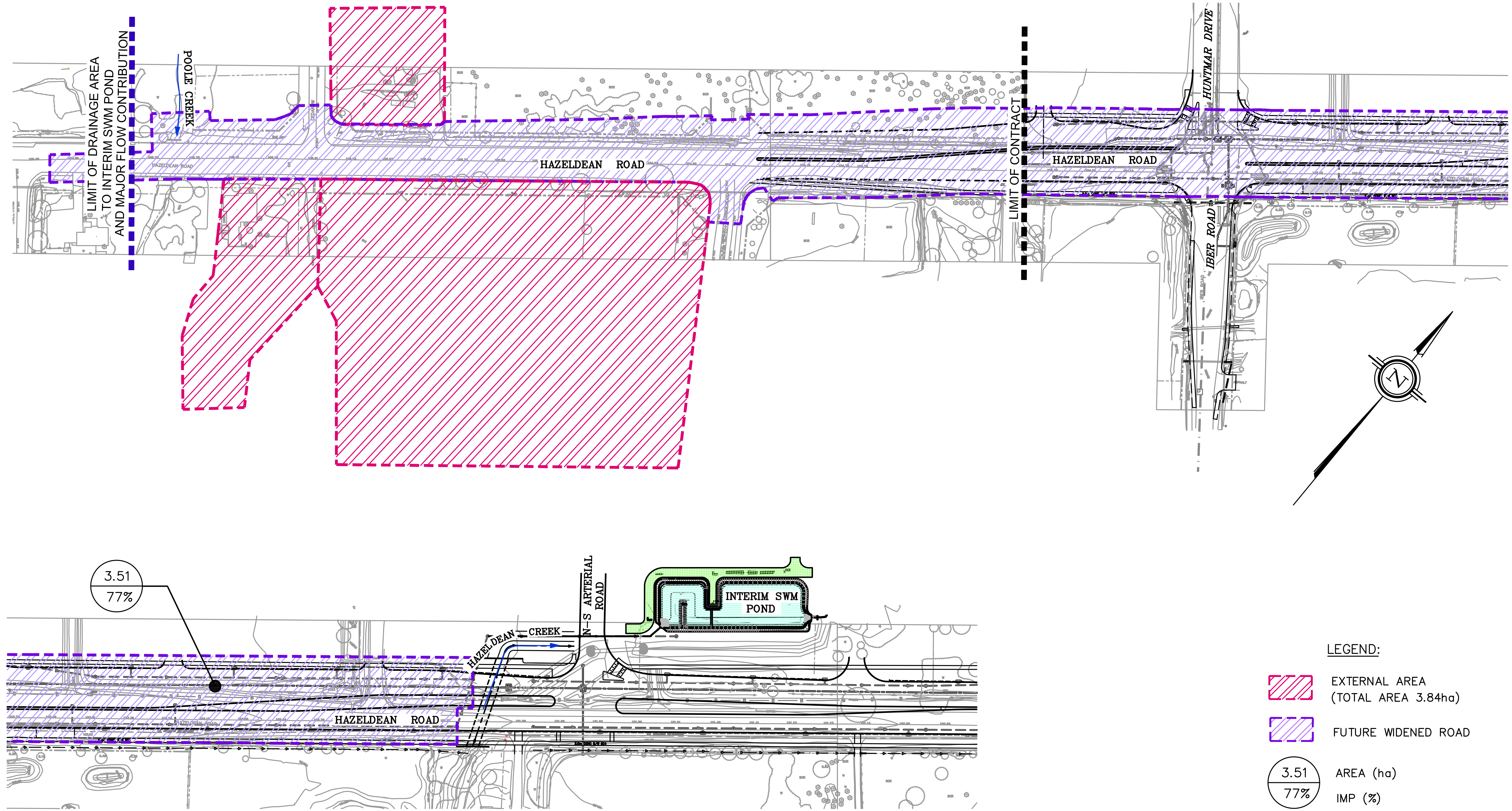
Table 2: 100-Year Flow Results

	100-Year Flow (L/s)	Description
Per Hazeldean SWM Report	503	100-Year 3 Hr Chicago based on pre-development conditions
Per 5 Orchard FSR	250.6	Rational Method based on pre-development conditions
Per JFSA Analysis	1470	100-Year 3 Hr Chicago based on post-development conditions

Due to the varying time to peak from the subject property to the Carp River and the peak flow within the Carp River, the ***JFSA SWM Analysis*** concluded that there is no impact to the Carp River water levels based on the 100-year flow from the subject property of ***1470 L/s***. The actual allowable release rate from the subject property is lower than the flow contemplated by JFSA, therefore, it is anticipated the release rates based on the ***5 Orchard FSR*** and ***Hazeldean SWM Report,*** will not have an impact on the Carp River water levels.

Yours Truly,

Steve Merrick, P.Eng.
Project Manager / Intermediate Designer



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Project Title: HAZELDEAN ROAD WIDENING
IBER ROAD TO TERRY FOX DRIVE

Drawing Title: FUTURE ROAD
RIGHT OF WAY DRAINAGE AREA
TO INTERIM SWM FACILITY

Sheet No.: FIGURE 4

Wet Pond Sizing Per MOE

Tributary Area	ha	8.912	
Estimated Imperviousness	(%)	75	
Permanent Pool Volume Requirements	m^3/ha	83.33	<-- 40 m3/ha accounted for in ext. detention
Permanent Pool Required	m^3	386.16	
Extended Detention Required	m^3	356.48	

Table 3.2 Water Quality Storage Requirements based on Receiving Waters[1, 2]

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal 70% long-term S.S. removal	Infiltration	20	20	25	30
	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic 60% long-term S.S. removal	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

Source: Stormwater Management Planning and Design Manual prepared by the MOE, 2003

Detailed Stormceptor Sizing Report – 5 Orchard Dr.

Project Information & Location			
Project Name	5 Orchard Dr.	**Project Number**	-
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	11/21/2018
Designer Information		**EOR Information (optional)**	
Name	Brandon O'Leary	**Name**	Steve Merrick
Company	Forterra	**Company**	David Schaeffer Engineering Ltd.
Phone #	905-630-0359	**Phone #**	(613) 222-7816
Email	brandon.oleary@forterrabp.com	**Email**	SMerrick@dsel.ca

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	5 Orchard Dr.
Recommended Stormceptor Model	EFO12
TSS Removal (%) Provided	71
PSD	Fine Distribution
RainFall Station	OTTAWA MACDONALD-CARTIER INT'L A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

EFO Sizing Summary			
EFO Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**	**Standard EFO Hydrocarbon Storage Capacity**
EFO4	35	29	265 L (70 gal)
EFO6	49	51	610 L (160 gal)
EFO8	58	68	1070 L (280 gal)
EFO10	66	79	1670 L (440 gal)
EFO12	71	85	2475 L (655 gal)
Parallel Units / MAX	Custom	Custom	Custom

OVERVIEW

Stormceptor ® EF is a continuation and evolution of the most globally recognized oil-grit separator (OGS) stormwater treatment technology - **Stormceptor ®.** Also known as a hydrodynamic separator, the enhanced flow Stormceptor EF is a high performing oil-grit separator that effectively removes a wide variety of pollutants from stormwater and snowmelt runoff at higher flow rates as compared to the original Stormceptor. Stormceptor EF captures and retains sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals. Stormceptor EF's patent-pending treatment and scour prevention technology and internal bypass ensures sediment is retained during all rainfall events.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Ontario	**Total Number of Rainfall Events**	4819
Rainfall Station Name	OTTAWA MACDONALD-CARTIER INT'L A	**Total Rainfall (mm)**	20978.1
Station ID #	6000	**Average Annual Rainfall (mm)**	567.0
Coordinates	45°19'N, 75°40'W	**Total Evaporation (mm)**	1560.2
Elevation (ft)	370	**Total Infiltration (mm)**	6071.0
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	13346.9

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

ONLINE APPLICATION

Stormceptor EF's internal bypass and patent-pending scour prevention technology has demonstrated very effective retention of pollutants in third-party testing and verification following the Canadian ETV's **Procedure for Laboratory Testing of Oil-Grit Separators.** Sediment scour prevention demonstrated an effluent concentration of less than 10 mg/L for sediment particles ranging from 1 to 1,000 microns, even during peak influent flow rates associated with infrequent high intensity storm events. While Stormceptor EF will capture oil, only the Stormceptor EFO configuration has been third-party tested and verified to retain greater than 99% of captured oil. Based on these verified performance attributes, the most efficient and widely accepted application of Stormceptor EF is an online configuration, which allows all upstream conveyance flows to enter and exit the unit. The online application eliminates the need for costly additional bypass structures, piping and installation expense.

FLOW ENTRANCE OPTIONS

Single Inlet Pipe – A common design which includes one inlet pipe and one outlet pipe. A 90-degree (maximum) bend is also accepted with this configuration.

Inlet Grate – Allows surface runoff to enter the unit from grade. The inlet grate option can also be used in conjunction with one inlet pipe or multiple inlet pipes. A removable flow deflector is added in the Stormceptor EF4/EFO4.

Maximum Pipe Diameter		
Model	Inlet (In/mm)	Outlet (In/mm)
EF4 / EFO4	24 / 610	24 / 610
EF6 / EFO6	36 / 915	36 / 915
EF8/ EFO8	48 / 1220	48 / 1220
EF10/EFO10	72 / 1828	72 / 1828
EF12/EFO12	72 / 1828	72 / 1828

Multiple Inlet Pipe – Allows for multiple inlet pipes of various diameters to enter the unit.

Maximum Pipe Diameter		
Model	Inlet (In/mm)	Outlet (In/mm)
EF4 / EFO4	18 / 457	24 / 610
EF6 / EFO6	30 / 762	36 / 915
EF8/ EFO8	42 / 1067	48 / 1220
EF10/EFO10	60 / 1524	72 / 1828
EF12/EFO12	60 / 1524	72 / 1828

Drainage Area	
Total Area (ha)	8.64
Imperviousness %	71

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Water Quality Objective	
TSS Removal (%)	70.0
Runoff Volume Capture (%)	85.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	5 Orchard Dr.

Site Details

Drainage Area	
Total Area (ha)	8.64
Imperviousness %	71
Oil Spill Capture Volume (L)	

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Surface Characteristics	
Width (m)	588.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Evaporation	
Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow	
Dry Weather Flow (lps)	0

Maintenance Frequency	
Maintenance Frequency (months) >	12

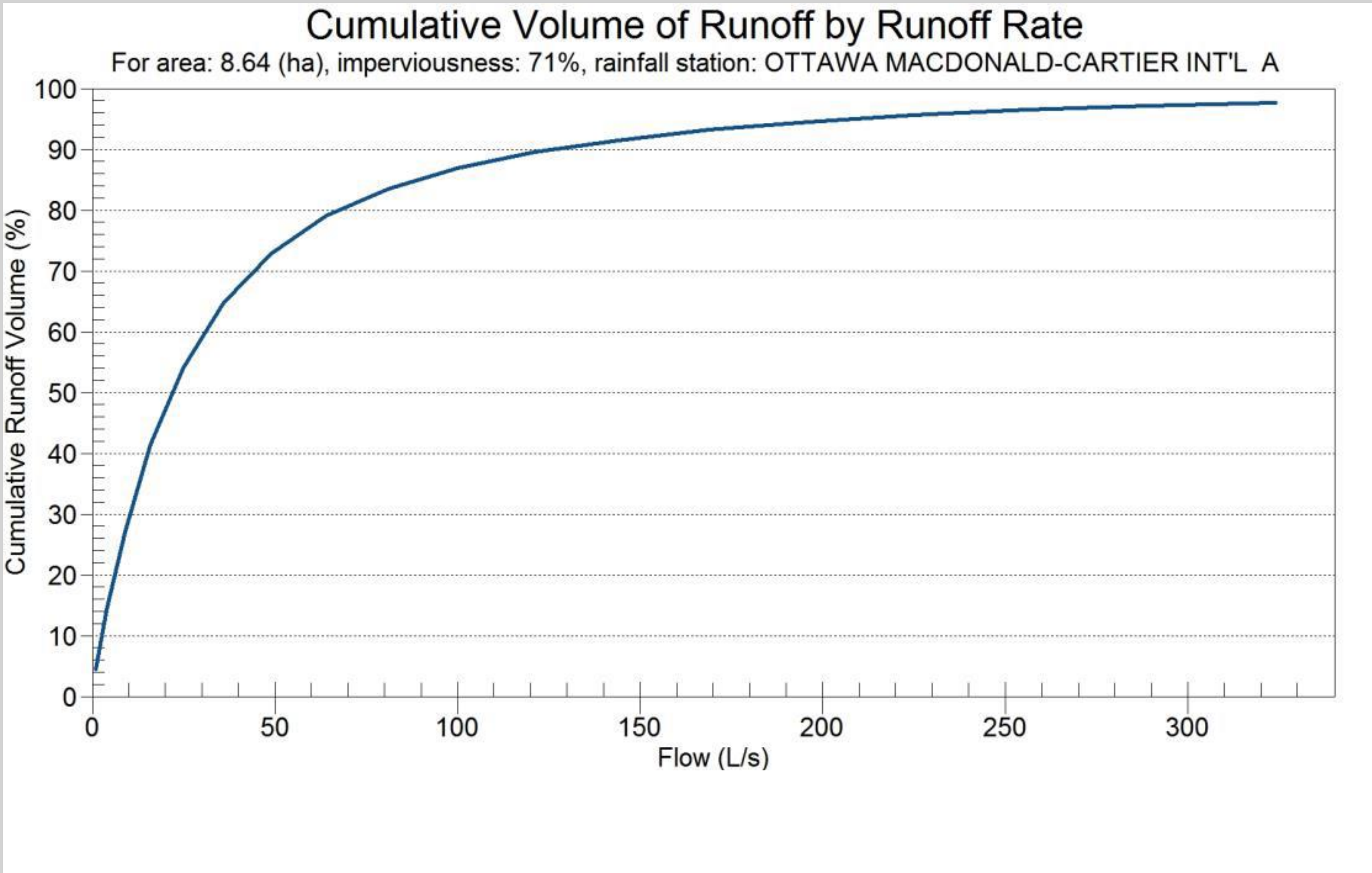
Winter Months	
Winter Infiltration	0

TSS Loading Parameters	
TSS Loading Function	Build Up/ Wash-off

Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	125
Exponential Buildup Power	0.40
Exponential Washoff Exponent	0.20

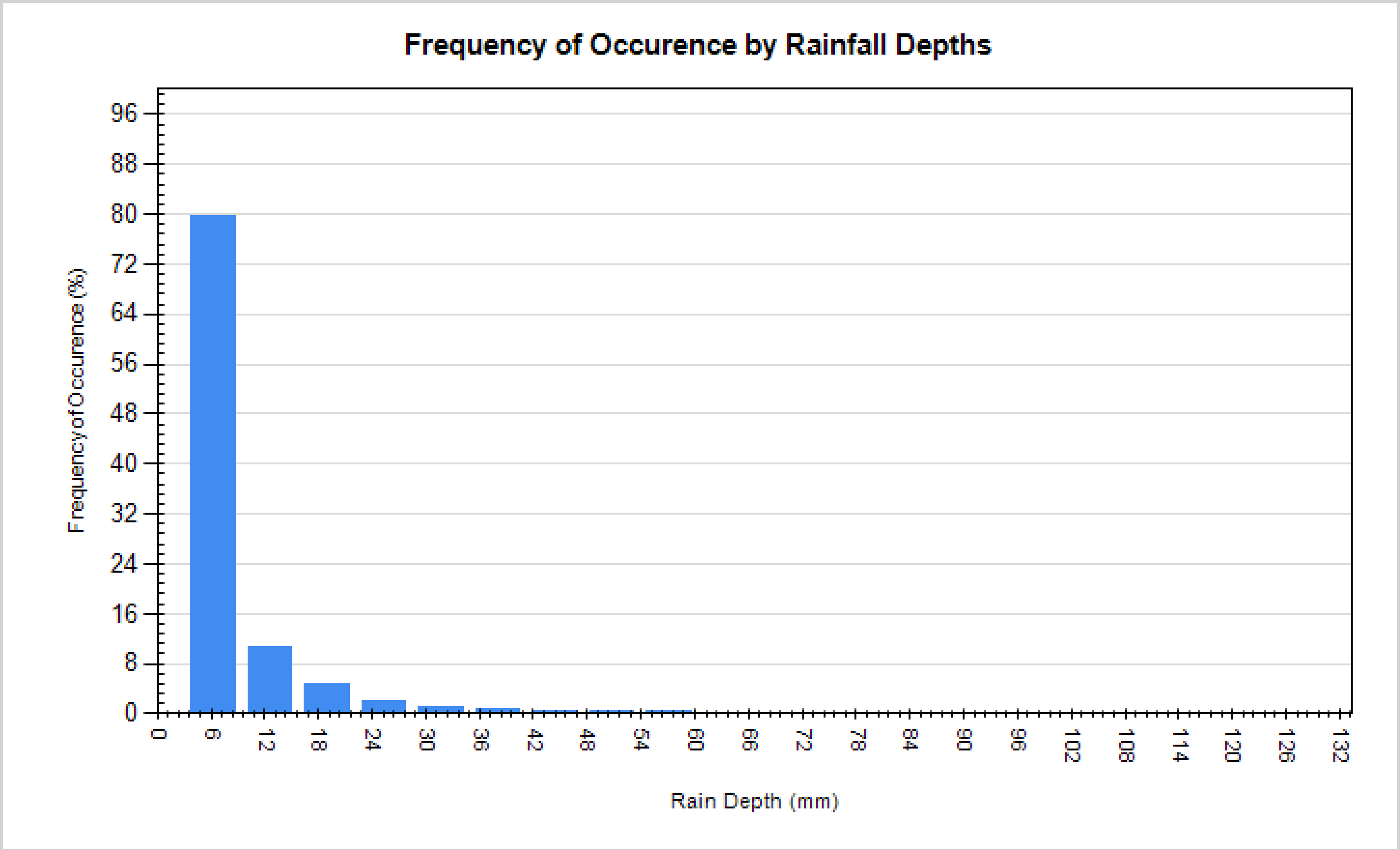
TSS Availability Parameters	
Availability Constant A	0.057
Availability Factor B	0.04
Availability Exponent C	1.10
Min. Particle Size Affected by Availability (micron)	400

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	**Runoff Volume (m^3)**	**Volume Over (m^3)**	**Cumulative Runoff Volume (%)**
1	51584	1106477	4.5
4	164802	993267	14.2
9	313156	845014	27
16	481063	676987	41.5
25	625965	531789	54.1
36	750385	407871	64.8
49	843936	314096	72.9
64	914304	243615	79
81	966756	191209	83.5
100	1005778	152194	86.9
121	1035826	122047	89.5
144	1059552	98351	91.5
169	1078996	78885	93.2
196	1094706	63214	94.5
225	1107297	50626	95.6
256	1117024	40895	96.5
289	1124925	33002	97.1
324	1131567	26366	97.7
361	1136919	21011	98.2
400	1141259	16674	98.6
441	1144809	13123	98.9
484	1147682	10255	99.1
529	1150164	7773	99.3
576	1152171	5764	99.5
625	1153790	4147	99.6
676	1155116	2822	99.8
729	1156038	1901	99.8
784	1156597	1343	99.9
841	1157006	933	99.9
900	1157321	618	99.9


Cumulative Volume of Runoff by Runoff Rate
For area: 8.64 (ha), imperviousness: 71%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A
Cumulative Runoff Volume (%)
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
Flow (L/s)

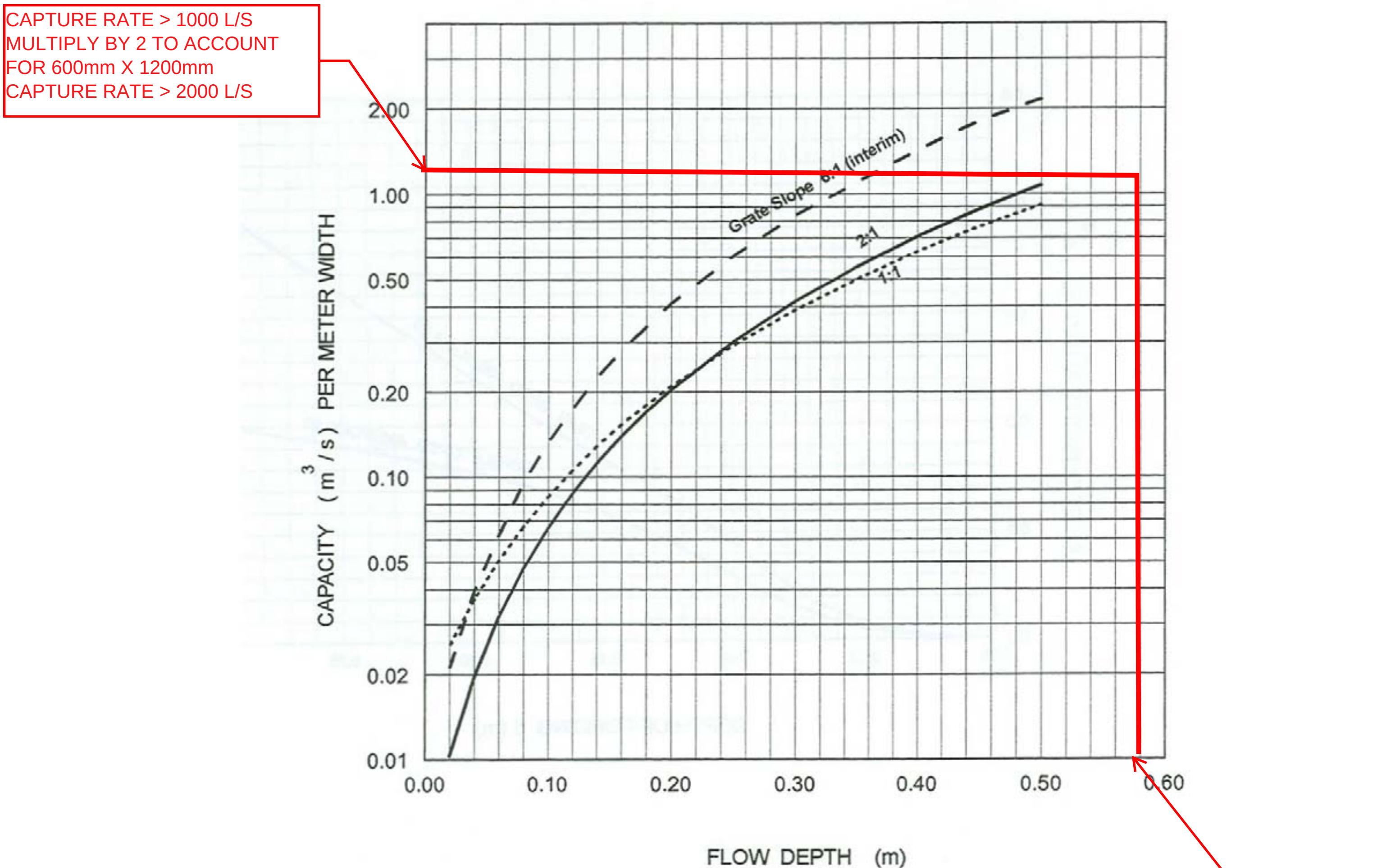
Rainfall Event Analysis

Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)
6.35	3843	79.7	5885	28.1
12.70	520	10.8	4643	22.1
19.05	225	4.7	3470	16.5
25.40	98	2.0	2144	10.2
31.75	58	1.2	1639	7.8
38.10	32	0.7	1118	5.3
44.45	24	0.5	996	4.7
50.80	9	0.2	416	2.0
57.15	5	0.1	272	1.3
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	1	0.0	109	0.5
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Design Chart 4.20: Ditch Inlet Capacity



Notes:

1. Curves apply to grate Type 403.01, but may be used for straight - bar inlets without significant loss of accuracy.
2. Capacities given by curves are for unobstructed grates only. For design use working capacity ≯ 0.5 x unobstructed capacity.
3. Capacities of grates operating in high velocity flows are less than indicated.

DESIGN GUIDE

STORMTANK® Module

BRENTWOOD®

Contents

General Notes

1. Brentwood recommends that the installing contractor contact either Brentwood or the local distributor prior to installation of the system to schedule a pre-construction meeting. This meeting will ensure that the installing contractor has a firm understanding of the installation instructions.
2. All systems must be designed and installed to meet or exceed Brentwood's minimum requirements. Although Brentwood offers support during the design, review, and construction phases of the Module system, it is the ultimate responsibility of the Engineer of Record to design the system in full compliance with all applicable engineering practices, laws, and regulations.
3. Brentwood requires a minimum cover of 24" (610 mm) and/or a maximum Module invert of 11' (3.35 m). Additionally, a minimum 6" (152 mm) leveling bed, 12" (305 mm) side backfill, and 12" (305 mm) top backfill are required on every system.
4. Brentwood recommends a minimum bearing capacity and subgrade compaction for all installations. If site conditions are found not to meet any design requirements during installation, the Engineer of Record must be contacted immediately.
5. All installations require a minimum two layers of geotextile fabric. One layer is to be installed around the Modules, and another layer is to be installed between the stone/soil interfaces.
6. Stone backfilling is to follow all requirements of the most current installation instructions.
7. The installing contractor must apply all protective measures to prevent sediment from entering the system during and after installation per local, state, and federal regulations.
8. The StormTank® Module carries a Limited Warranty, which can be accessed at www.brentwoodindustries.com.

1.0 Introduction

About Brentwood

Brentwood is a global manufacturer of custom and proprietary products and systems for the construction, consumer, medical, power, transportation, and water industries. A focus on plastics innovation, coupled with diverse production capabilities and engineering expertise, has allowed Brentwood to build a strong reputation for thermoplastic molding and solutions development.

Brentwood's product and service offerings continue to grow with an ever-increasing manufacturing presence. By emphasizing customer service and working closely with clients throughout the design, engineering, and manufacturing phases of each project, Brentwood develops forward-thinking strategies to create targeted, tailored solutions.

StormTank® Module

The StormTank Module is a strong, yet lightweight, alternative to other subsurface systems and offers the largest void space (up to 97%) of any subsurface stormwater storage unit on the market. The Modules are simple to assemble on site, limiting shipping costs, installation time, and labor. Their structural PVC columns pressure fit into the polypropylene top/bottom platens, with side panels inserted around the perimeter of the system. This open design and lack of internal walls make the Module system easy to clean compared to other subsurface box structures. When properly designed, applied, installed, and maintained, the Module system has been engineered to achieve a 50-year lifespan.

Technical Support

Brentwood's knowledgeable distributor network and in-house associates emphasize customer service and support by parterning with customers to extend the process beyond physical material supply. These trained specialists are available to assist in the review of proposed systems, conversions of alternatively designed systems, or to resolve any potential concerns before, during, and after the design process. To provide the best assistance, it is recommended that associates be provided with a site plan and cross-sections that include grading, drainage structures, dimensions, etc.

2.0 Product Information

Applications

The Module system can be utilized for detention, infiltration, capture and reuse, and specialty applications across a wide range of industries, including the commercial, residential, and recreational segments. The product's modular design allows the system to be configured in almost any shape (even around utilities) and to be located under almost any pervious or impervious surface.

Module Selection

Brentwood manufactures the Module in five different heights (Table 1) that can be stacked uniformly up to two Modules high. This allows for numerous height configurations up to 6' (1.83 m) tall. The Modules can be buried up to a maximum invert of 11' (3.35 m) and require a minimum cover of 24" (610 mm) for load rating. When selecting the proper Module, it is important to consider the minimum required cover, any groundwater or limiting zone restrictions, footprint requirements, and all local, state, and federal regulations.

Table 1: Nominal StormTank® Module Specificiations

	ST-18	ST-24	ST-30	ST-33	ST-36
Height	18" (457 mm)	24" (610 mm)	30" (762 mm)	33" (838 mm)	36" (914 mm)
Void Space	95.5%	96.0%	96.5%	96.9%	97.0%
Module Storage Capacity	6.54 ft^3 (0.18 m^3)	8.64 ft^3 (0.24 m^3)	10.86 ft^3 (0.31 m^3)	11.99 ft^3 (0.34 m^3)	13.10 ft^3 (0.37 m^3)
Min. Installed Capacity*	9.15 ft^3 (0.26 m^3)	11.34 ft^3 (0.32 m^3)	13.56 ft^3 (0.38 m^3)	14.69 ft^3 (0.42 m^3)	15.80 ft^3 (0.45 m^3)
Weight	22.70 lbs (10.30 kg)	26.30 lbs (11.93 kg)	29.50 lbs (13.38 kg)	31.3 lbs (14.20 kg)	33.10 lbs (15.01 kg)

Min. Installed Capacity includes the leveling bed, Module, and top backfill storage capacity for one Module. Stone storage capacity is based on 40% void space.* ***Side backfill storage is not included.*

3.0 Manufacturing Standards

Brentwood selects material based on long-term performance needs. To ensure long-term performance and limit component deflection over time (creep), Brentwood selected polyvinyl chloride (PVC) for the Module's structural columns and a virgin polypropylene (PP) blend for the top/bottom and side panels. PVC provides the largest creep resistance of commonly available plastics, and therefore, provides the best performance under loading conditions. Materials like polyethylene (HDPE) and recycled PP have lower creep resistance and are not recommended for load-bearing products and applications.

Materials:

Brentwood's proprietary PVC and PP copolymer resins have been chosen specifically for utilization in the StormTank® Module. The PVC is blended in house by experts and is a 100% blend of post-manuacturing/pre-consumer recycled material. Both materials exhibit structural resilience and naturally resist the chemicals typically found in stormwater runoff.

Methods:

Injection Molding

The Module's top/bottom platens and side panels are injection molded, using proprietary molds and materials. This allows Brentwood to manufacture a product that meets structural requirements while maintaining dimensional control, molded-in traceability, and quality control.

Extrusion

Brentwood's expertise in PVC extrusion allows the structural columns to be manufactured in house. The column extrusion includes the internal structural ribs required for lateral support.

Quality Control

Brentwood maintains strict quality control in order to ensure that materials and the final product meet design requirments. This quality assurance program includes full material property testing in accordance with American Society for Testing and Materials (ASTM) standards, full-part testing, and process testing in order to quantify product performance during manufacturing. Additionally, Brentwood conducts secondary finshed-part testing to verify that design requirements continue to be met post-manufacturing.

All Module parts are marked with traceability information that allows for tracking of manufacturing. Brentwood maintains equipment at all manufacturing locations, as well as at its corporate testing lab, to ensure all materials and products meet all requirements.

4.0 Structural Response

Structural Design

The Module has been designed to resist loads calculated in accordance with the American Association of State Highway and Transportation Official's (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design manual. This fully factored load includes a multiple presence factor, dynamic load allowance, and live load factor to account for real-world situations. This loading was considered when Brentwood developed both the product and installation requirements. The developed minimum cover ensures the system maintains an adequate resistance factor for the design truck (HS-20) and HS-25 loads.

Full-Scale Product Testing

Engineers at Brentwood's in-house testing facility have completed full-scale vertical and lateral tests on the Module to evaluate product response. To date, Brentwood continues in-house testing in order to evaluate long-term creep effects.

Fully Installed System Testing

Brentwood's dedication to providing a premier product extends to fully installed testing. Through a partnership with Queen's University's GeoEngineering Centre in Kingston, Ontario, Brentwood has conducted full-scale installation tests of single- and double-stacked Module systems to analyze short- and long-term performance. Testing includes short-term ultimate limit state testing under fully factored AASHTO loads and minimum installation cover, lateral load testing, long-term performance and lifecycle testing utilizing time-temperature superposition, and load resistance development. Side backfill material tests were also performed to compare the usage of sand, compacted stone, and uncompacted stone.

5.0 Foundation

The foundation (subgrade) of the subsurface storage structure may be the most important part of the Module system installation as this is the location where the system applies the load generated at the surface. If the subgrade lacks adequate support or encounters potential settlement, the entire system could be adversely affected. Therefore, when implementing an underground storage solution, it is imperative that a geotechnical investigation be performed to ensure a strong foundation.

Considerations & Requirements:

Bearing Capacity

The bearing capacity is the ability of the soil to resist settlement. In other words, it is the amount of weight the soil can support. This is important versus the native condition because the system is replacing earth, and even though the system weighs less than the earth, the additional load displacement of the earth is not offset by the difference in weight.

Using the Loading and Resistance Factor Design (LRFD) calculation for bearing capacity, Brentwood has developed a conservative minimum bearing capacity table (see Appendix). The Engineer of Record shall reference this table to assess actual cover versus the soil bearing required for each unit system.

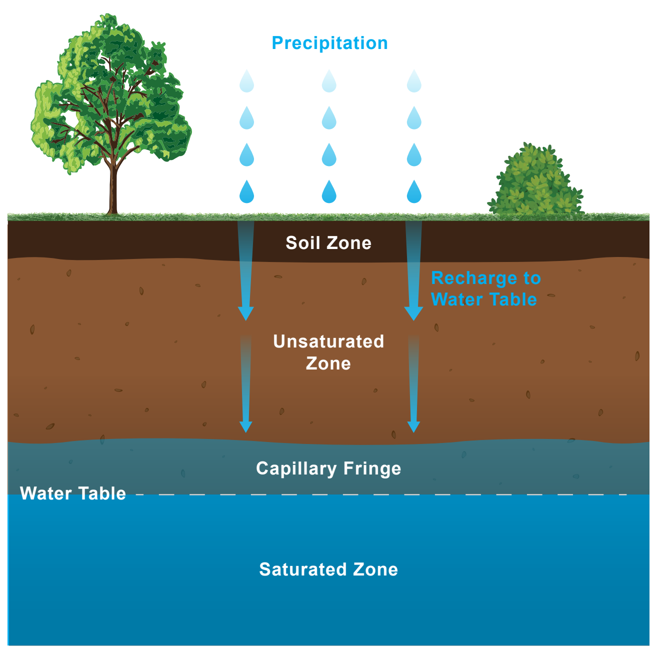
Soil Profile

Limiting Zones

Limiting zones are conditions in the underlying soils that can affect the maximum available depth for installation and can reduce the strength and stability of the underlying subgrade. The three main forms of limiting zones are water tables, bedrock, and karst topography. It is recommended that a system be offset a minimum of 12" (305 mm) from any limiting zones.

Compaction

Soil compaction occurs as the soil particles are pressed together and pore space is eliminated. By compacting the soils to 95% (as recommended by Brentwood), the subgrade strength will increase, in turn limiting both the potential for the soil to move once installed and for differential settlement to occur throughout the system. If designing the specific compaction requirement, settlement should be limited to less than 1" (25 mm) through the entire subgrade and should not exceed a 1/2" (13 mm) of differential settlement between any two adjacent units within the system over time.



Water Table Zones

Mitigation

If a minimum subgrade bearing capacity cannot be achieved because of weak soil, a suitable design will need to be completed by a Geotechnical Engineer. This design may include the over-excavation of the subgrade and an engineered fill or slurry being placed. Additional material such as geogrid or other products may also be required. Please contact a Geotechnical Engineer prior to selecting products or designing the subgrade.

6.0 System Materials

Geotextile Fabric

The 6-ounce geotextile fabric is recommended to be installed between the soil and stone interfaces around the Modules to prevent soil migration.

Leveling Bed

The leveling bed is constructed of 6”-thick (152 mm) angular stone (Table 2). The bed has not been designed as a structural element but is utilized to provide a level surface for the installation of the system and provide an even distribution of load to the subgrade.

Stone Backfill

The stone backfill is designed to limit the strain on the product through displacement of load and ensure the product’s longevity. Therefore, a minimum of 12”-wide (305 mm) angular stone must be placed around all sides of the system. In addition, a minimum layer of 12” (305 mm) angular stone is required on top of the system. All material is to be placed evenly in 12” (305 mm) lifts around and on top of the system and aligned with a vibratory plate compactor.

Table 2: Approved Backfill Material

Material Location	Description	AASHTO M43 Designation	ASTM D2321 Class	Compaction/Density
Finished Surface	Topsoil, hardscape, stone, concrete, or asphalt per Engineer of Record	N/A	N/A	Prepare per engineered plans
Suitable Compactable Fill	Well-graded granular soil/aggregate, typically road base or earthen fill (maximum 4" particle size)	56, 57, 6, 67, 68	I & II III (Earth Only)	Place in maximum 12" lifts to a minimum 90% standard proctor density
Top Backfill	Crushed angular stone placed between Modules and road base or earthen fill	56, 57, 6, 67, 68	I & II	Plate vibrate to provide evenly distributed layers
Side Backfill	Crushed angular stone placed between earthen wall and Modules	56, 57, 6, 67, 68	I & II	Place and plate vibrate in uniform 12" lifts around the system
Leveling Bed	Crushed angular stone placed to provide level surface for installation of Modules	56, 57, 6, 67, 68	I & II	Plate vibrate to achieve level surface

Impermeable Liner

In designs that prevent runoff from infiltrating into the surrounding soil (detention or reuse applications) or groundwater from entering the system, an impermeable liner is required. When incorporating a liner as part of the system, Brentwood recommends using a manufactured product such as a PVC liner. This can be installed around the Modules themselves or installed around the excavation (to gain the benefit of the void space in the stone) and should include an underdrain system to ensure the basin fully drains. This liner is installed with a layer of geotextile fabric on both sides to prevent puncture, in accordance with manufacturer recommendations.

7.0 Connections

Stormwater runoff must be able to move readily in and out of the StormTank® Module system. Brentwood has developed numerous means of connecting to the system, including inlet/outlet ports and direct abutment to a catch basin or endwall. All methods of connection should be evaluated as each one may offer a different solution. Brentwood has developed drawings to assist with specific installation methods, and these are available at www.brentwoodindustries.com.

Inlet/Outlet and Pipe Connections

To facilitate easy connection to the system, Brentwood manufactures two inlet/outlet ports. They are 12" (305 mm) and 14" (356 mm), respectfully, and utilize a flexible coupling connection to the adjoining pipe.

Another common installation method is to directly connect the pipe to the system. In order to do this, an opening is cut into the side panels, the pipe is inserted, and then the system is wrapped in geotextile fabric. When utilizing this connection method, the pipe must be located a minimum of 3" (76 mm) from the bottom of the system. This provides adequate clearance for the bottom platen and the required strength in the remaining side panel. To maintain the required clearances or reduce pipe size, it may be necessary to connect utilizing a manifold system.

Direct Abutment

The system can also be connected by directly abutting Modules to a concrete catch basin or endwall. This allows for a seamless connection of structures in close proximity to the system and eliminates the need for numerous pipe connections. When directly abutting one of these structures, remove any side panels that fully abut the structure, and make sure it is flush with the system to prevent material migration into the structure.

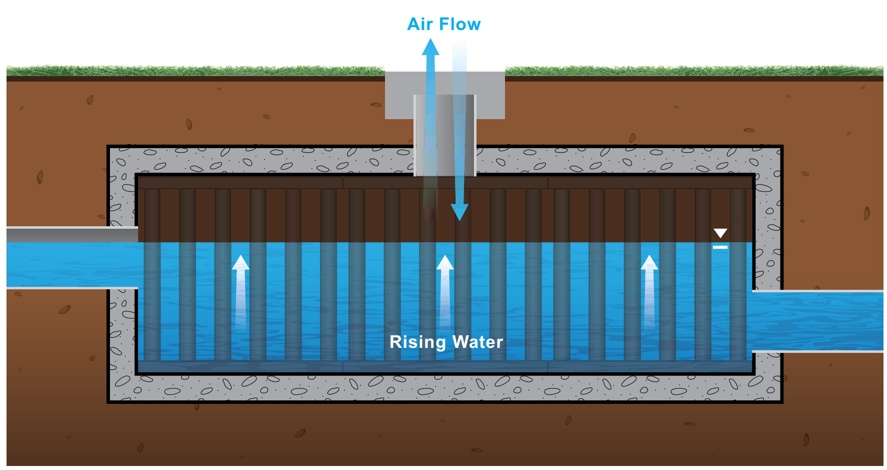
Underdrain

Underdrains are typically utilized in detention applications to ensure the system fully drains since infiltration is limited or prohibited. The incorporation of an underdrain in a detention application will require an impermeable liner between the stone-soil interface.

Cleanout Ports

Brentwood understands the necessity to inspect and clean a subsurface system and has designed the Module without any walls to allow full access. Brentwood offers three different cleanout/observation ports for utilization with the system. The ports are made from PVC, provide an easy means of connection, and are available in 6" (152 mm), 8" (203 mm) and 10" (254 mm) diameters. The 10" (254 mm) port is sized to allow access to the system by a vacuum truck suction hose for easy debris removal.

It is recommended that ports be located a maximum of 30' (9.14 m) on center to provide adequate access, ensure proper airflow, and allow the system to completely fill.



Ventilation and Air Flow

8.0 Pretreatment

Removing pollutants from stormwater runoff is an important component of any stormwater management plan. Pretreatment works to prevent water quality deterioration and also plays an integral part in allowing the system to maintain performance over time and increase longevity. Treatment products vary in complexity, design, and effectiveness, and therefore, should be selected based on specific project requirements.

Typical Stormwater System

Catch Basin → **Inlet Piping** → **Pretreatment** → **Storage Basin** → **Outlet Structure**

Pretreatment: STORMTANK® Shield

Storage Basin: STORMTANK® Module, STORMTANK® Pack

StormTank® Shield

Brentwood's StormTank Shield provides a low-cost solution for stormwater pretreatment. Designed to improve sumped inlet treatment, the Shield reduces pollutant discharge through gross sediment removal and oil/water separation. For more information, please visit www.brentwoodindustries.com.

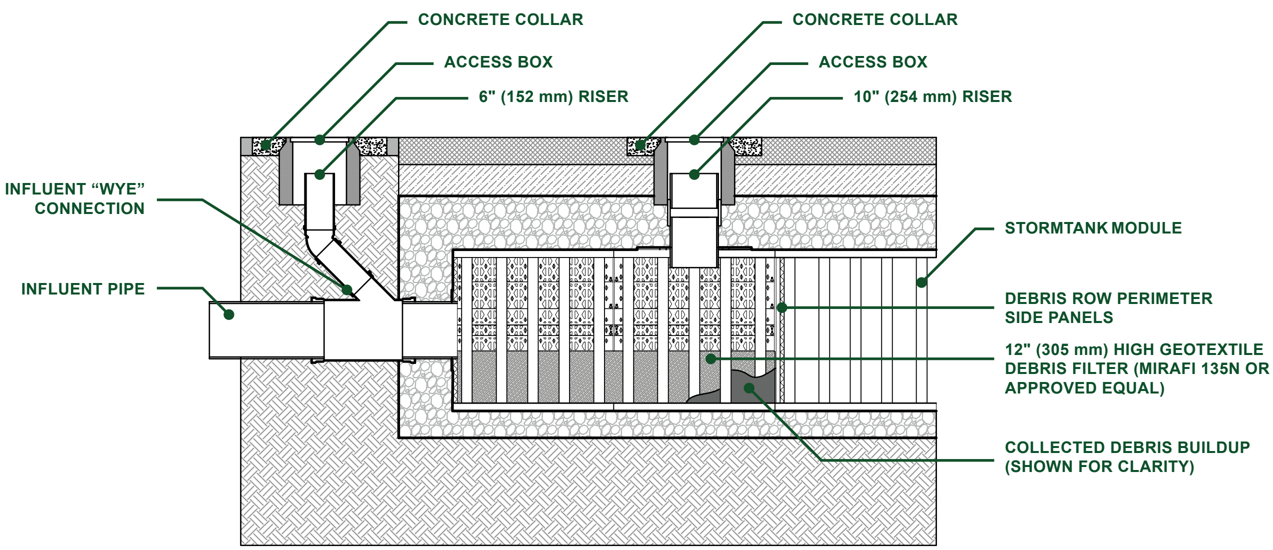
Debris Row (Easy Cleanout)

An essential step of designing, installing, and maintaining a subsurface system is preventing debris from entering the storage. This can be done by incorporating debris rows (or bays) at the inlets of the system to prevent debris from entering the rest of the system.

The debris row is built into the system utilizing side panels with a 12" (305 mm) segment of geotextile fabric. This allows for the full basin capacity to be utilized while storing any debris in an easy-to-remove location. To calculate the number of side panels required to prevent backing up, the opening area of the side panels on the area above the geotextile fabric has been calculated and compared to the inflow pipe diameter.

Debris row cleanout is made easy by including 10" (254 mm) suction ports, based on the length of the row, and a 6" (152 mm) saddle connection to the inflow pipe. If the system is directly abutting a catch basin, the saddle connection is not required, and the flush hose can be inserted through the catch basin. Debris is then flushed from the inlet toward the suction ports and removed.

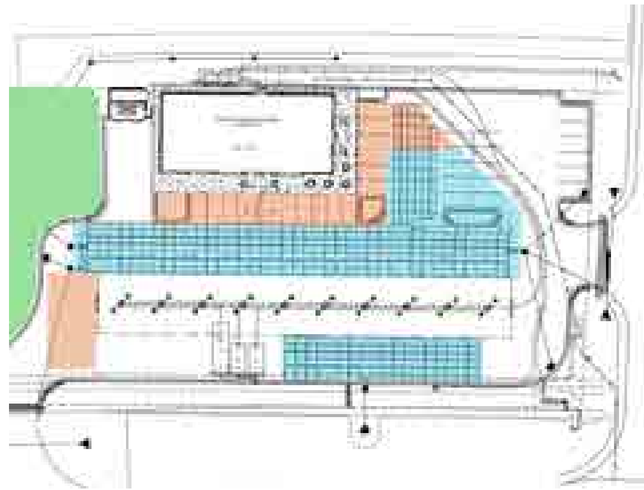
Brentwood has developed drawings and specifications that are available at www.brentwoodindustries.com to illustrate the debris row configuration and layouts.



Debris Row Section Detail

9.0 Additional Considerations

Many variable factors, such as the examples below, must be taken into consideration when designing a StormTank® Module system. As these considerations require complex calculations and proper planning, please contact Brentwood or your local distributor to discuss project-specific requirements.



Site Plan Module Layout Adaptability
(StormTank Modules shown in blue)

Adaptability

The Modules can be arranged in custom configurations to meet tight site constraints and to provide different horizontal and edge configurations. Modules can also be stacked, to a maximum 2 units tall, to meet capacity needs and can be buried to a maximum invert of 11' (3.35 m) to allow for a stacked system or deeper burial.

Adjacent Structures

The location of adjacent structures, especially the location of footings and foundations, must be taken into consideration as part of system design. The foundation of a building or retaining wall produces a load that is transmitted to a footing and then applied to the surface below. The footing is intended to distribute the line load of the wall over a larger area without increasing the larger wall's thickness. The reason this is important is because the load the footing is applying to the earth is distributed through the earth and could potentially affect a subsurface system as either a vertical load to the top of the Module or a lateral load to the side of the Module.

Based on this increased loading, it is recommended that the subsurface system either maintain a distance away from the foundation, footing equal to the height between the Module invert and structure invert of the system, or the foundation or footing extend at a minimum to the invert of the subsurface system. By locating the foundation away from the system or equal to the invert, the loading generated by the structure does not get transferred onto the system. It is recommended that all adjacent structures be completed prior to the installation of the Modules to prevent construction loads from being imparted on the system.

Adjacent Excavation

The subsurface system must be protected before, during, and after the installation. Once a system is installed, it is important to remember that excavation adjacent to the system could potentially cause the system to become unstable. The uniform backfilling will evenly distribute the lateral loads to the system and prohibit the system from becoming unstable and racking from unequal loads. However, it is recommended that any excavation adjacent to a system remain a minimum distance away from the system equal to the invert. This will provide a soil load that is equal to the load applied by the opposite side of the installation. If the excavation is to exceed the invert of the system, additional analysis may be necessary.

Sloped Finished Grade

Much like adjacent excavation, a finished grade with a differential cover could potentially cause a subsurface system to become disproportionately loaded. For example, if one side of the system has 10' (3.05 m) of cover and the adjacent side has 24" (610 mm) of cover, the taller side will generate a higher lateral load, and the opposite side may not have an equal amount of resistance to prevent a racking of the system. Additional evaluation may be required when working on sites where the final grade around a system exceeds 5%.

10.0 Inspection & Maintenance

Description

Proper inspection and maintenance of a subsurface stormwater storage system are vital to ensuring proper product functioning and system longevity. It is recommended that during construction the contractor takes the necessary steps to prevent sediment from entering the subsurface system. This may include the installation of a bypass pipe around the system until the site is stabilized. The contractor should install and maintain all site erosion and sediment per Best Management Practices (BMP) and local, state, and federal regulations.

Once the site is stabilized, the contractor should remove and properly dispose of erosion and sediment per BMP and all local, state, and federal regulations. Care should be taken during removal to prevent collected sediment or debris from entering the stormwater system. Once the controls are removed, the system should be flushed to remove any sediment or construction debris by following the maintenance procedure outlined below.

During the first service year, a visual inspection should be completed during and after each major rainfall event, in addition to semi-annual inspections, to establish a pattern of sediment and debris buildup. Each stormwater system is unique, and multiple criteria can affect maintenance frequency. For example, whether or not a system design includes inlet protection or a pretreatment device has a substantial effect on the system's need for maintenance. Other factors include where the runoff is coming from (hardscape, gravel, soil, etc.) and seasonal changes like autumn leaves and winter salt.

During and after the second year of service, an established annual inspection frequency, based on the information collected during the first year, should be followed. At a minimum, an inspection should be performed semi-annually. Additional inspections may be required at the change of seasons for regions that experience adverse conditions (leaves, cinders, salt, sand, etc).

Maintenance Procedures

Inspection:

1. Inspect all observation ports, inflow and outflow connections, and the discharge area.
2. Identify and log any sediment and debris accumulation, system backup, or discharge rate changes.
3. If there is a sufficient need for cleanout, contact a local cleaning company for assistance.

Cleaning:

1. If a pretreatment device is installed, follow manufacturer recommendations.
2. Using a vacuum pump truck, evacuate debris from the inflow and outflow points.
3. Flush the system with clean water, forcing debris from the system.
4. Repeat steps 2 and 3 until no debris is evident.

11.0 System Sizing

System Sizing Calculation

This section provides a brief description of the process required to size the StormTank® Module system. If you need additional assistance in determining the required number of Modules or assistance with the proposed configuration, it is recommended that you contact Brentwood or your local distributor. Additionally, Brentwood's volume calculator can help you to estimate the available storage volumes with and without stone storage. This tool is available at www.brentwoodindustries.com.

1. Determine the required storage volume (Vs):
It is the sole responsibility of the Engineer of Record to calculate the storage volume in accordance with all local, state, and federal regulations.

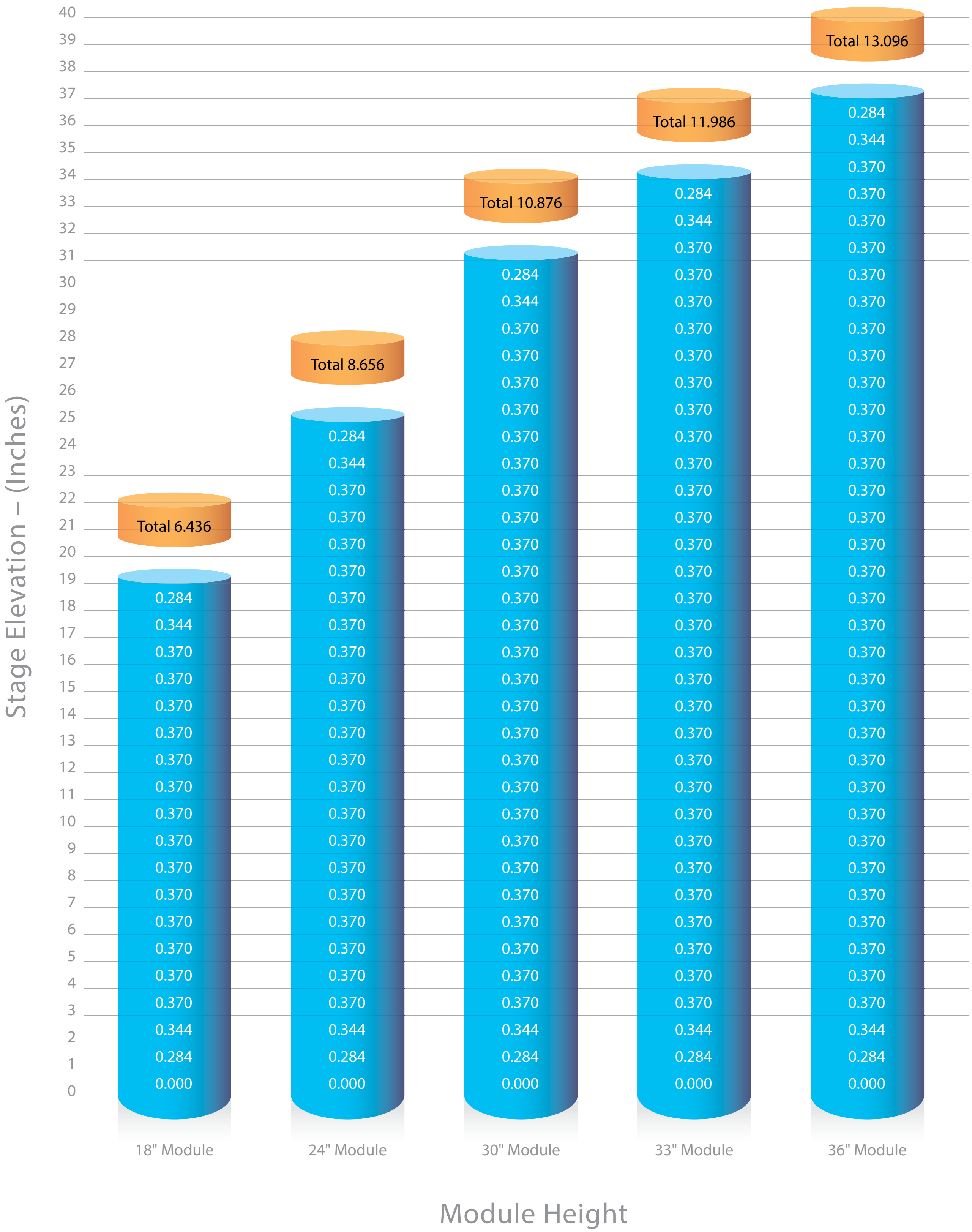
2. Determine the required number of Modules (N):
If the storage volume does not include stone storage, take the total volume divided by the selected Module storage volume. If the stone storage is to be included, additional calculations will be required to determine the available stone storage for each configuration.

3. Determine the required volume of stone (Vstone):
The system requires a minimum 6" (152 mm) leveling bed, 12" (305 mm) backfill around the system, and 12" (305 mm) top backfill utilizing 3/4" (19 mm) angular clean stone. Therefore, take the area of the system times the leveling bed and the top backfill. Once that value is determined, add the volume based on the side backfill width times the height from the invert of the Modules to the top of the Modules.

4. Determine the required excavation volume (Vexcv):
Utilizing the area of the system, including the side backfill, multiply by the depth of the system including the leveling bed. It is noted that this calculation should also include any necessary side pitch or benching that is required for local, state, or federal safety standards.

5. Determine the required amount of geotextile (G):
The system utilizes a multiple layer system of geotextile fabric. Therefore, two calculations are required to determine the necessary amount of geotextile. The first layer surrounds the entire system (including all backfill), and the second layer surrounds the Module system only. It is recommended that an additional 20% be included for waste and overlap.

11.1 Storage Volume



11.2 Material Quantity Worksheet

Project Name:

By:

Location:

Date:

System Requirements

Required Storage		ft³ (m³)
Number of Modules		Each
Module Storage		ft³ (m³)
Stone Storage		ft³ (m³)
Module Footprint		ft² (m²) Number of Modules x 4.5 ft² (0.42 m²)
System Footprint w/ Stone		ft² (m²) Module Footprint + 1 ft (0.3048 m) to each edge
Stone		Tons (kg) Leveling Bed + Side Backfill + Top Backfill
Volume of Excavation		yd³ (m³) System Footprint w/ Stone x Total Height
Area of Geotextile		yd² (m²) Wrap around Modules + Wrap around Stone/Soil Interface

System Cost

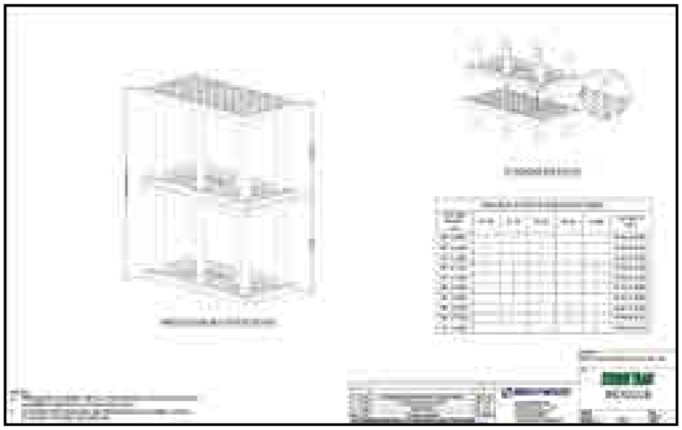
	Quantity			**Unit Price**			**Total**
Modules		ft³ (m³)	X	$	ft³ (m³)	=	$
Stone		Tons (kg)	X	$	Tons (kg)	=	$
Excavation		yd³ (m³)	X	$	yd³ (m³)	=	$
Geotextile		yd² (m²)	X	$	yd² (m²)	=	$
						Subtotal =	$
						Tons =	$

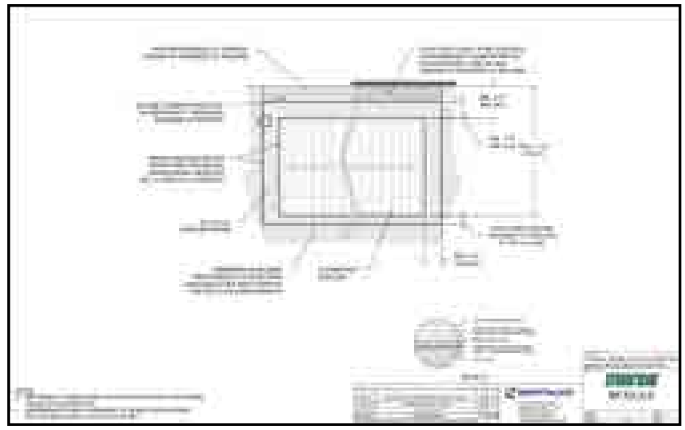
Material costs may not include freight.

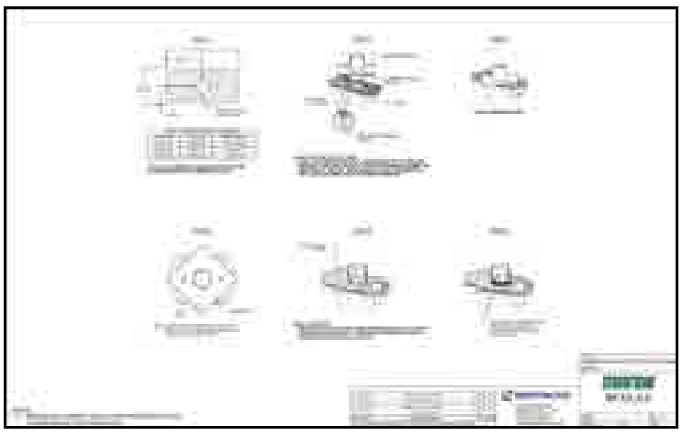
Please contact Brentwood or your local distributor for this information.

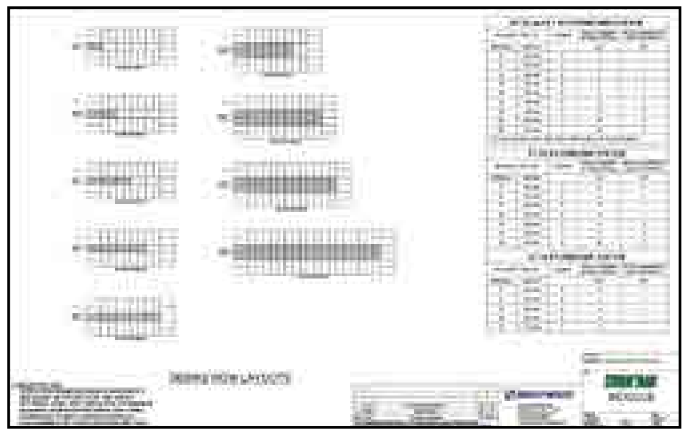
12.0 Detail Drawings

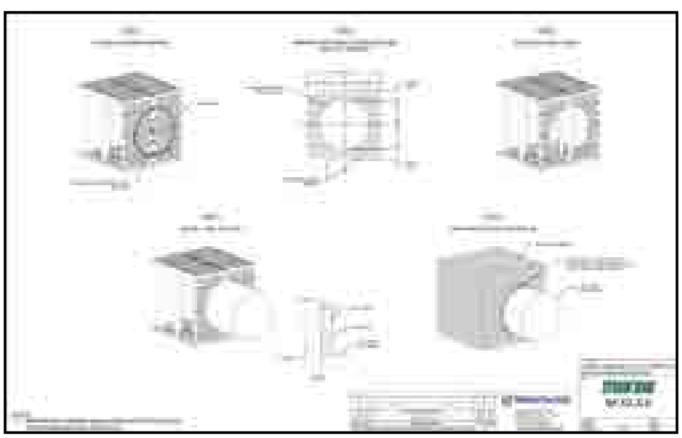
Brentwood has developed numerous drawings for utilization when specifying a StormTank® Module system. Below are some examples of drawings available at [www.brentwoodindustries.com.](http://www.brentwoodindustries.com)

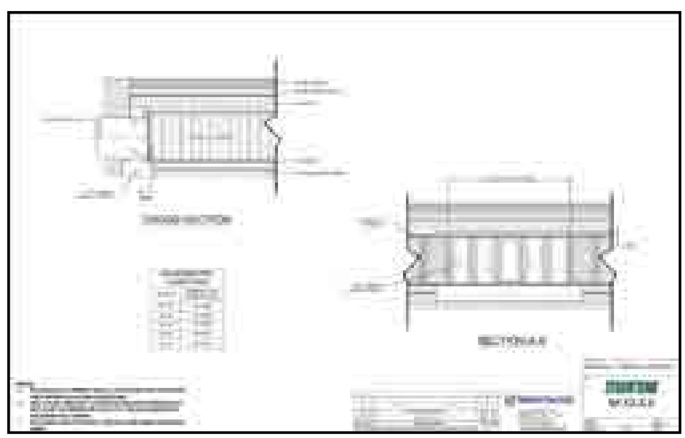












13.0 Specifications

1) General

a) This specification shall govern the implementation, performance, material, and fabrication pertaining to the subsurface stormwater storage system. The subsurface stormwater storage system shall be manufactured by Brentwood Industries, Inc., 500 Spring Ridge Drive, Reading, PA 19610 (610.374.5109), and shall adhere to the following specification at the required storage capacities.

b) All work is to be completed per the design requirements of the Engineer of Record and to meet or exceed the manufacturer's design and installation requirements.

2) Subsurface Stormwater Storage System Modules

a) The subsurface stormwater storage system shall be constructed from virgin polypropylene and 100% recycled PVC to meet the following requirements:

i) High-Impact Polypropylene Copolymer Material

(1) Injection molded, polypropylene, top/bottom platens and side panels formed to a dimension of 36" (914 mm) long by 18" (457 mm) wide [nominal].

ii) 100% Recycled PVC Material

(1) PVC conforming to ASTM D-1784 Cell Classification 12344 b-12454 B.

(2) Extruded, rigid, and 100% recycled PVC columns sized for applicable loads as defined by Section 3 of the AASHTO LRFD Bridge Design Specifications and manufactured to the required length per engineer-approved drawings.

iii) Platens and columns are assembled on site to create Modules, which can be uniformly stacked up to two Modules high, in vertical structures of variable height (custom for each project).

iv) Modular stormwater storage units must have a minimum 95% void space and be continuously open in both length and width, with no internal walls or partitions.

3) Submittals

a) Only systems that are approved by the engineer will be allowed.

b) At least 10 days prior to bid, submit the following to the engineer to be considered for pre-qualification to bid:

i) A list of materials to be provided for work under this article, including the name and address of the materials producer and the location from which the materials are to be obtained.

ii) Three hard copies of the following:

(1) Shop drawings.

(2) Specification sheets.

(3) Installation instructions.

(4) Maintenance guidelines.

c) Subsurface Stormwater Storage System Component Samples for review:

i) Subsurface stormwater storage system Modules provide a single 36" (914 mm) long by 18" (457 mm) wide, height as specified, unit of the product for review.

ii) Sample to be retained by owner.

d) Manufacturers named as acceptable herein are not required to submit samples.

4) Structural Design

a) The structural design, backfill, and installation requirements shall ensure the loads and load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 3 are met.

b) Product shall be tested under minimum installation criteria for short-duration live loads that are calculated to include a 20% increase over the AASHTO Design Truck standard with consideration for impact, multiple vehicle presences, and live load factor.

c) Product shall be tested under maximum burial criteria for long-term dead loads.

d) The engineer may require submission of third-party test data and results in accordance with items 4b and 4c to ensure adequate structural design and performance.

14.0 Appendix - Bearing Capacity Tables

Cover		HS-25 (Unfactored)		HS-25 (Factored)	
English (in)	Metric (mm)	English (ksf)	Metric (kPa)	English (ksf)	Metric (kPa)
24	610	1.89	90.45	4.75	227.43
25	635	1.82	86.96	4.53	216.90
26	660	1.75	83.78	4.34	207.80
27	686	1.69	80.88	4.16	199.18
28	711	1.63	78.24	3.99	191.04
29	737	1.58	75.82	3.84	183.86
30	762	1.54	73.62	3.70	177.16
31	787	1.50	71.60	3.57	170.93
32	813	1.46	69.75	3.45	165.19
33	838	1.42	68.06	3.34	159.92
34	864	1.39	66.51	3.24	155.13
35	889	1.36	65.10	3.14	150.34
36	914	1.33	63.80	3.05	146.03
37	940	1.31	62.62	2.97	142.20
38	965	1.29	61.54	2.90	138.85
39	991	1.26	60.55	2.83	135.50
40	1,016	1.25	59.65	2.76	132.15
41	1,041	1.23	58.54	2.70	129.28
42	1,067	1.21	58.09	2.67	127.84
43	1,092	1.20	57.42	2.60	124.49
44	1,118	1.19	56.81	2.55	122.09
45	1,143	1.18	56.26	2.50	119.70
46	1,168	1.16	55.77	2.46	117.79
47	1,194	1.16	55.33	2.42	115.87
48	1,219	1.15	54.94	2.39	114.43
49	1,245	1.14	54.59	2.36	113.00
50	1,270	1.13	54.29	2.33	111.56
51	1,295	1.13	54.03	2.30	110.12
52	1,321	1.12	53.80	2.27	108.69
53	1,346	1.12	53.62	2.25	107.73
54	1,372	1.12	53.46	2.23	106.77
55	1,397	1.11	53.34	2.21	105.82
56	1,422	1.11	53.24	2.19	104.86
57	1,448	1.11	53.18	2.17	103.90
58	1,473	1.11	53.14	2.16	103.42
59	1,499	1.11	53.12	2.14	102.46
60	1,524	1.11	53.13	2.13	101.98
61	1,549	1.11	53.16	2.12	101.51
62	1,575	1.11	53.21	2.11	101.03
63	1,600	1.11	53.28	2.10	100.55
64	1,626	1.11	53.37	2.09	100.07
65	1,651	1.12	53.48	2.08	99.59
66	1,676	1.12	53.61	2.08	99.59
67	1,702	1.12	53.75	2.07	99.11
68	1,727	1.13	53.91	2.07	99.11
69	1,753	1.13	54.08	2.06	98.63

Cover		HS-25 (Unfactored)		HS-25 (Factored)	
English (in)	Metric (mm)	English (ksf)	Metric (kPa)	English (ksf)	Metric (kPa)
70	1,778	1.13	54.26	2.06	98.63
71	1,803	1.14	54.46	2.06	98.63
72	1,829	1.14	54.67	2.06	98.63
73	1,854	1.15	54.90	2.06	98.63
74	1,880	1.15	55.13	2.06	98.63
75	1,905	1.16	55.38	2.06	98.63
76	1,930	1.16	55.64	2.06	98.63
77	1,956	1.17	55.90	2.06	98.63
78	1,981	1.17	56.18	2.06	98.63
79	2,007	1.18	56.46	2.07	99.11
80	2,032	1.19	56.76	2.07	99.11
81	2,057	1.19	57.06	2.07	99.11
82	2,083	1.20	57.37	2.08	99.59
83	2,108	1.20	57.69	2.08	99.59
84	2,134	1.21	58.02	2.09	100.07
85	2,159	1.22	58.35	2.09	100.07
86	2,184	1.23	58.69	2.10	100.55
87	2,210	1.23	59.04	2.11	101.03
88	2,235	1.24	59.39	2.11	101.03
89	2,261	1.25	59.75	2.12	101.51
90	2,286	1.26	60.11	2.13	101.98
91	2,311	1.26	60.48	2.13	101.98
92	2,337	1.27	60.86	2.14	102.46
93	2,362	1.28	61.24	2.15	102.94
94	2,388	1.29	61.62	2.16	103.42
95	2,413	1.30	62.01	2.17	103.90
96	2,438	1.30	62.41	2.18	104.38
97	2,464	1.31	62.81	2.19	104.86
98	2,489	1.32	63.21	2.20	105.34
99	2,515	1.33	63.62	2.21	105.82
100	2,540	1.34	64.03	2.22	106.29
101	2,565	1.35	64.45	2.23	106.77
102	2,591	1.35	64.87	2.24	107.25
103	2,616	1.36	65.29	2.25	107.73
104	2,642	1.37	65.72	2.27	108.69
105	2,667	1.38	66.15	2.28	109.17
106	2,692	1.39	66.58	2.29	109.65
107	2,718	1.40	67.02	2.30	110.12
108	2,743	1.41	67.45	2.31	110.60
109	2,769	1.42	67.90	2.33	111.56
110	2,794	1.43	68.34	2.34	112.04
111	2,819	1.44	68.79	2.35	112.52
112	2,845	1.45	69.24	2.36	113.00
113	2,870	1.46	69.69	2.38	113.96
114	2,896	1.47	70.15	2.39	114.43

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DRAWINGS / FIGURES