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FUNCTIONAL SERVICING REPORT

FOR

GREEN LANDS WEST & EAST
LAFFIN LANDS
(WESTERN DEVELOPMENT LANDS)

RICHMOND VILLAGE DEVELOPMENT CORPORATION

CITY OF OTTAWA

PROJECT NO.: 20-1183

JULY, 2020
1ST SUBMISSION

FUNCTIONAL SERVICING REPORT
FOR THE
GREEN LANDS WEST & EAST
LAFFIN LANDS
(WESTERN DEVELOPMENT LANDS)

RICHMOND VILLAGE DEVELOPMENT CORPORATION

PROJECT NO: 10-1183

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RICHMOND VILLAGE DEVELOPMENT CORPORATION

PROJECT NO: 20-1183

1.0 INTRODUCTION

This functional servicing report is submitted in support of a draft plan application for property parcels within the Western Development Lands (WDL) in the Village of Richmond on behalf of the Richmond Village Development Corporation (RVDC).

The following figure provides a site context for the WDL area in the within the Village.

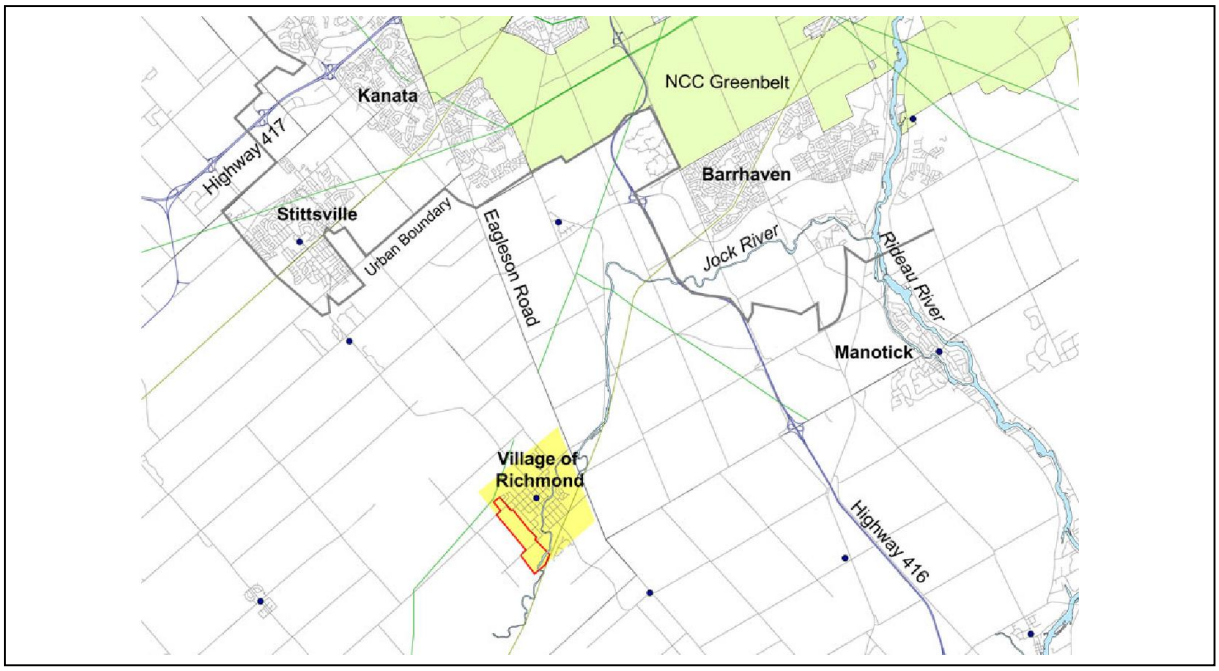


Figure A: Western Development Lands within Richmond

The ***Figure 1*** Site Location plan in the ***Figures*** section at the back of the report illustrates the land parcels that are the subject of the current draft plan application and are identified as “Green Lands West”, “Green Lands East” and the “Laffin Lands”. The draft plan for the areas is included for reference and identified as ***Figure 2***.

1.1 Green Lands West & East

Green Lands West is proposed to be comprised of 96 single family homes and 198 townhomes (total 294).

Green Lands East is proposed to be comprised of 42 single family homes.

Figure 1 also demonstrates the surrounding areas of development that have been advanced within the WDL to date:

1. The first phase of development within the WDL was Fox Run Phase 1 (located south of Perth Street) and consisted of 220 single family homes, an interim stormwater management (SWM) pond and a sanitary trunk sewer outlet upgrade for the WDL along Martin Street. Phase 1 has been constructed to base course asphalt and home construction activities are ongoing;

2. Subsequent to Phase 1, detailed design submissions were made for:

    a. Phase 2 (North) (between Green Lands West and East) which has been approved and is currently under construction at the time of the writing of this FSR. This phase of development also included an expansion to the interim SWM Pond to its ultimate footprint which will also service the Green Lands West (see further discussion in Section 5 of this FSR). Phase 2 (North) consists of 31 single family homes and 163 townhomes;

    b. Phase 2 (South) design approval is anticipated in July 2020 with servicing construction to commence upon approval. Phase 2 (South) consists of 200 single family homes.

1.2 Laffin Lands

The ***Master Drainage Plan Western Development Lands for Richmond Village (South) Limited*** prepared by David Schaeffer Engineering Ltd., dated November 2013 (***MDP***) and the subsequent ***March 2020*** update (***MDP Update*** approved in April 2020) proposed the lands east of the Fox Run Phase development to be serviced by two stormwater management ponds (“Pond 1” and “Pond 2“). The Laffin Lands, located in the central portion of the WDL south (between Perth Street and Ottawa Street) is where the site of Pond 2 was originally located. However, in order to optimize land usage, the Pond 2 is proposed to be removed from the Laffin Lands and utilization of the Pond 1 as one centralized facility. See discussion in Section 5 of this report.

The Laffin Lands are proposed to be comprised of 42 single family homes and 169 townhomes (total 211).

This FSR is provided to demonstrate conformance with the design criteria of the City of Ottawa, background studies, including the Master Servicing Study, and general industry practice.

1.3 Existing Conditions

Green Lands West: The majority of this 12.3ha site is currently undeveloped and is active farmland. The site area surrounds an existing BMR commercial property that fronts onto Perth Street. Immediately west of the BMR property is a residential property/structure at 6387 and 6409 Perth Street which will be removed as part of the site development. The general terrain is relatively flat and the majority has been previously cleared of trees, with the exception of some minor hedgerows along the some ditches, along the periphery of the site and in the vicinity of the existing residential buildings.

Existing ground elevations are on average between 96.10m to 94.40m (with some isolated higher elevations at the existing dwellings).

As identified in the ***Green Lands Geotechnical Report*** prepared by Golder Associates, the subsurface conditions within the development area are anticipated to consist of topsoil overlaying a silty clay over sandy silt and glacial till. For additional details please see the borehole logs and descriptions found in ***Appendix F***. The geotechnical investigation of the area indicates that the deposit of generally firm unweathered grey silty clay has a limited capacity to support additional stress and as such there are recommended grade raise restrictions of 1.3m to 1.5m at future home locations and approximately 2 meters at roadways.

Green Lands East: The majority of this 3.62ha site is currently undeveloped and is active farmland. The general terrain is relatively flat and the majority has been previously cleared of trees, with the exception of a hedgerow along the frontage of Mira Court. The future alignment of the Van Gaal Drain borders the west side of the property and the east side fronts onto Mira Court (the proposed south units) or back onto the adjacent Richmond Oaks Subdivision (the proposed north units).

Existing ground elevations are on average between 95.35m to 94.40m (with some isolated higher elevations at the existing dwellings) with a gradient to the southeast.

As identified in the ***Green Lands Geotechnical Report*** prepared by Golder Associates, the subsurface conditions within the development area are anticipated to consist of topsoil overlaying a silty clay over sandy silt and glacial till. For additional details please see the borehole logs and descriptions found in Appendix F. The geotechnical investigation of the area indicates that the deposit of generally firm unweathered grey silty clay has a limited capacity to support additional stress and as such there are

recommended grade raise restrictions of 1.3 m to 1.5 m at future home locations and approximately 2 m at roadways.

Laffin Lands: The majority of this 7.26ha site is currently undeveloped with approximately 80% as agricultural land and the remaining 20% an existing woodlot in the northeast quadrant of the property. Existing ground elevations are between 94.00 m to 97.15 m with the general terrain being relatively flat with a land gradient to the northwest.

As identified in the ***Laffin Lands Geotechnical Report*** prepared by Golder Associates, the subsurface conditions within the development area consists topsoil overlaying a silty sand fill (thickness ranging from 500 to 800 mm), sandy clayey silt (boreholes 20-306 and 20-307) and silty sand to sand and silt. Glacial till over rock was encountered in the majority of the borehole locations with auger refusals indicating potential bedrock or boulders within the till. Bedrock was encountered in boreholes 20-307 and 20-309 at depths of approximately 3 m. For additional details please see the borehole logs and descriptions found in ***Appendix F***. The geotechnical investigation of the area indicates that the site is generally underlain by loose to very dense native silty sand and silty sand till and therefore grade raises typical for low-rise subdivisions (assumed to be 1.5 to 2.5 m) are deemed acceptable.

The WDL development is located within the jurisdiction of the Rideau Valley Conservation Authority (RVCA).

1.4 Summary of Pre-Consultation

The following provides a summary of the pre-consultation:

1.4.1 Ministry of the Environment, Conservation and Parks (MECP)

Prior consultations associated with the Western Development Land area have previously been undertaken for the approval of the Martin Street Sanitary Trunk Sewer , the interim SWM ‘Pond 1’ that services the initial phases of development, and the sanitary/storm sewers associated with the Phase 1 development area.

1.4.2 City of Ottawa

The following is a list of the pre-consultation meetings with the City of Ottawa for the Green and Laffin Lands:

- March 13, 2020 – a formal pre-application Consultation with Municipal Staff for the Green Lands was held. The intent of the meeting was to discuss the proposed development, review technical considerations and identify/confirm

studies required to accompany the submission of a Plan of Subdivision application.

A copy of the above noted pre-consultation minutes are enclosed in ***Appendix A*** for reference.

1.5 Existing Permits / Approvals

The existing approvals for surrounding infrastructure, related to the proposed development areas, are presented in the following table. Prior ECA approvals are provided in ***Appendix B*** for reference.

Table 1: Existing Permits / Approvals

Agency	Approval Type	Approval Number	Remarks
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval	1608-BPHMBF (May 19, 2020)	Stormwater Management Pond 1 expansion which accounts for future drainage from the Green Lands West
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval	5426-A5PMR (January 6, 2016)	Martin Street Sanitary Trunk Sewer for conveyance of sanitary flows from the WDL development area.
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval	1528-BLFNVH (February 24, 2020)	Caivan Communities – Richmond Phase 2 (North) for sanitary and storm sewers
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval	9297-AV9KAL (January 25, 2018)	Caivan Communities – Richmond Phase 1 for sanitary and storm sewers
Rideau Valley Conservation Authority (RVCA)	Alteration of Waterways Permit under O.Reg. 174/06	RV5-4619 (October 1, 2019)	Authorization related to the construction of the Ultimate Stormwater Management Pond 1 located partially within the Regulatory Floodplain of the Jock River and Arbuckle Municipal Drain.
Rideau Valley Conservation Authority (RVCA)	Alteration of Waterways Permit under O.Reg. 174/06	RV5-2919 (January 23, 2020)	Authorization related to the realignment of the Van Gaal Municipal Drain to accommodate development in the WDL development area.

1.6 Required Permits / Approvals

The Green/Laffin Lands development areas are subject to the following permits/ approvals:

Table 2: Required Permits / Approvals

Agency	Approval Type	Trigger	Remarks
City of Ottawa	Commence Work Notification (CWN)	Construction of new sanitary and storm sewers throughout the subdivision.	The City of Ottawa will issue a commence work notification for construction of the sanitary and storm sewers once an ECA is issued by the MECP.
City of Ottawa	MECP Form 1 – Record of Watermains Authorized as a Future Alteration	Construction of watermains throughout the subdivision.	The City of Ottawa will review the watermains on behalf of the MECP through the Form 1 – Record of Watermains Authorized as a Future Alteration.
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval for sanitary and storm sewers	Construction of new sanitary/storm sewers throughout the subdivision areas.	The MECP will issue an ECA for the sanitary/storm sewer design through the transfer of review process.
City of Ottawa	Permission for a storm outlet from the Green Lands East to the Van Gaal Municipal Drain.	Condition of subdivision approval.	The City of Ottawa will issue a permission letter for the connection via the development review process.
Rideau Valley Conservation Authority (RVCA)	RVCA Letter of Permission: Fill Permit	Removal of a minor area of floodplain located in the northwest corner of the Green Lands West area.	Authorization related to a balanced cut/fill placement in a regulated area.
Rideau Valley Conservation Authority (RVCA)	RVCA Letter of Permission: Fill Permit	Alterations to SWM Pond 1 and work within the setback of the regulated area.	Authorization related to a balanced cut/fill placement and underground services within a regulated area.

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
  *(**Sewer Design Guidelines**)*

  - 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)
  - Technical Bulletin ISTB-2018-04
    City of Ottawa, June 27, 2018
    (ISTB-2018-04)

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

  - Technical Bulletin ISD-2010-2
    City of Ottawa, December 15, 2010.
    (ISD-2010-2)
  - Technical Bulletin ISDTB-2014-2
    City of Ottawa, May 27, 2014.
    (ISDTB-2014-2)
  - Technical Bulletin ISTB-2018-02
    City of Ottawa, March 21, 2018
    (ISTB-2018-02)

- **City of Ottawa Official Plan,**
  adopted by Council 2003.
  *(**Official Plan**)*

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

- **Erosion & Sediment Control Guidelines for Urban Construction**
  Greater Golden Horseshoe Area Conservation Authorities, December 2006
  *(**E&S Guidelines**)*

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

- **Village of Richmond Water and Sanitary Master Servicing Study**
  Stantec Consulting Ltd., July 2011 *(**MSS**)*

- **Village of Richmond Community Design Plan**
  City of Ottawa, July 2010 *(**CDP**)*

- **Master Drainage Plan Western Development Lands for Richmond Village (South) Limited**
  David Schaeffer Engineering Ltd., November 2013 and March 2020 as amended
  *(**MDP**)*

- **Preliminary Geotechnical Investigation Report, Proposed Residential Subdivision Perth and Ottawa Streets Richmond Area, Ottawa, ON.**
  Jacques Whitford Consultants, June 2007
  *(**Geotechnical Investigation**)*

- **Preliminary Geotechnical Report, Green Lands West and Green Lands East**
  Golder Associates, June 2020 (Project No. 20144864-3000-01)
  *(**Green Lands Geotechnical Report**)*

- **Geotechnical Investigation, Laffin Parcel.**
  Golder Associates, July 2020 (Report No. 20144864-3000-01)
  *(**Laffin Lands Geotechnical Report**)*

- **Groundwater Impact Assessment, Proposed Residential Development, 6305 Ottawa Street West - Richmond**
  Paterson Group, June 2020 (Reference No. PH4034-LET.01)
  ***(Paterson Groundwater Report**)*

- **Design Brief for Ultimate Stormwater Management Pond 1, Western Development Lands, Richmond**
  JF Sabourin & Associates Inc. and David Schaeffer Engineering Ltd, March

2020)
*(**Ultimate Pond 1 Design Brief**)*

- **Sanitary Design Brief (Off-Site Trunk Sewers) for Richmond Village (North & South) Ltd, Village of Richmond**
  David Schaeffer Engineering Ltd., October 26, 2015 (2nd Submission)
  *(**Off-Site Trunk Sewers**)*

- **Stormwater Management Report for Fox Run Subdivision – Phase 2 North**
  JF Sabourin and Associates, March 2020
  *(**PH2 North SWM Report**)*

- **Stormwater Management Report for Fox Run Subdivision – Phase 2 South**
  JF Sabourin and Associates, May 2020
  *(**PH2 South SWM Report**)*

- **Stormwater Management Report for Fox Run Subdivision – Phase 1**
  JF Sabourin and Associates, October 2017
  *(**PH1 SWM Report**)*

- **Design Brief for Caivan Communities Richmond Phase 1**
  DSEL, November 2017
  *(**PH1 Design Brief**)*

3.0 WATER SUPPLY SERVICING

3.1 Existing Water Supply Services

The existing City of Ottawa water distribution network currently terminates in Kanata and Barrhaven, approximately 10km from the subject site.

The majority of existing residences and businesses in the Village of Richmond are supplied with potable water by both shallow and deep private wells. Parts of the Village of Richmond are supplied with potable water by a public communal well system (King's Park Water Treatment Facility).

In tandem with the construction of Phase 1 of the Fox Run development area, a new communal well system was constructed (referred to as the Richmond West Pumping Station), and is now commissioned, and will provide water supply service to the entire future *WDL* area. With the advancement of the Phase 2 (North) and (South) development areas, the water supply network will be available to the boundaries of the Green Lands West development area at Perth Street at two locations as seen in ***Figure 3A*** and ***3B*** in the ***Figures*** section.

3.2 Proposed Water Supply

3.2.1 Green Lands West Water Supply

Water servicing for the Green Lands West area was contemplated in the ***Village of Richmond Water and Sanitary Master Servicing Study*** prepared by Stantec Consulting Ltd., July 2011 (***MSS***). The preferred design concept indicated by the ***MSS***, for development of the WDL, consisted of a new public communal well system connected to the deep aquifer. The facility is now operational.

The Green Lands West area will be serviced internally by 150 mm, 200 mm and 300mm diameter watermains designed in accordance with the ***Water Supply Guidelines*** and ***2013 Water Master Plan***. Various design criteria are summarized in the following table.

Table 3: Water Supply Design Criteria

Design Parameter	Value
Residential - Single Family	3.4 p/unit
Residential - Townhome	2.7 p/unit
Institutional	28,000 L/ha/day
(1) Residential – Basic Day Demand (BSDY)	180 L/cap/day (Singles); 198 L/cap/day (Townhomes)
(1) Residential - Maximum Daily Demand (MXDY)	As per 2013 WMP
(1) Residential – Peak Hour Demand (PKHR)	As per 2013 WMP
Fire Flow	Calculated as per the Fire Underwriter's Survey 1999.
Minimum Watermain Size	150 mm diameter
Service Lateral Size	19 mm dia Soft Copper Type 'K' or approved equivalent
Minimum Depth of Cover	2.4 m from top of watermain to finished grade
Peak hourly demand operating pressure	275 kPa and 690 kPa
Fire flow operating pressure minimum	140 kPa
Extracted from Section 4: Ottawa Design Guidelines, Water Distribution (July 2010), ISDTB-2010-2 *(1) See Section 2.3 "Demand Projections" discussion in Stantec Water Analysis found in **Appendix C**.*	

The internal watermains will connect to watermain stubs that were installed as part of the Phase 1 (a 300mm diameter stub to be extended from Equitation Circle across Perth Street) and Phase 2 (north) construction from Oldenburg Avenue (and from future watermain installations from extensions of Oldenburg Avenue). The proposed and existing watermains are depicted in ***Figure 3A***.

Stantec has completed a review of the Green Lands West area given that the prior projected number of units assessed for this land area, during evaluation of the Phase 2 (North) development, is increased from 150 single family homes (SFH) with a population of 510 (based on Table 3 above) to 96 SFH and 198 townhomes (861 people). Refer to the technical memorandum ***Richmond Caivan Green & Laffin Lands – Potable Water Capacity Analysis*** prepared by Stantec Consulting Ltd. dated July 2020 ***(Stantec Water Review)***, enclosed in ***Appendix C*** which indicates that the additional populations and unit counts can be accommodated. Future expansion of the Communal Well storage will ultimately be dictated by the rate of progress of the WDL area up until demand approaches the current 28 L/s supply with the largest well (40 L/s) out of service.

3.2.1 Green Lands East Water Supply

Section 4.3.3 of the ***Village of Richmond Water and Sanitary Master Servicing Study*** prepared by Stantec Consulting Ltd., July 2011 (***MSS***) discussed the use of private wells in *Section 4.3.3* and *4.6* and the feasibility for infilling and/or "rounding out" development areas for relatively minor development areas which the Green Lands East area could be considered. While the preferred design concept for the WDL, as indicated by the ***MSS***, consisted of a the new Communal Well it did not specifically include this remnant strip of land that is more closely associated with the adjacent Richmond Oaks development area to the east.

The constraint imposed by the adjacent Van Gaal Drain also lends to the preference to have the East lands serviced by private wells. Any extension of the Communal Well distribution network would require a minimum of one directional drilled crossing of the Van Gaal Drain which increases the potential for future increased maintenance costs for the City that could be avoided.

3.2.1 Laffin Lands Water Supply

Similar to the Green Lands West, the Laffin Lands were contemplated in the ***Village of Richmond Water and Sanitary Master Servicing Study*** prepared by Stantec Consulting Ltd., July 2011 (***MSS***) and is serviced by the Communal Well. The internal watermains will connect to the extension of watermains installed at the Communal Well which will extend through the Mattamy property located between Fox Run Phase 1 and the Laffin Lands. Any watermain services required will have to be coordinated with the future advancement of the detailed design of the Mattamy property (including any required watermain looping). The Laffin Lands area are anticipated to be serviced internally by 150mm, 200mm and 300mm diameter watermains designed in accordance with the prior Stantec evaluations. The proposed and existing watermains are depicted in ***Figure 3B***.

Stantec has completed a review of the expanded Laffin Lands area given that the prior projected number of units assessed for this land area, during evaluation of the Fox Run Phase 2 (North) and (South) developments, is increased from 98 units (80 SFH and 18 TH) to 211 units (42 SFH and 169 THs). A projected increase in population from 321 to 599 people. This is due to the removal of SWM Pond 2 as discussed further in Section 5 of this report. Refer to the ***Stantec Water Review*** for review of the Laffin Lands.

3.2.2 Water Demand Calculations

A summary of water demands taken from the ***Stantec Water Review*** is presented in the following table:

Table 4 – Summary of Water Demands(1)

Development Area	Unit Type	Population	Area (ha)	Water Demands		
				BSDY (L/s)	OWD (L/s)	MXDY (L/s)
(1)RVDC Fox Run Ph1	SFH	748	-	1.56	2.67	4.23
RVDC Fox Run Ph2 (North)	SFH	105	-	0.22	0.38	0.60
	MLT	440	-	1.01	-	1.01
RVDC Fox Run Ph2 (South)	SFH	680		1.42	2.43	3.85
Mattamy Ph1	SFH	449	-	0.94	1.60	2.54
	MLT	127	-	0.29	-	0.29
RVDC Green Lands West	SFH	326	-	0.68	1.17	1.85
	MLT	535	-	1.23	-	1.23
RVDC Laffin Lands	SFH	143	-	0.30	0.51	0.81
	MLT	456	-	1.05	-	1.05
Interim Conditions (Sub-total)		***4,009***	***0***	***8.70***	***8.76***	***17.46***
Mattamy Buildout	SFH	2,176	-	4.53	7.77	12.30
	MLT	635	-	1.45	-	1.45
	INS	-	2.63	0.85	-	0.85
RVDC Buildout	SFH	279	-	0.58	1.00	1.58
	MLT	146	-	0.33	-	0.33
Buildout Conditions (Total)		***7,245***	***2.63***	***16.44***	***17.53***	***33.97***

(1) Extracted from "Richmond Caivan Green & Laffin Lands – Potable Water Capacity Analysis" by Stantec Consulting Ltd. dated July 2020. See report in Appendix C for further population details and allocation for Phase 2 South and Phase 2 North..

(2) RVDC = Richmond Village Development Corporation

SFH (Single-Family Home); MLT (Multi / Townhouses); BSDY (Basic Day); OWD (Outdoor Water Demand); MXDY (Maximum Day).

3.3 Water Supply Conclusion

The proposed development areas will be serviced by 150 mm, 200mm and 300 mm diameter watermains which will be connected to the existing water distribution network currently in place. Coordination with the advancement of any detailed design of adjacent properties will be undertaken at the time of the design advancement of the Green or Laffin Lands properties. In addition, any other assessments of system capacity and possible storage enhancements will be made at that time.

The ***Stantec Water Review*** indicates that the proposed watermain layouts will satisfy the demands under all conditions and the proposed layout conforms to the water servicing plan as conceptualized in the Communal Well design.

4.0 WASTEWATER SERVICING

4.1 Existing/Approved Wastewater Services

The existing Village of Richmond is serviced primarily by City of Ottawa sanitary sewers that convey wastewater to the Richmond Pumping Station located south of the Jock River, on the northwest corner of Cockburn Street and York Street. The Richmond Pump Station (RPS) discharges to the Glen Cairn Trunk Sewer just south of Hazeldean and Robertson Road in Kanata.

The WDL is serviced via the new sanitary trunk sewer that has been recently constructed along Martin Street from Cockburn Street to the boundary of the Fox Run Phase 1 development area.

Wastewater collection services for the WDL was contemplated in the ***MDP***. The recommended solution is expanding the current wastewater collection system and to continue to pump wastewater to the City's central wastewater treatment facility.

The preferred design concept for the wastewater services includes:

- Upgrades to the existing gravity collection system (City program to remove extraneous flows and pipe size and length improvements for the gravity collection system along specific road segments). ***This was accomplished via the approved Martin Street trunk sewer upgrade.***
- Operation upgraded to facilitate emergency use of the Richmond Lagoon Cell C in extreme wet weather conditions. Twinning of 1200 m of existing forcemain with new 600 mm sewer and repairs to the existing 500mm diameter forcemain. ***Completed.***
- Upgrades / expansion of the existing Richmond Pump Station. ***Analysis/design ongoing.***
- New 600mm forcemain twinning from Richmond to the City's central collection system in Kanata. ***Future work.***

Ongoing coordination with the wastewater upgrades/analyses will determine how much flow from the advancing development of the WDL will be allowed. The City of Ottawa has retained Parsons to review wastewater within the Village of Richmond. They have prepared Technical Memorandums (***TM No.1 – Richmond Population and Wastewater Flow Projections (March 2019)*** and ***TM No.2 – Proposed Richmond Pumping Station Upgrade (May 2019)***) to review the sanitary system in order to facilitate growth within the Village of Richmond. Follow up analyses and consultations are continuing and will ultimately determine system capacity allocations.

4.2 Wastewater Design

The Green and Laffin Lands will be serviced by new gravity sewers designed in accordance with City of Ottawa design criteria which will connect to the existing sanitary sewer infrastructure constructed during the development of Fox Run Phase 1 and Phase 2 (North) areas. The proposed sanitary sewer layouts are depicted in ***Drawings 2A and 2B*** in the ***Drawings*** section at the back of this report. The following table summarizes the ***City Standards*** which are used in the design of the proposed wastewater sewer system.

Table 5: Wastewater Design Criteria

Design Parameter	Value
Residential - Single Family	3.4 persons/unit
Residential - Townhome	2.7 persons/unit
Residential - Average Daily Demand	280 L/d/person
Residential - Peaking Factor	Harmon's Peaking Factor. Max 4.0, Min 2.0
Harmon - Correction Factor	0.80
Institutional – Average Flow	28,000 L/ha/day
Institutional – Peaking Factor	1.5 if ICI in contributing area is >20% 1.0 if ICI in contributing area is <20%
Infiltration and Inflow Allowance	0.33 L/s/ha
Park Flow	9,300 L/ha/day
Sanitary sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} A R^{2/3} S^{1/2}$
Minimum Sewer Size	200 mm diameter
Minimum Manning's 'n'	0.013
Minimum Depth of Cover	2.5m 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 and Technical Bulletin ISTB-2018-01.	

The Fox Run Phase 1 sanitary design sheets are provided in ***Appendix D*** as a frame of reference for the previously anticipated sanitary flows from the future Green and Laffin properties. It is noted that the prior design for the ***WDL*** sewers was based on older City guidelines with an average daily demand of 350 L/d/person while the new guidelines specify 280 L/d/person. The prior infiltration allowance of 0.28 L/s/ha was also used while the current guidelines specify 0.33 L/s/ha as per the table above.

The updated design parameters from the above table are used for the Green Lands and Laffin Land areas.

4.2.1 Green Lands West

The draft plan demonstrates 96 single family homes and 198 townhomes (total 294 units) which results in an increased population that was projected from this external area in the Fox Run Phase 2 (North) sanitary design sheet (which was based on a per hectare population due to uncertainty about the future unit mix) . As per the sanitary design sheet for the Green Lands West area found in ***Appendix D***, the overall projected flows tributary to the connection point at the previously constructed trunk sewer (at existing sanitary manhole MH150A at the Perth Street and Meynell Road intersection) are lower than the flows assessed in the Fox Run Phase 1 design (i.e. 41.93 L/s from the Fox Run Phase 1 design and **33.19 L/**s in this FSR design sheet). As such, the proposed unit mix and population results in design flows through the Fox Run Phase 1 development area that are still lower than previously anticipated flows.

4.2.2 Green Lands East

The Draft Plan demonstrates 42 single family homes for the Green Lands East development area. As per the sanitary design sheet in ***Appendix D*** this area generates flows of approximately **2.88 L/s** that will be connected to existing sanitary sewers located within the Richmond Oaks development to the east. It is anticipated that this small increase in flows can be readily incorporated into the sewer networks and will ultimately be captured in the future sanitary system upgrades for the Village of Richmond.

4.2.3 Laffin Lands

The Draft Plan demonstrates that the Laffin Lands are proposed to be comprised of 42 single family homes and 169 townhomes (total 211 units).

The Fox Run Phase 1 sanitary system is designed to accept external flows from the future Mattamy and Laffin Lands. A summary of the Laffin external flows is as follows:

- Drainage Area = 7.12 ha
- Population = 580
- Total Peak Flow = ~9.44 L/s

Refer to ***Drawing 2B*** Sanitary Servicing Plan in the ***Drawings*** section and the sanitary sewer design sheet in ***Appendix D*** for details.

The peak sanitary flow contributions from the proposed development areas south of Fox Run Phase 1 were estimated to be ***62.33 L/s*** at the stub from the Fox Run Phase 1 development outlet (see the marked up sanitary design sheet from that phase in ***Appendix D***). As per the FSR design sheet for the Mattamy/Laffin Lands the projected flow is **61.34 L/s** therefore the downstream infrastructure up to the sanitary pump

station has sufficient capacity as designed/constructed and that the flows will ultimately be captured in the future sanitary system upgrades for the Village of Richmond.

4.3 Wastewater Servicing Conclusion

The Green Lands West and Laffin Lands will connect to existing downstream sewers previously constructed as part of the Fox Run Phase 1 development area. When comparing the projected flows from the areas the downstream systems were desgined for flows that were greater than the projected flows.

Green Lands East units will outlet to existing sewers in the adjacent Richmond Oaks development.

The functional sanitary sewers have been designed adhering to all relevant *City Standards*.

5.0 STORMWATER CONVEYANCE

Stormwater conveyance for the Green Lands West and Laffin Lands properties were contemplated in the ***Stormwater Management Report for Richmond Village (South) Limited*** (now known as RVDC) prepared by David Schaeffer Engineering Ltd., November 2013 ***(MDP)*** and the subsequent ***March 2020*** update (***MDP Update*** approved in April 2020). The Green Lands West area conforms to the ***MDP Update*** however it is proposed that the Laffin Lands will deviate from the document and pursue an alternate servicing arrangement. See discussion later in this section.

The Green Lands East area was not contemplated with the ***MDP*** studies and the proposed solution is based on maintaining post-development flows to pre-development levels for quantity control and quality controls via an oil-grit separator (OGS) unit as noted in the pre-consultation minutes.

5.1 Master Drainage Plan Updates

The original ***MDP*** for the WDL conceptualized the stormwater management systems based on the City of Ottawa standard criteria at the time (i.e. 5-year level of service for sewers and 30cm of ponding etc). The ***MDP Update*** was prepared at the request of City of Ottawa staff to reflect a number of important updates to the ***Sewer Design Guidelines*** subsequent to the preparation of the 2013 ***MDP***. As presented in the ***MDP/MDP Update***, the recommended stormwater servicing solution consists of a major system, a minor system, and homes with basements equipped with sump pumps to provide foundation drainage.

Drawing 3 (*Storm Servicing Plan*) from the ***MDP Update*** can be found in ***Appendix E*** for reference.

The following are the most relevant aspects of the ***MDP Update*** for the WDL:

- Technical Bulletin ISTB-2019-02 dated July 8, 2019 regarding the use of sump pumps;
- Technical Bulletin PIEDTB-2016-01 dated September 6, 2016 regarding the updated sizing for the minor system (i.e. 2-year for local streets, 5-year for collector streets and 10-year for arterial roads);

In addition, the ***MDP Update*** included the following:

- Updates to reflect small revisions in the drainage split between the proposed Pond 1 and 2 based on a design concept by Mattamy Homes;

- A section of the report regarding the Moore Tributary was added to describe some design elements of the Realignment of the Moore Tributary (north of the Laffin Lands);
- Maintained the proposal for a two pond servicing concept for the southern WDL area (discussion on the deviation from this aspect is detailed in the Laffin Lands discussion that follows); and
- To reflect optimized design, where sump pumps are eliminated for areas south of Ottawa Street and foundations are drained by gravity

Please refer to the ***MDP Update*** under separate cover for full details.

5.2 Green Lands West

5.2.1 Minor System

The Green Lands West development area will be serviced by a storm sewer system designed in accordance with the amendment to the storm sewer and stormwater management elements of the Ottawa Design Guidelines – Sewer (Technical Bulletin PIEDTB-2016-01).

The minor storm sewer system will be sized as follows:

- 2-year event for local streets;
- 5-year event for collector streets; and
- 10-year events for arterial roads

The storm sewers are sized using City of Ottawa IDF curves. The proposed storm sewer layout for the development is depicted in the schematic ***Drawing 3A*** *Storm Servicing Plan* in ***Drawings***. The storm sewers for this development area will outlet to future sewers to be constructed along Oldenburg Avenue as approved in the Fox Run Phase 2 (North) development and to the future extension of Oldenburg Avenue and sewer network as development progresses. The downstream sewers in Phase 2 (North) were designed with the Green Lands West considered. As illustrated in the Green Lands West and Fox Run Phase 2 (North) design sheets in ***Appendix E*** the projected storm flows of 2,339 L/s are comparable to the 2,201 L/s with the Oldenburg Avenue sewer segment MH263 to MH264 with sufficient capacity within the previously designed sewers all the way to the SWM Pond 1 inlet.

The sewers ultimately outlet to SWM Pond 1 as per the recently approved design for the ultimate pond that was designed and approved as a component of the Fox Run Phase 2 (North) development (see further discussion in Section 5.2.3 of this FSR report).

The following table summarizes the relevant ***City Standards*** employed in the design of the proposed minor storm sewer system.

Table 6: Storm Sewer Design Criteria

Design Parameter	Value
Minor System Design Return Period	2-Year (Local Streets), 5-Year (Collector Streets), 10-Year (Arterial Streets) – PIEDTB-2016-01
Major System Design Return Period	100-Year
Intensity Duration Frequency Curve (IDF) 5-year storm event. A = 998.071 B = 6.053 C = 0.814	$i = \frac{A}{(t_c + B)^C}$
Initial Time of Concentration	10 minutes
Rational Method	$Q = CiA$
Runoff coefficient for paved and roof areas	0.9
Runoff coefficient for landscaped areas	0.2
Storm sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} AR^{2/3} S^{1/2}$
Minimum Sewer Size	250 mm diameter
Minimum Manning's 'n'	0.013
Service Lateral Size	100 mm dia PVC SDR 28 with a minimum slope of 1.0%
Minimum Depth of Cover	2.0 m from crown of sewer to grade (insulation when not possible)
Minimum Full Flowing Velocity	0.8 m/s
Maximum Full Flowing Velocity	3.0 m/s
Extracted from Sections 5 and 6 of the City of Ottawa Sewer Design Guidelines, October 2012 and PIEDTB-2016-01	

The paved area and grassed area runoff coefficients of 0.9 and 0.2 were used to calculate average runoff coefficients that were applied across the site. The storm drainage areas are found in ***Drawings*** and the storm design sheets are enclosed in ***Appendix E*** for reference.

The storm sewers will be sized using City of Ottawa IDF curves. In keeping with the design for Fox Run Phase 2 (North) and (South), the system will not be designed with inlet control devices (ICDs) for catchbasins. The prior analyses for the adjacent phase of the development (which included the Green Lands West) have been modelled with no ICDs and modeled the catchbasins and surface storage dynamically as part of the XPSWMM storm sewer model. This was undertaken in order to confirm the

performance of the system when high hydraulic gradeline elevations interact with catchbasin and surface storage. A 100-year hydraulic grade line (HGL) analysis will be completed at the time of detailed design (with detailed grading in place) to confirm that the HGL will be maintained below the gutter line elevation, given that the development will be on sump pumps.

5.2.2 Major System

The major system flows will be conveyed through the internal road network where the 100-year event will be captured by required 100-year inlets prior to discharge to the SWM Pond 1 where they are managed for quality/quantity control prior to release to the Arbuckle Drain. Major events in excess of the 100-year event will outlet to the Van Gaal Drain through the adjacent development to the east (i.e. Fox Run Phase 2 (North) and subsequent phases) in accordance with the ***MDP Update*** (see MDP *Grading Plan Drawing 2* in ***Appendix E*** for details). The emergency overflow is via a 6m land block, proposed behind the existing residential property at 6305 Perth Street, as well as a curb cut along the south side of Perth Street.

The major system will be designed in accordance with the amendment to the storm sewer and stormwater management elements of the Ottawa Design Guidelines – Sewer (Technical Bulletin PIEDTB-2016-01).

5.2.3 Quality and Quantity Control

As per the ***MDP Update***, the storm outlet for both the minor/major systems (up to the 100-year event) from the Green Lands West will be to an Ultimate SWM Pond 1. This wet pond facility provides the required erosion, quality, and quantity release components and outlets to the existing Arbuckle Drain. Water quality control is provided by the permanent pool sized for enhanced level of protection per MECP guidelines (80% TSS Removal). The SWM Pond 1 facility was designed and approved during the design of the Fox Run Phase 2 (North) subdivision lands to the east and accounted for the subject lands within in the design. Further details of the SWM Pond 1 modelling and sizing are included in the ***Design Brief for Stormwater Management Pond 1, Western Development Lands – Richmond*** (Project No. 15-764 dated March 2020) prepared by J.F. Sabourin and Associates provided under separate cover.

5.2.4 Floodplain

In association with the development of the Fox Run Phase 2 (North), and other RVDC lands to the northeast of Green Lands West, the existing Van Gaal Drain which bisects those properties will be realigned (based on prior approvals already received) to the perimeter of that development area. Once construction is completed in August/September 2020 the floodline overlay will then be updated to officially remove the floodplain designation for those properties. As seen in the FSR Grading Plan

(***Drawing 1A***) and *Storm Servicing Plan* (***Drawing 3A***) there is a minor encroachment of the floodline into the proposed lot areas shown for Green Lands West property. The prior Van Gaal Drain realignment work does not specifically remove the floodline from the Green property as it did for the other WDL lands. It is proposed that similar to the adjacent development area to the northeast, the proposed Block 46 Open Space area (as shown in the ***Figure 2*** Draft Plan) will be used to provide channel and riparian improvements in order to contain the 100-year water levels within the corridor. Note that unlike the adjacent development the drain will not have to be re-routed as its current alignment is at the periphery, and parallel, to the site boundary. Based on the minimal extent of floodline impacted as shown in ***Drawings 1A/3A*** it is anticipated that the same resolution to the northeast is achievable and will be established at detailed design. This Block 46 area of the draft plan is currently active farmland with no special features or tree cover.

5.3 Green Lands East

5.3.1 Minor System

The Green Lands East development area will be serviced by a storm sewer system designed in accordance with the amendment to the storm sewer and stormwater management elements of the Ottawa Design Guidelines – Sewer (Technical Bulletin PIEDTB-2016-01).

With an individual local street being introduced for this infill development, the minor storm sewer system will be sized as follows:

- 2-year event for local streets;

The relevant ***City Standards*** summarized in Section 5.1.1 will be used for the design of the proposed minor storm sewer system.

The storm sewers will be sized using City of Ottawa IDF curves and are proposed to outlet to the adjacent Van Gaal Drain which is the natural receiver of stormwater runoff from these lands (similar to the nearby Mira Court sewers). Given that this is a Municipal Drain, the appropriate consultation with the City's Drainage Engineer and City staff will be undertaken.

A 100-year hydraulic grade line (HGL) analysis will be completed at the time of detailed design (with detailed grading in place) to confirm that the HGL will be maintained below the gutter line elevation, given that the development will be on sump pumps.

5.3.2 Major System

The major system flows will be conveyed through the internal road network where the 100-year event will be captured by required 100-year inlets prior to discharge to the SWM Pond 1 where they are managed for quality/quantity control prior to release to the Arbuckle Drain. Major events in excess of the 100-year event will outlet to the Van Gaal Drain as demonstrated in the conceptual *Grading Plan* ***Drawing 1A***, along with any required erosion control treatments.

5.3.3 Quantity and Quality Control

Unlike the Green Lands West area, ICDs will be employed to ensure that storm flows entering the minor system are limited to the pre-development limits. The evaluations related to ICDs for other WDL development areas was based on those areas being hydraulically connected to the SWM Pond 1 which is not the circumstance for the Green Lands East.
Quality control will be facilitated by an appropriately sized OGS unit prior to discharge to the adjacent Van Gaal Drain. A preliminary sizing for the unit (CDS Model 3020) can be found in ***Appendix E*** for reference and will be confirmed during future detailed design.

5.3.4 Floodplain

The Van Gaal Drain (VGD) currently bisects the property to the west of the Green Lands East area. The VGD, in its current state, imposes a floodplain overlay over a portion of the property (see the *Storm Servicing Plan* (***Drawing 3A***) in ***Appendix E*** for reference). As noted in Section 5.2.4, through a separate process, a design has been completed for a realignment of the Van Gaal Drain to be along the development boundary between the WDL and the Green Lands East area. The design has been vetted/approved through consultation with the City's Drainage Engineer, Rideau Valley Conservation Authority and the Department of Fisheries and Oceans.

The revised alignment and configuration defines a revised floodline within the limits of the Drain and ultimately removes the floodplain designation from the Green Lands East development area once the realignment construction of the Drain is completed in August/September 2020. Full details can be found in the ***Richmond Village Development / Proposed Realignment of Van Gaal Drain*** analysis prepared by JFSA (April 20, 2017) and other supporting documentation under separate cover.

5.4 Laffin Lands

5.4.1 Deviations from Master Drainage Plan

As noted in Section 5.1 of this report, the ***MDP Update*** contained various updates related to the stormwater design for the WDL. The proposed storm design deviations from the ***MDP Update*** related to the development of the Laffin Lands are as follows:

- The ***MDP Update*** continued with the concept of two SWM ponds to service the WDL area (as per the *Drawing 3* (*Storm Servicing Plan*) from the ***MDP Update*** in ***Appendix E)***. The ~2.75 ha block of land for SWM Pond 2 was proposed to be within the Laffin Lands development area in the ***MDP Update*** and would have had 38.66 ha of subdivision drainage and 71.8 ha of undeveloped external lands drainage from the southwest draining through it (total of 110.46 ha). The SWM Pond 2 outlet was to be to the Jock River via a new storm sewer along Ottawa Street. The proposal is now for the removal of the SWM Pond 2 and to service the majority of the WDL lands to a revised SWM Pond 1, instead of having two separate SWM ponds.;

- In order to mitigate the overall changes to SWM Pond 1 the proposed design redirects 39.2 ha of external drainage area, originally proposed to drain to Ottawa Street then to SWM Pond 2 in the ***MDP Update***, to now drain to the future Realigned Moore Tributary (realignment noted in Section 6.5 of the ***MDP Update***) and outlet to the Jock River via the Arbuckle Drain.

- The FSR proposes to redirect 32.6 ha of external drainage area (from the Ottawa Street road side ditch south) noted in Section 6.2 of the ***MDP Update*** (report excerpt in ***Appendix E***). These flows, in the existing condition, are directly conveyed to the Jock River via open ditches. Rather than conveying the flows through sewers to any proposed SWM pond, it is proposed that the flows be conveyed through a new piped outletting to the Jock River (see ***Drawing 5***) and thus more closely match existing drainage patterns. The Jock River does not require any quantity control measures and the stormwater would continue to outlet as it normally does. Note: Due to a sewer crossing conflict, the lands to the south of the proposed clean water pipe will connect to this system and will need to incorporate an OGS unit before outletting outlets to the clean water pipe. The proposed outlet (via sewer as opposed to open ditch) will require approval by the RVCA.

Based on the deviations to the ***MDP Update*** proposed, a technical review of the modelling has been completed by JFSA. The analysis confirms the drainage area of SWM Pond 1 can be modified (under the premise of the above changes) to include lands that were originally intended to go to a SWM Pond 2 conceptualized for the Laffin

Lands property but will require various adjustments/conditions required for SWM Pond 1 in order to facilitate this update as follows:

i. The Summer 100-year water level will be raised from 93.79 m to 94.09 m and the 100yr spring water level will be raised from 94.20 m to 94.34 m;
ii. The SWM Pond 1 pond berm has to be raised with partial sloping within the floodplain in order to accommodate the increased 100-year water level;
iii. The emergency spillway will be downsized from the current 85 m (67 m effective length) down to 20 m in order to adhere to the target release rates to the Arbuckle Drain;
iv. Portions of the current pond access road was designed to be above the 2-year water lever at 93.55 m or above the prior 100-year summer level (at the north forebay). The access roads can be assessed with City Staff to determine sections to be raised if deemed necessary;
v. Sediment management areas will be lifted ~0.3 m (above 100-year water level).
vi. The SWM Pond 1 southern forebay headwall and inlet sewer from the Mattamy/Laffin Lands will need be removed/replaced with a larger storm sewer size of 2250 mm (instead of the previously installed 1650 mm sewer);
vii. For the proposed SWM Pond 1 there was previously a surplus cut within the floodplain that was generated by the pond construction (in the order of 3,000 m^3). It is anticipated that the various potential adjustments to raise access roads etc will be accommodated.

A review of the existing SWM Pond 1 southern forebay calculations, based on the pond expansion, confirms that the existing forebay is sufficiently sized to provide adequate settling and dispersion. The average forebay velocity is marginally above the MECP minimum of 0.15 m/s, but not out of a reasonable range. The forebay calculation by JFSA is provided in *Calculation Sheet B-2* in ***Appendix E***.

5.4.2 Minor System

The Laffin Lands development area will be serviced by a storm sewer system designed in accordance with the amendment to the storm sewer and stormwater management elements of the Ottawa Design Guidelines – Sewer (Tech. Bulletin PIEDTB-2016-01).

The minor storm sewer system will be sized as follows:

- 2-year event for local streets;
- 5-year event for collector streets; and
- 10-year events for arterial roads

The minor storm sewer systems are sized using City of Ottawa IDF curves along with the relevant ***City Standards*** summarized in Section 5.2.1. The proposed storm sewer layout for the development is depicted in the schematic ***Drawing 3B*** *Storm Servicing Plan* in ***Drawings***. The storm sewers for this development area will outlet to the SWM Pond 1 forebay previously established during the development of the Fox Run Phase 1 land area. The Phase 1 design has previously provided for a 1650mm diameter storm sewer stub to service the development lands south of Fox Run Phase 1 in accordance with the ***MDP/MDP Update***. However, as noted in previous sections, the advancement of the Laffin Lands will be based on the removal of the previous SWM Pond 2 proposed on those lands and instead proposes to direct all stormwater flows to SWM Pond 1. Due to the increase in lands tributary to SWM Pond 1 the 1650mm diameter sewer will have to be upsized to a 2250 mm pipe as illustrated in ***Drawing 3B*** and based on the rational design sheet determinations.

5.4.1 Major System

The major system flows will be conveyed through the internal road networks and discharge to the SWM Pond 1 where they are managed for quantity control prior to release to the Arbuckle Drain. The major system will be designed in accordance with the amendment to the storm sewer and stormwater management elements of the Ottawa Design Guidelines – Sewer (Technical Bulletin PIEDTB-2016-01).

5.4.2 Quality and Quantity Control

The proposed revision to the SWM Pond 1 will provide the required quality and quantity control requirements noted previously.

SWM Pond 1 outflows require quality, quantity and erosion control prior to discharge to the Arbuckle Drain and then ultimately discharge to the Jock River. Quality control will be provided by 80% TSS removal as per MECP Enhanced Protection and quantity control by limiting the 2- and 100-year release rates to pre-development levels. Erosion control will be provided by controlling the 2-year release rate to 330 L/s or less and the velocity to 0.225 m/s or less to the Arbuckle Drain.

5.4.3 Realignment of the Moore Tributary

As per Section 6.5 of the ***MDP Update***, and subject to review and approval by the RVCA and City Drainage Engineer, the adjacent Mattamy development area includes the realignment of the existing Moore Tributary in order to align with the proposed Mattamy development plans as shown on the ***MDP Update*** *Storm Servicing Plan Drawing 3* provided in ***Appendix E.***

The realignment of the Moore Tributary in the ***MDP Update*** was to convey the 94.2 ha external flows through the subject site to eventually outlet to the Jock River. As per

Section 5.4.1 of this report, this would now include an additional 39.2 ha from Ottawa Street north ditch due to the removal of SWM Pond 2. Refer to ***Drawing 5*** in the ***Drawings*** section for a depiction of the external drainage areas 133.4 ha (94.2 + 39.2 ha) draining to the realigned Moore Tributary.

In the recent submissions for the Mattamy development area by that proponent, the proposed Moore Tributary channel sizing is to be comprised of 3:1 slopes with a 6.5 m bottom width, and is approximately 0.95 m deep as per Channel Cross Section 2-2 in *Figure 7* from the Mattamy submission. The existing ditch from Ottawa Street, and along the southwest edge of the Mattamy property, draining to the realignment of the Moore Tributary, is approximately 0.75 m deep with a 3.0 m wide bottom and 3:1 slopes as per Channel Cross Section 1-1. The realigned Moore Tributary consists of the following from southwest of the subject site to Queen Charlotte Street (see *Figure 7*):

- 250 m Ditch length at a slope of 0.1%;
- Proposed 3300x900 mm dia., 33.0 m long box culvert at a slope of 0.35% (capacity ~6,700 L/s);
- 255.5 m Ditch length at a slope of 0.13%;
- Proposed 3300x900 mm dia., 27.5 m long box culvert at a slope of 0.35% (capacity ~6,700 L/s);
- 56.4 m Ditch length at a slope of 0.58%.

This channel sizing would be able convey the 133.4 ha external drainage area for the 100-year 24-hr SCS design storm, which is approximately 2,793 L/s (the Moore Tributary conveyance calculation provided in Appendix E shows a capacity of 3,897 L/s) as per preliminary calculations from JFSA enclosed in ***Appendix E.***

5.5 Sump Pumps

Similar to Fox Run Phase 1 and Phase 2 (North/South), the proximity of the development area to the stormwater receiver (Arbuckle Drain), high HGL, and grade raise restrictions, the proposed centerline of road grades do not allow for standard basements with a gravity connection to the storm sewer system. Therefore the Green/Laffin areas will also be serviced entirely by sump pumps due to the site constraints imposed. This is consistent with the original ***MDP*** and ***MDP Update***.

In 2018 and 2019, the City published Technical Bulletins ITSB-2018-04 (June 27, 2018) and ITSB-2019-02 (July 8, 2019), which outline the criteria for sump pumps, the requirements for hydrogeological assessments areas with sump pumps, and revised information on HGL for storm sewers with sump pumps. In detailed design, the proposed sump pump design will conform to Technical Bulletins ITSB-2018-04 (June 27, 2018) and ITSB-2019-02 (July 8, 2019). The sump pump detail can be found on

Figure 4, and the sump pump components and requirements are outlined in the following table.

Table 7: Sump Pump Design Criteria

Component	Requirements
Sump Pump (General)	Shall be: o In accordance with City of Ottawa Technical Bulletin ISTB-2018-04 (June 27, 2018); o A submersible pump; o Automatically controlled and set to maintain the water level at the same elevation as the foundation drain; capable of discharging a minimum flow of 0.9 L/s at 3.6 m head.
Sump Pump (Primary)	Shall be: o CSA Approved; o Connected to an electrical circuit that supplies no other outlets, switches or equipment; o Equipped with a self-resetting thermal overload protection switch; o Rated for continuous duty.
Sump Pump (Backup)	Shall be: o CSA Approved; o Connected to an electrical circuit that supplies no other outlets, switches or equipment except: A) Charging equipment for backup power and B) Alarm system for primary pump and power failure; o Equipped with a self-resetting thermal overload protection switch; o Rated for continuous duty; o Equipped with an audible failure alarm to notify homeowner that the primary pump has failed or the power supply has been interrupted; o Capable of discharging a minimum capacity of 0.90 L/s at 3.6 m head; o Powered by a deep-cycle lead-acid battery with a minimum ampere-hour (AH) rating of 100 AH.
Sump Pit	Shall: o Have walls and bottoms constructed of concrete polyethylene, polypropylene, or fiberglass; o Be provided with a sealed cover; o Have a cover which must be secured in a manner acceptable to the authority having jurisdiction; o Be vented to the outdoors.
Discharge Pipe System from Sump Pump	Shall: o Be in accordance with *Appendix 9 – Standard Sump Pump Configuration in Greenfield Subdivisions with Clay Soils on Full Municipal Services*; o Consist of materials and be installed in conformance with the Ontario Building Code; o Have a minimum internal diameter of 38 mm (1-1/2”) from the sump pump to the 100 mm (4”) storm building drain; o Have a union, a check valve and a shut-off valve installed in that sequence in the direction of discharge outside of the sump pit; o Have a goose neck with a height of no more than 250 mm below the top of the foundation wall and discharge into the vertical leg of the storm building drain; o Have a minimum dimension of 600 mm from the vertical leg of the storm discharge pipe to the horizontal offset upstream of the backwater valve; o Include a CSA approved backwater valve for the stormwater discharge; o Include an emergency discharge pipe to the outside ground surface; o Be vented to the outdoors; Be graded or otherwise protected to prevent the freezing of water in the system.
Connections	o Only the perimeter foundation drainage system will be connected to the sump pit. Eaves trough, surface exterior drainage, swimming pool backwash, floor drains and any other water sources shall not be connected to the sump pit; o All new residences with installed sump pump systems must include:

	○ Eaves troughs discharging to the surface with appropriate drainage away from the house at the time of the original sale; ○ Drainage layer as per the Ontario Building Code; ○ Clay backfill placed against the drainage layer with the clay extending a minimum 1.5 m out from the drainage layer for all sides of the foundation; ○ Impervious backfill capping at the ground surface surrounding the perimeter of the residence area and slope away from the building after settling of backfill; except in areas where window wells are required by Ontario Building Code; The sump pump shall be directly connected to a storm building drain from the building to the property line.

5.6 Low Impact Development (LID)

The following Low Impact Development (LID) techniques are to be incorporated as part of detailed design:

- Rear-yard swales have been designed with minimum grades where possible, to promote infiltration;
- Rear-yard catchbasin leads/subdrain will be perforated (except for the last segment connecting to the storm sewer within the right-of-way), to promote infiltration; and,
- Where eavestroughs are provided on residential units, they are to be directed to landscaped surfaces, to promote infiltration.

These LIDs are implemented as part of the general design requirements for the site.

5.7 Stormwater Management Conclusions

Stormwater management for the Green Lands West follows the rationale provided for in the ***MDP Update***. Stormwater flows will be directed to SWM Pond 1 and managed for quality and quantity control prior to discharge to the Arbuckle Drain.

The Green Lands East area was not considered in the MDP Update and will provide quality and quantity control within that development area via ICDs and an OGS unit prior to any discharge. The lots to be provided on a new street extension will be tributary to a new outlet to the Van Gaal Drain (with the approval with the City Drainage Engineer). Sump pumps for the new units fronting onto the west side of existing Mira Court will connect to a storm sewer extension that will be installed for those 'clean water' connections.

The Laffin Lands servicing concept proposes to deviate from the ***MDP Update*** and remove the SWM Pond 2 requirement from that parcel and redirect flows to SWM Pond 1 for quality/quantity control to accommodate. This will require:

- Revisions to the SWM Pond 1 berm, water levels, and south forebay inlet and headwall replacements will be required to accommodate the additional tributary areas. The existing forebay is sufficiently sized for the proposed tributary area.
- The realignment of the Moore Tributary noted in the MDP Update will be updated with the inclusion of 39.2 ha of external land drainage that were originally proposed to go to SWM Pond 2 in order to mitigate flows through SWM Pond 1. This will be subject to RVCA and the City's Drainage Engineer's approval.
- 32.6 ha of land originally proposed to drain to Ottawa Street, then to SWM Pond 2, is proposed to drain to a new outlet through the development via a future storm trunk sewer outletting to the Jock River. The location of the drainage to outlet is based on an identified low point on topographic mapping. This work will require approval by the RVCA.

The associated storm sewer collection system, and stormwater management facility designs have been prepared in accordance with standard City of Ottawa modeling techniques.

In circumstances where infrastructure may be required outside of an individual landowner's development area (due to differences in development timing), there will need to be agreements in place facilitating cost sharing and access when necessary.

6.0 SITE GRADING

6.1 Grading Criteria

The following grading criteria and guidelines have been applied to the detailed design as per City of Ottawa Guidelines:

- Maximum slope in grassed areas between 2% and 5%;
- Grades in excess of 7% require terracing to a maximum of a 3:1 slope;
- Driveway grades between 2% and 6%;
- Drainage ditches and swales should have a minimum slope of 1.5%;
- Perforated pipe is required for swales less than 1.5% in slope;
- Swales are to be 0.15 m deep with 3:1 side slopes unless otherwise indicated on the drawings;

The ideal grading for the proposed 100-year ponding approach is summarized as follows:

- 0.5% longitudinal road slopes from high point to low point and from low point to high point within the ponding area;
- A 2.0% road cross-slope (although a 3.0% road cross-slope is also acceptable);
- As reasonable a freeboard as feasible between the maximum extent of surface storage on the road (i.e. the 100-year water level) and the lowest nearby building opening elevation, in order to ensure that the 100-year + 20% stress test water levels do not reach the building envelope; and
- Back-to-front drainage or well-spaced discharge points for excess rear yard flows draining to the street. Rear yard catchbasins are connected to street catchbasins, which in turn connects to the main storm sewer, allowing rear yard flows to back up into road ponding areas when the capacity of the catchbasin lead is exceeded.

6.2 Functional Grading Design

6.2.1 Green Lands West

The Green Lands West development is constrained by grade raise restrictions. The geotechnical investigation provided an assessment of permissible grade raises based on unit weights of fill of 18.0 kN/m^3 and 19.5 kN/m^3. The most restrictive grade raise is for the 19.5 kN/m^3 unit weight with restrictions of 2.0 m within the roadway and 1.3 m to 1.5 m at the house. See the ***Green Lands Geotechnical Report*** for full details. The servicing and grading have been designed as low as possible, to minimize the proposed grade raise within the subdivision and adheres to this requirement. In future, the detailed grading plans will be forwarded to the geotechnical consultant for review and recommendations. Final signoff for the detailed grading plans will be provided by the Geotechnical Engineer.

6.2.2 Green Lands East

The results of the ***Green Lands Geotechnical Report*** as summarized above for the Green Lands West is the same for the East area. Grading is kept as low as possible and ties into the adjacent existing development grading.

6.2.3 Laffin Lands

The geotechnical investigation of the area indicates that the site is generally underlain by loose to very dense native silty sand and silty sand till and therefore grade raises typical for low-rise subdivisions (assumed to be 1.5 to 2.5 m) are deemed acceptable. Based on the *Grading Plan* ***Drawing 1B*** for the property the proposed grade raise is approximately 2 m or less therefore no concerns are expected. The grading will ultimately be coordinated with the grading for the adjacent Mattamy development areas. Final signoff for the detailed grading plans will be provided by the Geotechnical Engineer.

7.0 EROSION AND SEDIMENT CONTROL

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

- 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.
- Installation of mud mats at construction accesses.

8.0 CONCLUSION AND RECOMMENDATIONS

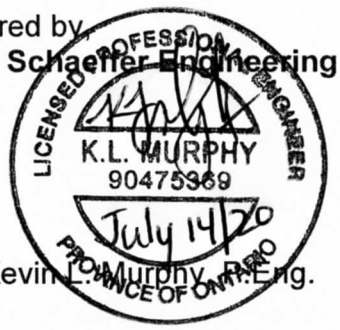
Richmond Village Development Corporation is proposing residential development within the Village of Richmond WDL. The subject properties are the Green Lands West (12.3 ha), Green Land East (3.62 ha) and Laffin Lands (7.62 ha). DSEL was retained to prepare a Functional Servicing Study in support of their draft plan application.

- Approvals will be required from the City of Ottawa, the Ministry of the Environment, Conservation and Parks (MECP) and the RVCA as required.
- Water supply to the Green Lands West and Laffin Lands was previously contemplated in the ***MSS***. Water supply to the development areas will be via extension of watermains from the now functional Communal Well for the WDL. Supply levels of the Communal Well will be assessed at detailed design to ascertain whether system updates to the Well facility will be required and is dependent upon the rate of the WDL buildout.
- Water supply for the Green Lands East is proposed to be by private wells in the rear of the lots along with an access easement to ensure access for future well maintenance or rehabilitation.
- Wastewater services will be provided through a network of gravity sewers that outlet to the recently constructed and commissioned Martin Street sanitary sewer and any future upgrades to the existing Richmond Sanitary Pumping Station. The off-site upgrades required to support the development were contemplated in the ***MSS***.
- With the implementation of the new sanitary design criteria as per Technical Bulletin ISTB-2018-01 (March 21, 2018), the proposed flows downstream of the WDL is lower than what the ***MSS*** calculated, even with the increase in population of the WDL from what the ***MSS*** originally projected.
- Foundation drainage for all units will be via sump pumps.
- Green Lands West storm sewers are designed in accordance with the new City of Ottawa stormwater guidelines with new 100-year ponding design criteria with a minimum 2-year minor system capture on local roads and a minimum 5-year minor system capture on collector roads. The sewers will outlet to SWM Pond 1 which has considered this drainage area.
- Green Lands East storm sewers are designed to the same standard noted for Green Lands West. The sewers will have a new outlet to the adjacent Van Gaal Drain (with the approval with the City Drainage Engineer). Quality and quantity control within the development area will be via ICDs and an OGS unit prior to any discharge. Sump pumps for the new units fronting onto the west side of existing Mira Court will connect to a storm sewer extension that will be installed for those ‘clean water’ connections.

- The Laffin Lands servicing concept proposes to deviate from the ***MDP Update*** and remove the SWM Pond 2 requirement from that parcel and redirect flows to and updated SWM Pond 1 for quality/quantity control to accommodate. This will require:
  - Revisions to the SWM Pond 1 berm, water levels, and south forebay inlet and headwall replacements will be required to accommodate the additional tributary areas. The existing forebay is sufficiently sized for the proposed tributary area.
  - The realignment of the Moore Tributary noted in the MDP Update will be updated with the inclusion of 39.2 ha of external land drainage that were originally proposed to go to SWM Pond 2 in order to mitigate flows through SWM Pond 1. This will be subject to RVCA and the City's Drainage Engineer's approval.
  - 32.6 ha of land originally proposed to drain to Ottawa Street, then to SWM Pond 2, is now proposed to drain to a new outlet through the development via a future storm trunk sewer outletting to the Jock River. The location of the drainage to outlet is based on an identified low point on topographic mapping. This work will require approval by the RVCA.
  - The proposed stormwater management Pond 1 was designed to meet MECP Enhanced Level of suspended solid removal and will attenuate stormwater to limit impacts on water levels in the receiving Arbuckle Drain.
- The Green Lands West/East will be subject to grade raise restrictions ranging from 2.0 m in the roadways to 1.3 m to 1.5 m at the future residential units. Ultimately the grading plan will be reviewed and signed off by the geotechnical engineer or they will provide recommendations to suite. The proposed grading is in general conformance with the proposed grading in the ***MDP***.
- The Laffin Lands is not subject to any grade raise restrictions.

Erosion and sediment control measures will be implemented and maintained throughout construction.

Prepared by,
David Schaeffer Engineering Ltd.



Per: Kevin L. Murphy, P.Eng.

20200714_FSR Green & Laffin Lands_Subm1.doc

APPENDIX A

PC2020-0062 – Perth and Ottawa Street Richmond: DRAFT

Friday March 13 2020

Attendance:

May Pham, Caivan

Matthew Hayley, Environmental Planner

Neeti Paudel, Transportation Engineer

Sarah McCormick, Planner

Damien Whittaker, Senior Engineer

Eric Lalande, RVCA

Reid Shepherd, Parks Planner

Cheryl McWilliams, Planner

Matthew Ippersiel, Urban Design (absent)

The proposal relates to residential subdivision development of lands known as the Green lands and the Laffin lands would see an additional approximately 600 plus units. There are a number of separate parcels at 6295, 6363, 6409 Perth Street and 6305 Ottawa Street.

General

Please note that this pre-consultation is only valid for one year. In addition, given the current sanitary servicing constraints in Richmond, capacity may not be available for the development of these sites until the completion of the final stage of the upgrades, which is the full replacement of the pump station not yet scheduled, so possibly 20 years away.

Given the timing and preliminary nature we are available to speak further on these matters and any revised plans.

Planning

- The road widths and cross-section, block depths and proposed setbacks must be demonstrated as supporting trees (one on each lot not just on average) as part of draft approval
- 16.5 m row widths will not be accepted
- The depths of the blocks must be adequate along the west lot line (Village boundary) to preserve any hedge row.
- There are some older trees on the house lot that should be preserved.
- Demonstrate consistency with the CDP and secondary plan for connections. Look at the north side potential of a MUP connecting across the drains to the east side of the van Gaal Drain to connect eventually to Cedarstone. Alternatively consider the hydro corridor. Royal York is the vehicular connection Mattamy is proposing to the village on

the south side. Burke Street connection as shown is also an option, but we would also want to see pedestrian links through to Meynell.
- Demonstrate compliance with the unit counts and density mixes per the CDP and secondary plan
- The sidewalk will need to be extended along Perth Street to the window street west of the Home Hardware.
- Servicing will need to be confirmed as available prior to supporting any draft approval.
- Consider approaching Hydro again with respect to their lands.
- The current version of the draft update to the Master Drainage Plan for the Western Development lands shows a 3rd storm pond within the hydro corridor and seems to be an in-line pond of the van Gaal. This is not acceptable.
- That same MDP is also showing much of the Laffin lands as a storm pond, which is consistent with the current approved version of the MDP but not the concept plan provided.
- An Archaeological Assessment will be needed
- The LandOwners Agreement and trustee sign-off will be required, for any works to commence.
- There is some sensitivity of the residents in Cedarstone Subdivision (north of Perth) to increases in traffic.
- There is a triangle parcel that is not owned and would limit frontage of the southern most lots on Mira.
- There is a small watercourse abutting the Laffin lands that will require some setback

Engineering

This is a follow-up to the pre-application consultation held on Friday March 13, 2020, at City Hall for regarding a proposal PC2020-0062 for development of the balance of the Western development Lands; 6363, 6409 and 6296 Perth Street in the City of Ottawa district of Rideau-Goulbourn (Ward 21) covered by Councillor Scott Moffatt. The purpose of the meeting was to identify and conduct a general overview of the key issues regarding the proposed development to ensure the application, when submitted, will be as complete as possible prior to circulation of the application and review.

Please find below City of Ottawa engineering/infrastructure information regarding an engineering design submission relevant to the proposed development. The information provided will assist the applicant for their plan of subdivision application.

Guidelines;

Please note that as this application is quite premature, the guidelines to be reviewed against will need to be the (future) amended versions, and there may even be guidelines in place then, that are not currently contemplated.

Water/Sanitary/Storm Servicing:

Water pipes:

Municipal water pipes will need to be extended to service the proposed development. The Western Development Lands developments will need to expand the well supply when appropriate and need to collectively expand the water storage at 28 l/s demand.

Sanitary Sewers:

No capacity exists in the sanitary sewer system presently and the application will not be accepted for draft approval for, probably, ten years, or more. Design parameters shall be the higher of the rates in the Sewer Design Guidelines, as amended and monitored flows. The developer shall apply I/I reduction techniques beyond that provided for the Fox Run Phase II development, that presently consists of blueskin wrap to the existing groundwater level and the use of pressure-rated pipe.

Storm Sewers:

The developer will need to extend conveyance systems in the Village of Richmond to include the development and, entirely at their cost, provide such extension.

Storm Water Management:

The consultant should determine a stormwater management regime for the application and, generally, maintain post-development flows to pre-development levels by way of providing storage to offset increased impervious areas. The existing runoff coefficient shall be taken as that from approved development; non-approved development should be ignored by the consultant in the determination of existing runoff coefficient and will not be taken into consideration by City engineering review staff.

Any existing stormwater runoff from adjacent site(s) that crosses the property must be accommodated by the proposed stormwater management design.

Stormwater quality control is required for the site. The Rideau Valley Conservation Authority (RVCA) can be contacted to determine the level of stormwater quality control required for the site.

All stormwater management determinations shall have supporting rationale.

Stormwater management solutions should be in concurrence with the content of the Western Development Lands Master Drainage Plan (MDP) that shows stormwater management ponds on both areas of proposed development; it is not clear how some of the development will proceed as the MDP plan currently shows the Laffin Lands to be entirely a SWM pond and SWM pond 1 was not designed to take more flow nor is there space for it to be expanded.

Please note that the SWM pond and upstream pipe/s and connected manholes shall be held in securities until the pond unit accepts the pond (at a date anticipated to be later than the rest of the subdivision)

A hydrogeoloogical report will be required for each, and all, stormwater management ponds

Please note that LID will be required and that the forthcoming LID policy may impact the design.

Roads:

Please refer to the City of Ottawa Private Approach By-Law 2003-447 for the entrance design.

Please note that Council has adopted a safer roads initiative called the Road Safety Action Plan that requires local residential roads be both, signed and designed to a 30 km/h limit. This means that curvilinear design is required to deny vehicles from achieving speeds accessible on long straight roads.

Please note that 16.5 m ROW will not be permitted for the development.

Please note that 18 m ROW will not be permitted where either sensitive marine clay is found (whether named or not) or a sidewalk is proposed
Please note that a 25 m, or wider, ROW will be required for any road sections with two sidewalks.

Sensitive Marine Clay:

It is understood that sensitive marine clay (or by any other name) exists in the vicinity. Enhanced investigation will be required including, but not limited to: Atterberg limits testing, sensitivity analysis (if sensitivity analysis is not included an exhaustive discussion of why will be required), consolidation testing (cyclic and non-cyclic) and plasticity chart

Discussion of vibration induced loss of strength (by any name) is required

Discussion of retrogressive landslides is required.

Peer-reviewed and published papers may be necessary for the consultant's reviews; any papers/articles/journals/textbooks used shall be sufficiently provided to the City and the reference shall show unmistakable and undeniable concurrence with the consultant's usage.

Relatively impervious clay shall not be accepted as a reason for not applying LID.

High Performance design Standard:

In due time the City will have High Performance Design Standards in place that the proposal will need to adhere to that may include, but not be limited to; enhanced insulation, electrical generation, electrical grid security, reduced energy demand, reduced environmental "footprint".

Permits and Approvals:

Please note that approval through the Ministry of the Environment, Conservation and Parks (MECP), amongst other federal and provincial departments/agencies, including the Rideau Valley Conservation Authority (RVCA), will be required to facilitate the development: responsibility rests with the developer and their consultant for determining which approvals are needed and for obtaining all external agency approvals. The address shall be in good standing with all approval agencies, for example the RVCA, prior to approval. Copies of confirmation of correspondence will be required by the City of Ottawa from all approval agencies that a form of assent is given. Please note that a stormwater program for multiple lots is understood to be the expanded transfer-of-review type of Environmental Compliance

Approval (ECA) application with the MECP; please speak with your engineering consultant to understand the impact of time and cost this has on the application. An MECP ECA is not submitted until after planning approval. No construction shall commence until after a commence work notification is given from an engineering representative from Development Review.

Ministry of the Environment, Conservation and Parks	Rideau Valley Conservation Authority
Contact Information:	Contact Information:
Christina Des Rochers	Eric Lalande
Water Inspector	eric.lalande@rvca.ca
613-521-3450 ext. 231	
Chstina.Desrochers@ontario.ca	

Plan requirements;

Grading and Drainage Plans*

Erosion and Sediment Control Plan/s*

*All identified required plans are to be submitted on standard A1 size sheets as per City of Ottawa Servicing and Grading Plan Requirements and note the survey monument used to establish datum on the plans with sufficient information to enable a layperson to locate the monument.

Report Submission Requirements[1]:

-Site Servicing Report

A plan is required that clearly shows the proposed water service layout.

-Storm Water Management Report

-Erosion and Sediment Control Measures

-Geotechnical Investigation Study

Please note that the area may contain sensitive marine clays. Please note that Atterberg limits, consolidation testing, grade raise restriction, and chemical analysis and discussion will be required in the report if sensitive marine clay is found. The geotechnical consultant will need to provide full copies of any published and peer reviewed papers relied on to determine results and conclusions

Earthquake analysis is now required to be provided in the report.

-Slope Stability Study (if topography deems necessary)

-Phase 1 Environmental Site Assessment (ESA)

The Phase 1 Environmental Site Assessment (ESA) as per O.Reg. 153/04. Phase 1 ESA documents performed to CSA standards are not acceptable.

Please find relevant City of Ottawa Links to Preparing Studies and Plans below:

Guide to preparing drawings for City of Ottawa engineering submissions

https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans#servicing-and-grading-plan-requirements

Guide to preparing City of Ottawa Studies and Plans:

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

Servicing Study Guidelines for Development Applications:

https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans#servicing-and-grading-plan-requirements

To request City of Ottawa plan(s) or report information please contact the ISD Information Centre:

Information Centre

(613) 580-2424 ext. 44455

Please feel free to contact me if you have any questions.

Damien

Parks Planning

- Area Parks Plan (APP) is currently in place and was approved in 2019.
- The amenities and park sizes in the APP should be considered minimum requirements for any new proposals.
- If unit density is above that which is listed in the APP, park size requirements and/or Cash-in-Lieu will be larger than those required in the APP. These sizes would need to be determined once a more detailed proposal is put forward containing actual unit numbers.
- Parkland funding agreement required to be in place prior to registering any new phases of development in Western Lands.
- Parks recommends that the lotting pattern around the proposed northern parkette be adjusted to shift the park south so that it is adjacent to the hydro corridor that contains a proposed Multi-Use Pathway (MUP). The adjustment will improve connectivity from the MUP to the park, which was the intention behind the proposed location originally shown in the APP.

Reid Shepherd

Environmental Planning

- A Tree Conservation Report and an Environmental Impact Statement will be required
- A preliminary Integrated Environmental Impact Statement will be required at submission, and form part of the Planning Rationale.
- A 30 m setback is require for the watercourses to the north
- A minimum 6 m access will be needed to the watercourse buffer lands – likely best off the north end of the collector road.

Matthew Hayley

Transportation:

- Follow Traffic Impact Assessment Guidelines
    - Traffic Impact Assessment will be required. Proceed to scoping.
    - Start this process asap.
    - Applicant advised that their application will not be deemed complete until the submission of the draft step 1-4, including the functional draft RMA package (if applicable) and/or monitoring report (if applicable).
    - Request base mapping asap if RMA is required. Contact Engineering Services (https://ottawa.ca/en/city-hall/planning-and-development/engineering-services)
- ROW protection on Perth Street between Eagleson and Village Boundary is 30m even.
- Geometric Road Design (GRD) drawings will be required with the first submission of underground infrastructure and grading drawings. These drawings should include such items as, but is not limited to:
    - Road Signage and Pavement Marking for the subdivision;
    - Intersection control measure at new internal intersections; and
    - Location of depressed curbs and TWSIs;
    - More details can be provided upon request
- Include traffic calming measures on roads within the limits of their subdivision to limit vehicular speed and improve pedestrian safety. Traffic calming measures shall reference best management practices from the Canadian Guide to Neighbourhood Traffic Calming, published by the Transportation Association of Canada, and/or Ontario Traffic Manual, and/or the City of Ottawa's Draft Traffic Calming Design Guidelines. These measures may include either vertical or horizontal features (such measures shall not interfere with stormwater management and overland flow routing), including but not limited to:
    - intersection or mid block narrowings, chicanes, medians;
    - speed humps, speed tables, raised intersections, raised pedestrian crossings;
    - road surface alterations (for example, use of pavers or other alternate materials, provided these are consistent with the City's Official Plan polices related to Design Priority Areas);
    - pavement markings/signage; and
    - temporary/seasonal installations such as flexi posts or removable bollards.
- Corner triangles as per OP Annex 1 - Road Classification and Rights-of-Way at the following locations on the final plan will be required:
    - Local Road to Local Road: 3 metre x 3 metres
    - Local Road to Collector Road: 5 metre x 5 metres

    - Collector Road to Collector Road: 5 metre x 5 metres
    - Collector Road to Arterial Road: 5 metre x 5 metres
- Noise Impact Studies required (Road):
    - Feasibility before draft approval
    - Detailed before registration

-Residential streets (local and collector) are to be designed for 30 kph speed limits (posted). (Direction from Councillors and Director of Traffic Services).

Neeti Paudel, P.Eng.

Rideau Valley Conservation Authority

- Some flood plain showing on the lands. Confirm that the realignment of the Van Gaal Drain resolves that
- Looking for 80% TSS removal for water quality
- Require a 30 metre setbacks from the drain to the north side of the Green lands.

Eric Lalande

Green Lands Urban Design Comments

- Ensure lot sizes, ROWs, and setbacks are sufficiently sized to achieve the design guidelines found in Section 7.4 of the Village of Richmond CDP. Currently, there may be enough space to achieve such guidelines as having enough space to plant a tree in the front yard, having a varied building setbacks, or parking a vehicle without it overhanging onto the sidewalk or street.
- Explore opportunities to integrate large-lot, village-style detached dwellings into the development along targeted and highly visible streets. See section 7.4.8 of the Village of Richmond CDP for additional details.
- Include a greater mix of the proposed building typologies. It appears the highest densities units have been clustered south of the hydro corridor.
- Open a vehicular connection to Perth Road as a gateway into the community, as shown in the Richmond CDP Demonstration Plan.
- If a window street is created adjacent to Perth Road, re-orient as many of the properties towards Perth as possible.
- Create pedestrian pathway connections in the north-most block to break up the long block and provide a link to a potential future pedestrian pathway north of the site. The pathways should be aligned with proposed north-south streets to create view corridors.
- It would be preferable to have the park open to the public realm on at least three sides, surrounded by single-loaded streets. Configure surrounding roads to have the park terminate views and offset the street grid.

Laffin Lands Urban Design Comments

- Relocate the proposed park to a more central location in the development that is well connected.
- Include mid-block pedestrian pathways to align with adjacent proposed pathways.

Matt Ippersiel

APPENDIX B

Ontario

Ministry of the Environment, Conservation and Parks
Ministère de l'Environnement, de la Protection de la nature et des Parcs

ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 1528-BLFNVH
Issue Date: February 24, 2020

Richmond Village Development Corporation
2934 Baseline Road, Unit 302
Ottawa, Ontario
K2H 1B2

Site Location: Fox Run Subdivision - Phase 2 (North)
6335 Perth Street
City of Ottawa, Ontario

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

the establishment of wastewater infrastructure Works located in the City of Ottawa, consisting of the following:

- **storm sewers** on proposed Trammel Road (from Station 0-14.006 to Station 0-0.25, and from Station 0-0.25 to Station 0+187.215), proposed Postilion Street (from Station 0+160 to Station 0+149.62, and from Station 0+149.62 to 0-1.995), proposed Latigo Ridge (from Station 0+1.952 to Station 0+151.572), proposed Chasing Grove (from Station 0+2.05 to Station 0+151.67), proposed Brush Lane (from Station 0+85.71 to Station 0+151.63), proposed Bascule Place (from Station 0+135.562 to Station 0+197.009, from Station 0+135.562 to Station 0+71.69, from Station 0+71.69 to 0+34.591, and from Station 0+34.591 to 0+2.202), proposed Vaulting Crescent (from Station 0+7.492 to Station 0+53.326), proposed Oldenburg Avenue (from Station 0+238.745 to Station 0+223.481, and from Station 223.481 to Station 0+0.813), Perth Street (from adjacent Block 221 to Station 0+241.788, from Station 0+36.821 to 0+476.497, from Station 0+476.497 to Station 0+37.095, from southwest of Block 282 to 0+242.061, from Station 240.762 to Station 0+285.925, and from Station 285.925 to 0+335.294), proposed Griseo Way (from Station 0+36.761 to Station 0+2.021), and servicing Block 280, discharging to the existing stormwater management facility, located southeast of the intersection of Perth Street and Meynell Road; and

- **sanitary sewers** on proposed Trammel Road (from Station 0+72.432 to Station 0+133.61, from Station 0+180.711 to Station 0+133.61, from Station 0+72.432 to Station 0-0.25, and from Station -0+14.006 to Station 0+0.25), proposed Postilion Street (from Station 0+160.000 to Station 0+0.000), proposed Latigo Ridge (from Station 0+0.000 to Station 149.620), proposed Chasing Grove (from Station 0+0.000 to Station 0+149.620), proposed Bascule Place (from Station 0+194.808 to Station 0+72.432, and from Station 0+72.432 to 0-0.25), and proposed Oldenburg Avenue (from Station 0+238.745 to Station 0+75.807, and from Station 0+75.807 to Station 0-14.971), discharging to existing sanitary sewers, located

on Meynell Road (southeast of Perth Street);

including erosion/sedimentation control measures during construction and all other controls and appurtenances essential for the proper operation of the aforementioned Works;

all in accordance with the submitted application and supporting documents listed in Schedule "A" forming part of this approval.

For the purpose of this environmental compliance approval, the following definitions apply:

DEFINITIONS

1. "Approval" means this entire document and any schedules attached to it, and the application;

2. "Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;

3. "District Manager" means the District Manager of the appropriate local District Office of the Ministry, where the Works are geographically located;

4. "EPA" means the *Environmental Protection Act,* R.S.O. 1990, c.E.19, as amended;

5. "Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;

6. "Owner" means Richmond Village Development Corporation, and includes its successors and assignees;

7. "OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O.40, as amended;

8. "Works" means the sewage Works described in the Owner's application, and this Approval.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITIONS

1. The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

2. Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval, and the application for approval of the Works.

3. Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the conditions in this Approval shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

4. Where there is a conflict between the documents listed in Schedule "A" and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

5. The conditions of this Approval are severable. If any condition of this Approval, or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

2. EXPIRY OF APPROVAL

1. This Approval will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Approval.

2. In the event that completion and commissioning of any portion of the Works is anticipated to be delayed beyond the specified expiry period, the Owner shall submit an application of extension to the expiry period, at least twelve (12) months prior to the end of the period. The application for extension shall include the reason(s) for the delay, whether there is any design change(s) and a review of whether the standards applicable at the time of Approval of the Works are still applicable at the time of request for extension, to ensure the ongoing protection of the environment.

3. CHANGE OF OWNER

1. The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

    a. change of Owner;

    b. change of address of the Owner;

    c. change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the *Business Names Act,* R.S.O. 1990, c.B17 shall be included in the notification to the District Manager; or

    d. change of name of the corporation where the Owner is or at any time becomes a

corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the District Manager.

2. In the event of any change in ownership of the Works, other than a change to a successor municipality, the Owner shall notify in writing the succeeding owner of the existence of this Approval, and a copy of such notice shall be forwarded to the District Manager and the Director.

3. The Owner shall ensure that all communications made pursuant to this condition refer to the number at the top of this Approval.

4. OPERATION AND MAINTENANCE

1. If applicable, any proposed storm sewers or other stormwater conveyance in this Approval can be constructed but not operated until the proposed stormwater management facilities in this Approval or any other Approval that are designed to service the storm sewers or other stormwater conveyance are in operation.

Schedule "A"

1. Application for Environmental Compliance Approval, dated December 12, 2019, received on January 20, 2020, submitted by Richmond Village Development Corporation;

2. Transfer of Review Letter of Recommendation, dated January 14, 2020, revised on January 31, 2020, and signed by Damien Whittaker, P. Eng., Senior Engineer - Infrastructure Applications, Planning, Infrastructure and Economic Development Department, City of Ottawa;

    a. Final Plans and Specifications prepared by David Schaeffer Engineering Ltd.

    b. Pipe Data Form - Watermain, Storm Sewer, Sanitary Sewer, and Forcemain Design Supplement to Application for Approval for Water and Sewage Works.

    c. Hydraulic Design Sheets prepared by David Schaeffer Engineering Ltd.

3. Emails dated January 30, 2020, January 31, 2020, and February 7, 2020, from Damien Whittaker, P. Eng., City of Ottawa.

4. Emails dated February 3, 2020 and February 7, 2020, from Kevin Murphy, David Schaeffer Engineering Ltd.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are constructed and operated in the manner in which they were described and upon which approval was granted. This condition is also included to emphasize the precedence of conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to the approved Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included to prevent the operation of stormwater pipes and other conveyance until such time that their required associated stormwater management Works are also constructed.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of
Part II.1 of the Environmental Protection Act
Ministry of the Environment,
Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 24th day of February, 2020

Aziz Ahmed, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

CA/

c: District Manager, MECP Ottawa
Clerk, City of Ottawa (File No. D07-16-19-0009)
Damien Whittaker, City of Ottawa
Kevin Murphy, David Schaeffer Engineering Ltd.

Ontario

Ministry of the Environment, Conservation and Parks
Ministère de l'Environnement, de la Protection de la nature et des Parcs

AMENDED ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 1608-BPHMBF
Issue Date: May 19, 2020

Richmond Village Development Corporation
2934 Baseline Road, Unit 302
Ottawa, Ontario
K2H 1B2

Site Location: Fox Run Subdivision
6350 Perth Street
City of Ottawa, Ontario

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

modifications to existing stormwater management Works to serve the Western Development Lands and related to the Fox Run subdivision Phase II (North), located in the City of Ottawa, for the collection, transmission, treatment and disposal of stormwater runoff from a total catchment area of 185.19 hectares, to provide Enhanced Level water quality protection and erosion control, baseflow augmentation, and to attenuate post-development peak flows to pre-development peak flows for all storm events up to and including the 100-year storm event, discharging to the Van Gaal/Arbuckle Drain, consisting of the following:

- **stormwater management facility (catchment area 185.19 hectares):** one (1) wet pond with two existing sediment forebays and the inclusion of an additional sediment forebay, located southeast of Perth Street, southwest of Queen Charlotte Street North and northeast of Meynell Road, having a permanent storage volume of 45,330 cubic metres, an extended detention volume of 43,875 cubic metres, and a total storage volume of 66,394 cubic metres including the permanent pool, at a total depth of 1.85 metres, and a new additional inlet structure consisting of a 2100 millimetre and a 975 millimetre diameter series of storm inlet pipes and a concrete headwall, an existing middle inlet of a 1200 millimetre diameter pipe and a concrete headwall, and 'south' inlet consisting of a 1350 millimetre and a 1650 millimetre diameter series of pipes; an outlet structure comprised of a 900 millimetre diameter storm outlet pipe equipped with a 300 millimetre diameter orifice, allowing a maximum extended detention discharge of 440 litres per second under the 100-year storm event to the Van Gaal/Arbuckle Drain, located to east of the pond, cool drain baseflow augmentation via a 100 millimetre diameter orifice and a 300 millimetre diameter pipe providing 28 litres per second and, for emergency events, a 45 metre wide spillway is also provided in

collaboration with an 88.5 metre long quantity control weir;

including erosion/sedimentation control measures during construction and all other controls and appurtenances essential for the proper operation of the aforementioned Works;

all in accordance with the submitted application and supporting documents listed in Schedule "A" forming part of this Approval.

For the purpose of this environmental compliance approval, the following definitions apply:

1. "Approval" means this entire document and any schedules attached to it, and the application;

2. "Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;

3. "District Manager" means the District Manager of the appropriate local District Office of the Ministry, where the Works are geographically located;

4. "EPA" means the *Environmental Protection Act,* R.S.O. 1990, c.E.19, as amended;

5. "Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;

6. "Owner" means Richmond Village Development Corporation, and includes its successors and assignees;

7. "OWRA" means the *Ontario Water Resources Act, R.S.O. 1990, c. O.40* , as amended;

8. "Works" means the sewage Works described in the Owner's application, and this Approval.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITIONS

1. The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

2. Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval, and the

application for approval of the Works.

3. Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the conditions in this Approval shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

4. Where there is a conflict between the documents listed in Schedule "A" and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

5. The conditions of this Approval are severable. If any condition of this Approval, or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

2. EXPIRY OF APPROVAL

1. This Approval will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Approval.

2. In the event that completion and commissioning of any portion of the Works is anticipated to be delayed beyond the specified expiry period, the Owner shall submit an application of extension to the expiry period, at least twelve (12) months prior to the end of the period. The application for extension shall include the reason(s) for the delay, whether there is any design change(s) and a review of whether the standards applicable at the time of Approval of the Works are still applicable at the time of request for extension, to ensure the ongoing protection of the environment.

3. CHANGE OF OWNER

1. The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

    a. change of Owner;

    b. change of address of the Owner;

    c. change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the *Business Names Act,* R.S.O. 1990, c.B17 shall be included in the notification to the District Manager; or

d. change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the *Corporations Information Act,* R.S.O. 1990, c. C39 shall be included in the notification to the District Manager.

2. In the event of any change in ownership of the Works, other than a change to a successor municipality, the Owner shall notify in writing the succeeding owner of the existence of this Approval, and a copy of such notice shall be forwarded to the District Manager and the Director.

3. The Owner shall ensure that all communications made pursuant to this condition refer to the number at the top of this Approval.

4. OPERATION AND MAINTENANCE

1. If applicable, any proposed storm sewers or other stormwater conveyance in this Approval can be constructed but not operated until the proposed stormwater management facilities in this Approval or any other Approval that are designed to service the storm sewers or other stormwater conveyance are in operation.

2. The Owner shall make all necessary investigations, take all necessary steps and obtain all necessary approvals so as to ensure that the physical structure, siting and operations of the Works do not constitute a safety or health hazard to the general public.

3. The Owner shall inspect and ensure that the design minimum liquid retention volume is maintained in the Works at all times, except when maintenance is required.

4. The Owner shall undertake an inspection of the condition of the Works, at least once a year, and undertake any necessary cleaning and maintenance to ensure that sediment, debris and excessive decaying vegetation are removed from the Works to prevent the excessive build-up of sediment, oil/grit, debris and/or decaying vegetation, to avoid reduction of the capacity and/or permeability of the Works, as applicable. The Owner shall also regularly inspect and clean out the inlet to and outlet from the Works to ensure that these are not obstructed.

5. The Owner shall construct, operate and maintain the Works with the objective that the effluent from the Works is essentially free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film, sheen, foam or discoloration on the receiving waters.

6. The Owner shall maintain a logbook to record the results of these inspections and any cleaning and maintenance operations undertaken, and shall keep the logbook at the Owner's administrative office for inspection by the Ministry. The logbook shall include the following:

   a. the name of the Works; and

b. the date and results of each inspection, maintenance and cleaning, including an estimate of the quantity of any materials removed and method of clean-out of the Works.

7. The Owner shall prepare an operations manual prior to the commencement of operation of the Works that includes, but is not necessarily limited to, the following information:

   a. operating and maintenance procedures for routine operation of the Works;

   b. inspection programs, including frequency of inspection, for the Works and the methods or tests employed to detect when maintenance is necessary;

   c. repair and maintenance programs, including the frequency of repair and maintenance for the Works;

   d. contingency plans and procedures for dealing with potential spills and any other abnormal situations and for notifying the District Manager; and

   e. procedures for receiving, responding and recording public complaints, including recording any follow-up actions taken.

8. The Owner shall maintain the operations manual current and retain a copy at the Owner's administrative office for the operational life of the Works. Upon request, the Owner shall make the manual available to Ministry staff.

5. TEMPORARY EROSION AND SEDIMENT CONTROL

1. The Owner shall install and maintain temporary sediment and erosion control measures during construction and conduct inspections once every two (2) weeks and after each significant storm event (a significant storm event is defined as a minimum of 25 mm of rain in any 24 hours period). The inspections and maintenance of the temporary sediment and erosion control measures shall continue until they are no longer required and at which time they shall be removed and all disturbed areas reinstated properly.

2. The Owner shall maintain records of inspections and maintenance which shall be made available for inspection by the Ministry, upon request. The record shall include the name of the inspector, date of inspection, and the remedial measures, if any, undertaken to maintain the temporary sediment and erosion control measures.

6. REPORTING

1. One (1) week prior to the start-up of the operation of the Works, the Owner shall notify the District Manager (in writing) of the pending start-up date.

2. The Owner shall, upon request, make all reports, manuals, plans, records, data, procedures and supporting documentation available to Ministry staff.

3. The Owner shall prepare a performance report within ninety (90) days following the end of the period being reported upon, and submit the report(s) to the District Manager when requested. The first such report shall cover the first annual period following the commencement of operation of the Works and subsequent reports shall be prepared to cover successive annual periods following thereafter. The reports shall contain, but shall not be limited to, the following information:

    a. a description of any operating problems encountered and corrective actions taken;

    b. a summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the Works, including an estimate of the quantity of any materials removed from the Works;

    c. a summary of any complaints received during the reporting period and any steps taken to address the complaints;

    d. a summary of all spill or abnormal discharge events; and

    e. any other information the District Manager requires from time to time.

7. RECORD KEEPING

1. The Owner shall retain for a minimum of five (5) years from the date of their creation, all records and information related to or resulting from the operation, maintenance and monitoring activities required by this Approval.

Schedule "A"

1. Application for Environmental Compliance Approval, dated March 27, 2020, received on April 30, 2020, submitted by Richmond Village Development Corporation;

2. Transfer of Review Letter of Recommendation, dated April 30, 2020 and signed by Damien Whittaker, P.Eng., Infrastructure Applications, Development Review, City of Ottawa, including the following supporting documents:

   a. Final Plans and Specifications prepared by David Schaeffer Engineering Ltd.

   b. Stormwater Management Report prepared by David Schaeffer Engineering Ltd.

   c. Design Brief for Stormwater Management Pond 1, Western Development Lands - Richmond, Revised March 2020, prepared by J.F. Sabourin and Associates & David Schaeffer Engineering Ltd.

3. Emails received on May 7, 2020, May 8, 2020, May 12, 2020, and May 13, 2020 from Damien Whittaker, P. Eng., City of Ottawa.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are constructed and operated in the manner in which they were described and upon which approval was granted. This condition is also included to emphasize the precedence of conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to the approved Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included as regular inspection and necessary removal of sediment and excessive decaying vegetation from the Works are required to mitigate the impact of sediment, debris and/or decaying vegetation on the treatment capacity of the Works. The Condition also ensures that adequate storage is maintained in the Works at all times as required by the design. Furthermore, this Condition is included to ensure that the Works are operated and maintained to function as designed.

5. Condition 5 is included as installation, regular inspection and maintenance of the temporary sediment and erosion control measures is required to mitigate the impact on the downstream receiving watercourse during construction until they are no longer required.

6. Condition 6 is included to provide a performance record for future references, to ensure that the Ministry is made aware of problems as they arise, and to provide a compliance record for all the terms and conditions outlined in this Approval, so that the Ministry can work with the Owner in resolving any problems in a timely manner.

7. Condition 7 is included to require that all records are retained for a sufficient time period to adequately evaluate the long-term operation and maintenance of the Works.

Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s). 1060-AY8JK4 issued on May 30, 2018.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of Part II.1 of the Environmental Protection Act
Ministry of the Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 19th day of May, 2020

Aziz Ahmed, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

SW/

c: District Manager, MECP Ottawa District Office
City Clerk, City of Ottawa
Damien Whittaker, P. Eng., Senior Engineer, Infrastructure Applications, City of Ottawa
Kevin Murphy, David Schaeffer Engineering Ltd.

Ontario

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 9297-AV9KAL
Issue Date: January 25, 2018

Richmond Village Development Corporation
2934 Baseline Road, Unit 302
Ottawa, Ontario
K2H 1B2

Site Location: Caivan Communities - Richmond Phase 1
6350 Perth Street
City of Ottawa, Ontario

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

sanitary and storm sewers to be constructed in the City of Ottawa, as follows:

- sanitary sewers on Meynell Road (from Station 0+671.0 to Station 1+225.3), Cantle Crescent (from Station 0+000.0 to Station 0+267.9), Pelham Crescent (from Station 0-013.0 to Station 0+377.6), Reynard Crescent (from Station 0+000.0 to Station 0+308.6), Noriker Court (from Station 0-014.0 to Station 0+228.3), Hackamore Crescent (from Station 0+000.0 to Station 0+084.3), Equitation Circle (from Station 0+000.0 to Station 0+503.4), and Pond Inlet 3 - Storm Trunk 2 (from Station 0+080.0 to Station 0+172.6), discharging to Richmond Stormwater Management Pond 1, located in the City of Ottawa; and

- storm sewers on Meynell Road (from Station 0+687.1 to Station 1+225.7), Cantle Crescent (from Station 0+002.5 to Station 0+267.9), Pelham Crescent (from Station 0-013.5 to Station 0+380.0), Reynard Crescent (from Station 0-002.0 to Station 0+310.6), Noriker Court (from Station 0-016.0 to Station 0+238.0), Hackamore Crescent (from Station 0-002.5 to Station 0+084.3), Equitation Circle (from Station 0+002.5 to Station 0+505.8), Block 235 (from Station 0+002.5 to Station 0+070.8), Pond Inlet 2 (from Station 0+006.9 to Station 0+076.8, Pond Inlet 3 - Storm Trunk 1 (from Station 0+003.9 to Station 0+162.3), and Pond Inlet 3 - Storm Trunk 2 (from Station 0+077.7 to Station 0+206.7), discharging to Richmond Stormwater Management Pond 1, located in the City of Ottawa;

all in accordance with the submitted application and supporting documents listed in Schedule "A" forming part of this approval.

For the purpose of this environmental compliance approval, the following definitions apply:

1. "Approval" means this entire document and any schedules attached to it, and the application;

2. "Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;

3. "District Manager" means the District Manager of the appropriate local District Office of the Ministry, where the Works are geographically located;

4. "EPA" means the Environmental Protection Act, R.S.O. 1990, c.E.19, as amended;

5. "Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;

6. "Owner" means Richmond Village Development Corporation, and includes their successors and assignees;

7. "OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O.40, as amended;

8. "Significant Threat Policy(ies)" has the same meaning as in the Clean Water Act, 2006;

9. "Source Protection Plan" means a drinking water source protection plan prepared under the Clean Water Act, 2006;

10. "Works" means the sewage works described in the Owner's application, and this Approval.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITIONS

1. The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

2. Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval, and the application for approval of the Works.

3. Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the conditions in this Approval shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

4. Where there is a conflict between the documents listed in Schedule "A" and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

5. The conditions of this Approval are severable. If any condition of this Approval, or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

2. EXPIRY OF APPROVAL

1. This Approval will cease to apply to those parts of the Work which have not been constructed within five (5) years of the date of this Approval.

2. In the event that completion and commissioning of any portion of the Works is anticipated to be delayed beyond the specified expiry period, the Owner shall submit an application of extension to the expiry period, at least twelve (12) months prior to the end of the period. The application for extension shall include the reason(s) for the delay, whether there is any design change(s) and a review of whether the standards applicable at the time of Approval of the Works are still applicable at the time of request for extension, to ensure the ongoing protection of the environment.

3. CHANGE OF OWNER

1. The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

   a. change of Owner;

   b. change of address of the Owner;

   c. change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, R.S.O. 1990, c.B17 shall be included in the notification to the District Manager; or

   d. change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the District Manager.

2. In the event of any change in ownership of the Works, other than a change to a successor municipality, the Owner shall notify in writing the succeeding owner of the existence of this Approval, and a copy of such notice shall be forwarded to the District Manager and the Director.

3. The Owner shall ensure that all communications made pursuant to this condition refer to the number at the top of this Approval.

4. Notwithstanding any other requirements in this Approval, upon transfer of the ownership or assumption of the Works to a municipality if applicable, any reference to the District Manager shall be replaced with the Water Supervisor.

4. OPERATION AND MAINTENANCE

1. If applicable, any proposed storm sewers or other stormwater conveyance in this Approval can be constructed but not operated until the proposed stormwater management facilities in this Approval or any other Approval that are designed to service the storm sewers or other stormwater conveyance are in operation.

5. SOURCE WATER PROTECTION

1. The Owner shall ensure, if applicable, that the design, construction and operation of the Works conforms to any Significant Threat Policies in any Source Protection Plan that applies to the location of the Works.

SCHEDULE "A"

1. Application for Environmental Compliance Approval for Municipal and Private Sewage Works, dated December 19, 2017 and received on December 28, 2017, submitted by Richmond Village Development Corporation.

2. Transfer of Review Letter of Recommendation, dated December 28, 2017 and signed by Damien Whittaker, Senior Engineer, City of Ottawa.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are constructed and operated in the manner in which they were described and upon which approval was granted. This condition is also included to emphasize the precedence of conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to approved Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included to prevent the operation of stormwater pipes and other conveyance until such time that their required associated stormwater management Works are also constructed.

5. Condition 5 is included to ensure that the Works conform to the policies of the local Source Water Protection Plan.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of
Part II.1 of the Environmental Protection Act
Ministry of the Environment and
Climate Change
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 25th day of January, 2018

C. Labarge

Christina Labarge, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

RS/

c: District Manager, MOECC Ottawa
City Clerk, City of Ottawa (File No. D07-16-11-0014)
Linda Carkner, Program Mananger, Right of Way Unit (MC 26-61)
Harry R. Alvey, P.E., P.Eng., Project Manager, Rural Branch
Kevin Murphy, David Schaeffer Engineering Ltd.

APPENDIX C

Stantec

Memo

To:	Kevin Murphy David Schaeffer Engineering Ltd.	From:	Jasmin Sidhu / Kevin Alemany Stantec Consulting Ltd.
File:	163401550	Date:	July 8, 2020

Reference: Richmond Caivan Green & Laffin Lands – Potable Water Capacity Analysis

OVERVIEW

To support David Schaeffer Engineering Ltd. (DSEL) with their Functional Servicing Report, Stantec Consulting Ltd. (Stantec) was retained by Richmond Village Development Corporation (RVDC) to complete a potable water hydraulic analysis for Caivan's recently acquired properties within the Richmond Western Development Lands.

To date, Stantec has completed hydraulic analyses for the water distribution system internal to the Western Development Lands, including that within Caivan's Richmond Fox Run development lands (Phases 1 and 2) and under buildout conditions.

Caivan has recently acquired additional property in the Western Development Lands, including:

(1) The lands adjacent to their Fox Run Subdivision lands on the north side of Perth Street (Green Lands West, formerly identified as 'Other' as part of previous potable water analyses complete for the Western Development Lands); and,

(2) The Laffin Lands which is within the land area owned by Mattamy.

This technical memorandum quantifies the updated unit density (and population) and documents the associated supply and distribution system capacity analyses to identify if these development lands can still be serviced by the Communal Well and if the existing watermain distribution network is capable of servicing the areas in question and if required, what watermain upgrades might be required.

HYDRAULIC ASSESSMENT

PHASING

For the purpose this assessment, development within the Western Development Lands, as shown in **Figure 1**, was assumed to occur (or have occurred) in the following phasing order:

(1) Caivan Fox Run Phase 1 (servicing construction completed and home building/occupancies ongoing);

(2) Caivan Fox Run Phase 2 North and South (draft approved with Phase 2 North servicing construction ongoing);

(3) Mattamy Phase 1 (future; not yet draft approved);

(4) Caivan Green Lands West and Laffin Lands; and,

(5) Buildout of the remaining Western Development Lands, including other developments from Mattamy and RVDC (draft approved RVDC landholdings with design pending).

Reference: **Richmond Caivan Green & Laffin Lands – Potable Water Capacity Analysis**

Herein, "interim conditions" was considered to include constructed and/or anticipated development up to, and including, the Caivan Green Lands West and Laffin Lands (i.e. development phases 1 to 4).

GROWTH & DEMAND PROJECTIONS

Growth Projections

The estimated residential population for the Green Lands West and Laffin Lands is estimated based on projected household sizes as per the Ottawa Water Design Guidelines. **Table 1** attached shows the estimated number of units for these two development lands and their respective projected populations based on the distribution of residential unit types. Green Lands West is estimated to have a total of 294 residential units with a population of 861 persons. Laffin Lands is estimated to have a total of 211 residential units with a population of 599 persons.

Upon buildout of the Western Development Lands, the majority of the land is proposed to be residential, with 2.63 ha proposed to be institutional (i.e. school) as a future phase of the Mattamy buildout development area. **Table 2** attached provides a breakdown of the estimated units and populations for each development phase/area within the Western Development Lands. The total number of units upon buildout is estimated to be 2,309, with a total projected population of 7,245 persons.

Demand Projections

The criteria outlined in the City of Ottawa 2013 Water Master Plan (WMP) were followed to establish water demands for the Green Lands West and Laffin Lands and the rest of the Western Development Lands. As per **Table 2** attached, the estimated buildout population for the Western Development Lands is 7,245 persons, therefore Zone Level demands for populations greater than 3,000 persons were used. The demand rates from the Table 3-1 of the 2013 WMP were applied to the population projections presented in **Table 2** attached based on land use and location with respect to the Greenbelt (i.e. outside, denoted as "outside Greenbelt" or OGB). Zone level demands are generally used to assess larger service areas and are not generally used to size smaller internal watermains; however, fire flows generally govern the minimum sizing for smaller internal watermain infrastructure and therefore the use of Zone Level demands for this analysis was considered appropriate.

For residential land use, single-family and semi-detached homes were considered to have similar demands, therefore both housing types were classified as "single-family houses" (SFH) that have a unit consumption rate of 180 L/cap/d. All townhouses were classified as "multi-level townhouses" (MLT) with a unit consumption rate of 198 L/cap/d. For the institutional (INS) lands, a unit demand rate of 28,000 L/ha/d was applied to establish basic day (BSDY) demands. BSDY demands for the Green Lands West and Laffin Lands and the rest of the Western Development Lands are summarized in **Table 3** attached.

To establish maximum day (MXDY) demands, an outdoor water demand (OWD) of 1,049 L/SFH/d was taken, as per the 2013 WMP, and allocated to all SFH units. This outdoor water demand was added to BSDY demands to obtain the MXDY demand (see **Table 3** attached).

Peak hour (PKHR) demands were established by applying diurnal patterns developed by the City of Ottawa to the maximum day demands. The diurnal patterns are different for each unit type and vary with time of day. The overall maximum observed demand, with patterns applied, is the PKHR demand. For example, single-family houses will typically have peak demands during 7 to 8 a.m. in the morning and 5 to 8 p.m. in the evening,

whereas a school will typically experience peak demands during lunch hours and during the evenings for custodial cleaning.

DISTRIBUTION SYSTEM CAPACITY ANALYSIS

Serviceability

System Pressures

As per the Ottawa Water Design Guidelines, the desired range of pressure under BSDY, MXDY and PKHR demands is 345 to 552 kPa (50 to 80 psi) and no less than 276 kPa (40 psi) at ground elevation (i.e. at street level). The maximum pressure at any point in the water distribution system should not exceed 552 kPa (80 psi); pressure reducing measures are required to service areas where pressures greater than 552 kPa (80 psi) are anticipated.

Under emergency fire conditions, the system must be able to supply appropriate fire flow while maintaining a residual pressure of 138 kPa (20 psi).

Fire Flows

The City requires a fire flow assessment to be completed to demonstrate that local watermains can provide the objective fire flows. For this analysis, an available fire flow of 167 L/s (10,000 L/min), as previously established for the Western Development Lands (Stantec, 2020), was applied. This flow rate was calculated based on the detailed Fire Underwriters Survey (FUS) Guidelines (long method) and capped as per the City of Ottawa Technical Bulletin ISDTB-2014-02 since a minimum separation of 10 m between backs of adjacent units will be provided. The local watermains must therefore be able to provide a minimum fire flow of 167 L/s at a residual pressure of 20 psi.

Proposed Watermain Sizing & Layout

Watermain sizing and layout proposed as part of the Fox Run Phase 2 development and buildout conditions water distribution system analysis (Stantec, 2020) were used for this analysis and updated to reflect the currently proposed site plans for the Green Lands West and Laffin Lands. The updated watermain sizing and layout for these two development areas are shown in **Figure 2** and **Figure 3**, respectively.

Within Green Lands West, the network is proposed to consist of 152 to 305 mm diameter watermains. Based on the current proposed site plan and phasing, 154 units would temporarily be serviced by a single feed until looping is provided through future development of adjacent lands. This does not meet the City of Ottawa design guideline for watermain configurations to avoid the creation of vulnerable service areas. Therefore, it is recommended that development of Green Lands West include a secondary feed along the northeastern edge of these lands, as shown in **Figure 2** attached. This proposed secondary feed was previously identified as being required upon buildout of the RVDC lands adjacent to Green Lands West. As such, the proposed secondary feed was sized to accommodate buildout demand conditions.

Within the Laffin Lands, the network is proposed to consist of 152 to 305 mm diameter watermains. As previously stated, it is assumed that development of the Mattamy Phase 1 lands, which are located north of the Laffin Lands, will start prior to development of the Laffin Lands. Based on the current proposed site plan, the Laffin Lands will consist of 211 residential units. As such, this development will need to be serviced by more than one feed. Therefore, it is proposed to service the Laffin Lands via two 305 mm diameter feeds through

the Mattamy buildout development lands, as shown in **Figure 3** attached. The current site plan also shows 5 properties located along Ottawa Street. To service these properties, the looped 305 mm diameter feed would need to be extended south to Ottawa Street and connected to a proposed 254 mm diameter watermain along Ottawa Street, as shown in **Figure 3** attached. Alternatively, sale of these 5 lots may be frozen until development of the adjacent Mattamy lands. The proposed 305 mm diameter feeds and 254 mm watermain extension along Ottawa Street were previously identified as required upon buildout of the surrounding Mattamy lands. As such, these proposed watermains have been sized to accommodate current buildout demand projections.

Model Results

Basic Day & Peak Hour Demands

Under both interim and buildout BSDY conditions, model results show that the maximum HGL in the system is 148 m, which corresponds to a maximum pressure of 524 kPa (76 psi). Under PKHR demands, model results show that the minimum HGL in the system is 144 m for interim conditions and 135 m for buildout conditions, which corresponds to minimum pressures of 455 kPa (66 psi) and 352 kPa (51 psi), respectively. Therefore, modelled minimum and maximum pressures are within the City's objective of 345 to 552 kPa (50 to 80 psi). Detailed modelling results are provided in the **Hydraulic Modelling Results** attachment.

Maximum Day + Fire Flow

Under both interim and buildout maximum day + fire flow (MXDY+FF) conditions, model results show that fire flows greater than 10,000 L/min with a residual pressure of 138 kPa (20 psi) are available throughout the distribution system. Detailed modelling results are provided in the **Hydraulic Modelling Results** attachment.

SUPPLY CAPACITY ANALYSIS

Maximum Day Supply

With respect to well supply capacity, the 2008 Ministry of Environment of Ontario Design Guidelines for Drinking-Water Systems require that the total developed groundwater source capacity shall equal or exceed the design maximum day demand with the largest producing well out of service (i.e. firm capacity). The two existing groundwater supply wells servicing the Richmond West Pumping Station provide 28 L/s and 40 L/s, respectively. With the largest well out of service, the available supply is **28 L/s**. The cumulative maximum day demand for interim conditions (i.e. constructed and/or anticipated development up to, and including, the Caivan Green Lands West and Laffin Lands) is **17.46 L/s** (refer to **Table 4** attached). Therefore, the existing firm capacity of the well supply exceeds the supply required to service these developments.

The projected buildout maximum day demand from other developments to be serviced by the Richmond West Pumping Station is currently estimated to exceed 28 L/s. As such, as the maximum day demand of the area to be serviced approaches the firm capacity of 28 L/s, additional well supply will be required. It is recommended that the well supply be expanded prior to the system demand reaching 90% of the firm capacity, or 25 L/s.

Total Storage Requirement

With respect to storage capacity, the Richmond West Pump Station has an existing reservoir storage volume of 1,175 m^3. The reservoir is comprised of two reservoirs each capable of operating independently with a volume of 588 m^3.

Reference: **Richmond Caivan Green & Laffin Lands – Potable Water Capacity Analysis**

To assess storage volume requirements, Section 8.4.2 (Sizing Treated Water Storage for Systems Providing Fire Protection) of the 2008 Ministry of Environment of Ontario Design Guidelines for Drinking-Water Systems is used. Specifically, the following formula is used in the assessment:

Total Treated Water Storage Requirements = A + B + C

where:

A = Fire Storage;

B = Equalization Storage (25% of Maximum Day Demand); and,

C = Emergency Storage (25% of A + B).

This equation reduces to:

Total Storage = (Maximum Day Demand / 4 + Fire Flow) * 1.25

The maximum fire flow proposed for the service area is 10,000 L/min or 167 L/s. The cumulative maximum day demand for interim conditions is 17.04 L/s.

For situations where the water supply system can supply more, as is the case for the Richmond West Pumping Station supply wells, the storage requirements can be reduced accordingly. Using the additional well capacity in excess of maximum day demand (i.e. 68 L/s - 17.46 L/s = 50.54 L/s) to reduce the fire flow storage, the resulting MOE total storage requirements is calculated to be **1,066 m^3** (refer to **Table 5** attached). The current storage capacity of **1,175 m^3** exceeds this amount. Therefore, the existing total storage capacity exceeds the supply required to service constructed and/or anticipated development up to, and including, the Caivan Green Lands West and Laffin Lands.

Using the total storage formula, we can calculate that once the maximum day demand exceeds 28 L/s (with a fire flow of 167 L/s), the available storage will be 0 m^3. As such, like the well supply, once the maximum day demand exceeds 28 L/s, either additional storage will be required or alternatively, the City may consider offsetting additional storage with additional well supply.

Redundant Storage Requirement

Section 3.29 (Reliability & Redundancy) of the 2008 Ministry of Environment of Ontario Design Guidelines for Drinking-Water Systems states:

> "*The design of water treatment plants should be based on the premise that failure of any single component must not prevent the drinking-water system from satisfying all applicable regulatory requirements and other site specific treated water quality and quantity criteria, while operating at design flows.*"

As such, with respect to treated storage, the failure of a single cell in the dual cell reservoir is considered a failure for reliability purposes. Furthermore, to supplement the MOE design guidelines, the City of Ottawa 2013 Water Master Plan Level of Service guidelines stated that for populations less than 10,000 persons, the minimum demands to be met by major infrastructure at all times is Basic Day demand only.

Reference: **Richmond Caivan Green & Laffin Lands – Potable Water Capacity Analysis**

The Richmond West Pumping Station has a reservoir that is split into two independent cells. The storage capacity of each cell is 588 m^3. For operation and reliability, each cell can operate independently when the other cell is taken out of service. The cumulative basic day demand for interim conditions is 8.7 L/s. Therefore, the well supply and remaining storage capacity meet the basic day demand with one cell out of service (refer to **Table 6** attached).

As the current service area is not currently projected to exceed 10,000 persons, the current redundant storage and well supply would be capable of meeting the buildout basic day demand of 16.4 L/s for all known developments.

CONCLUSION

Supply and distribution system capacity analyses were completed for the Green Lands West and Laffin Lands within Richmond's Western Development Lands. The purpose of these analyses was to identify if the additional associated properties can still be serviced by the Communal Well and if the existing watermain distribution network is capable of servicing the areas in question and if required, what watermain upgrades might be required. Based on the results of the analyses, the following conclusions were made:

- Within Green Lands West, the network is proposed to consist of 152 to 305 mm diameter watermains. To meet City of Ottawa standard of having at least two feeds into an area estimated to have a basic day demand of at least 50 m^3/d, it is recommended that development of Green Lands West include a secondary feed along the northeastern edge of these lands. This proposed secondary feed was previously identified as being required upon buildout of the RVDC lands adjacent to Green Lands West. As such, the proposed secondary feed has been sized to accommodate buildout demand conditions

- Similarly, the network within the Laffin Lands is proposed to consist of 152 to 305 mm diameter watermains and also requires more than one service feed to meet City of Ottawa standards. Therefore, it is proposed to service the Laffin Lands via two 305 mm diameter feeds through the Mattamy buildout development lands. The current site plan also shows 5 properties located along Ottawa Street. To service these properties, the looped 305 mm diameter feed would need to be extended south to Ottawa Street and connected to a proposed 254 mm diameter watermain along Ottawa Street. Alternatively, sale of these 5 lots may be frozen until development of the adjacent Mattamy lands. The proposed 305 mm diameter feeds and 254 mm watermain extension along Ottawa Street were previously identified as required upon buildout of the surrounding Mattamy lands. As such, these proposed watermains have been sized to accommodate buildout demand conditions.

- With the proposed watermain sizing/configuration, system pressures and fire flow serviceability requirements are met under interim and buildout conditions for BSDY, PKHR and MXDY+FF demands.

- The current well supply capacity of the Richmond West Pumping Station meets maximum day demands for constructed and/or anticipated development up to, and including, the Caivan Green Lands West and Laffin Lands (i.e. interim conditions).

- The current Richmond West Pumping Station currently has a total storage capacity of 1,175 m^3 which exceeds the calculated total storage amount required for interim conditions following MOE guidelines.

Reference: **Richmond Caivan Green & Laffin Lands – Potable Water Capacity Analysis**

- The current Richmond West Pumping Station has a storage volume of approximately 590 m^3 when one cell is taken out of service. Under the reliability scenario of one cell out of service, the supply wells and remaining storage are capable of meeting the required basic day demand.

REFERENCES

City of Ottawa. (2010). *Ottawa Design Guidelines - Water Distribution.* Ottawa.
City of Ottawa. (2014). *Technical Bulletin ISDTB-2014-02: Revisions to Ottawa Design Guidelines - Water.* Ottawa.
Ministry of the Environment Ontario. (2008). *Design Guidelines for Drinking-Water Systems.*
Stantec Consulting Ltd. (2013). *City of Ottawa 2013 Water Master Plan.* Ottawa.
Stantec Consulting Ltd. (2020). *Fox Run Subdivision Phase 2 Water Distribution System Analysis.* Ottawa.

Stantec Consulting Ltd.

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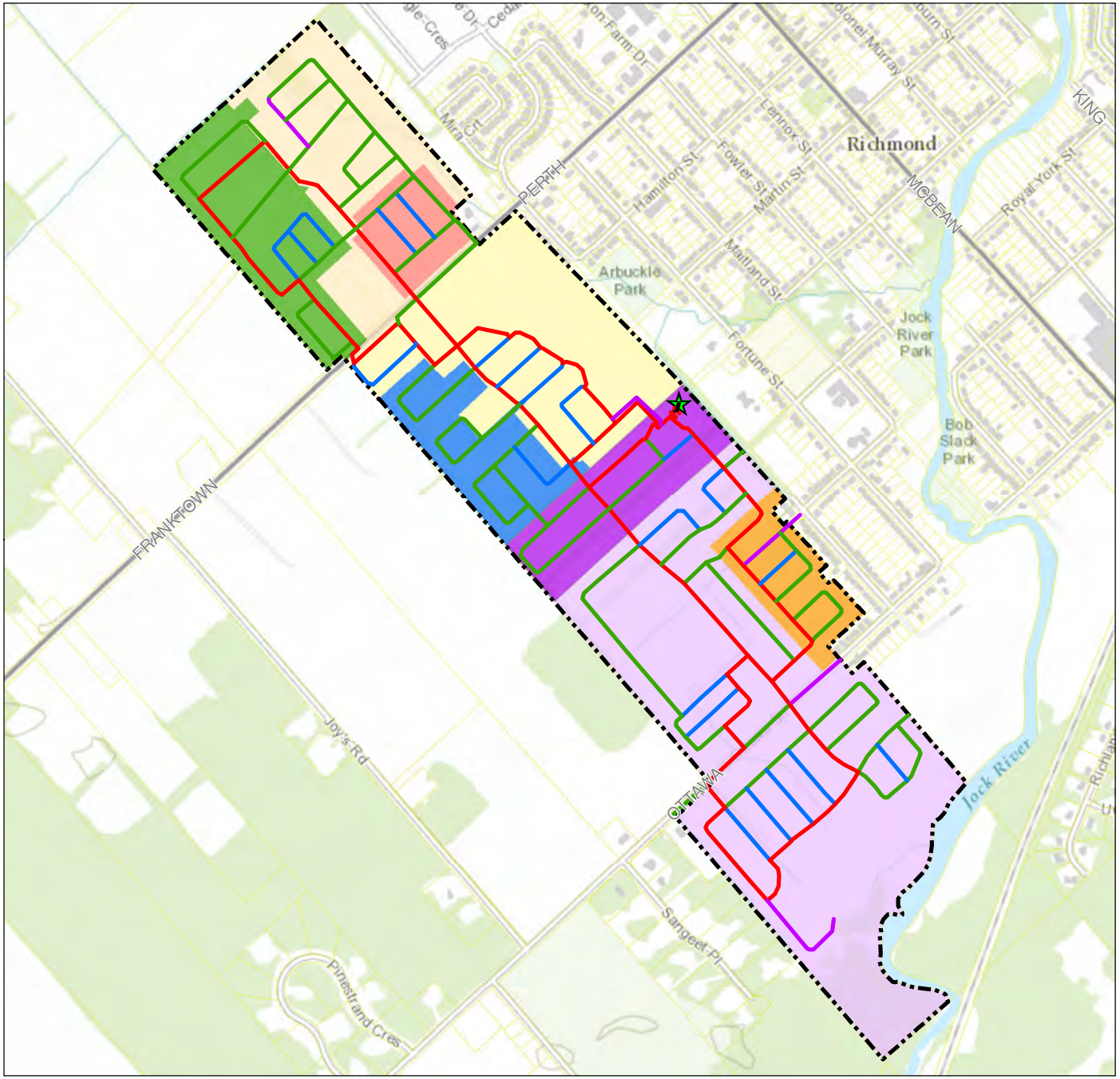
Attachments:

Figure 1: Western Development Lands
Figure 2: Proposed Watermain Sizing/Layout – Green Lands West
Figure 3: Proposed Watermain Sizing/Layout – Laffin Lands

Table 1: Estimated Unit Counts and Populations for Green & Laffin Lands
Table 2: Estimated Unit Counts and Populations for Buildout Conditions
Table 3: Estimated Water Demands
Table 4: Maximum Day Supply
Table 5: Total Storage Requirement
Table 6: Redundant Storage Requirement

Hydraulic Modelling Results



Stantec

Legend

- Caivan Fox Run Phase 1
- Caivan Fox Run Phase 2 North
- Caivan Fox Run Phase 2 South
- Caivan Green Lands West
- Caivan Laffin Lands
- Mattamy Phase 1
- Mattamy (Buildout)
- RVDC
- Western Development Lands
- Property Parcel
- Richmond West Pumping Station

Watermain Diameter (mm)

- 406
- 305
- 254
- 203
- 152

N

0 190 380 metres

(At original document size of 8.5x11)
1:15,000

Notes

1. Coordinate System: NAD 1983 MTM 9

Project Location
Richmond, ON

Client/Project
Richmond Village Development Corporation
Richmond Caivan Green & Laffin Lands
Potable Water Capacity Analysis

Figure No.
1

Title
Western Development Lands

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Stantec

Legend

Existing/Proposed (Interim) Watermain (mm)

- 305
- 203
- 152

Future (Buildout) Watermain (mm)

- 254
- 203

- Proposed Secondary Feed
- Caivan Green Lands West
- Other Development
- Western Development Lands

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(At original document size of 8.5x11)
1:4,000

Notes
1. Coordinate System: NAD 1983 MTM 9

Project Location
Richmond, ON

Client/Project
Richmond Village Development Corporation
Richmond Caivan Green & Laffin Lands
Potable Water Capacity Analysis

Figure No.
2

Title
Proposed Watermain Sizing/Layout - Green Lands West

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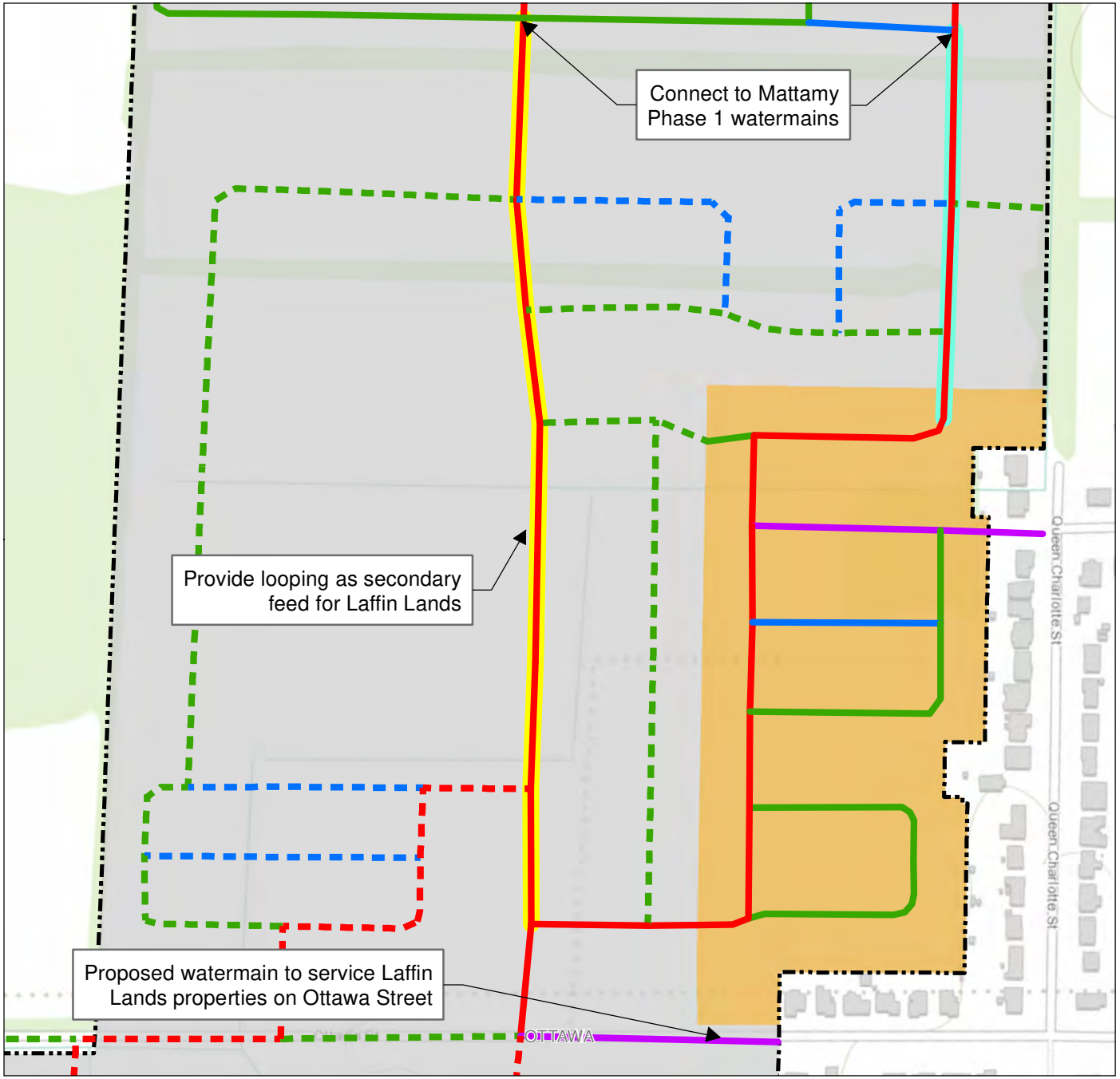

Stantec

Legend

Existing/Proposed (Interim) Watermain (mm)

- 305
- 254
- 203
- 152

Future (Buildout) Watermain (mm)

- 305
- 203
- 152
- Proposed Primary Feed
- Proposed Secondary Feed
- Caivan Laffin Lands
- Other Development
- Western Development Lands

N

0 50 100 metres

(At original document size of 8.5x11)

1:3,928

Notes

1. Coordinate System: NAD 1983 MTM 9

Project Location

Richmond, ON

Client/Project

Richmond Village Development Corporation
Richmond Caivan Green & Laffin Lands
Potable Water Capacity Analysis

Figure No.

3

Title

Proposed Watermain Sizing/Layout - Laffin Lands

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Stantec

Table 1: Estimated Unit Counts and Populations for Green & Laffin Lands

Development Area	Unit Type	Unit Count	PPU	Population
Caivan Green Lands West	SFH	96	3.4	326
	MLT	198	2.7	535
Caivan Laffin Lands	SFH	42	3.4	143
	MLT	169	2.7	456
	Total	***505***		***1,460***

Table 2: Estimated Unit Counts and Populations for Buildout Conditions

Development Area	Unit Type	Unit Count	Area (ha)	PPU	Population
Caivan Fox Run Phase 1	SFH	220	-	3.4	748
Caivan Fox Run Phase 2 North	SFH	31	-	3.4	105
	MLT	163	-	2.7	440
Caivan Fox Run Phase 2 South	SFH	200	-	3.4	680
Mattamy Phase 1	SFH	132	-	3.4	449
	MLT	47	-	2.7	127
Caivan Green Lands West	SFH	96	-	3.4	326
	MLT	198	-	2.7	535
Caivan Laffin Lands	SFH	42	-	3.4	143
	MLT	169	-	2.7	456
Interim Conditions (Sub-total)		***1,298***	***0***	***-***	***4,009***
Mattamy (Buildout)	SFH	640	-	3.4	2,176
	MLT	235	-	2.7	635
	INS	-	2.63	-	-
RVDC (Buildout)	SFH	82	-	3.4	279
	MLT	54	-	2.7	146
Buildout Conditions (Total)		***2,309***	***2.63***	***-***	***7,245***

Stantec

Table 3: Estimated Water Demands

Development Area	Unit Type	Population	Area (ha)	Water Demands		
				BSDY (L/s)	OWD (L/s)	MXDY (L/s)
Caivan Fox Run Phase 1	SFH	748	-	1.56	2.67	4.23
Caivan Fox Run Phase 2 North	SFH	105	-	0.22	0.38	0.60
	MLT	440	-	1.01	-	1.01
Caivan Fox Run Phase 2 South	SFH	680	-	1.42	2.43	3.85
Mattamy Phase 1	SFH	449	-	0.94	1.60	2.54
	MLT	127	-	0.29	-	0.29
Caivan Green Lands West	SFH	326	-	0.68	1.17	1.85
	MLT	535	-	1.23	-	1.23
Caivan Laffin Lands	SFH	143	-	0.30	0.51	0.81
	MLT	456	-	1.05	-	1.05
Interim Conditions (Sub-total)		***4,009***	***0***	***8.70***	***8.76***	***17.46***
Mattamy (Buildout)	SFH	2,176	-	4.53	7.77	12.30
	MLT	635	-	1.45	-	1.45
	INS	-	2.63	0.85	-	0.85
RVDC (Buildout)	SFH	279	-	0.58	1.00	1.58
	MLT	146	-	0.33	-	0.33
Buildout Conditions (Total)		***7,245***	***2.63***	***16.44***	***17.53***	***33.97***

Table 4: Maximum Day Supply

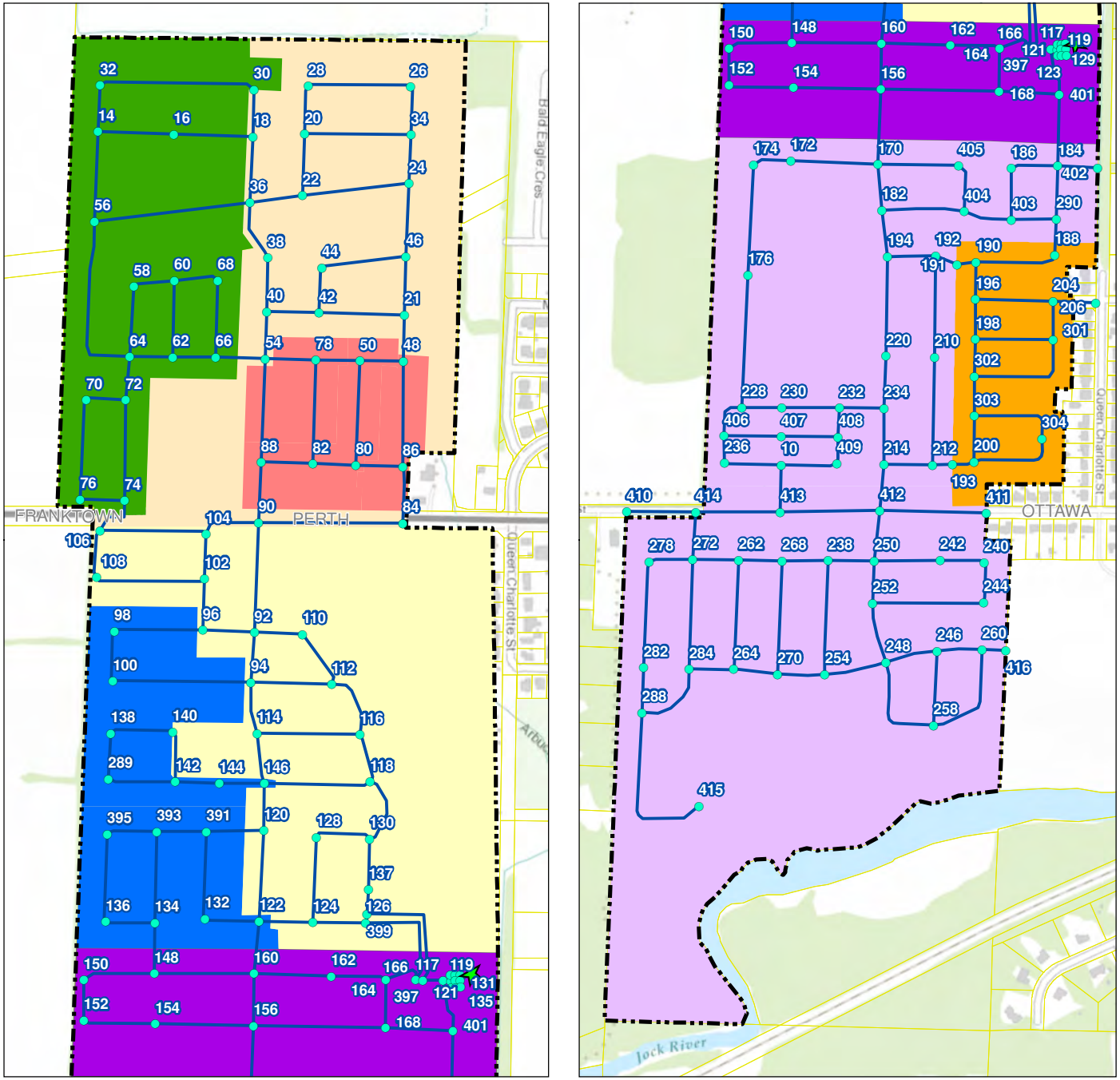
	(A)	(B)	(C)	(D)	(E) = *(D + C) - D*	(F) = *(E - B)*
Development Area	MXDY	Cumulative MXDY	Well #1	Well #2	Firm Supply Capacity (Largest Well out of Service)	Additional Firm Capacity Available for MXDY
	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)
Caivan Fox Run Phase 1	4.23	4.23	28	40	28	23.77
Caivan Fox Run Phase 2	5.46	9.69	28	40	28	18.31
Mattamy Phase 1	2.83	12.52	28	40	28	15.48
Caivan Green Lands West	3.08	15.60	28	40	28	12.40
Caivan Laffin Lands	1.86	17.46	28	40	28	10.54
Mattamy (Buildout)	14.60	32.06	28	40	28	-4.06
RVDC (Buildout)	1.91	33.97	28	40	28	-5.97
	Trigger:	*28.00*	*28*	*40*	*28*	*0*

Table 5: Total Storage Requirement

	(A)	(B)	(C)	(D)	(E)	(F)	(G) = *(E + F)*	(H) = *(G - B)*	(I) = *(C - H)*	(J) =*(B*60*60/4 + I*60*60*D)*1.25/ 1000*	(K)	(L) = *(K - J)*
Development Area	MXDY	Cumulative MXDY	FUS		Well #1	Well #2	Total Well Supply	Excess Well Supply	Adjusted FF	Volume Required (1/4MXDY + Fire)*1.25	Total Storage Available	Additional Storage Available
	(L/s)	(L/s)	(L/s)	(hrs)	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(m^3)	(m^3)	(m^3)
Caivan Fox Run Phase 1	4.23	4.23	166.7	2	28	40	68	63.77	102.9	931.1	1,175	243.9
Caivan Fox Run Phase 2	5.46	9.69	166.7	2	28	40	68	58.31	108.4	986.4	1,175	188.6
Mattamy Phase 1	2.83	12.52	166.7	2	28	40	68	55.48	111.2	1,015.1	1,175	159.9
Caivan Green Lands West	3.08	15.60	166.7	2	28	40	68	52.40	114.3	1,046.3	1,175	128.8
Caivan Laffin Lands	1.86	17.46	166.7	2	28	40	68	50.54	116.2	1,065.1	1,175	109.9
Mattamy (Buildout)	14.60	32.06	166.7	2	28	40	68	35.94	130.8	1,212.9	1,175	-37.9
RVDC (Buildout)	1.91	33.97	166.7	2	28	40	68	34.03	132.7	1,232.2	1,175	-57.2
	Trigger:	*28.32*	*166.7*	*2*	*28*	*40*	*68*	*39.68*	*127.0*	*1,175.0*	*1,175*	*0*

Table 6: Redundant Storage Requirement

	(A)	(B)	(C)	(D)	(E)	(F)	(G) = *(D) or (D + E)*	(H)	(I)	(J) = *(H + I)*	(K)	(L) = *(K*1000/2/3600)*	(M) = *(J + L)*	(N) = *(M - G)*
Development Area	Population	Cumulative Population	BSDY	Cumulative BSDY	FUS		BSDY (<10,000 persons) or BSDY + Fire Flow (>10,000 persons)	Well #1	Well #2	Total Well Supply	Available Storage with One Cell Out of Service	Flow from Storage with One Cell Out of Service (over 2 hours)	Total Well & Storage Supply Available (over 2 hours)	Excess Well & Storage Supply Available (over 2 hours)
	(persons)	(persons)	(L/s)	(L/s)	(L/s)	(hrs)	(L/s)	(L/s)	(L/s)	(L/s)	(m^3)	(L/s)	(L/s)	(L/s)
Caivan Fox Run Phase 1	748	748	1.56	1.56	0.0	0	1.56	28	40	68	588	82	150	148.0
Caivan Fox Run Phase 2	1,225	1,973	2.64	4.20	0.0	0	4.20	28	40	68	588	82	150	145.4
Mattamy Phase 1	576	2,549	1.23	5.43	0.0	0	5.43	28	40	68	588	82	150	144.2
Caivan Green Lands West	861	3,410	1.91	7.34	0.0	0	7.34	28	40	68	588	82	150	142.3
Caivan Laffin Lands	599	4,009	1.34	8.68	0.0	0	8.68	28	40	68	588	82	150	140.9
Mattamy (Buildout)	2,811	6,820	6.84	15.52	0.0	0	15.52	28	40	68	588	82	150	134.1
RVDC (Buildout)	425	7,245	0.91	16.43	0.0	0	16.43	28	40	68	588	82	150	133.2
	Trigger:	10,000		22.59	*166.7*	*2*	189.3	28	40	68	588	82	150	*-121.3*



Stantec

Legend

- Model Node
- Model Pipe
- Caivan Fox Run Phase 1
- Caivan Fox Run Phase 2 North
- Caivan Fox Run Phase 2 South
- Caivan Green Lands West
- Caivan Laffin Lands
- Mattamy Phase 1
- Mattamy (Buildout)
- RVDC
- Western Development Lands
- Property Parcel
- Richmond West Pumping Station

0 100 200 metres
(At original document size of 8.5x11)
1:9,500

Notes
1. Coordinate System: NAD 1983 MTM 9

Project Location
Richmond, ON

Client/Project
Richmond Village Development Corporation
Richmond Caivan Green & Laffin Lands
Potable Water Capacity Analysis

Figure No.
A1

Title
Model System Map

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163401550 - Richmond Caivan Water Distribution System Analysis - Scope Change 1

Model Results - BSDY (Interim Conditions)

Head

Min			***142.93***			
Max	***148.10***					
ID	Max.Value (m)	Max.Time (hrs.)	Min.Value (m)	Min.Time (hrs.)	Average (m)	Difference (m)
100	148.10	3:00	142.93	7:00	145.79	5.17
102	148.10	3:00	142.93	7:00	145.79	5.17
104	148.10	3:00	142.93	7:00	145.78	5.17
106	148.10	3:00	142.93	7:00	145.78	5.17
108	148.10	3:00	142.93	7:00	145.78	5.17
110	148.10	3:00	142.93	7:00	145.79	5.17
112	148.10	3:00	142.93	7:00	145.79	5.17
114	148.10	3:00	142.93	7:00	145.79	5.17
116	148.10	3:00	142.93	7:00	145.79	5.17
117	148.10	3:00	142.95	7:00	145.79	5.15
118	148.10	3:00	142.94	7:00	145.79	5.17
119	148.10	3:00	142.95	7:00	145.79	5.15
120	148.10	3:00	142.94	7:00	145.79	5.16
121	148.10	3:00	142.95	7:00	145.79	5.15
122	148.10	3:00	142.94	7:00	145.79	5.16
123	148.10	3:00	142.95	7:00	145.79	5.15
124	148.10	3:00	142.94	7:00	145.79	5.16
125	148.10	3:00	142.95	7:00	145.79	5.15
126	148.10	3:00	142.94	7:00	145.79	5.16
127	97.80	3:00	97.80	7:00	97.80	0
128	148.10	3:00	142.94	7:00	145.79	5.16
129	148.10	3:00	142.95	7:00	145.79	5.15
130	148.10	3:00	142.94	7:00	145.79	5.16
131	97.80	2:00	97.80	7:00	97.80	0
132	148.10	3:00	142.94	7:00	145.79	5.16
133	148.10	3:00	142.95	7:00	145.79	5.15
134	148.10	3:00	142.94	7:00	145.79	5.16
135	97.80	2:00	97.80	7:00	97.80	0
136	148.10	3:00	142.94	7:00	145.79	5.16
137	148.10	3:00	142.94	7:00	145.79	5.16
138	148.10	3:00	142.93	7:00	145.79	5.17
14	148.10	3:00	142.93	7:00	145.78	5.17
140	148.10	3:00	142.93	7:00	145.79	5.17
142	148.10	3:00	142.93	7:00	145.79	5.17
144	148.10	3:00	142.93	7:00	145.79	5.17
146	148.10	3:00	142.93	7:00	145.79	5.17
148	148.10	3:00	142.94	7:00	145.79	5.16
150	148.10	3:00	142.94	7:00	145.79	5.16
152	148.10	3:00	142.94	7:00	145.79	5.16
154	148.10	3:00	142.94	7:00	145.79	5.16
156	148.10	3:00	142.94	7:00	145.79	5.16
16	148.10	3:00	142.93	7:00	145.78	5.17
160	148.10	3:00	142.94	7:00	145.79	5.16
162	148.10	3:00	142.94	7:00	145.79	5.16
164	148.10	3:00	142.94	7:00	145.79	5.16
166	148.10	3:00	142.94	7:00	145.79	5.16
168	148.10	3:00	142.94	7:00	145.79	5.16
170	148.10	3:00	142.94	7:00	145.79	5.16
18	148.10	3:00	142.93	7:00	145.78	5.17
182	148.10	3:00	142.94	7:00	145.79	5.16
184	148.10	3:00	142.95	7:00	145.79	5.16
188	148.10	3:00	142.94	7:00	145.79	5.16
190	148.10	3:00	142.94	7:00	145.79	5.16
191	148.10	3:00	142.94	7:00	145.79	5.16
193	148.10	3:00	142.94	7:00	145.79	5.16
194	148.10	3:00	142.94	7:00	145.79	5.16
196	148.10	3:00	142.94	7:00	145.79	5.16
198	148.10	3:00	142.94	7:00	145.79	5.16
200	148.10	3:00	142.94	7:00	145.79	5.16
204	148.10	3:00	142.94	7:00	145.79	5.16
206	148.10	3:00	142.94	7:00	145.79	5.16
212	148.10	3:00	142.94	7:00	145.79	5.16
214	148.10	3:00	142.94	7:00	145.79	5.16
220	148.10	3:00	142.94	7:00	145.79	5.16
234	148.10	3:00	142.94	7:00	145.79	5.16
289	148.10	3:00	142.93	7:00	145.79	5.17
290	148.10	3:00	142.94	7:00	145.79	5.16
30	148.10	3:00	142.93	7:00	145.78	5.17
301	148.10	3:00	142.94	7:00	145.79	5.16
302	148.10	3:00	142.94	7:00	145.79	5.16
303	148.10	3:00	142.94	7:00	145.79	5.16
304	148.10	3:00	142.94	7:00	145.79	5.16
32	148.10	3:00	142.93	7:00	145.78	5.17
36	148.10	3:00	142.93	7:00	145.78	5.17
38	148.10	3:00	142.93	7:00	145.78	5.17
391	148.10	3:00	142.94	7:00	145.79	5.16
393	148.10	3:00	142.94	7:00	145.79	5.16
395	148.10	3:00	142.94	7:00	145.79	5.16
397	148.10	3:00	142.95	7:00	145.79	5.16
399	148.10	3:00	142.94	7:00	145.79	5.16
40	148.10	3:00	142.93	7:00	145.78	5.17
401	148.10	3:00	142.95	7:00	145.79	5.15
411	148.10	3:00	142.94	7:00	145.79	5.16
412	148.10	3:00	142.94	7:00	145.79	5.16
48	148.10	3:00	142.93	7:00	145.78	5.17
50	148.10	3:00	142.93	7:00	145.78	5.17
54	148.10	3:00	142.93	7:00	145.78	5.17
56	148.10	3:00	142.93	7:00	145.78	5.17
58	148.10	3:00	142.93	7:00	145.78	5.17
60	148.10	3:00	142.93	7:00	145.78	5.17
62	148.10	3:00	142.93	7:00	145.78	5.17
64	148.10	3:00	142.93	7:00	145.78	5.17

Pressure

			64.18			
	75.84					
ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
100	75.13	3:00	67.78	7:00	71.84	7.35
102	74.90	3:00	67.55	7:00	71.61	7.35
104	74.73	3:00	67.38	7:00	71.44	7.35
106	74.42	3:00	67.07	7:00	71.13	7.35
108	74.31	3:00	66.95	7:00	71.01	7.35
110	75.84	3:00	68.49	7:00	72.55	7.35
112	75.70	3:00	68.35	7:00	72.41	7.35
114	75.36	3:00	68.01	7:00	72.07	7.35
116	75.42	3:00	68.07	7:00	72.13	7.34
117	71.51	3:00	64.18	7:00	68.23	7.32
118	75.62	3:00	68.27	7:00	72.33	7.34
119	71.51	3:00	64.19	7:00	68.23	7.32
120	74.90	3:00	67.56	7:00	71.62	7.34
121	71.51	3:00	64.19	7:00	68.23	7.32
122	75.02	3:00	67.68	7:00	71.73	7.34
123	71.51	3:00	64.19	7:00	68.23	7.32
124	75.42	3:00	68.08	7:00	72.13	7.34
125	71.51	3:00	64.19	7:00	68.23	7.32
126	75.57	3:00	68.23	7:00	72.29	7.34
127	0	3:00	0	7:00	0	0
128	75.50	3:00	68.16	7:00	72.21	7.34
129	71.51	3:00	64.19	7:00	68.23	7.32
130	75.62	3:00	68.27	7:00	72.33	7.34
131	3.70	2:00	3.69	7:00	3.70	0
132	74.78	3:00	67.44	7:00	71.49	7.34
133	71.51	3:00	64.19	7:00	68.23	7.32
134	74.24	3:00	66.90	7:00	70.95	7.34
135	0	2:00	0	7:00	0	0
136	74.09	3:00	66.75	7:00	70.81	7.34
137	75.60	3:00	68.26	7:00	72.31	7.34
138	74.78	3:00	67.43	7:00	71.49	7.35
14	73.84	3:00	66.48	7:00	70.54	7.35
140	74.61	3:00	67.26	7:00	71.32	7.35
142	74.49	3:00	67.15	7:00	71.20	7.35
144	74.36	3:00	67.02	7:00	71.07	7.34
146	74.71	3:00	67.36	7:00	71.42	7.34
148	74.75	3:00	67.41	7:00	71.46	7.34
150	74.61	3:00	67.27	7:00	71.32	7.34
152	74.48	3:00	67.14	7:00	71.19	7.34
154	74.65	3:00	67.31	7:00	71.36	7.34
156	74.48	3:00	67.14	7:00	71.19	7.34
16	74.14	3:00	66.78	7:00	70.84	7.35
160	75.09	3:00	67.75	7:00	71.80	7.34
162	75.03	3:00	67.70	7:00	71.75	7.33
164	74.93	3:00	67.60	7:00	71.65	7.33
166	75.32	3:00	67.99	7:00	72.03	7.33
168	75.23	3:00	67.90	7:00	71.95	7.33
170	73.80	3:00	66.46	7:00	70.51	7.34
18	74.31	3:00	66.95	7:00	71.01	7.35
182	73.65	3:00	66.32	7:00	70.37	7.34
184	74.14	3:00	66.81	7:00	70.85	7.33
188	73.80	3:00	66.46	7:00	70.51	7.33
190	73.61	3:00	66.28	7:00	70.33	7.33
191	73.55	3:00	66.22	7:00	70.27	7.33
193	73.78	3:00	66.45	7:00	70.50	7.34
194	73.40	3:00	66.06	7:00	70.11	7.34
196	73.30	3:00	65.96	7:00	70.01	7.33
198	73.85	3:00	66.52	7:00	70.57	7.33
200	73.70	3:00	66.36	7:00	70.41	7.34
204	73.16	3:00	65.82	7:00	69.87	7.33
206	73.00	3:00	65.67	7:00	69.71	7.33
212	73.85	3:00	66.52	7:00	70.57	7.34
214	73.68	3:00	66.35	7:00	70.40	7.34
220	73.18	3:00	65.85	7:00	69.90	7.34
234	73.53	3:00	66.19	7:00	70.24	7.34
289	74.16	3:00	66.82	7:00	70.88	7.35
290	74.05	3:00	66.72	7:00	70.77	7.33
30	74.04	3:00	66.68	7:00	70.74	7.35
301	73.64	3:00	66.30	7:00	70.35	7.33
302	73.78	3:00	66.45	7:00	70.50	7.33
303	73.78	3:00	66.45	7:00	70.50	7.34
304	73.64	3:00	66.30	7:00	70.35	7.34
32	73.70	3:00	66.34	7:00	70.40	7.35
36	74.49	3:00	67.14	7:00	71.20	7.35
38	74.69	3:00	67.34	7:00	71.40	7.35
391	75.08	3:00	67.73	7:00	71.79	7.34
393	74.44	3:00	67.09	7:00	71.15	7.34
395	74.48	3:00	67.14	7:00	71.19	7.34
397	75.32	3:00	67.99	7:00	72.03	7.33
399	75.57	3:00	68.23	7:00	72.29	7.34
40	74.75	3:00	67.39	7:00	71.45	7.35
401	75.20	3:00	67.88	7:00	71.92	7.33
411	72.64	3:00	65.31	7:00	69.36	7.34
412	72.93	3:00	65.59	7:00	69.64	7.34
48	74.82	3:00	67.46	7:00	71.53	7.35
50	74.96	3:00	67.61	7:00	71.67	7.35
54	75.06	3:00	67.71	7:00	71.77	7.35
56	74.29	3:00	66.94	7:00	71.00	7.35
58	74.41	3:00	67.05	7:00	71.11	7.35
60	74.53	3:00	67.18	7:00	71.24	7.35
62	74.68	3:00	67.32	7:00	71.38	7.35
64	74.52	3:00	67.17	7:00	71.23	7.35

66	148.10	3:00	142.93	7:00	145.78	5.17	66	74.89	3:00	67.54	7:00	71.60	7.35
68	148.10	3:00	142.93	7:00	145.78	5.17	68	74.75	3:00	67.39	7:00	71.45	7.35
70	148.10	3:00	142.93	7:00	145.78	5.17	70	74.46	3:00	67.11	7:00	71.17	7.35
72	148.10	3:00	142.93	7:00	145.78	5.17	72	74.61	3:00	67.25	7:00	71.31	7.35
74	148.10	3:00	142.93	7:00	145.78	5.17	74	74.35	3:00	67.00	7:00	71.06	7.35
76	148.10	3:00	142.93	7:00	145.78	5.17	76	74.21	3:00	66.85	7:00	70.91	7.35
78	148.10	3:00	142.93	7:00	145.78	5.17	78	75.23	3:00	67.88	7:00	71.94	7.35
80	148.10	3:00	142.93	7:00	145.78	5.17	80	75.39	3:00	68.03	7:00	72.09	7.35
82	148.10	3:00	142.93	7:00	145.78	5.17	82	75.54	3:00	68.19	7:00	72.25	7.35
84	148.10	3:00	142.93	7:00	145.78	5.17	84	75.36	3:00	68.01	7:00	72.07	7.35
86	148.10	3:00	142.93	7:00	145.78	5.17	86	75.63	3:00	68.28	7:00	72.34	7.35
88	148.10	3:00	142.93	7:00	145.78	5.17	88	74.96	3:00	67.61	7:00	71.67	7.35
90	148.10	3:00	142.93	7:00	145.78	5.17	90	75.33	3:00	67.98	7:00	72.04	7.35
92	148.10	3:00	142.93	7:00	145.79	5.17	92	75.69	3:00	68.34	7:00	72.40	7.35
94	148.10	3:00	142.93	7:00	145.79	5.17	94	75.13	3:00	67.78	7:00	71.84	7.35
96	148.10	3:00	142.93	7:00	145.79	5.17	96	75.43	3:00	68.08	7:00	72.14	7.35
98	148.10	3:00	142.93	7:00	145.79	5.17	98	74.93	3:00	67.58	7:00	71.64	7.35

Dummy PS nodes; results at these nodes not reported.

163401550 - Richmond Caivan Water Distribution System Analysis - Scope Change 1

Model Results - BSDY (Buildout Conditions)

Head

Min			***130.75***			
Max	***147.92***					
ID	Max.Value (m)	Max.Time (hrs.)	Min.Value (m)	Min.Time (hrs.)	Average (m)	Difference (m)
10	147.92	3:00	130.76	7:00	142.14	17.17
100	147.92	3:00	130.76	7:00	142.14	17.16
102	147.92	3:00	130.76	7:00	142.14	17.17
104	147.92	3:00	130.75	7:00	142.14	17.17
106	147.92	3:00	130.75	7:00	142.14	17.17
108	147.92	3:00	130.75	7:00	142.14	17.17
110	147.92	3:00	130.76	7:00	142.14	17.16
112	147.92	3:00	130.76	7:00	142.14	17.16
114	147.92	3:00	130.76	7:00	142.14	17.16
116	147.92	3:00	130.76	7:00	142.14	17.16
117	147.92	3:00	130.80	7:00	142.16	17.13
118	147.92	3:00	130.76	7:00	142.15	17.16
119	147.92	3:00	130.80	7:00	142.16	17.12
120	147.92	3:00	130.76	7:00	142.15	17.16
121	147.92	3:00	130.81	7:00	142.16	17.11
122	147.92	3:00	130.77	7:00	142.15	17.15
123	147.92	3:00	130.80	7:00	142.16	17.12
124	147.92	3:00	130.77	7:00	142.15	17.15
125	147.92	3:00	130.81	7:00	142.16	17.11
126	147.92	3:00	130.77	7:00	142.15	17.15
127	97.80	3:00	97.79	7:00	97.80	0.01
128	147.92	3:00	130.77	7:00	142.15	17.15
129	147.92	3:00	130.80	7:00	142.16	17.12
130	147.92	3:00	130.77	7:00	142.15	17.16
131	97.80	3:00	97.80	7:00	97.80	0
132	147.92	3:00	130.77	7:00	142.15	17.16
133	147.92	3:00	130.80	7:00	142.16	17.12
134	147.92	3:00	130.77	7:00	142.15	17.16
135	97.80	3:00	97.80	7:00	97.80	0
136	147.92	3:00	130.77	7:00	142.15	17.16
137	147.92	3:00	130.77	7:00	142.15	17.15
138	147.92	3:00	130.76	7:00	142.14	17.16
14	147.92	3:00	130.75	7:00	142.14	17.17
140	147.92	3:00	130.76	7:00	142.14	17.16
142	147.92	3:00	130.76	7:00	142.14	17.16
144	147.92	3:00	130.76	7:00	142.14	17.16
146	147.92	3:00	130.76	7:00	142.14	17.16
148	147.92	3:00	130.77	7:00	142.15	17.16
150	147.92	3:00	130.77	7:00	142.15	17.16
152	147.92	3:00	130.77	7:00	142.15	17.16
154	147.92	3:00	130.77	7:00	142.15	17.16
156	147.92	3:00	130.77	7:00	142.15	17.16
16	147.92	3:00	130.75	7:00	142.14	17.17
160	147.92	3:00	130.77	7:00	142.15	17.15
162	147.92	3:00	130.77	7:00	142.15	17.15
164	147.92	3:00	130.78	7:00	142.15	17.14
166	147.92	3:00	130.78	7:00	142.15	17.14
168	147.92	3:00	130.78	7:00	142.15	17.15
170	147.92	3:00	130.76	7:00	142.15	17.16
172	147.92	3:00	130.76	7:00	142.14	17.16
174	147.92	3:00	130.76	7:00	142.14	17.16
176	147.92	3:00	130.76	7:00	142.14	17.16
18	147.92	3:00	130.75	7:00	142.14	17.17
182	147.92	3:00	130.76	7:00	142.14	17.16
184	147.92	3:00	130.78	7:00	142.15	17.15
186	147.92	3:00	130.77	7:00	142.15	17.15
188	147.92	3:00	130.77	7:00	142.15	17.15
190	147.92	3:00	130.76	7:00	142.14	17.16
191	147.92	3:00	130.76	7:00	142.14	17.16
192	147.92	3:00	130.76	7:00	142.14	17.16
193	147.92	3:00	130.76	7:00	142.14	17.16
194	147.92	3:00	130.76	7:00	142.14	17.16
196	147.92	3:00	130.76	7:00	142.14	17.16
198	147.92	3:00	130.76	7:00	142.14	17.16
20	147.92	3:00	130.75	7:00	142.14	17.17
200	147.92	3:00	130.76	7:00	142.14	17.16
204	147.92	3:00	130.76	7:00	142.14	17.16
206	147.92	3:00	130.76	7:00	142.14	17.16
21	147.92	3:00	130.75	7:00	142.14	17.17
210	147.92	3:00	130.76	7:00	142.14	17.16
212	147.92	3:00	130.76	7:00	142.14	17.16
214	147.92	3:00	130.76	7:00	142.14	17.16
22	147.92	3:00	130.75	7:00	142.14	17.17
220	147.92	3:00	130.76	7:00	142.14	17.16
228	147.92	3:00	130.76	7:00	142.14	17.17
230	147.92	3:00	130.76	7:00	142.14	17.17
232	147.92	3:00	130.76	7:00	142.14	17.17
234	147.92	3:00	130.76	7:00	142.14	17.16
236	147.92	3:00	130.76	7:00	142.14	17.17
238	147.92	3:00	130.75	7:00	142.14	17.17
24	147.92	3:00	130.75	7:00	142.14	17.17
240	147.92	3:00	130.75	7:00	142.14	17.17
242	147.92	3:00	130.75	7:00	142.14	17.17
244	147.92	3:00	130.75	7:00	142.14	17.17
246	147.92	3:00	130.75	7:00	142.14	17.17
248	147.92	3:00	130.75	7:00	142.14	17.17
250	147.92	3:00	130.75	7:00	142.14	17.17
252	147.92	3:00	130.75	7:00	142.14	17.17
254	147.92	3:00	130.75	7:00	142.14	17.17
258	147.92	3:00	130.75	7:00	142.14	17.17
26	147.92	3:00	130.75	7:00	142.14	17.17
260	147.92	3:00	130.75	7:00	142.14	17.17

Pressure

			45.57			
	75.59					
ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
10	73.09	3:00	48.68	7:00	64.87	24.40
100	74.88	3:00	50.48	7:00	66.66	24.40
102	74.65	3:00	50.25	7:00	66.43	24.40
104	74.48	3:00	50.07	7:00	66.26	24.40
106	74.17	3:00	49.76	7:00	65.95	24.41
108	74.05	3:00	49.65	7:00	65.84	24.41
110	75.59	3:00	51.19	7:00	67.37	24.40
112	75.45	3:00	51.05	7:00	67.23	24.40
114	75.11	3:00	50.71	7:00	66.89	24.40
116	75.16	3:00	50.77	7:00	66.95	24.39
117	71.26	3:00	46.91	7:00	63.06	24.35
118	75.36	3:00	50.97	7:00	67.15	24.39
119	71.26	3:00	46.92	7:00	63.06	24.34
120	74.65	3:00	50.26	7:00	66.44	24.39
121	71.26	3:00	46.93	7:00	63.07	24.33
122	74.76	3:00	50.38	7:00	66.55	24.39
123	71.26	3:00	46.92	7:00	63.06	24.34
124	75.16	3:00	50.78	7:00	66.95	24.39
125	71.26	3:00	46.93	7:00	63.07	24.33
126	75.32	3:00	50.94	7:00	67.11	24.38
127	0	3:00	-0.01	7:00	-0.01	0.01
128	75.25	3:00	50.86	7:00	67.04	24.39
129	71.26	3:00	46.92	7:00	63.06	24.34
130	75.36	3:00	50.97	7:00	67.15	24.39
131	3.70	3:00	3.69	7:00	3.69	0
132	74.52	3:00	50.13	7:00	66.31	24.39
133	71.26	3:00	46.92	7:00	63.06	24.34
134	73.98	3:00	49.59	7:00	65.77	24.39
135	0	3:00	0	7:00	0	0
136	73.84	3:00	49.45	7:00	65.63	24.39
137	75.35	3:00	50.96	7:00	67.14	24.39
138	74.52	3:00	50.13	7:00	66.31	24.40
14	73.58	3:00	49.17	7:00	65.36	24.41
140	74.35	3:00	49.96	7:00	66.14	24.40
142	74.24	3:00	49.84	7:00	66.02	24.40
144	74.11	3:00	49.72	7:00	65.90	24.39
146	74.45	3:00	50.06	7:00	66.24	24.39
148	74.49	3:00	50.11	7:00	66.28	24.39
150	74.35	3:00	49.96	7:00	66.14	24.39
152	74.22	3:00	49.84	7:00	66.01	24.39
154	74.39	3:00	50.01	7:00	66.18	24.39
156	74.22	3:00	49.84	7:00	66.01	24.39
16	73.88	3:00	49.47	7:00	65.66	24.41
160	74.84	3:00	50.45	7:00	66.63	24.39
162	74.78	3:00	50.40	7:00	66.57	24.38
164	74.68	3:00	50.31	7:00	66.48	24.37
166	75.06	3:00	50.70	7:00	66.86	24.37
168	74.98	3:00	50.61	7:00	66.77	24.37
170	73.54	3:00	49.15	7:00	65.33	24.39
172	73.26	3:00	48.86	7:00	65.04	24.40
174	73.14	3:00	48.75	7:00	64.93	24.40
176	72.82	3:00	48.42	7:00	64.60	24.40
18	74.05	3:00	49.64	7:00	65.83	24.41
182	73.40	3:00	49.01	7:00	65.19	24.39
184	73.88	3:00	49.51	7:00	65.68	24.38
186	73.73	3:00	49.35	7:00	65.52	24.38
188	73.54	3:00	49.16	7:00	65.33	24.39
190	73.36	3:00	48.96	7:00	65.14	24.39
191	73.30	3:00	48.91	7:00	65.09	24.39
192	73.20	3:00	48.80	7:00	64.99	24.40
193	73.53	3:00	49.13	7:00	65.31	24.40
194	73.14	3:00	48.75	7:00	64.93	24.40
196	73.04	3:00	48.65	7:00	64.83	24.40
198	73.60	3:00	49.20	7:00	65.38	24.40
20	73.88	3:00	49.47	7:00	65.66	24.41
200	73.44	3:00	49.04	7:00	65.23	24.40
204	72.90	3:00	48.51	7:00	64.69	24.40
206	72.75	3:00	48.35	7:00	64.53	24.40
21	74.52	3:00	50.11	7:00	66.30	24.41
210	73.44	3:00	49.04	7:00	65.23	24.40
212	73.60	3:00	49.20	7:00	65.38	24.40
214	73.43	3:00	49.03	7:00	65.21	24.40
22	73.92	3:00	49.51	7:00	65.70	24.41
220	72.93	3:00	48.53	7:00	64.72	24.40
228	72.80	3:00	48.40	7:00	64.59	24.40
230	72.96	3:00	48.56	7:00	64.74	24.40
232	73.11	3:00	48.71	7:00	64.90	24.40
234	73.27	3:00	48.87	7:00	65.06	24.40
236	72.99	3:00	48.58	7:00	64.77	24.40
238	72.63	3:00	48.23	7:00	64.41	24.40
24	73.77	3:00	49.36	7:00	65.55	24.41
240	72.25	3:00	47.84	7:00	64.03	24.40
242	72.89	3:00	48.48	7:00	64.67	24.40
244	69.97	3:00	45.57	7:00	61.76	24.40
246	69.97	3:00	45.57	7:00	61.76	24.41
248	71.25	3:00	46.85	7:00	63.04	24.40
250	72.73	3:00	48.33	7:00	64.51	24.40
252	72.18	3:00	47.77	7:00	63.96	24.40
254	71.92	3:00	47.52	7:00	63.70	24.41
258	70.91	3:00	46.51	7:00	62.69	24.41
26	73.46	3:00	49.04	7:00	65.24	24.41
260	70.71	3:00	46.31	7:00	62.49	24.41

262	147.92	3:00	130.75	7:00	142.14	17.17	262	72.28	3:00	47.87	7:00	64.06	24.40
264	147.92	3:00	130.75	7:00	142.14	17.17	264	71.86	3:00	47.46	7:00	63.65	24.41
268	147.92	3:00	130.75	7:00	142.14	17.17	268	71.96	3:00	47.56	7:00	63.75	24.40
270	147.92	3:00	130.75	7:00	142.14	17.17	270	71.75	3:00	47.34	7:00	63.53	24.41
272	147.92	3:00	130.75	7:00	142.14	17.17	272	72.12	3:00	47.71	7:00	63.90	24.40
278	147.92	3:00	130.75	7:00	142.14	17.17	278	71.86	3:00	47.46	7:00	63.65	24.40
28	147.92	3:00	130.75	7:00	142.14	17.17	28	73.71	3:00	49.30	7:00	65.49	24.41
282	147.92	3:00	130.75	7:00	142.14	17.17	282	71.61	3:00	47.20	7:00	63.39	24.41
284	147.92	3:00	130.75	7:00	142.14	17.17	284	71.72	3:00	47.32	7:00	63.50	24.41
288	147.92	3:00	130.75	7:00	142.14	17.17	288	71.35	3:00	46.95	7:00	63.13	24.41
289	147.92	3:00	130.76	7:00	142.14	17.16	289	73.91	3:00	49.52	7:00	65.70	24.40
290	147.92	3:00	130.77	7:00	142.15	17.15	290	73.80	3:00	49.41	7:00	65.59	24.38
30	147.92	3:00	130.75	7:00	142.14	17.17	30	73.78	3:00	49.37	7:00	65.56	24.41
301	147.92	3:00	130.76	7:00	142.14	17.16	301	73.39	3:00	48.99	7:00	65.17	24.40
302	147.92	3:00	130.76	7:00	142.14	17.16	302	73.53	3:00	49.13	7:00	65.31	24.40
303	147.92	3:00	130.76	7:00	142.14	17.16	303	73.53	3:00	49.13	7:00	65.31	24.40
304	147.92	3:00	130.76	7:00	142.14	17.16	304	73.39	3:00	48.99	7:00	65.17	24.40
32	147.92	3:00	130.75	7:00	142.14	17.17	32	73.44	3:00	49.03	7:00	65.22	24.41
34	147.92	3:00	130.75	7:00	142.14	17.17	34	73.77	3:00	49.36	7:00	65.55	24.41
36	147.92	3:00	130.75	7:00	142.14	17.17	36	74.24	3:00	49.83	7:00	66.02	24.41
38	147.92	3:00	130.75	7:00	142.14	17.17	38	74.44	3:00	50.03	7:00	66.22	24.41
391	147.92	3:00	130.76	7:00	142.15	17.16	391	74.82	3:00	50.43	7:00	66.61	24.39
393	147.92	3:00	130.76	7:00	142.15	17.16	393	74.18	3:00	49.79	7:00	65.97	24.39
395	147.92	3:00	130.76	7:00	142.15	17.16	395	74.22	3:00	49.83	7:00	66.01	24.39
397	147.92	3:00	130.79	7:00	142.15	17.14	397	75.06	3:00	50.70	7:00	66.86	24.36
399	147.92	3:00	130.77	7:00	142.15	17.15	399	75.32	3:00	50.94	7:00	67.11	24.38
40	147.92	3:00	130.75	7:00	142.14	17.17	40	74.49	3:00	50.08	7:00	66.27	24.41
401	147.92	3:00	130.79	7:00	142.15	17.14	401	74.95	3:00	50.59	7:00	66.75	24.36
402	147.92	3:00	130.78	7:00	142.15	17.15	402	73.81	3:00	49.44	7:00	65.61	24.38
403	147.92	3:00	130.77	7:00	142.15	17.15	403	73.67	3:00	49.28	7:00	65.46	24.39
404	147.92	3:00	130.77	7:00	142.15	17.16	404	74.66	3:00	50.28	7:00	66.45	24.39
405	147.92	3:00	130.76	7:00	142.15	17.16	405	74.81	3:00	50.42	7:00	66.60	24.39
406	147.92	3:00	130.76	7:00	142.14	17.17	406	72.82	3:00	48.41	7:00	64.60	24.40
407	147.92	3:00	130.76	7:00	142.14	17.17	407	72.96	3:00	48.56	7:00	64.74	24.40
408	147.92	3:00	130.76	7:00	142.14	17.17	408	73.24	3:00	48.84	7:00	65.03	24.40
409	147.92	3:00	130.76	7:00	142.14	17.17	409	73.38	3:00	48.98	7:00	65.17	24.40
410	147.92	3:00	130.75	7:00	142.14	17.17	410	72.39	3:00	47.99	7:00	64.17	24.40
411	147.92	3:00	130.76	7:00	142.14	17.17	411	72.39	3:00	47.99	7:00	64.17	24.40
412	147.92	3:00	130.76	7:00	142.14	17.17	412	72.67	3:00	48.27	7:00	64.46	24.40
413	147.92	3:00	130.76	7:00	142.14	17.17	413	72.25	3:00	47.84	7:00	64.03	24.40
414	147.92	3:00	130.75	7:00	142.14	17.17	414	72.11	3:00	47.70	7:00	63.89	24.40
415	147.92	3:00	130.75	7:00	142.14	17.17	415	71.39	3:00	46.99	7:00	63.18	24.41
416	147.92	3:00	130.75	7:00	142.14	17.17	416	70.68	3:00	46.28	7:00	62.47	24.41
42	147.92	3:00	130.75	7:00	142.14	17.17	42	74.25	3:00	49.84	7:00	66.03	24.41
44	147.92	3:00	130.75	7:00	142.14	17.17	44	74.10	3:00	49.69	7:00	65.88	24.41
46	147.92	3:00	130.75	7:00	142.14	17.17	46	74.28	3:00	49.87	7:00	66.06	24.41
48	147.92	3:00	130.75	7:00	142.14	17.17	48	74.56	3:00	50.16	7:00	66.35	24.41
50	147.92	3:00	130.75	7:00	142.14	17.17	50	74.71	3:00	50.30	7:00	66.49	24.41
54	147.92	3:00	130.75	7:00	142.14	17.17	54	74.81	3:00	50.40	7:00	66.59	24.41
56	147.92	3:00	130.75	7:00	142.14	17.17	56	74.04	3:00	49.63	7:00	65.82	24.41
58	147.92	3:00	130.75	7:00	142.14	17.17	58	74.15	3:00	49.74	7:00	65.93	24.41
60	147.92	3:00	130.75	7:00	142.14	17.17	60	74.28	3:00	49.87	7:00	66.06	24.41
62	147.92	3:00	130.75	7:00	142.14	17.17	62	74.42	3:00	50.01	7:00	66.20	24.41
64	147.92	3:00	130.75	7:00	142.14	17.17	64	74.27	3:00	49.86	7:00	66.05	24.41
66	147.92	3:00	130.75	7:00	142.14	17.17	66	74.64	3:00	50.23	7:00	66.42	24.41
68	147.92	3:00	130.75	7:00	142.14	17.17	68	74.49	3:00	50.08	7:00	66.27	24.41
70	147.92	3:00	130.75	7:00	142.14	17.17	70	74.21	3:00	49.80	7:00	65.99	24.41
72	147.92	3:00	130.75	7:00	142.14	17.17	72	74.35	3:00	49.94	7:00	66.13	24.41
74	147.92	3:00	130.75	7:00	142.14	17.17	74	74.10	3:00	49.69	7:00	65.88	24.41
76	147.92	3:00	130.75	7:00	142.14	17.17	76	73.95	3:00	49.55	7:00	65.73	24.41
78	147.92	3:00	130.75	7:00	142.14	17.17	78	74.98	3:00	50.57	7:00	66.76	24.41
80	147.92	3:00	130.75	7:00	142.14	17.17	80	75.13	3:00	50.72	7:00	66.91	24.41
82	147.92	3:00	130.75	7:00	142.14	17.17	82	75.29	3:00	50.88	7:00	67.07	24.41
84	147.92	3:00	130.75	7:00	142.14	17.17	84	75.10	3:00	50.70	7:00	66.89	24.41
86	147.92	3:00	130.75	7:00	142.14	17.17	86	75.37	3:00	50.97	7:00	67.16	24.41
88	147.92	3:00	130.75	7:00	142.14	17.17	88	74.71	3:00	50.30	7:00	66.49	24.41
90	147.92	3:00	130.75	7:00	142.14	17.17	90	75.08	3:00	50.67	7:00	66.86	24.41
92	147.92	3:00	130.76	7:00	142.14	17.16	92	75.43	3:00	51.03	7:00	67.22	24.40
94	147.92	3:00	130.76	7:00	142.14	17.16	94	74.88	3:00	50.48	7:00	66.66	24.40
96	147.92	3:00	130.76	7:00	142.14	17.17	96	75.18	3:00	50.77	7:00	66.96	24.40
98	147.92	3:00	130.76	7:00	142.14	17.16	98	74.68	3:00	50.28	7:00	66.46	24.40

Dummy PS nodes; results at these nodes not reported.

163401550 - Richmond Caivan Water Distribution System Analysis - Scope Change 1

Model Results - PKHR (Interim Conditions)

Head

Min			***143.84***			
Max	***148.41***					
ID	Max.Value (m)	Max.Time (hrs.)	Min.Value (m)	Min.Time (hrs.)	Average (m)	Difference (m)
100	148.41	3:00	143.85	20:00	147.13	4.55
102	148.41	3:00	143.85	20:00	147.13	4.55
104	148.41	3:00	143.85	20:00	147.13	4.56
106	148.41	3:00	143.85	20:00	147.13	4.56
108	148.41	3:00	143.85	20:00	147.13	4.56
110	148.41	3:00	143.86	20:00	147.13	4.55
112	148.41	3:00	143.86	20:00	147.13	4.54
114	148.41	3:00	143.86	20:00	147.13	4.54
116	148.41	3:00	143.87	20:00	147.13	4.54
117	148.41	3:00	143.95	20:00	147.15	4.46
118	148.41	3:00	143.87	20:00	147.13	4.53
119	148.41	3:00	143.96	20:00	147.16	4.45
120	148.41	3:00	143.88	20:00	147.13	4.53
121	148.41	3:00	143.96	20:00	147.16	4.45
122	148.41	3:00	143.89	20:00	147.14	4.52
123	148.41	3:00	143.96	20:00	147.16	4.45
124	148.41	3:00	143.89	20:00	147.14	4.52
125	148.41	3:00	143.96	20:00	147.16	4.45
126	148.41	3:00	143.89	20:00	147.14	4.52
127	97.80	3:00	97.79	20:00	97.80	0.01
128	148.41	3:00	143.88	20:00	147.14	4.52
129	148.41	3:00	143.96	20:00	147.16	4.45
130	148.41	3:00	143.88	20:00	147.14	4.53
131	97.80	3:00	97.79	20:00	97.80	0.01
132	148.41	3:00	143.88	20:00	147.14	4.53
133	148.41	3:00	143.96	20:00	147.16	4.45
134	148.41	3:00	143.88	20:00	147.14	4.53
135	97.80	3:00	97.79	20:00	97.80	0.01
136	148.41	3:00	143.88	20:00	147.13	4.53
137	148.41	3:00	143.89	20:00	147.14	4.52
138	148.41	3:00	143.86	20:00	147.13	4.55
14	148.41	3:00	143.84	20:00	147.13	4.56
140	148.41	3:00	143.86	20:00	147.13	4.55
142	148.41	3:00	143.86	20:00	147.13	4.55
144	148.41	3:00	143.86	20:00	147.13	4.55
146	148.41	3:00	143.87	20:00	147.13	4.54
148	148.41	3:00	143.88	20:00	147.14	4.53
150	148.41	3:00	143.88	20:00	147.14	4.52
152	148.41	3:00	143.88	20:00	147.14	4.52
154	148.41	3:00	143.89	20:00	147.14	4.52
156	148.41	3:00	143.90	20:00	147.14	4.51
16	148.41	3:00	143.84	20:00	147.13	4.56
160	148.41	3:00	143.90	20:00	147.14	4.51
162	148.41	3:00	143.91	20:00	147.14	4.50
164	148.41	3:00	143.91	20:00	147.15	4.49
166	148.41	3:00	143.92	20:00	147.15	4.49
168	148.41	3:00	143.91	20:00	147.14	4.50
170	148.41	3:00	143.90	20:00	147.14	4.51
18	148.41	3:00	143.84	20:00	147.13	4.56
182	148.41	3:00	143.90	20:00	147.14	4.51
184	148.41	3:00	143.93	20:00	147.15	4.48
188	148.41	3:00	143.92	20:00	147.15	4.48
190	148.41	3:00	143.92	20:00	147.15	4.49
191	148.41	3:00	143.92	20:00	147.15	4.49
193	148.41	3:00	143.91	20:00	147.14	4.50
194	148.41	3:00	143.90	20:00	147.14	4.51
196	148.41	3:00	143.92	20:00	147.14	4.49
198	148.41	3:00	143.91	20:00	147.14	4.49
200	148.41	3:00	143.91	20:00	147.14	4.50
204	148.41	3:00	143.91	20:00	147.14	4.49
206	148.41	3:00	143.91	20:00	147.14	4.49
212	148.41	3:00	143.91	20:00	147.14	4.50
214	148.41	3:00	143.91	20:00	147.14	4.50
220	148.41	3:00	143.90	20:00	147.14	4.50
234	148.41	3:00	143.90	20:00	147.14	4.50
289	148.41	3:00	143.86	20:00	147.13	4.55
290	148.41	3:00	143.93	20:00	147.15	4.48
30	148.41	3:00	143.84	20:00	147.13	4.56
301	148.41	3:00	143.91	20:00	147.14	4.49
302	148.41	3:00	143.91	20:00	147.14	4.50
303	148.41	3:00	143.91	20:00	147.14	4.50
304	148.41	3:00	143.91	20:00	147.14	4.50
32	148.41	3:00	143.84	20:00	147.13	4.56
36	148.41	3:00	143.85	20:00	147.13	4.56
38	148.41	3:00	143.85	20:00	147.13	4.56
391	148.41	3:00	143.88	20:00	147.13	4.53
393	148.41	3:00	143.88	20:00	147.13	4.53
395	148.41	3:00	143.88	20:00	147.13	4.53
397	148.41	3:00	143.93	20:00	147.15	4.48
399	148.41	3:00	143.89	20:00	147.14	4.52
40	148.41	3:00	143.85	20:00	147.13	4.56
401	148.41	3:00	143.94	20:00	147.15	4.47
411	148.41	3:00	143.91	20:00	147.14	4.50
412	148.41	3:00	143.91	20:00	147.14	4.50
48	148.41	3:00	143.85	20:00	147.13	4.56
50	148.41	3:00	143.85	20:00	147.13	4.56
54	148.41	3:00	143.85	20:00	147.13	4.56
56	148.41	3:00	143.84	20:00	147.13	4.56
58	148.41	3:00	143.84	20:00	147.13	4.56
60	148.41	3:00	143.84	20:00	147.13	4.56
62	148.41	3:00	143.85	20:00	147.13	4.56
64	148.41	3:00	143.85	20:00	147.13	4.56

Pressure

			65.60			
	76.28					
ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
100	75.57	3:00	69.10	20:00	73.75	6.47
102	75.34	3:00	68.86	20:00	73.52	6.47
104	75.17	3:00	68.69	20:00	73.35	6.48
106	74.86	3:00	68.38	20:00	73.04	6.48
108	74.74	3:00	68.26	20:00	72.92	6.48
110	76.28	3:00	69.81	20:00	74.46	6.46
112	76.14	3:00	69.68	20:00	74.32	6.46
114	75.79	3:00	69.34	20:00	73.98	6.46
116	75.85	3:00	69.40	20:00	74.04	6.45
117	71.95	3:00	65.60	20:00	70.16	6.34
118	76.05	3:00	69.60	20:00	74.24	6.45
119	71.95	3:00	65.62	20:00	70.17	6.32
120	75.34	3:00	68.90	20:00	73.53	6.44
121	71.95	3:00	65.62	20:00	70.17	6.32
122	75.45	3:00	69.03	20:00	73.65	6.42
123	71.95	3:00	65.62	20:00	70.17	6.32
124	75.85	3:00	69.43	20:00	74.05	6.42
125	71.95	3:00	65.62	20:00	70.17	6.32
126	76.01	3:00	69.59	20:00	74.21	6.42
127	0	3:00	-0.01	20:00	0	0.01
128	75.94	3:00	69.51	20:00	74.13	6.43
129	71.95	3:00	65.62	20:00	70.17	6.32
130	76.05	3:00	69.62	20:00	74.24	6.43
131	3.70	3:00	3.69	20:00	3.69	0.01
132	75.21	3:00	68.78	20:00	73.41	6.44
133	71.95	3:00	65.62	20:00	70.17	6.32
134	74.67	3:00	68.23	20:00	72.86	6.44
135	0	3:00	-0.01	20:00	0	0.01
136	74.53	3:00	68.09	20:00	72.72	6.44
137	76.04	3:00	69.61	20:00	74.23	6.43
138	75.21	3:00	68.74	20:00	73.40	6.47
14	74.27	3:00	67.79	20:00	72.45	6.48
140	75.04	3:00	68.57	20:00	73.23	6.47
142	74.93	3:00	68.46	20:00	73.11	6.47
144	74.80	3:00	68.34	20:00	72.99	6.46
146	75.14	3:00	68.69	20:00	73.33	6.45
148	75.18	3:00	68.75	20:00	73.38	6.43
150	75.04	3:00	68.61	20:00	73.24	6.43
152	74.91	3:00	68.48	20:00	73.11	6.43
154	75.08	3:00	68.66	20:00	73.28	6.43
156	74.91	3:00	68.50	20:00	73.11	6.41
16	74.57	3:00	68.09	20:00	72.75	6.48
160	75.53	3:00	69.11	20:00	73.72	6.41
162	75.47	3:00	69.07	20:00	73.67	6.40
164	75.37	3:00	68.98	20:00	73.57	6.39
166	75.75	3:00	69.38	20:00	73.96	6.38
168	75.67	3:00	69.28	20:00	73.87	6.39
170	74.23	3:00	67.82	20:00	72.43	6.41
18	74.74	3:00	68.26	20:00	72.92	6.48
182	74.09	3:00	67.68	20:00	72.29	6.41
184	74.57	3:00	68.21	20:00	72.79	6.36
188	74.23	3:00	67.86	20:00	72.44	6.37
190	74.05	3:00	67.66	20:00	72.25	6.38
191	73.99	3:00	67.61	20:00	72.20	6.38
193	74.22	3:00	67.82	20:00	72.42	6.40
194	73.83	3:00	67.43	20:00	72.03	6.41
196	73.73	3:00	67.35	20:00	71.94	6.39
198	74.29	3:00	67.90	20:00	72.49	6.39
200	74.13	3:00	67.74	20:00	72.34	6.40
204	73.59	3:00	67.20	20:00	71.80	6.39
206	73.44	3:00	67.05	20:00	71.64	6.39
212	74.29	3:00	67.89	20:00	72.49	6.40
214	74.12	3:00	67.72	20:00	72.32	6.40
220	73.62	3:00	67.22	20:00	71.82	6.40
234	73.96	3:00	67.56	20:00	72.16	6.40
289	74.60	3:00	68.13	20:00	72.78	6.47
290	74.49	3:00	68.12	20:00	72.70	6.37
30	74.47	3:00	67.99	20:00	72.65	6.48
301	74.08	3:00	67.69	20:00	72.28	6.39
302	74.22	3:00	67.83	20:00	72.42	6.39
303	74.22	3:00	67.82	20:00	72.42	6.39
304	74.08	3:00	67.68	20:00	72.28	6.39
32	74.13	3:00	67.65	20:00	72.31	6.48
36	74.93	3:00	68.44	20:00	73.11	6.48
38	75.13	3:00	68.64	20:00	73.30	6.48
391	75.51	3:00	69.07	20:00	73.70	6.44
393	74.87	3:00	68.43	20:00	73.06	6.44
395	74.91	3:00	68.47	20:00	73.10	6.44
397	75.75	3:00	69.39	20:00	73.96	6.37
399	76.01	3:00	69.59	20:00	74.21	6.42
40	75.18	3:00	68.70	20:00	73.36	6.48
401	75.64	3:00	69.29	20:00	73.85	6.35
411	73.08	3:00	66.68	20:00	71.28	6.40
412	73.36	3:00	66.97	20:00	71.57	6.40
48	75.25	3:00	68.77	20:00	73.43	6.48
50	75.40	3:00	68.91	20:00	73.58	6.48
54	75.49	3:00	69.01	20:00	73.67	6.48
56	74.73	3:00	68.24	20:00	72.91	6.48
58	74.84	3:00	68.36	20:00	73.02	6.48
60	74.97	3:00	68.48	20:00	73.15	6.48
62	75.11	3:00	68.63	20:00	73.29	6.48
64	74.95	3:00	68.47	20:00	73.13	6.48

66	148.41	3:00	143.85	20:00	147.13	4.56	66	75.32	3:00	68.84	20:00	73.50	6.48
68	148.41	3:00	143.84	20:00	147.13	4.56	68	75.18	3:00	68.70	20:00	73.36	6.48
70	148.41	3:00	143.85	20:00	147.13	4.56	70	74.90	3:00	68.41	20:00	73.08	6.48
72	148.41	3:00	143.85	20:00	147.13	4.56	72	75.04	3:00	68.56	20:00	73.22	6.48
74	148.41	3:00	143.85	20:00	147.13	4.56	74	74.78	3:00	68.30	20:00	72.96	6.48
76	148.41	3:00	143.85	20:00	147.13	4.56	76	74.64	3:00	68.16	20:00	72.82	6.48
78	148.41	3:00	143.85	20:00	147.13	4.56	78	75.67	3:00	69.18	20:00	73.85	6.48
80	148.41	3:00	143.85	20:00	147.13	4.56	80	75.82	3:00	69.34	20:00	74.00	6.48
82	148.41	3:00	143.85	20:00	147.13	4.56	82	75.98	3:00	69.50	20:00	74.16	6.48
84	148.41	3:00	143.85	20:00	147.13	4.56	84	75.79	3:00	69.31	20:00	73.97	6.48
86	148.41	3:00	143.85	20:00	147.13	4.56	86	76.06	3:00	69.58	20:00	74.24	6.48
88	148.41	3:00	143.85	20:00	147.13	4.56	88	75.40	3:00	68.92	20:00	73.58	6.48
90	148.41	3:00	143.85	20:00	147.13	4.56	90	75.77	3:00	69.29	20:00	73.95	6.48
92	148.41	3:00	143.86	20:00	147.13	4.55	92	76.12	3:00	69.65	20:00	74.31	6.47
94	148.41	3:00	143.86	20:00	147.13	4.55	94	75.57	3:00	69.10	20:00	73.75	6.46
96	148.41	3:00	143.85	20:00	147.13	4.55	96	75.86	3:00	69.39	20:00	74.05	6.47
98	148.41	3:00	143.85	20:00	147.13	4.55	98	75.37	3:00	68.90	20:00	73.55	6.47

Dummy PS nodes; results at these nodes not reported.

163401550 - Richmond Caivan Water Distribution System Analysis - Scope Change 1

Model Results - PKHR (Buildout Conditions)

Head

Min			***134.76***			
Max	***148.22***					
ID	Max.Value (m)	Max.Time (hrs.)	Min.Value (m)	Min.Time (hrs.)	Average (m)	Difference (m)
10	148.21	3:00	134.77	20:00	145.27	13.44
100	148.21	3:00	134.81	20:00	145.28	13.40
102	148.21	3:00	134.80	20:00	145.28	13.41
104	148.21	3:00	134.80	20:00	145.28	13.41
106	148.21	3:00	134.80	20:00	145.28	13.42
108	148.21	3:00	134.80	20:00	145.28	13.41
110	148.21	3:00	134.82	20:00	145.28	13.40
112	148.21	3:00	134.82	20:00	145.28	13.39
114	148.21	3:00	134.82	20:00	145.28	13.39
116	148.21	3:00	134.83	20:00	145.29	13.38
117	148.22	3:00	135.02	20:00	145.34	13.19
118	148.21	3:00	134.84	20:00	145.29	13.37
119	148.22	3:00	135.07	20:00	145.35	13.15
120	148.21	3:00	134.84	20:00	145.29	13.37
121	148.22	3:00	135.08	20:00	145.35	13.14
122	148.21	3:00	134.86	20:00	145.29	13.36
123	148.22	3:00	135.07	20:00	145.35	13.15
124	148.21	3:00	134.86	20:00	145.30	13.35
125	148.22	3:00	135.08	20:00	145.35	13.14
126	148.21	3:00	134.87	20:00	145.30	13.34
127	97.80	3:00	97.77	20:00	97.79	0.02
128	148.21	3:00	134.86	20:00	145.29	13.36
129	148.22	3:00	135.07	20:00	145.35	13.15
130	148.21	3:00	134.86	20:00	145.29	13.36
131	97.80	3:00	97.78	20:00	97.79	0.02
132	148.21	3:00	134.85	20:00	145.29	13.37
133	148.22	3:00	135.07	20:00	145.35	13.15
134	148.21	3:00	134.84	20:00	145.29	13.37
135	97.80	3:00	97.78	20:00	97.79	0.02
136	148.21	3:00	134.84	20:00	145.29	13.37
137	148.21	3:00	134.87	20:00	145.30	13.35
138	148.21	3:00	134.82	20:00	145.28	13.39
14	148.21	3:00	134.79	20:00	145.27	13.42
140	148.21	3:00	134.82	20:00	145.28	13.39
142	148.21	3:00	134.82	20:00	145.28	13.39
144	148.21	3:00	134.82	20:00	145.28	13.39
146	148.21	3:00	134.83	20:00	145.29	13.38
148	148.21	3:00	134.84	20:00	145.29	13.37
150	148.21	3:00	134.84	20:00	145.29	13.37
152	148.21	3:00	134.84	20:00	145.29	13.37
154	148.21	3:00	134.85	20:00	145.29	13.37
156	148.21	3:00	134.85	20:00	145.29	13.36
16	148.21	3:00	134.79	20:00	145.27	13.42
160	148.21	3:00	134.86	20:00	145.29	13.35
162	148.21	3:00	134.90	20:00	145.30	13.32
164	148.22	3:00	134.92	20:00	145.31	13.29
166	148.22	3:00	134.95	20:00	145.32	13.26
168	148.22	3:00	134.91	20:00	145.31	13.30
170	148.21	3:00	134.83	20:00	145.29	13.38
172	148.21	3:00	134.81	20:00	145.28	13.40
174	148.21	3:00	134.80	20:00	145.28	13.41
176	148.21	3:00	134.79	20:00	145.28	13.42
18	148.21	3:00	134.79	20:00	145.27	13.42
182	148.21	3:00	134.83	20:00	145.29	13.39
184	148.21	3:00	134.90	20:00	145.31	13.31
186	148.21	3:00	134.88	20:00	145.30	13.34
188	148.21	3:00	134.86	20:00	145.29	13.36
190	148.21	3:00	134.83	20:00	145.29	13.39
191	148.21	3:00	134.82	20:00	145.28	13.39
192	148.21	3:00	134.82	20:00	145.28	13.40
193	148.21	3:00	134.80	20:00	145.28	13.42
194	148.21	3:00	134.82	20:00	145.28	13.40
196	148.21	3:00	134.82	20:00	145.28	13.39
198	148.21	3:00	134.81	20:00	145.28	13.40
20	148.21	3:00	134.78	20:00	145.27	13.43
200	148.21	3:00	134.80	20:00	145.28	13.41
204	148.21	3:00	134.82	20:00	145.28	13.40
206	148.21	3:00	134.82	20:00	145.28	13.40
21	148.21	3:00	134.79	20:00	145.27	13.42
210	148.21	3:00	134.80	20:00	145.28	13.41
212	148.21	3:00	134.79	20:00	145.28	13.42
214	148.21	3:00	134.79	20:00	145.27	13.43
22	148.21	3:00	134.78	20:00	145.27	13.43
220	148.21	3:00	134.80	20:00	145.28	13.42
228	148.21	3:00	134.78	20:00	145.27	13.43
230	148.21	3:00	134.78	20:00	145.27	13.43
232	148.21	3:00	134.78	20:00	145.27	13.43
234	148.21	3:00	134.79	20:00	145.27	13.43
236	148.21	3:00	134.77	20:00	145.27	13.44
238	148.21	3:00	134.77	20:00	145.27	13.45
24	148.21	3:00	134.78	20:00	145.27	13.43
240	148.21	3:00	134.77	20:00	145.27	13.45
242	148.21	3:00	134.77	20:00	145.27	13.45
244	148.21	3:00	134.77	20:00	145.27	13.45
246	148.21	3:00	134.76	20:00	145.27	13.45
248	148.21	3:00	134.76	20:00	145.27	13.45
250	148.21	3:00	134.77	20:00	145.27	13.44
252	148.21	3:00	134.77	20:00	145.27	13.45
254	148.21	3:00	134.76	20:00	145.27	13.45
258	148.21	3:00	134.76	20:00	145.27	13.45
26	148.21	3:00	134.78	20:00	145.27	13.43
260	148.21	3:00	134.76	20:00	145.27	13.45

Pressure

			51.27			
	76.00					
ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
10	73.50	3:00	54.40	20:00	69.32	19.10
100	75.29	3:00	56.24	20:00	71.12	19.05
102	75.06	3:00	56.00	20:00	70.89	19.06
104	74.89	3:00	55.83	20:00	70.72	19.06
106	74.58	3:00	55.51	20:00	70.40	19.07
108	74.47	3:00	55.40	20:00	70.29	19.07
110	76.00	3:00	56.96	20:00	71.84	19.04
112	75.86	3:00	56.83	20:00	71.70	19.03
114	75.52	3:00	56.49	20:00	71.36	19.03
116	75.58	3:00	56.55	20:00	71.42	19.02
117	71.67	3:00	52.92	20:00	67.58	18.76
118	75.78	3:00	56.76	20:00	71.62	19.01
119	71.68	3:00	52.99	20:00	67.60	18.69
120	75.06	3:00	56.05	20:00	70.91	19.01
121	71.68	3:00	52.99	20:00	67.60	18.68
122	75.18	3:00	56.19	20:00	71.03	18.99
123	71.68	3:00	52.99	20:00	67.60	18.69
124	75.58	3:00	56.60	20:00	71.43	18.98
125	71.68	3:00	52.99	20:00	67.60	18.68
126	75.73	3:00	56.77	20:00	71.59	18.97
127	0	3:00	-0.04	20:00	-0.01	0.04
128	75.66	3:00	56.68	20:00	71.51	18.99
129	71.68	3:00	52.99	20:00	67.60	18.69
130	75.78	3:00	56.79	20:00	71.62	18.99
131	3.70	3:00	3.67	20:00	3.69	0.03
132	74.94	3:00	55.93	20:00	70.78	19.00
133	71.68	3:00	52.99	20:00	67.60	18.69
134	74.40	3:00	55.39	20:00	70.24	19.01
135	0	3:00	-0.03	20:00	-0.01	0.03
136	74.25	3:00	55.24	20:00	70.10	19.01
137	75.76	3:00	56.79	20:00	71.61	18.98
138	74.94	3:00	55.89	20:00	70.77	19.04
14	74.00	3:00	54.91	20:00	69.82	19.08
140	74.77	3:00	55.72	20:00	70.60	19.04
142	74.65	3:00	55.61	20:00	70.49	19.04
144	74.52	3:00	55.49	20:00	70.36	19.03
146	74.86	3:00	55.84	20:00	70.70	19.02
148	74.91	3:00	55.90	20:00	70.75	19.00
150	74.77	3:00	55.76	20:00	70.61	19.00
152	74.64	3:00	55.63	20:00	70.48	19.00
154	74.81	3:00	55.81	20:00	70.65	19.00
156	74.64	3:00	55.64	20:00	70.49	18.99
16	74.29	3:00	55.21	20:00	70.12	19.08
160	75.25	3:00	56.27	20:00	71.10	18.98
162	75.19	3:00	56.26	20:00	71.06	18.94
164	75.10	3:00	56.20	20:00	70.97	18.90
166	75.48	3:00	56.62	20:00	71.36	18.86
168	75.39	3:00	56.49	20:00	71.26	18.91
170	73.96	3:00	54.93	20:00	69.80	19.02
172	73.67	3:00	54.62	20:00	69.50	19.05
174	73.56	3:00	54.49	20:00	69.39	19.06
176	73.23	3:00	54.15	20:00	69.05	19.08
18	74.47	3:00	55.38	20:00	70.29	19.08
182	73.81	3:00	54.78	20:00	69.65	19.03
184	74.30	3:00	55.38	20:00	70.16	18.92
186	74.14	3:00	55.18	20:00	70.00	18.96
188	73.96	3:00	54.97	20:00	69.81	18.99
190	73.77	3:00	54.74	20:00	69.61	19.03
191	73.71	3:00	54.68	20:00	69.55	19.04
192	73.61	3:00	54.57	20:00	69.45	19.04
193	73.94	3:00	54.87	20:00	69.77	19.07
194	73.56	3:00	54.51	20:00	69.39	19.04
196	73.46	3:00	54.42	20:00	69.29	19.04
198	74.01	3:00	54.96	20:00	69.85	19.05
20	74.29	3:00	55.21	20:00	70.11	19.09
200	73.85	3:00	54.79	20:00	69.68	19.07
204	73.31	3:00	54.27	20:00	69.15	19.04
206	73.16	3:00	54.11	20:00	68.99	19.04
21	74.93	3:00	55.86	20:00	70.76	19.08
210	73.85	3:00	54.79	20:00	69.69	19.06
212	74.01	3:00	54.94	20:00	69.84	19.08
214	73.84	3:00	54.75	20:00	69.66	19.09
22	74.34	3:00	55.25	20:00	70.16	19.09
220	73.34	3:00	54.27	20:00	69.17	19.07
228	73.21	3:00	54.12	20:00	69.04	19.10
230	73.37	3:00	54.27	20:00	69.19	19.10
232	73.53	3:00	54.43	20:00	69.35	19.09
234	73.68	3:00	54.60	20:00	69.51	19.09
236	73.40	3:00	54.30	20:00	69.22	19.10
238	73.04	3:00	53.93	20:00	68.86	19.11
24	74.18	3:00	55.09	20:00	70.00	19.09
240	72.66	3:00	53.55	20:00	68.48	19.11
242	73.30	3:00	54.19	20:00	69.12	19.11
244	70.38	3:00	51.27	20:00	66.20	19.11
246	70.38	3:00	51.27	20:00	66.20	19.12
248	71.66	3:00	52.55	20:00	67.48	19.12
250	73.14	3:00	54.03	20:00	68.96	19.11
252	72.59	3:00	53.47	20:00	68.41	19.11
254	72.33	3:00	53.22	20:00	68.15	19.12
258	71.32	3:00	52.20	20:00	67.14	19.12
26	73.87	3:00	54.78	20:00	69.69	19.09
260	71.12	3:00	52.00	20:00	66.94	19.12

262	148.21	3:00	134.76	20:00	145.27	13.45	262	72.69	3:00	53.57	20:00	68.51	19.12
264	148.21	3:00	134.76	20:00	145.27	13.45	264	72.28	3:00	53.16	20:00	68.09	19.12
268	148.21	3:00	134.76	20:00	145.27	13.45	268	72.37	3:00	53.26	20:00	68.19	19.12
270	148.21	3:00	134.76	20:00	145.27	13.45	270	72.16	3:00	53.05	20:00	67.98	19.12
272	148.21	3:00	134.77	20:00	145.27	13.45	272	72.53	3:00	53.42	20:00	68.35	19.11
278	148.21	3:00	134.77	20:00	145.27	13.45	278	72.28	3:00	53.16	20:00	68.09	19.12
28	148.21	3:00	134.78	20:00	145.27	13.43	28	74.12	3:00	55.04	20:00	69.94	19.09
282	148.21	3:00	134.76	20:00	145.27	13.45	282	72.02	3:00	52.90	20:00	67.84	19.12
284	148.21	3:00	134.76	20:00	145.27	13.45	284	72.13	3:00	53.02	20:00	67.95	19.12
288	148.21	3:00	134.76	20:00	145.27	13.45	288	71.76	3:00	52.65	20:00	67.58	19.12
289	148.21	3:00	134.82	20:00	145.28	13.39	289	74.32	3:00	55.28	20:00	70.16	19.04
290	148.21	3:00	134.87	20:00	145.30	13.34	290	74.21	3:00	55.24	20:00	70.07	18.97
30	148.21	3:00	134.79	20:00	145.27	13.42	30	74.20	3:00	55.11	20:00	70.02	19.08
301	148.21	3:00	134.81	20:00	145.28	13.40	301	73.80	3:00	54.75	20:00	69.63	19.05
302	148.21	3:00	134.81	20:00	145.28	13.40	302	73.94	3:00	54.89	20:00	69.77	19.05
303	148.21	3:00	134.80	20:00	145.28	13.41	303	73.94	3:00	54.88	20:00	69.77	19.06
304	148.21	3:00	134.80	20:00	145.28	13.41	304	73.80	3:00	54.73	20:00	69.63	19.07
32	148.21	3:00	134.79	20:00	145.27	13.42	32	73.85	3:00	54.77	20:00	69.68	19.08
34	148.21	3:00	134.78	20:00	145.27	13.43	34	74.18	3:00	55.09	20:00	70.00	19.09
36	148.21	3:00	134.79	20:00	145.27	13.42	36	74.65	3:00	55.57	20:00	70.47	19.08
38	148.21	3:00	134.79	20:00	145.27	13.42	38	74.85	3:00	55.77	20:00	70.67	19.08
391	148.21	3:00	134.84	20:00	145.29	13.37	391	75.23	3:00	56.22	20:00	71.08	19.01
393	148.21	3:00	134.84	20:00	145.29	13.37	393	74.60	3:00	55.58	20:00	70.44	19.01
395	148.21	3:00	134.84	20:00	145.29	13.37	395	74.64	3:00	55.63	20:00	70.48	19.01
397	148.22	3:00	134.97	20:00	145.32	13.25	397	75.48	3:00	56.65	20:00	71.37	18.83
399	148.21	3:00	134.87	20:00	145.30	13.34	399	75.73	3:00	56.76	20:00	71.59	18.97
40	148.21	3:00	134.79	20:00	145.27	13.42	40	74.91	3:00	55.83	20:00	70.73	19.08
401	148.22	3:00	134.97	20:00	145.32	13.25	401	75.37	3:00	56.53	20:00	71.25	18.84
402	148.21	3:00	134.90	20:00	145.31	13.31	402	74.23	3:00	55.31	20:00	70.09	18.92
403	148.21	3:00	134.86	20:00	145.29	13.35	403	74.08	3:00	55.10	20:00	69.93	18.98
404	148.21	3:00	134.84	20:00	145.29	13.37	404	75.08	3:00	56.07	20:00	70.92	19.01
405	148.21	3:00	134.84	20:00	145.29	13.38	405	75.22	3:00	56.20	20:00	71.06	19.02
406	148.21	3:00	134.78	20:00	145.27	13.44	406	73.23	3:00	54.13	20:00	69.05	19.10
407	148.21	3:00	134.78	20:00	145.27	13.44	407	73.37	3:00	54.27	20:00	69.19	19.10
408	148.21	3:00	134.78	20:00	145.27	13.43	408	73.65	3:00	54.56	20:00	69.48	19.10
409	148.21	3:00	134.78	20:00	145.27	13.43	409	73.80	3:00	54.70	20:00	69.62	19.10
410	148.21	3:00	134.77	20:00	145.27	13.44	410	72.80	3:00	53.69	20:00	68.62	19.11
411	148.21	3:00	134.78	20:00	145.27	13.44	411	72.80	3:00	53.70	20:00	68.62	19.10
412	148.21	3:00	134.78	20:00	145.27	13.44	412	73.09	3:00	53.99	20:00	68.91	19.10
413	148.21	3:00	134.77	20:00	145.27	13.44	413	72.66	3:00	53.55	20:00	68.48	19.10
414	148.21	3:00	134.77	20:00	145.27	13.44	414	72.52	3:00	53.41	20:00	68.34	19.11
415	148.21	3:00	134.76	20:00	145.27	13.45	415	71.81	3:00	52.69	20:00	67.62	19.12
416	148.21	3:00	134.76	20:00	145.27	13.45	416	71.10	3:00	51.98	20:00	66.91	19.12
42	148.21	3:00	134.79	20:00	145.27	13.42	42	74.66	3:00	55.58	20:00	70.49	19.08
44	148.21	3:00	134.79	20:00	145.27	13.42	44	74.51	3:00	55.43	20:00	70.33	19.08
46	148.21	3:00	134.79	20:00	145.27	13.42	46	74.69	3:00	55.61	20:00	70.52	19.08
48	148.21	3:00	134.79	20:00	145.27	13.42	48	74.98	3:00	55.90	20:00	70.80	19.08
50	148.21	3:00	134.79	20:00	145.27	13.42	50	75.12	3:00	56.04	20:00	70.94	19.08
54	148.21	3:00	134.79	20:00	145.27	13.42	54	75.22	3:00	56.14	20:00	71.04	19.08
56	148.21	3:00	134.79	20:00	145.27	13.42	56	74.45	3:00	55.37	20:00	70.27	19.08
58	148.21	3:00	134.79	20:00	145.27	13.42	58	74.56	3:00	55.48	20:00	70.39	19.08
60	148.21	3:00	134.79	20:00	145.27	13.42	60	74.69	3:00	55.61	20:00	70.52	19.08
62	148.21	3:00	134.79	20:00	145.27	13.42	62	74.83	3:00	55.76	20:00	70.66	19.08
64	148.21	3:00	134.79	20:00	145.27	13.42	64	74.68	3:00	55.60	20:00	70.50	19.08
66	148.21	3:00	134.79	20:00	145.27	13.42	66	75.05	3:00	55.97	20:00	70.87	19.08
68	148.21	3:00	134.79	20:00	145.27	13.42	68	74.91	3:00	55.83	20:00	70.73	19.08
70	148.21	3:00	134.79	20:00	145.27	13.42	70	74.62	3:00	55.54	20:00	70.45	19.08
72	148.21	3:00	134.79	20:00	145.27	13.42	72	74.76	3:00	55.69	20:00	70.59	19.08
74	148.21	3:00	134.79	20:00	145.27	13.42	74	74.51	3:00	55.43	20:00	70.33	19.07
76	148.21	3:00	134.79	20:00	145.27	13.42	76	74.37	3:00	55.29	20:00	70.19	19.08
78	148.21	3:00	134.79	20:00	145.27	13.42	78	75.39	3:00	56.31	20:00	71.21	19.08
80	148.21	3:00	134.79	20:00	145.27	13.42	80	75.55	3:00	56.47	20:00	71.37	19.08
82	148.21	3:00	134.79	20:00	145.27	13.42	82	75.70	3:00	56.63	20:00	71.53	19.07
84	148.21	3:00	134.80	20:00	145.27	13.42	84	75.52	3:00	56.44	20:00	71.34	19.07
86	148.21	3:00	134.79	20:00	145.27	13.42	86	75.79	3:00	56.71	20:00	71.61	19.08
88	148.21	3:00	134.80	20:00	145.28	13.42	88	75.12	3:00	56.05	20:00	70.94	19.07
90	148.21	3:00	134.80	20:00	145.28	13.41	90	75.49	3:00	56.42	20:00	71.32	19.07
92	148.21	3:00	134.81	20:00	145.28	13.40	92	75.85	3:00	56.80	20:00	71.68	19.05
94	148.21	3:00	134.82	20:00	145.28	13.39	94	75.29	3:00	56.25	20:00	71.13	19.04
96	148.21	3:00	134.81	20:00	145.28	13.40	96	75.59	3:00	56.53	20:00	71.42	19.05
98	148.21	3:00	134.81	20:00	145.28	13.40	98	75.09	3:00	56.04	20:00	70.92	19.05

Dummy PS nodes; results at these nodes not reported.

163401550 - Richmond Caivan Water Distribution System Analysis - Scope Change 1

Model Results - MXDY+FF (Interim Conditions)

Min					***29.12***	***179.14***	
Max					***70.05***	***272.38***	
ID	Static Demand (L/s)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
100	0.28	93.94	161.33	167.00	53.48	225.61	20.00
102	0.13	93.71	161.33	167.00	63.02	251.05	20.00
104	0.13	93.54	161.33	167.00	62.48	249.65	20.00
106	0.13	93.23	161.33	167.00	60.81	245.07	20.00
108	0.13	93.11	161.33	167.00	33.24	185.30	20.00
110	0.13	94.65	161.33	167.00	65.56	257.75	20.00
112	0.13	94.51	161.33	167.00	65.78	258.76	20.00
114	0.13	94.17	161.34	167.00	66.13	260.68	20.00
116	0.13	94.23	161.34	167.00	66.07	260.30	20.00
118	0.13	94.43	161.34	167.00	66.74	262.28	20.00
120	0.13	93.72	161.34	167.00	66.94	264.07	20.00
122	0.13	93.84	161.34	167.00	68.20	267.45	20.00
124	0.13	94.24	161.34	167.00	68.29	267.01	20.00
126	0.13	94.40	161.34	167.00	68.75	268.10	20.00
128	0.13	94.32	161.34	167.00	39.95	195.69	20.00
130	0.13	94.43	161.34	167.00	67.46	264.35	20.00
132	0.28	93.60	161.34	167.00	39.35	195.12	20.00
134	0.28	93.05	161.34	167.00	58.72	239.30	20.00
136	0.28	92.91	161.34	167.00	53.35	226.21	20.00
137	0.13	94.42	161.34	167.00	68.08	266.11	20.00
138	0.28	93.59	161.33	167.00	29.22	179.36	20.00
14	0.20	92.64	161.33	167.00	56.82	234.97	20.00
140	0.28	93.42	161.33	167.00	31.42	182.72	20.00
142	0.28	93.30	161.33	167.00	38.56	193.96	20.00
144	0.28	93.18	161.33	167.00	51.96	223.02	20.00
146	0.13	93.52	161.34	167.00	66.10	261.87	20.00
148	0.28	93.57	161.34	167.00	61.87	247.59	20.00
150	0.32	93.43	161.34	167.00	55.81	231.41	20.00
152	0.32	93.30	161.34	167.00	54.61	228.72	20.00
154	0.32	93.47	161.34	167.00	56.28	232.47	20.00
156	0.32	93.30	161.34	167.00	67.54	266.55	20.00
16	0.20	92.94	161.33	167.00	56.99	235.03	20.00
160	0.32	93.91	161.34	167.00	68.62	268.71	20.00
162	0.32	93.86	161.34	167.00	68.47	268.31	20.00
164	0.32	93.76	161.35	167.00	69.00	270.03	20.00
166	0.13	94.15	161.35	167.00	70.05	272.38	20.00
168	0.32	94.06	161.35	167.00	65.53	258.56	20.00
170	0	92.62	161.34	167.00	65.37	260.61	20.00
18	0.20	93.11	161.33	167.00	57.50	236.16	20.00
182	0	92.48	161.34	167.00	64.53	257.83	20.00
184	0	92.97	161.35	167.00	66.60	263.90	20.00
188	0.16	92.63	161.35	167.00	64.71	258.26	20.00
190	0.16	92.44	161.35	167.00	63.55	254.60	20.00
191	0.16	92.38	161.35	167.00	56.88	234.97	20.00
193	0.16	92.61	161.35	167.00	62.75	251.65	20.00
194	0	92.22	161.34	167.00	63.69	255.36	20.00
196	0.16	92.13	161.35	167.00	62.91	253.02	20.00
198	0.16	92.68	161.35	167.00	63.17	252.90	20.00
200	0.16	92.52	161.35	167.00	62.69	251.63	20.00
204	0.16	91.99	161.35	167.00	58.79	240.64	20.00
206	0.16	91.83	161.35	167.00	53.79	228.03	20.00
212	0	92.68	161.34	167.00	62.80	251.55	20.00
214	0	92.51	161.34	167.00	62.67	251.42	20.00
220	0	92.01	161.34	167.00	62.61	252.10	20.00
234	0	92.35	161.34	167.00	62.68	251.72	20.00
289	0.28	92.98	161.33	167.00	29.86	180.43	20.00
290	0	92.89	161.35	167.00	65.52	260.50	20.00
30	0.20	92.84	161.33	167.00	50.06	218.37	20.00
301	0.06	92.47	161.35	167.00	57.98	237.66	20.00
302	0.06	92.61	161.35	167.00	63.05	252.53	20.00
303	0.06	92.61	161.35	167.00	62.88	251.96	20.00
304	0.06	92.47	161.35	167.00	54.67	229.33	20.00
32	0.20	92.50	161.33	167.00	49.75	217.93	20.00
36	0.15	93.30	161.33	167.00	58.47	238.42	20.00
38	0	93.50	161.33	167.00	59.19	239.96	20.00
391	0.28	93.89	161.34	167.00	62.42	248.78	20.00
393	0.28	93.25	161.34	167.00	59.00	239.80	20.00
395	0.28	93.30	161.34	167.00	53.64	226.49	20.00
399	0.13	94.40	161.34	167.00	68.53	267.45	20.00
40	0	93.55	161.33	167.00	59.99	242.11	20.00
401	0.32	94.04	161.35	167.00	69.46	270.84	20.00
411	0.16	91.47	161.34	167.00	47.29	212.46	20.00
412	0	91.76	161.34	167.00	59.74	243.53	20.00
48	0.18	93.63	161.33	167.00	51.35	220.89	20.00
50	0.18	93.77	161.33	167.00	54.28	227.55	20.00
54	0.18	93.87	161.33	167.00	61.20	245.35	20.00
56	0.20	93.10	161.33	167.00	58.08	237.70	20.00
58	0.20	93.21	161.33	167.00	31.49	182.80	20.00
60	0.20	93.34	161.33	167.00	40.06	196.53	20.00
62	0.20	93.48	161.33	167.00	56.82	233.96	20.00
64	0.20	93.33	161.33	167.00	59.87	242.30	20.00
66	0.20	93.70	161.33	167.00	56.91	233.94	20.00
68	0.20	93.55	161.33	167.00	29.12	179.14	20.00
70	0.20	93.27	161.33	167.00	54.64	228.89	20.00
72	0.20	93.41	161.33	167.00	60.06	242.73	20.00
74	0.20	93.16	161.33	167.00	60.23	243.57	20.00
76	0.20	93.01	161.33	167.00	54.07	227.83	20.00
78	0.18	94.04	161.33	167.00	56.99	233.72	20.00
80	0.18	94.19	161.33	167.00	56.13	231.43	20.00
82	0.18	94.35	161.33	167.00	57.80	235.38	20.00
84	0.18	94.17	161.33	167.00	52.83	223.96	20.00
86	0.18	94.44	161.33	167.00	55.97	230.78	20.00
88	0.18	93.77	161.33	167.00	61.87	247.46	20.00
90	0.13	94.14	161.33	167.00	63.22	251.00	20.00
92	0.13	94.50	161.33	167.00	65.49	257.83	20.00
94	0.13	93.94	161.33	167.00	65.33	258.30	20.00
96	0.13	94.24	161.33	167.00	64.28	254.24	20.00
98	0.28	93.74	161.33	167.00	54.32	227.69	20.00

No units serviced in this area under interim conditions

163401550 - Richmond Caivan Water Distribution System Analysis - Scope Change 1
Model Results - MXDY+FF (Buildout Conditions)

Min					***21.34***	***168.74***	
Max					***64.98***	***255.98***	
ID	Static Demand (L/s)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
10	0.26	91.47	160.85	167.00	56.52	235.44	20.00
100	0.28	93.27	160.86	167.00	48.37	213.91	20.00
102	0.13	93.04	160.86	167.00	57.89	237.08	20.00
104	0.13	92.87	160.86	167.00	57.34	235.78	20.00
106	0.13	92.55	160.85	167.00	55.67	231.58	20.00
108	0.13	92.44	160.86	167.00	28.10	177.49	20.00
110	0.13	93.98	160.86	167.00	60.45	243.37	20.00
112	0.13	93.84	160.86	167.00	60.68	244.30	20.00
114	0.13	93.50	160.86	167.00	61.05	246.01	20.00
116	0.13	93.56	160.86	167.00	60.99	245.68	20.00
118	0.13	93.76	160.87	167.00	61.66	247.14	20.00
120	0.13	93.05	160.87	167.00	61.89	248.61	20.00
122	0.13	93.17	160.87	167.00	63.18	251.73	20.00
124	0.13	93.57	160.87	167.00	63.25	251.33	20.00
126	0.13	93.73	160.87	167.00	63.70	252.29	20.00
128	0.13	93.66	160.87	167.00	34.90	187.54	20.00
130	0.13	93.77	160.87	167.00	62.40	248.91	20.00
132	0.28	92.93	160.87	167.00	34.33	187.00	20.00
134	0.28	92.38	160.87	167.00	53.74	226.65	20.00
136	0.28	92.24	160.87	167.00	48.37	214.59	20.00
137	0.13	93.76	160.87	167.00	63.02	250.50	20.00
138	0.28	92.92	160.86	167.00	24.15	172.30	20.00
14	0.20	91.97	160.85	167.00	51.81	222.59	20.00
140	0.28	92.75	160.86	167.00	26.35	175.19	20.00
142	0.28	92.63	160.86	167.00	33.49	185.77	20.00
144	0.28	92.51	160.86	167.00	46.89	211.51	20.00
146	0.13	92.85	160.86	167.00	61.04	246.77	20.00
148	0.28	92.90	160.87	167.00	56.90	234.35	20.00
150	0.32	92.76	160.87	167.00	50.85	219.50	20.00
152	0.32	92.63	160.87	167.00	49.66	217.02	20.00
154	0.32	92.80	160.87	167.00	51.34	220.56	20.00
156	0.32	92.63	160.87	167.00	62.69	251.39	20.00
16	0.20	92.26	160.85	167.00	51.98	222.71	20.00
160	0.32	93.24	160.87	167.00	63.64	253.03	20.00
162	0.32	93.20	160.88	167.00	63.44	252.47	20.00
164	0.32	93.11	160.89	167.00	63.94	253.92	20.00
166	0.13	93.50	160.89	167.00	64.98	255.98	20.00
168	0.32	93.40	160.88	167.00	60.44	244.01	20.00
170	0.26	91.94	160.86	167.00	61.03	248.02	20.00
172	0.26	91.65	160.86	167.00	46.50	211.27	20.00
174	0.26	91.53	160.86	167.00	43.29	205.09	20.00
176	0.26	91.20	160.86	167.00	40.42	199.05	20.00
18	0.20	92.44	160.85	167.00	52.51	223.81	20.00
182	0.61	91.80	160.86	167.00	60.43	247.07	20.00
184	0.26	92.31	160.88	167.00	61.95	249.76	20.00
186	0.26	92.14	160.88	167.00	38.76	195.16	20.00
188	0.13	91.95	160.87	167.00	60.39	246.27	20.00
190	0.13	91.75	160.86	167.00	59.46	243.68	20.00
191	0.13	91.70	160.86	167.00	57.38	237.33	20.00
192	0.61	91.59	160.86	167.00	57.19	237.40	20.00
193	0.13	91.92	160.86	167.00	58.44	240.33	20.00
194	0.26	91.54	160.86	167.00	59.61	244.68	20.00
196	0.13	91.44	160.86	167.00	58.54	241.27	20.00
198	0.13	91.99	160.86	167.00	58.69	240.92	20.00
20	0.15	92.26	160.85	167.00	21.86	169.37	20.00
200	0.13	91.83	160.86	167.00	58.29	239.97	20.00
204	0.13	91.30	160.86	167.00	54.36	229.40	20.00
206	0.13	91.14	160.86	167.00	49.36	217.50	20.00
210	0.26	91.83	160.86	167.00	49.60	217.57	20.00
212	0.26	91.99	160.86	167.00	58.63	240.94	20.00
214	0.26	91.81	160.85	167.00	58.42	240.59	20.00
22	0.50	92.31	160.85	167.00	36.76	191.79	20.00
220	0.26	91.32	160.86	167.00	58.13	240.38	20.00
228	0.26	91.18	160.85	167.00	49.10	217.10	20.00
230	0.26	91.34	160.85	167.00	33.95	186.89	20.00
232	0.26	91.50	160.85	167.00	57.38	237.91	20.00
234	0.26	91.66	160.85	167.00	58.35	240.60	20.00
236	0.26	91.37	160.85	167.00	50.98	221.20	20.00
238	0.26	91.01	160.85	167.00	51.23	222.18	20.00
24	0.15	92.15	160.85	167.00	29.43	179.50	20.00
240	0.26	90.63	160.85	167.00	42.87	204.91	20.00
242	0.26	91.27	160.85	167.00	45.77	210.23	20.00
244	0.26	88.35	160.85	167.00	40.55	201.17	20.00
246	0.26	88.35	160.85	167.00	43.21	207.18	20.00
248	0.26	89.63	160.85	167.00	52.62	227.09	20.00
250	0.26	91.11	160.85	167.00	55.54	233.18	20.00
252	0.26	90.56	160.85	167.00	54.26	230.36	20.00
254	0.26	90.30	160.85	167.00	53.08	227.54	20.00
258	0.26	89.29	160.85	167.00	41.94	203.74	20.00
26	0.15	91.84	160.85	167.00	25.00	173.38	20.00
260	0.26	89.09	160.85	167.00	39.03	197.44	20.00
262	0.26	90.65	160.85	167.00	50.56	220.95	20.00
264	0.26	90.24	160.85	167.00	52.69	226.58	20.00
268	0.26	90.34	160.85	167.00	49.69	219.23	20.00
270	0.26	90.13	160.85	167.00	52.76	226.90	20.00
272	0.26	90.50	160.85	167.00	53.84	229.29	20.00
278	0.26	90.24	160.85	167.00	52.76	226.75	20.00
28	0.15	92.09	160.85	167.00	21.34	168.74	20.00
282	0.26	89.99	160.85	167.00	51.69	224.34	20.00
284	0.26	90.10	160.85	167.00	52.28	225.70	20.00
288	0.26	89.73	160.85	167.00	51.44	224.00	20.00
289	0.28	92.31	160.86	167.00	24.79	173.18	20.00
290	0.26	92.21	160.87	167.00	61.25	248.18	20.00
30	0.20	92.16	160.85	167.00	45.05	208.22	20.00
301	0.13	91.78	160.86	167.00	53.53	226.70	20.00
302	0.13	91.92	160.86	167.00	58.52	240.52	20.00
303	0.13	91.92	160.86	167.00	58.37	240.07	20.00

304	0.13	91.77	160.86	167.00	50.19	218.83	20.00
32	0.20	91.82	160.85	167.00	44.74	207.86	20.00
34	0.15	92.15	160.85	167.00	32.89	184.86	20.00
36	0.15	92.62	160.85	167.00	53.50	225.98	20.00
38	0.15	92.82	160.85	167.00	54.29	227.74	20.00
391	0.28	93.22	160.87	167.00	57.41	235.38	20.00
393	0.28	92.58	160.87	167.00	54.01	227.12	20.00
395	0.28	92.63	160.87	167.00	48.66	214.89	20.00
399	0.13	93.73	160.87	167.00	63.48	251.70	20.00
40	0.15	92.88	160.85	167.00	55.18	229.96	20.00
401	0.32	93.39	160.90	167.00	64.43	254.78	20.00
402	0.26	92.24	160.88	167.00	48.29	214.34	20.00
403	0.26	92.08	160.87	167.00	57.44	236.97	20.00
404	0.26	93.07	160.87	167.00	57.22	235.00	20.00
405	0.26	93.21	160.87	167.00	32.97	184.70	20.00
406	0.26	91.20	160.85	167.00	50.72	220.75	20.00
407	0.26	91.34	160.85	167.00	29.98	180.55	20.00
408	0.26	91.63	160.85	167.00	57.13	236.98	20.00
409	0.26	91.77	160.85	167.00	56.98	236.36	20.00
410	0.26	90.77	160.85	167.00	30.99	182.25	20.00
411	0.13	90.77	160.85	167.00	44.18	207.33	20.00
412	0.26	91.06	160.85	167.00	56.62	236.31	20.00
413	0.26	90.63	160.85	167.00	55.38	233.33	20.00
414	0.26	90.49	160.85	167.00	54.12	230.06	20.00
415	0.26	89.77	160.85	167.00	32.11	184.30	20.00
416	0.26	89.06	160.85	167.00	31.00	182.67	20.00
42	0.15	92.63	160.85	167.00	49.62	216.99	20.00
44	0.15	92.48	160.85	167.00	44.15	206.32	20.00
46	0.15	92.66	160.85	167.00	43.46	204.68	20.00
48	0.18	92.95	160.85	167.00	51.58	221.10	20.00
50	0.18	93.09	160.85	167.00	51.39	220.52	20.00
54	0.18	93.19	160.85	167.00	56.09	232.03	20.00
56	0.20	92.42	160.85	167.00	53.04	225.09	20.00
58	0.20	92.54	160.85	167.00	26.38	175.18	20.00
60	0.20	92.66	160.85	167.00	34.95	188.14	20.00
62	0.20	92.81	160.85	167.00	51.71	221.55	20.00
64	0.20	92.65	160.85	167.00	54.76	229.15	20.00
66	0.20	93.02	160.85	167.00	51.81	221.57	20.00
68	0.20	92.88	160.85	167.00	24.01	172.05	20.00
70	0.20	92.59	160.85	167.00	49.51	216.83	20.00
72	0.20	92.74	160.85	167.00	54.94	229.53	20.00
74	0.20	92.48	160.85	167.00	55.10	230.22	20.00
76	0.20	92.34	160.85	167.00	48.94	215.81	20.00
78	0.18	93.36	160.85	167.00	52.48	222.77	20.00
80	0.18	93.52	160.85	167.00	51.86	221.18	20.00
82	0.18	93.67	160.85	167.00	53.00	223.68	20.00
84	0.18	93.49	160.85	167.00	48.38	213.75	20.00
86	0.18	93.76	160.85	167.00	52.17	221.68	20.00
88	0.18	93.09	160.85	167.00	56.69	233.75	20.00
90	0.13	93.46	160.86	167.00	58.07	237.07	20.00
92	0.13	93.82	160.86	167.00	60.37	243.40	20.00
94	0.13	93.27	160.86	167.00	60.22	243.77	20.00
96	0.13	93.57	160.86	167.00	59.16	240.08	20.00
98	0.28	93.07	160.86	167.00	49.21	215.79	20.00

4.3.3 Private Wells

Given that the majority of the existing residents and businesses in Richmond are serviced by private wells, further development on private wells is likely feasible for infilling and/or "rounding out" development. It may also be feasible for certain distinct smaller or isolated parcels of future development in the short term. Although it is not expected that the municipality or province would permit extensive additional private wells in Richmond (with a communal supply possible and much of the area on a public sewage collection system), the technical assessment includes this as an option.

Based on preliminary hydrogeological investigations (Golder Associates, 2008), typical private well yields from the upper bedrock aquifer are expected to range from 45-115 L/min, well above the typical residential unit day demand. Although further hydrogeological investigations would be required, it is expected that the upper aquifer could be capable of supplying the required water to the entire Village of Richmond (existing and growth) under the low growth potential scenario (estimated at approximately 4,141 units total), but not under the high growth potential scenario (6,372 units total). It is expected that the high development could be serviced by a combination of private wells in the upper and lower aquifers.

Cost estimates have been developed for drilling a private well and installing the necessary external and internal plumbing for individual properties. These are provided following:

- Well Drilling/Casing: $5,000 to $8,000 (shallow and deep aquifers respectively)
- Well pump, in-house appurtenances: $2,000 (typical or average)

Based on the total number of new residential units (excluding existing and infill lots), it is estimated that approximately 2319 to 3920 new private wells would be required for the low and high growth potential scenarios respectively (assuming 1 well for each single family unit and 1 well for every 2 medium density unit). The total estimated costs for private well water supplies to all new growth is thus expected to range from approximately **$16,200,000** (at an average of $7,000 per unit for low growth only) to **$32,200,000** (at an average total of $8,200 per unit for combined shallow and deep wells).

4.3.4 Source Water Protection

From the standpoint of source water protection, the installation of communal wells would be preferred over private wells. The potential for contaminating the aquifer(s) is significantly higher for thousands of holes (private wells) than for a small number of properly constructed and maintained communal wells.

As the majority of existing private wells within the Village of Richmond are considered "shallow" and the well capture zones for the existing King's Park communal wells and proposed communal wells throughout the Village lie within the Village boundary, it is important to ensure that the any proposed stormwater management ponds developed in the community will not adversely impact groundwater quality in the area. It is understood that all stormwater ponds constructed within the Village as part of the proposed development will be fully lined and thus will have no expected impact on the groundwater quality or quantity.

4.6 PREFERRED WATER SERVICING SOLUTION

The preferred solution for providing potable water to Richmond includes the following:

- Existing, infill and "rounding out" areas to be serviced by private wells until connection to communal system is warranted ("rounding out" is not specifically defined, although the intent is that this represents relatively minor development areas located throughout the village)
- Larger scale future growth areas to be serviced by communal system(s) with at-grade storage as required to meet balancing, fire and emergency needs
- Communal system(s) are to be designed to allow for expansion/integration to service all existing and future development areas within the Village of Richmond with the intent of ultimately creating a single communal well system (one primary storage/pumping facility with several individual well sites) for the entire Village.

This solution allows for existing residences, as well as institutional, commercial and industrial establishments to remain connected to private wells and allows for limited infill development and "rounding out" development to be serviced by new private wells in the short to medium terms. To provide potable water and fire protection for new large scale developments, a new communal well system will be constructed west of the Jock River within the Western Development Lands. This new system will be designed to current City of Ottawa standards and will consist of multiple deep wells, disinfection (and further treatment if required), at-grade storage, a high lift pumping station and a network of distribution watermains. This communal system will be designed for future expansion to service existing and other growth within the Village of Richmond. As well, an expansion and/or extension of the City of Ottawa's existing King's Park Communal Well System will be considered for servicing new development and/or existing areas east of the Jock River. A piped connection between these communal well systems is recommended when feasible to improve reliability for all serviced areas within the Village.

APPENDIX D

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE					
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL (FULL) (m/s)	VEL (ACT.) (m/s)
STREET 2004																										
	533A	534A	0.52		43	0.52	43	3.7	0.51		0.00		0.00		0.00	0.00	0.52	0.52	0.17	0.68	99.0	200	0.65	26.44	0.03	0.84	0.36
To STREET 2008, Pipe 534A - 539A						0.52	43				0.00		0.00		0.00			0.52									
STREET 2005																										
	520A	521A	0.49		40	0.49	40	3.7	0.48		0.00		0.00		0.00	0.00	0.49	0.49	0.16	0.64	64.5	200	0.65	26.44	0.02	0.84	0.35
	521A	522A	0.45		37	0.94	77	3.6	0.90		0.00		0.00		0.00	0.00	0.45	0.94	0.31	1.21	65.0	200	0.35	19.40	0.06	0.62	0.34
	522A	523A				0.94	77	3.6	0.90		0.00		0.00		0.00	0.00	0.00	0.94	0.31	1.21	6.5	200	0.35	19.40	0.06	0.62	0.34
	523A	527A	0.27		22	1.21	99	3.6	1.15		0.00		0.00		0.00	0.00	0.27	1.21	0.40	1.55	56.5	200	0.35	19.40	0.08	0.62	0.37
To STREET 2006, Pipe 527A - 532A						1.21	99				0.00		0.00		0.00			1.21									
Unknown Road8 - 2007																										
	525A	526A				0.00				2.22	2.22		0.00		0.00	0.72	2.22	2.22	0.73	1.45	30.5	200	0.35	19.40	0.07	0.62	0.36
To STREET 2006, Pipe 526A - 527A						0.00	0				2.22		0.00		0.00			2.22									
STREET 2006																										
	531A	532A	0.49		40	0.49	40	3.7	0.48		0.00		0.00		0.00	0.00	0.49	0.49	0.16	0.64	89.0	200	0.65	26.44	0.02	0.84	0.35
To STREET 2008, Pipe 532A - 534A						0.49	40				0.00		0.00		0.00			0.49									
	535A	536A	0.26		21	0.26	21	3.7	0.25		0.00		0.00		0.00	0.00	0.26	0.26	0.09	0.34	50.0	200	0.65	26.44	0.01	0.84	0.28
	536A	537A	0.22		18	0.48	39	3.7	0.46		0.00		0.00		0.00	0.00	0.22	0.48	0.16	0.62	51.5	200	0.35	19.40	0.03	0.62	0.28
	537A	538A				0.48	39	3.7	0.46		0.00		0.00		0.00	0.00	0.00	0.48	0.16	0.62	12.5	200	0.35	19.40	0.03	0.62	0.28
	538A	539A	0.79		65	1.27	104	3.6	1.21		0.00		0.00		0.00	0.00	0.79	1.27	0.42	1.63	107.5	200	0.35	19.40	0.08	0.62	0.37
To STREET 2008, Pipe 539A - 540A						1.27	104				0.00		0.00		0.00			1.27									
	524A	526A	0.44		36	0.44	36	3.7	0.43		0.00		0.00		0.00	0.00	0.44	0.44	0.15	0.57	64.0	200	0.65	26.44	0.02	0.84	0.34
Contribution From Unknown Road8 - 2007, Pipe 525A - 526A						0.00	0				2.22		0.00		0.00		2.22	2.66									
	526A	527A	0.44		36	0.88	72	3.6	0.85		2.22		0.00		0.00	0.72	0.44	3.10	1.02	2.59	78.5	200	0.35	19.40	0.13	0.62	0.43
Contribution From STREET 2005, Pipe 523A - 527A						1.21	99				0.00		0.00		0.00		1.21	4.31									
	527A	532A	0.16		13	2.25	184	3.5	2.10		2.22		0.00		0.00	0.72	0.16	4.47	1.48	4.30	60.5	200	0.35	19.40	0.22	0.62	0.49
To STREET 2008, Pipe 532A - 534A						2.25	184				2.22		0.00		0.00			4.47									
Unknown Road1 - 05																										
Contribution From STREET 2008, Pipe 539A - 540A						6.25	511				2.22		0.00		0.00		8.47	8.47									
	540A	261A	0.03		1	6.28	512	3.4	5.60		2.22		0.00		0.00	0.72	0.03	8.50	2.81	9.12	38.0	250	0.25	29.73	0.31	0.61	0.53
To OLDENBURG AVENUE, Pipe 261A - 262A						6.28	512				2.22		0.00		0.00			8.50									
STREET 2002																										
Contribution From STREET 2008, Pipe 515A - 517A						0.75	62				0.00		0.00		0.00		0.75	0.75									
Contribution From STREET 2008, Pipe 516A - 517A						0.16	13				0.00		0.00		0.00		0.16	0.91									
	517A	518A	0.43		35	1.34	110	3.6	1.28		0.00		0.00	1.12	1.12	0.12	1.55	2.46	0.81	2.21	103.5	200	0.35	19.40	0.11	0.62	0.41
	518A	519A	0.46		38	1.80	148	3.6	1.70		0.00		0.00		1.12	0.12	0.46	2.92	0.96	2.79	117.5	200	0.35	19.40	0.14	0.62	0.44
To OLDENBURG AVENUE, Pipe 519A - 323A						1.80	148				0.00		0.00		1.12			2.92									
STREET 2003																										
Contribution From STREET 2008, Pipe 511A - 512A						0.37	30				0.00		0.00		0.00		0.37	0.37									
	512A	513A	0.65		53	1.02	83	3.6	0.97		0.00		0.00		0.00	0.00	0.65	1.02	0.34	1.31	99.5	200	0.35	19.40	0.07	0.62	0.35

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha				
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph			
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	0.330	L/s/ha	
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	0.600	m/s	
Max Res. Peak Factor =	4.00				Manning's n = (Conc)	0.013	(Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=	2.7		
Institutional =	0.32	l/s/Ha			Single house coeff=	3.4		

Designed:

Checked:

Dwg. Reference:

Sanitary Drainage Plan, Dwgs. No.

PROJECT: **Green Lands East & West**

LOCATION: **City of Ottawa**

File Ref: 20-1183

Date: **26 Jun 2020**

Sheet No. 1 of 3

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
	513A	514A	0.77		63	1.79	146	3.6	1.68		0.00		0.00		0.00	0.00	0.77	1.79	0.59	2.27	118.5	200	0.35	19.40	0.12	0.62	0.41
To OLDENBURG AVENUE, Pipe 514A - 519A						1.79	146				0.00		0.00		0.00			1.79									
STREET 2008																											
	511A	512A	0.37		30	0.37	30	3.7	0.36		0.00		0.00		0.00	0.00	0.37	0.37	0.12	0.48	58.0	200	0.70	27.44	0.02	0.87	0.33
To STREET 2003, Pipe 512A - 513A						0.37	30				0.00		0.00		0.00			0.37									
	515A	517A	0.75		62	0.75	62	3.6	0.73		0.00		0.00		0.00	0.00	0.75	0.75	0.25	0.98	112.5	200	0.65	26.44	0.04	0.84	0.40
To STREET 2002, Pipe 517A - 518A						0.75	62				0.00		0.00		0.00			0.75									
	516A	517A	0.16		13	0.16	13	3.7	0.16		0.00		0.00		0.00	0.00	0.16	0.16	0.05	0.21	34.5	200	0.65	26.44	0.01	0.84	0.24
To STREET 2002, Pipe 517A - 518A						0.16	13				0.00		0.00		0.00			0.16									
			0.39		0	0.39	0				0.00		0.00		0.00		0.39	0.39									
	508A	509A	0.83		68	1.22	68	3.6	0.80		0.00		0.00		0.00	0.00	0.83	1.22	0.40	1.20	94.5	200	0.65	26.44	0.05	0.84	0.43
			0.27		0	1.49	68				0.00		0.00		0.00		0.27	1.49									
	509A	510A	0.93		76	2.42	144	3.6	1.66		0.00		0.00		0.00	0.00	0.93	2.42	0.80	2.46	110.5	200	0.35	19.40	0.13	0.62	0.42
To OLDENBURG AVENUE, Pipe 510A - 514A						2.42	144				0.00		0.00		0.00			2.42									
	528A	529A	0.80		66	0.80	66	3.6	0.78		0.00		0.00		0.00	0.00	0.80	0.80	0.26	1.04	104.5	200	0.65	26.44	0.04	0.84	0.41
	529A	530A				0.80	66	3.6	0.78		0.00		0.00		0.00	0.00	0.00	0.80	0.26	1.04	11.5	200	0.35	19.40	0.05	0.62	0.33
	530A	532A	0.28		22	1.08	88	3.6	1.03		0.00		0.00		0.00	0.00	0.28	1.08	0.36	1.38	53.0	200	0.35	19.40	0.07	0.62	0.36
Contribution From STREET 2006, Pipe 527A - 532A						2.25	184				2.22		0.00		0.00		4.47	5.55									
Contribution From STREET 2006, Pipe 531A - 532A						0.49	40				0.00		0.00		0.00		0.49	6.04									
	532A	534A	0.30		25	4.12	337	3.4	3.76		2.22		0.00		0.00	0.72	0.30	6.34	2.09	6.57	60.5	200	0.35	19.40	0.34	0.62	0.56
Contribution From STREET 2004, Pipe 533A - 534A						0.52	43				0.00		0.00		0.00		0.52	6.86									
	534A	539A	0.22		18	4.86	398	3.4	4.41		2.22		0.00		0.00	0.72	0.22	7.08	2.34	7.47	60.5	200	0.35	19.40	0.38	0.62	0.58
Contribution From STREET 2006, Pipe 538A - 539A						1.27	104				0.00		0.00		0.00		1.27	8.35									
	539A	540A	0.12		9	6.25	511	3.4	5.59		2.22		0.00		0.00	0.72	0.12	8.47	2.80	9.10	32.0	200	0.60	25.41	0.36	0.81	0.74
To Unknown Road1 - 05, Pipe 540A - 261A						6.25	511				2.22		0.00		0.00			8.47									
OLDENBURG AVENUE																											
Contribution From STREET 2008, Pipe 509A - 510A						2.42	144				0.00		0.00		0.00		2.42	2.42									
	510A	514A	0.46		28	2.88	172	3.5	1.97		0.00		0.00		0.00	0.00	0.46	2.88	0.95	2.92	71.5	200	0.65	26.44	0.11	0.84	0.55
Contribution From STREET 2003, Pipe 513A - 514A						1.79	146				0.00		0.00		0.00		1.79	4.67									
	514A	519A	0.42		25	5.09	343	3.4	3.83		0.00		0.00		0.00	0.00	0.42	5.09	1.68	5.51	96.0	200	0.35	19.40	0.28	0.62	0.53
Contribution From STREET 2002, Pipe 518A - 519A						1.80	148				0.00		0.00		1.12		2.92	8.01									
			0.06		4	6.95	495				0.00		0.00		1.12		0.06	8.07									
	519A	323A	2.63		158	9.58	653	3.3	7.05		0.00		0.00		1.12	0.12	2.63	10.70	3.53	10.70	34.0	250	0.25	29.73	0.36	0.61	0.55
	323A	324A	0.02		1	9.60	654	3.3	7.06		0.00		0.00		1.12	0.12	0.02	10.72	3.54	10.71	10.5	250	0.25	29.73	0.36	0.61	0.56
	324A	325A	0.14		8	9.74	662	3.3	7.14		0.00		0.00		1.12	0.12	0.14	10.86	3.58	10.84	37.5	250	0.25	29.73	0.36	0.61	0.56
	325A	326A				9.74	662	3.3	7.14		0.00		0.00		1.12	0.12	0.00	10.86	3.58	10.84	11.0	250	0.25	29.73	0.36	0.61	0.56
	326A	328A	0.60		36	10.34	698	3.3	7.50		0.00		0.00		1.12	0.12	0.60	11.46	3.78	11.40	70.0	300	0.20	43.25	0.26	0.61	0.52
			0.28		17	10.62	715				0.00		0.00		1.12		0.28	11.74									
	328A	261A	0.30		18	10.92	733	3.3	7.85		0.00		0.00		1.12	0.12	0.30	12.04	3.97	11.95	65.5	300	0.20	43.25	0.28	0.61	0.52
Contribution From Unknown Road1 - 05, Pipe 540A - 261A						6.28	512				2.22		0.00		0.00		8.50	20.54									
			0.25	6	21	17.45	1266				2.22		0.00		1.12		0.25	20.79									
	261A	262A	0.50	16	44	17.95	1310	3.2	13.49		2.22		0.00		1.12	0.84	0.50	21.29	7.03	21.35	75.0	300	0.20	43.25	0.49	0.61	0.61

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha				
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph			
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	0.330	L/s/ha	
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	0.600	m/s	
Max Res. Peak Factor =	4.00				Manning's n = (Conc)	0.013	(Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=	2.7		
Institutional =	0.32	l/s/Ha			Single house coeff=	3.4		

Designed:

Checked:

Dwg. Reference:
Sanitary Drainage Plan, Dwgs. No.

PROJECT:
Green Lands East & West

LOCATION:
City of Ottawa

File Ref: 20-1183

Date: **26 Jun 2020**

Sheet No. 2 of 3

Lower flows projected than the flows previously summarized in the Fox Run Phase 1 design sheet.

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
			0.26	9	25	18.21	1335				2.22		0.00		1.12		0.26	21.55									
	262A	263A	0.29	8	28	18.50	1363	3.2	13.99		2.22		0.00		1.12	0.84	0.29	21.84	7.21	22.04	75.0	300	0.20	43.25	0.51	0.61	0.61
			0.23	4	14	18.73	1377				2.22		0.00		1.12		0.23	22.07									
			4.04	127	355	22.77	1732				2.22		0.00		1.12		4.04	26.11									
	263A	267A	5.24		315	28.01	2047	3.1	20.31		2.22		0.00		1.12	0.84	5.24	31.35	10.35	31.50	69.0	375	0.15	67.91	0.46	0.61	0.60
			0.73		2	28.74	2049				2.22		0.00		1.12		0.73	32.08									
	267A	150A	0.88	46	126	29.62	2175	3.0	21.47		2.22		0.00		1.12	0.84	0.88	32.96	10.88	33.19	22.0	375	0.15	67.91	0.49	0.61	0.61
STREET 2001																											
	505A	506A	0.61		24	0.61	24	3.7	0.29		0.00		0.00		0.00	0.00	0.61	0.61	0.20	0.49	74.5	200	0.65	26.44	0.02	0.84	0.32
To STREET 2009, Pipe 506A - 507A						0.61	24				0.00		0.00		0.00			0.61									
	502A	503A	0.70		28	0.70	28	3.7	0.33		0.00		0.00		0.00	0.00	0.70	0.70	0.23	0.57	86.5	200	0.35	19.40	0.03	0.62	0.27
	503A	504A	0.56		22	1.26	50	3.7	0.59		0.00		0.00		0.00	0.00	0.56	1.26	0.42	1.01	84.0	200	0.35	19.40	0.05	0.62	0.32
	504A	506A	0.26		10	1.52	60	3.6	0.71		0.00		0.00		0.00	0.00	0.26	1.52	0.50	1.21	84.0	200	0.35	19.40	0.06	0.62	0.34
To STREET 2009, Pipe 506A - 507A						1.52	60				0.00		0.00		0.00			1.52									
STREET 2009																											
Contribution From STREET 2001, Pipe 504A - 506A						1.52	60				0.00		0.00		0.00		1.52	1.52									
Contribution From STREET 2001, Pipe 505A - 506A						0.61	24				0.00		0.00		0.00		0.61	2.13									
	506A	507A				2.13	84	3.6	0.98		0.00		0.00		0.00	0.00	0.00	2.13	0.70	1.69	38.5	200	0.35	19.40	0.09	0.62	0.37
Green Lands East																											

DESIGN PARAMETERS								
Park Flow =	9300	L/ha/da	0.10764	l/s/Ha				
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph			
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	0.330	L/s/ha	
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	0.600	m/s	
Max Res. Peak Factor =	4.00				Manning's n = (Conc)	0.013	(Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=	2.7		
Institutional =	0.32	l/s/Ha			Single house coeff=	3.4		

Designed:	PROJECT:		
	Green Lands East & West		
Checked:	LOCATION:		
	City of Ottawa		
Dwg. Reference:	File Ref: 20-1183	Date:	Sheet No. 3
Sanitary Drainage Plan, Dwgs. No.		**26 Jun 2020**	of 3

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Unknown Road4 - 04																											
	518A	519A	0.67		54	0.67	54	4.0	0.70		0.00		0.00		0.00	0.00	0.67	0.67	0.19	0.89	113.0	200	0.65	26.44	0.03	0.84	0.39
To Unknown Road2 - 02, Pipe 519A - 521A						0.67	54				0.00		0.00		0.00			0.67									
Unknown Road2 - 02																											
	515A	516A	0.67		54	0.67	54	4.0	0.70		0.00		0.00		0.00	0.00	0.67	0.67	0.19	0.89	105.5	200	0.65	26.44	0.03	0.84	0.39
	516A	517A	0.15		12	0.82	66	4.0	0.86		0.00		0.00		0.00	0.00	0.15	0.82	0.23	1.09	11.0	200	0.34	19.12	0.06	0.61	0.33
	517A	519A	0.21		17	1.03	83	4.0	1.08		0.00		0.00		0.00	0.00	0.21	1.03	0.29	1.37	53.0	200	1.28	37.11	0.04	1.18	0.56
Contribution From Unknown Road4 - 04, Pipe 518A - 519A						0.67	54				0.00		0.00		0.00		0.67	1.70									
	519A	521A	0.19		16	1.89	153	4.0	1.98		0.00		0.00		0.00	0.00	0.19	1.89	0.54	2.52	60.5	200	0.34	19.12	0.13	0.61	0.42
To Unknown Road3 - 03, Pipe 521A - 522A						1.89	153				0.00		0.00		0.00			1.89									
Unknown Road3 - 03																											
	520A	521A	0.70		56	0.70	56	4.0	0.73		0.00		0.00		0.00	0.00	0.70	0.70	0.20	0.93	113.0	200	0.65	26.44	0.04	0.84	0.39
Contribution From Unknown Road2 - 02, Pipe 519A - 521A						1.89	153				0.00		0.00		0.00		1.89	2.59									
	521A	522A	0.07		6	2.66	215	4.0	2.79		0.00		0.00		0.00	0.00	0.07	2.66	0.76	3.55	18.0	200	0.34	19.12	0.19	0.61	0.46
To Unknown Road8 - 08, Pipe 522A - 523A						2.66	215				0.00		0.00		0.00			2.66									
Unknown Road8 - 08																											
Contribution From Unknown Road3 - 03, Pipe 521A - 522A						2.66	215				0.00		0.00		0.00		2.66	2.66									
			0.02		2	2.68	217				0.00		0.00		0.00		0.02	2.68									
	522A	523A	0.09		8	2.77	225	4.0	2.92		0.00		0.00		0.00	0.00	0.09	2.77	0.79	3.71	45.0	200	0.34	19.12	0.19	0.61	0.47
	523A	524A	0.02		2	2.79	227	4.0	2.94		0.00		0.00		0.00	0.00	0.02	2.79	0.80	3.74	27.5	200	0.34	19.12	0.20	0.61	0.47
To Unknown Road1 - 01, Pipe 524A - 525A						2.79	227				0.00		0.00		0.00			2.79									
Unknown Road5 - 05																											
	506A	507A	0.14		12	0.14	12	4.0	0.16		0.00		0.00		0.00	0.00	0.14	0.14	0.04	0.20	30.5	200	0.65	26.44	0.01	0.84	0.24
To Unknown Road6 - 06, Pipe 507A - 508A						0.14	12				0.00		0.00		0.00			0.14									
	501A	502A	0.28		23	0.28	23	4.0	0.30		0.00		0.00		0.00	0.00	0.28	0.28	0.08	0.38	55.0	200	0.65	26.44	0.01	0.84	0.29
	502A	503A	0.13		11	0.41	34	4.0	0.44		0.00		0.00		0.00	0.00	0.13	0.41	0.12	0.56	11.0	200	0.34	19.12	0.03	0.61	0.27
			0.28		23	0.69	57				0.00		0.00		0.00		0.28	0.69									
	503A	508A	0.33		27	1.02	84	4.0	1.09		0.00		0.00		0.00	0.00	0.33	1.02	0.29	1.38	101.5	200	0.34	19.12	0.07	0.61	0.35
To Unknown Road6 - 06, Pipe 508A - 509A						1.02	84				0.00		0.00		0.00			1.02									
	501A	504A	0.17		14	0.17	14	4.0	0.18		0.00		0.00		0.00	0.00	0.17	0.17	0.05	0.23	11.0	200	0.65	26.44	0.01	0.84	0.26
	504A	505A	0.56		45	0.73	59	4.0	0.76		0.00		0.00		0.00	0.00	0.56	0.73	0.21	0.97	80.5	200	0.34	19.12	0.05	0.61	0.31
	505A	507A	0.14		12	0.87	71	4.0	0.92		0.00		0.00		0.00	0.00	0.14	0.87	0.25	1.17	21.5	200	0.34	19.12	0.06	0.61	0.33
To Unknown Road6 - 06, Pipe 507A - 508A						0.87	71				0.00		0.00		0.00			0.87									
Unknown Road6 - 06																											
Contribution From Unknown Road5 - 05, Pipe 505A - 507A						0.87	71				0.00		0.00		0.00		0.87	0.87									
Contribution From Unknown Road5 - 05, Pipe 506A - 507A						0.14	12				0.00		0.00		0.00		0.14	1.01									
	507A	508A	0.26		21	1.27	104	4.0	1.35		0.00		0.00		0.00	0.00	0.26	1.27	0.36	1.71	74.0	200	0.34	19.12	0.09	0.61	0.37
Contribution From Unknown Road5 - 05, Pipe 503A - 508A						1.02	84				0.00		0.00		0.00		1.02	2.29									
	508A	509A	0.22		18	2.51	206	4.0	2.67		0.00		0.00		0.00	0.00	0.22	2.51	0.72	3.39	60.5	200	0.34	19.12	0.18	0.61	0.45
	509A	510A	0.22		18	2.73	224	4.0	2.90		0.00		0.00		0.00	0.00	0.22	2.73	0.78	3.68	60.5	200	0.34	19.12	0.19	0.61	0.47
	510A	511A	0.24		20	2.97	244	4.0	3.16		0.00		0.00		0.00	0.00	0.24	2.97	0.85	4.01	61.5	200	0.34	19.12	0.21	0.61	0.48

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha			
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph		
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	0.286	L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	0.600	m/s
Max Res. Peak Factor =	4.00				Manning's n = (Conc)	0.013 (Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=	2.7	
Institutional =	0.32	l/s/Ha			Single house coeff=	3.4	

Designed:

Checked:

Dwg. Reference:
Sanitary Drainage Plan, Dwgs. No.

PROJECT: Laffin Lands

LOCATION: **City of Ottawa**

File Ref:

Date: **22 Jun 2020**

Sheet No. 1 of 2

TOTAL FLOWS FROM LAFFIN ONLY

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION				RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET		FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
		511A	513A	0.19		16	3.16	260	4.0	3.37		0.00		0.00		0.00	0.00	0.19	3.16	0.90	4.27	60.5	200	0.34	19.12	0.22	0.61	0.49
To Unknown Road1 - 01, Pipe 513A - 514A							3.16	260				0.00		0.00		0.00			3.16									
Unknown Road1 - 01																												
		512A	513A	0.11		9	0.11	9	4.0	0.12		0.00		0.00		0.00	0.00	0.11	0.11	0.03	0.15	30.5	200	0.65	26.44	0.01	0.84	0.22
Contribution From Unknown Road6 - 06, Pipe 511A - 513A							3.16	260				0.00		0.00		0.00		3.16	3.27									
		513A	514A	0.71		57	3.98	326	4.0	4.23		0.00		0.00		0.00	0.00	0.71	3.98	1.14	5.36	120.0	200	0.34	19.12	0.28	0.61	0.52
		514A	524A	0.05		4	4.03	330	4.0	4.28		0.00		0.00		0.00	0.00	0.05	4.03	1.15	5.43	9.5	200	0.34	19.12	0.28	0.61	0.52
Contribution From Unknown Road8 - 08, Pipe 523A - 524A							2.79	227				0.00		0.00		0.00		2.79	6.82									
				0.15		12	6.97	569				0.00		0.00		0.00		0.15	6.97									
		524A	525A	0.15	3	11	7.12	580	3.9	7.41		0.00		0.00		0.00	0.00	0.15	7.12	2.04	9.44	61.0	250	0.25	29.73	0.32	0.61	0.54
		525A	526A	0.80	18	62	7.92	642	3.9	8.15		0.00		0.00		0.00	0.00	0.80	7.92	2.27	10.41	83.5	250	0.25	29.73	0.35	0.61	0.55
				0.32	2	7	8.24	649				0.00		0.00		0.00		0.32	8.24									
		526A	8A	6.30		481	14.54	1130	3.8	13.79		0.00		0.00		0.00	0.00	6.30	14.54	4.16	17.95	81.5	250	0.25	29.73	0.60	0.61	0.63
		8A	9A	0.12	3	11	14.66	1141	3.8	13.91		0.00		0.00		0.00	0.00	0.12	14.66	4.19	18.10	26.0	250	0.25	29.73	0.61	0.61	0.63
		9A	11A	0.25	4	14	14.91	1155	3.8	14.07		0.00		0.00		0.00	0.00	0.25	14.91	4.26	18.33	11.0	250	0.25	29.73	0.62	0.61	0.64
		11A	12A	0.26	6	21	15.17	1176	3.8	14.31		0.00		0.00		0.00	0.00	0.26	15.17	4.34	18.64	44.5	250	0.25	29.73	0.63	0.61	0.64
		12A	13A	0.26	6	21	15.43	1197	3.7	14.54		0.00		0.00		0.00	0.00	0.26	15.43	4.41	18.95	41.5	250	0.25	29.73	0.64	0.61	0.64
To Unknown Road9 - 09, Pipe 13A - 20A							15.43	1197				0.00		0.00		0.00			15.43									
Unknown Road9 - 09																												
Contribution From Unknown Road1 - 01, Pipe 12A - 13A							15.43	1197				0.00		0.00		0.00		15.43	15.43									
				0.25	3	11	15.68	1208				0.00		0.00		0.00		0.25	15.68									
		13A	20A	44.98		2874	60.66	4082	3.3	43.99		0.00		0.00		0.00	0.00	44.98	60.66	17.35	61.34	64.5	375	0.22	82.24	0.75	0.74	0.81
		20A	21A				60.66	4082	3.3	43.99		0.00		0.00		0.00	0.00	0.00	60.66	17.35	61.34	47.5	450	0.12	98.76	0.62	0.62	0.65
		21A	210A				60.66	4082	3.3	43.99		0.00		0.00		0.00	0.00	0.00	60.66	17.35	61.34	14.5	450	0.12	98.76	0.62	0.62	0.65

TOTAL FLOWS FROM ALL SOUTH LANDS TO PHASE 1 SEWER

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha			
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph		
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	0.286	L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	0.600	m/s
Max Res. Peak Factor =	4.00				Manning's n = (Conc)	0.013	(Pvc) 0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=	2.7	
Institutional =	0.32	l/s/Ha			Single house coeff=	3.4	

Designed:

Checked:

Dwg. Reference: Sanitary Drainage Plan, Dwgs. No.

PROJECT: Laffin Lands

LOCATION: City of Ottawa

File Ref:

Date: 22 Jun 2020

Sheet No. 2 of 2

SANITARY SEWER CALCULATION SHEET

Ottawa

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA Nominal (mm)	DIA Actual (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)
cercle Equitation Circle																											
	5A	6A	0.38	9	30.6	0.38	30.6	4.00	0.50								0.38	0.38	0.106	0.61	50.0	200	200	0.90	31.12	0.02	0.99
	6A	7A	0.71	20	68.0	1.09	98.6	4.00	1.60								0.71	1.09	0.305	1.91	107.5	200	200	0.40	20.74	0.09	0.66
To cercle Equitation Circle , Pipe 7A - 8A						1.09	98.6																				
	1A	2A	0.24	4	13.6	0.24	13.6	4.00	0.22								0.24	0.24	0.067	0.29	40.0	200	200	0.65	26.44	0.01	0.84
	2A	3A	0.38	8	27.2	0.62	40.8	4.00	0.66								0.38	0.62	0.174	0.83	94.0	200	200	0.40	20.74	0.04	0.66
	3A	4A	0.06	1	3.4	0.68	44.2	4.00	0.72								0.06	0.68	0.190	0.91	11.0	200	200	0.40	20.74	0.04	0.66
	4A	7A	0.29	7	23.8	0.97	68.0	4.00	1.10								0.29	0.97	0.272	1.37	62.5	200	200	0.85	30.24	0.05	0.96
Contribution From cercle Equitation Circle, Pipe 6A - 7A						1.09	98.6										1.09	2.06									
	7A	8A	0.25	5	17.0	2.31	183.6	4.00	2.98								0.25	2.31	0.647	3.63	70.5	200	200	0.40	20.74	0.18	0.66
To croissant Hackamore Crescent , Pipe 8A - 152A						2.31	183.6																				
croissant Hackamore Crescent																											
Contribution From Future Phase						0.94	72.0										0.94	0.94									
	PLUG	8A	0.04	1	3.4	0.98	75.4	4.00	1.22								0.04	0.98	0.274	1.49	11.0	200	200	0.50	23.19	0.06	0.74
Contribution From cercle Equitation Circle, Pipe 7A - 8A						2.31	183.6										2.31	3.29									
	8A	152A	0.26	5	17.0	3.55	276.0	4.00	4.47								0.26	3.55	0.994	5.46	73.5	200	200	0.40	20.74	0.26	0.66
To chemin Meynell Road, Pipe 152A - 153A						3.55	276.0																				
croissant Cantle Crescent																											
Contribution From Flushing Device (1.50 L/s)																				1.50							
	9A	152A	0.34	4	13.6	0.34	13.6	4.00	0.22								0.34	0.34	0.095	1.82	59.0	200	200	0.65	26.44	0.07	0.84
To chemin Meynell Road, Pipe 152A - 153A						0.34	13.6																				
	10A	11A	0.22	3	10.2	0.22	10.2	4.00	0.17								0.22	0.22	0.062	0.23	16.5	200	200	0.65	26.44	0.01	0.84
	11A	153A	0.65	16	54.4	0.87	64.6	4.00	1.05								0.65	0.87	0.244	1.29	103.5	200	200	0.35	19.40	0.07	0.62
To chemin Meynell Road, Pipe 153A - 155A						0.87	64.6																				
Contribution From Future Phase						1.73	130.0										1.73	1.73									
	PLUG	153A	0.00	0	0.0	1.73	130.0	4.00	2.11								0.00	1.73	0.484	2.59	15.5	200	200	0.40	20.74	0.12	0.66
To chemin Meynell Road, Pipe 153A - 155A						1.73	130.0																				
croissant Pelham Crescent																											
	12A	13A	0.36	7	23.8	0.36	23.8	4.00	0.39								0.36	0.36	0.101	0.49	38.0	200	200	0.65	26.44	0.02	0.84
	13A	155A	0.65	16	54.4	1.01	78.2	4.00	1.27								0.65	1.01	0.283	1.55	105.0	200	200	0.40	20.74	0.07	0.66
To chemin Meynell Road, Pipe 155A - 156A						1.01	78.2																				
	1500A	15A	0.11	1	3.4	0.11	3.4	4.00	0.06								0.11	0.11	0.031	0.09	10.0	200	200	0.65	26.44	0.00	0.84
	15A	16A	0.27	6	20.4	0.38	23.8	4.00	0.39								0.27	0.38	0.106	0.50	37.0	200	200	0.65	26.44	0.02	0.84
	16A	156A	0.73	19	64.6	1.11	88.4	4.00	1.43								0.73	1.11	0.311	1.74	112.0	200	200	0.40	20.74	0.08	0.66
To chemin Meynell Road, Pipe 156A - 157A						1.11	88.4																				
Contribution From Future Phase						2.25	162.0										2.25	2.25									
	PLUG	156A	0.00	0	0.0	2.25	162.0	4.00	2.63								0.00	2.25	0.630	3.26	14.5	200	200	0.40	20.74	0.16	0.66
To chemin Meynell Road, Pipe 156A - 157A						2.25	162.0																				

DESIGN PARAMETERS

Average Daily Flow =	350	l/p/day	Industrial Peak Factor = as per MOE Graph	
Commercial/Institution Flow =	50000	L/ha/da	Extraneous Flow =	0.280 L/s/ha
Industrial Flow =	35000	L/ha/da	Minimum Velocity =	0.60 m/s
Max Res. Peak Factor =	4.00		Manning's n =	0.013
Commercial/Institution/Park Peak Factor =	1.50		Townhouse coeff=	2.7
Park Average Flow =	9300	L/ha/da	Single house coeff=	3.4

Designed: K.M.

Checked: W.L.

Dwg. Reference: Sanitary Drainage Plan, Dwg. No. 39 - 40

PROJECT: **Caivan Coomunities - Richmond Phase 1**

LOCATION: **City of Ottawa**

File Ref: 15-783

Date: November, 2017

Sheet No. 1 of 2

SUMMATION OF PROJECTED POPULATIONS FROM THE AREAS NORTH OF PERTH STREET CONSIDERED IN THE FOX RUN PHASE 1 DESIGN:
TO MH150A = 1897 persons

Projected Total flow of 41.93 L/s in the Phase 1 design sheet.

Projected Total flow from the Phase 2 (North) and Green Lands West design sheet (including external areas) = XXL/s < 41.93 L/s therefore OK for downstream capacities.

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA Nominal (mm)	DIA Actual (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)
croissant Reynard Crescent																											
	17A	18A	0.20	2	6.8	0.20	6.8	4.00	0.11								0.20	0.20	0.056	0.17	11.0	200	200	2.00	46.38	0.00	1.48
	18A	19A	0.28	4	13.6	0.48	20.4	4.00	0.33								0.28	0.48	0.134	0.46	61.0	200	200	0.50	23.19	0.02	0.74
	19A	20A	0.09	1	3.4	0.57	23.8	4.00	0.39								0.09	0.57	0.160	0.55	11.0	200	200	0.40	20.74	0.03	0.66
	20A	160A	0.77	9	30.6	1.34	54.4	4.00	0.88								0.77	1.34	0.375	1.26	114.0	200	200	0.40	20.74	0.06	0.66
To cour Noriker Court, Pipe 160A - 161A						1.34	54.4																				
	17A	159A	0.84	13	44.2	0.84	44.2	4.00	0.72								0.84	0.84	0.235	0.96	113.5	200	200	0.65	26.44	0.04	0.84
To cour Noriker Court, Pipe 159A - 160A						0.84	44.2																				
chemin Meynell Road																											
Contribution From External						31.61	1897.0			1.12		2.75		1.13			36.61	36.61									
	150A	151A	0.45	7	23.8	32.06	1920.8	3.60	28.01		1.12		2.75		1.13	3.54	0.45	37.06	10.377	41.93	73.5	450	450	0.13	102.80	0.41	0.65
	151A	152A	0.51	11	37.4	32.57	1958.2	3.59	28.48		1.12		2.75		1.13	3.54	0.51	37.57	10.520	42.54	73.5	450	450	0.13	102.80	0.41	0.65
Contribution From croissant Cantle Crescent, Pipe 9A - 152A						0.34	13.6										0.34	37.91									
Contribution From croissant Hackamore Crescent, Pipe 8A - 152A						3.55	276.0										3.55	41.46									
	152A	153A	0.13	0	0.0	36.59	2247.8	3.55	32.33		1.12		2.75		1.13	3.54	0.13	41.59	11.645	49.02	70.5	450	450	0.13	102.80	0.48	0.65
Contribution From Future Street, Pipe Plug - 153A						1.73	130.0										1.73	43.32									
Contribution From croissant Cantle Crescent, Pipe 11A - 153A						0.87	64.6										0.87	44.19									
	153A	155A	0.14	0	0.0	39.33	2442.4	3.52	34.83		1.12		2.75		1.13	3.54	0.14	44.33	12.412	52.28	70.5	450	450	0.13	102.80	0.51	0.65
Contribution From Block 236 (Park)														0.96	0.96	0.16	0.96	0.96	0.269	0.43	13.0	200	200	1.00	32.80	0.01	1.04
Contribution From croissant Pelham Crescent, Pipe 13A - 155A						1.01	78.2										1.01	46.30									
	155A	156A	0.14	0	0.0	40.48	2520.6	3.51	35.84		1.12		2.75		2.09	3.70	0.14	46.44	13.003	54.04	71.0	450	450	0.13	102.80	0.53	0.65
Contribution From Future Street, Pipe Plug - 156A						2.25	162.0										2.25	48.69									
Contribution From croissant Pelham Crescent, Pipe 16A - 156A						1.11	88.4										1.11	49.80									
	156A	157A	0.63	12	40.8	44.47	2811.8	3.47	39.52		1.12		2.75		2.09	3.70	0.63	50.43	14.120	58.84	102.5	450	450	0.13	102.80	0.57	0.65
	157A	158A	0.68	15	51.0	45.15	2862.8	3.46	40.13		1.12		2.75		2.09	3.70	0.68	51.11	14.311	59.64	92.5	450	450	0.13	102.80	0.58	0.65
To cour Noriker Court, Pipe 158A - 159A						45.15	2862.8				1.12		2.75		2.09												
cour Noriker Court																											
Contribution From Future Phase						4.42	330.0										4.42	4.42									
	PLUG	158A	0.00	0	0.0	4.42	330.0	4.00	5.35								0.00	4.42	1.238	6.59	14.0	200	200	0.35	19.40	0.34	0.62
Contribution From chemin Meynell Road, Pipe 157A - 158A						45.15	2862.8				1.12		2.75		2.09		51.11	55.53									
	158A	159A	0.34	4	13.6	49.91	3206.4	3.42	44.42		1.12		2.75		2.09	3.70	0.34	55.87	15.644	65.26	79.5	450	450	0.13	102.80	0.63	0.65
Contribution From croissant Reynard Crescent, Pipe 17A - 159A						0.84	44.2										0.84	56.71									
	159A	160A	0.37	5	17.0	51.12	3267.6	3.41	45.14		1.12		2.75		2.09	3.70	0.37	57.08	15.982	66.32	76.5	450	450	0.13	102.80	0.65	0.65
Contribution From croissant Reynard Crescent, Pipe 20A - 160A						1.34	54.4										1.34	58.42									
	160A	161A	0.36	4	13.6	52.82	3335.6	3.40	45.94		1.12		2.75		2.09	3.70	0.36	58.78	16.458	67.60	72.5	450	450	0.13	102.80	0.66	0.65
To Block 222 (SWM Pond), Pipe 161A - 121A						52.82	3335.6				1.12		2.75		2.09												
Block 222 (SWM Pond)																											
Contribution From External						51.61	3097.0					2.65		4.10			58.36	58.36									
	PLUG	161A	0.00	0	0.0	51.61	3097.0	3.43	43.03				2.65		4.10	2.96	0.00	58.36	16.341	62.33	48.5	450	450	0.13	102.80	0.61	0.65
Contribution From cour Noriker Court, Pipe 160A - 161A						52.82	3335.6				1.12		2.75		2.09		58.78	117.14									
	161A	121A	0.00	0	0.0	104.43	6432.6	3.14	81.82		1.12		5.40		6.19	6.66	0.00	117.14	32.799	122.78	42.0	600	600	0.12	212.70	0.58	0.75
To Sanitary Trunk, Pipe 121A - 123A						104.43	6432.6				1.12		5.40		6.19												

DESIGN PARAMETERS				
Average Daily Flow =	350	l/p/day	Industrial Peak Factor = as per MOE Graph	
Commercial/Institution Flow =	50000	L/ha/da	Extraneous Flow =	0.280 L/s/ha
Industrial Flow =	35000	L/ha/da	Minimum Velocity =	0.60 m/s
Max Res. Peak Factor =	4.00		Manning's n =	0.013
Commercial/Institution/Park Pea				
Park Average Flow =				

Designed: K.M.

Checked: W.L.

PROJECT: **Caivan Coomunities - Richmond Phase 1**

LOCATION: **City of Ottawa**

File Ref: 15-783 | Date: November, 2017 | Sheet No. 2 of 2

SUMMATION OF PROJECTED POPULATIONS FROM THE AREAS SOUTH OF FOX RUN PHASE 1 DESIGN (i.e. Mattamy Lands and the Laffin Lands (RVDC):
TO MH161A

Projected Total flow of 62.33 L/s in the Phase 1 design sheet.

Projected Total flow from the Mattamy Lands and Laffin Lands design sheet = 61.34L/s < 62.33 L/s therefore OK for downstream capacities

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
PERTH STREET																													
		0.26						0.26					0.00		0.00		0.00	0.00	0.26	0.26	0.09	0.09							
	264A	265A	0.20	11		11	30	0.46	30	3.68	0.36		0.00		0.00		0.00	0.00	0.20	0.46	0.15	0.51	74.0	200	0.65	26.44	0.02	0.84	0.33
			0.47				0	0.93	30	3.68	0.36		0.00		0.00		0.00	0.00	0.47	0.93	0.31	0.67							
	265A	267A	0.23	13		13	36	1.16	66	3.63	0.78		0.00		0.00		0.00	0.00	0.23	1.16	0.38	1.16	120.0	200	0.75	28.40	0.04	0.90	0.44
To OLDENBURG AVENUE, Pipe 267A - 150A								1.16	66				0.00		0.00		0.00			1.16									
CHASING GROVE																													
	251A	258A	0.41	15		15	41	0.41	41	3.67	0.49		0.00		0.00		0.00	0.00	0.41	0.41	0.14	0.62	71.5	200	0.65	26.44	0.02	0.84	0.35
	258A	259A	0.48	18		18	49	0.89	90	3.60	1.05		0.00		0.00		0.00	0.00	0.48	0.89	0.29	1.35	78.5	200	0.80	29.34	0.05	0.93	0.47
To BASCULE PLACE, Pipe 259A - 263A								0.89	90				0.00		0.00		0.00			0.89									
LATIGO RIDGE																													
Contribution From TRAMMEL ROAD, Pipe 250A - 252A								0.20	17				0.00		0.00		0.00		0.20	0.20									
Contribution From TRAMMEL ROAD, Pipe 251A - 252A								0.22	19				0.00		0.00		0.00		0.22	0.42									
	252A	253A	0.54	20		20	54	0.96	90	3.60	1.05		0.00		0.00		0.00	0.00	0.54	0.96	0.32	1.37	98.5	200	0.35	19.40	0.07	0.62	0.35
	253A	257A	0.29	10		10	27	1.25	117	3.58	1.36		0.00		0.00		0.00	0.00	0.29	1.25	0.41	1.77	51.5	200	0.35	19.40	0.09	0.62	0.38
To BASCULE PLACE, Pipe 257A - 259A								1.25	117				0.00		0.00		0.00			1.25									
BASCULE PLACE																													
Contribution From POSTILION STREET, Pipe 255A - 256A								6.16	394				0.00		0.00		0.00		6.16	6.16									
	256A	257A	0.24	8		8	22	6.40	416	3.41	4.60		0.00		0.00		0.00	0.00	0.24	6.40	2.11	6.71	61.0	250	0.25	29.73	0.23	0.61	0.49
Contribution From LATIGO RIDGE, Pipe 253A - 257A								1.25	117				0.00		0.00		0.00		1.25	7.65									
	257A	259A	0.26	7		7	19	7.91	552	3.36	6.01		0.00		0.00		0.00	0.00	0.26	7.91	2.61	8.62	61.0	250	0.25	29.73	0.29	0.61	0.52
Contribution From CHASING GROVE, Pipe 258A - 259A								0.89	90				0.00		0.00		0.00		0.89	8.80									
	259A	263A	0.21	4		4	11	9.01	653	3.33	7.05		0.00		0.00		0.00	0.00	0.21	9.01	2.97	10.02	72.5	300	0.20	43.25	0.23	0.61	0.50
To OLDENBURG AVENUE, Pipe 263A - 267A								9.01	653				0.00		0.00		0.00			9.01									
TRAMMEL ROAD																													
	250A	252A	0.20	6		6	17	0.20	17	3.71	0.20		0.00		0.00		0.00	0.00	0.20	0.20	0.07	0.27	47.0	200	0.70	27.44	0.01	0.87	0.28
To LATIGO RIDGE, Pipe 252A - 253A								0.20	17				0.00		0.00		0.00			0.20									
	251A	252A	0.22	7		7	19	0.22	19	3.71	0.23		0.00		0.00		0.00	0.00	0.22	0.22	0.07	0.30	61.0	200	0.85	30.24	0.01	0.96	0.31
To LATIGO RIDGE, Pipe 252A - 253A								0.22	19				0.00		0.00		0.00			0.22									
	251A	261A	0.24	7		7	19	0.24	19	3.71	0.23		0.00		0.00		0.00	0.00	0.24	0.24	0.08	0.31	72.5	200	1.40	38.81	0.01	1.24	0.36
To OLDENBURG AVENUE, Pipe 261A - 262A								0.24	19				0.00		0.00		0.00			0.24									

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha			
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph		
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	0.330	L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	0.600	m/s
Max Res. Peak Factor =	3.80				Manning's n = (Conc)	0.013	(Pvc) 0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=	2.7	
Institutional =	0.32	l/s/Ha			Single house coeff=	3.4	

Designed: SLM

Checked: ADF

Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 28

PROJECT: **Caivan Foxrun - Phase 2B**

LOCATION: **City of Ottawa**

File Ref:

Date: **November 26 2019**

Sheet No. 1 of 2

1083_SAN_v3.xlsx

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
TRAMMEL ROAD																													
			0.05				1	0.05	1				0.00		0.00		0.00		0.05	0.05									
	329A	261A	5.87				353	5.92	354	3.44	3.94	1.87	1.87		0.00	1.14	1.14	0.73	8.88	8.93	2.95	7.62	38.0	250	0.25	29.73	0.26	0.61	0.51
To OLDENBURG AVENUE, Pipe 261A - 262A								5.92	354				1.87		0.00		1.14			8.93									
POSTILION STREET																													
	Fut. 317A	254A	5.15				308	5.15	308	3.46	3.45		0.00		0.00		0.00	0.00	5.15	5.15	1.70	5.15	65.5	250	0.25	29.73	0.17	0.61	0.45
			0.23	8		8	22	5.38	330				0.00		0.00		0.00		0.23	5.38									
	254A	255A	0.29	8	8		28	5.67	358	3.44	3.99		0.00		0.00		0.00	0.00	0.29	5.67	1.87	5.86	77.5	250	0.25	29.73	0.20	0.61	0.47
			0.20	7		7	19	5.87	377				0.00		0.00		0.00		0.20	5.87									
	255A	256A	0.29	5	5		17	6.16	394	3.42	4.37		0.00		0.00		0.00	0.00	0.29	6.16	2.03	6.40	72.0	250	0.25	29.73	0.22	0.61	0.48
To BASCULE PLACE, Pipe 256A - 257A								6.16	394				0.00		0.00		0.00			6.16									
OLDENBURG AVENUE																													
	Fut. 328A	261A	12.29				740	12.29	740	3.30	7.92		0.00		0.00		0.00	0.00	12.29	12.29	4.06	11.98	65.5	300	0.20	43.25	0.28	0.61	0.52
Contribution From TRAMMEL ROAD, Pipe 329A - 261A								5.92	354				1.87		0.00		1.14		8.93	21.22									
Contribution From TRAMMEL ROAD, Pipe 251A - 261A								0.24	19				0.00		0.00		0.00		0.24	21.46									
			0.25	6	6		21	18.70	1134				1.87		0.00		1.14		0.25	21.71									
	261A	262A	0.26	9		9	25	18.96	1159	3.21	12.04		1.87		0.00		1.14	0.73	0.26	21.97	7.25	20.02	75.0	300	0.20	43.25	0.46	0.61	0.60
			0.26	9		9	25	19.22	1184				1.87		0.00		1.14		0.26	22.23									
	262A	263A	0.29	8	8		28	19.51	1212	3.20	12.55		1.87		0.00		1.14	0.73	0.29	22.52	7.43	20.71	75.0	300	0.20	43.25	0.48	0.61	0.60
Contribution From BASCULE PLACE, Pipe 259A - 263A								9.01	653				0.00		0.00		0.00		9.01	31.53									
			0.18	4		4	11	28.70	1876				1.87		0.00		1.14		0.18	31.71									
	263A	267A	0.23	4	4		14	28.93	1890	3.08	18.89		1.87		0.00		1.14	0.73	0.23	31.94	10.54	30.16	66.0	375	0.15	67.91	0.44	0.61	0.60
Contribution From PERTH STREET, Pipe 265A - 267A								1.16	66				0.00		0.00		0.00		1.16	33.10									
	267A	150A						30.09	1956	3.07	19.49		1.87		0.00		1.14	0.73	0.00	33.10	10.92	31.14	25.0	375	0.15	67.91	0.46	0.61	0.60
MEYNELL ROAD																													
	150A	151A						30.09	1956	3.07	19.49		1.87		0.00		1.14	0.73	0.00	33.10	10.92	31.14	73.5	450	0.13	102.80	0.30	0.65	0.56

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha			
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph		
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	0.330	L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	0.600	m/s
Max Res. Peak Factor =	3.80				Manning's n = (Conc)	0.013	(Pvc) 0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=	2.7	
Institutional =	0.32	l/s/Ha			Single house coeff=	3.4	

Designed: SLM	PROJECT: **Caivan Foxrun - Phase 2B**		
Checked: ADF	LOCATION: **City of Ottawa**		
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 28	File Ref:	Date: **November 26 2019**	Sheet No. 2 of 2

Sanitary flow at Meynell/Perth Intersection (Ex Sanitary MH 150A)

APPENDIX E

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

	LOCATION		AREA (Ha)														FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year	10 Year	100 Year										
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	LOW (min	Q/Q full
STREET 2004																																
	535	536	0.52	0.66	0.95	0.95			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	73	450	450	CONC	0.20	101.0	127.5033	0.8017	2.0997	0.575
To STREET 2008, Pipe 536 - 541						0.95				0.00				0.00				0.00	12.10														
STREET 2005																																
	522	523	0.49	0.66	0.90	0.90			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	69	375	375	PVC	0.30	64.5	96.0323	0.8695	1.2364	0.719
	523	524	0.45	0.66	0.83	1.72			0.00	0.00			0.00	0.00			0.00	0.00	11.24	72.36	98.09	114.95	168.00	125	450	450	CONC	0.30	64.5	156.1591	0.9819	1.0949	0.799
	524	525			0.00	1.72			0.00	0.00			0.00	0.00			0.00	0.00	12.33	68.88	93.30	109.32	159.73	119	450	450	CONC	0.25	5.0	142.5531	0.8963	0.0930	0.833
	525	529	0.27	0.66	0.50	2.22			0.00	0.00			0.00	0.00			0.00	0.00	12.42	68.60	92.92	108.87	159.07	152	525	525	CONC	0.20	57.5	192.3297	0.8885	1.0786	0.792
To STREET 2006, Pipe 529 - 534						2.22				0.00				0.00				0.00	13.50														
Unknown Road8 - 2007																																
	527	528	2.22	0.80	4.94	4.94			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	379	525	525	CONC	1.10	29.0	451.0531	2.0836	0.2320	0.841
To STREET 2006, Pipe 528 - 529						4.94				0.00				0.00				0.00	10.23														
STREET 2006																																
	533	534	0.48	0.66	0.88	0.88			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	68	450	450	CONC	0.20	90.5	127.5033	0.8017	1.8814	0.531
To STREET 2008, Pipe 534 - 536						0.88				0.00				0.00				0.00	11.88														
	537	538	0.29	0.66	0.53	0.53			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	41	300	300	PVC	0.35	51.5	57.2089	0.8093	1.0605	0.714
	538	539	0.35	0.66	0.64	1.17			0.00	0.00			0.00	0.00			0.00	0.00	11.06	72.96	98.91	115.91	169.41	86	375	375	PVC	0.35	49.0	103.7267	0.9392	0.8696	0.826
	539	540			0.00	1.17			0.00	0.00			0.00	0.00			0.00	0.00	11.93	70.11	95.00	111.31	162.65	82	450	450	CONC	0.20	10.5	127.5033	0.8017	0.2183	0.646
	540	541	0.63	0.66	1.16	2.33			0.00	0.00			0.00	0.00			0.00	0.00	12.15	69.44	94.07	110.22	161.05	162	525	525	CONC	0.20	108.5	192.3297	0.8885	2.0354	0.841
To STREET 2008, Pipe 541 - 542						2.33				0.00				0.00				0.00	14.18														
	526	528	0.42	0.66	0.77	0.77			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	59	375	375	PVC	0.30	60.0	96.0323	0.8695	1.1501	0.616
Contribution From Unknown Road8 - 2007, Pipe 527 - 528						4.94				0.00				0.00				0.00	10.23														
	528	529	0.47	0.66	0.86	6.57			0.00	0.00			0.00	0.00			0.00	0.00	11.15	72.65	98.49	115.42	168.69	477	900	900	CONC	0.10	78.5	572.4707	0.8999	1.4539	0.834
Contribution From STREET 2005, Pipe 525 - 529						2.22				0.00				0.00				0.00	13.50														
	529	534	0.16	0.66	0.29	9.08			0.00	0.00			0.00	0.00			0.00	0.00	13.50	65.54	88.73	103.94	151.82	595	900	900	CONC	0.15	61.0	701.1305	1.1021	0.9225	0.849
To STREET 2008, Pipe 534 - 536						9.08				0.00				0.00				0.00	14.43														
Unknown Road1 - 05																																
Contribution From STREET 2008, Pipe 541 - 542						14.96				1.49				0.00				0.00	16.35														
	542	263	0.07	0.85	0.17	15.12			0.00	1.49			0.00	0.00			0.00	0.00	16.35	58.76	79.44	93.01	135.79	1006	1050	1050	CONC	0.25	40.0	1365.3626	1.5768	0.4228	0.737
To OLDENBURG AVENUE, Pipe 263 - 264						15.12				1.49				0.00				0.00	16.77														
STREET 2002																																
Contribution From STREET 2008, Pipe 516 - 518						0.00				1.38				0.00				0.00	11.93														
Contribution From STREET 2008, Pipe 517 - 518						0.00				0.29				0.00				0.00	10.66														
			0.43	0.66	0.79	0.79			0.00	1.67			0.00	0.00			0.00	0.00														
	518	519	1.12	0.40	1.25	2.03			0.00	1.67			0.00	0.00			0.00	0.00	11.93	70.11	95.00	111.31	162.65	301	675	675	CONC	0.20	104.5	375.9224	1.0505	1.6579	0.801
	519	520	0.25	0.66	0.46	2.49			0.00	1.67			0.00	0.00			0.00	0.00	13.59	65.32	88.42	103.57	151.28	310	675	675	CONC	0.20	60.0	375.9224	1.0505	0.9519	0.826
	520	521	0.21	0.66	0.39	2.88			0.00	1.67			0.00	0.00			0.00	0.00	14.54	62.88	85.08	99.64	145.51	323	750	750	CONC	0.15	60.0	431.1703	0.9760	1.0246	0.749
To OLDENBURG AVENUE, Pipe 521 - 323						2.88				1.67				0.00				0.00	15.56														
STREET 2003																																
					0.00	0.00	0.37	0.66	0.68	0.68			0.00	0.00			0.00	0.00														
	512	513	0.61	0.66	1.12	1.12			0.00	0.68			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	157	525	525	CONC	0.20	100.5	192.3297	0.8885	1.8853	0.815
	513	514	0.48	0.66	0.88	2.00			0.00	0.68			0.00	0.00			0.00	0.00	11.89	70.25	95.19	111.54	162.98	205	600	600	CONC	0.15	61.0	237.8056	0.8411	1.2088	0.863
	514	515	0.33	0.66	0.61	2.61			0.00	0.68			0.00	0.00			0.00	0.00	13.09	66.67	90.27	105.75	154.48	235	600	600	CONC	0.20	61.0	274.5943	0.9712	1.0468	0.856
To OLDENBURG AVENUE, Pipe 515 - 521						2.61				0.68				0.00				0.00	14.14														
STREET 2008																																
	516	518			0.00	0.00	0.75	0.66	1.38	1.38			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	143	525	525	CONC	0.25	115.0	215.0311	0.9933	1.9295	0.667
To STREET 2002, Pipe 518 - 519						0.00				1.38				0.00				0.00	11.93														

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed:
Checked:
Dwg. Reference:

PROJECT: **Green Lands East & West**
LOCATION: **City of Ottawa**
File Ref: 20-1183
Date: 26-Jun-20
Sheet No. SHEET 1 OF 3

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

	LOCATION		AREA (Ha)																FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
Location	From Node	To Node	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	Conc. (min)	2 Year (mm/h)	5 Year (mm/h)	10 Year (mm/h)	100 Year (mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	LOW (min	Q/Q full
	517	518			0.00	0.00	0.16	0.66	0.29	0.29			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	31	300	300	PVC	0.35	32.0	57.2089	0.8093	0.6590	0.535
To STREET 2002, Pipe 518 - 519						0.00				0.29				0.00				0.00	10.66														
	508	509			0.00	0.00	1.22	0.66	2.24	2.24			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	233	600	600	CONC	0.35	94.5	363.2541	1.2847	1.2259	0.642
	509	510			0.00	0.00	1.20	0.66	2.20	4.44			0.00	0.00			0.00	0.00	11.23	72.40	98.13	115.01	168.08	436	750	750	CONC	0.30	112.5	609.7669	1.3802	1.3585	0.715
To OLDENBURG AVENUE, Pipe 510 - 515						0.00				4.44				0.00				0.00	12.58														
	530	531			0.00	0.00	0.67	0.66	1.23	1.23			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	128	525	525	CONC	0.20	105.0	192.3297	0.8885	1.9697	0.666
	531	532			0.00	0.00	0.14	0.66	0.26	1.49			0.00	0.00			0.00	0.00	11.97	69.99	94.83	111.11	162.36	141	525	525	CONC	0.20	13.0	192.3297	0.8885	0.2439	0.733
	532	534	0.29	0.66	0.53	0.53			0.00	1.49			0.00	0.00			0.00	0.00	12.21	69.24	93.79	109.90	160.57	176	600	600	CONC	0.15	56.0	237.8056	0.8411	1.1097	0.741
Contribution From STREET 2006, Pipe 529 - 534						9.08				0.00				0.00				0.00	14.43														
Contribution From STREET 2006, Pipe 533 - 534						0.88				0.00				0.00				0.00	11.88														
	534	536	0.30	0.66	0.55	11.05			0.00	1.49			0.00	0.00			0.00	0.00	14.43	63.16	85.46	100.09	146.18	825	975	975	CONC	0.20	60.5	1002.2295	1.3424	0.7512	0.823
Contribution From STREET 2004, Pipe 535 - 536						0.95				0.00				0.00				0.00	12.10														
	536	541	0.22	0.66	0.40	12.40			0.00	1.49			0.00	0.00			0.00	0.00	15.18	61.35	82.99	97.19	141.92	884	1050	1050	CONC	0.15	56.5	1057.6053	1.2214	0.7710	0.836
Contribution From STREET 2006, Pipe 540 - 541						2.33				0.00				0.00				0.00	14.18														
	541	542	0.12	0.66	0.22	14.96			0.00	1.49			0.00	0.00			0.00	0.00	15.95	59.62	80.62	94.39	137.82	1011	1050	1050	CONC	0.20	34.0	1221.2174	1.4103	0.4018	0.828
To Unknown Road1 - 05, Pipe 542 - 263						14.96				1.49				0.00				0.00	16.35														
OLDENBURG AVENUE																																	
Contribution From STREET 2008, Pipe 509 - 510						0.00				4.44				0.00				0.00	12.58														
	510	515	0.46	0.65	0.83	0.83			0.00	4.44			0.00	0.00			0.00	0.00	12.58	68.13	92.27	108.10	157.94	466	900	900	CONC	0.10	75.5	572.4707	0.8999	1.3984	0.815
Contribution From STREET 2003, Pipe 514 - 515						2.61				0.68				0.00				0.00	14.14														
	515	521	0.42	0.65	0.76	4.20			0.00	5.12			0.00	0.00			0.00	0.00	14.14	63.87	86.44	101.24	147.87	710	1050	1050	CONC	0.10	95.5	863.5311	0.9973	1.5960	0.823
Contribution From STREET 2002, Pipe 520 - 521						2.88				1.67				0.00				0.00	15.56														
			2.81	0.65	5.08	12.15			0.00	6.79			0.00	0.00			0.00	0.00	15.50														
					0.00	12.15	0.00	0.00	0.00	6.79			0.00	0.00			0.00	0.00	15.49														
	521	323			0.00	12.15			0.00	6.79			0.00	0.00			0.00	0.00	15.74	60.08	81.25	95.14	138.91	1282	1050	1050	CONC	0.30	32.0	1495.6798	1.7273	0.3088	0.857
	323	324	0.03	0.65	0.05	12.21			0.00	6.79			0.00	0.00			0.00	0.00	16.05	59.40	80.32	94.05	137.32	1270	1050	1050	CONC	0.30	10.5	1495.6798	1.7273	0.1013	0.849
	324	325			0.00	12.21	0.30	0.65	0.54	7.33			0.00	0.00			0.00	0.00	16.15	59.19	80.03	93.70	136.80	1309	1200	1200	CONC	0.15	37.5	1509.9717	1.3351	0.4681	0.867
	325	326			0.00	12.21	0.61	0.65	1.10	8.43			0.00	0.00			0.00	0.00	16.62	58.20	78.68	92.11	134.48	1374	1200	1200	CONC	0.20	11.5	1743.5652	1.5417	0.1243	0.788
	326	328			0.00	12.21			0.00	8.43			0.00	0.00			0.00	0.00	16.74	57.95	78.33	91.70	133.87	1368	1350	1350	CONC	0.10	72.0	1687.8347	1.1792	1.0177	0.810
			0.19	0.65	0.34	12.55			0.00	8.43			0.00	0.00			0.00	0.00	11.40														
	328	263			0.00	12.55	0.26	0.65	0.47	8.90			0.00	0.00			0.00	0.00	17.76	55.94	75.59	88.49	129.15	1375	1350	1350	CONC	0.10	65.5	1687.8347	1.1792	0.9258	0.815
Contribution From Unknown Road1 - 05, Pipe 542 - 263						15.12				1.49				0.00				0.00	16.77														
					0.00	27.67	0.00	0.00	0.00	10.39			0.00	0.00			0.00	0.00	11.31														
			0.40	0.67	0.75	28.41			0.00	10.39			0.00	0.00			0.00	0.00	11.30														
					0.00	28.41	0.12	0.71	0.24	10.63			0.00	0.00			0.00	0.00															
	263	264			0.00	28.41	0.12	0.75	0.25	10.88			0.00	0.00			0.00	0.00	18.68	54.25	73.28	85.77	125.17	2339	1500	1500	CONC	0.15	75.0	2737.7609	1.5493	0.8068	0.854
					0.00	28.41	0.19	0.75	0.40	11.27			0.00	0.00			0.00	0.00															
			0.22	0.54	0.33	28.75			0.00	11.27			0.00	0.00			0.00	0.00															
	264	265			0.00	28.75	0.25	0.71	0.49	11.77			0.00	0.00			0.00	0.00	19.49	52.87	71.39	83.55	121.91	2360	1500	1500	CONC	0.15	75.0	2737.7609	1.5493	0.8068	0.862
			2.93	0.69	5.62	34.37			0.00	11.77			0.00	0.00			0.00	0.00	16.70														
					0.00	34.37	0.00	0.00	0.00	11.77			0.00	0.00			0.00	0.00															
					0.00	34.37	0.00	0.00	0.00	11.77			0.00	0.00			0.00	0.00															
					0.00	34.37	0.00	0.00	0.00	11.77			0.00	0.00			0.00	0.00															
					0.00	34.37	0.00	0.00	0.00	11.77			0.00	0.00			0.00	0.00															
					0.00	34.37	0.11	0.75	0.23	12.00			0.00	0.00			0.00	0.00															
	265	266			0.00	34.37	0.12	0.71	0.24	12.23			0.00	0.00			0.00	0.00	20.30	51.56	69.61	81.45	118.84	2623	1500	1500	CONC	0.20	75.0	3161.2940	1.7889	0.6987	0.830
To PERTH STREET, Pipe 266 - 267TEE						34.37				12.23				0.00				0.00	21.00														
PERTH STREET																																	
					0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00						3186									
	546	544			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	3186	1650	1650	CONC	0.15	91.5	3530.0106	1.6509	0.9237	0.903
	544	280			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	10.92	73.43	99.55	116.68	170.53	3186	1650	1650	CONC	0.15	75.0	3530.0106	1.6509	0.7572	0.903

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed:
Checked:
Dwg. Reference:

PROJECT:
Green Lands East & West
LOCATION:
City of Ottawa
File Ref: 20-1183
Date: 26-Jun-20
Sheet No. SHEET 2 OF 3

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

	LOCATION		AREA (Ha)																FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR																		
Location	From Node	To Node	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	Time of Conc. (min)	Intensity 2 Year (mm/h)	Intensity 5 Year (mm/h)	Intensity 10 Year (mm/h)	Intensity 100 Year (mm/h)	Peak Flow Q (l/s)	DIA. (mm) (actual)	DIA. (mm) (nominal)	TYPE	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME OF LOW (min	RATIO Q/Q full
			0.07	0.54	0.11	0.11			0.00	0.00			0.00	0.00			0.00	0.00															
	280	266			0.00	0.11			0.00	0.00	0.80	0.85	1.89	1.89			0.00	0.00	11.68	70.90	96.08	112.59	164.53	3406	1650	1650	CONC	0.15	44.5	3530.0106	1.6509	0.4493	0.965
Contribution From OLDENBURG AVENUE, Pipe 265 - 266						34.37				12.23				0.00				0.00	21.00														
	266	267TEE			0.00	34.47			0.00	12.23	0.23	0.85	0.54	2.43			0.00	0.00	21.00	50.48	68.14	79.73	116.31	5954	2100	2100	CONC	0.15	70.5	6715.3752	1.9388	0.6060	0.887
To Unknown Road2 - 100, Pipe 267TEE - 26701						34.47				12.23				2.43				0.00	21.60					3186									
Unknown Road2 - 100																																	
					0.00	0.00			0.00	0.00	0.87	0.85	2.06	2.06			0.00	0.00	21.68														
			1.33	0.68	2.51	2.51			0.00	0.00			0.00	2.06			0.00	0.00	21.68														
			5.25	0.65	9.49	12.00			0.00	0.00			0.00	2.06			0.00	0.00	21.68														
					0.00	12.00	0.00	0.00	0.00	0.00			0.00	2.06			0.00	0.00	21.50														
					0.00	12.00	0.00	0.00	0.00	0.00			0.00	2.06			0.00	0.00															
					0.00	12.00	0.00	0.00	0.00	0.00			0.00	2.06			0.00	0.00															
					0.00	12.00	0.00	0.00	0.00	0.00			0.00	2.06			0.00	0.00															
					0.00	12.00	0.00	0.00	0.00	0.00			0.00	2.06			0.00	0.00															
	278	279			0.00	12.00	0.00	0.00	0.00	0.00			0.00	2.06			0.00	0.00	21.68	49.48	66.77	78.12	113.95	754	975	975	CONC	0.20	15.5	1002.2295	1.3424	0.1924	0.753
	279	27900			0.00	12.00			0.00	0.00			0.00	2.06			0.00	0.00	21.87	49.20	66.39	77.68	113.31	750	975	975	CONC	0.20	16.5	1002.2295	1.3424	0.2049	0.748
Contribution From PERTH STREET, Pipe 266 - 267TEE						34.47				12.23				2.43				0.00	21.60					3186									
	267TEE	26701			0.00	34.47			0.00	12.23			0.00	2.43			0.00	0.00	21.60	49.59	66.92	78.30	114.22	5905	2100	2100	CONC	0.15	19.0	6715.3752	1.9388	0.1633	0.879
	26701	26700			0.00	34.47			0.00	12.23			0.00	2.43			0.00	0.00	21.76	49.36	66.60	77.92	113.67	5892	2100	2100	CONC	0.15	18.0	6715.3752	1.9388	0.1547	0.877
STREET 2001																																	
	500	502	0.20	0.66	0.37	0.37			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	28	300	300	PVC	0.35	33.0	57.2089	0.8093	0.6796	0.493
	502	503	0.65	0.66	1.19	1.56			0.00	0.00			0.00	0.00			0.00	0.00	10.68	74.29	100.74	118.07	172.58	116	450	450	CONC	0.25	112.0	142.5531	0.8963	2.0826	0.813
	503	504	0.48	0.66	0.88	2.44			0.00	0.00			0.00	0.00			0.00	0.00	12.76	67.61	91.56	107.27	156.72	165	525	525	CONC	0.20	109.0	192.3297	0.8885	2.0447	0.858
	504	505	0.73	0.66	1.34	3.78			0.00	0.00			0.00	0.00			0.00	0.00	14.81	62.23	84.19	98.59	143.98	235	600	600	CONC	0.20	109.0	274.5943	0.9712	1.8706	0.857
To Unknown Road9 - 2010, Pipe 505 - 506						3.78				0.00				0.00				0.00	16.68														
Unknown Road9 - 2010																																	
Contribution From STREET 2001, Pipe 504 - 505						3.78				0.00				0.00				0.00	16.68														
	505	506	0.62	0.66	1.14	4.92			0.00	0.00			0.00	0.00			0.00	0.00	16.68	58.07	78.50	91.91	134.17	286	600	600	CONC	0.30	13.5	336.3080	1.1894	0.1892	0.849
	506	507			0.00	4.92			0.00	0.00			0.00	0.00			0.00	0.00	16.87	57.69	77.97	91.29	133.26	284	600	600	CONC	0.30	36.5	336.3080	1.1894	0.5114	0.843

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed:	PROJECT: Green Lands East & West		
Checked:	LOCATION: City of Ottawa		
Dwg. Reference:	File Ref: 20-1183	Date: 26-Jun-20	Sheet No. SHEET 3 OF 3

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

	LOCATION		AREA (Ha)																FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year	10 Year	100 Year									FLOW	
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	(min.	Q/Q full
Unknown Road4 - 04																																	
	518	519	0.67	0.70	1.30	1.30			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	100	450	450	PVC	0.25	116.5	142.55	0.90	2.17	0.70
To Unknown Road2 - 02, Pipe 519 - 521						1.30				0.00				0.00				0.00	12.17														
Unknown Road2 - 02																																	
	515	516	0.66	0.70	1.28	1.28			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	99	450	450	PVC	0.25	109.0	142.55	0.90	2.03	0.69
	516	517	0.15	0.70	0.29	1.58			0.00	0.00			0.00	0.00			0.00	0.00	12.03	69.81	94.58	0.00	161.94	110	450	450	PVC	0.27	13.5	148.15	0.93	0.24	0.74
	517	519	0.19	0.70	0.37	1.95			0.00	0.00			0.00	0.00			0.00	0.00	12.27	69.07	93.57	0.00	160.18	134	525	525	PVC	0.20	51.0	192.33	0.89	0.96	0.70
Contribution From Unknown Road4 - 04, Pipe 518 - 519						1.30				0.00				0.00				0.00	12.17														
	519	521	0.20	0.70	0.39	3.64			0.00	0.00			0.00	0.00			0.00	0.00	13.23	66.30	89.77	0.00	153.62	241	675	675	CONC	0.15	60.5	325.56	0.91	1.11	0.74
To Unknown Road3 - 03, Pipe 521 - 522						3.64				0.00				0.00				0.00	14.33														
Unknown Road3 - 03																																	
	520	521	0.72	0.70	1.40	1.40			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	108	450	450	PVC	0.26	114.0	145.38	0.91	2.08	0.74
Contribution From Unknown Road2 - 02, Pipe 519 - 521						3.64				0.00				0.00				0.00	14.33														
	521	522	0.05	0.70	0.10	5.14			0.00	0.00			0.00	0.00			0.00	0.00	14.33	63.39	85.77	0.00	146.72	326	750	750	CONC	0.16	13.0	445.31	1.01	0.21	0.73
To Unknown Road7 - 08, Pipe 522 - 523						5.14				0.00				0.00				0.00	14.55														
Unknown Road7 - 08																																	
Contribution From Unknown Road3 - 03, Pipe 521 - 522						5.14				0.00				0.00				0.00	14.55														
			0.02	0.70	0.04	5.18			0.00	0.00			0.00	0.00			0.00	0.00															
	522	523	0.10	0.70	0.19	5.37			0.00	0.00			0.00	0.00			0.00	0.00	14.55	62.85	85.05	0.00	145.46	338	825	825	CONC	0.10	46.0	453.92	0.85	0.90	0.74
	523	524	0.02	0.70	0.04	5.41			0.00	0.00			0.00	0.00			0.00	0.00	15.45	60.72	82.13	0.00	140.43	329	825	825	CONC	0.10	30.5	453.92	0.85	0.60	0.72
To Unknown Road1 - 01, Pipe 524 - 525						5.41				0.00				0.00				0.00	16.05														
Unknown Road5 - 05																																	
	506	507	0.15	0.70	0.29	0.29			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	22	300	300	PVC	0.40	33.5	61.16	0.87	0.65	0.37
To Unknown Road6 - 06, Pipe 507 - 508						0.29				0.00				0.00				0.00	10.65														
	501	504	0.18	0.70	0.35	0.35			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	27	300	300	PVC	0.40	13.5	61.16	0.87	0.26	0.44
	504	505	0.58	0.70	1.13	1.48			0.00	0.00			0.00	0.00			0.00	0.00	10.26	75.82	102.84	0.00	176.22	112	450	450	PVC	0.28	82.0	150.86	0.95	1.44	0.74
	505	507	0.12	0.70	0.23	1.71			0.00	0.00			0.00	0.00			0.00	0.00	11.70	70.84	95.99	0.00	164.37	121	450	450	PVC	0.33	18.5	163.78	1.03	0.30	0.74
To Unknown Road6 - 06, Pipe 507 - 508						1.71				0.00				0.00				0.00	12.00														
	501	502	0.25	0.70	0.49	0.49			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	37	375	375	PVC	0.26	57.5	89.40	0.81	1.18	0.42
	502	503	0.14	0.70	0.27	0.76			0.00	0.00			0.00	0.00			0.00	0.00	11.18	72.54	98.33	0.00	168.42	55	375	375	PVC	0.26	13.5	89.40	0.81	0.28	0.62
	503	508	0.62	0.70	1.21	1.97			0.00	0.00			0.00	0.00			0.00	0.00	11.46	71.61	97.06	0.00	166.22	141	525	525	PVC	0.20	100.0	192.33	0.89	1.88	0.73
To Unknown Road6 - 06, Pipe 508 - 509						1.97				0.00				0.00				0.00	13.34														
Unknown Road6 - 06																																	
Contribution From Unknown Road5 - 05, Pipe 505 - 507						1.71				0.00				0.00				0.00	12.00														
Contribution From Unknown Road5 - 05, Pipe 506 - 507						0.29				0.00				0.00				0.00	10.65														
	507	508	0.27	0.70	0.53	2.53			0.00	0.00			0.00	0.00			0.00	0.00	12.00	69.89	94.69	0.00	162.13	177	750	750	CONC	0.11	79.5	369.23	0.84	1.59	0.48
Contribution From Unknown Road5 - 05, Pipe 503 - 508						1.97				0.00				0.00				0.00	13.34														
	508	509	0.21	0.70	0.41	4.90			0.00	0.00			0.00	0.00			0.00	0.00	13.59	65.32	88.42	0.00	151.30	320	825	825	CONC	0.10	54.5	453.92	0.85	1.07	0.71
	509	510	0.46	0.70	0.90	5.80			0.00	0.00			0.00	0.00			0.00	0.00	14.66	62.59	84.69	0.00	144.85	363	825	825	CONC	0.12	60.5	497.25	0.93	1.08	0.73
	510	511			0.00	5.80			0.00	0.00			0.00	0.00			0.00	0.00	15.74	60.08	81.24	0.00	138.90	348	825	825	CONC	0.11	61.5	476.08	0.89	1.15	0.73
	511	513	0.21	0.70	0.41	6.21			0.00	0.00			0.00	0.00			0.00	0.00	16.89	57.64	77.91	0.00	133.15	358	825	825	CONC	0.11	67.0	476.08	0.89	1.25	0.75
To Unknown Road1 - 01, Pipe 513 - 514						6.21				0.00				0.00				0.00	18.14														
Unknown Road1 - 01																																	
	512	513	0.13	0.70	0.25	0.25			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	19	825	825	CONC	0.10	33.5	453.92	0.85	0.66	0.04
Contribution From Unknown Road6 - 06, Pipe 511 - 513						6.21				0.00				0.00				0.00	18.14														
	513	514	0.68	0.70	1.32	7.78			0.00	0.00			0.00	0.00			0.00	0.00	18.14	55.22	74.61	0.00	127.46	430	900	900	CONC	0.11	115.5	600.41	0.94	2.04	0.72
	514	524	0.05	0.70	0.10	7.88			0.00	0.00			0.00	0.00			0.00	0.00	20.18	51.74	69.85	0.00	119.26	408	900	900	CONC	0.10	6.0	572.47	0.90	0.11	0.71

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed:
Checked:
Dwg. Reference:

PROJECT: LAFFIN LANDS
LOCATION: City of Ottawa
File Ref:
Date: 23 Jun 2020
Sheet No. SHEET 1 OF 4

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

LOCATION			AREA (Ha) 2 YEAR				5 YEAR				10 YEAR				100 YEAR				FLOW						SEWER DATA							
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	Conc. (min)	2 Year (mm/h)	5 Year (mm/h)	10 Year (mm/h)	100 Year (mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	FLOW (min.	Q/Q full
Contribution From Unknown Road7 - 08, Pipe 523 - 524						5.41				0.00				0.00				0.00	16.05														
			0.15	0.70	0.29	13.58			0.00	0.00			0.00	0.00			0.00	0.00															
	524	525	0.25	0.70	0.49	14.07			0.00	0.00			0.00	0.00			0.00	0.00	20.29	51.56	69.61	0.00	118.85	725	1050	1050	CONC	0.13	57.0	984.58	1.14	0.84	0.74
	525	526	0.64	0.70	1.25	15.32			0.00	0.00			0.00	0.00			0.00	0.00	21.13	50.28	67.86	0.00	115.84	770	1200	1200	CONC	0.10	89.5	1232.89	1.09	1.37	0.62
To Unknown Road9 - 20, Pipe 526 - 8						15.32				0.00				0.00				0.00	22.50														
Unknown Road9 - 20																																	
	32	33	1.23	0.70	2.39	2.39			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	184	975	975	CONC	0.16	95.0	896.42	1.20	1.32	0.21
	33	34	0.77	0.70	1.50	3.89			0.00	0.00			0.00	0.00			0.00	0.00	11.32	72.09	97.71	0.00	167.34	281	975	975	CONC	0.19	110.5	976.85	1.31	1.41	0.29
	34	35	0.63	0.70	1.23	5.12			0.00	0.00			0.00	0.00			0.00	0.00	12.73	67.71	91.70	0.00	156.96	347	1050	1050	CONC	0.15	110.5	1057.61	1.22	1.51	0.33
	35	36	0.17	0.70	0.33	5.45			0.00	0.00			0.00	0.00			0.00	0.00	14.23	63.64	86.12	0.00	147.31	347	1050	1050	CONC	0.14	63.5	1021.74	1.18	0.90	0.34
	36	38	0.58	0.70	1.13	6.58			0.00	0.00			0.00	0.00			0.00	0.00	15.13	61.46	83.14	0.00	142.17	404	1050	1050	CONC	0.16	43.0	1092.29	1.26	0.57	0.37
	38	40	1.83	0.70	3.56	10.14			0.00	0.00			0.00	0.00			0.00	0.00	15.70	60.16	81.36	0.00	139.11	610	1050	1050	CONC	0.23	72.0	1309.61	1.51	0.79	0.47
	40	41	0.70	0.70	1.36	11.50			0.00	0.00			0.00	0.00			0.00	0.00	16.49	58.46	79.03	0.00	135.08	672	1200	1200	CONC	0.13	77.0	1405.71	1.24	1.03	0.48
	41	42	0.15	0.70	0.29	11.79			0.00	0.00			0.00	0.00			0.00	0.00	17.53	56.39	76.20	0.00	130.20	665	1200	1200	CONC	0.13	12.5	1405.71	1.24	0.17	0.47
	42	526			0.00	11.79			0.00	0.00			0.00	0.00			0.00	0.00	17.69	56.07	75.76	0.00	129.44	661	1200	1200	CONC	0.13	61.5	1405.71	1.24	0.82	0.47
Contribution From Unknown Road1 - 01, Pipe 525 - 526						15.32				0.00				0.00				0.00	22.50														
	526	8	0.21	0.70	0.41	27.52			0.00	0.00			0.00	0.00			0.00	0.00	22.50	48.33	65.20	0.00	111.26	1330	1350	1350	CONC	0.11	77.0	1770.22	1.24	1.04	0.75
	8	9	0.11	0.70	0.21	27.73			0.00	0.00			0.00	0.00			0.00	0.00	23.54	46.96	63.34	0.00	108.05	1302	1350	1350	CONC	0.11	25.5	1770.22	1.24	0.34	0.74
	9	11	0.26	0.70	0.51	28.24			0.00	0.00			0.00	0.00			0.00	0.00	23.88	46.52	62.74	0.00	107.03	1314	1350	1350	CONC	0.11	10.5	1770.22	1.24	0.14	0.74
	11	12	0.25	0.70	0.49	28.72			0.00	0.00			0.00	0.00			0.00	0.00	24.02	46.35	62.50	0.00	106.61	1331	1350	1350	CONC	0.11	41.0	1770.22	1.24	0.55	0.75
	12	13	0.27	0.70	0.53	29.25			0.00	0.00			0.00	0.00			0.00	0.00	24.57	45.67	61.58	0.00	105.03	1336	1350	1350	CONC	0.11	40.0	1770.22	1.24	0.54	0.75
To Unknown Road8 - 10, Pipe 13 - 20						29.25				0.00				0.00				0.00	25.11														
Unknown Road11 - 40																																	
					0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00						40									
			0.15	0.70	0.29	0.29			0.00	0.00			0.00	0.00			0.00	0.00															
					0.00	0.29	0.23	0.70	0.45	0.45			0.00	0.00			0.00	0.00															
	124	125			0.00	0.29			0.00	0.45			0.00	0.00	0.96	0.70	1.87	1.87	10.00	76.81	104.19	0.00	178.56	443	825	825	CONC	0.16	83.5	574.17	1.07	1.30	0.77
	125	76			0.00	0.29	0.56	0.70	1.09	1.54			0.00	0.00			0.00	1.87	11.30	72.16	97.81	0.00	167.52	524	900	900	CONC	0.14	84.0	677.36	1.06	1.31	0.77
To Unknown Road8 - 10, Pipe 76 - 23						0.29				1.54				0.00				1.87	12.61					40									
					0.00	0.00			0.00	0.00			0.00	0.00	0.00	0.00	0.00	0.00						800									
	120	121			0.00	0.00	0.46	0.70	0.90	0.90			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	893	1050	1050	CONC	0.19	113.0	1190.30	1.37	1.37	0.75
	121	122			0.00	0.00	0.41	0.70	0.80	1.69			0.00	0.00			0.00	0.00	11.37	71.92	97.47	0.00	166.94	965	1050	1050	CONC	0.23	85.0	1309.61	1.51	0.94	0.74
	122	123			0.00	0.00	0.51	0.70	0.99	2.69			0.00	0.00			0.00	0.00	12.31	68.95	93.41	0.00	159.90	1051	1200	1200	CONC	0.13	97.5	1405.71	1.24	1.31	0.75
	123	76			0.00	0.00	0.49	0.70	0.95	3.64			0.00	0.00			0.00	0.00	13.61	65.24	88.32	0.00	151.12	1121	1200	1200	CONC	0.15	105.5	1509.97	1.34	1.32	0.74
To Unknown Road8 - 10, Pipe 76 - 23						0.00				3.64				0.00				0.00	14.93					800									
Unknown Road10 - 30																																	
	14	15	0.66	0.70	1.28	1.28			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	99	450	450	PVC	0.25	81.5	142.55	0.90	1.52	0.69
	15	16	0.47	0.70	0.91	2.20			0.00	0.00			0.00	0.00			0.00	0.00	11.52	71.44	96.82	0.00	165.80	157	600	600	PVC	0.15	66.0	237.81	0.84	1.31	0.66
	16	17	0.94	0.70	1.83	4.03			0.00	0.00			0.00	0.00			0.00	0.00	12.82	67.43	91.32	0.00	156.30	272	675	675	CONC	0.19	44.5	366.40	1.02	0.72	0.74
	17	18	0.06	0.70	0.12	4.14			0.00	0.00			0.00	0.00			0.00	0.00	13.55	65.42	88.56	0.00	151.54	271	675	675	CONC	0.19	37.0	366.40	1.02	0.60	0.74
			0.25	0.40	0.28	4.42			0.00	0.00			0.00	0.00			0.00	0.00															
	18	19	2.82	0.70	5.49	9.91			0.00	0.00			0.00	0.00			0.00	0.00	14.15	63.85	86.41	0.00	147.82	633	825	825	CONC	0.34	54.0	837.00	1.57	0.57	0.76
	19	200	1.45	0.70	2.82	12.73			0.00	0.00			0.00	0.00			0.00	0.00	14.72	62.42	84.46	0.00	144.45	795	975	975	CONC	0.22	45.5	1051.15	1.41	0.54	0.76
	200	210	2.09	0.70	4.07	16.80			0.00	0.00			0.00	0.00			0.00	0.00	15.26	61.15	82.72	0.00	141.44	1027	1050	1050	CONC	0.25	62.0	1365.36	1.58	0.66	0.75
To Unknown Road8 - 10, Pipe 210 - 76						16.80				0.00				0.00				0.00	15.92														
Unknown Road8 - 10																																	
	1	2	0.22	0.70	0.43	0.43			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	33	300	300	PVC	0.35	31.0	57.21	0.81	0.64	0.57
	2	3	0.46	0.70	0.90	1.32			0.00	0.00			0.00	0.00			0.00	0.00	10.64	74.44	100.94	0.00	172.93	99	450	450	PVC	0.22	61.0	133.73	0.84	1.21	0.74
	3	4	0.22	0.70	0.43	1.75			0.00	0.00			0.00	0.00			0.00	0.00	11.85	70.37	95.35	0.00	163.27	123	525	525	PVC	0.17	10.5	177.32	0.82	0.21	0.70
	4	5	0.51	0.70	0.99	2.74			0.00	0.00			0.00	0.00			0.00	0.00	12.06	69.70	94.44	0.00	161.68	191	600	600	PVC	0.18	77.0	260.50	0.92	1.39	0.73
	5	6	0.56	0.70	1.09	3.83			0.00	0.00			0.00	0.00			0.00	0.00	13.45	65.67	88.91	0.00	152.13	252	675	675	CONC	0.16	77.0	336.24	0.94	1.37	0.75

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed:
Checked:
Dwg. Reference:

PROJECT: LAFFIN LANDS
LOCATION: City of Ottawa
File Ref:
Date: 23 Jun 2020
Sheet No. SHEET 2 OF 4

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

	LOCATION		AREA (Ha)														FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year	10 Year	100 Year									FLOW	
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	(min.	Q/Q full
			0.55	0.70	1.07	4.90			0.00	0.00			0.00	0.00			0.00	0.00														
	6	60	0.63	0.70	1.23	6.13			0.00	0.00			0.00	0.00			0.00	0.00	14.82	62.20	84.14	0.00	143.91	381	750	750	CONC	0.21	67.0	510.17	1.15	0.97	0.75
	60	302			0.00	6.13			0.00	0.00			0.00	0.00			0.00	0.00	15.79	59.97	81.10	0.00	138.65	368	825	825	CONC	0.18	5.0	609.00	1.14	0.07	0.60
To Unknown Road12 - 50, Pipe 302 - 303						6.13				0.00				0.00				0.00	15.86													
	70	7	0.31	0.70	0.60	0.60			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	46	300	300	PVC	0.41	41.5	61.92	0.88	0.79	0.75
	7	80	0.85	0.70	1.65	2.26			0.00	0.00			0.00	0.00			0.00	0.00	10.79	73.90	100.20	0.00	171.65	167	600	600	PVC	0.15	117.0	237.81	0.84	2.32	0.70
	80	90	0.27	0.70	0.53	2.78			0.00	0.00			0.00	0.00			0.00	0.00	13.11	66.63	90.21	0.00	154.39	185	600	600	PVC	0.16	10.5	245.60	0.87	0.20	0.75
	90	100	0.38	0.70	0.74	3.52			0.00	0.00			0.00	0.00			0.00	0.00	13.31	66.07	89.45	0.00	153.07	233	675	675	CONC	0.14	65.5	314.52	0.88	1.24	0.74
	100	110	1.87	0.70	3.64	7.16			0.00	0.00			0.00	0.00			0.00	0.00	14.55	62.85	85.03	0.00	145.44	450	825	825	CONC	0.18	72.0	609.00	1.14	1.05	0.74
	110	1200	1.28	0.70	2.49	9.65			0.00	0.00			0.00	0.00			0.00	0.00	15.60	60.38	81.65	0.00	139.61	583	900	900	CONC	0.19	68.0	789.10	1.24	0.91	0.74
	1200	130	1.40	0.70	2.72	12.38			0.00	0.00			0.00	0.00			0.00	0.00	16.52	58.40	78.95	0.00	134.95	723	975	975	CONC	0.19	72.0	976.85	1.31	0.92	0.74
	130	210	0.99	0.70	1.93	14.30			0.00	0.00			0.00	0.00			0.00	0.00	17.44	56.56	76.43	0.00	130.60	809	1050	1050	CONC	0.16	72.5	1092.29	1.26	0.96	0.74
Contribution From Unknown Road10 - 30, Pipe 200 - 210						16.80				0.00				0.00				0.00	15.92													
	210	76			0.00	31.10	0.15	0.70	0.29	0.29			0.00	0.00			0.00	0.00	18.39	54.77	73.99	0.00	126.39	1725	1200	1200	CONC	0.35	76.5	2306.52	2.04	0.63	0.75
Contribution From Unknown Road11 - 40, Pipe 123 - 76						0.00				3.64				0.00				0.00	14.93					800								
Contribution From Unknown Road11 - 40, Pipe 125 - 76						0.29				1.54				0.00				1.87	12.61					40								
			0.09	0.70	0.18	31.57			0.00	5.47			0.00	0.00			0.00	1.87														
	76	23			0.00	31.57	0.13	0.70	0.25	5.72			0.00	0.00			0.00	1.87	19.02	53.67	72.48	0.00	123.79	3180	1800	1800	CONC	0.14	74.0	4300.95	1.69	0.73	0.74
			0.21	0.70	0.41	31.98			0.00	5.72			0.00	0.00			0.00	1.87														
					0.00	31.98	0.22	0.70	0.43	6.15			0.00	0.00			0.00	1.87														
	23	24	0.22	0.70	0.43	32.41			0.00	6.15			0.00	0.00			0.00	1.87	19.75	52.44	70.81	0.00	120.91	3201	1800	1800	CONC	0.14	90.0	4300.95	1.69	0.89	0.74
					0.00	32.41	0.19	0.70	0.37	6.52			0.00	0.00			0.00	1.87														
			0.21	0.70	0.41	32.82			0.00	6.52			0.00	0.00			0.00	1.87														
			0.51	0.70	0.99	33.81			0.00	6.52			0.00	0.00			0.00	1.87														
	24	25	2.82	0.75	5.88	39.69			0.00	6.52			0.00	0.00			0.00	1.87	20.64	51.03	68.89	0.00	117.60	3534	1800	1800	CONC	0.17	80.5	4739.41	1.86	0.72	0.75
					0.00	39.69	0.18	0.70	0.35	6.87			0.00	0.00			0.00	1.87														
	25	26	0.22	0.70	0.43	40.12			0.00	6.87			0.00	0.00			0.00	1.87	21.36	49.95	67.41	0.00	115.05	3522	1800	1800	CONC	0.17	80.5	4739.41	1.86	0.72	0.74
			0.16	0.70	0.31	40.43			0.00	6.87			0.00	0.00			0.00	1.87														
					0.00	40.43	0.18	0.70	0.35	7.22			0.00	0.00			0.00	1.87														
	26	27	3.60	0.40	4.00	44.43			0.00	7.22			0.00	0.00			0.00	1.87	22.08	48.91	66.00	0.00	112.63	3700	1800	1800	CONC	0.19	80.5	5010.45	1.97	0.68	0.74
					0.00	44.43	0.17	0.70	0.33	7.55			0.00	0.00			0.00	1.87														
			0.36	0.70	0.70	45.13			0.00	7.55			0.00	0.00			0.00	1.87														
	27	28	2.62	0.75	5.46	50.59			0.00	7.55			0.00	0.00			0.00	1.87	22.76	47.98	64.73	0.00	110.44	3962	1800	1800	CONC	0.21	72.5	5267.56	2.07	0.58	0.75
					0.00	50.59	0.14	0.70	0.27	7.82			0.00	0.00			0.00	1.87														
	28	29	0.17	0.70	0.33	50.92			0.00	7.82			0.00	0.00			0.00	1.87	23.34	47.21	63.68	0.00	108.63	3945	1800	1800	CONC	0.21	72.5	5267.56	2.07	0.58	0.75
					0.00	50.92	0.25	0.70	0.49	8.31			0.00	0.00			0.00	1.87														
	29	30	3.68	0.70	7.16	58.09			0.00	8.31			0.00	0.00			0.00	1.87	23.93	46.47	62.67	0.00	106.89	4259	1950	1950	CONC	0.14	116.0	5324.30	1.78	1.08	0.80
			0.56	0.70	1.09	59.18			0.00	8.31			0.00	0.00			0.00	1.87														
	30	31	1.62	0.70	3.15	62.33			0.00	8.31			0.00	0.00			0.00	1.87	25.01	45.16	60.88	0.00	103.82	4354	1950	1950	CONC	0.14	91.5	5324.30	1.78	0.86	0.82
	31	13	0.66	0.70	1.28	63.61			0.00	8.31			0.00	0.00			0.00	1.87	25.87	44.18	59.55	0.00	101.53	4335	2100	2100	CONC	0.10	97.5	5483.08	1.58	1.03	0.79
Contribution From Unknown Road9 - 20, Pipe 12 - 13						29.25				0.00				0.00				0.00	25.11													
	13	20			0.00	92.86			0.00	8.31			0.00	0.00			0.00	1.87	26.89	43.06	58.03	0.00	98.93	5506	2250	2250	CONC	0.12	62.5	7219.67	1.82	0.57	0.76
					0.00	92.86	0.23	0.70	0.45	8.76			0.00	0.00			0.00	1.87														
			0.25	0.70	0.49	93.35			0.00	8.76			0.00	0.00			0.00	1.87														
			1.45	0.70	2.82	96.17			0.00	8.76			0.00	0.00			0.00	1.87														
	20	21TEE	1.79	0.70	3.48	99.65			0.00	8.76			0.00	0.00			0.00	1.87	27.47	42.47	57.22	0.00	97.53	5755	2250	2250	CONC	0.13	39.0	7514.47	1.89	0.34	0.77
	21TEE	49	0.84	0.70	1.63	101.29			0.00	8.76			0.00	0.00			0.00	1.87	27.81	42.12	56.75	0.00	96.72	5784	2250	2250	CONC	0.13	68.5	7514.47	1.89	0.60	0.77
	49	50			0.00	101.29			0.00	8.76			0.00	0.00			0.00	1.87	28.41	41.52	55.94	0.00	95.33	5714	2250	2250	CONC	0.13	41.5	7514.47	1.89	0.37	0.76
	50	51			0.00	101.29			0.00	8.76			0.00	0.00			0.00	1.87	28.78	41.17	55.46	0.00	94.50	5672	2250	2250	CONC	0.12	38.0	7219.67	1.82	0.35	0.79
Unknown Road12 - 50																																
					0.00	0.00			0.00	0.00			0.00	0.00	0.00	0.00	0.00	0.00						800								
	300	302			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	0.00	178.56	800	975	975	CONC	0.16	43.0	896.42	1.20	0.60	0.89
Contribution From Unknown Road8 - 10, Pipe 60 - 302						6.13				0.00				0.00				0.00	15.86													
	302	303			0.00	6.13			0.00	0.00			0.00	0.00			0.00	0.00	15.86	59.81	80.88	0.00	138.27	1167	1200	1200	CONC	0.11	91.0	1293.06	1.14	1.33	0.90
	303	304			0.00	6.13			0.00	0.00			0.00	0.00			0.00	0.00	17.19	57.05	77.10	0.00	131.75	1150	1200	1200	CONC	0.10	54.0	1232.89	1.09	0.83	0.93

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed:
Checked:
Dwg. Reference:

PROJECT: LAFFIN LANDS
LOCATION: City of Ottawa
File Ref:
Date: 23 Jun 2020
Sheet No. SHEET 3 OF 4

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

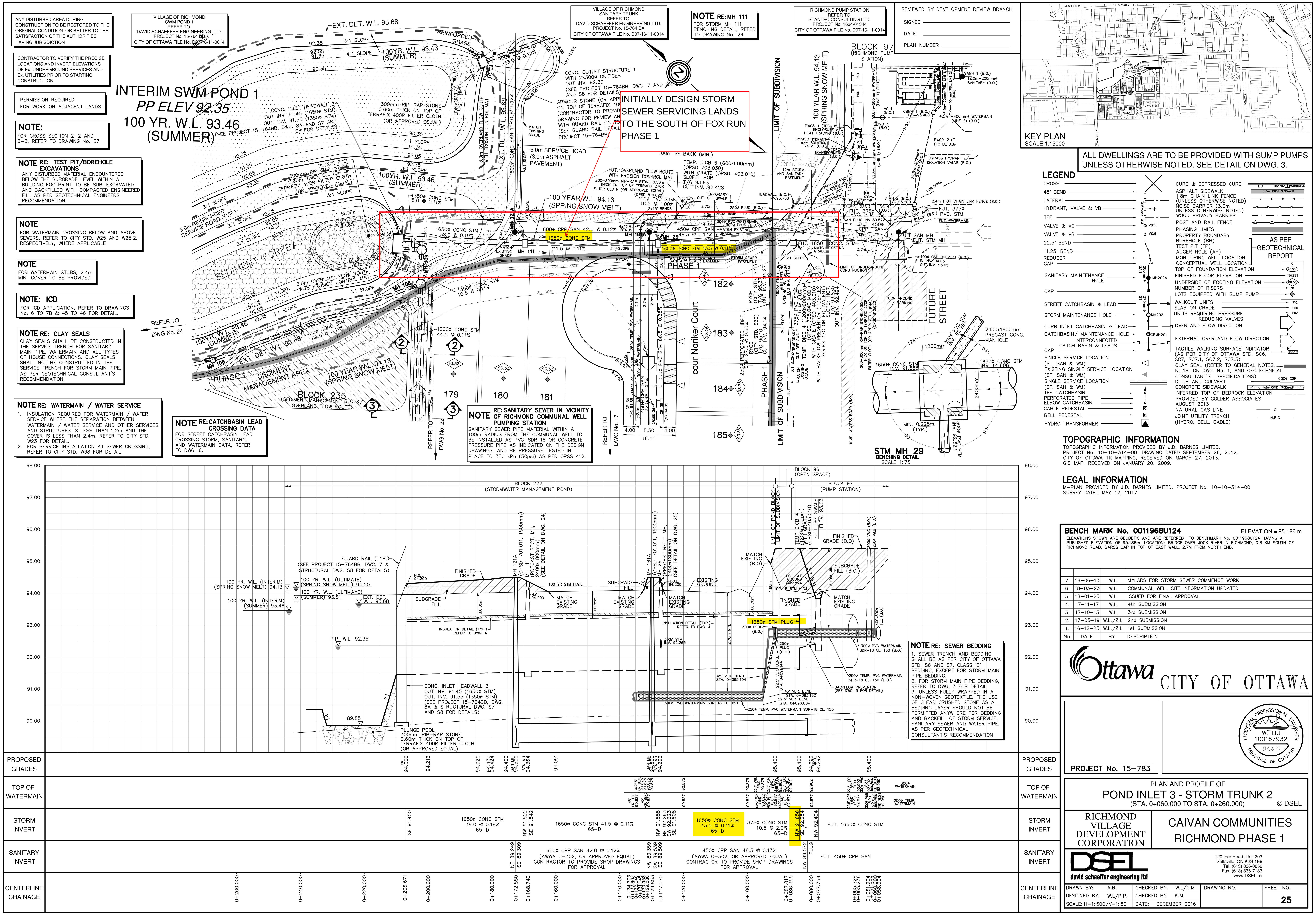
	LOCATION		AREA (Ha)														FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year	10 Year	100 Year										
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	FLOW (min.	Q/Q full
	304	305			0.00	6.13			0.00	0.00			0.00	0.00			0.00	0.00	18.01	55.47	74.94	0.00	128.03	1140	1200	1200	CONC	0.10	86.5	1232.89	1.09	1.32	0.92
	305	306			0.00	6.13			0.00	0.00			0.00	0.00			0.00	0.00	19.33	53.13	71.75	0.00	122.53	1126	1200	1200	CONC	0.10	16.5	1232.89	1.09	0.25	0.91

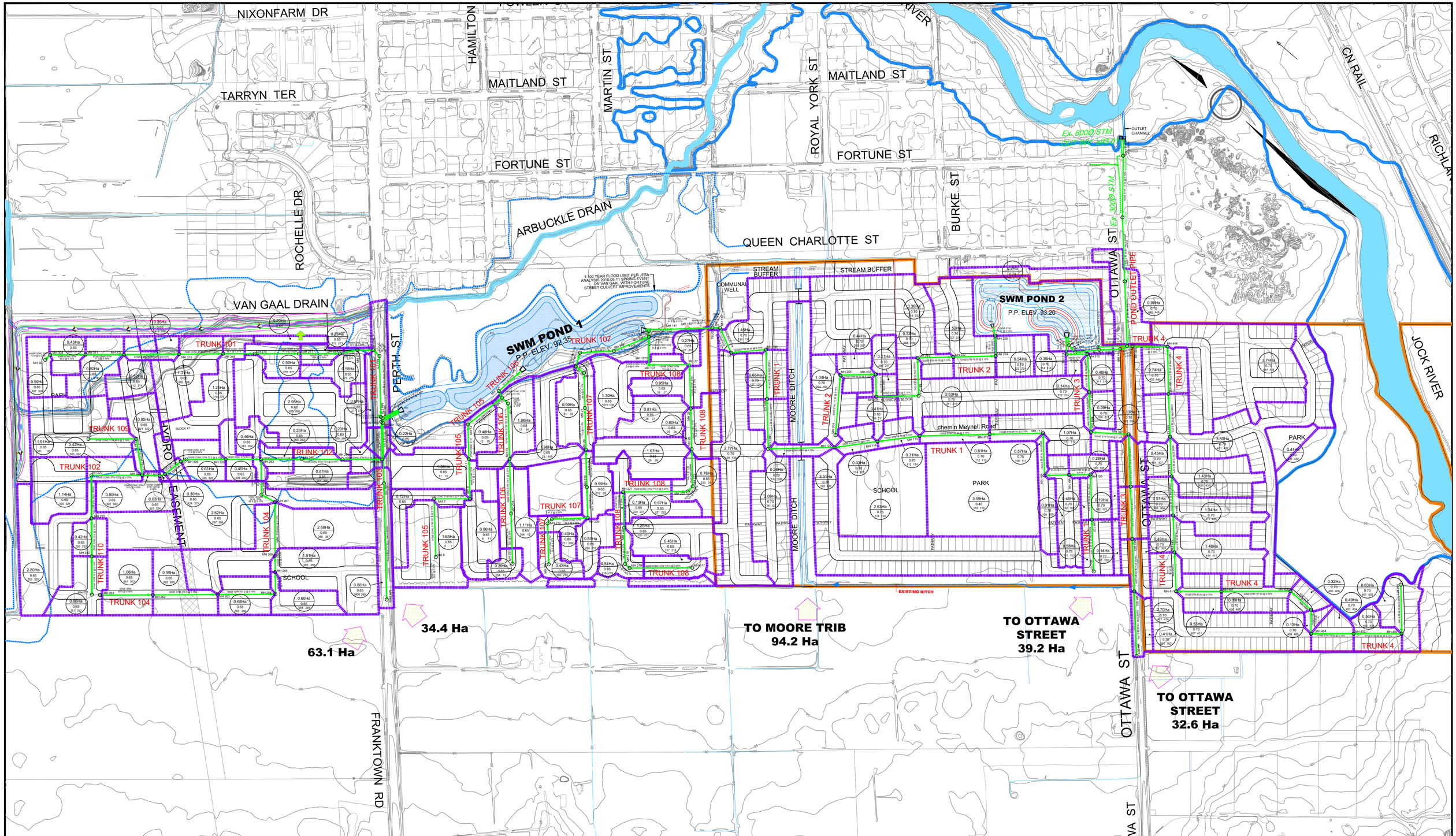
Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed:
Checked:
Dwg. Reference:

PROJECT: LAFFIN LANDS
LOCATION: City of Ottawa
File Ref:
Date: 23 Jun 2020
Sheet No. SHEET 4 OF 4


ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO THE ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE AUTHORITIES HAVING JURISDICTION
CONTRACTOR TO VERIFY THE PRECISE LOCATIONS AND INVERT ELEVATIONS OF Ex. UNDERGROUND SERVICES AND Ex. UTILITIES PRIOR TO STARTING CONSTRUCTION
PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS
NOTE: FOR CROSS SECTION 2-2 AND 3-3, REFER TO DRAWING No. 37
NOTE RE: TEST PIT/BOREHOLE EXCAVATIONS
ANY DISTURBED MATERIAL ENCOUNTERED BELOW THE SUBGRADE LEVEL WITHIN A BUILDING FOOTPRINT TO BE SUB-EXCAVATED AND BACKFILLED WITH COMPACTED ENGINEERED FILL AS PER GEOTECHNICAL ENGINEERS RECOMMENDATION.
NOTE
FOR WATERMAIN CROSSING BELOW AND ABOVE SEWERS, REFER TO CITY STD. W25 AND W25.2, RESPECTIVELY, WHERE APPLICABLE
NOTE
FOR WATERMAIN STUBS, 2.4m MIN. COVER TO BE PROVIDED
NOTE: ICD
FOR ICD APPLICATION, REFER TO DRAWINGS No. 6 TO 7B & 45 TO 46 FOR DETAIL.
NOTE RE: CLAY SEALS
CLAY SEALS SHALL BE CONSTRUCTED IN THE SERVICE TRENCH FOR SANITARY MAIN PIPE, WATERMAIN AND ALL TYPES OF HOUSE CONNECTIONS. CLAY SEALS SHALL NOT BE CONSTRUCTED IN THE SERVICE TRENCH FOR STORM MAIN PIPE, AS PER GEOTECHNICAL CONSULTANT'S RECOMMENDATION.
NOTE RE: WATERMAIN / WATER SERVICE
1. INSULATION REQUIRED FOR WATERMAIN / WATER SERVICE WHERE THE SEPARATION BETWEEN WATERMAIN / WATER SERVICE AND OTHER SERVICES AND STRUCTURES IS LESS THAN 1.2m AND THE COVER IS LESS THAN 2.4m. REFER TO CITY STD. W23 FOR DETAIL.
2. FOR SERVICE INSTALLATION AT SEWER CROSSING, REFER TO CITY STD. W38 FOR DETAIL
NOTE RE: CATCHBASIN LEAD CROSSING DATA
FOR STREET CATCHBASIN LEAD CROSSING STORM, SANITARY, AND WATERMAIN DATA, REFER TO DWG. 6.
NOTE RE: SANITARY SEWER IN VICINITY OF RICHMOND COMMUNAL WELL PUMPING STATION
SANITARY SEWER PIPE MATERIAL WITHIN A 100m RADIUS FROM THE COMMUNAL WELL TO BE INSTALLED AS PVC-SDR 18 OR CONCRETE PRESSURE PIPE AS INDICATED ON THE DESIGN DRAWINGS, AND BE PRESSURE TESTED IN PLACE TO 350 kPa (50psi) AS PER OPSS 412.
VILLAGE OF RICHMOND SWM POND 1 REFER TO DAVID SCHAEFFER ENGINEERING LTD. PROJECT No. 15-764 BB CITY OF OTTAWA FILE No. D07-16-11-0014
VILLAGE OF RICHMOND SANITARY TRUNK REFER TO DAVID SCHAEFFER ENGINEERING LTD. PROJECT No. 15-764 BA CITY OF OTTAWA FILE No. D07-16-11-0014
NOTE RE: MH 111
FOR STORM MH 111 BENCHING DETAIL, REFER TO DRAWING No. 24
RICHMOND PUMP STATION REFER TO STANTEC CONSULTING LTD. PROJECT No. 1634-01344 CITY OF OTTAWA FILE No. D07-16-11-0014
REVIEWED BY DEVELOPMENT REVIEW BRANCH
SIGNED
DATE
PLAN NUMBER
INTERIM SWM POND 1
PP ELEV 92.35
100 YR. W.L. 93.46 (SUMMER)
INITIALLY DESIGN STORM SEWER SERVICING LANDS TO THE SOUTH OF FOX RUN PHASE 1
SEDIMENT FOREBAY
PHASE 1 SEDIMENT MANAGEMENT AREA
BLOCK 235 (SEDIMENT MANAGEMENT BLOCK/ OVERLAND FLOW ROUTE)
cour Noriker Court
FUTURE STREET
LIMIT OF SUBDIVISION
PHASE 1
BLOCK 97 (RICHMOND PUMP STATION)
BLOCK 96 (OPEN SPACE)
1650ø CONC STM
1650ø CONC STM 43.5 @ 0.11%
STM MH 29 BENCHING DETAIL SCALE 1:75
2400x1800mm PRECAST CONC. MANHOLE
KEY PLAN SCALE 1:15000
ALL DWELLINGS ARE TO BE PROVIDED WITH SUMP PUMPS UNLESS OTHERWISE NOTED. SEE DETAIL ON DWG. 3.
LEGEND
TOPOGRAPHIC INFORMATION
TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 10-10-314-00. DRAWING DATED SEPTEMBER 26, 2012. CITY OF OTTAWA 1K MAPPING, RECEIVED ON MARCH 27, 2013. GIS MAP, RECEIVED ON JANUARY 20, 2009.
LEGAL INFORMATION
M-PLAN PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 10-10-314-00, SURVEY DATED MAY 12, 2017
BENCH MARK No. 0011968U124 ELEVATION = 95.186 m
ELEVATIONS SHOWN ARE GEODETIC AND ARE REFERRED TO BENCHMARK No. 0011968U124 HAVING A PUBLISHED ELEVATION OF 95.186m. LOCATION: BRIDGE OVER JOCK RIVER IN RICHMOND, 0.8 KM SOUTH OF RICHMOND ROAD, BARSS CAP IN TOP OF EAST WALL, 2.7M FROM NORTH END.
7. 18-06-13 W.L. MYLARS FOR STORM SEWER COMMENCE WORK
6. 18-03-23 W.L. COMMUNAL WELL SITE INFORMATION UPDATED
5. 18-01-25 W.L. ISSUED FOR FINAL APPROVAL
4. 17-11-17 W.L. 4th SUBMISSION
3. 17-10-13 W.L. 3rd SUBMISSION
2. 17-05-19 W.L./Z.L. 2nd SUBMISSION
1. 16-12-23 W.L./Z.L. 1st SUBMISSION
No. DATE BY DESCRIPTION
NOTE RE: SEWER BEDDING
1. SEWER TRENCH AND BEDDING SHALL BE AS PER CITY OF OTTAWA STD. S6 AND S7, CLASS 'B' BEDDING, EXCEPT FOR STORM MAIN PIPE BEDDING.
2. FOR STORM MAIN PIPE BEDDING, REFER TO DWG. 3 FOR DETAIL.
3. UNLESS FULLY WRAPPED IN A NON-WOVEN GEOTEXTILE, THE USE OF CLEAR CRUSHED STONE AS A BEDDING LAYER SHOULD NOT BE PERMITTED ANYWHERE FOR BEDDING AND BACKFILL OF STORM SERVICE, SANITARY SEWER AND WATER PIPE, AS PER GEOTECHNICAL CONSULTANT'S RECOMMENDATION
BLOCK 222 (STORMWATER MANAGEMENT POND)
1650ø STM PLUG
PROPOSED GRADES
TOP OF WATERMAIN
STORM INVERT
SANITARY INVERT
CENTERLINE CHAINAGE
1650ø CONC STM 38.0 @ 0.19% 65-D
1650ø CONC STM 41.5 @ 0.11% 65-D
1650ø CONC STM 43.5 @ 0.11% 65-D
375ø CONC STM 10.5 @ 2.0% 65-D
FUT. 1650ø CONC STM
600ø CPP SAN 42.0 @ 0.12% (AWWA C-302, OR APPROVED EQUAL) CONTRACTOR TO PROVIDE SHOP DRAWINGS FOR APPROVAL
450ø CPP SAN 48.5 @ 0.13% (AWWA C-302, OR APPROVED EQUAL) CONTRACTOR TO PROVIDE SHOP DRAWINGS FOR APPROVAL
FUT. 450ø CPP SAN
Ottawa CITY OF OTTAWA
W. LIU 100167932 PROVINCE OF ONTARIO
PROJECT No. 15-783
PLAN AND PROFILE OF
POND INLET 3 - STORM TRUNK 2
(STA. 0+060.000 TO STA. 0+260.000)
© DSEL
RICHMOND VILLAGE DEVELOPMENT CORPORATION
CAIVAN COMMUNITIES RICHMOND PHASE 1
DSEL david schaeffer engineering ltd
120 Iber Road, Unit 203 Stittsville, ON K2S 1E9 Tel. (613) 836-0856 Fax. (613) 836-7183 www.DSEL.ca
DRAWN BY: A.B.
CHECKED BY: W.L./C.M
DRAWING NO.
SHEET NO. 25
DESIGNED BY: W.L./P.P.
CHECKED BY: K.M.
SCALE: H=1:500/V=1:50
DATE: DECEMBER 2016
CITY PLAN No.
CITY FILE No. D07-16-11-0014



DSEL
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120 Iber Road, Unit 103
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Fax. (613) 836-7183
www.DSEL.ca

WESTERN DEVELOPMENT LANDS
STORM SERVICING PLAN
CITY OF OTTAWA

LEGEND

- STUDY LIMIT
- EXISTING DITCH
- STORM TRIBUTARY AREA
- STORM TRUNK
- LOCAL STORM SEWER
- EXISTING STORM TRUNK
- STORM TRUNK BY OTHERS
- 1:100 YEAR REGULATORY FLOOD LINE PER JFSA NOVEMBER 2009 (BACKWATER FROM JOCK RIVER)
- 8.26Ha / 0.62 — DRAINAGE AREA IMPERVIOUSNESS
- EXTERNAL DRAINAGE
- 100 YEAR INTAKE AREA

PROJECT No.:	17-977
DATE:	October 2019
SCALE:	1:3000
DRAWING:	3

The subject lands sloped generally from west to east under pre-development conditions. As described in ***Section 3.4***, there are significant areas west of the subject land that drain through the development property under pre-development conditions. As illustrated on ***Drawing 3***, the external areas are summarized below:

- 63.1 ha Perth Street road side ditch north;
- 34.4 ha Perth Street road side ditch south;
- 94.2 ha approximately midpoint between Perth and Ottawa Streets;
- 39.2 ha Ottawa Street road side ditch north and;
- 32.6 ha Ottawa Street road side ditch south.

The above external areas will be serviced by the two SWM ponds as they were included in the design of Pond 1 and Pond 2.

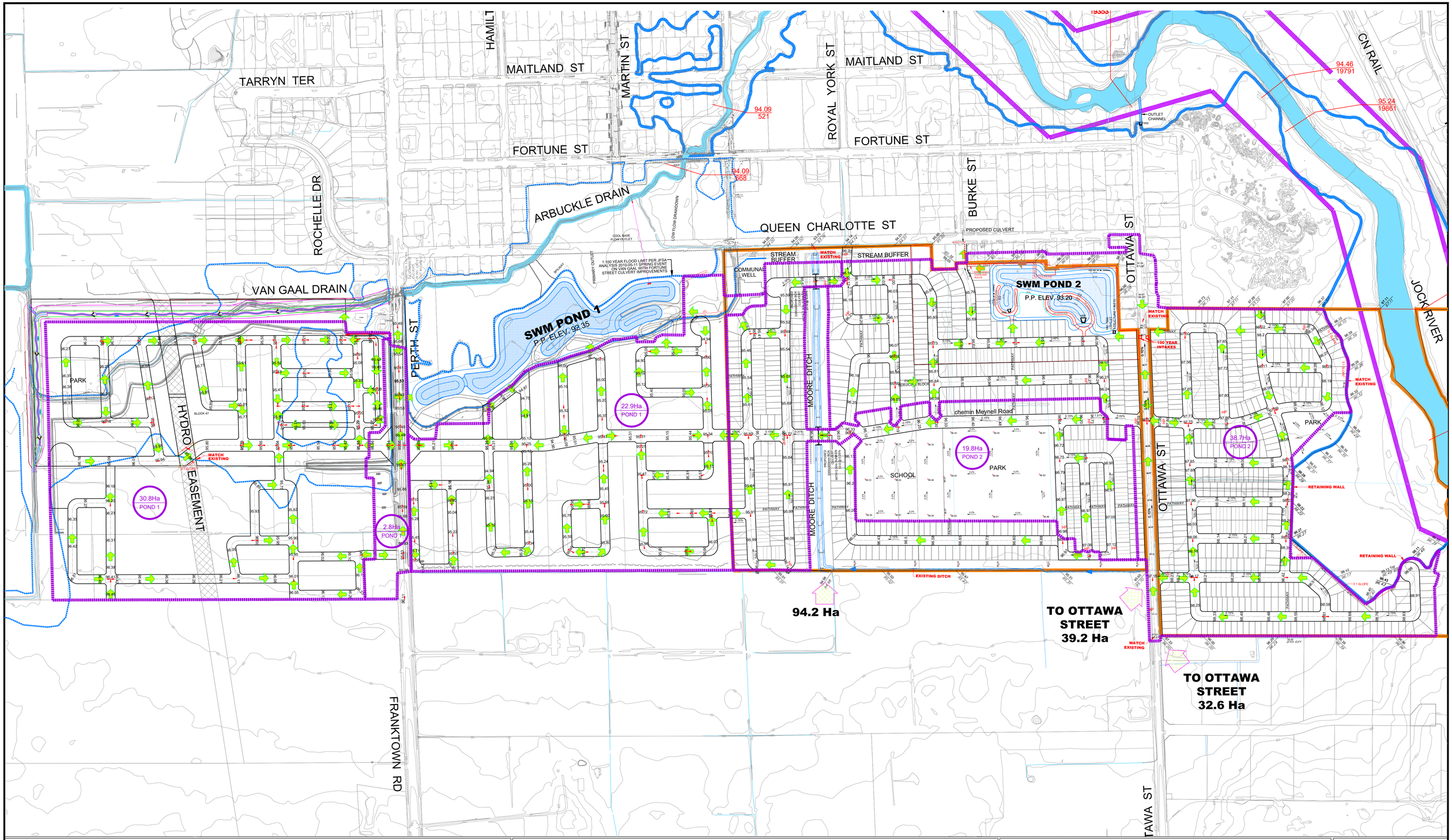
Due to anticipated urbanization of Perth Street and Ottawa Street as well as the site at large, these external areas will be collected and conveyed within storm sewers. These areas will be directed through the stormwater management facilities.

6.2.1 Deviations from Design Guidelines

The design of the sewer outfall from SWM Facility #1 (see ***Section 7.1*** of this report for Facility #1 details) results in a circumstance where it has to cross underneath the existing Moore tributary as noted in the ***Ultimate Pond 1 Design Brief***. Due to site constraints (i.e. grading and both conveyances outletting to the same tributary) there is minimum cover between the ditch invert and the obvert of the sewer outfall (0.10 m). In the detailed design of SWM Facility #1, twin 525 mm storm pipes were proposed and installed, crossing under the Moore tributary to mitigate the depth of cover. As a result, some of the storm sewers in the RVDC lands use spring line to spring line connections, deviating from obvert to obvert connections per *Section 6.2.10* of the ***Sewer Design Guidelines***. Justification for spring line to spring line connections is provided in ***Deviations from Guidelines and Standards Report (Springline Connections) Fox Run Subdivision Richmond – Phase 2 (South)*** prepared by DSEL, dated May 31, 2019 for the RVDC lands. If necessary, justification for spring line connections will be provided in the detailed design of the other land holdings within the Western Development Lands.

6.3 Sump Pump Service

The majority of the Village of Richmond is reliant on sump pumps for foundation drainage as discussed in ***Section 5.2.4***. The use of sump pumps for the subject lands remains consistent with the existing level of service within the Village of Richmond.



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WESTERN DEVELOPMENT LANDS

GRADING PLAN

CITY OF OTTAWA

LEGEND

- STUDY LIMIT
- EXISTING DITCH
- EXISTING ELEVATION CONTOUR
- MAJOR OVERLAND FLOW
- EXTERNAL DRAINAGE
- 1:100 YEAR REGULATORY FLOOD LINE PER JFSA NOVEMBER 2009 (BACKWATER FROM JOCK RIVER)
- EMERGENCY OVERLAND FLOW
- STORM MAJOR TRIBUTARY AREA
- 30.8Ha POND 1 — DRAINAGE AREA

CUT-FILL DEPTH ALONG CENTER LINE:

CUT DEPTH (m)	FILL DEPTH (m)
0 - 1	0 - 1
1 - 2	1 - 2
2 - 3	2 - 3

PROJECT No.:	17-977
DATE:	October 2019
SCALE:	1:3000
DRAWING:	2

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A FINE PARTICLE SIZE DISTRIBUTION

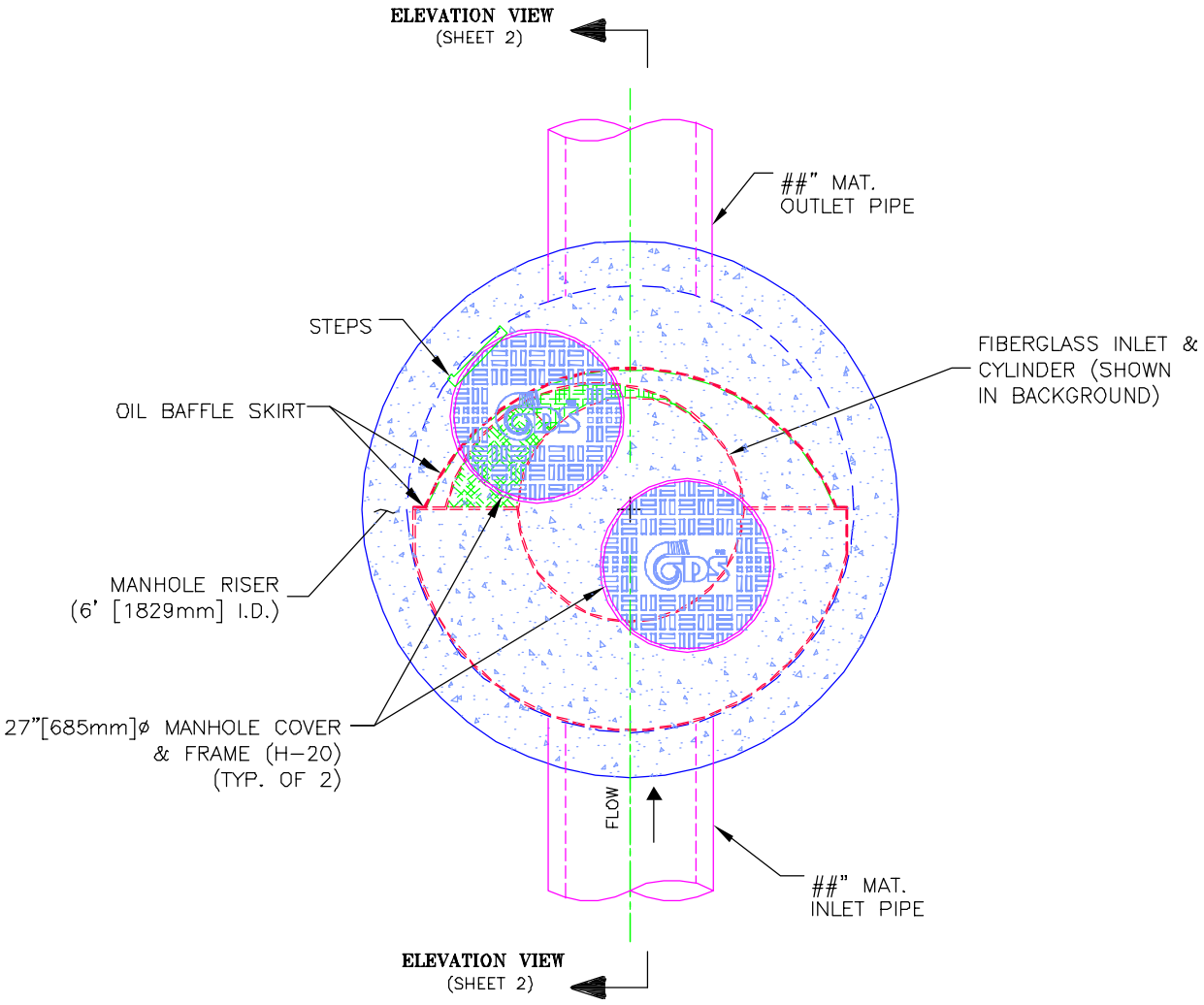
Project Name:	Green Property - Richmond	**Engineer:**	**DSEL**
Location:	Richmond, ON	**Contact:**	S. Merrick, P.Eng
OGS #:	OGS	**Report Date:**	8-Jul-20

Area	2.16	ha	**Rainfall Station #**	215	
Weighted C	0.66		**Particle Size Distribution**	FINE	
CDS Model	3020		**CDS Treatment Capacity**	57	l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	9.2%	9.2%	2.0	2.0	3.5	97.9	9.0
1.0	10.6%	19.8%	4.0	4.0	7.0	96.9	10.3
1.5	9.9%	29.7%	5.9	5.9	10.5	95.8	9.5
2.0	8.4%	38.1%	7.9	7.9	14.0	94.8	7.9
2.5	7.7%	45.8%	9.9	9.9	17.5	93.8	7.2
3.0	5.9%	51.7%	11.9	11.9	21.0	92.8	5.5
3.5	4.4%	56.1%	13.9	13.9	24.5	91.8	4.0
4.0	4.7%	60.7%	15.9	15.9	28.0	90.8	4.2
4.5	3.3%	64.0%	17.8	17.8	31.5	89.8	3.0
5.0	3.0%	67.1%	19.8	19.8	35.0	88.8	2.7
6.0	5.4%	72.4%	23.8	23.8	42.0	86.8	4.7
7.0	4.4%	76.8%	27.7	27.7	49.0	84.8	3.7
8.0	3.5%	80.3%	31.7	31.7	56.0	82.8	2.9
9.0	2.8%	83.2%	35.7	35.7	63.0	80.8	2.3
10.0	2.2%	85.3%	39.6	39.6	70.0	78.8	1.7
15.0	7.0%	92.3%	59.4	56.6	100.0	66.9	4.7
20.0	4.5%	96.9%	79.3	56.6	100.0	50.2	2.3
25.0	1.4%	98.3%	99.1	56.6	100.0	40.1	0.6
30.0	0.7%	99.0%	118.9	56.6	100.0	33.4	0.2
35.0	0.5%	99.5%	138.7	56.6	100.0	28.7	0.1
40.0	0.5%	100.0%	158.5	56.6	100.0	25.1	0.1
							86.7
						Removal Efficiency Adjustment[2] =	6.5%
						Predicted Net Annual Load Removal Efficiency =	**80.2%**
						Predicted % Annual Rainfall Treated =	**96.8%**

1 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa ON
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.
3 - CDS Efficiency based on testing conducted at the University of Central Florida
4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications

PLAN VIEW

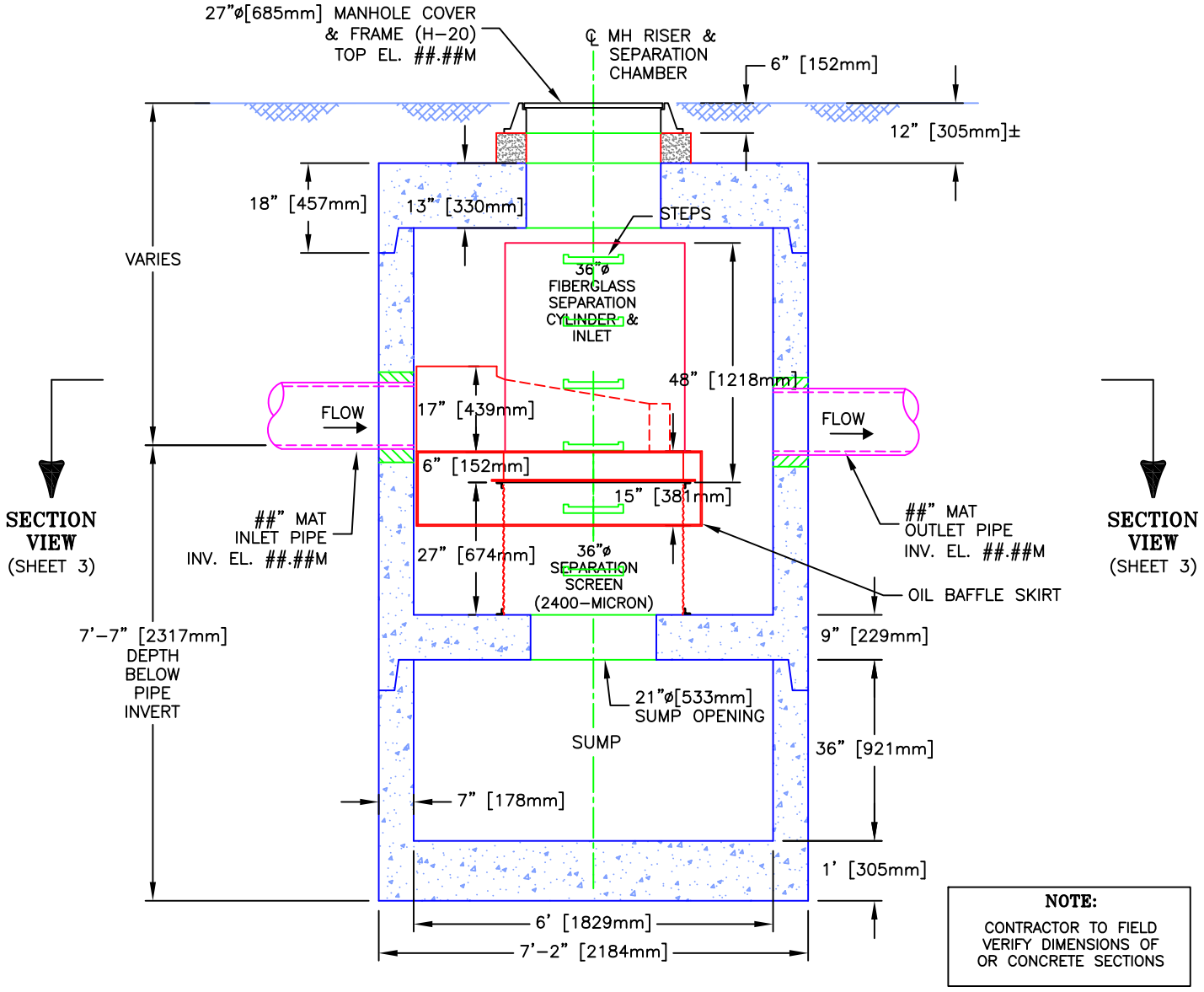


CDS MODEL PMSU30_20m, 2 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB# CAN-##-###	SCALE 1" = 2.5'
		DATE ##/##/##	SHEET 1
		DRAWN INITIALS	
		APPROV.	

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

ELEVATION VIEW



NOTE:
CONTRACTOR TO FIELD VERIFY DIMENSIONS OF OR CONCRETE SECTIONS

CDS MODEL PMSU30_20m, 2 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB# CAN-##-###	SCALE 1" = 3'
		DATE ##/##/##	SHEET 2
		DRAWN INITIALS	
		APPROV.	

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

CALCULATION SHEET B-2: FOREBAY SIZING FOR SWM FACILITY

WESTERN DEVELOPMENT LANDS - RICHMOND
SWM Pond 1
City of Ottawa
Calculation of Forebay Size
South Forebay

Settling Criteria

From the SWMP Manual, the required length for settling is as follows:

$$L_{min} = \left(\frac{r\,Q_p}{V_s}\right)^{0.5}$$

where:
- r = length to width ratio, at the invert of the inlet pipe.
- Q_p = peak outflow during design quality storm
- V_s = settling velocity

Input:

r =	3.07		(83 m / 27 m)
Q_p =	0.341	m^3/s	(at elevation 93.68 m)
V_s =	0.0003	m/s	

L_{min} = 59.11 m

The peak flow rate from the pond during the quality storm is taken as the flow that would occur just below the quantity controls (Refer to Table B-5 of Appendix B)

Dispersion Criteria

From the SWMP Manual, the required length for dispersion is as follows:

$$L_{min} = \frac{8\,Q}{d\,V_f}$$

where:
- Q = Inlet flowrate (10-Year, 24-Hour SCS Storm)
- d = depth of permanent pool (forebay)
- V_f = desired final velocity

Input:

Q =	9.223	m^3/s
d =	2.0	m
Vf =	0.5	m/s

L_{min} = 73.78 m

The minimum forebay length is determined by the larger of the settling or dispersion criteria.

Minimum Length of Forebay Required	73.78 m	
Length of Forebay Provided	**83.00 m**	(at elevation 92.35 m)

Average Forebay Velocity

From the SWMP Manual, the maximum allowable average velocity is 0.15 m/s:

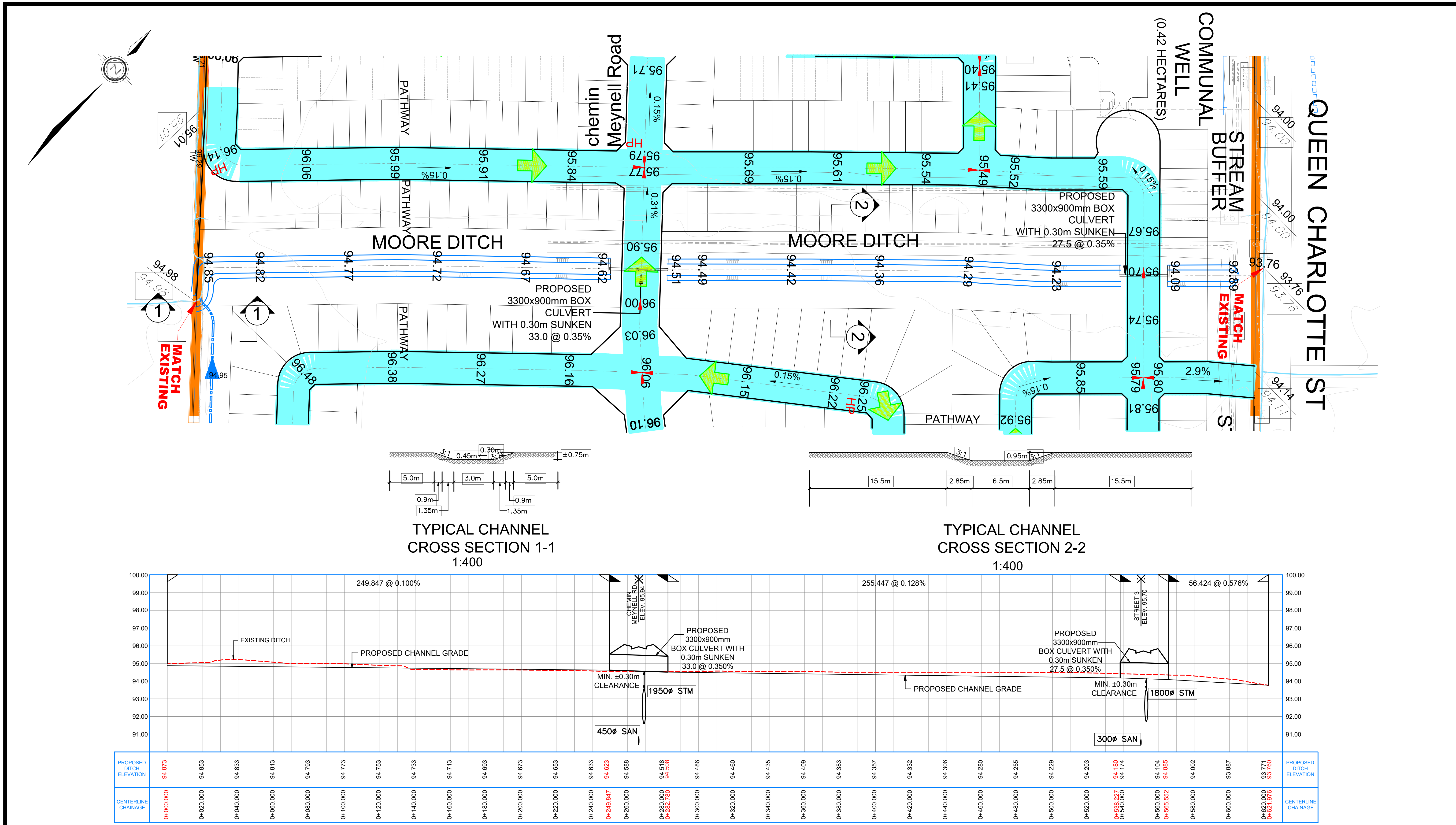
$$V_{avg} = \frac{Q}{d\,W_{avg}}$$

where:
- Q = Inlet flowrate (10-Year, 24-Hour SCS Storm)
- d = depth of pond during peak 10-year inflow (12h:00min)
- W_{avg} = average width of forebay

Input:

Q =	9.223	m^3/s	
d =	2.65	m	
W_{avg} =	21	m	(15 m bottom, 27 m permanent pool)

V = 0.17 m/s > 0.15 m/s



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MATTAMY - VILLAGE OF RICHMOND WESTERN DEVELOPMENT LANDS

MOORE TRIBUTARY - PLAN PROFILE

CITY OF OTTAWA

LEGEND

- STUDY LIMIT
- REGULATORY FLOOD LINE
- OVERLAND FLOW DIRECTION
- EXISTING DITCH
- 95.00 EXISTING ELEVATION CONTOUR

PROJECT No.:	17-977
DATE:	June 2019
SCALE:	1:2000
FIGURE:	7

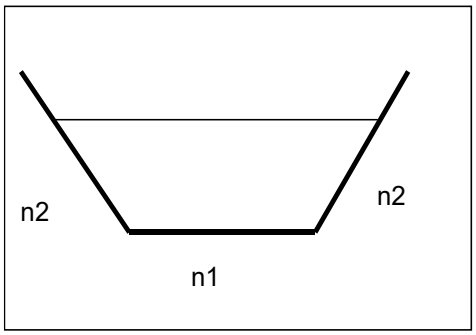
Date: January, 2019
DSEL File: 17-977

Moore Ditch

Channel Conveyance Calculations

Input:

Bottom Width	6.500	m	
Bottom "n1"	0.035		grass
Side Slope	3	:1	
Side "n2"	0.035		grass
Depth	0.650	m	
Freeboard	0.300	m	
Slope	0.10%		



Output:

Flow	**3.387**	**m^3/s**	
>	**2.793**	**m^3/s**	Outflow per JFSA: VG-6 and VG7 - 100 yr 24Hr SCS design flow. Nov 18, 2016
	OK		\\dse-fsm1.dse.ads\design$\Design\11468\Others\JF\54_Nov1816_External_Predeve
Velocity	**0.62**	**m/s**	
Total Width	**12.2**	**m**	

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

LOCATION			AREA (Ha)															FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year	10 Year	100 Year										
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	LOW (min	Q/Q full
External VG-6 to Moore Trib															94.20									1885								
External VG-7 to Pond 2															39.20									908								
Total Flow															133.40									2793	1800		CONC	0.16		4598	1.81	0.00	0.61
																								2793	2400x1200		CONC	0.16		4811	1.67	0.00	0.58
Note: Please see link below for flowrate information (100-yr 24hr SCS for area VG-6 and VG-7)																																
Z:\Projects\17-977_Mattamy_Richmond\B_Design\B1_Analysis\B1-3_Storm\2018-11-28_markham_moore_calcs																																
																								2793	1800x900		CONC	0.35		3304	2.04	0.00	0.85
Ottawa St. Ditch 100 YR							0.00								32.60									1154	1050		CONC	0.18		1159	1.34	0.00	1.00
Ottawa St. Ditch 5 YR							32.60																	681	900		CONC	0.18		768	1.21	0.00	0.89
Note: flows calculated from Upland Method																																
Ottawa St. Ditch 100 YR							0.00								32.60									1259	1050		CONC	0.18		1159	1.34	0.00	1.09
Ottawa St. Ditch 5 YR							32.60																	585	900		CONC	0.18		768	1.21	0.00	0.76
Note: flows per JFSA email, Nov 18, 2016																																
Z:\Projects\17-977_Mattamy_Richmond\B_Design\B1_Analysis\B1-3_Storm\2018-11-28_markham_moore_calcs																																

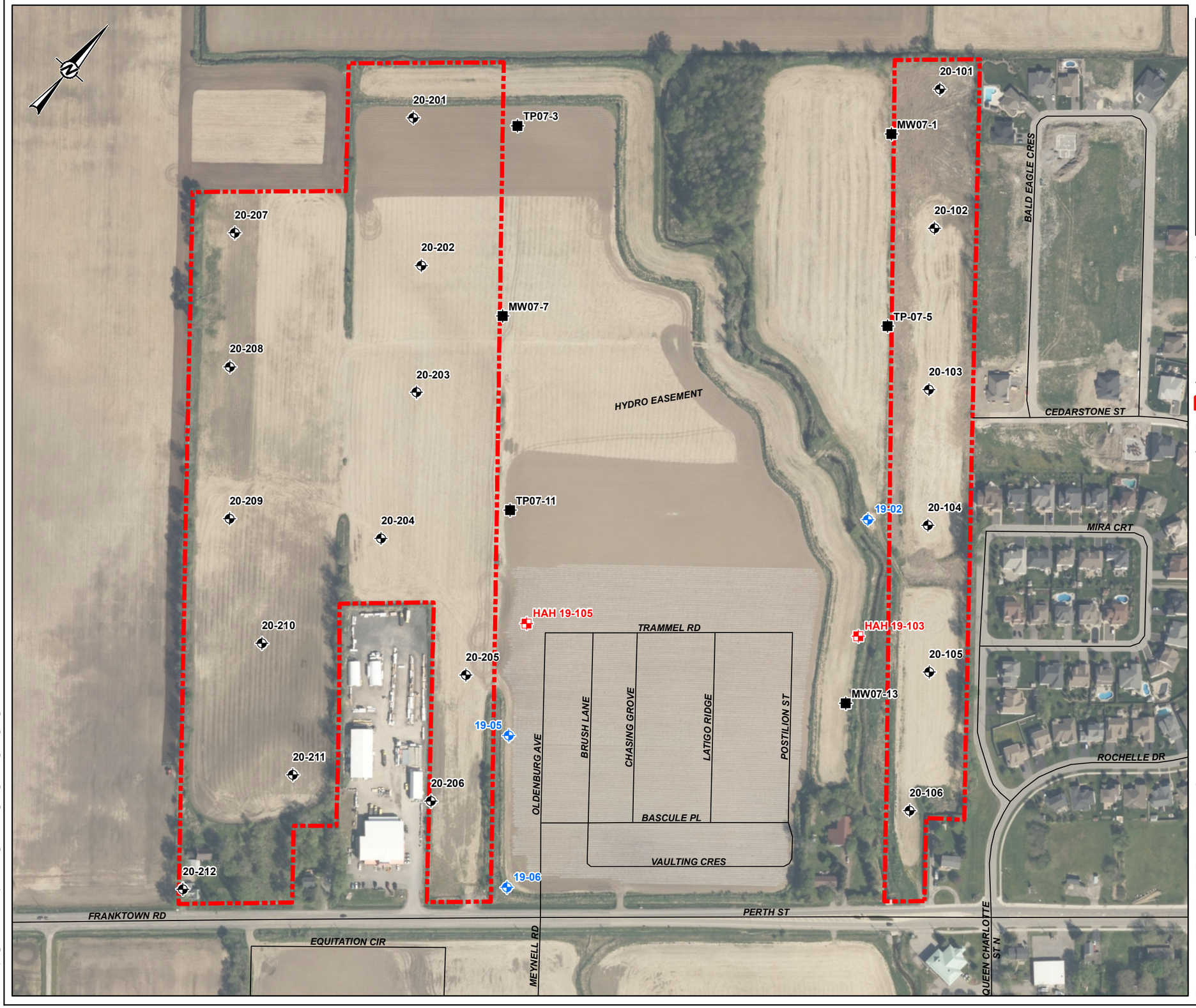
to Moore Ditch

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

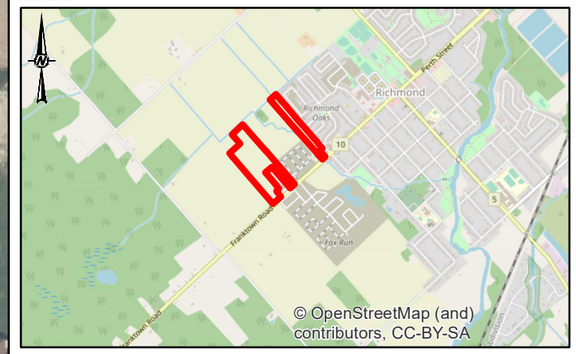
Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed: A.S.	PROJECT:		
Checked: V.C.	LOCATION: City of Ottawa		
Dwg. Reference:	File Ref: 14-733	Date: May, 2018	Sheet No. 1

APPENDIX F



KEY MAP



SCALE 1:50,000

LEGEND

- PROPOSED BOREHOLE LOCATION
- APPROXIMATE HAND AUGERHOLE LOCATION, PREVIOUS INVESTIGATION
- APPROXIMATE BOREHOLE LOCATION, PREVIOUS INVESTIGATION
- APPROXIMATE TESTHOLE LOCATION, PREVIOUS INVESTIGATION BY JACQUES WHITFORD, JUNE 2007
- ROADWAY
- APPROXIMATE SITE BOUNDARY

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 30 60 120

1:3,000 METRES

CLIENT

CAIVAN (RICHMOND NORTH) LIMITED

PROJECT

PRELIMINARY GEOTECHNICAL REPORT
GREEN LANDS EAST AND GREEN LANDS WEST

TITLE

SITE PLAN

CONSULTANT

GOLDER

YYYY-MM-DD	2020-06-29
DESIGNED	----
PREPARED	JEM
REVIEWED	KCP
APPROVED	WC

PROJECT NO.	CONTROL	REV.	FIGURE
20144864	0005	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Path: N:\Active\Spatial_IM\Caivan\Richmond\Proposed\SWMP\99_PRO\20144864_Caivan_Enviro\0005_Geotech_Memo_Green\EW\20144864-0005-BG-0001.mxd

APPENDIX A

Record of Previous Investigations

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERINGS STATE

Fresh: no visible sign of rock material weathering.

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)
The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)
The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)
The percentage of solid drill core, greater than 100 mm length, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index
A count of the number of naturally occuring discontinuities (physical separations) in the rock core. Mechanically induced breaks caused by drilling are not included.

Dip with Respect to Core Axis
The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90^{o} angle is horizontal.

Description and Notes
An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

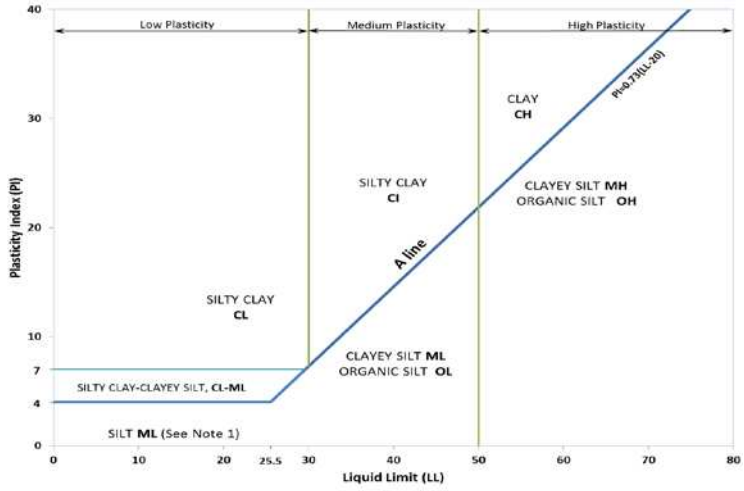
JN	Joint	PL	Planar
FLT	Fault	CU	Curved
SH	Shear	UN	Undulating
VN	Vein	IR	Irregular
FR	Fracture	K	Slickensided
SY	Stylolite	PO	Polished
BD	Bedding	SM	Smooth
FO	Foliation	SR	Slightly Rough
CO	Contact	RO	Rough
AXJ	Axial Joint	VR	Very Rough
KV	Karstic Void		
MB	Mechanical Break		

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.
Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.
For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.
For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.
A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.
2. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation
w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c′	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

PROJECT: 1522173

RECORD OF BOREHOLE: 19-02

SHEET 1 OF 1

LOCATION: N 5005908.9 ;E 355900.6

BORING DATE: April 23, 2019

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		94.75							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL- (ML) sandy SILT; dark brown		0.00 94.50	1	GRAB	-				Bentonite Seal
		(CL-ML) CLAYEY SILT to SILTY CLAY; grey brown, fissured, contains silty sand seams (WEATHERED CRUST); cohesive, w<PL, very stiff		0.25							
1					2	SS	6				
				93.38							Silica Sand
		(CI/CH) SILTY CLAY to CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, stiff		1.37							
2					3	SS	2				32 mm Diam. PVC #10 Slot Screen 'B'
				91.70							
3		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, firm		3.05							
					4	TP	PH				
4											Native Backfill
					5	SS	WH				
5											Bentonite Seal
											Silica Sand
6				88.65							
		(CI/CH-ML) SILTY CLAY to CLAYEY SILT; grey; cohesive, w>PL		6.10 88.35	6	SS	4				
		(ML) sandy SILT; grey; non-cohesive, wet, loose to very loose		6.40							32 mm Diam. PVC #10 Slot Screen 'A'
7					7	SS	7				
											Silica Sand
8				86.52	8	SS	2				
		End of Borehole		8.23							WL in screen 'A' at Elev. 94.31 m on May 6, 2019 WL in screen 'B' at Elev. 93.64 m on May 6, 2019
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: PAH

CHECKED: WAM

MIS-BHS 001 1522173.GPJ GAL-MIS.GDT 19-6-12 SGL/JM

PROJECT: 1522173

RECORD OF BOREHOLE: 19-06

SHEET 1 OF 1

LOCATION: N 5005503.4 ;E 355883.6

BORING DATE: April 25, 2019

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		94.25							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (CL) SILTY CLAY; dark brown		0.00 94.03	1	AS	-				Bentonite Seal
		(CI/CH) SILTY CLAY to CLAY; grey brown, contains silty sand seams (WEATHERED CRUST); cohesive, w>PL very stiff to stiff		0.22							
1					2	SS	7				
											Silica Sand
2					3	SS	5				
											32 mm Diam. PVC #10 Slot Screen
3				91.20							
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, firm		3.05	4	SS	1				
4											
				89.68							Native Backfill
		(CI/CH-ML) SILTY CLAY, CLAYEY SILT and sandy SILT; grey, laminated; cohesive, w>PL, firm		4.57	5	TP	PH				
5											
				88.31							
6		End of Borehole Auger Refusal		5.94							WL in screen at Elev. 93.50 m on May 6, 2019
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: PAH

CHECKED: WAM

MIS-BHS 001 1522173.GPJ GAL-MIS.GDT 19-6-12 SGL/JM

TABLE 1

RECORD OF HAND AUGERHOLES

Hand Augerhole Number	Depth (metres)	Description
19-103	0.0 – 0.3	TOPSOIL – (ML) CLAYEY SILT some sand; brown; non-cohesive, moist
	0.3 – 0.5	(ML) CLAYEY SILT, some sand; brown (WEATHERED CRUST); cohesive, w>PL
	0.5 – 1.9	(ML-CI/CH) CLAYEY SILT to SILTY CLAY, trace to some sand; grey brown (WEATHERED CRUST); cohesive, w>PL
	1.9 – 2.5	(CI/CH) SILTY CLAY to CLAY trace sand; grey; cohesive, w>PL
	2.50	END OF AUGERHOLE
		Note: water seepage at 1.1 m depth upon completion

Sample	Depth (m)	Lab Testing
1	1.1 – 1.5	w_n = 51%, PI=35%, LL=56%
2	1.5 – 1.9	
3	1.9 – 2.3	
4	2.3 – 2.5	

19-105	0.00 – 0.20	TOPSOIL – (ML) CLAYEY SILT some sand; brown; non-cohesive, moist
	0.20 – 1.60	(CI/CH-ML) SILTY CLAY to CLAYEY SILT, some sand; grey brown (WEATHERED CRUST); cohesive, w>PL
	1.60 – 2.00	(CI/CH) SILTY CLAY to CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL
	2.00 – 2.50	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL
	2.50	END OF AUGERHOLE
		Note: water seepage at 1.1 m depth upon completion

Sample	Depth (m)	Lab Testing
1	0.7 – 1.1	w_n = 43%, PI=27%, LL=52%
2	1.1 – 1.6	
3	1.6 – 2.0	
4	2.0 – 2.5	

Jacques Whitford

MONITORING WELL RECORD

MW07-1

CLIENT Mattamy Homes

LOCATION Proposed Subdivision, Richmond, ON

DATES: BORING June 18, 2007 WATER LEVEL June 20, 2007

BOREHOLE No. MW07-1

PROJECT No. 1026929

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	100.32							
	100.2	150 mm TOPSOIL			SS	1	300	4
		Firm to stiff, greyish brown lean CLAY (CL)						
1				▼	SS	2	610	5
2				▽	SS	3	610	6
3	97.3							
		Firm to stiff, grey lean CLAY			SS	4	610	3
4								
5					ST	5	610	
6								
	93.8				SS	6	610	2
7	93.6	Very loose, grey SANDY SILT (ML)						
		End of Borehole						
		Monitoring Well Installed						
8								
9								
10								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

□ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd _____

Date _____

JWL-OLD 1026929.GPJ SMART.GDT 07/06/22

Jacques Whitford

MONITORING WELL RECORD

MW07-7

CLIENT Mattamy Homes

LOCATION Proposed Subdivision, Richmond, ON

DATES: BORING June 18, 2007 WATER LEVEL June 20, 2007

BOREHOLE No. MW07-7

PROJECT No. 1026929

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	100.21							
		Firm to stiff, greyish brown lean CLAY (CL)						
1					SS	1	610	4
					SS	2	610	4
2								
3	97.2							
		Firm to stiff, grey lean CLAY			SS	3	610	3
4								
5					SS	4	610	2
6								
	93.8				SS	5	150	6
	93.5	Loose, grey SANDY SILT (ML)						
7		End of Borehole						
		Monitoring Well Installed						
8								
9								
10								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m *

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd

Date

JWL-OLD 1026929.GPJ SMART.GDT 07/08/22

Jacques Whitford

MONITORING WELL RECORD

MW07-13

CLIENT Mattamy Homes

LOCATION Proposed Subdivision, Richmond, ON

DATES: BORING June 18, 2007 WATER LEVEL June 20, 2007

BOREHOLE No. MW07-13

PROJECT No. 1026929

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	99.30							
		Stiff, greyish brown lean CLAY (CL)			SS	1	120	8
1				▼	SS	2	75	7
2					SS	3	610	6
3	96.3			▽				
		Firm to stiff, grey lean CLAY			SS	4	40	4
4								
5					ST	5	610	
6	93.2							
		Very loose, grey SANDY SILT (ML)			SS	6	300	1
	92.6							
7		End of Borehole						
		Monitoring Well Installed						
8								
9								
10								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

□ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd _____

Date _____

JWL-OLD 1026929.GPJ SMART.GDT 07/06/22

Jacques Whitford

TEST PIT RECORD

TP07-3

CLIENT Mattamy Homes

LOCATION Proposed Subdivision, Richmond, ON

DATES: BORING June 16, 2007 WATER LEVEL

BOREHOLE No. TP07-3

PROJECT No. 1026929

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	100.27							
	100.0	230 mm TOPSOIL						
		Stiff, greyish brown lean CLAY (CL)		▽				
1					BS	1		
2					BS	2		
	97.7							
		Firm, grey lean CLAY (CL)						
3					BS	3		
4					BS	4		
	96.1	End of Borehole						
5								
6								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m *

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa App'd

△ Pocket Penetrometer Test, kPa Date

JWL-OLD 1026929.GPJ SMART.GDT 07/06/21

Jacques Whitford

TEST PIT RECORD

TP07-5

CLIENT Mattamy Homes

LOCATION Proposed Subdivision, Richmond, ON

DATES: BORING June 16, 2007 WATER LEVEL

BOREHOLE No. TP07-5

PROJECT No. 1026929

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	100.11							
	99.9	250 mm TOPSOIL			BS	1		
		Stiff, greyish brown lean CLAY (CL)		▽				
1					BS	2		
	98.1				BS	3		
2		Firm, grey lean CLAY (CL)						
					BS	4		
3								
					BS	5		
4	95.9				BS	6		
		End of Borehole						
5								
6								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m *

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd

Date

JWL-OLD 1026929.GPJ SMART.GDT 07/06/21

Jacques Whitford

TEST PIT RECORD

TP07-11

CLIENT Mattamy Homes

LOCATION Proposed Subdivision, Richmond, ON

DATES: BORING June 16, 2007 WATER LEVEL

BOREHOLE No. TP07-11

PROJECT No. 1026929

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	99.89							
	99.6	250 mm TOPSOIL						
		Stiff, brown and grey lean CLAY (CL)		▽	BS	1		
1					BS	2		
2					BS	3		
	96.9				BS	4		
3		Firm, grey lean CLAY (CL)						
	96.2				BS	5		
		End of Borehole						
4								
5								
6								

UNDRAINED SHEAR STRENGTH - kPa

50 100 150 200

WATER CONTENT & ATTERBERG LIMITS W_P W W_L

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa

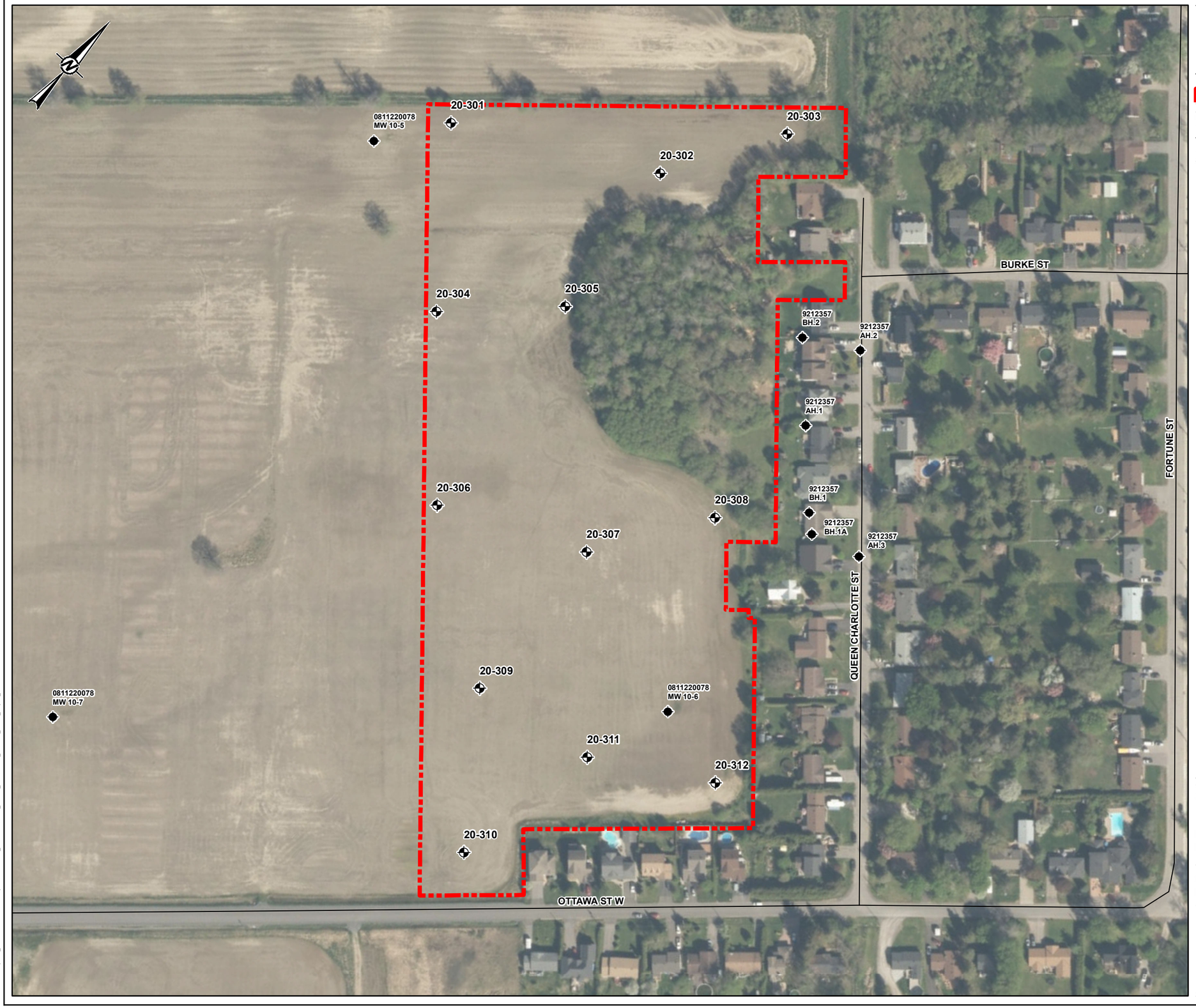
□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd

Date

JWL-OLD 1026929.GPJ SMART.GDT 07/08/21



LEGEND

- PROPOSED BOREHOLE LOCATION
- EXISTING BOREHOLE LOCATION
- ROADWAY
- APPROXIMATE SITE BOUNDARY

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

DRAFT

0 20 40 80

1:2,000 METRES

CLIENT
CAIVAN (RICHMOND NORTH) LIMITED

PROJECT
PRELIMINARY GEOTECHNICAL REPORT
LAFFIN PARCEL

TITLE
SITE PLAN, PREVIOUS AND PROPOSED TESTHOLE LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-07-01
DESIGNED	----
PREPARED	JEM
REVIEWED	KM
APPROVED	CH

PROJECT NO.	CONTROL	REV.	FIGURE
20144864	0006	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

Path: N:\Active\Spatial_IM\Caivan\Richmond\Proposed\SWMP\99_PRO_20144864_Caivan_Enviro\0006_Geotech_Prelim_Report_LaffinParcel\20144864-0006-BG-0001.mxd

APPENDIX A

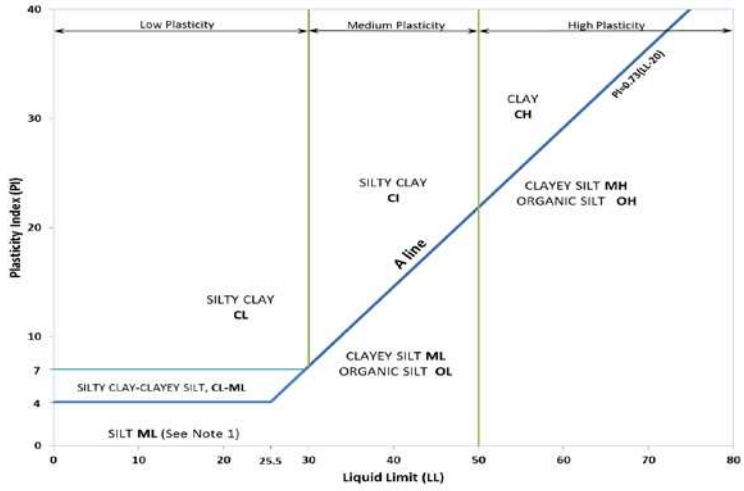
Record of Previous Investigations

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.
Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.
For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.
For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.
A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.
2. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation
w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c′	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERINGS STATE

Fresh: no visible sign of rock material weathering.

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)
The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)
The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)
The percentage of solid drill core, greater than 100 mm length, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index
A count of the number of naturally occuring discontinuities (physical separations) in the rock core. Mechanically induced breaks caused by drilling are not included.

Dip with Respect to Core Axis
The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90^{o} angle is horizontal.

Description and Notes
An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

JN	Joint	PL	Planar
FLT	Fault	CU	Curved
SH	Shear	UN	Undulating
VN	Vein	IR	Irregular
FR	Fracture	K	Slickensided
SY	Stylolite	PO	Polished
BD	Bedding	SM	Smooth
FO	Foliation	SR	Slightly Rough
CO	Contact	RO	Rough
AXJ	Axial Joint	VR	Very Rough
KV	Karstic Void		
MB	Mechanical Break		

PROJECT: 08-1122-0078

RECORD OF BOREHOLE: 10-5

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Apr. 30, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp W Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		94.82									
0		TOPSOIL		0.00									
	Power Auger 200mm Diam. (Hollow Stem)	Compact grey brown SILTY fine SAND		0.10									Bentonite Seal
1					1	50 DO	15						Silica Sand
					2	50 DO	5						32mm Diam. PVC #10 Slot Screen 'B'
2				92.84									Silica Sand
		Compact to very dense grey SANDY SILT, some gravel, trace clay (GLACIAL TILL)		1.98									Bentonite Seal
					3	50 DO	15						Silica Sand
3					4	50 DO	>100						32mm Diam. PVC #10 Slot Screen 'A'
				90.86									
4		End of Borehole		3.96									
5													
6													
7													
8													
9													
10													

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: J.D.

CHECKED: BB

MIS-BHS 001 0811220078-9500.GPJ GAL-MIS.GDT 5/19/10 JM

PROJECT: 08-1122-0078

RECORD OF BOREHOLE: 10-6

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: Apr. 30, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		95.67							
0	Power Auger 200mm Diam. (Hollow Stem)	TOPSOIL		0.00 / 95.42							Bentonite Seal
		Loose to compact grey brown SANDY SILT to SILTY SAND, trace clay		0.25	1	50 DO	6				Silica Sand
1											
				93.84	2	50 DO	27				32mm Diam. PVC #10 Slot Screen 'B'
2		Dense to very dense grey brown SANDY SILT, some gravel, cobbles and boulders (GLACIAL TILL)		1.83							Silica Sand
					3	50 DO	68				
3				92.60	4	50 DO	>100				Bentonite Seal
	Rotary Drill NQ Core	Thinly to medium bedded light grey intebedded SANDSTONE and DOLOSTONE BEDROCK		3.07	C1	NQ RC	DD				Silica Sand
4											
					C2	NQ RC	DD				32mm Diam. PVC #10 Slot Screen 'A'
5				90.49							
		End of Borehole		5.18							
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: J.D.

CHECKED: hh

MIS-BHS 001 0811220078-9500.GPJ GAL-MIS.GDT 5/19/10 JM

PROJECT: 08-1122-0078

RECORD OF DRILLHOLE: 10-6

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: Apr. 30, 2010

DATUM:

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling

FR/FX-FRACTURE F-FAULT SM-SMOOTH FL-FLEXURED BC-BROKEN CORE
CL-CLEAVAGE J-JOINT R-ROUGH UE-UNEVEN MB-MECH. BREAK
SH-SHEAR P-POLISHED ST-STEPPED W-WAVY B-BEDDING
VN-VEIN S-SLICKENSIDED PL-PLANAR C-CURVED

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	DIAMETRAL POINT LOAD INDEX (MPa)	NOTES WATER LEVELS INSTRUMENTATION
		BEDROCK SURFACE		92.60													
4	Rotary Drill NQ Core	Thinly to medium bedded light grey intebedded SANDSTONE and DOLOSTONE BEDROCK		3.07	1												Bentonite Seal Silica Sand 32mm Diam. PVC #10 Slot Screen 'A'
5				90.49													
		End of Borehole		5.18													
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: J.D.

CHECKED:

MIS-RCK 001 08112200078-9500 (ROCK).GPJ GAL-MISS.GDT 5/19/10 JM

PROJECT: 08-1122-0078

RECORD OF BOREHOLE: 10-7

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: Apr. 29, 2010

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp — W — Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		95.36									
0		TOPSOIL		0.00									
		Stiff grey to brown SILT, trace to some clay, trace fine sand		0.08									Bentonite Seal
1	Power Auger 200mm Diam. (Hollow Stem)				1	50 DO	5						Silica Sand
					2	50 DO	9						
2				93.07									
		Loose grey brown SILTY fine SAND		2.29	3	50 DO	8						32mm Diam. PVC #10 Slot Screen
3					4	50 DO	9						
				91.40									
4		End of Borehole		3.96									
5													
6													
7													
8													
9													
10													

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: J.D.

CHECKED:

MIS-BHS 001 0811220078-9500.GPJ GAL-MIS.GDT 5/19/10 JM

APPENDIX B

Current Investigation - Record of Boreholes

PROJECT: 20144864

RECORD OF BOREHOLE: 20-301

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE											
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; dark brown, contains organic matter; moist		0.00 / 0.11	1	SS	5						
1		(SM) SILTY SAND; grey brown; non-cohesive, moist, very loose to compact			2	SS	8						
2					3	SS	24						
		(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, moist, compact		2.13 / 2.28									
		End of Borehole Auger Refusal											Open borehole dry upon completion of drilling
3													
4													
5													
6													
7													
8													
9													
10													

DEPTH SCALE

1 : 50

GOLDER

LOGGED: KM

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-302

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; dark brown; moist		0.00							
		FILL - (SM) SILTY SAND; red brown; non-cohesive, moist, loose		0.11	1	SS	7				
1		(SM) SILTY SAND; grey brown; non-cohesive, moist, compact		0.76	2	SS	23				
2					3	SS	30				
		(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, moist, compact to dense		2.29	4	SS	35				
3		End of Borehole Auger Refusal		2.77							Open borehole dry upon completion of drilling
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: KM

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-303

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE											
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; dark brown, contains organic matter; moist		0.00									
		FILL - (SM) SILTY SAND; grey brown, mottled, contains organic matter; non-cohesive, moist, loose		0.11	1	SS	5						
1		(SM) SILTY SAND; grey brown; non-cohesive, moist, compact to very dense		0.61	2	SS	16						
					3	SS	57/ 0.28						
2		End of Borehole Auger Refusal		1.96									Open borehole dry upon completion of drilling
3													
4													
5													
6													
7													
8													
9													
10													

DEPTH SCALE

1 : 50

GOLDER

LOGGED: KM

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-304

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 24, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SM) SILTY SAND; grey brown; non-cohesive, moist, loose		0.00	1	SS	7				Bentonite Seal
1		(SM) SILTY SAND; grey brown; non-cohesive, moist to wet, compact		0.61	2	SS	10				Silica Sand
2					3	SS	20				
3		(SM/ML) gravelly SAND and SILT; grey, with cobbles and boulders (GLACIAL TILL); non-cohesive, wet, loose to compact		2.13	4	SS	4				38 mm Diam. PVC #10 Slot Screen
4					5	SS	16				
5					6	SS	17				
					7	SS	16				
		End of Borehole		5.18							WL in open borehole at 3.57 m depth below ground surface upon completion of drilling
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: DG

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-305

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; dark brown, contains organic; moist		0.00							
		FILL - (SM) SILTY SAND; brown, mottled, contains organic matter; non-cohesive, moist, loose		0.10	1	SS	6				
1		(SM) SILTY SAND; grey brown; non-cohesive, moist, compact to loose		0.76	2	SS	10				
2					3	SS	9				
		(SM) gravelly SILTY SAND; grey (GLACIAL TILL); non-cohesive, moist, loose		2.29	4	SS	6				
3		End of Borehole Auger Refusal		3.07	5	SS	50/ 0.03				Open borehole dry upon completion
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: KM

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-306

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 24, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SM) SILTY SAND; grey brown; non-cohesive, moist, loose		0.00	1	SS	6				
1		(ML) sandy CLAYEY SILT; grey brown, contains silty sand layers; cohesive, w~PL, stiff		0.61	2	SS	3				
2					3	SS	10				
					4	SS	7				
3		(SM/ML) SAND and SILT; grey brown; non-cohesive, wet, compact		2.90	5	SS	14				▽
4		(SM/ML) gravelly SAND and SILT; grey, with cobbles and boulders (GLACIAL TILL); non-cohesive, wet		3.66	6	SS	51				
		End of Borehole Auger Refusal		4.26							WL in open borehole at 3.55 m depth below ground surface upon completion of drilling
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: DG

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-307

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 24, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SM) SILTY SAND; grey brown; non-cohesive, moist, loose		0.00	1	SS	5				
1		(ML) sandy CLAYEY SILT; grey brown, contains silty sand layers; cohesive, w~PL, very stiff		0.76	2	SS	4				
2					3	SS	12				
					4	SS	55/ 0.23				
3	Rotary Drill NQ Core	Fresh, medium bedded, grey, medium to strong LIMESTONE BEDROCK		2.66	5	RC	DD				
4		End of Borehole		4.31							
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: DG

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-308

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL/FILL - (SM) SILTY SAND; dark brown, contains organic matter; non-cohesive, moist		0.00	1	SS	6				
		(SM) SILTY SAND; grey; non-cohesive, moist, loose to compact		0.30							
1					2	SS	4				
2					3	SS	16				
		(SM) gravelly SILTY SAND; grey, contains cobbles and boulders (GLACIAL TILL); non-cohesive, moist, very dense		2.13	4	SS	50/ 0.25				
		End of Borehole Auger Refusal		2.51							WL in open borehole dry upon completion of drilling
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: KM

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-309

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 24, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; dark brown, with rootlets; non-cohesive, moist		0.00	1	SS	8				
1		(SM) SILTY SAND; grey brown; non-cohesive, moist to wet, loose to compact		0.61	2	SS	3				
2					3	SS	12				
3					4	SS	10				▽
					5	SS	50/ 0.05				
	Rotary Drill NQ Core	Slightly weathered to fresh, medium bedded, grey, medium to strong LIMESTONE BEDROCK		3.09	6	RC	DD				
4					7	RC	DD				
5					8	RC	DD				
6		End of Borehole		6.32							WL in open borehole at 2.50 m depth below ground surface upon completion of drilling
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: DG

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-310

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 24, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SM) SILTY SAND; brown; non-cohesive, moist, loose		0.00	1	SS	6				Bentonite Seal
1		(SM) SILTY SAND, fine; grey brown, contains silt layers; non-cohesive, moist to wet, compact		0.76	2	SS	15				Silica Sand
2					3	SS	15				
3		(SM/ML) gravelly SAND and SILT; grey, with cobbles and boulders (GLACIAL TILL); non-cohesive, wet, loose to very dense		2.29	4	SS	9				38 mm Diam. PVC #10 Slot Screen
4					5	SS	15				
5					6	SS	21				
6					7	SS	92				
					8	SS	58				
		End of Borehole		6.09							Water level in open borehole at 1.52 m depth below ground surface upon completion
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: DG

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-311

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL/FILL - (SM) SILTY SAND; dark brown, contains organic matter; moist		0.00	1	SS	3				
		(SM) SILTY SAND; grey brown to grey, contains layers of clayey silt; non-cohesive, moist, very loose to loose		0.30	2	SS	5				
1											
2		(SM) gravelly SILTY SAND; grey, contains cobbles and boulders (GLACIAL TILL); non-cohesive, moist, compact to very dense		1.52	3	SS	26				
					4	SS	50/ 0.03				
		End of Borehole Auger Refusal		2.46							Open borehole dry upon completion of drilling
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: KM

CHECKED:

PROJECT: 20144864

RECORD OF BOREHOLE: 20-312

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: June 23, 2020

DATUM:

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE									
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL/FILL - (SM) SILTY SAND; dark brown, contains organic matter; non-cohesive, moist, very loose		0.00	1	SS	4				
1		(SM) gravelly SILTY SAND; grey brown, contains cobbles and boulders (GLACIAL TILL); non-cohesive, moist, compact to very dense		0.61	2	SS	19				
					3	SS	50/ 0.10				
2		End of Borehole Auger Refusal		1.78							Open borehole dry upon completion of drilling
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

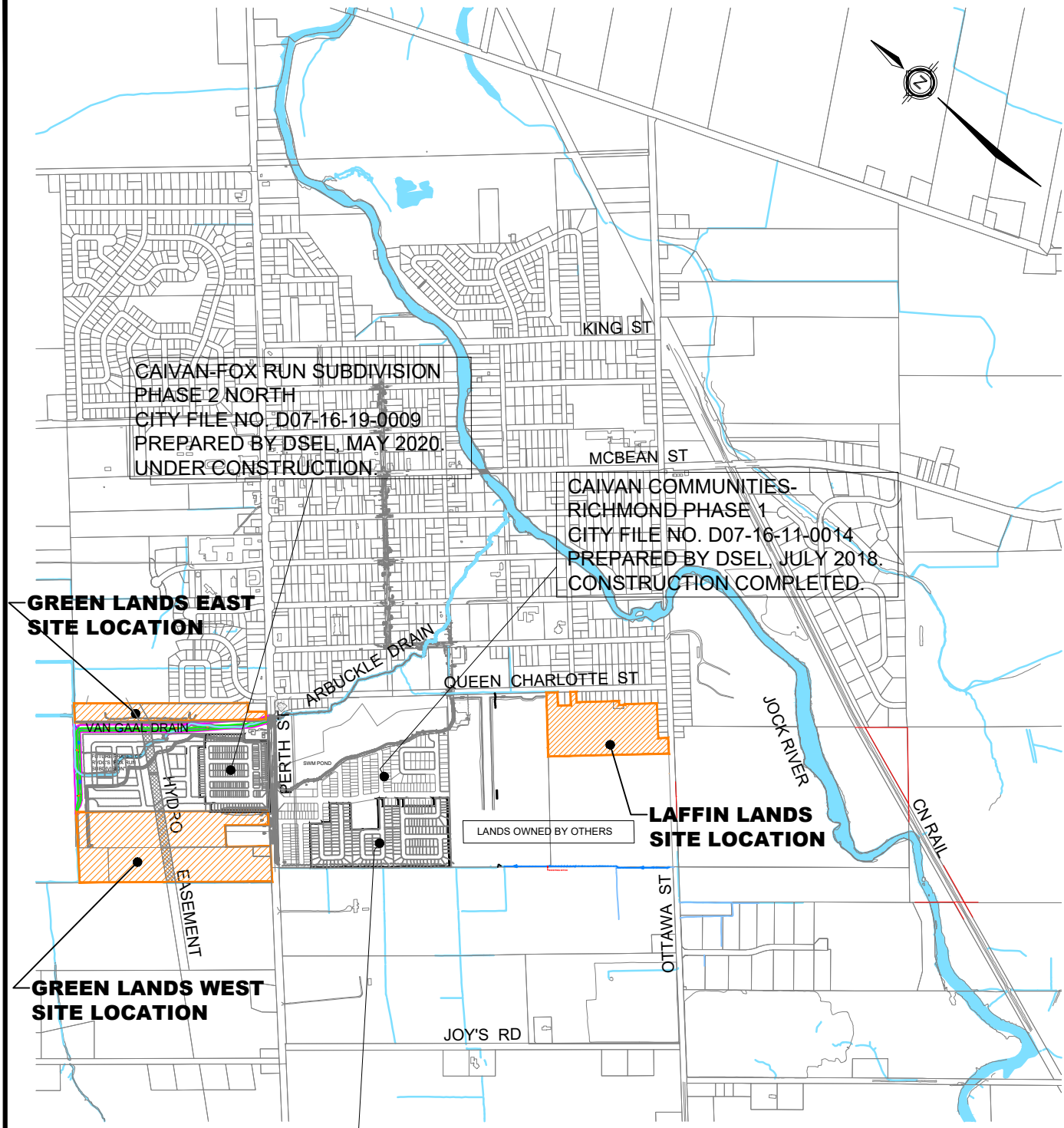
1 : 50

GOLDER

LOGGED: KM

CHECKED:

FIGURES



RICHMOND VILLAGE DEVELOPMENT CORPORATION	SITE LOCATION	SCALE: 1:20,000
david schaeffer engineering ltd	120 Iber Road, Unit 103 Stittsville, ON K2S 1E9 Tel. (613) 836-0856 Fax. (613) 836-7183 www.DSEL.ca	DATE: June 2020 PROJECT No.: 20-1184 FIGURE: 1

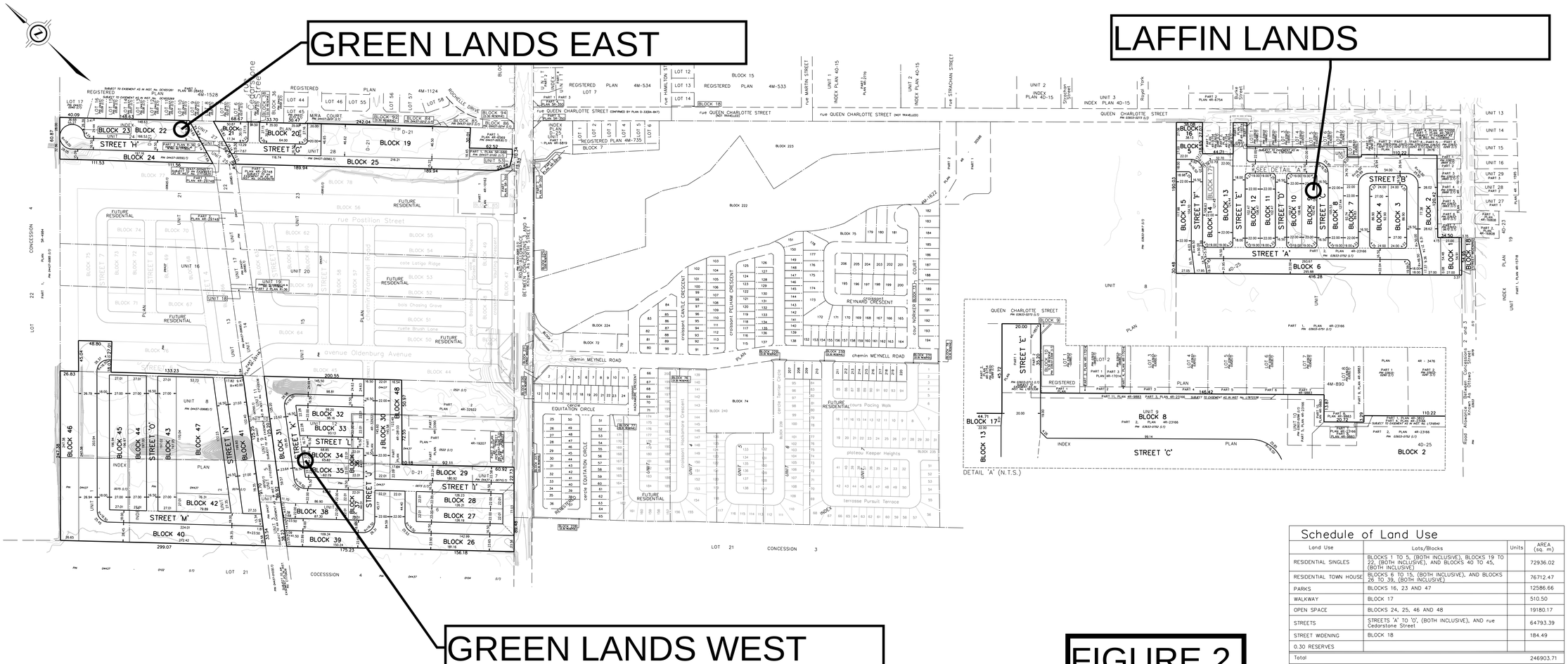
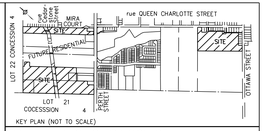


FIGURE 2

Schedule of Land Use

Land Use	Lots/Blocks	Units	AREA (sq. m)
RESIDENTIAL SINGLES	BLOCKS 1 TO 5, (BOTH INCLUSIVE), BLOCKS 19 TO 22, (BOTH INCLUSIVE), AND BLOCKS 40 TO 45, (BOTH INCLUSIVE)		72936.02
RESIDENTIAL TOWN HOUSE	BLOCKS 6 TO 15, (BOTH INCLUSIVE), AND BLOCKS 26 TO 39, (BOTH INCLUSIVE)		76712.47
PARKS	BLOCKS 16, 23 AND 47		12586.66
WALKWAY	BLOCK 17		510.50
OPEN SPACE	BLOCKS 24, 25, 46 AND 48		19180.17
STREETS	STREETS 'A' TO 'O', (BOTH INCLUSIVE), AND rue Cedarstone Street		64793.39
STREET WIDENING	BLOCK 18		184.49
0.30 RESERVES			
Total			246903.71



KEY PLAN (NOT TO SCALE)

DRAFT PLAN OF SUBDIVISION OF
PART OF UNITS 6, 12 AND 28 INDEX PLAN D-21
AND
ALL OF UNITS 2, 8 AND 24 INDEX PLAN D-21
AND
PART OF UNITS 9 AND 10 INDEX PLAN 4D-25
(GEOGRAPHIC TOWNSHIP OF GOULBOURN)
NOW IN THE
CITY OF OTTAWA
J. D. BARNES LIMITED
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METRIC DISTANCES AND/OR COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

SCALE 1: 2000
50 0 50 100 150 metres

ELEVATION NOTE
1. ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM THE MUNICIPALITY BENCHMARK No. 001968U124 HAVING A PUBLISHED ELEVATION OF 95.185 METERS.
2. IT IS THE RESPONSIBILITY OF THE USER OF THIS INFORMATION TO VERIFY THAT THE SITE BENCHMARK HAS NOT BEEN ALTERED OR DISTURBED AND THAT ITS RELATIVE ELEVATION AND DESCRIPTION AGREES WITH THE INFORMATION SHOWN ON THIS DRAWING.

NOTES
DISTANCES ARE GROUND.
ALL DISTANCES ON CURVES ARE ARC DISTANCES UNLESS OTHERWISE SPECIFIED

ADDITIONAL INFORMATION
As required under section 51(17) of the Planning Act R.S.O. 2001

(a)(b)(e)(f)(g)(i) and (l) - As shown on this Plan.
(c) - As shown on this Draft and Key Plan
(d) - Land to be used in accordance with the Schedule of Land Use.
(h)(k) - Full Municipal Services
(j) - Offshore Marine Deposits of clay, silty clay and silt, Bedrock Ottawa Formation, limestone

SUBJECT TO THE CONDITIONS, IF ANY, SET FORTH IN OUR LETTER DATED..... THIS DRAFT PLAN IS APPROVED BY THE CITY OF OTTAWA UNDER SECTION 51 OF THE PLANNING ACT THIS ..... DAY OF ....., 2020.

LILY XU, MCIP, RPP, MANAGER
DEVELOPMENT REVIEW SOUTH
PLANNING, INFRASTRUCTURE AND ECONOMIC DEVELOPMENT DEPARTMENT,
CITY OF OTTAWA

OWNER'S CERTIFICATE
RICHMOND VILLAGE DEVELOPMENT CORPORATION, BEING THE REGISTERED OWNER OF THE SUBJECT LANDS HEREBY AUTHORIZES J. D. BARNES LIMITED TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION FOR APPROVAL.

DATE — FRANK CAIRO, PRESIDENT
(I HAVE THE AUTHORITY TO BIND THE CORPORATION)
RICHMOND VILLAGE DEVELOPMENT CORPORATION

SURVEYOR'S CERTIFICATE
I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED ARE CORRECTLY SHOWN.

DATE — PRELIMINARY
CM FOR ONTARIO LAND SURVEYOR

J.D.BARNES LIMITED — SURVEYING MAPPING GIS
LAND INFORMATION SPECIALISTS
240 DON REID DRIVE, SUITE 264, OTTAWA, ON K1H 1E1
T: (613) 733-7244 F: (613) 733-8955 www.jdbarnes.com

DRAWN BY:	CHECKED BY:	REFERENCE NO.: 10-10-314-00 DRAFT
NS	CF	DATED: 6/19/2020

FILE: G:\19-10-122\001\Drawing\Draft Plan 2020\19-10-122-00_DraftPlan(Grid).dgn

GREEN LANDS EAST

GREEN LANDS WEST

BALD EAGLE CRESCENT
CEDARSTONE STREET
MIRA COURT
ROCHELLE DRIVE
PERTH STREET
PROPOSED PRIVATE WELLS (WITH ACCESS EASEMENT)
STREET 2000
STREET 2001
BLOCK 2
#6305 PERTH STREET
POSITION STREET
CAIVAN-FOX RUN SUBDIVISION PHASE 2 NORTH CITY FILE NO. D07-16-19-0009 PREPARED BY DSEL, MAY 2020. UNDER CONSTRUCTION.
FUTURE ALIGNMENT OF VAN GAAL DRAIN (CONSTRUCTION PLANNED AUG 2020)
FUTURE PHASES OF RVDC'S "FOX RUN SUBDIVISION"
100 YEAR FLOODPLAIN
LATIGO RIDGE
BASCULE PLACE
TRAMMEL ROAD
GRISEO WAY
VAULTING CRESCENT
CHASING GROVE
BRUSH LANE
OLDENBURG AVENUE
FUT. 200mmØ WM (B.O)
FUT. 150mmØ WM (B.O)
FUT. 300mmØ WM (B.O)
200Ø
150Ø
300Ø
PARK
STREET 2002
STREET 2003
STREET 2004
STREET 2005
STREET 2006
STREET 2008
HYDRO EASEMENT
EXISTING COMMERCIAL (BMR)
SWM POND 1
EX.300Ø WATERMAIN
EX.150Ø WATERMAIN
CAIVAN COMMUNITIES-RICHMOND PHASE 1 CITY FILE NO. D07-16-11-0014 PREPARED BY DSEL, JULY 2018. CONSTRUCTION COMPLETED.
CHEMIN MEYNELL ROAD
CROISSANT PELHAM CRESCENT
CROISSANT HACKAMORE CRESCENT
CERCLE EQUITATON CIRCLE
CERCLE TERRIER CIRCLE
TERRASSE PURSUIT TERRACE
CAIVAN-FOX RUN SUBDIVISION PHASE 2 SOUTH CITY FILE NO. D07-16-19-0009 PREPARED BY DSEL, JUNE 2020. CONSTRUCTION TO COMMENCE JULY 2020.

LEGEND

- SUBJECT LANDS
- PROPOSED LOCAL WATERMAIN
- EXISTING WATERMAIN
- PROPOSED WATERMAIN BY OTHERS
- FUTURE WATERMAIN
- PROPOSED PRIVATE WELL
- PLUG
- 100 YEAR FLOODPLAIN

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RICHMOND VILLAGE DEVELOPMENT CORPORATION CITY OF OTTAWA

CONCEPTUAL WATERMAIN
GREEN LANDS WEST AND EAST

SCALE:	1:1500	PROJECT No.:	1183
DATE:	JUNE 2020	FIGURE:	3A

VAN GAAL DRAIN

QUEEN CHARLOTTE ST

BURKE ST

OTTAWA ST

STREAM BUFFER

STREAM BUFFER

STREAM BUFFER

COMMUNAL WELL

SWM POND 1
(BY OTHERS)
P.P. ELEV. 92.35

SERVICING BLOCK

PATHWAY/ SERVICING BLOCK

STREET B

STREET F

STREET E

STREET D

STREET C

STREET B

STREET A

PATHWAY

PATHWAY

MOORE DITCH

PATHWAY/ SERVICING BLOCK

chemin Meynell Road

PATHWAY

SCHOOL

PARK

A ST

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CAIVAN RICHMOND LAFFIN

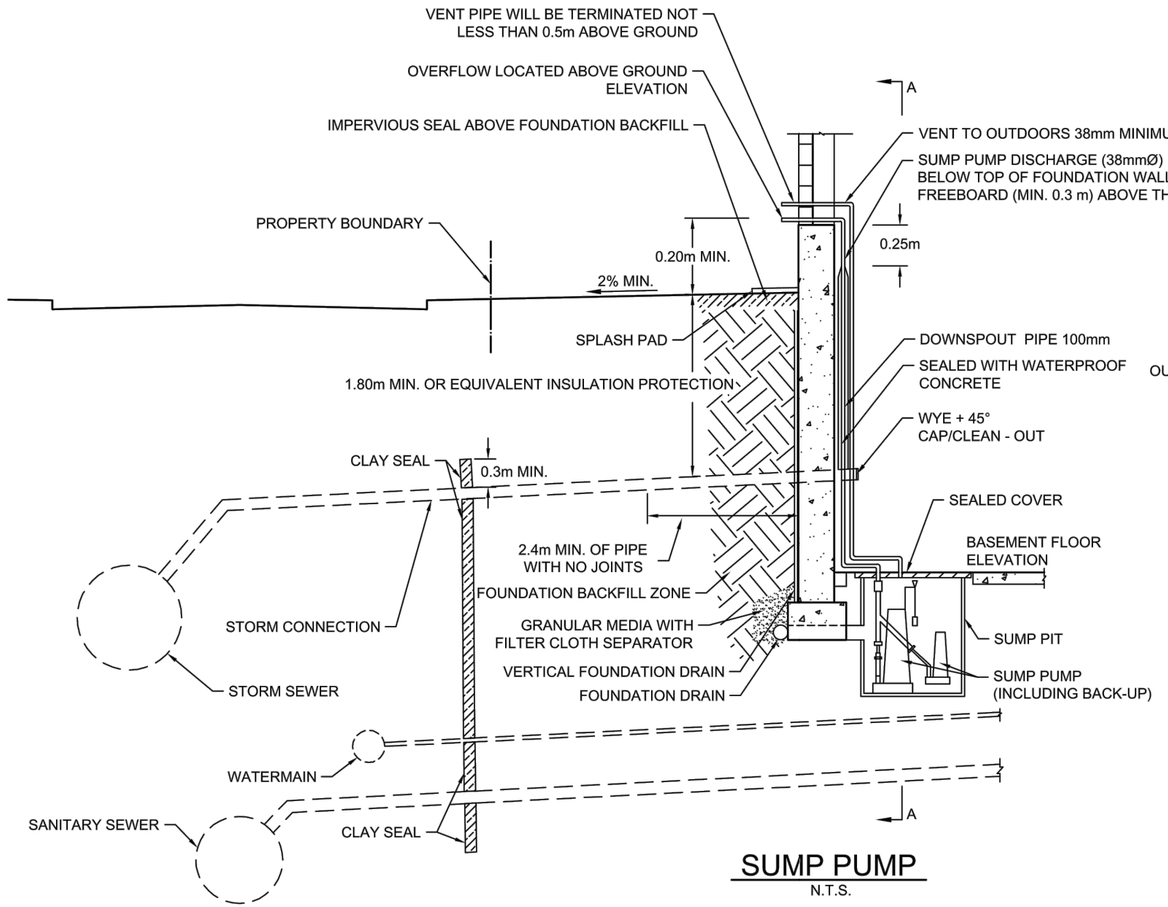
CONCEPTUAL WATERMAIN

CITY OF OTTAWA

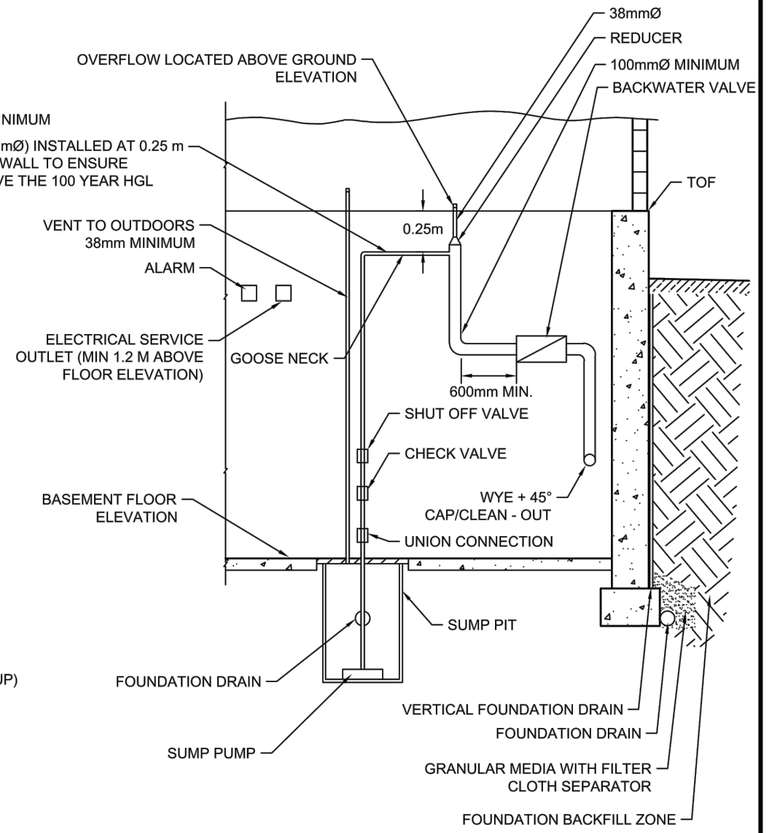
LEGEND

- SITE BOUNDARY
- PROP 300Ø WATERMAIN
- PROP LOCAL WATERMAIN
- EXISTING WATERMAIN
- PLUG
- COMMUNAL WELL

PROJECT No.:	20-1184
DATE:	July 2020
SCALE:	1:2500
FIGURE:	3B



SUMP PUMP
N.T.S.



SECTION A-A
N.T.S.

NOTES:
1. WORKS TO BE COMPLETED IN ACCORDANCE WITH CITY OF OTTAWA STANDARDS, POLICIES AND GUIDELINES.
2. PRIMARY DISCHARGE TO STORM SEWER WITH OVERFLOW TO GRADE, AS INDICATED.
3. SERVICE TRENCH WILL HAVE CLAY SEAL TO PREVENT GROUNDWATER FLOW THROUGH SERVICE TRENCH TO FOUNDATION.
4. INSULATION DETAIL MUST BE PROVIDED BY PROFESSIONAL ENGINEER.
5. BACKWATER VALVE TO BE CSA APPROVED COMPLETE WITH ADEQUATE SUPPORT FOR PIPING.
6. REFER TO GUIDELINES FOR SUMP PIT LOCATION.
7. IMPERVIOUS SEAL TO EXTEND BEYOND THE LINE OF EXCAVATION, SLOPED AWAY FROM BUILDING A MINIMUM OF 2% AFTER SETTLING OF BACKFILL. SEAL CAN BE CLAY, OR A MEMBRANE OR LOW-PERMEABILITY INSULATION BOARD PLACED JUST BELOW GROUND.
8. FILL PLACED IN SERVICE TRENCH MUST BE COMPACTED TO AT LEAST 98% OF ITS STANDARD PROCTOR MAXIMUM DRY DENSITY.
9. FOUNDATION BACKFILL ZONE WILL CONSIST OF CLAY WITH A MINIMUM HORIZONTAL WIDTH OF 1.5m.
10. VERTICAL FOUNDATION DRAINS ARE REQUIRED ON THE PERIMETER OF THE FOUNDATION.
11. EVERY SERVICE TRENCH REQUIRES CLAY SEAL AS PER CITY STANDARD S8. CLAY SEAL TO EXTEND A MINIMUM 0.3m ABOVE THE OBVERT OF THE STORM SERVICE PIPE.

Ottawa

STANDARD SUMP PUMP CONFIGURATION
GREENFIELD SUBDIVISIONS WITH CLAY SOILS
AND FULL MUNICIPAL SERVICES

DATE:	JUNE 2018
REV. DATE:	JUNE 2018
DWG. No.:	P 01

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CAIVAN RICHMOND LAFFIN

SUMP PUMP DETAIL

CITY OF OTTAWA

PROJECT No.:	20-1184
DATE:	July 2020
SCALE:	N.T.S.
FIGURE:	4

DRAWINGS

GREEN LANDS EAST

GREEN LANDS WEST

BALD EAGLE CRESCENT

CEDARSTONE STREET

MIRA COURT

ROCHELLE DRIVE

PERTH STREET

Queen Charlotte St

STREET 2001

STREET 2002

STREET 2003

STREET 2004

STREET 2005

STREET 2006

STREET 2008

BLOCK X

BLOCK Y

CAIVAN-FOX RUN SUBDIVISION
PHASE 2 NORTH
CITY FILE NO. D07-16-19-0009
PREPARED BY DSEL, MAY 2020.
UNDER CONSTRUCTION.

FUTURE ALIGNMENT OF VAN GAAL DRAIN (CONSTRUCTION PLANNED AUG 2020)

FUTURE PHASES OF RVDC'S "FOX RUN SUBDIVISION"

FLOODLINE WITH PHASE 2 (NORTH) TO BE REVISED UPON COMPLETION OF VAN GAAL DRAIN PER PREVIOUS APPROVED DESIGN

100 YEAR FLOODPLAIN

POSTILION STREET

BASCULE PLACE

LATIGO RIDGE

GRISEO WAY

HAMMER ROAD

VAULTING CRESCENT

CHASING GROVE

BRUSH LANE

OLDENBURG AVENUE

#6305 PERTH STREET

EXISTING COMMERCIAL (BMR)

HYDRO EASEMENT

PARK

SWM POND 1

CAIVAN COMMUNITIES-
RICHMOND PHASE 1
CITY FILE NO. D07-16-11-0014
PREPARED BY DSEL, JULY 2018.
CONSTRUCTION COMPLETED.

CHEMIN MEYNELL ROAD

CROISSANT CANTILE CRESCENT

CROISSANT PELHAM CRESCENT

CROISSANT HACKAMORE CRESCENT

CERCLE EQUITATON CIRCLE

CERCLE TERRIER CIRCLE

CAIVAN-FOX RUN SUBDIVISION
PHASE 2 SOUTH
CITY FILE NO. D07-16-19-0009
PREPARED BY DSEL, JUNE 2020.
CONSTRUCTION TO COMMENCE
JULY 2020.

LEGEND

- SUBJECT LANDS
- STORM OVERLAND FLOW ARROW
- 192.851 PROPOSED CENTERLINE ELEVATION
- [192.85] FUTURE GRADES (BY OTHERS)
- 100 YEAR FLOODPLAIN
- 193.50 / 193.90 PROPOSED ELEVATION / EXISTING ELEVATION
- 244.50 EXISTING CONTOUR ELEVATION
- ←1.00m→ GRADE CHANGE

CUT-FILL DEPTH ALONG CENTER LINE:

CUT DEPTH (m)	FILL DEPTH (m)
0 - 0.5	0 - 0.5
0.5 - 1.0	0.5 - 1.0
1.0 - 1.5	1.0 - 1.5
1.5 - 2.0	1.5 - 2.0
2.0- 2.5	2.0- 2.5
> 2.5	> 2.5

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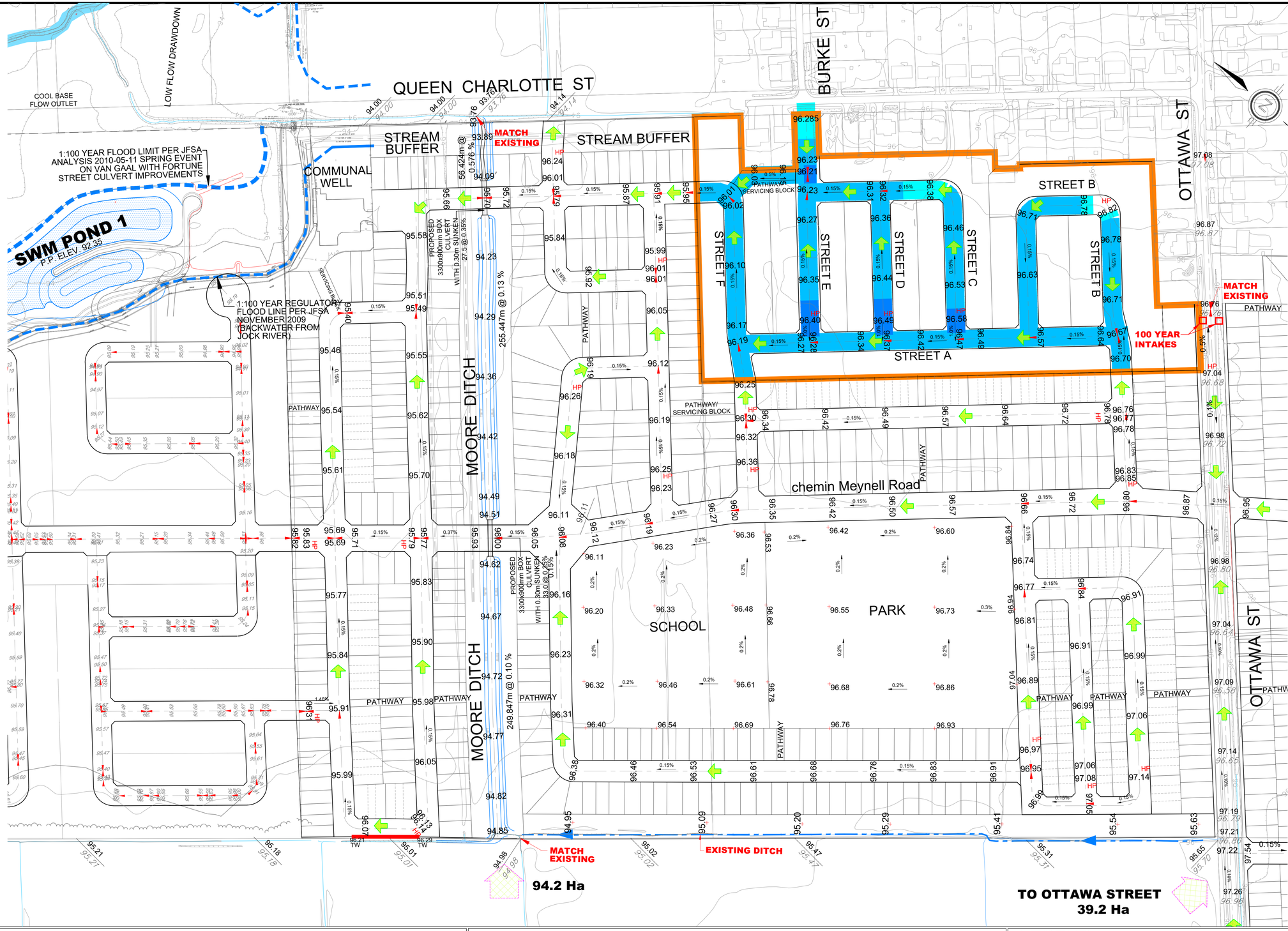
RICHMOND VILLAGE DEVELOPMENT CORPORATION CITY OF OTTAWA

GRADING PLAN GREEN LANDS WEST AND EAST

SCALE:	1:1500	PROJECT No.:	1183
DATE:	JUNE 2020	DRAWING:	1A



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CAIVAN RICHMOND LAFFIN

GRADING PLAN

CITY OF OTTAWA

LEGEND

- STUDY LIMIT
- EXISTING DITCH
- EXISTING ELEVATION CONTOUR (95.00)
- MAJOR OVERLAND FLOW
- EXTERNAL DRAINAGE
- 96.73 / 96.73 PROPOSED ELEVATION / EXISTING ELEVATION
- EMERGENCY OVERLAND FLOW

CUT-FILL DEPTH ALONG CENTER LINE:

CUT DEPTH (m)	FILL DEPTH (m)
0.00~0.50:	0.00~0.50:
0.50~1.00:	0.50~1.00:
1.00~1.50:	1.00~1.50:
1.50~2.00:	1.50~2.00:
>2.00	>2.00

PROJECT No.:	20-1184
DATE:	July 2020
SCALE:	1:1500
DRAWING:	1B

GREEN LANDS EAST

GREEN LANDS WEST

CAIVAN-FOX RUN SUBDIVISION
PHASE 2 NORTH
CITY FILE NO. D07-16-19-0009
PREPARED BY DSEL, MAY 2020.
UNDER CONSTRUCTION.

SANITARY FLOW FROM UNITS FRONTING MIRA COURT DIRECTED TO PROPOSED AND EXISTING SANITARY SEWERS IN MIRA COURT.

FUTURE ALIGNMENT OF VAN GAAL DRAIN (CONSTRUCTION PLAN - ED AUG 2020)

FUTURE PHASES OF RVDC'S "FOX RUN SUBDIVISION"

CAIVAN COMMUNITIES-
RICHMOND PHASE 1
CITY FILE NO. D07-16-11-0014
PREPARED BY DSEL, JULY 2018.
CONSTRUCTION COMPLETED.

EXISTING COMMERCIAL (BMR)

CAIVAN-FOX RUN SUBDIVISION
PHASE 2 SOUTH
CITY FILE NO. D07-16-19-0009
PREPARED BY DSEL, JUNE 2020.
CONSTRUCTION TO COMMENCE JULY 2020.

SWM POND 1

PARK

LEGEND

- SUBJECT LANDS
- SANITARY TRUNK
- LOCAL SANITARY SEWER
- EXISTING SANITARY SEWER
- SANITARY SEWER BY OTHERS
- SANITARY DRAINAGE AREA
- EXISTING SANITARY DRAINAGE AREA
- SANITARY DRAINAGE AREA SUBCATCHMENT
- 100 YEAR FLOODPLAIN
- 0.77 / 82.07 / 63 / MH 513A / MH 514A / RESIDENTIAL — DRAINAGE AREA IN HECTARES; POPULATION PER HA; POPULATION; UPSTREAM MANHOLE; DOWNSTREAM MANHOLE; TRIBUTARY TYPE
- SANITARY MANHOLE
- 3.4 / 0.30 / 60 / 18 / Residential — POPULATION PER UNIT; EXTERNAL DRAINAGE AREA IN HECTARES; POPULATION PER HA; POPULATION; TRIBUTARY TYPE

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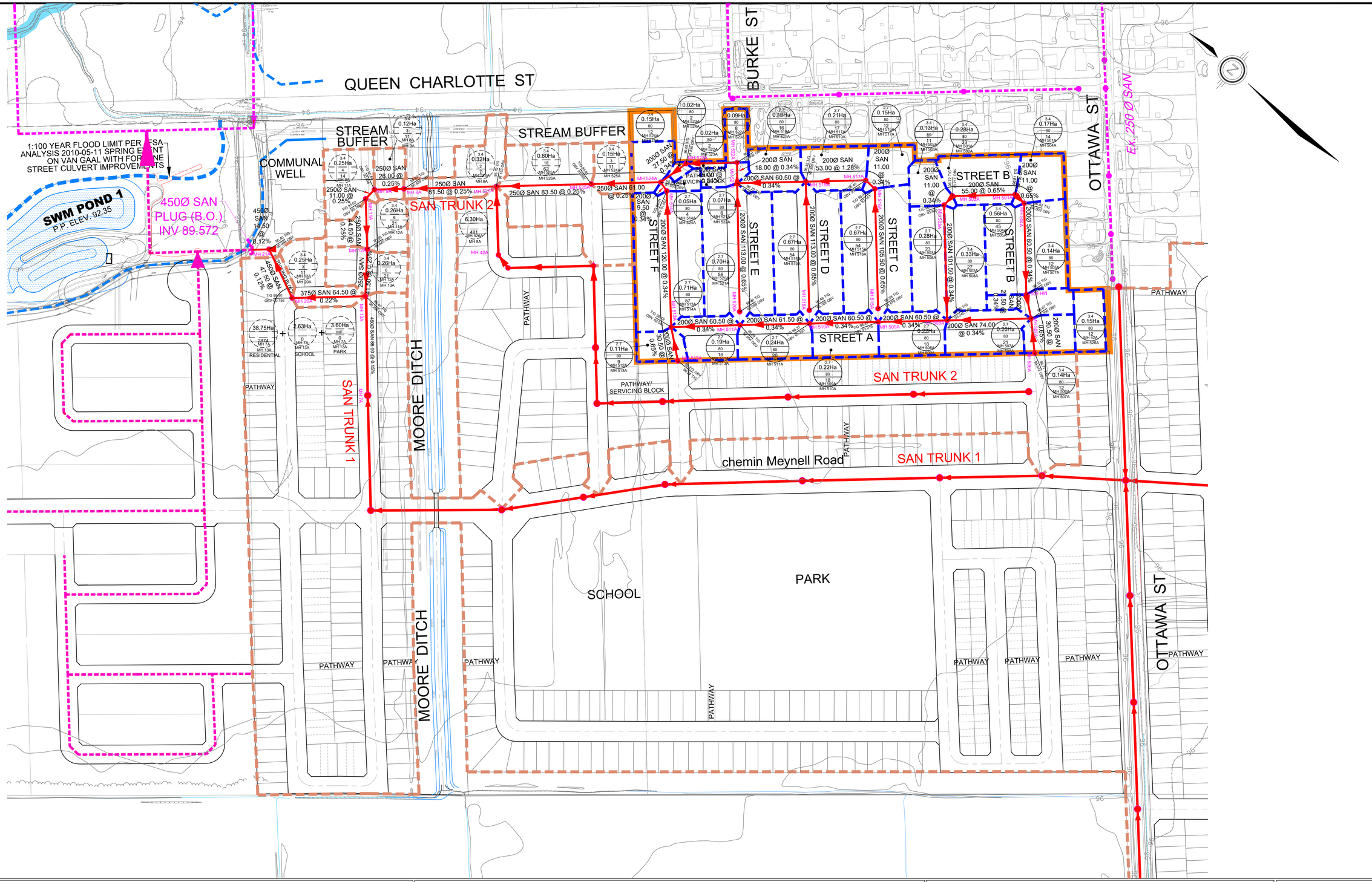
RICHMOND VILLAGE
DEVELOPMENT
CORPORATION
CITY OF OTTAWA

SANITARY SERVICING PLAN
GREENLANDS EAST & WEST

SCALE:	1:1500	PROJECT No.:	1183
DATE:	JUNE 2020	DRAWING:	2A



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CAIVAN RICHMOND LAFFIN

SANITARY SERVICING PLAN

CITY OF OTTAWA

LEGEND

- STUDY LIMIT
- SANITARY DRAINAGE BOUNDARY
- EXTERNAL SANITARY DRAINAGE BOUNDARY
- PROPOSED SANITARY SEWER
- POPULATION PER UNIT / SANITARY DRAINAGE AREA / NUMBER OF UNITS / TOTAL POPULATION / UPSTREAM/DOWNSTREAM MANHOLE

PROJECT No.:	20-1184
DATE:	July 2020
SCALE:	1:1500
DRAWING:	2B

GREEN LANDS EAST

GREEN LANDS WEST

BALD EAGLE CRESCENT

CEDARSTONE STREET

MIRA COURT

ROCHELLE DRIVE

PERTH STREET

CAIVAN-FOX RUN SUBDIVISION
PHASE 2 NORTH
CITY FILE NO. D07-16-19-0009
PREPARED BY DSEL, MAY 2020.
UNDER CONSTRUCTION.

OGS

#0305 PERTH STREET

FUTURE ALIGNMENT OF VAN GAAL DRAIN (CONSTRUCTION PLANNED AUG 2020)

FUTURE PHASES OF RVDC'S "FOX RUN SUBDIVISION"

FLOODLINE WITH PHASE 2 (NORTH) TO BE REVISED UPON COMPLETION OF VAN GAAL DRAIN PER PREVIOUS APPROVED DESIGN

100 YEAR FLOODPLAIN

POSTILION STREET

LATIGO RIDGE

ASCULE PLACE

TRAMMEL ROAD

GRISEO WAY

VAULTING CRESCENT

CHASING GROVE

BASCULE PLACE

BRUSH LANE

OLDENBURG AVENUE

HYDRO EASEMENT

PARK

EXISTING COMMERCIAL (BMR)

SWM POND 1

CAIVAN COMMUNITIES-
RICHMOND PHASE 1
CITY FILE NO. D07-16-11-0014
PREPARED BY DSEL, JULY 2018.
CONSTRUCTION COMPLETED.

CROISSANT REYNA

CROISSANT GAMBLE CRESCENT

CROISSANT PELHAM CRESCENT

CHEMIN MEYNELL ROAD

CROISSANT HACKAMORE CRESCENT

CERCLE EQUITATON CIRCLE

CERCLE TERRIER CIRCLE

TERRASSE PURSUIT TERRACE

PARK

CAIVAN-FOX RUN SUBDIVISION
PHASE 2 SOUTH
CITY FILE NO. D07-16-19-0009
PREPARED BY DSEL, JUNE 2020.
CONSTRUCTION TO COMMENCE
JULY 2020.

LEGEND

- SUBJECT LANDS
- STORM TRUNK
- LOCAL STORM SEWER
- EXISTING STORM SEWER
- STORM SEWER BY OTHERS
- STORM DRAINAGE AREA
- EXISTING STORM DRAINAGE AREA
- STORM DRAINAGE AREA SUBCATCHMENT
- 0.45 / 0.66 / MH 523 MH 524 / 2-YEAR — DRAINAGE AREA, IMPERVIOUSNESS, UPSTREAM/DOWNSTREAM MANHOLE, STORM FREQUENCY
- EXTERNAL DRAINAGE
- 100 YEAR FLOODPLAIN
- PROPOSED CUTOFF SWALE
- STORM MANHOLE
- 0.22 / 0.54 — EXTERNAL DRAINAGE AREA IMPERVIOUSNESS
- 2 Yr — STORM FREQUENCY

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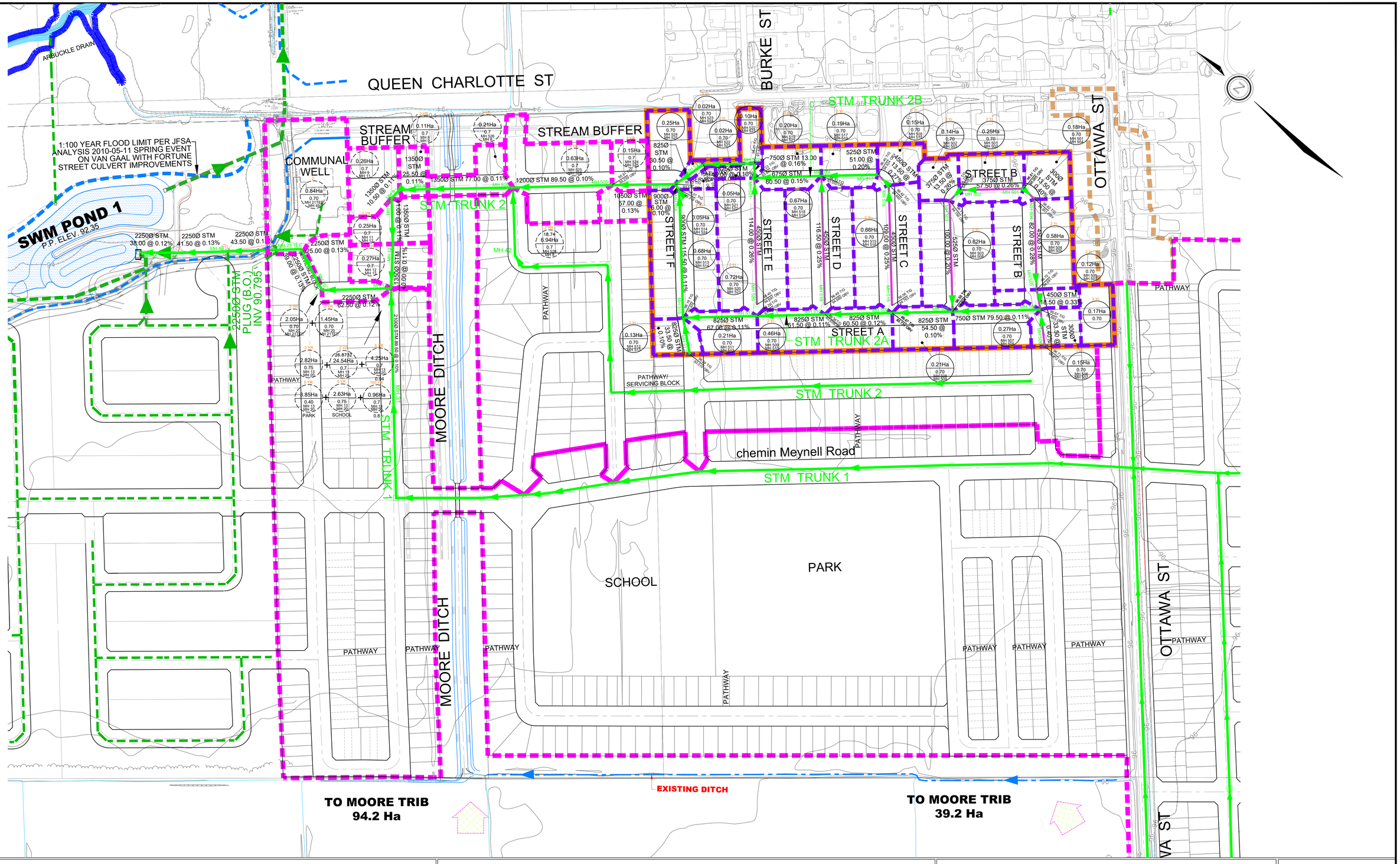
RICHMOND VILLAGE DEVELOPMENT CORPORATION
CITY OF OTTAWA

STORM SERVICING PLAN
GREEN LANDS WEST AND EAST

SCALE:	1:1500	PROJECT No.:	1183
DATE:	JUNE 2020	DRAWING:	3A



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CAIVAN RICHMOND LAFFIN

STORM SERVICING PLAN

CITY OF OTTAWA

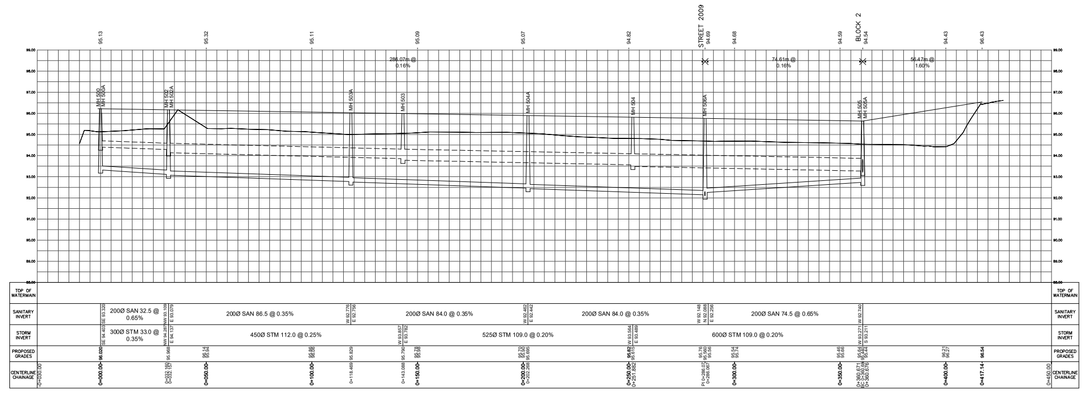
LEGEND

- STUDY LIMIT
- EXISTING DITCH
- STORM TRIBUTARY AREA
- EXTERNAL STORM TRIBUTARY AREA
- STORM TRUNK
- LOCAL STORM SEWER
- STORM TRUNK BY OTHERS
- STORM FREQUENCY / DRAINAGE AREA / RUN-OFF COEFFICIENT / UPSTREAM/DOWNSTREAM MANHOLE
- STORM FREQUENCY / EXTERNAL DRAINAGE AREA / RUN-OFF COEFFICIENT / UPSTREAM/DOWNSTREAM MANHOLE
- EXTERNAL DRAINAGE
- 100 YEAR INTAKE AREA

PROJECT No.:	20-1184
DATE:	July 2020
SCALE:	1:1500
DRAWING:	3B

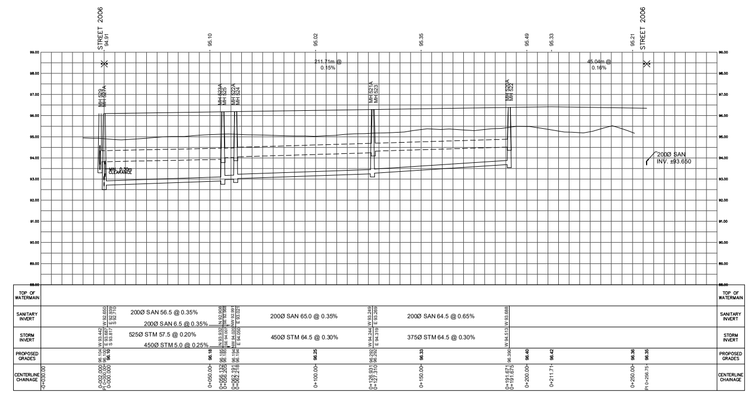
2001

STREET 2001



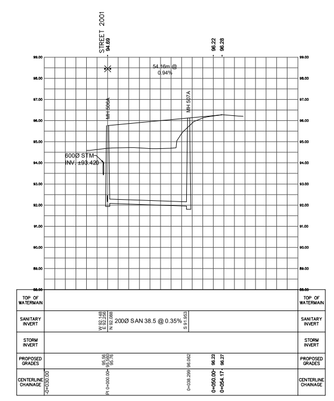
2005

STREET 2005



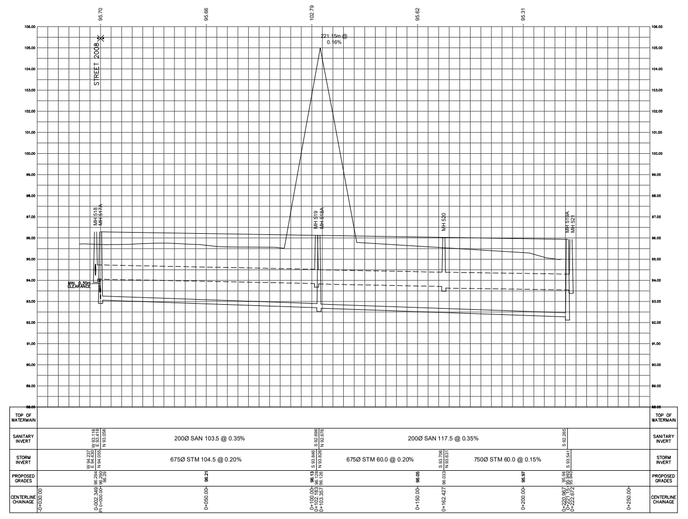
2009

STREET 2009



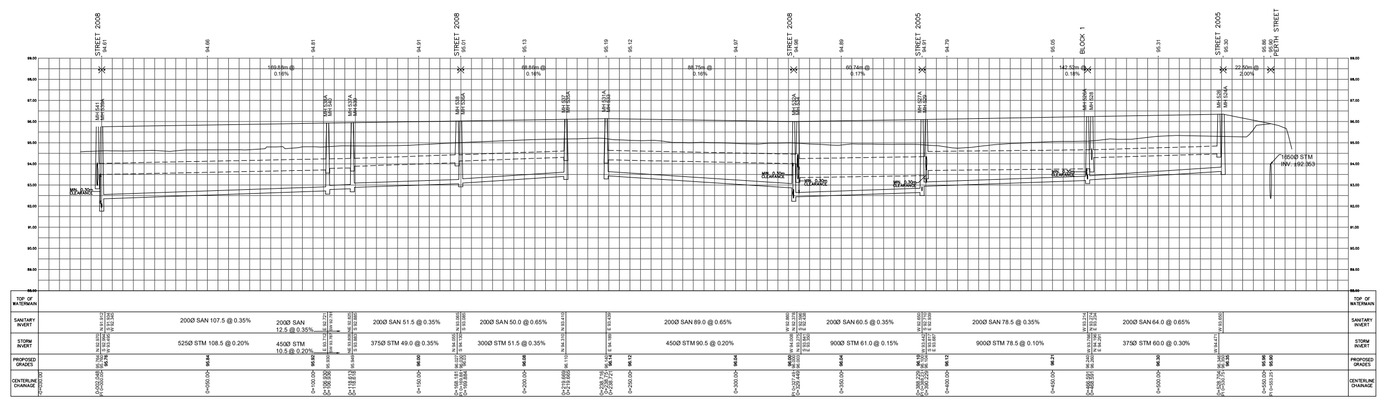
2002

STREET 2002



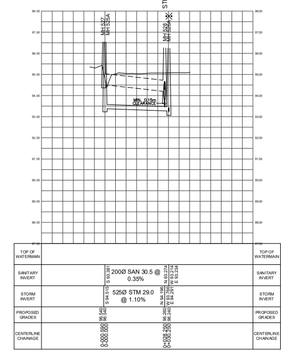
2006

STREET 2006



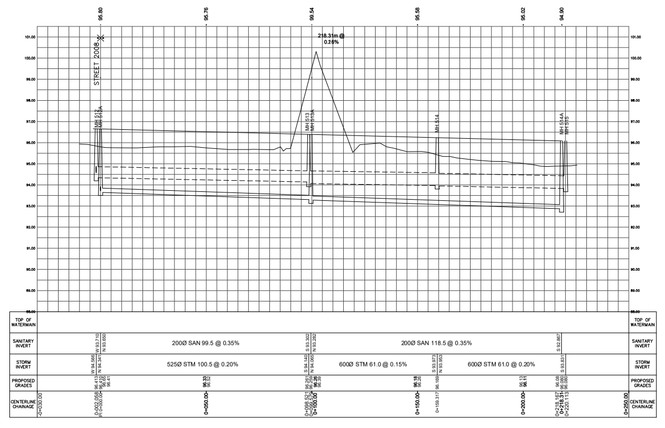
2007

BLOCK 1



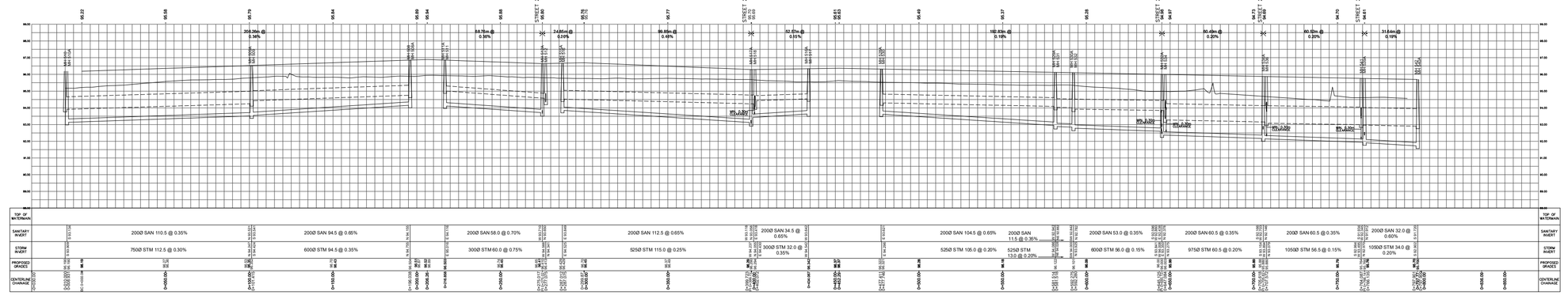
2003

STREET 2003



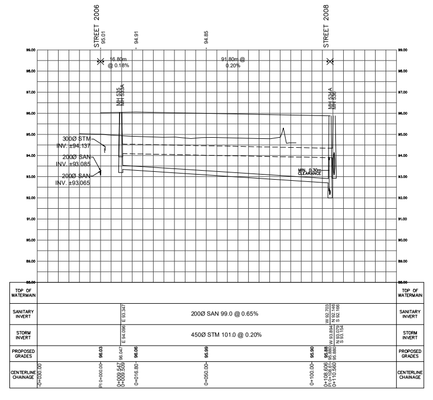
2008

STREET 2008



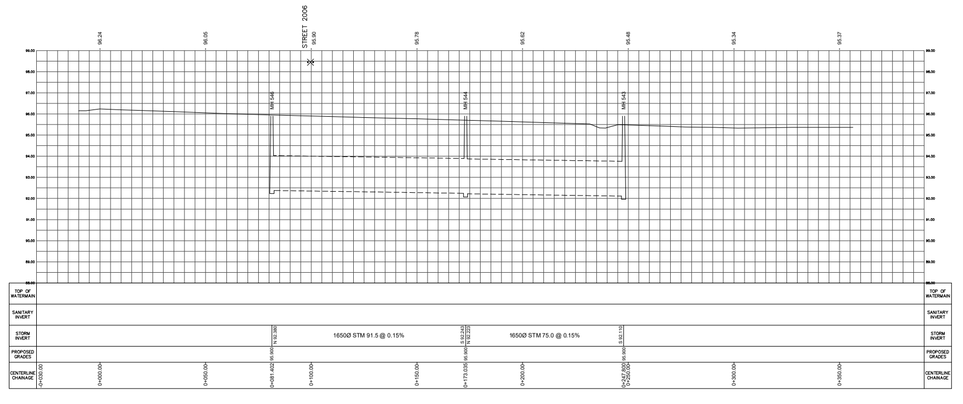
2004

STREET 2004



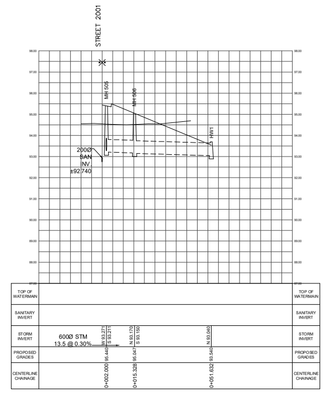
2014

PERTH STREET



2010

BLOCK 2



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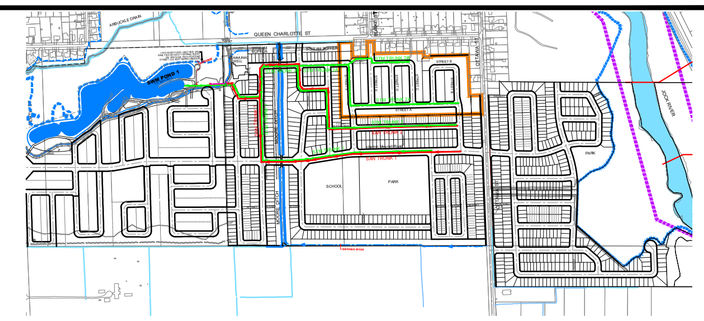
RICHMOND VILLAGE DEVELOPMENT CORPORATION
CITY OF OTTAWA

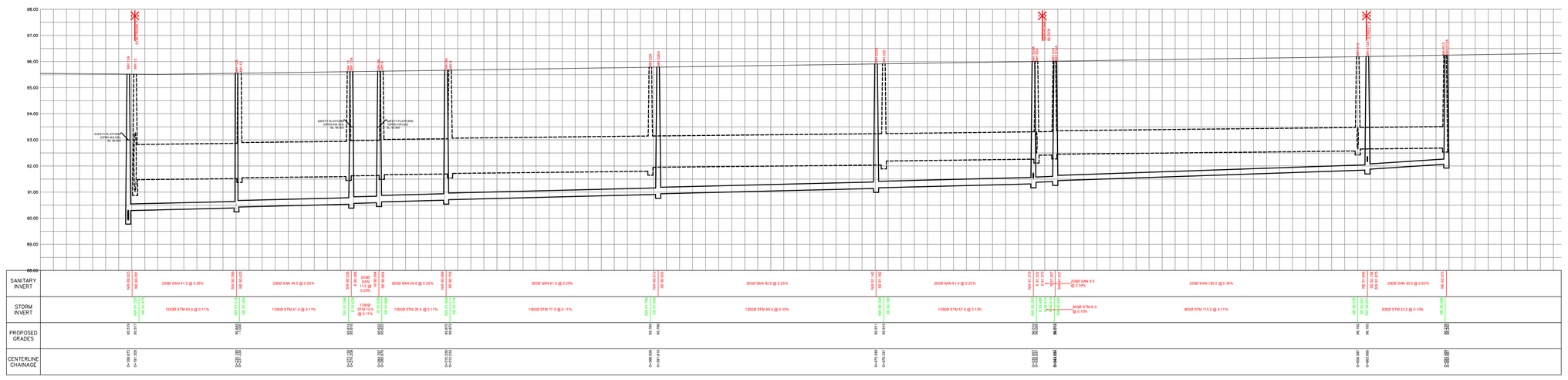
PROFILES
GREEN LANDS WEST AND EAST

SCALE:	1:2000	PROJECT No.:	1183
DATE:	JUNE 2020	DRAWING:	4A



PROFILES KEYPLAN SCALE: 1:6000

01
STREET F



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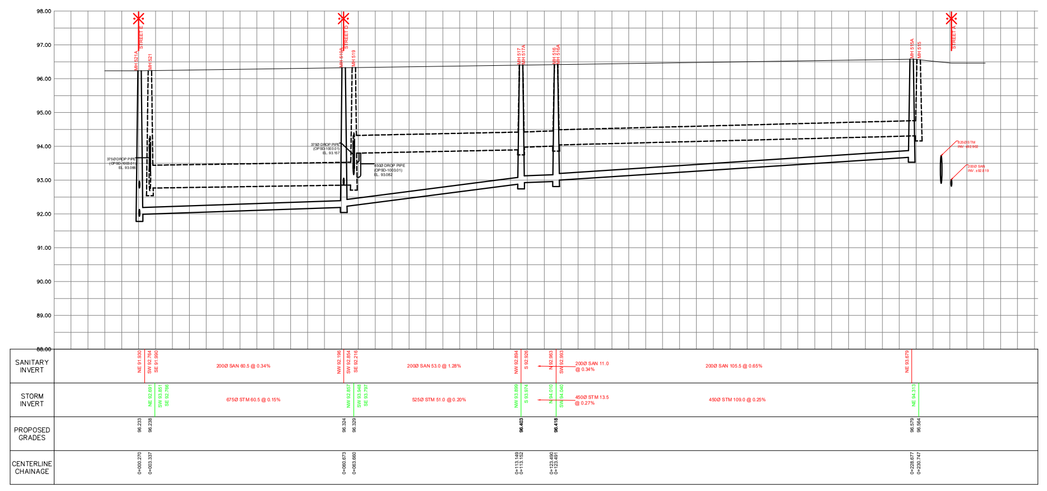

03
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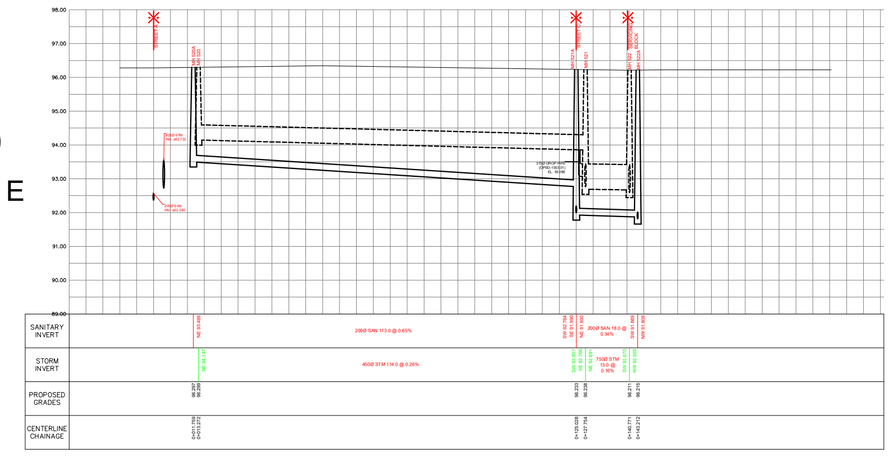

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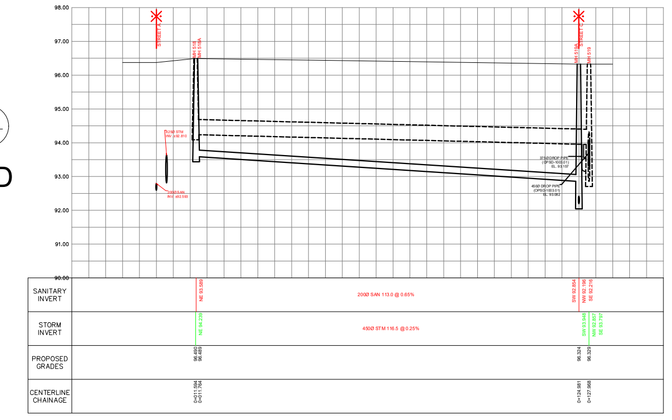
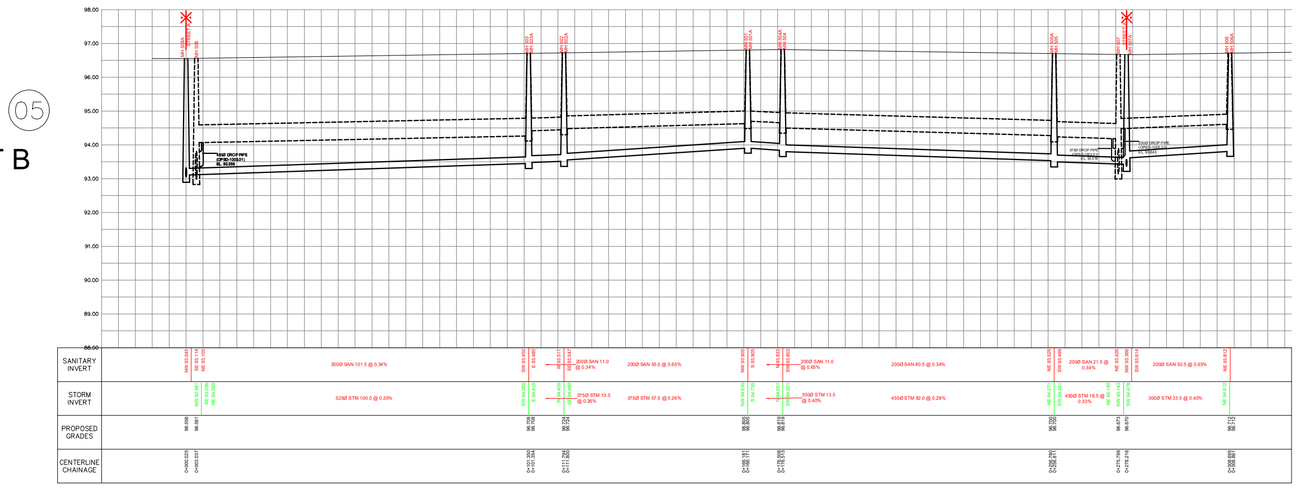
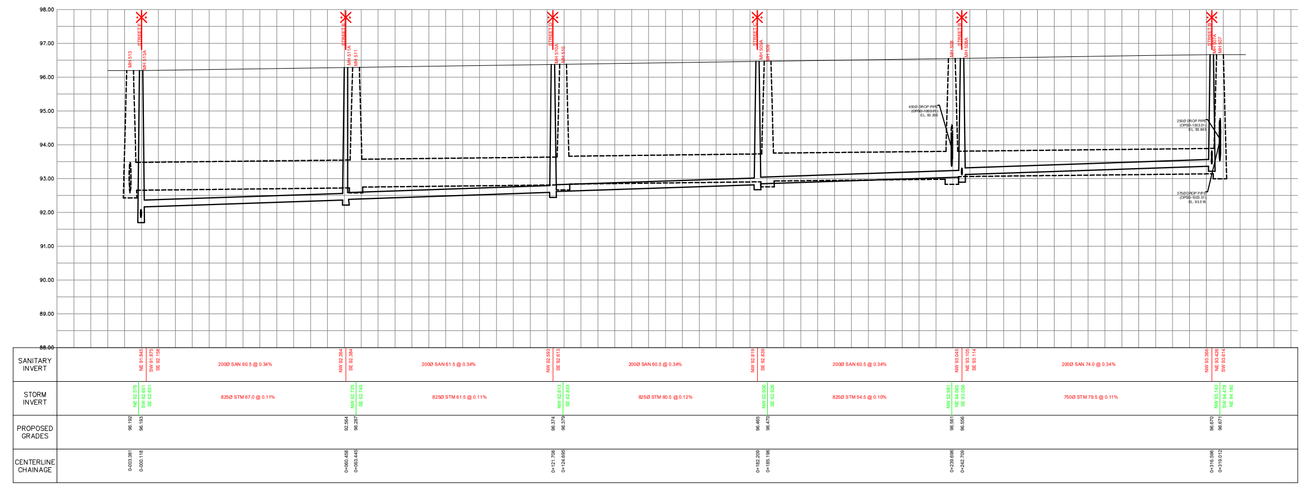


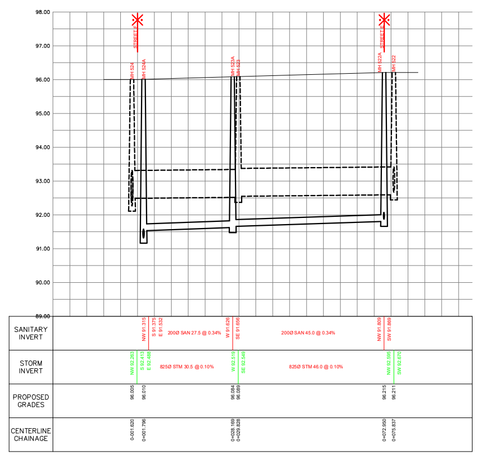
05
STREET B



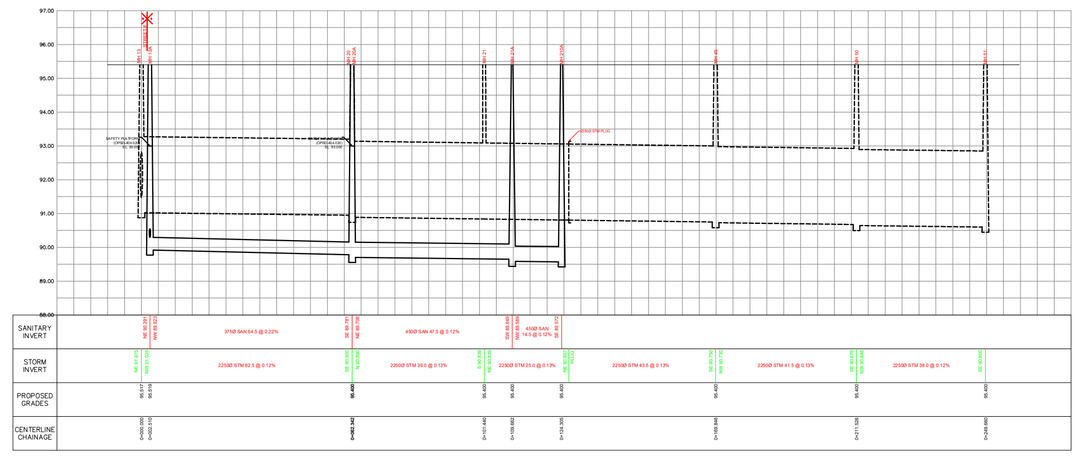
06
STREET A



08
SERVICING BLOCK



09
ALLIGNMENT 09



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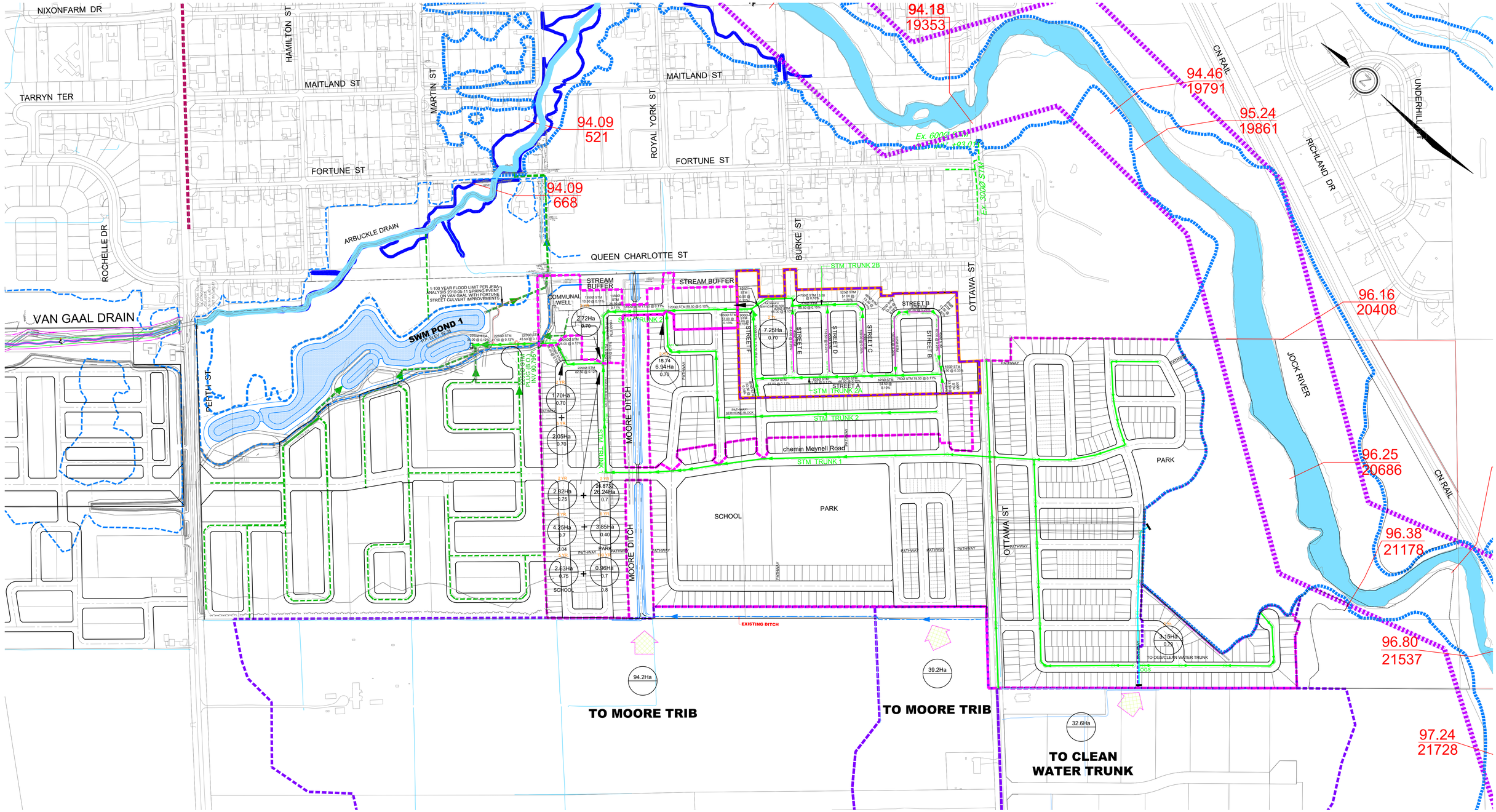
CAIVAN RICHMOND LAFFIN

STORM AND SAN SERVICING PROFILES

CITY OF OTTAWA

PROJECT No.:	20-1184
DATE:	July 2020
SCALE:	1:1250
DRAWING:	4B



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CAIVAN RICHMOND LAFFIN

OVERALL STM SERVICING

CITY OF OTTAWA

LEGEND

- STUDY LIMIT
- EXISTING DITCH
- STORM TRIBUTARY AREA
- EXTERNAL STORM TRIBUTARY AREA
- STORM TRUNK
- LOCAL STORM SEWER
- STORM TRUNK BY OTHERS
- STORM FREQUENCY / DRAINAGE AREA / RUN-OFF COEFFICIENT / UPSTREAM/DOWNSTREAM MANHOLE (2 Yr: 0.13Ha, 0.70, MH 51A, MH 51; 100 YR)
- STORM FREQUENCY / EXTERNAL DRAINAGE AREA / RUN-OFF COEFFICIENT / UPSTREAM/DOWNSTREAM MANHOLE (0.96Ha, 0.7, MH 13, MH 2A)
- EXTERNAL DRAINAGE
- 100 YEAR INTAKE AREA

PROJECT No.:	20-1184
DATE:	July 2020
SCALE:	1:3000
DRAWING:	5